2009 Compliance Recertification Application (2009 CRA)
Compliance Application Review Documents (CARD) 194.14 and 194.15

Content of Compliance Certification Application
Content of Compliance Recertification Application(s)

15.0 BACKGROUND (194.14 AND 194.15)

Section 194.15 states EPA's expectations for what should be in a compliance recertification application. Much of the information requirements parallel the requirements of Section 194.14, which applied primarily to the original application. Because of the related nature of sections 194.14 and 194.15, these sections are discussed together in this CARD. EPA's focus with this section is to require any compliance recertification application to include information on the changes to the disposal system and facilities since the previous certification or recertification. The information in this section is essentially updating the information in all aspects of the disposal system and waste related items. If items and assumptions have not changed, then EPA would not expect new information to be developed for those topics. It was EPA's intention that each Compliance Recertification Application (CRA) should clearly reference and/or summarize such unchanged information.

For each CRA, EPA expects DOE to identify all systems and program changes implemented during the preceding five-year period. Any activity or assumption that deviated from what was described in the most recent compliance application would be considered a change. EPA also expects each CRA to summarize all changes that EPA reviewed and approved in the preceding five-year period (through modification of the certification or other processes). We further expect each CRA to indicate where new baseline program elements have been established as a result of changes, and to show which parts of the application have been revised accordingly. These expectations were outlined in the Compliance Application Guidance (Docket A-93-02, Item II-B-29) and the Guidance to the U.S. Department of Energy on Preparation for Recertification of the Waste Isolation Pilot Plant with 40 CFR Parts 191 and 194 (Docket A-98-49, Item II-B3-14). Recertification is defined in section 8(f) of the WIPP Land Withdrawal Act as a determination "whether or not the WIPP facility continues to be in compliance with the final disposal regulations." Thus, recertification is a process that evaluates changes at WIPP to determine if the facility continues to meet all the requirements of EPA's disposal regulations, using the most accurate, up-to-date information available. Recertification is not a reconsideration of the decision to open the facility.

EPA provided opportunities for public comment throughout the recertification process. All public comments received are listed, along with references to EPA's response, in Appendix 15-C. Some public comments objected to the mission of WIPP and to the shipment of wastes into New Mexico, and demanded closure of the facility. For the reasons described in the previous paragraph, these comments fell outside the scope of the recertification decision. They are included in Appendix 15-C. Commenters also raised issues related to karst in the 2009 CRA. EPA continues to agree that DOE appropriately ruled out karst as a feature that would occur at WIPP over the regulatory period. In this CARD, the Agency briefly revisits the karst issue, once again, and the issues raised by the commenters. In addition to the discussion in 194.15 (a)(1), Appendix 15-B responds to specific questions by commenters.

15.1 REQUIREMENT (194.14)

Section 194.14 requirements are listed in Appendix 14-A below. Baseline documentation for section 194.14 was established at the time of the original recertification and approved by EPA. See CCA CARD 14 for details of EPA's review and EPA's approval. Changes to section 194.14 topics areas since the original certification are required by section 194.15 and discussed below in this CARD.

15.1.1 1998 CERTIFICATION DECISION (194.14)

EPA expected the CCA to include, at a minimum, basic information about the WIPP site and disposal system design. In general, DOE's characterization of the WIPP site and disposal system was discussed in Chapters 2 and 3 of the CCA (Appendices GCR, Hydro and MASS). Other characteristics, design, location and construction information was primarily provided in CCA Chapter 7 and Appendices BACK, DEL, PCS, and SEAL. EPA concluded that DOE adequately addressed geology, geophysics, hydrogeology, hydrology, meteorology, climatology, potential pathways, and effects of waste and geochemistry of the disposal system and its vicinity and how these conditions are expected to change and interact over the regulatory time frame.

EPA thoroughly reviewed DOE's CCA and the additional information submitted by DOE, and determined that DOE complied with each of the requirements of Section 194.14, conditioned upon DOE's implementation of the most robust panel closure system design (designated as Option D) with a slight modification (i.e., the use of Salado mass concrete instead of freshwater concrete).

A complete description of EPA's 1998 Certification Decision for Section 194.14 can be obtained from EPA Air Docket, A-93-02, Items V-A-1 and V-B-2.

15.1.2 CHANGES IN THE 2004 CRA (194.14)

Baseline documentation for section 194.14 was established at the time of the original certification and approved by EPA. See CCA CARD 14 for details of EPA's review and EPA's approval. Changes to section 194.14 topic areas since the original certification or most recent CRA are required by section 194.15 and discussed below in this CARD. Any changes since the CCA are documented in each CRA submitted by DOE and reviewed by EPA under section 194.15 requirements.

15.1.3 EVALUATION OF COMPLIANCE FOR 2004 RECERTIFICATION (194.14)

The intent for section 194.14, Content of compliance certification application, was to provide the baseline information for the compliance application. In the CCA and supplemental information and the compliance performance assessment (the performance verification test or PAVT), DOE provided the baseline information on WIPP and important features, events and processes that could affect the disposal system's containment capabilities. The Option D panel closure requirement identified by EPA as a condition in the certification has been incorporated into DOE's performance assessments as required (see 2004 CRA CARD 23). Since DOE complied with the sections of 194.14 in the original certification, EPA found that DOE complied with all sections of 194.14 for the 2004 CRA.

EPA did not receive any public comments on DOE's continued compliance with the content of compliance certification application requirements of Section 194.14.

15.1.4 2004 Recertification Decision (194.14)

Based on a review and evaluation of the 2004 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2004-0025, Air Docket A-98-49), EPA determined that DOE continues to comply with the requirements for Section 194.14.

15.1.5 Changes in the 2009 CRA (194.14)

Baseline documentation for section 194.14 was established at the time of the original certification and approved by EPA. See CCA CARD 14 for details of EPA's review and EPA's approval. Changes to section 194.14 topics areas since the original certification are required by section 194.15 and discussed below in this CARD. Any changes since the CCA and the 2004 CRA are documented in the 2009 CRA submitted by DOE and reviewed by EPA under section 194.15 requirements.

15.1.6 Evaluation of Compliance for 2009 Recertification (194.14)

The intent for section 194.14, Content of Compliance Certification Application, was to provide the baseline information for the original compliance application. In the CCA and supplemental information and the compliance performance assessment (the performance verification test or PAVT), DOE provided the baseline information on WIPP and important features, events and processes (FEPs) that could affect the disposal system's containment capabilities. Since DOE complied with the sections of 194.14 in the original certification and the 2004 CRA, EPA finds that DOE complies with all sections of 194.14 for the 2009 CRA.

EPA did not receive any public comments on DOE's continued compliance with the content of compliance certification application requirements of Section 194.14.

15.1.7 2009 Recertification Decision (194.14)

Based on a review and evaluation of the 2009 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2009-0330, Air Docket A-98-

49), EPA determines that DOE continues to comply with the requirements of Section 194.14.

15.2 REQUIREMENTS (194.15(a)(1))

(a) "In submitting documentation of continued compliance pursuant to section 8(f) of the WIPP LWA, the previous compliance application shall be updated to provide sufficient information for the Administrator to determine whether or not the WIPP continues to be in compliance with the disposal regulations. Updated documentation shall include:

(1) All additional geologic, geophysical, geochemical, hydrologic, and meteorological information."

15.2.1 Changes in the 2004 CRA (194.15(a)(1))

Earthquake/Seismic Information

DOE updated information on earthquakes within 150 miles of WIPP. DOE identified that within 150 miles of WIPP, 14 earthquakes of Richter scale magnitude 3.0 or greater occurred between January 1, 1995 and September 30, 2002, the cutoff date for information for the PA. The largest was a 5.3 magnitude earthquake in Brewster County, Texas. For comparison, the largest earthquake identified in the CCA between 1926 and 1994 was 6.0. WIPP's design basis is for much larger earthquakes than those which have occurred in the immediate vicinity of WIPP (2004 CRA Chapter 2). In response to an EPA question, DOE provided an updated Figure for the seismic events and a table listing the seismic events since 1926. (Docket A-98-49, II-B2-38)

Natural Resources

In the CCA much effort was devoted to identifying natural resource potential at the WIPP site. The major resources in the area are potash, oil and natural gas. DOE identified and EPA concurred that potash would not be mined above the waste area (CCA CARD 14) because the potash zone is considered to be barren above the waste area.

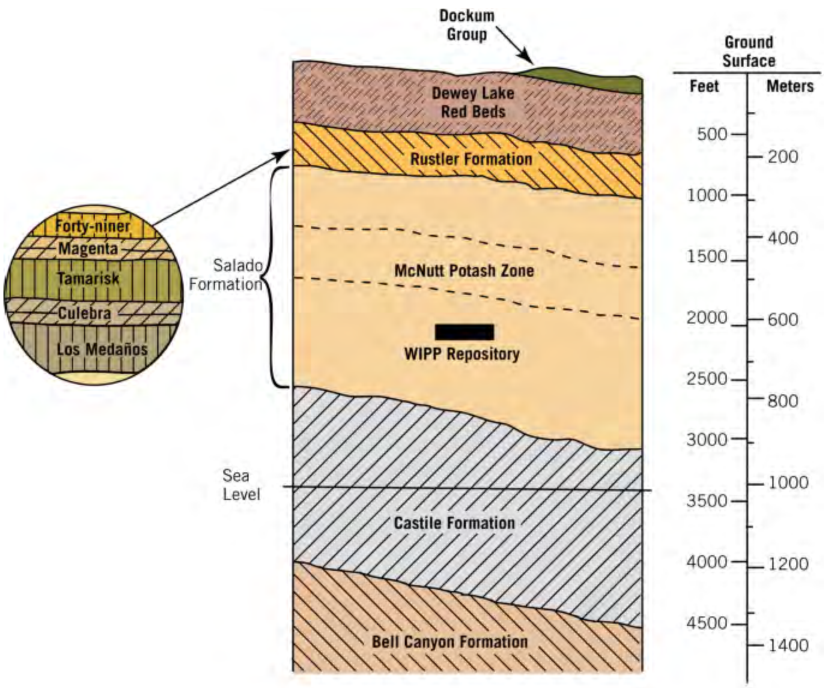
This has not changed since the CCA. There is the possibility that oil and natural gas wells and associated fluid injection wells could affect the WIPP site and so remain part of the future WIPP scenarios. For the CRA-04, the deep drilling rate increased to 52.2 boreholes per km^2 per 10,000 years from the 46.8 boreholes per km^2 per 10,000 years used in the original application. In response to comments from the public [Docket A-98-49, Item II-B2-39], EPA had DOE conduct an analysis on the effect of increased drilling at WIPP. The result indicates that WIPP would comply with the numerical release standards even if the drilling rate of 52.2 boreholes per km^2 doubled. The CRA-04 also included new fluid injection wells in the vicinity of WIPP; however, the average injection rate remained constant at 1,250 barrels of water per day/well. (Also see 2004 CRA CARD 23, Human Intrusion TSD [Docket A-98-49 Item II-B1-10] CRA Section 45, CRA response to comments).

Hydrologic Issues

Geologic Model

At the WIPP site, the primary hydrologic unit of importance is the Rustler Formation because it directly overlies the Salado Formation. DOE stated that the units above the Salado (i.e. the Rustler, the Dewey Lake and the Santa Rosa) are classified as a single hydrostratigraphic unit for conceptual and computer modeling. The Rustler is of particular importance for WIPP because it contains the most transmissive units above the repository. In general, fluid flow in the Rustler is characterized by DOE as exhibiting very slow vertical leakage through confining layers and faster lateral flow in conductive units. Of the five members of the Rustler at the WIPP, the Culebra and the Magenta are considered conductive units and the Los Medaños (formally Unnamed Lower Member), the Tamarisk, and the Forty-niner are considered confining units. Figure 15-1 is a stratigraphic column that shows the sequence of rocks at the WIPP. Table 15-1 summarizes selected hydrologic properties of the Rustler Formation.

Figure 15-1. Geologic Strata at the WIPP site.



In the CCA, EPA generally accepted DOE's characterization that the Culebra is a fractured dolomite with non-uniform properties, both horizontally and vertically (CCA CARD 14). The Culebra exhibits matrix (interparticle to vugular, and intercrystalline) and fracture (micro to macro) porosity. Flow within the Culebra occurs primarily within fractures, although flow also occurs within vugs where they are connected by fractures and, to some extent, within interparticle porosity where this porosity is higher. Flow in the Culebra is dominantly lateral and southward, although there are localized variations in the flow direction (2004 CRA Figures 2-37a and 2-37b are contour maps of the equivalent freshwater hydraulic heads in the Culebra. The ground water flow direction is at approximately right angles to the contour lines.) DOE identifies that the Culebra transmissivity exhibits a bimodal distribution (2004 CRA Appendix PA, Attachment TFIELD). In areas where the Culebra dolomite has transmissivity less than 4 x 10^{-6} m^2/s ($10^{-5.4}$ m^2/s), the Culebra is considered to be dominated by single (matrix) porosity. Above this transmissivity the Culebra is believed to have dual porosity so that fractures and the dolomite matrix are important.

Table 15-1. 2004 CRA-Selected Rustler Formation Hydraulic Properties

Rustler Member	Hydraulic Conductivity[1]	Transmissivity	Thickness
Forty-niner	1×10^{-13} to 1×10^{-11} m/s (anhydrite) 1×10^{-9} m/s (mudstone)	8×10^{-8} to 8×10^{-11} m^2/s	13 to 23 m
Magenta	$1 \times 10^{-8.5}$ to $1 \times 10^{-4.5}$ m/s	4×10^{-4} to 1×10^{-9} m^2/s	7 to 8.5 m
Tamarisk	1×10^{-13} to 1×10^{-11} m/s	$< 2.7 \times 10^{-11}$ m^2/s	26 to 56 m
Culebra	$1 \times 10^{-7.5}$ to $1 \times 10^{-5.5}$ m/s	1×10^{-3} to 1×10^{-9} m^2/s	4 to 11.6 m
Los Medaños	6×10^{-15} to 1×10^{-13} m/s	2.9×10^{-10} to 2.2×10^{-13} m^2/s	29 to 38 m

DOE stated that the Culebra is the most transmissive hydrostratigraphic unit at the WIPP site. The Magenta is the second most transmissive unit. New hydraulic data obtained for the Culebra and the Magenta confirmed the range for transmissivity used in the CCA. Magenta well H-19b1, located just southeast of the site center, had a higher transmissivity (0.38 ft^2/ day or 4.1×10^{-7} m^2/s) than the previous "highest" transmissivity well, H-6a, located within the WIPP LWA boundary. The Magenta transmissivity at H-6a was reported in CCA Appendix Hydro to be 0.3 ft^2/day (3.2×10^{-7} m^2/s). DOE points out, however, that in all locations where both Culebra and Magenta wells have been tested, "the transmissivity of the Magenta is much lower than that of the Culebra" (Beauheim and Ruskauff, 1998).

The Culebra transmissivity characteristics appear to be zonal with higher transmissivity found in Nash Draw and lower transmissivity found to the east of the WIPP site boundary. In between these areas the Culebra transmissivity is variable. DOE postulates that this spatial transmissivity distribution is due to post-depositional processes and geologic controls (2004 CRA Chapter 2, p. 2-107). Geologic controls are now believed to include overburden thickness, dissolution of the upper Salado, and the occurrence of halite in the mudstone Rustler units above and below the Culebra (ibid). DOE uses the observation of a bimodal distribution of transmissivity and these geologic controls in the development of the transmissivity fields used to calculate releases from the Culebra (2004 CRA Chapter 2.2.1.4 and Appendix PA Attachment TFIELD).

<u>Changes in Water Levels</u>

As part of DOE's monitoring program, DOE is required to monitor the water levels in the Culebra. DOE monitors the Culebra in a network of over 30 wells. DOE also monitors a limited number of Magenta wells. In both units DOE has seen water level changes, but the source of the changes is unknown. DOE's investigation of the water level changes has focused on the Culebra because it is identified as the primary potential pathway for groundwater releases at WIPP. The water level has generally tended to increase, although there was a noticeable increase in the rate in the late 1990s in some wells with a just as dramatic drop in the early 2000s (see for example 2004 CRA

---
1 Lower numbered negative exponents indicate faster flow.

Figure 2-36) for some wells. This increase was observed at the time of the CCA but became more widespread after DOE submitted the CCA. DOE notes, however, that the head distribution in the Culebra still indicates that the flow is generally in the same direction as previously reported. There are several theories to explain the water level increases, including potash mining and petroleum industry brine injection. Water level changes as a response to precipitation [See Section 15.2.4 below for new information in the 2009 CRA] is not considered to be a viable theory because wells do not respond to precipitation events.

Change in Culebra Radionuclide Travel Time

Compared to the CCA, the 2004 CRA performance assessment (and in the 2004 performance assessment baseline calculations or 2004 PABC[2]) predicted a longer time for a particle to travel through the groundwater to the WIPP site boundary. DOE attributes the longer travel times to a reduced—relative to the CCA—hydraulic gradient from the north to the south across the site. This is primarily due to differences in how the Culebra water levels (heads) were determined in the CCA and the 2004 CRA. For the CCA head estimates, modelers had to contend with the Culebra water level responses to WIPP shaft construction and large-scale pumping tests at the WIPP site and different stages of responses for different wells. The modelers were thus forced to use heads measured in different years, thus adding uncertainty. For the 2004 CRA head estimates, DOE used only head data measured in 2000.

In addition, DOE believes there are other factors that play into longer travel times (2004 CRA Appendix PA Attachment TFIELD page 127):

> "In the case of the [transmissivity] T fields unaltered for the effects of mining, the longer travel times are caused by a shift of relatively high Ts from the southeastern to the southwestern portion of the WIPP site relative to the CCA T fields. In the case of the T fields altered for full and partial mining, the longer travel times are the combined result of the westward shift of high Ts discussed above and a change in the definition of the areas to be mined that resulted in less water entering the Culebra on the WIPP site."

Inclusion of mining in the northern zone, that DOE had omitted previously, enhances the effect of mining on the transmissivity. The increased area of higher transmissivity due to mining is expected to divert more flow around the WIPP site, reducing the importance of any high transmissivity zones in the WIPP site (Docket A-98-49, Item II-B2-59). Thus, multiple factors are responsible for longer travel times, but the use of contemporaneous data with a lower gradient probably explains the longer travel time for the PABC when compared to the PAVT.

Retardation of Radionuclides (Distribution Coefficients or Kds)

Radionuclides may reach the Culebra member of the Rustler Formation because of brine flow through a borehole that intersects the waste in the repository. Radionuclides introduced into the Culebra may then be transported through natural

---

[2] EPA required DOE to conduct a second performance assessment, called the 2004 PABC. The 2004 PABC is discussed more thoroughly in the 2004 PABC TSD (Docket A-98-49 Item II-B1-16). A summary of changes is included in this CARD at section 194.15(a)(7).).

groundwater flow. Predictions of transport and release of radionuclides through the Culebra are affected by sorption onto minerals along this potential pathway. Accordingly, DOE developed single-parameter distribution coefficients (K_ds) to express a linear relationship between sorbed and aqueous concentrations of the radionuclides (2004 CRA Chapter 6, Section 6.4.6.2.1). No additional sorption experiments have been carried out since the CCA and PAVT. However, in support of the 2004 CRA, DOE did reanalyze the data and correct some minor errors to the values used in the PAVT. The changes resulted in minor reductions in the amount of retardation that would be expected.

Water in the Air-Exhaust Shaft

In 1995 DOE first identified water in the WIPP exhaust shaft at a depth of about 80 feet and began an investigation into the source of the water (2004 CRA Chapter 2.2.1.4.2.2). DOE drilled 12 wells around the site surface facilities. [See map on page 2-128 in the 2004 CRA Chapter 2.2.1.5] Water was typically encountered around 50-60 feet below the ground surface. One of the 12 wells was dry. Another 27 holes were hand-augured to a depth of 14 feet, and no water was detected in any of these boreholes.

DOE identified that the highest water levels in the test wells were near the salt water evaporation pond (2004 CRA Figure 2-40, ibid). The water flows from this high water level outward to other areas, including the exhaust shaft. No evidence of karst (large voids) was found in the 12 wells drilled through the Santa Rosa and into the Dewey Lake Formations.

DOE believes that the source of the water is from (1) runoff of rainfall into and infiltration from the retention ponds located to the south of the WIPP surface facilities, and (2) infiltration of saline waters from the salt storage area, the salt storage evaporation pond, and perhaps remnants of the drilling and tailings pit used during the construction of the WIPP salt shaft.

Karst

DOE reviewed the available site characteristic information pertaining to karst during the analysis for the original CCA and summarized relevant information in the 2004 CRA Chapter 2, Section 2.1.6.2. Karst development is formed in rocks susceptible to dissolution, such as carbonates and evaporates, both of which are present at and around WIPP. In the region around WIPP, DOE identified that Nash Draw was developed, in part, through dissolution and contains karst features. However, DOE determined that the karst environment in Nash Draw does not extend to the WIPP site. EPA's analysis of the information available at the time of the CCA came to the same conclusion (CCA CARD 14 and CCA Response to Comment (Docket A-93-02 Item V-C-1)).

Due to public interest in the issue, DOE reanalyzed existing information related to karst, including specific topics of interest to commenters. DOE's study[3] (Lorenz 2005, at

[3] EPA considers the Lorenz 2005 report a technical response to our request for more information related to karst; EPA does not believe this document is part of our completeness determination. It is a technical document reviewed as part of the Agency's final technical review related to the recertification.

Docket A-98-49 II-B2-53) concluded that “outside of Nash Draw, definitive evidence for the development of karst in the Rustler Formation near the WIPP site is limited to the horizon of the Magenta Member in drillhole WIPP-33.” WIPP-33 is about 1 kilometer (0.6 miles) west of the WIPP Land Withdrawal Boundary. The overall conclusion of the report is that the evidence provided by proponents of karst does not withstand scrutiny, and extrapolation of the known karst features in Nash Draw eastward to the WIPP site is unwarranted (Docket A-98-49 II-B2-53).

Current climatologic and meteorological conditions in the vicinity

WIPP is located in the desert southwest with limited annual precipitation (< 11.1 inches on average from 1995 through 2002). With some exceptions, limited precipitation has been the norm since the retreat of the last ice sheet around 10,000 years ago. DOE provided information on the climate for the CCA with updated information provided on recent climatic conditions in annual reports (2004 CRA Chapter 2.5.2). 2004 CRA Table 2-14 and Figures 2-49 through Figure 2-56 provide recent meteorological information. DOE did not alter the CCA assumptions about future climate in the performance assessment.

15.2.3 EVALUATION OF COMPLIANCE FOR 2004 RECERTIFICATION (194.15(a)(1))

Earthquake/Seismic Information

DOE provided information on recent earthquakes in the 2004 CRA Chapter 2. DOE concluded that any recent seismic activity is consistent with previous conclusions. Therefore, DOE did not need to change any analyses or calculations for the 2004 CRA related to the recent seismic data. EPA found DOE’s information to be adequate.

Natural Resources

DOE performed due diligence in keeping abreast of the drilling activities through the Delaware Basin Monitoring Program and appropriately captured the drilling events that would affect the drilling rate used for the PA. In addition, DOE’s analysis indicated that even a doubled drilling rate would not affect performance. Since the volume of fluids injected, per well, remained the same since the CCA, EPA agreed that no additional consideration of this is necessary. No new information had arisen that would change the potash zone impact on the WIPP site. EPA found this information to be adequate.

Hydrologic Issues

Geologic Model

EPA reviewed DOE’s development of the transmissivity (T) fields (Docket A-98-49, Item II-B1-16) and concludes that it is adequate for the intended purpose of establishing base T fields for PA. However, while the geologic model provides a reasonable explanation of the transmissivity on the eastern and western areas around WIPP, there is enough variability in the data to reduce the model’s predictive capability in the central region around the site. Nevertheless, the approach used to develop and implement the T fields using the MODFLOW and PEST computer codes is an improvement over the T field development process used in the CCA. EPA finds DOE's treatment of this topic to be adequate.

Changes in Water Levels

EPA agrees with DOE that the water levels in the Culebra and other units are most likely due to anthropogenic sources. Natural recharge can be eliminated because there is no response in well data to precipitation events (See Section 15.2.4 below for new information in the 2009 CRA). Because of the confined nature of the Rustler Formation units and the fact that the pumping tests in the Culebra indicate that pressure changes can be propagated throughout the vicinity of WIPP, the change in water levels is most likely due to natural resource extraction or fluid injection somewhere in the vicinity of WIPP. If this is the reason for the changes in water levels, then it would stop once the resource related activity ceased and its impact will be short term. Thus, the water level changes are believed to be a transient phenomenon. DOE has modified the transmissivity field to account for the changes in the water level rise since the CCA and incorporated the changes in the performance assessment. In addition, DOE is required to monitor the Rustler water levels, so any changes in water levels can be incorporated into future PAs. EPA finds DOE's approach to the water level changes to be adequate.

Change in Culebra Radionuclide Travel Time

EPA reviewed DOE's information in the 2004 CRA and supplemental information (Docket A-98-49, Item II-B2-35, response to comment G-7; Docket A-98-49, Item II-B2-59), and agrees with DOE that the reduction in the measured hydraulic gradient accounts for most of the increase in travel time. EPA finds that the longer travel times to be reasonable and based on appropriate data and modeling.

Retardation of Radionuclides (Distribution Coefficients or K_ds)

No additional sorption experiments have been carried out since the CCA and PAVT in support of the 2004 CRA. Based on the K_d ranges provided for the PAVT, the changes are small and all changes result in more conservatism, i.e., small K_d values, which should result in less sorption. The values used in the 2004 CRA PABC are acceptable because no new experimental sorption data are available, the changes to the K_d ranges are minor and conservative, and these results have been previously reviewed by the Agency (Docket A-98-49 Item II-B1-3). EPA finds this to be adequate.

Water in the Air-Exhaust Shaft

Beginning around 1995, DOE detected water flowing into the air exhaust shaft. Proponents of karst point to this water inflow as evidence of shallow karst at the site. DOE investigated this water inflow, which continues today. DOE drilled wells around the WIPP surface facilities, hit water around 50-60 feet below ground surface, and identified that the highest levels of water are around the salt evaporation pond and that water flows toward the exhaust shaft. DOE did not find any karst related features in the wells drilled for the characterization.

EPA reviewed the 2004 CRA and the supporting documents (Docket A-98-49, Item II-B1-18) and found DOE conducted a reasonable and thorough study of the source of the water inflow. EPA believes that DOE's explanation of infiltration from the WIPP facility adequately accounts for the water movement, and does not show evidence of karst.

Current climatologic and meteorological conditions in the vicinity

DOE updated the recent meteorological conditions in the 2004 CRA Chapter 2 to include the most recent meteorological conditions. These updates did not require changes in the modeling of future climate. DOE's treatment of the topic is adequate.

Karst

Background and Summary

In comments to EPA on the 2004 CRA, some members of the public continue to assert that the geologic characterization of the subsurface surrounding the WIPP repository does not adequately identify the presence of karst. As a result of these concerns, EPA evaluated information on the potential for the presence of karst at WIPP and the possible impacts on the long-term containment of waste for WIPP. For the 2004 recertification, EPA conducted a thorough reevaluation of geologic and hydrologic information related to karst. Most of the information reviewed was developed at the time of the CCA, however, DOE continued to collected or analyzed data since the submission of the CCA. In addition, commenters identified documentation (e.g., the "Hill report" in Docket A-98-49, Item II-B3-76) that they wanted included in the review.

If substantial and abundant interconnected karst features were present at WIPP, such features could create a pathway that could increase the speed at which releases of radionuclides travel away from the repository through the subsurface to the accessible environment. Nash Draw, an elongate, dog-boned shaped depression located west of the WIPP site is known to contain karst features. Its origin is believed to be due to a combination of erosion and dissolution during past wetter climates ~500,000 or so years ago (Bachman, 1985).

The WIPP site does not appear to have been subjected to pervasive dissolution that would form karst as commenters claim. The data indicate that Nash Draw and the WIPP site are essentially two separate hydrologic systems under the current climate, have been that way for some time, and would be expected to remain relatively independent into the future. Precipitation events at the WIPP do not immediately, if at all, recharge the underlying units and the lack of runoff does not indicate karst below. Any significant recharge to the geologic units at the WIPP site appears to be the result of distal processes and/or from infiltration that takes thousands of years to reach the Rustler Formation. Precipitation events in Nash Draw may result in noticeable effects in Nash Draw as might be expected in a karst environment (See Section 15.2.4 below for new information in the 2009 CRA). But, responses in Nash Draw provide little, if any, information about the WIPP site or the ability of WIPP to contain radionuclides.

Many of the arguments for karst that the commenters have made are the same or similar to those made during the original certification decision. In the 1998 certification decision, EPA concluded that dissolution is not an ongoing pervasive process at the WIPP site and therefore, karst feature development would not impact the containment capabilities of the WIPP for at least the 10,000-year regulatory period (CCA CARD 14). EPA's 2004 recertification review again comes to the same conclusion that karst will not affect WIPP's performance. Appendix 15-A of this CARD addresses some specific questions raised by commenters.

The Agency also requested that DOE/Sandia National Laboratories (SNL) conduct a separate analysis of the potential for karst and address issues raised by commenters. Major issues reviewed in the report (Lorenz 2005) are: insoluble residues, negative gravity anomalies, specific well results, and recharge and discharge issues. This effort reaffirmed the previous analysis that karst processes had been active outside the WIPP site in Nash Draw, but not at the WIPP site. The report also concluded that many of the assertions made by proponents of karst at the WIPP site "tend to mix data, to take data out of context, and to offer theory as fact and to continue to offer misconceptions in the face of evidence."

Conceptual Understanding of Karst at and Around WIPP

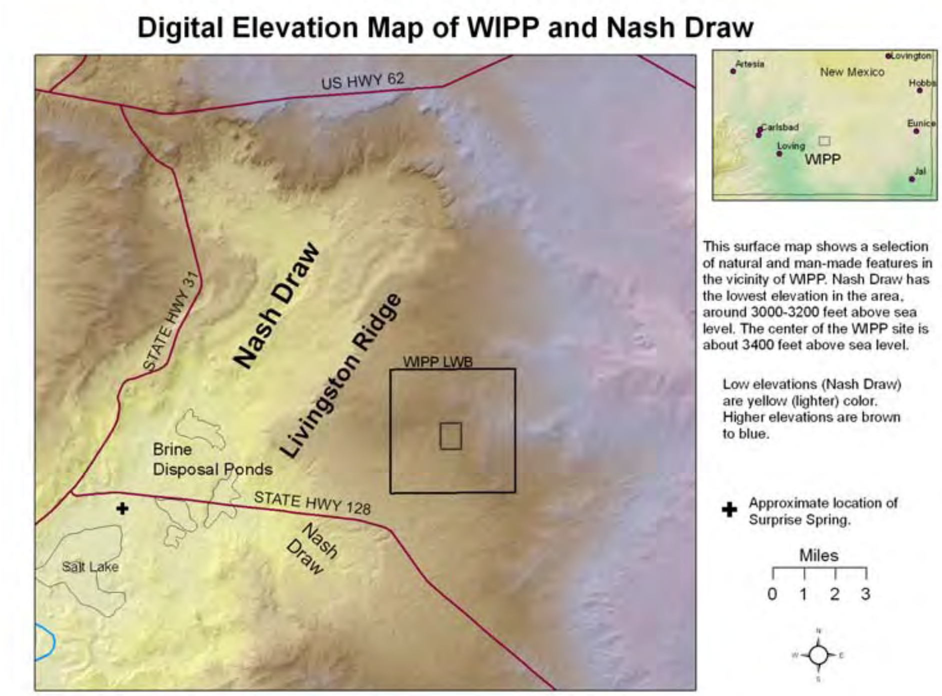
As part of the effort to review the evidence for karst, EPA also made a site visit to re-examine the evidence of karst around the WIPP site and in nearby Nash Draw (Docket A-98-49, Item II-B3-93). EPA prepared a technical support document that discusses EPA's in-depth review of the karst issue (Docket A-98-49, Item II-B1-15). From this review, EPA has developed a better conceptual understanding of the disposal system and surrounding area.

Because EPA's release requirements apply to the site, our primary interest is what happens at the WIPP site, that is, within the land withdrawal boundary (LWB), because the LWB defines the accessible environment. However, to get a better understanding of the WIPP site, it is useful to look at the area around the WIPP site. The land surface at the WIPP site generally slopes to the south and southwest. There is a topographic high, Livingston Ridge, northwest of the site, which is adjacent to Nash Draw, a topographic depression, further west (Figure 15-2).

Karst at Nash Draw

Around 12 million years ago, the Delaware Basin experienced regional tilting so that the rock layers are tilting down (dip) to the east. According to Bachman (1985) (CCA Reference 26, Docket A-93-02, REFLST1), streams, represented by the Gatuña Formation, conducted water to what is now Nash Draw. Water possibly followed the regional strike, and with the combination of erosion and dissolution and associated collapse, formed Nash Draw. The tilting of the beds combined with erosion and dissolution brought the Rustler Formation to the surface or near the surface in Nash Draw today. However, this process did not have the same effect at the WIPP site where the Rustler Formation is currently more than 500 feet below the ground surface and 1,000 feet above the repository. WIPP is thus located in a region (e.g., Delaware Basin) where karst exists, however, the WIPP LWB does not appear to have undergone erosional and dissolution processes like Nash Draw, even though some proponents of karst believe it has (e.g., Phillips, 1987 in A-93-02, Item II-H-33).

Figure 15-2. The WIPP Site is to the East of Nash Draw and Topographically Higher Than Nash Draw. Response to Precipitation Events at Surprise Springs Reflect Flow in Nash Draw, but not at the WIPP Site, Which is Over 8 Miles From the Land Withdrawal Boundary.



The erosion and dissolution that created Nash Draw also created caverns and ponds. These appear to be supplied primarily by potash effluent from operations north of Nash Draw, although local precipitation can contribute to maintaining them. Also, Nash Draw contains diverted drainage, vanishing streams and the open sinkholes that capture them. Phreatophytes (plants with deep root systems, e.g., cottonwoods) indicating groundwater discharge areas are common in parts of Nash Draw. Because the water table is high in Nash Draw, the integrated system in Nash Draw can respond quickly to precipitation events (See Section 15.2.4 below for new information in the 2009 CRA).

It is possible that the Salt Lake and brine disposal ponds in Nash Draw represent the Rustler heads in central Nash Draw; if one extrapolates the Magenta head data from around Livingston Ridge into Nash Draw, the Nash Draw pond water levels appear to match what would be expected based on well data. Thus, there may be a transition zone at Nash Draw where at least the Magenta (which is stratigraphically and topographically higher than the Culebra) becomes unconfined where it is present. It appears to EPA that the Culebra transitions to an unconfined aquifer in the southern part of Nash Draw where it appears that the Culebra is near the surface and responds to irrigation practices (Lorenz 2005 p. 85).

Karst at the WIPP Site

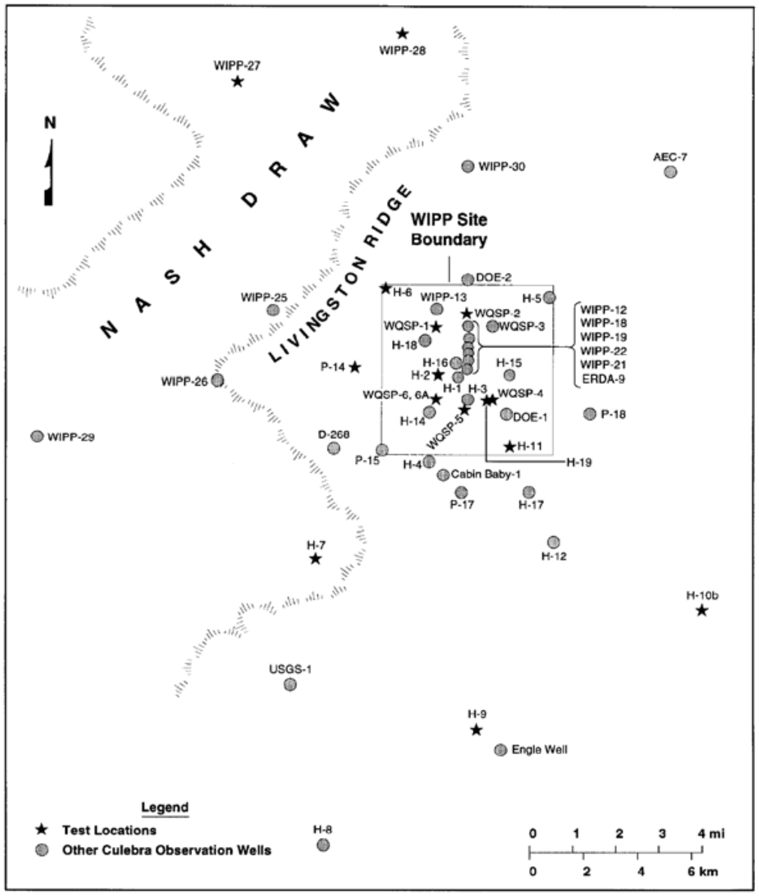
In contrast, the surface at the WIPP site—several hundred feet higher than the floor of Nash Draw—is characterized by sand dunes, caliche, and no discernable drainage systems. The dominant upland vegetation is a grassland shrub mix typical of Aeolian (wind blown) regions of the southern High Plains climatological region. Shrubs characteristic of the Chihuahuan desert are also observed. These species are also adapted to high evapotranspiration rates, which limit infiltration and recharge in these areas. Research into recharge in the desert southwest indicates that recharge through the floors of basins, such as at the WIPP site, is unlikely in the current climate because vegetation and evaporation alone can circumvent recharge (Walvoord et al, 2004).

The Rustler Formation above the waste area is over 500 feet below the ground surface and overlain by the Dewey Lake Formation, and in some places the Gatuña Formation, the Santa Rosa Formation over the eastern half of the site, and the widespread Mescalero caliche. In parts of the site, the Dewey Lake contains a sulfate cement that appears to retard downward movement of water (2004 CRA Chapter 2.2.1.4.2.1). These units are absent in Nash Draw. In the original certification decision, the Agency observed that the Mescalero caliche is almost continuous over the WIPP site. Because caliche only develops in arid areas with little vertical recharge, the presence of the Mescalero caliche indicates that there has been an arid climate and very low recharge conditions over a long period of time at the WIPP site (CCA CARD 14). The caliche, in combination with shifting sand dunes and vegetation and high transpiration, can explain the lack of surface runoff evidence, such as surface drainage channels, near the WIPP site.

Karst and Hydrologic Data

DOE has studied the WIPP site and vicinity for over thirty years (see Figure 15-3 for locations of Culebra well tests). New data is collected annually. In addition to the geologic studies, numerous pump test tests have been done, including large scale pumping tests (e.g., Beauheim and Ruskauff, 1998) and other analyses. DOE has provided these data and analysis results in the 2004 CRA and other reports. These data and their analyses provide information over large areas and form the basis for the performance assessment modeling and much of the discussion presented here. For example, in the 2004 CRA, DOE identified that the Culebra transmissivity is a function of overburden thickness—the deeper the Culebra, the lower the transmissivity (2004 CRA Appendix PA, Attachment TFIELD). Superimposed on the depth are geologic factors such as the location relative to the margin of upper Salado dissolution and to halite in the M3/H3 interval of the Tamarisk.

Figure 15-3. **2004 CRA-Locations of Culebra well tests.**



The Magenta and Culebra appear to have little real-time connection to one another as claimed by some commenters. Numerous pumping tests show that the Magenta and Culebra are independent of one another (Beauheim and Ruskauff, 1998; Meigs et al, 2000; 2004 CRA Chapter 2, section 2.2.1.4.1.2). Pump tests in the Culebra elicit no response from the Magenta. Even at WIPP-25 in Nash Draw, a pumping test conducted in 2004 indicates that the Magenta and Culebra are hydraulically isolated from one another (Lorenz 2005 p. 63). This is typical for all pump tests performed. In addition water chemistry differences also point to lack of connections between the two units.

Hydrologic pumping tests do not indicate the presence of karst. By interrogating large volumes of water in a fractured system, these large scale pumping tests negate the need to have wells everywhere as some commenters suggest. In pump tests, the Culebra exhibits double porosity. The interpretation of the data is that pump tests initially capture fluid from fractures and then fluid comes from the rock matrix. DOE has not seen evidence of continuous high inflows from "underground rivers" caused by karst development.

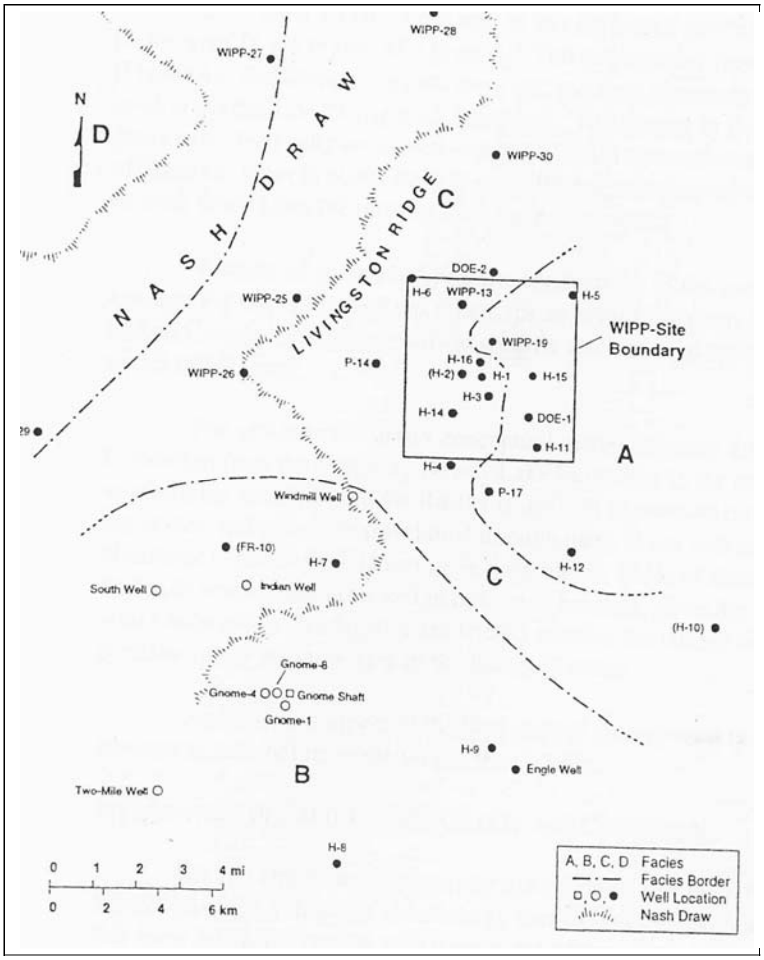
Ground water flow in the Culebra generally flows from the north to the south at the WIPP site and from the northeast to the southwest in Nash Draw. The Magenta ground water flows generally east to west across (see 2004 CRA Chapter 2 page 2-122) the WIPP site and in Nash Draw, the Magenta appears to flow to the southwest. Thus, Nash Draw and the WIPP site exhibit groundwater flow differences in addition to the other differences discussed above. A major implication of this is that flow in Nash Draw is primarily along the axis of Nash Draw—from northeast to southwest. Therefore, flow in northern and central Nash Draw is primarily limited to inputs from within Nash Draw (e.g., potash effluent) and points north.

Corbet (1997) has inferred a recharge area for the Rustler south and west of the site in the southeastern part of Nash Draw with corresponding flow to the southeast, away from Nash Draw. This area corresponds to the hydrochemical Facies B of Siegel et al (1991) which has the lowest total dissolved solids in the region around WIPP. This is one example where Corbet (1997) used the groundwater basin modeling to reasonably integrate the hydrogeochemistry of Siegel et al. (1991).

In the ground water basin model, the eastern part of the system is characterized by extremely slow horizontal and vertical flow, with high salinity (Facies A) (Figure 15-4). In the middle of the WIPP site (Facies C), the lateral flow is slightly faster, but still slow. Corbet (1997) estimates that it would take 20,000 years for water to flow across the WIPP site in Facies C. Vertical flow (specific discharge) would be 0.01 to 0.03 m/1000 years. The water in both facies have had long residence times and interacted with the anhydrite and halite in the system, thus reducing their reactivity and ability to dissolve rock under current climate or in the last several thousand years. Limited age dating of water at the WIPP site also indicates that the Culebra water is old (2004 CRA Chapter 2, section 2.2.1.4.1.2). Flow is driven by recharge to the system over 8,000 years ago, much of which occurred more than 14,000 years ago during glacial times, and the system is still equilibrating to the change in climate regime. The model indicates that only about 2 mm/yr recharge is necessary to produce the flow that we see today. This corresponds well to the research on recharge that shows it to be limited (Campbell et al, 1996; Hogan et al, 2004) in the WIPP region.

EPA believes that, on a regional scale, the groundwater basin model done by DOE reasonably predicts the current ground water flow regime and the geochemistry of the site.

Figure 15-4. 2004 CRA-Four Hydrochemical Facies in the Culebra Siegel et al. 1991



EPA also reviewed the commenter's allegations that a data point at the H-3 well had been falsified and led to an incorrect characterization of the Magenta Dolomite. Commenters stated that CCA Appendix GCR (p. 6-53) indicated that the Magenta at well H-3 has high transmissivity that DOE does not account for in its modeling. Based on our understanding of the geohydrology in the area, evidence provided by DOE in its Magenta Transmissivity fact sheet and the raw data and graphs, and the fact that the CCA Appendix GCR data point is not confirmed by subsequent testing, EPA believes that the CCA Appendix GCR data point is an error. The remainder of the data indicates that the Magenta has generally low transmissivity—lower than the Culebra. The Magenta Dolomite has high transmissivity in Nash Draw, but the geologic processes that formed Nash Draw are different than what has transpired at the WIPP site. Thus, EPA still believes that the Culebra Dolomite is the more transmissive unit, and that it is appropriate to consider the Culebra Dolomite as providing the pathway that would lead to the most releases.

Conclusions Related to Karst

The hydrologic data, combined with geochemical and geologic information, and modeling, indicate that the WIPP site has not been subject to karst formation processes and the assumption of karst is not an appropriate representation of expected site conditions during the 10,000 year regulatory time period. DOE reviewed the information on karst in the performance assessment process and excluded karst features from the performance assessment calculations in the CCA and 2004 CRA and 2004 PABC. EPA has again reviewed data related to karst at WIPP and finds DOE appropriately excluded the effects of karst from the performance assessment calculations. The Lorenz (2005) report (Docket A-98-49, Item II-B2-53) and the EPA Karst TSD (Docket A-98-49, Item II-B1-15) provide a thorough discussion of the major issues as does EPA's response to comments in the original certification decision (Docket A-93-02, Item V-C-1).

Our understanding of the disposal system indicates that the WIPP site characteristics are distinct from Nash Draw such that extrapolations of karst in Nash Draw have little bearing on the WIPP site. Recharge characteristics and resulting discharge are one example of misrepresentation of the data by commenters. Precipitation events that occur in Nash Draw affect Nash Draw but appear to be independent of the WIPP site (See Section 15.2.4 below for new information in the 2009 CRA). The use of Surprise Spring in Nash Draw (see Figure 15-2) as an indicator of karst at WIPP is inappropriate. Surprise Spring is over 8 miles from the WIPP LWB. With the northeast to southwest flow in Nash Draw and a water table that is near the surface, Surprise Spring discharges are only a result of precipitation events that affect Nash Draw. In contrast at the WIPP site, well head data shows no response to precipitation events.

Based on the discussion above, EPA's Karst TSD (Docket A-98-49, Item II-B1-15), Lorenz's report, and other information in the CCA, 2004 CRA, and EPA's original certification response to comments, the following reasons summarize why EPA does not believe that karst will be a pervasive process at WIPP that would affect WIPP's ability to contain radionuclides:

- Low precipitation, high evapotranspiration reduces the potential for infiltration

- Sulfate cement boundary in Dewey Lake toward the south and west

- Depth of Rustler is greater in the LWB than in Nash Draw and where WIPP-33 is located; this will reduce the possibility of reactive water reaching the Magenta and especially the Culebra

- Lack of response of water levels to precipitation events indicates no zones of measurable recharge in the Magenta and Culebra (See Section 15.2.4 for new information in the 2009 CRA)

- Hydrologic data indicate confined aquifers at the WIPP site, implying limited vertical recharge

- Ground water basin modeling indicates recharge is at a distance from the site

- Age of ground water appears to be old

- Lack of Magenta hydrologic response when Culebra is pump tested

- When Culebra is pump tested there is no evidence that "underground rivers" are present; in pump tests, the Culebra exhibits double porosity.

15.2.3 2004 RECERTIFICATION DECISION (194.15(a)(1))

Based on a review and evaluation of the 2004 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2004-0025, Air Docket A-98-49), EPA determined that DOE continues to comply with the requirements for Section 194.15(a)(1).

15.2.4 CHANGES IN THE 2009 CRA (194.15(a)(1))

<u>Earthquake/Seismic Information</u>

Seismic results reported in the 2009 CRA were impacted by two changes made in the monitoring and tracking of earthquakes since the 2002 data cutoff of the 2004 CRA. The New Mexico Institute of Mining and Technology (NMIMT) added two seismograph stations to its network, both sited in the Dagger Draw area of Eddy County, west-northwest of Carlsbad, previously noted to have a high level of seismic activity likely induced by gas production. The addition of the stations allowed the recording of events which were previously undetectable. The NMIMT also updated its historical catalogs of seismic information, using new software to calculate magnitude and epicenter of events. These changes in recorded historic events were incorporated in the 2007 update of the Delaware Basin Drilling Surveillance Program's seismic database.

DOE updated information on earthquakes within 150 miles of the WIPP site and within the Delaware Basin. Section 15.6.1.2 of the 2009 CRA, reports that 703 seismic events took place within 150 miles of the WIPP site during the current monitoring period of October 2002 through September 2007. 85% of all recorded events took place in the vicinity of Dagger Draw, half of which would not have been detected without the new seismic stations. (Hughes 2008a) Eighty-seven events with a magnitude of 3.0 or greater were reported within 150 miles of the WIPP site, with only four occurring in the Delaware basin. The closest to WIPP was caused by a roof fall in a potash mine. The 2004 CRA reported 14 earthquakes between January 1, 1995 and September 30, 2002 with a magnitude 3.0 or greater. [Note: The largest magnitude event for this reporting interval is not given. The 2004 CARD reports: "The largest was a 5.3 magnitude earthquake in Brewster County, Texas.   For comparison, the largest earthquake identified in the CCA was 6.0 between 1926 and 1994."]   Table 15.2 of the 2009 CRA is the current version of the table requested during the CCA (Docket A-98-49, II-B2-38), and updated as Appendix DATA-2009, Table DATA-A-12 of the 2004 CRA. Seismic events in the Delaware Basin are mapped in a memorandum (Hughes 2008a) and referenced in Appendix DATA-2009, Section Data-2.2.

Natural Resources

Major natural resources considered at the WIPP site, originally identified in the CCA, continue to be potash, oil, and natural gas. The potash zone is still considered barren above the repository (see 2009 CRA, Section 15.1.2). Oil, natural gas, and fluid injection wells remain part of future WIPP scenarios.   The deep drilling rate (intrusion rate), calculated by extrapolating the past 100 years of data, has increased from 46.8 boreholes per km^2 in the CCA, to 52.2 in the 2004 CRA, to 59.8 boreholes per km^2 in the 2009 PABC (EPA 2010g-EPA parameter TSD).

The same range of probabilities for Castile brine pocket encounters (0.01 to 0.60 used in the Performance Assessment Verification Test (PAVT) is used in the 2009 PABC. To verify this range updated drilling data was used to calculate the current probability of 0.05, with 34 Castile formation brine encounters out of 678 possibilities. (Hughes, 2007) This represents a reduction from the 1996 calculated probability of 0.08%.

The duration of direct brine releases (DBR) is addressed in Table PA-1 of Appendix PA-2009. The minimum duration for DBR (MINFLOW), originally set by Leonard (1996), was reviewed by the Delaware Basin Monitoring program, and the 3-day limit was determined to still be valid. The maximum duration of DBR (MAXFLOW) was previously set at eleven days, based on a single incident that occurred in 1978. (Stoelzel 1996) DOE reviewed data from the historic DBR parameter package, historic and updated Delaware Basin Monitoring Program data (Leonard 1996 and Kouba 2007), and interviews with current drilling personnel in the WIPP area. The eleven day maximum was determined not to be realistic for drilling generally in the Delaware Basin, and the MAXFLOW parameter was revised to be set at 4.5 days based on interviews with operators in the Delaware Basin (Kirkes 2007).

A report by Hall et al.(2008) summarized information regarding fluid injection activities (both brine disposal and enhanced petrochemical recovery) in the nine-township area up to 2008. The 2004 CRA had reported new fluid injection wells in the vicinity of WIPP (but an average injection rate that had not changed since the CCA (see Section 5.2.1). The number of salt water disposal and injection wells within the nine-township area has increased from 26 in 1997, to 39 in 2003, to 54 in 2008. Hall et al. also stated that the current average injection rate is about 1,480 BWPD, compared to 1,250 BWPD average injection in 2003, a 75% increase in total injection volume. Also see EPA Human Intrusion TSD (EPA 2010d).

Hydrologic Issues

Geologic Model

The geologic description and characteristics of the WIPP site have not changed since the 2004 CRA; please examine Section 15.2.1 **Geologic Model** of this CARD for this information. The Culebra freshwater hydraulic head contour map is updated with new monitor well data annually, see Figure 6-11 of DOE/WIPP 08-2225 for a recent example including new wells drilled since the 2004 CRA (Figure 15-6 below). DOE continues to note that the Culebra transmissivities exhibit a bimodal distribution (2009 CRA Appendix TFIELD-2009 Section TFIELD-3.1) as discussed in Section 15.2.1 of this CARD.

DOE performed a well network optimization study in 2003 to select new well locations that would decrease transmissivity uncertainty the greatest, to guide future decisions to plug old wells and to select the best locations for new wells to be drilled (2009 CRA Appendix HYDRO-2009, Section HYDRO-2.0). DOE plugged 17 wells mainly because of borehole conditions, and modified others to monitor other geologic units such as the Magenta (2009 CRA Appendix HYDRO-2009, Section HYDRO-4.0). DOE located many new wells based on the optimization study prediction that identified areas were the wells would be most valuable. Eighteen new Culebra monitoring wells were added to the WIPP network from April 2003 to October 2006 (2009 CRA Appendix HYDRO-2009, Section HYDRO-3.0, Figures 15.5 and 15.6 of this CARD). Twelve of these wells were drilled in locations to confirm the correlations proposed between Culebra transmissivity and various geologic conditions (Figure 15-6).

Table 15-2. 2009 CRA-Selected Rustler Formation Hydraulic Properties

Rustler Member	Hydraulic Conductivity[4]	Transmissivity	Thickness
Forty-niner	1×10^{-13} to 1×10^{-11} m/s (anhydrite) 1×10^{-9} m/s (mudstone)	8×10^{-8} to 8×10^{-11} m^2/s	13 to 23 m
Magenta	$1 \times 10^{-8.5}$ to $1 \times 10^{-4.5}$ m/s	4×10^{-4} to 1×10^{-9} m^2/s	7 to 8.5 m
Tamarisk	1×10^{-13} to 1×10^{-11} m/s	$< 2.7 \times 10^{-11}$ m^2/s	26 to 56 m
Culebra*	1.5×10^{-14} to $1 \times 10^{-5.5}$ m/s	1×10^{-3} to 1.4×10^{-13} m^2/s	4 to 11.6 m
Los Medaños	6×10^{-15} to 1×10^{-13} m/s	2.9×10^{-10} to 2.2×10^{-13} m^2/s	29 to 38 m

***Update Culebra values only based on recent new well testing, lowest values from SNL-15 pump tests.**

The Culebra continues to be the most transmissive hydrostratigraphic unit above the Salado (salt) Formation (2009 CRA Appendix PA-09 Section PA 2.1.4). The transmissivities measured in wells drilled since the 2004 CRA continue to confirm the range of transmissivities used in the PA calculations with modifications to the lowest

4 Lower numbered negative exponents indicate faster flow.

values for the Culebra (Table 15-2 above). SNL-15, drilled due east of the WIPP site boundary (Appendix HYDRO-2009, Figure HYDRO-1, Figures 15-5 and 15-6), exhibited very low hydraulic conductivity and transmissivity (Appendix HYDRO-2009 Section HYDRO-8.0), lowering the range in Table 15-2. Culebra transmissivity characteristics continue to be zonal in nature (2009 CRA Appendix TFIELD-09 Section 3.0).

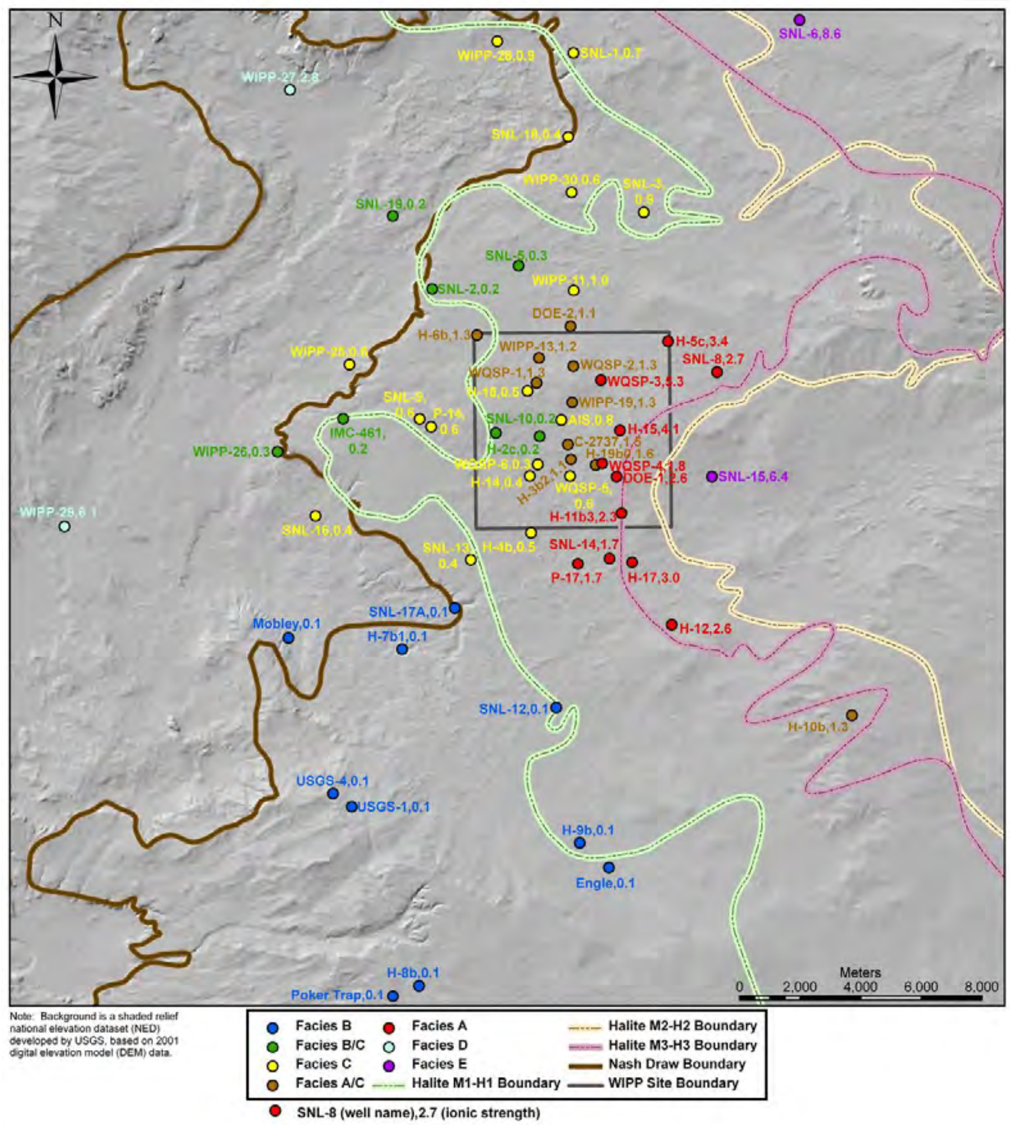


Figure 15-5 2009 CRA-Culebra Monitor Well Locations and Hydrochemical Facies (Source: 2009 CRA Figure HYDRO-49)

DOE performed a peer review of the revised Culebra Hydrogeology Conceptual Model (CHCM) used in the WIPP performance assessment modeling. The purpose and scope of the peer review was to determine the adequacy and conduct an independent review of the "Culebra hydrogeology conceptual model for the purpose of establishing T fields to be used in PA calculations of radionuclide transport through the Culebra."

The new conceptual model uses information gained from the new monitoring wells drilled and tested (Burgess et al. 2008, Figure 15-6 of this CARD) since the 2004 CRA. The original CCA conceptual model peer review panel found that the CHCM failed to correlate the detailed hydrogeology of the Culebra with its tested hydrologic character but that adequate data existed from hydraulic testing to develop a numerical model for PA. In particular, the new well data has allowed DOE to modify the implementation of this conceptual model. As noted on Page 1 of Burgess et al. 2008 of the revised conceptual model; "…the hydraulic properties of the Culebra are related to geologic features and processes. By correlating the measured hydraulic properties at individual well locations to the geologic conditions at those locations, a basis can be developed for assigning hydraulic properties at untested locations where the geologic properties are known." Inclusion of recent well data into the new conceptual model allowed DOE to develop transmissivity fields that are geologically based, consistent with observed groundwater heads, consistent with groundwater responses in Culebra pump test, and consistent with water chemistry (Burgess et al. 2008, page 3).

Changes in Water Levels

DOE continues to monitor water levels with a network of 66 groundwater wells. DOE's network contains 46 Culebra, 17 Magenta, 1 Dewey Lake, and 2 Bell Canyon water wells (2009 CRA Appendix HYDRO-2009 Section HYDRO-5.0). Since the 2004 recertification DOE has made significant changes in the groundwater monitoring program (See Figure 15.6). DOE performed a Culebra monitoring-network optimization study (DOE Section 15.6.1.4.2) to determine the optimum location for new wells to provide the best information and to select and remove (i.e., plug and abandon) wells that would have little impact on the quality of the data acquired. DOE has added 18 new wells and removed 17 wells since 2004 (CRA 2009 Appendix HYDRO Section HYDRO-4.0).

DOE also modified how water level data is acquired from the well monitor network. DOE continues to manually measure the water level at each well monthly, but has equipped most of the wells with instruments called TROLLs (downhole programmable pressure gauges that record pressure fluctuations that can be calibrated to water level changes). TROLL measurements are generally recorded hourly rather than the normal frequency of monthly. One outgrowth of the use of TROLLs it that, for the first time, DOE found that a few wells in Nash Draw response to rainfall events (CRA 2009 Appendix HYDRO, page HYDRO-16); see the section below.

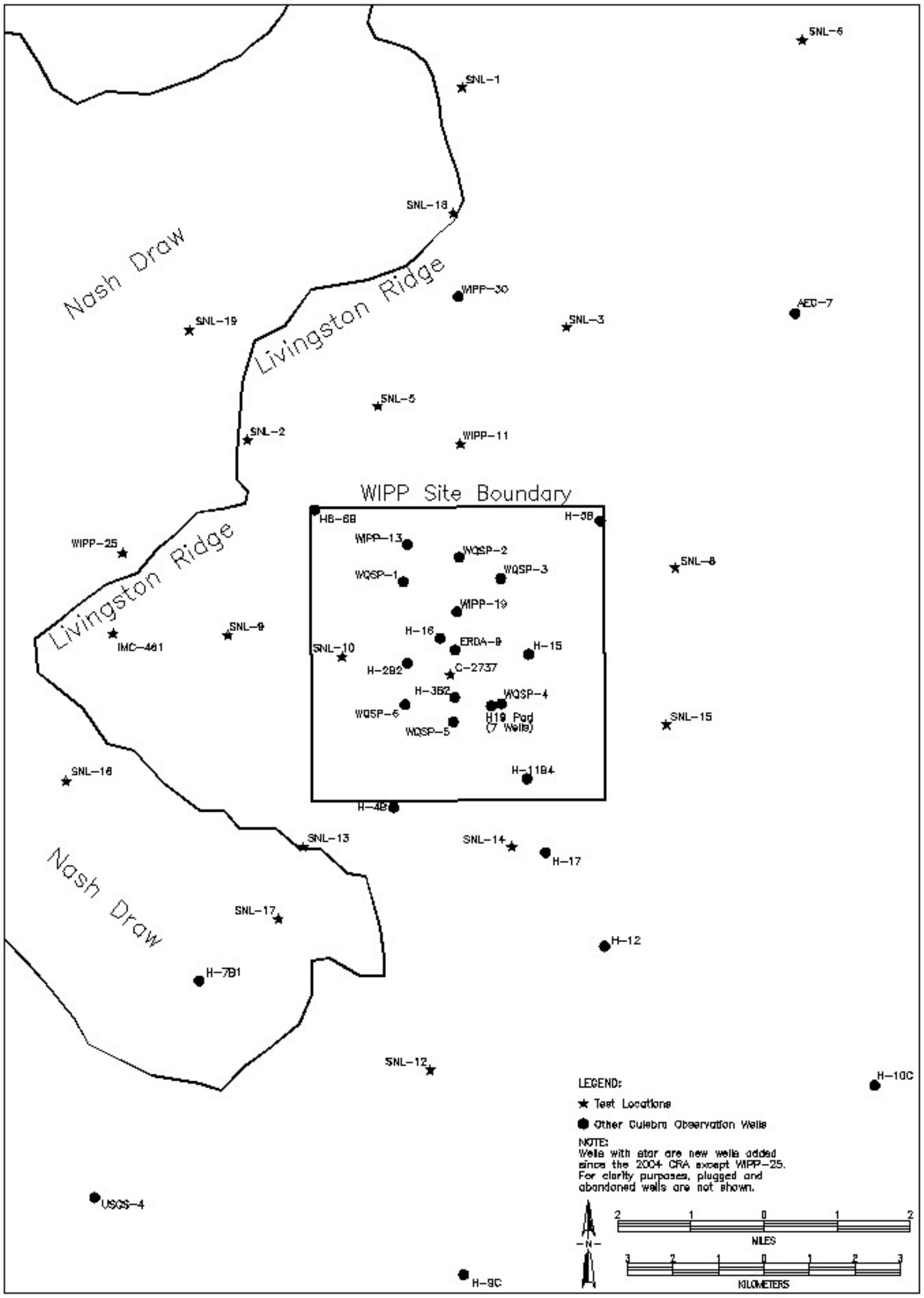


Figure 15-6 2009 CRA-Culebra Tests Wells

Generally the Culebra and Magenta continue to exhibit rising water levels around the WIPP site (CRA 2009 Appendix HYDRO Section HYDRO-5.5). TROLL data, discussed in detail later in this section, has also indicated that water levels respond to oil and gas drilling activities nearby (CRA 2009 Appendix HYDRO page HYDRO-31) as well as to rainfall events in Nash Draw. DOE also performed model studies to attempt to understand possible sources that may cause the water level increases (CRA 2009 Appendix HYDRO Section HYDRO-9.0). Theses studies concluded that poorly plugged oil, gas, and/or potash characterization wells are plausible sources for the water level increases.

Nash Draw Rainfall Impact on Culebra Water Levels

In addition to the well optimization program summarized above, DOE added instrumentation in all Culebra monitoring wells that are not used for water quality. TROLL® instruments made by In-Situ, Inc., when installed in monitoring wells, measure pressure changes in the water column and transmit real-time data to a computer at the surface at pre-programmed intervals. These monitoring wells are able to provide virtually continuous data, in this case hourly, offering a more complete record of the changes in hydraulic head occurring in the wells than provided by manual monthly water-level measurements alone (DOE 2009 CRA, Section 15.6.1.4.2).

The higher temporal resolution of hydraulic head measurements has greatly enhanced understanding of water level changes in the Culebra. Most notably, many Culebra water-level changes previously considered unpredictable and anthropogenic in origin can now be demonstrated to be responses to rainfall in Nash Draw, while others can be conclusively linked to well drilling activities. Comparing daily rainfall measured at the WIPP weather station to the TROLL® pressure data reveals spikes in pressure that correlate with rainfall events of approximately 0.4 inches or more in 24 hours in Nash Draw. These rainfall-induced head changes originate in Nash Draw creating a pressure pulse that propagates under Livingston Ridge and west to east across the WIPP site, decreasing in magnitude, over periods of days to months. This is not an observation of rapid recharge of rainwater at the WIPP site, but a communication of pressure response across the WIPP site from Nash Draw. These observations confirm previous suspicions put forth by Beauheim and Holt (1990) and discussed by EPA in the 2004 CRA (Section 15.2.1 of this CARD, last paragraph) that the Culebra is unconfined in portions of Nash Draw. This understanding enhanced the development of the revised Culebra Hydrology Conceptual Model, which was peer reviewed in 2008. More detailed information may be found in 2009 CRA Appendix HYDRO-2009 Section HYDRO-5.1.

Production Brine Well Cavity Collapse

Oil and gas drillers who drill through the Salado (primarily salt) and Castile (salt and anhydrite) Formations are required to use salt saturated drilling fluid to assure a stable borehole through the salt. Generally this salt laden brine is produced by drilling, or converting, a well drilled into the shallow salt mainly on the Northwestern Platform north of the Delaware Basin. Salt saturated brine is produced by injecting fresh water into the salt, pumping the resultant salt saturated brine to the surface, and trucking it to oil and gas drilling locations that need the brine to drill through salt bearing strata in the Delaware Basin. This process of brine production creates a brine filled cavity that increases in size as saturated brine is produced. These brine filled brine production cavities are generally located close to the surface, on the order of 500 feet deep, in shallow salt, and near low cost sources of fresh water, such as the Capitan Reef. If the size of the cavity is not controlled and regulated, it may grow too large for the surface rock formations to support the cavity roof and collapse, thus creating a sink hole potentially expressing itself on the surface as a sink hole.

In 2008 two brine production wells experienced cavity collapsed resulting in sink holes on the surface north of the Delaware Basin on the Northwest Platform. The Jim's Water Service (BW-005, State of New Mexico well number) failed on July 16, 2008 creating a surface sink hole. On November 3, 2008 the Loco Hill Water Disposal Company (BW-021) brine production well failed also creating a surface sink hole (OCD 2009). The closest brine production well to the WIPP site is located near Carlsbad, New Mexico, about 20 miles west of the WIPP site. These specific occurrences were not discussed in the 2009 CRA. Therefore, in its July 16, 2009 completeness letter (EPA 2009c), comment 2-33-2, EPA requested that DOE discuss the potential impact of such an event near WIPP. DOE's response is examined in Section 15.2.5 below.

Change in Culebra Radionuclide Travel Time

The 2009 PABC calculations predict shorter travel time for a particle to travel through the Culebra to the WIPP site boundary than did the 2004 PABC. Three main changes contributed to these changes in flow time (Kuhlman 2010a page 52); BLM redefined the definition of minable potash in 2009 in particular within the WIPP site near the waste disposal panels, matrix distribution coefficients (K_ds) decreased several orders of magnitude for most radionuclides when the increase in the organic ligand inventory was included, and SNL-14 confirmed the existence of the high-transmissivity zone in the southeastern portion of the WIPP site which creates a pathway for radionuclides to leave the Land Withdrawal Boundary. These changes make the travel time closer to that predicted in the original compliance certification (Kuhlman 2010a Figure 3-10).

Retardation of Radionuclides (Distribution Coefficients or K_ds)

DOE's method for determining retardation of radionuclides, K_ds, in the 2009 recertification performance assessment calculations has not changed (see Section 15.2.1 of this CARD), but the K_ds were recalculated for the 2009 PABC. EPA noted in completeness comment 3-C-25 that, "…increased concentrations of organic ligands indicates that the K_ds…are potentially too high and overestimate the potential retardation in the Culebra."(EPA 2009c). DOE recalculated the K_ds in response to EPA's comment using the new inventory data which, "…decreased several orders of magnitude…" (DOE 2010a page 52, item 2). These new K_ds were used in the 2009 PABC calculations.

Water in the Air-Exhaust Shaft

Water identified in the WIPP exhaust shaft in 1995 at a depth of about 80 feet continues to flow as reported in the 2004 CRA, see Section 15.2.1 above. Since the 2004 CRA DOE drilled three additional shallow wells, PZ-13, PZ-14, and PZ-15, to evaluate the potential impact of the decommissioned and covered Site and Preliminary Design Validation (SPDV) mine tailing pile east of the WIPP air exhaust shaft (Figure 15-7 below, 2009 CRA Section 15.6.1.4.1). Evaluation of these wells showed that the SPDV pile may not contribute to shallow brine that continues to impact the exhaust shaft (Stephens 2008, page ES-2).

In 2004 and 2005 DOE installed numerous infiltration controls to mitigate the impact of surface runoff on the shallow water found in the exhaust shaft (Stephens 2008 page ES-1). DOE installed a number of lined storm water ponds to capture run off from the various surface salt piles and surface facilities at WIPP (Figure 15-2 capture basins and ponds). In 2008 some of the 15 shallow monitoring wells water level measurements declined for the first time, possibly indicating the first sign of the effectiveness of the infiltration controls (Stephens 2008 ES-2).

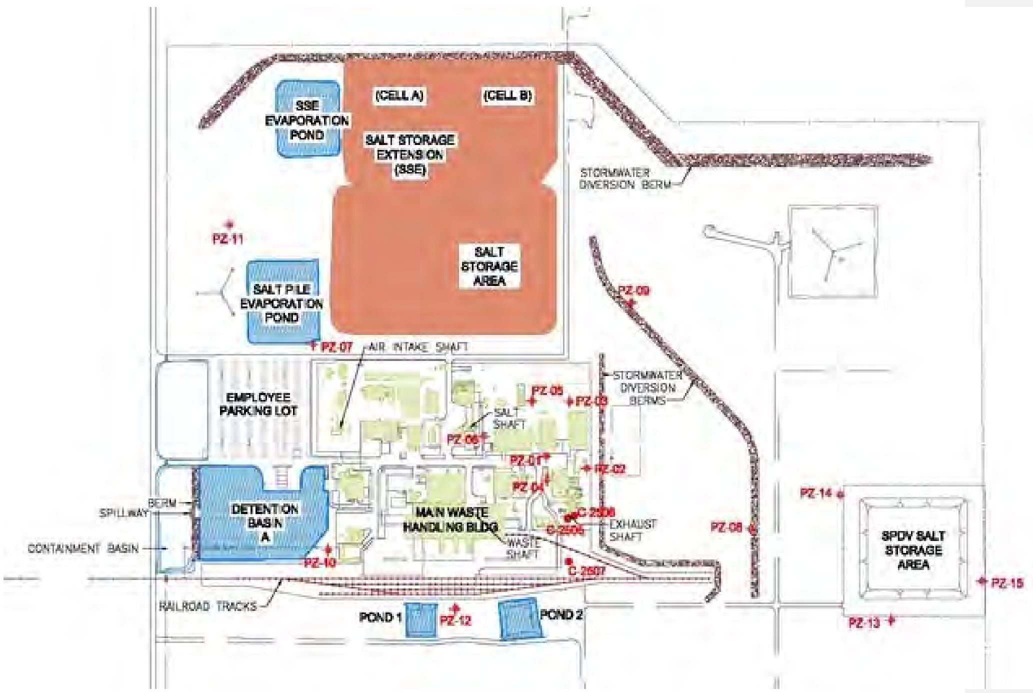


Figure 15-7 PZ Shallow Water Wells

<u>Current climatologic and meteorological conditions in the vicinity</u>

As noted in Section 15.2.1 above WIPP is located in the desert southwest with limited annual precipitation. Limited precipitation continues to be the norm since the retreat of the last ice sheet around 10,000 years ago. DOE provided updated information on recent climatic conditions in WIPP Annual Site Environmental Reports (DOE 2008d Chapter 5.3). The 2009 CRA Table 15-3 and Figures 15-1 through 15-5 provide recent meteorological information (2009 CRA Section 15.6.1.5). DOE notes in the 2009 CRA

Section 15.6.1.5 that no changes in climatic conditions occurred during 2002-2006 therefore, CCA assumptions about future climate in the performance assessment have not changed for this recertification.

Karst

DOE reviewed and updated geologic data in Section 15.6.1 of the 2009 CRA. According to Section 15.6.1.1, "Geologic studies between 2003 and 2007 focused on Rustler halite margins and karst." In the time since the 2003 data cutoff for the 2004 CRA, DOE undertook a monitoring well optimization program under which it expanded its monitoring well network, conducted extensive hydrologic testing, and added instrumentation that allowed more precise analysis of Culebra water levels. The resultant data, described in the 2009 CRA Section 15.6.1.4, Hydrologic Information, and 2009 CRA Appendix HYDRO reinforced and enhanced the conceptual understanding of the Culebra hydrogeology, and allowed the integration of the tested hydrologic characteristics of the Culebra with its observed geologic characteristics.

As a part of its recertification review in 2006, EPA required DOE to conduct additional investigations into the issue of karst because of public comments. The results of this investigation (Lorenz 2006a and Lorenz 2006b), as well as arguments for the presence of karst at the WIPP site (Hill 1999) were presented along with the new hydrogeologic findings to the revised Culebra Hydrology Conceptual Model Peer Review Panel in August 2008 (Burgess et al. 2008).

Citizens Against Radioactive Dumping (CARD) submitted to EPA a document by Dr. Richard Hayes Phillips, entitled "Proof of Rapid Rainwater Recharge at the WIPP Site" and dated March 25, 2009 (CARD 2009 and Phillips 2009). Dr. Phillips presented his findings orally to EPA at a public holder meeting held in Albuquerque on June 30, 2009. Dr. Phillips offers a radically differing conceptual model of Culebra hydrogeology. During its review of the Phillips report, EPA identified eight specific challenges to the current conceptual model and asked DOE to respond as part of the completeness process. DOE responded in detail to these challenges in its third completeness response letter to EPA (DOE 2009f). Chaturvedi (2009) and PECOS Management (2009) commented on the Phillips report in writing.

The impact of these changes as they pertain to the issue of karst is fully discussed in section 15.2.5, Evaluation of Compliance below.

15.2.5 Evaluation of Compliance for 2009 Recertification (194.15(a)(1))

Earthquake/Seismic Information

DOE provided information on recent seismic activity in the 2009 CRA Section 15.6.1.2 and Appendix DATA-2009 Section DATA-2.2. Although the new analysis of historical data and increased monitoring capabilities have increased the number of events that are recorded, DOE concludes that "no significant or anomalous seismic events have occurred in the vicinity of the WIPP since the CRA-2004," and no changes to analyses or calculations need to be made for the 2009 CRA. EPA reviewed DOE documentation and analyses. EPA finds DOE's reporting and conclusions to be complete and adequate.

Natural Resources

DOE has continued to monitor drilling activities through the Delaware Basin Monitoring Program and has appropriately captured the drilling events that would affect the drilling rate used for the PA. Although the drilling rate has again increased to 59.8 boreholes/km^2 in the 2009 PABC, DOE analysis performed during the 2004 recertification process indicated that even a drilling rate as high as 105 boreholes/km^2 would not affect performance (Kanny and Kirchner 2004). Furthermore, this calculation was based upon the past 100 years of drilling, and due to the fact that the first deep borehole was drilled in 1911, boreholes will begin to be subtracted from the total, as well as added, starting in 2011. EPA has reviewed changes to the DBR parameter MAXFLOW and finds them to be reasonable.

DOE's FEPs screening of the fluid injection parameters has not changed since the 2004 CRA, and DOE's review of injection activities is adequate. The number of salt water disposal and injection wells within the nine-township area has increased from 26 in 1997, to 39 in 2003, to 54 in 2008. Hall et al. 2008 also stated that the current average injection rate is about 1,480 barrels of water per day (BWPD), compared to 1,250 BWPD average injection in 2003, with a 75% increase in total injection volume. EPA asked, in a March 10, 2010 completeness email request (EPA 2010j, completeness comment E-33-1) if these increases in average injection rates and total volumes had any impact on the previous fluid injection analysis done during the CCA and confirmed in the 2004 CRA. DOE's response, dated March 31, 2010, concluded; "These increases, however, are easily bounded by current FEPs screening assumptions and their justifying analyses (in this case, Stoelzel and Swift. 1997)." EPA reviewed DOE's analysis and finds information related to natural resources to be adequate.

Hydrologic Issues

Geologic Model

One conceptual model was changed for the 2009 PABC calculations. DOE modified the Culebra Hydrology Conceptual Model by making the model-derived transmissivity fields more geologically based. DOE's computational approach is basically the same as in the 2004 CRA, but the parameterization and some assumptions have been changed and refined based on new well data and testing. One example is that additional hydrochemical facies have been added based on new well data (2009 CRA Appendix TFIELD-2009 Section TFIELD-1.0; ERMS 552951 Sections 2.0 and 3.0). The model changes were based on extensive new hydrological investigations and testing conducted by the Department and its Contractors. McKenna (2004) conducted an optimization study using 100 T-fields to identify the most appropriate locations of the head and transmissivity data which helped to reduce the uncertainty associated with the groundwater travel time in the Culebra. Roberts (2007) used nSIGHTS (n-dimensional Statistical Inverse Graphical Hydraulic Test Simulator) to create new T field estimates from the new pumping tests. nSIGHTS utilizes "perturbation analysis" to quantify the uncertainty in the parameter estimates. The new T-field estimates are consistent with the T-geology correlation used in CRA-2004.

EPA examined DOE's conceptual model peer review (Burgess et al. 2008) findings and model changes implementation in developing the transmissivity fields (ERMS 552951 Section 3.0) and determined that DOE's approach was adequate and reasonably documented. See CARD 27, Section 27.4.1, for additional detail.

Changes in Water Levels

EPA continues to agree that the primary origin of water level changes is probably anthropogenic (i.e., influence of humans on nature). However, with the introduction of new monitoring wells equipped with more frequent measurements a natural component, rainfall, may also potentially have an impact on water level measurements. Since the 2004 CRA, DOE has significantly improved the water well monitoring network and improved over all system understanding. DOE continues to include the effect of water level changes in the performance assessment calculations by updating transmissivity fields with the latest calibrated well data. EPA examined DOE's work and documentation since the 2004 CRA and finds DOE's approach and conclusions to be adequate.

Nash Draw Rainfall Impact Culebra Water Levels

2009 CRA Appendix-HYDRO Section HYDRO-5.1 describes the characteristics of this phenomenon. Fairly quickly--hours to days--after a rainfall event in Nash Draw, some monitoring wells in Nash Draw show a variation in water level. This increases the hydrostatic head (i.e., water pressure) in the vicinity of rainfall in Nash Draw. This pressure increase is slowly propagated east into the monitor well network around WIPP over weeks and months. However, the monitoring well network does not show any impact due to rainfall events east of Nash Draw at or near the Land Withdrawal Boundary. Therefore, this propagation eastward of rainfall in Nash Draw does not indicate infiltration from the surface near the WIPP but is an expression of the increase in water pressure in Nash Draw due to local rainfall events. EPA examined all aspects of rainfall impact, DOE's detailed discussion of this phenomenon, and concluded that DOE had documented and explained the phenomenon adequately. EPA concurs that the rainfall event data in Nash Draw do not 1) indicate rapid infiltration is occurring at the WIPP site proper and 2) do not challenge the Culebra hydrology conceptualization.

Production Brine Well Cavity Collapse

During EPA's review of the 2009 CRA documentation it did not appear that this particular event was considered in the recertification documentation. EPA asked DOE to evaluate the impact of a production brine well cavity collapse in our second completeness letter dated July 16, 2009, completeness comment 2-33-2. DOE's evaluation noted that this scenario is similar to potash mining taking place in the upper Salado Formation near WIPP; the applicable effects of the potash mining were included in DOE's 2009 CRA documentation. EPA believes that the by addressing potash mining effects, the performance assessment accounts for the effects that would be seen if brine solution mining were to occur in the vicinity of WIPP. In addition, it should be noted that brine production around WIPP is not a likely scenario, given the depth to the salt and the lack of fresh water in the vicinity. The salt is nearer the surface in other areas where there is fresher water available. DOE noted in their January 12, 2010 response (DOE 2010a) that: "…EPA requires that performance assessments incorporate mining by significantly varying the hydraulic transmissivity within the overlying rock units. This is because the most significant effect of total removal of an ore body is understood to be subsidence and disruption [by fracturing] of the overlying rocks.

A cavity collapse would be very localized; see Figure 15-8 for an example, and the WIPP performance assessment evaluates the impact of widespread removal of an entire ore body by mining activities. The effects of subsidence due to brine extraction are therefore accounted for within the mining scenario in performance assessment. EPA examined DOE's response to completeness comments and relevant documentation in the 2009 CRA and found them to be adequate.

Figure 15-8 Jim's Water Service Sinkhole, formed by a brine production well collapse, 2008. Approx. 400 feet in diameter, located 17 miles southeast of Artesia, NM.

Change in Culebra Radionuclide Travel Time

EPA examined the information DOE supplied in the 2009 CRA and determined that the decrease in travel times, compared to the 2004 CRA, are appropriate and reasonable. The decrease in travel time and increase in radionuclide transport are attributed to three changes since the 2004 CRA: changes in the definition of minable potash, changes in the lower limit of the K_d ranges, and the presence of the high-transmissivity pathway of the southeast porting of the WIPP site confirmed by the SNL-14 pumping test (Kuhlman 2010a page 53). EPA finds that the decreased travel time for the 2009 CRA to be reasonable and based on appropriate data and modeling done by DOE.

Retardation of Radionuclides (Distribution Coefficients or K_ds)

EPA noted in the October 19, 2009 completeness letter (EPA 2009c), comment 3-C-25, that the impact of higher organic ligand concentrations on K_ds in the updated WIPP inventory had not been included in the WIPP performance assessment by DOE. DOE agreed with EPA's comment and included new K_d values in the 2009 PABC (Clayton et al. 2009 Section 2.5). EPA examined DOE's response and verified that these changes are included in the 2009 PABC and found them to be adequate.

Water in the Air-Exhaust Shaft

EPA reviewed various 2009 CRA documents and evaluated DOE's proactive approach attempting to mitigate the potential surface sources of water in the air exhaust shaft. It appears clear that the origin of this near surface water is derived from anthropogenic sources, such as surface facility runoff from the salt stack and parking lots, and there continues to be no evidence that near surface karst are involved as claimed by some stakeholders. EPA finds DOE's discussion of this issue to be adequate.

Current climatologic and meteorological conditions in the vicinity

EPA examined 2009 CRA documentation and DOE's conclusions related to these topics and found that there are no expected changes in climate conditions and no significant changes in meteorological conditions have take place in the vicinity of WIPP. EPA find DOE's conclusion to be adequate.

Karst in 2009 CRA Review

Karst-Background

Concerns that active karst processes occur at the WIPP site have been raised and addressed during each of the previous two certifications. During the 2004 recertification, in response to stakeholder comments, U.S. EPA conducted an exhaustive review of the issue. The response included EPA staff and representatives visiting the WIPP site and nearby areas specifically to examine evidence of karstic processes, production of an additional karst Technical Support Document (EPA 2006d), and a request for DOE to submit a report addressing karst as part of completeness (Lorenz 2006a and Lorenz 2006b). EPA's full conclusions are contained above in Section 15.2.3 of this CARD. In short, EPA found that karst does not impact the Land Withdrawal Area, citing the following reasons:

- *Low precipitation, high evapotranspiration reduces the potential for infiltration*
- *Sulfate cement boundary in Dewey Lake toward the south and west*
- *Depth of Rustler is greater in the LWB than in Nash Draw and where WIPP-33 is located; this will reduce the possibility of reactive water reaching the Magenta and especially the Culebra*
- *Lack of response of water levels to precipitation events indicates no zones of measurable recharge in the Magenta and Culebra (See Section 15.2.4, Nash Draw Rainfall Impact Culebra Water Levels, for new information in the 2009 CRA)*
- *Hydrologic test data indicate confined aquifers at the WIPP site, implying limited vertical recharge (linkage)*
- *Ground water basin modeling indicates recharge is at a distance from the site*

- *Age of ground water appears to be old*
- *Lack of Magenta hydrologic response when Culebra is pump tested*
- *When Culebra is pump tested there is no evidence that "underground rivers" are present; in pump tests, the Culebra exhibits double porosity.*

<u>Karst and Hydrologic Data</u>

As part of its recertification review in 2006, EPA required that DOE conduct additional investigations into the issue of karst. These investigations led to the Lorenz Report (2006a). Additionally, starting in 2003, DOE undertook the project of updating the water monitor well program by first optimizing its monitoring well network, eventually generating data that enhanced the conceptual understanding of Culebra and is fully discussed above in this CARD in "Changes in Water Levels", and "Nash Draw Rainfall Impact Culebra Water Levels." The revised conceptual model, recalibrated T-fields, and karst studies were presented to the Revised Culebra Hydrogeology Peer Review Panel in August 2008. The panel concluded that "These and other arguments made by Lorenz (2006a) and Powers (2008) have convinced the Panel that significant karst features are not present at the WIPP site" (Burgess et al. 2008).

The primary refinement in the understanding of the Culebra hydrogeology which impacts the karst issue is that additional monitoring of water levels have conclusively demonstrated a pressure response to rainfall by the Culebra in Nash Draw. As presented in 2009 CRA Appendix HYDRO-2009 and discussed above, following a rainfall event in Nash Draw a pressure response propagates under Livingston Ridge, west to east, and across the WIPP site over period of days to months. This proves the presence of unconfined areas of the Culebra in the vicinity of Nash Draw, as was inferred at the time of the 2004 CRA, and explains many changes in water levels which were poorly understood during the previous recertification (Section 15.2.1). Furthermore, it demonstrates the confined character of the Culebra dolomite at the WIPP site.

Dr. Richard Phillips' report, "Proof of Rapid Rainwater Recharge at the WIPP Site," (Phillips 2009) puts forth the same arguments that some stakeholders have made during previous certifications, arguing that rainwater falling at the site rapidly infiltrates the Rustler Formation at WIPP, and that this hypothesis is supported by the groundwater data collected by DOE in preparation for the revised Culebra Hydrology Conceptual Model Peer Review. Dr. Phillips asserts that the correlation of rainfall events to pressure changes in the Culebra proves rapid rainwater infiltration, recharge, several hundred feet to the Culebra at the WIPP site. EPA fully reviewed the Phillips report, and in order to guide its review, identified eight primary assertions in the report that appear to challenge aspects of the WIPP conceptual models. DOE responded in its third completeness response (DOE 2009f) and each assertion of the CARD report is discussed specifically in Appendix 15-B, below.

Review of the Phillips report shows that it fails to address either numerous geologic difficulties that contradict its hypothesis or the findings presented in 2009 CRA Appendix HYDRO-2009 which offer a far more plausible explanation of Culebra water level rainfall responses. Dr. Phillips does not challenge any of the evidence against karst, stated at the beginning of this section that informed EPA's previous conclusions. Furthermore, as stated in the third completeness response letter, "…significant, persistent differences in head between the Magenta and Culebra are observed all over the WIPP site. These head differences alone provide clear evidence that rain water cannot be 'recharging' the Rustler dolomites through vertical infiltration at the WIPP site (DOE 2009f Enclosure 1)."

The Phillips submission was also independently reviewed by Lokesh Chaturvedi (Chaturvedi 2009) and by PECOS Management Services, Inc. (PECOS 2009). Chaturvedi (2009) concluded, "A review of the CARD press release (CARD 2009) and critique by Phillips (2009) does not reveal any new issues which have not already been addressed by DOE and EPA. The 2008 peer review of the refined Culebra model was fairly and openly conducted to continue to improve our understanding of the geology and hydrology of the WIPP site." PECOS (2009) likewise found that "…the [Phillips] report does not contain any new evidence of karst conditions and is essentially a re-statement of the arguments about the presence of karst at and around WIPP that were presented previously to EPA during the original certification and 2004 recertification of WIPP."

Upon technical review, the preponderance of geologic and hydrologic data contradicts the hypothesis that rapid leakage of groundwater reaches the Culebra or that any other karstic processes impact the WIPP site. New data collected by Sandia National Laboratories successfully integrates the geologic and hydrologic models, and has been adequately peer reviewed (see CARD 27, Peer Review Section 27.4.1) EPA finds that the research presented in Appendix HYDRO-2009 now integrates Culebra water level data into a more refined understanding of the site's hydrology. The Phillips report fails to challenge the conceptual model or the calculation of transmissivities used in the performance assessment. EPA finds that as in the CCA and the 2004 CRA, DOE has appropriately excluded the effects of karst from the performance assessment calculations. Furthermore, EPA considers the issue of karst at the WIPP site to be closed, unless compelling new data suggest that the issue be revisited.

15.2.6 2009 RECERTIFICATION DECISION (194.15(a)(1))

Based on a review and evaluation of the 2009 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2009-0330, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(1).

15.3 BACKGROUND (194.15 (a)(2))

DOE monitors ten parameters selected during the CCA to verify predicted performance of the WIPP repository. The monitored parameters are listed in Table 15.3 below. EPA keeps abreast of DOE's monitoring during annual inspections of the parameter monitoring program to verify that DOE's process and monitoring programs are adequate. EPA continues to evaluate DOE's parameter monitoring program and their response to changes in parameters to be in compliance with this requirement.

15.3.1 REQUIREMENTS (194.15(a)(2)

(a) "In submitting documentation of continued compliance pursuant to section 8(f) of the WIPP LWA, the previous compliance application shall be updated to provide sufficient information for the Administrator to determine whether or not the WIPP continues to be in compliance with the disposal regulations. Updated documentation shall include:

(2) All additional monitoring data, analyses and results

Table 15.3 – Monitored Parameters	
Geomechanical Parameters- -Creep closure, -Extent of deformation, -Initiation of brittle deformation, and -Displacement of deformation features.	**Waste Activity Parameter*-** -Waste Activity **Subsidence Parameter-** -Subsidence measurements
Hydrological Parameters*- -Culebra groundwater composition and -Change in Culebra groundwater flow direction.	**Drilling Related Parameters*-** -Drilling rate and -The probability of encountering a Castile brine reservoir.
*Parameters exhibiting changes since the CCA approval.	

15.3.2 Changes in the 2004 CRA (194.15(a)(2)

DOE documented monitoring relevant changes since the CCA in Wagner 2003, 2004 CRA Chapters 2 and 7.2, 2004 CRA Appendix DATA, 2004 CRA Appendix MON 2004, and other parameter monitoring related documents.

15.3.3 Evaluation of Compliance for 2004 Recertification (194.15(a)(2))

EPA reviewed Wagner 2003, 2004 CRA Chapters 2 and 7.2, 2004 CRA Appendix DATA, 2004 CRA Appendix MON 2004, and other parameter monitoring related documents. EPA also confirmed that DOE has not modified any of the parameter selection arguments or conclusions since the original CCA, nor have the parameter monitoring programs been changed.

DOE determined that even though some monitored parameters have changed, no new parameters need to be added nor did the parameter monitoring programs need to be modified. DOE did not change any argument or conclusion that justified why a parameter was considered significant or insignificant for the 2004 CRA, nor did DOE change their pre-closure or post-closure program plans or activities.

EPA did not receive any public comments on DOE's continued compliance with the content of recertification application(s) requirements of Section 194.15(a)(2).

15.3.4 2004 Recertification Decision (194.15(a)(2))

Based on a review and evaluation of the 2004 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2004-0025, Air Docket A-98-49) as well as 2004 CRA CARDs 23 and 42, EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(2).

15.3.5 Changes in the 2009 CRA (194.15(a)(2)

DOE documented monitoring relevant changes since the 2004 CRA in Wagner 2008a and 2008b, 2009 CRA Sections 15 and 42, 2009 CRA Appendix DATA-2009, 2009 CRA Appendix MON-2009, and other parameter monitoring related documents.

15.3.6 Evaluation of Compliance for 2009 Recertification (194.15(a)(2))

EPA reviewed Wagner 2008a and 2008b, 2009 CRA Sections 15 and 42, 2009 CRA Appendix DATA-2009, 2009 CRA Appendix MON-2009, and other parameter monitoring related documents. EPA also confirmed that DOE has not modified any of the parameter selection arguments or conclusions since the original CCA and the 2004 CRA nor have the parameter monitoring programs been changed.

DOE continues to conclude that even though some monitored parameters have changed, no new parameters need to be added nor did the parameter monitoring programs need to be modified. DOE did not change any argument or conclusion that justified why a parameter was considered significant or insignificant for the 2009 CRA nor did DOE change their pre-closure or post-closure program plans or activities.

EPA did not receive any public comments on DOE's continued compliance with the content of recertification application(s) requirements of Section 194.15(a)(2).

15.3.7 2009 RECERTIFICATION DECISION (194.15(a)(2))

Based on a review and evaluation of the 2009 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2009-0330, Air Docket A-98-49) as well as 2004 CRA CARDs 23 and 42, EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(2).

15.4 REQUIREMENTS (194.15(a)(3))

(a) "In submitting documentation of continued compliance pursuant to section 8(f) of the WIPP LWA, the previous compliance application shall be updated to provide sufficient information for the Administrator to determine whether or not the WIPP continues to be in compliance with the disposal regulations. Updated documentation shall include:

(3) All additional analyses and results of laboratory experiments conducted by the Department or its contractors as part of the WIPP program

15.4.1 CHANGES IN THE 2004 CRA (194.15(a)(3))

<u>Supercompacted Waste</u>

DOE requested (Docket A-98-49, Item II-B2-15) EPA's approval for the disposal of supercompacted waste from INL. EPA required DOE to conduct several analyses of the effect of the denser waste form and higher amounts of cellulosic, plastic, and rubber materials (CPR) (see Docket A-98-49, Items II-B2-22 to B2-26 and Items II-B2-28 and II-B2-29). EPA's review of the subject culminated in an approval of the emplacement of the supercompacted waste in the WIPP and a requirement to keep the magnesium oxide safety factor at least 1.67 for the remainder of the panels (Docket A-98-49, Item II-B3-68).

<u>STTP Experiments</u>

DOE conducted source term test plan (STTP) experiments to provide data on the concentrations of actinides, actinide-containing colloids, complexing agents, and other chemical reactants in simulated WIPP brine in contact with candidate backfill materials and actual transuranic (TRU) wastes (Docket A-98-49, Item II-B1-3). DOE indicated that the results of experiments had no relevance to WIPP conditions, because of the high carbon dioxide overpressure and relatively low pH (2004 CRA Appendix PA Attachment SOTERM-4.8). The Environmental Evaluation Group (EEG) contended that the experiments were relevant and indicated the presence of nesquehonite, a form of magnesium oxide that would have contributed to higher actinide solubility than DOE used in PA. The Agency reviewed the results of the STTP experiments and EEG's concerns and determined that the experiment with MgO was not relevant to repository conditions because of the high carbon dioxide partial pressure (See Docket A-98-49, Item II-B1-3 for a summary and additional references).

15.4.3 Evaluation of Compliance for 2004 Recertification (194.15(a)(3))

EPA approved the supercompacted waste in a previous action (Docket A-98-49, Item II-B3-68), and the STTP experimental results were not applicable at WIPP, and therefore were not used in the WIPP performance assessment.

EPA did not receive any public comments on DOE's continued compliance with the content of compliance recertification application(s) requirements of Section 194.15(a)(3).

15.4.4 2004 Recertification Decision (194.15(a)(3))

Based on a review and evaluation of the 2004 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2004-0025, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(3).

15.4.5 Changes in The 2009 CRA (194.15(a)(3))

Experiments "analyses and results of laboratory experiments conducted" by DOE since the 2004 CRA include the following (from 2009 CRA Section 15.6.3 and DOE 2010f):

<u>Disturbed Rock Zone (DRZ) Experiments (DOE Section 15.6.3.1)</u>

<u>Waste Shear Strength Experiments (DOE Section 15.6.3.1)</u>

<u>Characterization and Qualification of MgO Experiments (DOE Section 15.6.3.2)</u>

<u>MgO Hydration and Carbonation Experiments (DOE Section 15.6.3.2)</u>

<u>Solubility of Neodymium (Nd) (III) Experiments (DOE Section 15.6.3.3)</u>

<u>Reduction of Higher Valent Pu (V/VI) by Iron Experiments (DOE Section 15.6.3.3)</u>

<u>Solubility of U (VI) in Carbonate-free WIPP Brine Experiments (15.6.3.3)</u>

<u>Iron and Lead Corrosion Studies</u>

15.4.6 EVALUATION OF COMPLIANCE FOR 2009 RECERTIFICATION (194.15(a)(3))

EPA during its review of this requirement for the 2009 CRA EPA examined DOE's 2009 CRA Section 15.6.3 and 2009 CRA Appendix DATA-2009 Section Data-9.0 and was unable to easily trace the information provided by DOE. EPA requested that DOE clarify the information and link reports to the appropriate experiments (Email dated March 12, 2010). DOE response (DOE 2010f includes EPA's email text) is summarized below:

<u>Disturbed Rock Zone (DRZ) Experiments (DOE Section 15.6.3.1)</u>

No changes were made in WIPP repository conditions or subsurface processes used in PA to establish compliance since the 2004 CRA based on these experiments. The DRZ analyses referenced in the 2009 CRA Section 15.6.3.1 under AP-133 are complete and documented in the report referenced in Appendix DATA-2009 Section DATA-9.0 (Park et al. 2007). Additional 2009 CRA information concerning the DRZ can be found in Appendix SOTERM-2009 SOTERM-2.2.5, Appendix DATA-2009 Section DATA-9.0; Park et al., 2007; ERMS 546370, Ismail 2007; ERMS 545755, Holcomb and Hardy 2001; ERMS 545575.

<u>Waste Shear Strength Experiments (DOE Section 15.6.3.1)</u>

No changes were made to the WIPP repository conditions used in PA to establish compliance since the 2004 CRA based on these experiments.

The Waste Shear Strength analysis referenced in 2009 CRA Section 15.6.3.1 under AP-131 were completed and documented in the report referenced in 2009 CRA Appendix DATA-2009 Section DATA-9.0; Herrick et al., 2007; ERMS 546343. Planned Waste shear strength experiments under test plans TP 09-01 and TP 08-01 have not been started.

<u>Characterization and Qualification of MgO Experiments (DOE Section 15.6.3.2)</u>

No changes were made in PA as a result of MgO characterization studies. The specific analyses referenced in Section 15.6.3.2 are complete and are documented in Appendix MgO-2009 Section MgO-3.2.3 (Results since the CRA-2004 in Characteristics of MgO) and Appendix DATA-2009 Section DATA-9.0. MgO Characterization, hydration and carbonation experiments were performed under AP-108, TP 00-07 and TP 06-03. Additional MgO characterization and qualification of vendor-provided MgO analyses were discussed in response to EPA's comments 1-C-1 and 1-C-2 (EPA 2009a). At the present the MgO excess factor stands at 1.2 which EPA approved in 2008 (Reyes 2008) with conditions to calculate and track MgO on a room-by-room basis and verify that the reactivity of MgO is maintained 96 (mol)% (Appendix MgO-2009).

<u>MgO Hydration and Carbonation Experiments (DOE Section 15.6.3.2)</u>

No changes were made in PA as a result of MgO hydration analyses. MgO hydration and carbonation experiments are performed under AP-108, TP 00-07 and TP 06-03 and are ongoing. Completed MgO hydration analyses results are discussed in 2009

CRA Appendix MgO-2009 Section MgO-4.1.2 (Results since the 2004 CRA Regarding Hydration of MgO). The latest hydration results are discussed in the MgO milestone report (Deng et al., 2008) while there are no carbonation results available from the ongoing experiments.

Solubility of Neodymium (Nd) (III) Experiments (DOE Section 15.6.3.3)

These data were summarized in Appendix SOTERM-2009 Section 3.6.2. A more detailed report entitled “Actinide (III) Solubility in WIPP Brine: Data Summary and Recommendations,” and designated as report LCO-ACP-08 (Borkowski et al. 2009), was provided to the EPA. Although some of the actinide data were used indirectly for the development of uncertainties in solubility, these data supported existing PA assumptions and did not result in any changes (see Summary Report for 2009 CRA PABC, Section 2.2 (Clayton et al. 2009)).

Reduction of Higher Valent Pu (V/VI) by Iron Experiments (DOE Section 15.6.3.3)

These data were summarized in Appendix SOTERM-2009, Section 3.5.2. A more detailed report entitled “Reduction of Higher-Valent Plutonium by Iron Under Waste Isolation Pilot Plant (WIPP)-Relevant Conditions: Data Summary and Recommendations,” and designated as report LCO-ACP-09 (Reed et al. 2010), was provided to the EPA via email on March 12, 2010. No changes were made in PA as a result of these analyses.

Solubility of U (VI) in Carbonate-free WIPP Brine Experiments (15.6.3.3)

These data were summarized in 2009 CRA Appendix SOTERM-2009 Section 3.3.2. A more detailed report entitled “Actinide (VI) Solubility in Carbonate-free WIPP Brine: Data Summary and Recommendations,” and designated as report LCO-ACP-10 (Lucchini et al. 2010), was provided to the EPA via email on February 8, 2010. No changes were made in PA as a result of these analyses.

Iron and Lead Corrosion Studies

Iron and lead corrosion studies were initiated under TP 06-02 and TP 08-02. Iron and lead chemistry long-term experiments are in progress. The first six-month report for this activity was completed in late 2009 after submittal of the 2009 CRA (Roselle 2009). No changes were made in PA as a result of these analyses.

EPA examined DOE’s response to our comments (DOE 2010f) and found that DOE adequately documented experiments performed and ongoing since the 2004 CRA and that they have not been used in the 2009 CRA PAs.

EPA did not receive any public comments on DOE’s continued compliance with the content of compliance recertification application(s) requirements of Section 194.15(a)(3).

15.4.7 2009 RECERTIFICATION DECISION (194.15(a)(3))

Based on a review and evaluation of the 2009 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2009-0330, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(3).

15.5 REQUIREMENTS (194.15(a)(4))

(a) “In submitting documentation of continued compliance pursuant to section 8(f) of the WIPP LWA, the previous compliance application shall be updated to provide sufficient information for the Administrator to determine whether or not the WIPP continues to be in compliance with the disposal regulations. Updated documentation shall include:

(4) An identification of any activities or assumptions that deviate from the most recent compliance application

15.5.1 CHANGES IN THE 2004 CRA (194.15(a)(4))

DOE made changes to several specific activities and assumptions, and to several categories of items. These items are grouped in Table 15-4, but discussed primarily in other CARDs and Technical Support Documents (TSDs)

Table 15-4. 2004 CRA-List of Activities and Assumptions That Deviate from the CCA and PAVT.

Item	DOE	EPA Decision
Early closure of panel 1	DOE requested to close Panel 1 before completely filling all the rooms with waste	EPA approved the change (Docket A-98-49, Item II-B3-44).
Parameters and computer codes	DOE updated some parameters and computer codes since the CCA and PAVT.	EPA found the parameter changes to be reasonable. See 2004 CARD 23 and related technical support documents (Docket A-98-49, Items II-B1-6, II-B1-7, II-B1-8, II-B1-12, and II-B1-16).
Disposal system conceptual model and implementation	The disposal system conceptual model was changed and underwent a peer review.	DOE’s conceptual model peer review was adequate and DOE appropriately implemented the change in PA. See 2004 CRA CARDs 23, 27.
MODFLOW and PEST	DOE replaced the previous ground water flow model and the model used to establish Culebra transmissivity fields.	DOE’s change was an improvement over the CCA approach. See 2004 CRA CARD 23, the technical support document for section 23 (Docket A-98-49, Items

Item	DOE	EPA Decision
		II-B1-8 and II-B1-16) and the discussion in 2004 CRA CARD 15 section (a)(1).
Move to clay seam G	DOE requested EPA to allow DOE to move the waste area roof and floor up ~2.5 meters to clay seam G.	EPA approved this change in a letter (Docket A-98-49, Item II-A3-24)
MgO amount	DOE reduced the amount of MgO by taking out the mini-sacks.	EPA approved the change in a letter (Docket A-98-49, Item II-B3-15)
Option D panel closure	EPA required DOE to install Option D of the CCA listed options.	Option D is included in the 2004 PABC.
Waste inventory update	DOE revised its estimate of waste volumes and radioactivity.	EPA reviewed the 2004 CRA information and supplemental information provided by in response to EPA's requests. EPA approved the updated inventory for use in the 2004 PABC. See the discussion in 2004 CRA CARD 24, the inventory review technical support document and the 2004 PABC review technical support document (Docket A-98-49, Items II-B1-9 and II-B1-16).
Chemistry changes, including gas generation rate change, effect of organic ligands on actinide solubility, actinide solubility, actinide solubility uncertainty changes	DOE updated some aspects of the actinide solubility	EPA's review identified some issues with DOE's waste chemistry changes. These were resolved and included in the 2004 PABC. See 2004 CRA CARD 24 and related technical support documents (Docket A-98-49, Items II-B1-3 and II-B1-15).

Item	DOE	EPA Decision
Methanogenesis		EPA's review identified some issues associated with DOE's methanogenesis assumptions. See the discussion in 2004 CRA CARD 24 and its Technical Support Document (A-98-49, Item II-B1-3).

15.5.2 EVALUATION OF COMPLIANCE FOR 2004 RECERTIFICATION (194.15(a)(4))

EPA's review of these changes is presented in multiple CARDs and Technical Support Documents. In addition, the changes were incorporated in the 2004 PABC (see CARDs 23 and 24; Docket A-98-49 Items II-B1-3, II-B1-10, II-B1-11, II-B1-15, II-B1-16, II-B1-17). EPA found DOE changes adequate and appropriately implemented in the CRA performance assessments.

EPA did not receive any public comments on DOE's continued compliance with the content of compliance recertification application(s) requirements of Section 194.14(a)(4).

15.5.3 2004 RECERTIFICATION DECISION (194.15(a)(4))

Based on a review and evaluation of the 2004 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2004-0025, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(4).

15.5.4 CHANGES IN THE 2009 CRA (194.15(a)(4))

DOE made changes to several specific activities and assumptions, and to several categories of items. These items are grouped in Table 15-5, but discussed primarily in other CARDS and Technical Support Documents (TSDs)

Table 15-5. List of Activities and Assumptions That Deviate from the 2004 to 2009 CRA.

Item	DOE	EPA Decision
Panel closure modification	DOE requested panel closures be delayed in a letter January 11, 2007 (DOE 2007b) until a new design could be approved.	EPA approved this request in a February 22, 2007 letter (EPA 2007a).

Item	DOE	EPA Decision
Parameters and computer codes	DOE updated some parameters and computer codes the 2009 PABC.	EPA found the parameter changes to be reasonable. See 2009 CARD 23 and related technical support documents (EPA 2010g-Parameter TSD, EPA 2010b-PABC TSD).
Modified Culebra Hydrology Conceptual Model	DOE modified one conceptual model and calculated new transmissivity fields for the 2009 PABC	DOE modified this conceptual model and performed a peer review in August 2008 (SCA 2008). DOE include this change in the 2009 PABC (Clayton et al. 2009, Kuhlman 2010a, Kuhlman 2010b, EPA 2010b-PABC TSD)
DOE decrease the amount of MgO from 1.67 to 1.2 times the amount carbon in the waste.	DOE reduced the amount of MgO in each disposal room.	EPA approved the change in a February 11, 2008 letter (EPA 2008)
DOE used the 2008 waste inventory update for the 2009 PABC	DOE revised its estimate of waste volumes, in particular organic ligands, and radioactivity.	EPA reviewed the 2009 CRA and 2009 PABC information and supplemental information provided by in response to EPA's requests. EPA approved the updated inventory for use in the 2009 PABC. See the discussion in 2009 CRA CARD 24, the inventory review technical support document and the 2009 PABC review technical support document (EPA 2010b, EPA 2010f, Clayton et al. 2009).
Chemistry included the effect of organic ligands on actinide solubility and actinide solubility uncertainty changes the 2009 PABC.	DOE updated the actinide solubility and the solubility uncertainty calculations for the 2009 PABC.	EPA's review identified issues related to the potential impact of inventory changes on repository chemistry. These were resolved and included in the 2009 PABC. See 2009 CRA CARD 24 and related technical support

Item	DOE	EPA Decision
		documents (EPA 2010b, EPA 2010f).
Changes in underground excavation and other changes.	Since 2004 DOE filled panels 1, 2 and 3 with waste; started placing waste in panel 4 and mined panel 5. DOE modified the catch basin at the base of the air exhaust shaft.	EPA was aware of these changes and events since 2004 (2009 CRA Section 15.6.4.1).
Start of RH waste emplacement	DOE starting emplacing RH waste into the walls of panel 4.	EPA inspected and approved RH emplacement in February 2007 (EPA 2007b, 2009 CRA Section 15.6.4.2).
Underground experiment changes.	DOE started the SEGA and MEGA experiments in 2005 and started to setup the EXO experiment in 2008.	EPA previously approved these experiments and continues to monitor them during annual inspections (DOE 2009 CRA Section 15.6.4.4).

15.5.5 EVALUATION OF COMPLIANCE FOR 2009 RECERTIFICATION (194.15(a)(4))

EPA's review of these changes is presented in multiple 2009 CARDs and Technical Support Documents (TSDs). In addition, some changes were incorporated in the 2009 PABC (see 2009 CARDs 23 and 24; EPA 2010b-PABC review, EPA 2010g-Parameter report). EPA found DOE changes adequate and appropriately implemented in the 2009 PABC calculations.

EPA did not receive any public comments on DOE's continued compliance with the content of compliance recertification application(s) requirements of Section 194.14(a)(4).

15.5.6 2009 RECERTIFICATION DECISION (194.15(a)(4))

Based on a review and evaluation of the 2009 CRA, 2009 PABC, and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2009-0330, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(4).

15.6 REQUIREMENTS (194.15(a)(5))

(a) "In submitting documentation of continued compliance pursuant to section 8(f) of the WIPP LWA, the previous compliance application shall be updated to provide sufficient information for the Administrator to determine whether or not the WIPP continues to be in compliance with the disposal regulations. Updated documentation shall include:

> (5) A description of all waste emplaced in the disposal system since the most recent compliance certification or re-certification application. Such description shall consist of a description of the waste characteristics and waste components identified in §§194.24(b)(1) and 194.24(b)(2)

15.6.1 Changes in the 2004 CRA (194.15(a)(5)

DOE updated this information for emplaced waste at the WIPP, waste stored at the waste generator sites, and waste anticipated to go to WIPP. This is discussed in multiple locations in the 2004 CRA, including Chapter 4, Appendix DATA, and Attachment F: Transuranic Waste Inventory Update Report, 2003, and Appendix TRU Waste. This information is further updated for the PABC in the PABC Inventory Report (Docket A-98-49, Item II-B2-60).

15.6.2 Evaluation of Compliance for 2004 Recertification (194.15(a)(5))

In DOE's updated waste inventory information (Docket A-98-49, Item II-B2-60), DOE kept the same categories of waste used in the CCA, so that the major changes were changes to waste volumes. The radioactivity of the waste was estimated to decrease from the CCA, the contact-handled TRU waste volume is greater than in the CCA, while DOE estimates that there is more remote-handled waste in the inventory than there is allowable space in WIPP. Prior to the submission of the 2004 CRA, DOE requested to dispose of supercompacted waste. After a thorough analysis, EPA allowed this waste in the performance assessment.

In addition, DOE proposed to dispose of some wastes from the Hanford waste site tank farms and what is known as K-Basin sludges. EPA allowed this material in the performance assessment since DOE may be able to demonstrate that it is TRU waste. DOE has proposed a public process to address the classification of the Hanford tank waste before DOE requests approval for disposal at WIPP. EPA identified that DOE appropriately provided the waste information and that the waste inventory is adequately included in the 2004 PABC. EPA's inventory review is discussed, at length, in 2004 CRA CARD 24 and the Technical Support Document for 194.24: Review of the Baseline Inventory used in the Compliance Recertification Application and the Performance Assessment Baseline Calculation (Docket A-98-49, Item II-B1-9).

15.6.3 2004 Recertification Decision (194.15(a)(5))

Based on a review and evaluation of the 2004 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2004-0025, Air Docket A-98-49) as well as EPA's review discussed CRA CARD 24, EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(5).

15.6.4 CHANGES IN THE 2009 CRA (194.15(a)(5)

DOE updated information for emplaced waste at the WIPP, waste stored at the waste generator sites, and waste anticipated to go to WIPP for the 2009 PABC. This is discussed in the 2009 CRA, including Appendix DATA-2009 Section DATA-7.0, and the Annual Transuranic Waste Inventory Report-2008 (ATWIR 2008). This information is further updated for the 2009 PABC in the Performance Assessment Inventory Report-2008 (PAIR 2008) and the Radionuclide Inventory Screening Analysis Report for the PABC-2009 (Fox et al. 2009). DOE has emplaced a total of $52{,}000\mathrm{m}^3$ of CH waste and $88\mathrm{m}^3$ of RH waste (ATWIR-2008 Section 3.1.1).

15.6.5 EVALUATION OF COMPLIANCE FOR 2009 RECERTIFICATION (194.15(a)(5))

DOE generally kept the same categories of waste for the 2009 PABC. The major changes were changes to waste volumes and radioactive content since the 2004 CRA. The radioactivity of the waste was estimated to decrease since the 2004 CRA principally because of the removal of Hanford tank waste from the WIPP bound waste category (EPA 2010f). This change also decreased the volume of both contact-handled and remote-handled waste in the inventory. EPA examined DOE's documentation to verify that the approach was adequate and reasonable (EPA 2010f Section 3.0). EPA found DOE's inventory estimates of waste projected to be emplaced at WIPP to be reasonable and adequate. EPA expects any changes in projected inventory by DOE, such as waste presently listed as not WIPP bound in the future inventory estimates, to be fully explained, justified, and confirmed by the use of a new compliant performance assessment calculation.

15.6.6 2009 RECERTIFICATION DECISION (194.15(a)(5))

Based on a review and evaluation of the 2009 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2009-0330, Air Docket A-98-49) as well as EPA's review discussed CRA CARD 24, EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(5).

15.7 REQUIREMENTS (194.15(a)(6))

(a) "In submitting documentation of continued compliance pursuant to section 8(f) of the WIPP LWA, the previous compliance application shall be updated to provide sufficient information for the Administrator to determine whether or not the WIPP continues to be in compliance with the disposal regulations. Updated documentation shall include:

> (6) Any significant information not previously included in a compliance certification or re-certification application related to whether the disposal system continues to be in compliance with the disposal regulations

15.7.1 CHANGES IN THE 2004 CRA (194.15(a)(6))

As part of the completeness review, EPA realized that the 2004 CRA PA calculations did not meet regulatory requirements that addressed uncertainty (40 CFR Part 194.34). EPA therefore required DOE to conduct another performance assessment. DOE conducted this additional performance assessment, termed the performance assessment baseline calculations (PABC-2004). This PA replaced the 2004 CRA PA for compliance purposes. A summary of the 2004 PABC review, including changes in the 2004 PABC from the 2004 CRA PA, is provided below and more in depth in Technical Support Document for Section 194.23: Review of the 2004 Compliance Recertification Performance Assessment Baseline Calculation (2004 PABC Review TSD, Docket A-98-48 Item II-B2-15). The changes can be grouped into two major categories: waste inventory and modeling assumptions. Parameters were changed to accommodate these changes.

<u>Waste Inventory</u>

During its review of the 2004 CRA inventory, DOE uncovered several discrepancies and changed situations regarding the baseline inventory. Concurrent with the DOE review of the 2004 CRA inventory, EPA's independent review raised questions regarding completeness and technical adequacy of the 2004 CRA inventory. Based on its review, EPA required that the baseline inventory be revised for the 2004 PABC. Changes to the inventory between the 2004 CRA and the 2004 PABC include the following:

- Removal of double-counted waste streams at Hanford-RL
- Inclusion of pre-1970 buried waste streams from INEEL
- Adjustment of the volume and fissile grams equivalents of an important LANL waste stream
- Correction of all other errors detected in DOE and EPA audits of 2004 CRA inventory

In addition, EPA required that emplacement materials be added to the quantities of cellulosics, plastics, and rubber in the baseline inventory. EPA verified that all changes to inventory parameters used in the 2004 PABC were correctly implemented (Docket A-98-49 Item II-B1-16). Based on its review of the process by which the 2004 CRA and 2004 PABC inventories were developed and implementation of EPA's required changes for the 2004 PABC inventory, the Agency concluded that the 2004 PABC baseline inventory was adequate for use in the performance assessment.

<u>Modeling Assumptions</u>

Microbial degradation of cellulosics, plastics, and rubber (CPR) may influence WIPP repository performance because of their effects on repository chemistry and gas generation. As a result of the Agency's review of the 2004 CRA, DOE changed the modeling of microbial degradation processes for the 2004 PABC. 2004 CRA CARD 24 and the 2004 PABC review (Docket A-98-49 Item II-B1-16) describe the results of the Agency's review of these changes. Because of additional information developed since the PAVT related to microbial presence in diverse environments and microbial viability, the Agency found that the probability of significant microbial degradation of cellulosics should be increased in PA. The Agency therefore specified and DOE implemented a change in the microbial degradation probability for CPR materials from the probability of 0.5 used in the PAVT to 1.0 in the 2004 PABC. For the 2004 PABC, there was a 0.75 probability of degradation of cellulosics alone, with a 0.25 probability of degradation of plastics and rubber materials, as well as cellulosics. Consequently, microbial degradation of cellulosics was assumed to occur in all vectors in the 2004 PABC.

Because of the presence of abundant sulfates in brine and solid phases [anhydrite, $CaSO_4$(s)] in the Salado Formation, the Agency also specified that the 2004 PABC should include the assumption that excess sulfate in the repository would prevent the microbial degradation of CPR via the reaction that produces methane (methanogenesis). Therefore, for the 2004 PABC, all CPR degradation was assumed to take place via denitrification and sulfate reduction reactions, which resulted in the production of one mole of carbon dioxide (CO_2) for each mole of organic carbon consumed. During the review of the 2004 CRA PA, the Agency noted that additional experimental data were available since the PAVT related to microbial gas generation rates and requested that DOE assess the potential effects of these data on PA. DOE used the additional data to revise the gas generation rates. The revised approach assumed rapid initial gas generation followed by much slower, long-term rates. The Agency reviewed DOE's evaluation of the microbial gas generation rates and implementation of the revised microbial degradation probability and gas generation rates and found them to be appropriately implemented in the 2004 PABC.

The Agency also verified that methanogenesis was not included in the 2004 PABC – an assumption unchanged since the PAVT. As a result of these changes in microbial gas generation probability and rates, modeled repository pressures were lower for the 2004 PABC than for the PAVT. These lower repository pressures caused decreased spallings releases. However, direct brine releases (DBR) increased in the 2004 PABC relative to the PAVT due to changes in solubility discussed below and because lower gas pressures allowed for higher brine saturations in the repository.

Some aspects of the actinide solubility calculations and the development of uncertainty distributions were changed for the 2004 PABC (Docket A-98-49 Item II-B1-16). The methodology for modeling +III, +IV, and +V actinide solubilities using the Fracture-Matrix Transport (FMT) code remained unchanged since the PAVT. However, the thermodynamic database used by FMT was updated, including data for actinide solid phases and aqueous species and inclusion of data necessary for calculating the effects of organic ligands on actinide solubilities. The concentrations of organic ligands used in the solubility calculations were based on estimated inventory amounts of acetate, citrate, EDTA and oxalate and the minimum amount of brine required for DBR.

Since the PAVT, the Salado Brine formulation used in the solubility calculations changed from Brine A to GWB. Based on published data available since the PAVT, the Agency specified use of an increased fixed uranium (VI) concentration in the 2004 PABC (10^{-3} M) instead of the lower concentration (18.8×10^{-6} M) plus an estimated uncertainty range used in the PAVT. At the Agency's direction, DOE used the revised FMT thermodynamic database and available measured solubilities to develop new uncertainty ranges for the +III, +IV, and +V actinide solubility calculations for the 2004 PABC. These changes were reviewed by the Agency and found to be adequately documented and technically acceptable. The new data regarding complexation of actinides by organic ligands indicated that organic ligands could significantly affect the solubilities of the +III actinides. Because of the increased solubilities and associated uncertainties predicted for the 2004 PABC, DBR replaced spallings as the second-most important release mechanism at higher probabilities, behind cuttings and cavings. At low probabilities for the 2004 PABC, DBR becomes the most important release mechanism.

In the PAVT, 2004 CRA PA, and 2004 PABC, the Culebra member of the Rustler Formation is conceptualized as a horizontal, confined aquifer of uniform density. For fluid flow, the Culebra is assumed to be a heterogeneous porous medium with spatially varying transmissivity (T). A heterogeneous velocity field is used for radionuclide transport, but all other rock properties are conceptualized as constant (homogeneous) across the model domain. The Culebra is assumed to have two types of porosity; a portion of the porosity is associated with high-permeability features where transport occurs by advection, and the rest of the porosity is associated with low-permeability features where flow does not occur and retardation occurs by physical processes (diffusion) and chemical processes (sorption). This type of conceptual model is commonly referred to as double-porosity.

The key factors controlling fluid flow in the Culebra are the hydraulic gradient, transmissivity distribution, and porosity. In the Culebra conceptual model, the spatial distribution of transmissivity is important. In its review of the 2004 CRA, EPA determined that the approach taken by DOE to modify the transmissivity fields to include the effects of mining was not acceptable, not consistent with our regulation, and required a revised approach for the 2004 PABC. In developing transmissivity fields for the 2004 CRA, DOE had assumed a one-mile exclusion zone from potash mining around existing oil and gas wells. In the 2004 PABC, the potash mining area was assumed to involve all mined and unmined potash resources regardless of proximity to oil or gas wells.

The increase in transmissivity due to mining increases the relative flow rate through the mining zones, with a corresponding decrease in flow through the non-mining zones. This decrease in flow through the non-mining zones produces longer travel times for the mining scenarios. Comparing the full-mining scenarios of the 2004 PABC analysis to the CCA and 2004 CRA calculations, the median travel times are approximately 2.53 and 1.14 times longer, respectively. By eliminating the exclusion zone around the existing oil and gas wells, DOE has addressed the Agency's concern regarding the mining scenario. EPA has determined that this change has been properly implemented in the 2004 PABC.

Flow in the Salado is computed by the BRAGFLO code, which simulates brine and gas flow in and around the repository. BRAGFLO includes the effects of processes such as gas generation and creep closure. Outputs from the BRAGFLO simulations describe the conditions (pressure, brine saturation, porosity) and flow patterns (brine flow up an intrusion borehole and out anhydrite marker beds to the accessible environment) that are used by other software to predict radionuclide releases. EPA noted a number of necessary technical changes and corrections to the 2004 CRA. Additionally, EPA stated that a number of modeling assumptions used in 2004 CRA have not been sufficiently justified and that alternative modeling assumptions must be used. The issues and changes for the 2004 PABC that effect the BRAGFLO\NUTS portion of WIPP PA include:

- Inventory information was updated
- Parameters describing the bulk compressibility and residual gas saturation for the marker bed materials were changed to constants
- Changes to the parameter describing the probability of microbial gas generation in the repository were made
- Methanogenesis is no longer assumed to be the primary microbial gas generation reaction
- Microbial gas generation rates were revised to be consistent with, long-term laboratory experimental results
- The LHS software was revised.

The Agency concludes that changes to the computer codes for modeling Salado Formation flow and transport have been properly implemented, as have changes in conceptual models and model parameters. The Agency finds that the approach taken by DOE for the modeling the Salado is acceptable.

<u>Releases from the 2004 PABC</u>

Direct releases are defined as solid and liquid materials removed from the repository and carried to the ground surface through intrusion boreholes at the time of drilling. Direct releases occur in WIPP PA through cuttings and cavings releases, DBR, and spallings releases. Cuttings and cavings are the solid materials removed from the repository and carried to the ground surface by drilling fluid during the process of drilling a borehole that intersects the repository. Cuttings are the materials removed directly by the drill bit, and cavings are the materials eroded from the borehole walls by shear stresses from the circulating drill fluid. The contribution of mean cuttings and cavings releases to total mean radionuclide releases for the 2004 PABC are similar to the PAVT. Direct brine releases occur when contaminated brine originating in the repository is driven up an intrusion borehole to the ground surface by repository gas pressure.

Because of the increased actinide solubilities and associated uncertainties used in the calculations, and higher brine saturations caused by lower gas generation rates, the contribution of DBR to total mean direct radionuclide releases for the 2004 PABC was greater than for the PAVT. Spallings releases occur when solid waste is ejected through an intrusion borehole by repository gas pressures that exceed the estimated 8 MPa hydrostatic pressure of the drilling fluid. Spallings releases calculated for the 2004 PABC were lower than those calculated for the PAVT. This reduction in calculated spallings releases was caused in part by revisions to the spallings model. In addition, lower long-term microbial gas generation rates resulted in lower 2004 PABC spallings releases because of the prediction of lower repository pressures than the PAVT. Table 15-5 lists the results from the 2004 PABC, the 2004 CRA PA, and the CCA PAVT.

There were no releases from transport up the shaft in the 2004 PABC and no disturbed releases through the anhydrite interbeds. Undisturbed releases through the anhydrite interbeds in the 2004 PABC were as much as 11 orders of magnitude smaller than the typical disturbed releases, and were therefore not significant contributors to total normalized releases.

Because cuttings, cavings, direct brine, and spallings releases account for an overwhelming majority of the total releases, the calculated total releases are most sensitive to uncertainties in the parameters governing these release mechanisms. In both the PAVT and the 2004 PABC analyses, total normalized releases were most sensitive to uncertainty in waste shear strength (WTAUFAIL), which is a key parameter governing cavings volume. In the 2004 PABC, direct brine releases supplant spallings as the second-most important contributor to total releases and even surpass cuttings and cavings at low probabilities. The second most important variable in the PABC analysis is WSOLVAR3, a solubility multiplier added to the 2004 analysis to represent uncertainty in solubilities for all actinides in the +3 oxidation state.

DOE made changes in the WIPP parameters for the 2004 PABC to accommodate the changes discussed above. The Agency reviewed the procedural adequacy of changes made to the parameter database for the 2004 PABC as well as the technical adequacy of all parameter database changes made since the PAVT. The review (Docket A-98-49, Item II-B1-16) show that the parameters used in the 2004 PABC were technically acceptable and appropriately documented.

15.7.2 Evaluation of Compliance for 2004 Recertification (194.15(a)(6))

DOE adequately responded to EPA's requests by including EPA requirements in the 2004 PABC. EPA's main review of the 2004 PABC is provided in the 2004 PABC review document (A-98-49, Item II-B1-16) with additional discussion in 2004 CARDs 23 and 24. Based on our review, EPA finds that DOE adequately implemented EPA's required changes in the 2004 PABC. The 2004 PABC calculations show that the repository meets the numerical standards at 40 CFR 191.13 as well as the compliance assessment requirements for the undisturbed case.

EPA did not receive any public comments on DOE's continued compliance with the content of compliance recertification application(s) requirements of Section 194.15(a)(6).

15.7.3 2004 RECERTIFICATION DECISION (194.15(a)(6))

Based on a review and evaluation of the 2004 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2004-0025, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(6).

15.7.4 CHANGES IN THE 2009 CRA (194.15(a)(6))

During EPA's initial completeness review of DOE's 2009 CRA documents EPA determined that the 2009 CRA PA calculations were incomplete because of recent changes in the waste inventory, in particular the significant changes in the quantities of some organic ligands (PAIR 2008 Table 5-7). EPA directed DOE to conduct another performance assessment in EPA's first completeness letter dated May, 21, 2009 (EPA 2009a). DOE conducted this additional performance assessment, termed the 2009 performance assessment baseline calculations (2009 PABC). The 2009 PABC replaces the 2009 CRA performance assessment (PA) for compliance purposes. An overall summary of the 2009 PABC review, including changes in the 2009 PABC from the 2009 CRA PA, is provided below and more in depth in 2009 Technical Support Document for Section 194.23: Review of the 2009 Compliance Recertification Performance Assessment Baseline Calculation (EPA 2010b). The changes can be grouped into two major categories: waste inventory and modeling assumptions. 2009 PABC parameters were changed to accommodate these changes.

<u>Waste Inventory</u>

Since the 2004 CRA DOE has been doing annual inventory updates, the most recent waste inventory (PAIR 2008) was used in the 2009 PABC. Listed below is a summary of inventory changes since the 2004 CRA (ATWIR 2007, Executive Summary, page 3 and ATWIR 2008, Executive Summary, page 14):

-Paducah Gaseous Diffusion Plant waste was re-categorized to WIPP bound (ATWIR 2008 page 14).

-The following waste was placed in the potential category (<u>Not in Planned Inventory for WIPP</u>): General Electric Vallecitos Nuclear Center, Babcock and Wilcox, Nuclear Radiation Development Site, some Hanford RL waste, Material Fuel Complex, Hanford RL K-Basin knock-out pot sludge, Hanford (RP) tank waste, and two INL sodium-bearing wastes. [Note: During the review of the 2009 CRA, GE Vallecitos was approved, and eventually shipped to WIPP. Please refer to CARD 24, Section 24.1.5.

-Because of significant changes in the estimate of the quantity of organic ligands in the most recent WIPP inventory, in particular EDTA, DOE recalculated actinide solubilities, solubility uncertainties, and matrix diffusion coefficients (K_ds) for the 2009 PABC.

-Inclusion of emplaced cellulosic, plastic and rubber materials into the performance assessment calculations.

EPA verified that all changes to inventory parameters used in the 2009 PABC were correctly implemented (EPA 2010b). Based on EPA's review of DOE's inventory process used in the 2009 PABC EPA determined that DOE developed and implemented numerous changes to the inventory adequately and are appropriate for use in the performance assessment.

Modeling Assumptions

As noted in Section 15.7.1 Modeling Assumptions above DOE made a number of changes to performance assessment models in the 2004 CRA. Since the 2004 PABC DOE has made limited changes to the performance assessment modeling assumptions and updated or corrected a few parameters. DOE performed a peer review (Burgess et al. 2008) of the Culebra Hydrogeology conceptual model. As noted on Page 1 of Burgess et al. 2008 (SCA 2008) of the revised conceptual model; "…the hydraulic properties of the Culebra are related to geologic features and processes. By correlating the measured hydraulic properties at individual well locations to the geologic conditions at those locations, a basis can be developed for assigning hydraulic properties at untested locations where the geologic properties are known". Inclusion of new well data in the conceptual model modification allowed DOE to develop transmissivity fields that are geologically based, consistent with observed groundwater heads, consistent with groundwater responses in Culebra pump test, and consistent with water chemistry (Burgess et al. 2008 page 3). DOE used this new conceptualization of the Culebra hydrology to develop updated transmissivity fields used in the 2009 PABC.

Since the 2004 PABC DOE changed a number of parameters: the duration of a direct brine release (Kirkes 2007); updated the CPR degradation rates (Kirchner 2008a); modified the BRAGFLO flow chemistry implementation (Nemer and Clayton 2008); updated the capillary pressure and related permeability implementation (Nemer and Clayton 2008); and used recent data to calculate the drilling rate and borehole plugging patterns (Clayton 2010b). DOE also corrected a few parameter errors: halite/DRZ parameter error; the fraction of the repository occupied by waste; and corrected NUTS and DBR input files (Nemer 2007, Ismail 2007b, Dunagan 2007, Ismail 2007a), Clayron 2007a and Clayton 2007b).

EPA reviewed the changes incorporated into the 2009 CRA PA and the 2009 PABC concluding that the parameter, conceptual model, and other changes have been properly documented and implemented (EPA 2010b).

Releases from the 2009 PABC

Direct releases are defined as solid and liquid materials removed from the repository and carried to the ground surface through intrusion boreholes at the time of drilling. Direct releases occur in WIPP PA through four processes: cuttings and cavings releases, DBR, and spallings releases. Cuttings and cavings are the solid materials removed from the repository and carried to the ground surface by drilling fluid during the process of drilling a borehole that intersects waste in the repository. Cuttings are the materials removed directly by the drill bit, and cavings are the materials eroded from the borehole walls by shear stresses from the circulating drill fluid. The contribution of mean cuttings and cavings releases to total mean radionuclide releases for the 2009 PABC are similar to the 2004 PABC with a small increase related to changes in the drill rate and waste inventory (Clayton et al. DOE 2009).

Direct brine releases occur when contaminated brine originating in the repository is driven up an intrusion borehole to the ground surface by repository gas pressure. Mainly because of the increased actinide solubilities and associated uncertainties used in the 2009 PABC calculations, the contribution of DBR to total mean direct radionuclide releases for the 2009 PABC was greater than the 2004 PABC. Spallings releases occur when solid waste is ejected through an intrusion borehole by repository gas pressures that exceed the estimated 8 MPa hydrostatic pressure of the drilling fluid. Spallings releases calculated for the 2009 PABC were little changed than those calculated for the 2004 PABC. The small difference was due to lower repository pressure and inventory changes. Table 15-5 compares the results from the 2009 PABC, 2009 CRA PA, 2004 PABC, the 2004 CRA PA, and the CCA PAVT.

Table 15-5. For Various PAs--Statistics on the Overall Mean for Total Normalized Releases (in EPA Units) at Probabilities of 0.1 and 0.001, All Replicates Pooled.

Probability	PA Analysis	Mean Total Release	90th Quantile Total Release	Lower 95% CL	Upper 95% CL
0.1	CCA PAVT	1.237E-1	1.916E-1	1.231E-1	1.373E-1
	CRA-2004	9.565E-2	1.571E-1	8.070E-2	1.104E-1
	PABC-2004	8.770E-2	1.480E-1	8.471E-2	9.072E-2
	CRA-2009	1.000E-1	1.700E-1	1.000E-1	1.100E-1
	PABC-2009	9.000E-2	1.600E-1	9.000E-2	1.000E-1
0.001	CCA PAVT	3.819E-1	3.907E-1	2.809E-1	4.357E-1
	CRA-2004	5.070E-1	8.582E-1	2.778E-1	5.518E-1
	PABC-2004	6.006E-1	8.092E-1	5.175E-1	6.807E-1
	CRA-2009	7.200E-1	8.100E-1	4.800E-1	9.200E-1
	PABC-2009	1.100E+0	1.000E+0	3.700E-1	1.77E+0

CL = Confidence Limit

There were no releases from transport up the shaft in the 2009 PABC and no disturbed releases through the anhydrite interbeds. Undisturbed releases through the anhydrite interbeds in the 2009 PABC were as much as 11 orders of magnitude smaller than the typical disturbed releases, and were therefore not significant contributors to total normalized releases. Release through the Culebra increased by approximately two orders of magnitude when the 2004 PABC and Replicate 2 of the 2009 PABC are compared.

Cuttings, cavings, direct brine, and spallings releases continue to account for an overwhelming majority of the total releases, the calculated total releases are most sensitive to uncertainties in the parameters governing these release mechanisms. In both the 2004 PABC and the 2009 PABC analyses, total normalized releases were most sensitive to uncertainty in waste shear strength (WTAUFAIL), which continues to be a key parameter governing cavings volumes.

DOE made changes in the WIPP parameters for the 2009 PABC to accommodate the changes discussed above. The Agency reviewed the procedural adequacy of changes made to the parameter database for the 2009 PABC as well as the technical adequacy of all parameter database changes made since the 2004 PABC. EPA 2010g shows that the parameters used in the 2009 PABC were technically acceptable and appropriately documented.

15.7.5 EVALUATION OF COMPLIANCE FOR 2009 RECERTIFICATION (194.15(a)(6))

DOE adequately responded to EPA's requests by including EPA requirements in the 2009 PABC. EPA's main review of the 2009 PABC is provided in the 2009 PABC review document (EPA 2010b) with additional discussion in 2009 CRA CARDs 23 and 24. Based on our review, EPA finds that DOE adequately implemented EPA's required changes in the 2009 PABC. The 2009 PABC calculations show that the repository meets the numerical standards at 40 CFR 191.13 as well as the compliance assessment requirements for the undisturbed case.

EPA did not receive any public comments on DOE's continued compliance with the content of compliance recertification application(s) requirements of Section 194.15(a)(6).

15.7.6 2009 RECERTIFICATION DECISION (194.15(a)(6))

Based on a review and evaluation of the 2009 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2009-0330, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(6).

15.8 BACKGROUND (194.15(a)(7))

During the course of the completeness and technical review of each recertification, the Agency submits numerous requests to DOE for additional information. The docket categories in which these can be found are listed below.

15.8.1 REQUIREMENTS (194.15(a)(7))

(a) "In submitting documentation of continued compliance pursuant to section 8(f) of the WIPP LWA, the previous compliance application shall be updated to provide sufficient information for the Administrator to determine whether or not the WIPP continues to be in compliance with the disposal regulations. Updated documentation shall include:

> (7) Any additional information requested by the Administrator or the Administrator's authorized representative."

15.8.2 CHANGES IN THE 2004 CRA (194.15(a)(7)

During the course of the completeness and technical review of the 2004 CRA, the Agency submitted numerous requests to DOE for additional information. The docket categories in which these can be found are listed below.

The information submitted by DOE and commenters, and developed by EPA can be found in the following categories for EPA Air Docket A-98-49.

1. QA Audits/Inspections, and their approvals -- **Category II-A1.**
2. WC Audits/Inspections, and their approvals -- **Category II-A4.**
3. Background/support documents (i.e., TSD's, fact sheets) -- **Category II-B1.**
4. Correspondence/information submitted by DOE (including responses to EPA requests, e.g., 2004 CRA completeness and technical issues) -- **Category II-B2.**
5. Correspondence/information sent to DOE by EPA (including completeness and technical requests for additional information) -- **Category II-B3.**
6. 2004 CRA CARDs -- **Category V-B2.**

15.8.3 EVALUATION OF COMPLIANCE FOR 2004 RECERTIFICATION (194.15(a)(7)

The information provided by DOE is reviewed by EPA in the CARD and Technical Support Documents related to the particular topic. DOE responded to all requests for information made by EPA.

15.8.4 2004 RECERTIFICATION DECISION (194.15(a)(7))

Based on a review and evaluation of the 2004 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2004-0025, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(7).

15.8.5 CHANGES IN THE 2009 CRA (194.15(a)(7))

The Agency submitted numerous requests to DOE for additional information during the completeness and technical review of the 2009 CRA. The docket categories in which these can be found are listed below.

The information submitted by DOE and commenters, and developed by EPA can be found in the following categories for EPA Air Docket A-98-49.

[***RAY should all be the same, few changes-may need to update categories-Check RayL]

Comment [c1]: Don't forget to fix and then delete the note.

1. QA Audits/Inspections, and their approvals -- **Category II-A1.**
2. WC Audits/Inspections, and their approvals -- **Category II-A4.**
3. Background/support documents (i.e., 2009 TSD's, fact sheets) -- **Category II-B1.**
4. Correspondence/information submitted by DOE (including responses to EPA requests, e.g., 2009 CRA completeness and technical issues) -- **Category II-B2.**
5. Correspondence/information sent to DOE by EPA (including completeness and technical requests for additional information) -- **Category II-B3.**
6. 2009 CRA CARDs -- **Category V-B2.**

15.8.6 Evaluation of Compliance for 2009 Recertification (194.15(a)(7))

The information provided by DOE is reviewed by EPA in the CARDs and Technical Support Documents related to the particular topic. DOE responded to all requests for information made by EPA.

15.8.7 2009 Recertification Decision (194.15(a)(7))

Based on a review and evaluation of the 2009 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2009-0330, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.15(a)(7).

15.9 Requirements (194.15(b))

(b) "To the extent that information required for a re-certification of compliance remains valid and has been submitted in previous certification or re-certification application(s), such information need not be duplicated in subsequent applications; such information may be summarized and referenced."

15.9.1 Changes in the 2004 CRA (194.15(b))

DOE provided information in a format similar to that provided for the CCA. This included a main volume with appendices. DOE did summarize topics and provided new information where appropriate. DOE did consolidate some appendices relative to the CCA and did not submit appendices which did not change (e.g., the Geological Characterization Report of Appendix GCR).

15.9.2 Evaluation of Compliance for 2004 Recertification (194.15(b))

DOE provided relevant information from the CCA and updated information in the 2004 CRA and in response to EPA's requests, including a new performance assessment.

EPA did not receive any public comments on DOE's continued compliance with the content of compliance recertification application(s) requirements of Section 194.15(b).

15.9.3 2004 RECERTIFICATION DECISION (194.15(b))

Based on a review and evaluation of the 2004 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2004-0025, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.194.15(b).

15.9.4 CHANGES IN THE 2009 CRA (194.15(b))

DOE provided information in a modified format compared to the original CCA and the 2004 CRA to make the review by EPA and others generally simpler. DOE adopted the same format that EPA uses to document compliance with regulation 40 CFR 194, EPA's compliance application review documents (CARDs). Rather than use one main document with chapters that describe particular technical topics as done in the CCA and 2004 CRA DOE followed the EPA CARD format were each section of the rule requirements has a specific section dedicated to that requirement. This included a DOE rule section with supporting appendices. DOE continued to summarize topics and provided new information where appropriate. DOE did consolidate some appendices and remove some appendices in the 2009 CRA, especially for information that did not change.

15.9.5 EVALUATION OF COMPLIANCE FOR 2009 RECERTIFICATION (194.15(b))

DOE provided relevant information from the CCA, the 2004 CRA, and updated information in the 2009 CRA and in response to EPA's requests, including a new performance assessment.

EPA did not receive any public comments on DOE's continued compliance with the content of compliance recertification application(s) requirements of Section 194.15(b).

15.9.6 2009 RECERTIFICATION DECISION (194.15(b))

Based on a review and evaluation of the 2009 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2009-0330, Air Docket A-98-

49), EPA determines that DOE continues to comply with the requirements for Section 194.15(b).

APPENDIX 14-A
REQUIREMENTS (194.14)

§ 194.14 Content of compliance certification application.

Any compliance application shall include:

(a) A current description of the natural and engineered features that may affect the performance of the disposal system. The description of the disposal system shall include, at a minimum, the following information:

> (1) The location of the disposal system and the controlled area;
> (2) A description of the geology, geophysics, hydrogeology, hydrology, and geochemistry of the disposal system and its vicinity and how these conditions are expected to change and interact over the regulatory time frame. Such description shall include, at a minimum:
>
> > (i) Existing fluids and fluid hydraulic potential, including brine pockets, in and near the disposal system; and
> > (ii) Existing higher permeability anhydrite interbeds located at or near the horizon of the waste.
>
> (3) The presence and characteristics of potential pathways for transport of waste from the disposal system to the accessible environment including, but not limited to: Existing boreholes, solution features, breccia pipes, and other potentially permeable features, such as interbeds.
> (4) The projected geophysical, hydrogeologic and geochemical conditions of the disposal system due to the presence of waste including, but not limited to, the effects of production of heat or gases from the waste.

(b) A description of the design of the disposal system including:

> (1) Information on materials of construction including, but not limited to: Geologic media, structural materials, engineered barriers, general arrangement, and approximate dimensions; and
> (2) Computer codes and standards that have been applied to the design and construction of the disposal system.

(c) Results of assessments conducted pursuant to this part.

(d) A description of input parameters associated with assessments conducted pursuant to this part and the basis for selecting those input parameters.

(e) Documentation of measures taken to meet the assurance requirements of this part.

(f) A description of waste acceptance criteria and actions taken to assure adherence to such criteria.

(g) A description of background radiation in air, soil and water in the vicinity of the disposal system and the procedures employed to determine such radiation.

(h) One or more topographic map(s) of the vicinity of the disposal system. The contour interval shall be sufficient to show clearly the pattern of surface water flow in the vicinity of the disposal system. The map(s) shall include standard map notations and symbols, and, in addition, shall show boundaries of the controlled area and the location of any active, inactive, and abandoned injection and withdrawal wells in the controlled area and in the vicinity of the disposal system.

(i) A description of past and current climatologic and meteorologic conditions in the vicinity of the disposal system and how these conditions are expected to change over the regulatory time frame.

(j) The information required elsewhere in this part or any additional information, analyses, tests, or records determined by the Administrator or the Administrator’s authorized representative to be necessary for determining compliance with this part.

APPENDIX 15-A, HYDROLOGIC COMMENTS FROM 2004 RECERTIFICATION

In the original Compliance Certification Application performance assessment, EPA agreed that DOE appropriately ruled out karst as a feature that would occur at WIPP over the regulatory period (see CCA CARD 14 and CCA response to comments). However, in the 2004 CRA, commenters again raised issues related to karst. Appendix 15-A responds to selected questions raised by commenters. In the 2004 CRA, DOE again omits karst features in the performance assessment. As discussed in the main body of CARD 15, EPA again agrees with DOE that karst features can be omitted from the performance assessment.

Topic	Commenter Concern	EPA Response
H-3	**CCA Appendix GCR data point shows there is high transmissivity indicative of karst in the Magenta at the H-3b1 location. Commenters believed DOE falsified a data point from the well to hide karst and make the Magenta appear less transmissive than what DOE claims.**	Based on multiple measurements over time, DOE believes the transmissivity of the Magenta at well H-3 to be between 0.1 and 0.2 ft^2/day. The H-3 well of CCA Appendix GCR (p 6-53), now known as H-3b1, reported 360 gallons in 6 hours being pumped during its first Magenta testing in 1977. This could be indicative of very high transmissivity. However, DOE has measured much lower transmissivity in later tests in the same well. EPA reviewed the data (Docket A-98-49, Item II-B3-90) and agrees with DOE in its Magenta Transmissivity Fact sheet that the original testing was in error. DOE provided a chronology of the well testing that indicated the well testers used the H-3 (now known as H-3b1) well to measure both Magenta and Culebra water levels. Initial measurements showed that the Culebra and Magenta appeared to have nearly the same water levels in this well. After the Culebra water levels were initially measured, the two formations were separated by a removable plug (production injection packer or PIP). The Magenta water levels were measured after the PIP was installed and water levels similar to the Culebra water levels were recorded. The PIP apparently failed and allowed Culebra water to flow and combine with the Magenta water. After the PIP was modified to allow Culebra water to move through tubing in the packer, water levels in the Magenta and Culebra eventually stabilized at much different levels. Five months after the disputed test, the Culebra water level stabilized around 407 feet below ground surface (bgs) and the Magenta water level stabilized at around 248 feet below ground surface. Subsequent measurements and testing have indicated that the water levels in the Culebra and Magenta have maintained separate levels, unlike the initial measurements, and that pumping tests in other wells identify a lack of communication between the two units. During the 1995 and 1996 H-19 Culebra pumping test, the H-3b1 Culebra zone responded to pumping while the Magenta

Topic	Commenter Concern	EPA Response
		showed no change. In addition, transmissivity tests in 1979 and 1989 corroborate the low transmissivity (0.1 and 0.2 ft^2/day) in the Magenta at this well. This information indicates to EPA that there were testing problems with the initial test in 1977 and that later tests confirmed much lower transmissivity in the Magenta at H-3. Thus, EPA's interpretation is that well H-3 indicates that karst processes have <u>not</u> created high transmissivity at H-3, and that the commenters' claim of falsified data is erroneous and ignores subsequent data collected at the well.
H-6	**H-6 has a similar head in the Magenta and Culebra, indicating karst and communication between the two units.**	At H-6, the Magenta and Culebra do have similar measured water levels. At H-6, hydrologic data, however, indicate that the Culebra and Magenta are clearly not well connected despite the similar heads. During the WIPP-13 multipad pumping test, approximately 18 ft of drawdown was observed in H-6a and H-6b, both completed in the Culebra, while no response was observed in H-6c completed to the Magenta (Beauheim 1987--CCA Reference 42). Culebra and Magenta water qualities at H-6 are also distinctly different (Randall et al. 1988). With respect to Snow's assertion that heads are equal in the Magenta and Culebra at Wells H-6, WIPP-13, WIPP-33, and WIPP-25, Beauheim (EPA Air Docket A-98-49, Item B2-64) (p.3) points out that for WIPP-13 and WIPP-33, no Magenta measurements have ever been performed at WIPP-13, and no monitoring of either the Culebra or Magenta was performed before WIPP-33 was plugged and abandoned, so Snow's assertion of equal heads at those two wells is baseless.
WIPP-13	**Evidence at WIPP-13 indicates karst.**	Lorenz (2005) notes that the drillhole at WIPP-13 penetrated a normal stratigraphic section with only localized, apparent brecciation of a thin sulfate bed within the Tamarisk mudstone unit. Beauheim 1987 (CCA Reference 42) concludes that the Culebra exhibits double-porosity, with higher permeability and lower storage in the fractures and rock matrix primary porosity with lower permeability and higher storage. No response was seen in Magenta wells, including H-6 just to the northwest of WIPP-13. Lorenz 2005 (p. 109) observes that the breccias found in WIPP-13 could be interpreted in several different ways. The lower interval is most easily explained as a limited zone of dissolution adjacent to the water-bearing Culebra, whereas the upper interval is probably of syndepositional origin. Some of the well-test data may be ambiguous, but they are not suggestive of karst-type flow of the Rustler waters. EPA agrees that no karst-type flow exists at WIPP-13 and the double-porosity model adequately characterizes ground-water flow at the well.

Topic	Commenter Concern	EPA Response
WIPP-13, WIPP-14 and gravity anomalies	**Hill (1999, pp. 37–40; 2003, p. 205) asserts that negative gravity anomalies indicate the presence of karst across the WIPP site. Most of Hill's discussion revolved around the WIPP gravity survey (Barrows et al. 1983).**	Hill 1999 (Docket A-98-49 Item II-B3-76, pp. 37–40) cites the Barrows et al. 1983 report as showing four "sharp" negative gravity anomalies that are "consistent with" solution caverns, although only the WIPP-14 and WIPP-33 anomalies were discussed and attributed to subsurface karsting by Barrows et al. 1983. Barrows et al. 1983 calculated that the depth to the top of the "causative structure" that is responsible for the WIPP-14 gravity anomaly is shallow, not more than 225 ft below the surface. This depth puts the inferred deficiency in mass, i.e., karst, within the Dewey Lake Formation, reported to lie between the depths of 141-639 ft in this hole (SNL and USGS 1981). This does not correlate to the two zones (300–400 ft, and 650–750 ft) where Barrows et al. calculated the presence of mass deficiencies from the density logs, or with the concept of karst development being in the Rustler formation. Barrows et al. 1983 noted that seismic data at the WIPP site above the Castile Formation "are considered too unreliable to map" (Barrows 1983, p. 16), yet later in the report (p. 57) used this shallow seismic data in the vicinity of WIPP-14 to infer that "a seismic time syncline [is] coincident with the [shallow] negative gravity anomaly. Both the seismic time syncline and the negative anomaly are explained by lateral velocity and inferred density variations comparable to those observed in uphole velocity surveys." WIPP-14 was sited to investigate the possibility that a circular surface topographic depression, about 700 ft in diameter, 10 ft deep, and located above the axis of a much larger gravity anomaly, is large enough to have collected sufficient water to create a major sinkhole. Hill (1999) suggests that the conversion of anhydrite to gypsum in certain beds, and a calculated mass deficiency related to that conversion, indicate karst in the subsurface even though the hole did not penetrate or recover evidence for karst. Lorenz 2005 (p. 110) responds with the following discussion: "Most of the units above the Rustler were cored in WIPP-14, but only the top and bottom of the Rustler Formation itself were cored, as intended (see Appendix B, page 1; Sandia National Laboratories and D'Appolonia Consulting Engineers, 1982). The lithology penetrated by the rest of the hole was reconstructed from cuttings and the geophysical logs. The core and logs from the WIPP-14 drillhole document a normal stratigraphic section at this location, i.e., the stratigraphic tops have not been displaced relative to their expected depths

Topic	Commenter Concern	EPA Response
		projected from nearby control points, and bedding is in a normal, flat-lying attitude (Sandia National Laboratories and D'Appolonia Consulting Engineers, 1982; Bachman, 1985). The daily drilling reports and the geologist's lithologic log record no unusual lost-circulation or fluid-entry zones, and core recovery percentages were consistently high. The geophysical logs run in the hole also indicate normal lithologies, normal depths, and no anomalous hole diameters." The hydrostructural units at the WIPP site, most notably the irregularities observed at WIPP-14, were investigated by drilling and for hydrologic system attributes. The geophysical logs for this interval show a normal signature as observed in hundreds of other wells (near and far). Furthermore, the presence of "underground rivers," either hydrologically or lithologically, has not been directly shown by these drill holes, or other drill holes into the Culebra or Magenta hydrogeologic units. Hill (1999) suggests that two other gravity anomalies at and near WIPP also indicate the locations of subsurface karst. These locations are around the WIPP-13 and H-3 drillholes. Hill 1999 (p. 48) states that, "both WIPP-13 and H-3 are located within negative gravity features (sinkholes?)." Lorenz 2005 (p. 78) noted that the Rustler strata cored in both these holes show some disruption, possible indications of dissolution but more plausibly interpreted as syndepositional (i.e., at the time of deposition) disruption, because they are overlain by undisrupted strata with primary depositional structures. Although Holt and Powers 1988 inferred some stratigraphic displacement of the angular sulfate fragments encountered in the WIPP-13 core just below the contact with the A-3 sulfate of the Tamarisk, they also reported two thin anhydrite beds and a polyhalite bed to the east in a stratigraphically equivalent halite bed. Lorenz concluded that this angular fragment can as easily represent a stratigraphically in-place remnant of one of these thin units, as Holt and Powers 1988 and Powers and Holt 2000 described how the polyhalite, and presumably the upper anhydrites, converge with the base of A-3 westward from the depositional center of the unit. In addition, Lorenz believes that the shaft mapping shows a thin sulfate bed in this stratigraphic position, with a breccia and conglomerates at the base of A-3 and overlain by an erosional surface. Lorenz concluded that both holes encountered normal stratigraphic successions, and the cored breccias are too thin and too deep to have affected the gravity survey. EPA finds Lorenz's conclusion to be reasonable.

Topic	Commenter Concern	EPA Response
Lack of surface runoff	**Lack of surface runoff indicates karst is present at the WIPP site.**	The lack of surface runoff does not indicate karst is present at the WIPP site. Hill 1999 (p. 40–42) suggests that (1) because the WIPP site "is characterized by almost no surface runoff," despite 12 inches of annual precipitation, and (2) because the chloride mass balance techniques used by Campbell et al. (1996) suggested that infiltration of water through the soil is not the major source of recharge into the Rustler Formation ["…our data do not support direct infiltration through the overlying soil as the major source of aquifer recharge…", page 164], that therefore, recharge of the subsurface Rustler units must be through surface runoff that flows primarily into sinkholes, and that therefore must be sinkholes and an associated subsurface karst system at the WIPP site. On page 80, Lorenz (2005) presented a series of arguments for the lack of surface runoff at the WIPP site which are summarized as follows. The poor development of surface drainage over the WIPP site is due to the absence of requirements for such a drainage network. The low rate of precipitation, the presence of sandy surficial deposits that quickly soak up precipitation, the low dip of the strata that does not funnel drainage in any particular direction, and the shifting of dune sands that blocks drainage as it develops, combine to prevent an organized drainage system from forming in this area. It is not necessary to postulate a complex process of stream capture by an organized system of sinkholes and subsurface drainage to explain this pattern. To EPA, the evidence provided by Campbell et al, 1996 corroborates other data from similar areas (Hogan et al, 2004) that recharge does not occur through basin floors as at WIPP. The Campbell et al 1996 and other data indicate that the high evapotranspiration (evaporation and use by vegetation) reduces the potential for any recharge. Thus the combination of vegetation and sandy surficial soils are sufficient to prevent runoff in this arid climate.
Water in the exhaust shaft	**The water flowing in the exhaust shaft is due to the presence of karst at the WIPP site.**	Beginning around the time of the submission of the CCA, DOE detected water flowing into the air exhaust shaft; no water had been previously detected since shafts were excavated. Some commenters point to this water inflow as evidence of karst at the site. DOE has investigated this water inflow, which continues today. DOE has drilled wells around the WIPP surface facilities, hit water around 50-60 feet below ground surface, and identified that the highest levels of water are around the salt evaporation

Topic	Commenter Concern	EPA Response
		pond and that water flows toward the exhaust shaft. DOE did not find any karst related features in the wells drilled for the characterization. EPA believes that DOE's explanation of infiltration from the surface facility adequately accounts for the water movement, and does not require the invocation of karst.
Salinity/ground water geochemistry variations	**Salinity/ground water geochemistry variations indicate karst at WIPP** **Phillips 1987, p. 282**	DOE's hydrochemistry model recognizes four different ground water geochemical zones that differ in geochemical characteristics, recharge rates, and recharge locations. This interpretation allows for very slow vertical infiltration to the Culebra through overlying beds, although the primary Asource@ of ground water will be lateral flow from recharge areas north of the site. EPA believes the groundwater basin model provides a realistic representation of site conditions because it conceptualizes slow, downward infiltration of meteoric water. In the review of the CCA, EPA examined all data pertaining to ground water flow in the Rustler, and believes DOE=s <u>total</u> conceptualization adequately described system behavior for the purposes of performance assessment. [Docket: A-93-02, Items V-B-3, Section IV.C.1.i and V-B-7, Section 3.0] Corbet (1997) expands this by integrating the hydrochemical facies delineated by Siegel et al. (1991), with that of the hydrogeology to assess groundwater flow and recharge characteristics. The groundwater flow, characterized as confined and dual-porosity, is slow with no evidence of rapid groundwater flow conduits or chemistry changes, and no evidence of vertical connection to adjacent aquifers. Hill (1999) believes that total dissolved solids (TDS) variations indicate karst. EPA does not agree. The Culebra wells (H-1, H-2, and H-3) identified by Hill are all within the Culebra Facies C identified by Siegel. Facies C has a TDS range of 10,000 to 80,000 mg/l. Further, H-3, the well identified by commenters as a location that strongly exhibits karst, has had TDS measured at over 50,000 mg/l. If fast recharge due to karst were occurring at that location, EPA believes that at the WIPP site, one would expect the TDS value to be much lower. EPA finds the ground water basin model to provide a more reasonable explanation of the TDS variation than Hill's explanation.
Fractures in the Salado will be continuous	**Continuous vertical fractures will exist from the waste area to the Rustler Formation, enhancing**	One commenter speculates that vertical fractures will connect the repository with the overlying Culebra dolomite, a distance in excess of several hundred meters. However, DOE's and other experimental and modeling studies do not support these claims. Disturbed Rock Zone (DRZ): The commenter implies that an

Topic	Commenter Concern	EPA Response
	radioactive releases at WIPP.	extended disturbed rock zone forms around mined rooms and that these fractures will then be extended by high gas pressures propagating up to the Culebra. A limited DRZ does form and it is accounted for in the performance assessment; however, it's extent into the salt is not far. The DRZ has been characterized by visual, geophysical and permeability measurements (Borns and Stormont, 1988). Based on 12 holes cored in Room Q and associated sonic velocity measurements, it was shown that a "DRZ of less than 2 meters developed along the wall is typical for WIPP openings"(Hansen, 2003). In earlier investigations conducted by Holcomb and Hardy (2001), the maximum area of extension of DRZ was 2 meters. In the corner of the Room Q alcove, the DRZ only extended 1 meter and there were many areas where damage was not noticed. Dale and Hurtado (1998) have confirmed that the undisturbed formation around the WIPP Air intake shaft is less than 3 meters. Fractures: The commenter also speculates that development of long vertical fractures will start and then propagate due to excavation of the repository and higher gas pressure. Extensive experimental and simulation work was done to understand the fracture characteristics in the WIPP environment. In experiments, fracturing took place when the fluid pressure in MB 139 exceeded the assumed total local in-situ stress (14.8MPa, local vertical stress 12.4 MPa) normal to the fracture plus the tensile strength of the rock. These studies also established that the fractures will follow the path of least resistance, and are typically guided by weak horizontal zones and the preferred orientation in the direction of preexisting fractures, so that the fractures will be horizontal, not vertical.. Wawersik and others (1997) proposed that "both upward growth of horizontal fractures out of the interbeds, especially MB139, and a change in fracture orientation from horizontal to vertical are unlikely if the preexisting weakness planes in MB 139 (typical under the existing WIPP excavations) continued to act as regionally pervasive fracture guides." DOE used measurement data to develop a fracture model that is incorporated into the performance assessment. The fracture model assumes that existing fractures will be expanded laterally in response to high gas pressures. EPA extensively reviewed the fracture model and found it to be adequate (CCA CARD 23). Salt Creep: Located over 650 meters below the surface, the WIPP halite is under vertical pressure and creeps to redistribute stresses. Experiments at WIPP show that any opening/cavity in the salt, including fractures, will be eliminated by salt creep over

Topic	Commenter Concern	EPA Response
		a short time. Creep occurs due to plastic deformation and increases with the depth of the cavity. The rate of closure depends upon other factors, too; however, an approximate 1% reduction in volume per year can be used as a guide for the WIPP environment. Halite creep will thus close and eliminate fractures. EPA concludes that long, sustained vertical fractures to the Culebra or the accessible environment proposed by the commenter are unrealistic. Current fractures around the waste area excavation appear to be no more than about three meters in length. If additional fracturing were to occur, due to high repository pressures, then the fractures would be expected to propagate horizontally in the anhydrite marker beds where there are pre-existing fractures, not vertically into intact halite. From these data EPA concludes that the DRZ is limited in scope and fractures would not propagate vertically hundreds of meters to the Culebra.
Limited number of wells miss the karst	**DOE has not drilled enough wells to identify karst. Only two wells have been placed where karst might exist.**	The Culebra is characterized as being a fractured medium with the fractures having multiple orientations, including horizontal. The dual-porosity conceptual model accounts for fractures. The presence of fractures is explicitly modeled in transport calculations in the PA. Although the well bore diameter is on the order of inches, a well-pumping test interrogates large enough volumes of rock, via the fracture network so that if large voids or "underground rivers" were present, the pumping tests would have a good chance of identifying such features. That is, because the wells access fractures, the information from a limited number of wells can characterize a relatively large footprint. EPA believes that there are enough pumping tests in the Culebra to have identified if karst features were present. However, the data from the Culebra pumping tests are reasonably interpreted as being dual porosity.
Caliche and recharge	**Caliche at WIPP will allow water to infiltrate into the Rustler.**	Phillips (1987) conducted field work at and around WIPP in the 1980s when there was not nearly as much site characterization information as there is today. In that study, Phillips considered the Mescalero caliche, a soil formed in the WIPP area, to be a karst forming carbonate. Thus, any dissolution of the caliche by his definition must be evidence of karst. This provides an initial preconceived supposition that there is karst at WIPP. From his work in shallow trenches, Phillips estimated that 15% of the caliche has been dissolved or disrupted and that this allows water to move into openings and recharge the Rustler. However, if only 15% of the caliche is missing, then conversely about 85% of the caliche is still there to generally reduce infiltration. EPA believes that the caliche does not prevent all water from

Topic	Commenter Concern	EPA Response
		infiltrating but it greatly reduces the infiltration. The caliche does, however, indicate that the area has been arid and has been for quite some time. When combined with the sands, low precipitation, high evaporation rates, and the presence of vegetation, only limited infiltration would be expected.
Analysis of caliche as an indicator of subsurface karst	**Surficial trenching by Phillips (1987) indicates karst in the subsurface**	Phillips (1987; Docket A-93-02, Item II-H-33) used shallow trenches in the surface at and around the WIPP site to demonstrate that there is karst in the subsurface. He claimed that he identified several locations with collapsed caliche where he "reasonably assumed" that there was karst below, even though he did not have the information in the subsurface to support the claim. WIPP-14 is a well location in which Phillips believes his trenching shows subsurface karst: "the WIPP-14 topographic depression is underlain by a structural depression in the caliche surface…." In the subsurface, however, geophysical logs in WIPP-14 indicate a normal signature although commenters have contended that an interval around 81 ft is a mud-filled cavern (CCA CARD 14; Beauheim et al., 2000). For the CCA, EPA examined geologic data in and around the WIPP site, and has recognized that topographic depressions are present immediately north of the WIPP site, in the WIPP-14 area. Although DOE did not provide an explicit explanation of WIPP-14, they identified only a minor topographic depression, and that Athere is no evidence of collapse at the surface [at WIPP-14].@ [Docket: A-93-02, Item II-G-1, Ref. 26, pp. 25 and 26] DOE also stated that AWIPP-14 contained no subsurface cavities.@ [ibid., p. 25] Without direct evidence of cavernous porosity and subsequent collapse of overlying beds that would be associated with a karst origin of this feature, this interpretation is consistent with available data. There is no evidence that potential dissolutional features are the result of ongoing karst processes that would result in cavernous porosity and solution pipeways and caves. In the CCA, commenters mentioned the presence of Amud@ at WIPP-14 and EPA considered that unlikely. DOE states [Docket: A-93-02, Item II-G-1, Ref. 26, p. 26] that Athe stratigraphic succession at WIPP-14 is comparable to that in other drillholes.@ The Santa Rosa sandstone occurs from 15.4 to 141.0 feet below ground surface (bgs), and the Dewey Lake Redbeds occur from 141.0 to 638.7 feet bgs. Remaining strata are comprised of the Rustler Formation from 638.7 feet bgs to the top of the Salado at 951.6 feet bgs. AMud@ is not identified, but perhaps the commenter is referring to units such as the

Topic	Commenter Concern	EPA Response
		Unnamed Lower Member, or the Rustler-Salado contact area. [Appendix BH, p. 51 of the CCA] Given that there is a stratigraphic succession similar to other boreholes, it is difficult to reconcile Phillips' surface trench work to the actual subsurface data. Lorenz (2005) also addresses this issue in a reasonable analysis. EPA's interpretation of Phillips (1987) trenching in the caliche, is that the trenching identifies that the caliche is widespread, but is disrupted in areas. EPA does not believe that the shallow trenching provides evidence of widespread karst below the surface or any information about the subsurface. The use of the shallow trenching information to extrapolate hundreds of feet below ground surface is not inappropriate and unreasonable.
Recharge	**Recharge data and observations around WIPP indicate karst is present. (Also see Surprise Spring discussion.)** **Phillips, 1987; p. 283 Rustler is recharged by rainwater then Rustler flow fluctuates with rainfall**	Hill (1999) (p. 44 and Appendix A) suggests that records of rainfall near the WIPP site from September of 1986 through December of 1988 can be correlated with discharge variations at the Malaga Bend springs. Discharge from these numerous and obscure springs in the alluvium at and below the riverbed was calculated by subtracting flow in the Pecos River measured at gauging stations below the springs from river discharge measurements made above them. Hill (1999) speculated a 90- to 94-day lag-time response between precipitation in the area east of Carlsbad and discharge pulses at Malaga Bend in five out of eight cases, "suggestive of a possible connection" between the WIPP site and Malaga Bend. Hill did not discuss the numerous other rainfall spikes in the records that are not associated with river discharge peaks, and she did not try to correlate the volume of rainfall with volume of spring discharge. She also noted, but did not account for, the fact that Pierce Canyon, south of the WIPP site and the only large drainage point east of the Pecos for miles around, also empties into the river between the two gauging stations. Hill (1999) acknowledged that her study was poorly controlled and that it might not be statistically meaningful, since it did not account for factors such as irrigation, Pecos flood pulses, or industry water withdrawals at Nash Draw, and because it made no differentiation between precipitation over Nash Draw (where sinkhole catchment of drainage is known) and precipitation over the WIPP site where she was trying to prove the connection. She nevertheless justified the study with the statement that "The purpose of the above exercise is to show that actual measurements of recharge/discharge should be made in any serious attempt of studying karst at the WIPP site" (Hill 1999, p. 47), and although she did not in fact do this herself, the reader is

Topic	Commenter Concern	EPA Response
		ultimately left with the impression that in Hill's opinion, the data support the presence of karst in the Rustler at the WIPP site. However, what little definitive data exist suggest that recharge, flow, and discharge within the Rustler Formation are relatively rapid within the confines of Nash Draw, but that the same aquifer horizons exhibit different characteristics to the east, under the WIPP site. At the WIPP site there are several indicators that support a system of slow groundwater flow: a high degree of mineralization of the formation waters, lower measured hydraulic conductivities, and isotopic studies. The potentiometric head data suggest that flow in the Rustler members is slow at WIPP and that it would flow to the south (Culebra) and west (Magenta). The data suggest that if a karst conduit system exists in the Rustler Formation, it is confined to the Nash Draw area. EPA believes that while some recharge from local precipitation may occur in Nash Draw, EPA finds Hill's findings to be speculative and the Nash Draw information should not be extrapolated beyond Nash Draw. An important aspect of the recharge issue is that commenters (e.g., Phillips, 1987) have stated Rustler Formation recharge occurs at WIPP with the implication that there is enough recharge capable of creating karst. If it were the case that significant recharge was occurring in the Rustler at WIPP, one would expect to see a response in the well data. However, no response in water levels occurs at WIPP attributable to precipitation. This indicates to EPA that either 1) no recharge is occurring today or the 2) what recharge is occurring is small and would not be sufficient to dissolve the Rustler after infiltrating to it, and would not be sufficient to support flow in an "underground river" as commenters claim there is at the WIPP site. **[CRA 2009 note: Please see Section 15.2.5 for updated information on Culbra water level changes.]**
Surprise Spring	**Surprise Spring in Nash Draw is connected to the WIPP site and is evidence of karst at WIPP.**	Commenters refer to Phillips' (1987) observation that there was a rapid response of Surprise Spring to a large 1985 rainfall event and proves karst exist at the WIPP site. Surprise Spring is located near the Salt Lake, toward the western side of Nash Draw and is over 8 miles from the western side of the LWB. EPA and DOE acknowledge that Nash Draw has karst like features. Thus, it is not unreasonable to assume that a large rainfall event would create flow in Nash Draw. *However, that has no bearing on the WIPP site and any attempt to connect a response in Nash Draw to the WIPP site is unreasonable.* As discussed in this CARD (2004 CRA CARD 15), EPA's understanding of the WIPP/Nash Draw system is that the two

Topic	Commenter Concern	EPA Response
		areas are vastly different in their hydrogeologic character. While Nash Draw has karst like features and the Rustler is near the surface, at WIPP the Rustler is hundreds of feet below the surface. While Nash Draw areas appear to respond rapidly to precipitation events, no responses are seen in the well data for the Magenta and Culebra Dolomites at the WIPP site. Thus, the observation of rain water well response at Surprise Spring has no bearing on the WIPP site.
Coercion of scientists	**Commenters claim that WIPP project scientists have been silenced on the karst topic.**	EPA is basing its conclusions on karst on the available data. The available data indicates to us that there is karst around WIPP (e.g., Nash Draw), but there is no evidence to suggest that karst would affect the performance of WIPP during the regulatory period. EPA has no comment on past management practices at WIPP by Sandia National Laboratories, DOE or the USGS and there are sufficient data available for EPA to conclude that karst will not affect the performance of WIPP.
Magenta should be modeled	**Commenters believe that the Magenta Dolomite should be modeled as a radionuclide transport pathway at WIPP in PA.**	DOE has identified that the Culebra and Magenta Dolomites of the Rustler Formation could be pathways for radionuclide transport in the case of a drilling intrusion. However, the Culebra exhibits higher transmissivity than the Magenta everywhere within the WIPP Land Withdrawal Boundary. EPA has reviewed the evidence for high Magenta transmissivity at the well H-3 (now called H-3b1) and found it to be incorrect (see discussion on the H-3 information above). EPA does not believe that karst is present in the Magenta within the Land Withdrawal Boundary. Although the Magenta is not currently excluded from receiving fluids from the repository, the Magenta and Culebra Dolomites are parameterized in the PA such that more fluid would enter the Culebra and only transport is considered in the Culebra. DOE believes, and EPA concurs, that since the Culebra has a higher transmissivity than the Magenta, the use of the Culebra as a pathway would contribute to more releases than if both the Culebra and the Magenta were modeled. In addition to requiring a more pressurized flow up the borehole to the Magenta since it is above the Culebra, the radionuclide concentration would be shared between the Culebra and the Magenta, which would decrease releases. Since the Magenta is considered to have flow through the rock matrix and not fractures, there would be a much greater chance for radionuclide retardation than in the Culebra, which does have fracture flow in addition to the matrix. Combined with low transmissivity and long radionuclide travel times, the inclusion of the Magenta as focus of radionuclide transport would split the radionuclide amounts into two rock

Topic	Commenter Concern	EPA Response
		units, thus retaining more radionuclides within the Land Withdrawal Boundary than is currently modeled. This would reduce predicted releases, therefore EPA believes it is appropriate to focus release into the Culebra in PA modeling.
Inadequate characterization of karst at WIPP	**Commenters claimed during the CCA and continue to claim that DOE has not adequately characterized karst at the site for compliance purposes.**	EPA disagreed with this in the certification decision and continues to disagree with this claim (CCA CARD 14). In the CCA, EPA found that DOE adequately identified that the two major groundwater bearing units at the WIPP site are the Culebra and Magenta Dolomites Members of the Rustler Formation. To support this characterization, DOE provided a table of hydraulic properties of the hydrologic units at WIPP, a portion of which has been reproduced in this CARD in Table 15-1. DOE conducted basic studies of geology (e.g., CCA Appendix GCR) and tested numerous wells and continues to conduct geologic and hydrologic studies. The Culebra is of particular interest because it is the most transmissive, saturated unit above the WIPP repository. The two primary types of field tests used to characterize the flow and transport characteristics of the Culebra are hydraulic tests and tracer tests. Extensive testing of the Culebra has been performed at 43 well locations to determine its hydraulic properties. The hydraulic testing consists of pumping, injection, and slug testing of wells across the study area. The most detailed hydraulic test data exist for the WIPP hydropads. The hydropads generally comprise a network of three or more wells located within a few tens of meters of each other. Long-term pumping tests have been conducted at hydropads H-3, H-11, and H-19 and at well WIPP-13 (Beauheim 1987b; 1989; Beauheim et al. 1995; Meigs et al. 2000). A map of these locations is provided in Figure 15-3 of this CARD. These pumping tests provided transient pressure data at the hydropad and over a much larger area. Tests often included use of automated data-acquisition systems, providing high-resolution (in both space and time) data sets of pump test results. In addition to long-term pumping tests, slug tests and short-term pumping tests have been conducted at individual wells to provide pressure data that can be used to interpret the transmissivity at that well (Beauheim 1987a). Additional short-term pumping tests have been conducted in the WQSP wells (Beauheim and Ruskauff 1998). Detailed cross-hole hydraulic testing has been conducted at the H-19 hydropad (Beauheim 2000). It appears to EPA that commenters ignore the wealth of historical information collected (at the site in the 1990s and recently) and focus on isolated old data, such as one H-3 data

Topic	Commenter Concern	EPA Response
		point from 1977. Other examples include water in the exhaust shaft, and pumping test data. As described in this table of responses and elsewhere in this CARD, DOE has conducted site characterization to reasonably explain the water in the shaft, and this drilling did not encounter karst at the above ground WIPP facility. Commenters do not appear to acknowledge this new information. DOE has conducted a number of well pump tests that provides a strong basis for concluding that the Culebra is a dual-porosity system and not karst-like in nature. Commenters have not accounted for this data.

APPENDIX 15-B, HYDROLOGIC COMMENTS FROM 2009 RECERTIFICATION

In the original Compliance Certification Application performance assessment and 2004 Recertification, EPA continued to agree that DOE appropriately ruled out karst as a feature that would occur at WIPP over the regulatory period (see CCA and 2004 CRA CARD 14 and CCA response to comments). However, in the 2009 CRA, commenters continued to raise issues related to karst. Appendix 15-B responds to selected questions raised by commenters. In the 2009 CRA, DOE again omits karst features in the performance assessment. As discussed in the main body of 2009 CARD 15, EPA again agrees with DOE that karst features can be omitted from the performance assessment.

Comment	Commenter Concern	EPA Response
2-15-CARD-1	**Phillips 2009 page 1, last line- CARD states, "This is why the proponents of WIPP deny the existence of karst at the WIPP site. They argue, in effect, that WIPP is a karst-free island in the midst of a regional karstland."**	CARD does not supply any new data to support this specific assertion, which it put forward during both previous certifications, and was already considered by EPA in significant depth. In Section 15.2.3 of this CARD, EPA states that a review of geologic data "indicate[s] that Nash Draw and the WIPP site are essentially two separate hydrologic systems under the current climate, have been that way for some time, and would be expected to remain relatively independent into the future." (14/15-11) Section 15.2.3 also discusses the mechanism in considerable detail. Nearby karst occurs where the Rustler was exposed at the surface by regional dip during the Miocene epoch, and then eroded by a large drainage system during the Pleistocene in Nash Draw. The processes which made this possible did not occur at the WIPP site and does not occur in the present climate. Karst outside the Land Withdrawal Boundary in Nash Draw does not affect the WIPP system performance, and there is no new data which calls into question the boundaries of areas affected by karst. See DOE responses to CARDs comments on page 34 of DOE 2009f.
2-15-CARD-2	**Phillips 2009 page 2, page 2, first line- CARD states, "The supposed reliability of the Rustler Formation as a barrier to the migration of contaminated water hangs upon a postulated lack of rainwater recharge."**	This comment does not accurately reflect the conceptual model. The conceptual model considers the water-bearing units of the Rustler to be saturated confined aquifers at WIPP, which transmit liquid laterally through a porous medium of varied transmissivity with very slow local leakage (DOE 2009f, page 34). The Culebra's ability to limit contaminant transport depends on its physical and chemical retardation processes more than its transmissivity distribution (DOE 2009f, page 35). For further information, refer to 2009 CRA, Appendix MASS-2009 Section MASS-15 and DOE 2009f.
2-15-	**Phillips 2009 page 2,**	This is the principle argument which Dr. Phillips has made in the

Comment	Commenter Concern	EPA Response
CARD-3	**third paragraph- CARD states, "Proof of rainwater recharge at the WIPP site would constitute proof that WIPP is part of the regional karstland of the Pecos River Valley."**	past – that rainwater which falls at the WIPP site rapidly infiltrates the Rustler formation, "recharging" it 500 feet below the surface. Recharge traditionally describes rainwater infiltrating the ground and reaching the water table, which occurs at the WIPP site in the upper Dewey Lake formation. For confined aquifers, such as the Culebra and Magenta dolomites of the Rustler formation, water is expected to pass through confining beds, or aquitards, in a process called leakage. This process occurs at a much slower rate than lateral flow through the aquifer (DOE 2009f page 34). Section 15.2.3 of this CARD lists several strong challenges to the theory that significant amounts of groundwater reach the Rustler formation at the WIPP site. These include flora at the surface which indicate high levels of evapotranspiration, the depth to the aquifers of the Rustler formation, low-permeability insoluble rock strata that overlie the Rustler, age of the water in the Rustler, and perhaps most significantly, the difference in hydraulic heads between the various aquifers at the WIPP sites - indicating the efficiency of the confining layers that separate them (DOE 2009f page 35 paragraph one). Phillips' (2009) submission fails to address any of these issues.
2-15-CARD-4	**Phillips 2009 page 3, third paragraph- CARD states, "This is the very definition of karst. Simply stated, if rainwater recharge does reach the Culebra dolomite, the Culebra is not a confined aquifer, and the conceptual model is wrong."**	As stated above, a confined aquifer is not expected to be free of slow vertical leakage. The conceptual model clearly states that "groundwater flow in the Rustler is characterized by very slow vertical leakage through confining units and faster lateral flow in conductive units." (CCA, Appendix MASS, Section 14.2, p.71 line 25) For the reasons listed above, geologic data overwhelmingly indicate that leakage to the Culebra is an extremely slow process. The Culebra is assumed, for the purpose of calculating transmissivity values, not to experience vertical leakage. This is not an aspect of the conceptual model. Rather, it is a conservative assumption of the numerical model: calibrating the transmissivity fields while assuming no vertical leakage, increases the horizontal velocity of Culebra groundwater. (DOE 2009f page 37)
2-15-CARD-5	**Phillips 2009 page 4, paragraph 2-CARD states, "But the point to remember is this: none of this rainwater recharge is supposed to be happening. Not every one of these**	Dr. Phillips (Phillips 2009) attempts to build the case that the correlation of water increases in the Culebra monitor wells with rainfall events can constitute proof that rain water infiltrates to the Culebra dolomite through karst conduits. The multiple difficulties of this hypothesis are outlined in the response to comment 2-15-CARD-3, above, and discussed in Section 15.2.3 of this CARD. Phillips 2009 ignores the significant hydrological pump test data

Comment	Commenter Concern	EPA Response
	recharge events can be correlated with the rainstorms recorded at the weather stations, but most of them can, dozens of them, recurrently, over an eleven-year period, with lag times less than a months, this invalidates the groundwater model upon which the certification of WIPP was based.”	acquired and the research that was performed during the preparation of the Revised Culebra Hydrogeology Conceptual model, which is described in 2009 CRA Appendix HYDRO-2009 Section HYDRO-5.1, and reviewed by EPA in Section 15.2.4 of this CARD, “Nash Draw Impact on Culebra Water Levels”. As discussed previously in this section of CARD 15, the significance of this work has been to definitively correlate water level changes in Culebra monitoring wells with potentiometric responses to rainfall events in Nash Draw, where the Rustler Formation is near surface, possibly exposed, and unconfined. During the previous recertification, EPA noted that “Corbet (1997) has inferred a recharge area for the Rustler south and west of the site in the southeastern part of Nash Draw with corresponding flow to the southeast, away from Nash Draw. This area corresponds to the hydrochemical Facies B of Siegel et al (1991) which has the lowest total dissolved solids in region around WIPP. This is one example where Corbet (1997) used the groundwater basin modeling to reasonably integrate the hydrogeochemistry of Siegel et al. (1991).” (Section 15.2.3, p16). EPA finds that the new data and research presented in Appendix HYDRO-2009 better integrates Culebra water level data into a more refined understanding of the site’s hydrology.
2-15-CARD-6	**Phillips 2009 page 14 last line-CARD states, "This strongly suggests that the water table will continue to rise at the WIPP site. Thus the Culebra is not in hydraulic steady state, as hypothesized in the conceptual model, on the basis of which the WIPP was certified.”**	It is important to note that, as stated in the response to the third comment, the water table at the WIPP site is found in the Dewey Lake, and not in the Rustler. The conceptual model, in any event, does not assume that any aquifer at the site is in a ‘steady state.’ Sections 6.4.6.2 and 6.4.9 of the original CCA discuss the changes in Culebra velocity that could result from different future meteorological conditions. For the purpose of performance assessment, a steady state is assumed only for the calibration of the Culebra transmissivity (T) fields, and the Climate Index is used to vary Culebra heads in the future (DOE 2009f page 37). For more information, see 2004 CRA Appendix MASS, Section 17.0, Climate Change.
2-15-CARD-7	**Phillips 2009 page 30, first paragraph-CARD states, "If groundwater is supposed to be flowing from north to south, as DOE contends, how then did dissolved halite appear in these test wells?”**	DOE does not deny that in addition to the overall southward Culebra flow, there is also a westward trend in flow near the well that CARD identifies (H-6, P-14, WIPP-25, and WIPP 26) (DOE 2009f page 38). Additionally, halite is found in the Los Medanos member of the Rustler nearby, and in all non-dolomite Rustler strata to the north. Because of the residence time of Culebra groundwater, diffusion is likely mechanism for the movement of halite. (DOE 2009f page 38)

Comment	Commenter Concern	EPA Response
2-15-CARD-8	**Phillips 2009 page 36, 6th paragraph-CARD states in conclusion, "Proof of rapid rainwater recharge at the WIPP site renders invalid the hydrologic model of the Culebra by which the WIPP site was certified by the Environmental Protection Agency. Because rainwater recharge does reach the Culebra dolomite, dissolution of the overlying evaporates is occurring, the Culebra is not in hydraulic steady state, the Culebra is not a confined aquifer, and the Culebra is not the only potential pathway for contaminated water."**	This comment contains several troubling statements. Previous responses enumerate the significant body of geologic evidence submitted to EPA that contradicts the theory that rainwater rapidly infiltrates to the Culebra and causes significant dissolution. Previous responses also establish that hydraulic steady state is not a component of the conceptual model, and that hydraulic head measurements indicate that the Culebra is unquestionably confined at the WIPP site. This statement by CARD, Phillips 2009, contains an additional misconception: the conceptual model explicitly includes other pathways. According to the 2004 CRA, Chapter 6 Section 6.4.6 line 13) "BRAGFLO parameters are specified so that brine flow from the intrusion borehole is possible not only into the Culebra but also into the Magenta, Dewey lake, and overlying units (as well as the ground surface)." PA modeling results indicate that contaminated water does not reach these units, because of the Culebra's relatively high transmissivity and low potentiometric surface (DOE 2009f page 38). Having all contaminants move through the most transmissive unit at the site is a conservative scenario, in that any contaminants which enter other units would move much more slowly towards the Land Withdrawal Boundary.

APPENDIX 15-C, GENERAL COMMENTS FROM 2009 RECERTIFICATION

All comments received during the 2009 CRA are listed below, and EPA's response to each is documented.

Comment	Commenter Concern	EPA Response
COM-CRA09-1 SWRIC Letter, 6/16/2009 1 of 4	**"First a major, long-standing concern is that the Comprehensive Inventory Database (CID) is not available. …the CID is an essential source for the *Inventory Report*. Like other sources and references, the CID must be publicly available to confirm the accuracy an reliability of the WIPP inventory."**	Availability of the CID is discussed above in Section 24.1.6.
COM-CRA09-2 SWRIC Letter, 6/16/2009 2 of 4	**"Second, the WIPP inventory is not complete because Appendices A and C do not accurately reflect DOE's current plans for waste that is to be emplaced at WIPP and potential WIPP waste streams. … A complete application must include the Inventory that reflects DOE's current plans . . . other waste streams that do not have a defense determination or are not permitted at WIPP should also be excluded. DOE must also state what process it intends to use for future defense determinations."**	Comments related to inventory accuracy and legality are discussed in Section 24.1.6.
COM-CRA09-3 SWRIC Letter, 6/16/2009 3 of 4	**"Third SRIC aggress with EPA's May 21 2009 letter that the new Culebra Hydrology model and most recent parameters must be included in a complete application. Moreover, the Section 27 peer review is incomplete because it does not accurately reflect current information regarding the Disturbed rock Zone (DRZ) conceptual model . . . EPA must have full information about limitations of the existing models. Section 27 information must be substantially enlarged and revised to fully describe the deficiencies of the DRZ and cuttings and cavings sub-models, and how those limitations affect other aspects of the CRA..**	This comment is specifically addressed in Section 27.4.1.
COM-CRA09-4	**Fourth, the CRA is incomplete because it does not discuss the July-**	These shipments and suspensions are discussed in Section 8.4.1.

Comment	Commenter Concern	EPA Response
SWRIC Letter, 6/16/2009 4 of 4	**August 2007 suspension of shipments from the Idaho National Laboratory (INL) to WIPP [and 2008 LANL suspension]. That suspension and its implications for WIPP's compliance also should be included in a complete CRA."**	
COM-CRA09-5 CACNNP Letter, 6/30/2009	**"WIPP is insane, irresponsible, a disgrace and poses immediate and long-term dangers to our health and environment. We the People are opposed to the recertification of WIPP, for many reasons…"**	Comments regarding WIPP's mission are addressed in Section 15.0.
COM-CRA09-6 CACNNP Letter 7/22/2009	**"WIPP is the greatest crime to life on the planet and the universes(sic)."**	See COM-CRA09-5.
COM-CRA09-7 SRIC Letter, 7/31/2009 1 of 6	**"First, a major continuing, long-standing concern is that the Comprehensive Inventory Database (CID) is not available . . . On July 23, SRIC received a CD with a PDF and excel spreadsheet with some data . . . the spreadsheet does not contain much of the information in the CID, nor much of the information in the 2008 inventory."**	See COM-CRA09-1.
COM-CRA09-8 SRIC Letter, 7/31/2009 2 of 6	**"Second, the 2008 Inventory is inaccurate, unreliable, and incomplete in dealing with the defense determination. …SRIC believes all waste streams classified as 'Likely defense-Related' must be excluded from Appendix A. SRIC also questions some of the defense determinations. … SRIC requests that EPA require that DOE describe how it will make defense determinations in the future and to make the basis of such determinations publicly available. The inconsistent use of the term 'Pending Determination' is inappropriate. . . . DOE must comply**	See COM-CRA09-2.

Comment	Commenter Concern	EPA Response
	with the law, and EPA should ensure that it does so by prohibiting any commercial waste at WIPP and requiring that DOE eliminate all commercial wastes from its Inventory. ”	
COM-CRA09-9 SRIC Letter, 7/31/2009 3 of 6	**“Third, the 2008 Inventory includes high-level waste streams that are not allowed at WIPP. …for high-level waste, for non-defense wastes, and for other wastes not allowed at WIPP, EPA should specify how it will ensure that DOE does not ship such wastes to WIPP.”**	See COM-CRA09-2.
COM-CRA09-10 SRIC Letter, 7/31/2009 4 of 6	**“Fourth, the 2008 Inventory includes additional waste streams that are not allowed at WIPP. …EPA should ensure that [DOE comply with the LWA] by prohibiting any waste that exceeds the legal limit of 23 Curies per liter.”**	See COM-CRA09-2.
COM-CRA09-11 SRIC Letter, 7/31/2009 5 of 6	**Fifth, the Inventory includes sealed sources, some of which are prohibited at WIPP. …SRIC disagrees that foreign wastes could come to WIPP and requests that EPA require that they be eliminated from the Inventory.”**	See COM-CRA09-2.
COM-CRA09-12 SRIC Letter, 7/31/2009 6 of 6	**Sixth the 2008 Inventory does not include some wastes that DOE is planning to dispose at WIPP.”**	See COM-CRA09-2.
COM-CRA09-13 Jeffrey Thompson Email, 5/11/2010	**“Do not expand WIPP and do not bring waste from outside New Mexico and travel on our highways.”**	See COM-CRA-09-5.

Comment	Commenter Concern	EPA Response
COM-CRA09-14 Sayrah Namaste Email, 5/9/2010 1 of 1	**"I am a mother living in Albuquerque, new Mexico and am concerned about the possibility of plutonium being transported to a WIPP site which would mean exposure to this toxin for me and my daughter. I know there is a public hearing coming up but I work full time and am a single mother so will not be attending. But I want to go on record as being opposed to more wastes being brought into New Mexico."**	See COM-CRA-09-5.
COM-CRA09-15 CARD Verbal comments, 5/12/2010 meeting	**CARD questioned whether the PA accounted for Argonne National Laboratory results on the structure of plutonium nanoclusters.**	ANL's results, and the inclusion of colloidal actinide transport in PA, is discussed in Section 24.2.6.
COM-CRA09-16 Judith Murphy Email, 5/13/2010 1 of 1	**"I strongly oppose any expansion of WIPP's capacity. We in New Mexico have had more than enough nuclear waste traveling through our most populous cities and roads. We do not more forced on us from Hanford, Savannah River, or anywhere else."**	See COM-CRA-09-5.
COM-CRA09-17 John Boomer Email, 5/19/2010 1 of 1	**"I am a concerned citizen living in New Mexico along Interstate 40, a route to the WIPP site. I am concerned about shipments of highly contaminated and radioactive material being brought to this area. I am even more deeply concerned that this material is still being produced. More will be produced in the future by the nuclear energy industry expansion. Why? Shouldn't we find a solution before we add to the problem? Thank you."**	See COM-CRA-09-5.
COM-CRA09-18 SRIC	**SRIC continues to object that the Comprehensive Inventory Database (CID is not available. While SRIC appreciates the fact that CBFO has**	See COM-CRA09-1.

Comment	Commenter Concern	EPA Response
Letter, 5/27/2010 1 of 5	**provided a CD with a PDF and Excel spreadsheet . . . that is not sufficient."**	
COM-CRA09-19 SRIC Letter, 5/27/2010 2 of 5	**Second, the 2008 Inventory . . . is inaccurate, unreliable and incomplete with regard to defense determination, as discussed in our July 31, 20079 comments. Thus the PABC-2009 includes waste streams that are "Likely Defense-Related," but without defense determinations, in the inventoryand excludes other waste streams that are "likely Defense-Related." . . . SRIC again requests that EPA require DOE to describe how it will make defense determinations in the future and to make all such determinations publicly available."**	See COM-CRA09-2.
COM-CRA09-20 SRIC Letter, 5/27/2010 3 of 5	**"Third, as discussed in our July 31, 2009 comments, there are sealed sources waste streams included in the 2008 inventory, which are prohibited at WIPP."**	See COM-CRA09-2.
COM-CRA09-21 SRIC Letter, 5/27/2010 4 of 5	**"Fourth, the 2008 Inventory and the PABC-2009 do not include all of the waste streams the DOE apparently intends to ship to WIPP during the term of the CRA-2009."**	See COM-CRA09-2.
COM-CRA09-22 SRIC Letter, 5/27/2010 5 of 5	**"Fifth, DOE has recently made a decision to ship hundreds and perhaps thousands of high carbon tetrachloride waste containers from Idaho National Lab (INL) to WIPP in Ten drum Overpacks (TDOPs) . . . SRIC also requests that EPA require a new sensitivity analysis of the impacts of having many more 55-gallon drums in TDOPs than are**	CARD 24, Section 24.10.6 discusses the impact of waste loading on the PA, and specifically addresses this comment.

Comment	Commenter Concern	EPA Response
	presumed in the PABC-2009."	
COM-CRA09-23 Concerned Citizens for Nuclear Safety (CCNS) Email, 5/28/2010 1 of 1	**"CCNS wholeheartedly supports the three sets of comments submitted by the Southwest Research and Information Center . . . CCNS remains concerned about the lack of an adequate inventory in order to conduct the inventory analyses."**	See COM-CRA09-2.
COM-CRA09-24 CARD Letter, 6/2/2010 1 of 4	**"In concert with Southwest Research and Concerned Citizens for Nuclear Safety, CARD finds the lack of public access to the CID incompatible with the new age of transparency in government declared by President Obama and a completeness issue. Stakeholders cannot make clear judgments concerning WIPP when basic information is withheld from them therefore meaningful public participation has been thwarted by the lack of a publicly available CID."**	See COM-CRA09-1.
COM-CRA09-25 CARD Letter, 6/2/2010 2of 4	**Not all waste mentioned as being part of DOE's near term plans are included in the inventory (Argonne East); another completeness issue. Including waste in the inventory not legally able to be accepted at WIPP (sealed sources) is also a completeness issue.**	See COM-CRA09-2.
COM-CRA09-26 CARD Letter, 6/2/2010 3 of 4	**Without a newly configured placement diagram, we are at a loss to know how the many proposed ten drum overpacks will fit into the underground, a matter of incompleteness of information.**	See COM-CRA09-22.
COM-CRA09-27 CARD	**"At EPA's first public scoping meeting concerning recertification, Rick Boheim gave a long oral presentation on the movement of well**	EPA disagrees with this characterization of Appendix HYDRO. In order to alleviate any possible confusion, EPA agreed to provide a "crosswalk" document which explicitly

Comment	Commenter Concern	EPA Response
Letter, 6/2/2010 4 of 4	**heads at WIPP. No written report was ever submitted to coincide with that presentation making it difficult to impossible to have Boheim's position and Richard Phillips opposing position peer reviewed. CARD was referred to Appendix Hydro as a report encompassing Boheim's presentation, however Boheim's long presentation filled with diagrams and other illustrations is covered by only a few sentences in AH. Appendix HYDRO and Boheim's presentation are two totally different (though very closely related) reports. EPA, much to CARD's dismay, only relies on DOE contractors and employees for information on stability of the WIPP site and now is standing in the way of stakeholders performing an independent review of a very crucial hydrological issue at the WIPP site. The lack of Boheim's written report concerning movement of well heads at WIPP is an incompleteness issue of great concern to our constituency."**	references Dr. Boheim's Powerpoint slides to individual sections of Appendix HYDRO. This document was provided via email to CARD on June 3, 2010 (Docket A-98-49, Item II-B3-113.)
COM-CRA09-28 SRIC Letter, 8/16/2010 1 of 7	**"First, SRIC strongly objects to the new rationale for not making available the Comprehensive Inventory Database (CID)."**	See COM-CRA09-1.
COM-CRA09-29 SRIC Letter, 8/16/2010 2 of 7	**"Second, EPA must ensure that only transuranic (TRU) waste, not low-level waste, nor high-level waste, nor commercial waste is disposed at WIPP. … SRIC believes that in its recertification decision, EPA should specify that such a public process is required for tank wastes and for all other waste streams that have ever been managed as high-level waste."**	See COM-CRA09-2.
COM-CRA09-30 SRIC Letter,	**Third, SRIC strongly objects to the non-public, effectively secret proicess for making defense determinations. … EPA's recertification decision should require that all defense**	See COM-CRA09-2.

Comment	Commenter Concern	EPA Response
8/16/2010 3 of 7	**determinations be made publicly availableand describe the process that EPA uses to verify that the determinations meet the legal and technical requirements if disposal of defense waste."**	
COM-CRA09-31 SRIC Letter, 8/16/2010 4 of 7	**"Fourth, SRIC continues to object to an inaccurate, incomplete waste inventory being used for the recrtification and the performance assessment. … Moreover, shipping waste to WIPP that is not included in certification or recertifiation inventories and performance assessments must be considered cviolations of the certification or recertification."**	See COM-CRA09-2.
COM-CRA09-32 SRIC Letter, 8/16/2010 5 of 7	**Fifth, there are numerous other inaccuracies in the 2008 Inventory.**	See COM-CRA09-2.
COM-CRA09-33 SRIC Letter, 8/16/2010 6 of 7	**Sixth, the Appendix A information in the Inventory-2008, which provides much of the data for the PABC-2009, cannot be verified as accurate.**	See COM-CRA09-2.
COM-CRA09-34 SRIC Letter, 8/16/2010 7 of 7	**"SRIC believes that DOE must submit its additional information and have at least one public meeting on the information before EPA proceeds with any further consideration of shielded containers. … Regarding panel closure, DOE has not supplied adequate information about its plans for panels 9 and 10. Once again, such information should be discussed with stakeholders prior to DOE asking EPA to begin the rulemaking process."**	Consideration of shielded containers or panel closure falls outside the scope of Recertification. EPA will not consider any facility changes as part of a Recertification decision. The Agency has committed, however, to follow a public process for any future facility modifications.