Hi Pam,

Please include this email along with the attachment to the December WIPP file. Thank you!

-----Original Message-----
From: card [mailto:contactus@cardnm.org]
Sent: Friday, December 30, 2011 10:21 AM
To: Kliphuis, Trais, NMENV; Maestas, Ricardo, NMENV; Holmes, Steve, NMENV
Subject: Summary of controversy concerning karst at WIPP

Hi,

Attached is a summary of the karst issue put together by CARD and the Sisters of Loretto. Dr. Snow and Carole Hill were DOE contractors. Dr. Barrows was a seismologist with the Sandia WIPP team. Dr. Snow's advice (to actively look for karst) was disregarded; after he came out with papers that supported the karst position, he was never hired as a Federal contractor again causing hardship to his family. Dr. Barrows work including seismic readings indicating karst were never published; he was inappropriately transferred and then resigned; he had a young family at the time. Carole Hill's papers were never published; we received her work through a colleague. DOE never published any papers generated by their scientists or contractors that supported the karst position. There might be more. Only a few DOE earth scientists have taken the position that is no karst at WIPP; no independent earth scientist has taken that position.

The CARD web site plus this paper covers the issue fairly well.

I will send you another e-mail covering other subjects which we discussed before noon.

Best Wishes,

Janet Greenwald
COMMENTS ON EPA’S RECERTIFICATION OF WIPP

By Janet Greenwald, Citizens for Alternatives to Radioactive Dumping (CARD) and Penelope McMullen, SL, Loretto Community

December 5, 2005

Introduction

Water flow rates at WIPP are crucial to WIPP meeting EPA standards. EPA’s certification of WIPP was based on inadequate and falsified information concerning water flow at the WIPP site.

According to the Department of Energy (DOE), the Rustler formation is the most likely vehicle for contaminated water to travel beyond the WIPP site. Karst allows rapid transport of water. Whether or not karst exists in the Rustler is therefore crucial. After WIPP’s certification by EPA, two well-known earth scientists have questioned the adequacy of DOE’s investigation of karst in the Rustler.

According to geologist Carol Hill, in her unpublished September 1999 report contracted by the DOE, “Whether karst is, or is not, present at the WIPP site must be based on evidence. So far, WIPP investigations have not obtained this evidence.” [Intrastratal Karst at the WIPP Site, p. 72, para. 2].

According to hydrologist Dr. David Snow, former DOE contractor at WIPP, in his 1999 report contracted for CARD, “The most evident aquifer in the Rustler, the Culebra dolomite, is claimed by DOE to provide such slow transport that the Rustler can be considered an adequate barrier to waste migration. But performance assessment modeling, based on insufficient exploration data, unsupportable deductions, and faulty assumptions led to that claim.” [Unsafe Radwaste Disposal at WIPP, www.cardnm.org, technical section, summary].

Also, after WIPP’s certification, other well respected earth scientists reported falsification of information during the siting of WIPP. According to Dr. Roger Anderson, hydrologist and professor emeritus at the University of NM, former DOE consultant at WIPP, “One flagrant abuse of science is exposed by the attempt by WIPP science managers to deny the presence of dissolution above the WIPP repository.... In important ways, this falsehood is more serious because it involves more than simple scientific error.” [http://www.unm.edu/~ryand/otherwipp/otherwipp3.html, EXAMPLE 1: Mendaceous Science, The Other WIPP, para. 5 & 6, faxed to EPA Dec.5, 2005].

Evidence supporting our concerns follows.

I. Evidence Showing That Karst Is Crucial To WIPP Meeting EPA Standards

We begin this section by defining karst. “Possibly the most important difference between ground water flow in karst terrains and in porous media is that conduit flow generally dominates in the karst terrain, both above and below the water table, so that flow velocities are often orders of magnitude greater in karst. Another consequence is that filtration which acts in porous media to remove many contaminates from the water, is virtually absent in the karst environment.” [Foundation Considerations in Siting of Nuclear Facilities in Karst Terrains and Other Areas Susceptible to Ground Collapse, May 1981, A.G. Franklin, et al, p. 57, para. 1].

“Karst aquifers are heterogeneous and anisotropic, and become more so with time as the flow of water through the aquifer enlarges the most effective flow paths through preferential solutions. Limestones may have very high values of conductivity along joints, faults, and bedding plains, extremely high conductivity within solution conduits, and virtually zero conductivity within the unfractured wall rock. It is simplistic to
assume that transmissivity remains constant over a large distance. According to White (1988, pp. 187-188): the well bore is a very small object on the scale of the heterogeneities of a karst aquifer, and one does not know what component of the subsurface drainage system is being probed. Values obtained from pump tests vary widely over short distances, depending on exactly where the wells are drilled. A well that taps a connection with the conduit system can produce very large quantities of water with negligible drawdown, leading to extremely large calculated transmissivities. A well drilled a few meters away in an unfractured block of limestone may have negligibly small yields. [A Conceptual Model for Contaminant Transport in Karst Aquifers at the WIPP Site, by Dr. Richard H. Phillips and Dr. David T. Snow, sent to EPA by FedEx on Dec. 2, 2005; p. 3, para. 4].

In the Federal Register, under 40 CFR Part 194, Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant’s Compliance with the Disposal Regulations: Certification Decision, Final rule: “The Rustler is of particular importance for WIPP because it contains the most transmissive units above the repository (i.e., has the highest potential rate of groundwater flow). In particular, the Culebra dolomite member of the Rustler Formation is considered to be the primary groundwater pathway for radionuclides because it has the fastest groundwater flow in the Rustler Formation.” [p. 2732, para. 2].

“In SEIS-II, the potential impact from a single borehole scenario can be approximated by examining the analysis of a future intrusion that penetrates directly into the repository and subsequently encounters a pressurized brine reservoir. The analysis showed that in an intrusion borehole case, contamination may reach the Culebra Dolomite, but transport modeling showed that only very small amounts of contaminants would migrate from the point of release over 10,000 years.” [Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement, Vol. III, Comment Response Document, 13.07 (05), response, para. 2].

In the final WIPP SEIS-II, Appendix H, under Physical Retardation (Matrix Diffusion), first paragraph: “Performance assessment calculations (SNL 1992) suggest that radionuclides will take from a 100 to 1000 years to travel from the repository to the WIPP boundary. This indicates that without matrix diffusion to slow up (retard) the radionuclides, cumulative releases would be greater than the 10,000-year regulatory period. It is believed by some (Neill et al. 1996; Konikow 1995) that there is insufficient evidence to assume that matrix diffusion plays an important role in retarding radionuclides in the Culebra. It is Konikow’s (1995) opinion that field tests performed to date are ambiguous, that diffusion parameters have not been adequately characterized in laboratory tests, and that the nature of the fractures in the Culebra are not known sufficiently well to formulate a representative model.”

From the two definitions of karst included in this section, we can see that flow velocities in karst channels tend to be much faster than in porous media, becoming progressively faster as more and more rock is dissolved by the fast moving water. We can also appreciate the difficulty of detecting the discreet karst channels. According to EPA’s final rule, the Rustler, Culebra member, is considered as the primary ground water pathway for radionuclides. In SEIS-II we read that, though analysis shows that contamination will reach the Culebra, “transport modeling showed that only very small amounts of contaminants would migrate from the point of release over 10,000 years.” If, however, there is no matrix diffusion in the Culebra, according once again to SEIS-II, then radionuclides could reach the WIPP boundary in 100 to 1000 years. Obviously, there is very little, if any, matrix diffusion in karst, as defined by A. G. Franklin et al. in the first paragraph of this section.

II. Evidence Of Karst At WIPP

The following quotes are from Larry Barrows, “WIPP Geohydrology – The Implications of Karst”, 5-20-82, pp. 2-4, EEG-32, app A:

“A literature review places the WIPP site within one of the largest karstlands of the United States. Davies and LeGrand (1972) and LeGrand, Stringfield and LeMoreaux (1976) both summarize the important karstlands of the U.S. and include the Pecos Valley of southern New Mexico in their
discussions. The maps in these articles (p. 470 and p. 36 respectively) indicate the WIPP site lies within an extensive karstland. A similar map is reproduced in Milanovic (1981, p. 15) and in slightly more detail in Davies (1970, p. 77)."

"Morgan (1941) ... notes that over large areas the surface drainage systems have been completely disrupted by development of subterranean drainage through solution channels. The WIPP site is indicated by his map (Fig. 1, p. 28) as lying in one of these areas."

"More recently Gustavson, Hoadley, and Simpkins (1981) ... maps place the WIPP in a karstland."

"G. O. Bachman has conducted extensive investigations of the surface geology of the Los Medanos area to support geologic feasibility studies of the WIPP. The results of this field work ... are in Bachman (1980). This report describes dissolution and karst development in the Permian evaporates of the Pecos drainage in the Delaware Basin (including the WIPP site).... Here and in Bachman (1974), it is suggested that the rate of karstification is dependent on climate with more rapid dissolution and collapse during humid intervals and active fields of windblown sand during arid intervals. The result is an extensive, partially-buried karst plain."

"... Presently active dissolution of gypsum from the Rustler Formation has resulted in numerous collaps (sic.) sinks, caves, and tunnels, in a complex karst topography...."

"The evidence for regional karstification is extensive, and there is no reason to preclude karst conditions from the immediate vicinity of the Wipp site. The following observations indicate that the karst conditions do exist at the site:
- the Rustler Formation isopach
- solution-controlled anisotropic heterogeneous vugular porosity
- closed topographic depressions
- the WIPP 33 cavities
- the gravity field
- lack of surface runoff
- the water balance."

Dr. Larry Barrows elaborates on each of the above points on p. 5-11. He is a geohydrologist who was employed by Sandia National Lab (SNL) and was a prominent member of the SNL team that investigated the WIPP site. His conclusion (p. 11) is that "The WIPP site is reasonably described as a karstland."

On p. 17, Dr. Barrows also concludes, on p. 17: "Flow in the Rustler Formation is expected to be highly irregular in both space and time, through open channels with a minimum of filtration, and (under the right weather conditions) extremely fast." And "The Rustler Formation is not a reliable barrier to the migration of contaminated water."

Dr. Barrows interpreted a seismic reflection survey for SNL of the WIPP site during his time of employment as part of the SNL team, and saw irregularities in that survey which he interpreted as complex geological structures. Dr. Barrows also conducted a gravity survey of the WIPP site that revealed anomalies that he interpreted to be karst conduits. His three and a half years as an exploration physicist with Mobil Oil plus and education geared toward fieldwork very adequately prepared him to make these judgments. [Written Deposition Questions for Dr. Lawrence Barrows from Plaintiff Citizens for Alternatives to Radioactive Dumping, faxed to EPA Dec. 5, 2005].

Geomorphologist Dr. Richard Hayes Phillips also found evidence of karst at WIPP, given in "Cavernous Zones at the WIPP site," submitted to EPA Jan. 20, 1998. His conclusion is: "The Culebra, in most places, is highly fractured, and the effective groundwater flow paths are through the largest fractures." [para. 2]. He also concludes in "Rainwater Recharge at the WIPP Site," submitted to EPA Jan. 20, 1998 that "The WIPP site is located in one of the largest karstlands in the world" [para. 4] and then explains in this report how karst hydrology is active today at the WIPP site.
In 1998, Dr. David T. Snow "calculated a transmissivity of 330 square feet per day [in the Magenta].... This was four times higher than any transmissivity ever reported at any well in any Rustler aquifer within the WIPP site, and it was very near the waste panels.... This evidence was uncontested." [Dr. Richard Hayes Phillips, Affidavit, July 2004, faxed to EPA on Dec. 5, 2005]. According to a conversation between Janet Greenwald and Rick Boheim on Dec. 1, 2005, this figure remains uncontested to this day.

In the report by Drs. Phillips and Snow, "A Conceptual Model for Contaminant Transport in Karst Aquifers at the WIPP Site," under the section "Application of Karst Model to WIPP Site," they list on p. 10-20 evidence of karst at the WIPP site, as well as reasons why karst cannot be ruled out. Following are conclusions and highlights from that report. Though we believe that this report was previously submitted to EPA, we cannot find the date of that submission and have therefore sent it to Sharon White by FedEx on Dec. 2, 2005.

1. The Rustler aquifer, as a whole, is unconfined. It is one complex aquifer with five members and can only be understood in three dimensions. Water levels in some WIPP test wells are free to rise and fall in response to variations in recharge. This is the hallmark of an unconfined aquifer....

2. The Magenta and Culebra dolomite members of the Rustler Formation may be considered partially confined.... At H-6, in the northwestern corner of the WIPP site, the Culebra and Magenta hydraulic heads are known to be equal, indicating a hydraulic connection through the Tamarisk member....

3. There are localized occurrences of perched water at the WIPP site, indicating the presence of underlying beds which are impermeable locally, but not generally.... Perched water in both the Santa Rosa and Dewey Lake formations is fresh enough to be attributed to rainwater recharge, and its inconsistent occurrence indicates that, elsewhere, the water drains to the water table.

4. The position of the water table at WIPP is unknown. For this reason, it is not known where the Magenta and Culebra are confined and where they are unconfined....

5. Effective porosity in the Rustler Formation is unknown. Fracture pores and solution channels are not well described, nor do we know their orientations....

6. Karst aquifers are heterogeneous and anisotropic. Transmissivity varies with position and direction. Within the WIPP site, measured Culebra transmissivity varies by nearly three orders of magnitude.... Within one mile of the WIPP site, Culebra transmissivity varies by more than five orders of magnitude....

7. The hydraulic gradients along the ground water flow paths at the WIPP site are unknown.... neither the flow directions nor the hydraulic gradients can be stated with certainty....

8. Groundwater flow in karst, especially in the phreatic zone, tends to be convergent.... This can be seen along the southeasterly flow path, where the Culebra heads reported by Lappin (1989) ... are equal and are lower than the Culebra heads in the surrounding test wells.

9. Within the WIPP site, most of the infiltrating rainwater is funneled not through sinkholes, but through a perforated caprock of Mescalero caliche. Once beneath the caliche, the water is protected from evaporation and finds its way to vadose feeder channels in the Dewey Lake Redbeds."

10. The authors explain vadose flow and the corresponding structure in the Dewey Lake Redbeds and concludes: "This is entirely consistent with the concept of vadose flow following the structural dip, collecting as perched water in a structural depression, and finding its way downward through feeder channels under the control of gravity. West of the WIPP site the Dewey Lake Redbeds dip westward at about 50 feet per mile; here the vadose flow would be westward, directly toward Nash Draw."

11. The authors explain concept of phreatic flow and the structures in the Rustler and concludes: "This is consistent with the concept of karstic phreatic flow primarily through the Rustler dolomites, and secondarily above the Rustler mudstones, not because the flow is full confined, but because these are the most permeable strata, the paths of least resistance."

12. When flow along the northwesterly path reaches WIPP-13 it becomes unconfined. ... The calculated transmissivity along the flow path between WIPP-13 and WIPP-25 was much higher (650 sq. ft. per day) than the transmissivities calculated at the individual wells (69.0 sq. ft. per day at WIPP-13, 270 sq. ft. per day at WIPP-25). This reflects the presence of a zone
with extremely high transmissivity between WIPP-13 and WIPP-25, most likely the caverns at WIPP-33, all of which are higher than the Culebra…

13. The authors give more observations at the WIPP site, concluding “Thus the observations are consistent with the karst model.”

14. Describes groundwater discharges, concluding “Large, transient groundwater discharges from a few springs is one of the classic characteristics of a karstland.”

15. Will be cited under “Inadequate Investigation.”

16. Describes fluid velocity and concludes: “Thus the groundwater travel time along the northwesterly flow path from the WIPP shafts to Laguna Grande de la Sal could be as short as 10 years using our estimates of karst geometry, or as long as 400 years using DOE’s geometry, but never 10,000 years.

17. Thus the travel time along the southeasterly flow path from the WIPP shafts to the WIPP site boundary could be as short as 15 years using our estimates of karst geometry, or as long as 200 years using DOE’s geometry, but never 10,000 years.”

18. Will be cited under “Inadequate Investigation.”

19. Outlines how radionuclides could travel to the Pecos River, and “it is here and downriver that actual victims would be affected.”

Dr. David Snow, in another report, “Unsafe Radwaste Disposal at WIPP,” sent by email Dec. 2, 2005, states “Uncertain regional boundary conditions and a great range of transmissibilities across the site leave doubts about the paths and destinations of contaminants that may escape the repository, thus uncertainties of the time to reach outlets or the nearer accessible environment, nominally the subsurface limits of the LWA.” [Section titled The Hydrogeologic Setting of WIPP, last sentence], faxed to EPA on Dec. 5, 2005. “Some fractures extending up from the repository will not anneal, but because of movement and flow, will remain open for gas and brine leakage during the years of pressurization by closure and gas generation.” Contaminated Brine Discharge from the Repository, para. 1, last sentence].

“…There is currently a concentrated leakage occurring into the Construction and Salt handling Shaft, from the top of Dewey Lake Redbeds at 20 to 70 ft. in depth, thence into the repository, believed to arise from the runoff at the parking lot. In European potash mining experience, such incipient karstic shaft leakage has been found to be irreparable. The first drop of water signals the eventual flooding of the mine.” Dr. David Snow, “Unsafe Radwaste Disposal at WIPP,” Contaminated Brine Discharge from the Repository, para. 3].

Geologist Carol Hill, in her September 1999 unpublished report contracted by the DOE, “Intrastratal karst at the WIPP site,” states “Many indirect lines of evidence suggest the possible presence of karst: surface topographic depressions, negative gravity anomalies, lack of surface runoff, collapse breccias, insoluble residue horizons, WIPP-33 sinkholes and caves, anomalous drawdowns, and salinity variations within boreholes. Using karst principles and this evidence, a hypothetical model has been constructed of how intrastratal karst might ‘work’ at he WIPP site. This karst, if it exists, would bypass slow matrix flow in the Culebra Dolomite aquifer and be subject to fast flow in cave conduits.” [Abstract, para. 1].

In 5.1.1, Hill states that karst would have no impact if WIPP is completely sealed off. The question arises whether it is possible to completely seal off the WIPP repository when water is already flowing down the exhaust shaft. Hill concludes in 5.1.2: “If the WIPP shafts are kept open, then karst might have an impact on the transport of nuclear waste out of the system.”

In 5.2, Hill states “The impact of karst on the second DOE hydrologic criteria [it must be shown that water cannot escape via some aquifer unit should an accidental break of the repository occur] is significant because if karst does exist at the WIPP site, it means that the Culebra is not the aquifer by which most of the water is discharging from the system.”

In the 7-page report by Richard Hayes Phillips, “Supplement to CARD Rebuttal to DOE Response to CARD Comments”, Dr. Phillips outlines (see report headings) evidence of karst at H-6, at H-3, and in the exhaust shaft. He also lists 12 indications of karstic areas that showed up in the early WIPP site resistivity
survey, which was done when the WIPP site was still known as the Los Medanos site. [faxed to EPA Dec 5, 2005.]

In the 8-page report by Dr. David Snow, “Unsafe Radwaste Disposal at WIPP”, he shows “that the Rustler formation overlying and down-gradient of the WIPP repository will not provide the claimed geologic containment because karst conduits are present that will facilitate rapid, ephemeral flow. If disposal is not halted and timely rectified, escaping radioactivity may reach Nash Draw within a thousand years, contaminating the Pecos River and Rio Grande.” [Summary], faxed Dec. 5, 2005.

III. Evidence Of DOE’s Inadequate Investigation Of Karst At WIPP

The following quotes are from the Phillips and Snow report, 2005, “A Conceptual Model for Contaminant Transport in Karst Aquifers at the WIPP Site,” (sent to EPA by FedEx on Dec. 2, 2005) under the section “Application of Karst Model to WIPP Site”:

“While the rise in Magenta and Culebra water levels cannot be correlated with individual rainstorms, it can be correlated with short-term trends in precipitation. Such a short-term response can only occur due to downward infiltration of rainwater through all overlying strata. All must be transmissive to recharge. DOE has made no measurements of rainwater recharge, and relies instead on measurements of permeability to estimate vertical transmissivity.” [p. 10, #1].

“DOE should have located and characterized the connecting channels through the Tamarisk, but has not done so.” [p. 11, #2].

“Failure to define the water table is a fatal flaw in hydrogeologic characterization.” [p. 11, #4].

“DOE has no measurements of porosity in regions of the Rustler transected by solution conduits, and therefore does not know the effective porosity, nor therefore the velocity of transport. Nor has Doe demonstrated the effectiveness of matrix diffusion in karstified areas; the conservative assumption is that radionuclides will travel at the speed of water in channel flow.” [p. 12, #5].

“The [transmissivity] data cannot be treated as random variables, as DOE has done in its stochastic performance assessment…. Transmissivity data in karst cannot be averaged or interpolated between data points. The Discontinuous nature of the conduit system violates the mathematical assumption that transmissivity (T) is continuously verifying.” [p. 12, #6].

“DOE, in its performance assessment (CCA, Table TFIELD-2) has selectively used calculated transmissivities at the low end of the scale, especially within one mile of the center of the WIPP site (Table 3). The result of such selective presentation of data is to completely misrepresent the transmissivity field at the WIPP site. DOE’s model assumes a continuous swath of low transmissivity across the WIPP site (Figure 2), when the highest calculated transmissivities show a continuous swath of high transmissivity across the WIPP site (Table 3). Use of the highest measured values of transmissivity is both realistic and conservative.” [p. 13, #6 cont’d.].

“The data set for hydraulic heads in the Magenta is incomplete, because DOE does not recognize the importance of the Magenta to ground water flow in the Rustler. DOE has proceeded on the assumption that the Culebra is a confined aquifer…. Consequently, we do not know where the Culebra is confined and where it is not, nor what is the full extent of the aquifer. … We have found eight examples of test wells where DOE’s assumed values are clearly in error.” [p. 13, #7]. See A-6.

“DOE, in its performance assessment, assumes that all flow is through a confined Culebra dolomite aquifer with only steady matrix and fracture flow. All of DOE’s data collection was based upon this assumption, inadequate for the purpose of modeling because it neglects the extreme heterogeneity and transient behavior of a karst. DOE has never characterized the orientations, spacings, and apertures of fractures in the Rustler Formation or they would have
discovered the dissolution conduits. Without knowledge of the apertures of fractures or solution conduits it is not possible to make reliable calculations of transport or radionuclides.” [p. 15, #15].

“DOE has computed travel times over shorter paths (just to the compliance boundary, not Nash Draw) that are two to three orders of magnitude greater. The reasons are: (1) that they have used synthetic head data that reflect much of the drawdown to the shafts, giving low gradients; (2) that they have used minimum values of conductivity, instead of the highest values appropriate to karst conditions; and (3) that they have used recharge rates commensurate with the minimized conductivities, 0.2 to 2.0 mm/yr, whereas evidence given below suggests recharge rates close to 18 mm/yr. DOE’s recharge rate was determined by what would calibrate their distorted model.” [p.19, #17 cont’d.]

“Based on these unwarranted assumptions, DOE concludes that thousands or tens of thousands of years are required for infiltrating rainwater to reach the Rustler Formation and, consequently, that an equivalent amount of time is necessary to drain the Rustler aquifer. These assumptions are not based upon measured data, are inconsistent with the regional water balance, and cannot account for the 580,000,000 cubic feet/year of naturally occurring groundwater evaporating from Laguna Grande de la Sal. Any calculations of infiltration or groundwater travel times which are inconsistent with these magnitudes based on a water balance must be wrong.” [p. 19, #18].

“The standard methodology for identifying flow paths and measuring travel times in karst aquifers is through the use of fluorescent dyes or other tracers. This method should have been used, and still could be used, at WIPP.” [p.19, #19].

“Unless monitoring wells intercept the karst conduits, contaminants in groundwater can bypass an array of monitoring wills and remain undetected until discharging at distant springs. In the case of WIPP, this could mean that failure of containment would go unrecognized until much of Nash Draw is contaminated.” [p. 20, #19 cont’d.]

Dr. David Snow, in his report “Unsafe Radwaste Disposal at WIPP” (sent by fax to EPA Dec. 5, 2005) adds further evidence.

“Because adequate containment conditions were not proven at the WIPP site, the facility does not make the case for safe geologic disposal.” [Introduction, para. 2.]

“DOE has maintained a mission-oriented relationship with its consultant, Sandia National Laboratories. Consequently, serious faults in the investigations have been perpetuated from the early 1980s thorough the 1996-1998 certification period.” [Introduction, last sentences].

“Scrutiny reveals that underlying the mathematical elegance and the comprehensive array of data manipulated are numerous assumptions, many of which have over-riding significance to the results. Some of the hydrogeological assumptions violate the perceptions of qualified critics, such as Anderson, 1978, Ferrall and Gibbons, 1980, Barrows, 1982, Snyder, 1985, Phillips, R. H., 1987, Snow, 1998 and Hill, 1999, and arguably differ from actual conditions. Management has exerted its will to succeed in the licensing process, influencing the scientific staff to adopt models and select studies favorable to Doe’s objectives, biasing the results of PA.” [Performance Assessment].

“…[It is] indicated (by PA) that the undisturbed scenario poses no hazard of a significant breach or accumulation beyond the accessible environment. The fallacy of that conclusion stems from a misconception of the behavior of the Salado overburden. … DOE has assumed roof fractures extending upwards only to marker Bed #138, but as creep subsidence incorporates whole panels and then the repository width, horizontal slip and openings will occur on successive higher clay seams, most bounding stiff anhydrites.” [Contaminated Brine Discharge from the Repository, para. 1].
"What is significantly wrong with the model is that it assumes no fracture conduits reaching high above the panels. ... Because of the non-conservative assumption that the Salado is structureless, and consequently because the rock mechanics model is unrealistic of long-term subsidence, the conclusion from PA calculations that the undisturbed scenario is innocuous has to be wrong. Histories and subsidence behavior of the analogous Salado interval above the McNutt horizon at nearby potash mines of Eddy County, NM could have been studied, reported and modeled, to derive more realistic WIPP-site subsidence predictions. ... WIPP modeling employed idealistic assumptions of continuous media, when discontinuous (fracture) properties would have been appropriate." [Contaminated Brine Discharge from the Repository, para. 2]."

The National Academy of Sciences WIPP Committee (Chapter 6 and Appendix F of Ref. 20) raised a number of issues regarding the conceptual model and numerical model of transport through the Culebra aquifer. These issues do not appear to have been addressed by the EPA in the certification decision." [EEG-83, "Identification of Issues Relevant to the First Recertification of WIPP, September 2002, 4.2 Radionuclide Transport Through the Culebra, para. 2].

The NM Environmental Evaluation Group (EEG) describes those issues in detail in the 1998 EEG report by D. F. Rucker, "Sensitivity Analysis of Performance Parameters used in Modeling the WIPP." The issues are summarized in EEG-83: heterogeneity and model discretization (4.2.1), heterogeneity of other transport parameters and process (4.2.2), sampling procedures for input parameters (4.2.3), consistency between performance assessment (PA) models (4.2.4), and other concerns about the Culebra parameters and processes (4.2.5).

Geologist Carol Hill’s September 1999 unpublished report contracted by the DOE, “Intrastratal karst at the WIPP site,” lists in her abstract and elaborates in section 6, “Deliverables,” suggestions for evaluating the potential of karst at the WIPP site. Those suggestions relate to methods that have not yet been applied: “(1) inventory the caves near the WIPP site, (2) detect cave passages along the edge of the WIPP ridge by using geophysical techniques, (3) set up precipitation monitoring stations along the Nash Draw drainage system and hydrographs at the Malaga Bend (and other) springs, (4) measure the permeability of the anhydrite/dolomite contact zone, (5) perform conduit-flow modeling, and (6) apply a ‘total karst systems approach’ to the WIPP site.” Hill concludes: “Intrastratal karst has been an underestimated dissolution mechanism in WIPP studies, one which could affect DOE guidelines for the safe disposal of nuclear waste at the WIPP site.” [Abstract].

IV. DOE Coercion Of Scientists, Obfuscation Of Scientific Reports, and Use Of Non Conservative and Falsified Data

A. Coercion of Scientists - Dr. Lawrence Barrows

Dr. Lawrence Barrows was well qualified to interpret gravity surveys when he joined the WIPP site investigation team at Sandia National Laboratories in the early 1980’s. He had been an exploration geophysicist with Mobil Oil for 3½ years, with a previous year of schooling specifically focused on gravity and magnetic methods of explorations. He conducted a gravity survey of the WIPP site that revealed anomalies that he interpreted as karst conduits, (written deposition “Questions for Dr. Lawrence Barrows from Plaintiff Citizens for Alternatives to Radioactive Dumping”, on Nov 18, 2000, questions 5-7, faxed to EPA on Dec. 5, 2005)

He soon after wrote a paper for DOE, “The Implications of Karst”. Though both of his interpretations and the Implications of Karst were unpublished by DOE, EEG later published “Implications...” in EEG-32, App. A.

During the time of his employment at SNL, Southwest Research and Information Center SRIC made a FOIA request to SNL concerning geological and hydrological information at WIPP. Dennis Powers,
Barrows supervisor, in Barrows presence, said that he would not send SRIC Barrows interpretation of the gravity survey. (ibid, question 8)

During the time of his employment at SNL, in his presence, a geophysicist employed by Bechtel Corporation protested that Bechtel erased faults that he had drawn in its maps of the WIPP site. (ibid, question 10)

After Barrows transferred from the WIPP site investigation team, he received phone calls from his former co-workers, saying that they had been told by Wendel Weart, not to use the word “karst”. (ibid, question 13)

These events occurred at a time when the DOE was making crucial decisions about where and to what depth test wells should go.

B. Obfuscation of Scientific Work – Dr. Roger Anderson

The following quotes come from “Summary of Dr. Roger Y. Anderson’s Position on WIPP”, using excerpts from his website (HTTP://www.unm.edu/wryand/otherwipp/otherwipp3.html), faxed to EPA on Dec. 5, 2005

“I was taught, or at least I have come to believe, that scientific thinking differs from other kinds of thought in two ways. The first is in making a serious effort to remain objective and credible no matter what the consequences. The second way is in trying to prove that a brilliant idea (hypothesis) that just came into your head or someone else’s head is wrong. When I joined the WIPP project in 1975 Wendell Weart was the boss, and the brilliant idea (hypothesis) was that the site in New Mexico they had chosen for WIPP, was a good place to dispose of nuclear waste. My job, as I saw it, was disproving the hypothesis.”

“One Flagrant abuse of science is the attempt by WIPP science managers to deny the presence of dissolution above the WIPP repository. The predicament arose when the original site for WIPP was abandoned and WIPP was moved to its present location 8 miles farther to the west. Extensive dissolution at the new site meant that it was difficult to understand and predict the hydrology of the Rustler aquifer and to assure its long-term stability.”

“DOE science managers simply denied the existence of dissolution at the new site. In important ways this falsehood is very serious because it involves more than simple scientific error. The results of previous geologic investigations, reviewed and published long before the WIPP site was selected, demonstrated that a regional front of salt dissolution had passed over the area and removed substantial thickness of salt from the Rustler Formation. To head off this evidence WIPP science managers asked in-house geologists to prepare a new report. The new report dismissed the previous evidence, claimed that little or no salt had been removed by dissolution, and offered the opinion that the site had been stable for millions of years. A State geologist who had conducted his own investigation of the problem was outraged and the State hired an independent expert with superb credentials to review the defective report. The expert concluded that the original geological studies were correct. There is abundant evidence for dissolution.”

“DOE used the spurious report to support its claim of site stability, citing the document 14 times in the EIS. The bogus report was brought to the attention of the EPA but that agency has accepted DOE’S citations and conclusions. Reliance on a scientific report that is demonstrably false shows what can happen to the truth, even peer-reviewed truth, when the stakes are high enough.

Again, Dr. Anderson’s tale of the Obfuscation of scientific information takes place at that crucial time in the WIPP site investigation history when decisions were being made as to where and to what depth to site test wells. We have attached Dr. Anderson’s resume to the “Summary…”, faxed Dec. 5, 2005.
C. Use of Non Conservative Data


“DOE considers that 10 ft²/day is a high transmissivity. In the Culebra dolomite, measurements higher than 10 ft²/day have been reported at ten of fifteen locations within 1.5 miles of the waste panels. These include the ERDA-9 test well (22.0 ft²/day) and the WIPP exhaust shaft (28.0 ft²/day) at the center of the WIPP site, and the H-1 test well (20.0 ft²/day) directly above the waste panels. Yet the DOE assumes low transmissivities, no greater than 2.2 ft²/day, at all but one of these fifteen locations, the lone exception being DOE-1 (11.0 ft²/day), located 1.1 miles southeast of the waste panels, where transmissivity of 33.0 ft²/day has been reported”.

“The net effect of such selective representation of data is to completely misrepresent the transmissivity field at the WIPP site.”

D. Use of Falsified Data

See ‘V’.

V. Concerning the “Magenta Transmissivity Fact Sheet”

MAGENTA TRANSMISSIVITY FACT CHECK

Richard Hayes Phillips, Ph.D.
December 5, 2005

I, Richard Hayes Phillips, Ph.D., geologic consultant to Citizens for Alternatives to Radioactive Dumping (CARD), stated in an affidavit dated June 1, 2000, and submitted to the United States District Court, that the 1983 decision by the Department of Energy (DOE) to stop investigating the Magenta dolomite as a potential pathway for groundwater contamination from the Waste Isolation Pilot Plant (WIPP) was based upon falsified hydrologic data pertaining to the H-3 test well; that these data were altered by Jerry Mercer, then a hydrologist with the United States Geological Survey (USGS) and presently employed by Sandia National Laboratories; and that this data falsification allowed DOE to ignore the Magenta, even though it is the most transmissive aquifer in the immediate vicinity of the WIPP waste panels. Finally, more than five years later, CARD has received a written response from DOE. The response, dated October 24, 2005, is entitled “Magenta Transmissivity Fact Sheet.” This statement is a rebuttal to what DOE has put forth as “fact.”

The DOE “concluded that there was no basis to believe that data important to the long-term performance of WIPP had been compromised.” I disagree. It is evident that the compromised data is extremely important to the long-term performance of WIPP.

The DOE begins its response with an unwarranted assumption, stated categorically: “The Culebra lies below the Magenta (closer to the repository level) and is more transmissive.” (emphasis added)

This is not everywhere the case. For example, at WIPP-33, located 2853 feet west of the WIPP site, two open, water-filled caverns, measuring 2 feet and 5 feet from top to bottom, were found in the Magenta; none were found in the Culebra. At WIPP-13, located within the WIPP site, 8611 feet northwest of the center, the Magenta is broken and shattered by numerous steeply dipping fractures, as described in the lithologic log and confirmed by photographs of core. At H-3, located 3198 feet south of the center of the WIPP site, within 400 feet of the WIPP waste panels, a Magenta transmissivity of 330 ft²/day was calculated by CARD, based upon inflow and drawdown measurements published in 1978 by Sandia National Laboratories (SAND 78-1596, p. 6-53 and Table
This is nearly four times higher than at H-6, where the highest Culebra transmissivity (88.0 ft²/day) within the WIPP site was reported; and H-3 is much closer to the WIPP waste panels.

DOE concedes that in the Performance Assessment (PA) for its Compliance Certification Application (CCA), the document of record that convinced the Environmental Protection Agency (EPA) to certify the WIPP site, none of the breach scenarios considered the consequences of contaminated brine rising to the level of the Magenta dolomite. DOE explains its failure to do so with the same unwarranted assumption, stated categorically, that the Magenta "in any case is less permeable (than the Culebra) and would offer more resistance to outward flow."

DOE contends that my "allegation of data falsification and misdirection of the WIPP hydrology program is utterly erroneous." DOE points to two wells "tested AFTER Mercer made his revisions" (capitalization in original), for which the "correct values" of 53 ft²/day and 375 ft²/day "were accurately reported in Mercer's 1983 USGS report." (USGS W-RI 83-401, Table 7, p. 105) DOE later states that "far from concealing the true range of Magenta transmissivity values as alleged by Phillips, the USGS openly expanded the range as additional data became available." This is a deliberately misleading statement. DOE does not identify these two wells or state their location. The two wells are WIPP-27 and WIPP-25, respectively. Neither one is located anywhere near the WIPP site. Both are located within Nash Draw, one of the largest surface karst features in North America, where extremely high transmissivity would be expected at any test well. The issue at hand is Magenta transmissivity within the WIPP site, specifically at H-3, located only 400 feet from the WIPP waste panels.

In fact, Mercer's Table 7 was attached to my affidavit. I am well aware of these data. It is interesting to note that at WIPP-25, located 2.00 miles west of WIPP-33, the Culebra transmissivity reported by Mercer is 270 ft²/day, compared to 375 ft²/day in the Magenta (USGS W-RI 83-401, Table 7, p. 105). This is yet another location where the Magenta is more transmissive than the Culebra.

In addressing the basis of the allegations contained in my original affidavit dated June 1, 2000, DOE does not deny that Jerry Mercer revised the transmissivity range for the Magenta dolomite from 1-40 ft²/day to .0001-1.0 ft²/day. DOE fails to mention that these data refer to the range of transmissivity within the WIPP site. As no field measurements have ever been published justifying the reported values of 40 ft²/day or 1.0 ft²/day, I stated in my affidavit that Mercer's handwritten alteration was an "act of data falsification (that) has steered the entire WIPP hydrologic investigation in a false direction, allowing the DOE to completely ignore the most transmissive aquifer in the immediate vicinity of the WIPP waste panels."

DOE now claims that the bailing test performed at the H-3 test well in April 1977, from which the Magenta transmissivity of 330 ft²/day was calculated, is unreliable because "a packer placed in the well to isolate the Magenta from the more transmissive Culebra was leaking during the bailing test..." One more time, DOE makes the categorical statement that the Culebra is more transmissive than the Magenta, as if this were everywhere the case. Moreover, there is no paper trail to support the interpretation that the packer was leaking. DOE then states that "the leaking packer was replaced and a slug test was performed on the Magenta. The data from this test have never been published, but the test was interpreted by the USGS, and reported to show a transmissivity of 0.1 ft²/day in a 1983 report by Mercer."

In my affidavit dated June 1, 2000, I traced the steadily diminishing Magenta transmissivity reported for H-3, from 40 ft²/day (Powers et al., 1978, SAND 78-1596, p. 6-36) to 2.0 ft²/day (Mercer and Orr, 1979, USGS, W-RI 79-98, p. 162) to 0.1 ft²/day (Mercer, 1983, USGS W-RI 83-401, Table 7, p. 105). Contained in the first two of these reports are the very field measurements of inflow and drawdown that result in our correctly calculated transmissivity of 330 ft²/day. I correctly stated that there is no published field data supporting any of the three reported values. DOE has had more than six years to locate and publish these data, and still has not done so.
Indeed, DOE admits that "No analysis of data collected in April 1977 is documented in any USGS report," including the 1978 report by Powers et al. (SAND 78-1596) where the data was first published, and in which the maximum Magenta transmissivity within the WIPP site was said to be 40 ft²/day. DOE admits that Mercer and Orr, in their 1979 report (USGS, W-RI 79-98) in which the Magenta transmissivity for H-3 was said to be 2.0 ft²/day, provided "no indication of the test from which the H-3 value was derived, or the method used for its derivation." DOE admits that Mercer, in his 1983 report (USGS W-RI 83-401) in which the Magenta transmissivity for H-3 was said to be 0.1 ft²/day, gave "no indication of the source of the data." DOE can only point to a semilog plot of water-level recovery data following the bailing test of April 1977 which "may be" the source of the 1978 and 1979 "data," and to a semilog plot of data from a slug test performed at H-3 in May 1979 which "appears to be" the source of the 1983 "data." These semilog plots are said to be in the USGS files. Neither one has ever been published.

DOE also states that Beauheim et al. (1991, SAND 89-0869) retested the Magenta at H-3 in 1989 and "inferred" transmissivity values between 0.14 ft²/day and 0.18 ft²/day. DOE does not advise its readers that, beginning in October 1983, H-3 was expanded to an array of four test wells. The original test well is now known as H-3b1. The other three wells, called H-3b2, H-3b3, and H-3b4, are located 100.2 feet, 101.2 feet, and 31.8 feet, respectively, from H-3b1. DOE does not reveal at which well the 1989 test was performed. This is important because, in a karstland, groundwater flows primarily through conduits and channels in otherwise relatively impermeable rocks. A well that taps a connection with a karst conduit system may produce very large quantities of water, orders of magnitude higher than those of a well drilled into an unfractured block of dolomite only a few meters away. Photographs of core at H-3b3 show two broken and shattered intervals in the Magenta dolomite, while the lithologic log for the Magenta at H-3b2 describes no fractures at all.

DOE describes the 1977 bailing test at H-3 in some detail. Thirty bailing runs were made in the well, removing 360 gallons of water and causing the water level to drop 6 feet. These are the data reported at SAND 78-1596, p. 6-53 and Table 6.3-4, and at USGS, W-RI 79-98, p. 52, from which our calculated transmissivity of 330 ft²/day was derived. Later monitoring showed the Magenta water level (presumably meaning the fresh water hydraulic head) to be about 250 feet below land surface, and the Culebra water level to be about 405 feet below land surface. More specifically, these levels were reportedly 245.1 feet and 404.5 feet below land surface (Powers et al., 1978, SAND 78-1596, p. 6-53). DOE states that the 6-foot drawdown observed during the bailing test was from 405.1 to 411.1 feet below land surface; these data were published by Mercer and Orr (USGS, W-RI 79-98, Table 12, p. 52). Given that the water levels measured at the time of the test were "typical of the Culebra, not the Magenta," DOE "surmises" that the packer separating the Magenta from the Culebra was leaking during the test. However, it is possible that the reported hydraulic head for the Magenta, for which no supporting evidence is given, is incorrect; that the Magenta and Culebra are interconnected at H-3, and their hydraulic heads are equal, as they are at H-6 and WIPP-13.

According to Powers et al. (1978, SAND 78-1596, Table 6.3-4), H-3 was a cased well with specific intervals perforated during the bailing tests (562-590 feet below land surface for the Magenta, and 675-703 below land surface for the Culebra). Whereas the fluid yield during the Culebra test was only 200 gallons per day, the fluid yield during the Magenta test was 360 gallons in one hour, or 8640 gallons per day. If the inflow measured during the Magenta test was really coming from the Culebra, as DOE now "surmises," there should have been a similar inflow during the bailing test when the well casing was deliberately perforated in the Culebra interval. And even if the inflow during the Magenta test did not come from the Magenta, it did come from somewhere. Field measurements at H-3 equate to a transmissivity of 330 ft²/day, nearly four times higher than the highest reported transmissivity for any member of the Rustler Formation anywhere within the WIPP site. This is of critical importance, because H-3 is located only 400 feet south of the WIPP waste panels.
It is important to note that at H-3 the top of the Rustler Formation is 502 feet below land surface, whereas the water level in the well is stated by DOE to have risen as high as 401.3 feet below land surface. Thus the water table at H-3, insofar as there ever is a “water table” in a karstland, is 100 feet above the Rustler Formation, in the overlying Dewey Lake Redbeds. If the inflow during the bailing test at H-3 did not come from the Magenta, it could just as easily have come from the lower 100 feet of the Dewey Lake Redbeds as from the Culebra member of the Rustler Formation. Neither the Magenta dolomite nor the Dewey Lake Redbeds were modeled as potential pathways for migration of contaminated water in DOE’s Performance Assessment.

To my knowledge, transmissivity in the Dewey Lake Redbeds has been measured only at test well WQSP-6a, where a saturated fractured zone yielded enough water to result in a calculated transmissivity of 360 ft²/day (SAND 98-0049, p.193), remarkably close to the calculated transmissivity of 330 ft²/day at H-3. WQSP-6a is located 0.44 miles southwest of the WIPP waste panels, about 2000 feet from H-3.

The DOE’s Compliance Certification Application (CCA), the document of record that convinced the Environmental Protection Agency (EPA) to certify the WIPP site, is not a bounding analysis or a worst-case scenario. DOE treated the Culebra dolomite as the only potential pathway for transport of contaminated water from the WIPP site to the accessible environment, and modeled it in two dimensions as a confined aquifer bounded above and below by impermeable strata rather than in three dimensions as part of one complex karst aquifer. DOE completely dismissed the Magenta dolomite and the Dewey Lake Redbeds as potential pathways, despite the fact that the two highest transmissivity values calculated anywhere within the WIPP site were derived from tests conducted in the Magenta at H-3 (330 ft²/day) and in the Dewey Lake Redbeds at WQSP-6a (360 ft²/day). Both wells are located perilously close to the WIPP waste panels, about 400 feet away and 2300 feet away, respectively. The transmissivity value assumed in the CCA for H-3 was only 2.2 ft²/day. This is 150 times less than the reality. In fact, the highest transmissivity value assumed in the CCA for any well within 1.5 miles of the center of the WIPP site was 11.0 ft²/day at DOE-1. Thus the CCA bears no resemblance to reality. The EPA should recognize this and rescind its certification of the WIPP site unless and until DOE completes a realistic performance assessment.

VI. Conclusion

Out of 70 test wells at WIPP, only two are situated in areas that showed indications of karst. Why did this occur when the WIPP site is known to be in one of the largest karst lands in the world? Because DOE systematically coerced scientists, obfuscated scientific knowledge, used non-conservative data, and at last falsified data to make sure that the site investigation of the WIPP site did not consider the Rustler as a whole system, a system which is riddled with karst, making the WIPP site unfit for radioactive waste disposal.