# AGENDA

## 56th WIPP QUARTERLY REVIEW MEETING
November 26, 1996

Environmental Evaluation Group
7007 Wyoming Blvd. NE, Suite F-2
Albuquerque, NM 87109
505-828-1003

| | | | |
|---|---|---|---|
| 8:30 a.m. | Introduction | 10 min. | Matthew Silva |
| 8:40 a.m. | U.S. Department of Energy Status/Activity Report | 15 min. | George Dials |
| 8:55 a.m. | Environmental Evaluation Group Status/Activity Report | 15 min. | Robert Neill |
| 9:10 a.m. | NM Radioactive Waste Task Force Status/Activity Report | 15 min. | Chris Wentz |
| 9:25 a.m. | NMED Status Activity Report | 15 min. | Steve Zappe & John Parker |
| 9:40 a.m. | BREAK | | |
| 10:00 a.m. | Overview of the CCA | 105 min. | Jim Mewhinney, Peter Swift |
| 11:45 a.m. | LUNCH | | |
| 1:00 p.m. | Contents of the December 1996 Sensitivity Analysis Report | 120 min. | G. Basabilvazo, ~~Jon Helton~~ Peter Swift |
| 3:00 p.m. | BREAK | | |
| 3:20 p.m. | Treatment of Data in the CCA<br>Dewey Lake Redbeds<br>G-Seep Water | 30 min. | Rick Beauheim |
| 3:50 p.m. | Ground Water Basin Model | 30 min. | Tom Corbet |
| 4:20 p.m. | Closing Comments, Action Items, and Schedule Next Quarterly | 10 min. | |
| 4:30 p.m. | Adjourn | | |

961116

# 56th WIPP QUARTERLY REVIEW MEETING

November 26, 1996

Environmental Evaluation Group
7007 Wyoming Blvd. NE, Suite F-2
Albuquerque, NM 87109

## ATTENDANCE SHEET

| Name/Affiliation | | Address | Phone/Fax |
|---|---|---|---|
| MATTHEW SILVA/EEG | | 7007 WYOMING BLVD NE, F-2 | 505-828-1003 |
| W Lee | | " | " |
| Steve Zappe | NMED | PO Box 26110 Santa Fe | 827-1561 |
| S. P. Andersen | " | 2044-A Galisteo " | 827-1536 |
| Tom Tatkin | NMED | 2044A Galisteo Santa Fe | 827-1536 |
| John Parker | NMED | " | " |
| TOM CLEMO | EEG | 7007 WYOMING suite F-2 ALB | 828-1003 |
| [illegible] | [illegible] | [illegible] / NM | (505) [illegible] |
| [illegible] | | [illegible] | (415) 747-0441 |
| STEVE ALCORN | BATTELLE | RANDOLPH RD, ABQ, NM | (505)224-8025 |
| Bill Bartlett | EEG | AlBQ, NM | 828-1003 |
| Ben Walker | EEG | [illegible] N. Main Carlsbad NM | 505-885-9675 |
| Patricia Kilgore | CAO | P.O. Box 3090, Carlsbad | 505 234-7302<br>887-5419 fax |
| Jim Mewhinney | CAO | Carlsbad | 505 234 7480 |
| George Basabilvazo | CAO | Carlsbad | 505-234-7488 |
| Jon Helton | SNL | Alb NM | 505-848-0701 |
| Paul W. Eslinger | PNL | P.O.Box 999, Richland WA 99352 | 509-375-2775 |
| Rip Anderson | SNL | Sandia Lab | 505 848 0692 |
| Peter Swift | SNL | MS 1341 Alb. 87185 | 505 848 0699 |
| Kurt Larson | SNL | MS 1341 Alb. 87185 | 505 848 0862 |
| Cooper Wayman | CAO | 101 GREENE CARLSBAD | 505-234-7329 |
| Lokesh Chaturvedi | EEG | 7007 Wyoming NE, F-2<br>Alb NM 87111 | 505-828-1003 |

# 56th WIPP QUARTERLY REVIEW MEETING

November 26, 1996

## ATTENDANCE SHEET
(page 2)

| Name/Affiliation | Address | Phone/Fax |
|---|---|---|
| Lindsay Lovejoy - NM Atty Gen Off | P.O. Drawer 1508/SF | 505-827-6695 |
| Heidi Snow | NM Rad. Waste Task Force, 2040 S. Pacheco SF, NM 87505 | 505/827-1377 |
| Chris Wentz | " " | 505/827-1372 |
| Michael H. McFadden | DOE/CAO Carlsbad, NM | 505/234-7486 |
| George E. Dials | DOE/CAO " | 505 234-7333 |
| Robert H Neill | NM EEG | 505-828-1003 |
| Don Hancock | SRIC, PO Box 4524, Abq NM | 262-1862 |
| Tom Corbet | SNL ABQ | 505-848-0714 |
| Mel Marietta | SNL/CNM | 5052340054 |
| Rick Beauheim | SNL [illegible] | 848-0675 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Nov 26 1996

56th Quarterly

George Dials See handout

CCA CD Rom out in Mid December

~~#~~SEIS hearings Mid January SF/Alb.

? about mobile characterization - high priority, substantial cost savings. Use at small Q generators & certain large generator sites. Not sure how mobile char will be dealt with during "certification" process.

- Lokesh asked DOE to quantify risk to people due to existing waste. George responded the potential risk is a given. Perception of risk is individual

~~Bob Neill~~ - Bill Bartlett asked about treatment technologies - not required, but INEL needs it to deal with comingled Alpha LLW

Bob Neill See handout.

Definitions of RH TRU waste + defense waste apparently recently issued by DOE General counsel. George said it is guidance to the field, follows NWPA. Policy letter is final, guidance is draft. Will be provided to us when available (action item).

Report issued on brine flow from exhaust shaft. Lokesh concerned over moisture affecting monitoring at station A.

Chris Wentz. handout

SEIS hearings Alb 1/6-7 SF 1/8-10 Carlsbad 1/13

CAO doing citizens guide to CCA - issued in next couple of weeks

Steve - usual stuff - Lokesh asked about permit - didn't think it was for disposal, thought that's what NMVP took care of

John Parker introduced Tom & Scott

Jim Mewhinney CCA issued on 6 CDs - ~~#~~ one has regulations and original application, five of bitmaps copies of references.

# CCA Overview



Peter Swift

New Aspects of 96 PA: - complete QA, comprehensive scenario development (now includes mining), modeling improvements. Two slides show changes in PA process from 89 to 96. Sensitive parameters reduced to a few issues - either we know others, or now know they aren't as important.

Undisturbed - shaft seals assumed to be perfect ("very effective") - no transport thru shaft seal to top of salt. Migration thru marker beds. Flow up abandoned deep borehole (at boundary, not ERDA-9). CCDF is off scale. 9 out of 300 realizations had releases that were minor (Pu 239 $10^{-12}$ ci/l)

Disturbed now includes spallings & direct brine release, release to GW, drilling rate 46.8 boreholes/km$^2$/10,000 yrs (previously used up to 30). Also considered potash mining effects.

E1 E2 - main release to surface, secondary release to Culebra. Inventory assumed to at 2033. Major release from cuttings & cavings (occur every time there is an intrusion). Spallings occur half the time. Brine release has very small effect. Transport thru Culebra is neglible + not shown. Effective barrier via chemical + radiologic retardation, because properties are now well known.

Conclusions on Slide 17 - isolation effective even w/ multiple intrusions. Natural & engineered systems robust & well understood.

George Basabilvazo — Sensitivity Analysis overview - Appendix SA. Only concerned with parameters affecting direct releases. Sensitivity Analysis Report (out 12/96) looks at sensitivity of other dependent variables not related to total releases. App SA addresses EPA requirements. Sens. Anal Rept goes beyond

Peter Swift PA Modeling System & Sensitivity Analysis
Important processes in undisturbed performance - (1) brine inflow, (2) gas generation, (3) pressure - closely coupled
p 23 pressure builds up significantly in first 500 years
(lithostatic pressure ~15 mpa, hydrostatic ~8 mpa)
p25 Microbial gas (rubber/cellulose) generation is rapid, short lived (consumes all). Corrosion is long lived, doesn't consume all iron - limiting factor is brine availability.

More than half brine comes from DRZ, within first 150 - 200 years

Sensitivity Analysis

A) Repository Pressure / Gas Generation (1) probability of microbial degradation (2) Halite porosity (DRZ), (3) Corrosion rates

Doesn't take into account (for model) MgO consuming brine.
Discussion ensued as to whether this ommission (not modeling MgO / brine / microbial degradation interaction) led to more "conservative assumptions".

B) Brine inflow (1) probability of microbial degradation (2) anhy. perm, (3) Halite porosity (4) corrosion rate (5) Halite perm.

Disturbed scenario
Important parameters - drilling rate (constant), pressure
8 mpa is ~~c~~ cutoff for spallings & direct brine releases - (bore hole hydrostatic) If less than 8 mpa, nothing happens. If above volume of spallings f(particle size), brine is 2 phase flow.

Flow / transport in Culebra - flow fields / travel paths
mining impact - shift to west, slower paths. However, physical & chemical retardation prevent transport in Culebra

Tom Corbet 3D Regional GW flow in Culebra
SNL handout

Rick Dewey Lake / G-Seep - treatment in CCA
Beauheim handout

Next Quarterly 2/6 or 2/13
depending on WIPP EPA hearing -

**Department of Energy**
Washington, DC 20585

September 9, 1996

MEMORANDUM FOR: AL ALM
ASSISTANT SECRETARY
FOR ENVIRONMENTAL MANAGEMENT

GEORGE DIALS
MANAGER
CARLSBAD AREA OFFICE

FROM: ROBERT R. NORDHAUS
GENERAL COUNSEL

SUBJECT: Interpretation of the Term "Atomic Energy Defense Activities" As Used In the Waste Isolation Pilot Plant Land Withdrawal Act

## INTRODUCTION

The Department of Energy (DOE) is proposing to begin the disposal phase at the Waste Isolation Pilot Plant (WIPP), the nation's first deep-geologic nuclear waste repository, in 1998. A question has arisen concerning the meaning of the term "atomic energy defense activities" as that term is used in the Waste Isolation Pilot Plant Land Withdrawal Act (LWA), Pub. L. No. 102-579, 106 Stat. 477 (1992), to define the source of waste that may be disposed at WIPP. The purpose of this memorandum is to determine the scope of that term so that the Office of Environmental Management and the Carlsbad Area Office can provide technical guidance to the sites around the complex as to what transuranic (TRU) waste qualifies for disposal at WIPP.

## FACTUAL BACKGROUND

In 1979, Congress authorized WIPP as a "research and development facility to demonstrate the safe disposal of radioactive waste resulting from defense activities and programs of the United States." Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act (DOE National Security Act), Pub. L. No. 96-164, § 213 (emphasis added). On July 1, 1981, DOE agreed with the State of New Mexico to limit WIPP to the disposal of defense transuranic waste.[1]

---

[1] The Agreement for Consultation and Cooperation between DOE and New Mexico settled the litigation known as State of New Mexico v. Dep't of Energy, Civil Action No. 81-0363 JB. Among other things, the Agreement excludes "any radioactive waste generated by the commercial nuclear power industry" from its definition of WIPP eligible "defense waste." Article II - Definitions at E.

On October 30, 1992, Congress enacted the LWA, withdrawing the land surrounding WIPP for exclusive use by DOE and expressly defining WIPP's mission as the disposal of transuranic waste generated by "atomic energy defense activities:"

> The term "WIPP" means the Waste Isolation Pilot Plant project authorized under section 213 of the Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Pub. L. 96-164; 93 St. 1259, 1265) to demonstrate the safe disposal of radioactive waste materials generated by <u>atomic energy defense activities</u>.

Pub. L. No. 102-579, § 2(21) (emphasis added).[2]

DOE has historically defined the TRU waste eligible for WIPP as follows:

> <u>Defense waste</u>
> Nuclear waste deriving from the manufacture of nuclear weapons and operation of naval reactors. Associated activities such as the research in the weapons laboratories also produce defense waste.[3]

Recently, the Carlsbad Area Office has suggested, based upon its reading of the Atomic Energy Act of 1954 (AEA), 42 U.S.C. §§ 2011, et seq., that for purposes of determining what waste qualifies for WIPP, the term "atomic energy defense activities" as used in § 2(21) of the LWA could be interpreted to include any transuranic waste generated by any DOE atomic energy activity. Under the suggested interpretation, only TRU waste generated by the commercial nuclear power industry would be barred from WIPP, and that by operation of the 1988 Agreement between DOE and New Mexico, not by the definition in § 2(21). This suggestion is derived from a portion of the Congressional declaration of policy in the AEA at 42 U.S.C. § 2011(a) ("...the development, use and control of atomic energy shall be directed so as to make the

---

[2] TRU waste is waste that contains alpha particle emitting radionuclides with atomic numbers greater than that of uranium (92), and half lives greater than 20 years, in concentrations greater than 100 nanocuries per gram of waste. TRU waste is primarily generated by research and development activities, plutonium recovery, weapons manufacturing, environmental restoration, and decontamination and decommissioning projects.

[3] See, e.g., First Supplement to the WIPP Environmental Impact Statement (SEIS I) (1990) Glossary at 5. The SEIS I also recognized that "[t]he post-1970 generated TRU waste proposed to be disposed of at the WIPP results primarily from defense-related plutonium reprocessing and fabrication as well as defense-related research activities at DOE facilities." SEIS at GLO-5 and 1-1, 2-8. Most recently, the February 1996 Implementation Plan of the WIPP Disposal Phase Supplemental Environmental Impact Statement (SEIS II) defined defense waste identically to SEIS I. SEIS II, Glossary at vii.

maximum contribution to the general welfare, subject at all times to the paramount objective of making the maximum contribution to the common defense and security") and 42 U.S.C. § 2102(a) ("the development, utilization and control of atomic energy for military and for all other purposes are vital to the common defense and security").

The suggested interpretation would define WIPP-eligible waste broadly enough to make all TRU waste generated by DOE eligible for disposal and thereby free WIPP and the generator sites from the need to determine the origin of their TRU waste.

## CONCLUSION

The term "atomic energy defense activities" permits WIPP to dispose of defense TRU waste resulting from all of the noncivilian activities and programs of DOE, including weapons production, naval reactors, defense research and development, associated defense environmental restoration and waste management, and other defense-related activities, as defined more specifically in the Nuclear Waste Policy Act, from which the term was borrowed. The information available to the Office of General Counsel indicates that, as so understood, "atomic energy defense" TRU waste represents the overwhelming majority of the Department's TRU waste. On the other hand, neither the applicable statutory provisions, the legislative history or the Department's own historic interpretations of the term permit an interpretation of "atomic energy defense activities" that would extend WIPP's mission to the disposal of waste from DOE's purely civilian atomic energy activities and programs.

## ANALYSIS

The express terms of § 2(21) of the LWA indicate that Congress intended WIPP to provide for the disposal of waste from "defense" activities. If Congress intended that all TRU waste – from both the civilian and defense programs and activities of the Department – be eligible for WIPP, it could (and presumably would) have said had so. Indeed, in § 7(b)(5) of the LWA, Congress directed the Secretary to submit "recommendations for the disposal of <u>all transuranic waste under the control of the Secretary</u>...." (emphasis added). Application of the principle of statutory construction known by the maxim "*expressio unius est exclusio alterius*" suggests that where Congress uses a general term in one provision, here by providing for a report addressing "all" waste under the Secretary's control in § 7(b)(5), and limits another provision, here by restricting WIPP to waste from defense activities in § 2(21), Congress is deemed to have intended the limitation it expressed. On the other hand, Congress appears to have intended TRU waste from all of the Department's defense-related activities to qualify for disposal at WIPP.

The legislative history of both the LWA and the DOE National Security Act supports the conclusion that Congress did not intend to permit disposal of all of the Department's TRU waste at WIPP, but instead specifically intended WIPP to handle the Department's defense TRU waste.

A. The DOE National Security Act

Since the passage of the DOE National Security Act in 1979, WIPP's mission has been described as the disposal of "defense waste:"

> The Secretary of Energy shall proceed with the Waste Isolation Pilot Plant construction project authorized to be carried out in the Delaware Basin of Southeast New Mexico (project 77-13-f) in accordance with the authorization of such project as modified by this section. Notwithstanding any other provision of law, the Waste Isolation Pilot Plant is authorized as a defense activity of the Department of Energy, administered by the Assistant Secretary of Energy for Defense Programs, for the express purpose of providing a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States exempted from regulation by the Nuclear Regulatory Commission.

Pub. L. No. 96-164, § 213 (emphasis added).

In the Conference Report accompanying the DOE National Security Act, the joint conferees indicated that they understood "defense waste" to include waste from the production of nuclear weapons:

> The process of producing nuclear weapons yields byproducts, customarily referred to as nuclear wastes, that are hazardous in certain regimes and which should be isolated from the biosphere on a permanent basis. Defense nuclear wastes have been accumulating and safely stored at temporary storage sites over the past 35 years. The issue of the ultimate disposal of nuclear waste is one of the most troublesome challenges of our time. The United States has not yet decided the issue of how to permanently store nuclear wastes resulting from various national defense programs. The right combination of public concern, technology and resource application is needed in order to produce a decision. Such a decision will not be simple, and the WIPP will contribute but one small piece to that decision.

H. R. Rep. No.702, 96th Cong., 1st Sess., at 18 (1979).

The conferees also expressly rejected the Administration's proposal to dispose of commercial waste at WIPP:

> The WIPP, originally authorized in 1976, was conceived as a research, development and demonstration project for the storage of defense waste. Since that time, the Administration has proposed changes to the mission of the WIPP regularly, first to include the storage of 1,000 spent fuel assemblies from commercial reactors, and later a commercial type "intermediate scale facility"

> where defense nuclear wastes would be stored for the payment of a "fee." This constant attempt to change the purpose of WIPP has resulted in delay and confusion.

Id.

B. The Land Withdrawal Act

On October 30, 1992, Congress reaffirmed the nature of WIPP's mission as a repository for defense waste when it passed the LWA:

> The term "WIPP" means the Waste Isolation Pilot Plant project authorized under section 213 of the Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Pub. L. 96-164; 93 Stat. 1259, 1265) to demonstrate the safe disposal of radioactive waste materials generated by atomic energy defense activities.

Pub. L. No. 102-579, § 2(21) (emphasis added).

The history of the LWA indicates that Congress intended the term "atomic energy defense activities" to distinguish defense activities from civilian atomic energy activities. Both the Senate version of the LWA, S. 1671, and the version of H.R. 2637 offered by the House Armed Services Committee proposed to expressly define "atomic energy defense activity" as having "the same meaning as is provided in section 2 of the Nuclear Waste Policy Act of 1982 (NWPA) (42 U.S.C. 10101)."[4] The NWPA defines the term "atomic energy defense activity" to cover a broad range of defense activities:

> (3) The term "atomic energy defense activity" means any activity of the Secretary [of Energy] performed in whole or in part in carrying out any of the following functions:
>
> (A) naval reactors development;
>
> (B) weapons activities including defense inertial confinement fusion;
>
> (C) verification and control technology;
>
> (D) defense nuclear materials production;

---

[4] As originally introduced in the House on June 13, 1991, H.R. 2637 defined WIPP at § 2(17) as a "project ... to demonstrate the safe disposal of radioactive waste materials generated by defense programs."

(E) defense nuclear waste and materials by-products management;

(F) defense nuclear materials security and safeguards and security investigations; and

(G) defense research and development.

42 U.S.C. § 10101(3) (emphasis added). At the same time, however, the NWPA clearly distinguishes between civilian and defense nuclear activities. Specifically, the NWPA defines "civilian nuclear activity" as any atomic energy activity other than a defense activity. 42 U.S.C. §10101(5).[5]

While the express reference to the NWPA definition was not included in the final text of the LWA, it appears from the history of the Senate and House proceedings that Congress adopted the term "atomic energy defense activities," the same term Congress had used in the NWPA, in order to limit waste that could be disposed of at WIPP to waste from "defense activities" as that term has been traditionally understood. For example, the Senate Report describes WIPP's mission and scope as follows:

> The Waste Isolation Pilot Plant is a research and development facility of the Department of Energy authorized by Public Law 96-164 for the purpose of demonstration of the safe disposal of radioactive waste generated by DOE's nuclear weapons production activities.
>
> The United States has been generating radioactive waste in its national defense programs since the 1940's. . . . The transuranic waste that would be emplaced at WIPP results primarily from plutonium reprocessing and fabrication, as well as from research and development activities at various DOE facilities.

S. Rep. No. 196, 102d Cong., 2d Sess., at 15 (1991) (emphasis added).

The Senate Report includes two letters from Secretary of Energy Watkins, dated October 4 and 15, 1991, respectively. Neither letter raises any issue with respect to the nature of transuranic

---

[5] Some of DOE's sites have historically performed both defense and civilian atomic energy activities and have stored their TRU waste from both together. The language in the NWPA, which defines "atomic energy defense activity" to include "any activity . . . performed in whole or in part in carrying out . . . defense nuclear waste and materials by-products management," would allow disposal of such historically co-mingled waste at WIPP because the activity has been "in part" defense nuclear waste management. To avoid any abuse of this provision of the NWPA, however, TRU waste resulting from defense activities should be segregated from TRU waste resulting from civilian nuclear activities where it is feasible to do so, and only the defense waste portion should be shipped to WIPP.

waste that may be emplaced at WIPP. Indeed, both letters appear to proceed from the assumption that the definition of waste in the proposed legislation was acceptable. Id at 34-37.[6]

The full Senate considered the bill on November 5, 1991. In the debate, Senator Bennett Johnston, Chairman of the Committee on Energy and Natural Resources, described WIPP as follows:

> The Waste Isolation Pilot Plant is a research and development facility of the Department of Energy that was authorized by Public Law 96-164 for the purpose of demonstrating the safe disposal of radioactive waste generated by DOE's nuclear weapons production activities. . . . The facility is now ready to open to begin the experimental program. During that program, DOE will conduct a series of experiments to evaluate the facility's ability to comply with the environmental laws governing the safe storage and disposal of nuclear waste. . . . The transuranic waste that will be emplaced at WIPP results primarily from plutonium reprocessing and fabrication, as well as from research and development at various DOE facilities. . . . This is a major milestone in the Department's efforts to demonstrate that we have the technology necessary to store and dispose safely the byproducts of our Nation's nuclear weapons.

137 Cong. Rec. S15988 (daily ed. November 5, 1991) (emphasis added).

The House was equally clear in its view of WIPP's role as a repository for waste from defense activities, not simply "any" atomic energy activity. See, e.g., Report of the Committee on Interior and Insular Affairs, H. R. Rep. No. 241, Part 1, 2d Cong., 1st Sess., at 12-14 (1991), discussing both the defense waste program and the history of WIPP. There, as in the Senate, the Secretary of Energy lodged DOE's comments on H.R. 2637 and did not dispute the committee's characterization of the defense waste planned for disposal at WIPP. Id. at 24-29.

There is no suggestion in the legislative history that, in referring to "atomic energy defense activity," Congress was harkening back to the broad notion of "common defense and security" referenced in the Atomic Energy Act. Rather, the repeated references by Congress to the Department's nuclear weapons production activities in describing WIPP's mission, and the absence of any reference to the Department's civilian nuclear programs throughout this legislative history, reinforce the conclusion that the LWA reference to "atomic energy defense activities" was intended to connote the common "national defense" sense of the phrase rather than a broad notion of "the common defense and security."

Even without the legislative history indicating that Congress borrowed the term directly from the NWPA, principles of *in pari materia* dictate that the same term dealing with the same general

---

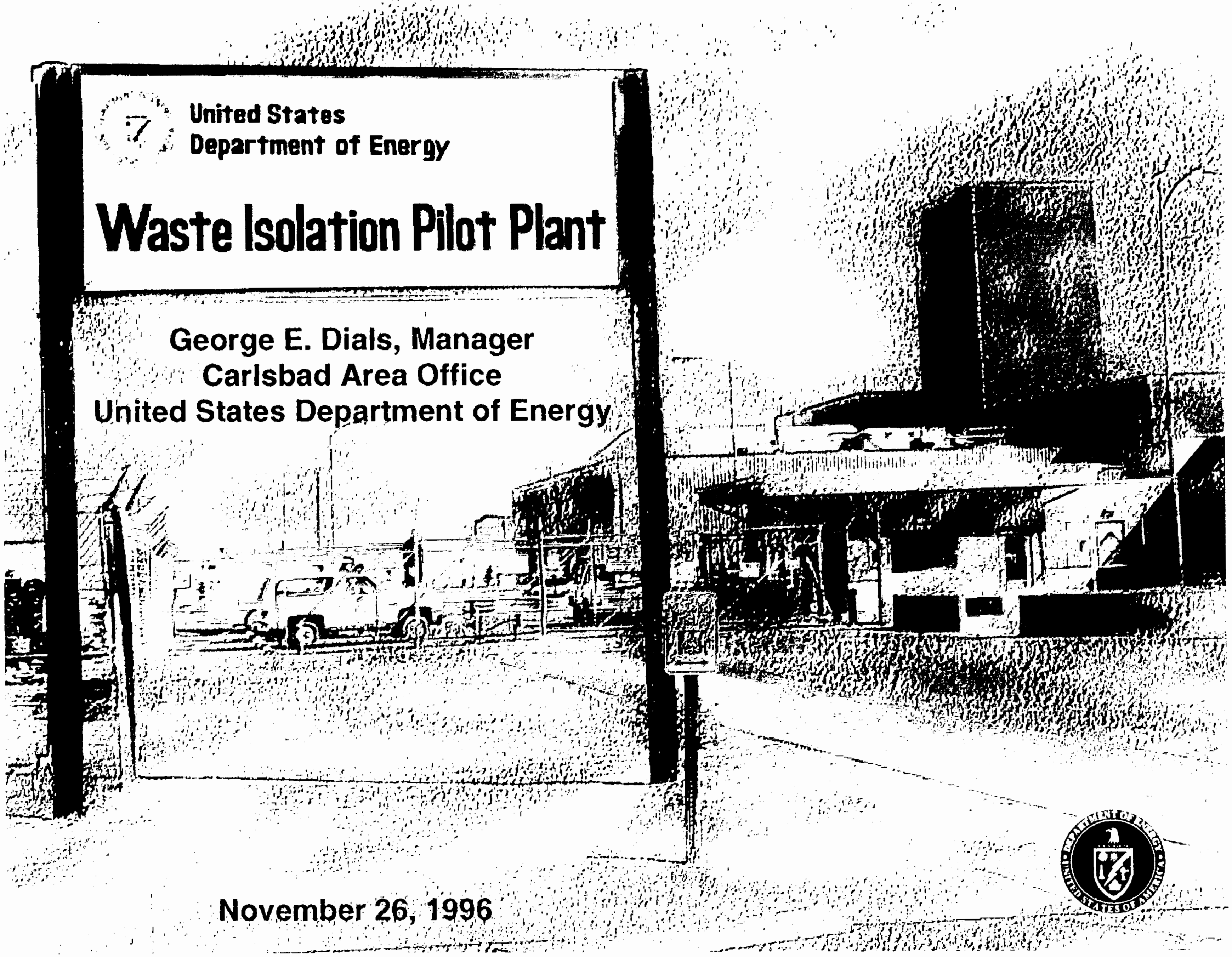
[6] The same is true for the Statement of Leo P. Duffy, Director of Environmental Restoration and Waste Management. S. Rep. No. 196 at 37.

subject matter be interpreted to have the same meaning, absent an indiction that Congress intended otherwise. In this instance, no such intent appears. Thus, the term "atomic energy defense activities" as used in the LWA should be interpreted to cover the same broad array of defense activities and related cleanup activities described in the NWPA as falling within that term.[7] This is entirely consistent with the definition of defense nuclear waste historically used by WIPP, *i.e.*, waste derived "from the manufacture of nuclear weapons and operation of naval reactors" and "[a]ssociated activities such as the research in the weapons laboratories." A broader interpretation that would include waste from DOE's civilian atomic energy activities, based on references in the AEA to the "common defense and security" interests served by the development of peaceful uses of nuclear power, is not supported by the language of the statute, the legislative history, or the Department's own historic interpretation of the term.

---

[7] As the legislative history of the NWPA's definition of "atomic energy defense activities" makes clear, TRU waste generated by the DOE Environmental Management program in its cleanup and management of weapons production waste qualifies for disposal at WIPP because it is so "closely intertwined" with defense production activities.

# WIPP 56th QUARTERLY REVIEW




George E. Dials, Manager
Carlsbad Area Office
United States Department of Energy

November 26, 1996

# CARLSBAD AREA OFFICE

- Compliance is the challenge
  - Within schedule
  - Within budget
- Disposal/cleanup - the goal

1196R:7038c

# ACTION ITEMS
# 55th WIPP QUARTERLY REVIEW
# July 25, 1996

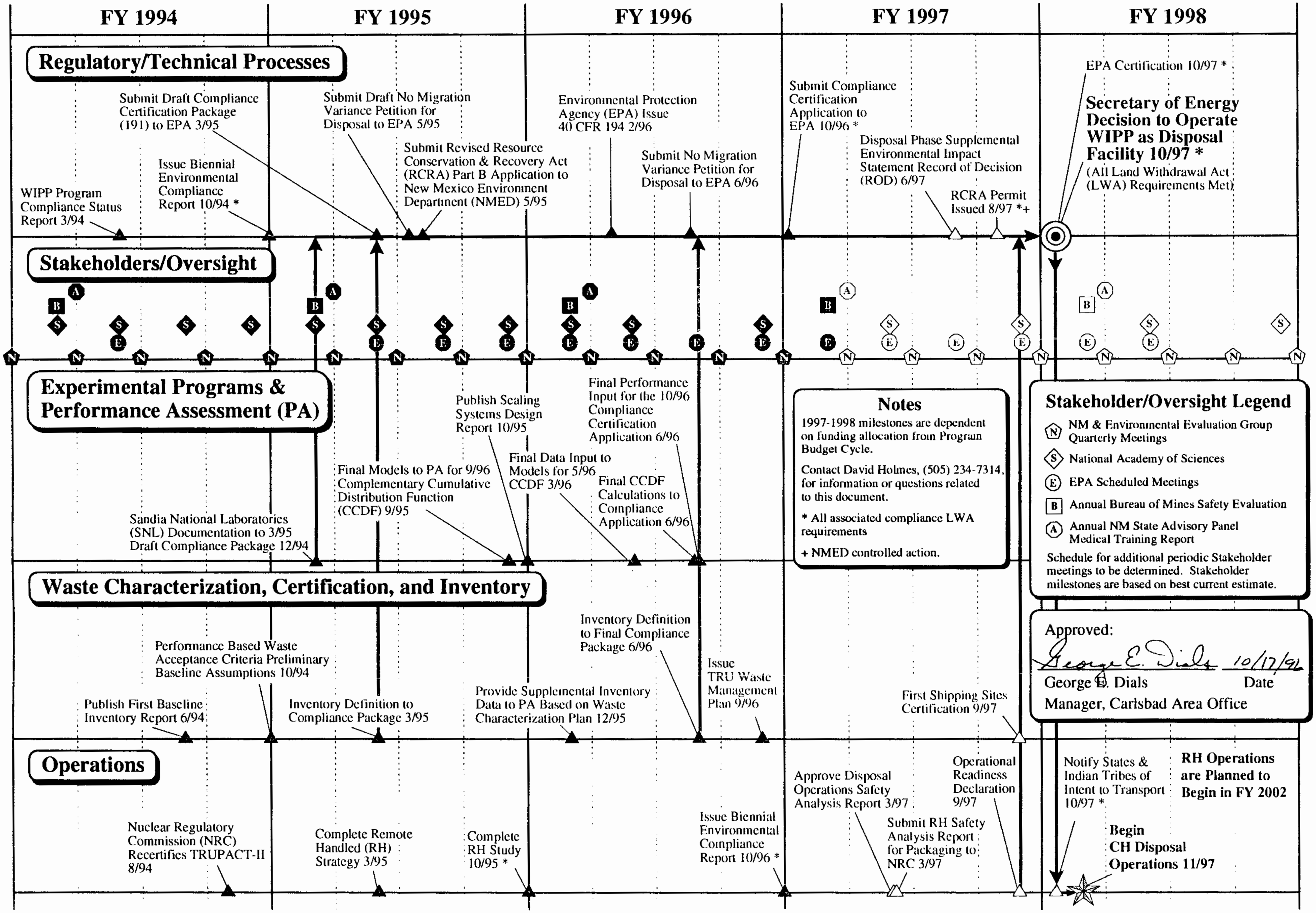
11/20/96

| Action Items | Action By |
|---|---|
| Provide information to EEG, NMED, NMEMNRD Task Force, and NMAG about cost savings to the taxpayers if Congress passes the LWA amendment which waives the No-Migration Variance regulation on WIPP. | **Dave Holmes, CAO**<br><br>*Since there would be no need for Environment, Safety, and Health FTEs and associated subcontractor support, materials, training, etc., the taxpayers would realize a savings of approximately $682,000 for FY 97. No funds were programmed for FY 98.* |
| Provide the EEG with Waste Characterization Analysis Report references. | **George Basabilvazo, CAO**<br><br>*Completed with the August 19, 1996, submittal of the draft CCA chapters and appendices to the EPA and the EEG.* |
| Provide letter of agreement on the International Peer Review to EEG, NMED, NMEMNRD Task Force, and NMAG. | **Tim Sweeney, CAO**<br><br>*Letter sent 9/27/96; Terms of Reference and letters referenced in agreement letter sent 10/8/96.* |
| Provide EEG with a copy of NEA/IAEA questionnaire and the CAO response upon verification with NEA/IAEA that it is okay to do so. | **George Basabilvazo, CAO**<br><br>*The NEA was contacted via telecon in early October regarding the responses to the IPAG questionnaire. The responses to the IPAG questionnaire are related to a working group of the NEA; not related to the IAEA. The NEA agreed that we could provide the EEG with a copy of our responses. Closed out via telecon 10/3/96. A subsequent letter containing CAO responses to the IPAG questionnaire was forwarded to the EEG 10/30/96.* |
| Issue a letter from the CAO to NEA/IAEA, with a copy to EEG, informing NEA/IAEA that the reviewers are free to meet with other organizations other than DOE. | **George Basabilvazo, CAO**<br><br>*The NEA/IAEA coordinator for the international review team was contacted via telecon and was advised that the review team can meet with other organizations if they so desire. The NEA/IAEA review team will inform the CAO if they want to meet with any other organizations during their visit to the USA. Closed out via telecon 10/3/96.* |
| The NMEMNRD Task Force requested that the CAO conduct a technical exchange on backfill. | **Jim Mewhinney, CAO** |

| | |
|---|---|
| The EEG requested the CAO provide the humidity relations analysis on condensation in the exhaust shaft. | **Wayne Walker, CAO**<br><br>*Sent 11/19/96.* |
| Provide the EEG with description of the type of computer model used for the National TRU Waste Management Plan. | **Don Watkins, CAO**<br><br>*Sent 10/10/96.* |
| Provide NM Radioactive Waste Task Force with a copy of National TRU Program Plan. | **Don Watkins, CAO**<br><br>*Sent 10/4/96.* |
| Include the water/lead issue on the 56th Quarterly agenda. | **Bob Neill, EEG**<br><br>*It was later agreed that the 56th Quarterly would be devoted to the CCA.* |
| Schedule 56th WIPP Quarterly Review. | **Bob Neill, EEG**<br><br>*Scheduled for November 26 1996 at the EEG office in Albuquerque* |

# WIPP Disposal Decision Plan

Revision 3
October 17, 1996
Updated 11/26/96



# DDP MILESTONES

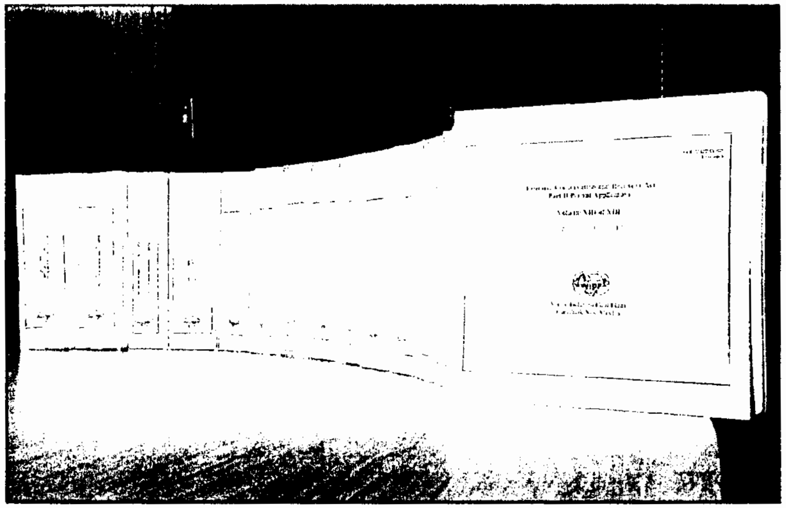
- Completed DDP milestones since last Quarterly
  - Issued TRU Waste Management Plan *9/96*
  - CCA submitted to EPA *10/96*
  - Issued Biennial Environmental Compliance Report *10/96*
- Upcoming DDP milestones
  - SEIS-II ROD *8/97*
  - RCRA Permit issued *8/97*

1196R:7046a

# RESOURCE CONSERVATION AND RECOVERY ACT PART B APPLICATION

## 40 CFR 264 Operating Standards

- Final application submitted to New Mexico Environment Department on 5/26/95



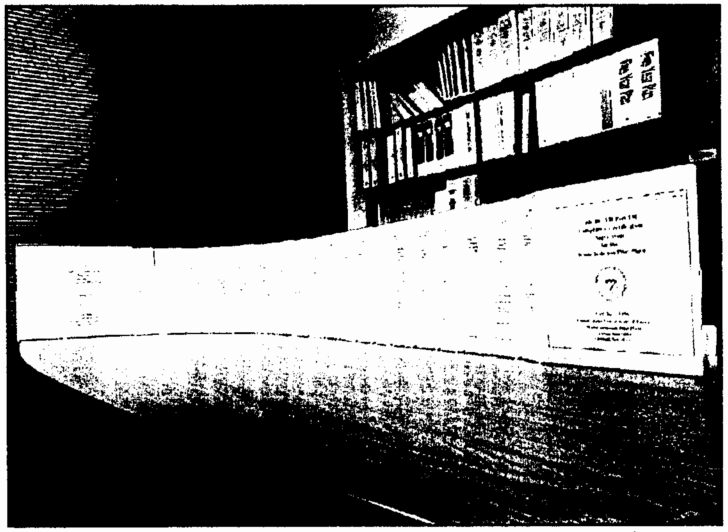
- Notice of Deficiency received 3/14/96
- DOE responses provided 4/12/96
- DOE received Notice of Completeness 6/27/96
- CAO anticipates permit issuance in the summer of 1997

1196R:7046b

# COMPLIANCE CERTIFICATION APPLICATION

## 40 CFR 191 Disposal Standards

- Draft application submitted to EPA and stakeholders March 1995
- Comments received on draft application January 1996
- Final draft application submitted to EPA and stakeholders May - August 1996



- Comments received on final draft August 1996
- Compliance Certification Application submitted October 29, 1996
- CAO anticipates EPA certification October 1997

1196R:7038h

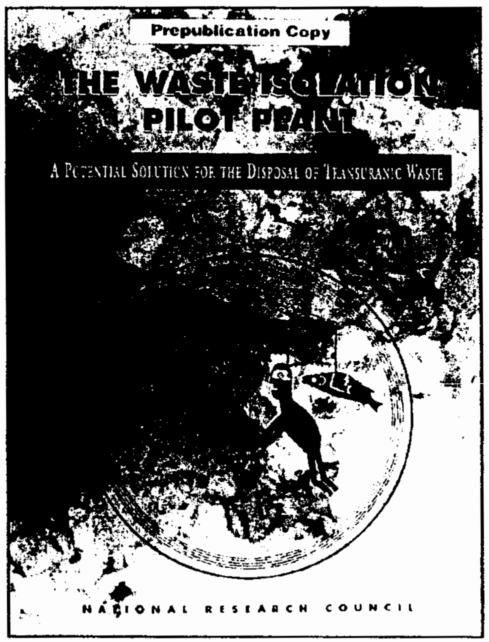
# SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT REVISED SCHEDULE

- Notice of Intent *8/95 (Complete)*
- Scoping meetings *9-10/95 (Complete)*
- Implementation plan approved *4/96 (Complete)*
- Draft Supplemental Environmental Impact Statement (SEIS) distributed *11/96*
- Public hearings *1/97*
- Final SEIS *7/97*
- Record of Decision *8/97*

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

1196R:7038i

"Despite the nominal possibility of human intrusion into the proposed repository, the committee is confident in its judgment that DOE should be able to demonstrate that radionuclide releases at the WIPP will be within the limits allowed by the Environmental Protection Agency. The associated health risks are likely to be well below the levels allowed under international standards."




National Research Council Report
The Waste Isolation Pilot Plant:
A Potential Solution for the Disposal
of Transuranic Waste
October 23, 1996

1196R:7008w

# CARLSBAD AREA OFFICE BUDGET PROFILE

*(Millions)*

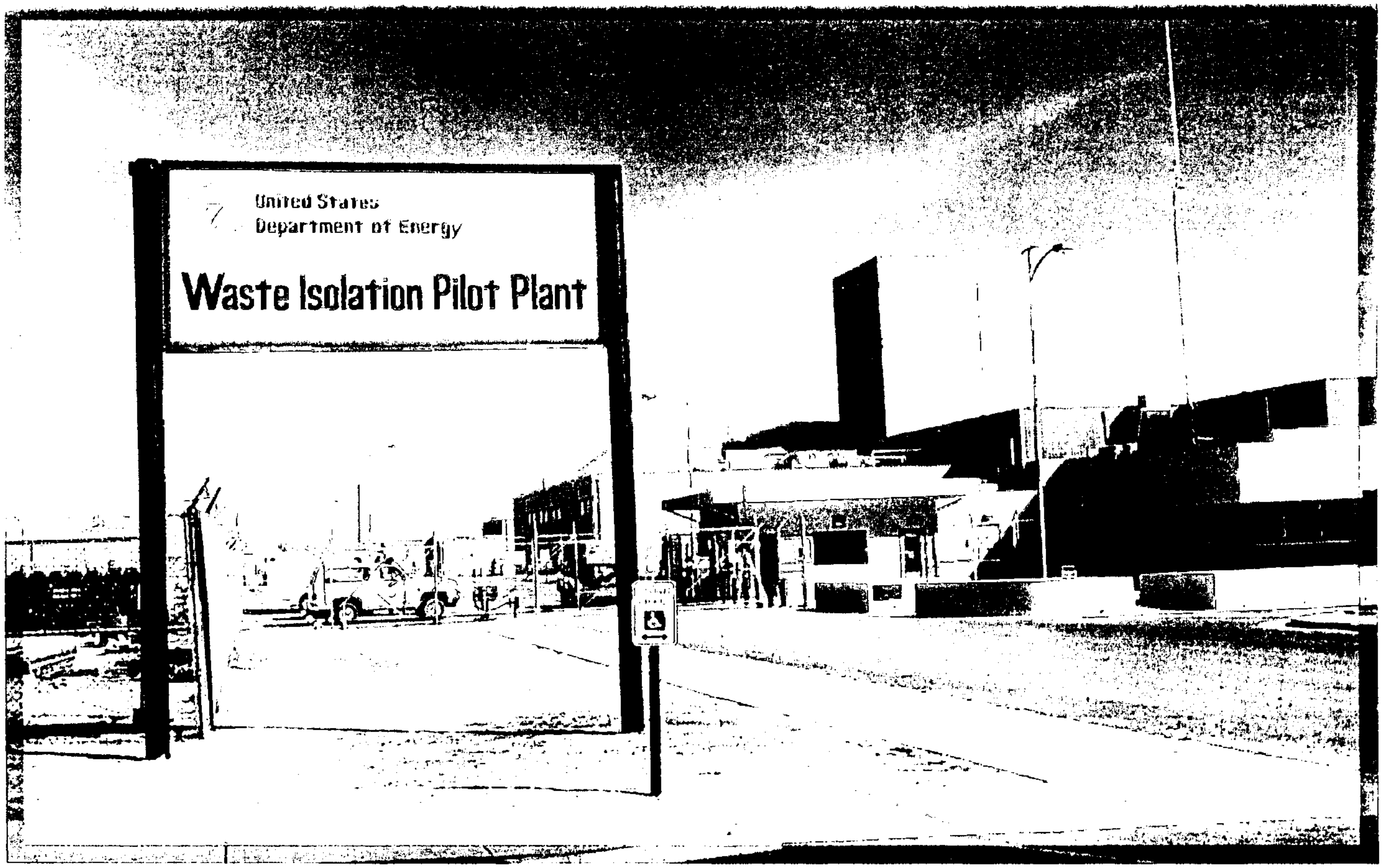
| Program | FY95 | FY96 | FY97 | FY98 |
|---|---|---|---|---|
| WIPP | 147.5 | 157.2 | 165.6 | 167.0 |
| NTP | 22.3 | 24.9 | 24.0 | 30.6 |
| Subtotal | 169.8 | 177.7 | 189.6 | 197.6 |
| Program direction | 5.1 | 5.5 | 6.2 | 7.8 |
| Total | 174.9 | 183.2 | 195.8 | 205.4 |

# POSSIBLE IMPEDIMENTS TO PROGRESS

- EPA review schedule
- Litigation
  - Compliance Certification Application
  - Resource Conservation and Recovery Act Part B permit
  - Supplemental Environmental Impact Statement Record of Decision
- Budget allocations

1196R:7038j

# WIPP ONE VALUABLE STEP TOWARD SOLUTION OF THE NATIONAL NUCLEAR WASTE DISPOSAL PROBLEM




- WIPP is focused and on schedule
- Transportation system is operational and safe
- Path to regulatory compliance identified
- Disposal operations will begin November 1997

596R:6955c

ENVIRONMENTAL EVALUATION GROUP

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER

7007 WYOMING BOULEVARD, N.E.
SUITE F-2
ALBUQUERQUE, NEW MEXICO 87109
(505) 828-1003
FAX (505) 828-1062

# 56TH QUARTERLY MEETING

## US Department of Energy

## NM Energy, Minerals and Natural Resources Department

## NM Environment Department

## NM Environmental Evaluation Group

**Robert H. Neill**

**November 26, 1996**

**Albuquerque, NM**

*Providing an independent technical analysis of the Waste Isolation Pilot Plant (WIPP), a federal transuranic nuclear waste repository.*

# Preliminary List of Potential Issues Concerning the CCA

- Certain parameter values are inadequately justified. For example, the initial volume and pressure of a potential brine reservoir, radionuclide partition coefficients for the Culebra aquifer, and the solubility of radionuclides in the WIPP brine.

- Certain assignments of probabilities are inadequately justified. For example, the probability of a future well encountering brine reservoir under the repository.

- Certain scenarios not analyzed or inadequately analyzed. For example, the effects of water-flooding for secondary recovery of oil, and the effect of solution mining.

- Certain conceptual models are inadequately justified. For example, no brine entrainment during spallings release of gas and solids.

- Credit for active and passive institutional controls has not been justified.

- The decision to include additional engineered barriers appears to be predicated solely on the results of the containment calculations.

- Failure to meet the Assurance Requirement concerning the presence of natural resources (40 CFR 191.14e) not compensated by additional engineered barriers.

- 1996 Draft SAR being reviewed
- Retardation Coefficients
    - C & C commitment met by DOE
    - EEG recommends different retardation coefficients
- RH-TRU waste and defense waste definitions
    - DOE OGC determination not available
- Draft SEIS received 11/25/96
    - 60 day review period
- Environmental surveillance
    - Moisture effects on Station A air flow

# STATE OF NEW MEXICO'S UPDATE ON WIPP ACTIVITIES

**Presented to**

## 56th WIPP QUARTERLY REVIEW MEETING

**EEG Offices**
**Albuquerque, NM**
**November 26, 1996**

**By**

**CHRIS J. WENTZ**
**COORDINATOR**
**N.M. RADIOACTIVE WASTE TASK FORCE**

# TASK FORCE ACTIVITIES SINCE LAST MEETING

* CONTINUED MONTHLY MEETINGS OF THE TASK FORCE'S WIPP WORKING GROUP

  -- WORKING GROUP COMPRISED OF KEY TECHNICAL STAFF OF TASK FORCE MEMBER CABINET AGENCIES

  -- PRIMARY FOCUS: STATE OF NEW MEXICO'S WIPP TRANSPORTATION SAFETY PROGRAM

  -- CURRENTLY FINALIZING A WIPP TRANSPORTATION OPERATIONS MANUAL FOR USE BY STATE AGENCIES

* LIAISON WITH INTERIM LEGISLATIVE COMMITTEE

  -- PRESENTED OVERVIEW OF WIPP LAND WITHDRAWAL AMENDMENTS ACT TO RADIOACTIVE AND HAZARDOUS MATERIALS COMMITTEE OF THE N.M. LEGISLATURE ON SEPTEMBER 6

* WIPP LAND MANAGEMENT

  -- FINALIZING DOE/NM JOINT POWERS AGREEMENT FOR ENHANCING COMMUNICATIONS/COORDINATION ON WIPP LAND MANAGEMENT ISSUES

  -- EXECUTION OF AGREEMENT TARGETED FOR NEXT MONTH (DECEMBER 1996)

# TASK FORCE ACTIVITIES SINCE LAST MEETING
# (continued)

* WIPP INFORMATION EXCHANGE

  -- HELPED ORGANIZE AN EMERGENCY RESPONSE WORKSHOP FOR STATE, LOCAL, AND TRIBAL GOVERNMENT REPRESENTATIVES ON SEPTEMBER 24 IN LOS ALAMOS; FOCUS WAS ON LANL SHIPMENTS

  -- SPONSORED AND ASSISTED IN COORDINATING A REGIONAL HAZARDOUS MATERIALS TRANSPORTATION SYMPOSIUM ON OCTOBER 14-18 IN ALBUQUERQUE; SEVERAL WIPP-RELATED PRESENTATIONS ON AGENDA

  -- DESIGNATED NEW MEXICO REPRESENTATIVE ON DOE/HQ TRANSPORTATION EXTERNAL COORDINATION (TEC) WORKING GROUP; PARTICIPATING ON NEW COMMITTEE TO IDENTIFY APPROPRIATE EQUIPMENT FOR VARIOUS LEVELS OF RADIOLOGICAL EMERGENCY RESPONSE

* WGA TECHNICAL ADVISORY GROUP ON WIPP TRANSPORT

  -- DESIGNATED NEW MEXICO REPRESENTATIVE ON THE WGA ADVISORY GROUP

  -- PARTICIPATED IN PREPARATION OF:

  WIPP COMMUNICATIONS & PUBLIC INVOLVEMENT PLAN;
  WIPP TRANSPORTATION SAFETY FACT SHEET

# TASK FORCE ACTIVITIES SINCE LAST MEETING
## (continued)

* WIPP LAND WITHDRAWAL AMENDMENTS ACT

  -- FACILITATED PREPARATION OF GRANT APPLICATION TO DOE FOR TRANSFER OF $20 MILLION TO NEW MEXICO

  -- FUNDING TO BE USED FOR WIPP ROUTE IMPROVEMENTS (*i.e.*, BY-PASS CONSTRUCTION, U.S. 285 UPGRADES)

* WIPP PERFORMANCE ASSESSMENT (PA)

  -- PARTICIPATED IN A TECHNICAL BRIEFING BY JOHN BREDEHOEFT ON THE POTENTIAL EFFECTS OF MAGNESIUM OXIDE BACKFILL AT WIPP ON AUGUST 29 IN ALBUQUERQUE

  -- PARTICIPATED IN A DOE/EPA TECHNICAL EXCHANGE ON CASTILE BRINE RESERVOIRS AND FLUID INJECTION ON OCTOBER 10 IN CARLSBAD

  -- PARTICIPATED IN A SECOND DOE/NM "CONSULTATION AND COOPERATION" MEETING ON ACTINIDE DISTRIBUTION COEFFICIENTS ($K_d$ VALUES) FOR WIPP PA ON OCTOBER 11 IN CARLSBAD

# WIPP TRANSPORTATION SAFETY PROGRAM

* WESTERN GOVERNORS' ASSOCIATION (WGA) WIPP TRANSPORT SAFETY PROGRAM IMPLEMENTATION GUIDE

  -- COOPERATIVELY DEVELOPED BY WGA (10 WESTERN WIPP CORRIDOR STATES) AND DOE-CAO

  -- ADDRESSES ACCIDENT PREVENTION, EMERGENCY RESPONSE PREPAREDNESS, AND PUBLIC INFORMATION/ PARTICIPATION FOR THE WIPP SHIPPING CAMPAIGN

  -- UNANIMOUSLY ADOPTED BY WGA AT THEIR DECEMBER 1995 ANNUAL MEETING

  -- MEMORANDUM OF UNDERSTANDING EXECUTED BETWEEN WGA AND DOE; ENDORSES THE PRINCIPLES, APPROACHES, AND PROCEDURES IN THE GUIDE

  -- CURRENTLY IN PROCESS OF BEING REFINED AND UPDATED IN LIGHT OF PROJECTED NOVEMBER 1997 EARLY OPENING DATE FOR WIPP

* WIPP TRAINING

  -- ALL LEVELS OF EMERGENCY RESPONSE TRAINING IS CONTINUING ON A REGULAR BASIS

  -- RADIATION EMERGENCY ASSISTANCE CENTER/ TRAINING SITE (REAC/TS) PERSONNEL COMING TO NEW MEXICO HOSPITALS ON WIPP ROUTE IN EARLY 1997

# WIPP TRANSPORTATION SAFETY PROGRAM
## (continued)

* WIPP PUBLIC OUTREACH EFFORT: 1996

-- WIPP "OPEN HOUSES" HELD IN ALBUQUERQUE; PUEBLO OF TESUQUE; LAS VEGAS, NM; PUEBLO OF NAMBE; PUEBLO OF POJOAQUE; SANTA FE; LOS ALAMOS; PUEBLO OF SAN ILDEFONSO; SPRINGER; WAGON MOUND; RATON; ELDORADO; GALISTEO; VAUGHN; ROSWELL

-- BRIEFINGS ON NM WIPP TRANSPORTATION SAFETY PROGRAM TO ALBUQUERQUE LOCAL EMERGENCY PLANNING COMMITTEE; STATE/TRIBAL GOVERNMENT MEETING (TESUQUE); LAS VEGAS CITY COUNCIL; SAN MIGUEL COUNTY COMMISSION; WAGON MOUND VILLAGE COUNCIL; MORA COUNTY COMMISSION; RATON CITY COUNCIL; NM ASSOCIATION OF MUNICIPAL FIRE CHIEFS

* WIPP EMERGENCY RESPONSE EXERCISES

-- AT LEAST TWO PER YEAR SCHEDULED

-- FIELD EXERCISES IN 1996/1997:

1) ALBUQUERQUE EXERCISE (WIPPTRAX 96-1) HELD ON MAY 31
2) MORIARTY EXERCISE (WIPPTRAX 96-2) HELD ON EVENING OF AUGUST 27
3) LAS VEGAS EXERCISE (WIPPTRAX 97-1): RE-SCHEDULED TO MARCH 22, 1997
4) NM/CO EXERCISE AT RATON PASS: APRIL 1997

# UPCOMING EVENTS: 1996/1997

| | | |
|---|---|---|
| * | DECEMBER 2-3 | JOINT MEETING OF THE TASK FORCE & INTERIM LEGISLATIVE RADIOACTIVE AND HAZARDOUS MATERIALS COMMITTEE IN CARLSBAD |
| * | DECEMBER 9 | NEW MEXICO WIPP PUBLIC AWARENESS "OPEN HOUSE" IN ARTESIA |
| * | DECEMBER 10 | NEW MEXICO WIPP PUBLIC AWARENESS "OPEN HOUSE" IN CARLSBAD |
| * | DECEMBER 11 | NEW MEXICO WIPP PUBLIC AWARENESS "OPEN HOUSE" IN LOVING |
| * | JANUARY 6-7 | WIPP SEIS-II HEARINGS IN ALBUQUERQUE |
| * | JANUARY 8-10 | WIPP SEIS-II HEARINGS IN SANTA FE |
| * | JANUARY 13 | WIPP SEIS-II HEARINGS IN CARLSBAD |
| * | JANUARY 14-16 | DOE/HQ TRANSPORTATION EXTERNAL COORDINATION GROUP: MEETING IN CHARLESTON, SOUTH CAROLINA |
| * | JANUARY 27-28 | WGA TECHNICAL ADVISORY GROUP ON WIPP TRANSPORTATION: MEETING IN CONCORD, CALIFORNIA |

# WIPP Quarterly Review
# November 26, 1996

### Activities Update for NMED's
### RCRA Permits Program

1. Meetings, trips, training, etc.

   - Attend LANL Waste Characterization Surveillance, August 13 - 16.
   - Attend EPA Risk Assessment training in Santa Fe, August 27 - 30.
   - Attend WIPP Transportation Safety Program Open House in Eldorado, September 11.
   - Attend CAO Auditor course in Carlsbad, September 24 - 26.
   - Met with EPA ORIA WIPP staff members in Santa Fe, October 8.

2. Review of WIPP Land Withdrawal Act Amendment

   - Evaluated impact of exemption of WIPP TRU-mixed waste from treatment standards and land disposal prohibitions in the Solid Waste Disposal Act.
   - Took issue with several prominent statements concerning WIPP's "exemption from Federal RCRA requirements" (i.e., Senator Domenici, NAS WIPP report).
   - Prepared and distributed revised copies of the LWA as amended by P.L. 104-201.

3. RCRA Part B Permit - Development

   - Confirmed that this will be the first draft permit issued for disposal in a geologic repository - no standard "model" language available for guidance.
   - Working with EPA Region 6 and DOE/WID on data needs for HSWA module development.
   - Draft Permit still under development.
   - May have more specific information on anticipated release by next quarterly meeting.

# WIPP 56th Quarterly: Sensitivity Analyses; Appendix SA and Sensitivity Analysis Report

George T. Basabilvazo

Performance Assessment Scientist

November 26, 1996

# Background

- Over 15 years of collecting experimental data and technical information on geology, hydrology, geochemistry, waste components, etc., for the WIPP site.
- This data forms the technical basis used to develop conceptual models, assign PA parameter values and determine statistical limits or bounds for parameter values.

# Background - continued

- Used sensitivity analysis to guide project.
- The project has developed both a reasonable and well supported scientific and technical baseline.
- Results from PA calculations show a compliant mean CCDF.
- Conducted sensitivity analysis (Appendix SA) for the final total releases, as required by 40 CFR 194.

# Sensitivity Analyses

- Important part of Performance Assessment (PA) Methodology
  - evaluate the influence of uncertainty of parameters on the mean CCDF
  - provides programmatic feedback
  - partial verification that the PA system is operating properly; physically realistic

# Appendix SA

- Presents results of the sensitivity analyses conducted on the total normalized releases to the accessible environment.
- Use techniques based on analysis of scatter plots, regression analysis, and partial correlation analysis.
- Total releases are only direct releases.

# Appendix SA -- continued

- Location of the mean CCDF is sensitive to parameters used to determine releases from direct releases (cuttings, cavings, spallings and direct brine releases)
- Other sampled parameters are not discussed in Appendix SA because they do not influence total releases (mean CCDF location).

# Sensitivity Analysis Report

- Presents sensitivity results for dependent variables other than total releases (i.e., pressure, volume of brine inflow and outflow).
- Use techniques based on analysis of scatter plots, regression analysis, and partial correlation analysis.
- Structured similar to Volume 4 of the *"Preliminary Performance Assessment for the WIPP, December 1992"*

# Documentation that Address Questions on Sensitivity Analysis

- Appendix SA
  - Presents results for the sampled parameters that contribute the most influence on the location of the mean CCDF.
  - Direct release mechanisms major contributors (cuttings, cavings, spallings and direct brine releases)
- Sensitivity Analysis Report
  - Presents further sensitivity results for dependent variables of interest, other than total releases

# Conclusions from PA Results and Appendix SA

- PA system is operating appropriately.
- High confidence in our results; and therefore, the technical position.
- Identified and evaluated the influential parameters for the total releases.
- Better understanding of the system.
- No technical justification to modify our technical baseline.

# Overview of the Compliance Certification Application Performance Assessment

Rip Anderson, Hong-Nian Jow, Mel Marietta,
Jon Helton, Palmer Vaughn, Jerry Berglund,
Dan Stoelzel, Kurt Larson, and Peter Swift
Sandia National Laboratories

Presentation to the 56th WIPP Quarterly Review Meeting
Albuquerque, New Mexico
November 26, 1996

# Outline of Topics

- The 1996 PA results
  - Introduction, Development of the PA modeling system
  - Undisturbed Performance
  - Human Intrusion CCDFs
- The 1996 PA Modeling System and Sensitivity Analysis Results
- Specific Technical Topics in Brief
  - Treatment of DRZ, Panel Closures, and Compartmentation, Drilling Assumptions, Potash Mining, Brine Reservoirs, Waterflood, Guidance to Waste Characterization
  - Other topics discussed in the NAS report will be covered in later presentations

# New Aspects of the 1996 PA Methodology

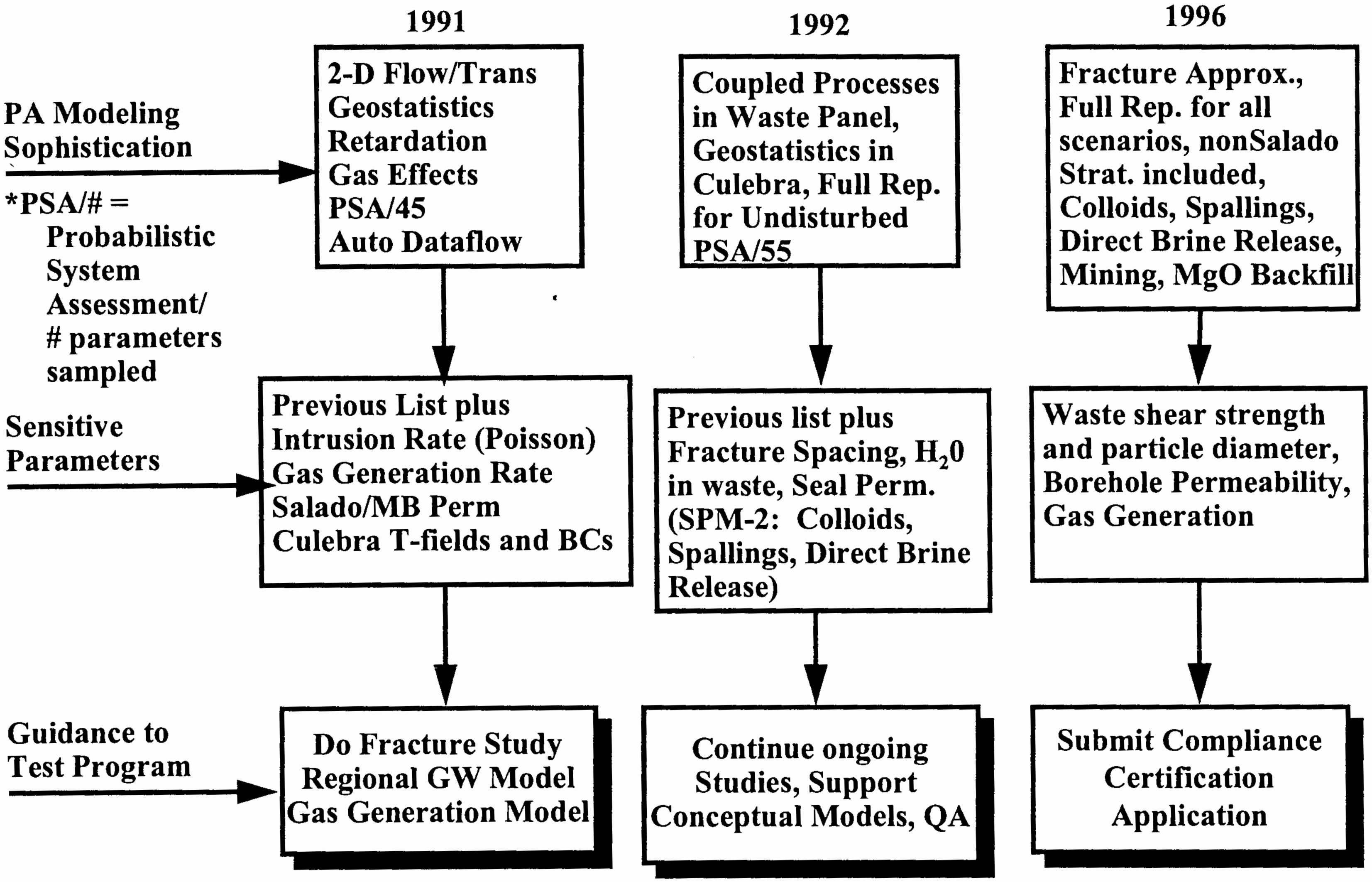
- Quality Assurance
  - data, parameters, software, and analysis
- Scenario Development
  - comprehensive approach to screening features, events, and processes
  - undisturbed performance, drilling intrusion, mining
- Modeling enhancements

# Maturation of PA Process

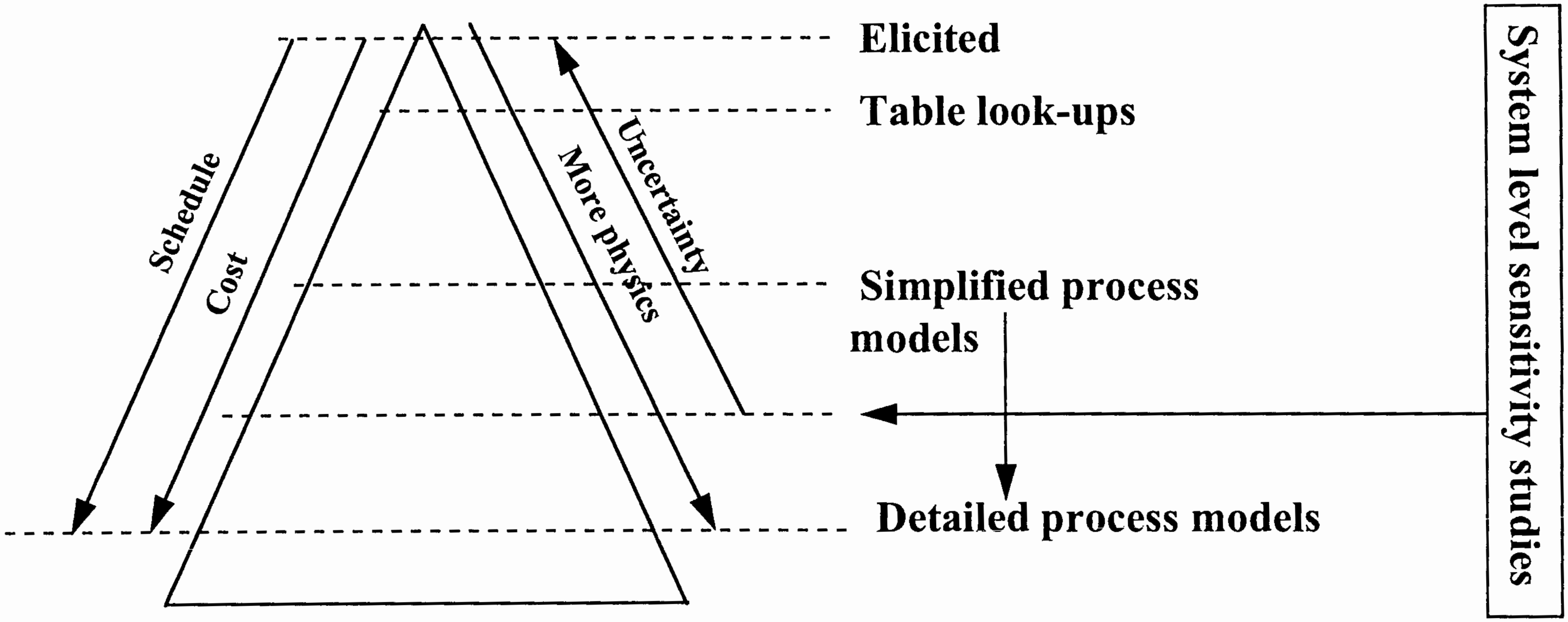
| | pre 1989 | 1989 | 1990 |
|---|---|---|---|
| PA Modeling Sophistication | 1-D Flow<br>No Retardation<br>No Gas Effects<br>No PSA*<br>Manual Dataflow | 1-D Flow/Trans<br>No Retardation<br>No Gas Effects<br>PSA/12<br>Auto Dataflow | 2-D Flow/Trans<br>No Retardation<br>No Gas Effects<br>PSA/29<br>Auto Dataflow |
| Sensitive Parameters | (simple estimates)<br>Brine Inflow<br>Gas Generation<br>Human Intrusion Scenarios | Solubility<br>Intrusion Time<br>Borehole Fill Cond.<br>Wasteform Porosity & Conductivity | Solubility<br>Intrusion Time<br>Borehole Diameter<br>Culebra Retardation<br>Dual Por. vs. Fractures |
| Guidance to Test Program | Study Brine Inflow, EPA Regulation | Do Engineered Alternatives Study | Do Dual Porosity, Retardation & Solubility Studies |

*PSA/# = Probabilistic System Assessment/ # parameters sampled

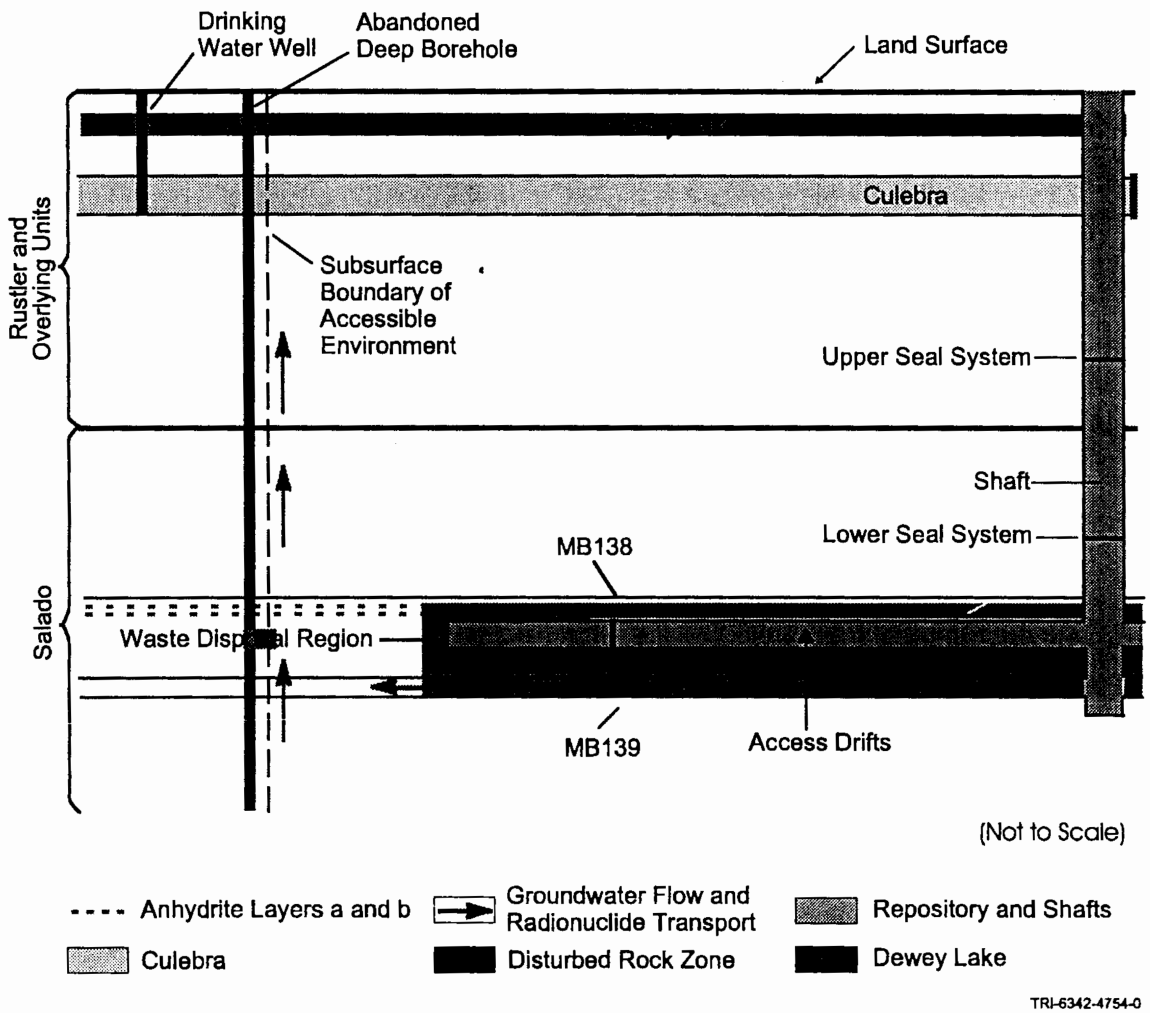
# Maturation of PA Process (cont.)



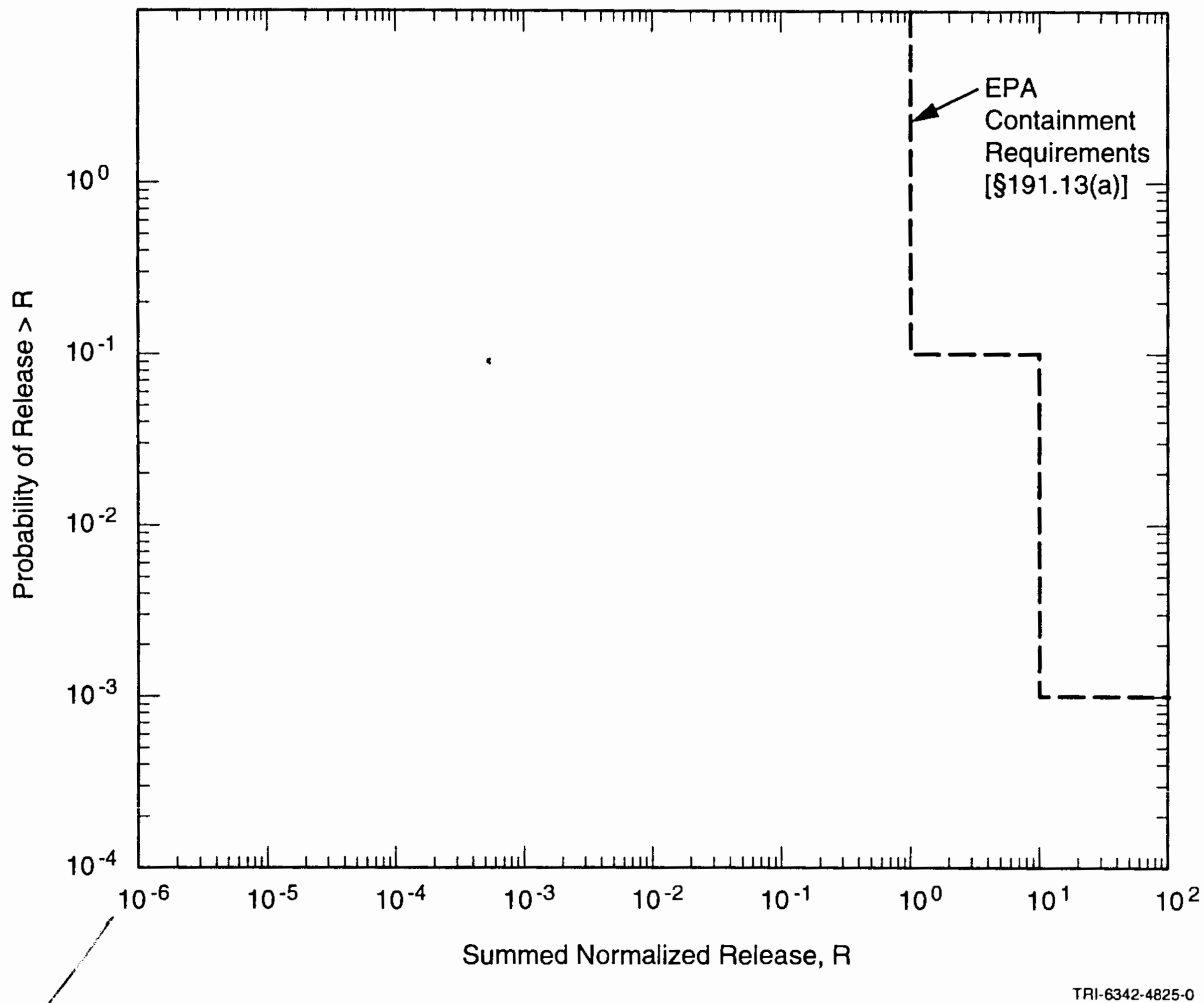
# Predictive Model Selection



# Undisturbed Performance



# Conditional CCDF for Undisturbed Performance



# Undisturbed Performance

- Results show compliance with Individual and Groundwater Protection Requirements
- No radionuclides reach top of Salado in shaft at 10,000 years
- 9 out of 300 realizations show minor amounts of contaminated brine reaching lateral boundary in marker beds
  - Peak concentration at 10,000 years is Pu-239, $5.85 \times 10^{-12}$ Ci/L, also Am-241, U-234, Th-230

# Undisturbed Performance (cont.)

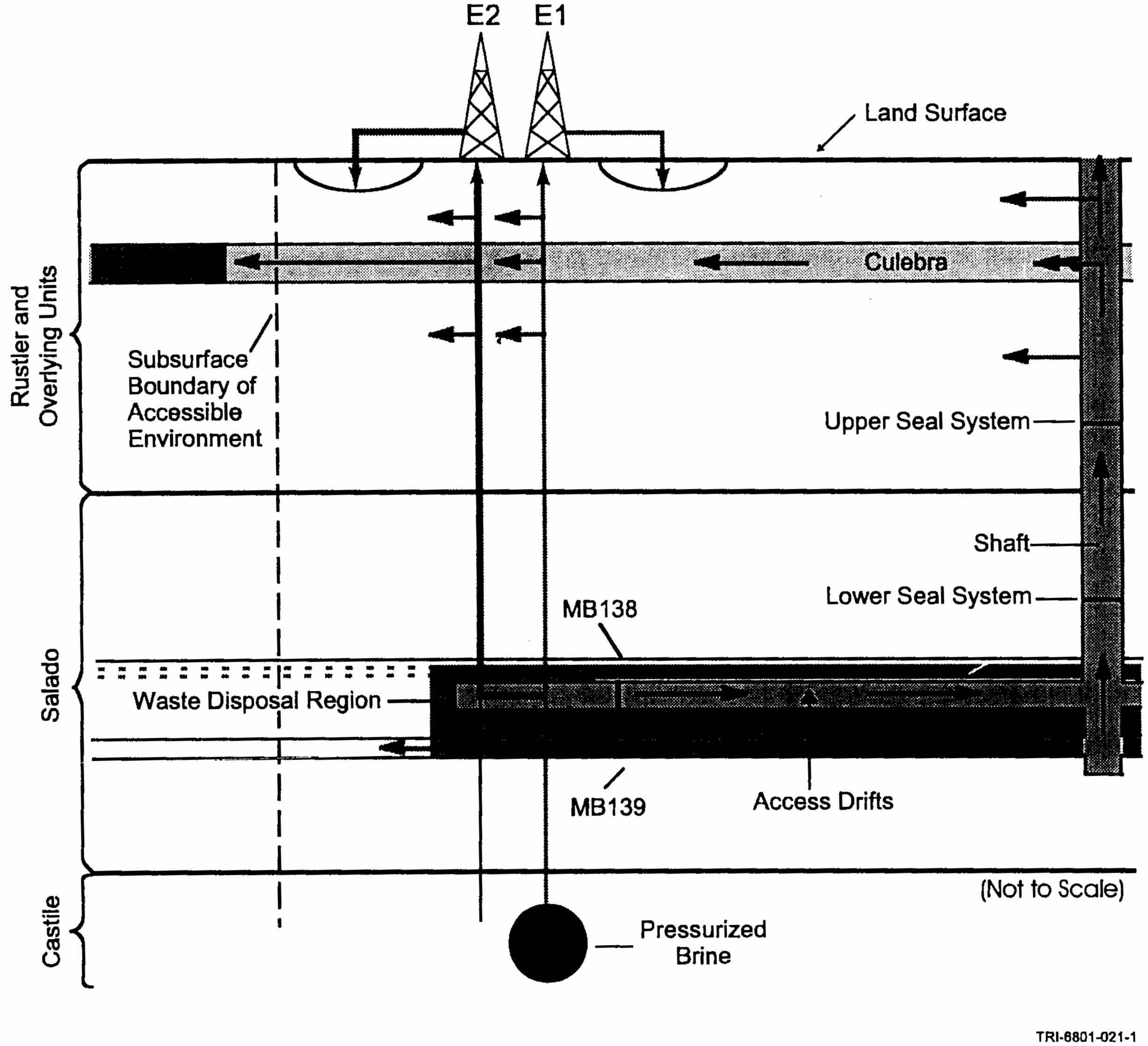
– Bounding approach to dose calculation

- No transport or pathway assumptions--all radionuclides at boundary are available to be ingested
- Marker bed brine is diluted by a factor of 32.4 to reach 10,000 ppm TDS
- Human receptor drinks two liters/day for one year
- Maximum annual committed effective dose is 0.47 millirems (291 out of 300 realizations yield zero)
- Regulatory limit is 15 millirems for annual committed effective dose

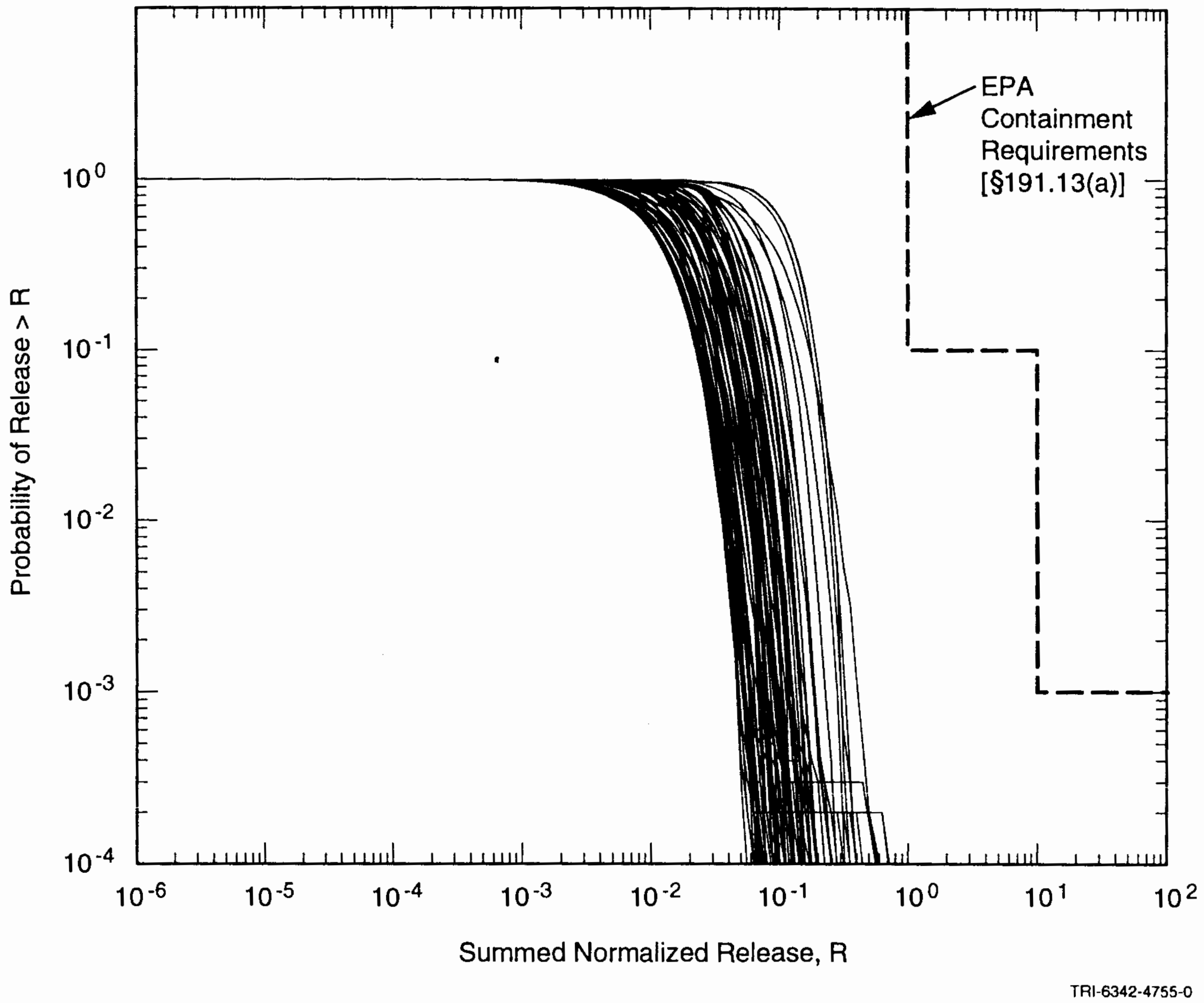
# Disturbed Performance (Human Intrusion)

- Includes
  - Intrusion Boreholes
    - direct releases at the surface (cuttings, cavings, spallings, direct brine release)
    - groundwater release
    - Drilling rate is 46.8 boreholes/$km^2$/10,000 yr
  - Potash Mining
    - Effect on Culebra modeled as specified by the EPA

# Human Intrusion Scenario

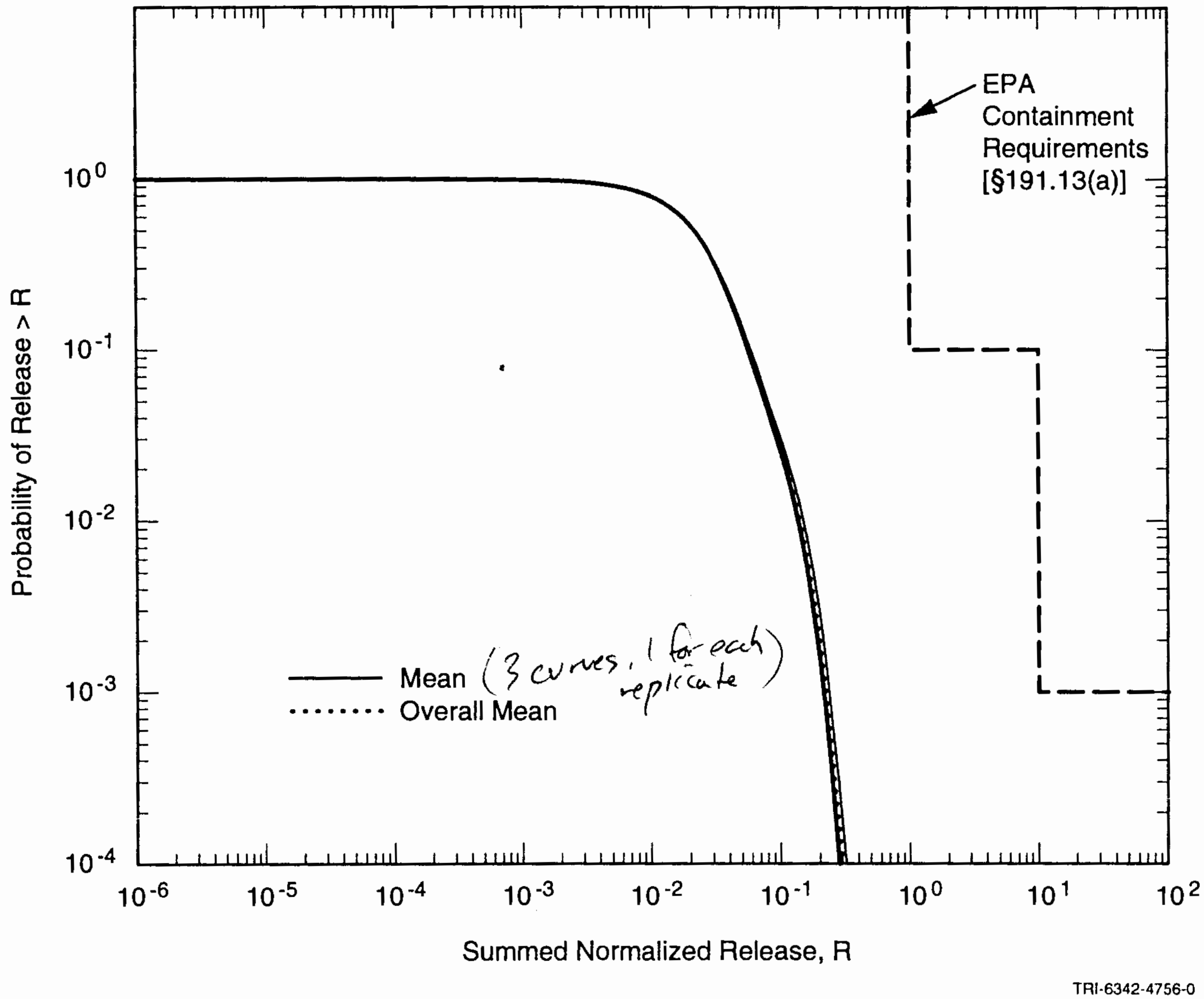


# Distribution of CCDFs



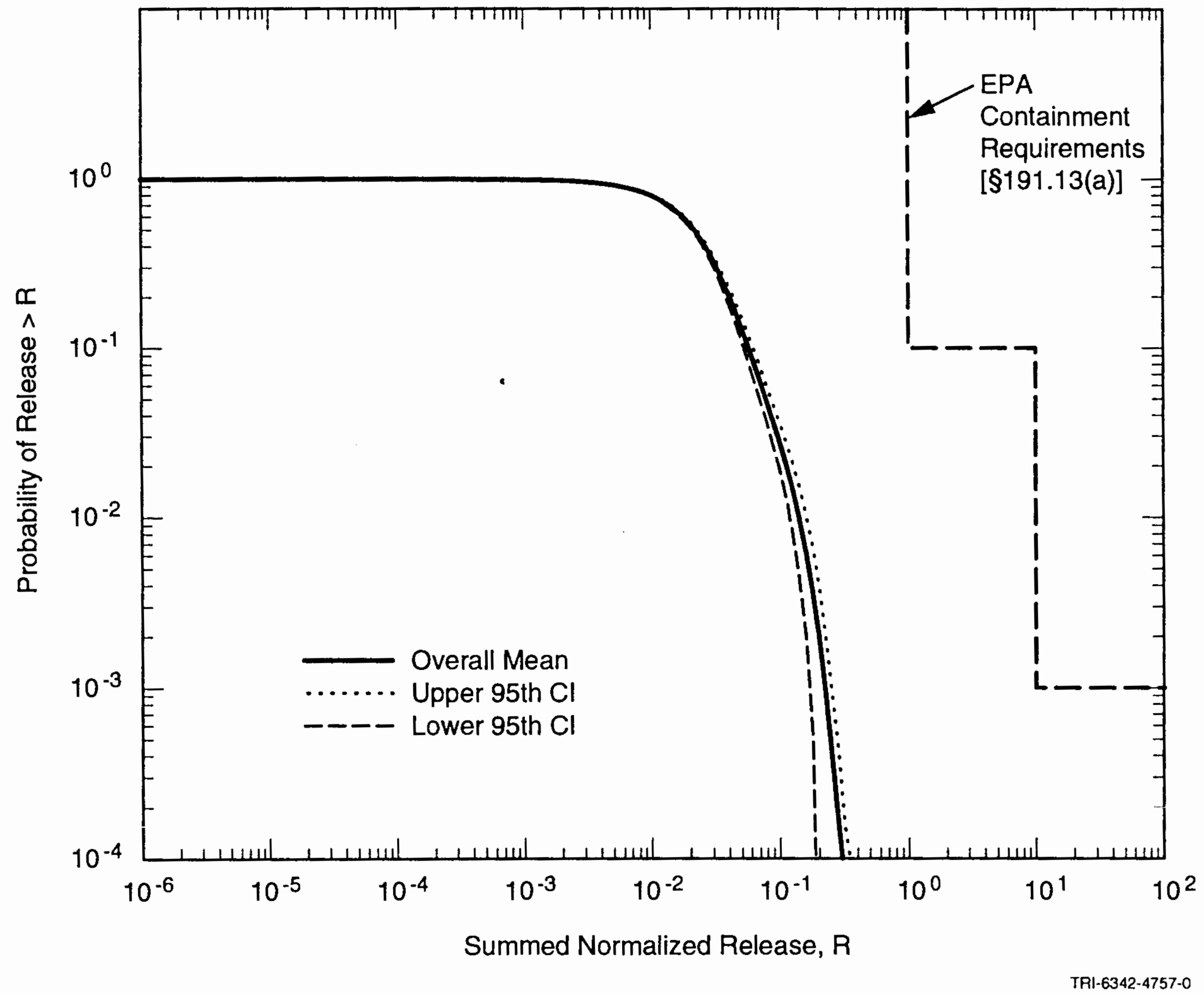

WIPP CCA, Replicate 1, 100 realizations,
Total Releases to Accessible Environment

# The Mean CCDF



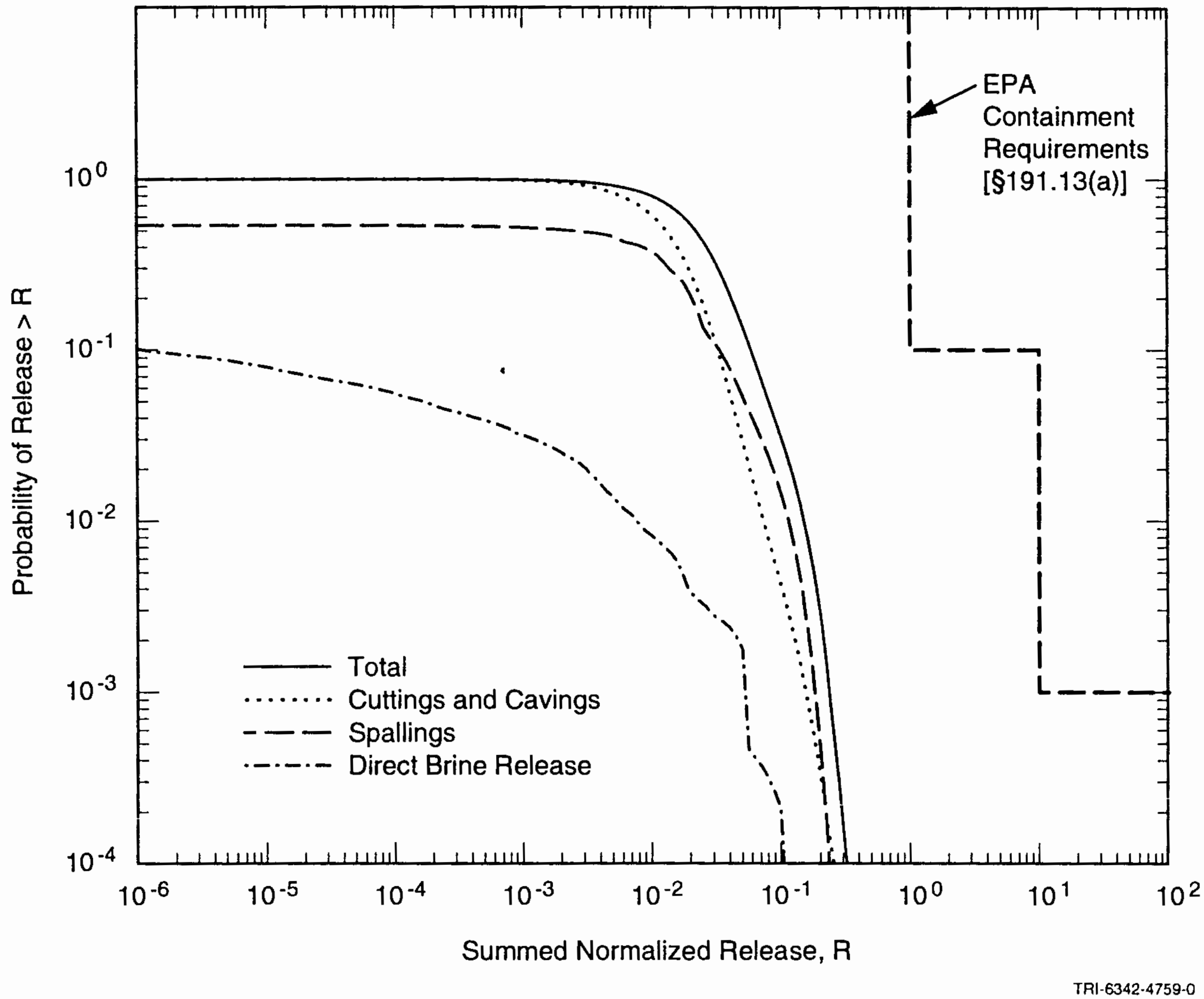

WIPP CCA: Total releases to the accessible environment. Three mean CCDFs from each of three replicates are shown together with their arithmetic mean

# Confidence Levels for the Mean CCDF




WIPP CCA: Total releases to the accessible environment. The overall mean CCDF is shown with the upper and lower 0.95 confidence intervals of the Student-T distribution estimated from the three individual mean CCDFs

# Contribution of Release Modes



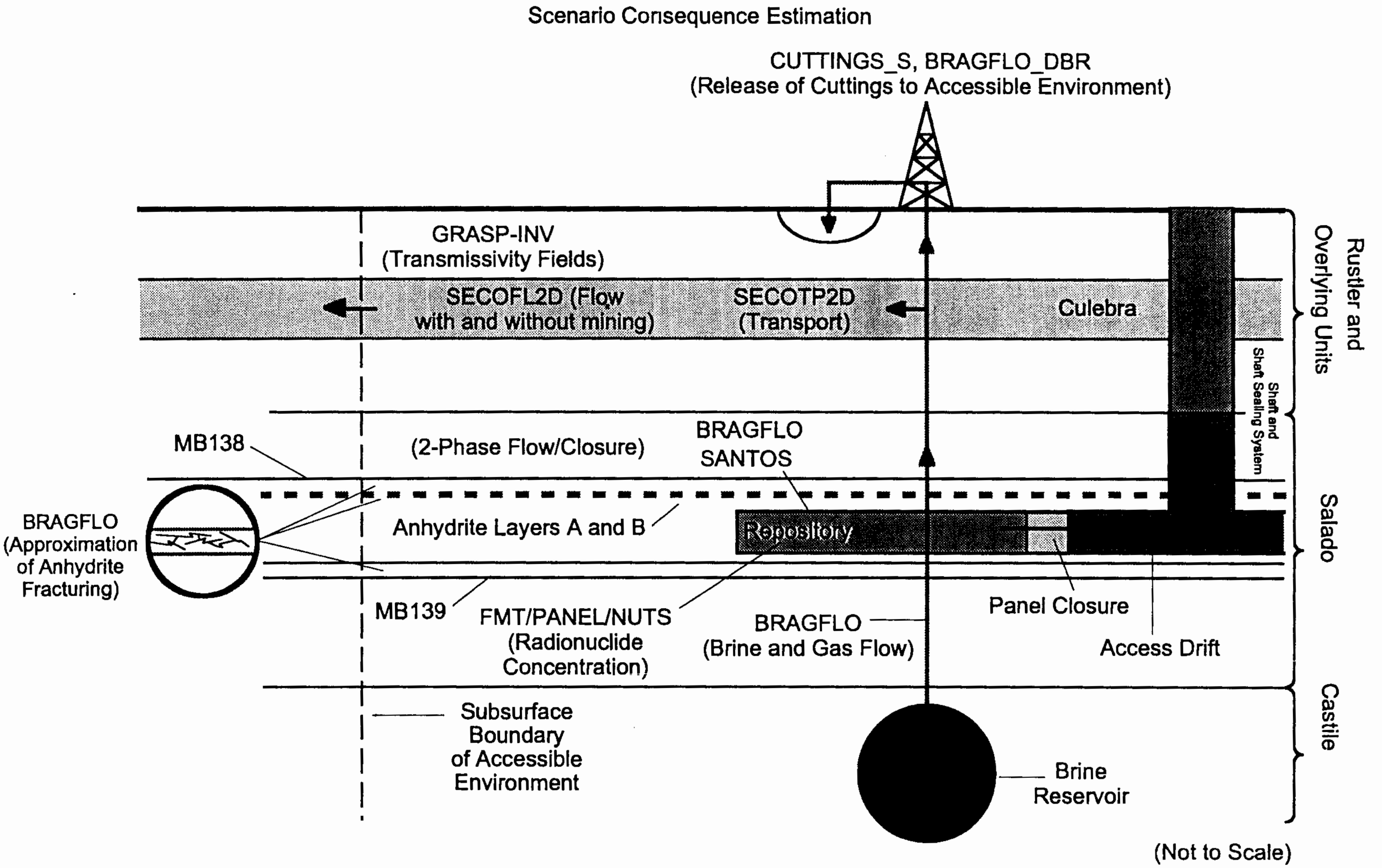

WIPP CCA Replicate 1: Mean CCDF for total releases to the accessible environment shown with mean CCDFs resulting from each of the three main release modes.

# Conclusions

- WIPP is in compliance with quantitative requirements for long-term disposal
- Undisturbed performance is excellent
- Isolation is effective even with multiple human intrusions
  - Direct releases at surface dominate
  - Groundwater releases are near zero
  - Natural and engineered systems are robust and well understood: Parameter uncertainty has little effect on CCDF

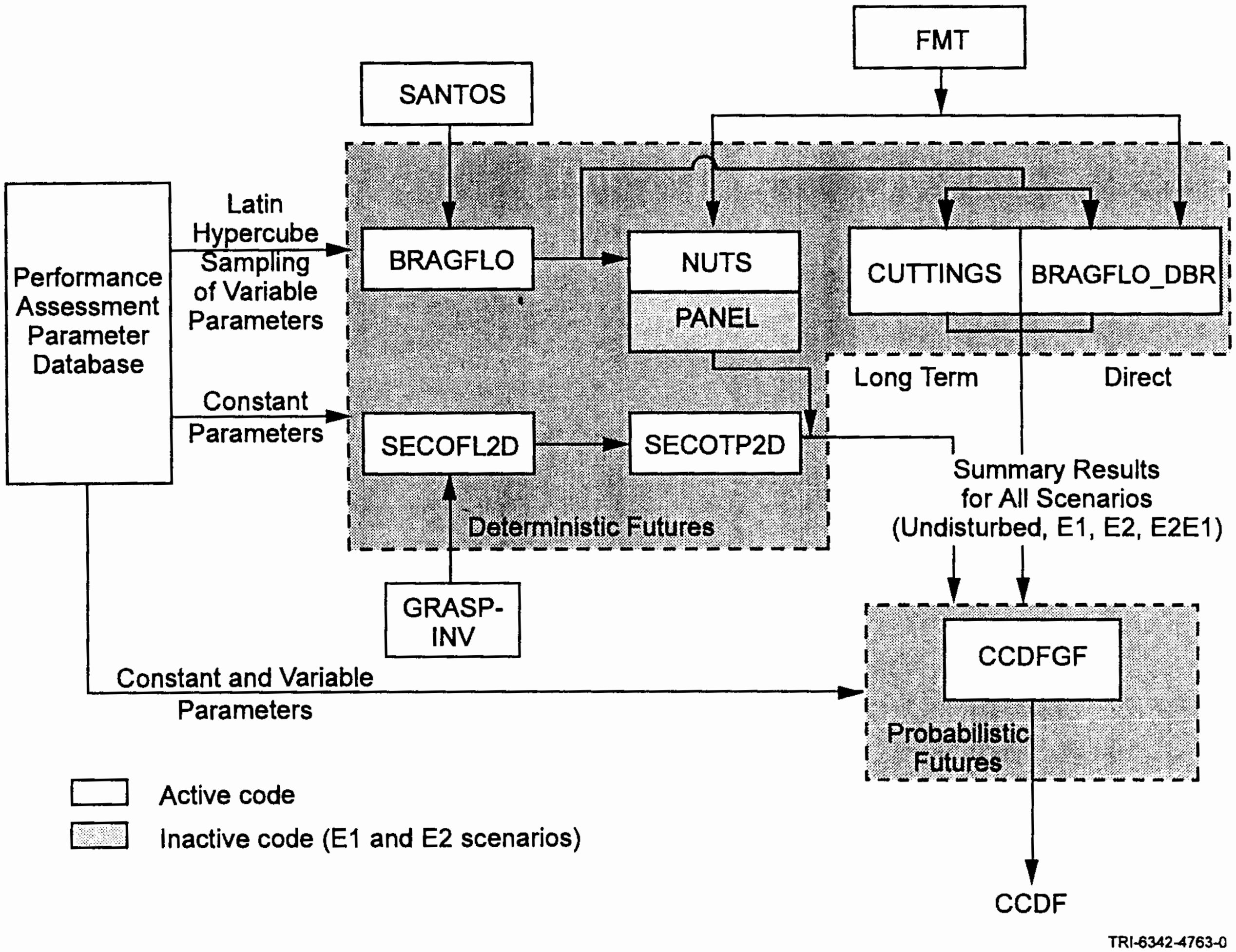
# The 1996 PA Modeling System and Sensitivity Analysis Results

# Conceptual Models Used in PA

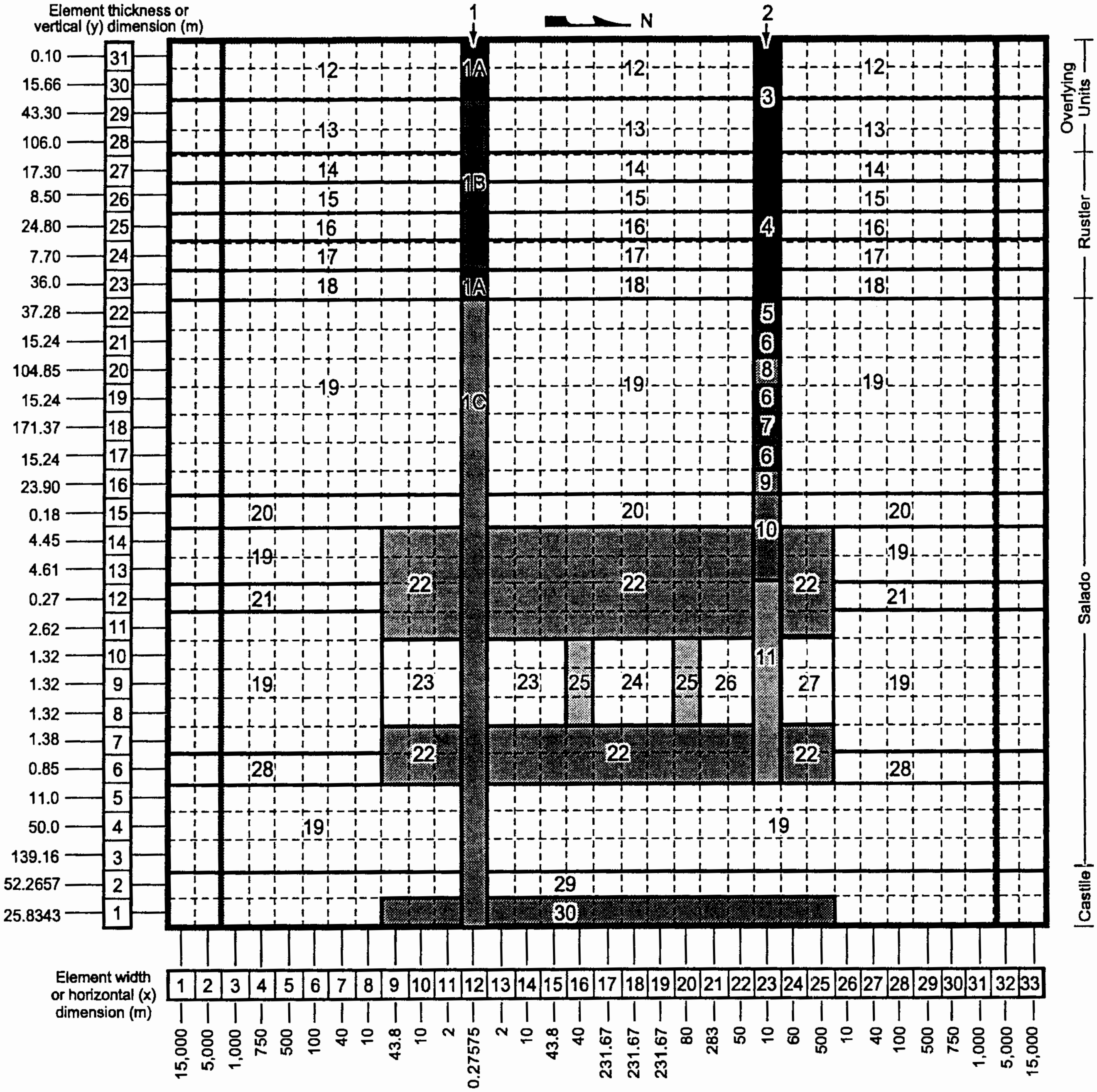



TRI-6342-4768-0

# Linkage of Computational Models



# The BRAGFLO Mesh

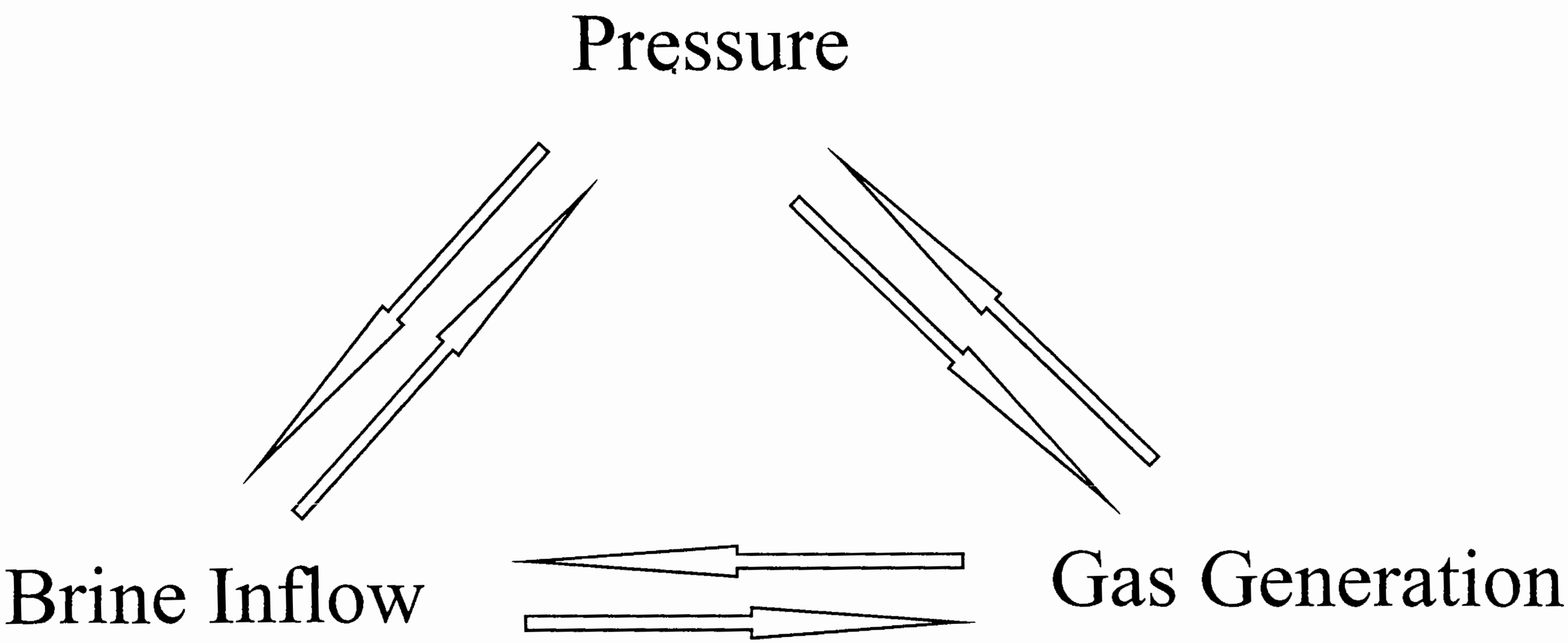



1. Borehole (first 200 years)
1A. Borehole concrete plug
1B. Upper unrestricted borehole
1C. Lower unrestricted borehole
2. Shaft
3. Earth fill
4. Rustler compacted clay column
5. Asphalt
6. Concrete
7. Crushed salt (compacted salt column)
8. Upper Salado compacted clay column
9. Lower Salado compacted clay column
10. Lower clay component
11. Concrete monolith
12. Units above the Dewey Lake
13. Dewey Lake
14. Forty-niner
15. Magenta
16. Tamarisk
17. Culebra
18. Unnamed lower Member
19. Impure halite
20. MB138
21. Anhydrite layer a and b
22. Disturbed rock zone
23. Waste panel
24. Rest of repository
25. Panel closures
26. Operation region
27. Experimental area
28. MB139
29. Castile
30. Brine reservoir

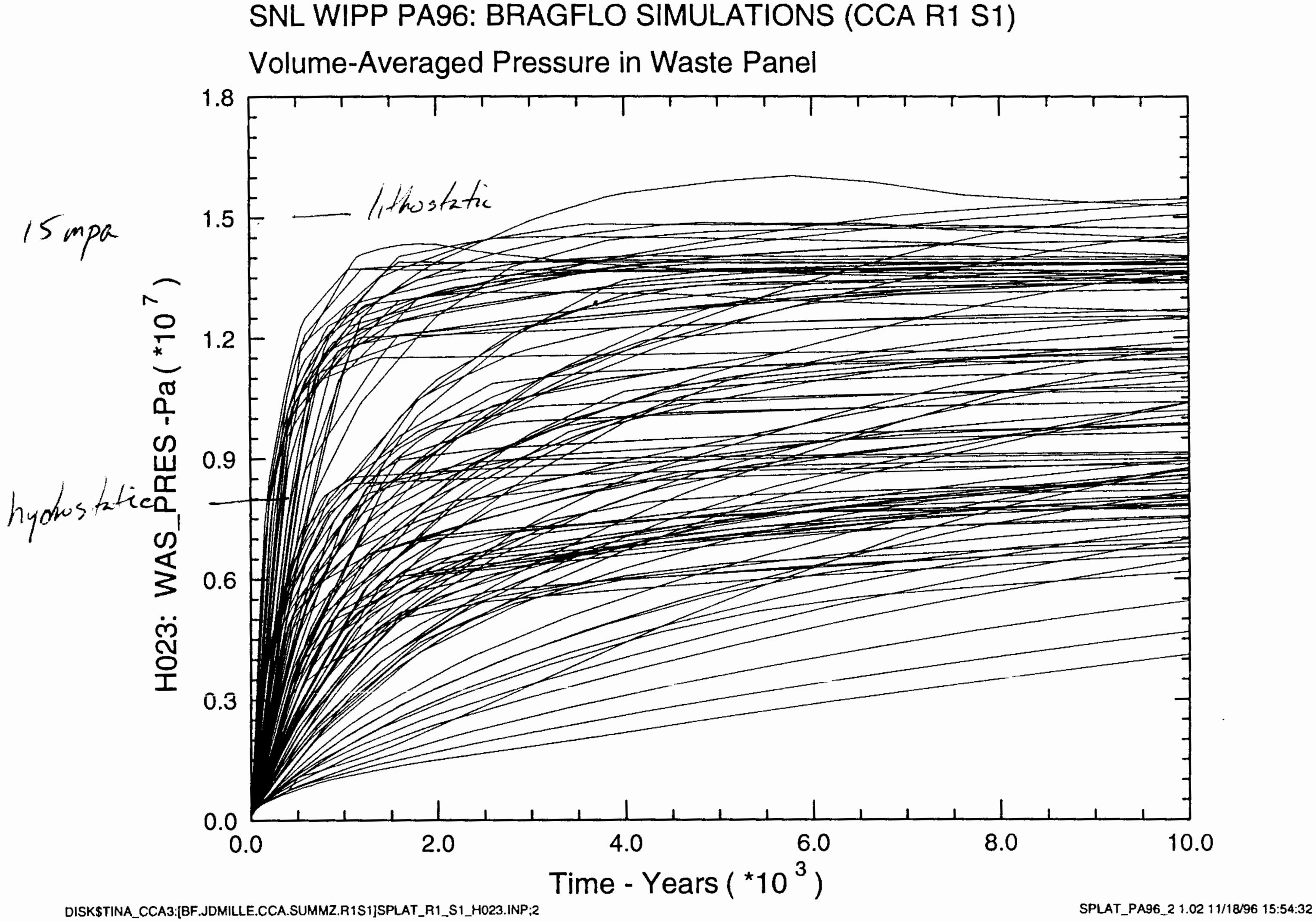
Boundary of accessible environment

TRI-6342-4753-0

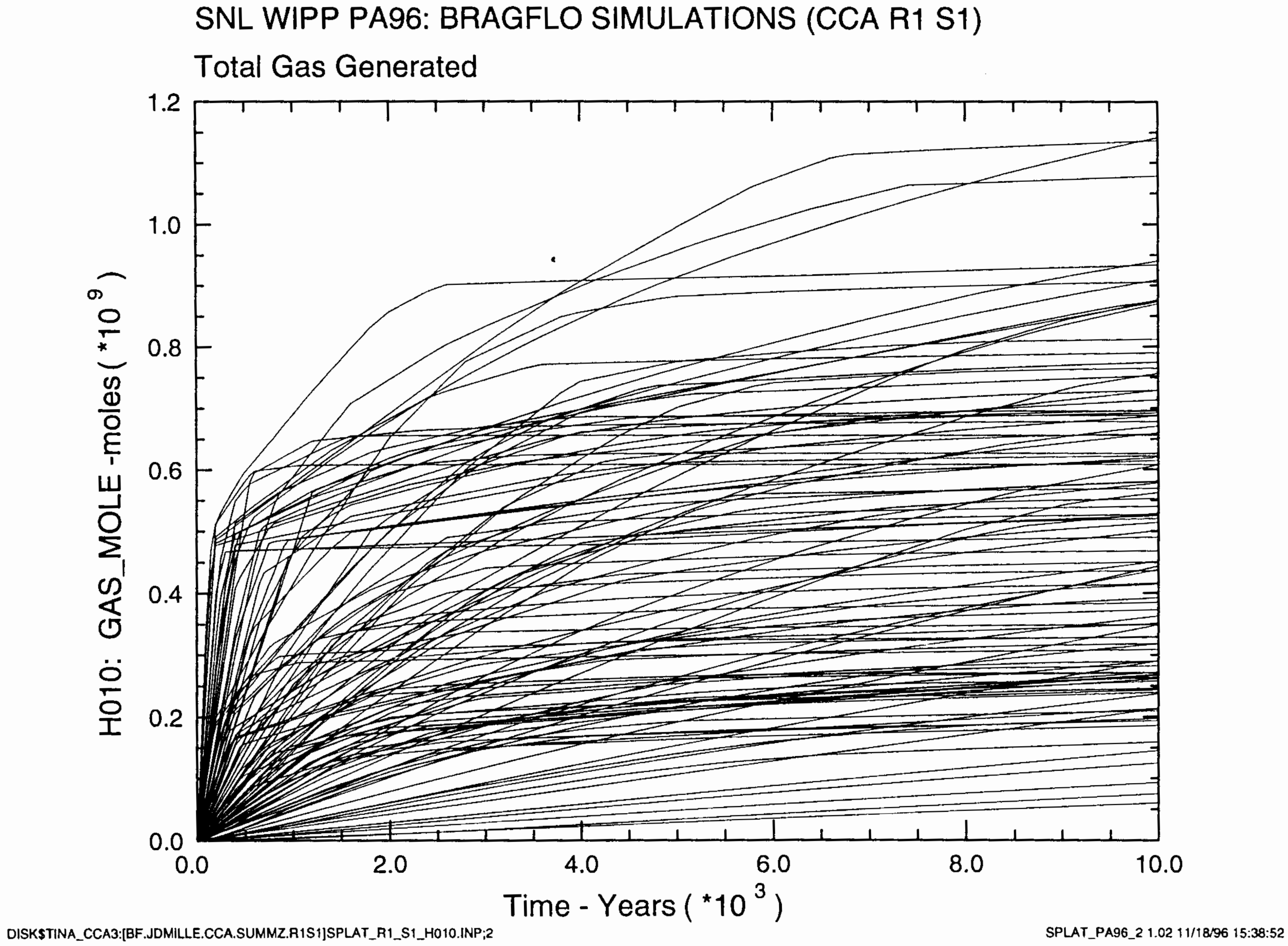
# Important Processes in Undisturbed Performance



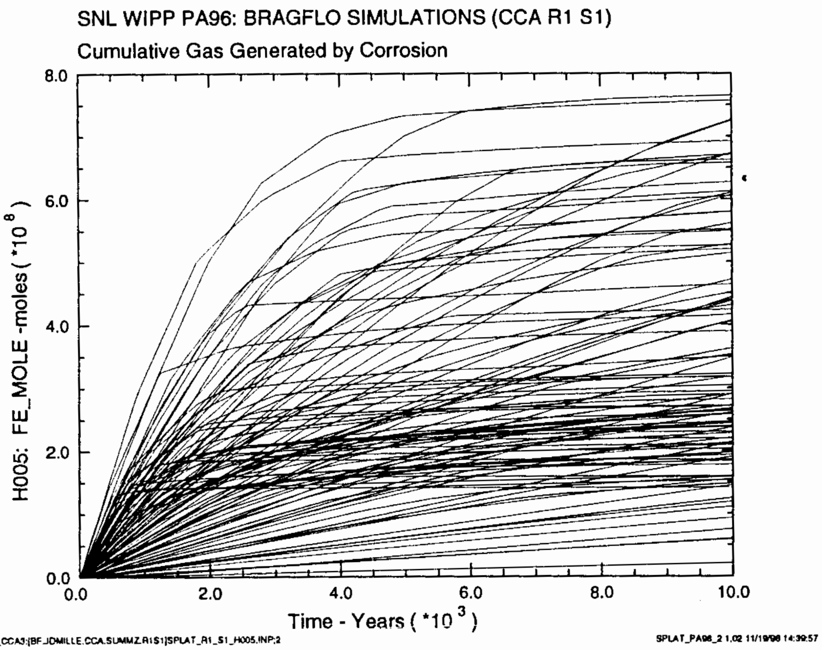
# Pressure in Undisturbed Repository

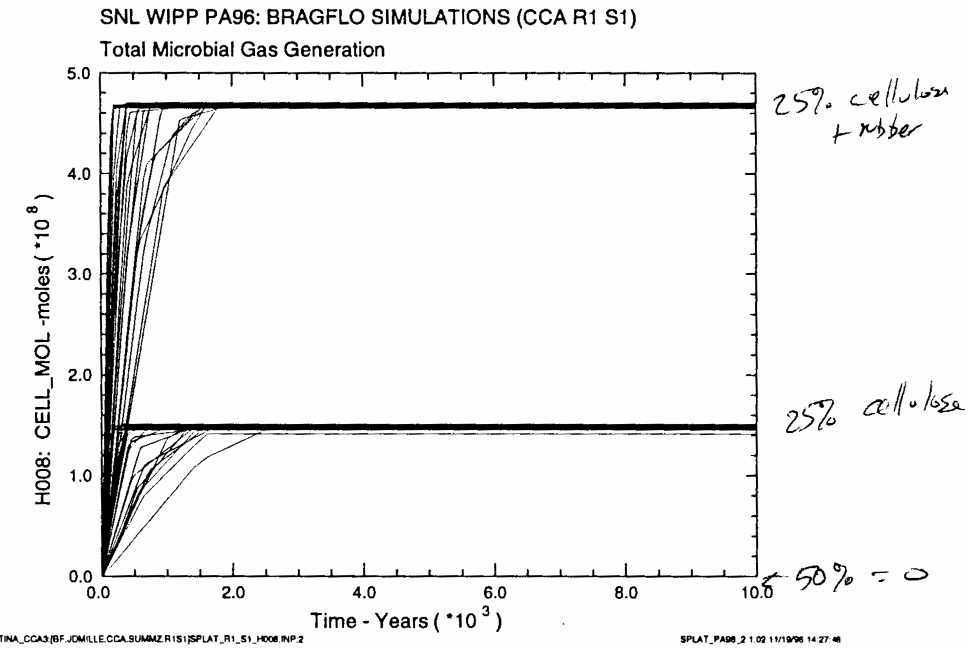


# Gas Generation: Total Moles Undisturbed Repository

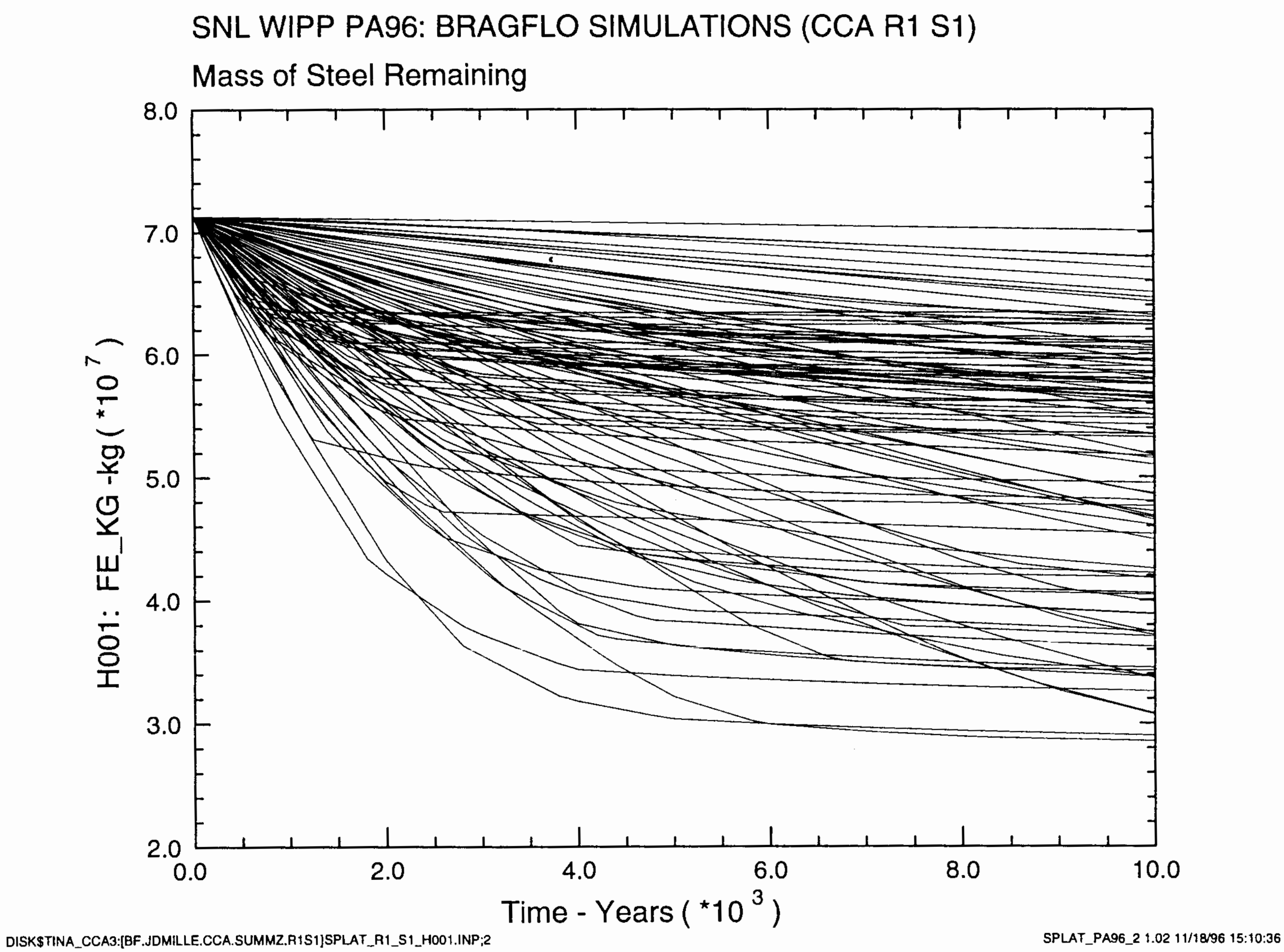


# Gas Generation from Corrosion and Microbial Degradation

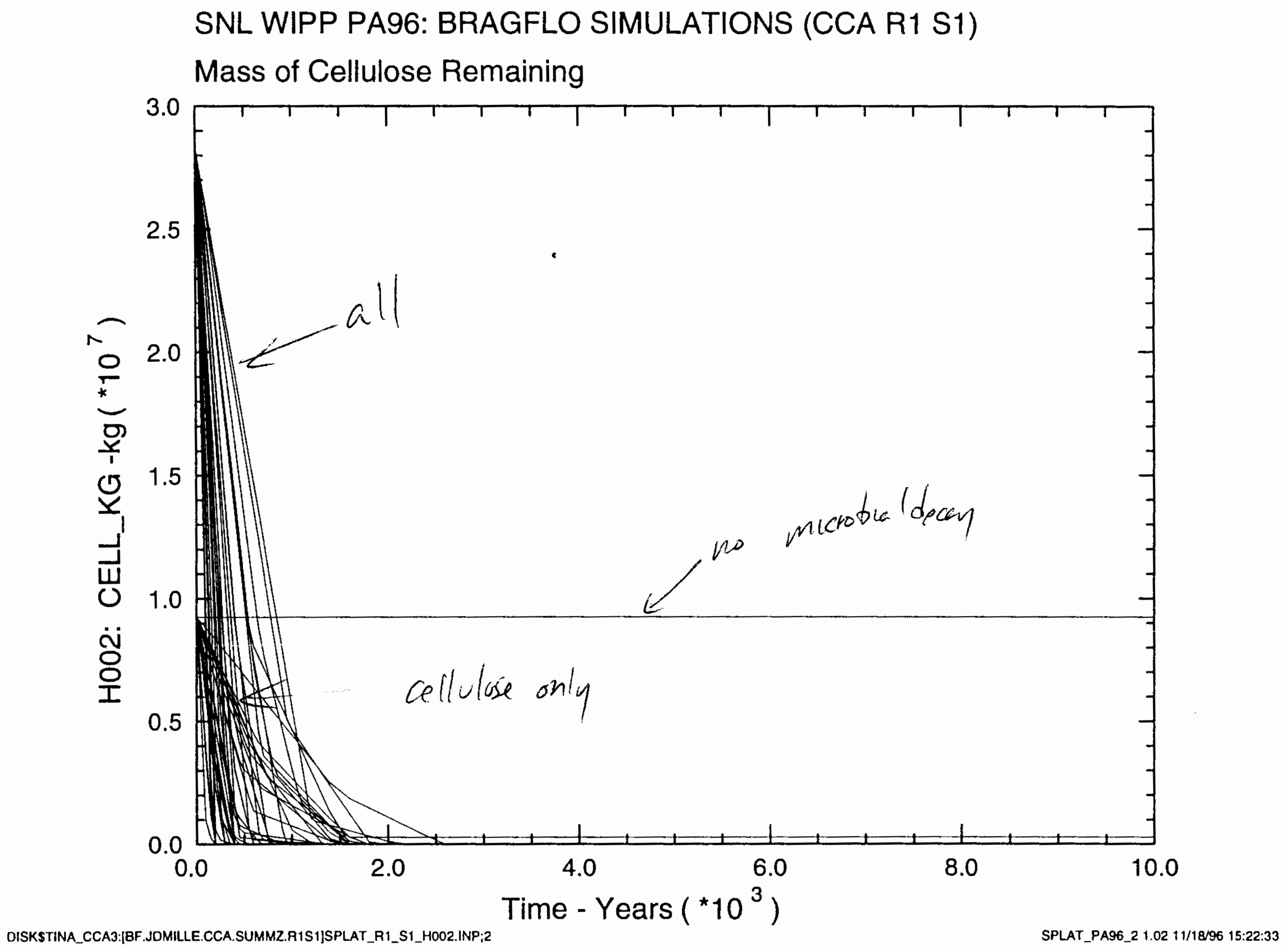


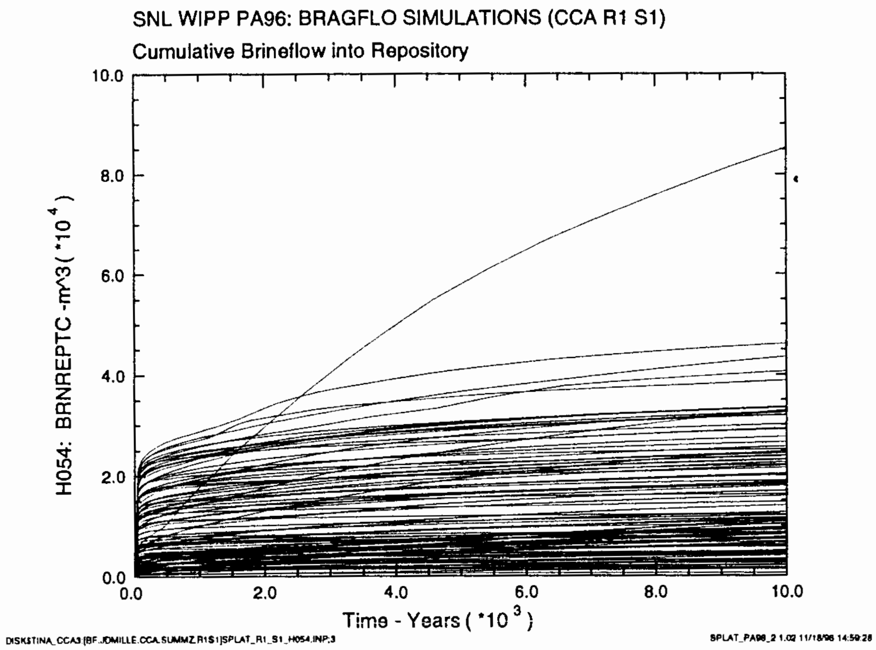
# Gas Generation: Mass of Steel Remaining
# Undisturbed Repository



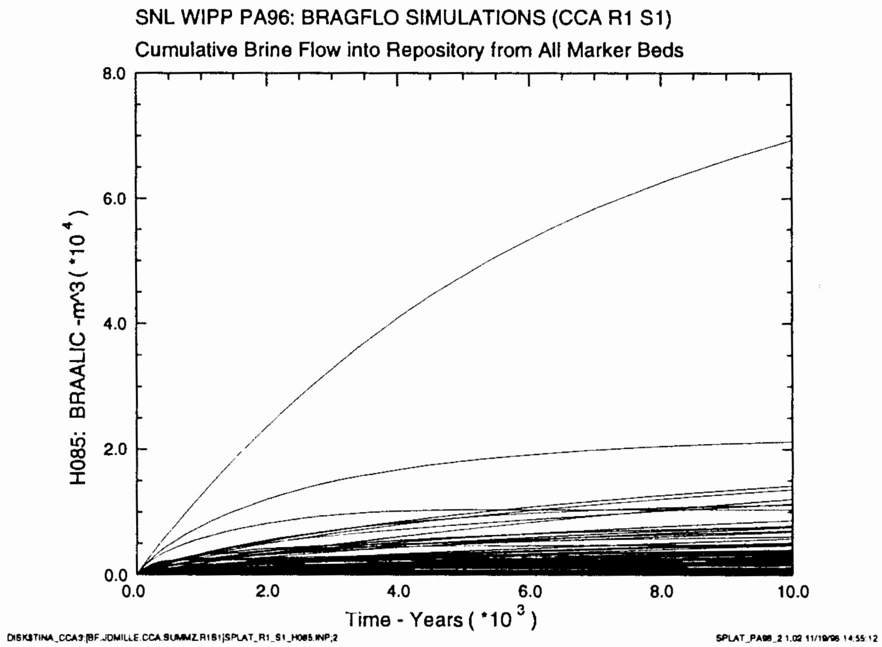
# Gas Generation: Mass of Cellulose Remaining
# Undisturbed Repository



# Brine Inflow into the Undisturbed Repository




far field + DRZ brine




Far field

# Sensitivity Analysis for Undisturbed Performance

- Regression Analysis results are conditional on models and parameter distributions
- Repository Pressure
  - Probability of microbial degradation
  - Halite porosity
  - Corrosion rate
- Gas Generation
  - Probability of microbial degradation
  - Halite porosity
  - Corrosion rate

# Sensitivity Analysis for Undisturbed Performance -- Brine Inflow

- Marker Beds
  - Probability of Microbial Degradation
  - Anhydrite Permeability
  - Halite Porosity
  - Corrosion Rate
  - Halite Permeability
- Total
  - Halite Porosity (controls DRZ porosity)
  - Same list as above

# What Affects Human Intrusion Releases?

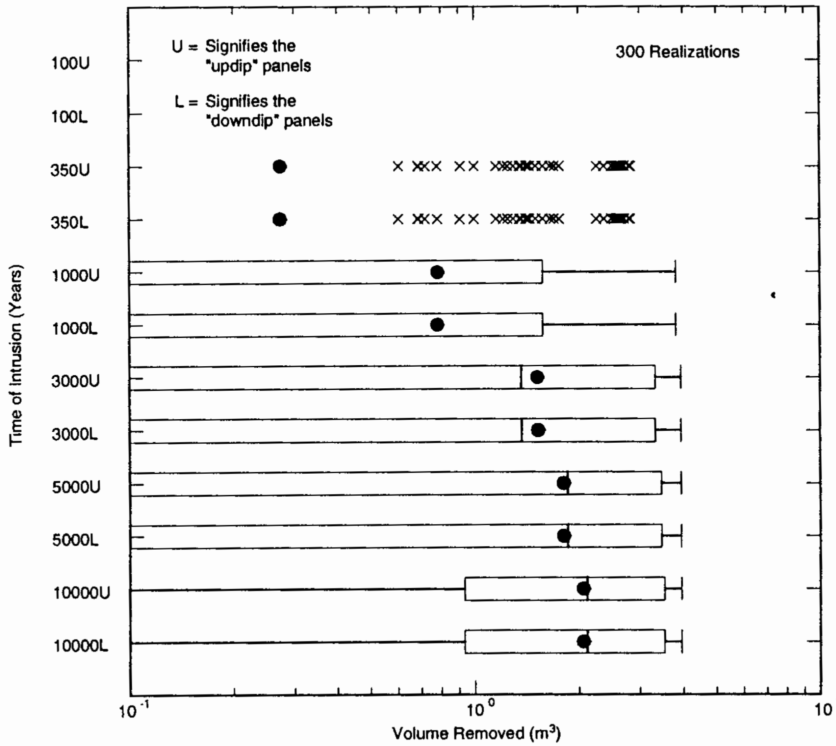
Cuttings and Cavings + Spallings + Direct Brine Release + Groundwater Transport (Culebra and Marker Beds) = Total

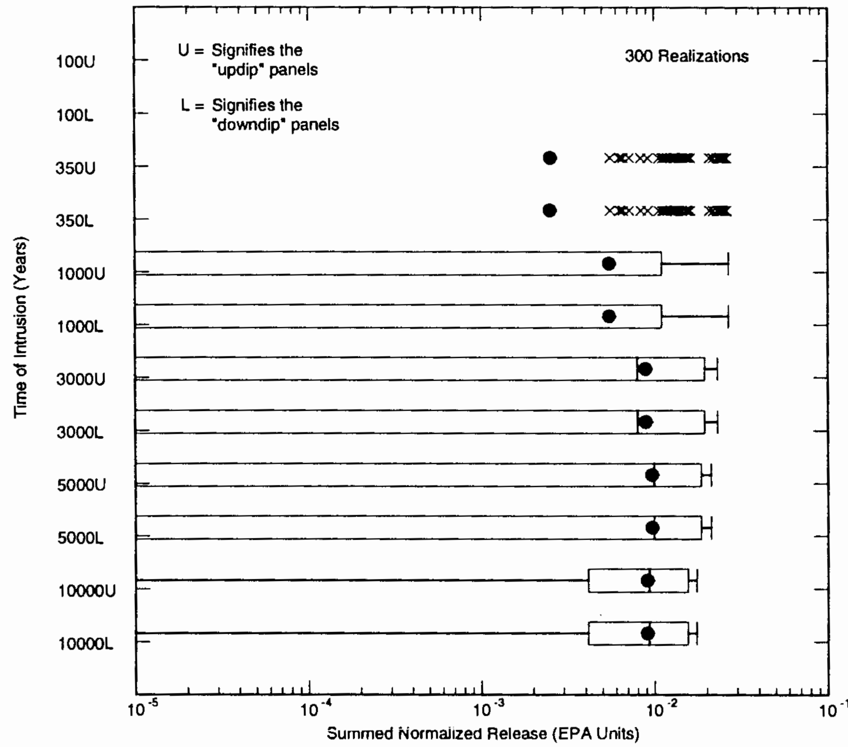
| Cuttings and Cavings | Spallings | Direct Brine Release | Groundwater Transport (Culebra and Marker Beds) |
|---|---|---|---|
| Drilling Rate (constant) | Drilling Rate (constant) | Drilling Rate (constant) | no release at scale of interest |
| Bit Diameter (constant) | Pressure (calculated) | Pressure (calculated) | |
| Waste Erosion Shear Strength (sampled) | Particle Diameter (sampled) | Waste Saturation (calculated) | |
| | Waste Tensile Strength (constant) | Concentrations (calculated from sampled values) | |

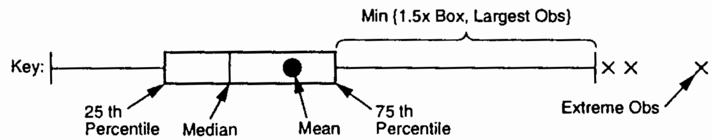
# Spallings

- If pressure is less than borehole hydrostatic (8 MPa) at intrusion, no spalling occurs
- If pressure exceeds 8MPa
  - gas flows toward borehole through channels
  - erosion of waste occurs from channel walls
  - volume of waste removed is sensitive to particle diameter

# Spallings Releases



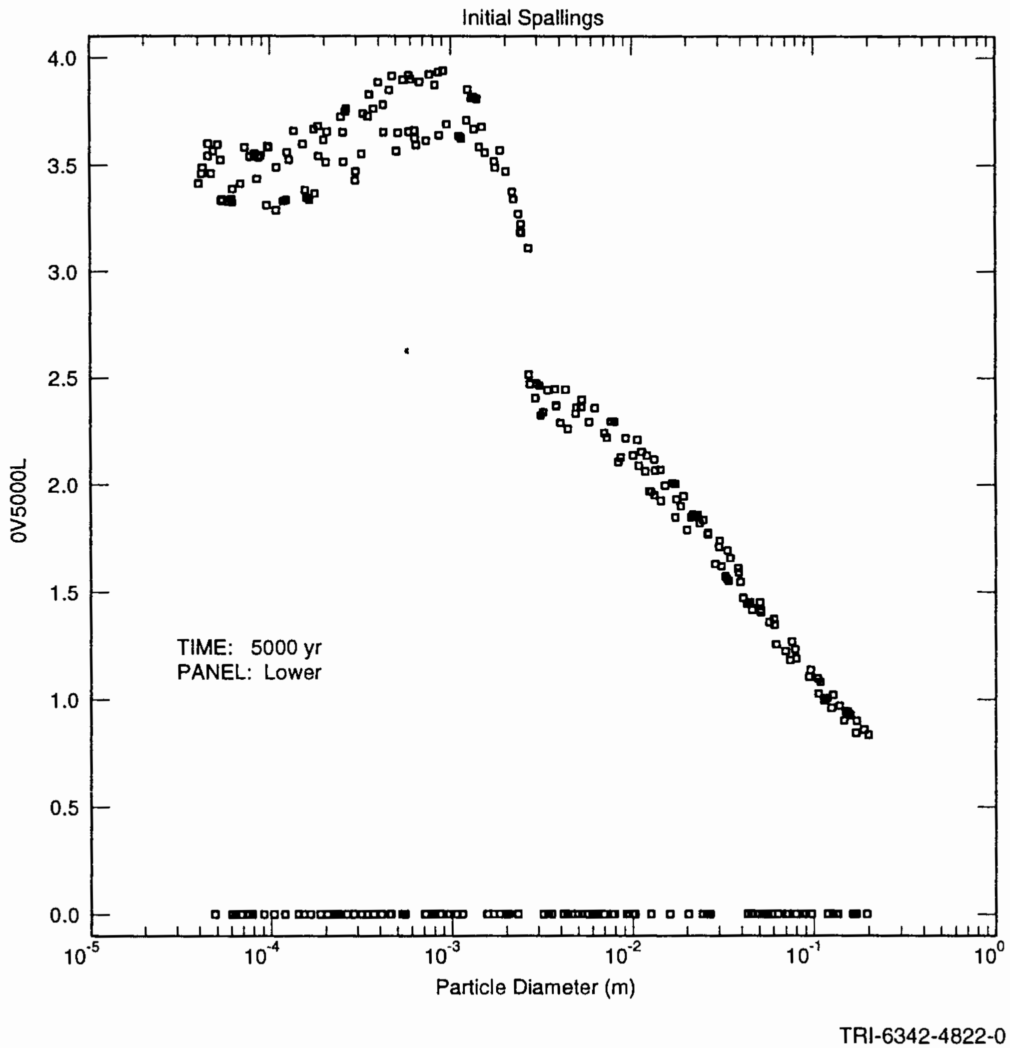




TRI-6342-4773-1

CCA-SA007-0

# Spallings Volume ($m^3$) vs. Waste Particle Diameter

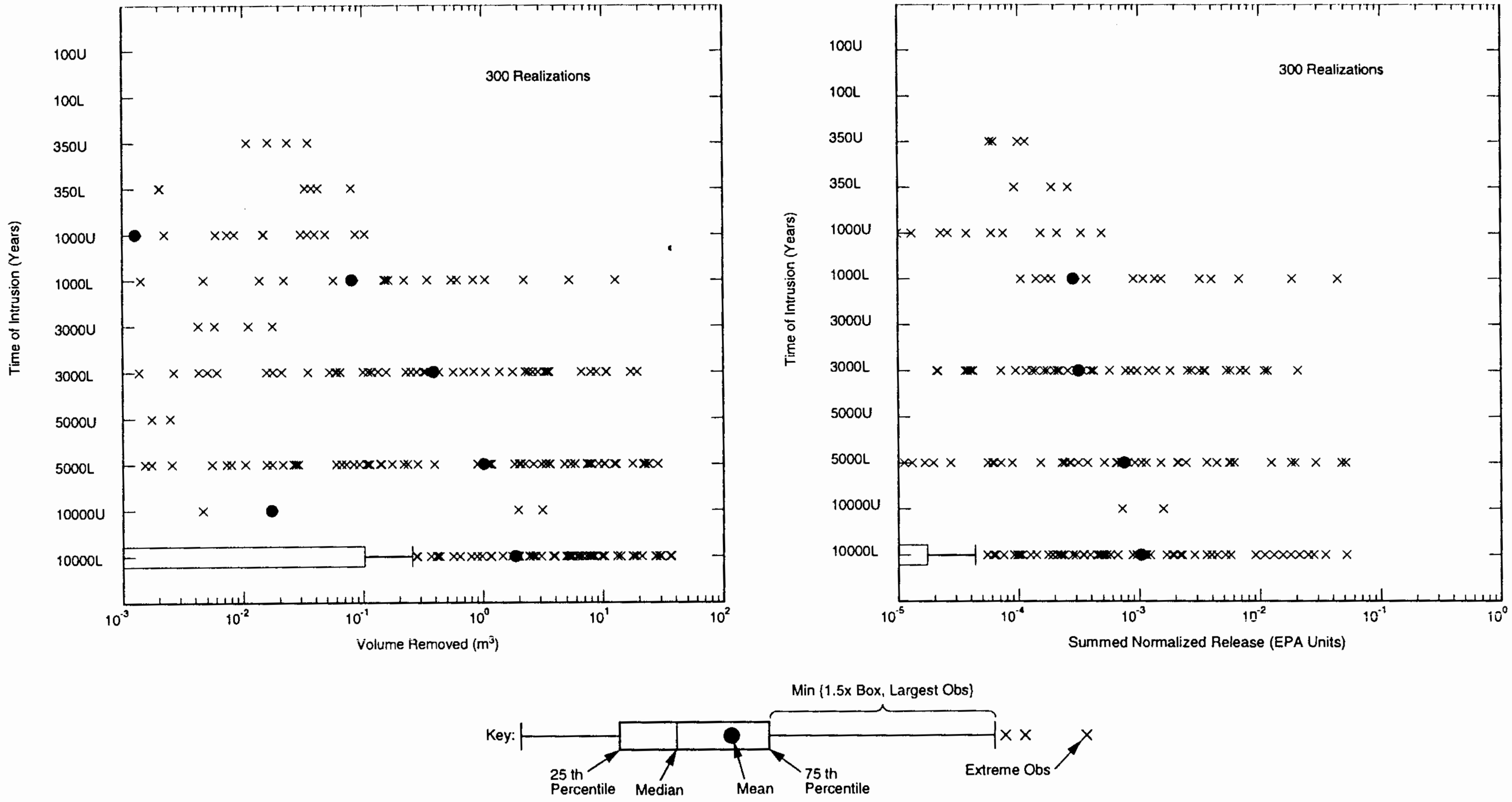



CCA-SA009-0

# Direct Brine Release

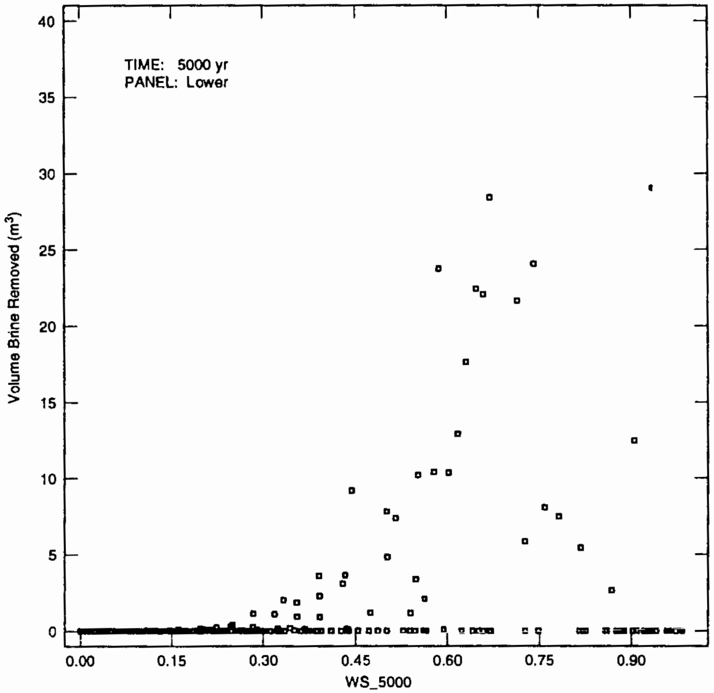
- If pressure is less than 8 MPa at intrusion, no direct brine release occurs
- If pressure is greater than 8 MPa
  - Two-phase flow toward the borehole is calculated using BRAGFLO_DBR
  - If flow occurs, volume is sensitive to pressure and saturation
  - Actinides transported in liquid phase that goes up borehole are added to total release

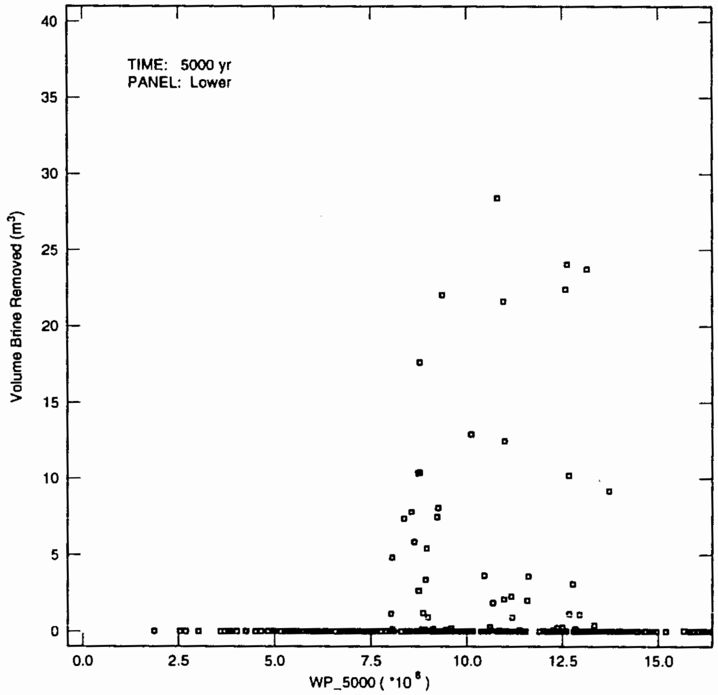
# Direct Brine Releases




TRI-6342-4775-1

# Direct Brine Releases vs. Brine Saturation (left) and Pressure (right)

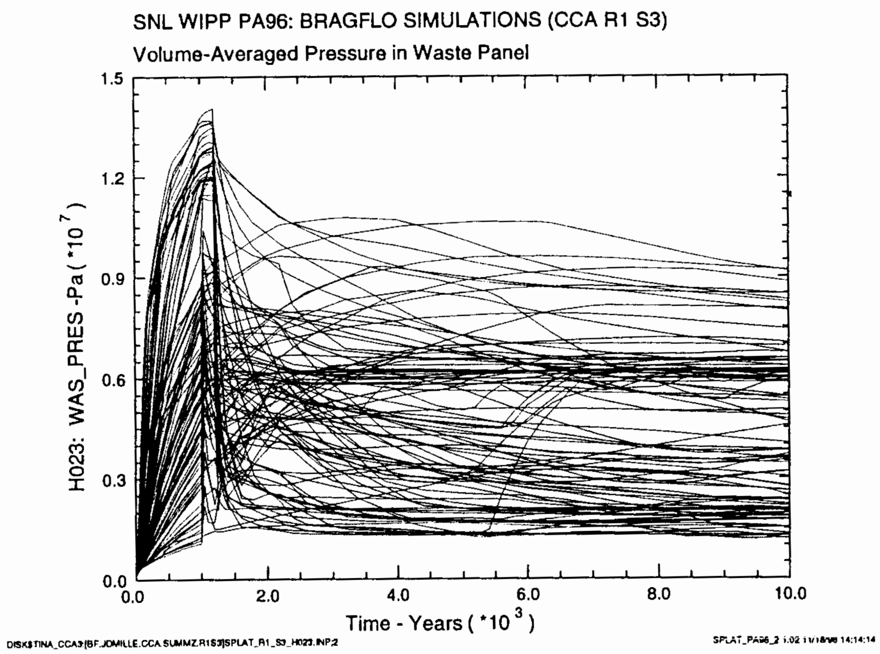


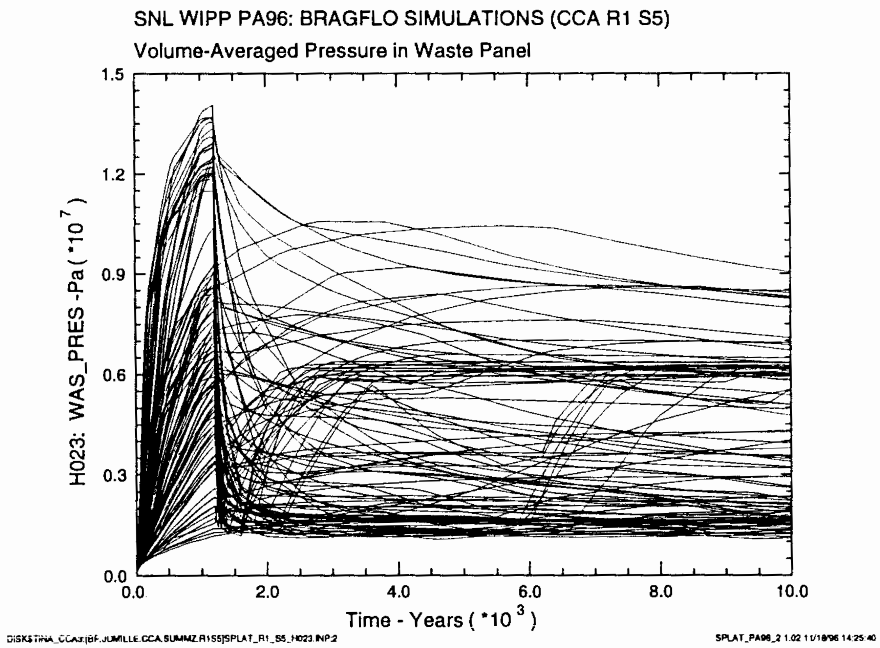

TRI-6342-4823-0

CCA-SA017-0

# Pressure in Waste Panel with E1 and E2 Intrusions at 1000 years




E1

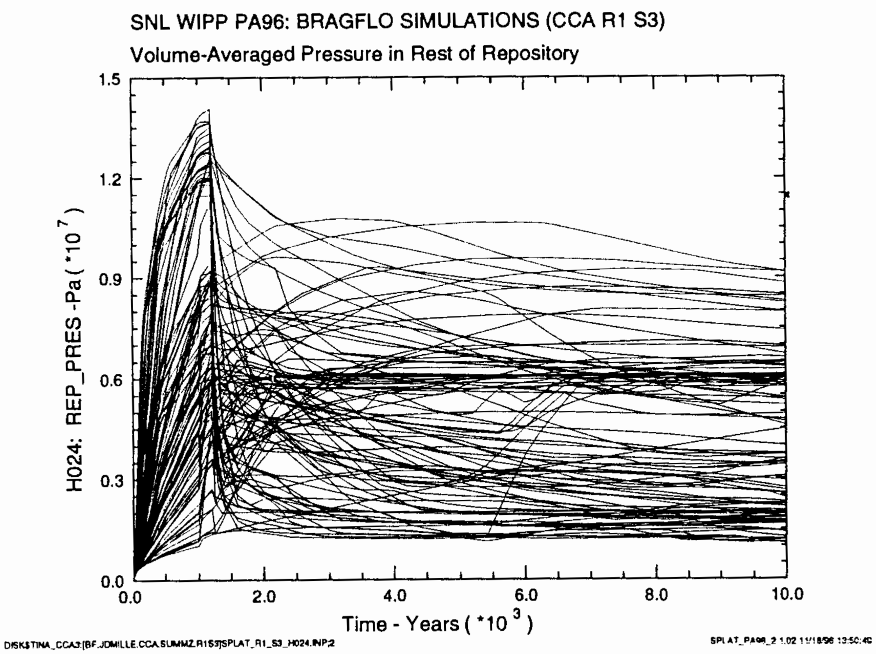



E2

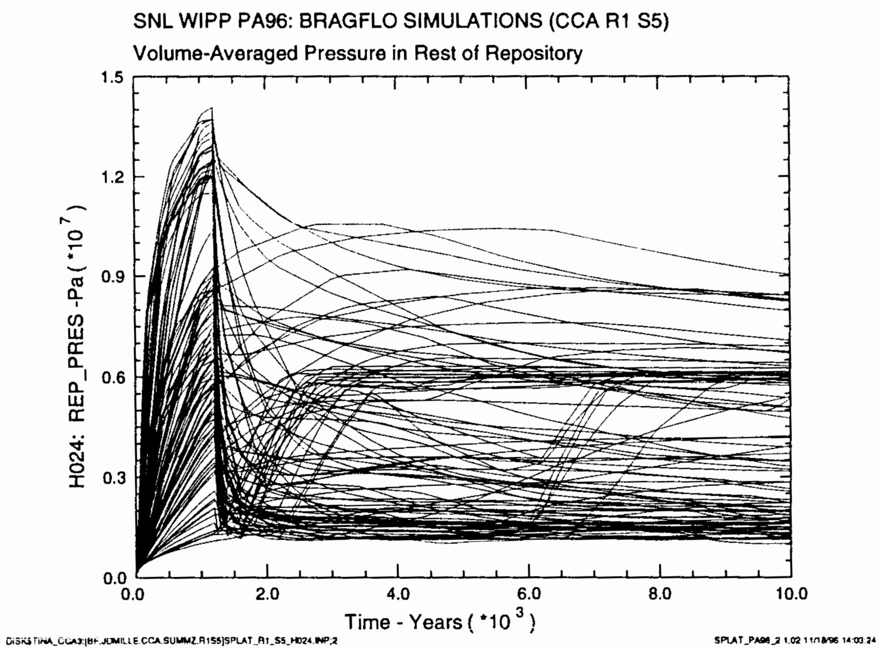
# Sensitivity Analysis for Disturbed Performance

- Pressure in panel for E1 and E2 intrusions
  - Probability of Microbial Degradation
  - Corrosion Rate
  - Wicking Parameter
  - Borehole Permeability (dominates after intrusion)

# Pressure in Rest of Repository for E1 and E2 at 1000 years




E1

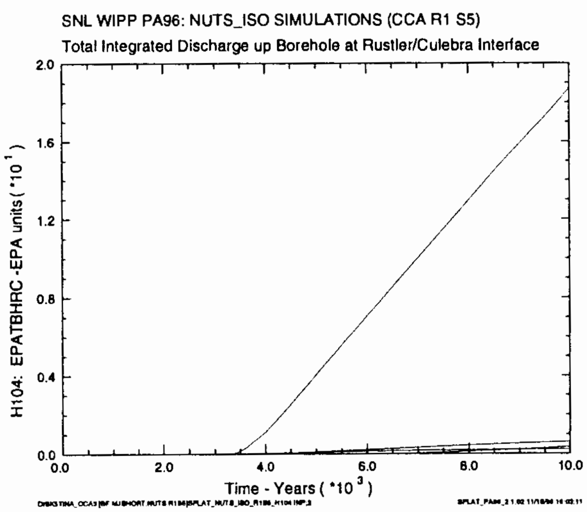



E2

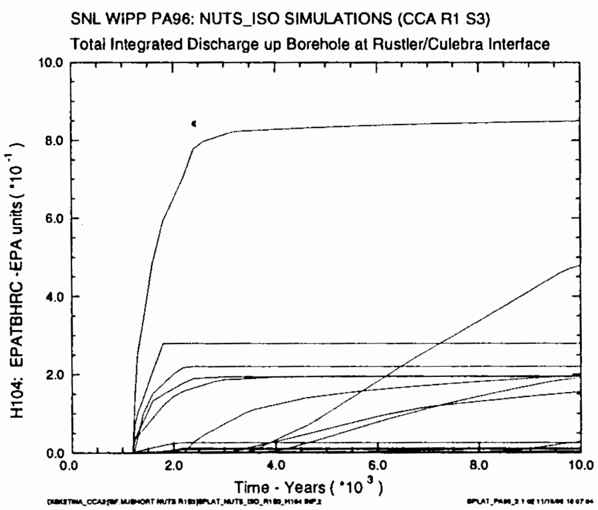
# Flow and Transport in Culebra

- Flow fields and travel paths are affected by mining, result is a shift to west, into generally slower travel paths see slide 54
  - no effect on CCDF for total releases
- Combination of physical and chemical retardation processes are effective in preventing transport
  - No contribution to the CCDF for total releases from groundwater releases through Culebra

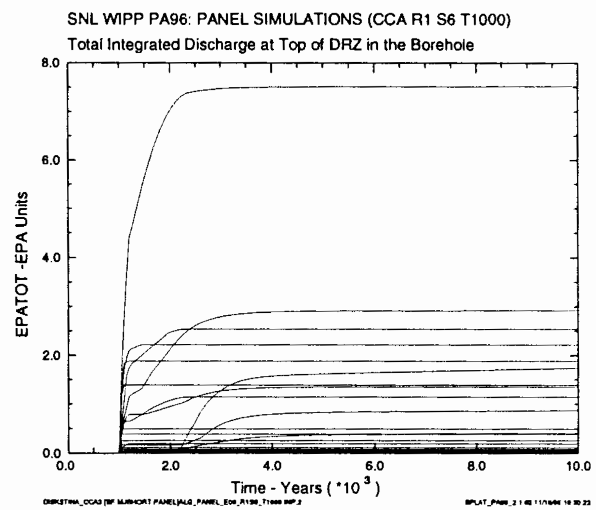
# Releases from the Borehole to the Culebra (in EPA Units)




E2




E1




E1E2

Intrusions at 1000 years

# Specific Topics in Brief

- Room Chemistry, Actinide Source Term, Gas Generation, Culebra Flow and Transport, and Regional Groundwater Flow will be covered in later presentations
- Treatment of the DRZ, Panel Closures, and Compartmentation
- Drilling Assumptions (rate, plugging)
- Potash Mining
- Castile Brine Reservoirs
- Waterfloods for secondary oil recovery
- Guidance to Waste Characterization

# The Disturbed Rock Zone

- Around Shaft Seals (see later presentation)
  - Halite DRZ heals with time
    - Shaft seal component permeabilities adjusted in BRAGFLO
  - Continuous vertical DRZ not present because of thick sections of halite
- Around panels and drifts
  - DRZ assumed not to heal with time

# The Disturbed Rock Zone (cont.)

- Basis for constant DRZ properties
  - Nearby anhydrite layers will not heal
    - MB139 is about 1.5 m below, a and b are 2 and 4 meters above
    - rock bolts and test boreholes provide connections, no present plan to plug them all
  - Effects of pressure-dependent increases in permeability and porosity (i.e., fracturing) are minor

# The Disturbed Rock Zone (cont.)

- The DRZ around rooms and drifts
  - As modeled, extends from base of MB138 to base of MB139 (11.95 m above and 2.23 m below panels)
  - Permeability constant at $10^{-15}$ $m^2$
    - $10^{-17}$ $m^2$ during a five year start-up operational simulation
  - Porosity is 0.29 % greater than sampled value for halite
    - halite porosity ranges from 0.1 % to 3.0 %
  - Initially fully saturated with brine

# The DRZ around Panel Closures

- Assumed to be the same as the DRZ around the rooms
  - reasonable with respect to anhydrite layers
  - perhaps underestimates rehealing of halite, depending on the panel closure design
- Permeability of panel closures same as DRZ in model (porosity is 7.5%)
  - based on estimate of little degradation of concrete closure and potential for DRZ bypass

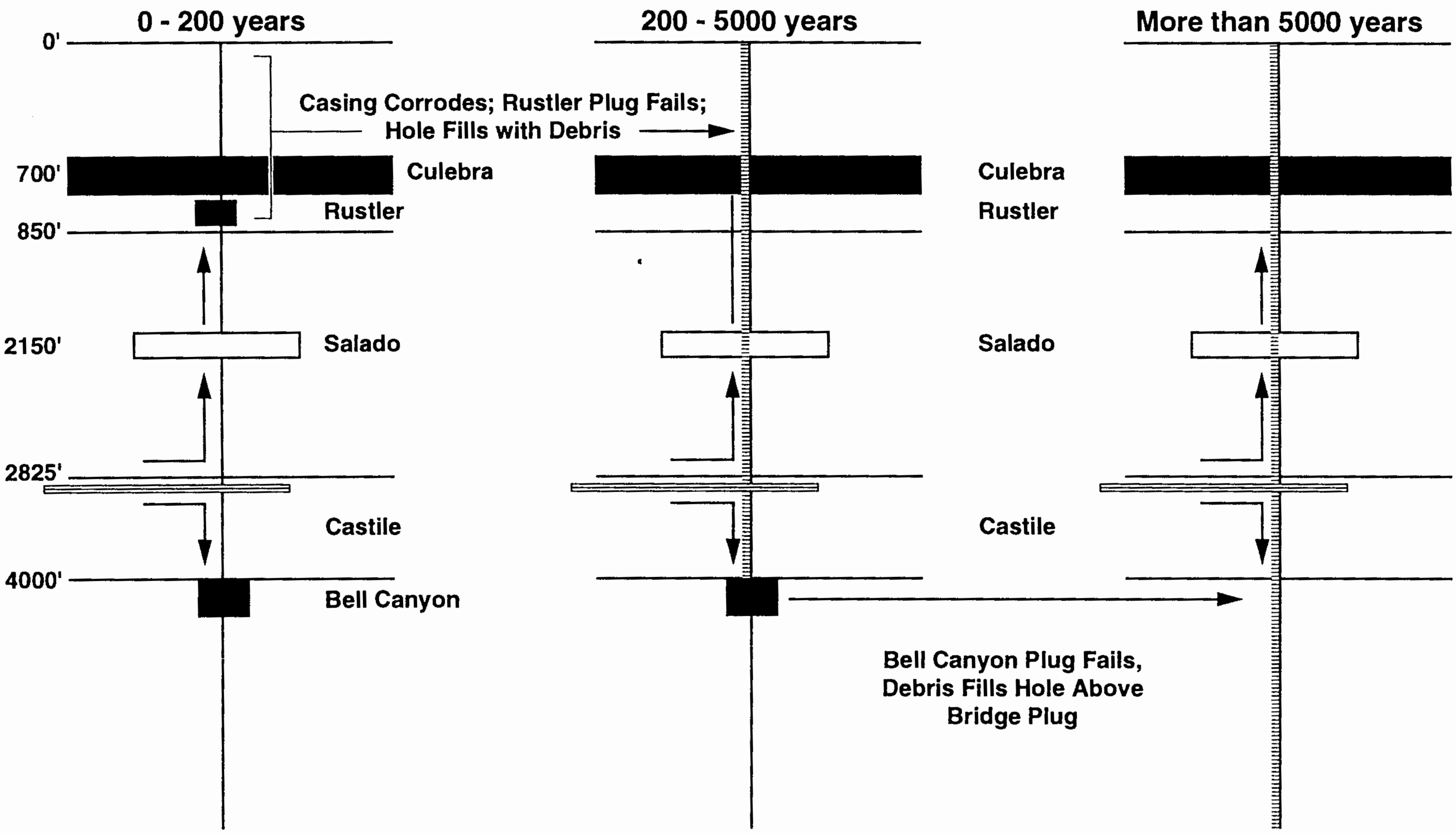
# Panel Closures and Compartmentation

- Panel closures have little effect on pressure-dependent direct releases
- Panel closures do affect groundwater releases
  - panel closures are sufficiently effective that boreholes in separate panels are modeled independently with respect to brine flow
  - E1E2 combinations limited to borehole pairs in the same panel
    - Complete mixing assumed within single panel for E1E2 (PANEL code used)
- Modifications to panel closure design are not needed to demonstrate compliance

# Drilling Assumptions

- Rate is held constant at 46.8 boreholes/km$^2$/10,000 years
- Active and Passive Institutional Controls 99% effective for 700 years
- Drilling technique based on current practice
  - rotary drilling, constant borehole diameter (12.25 in)
  - flow at surface during drilling possible, limited to eleven days
  - surface casing in place before entering salt
- Plugging patterns based on current practice

# Plugging Patterns: The Two-Plug Configuration




TRI-6342-4824-0

# Potash Mining

- Treatment specified by the EPA
  - transmissivity in Culebra varied between "unchanged and increased 1000-fold relative to to the value that would exist in the absence of mining."
  - mining limited to resource "similar in quality and type to those resources currently extracted from the Delaware Basin"
  - mining outside controlled area assumed to occur in near future
  - mining inside controlled area occurs randomly, with a 1 in 100 chance of occurring in each future century (adjusted for passive controls)
- No effect on CCDF for total releases

# Effect of Mining Outside Controlled Area


CCA-128-2

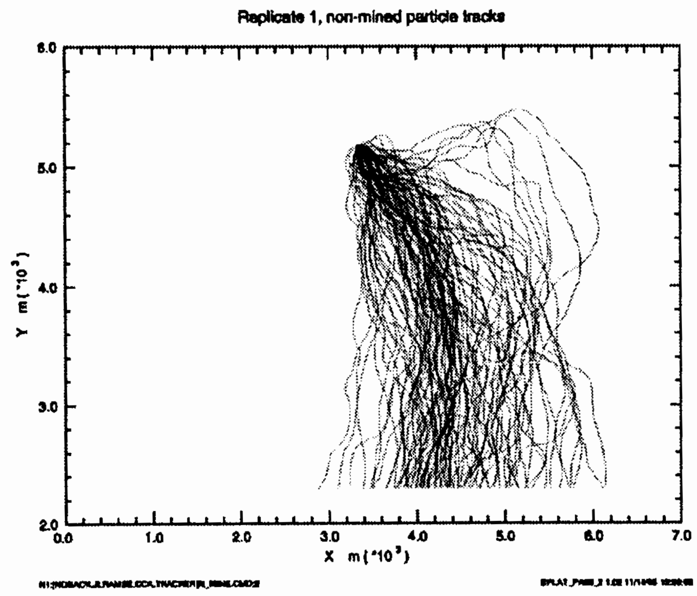
TRI-6342-4770-0

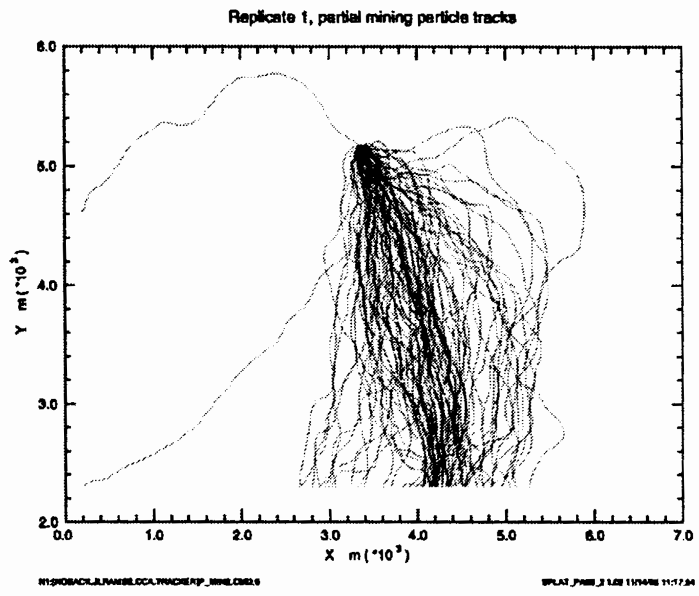
# Effect of Mining Inside Controlled Area

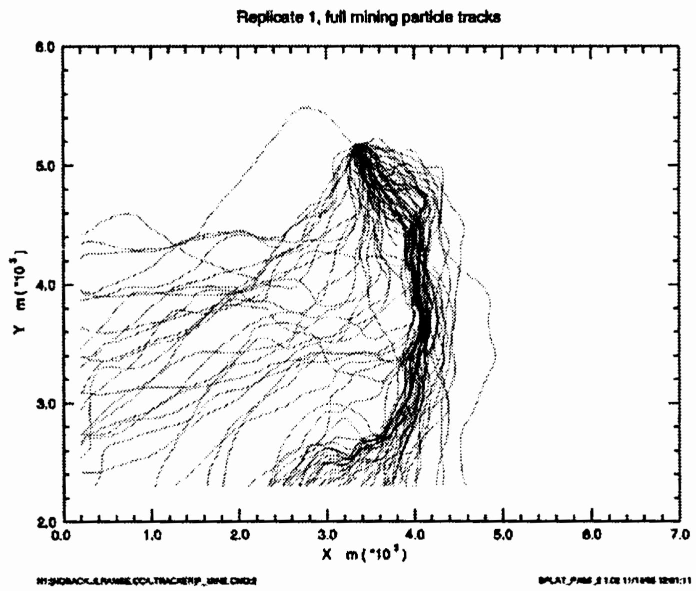

CCA-129-2

TRI-6342-4771-0

# Impact of Mining on Culebra Flow



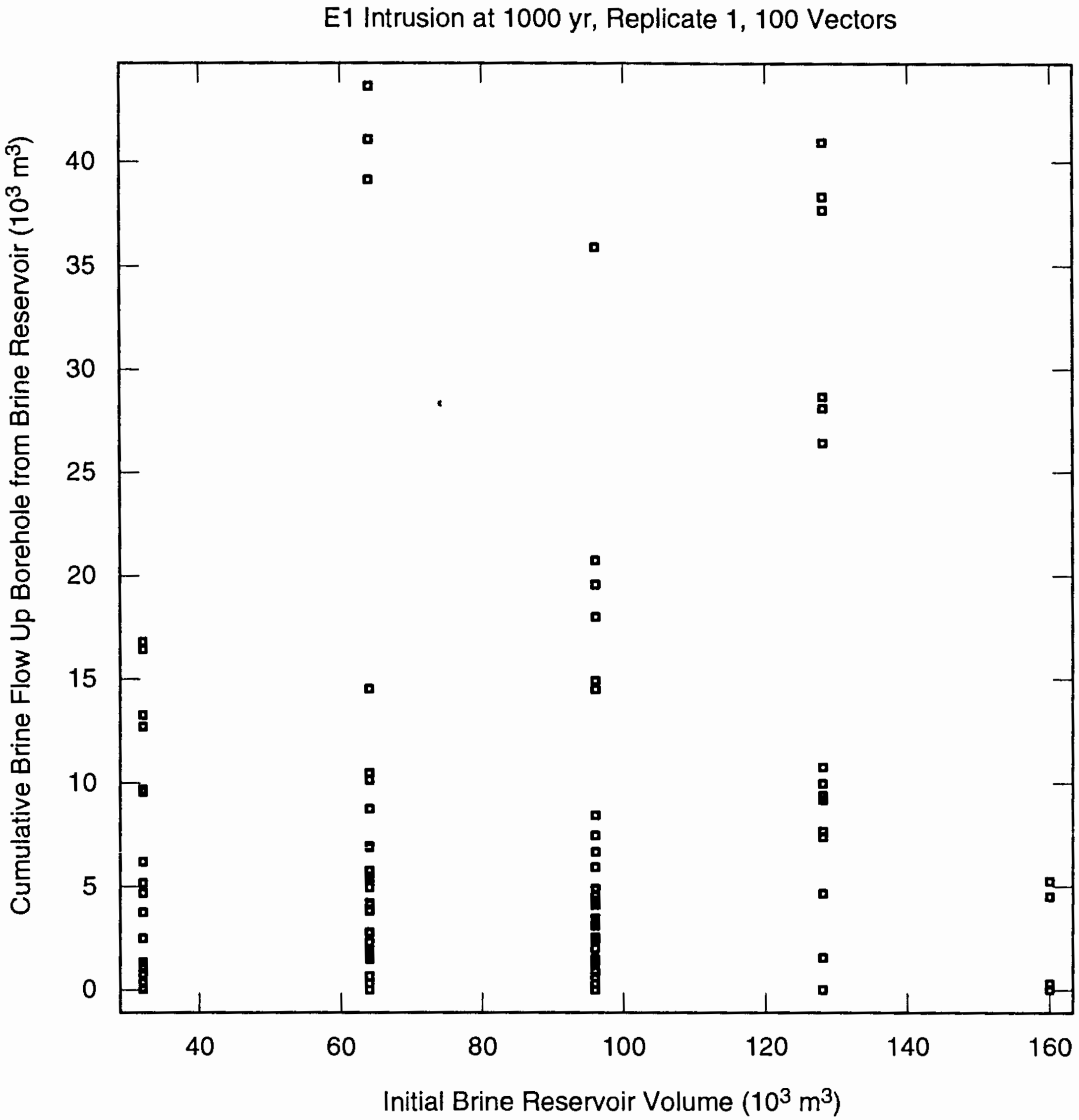



# Castile Brine Reservoirs

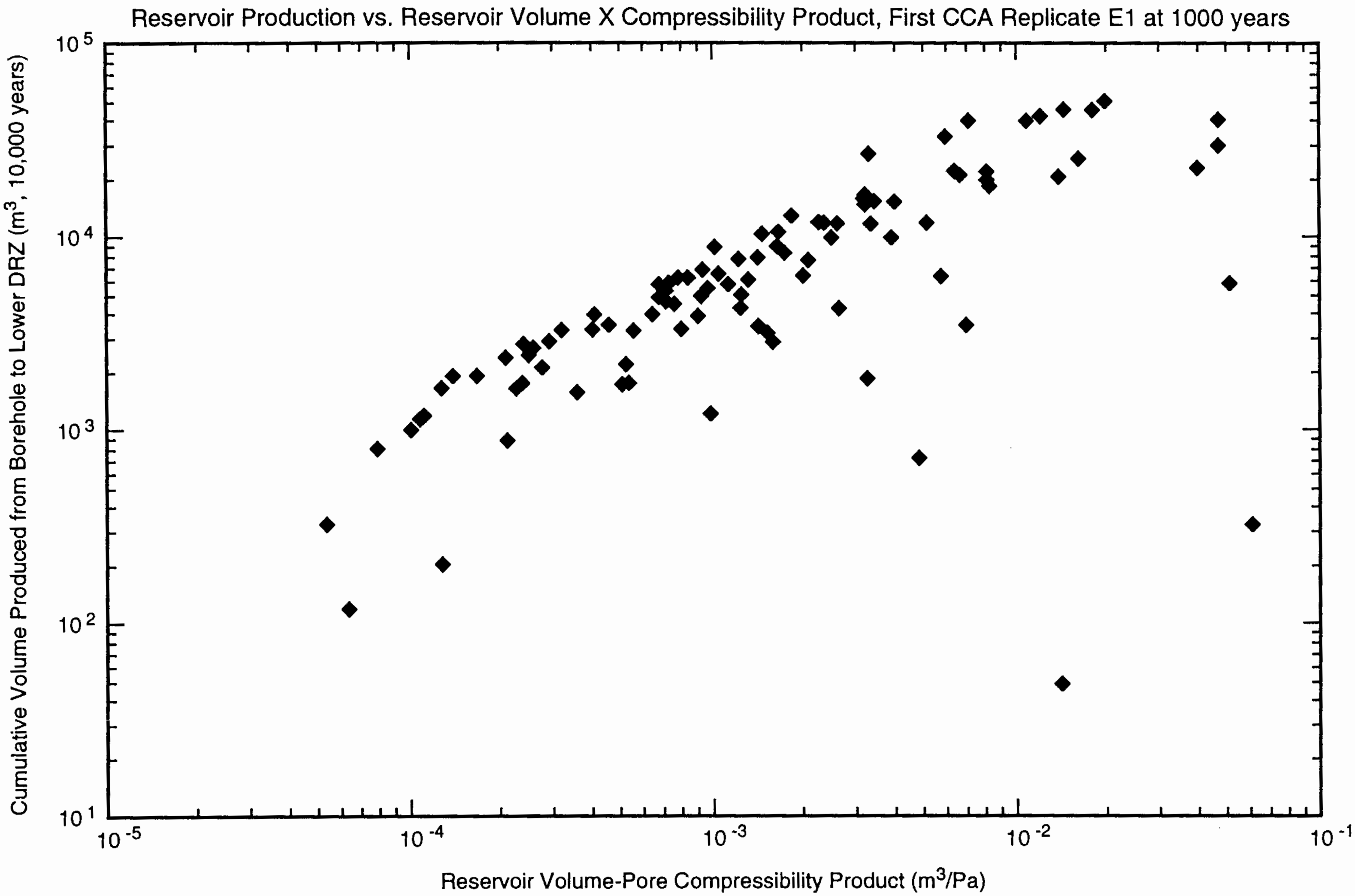
- Probability of encountering brine under panels
  - 0.08, based on geostatistical interpretation of large regional database (354 boreholes)
  - Consistent with interpreting TDEM and core data as indicating presence of brine in a fractured reservoir--not all boreholes intersect brine

# Brine Reservoir Volume and Borehole Flow




TRI-6342-4728-0

# The Role of Compressibility in Borehole Flow




TRI-6342-4826-0

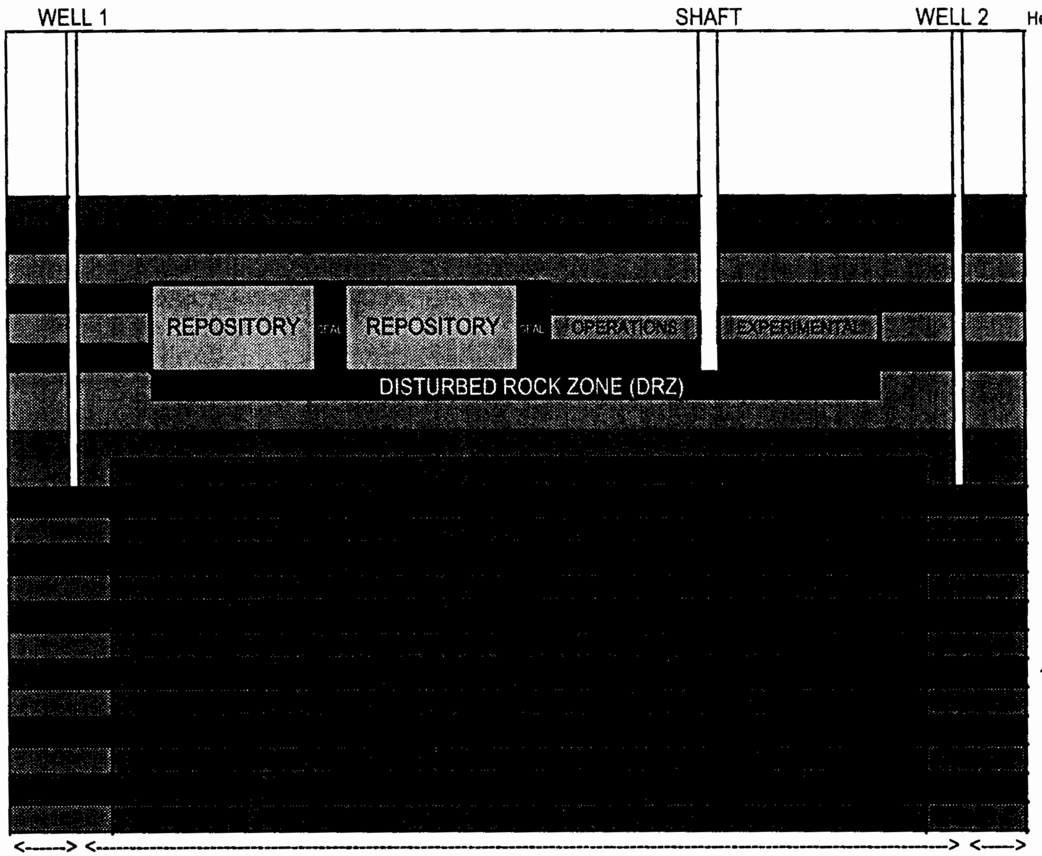
# Waterflood and Brine Disposal

- Scenario evaluated
  - disposal well operating at Land Withdrawal Boundary for 50 years
  - passive flow for 9950 years following
- BRAGFLO calculation
  - no consequence for WIPP geology
  - possible flow for Rhodes-Yates geology

# Saltwater Disposal Model

**WIPP GEOLOGY** — **SOUTH**

**NORTH** — **RHODES-YATES GEOLOGY**




**WIPP GEOLOGY**

| Surface (Elevation MSL = 1039.06 m) | Vertical Height (m) |
|---|---|
| | 215.660 |
| Formation: | |
| Culebra | 7.700 |
| Rustler | 36.000 |
| Salado | 395.248 |
| MB138 + Anhydrites A, B | 0.450 |
| Waste | 2.662 |
| MB139 | 0.850 |
| DRZ | 5.118 |
| Salado | 197.272 |
| Castile | 381.000 |
| Upper Bell Canyon (Pay) | 112.471 |
| L. Bell Cany.-Upper Cherry (No Pay) | 547.421 |
| Cherry-Upper Brushy-L. Ridge (Pay) | 4.572 |
| Upper Brushy Canyon (No Pay) | 518.160 |
| Lower Brushy Canyon (Pay) | 6.096 |
| Upper Bone Spring (No Pay) | 523.265 |
| Bone Spring (Pay) | 10.135 |
| L. Bone Spr-Wlfcmp-Strwn (No Pay) | 1013.887 |
| Strawn (Pay) | 7.193 |
| Atoka (No Pay) | 192.176 |
| Atoka (Pay) | 5.944 |
| Morrow Lime (No Pay) | 205.222 |
| Morrow Clastic (Pay) | 8.138 |
| Total Depth Below Surface: | 4396.640 |
| Elevation MSL: | -3357.580 |

**RHODES-YATES GEOLOGY**

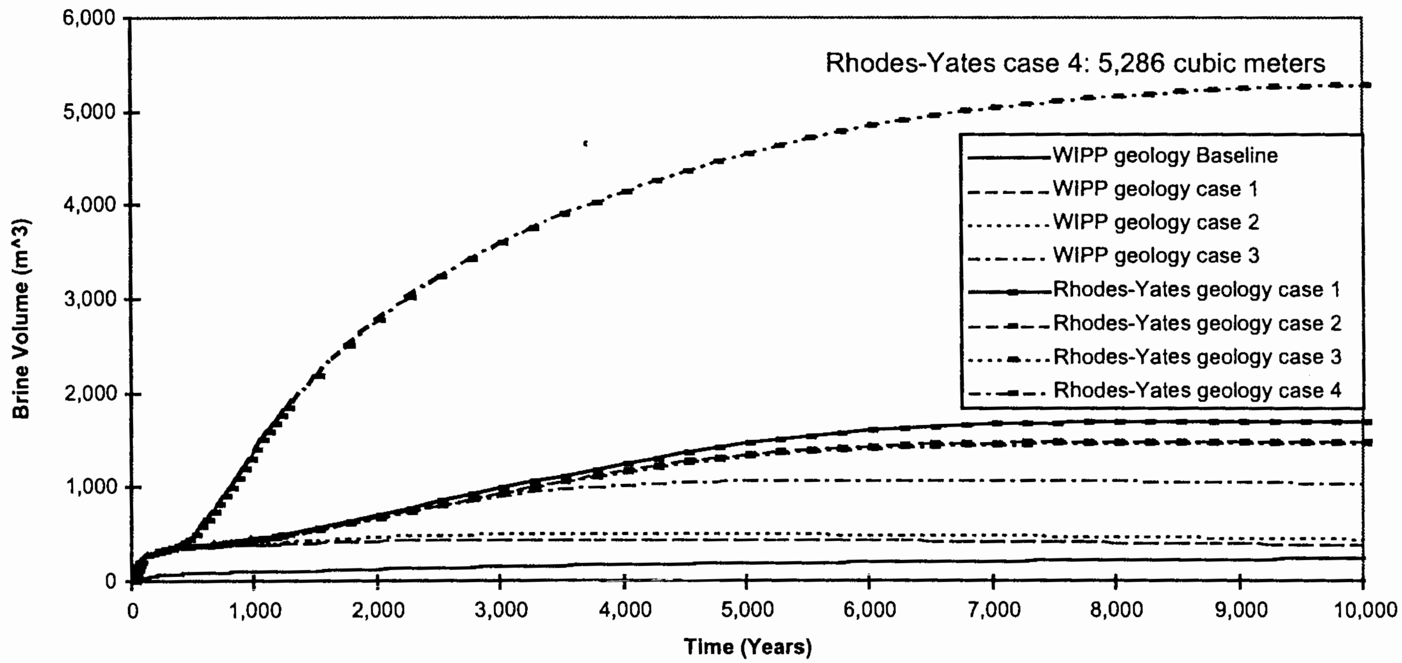
| Vertical Height (m) | Formation |
|---|---|
| 215.660 | |
| | Formation: |
| 7.700 | Culebra |
| 36.000 | Rustler |
| 395.248 | Salado |
| 0.450 | MB138 + Anhydrites A, B |
| 2.662 | Waste |
| 0.850 | MB139 |
| 5.118 | DRZ |
| **116.8** | Salado |
| **38.1** | **Tansill** |
| 112.471 | **Yates** |
| 547.421 | L. Bell Cany.-Upper Cherry (No Pay) |
| 4.572 | Cherry-Upper Brushy-L. Ridge (Pay) |
| 518.160 | Upper Brushy Canyon (No Pay) |
| 6.096 | Lower Brushy Canyon (Pay) |
| 523.265 | Upper Bone Spring (No Pay) |
| 10.135 | Bone Spring (Pay) |
| 1013.887 | L. Bone Spr-Wlfcmp-Strwn (No Pay) |
| 7.193 | Strawn (Pay) |
| 192.176 | Atoka (No Pay) |
| 5.944 | Atoka (Pay) |
| **628.59** | Morrow Lime (No Pay) |
| 8.138 | Morrow Clastic (Pay) |

| 0.25 miles | 4 miles | 0.25 miles |
|---|---|---|
| 402.3 meters | 6437.4 meters | 402.3 meters |

# Cases considered in Modeling Brine Disposal

| MODEL: | WIPP Geology | | | | Rhodes-Yates Geology | | | |
|---|---|---|---|---|---|---|---|---|
| SCENARIO: | Base-line | Case 1 | Case 2 | Case 3 | Case 1 | Case 2 | Case 3 | Case 4 |
| DESCRIPTION: | Median Database, Marker bed high perm. channel | Sand-filled channel behind casing, Marker bed high perm. channel | Tubing and casing leaks, Marker bed high perm. channel | Tubing and casing leaks - Marker bed open channel frac. | Sand-filled channel behind casing - Inj. gradient above frac. gradient, Marker bed high perm. channel | High perm. channel behind casing - Inj. gradient at frac. gradient, Marker bed high perm. channel | Tubing and casing leaks Marker bed high-perm channel, Marker bed high perm. channel | Tubing and casing leaks, Marker bed open channel frac. |
| BRAGFLO Filename: | BRAGFLO_ WATFLD_ BASE01_ R001.CDB | BRAGFLO_ WATFLD_ BASE01_ R002.CDB | BRAGFLO_ WATFLD_ BASE01_ R004.CDB | BRAGFLO_ WATFLD_ BASE01_ R005.CDB | BRAGFLO_ WATFLD_ YATES01_ R002.CDB | BRAGFLO_ WATFLD_ YATES01_ R003.CDB | BRAGFLO_ WATFLD_ YATES01_ R004.CDB | BRAGFLO_ WATFLD_ YATES01_ R005.CDB |
| Salado Permeability ($m^2$) | 3.981E-24 | 1.778E-25 | 1.778E-25 | 1.778E-25 | 1.778E-25 | 1.778E-25 | 1.778E-25 | 1.778E-25 |
| Anhydrite Permeability ($m^2$) | 1.288E-19 | 7.943E-18 | 7.943E-18 | 7.943E-18 | 7.943E-18 | 7.943E-18 | 7.943E-18 | 7.943E-18 |
| Effective Leaky Borehole Permeability ($m^2$) | 3.162E-13 | 1.0E-11 | 1.0E-03 | 1.0E-03 | 1.0E-11 | 1.0E-09 | 1.0E-03 | 1.0E-03 |
| Effective Abandoned Borehole Permeability ($m^2$) | 3.162E-13 | 1.0E-11 | 1.0E-11 | 1.0E-11 | 1.0E-11 | 1.0E-11 | 1.0E-11 | 1.0E-11 |
| Bottomhole Inj. Press. (Pa) | 22.8E06 | 22.8E06 | 22.8E06 | 22.8E06 | 22.8E06 | 18.53E06 | 18.53E06 | 18.53E06 |
| Bottomhole Inj. Press. (psi) | 3307 | 3307 | 3307 | 3307 | 3307 | 2687 | 2687 | 2687 |
| Injection Depth (m) | 1298.4 | 1298.4 | 1298.4 | 1298.4 | 819.13 | 819.13 | 819.13 | 819.13 |
| injection Depth (ft) | 4260 | 4260 | 4260 | 4260 | 2687.4 | 2687.4 | 2687.4 | 2687.4 |
| Injection Gradient (psi/ft) | 0.78 | 0.78 | 0.78 | 0.78 | 1.23 | 1.00 | 1.00 | 1.00 |
| Max. Marker Bed Perm ($m^2$) | 1.0E-09 | 1.0E-09 | 1.0E-09 | 1.0E-03 | 1.0E-09 | 1.0E-09 | 1.0E-09 | 1.0E-03 |

# Total volume of brine entering repository in brine disposal model



# Guidance to Waste Characterization

- Past preliminary PAs have indicated that performance is not sensitive to waste characteristics
- 40 CFR 194.24(c) states
  - "For each waste component ... the [DOE] shall specify the limiting value ... of the total inventory of such waste proposed for disposal...."
- Appendix WCL of the Application provides limits

# Waste Component Limits

| Waste Component | Effect on Performance | Limit |
|---|---|---|
| Radionuclides Am-241, Pu-238, Pu-239, Pu-240, Pu-242, U-233, U-234, U-238, Sr-90, Cs-137 | Regulated component of waste (U-238 may affect aqueous concentrations of other U species) | No total limits because releases are normalized. These radionuclides must be assayed because compliance measure could change if ratios changed (could require recertification). |
| Iron | Corrosion gas generation reactant (could affect direct releases) Maintains reducing conditions | No upper limit. Iron is not all consumed, 2-3 orders of magnitude more than needed to assure reducing conditions |
| Cellulose, Plastic, Rubber, Nitrate, and Sulfate | Microbial gas generation (could affect direct releases) | No lower limit (PA considers zero). Coarse upper limit of $2x10^7$ kg to ensure not exceeding capacity of MgO. |
| Solid Components | Waste erosion shear strength and tensile strength may affect direct releases | No limit. PA values are conservative. |
| Water content of waste | Corrosion gas reactant | Limit set by WAC |
| Humic substances | May affect colloidal transport | No limit. Modeling approach assumes unlimited source of humics |
| Nonferrous metals | May affect complexing of actinides with ligands | No limit. Effect is beneficial, and nonferrous metals will be present in excess, given present estimates of future waste |
| Organic ligands | May affect actinide transport | No limit given present estimates of future waste (quantities small). Limit will be specified in future if needed. |

# Selected Parameter Values

| Parameter | Distribution Type | Units | Low | High | Median/ Constant |
|---|---|---|---|---|---|
| Prob. of Microbial Degradation | delta | none | 0 | 2 | 2 |
| Corrosion gas gen. rate (inundated) | uniform | m/s | 0 | $1.59 \times 10^{-14}$ | $7.94 \times 10^{-15}$ |
| Microbial gas gen. rate (inundated) | uniform | mol/kg*s | $3.17 \times 10^{-10}$ | $9.51 \times 10^{-9}$ | $4.92 \times 10^{-9}$ |
| Microbial gas gen. rate (humid) | uniform | mol/kg*s | 0 | $1.27 \times 10^{-9}$ | $6.34 \times 10^{-10}$ |
| Wicking Parameter | uniform | none | 0 | 1 | 0.5 |
| Anhydrite Permeability | cumulative | $m^2$ | $10^{-21}$ | $7.94 \times 10^{-18}$ | $1.29 \times 10^{-19}$ |
| Anhydrite Porosity | constant | none | | | 0.011 |
| Halite Permeability | cumulative | $m^2$ | $10^{-24}$ | $10^{-21}$ | $3.16 \times 10^{-23}$ |
| Halite Porosity | cumulative | none | 0.001 | 0.03 | 0.01 |
| Waste Erosion Shear Strength | uniform | Pa | 0.05 | 10 | 5.03 |
| Waste Tensile Strength | constant | Pa | | | 6895 (1 psi) |
| Waste Particle Diameter | loguniform | m | $4 \times 10^{-5}$ | 0.2 | $2.83 \times 10^{-3}$ |
| Waste Initial Water Saturation | constant | none | | | 0.015 |
| Borehole Permeability | loguniform | $m^2$ | $10^{-14}$ | $10^{-11}$ | $3.16 \times 10^{-13}$ |
| DRZ Permeability | constant | $m^2$ | | | $10^{-15}$ |
| DRZ Porosity | halite value plus 0.0029 | none | 0.0039 | 0.0329 | 0.0129 |
| Panel Closure Permeability | constant | $m^2$ | | | $10^{-15}$ |
| Panel Closure Porosity | constant | none | | | 0.075 |
| Brine Reservoir Rock Compressibility | triangular | 1/Pa | $5.0 \times 10^{-12}$ | $10^{-8}$ | $10^{-10}$ |
| Brine Reservoir Initial Pressure | triangular | MPa | 11.1 | 17.0 | 12.7 |
| Brine Reservoir Permeability | triangular | $m^2$ | $2.0 \times 10^{-15}$ | $1.58 \times 10^{-10}$ | $1.58 \times 10^{-12}$ |
| Brine Reservoir Porosity | constant | none | | | 0.0087 |

# Update on 3D Regional Groundwater Flow Model

Tom Corbet
Geohydrology Department
Sandia National Laboratories

Presentation to
Environmental Evaluation Group WIPP Quarterly Review
November 26, 1996

# Presentation Outline

1) Review 3D model of regional groundwater flow.

2) Discuss the rationale for the 2D confined model used in CCA calculations.

3) Discuss implementation of climate change in CCA calculations.

4) Update on consistency of Culebra flow and geochemistry.

# Acknowledgments

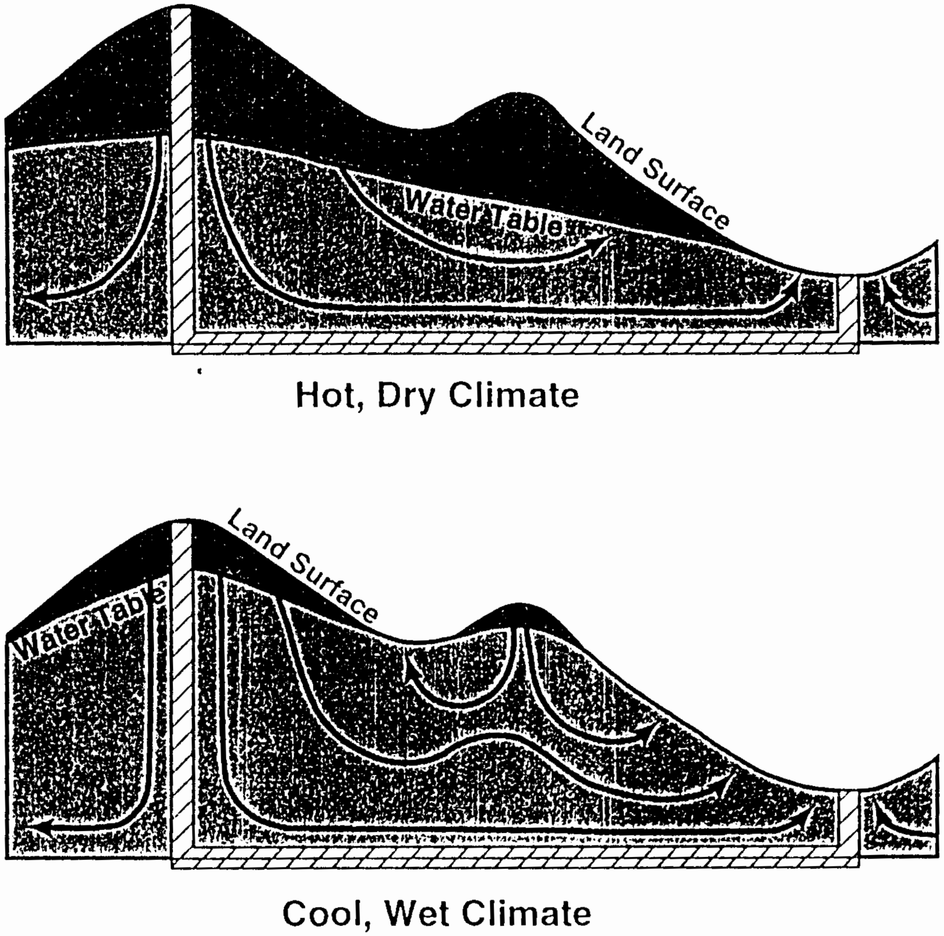
The efforts of a number of people made the 3D simulations possible:

| | |
|---|---|
| Pat Knupp | Peter Davies |
| Mike Wallace | Lucy Meigs |
| Peter Swift | Bob Holt |
| Roy Courtright | Steve Askew |
| Ellen Dombrowski | Rebecca Blaine |
| Ken Brinster | |

# New Reference on 3D Simulations

Corbet and Knupp, 1996. The role of regional groundwater flow in the hydrogeology of the Culebra Member of the Rustler Formation at the Waste Isolation Pilot Plant (WIPP), Southeastern New Mexico. SAND96-2133 (in press)

# Role of Topography in Driving Regional-Scale, Ground-Water Flow Under Varying Climatic Conditions



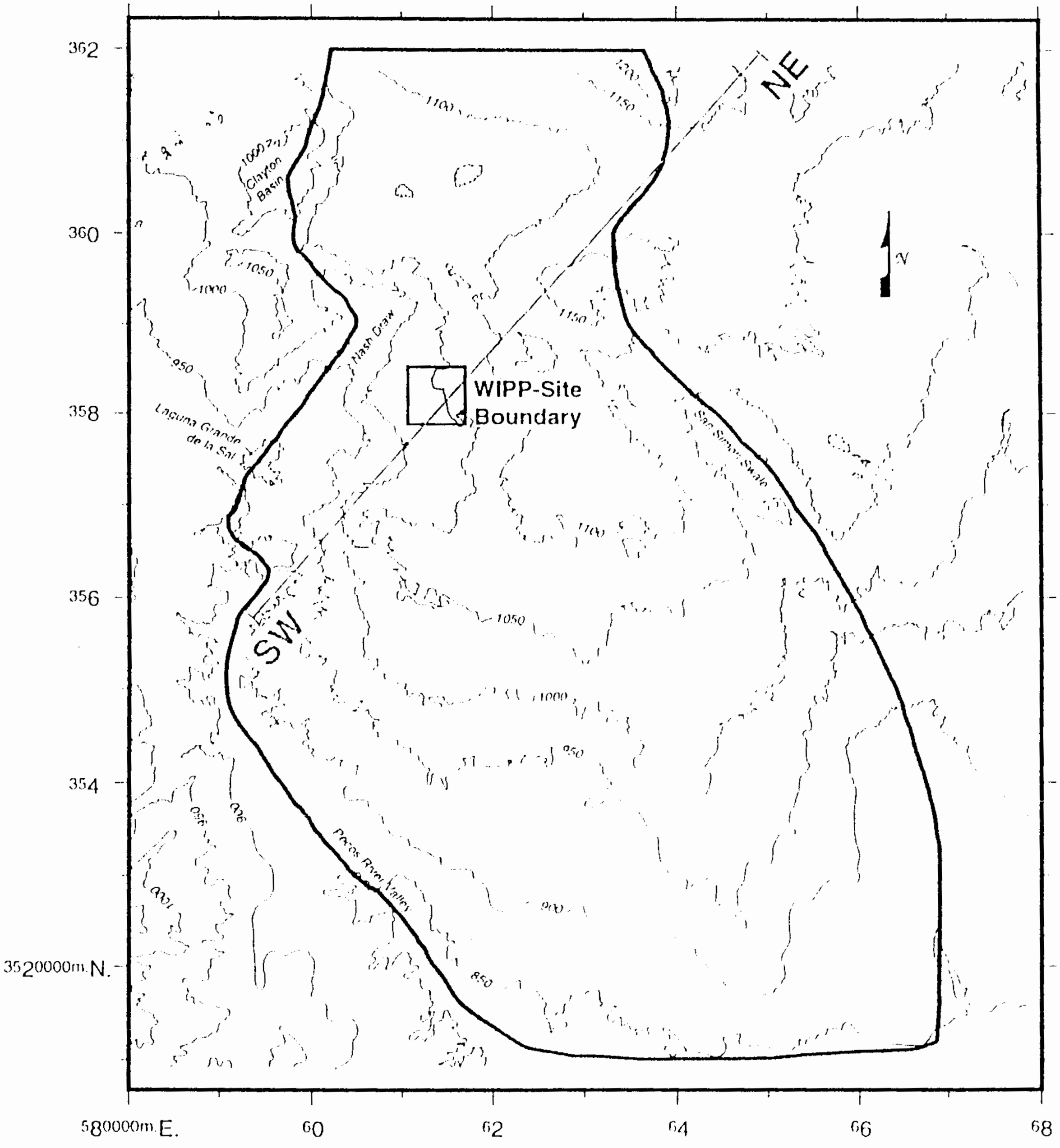

Key literature on the role of topography in regional-scale flow:

Hubbert (1940)
Toth (1963)
Freeze and Witherspoon (1966)
Bredehoeft et al. (1982)

Corbet and Knupp, 1996

2837-1

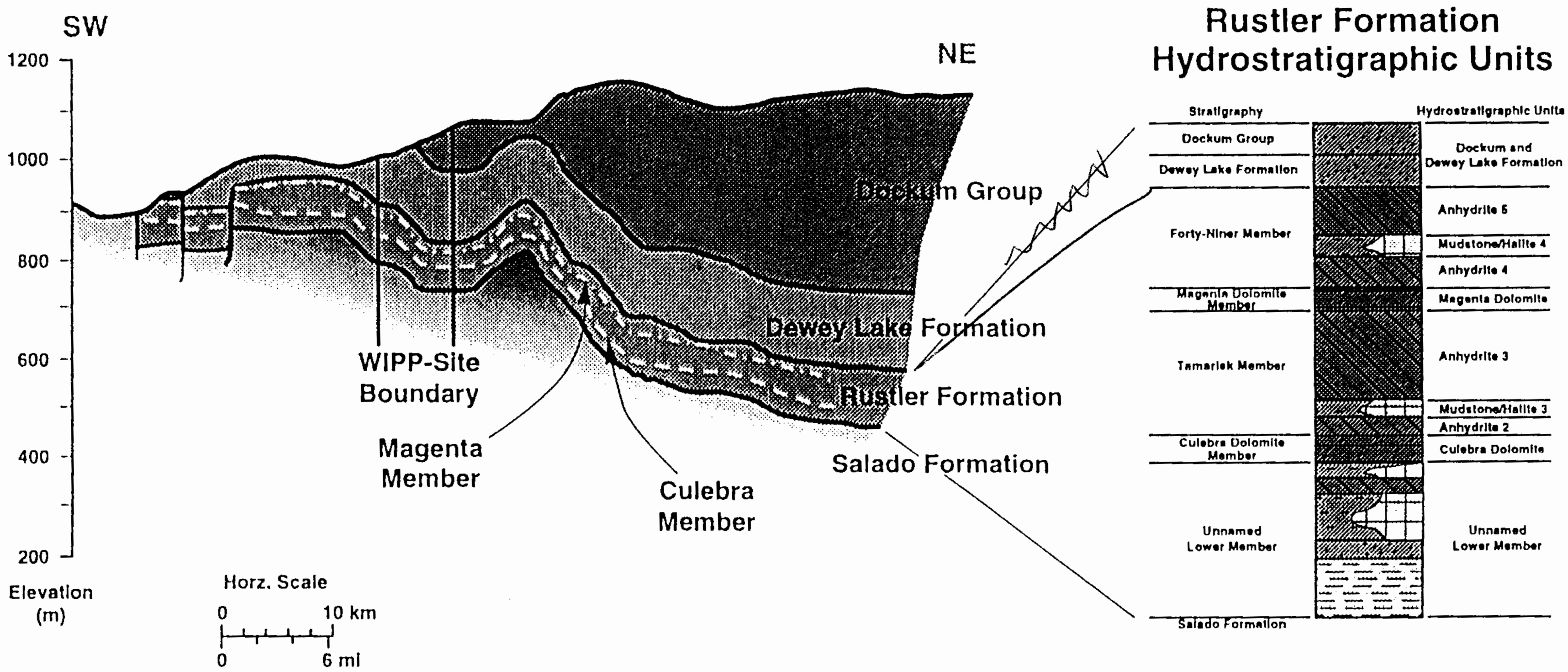
# Topography in WIPP Region and Boundaries of the Regional Flow Model




Corbet and Knupp, 1996

2840-1

# Definition of Hydrostratigraphic Units for 3-Dimensional Regional Flow Model

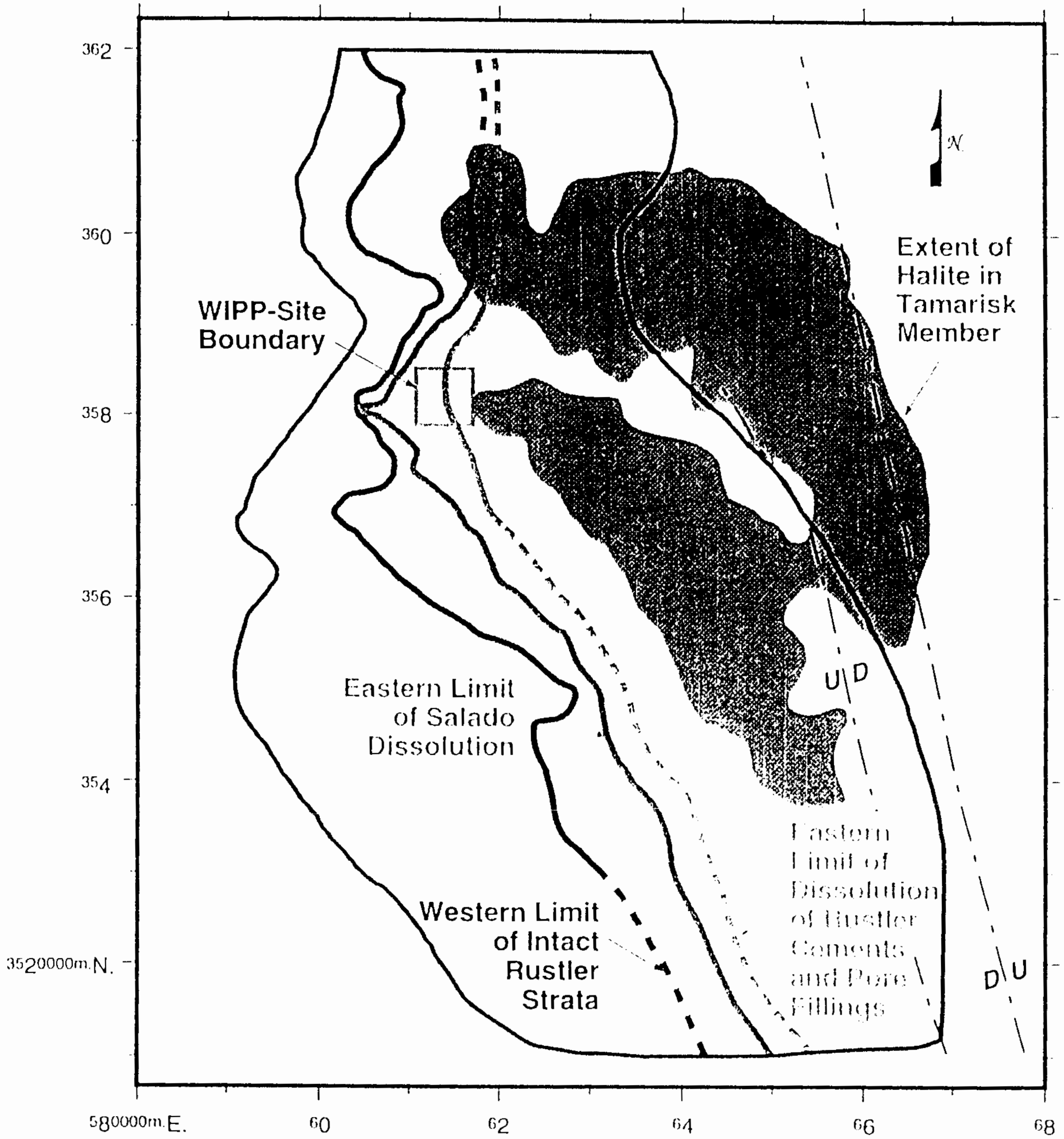



Vertical Exaggeration is 45 to 1

Corbet and Knupp, 1996

2835-1

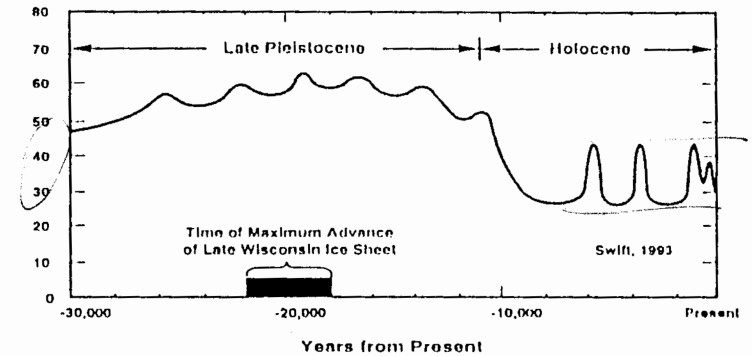
# Regions Where Post-Depositional Processes Have Altered Hydraulic Conductivity



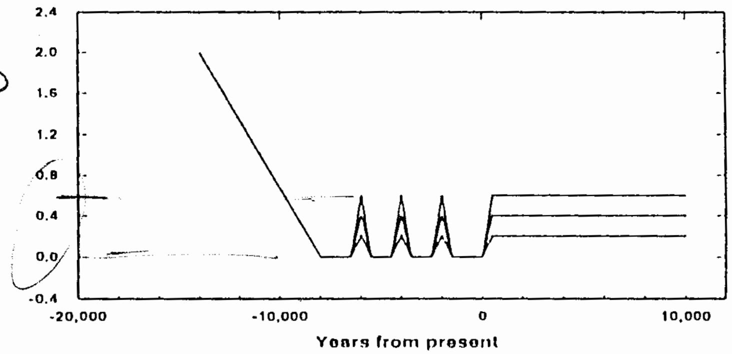

Corbet and Knupp, 1996

# Estimated Mean Annual Precipitation and Assumed Functions for Recharge to Water Table

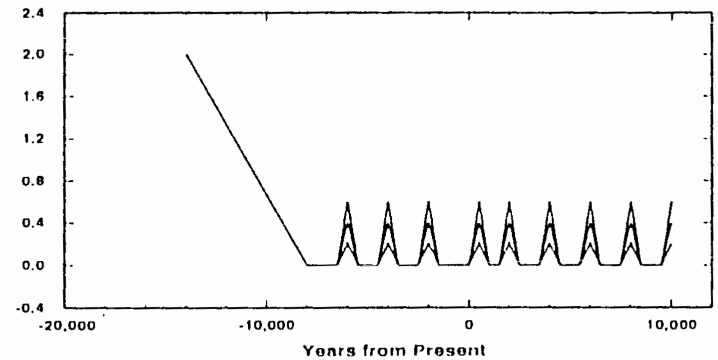
Estimated Annual Precipitation (cm/yr)




Modeled Recharge to Water Table mm/yr [ Future Scenarios I ]

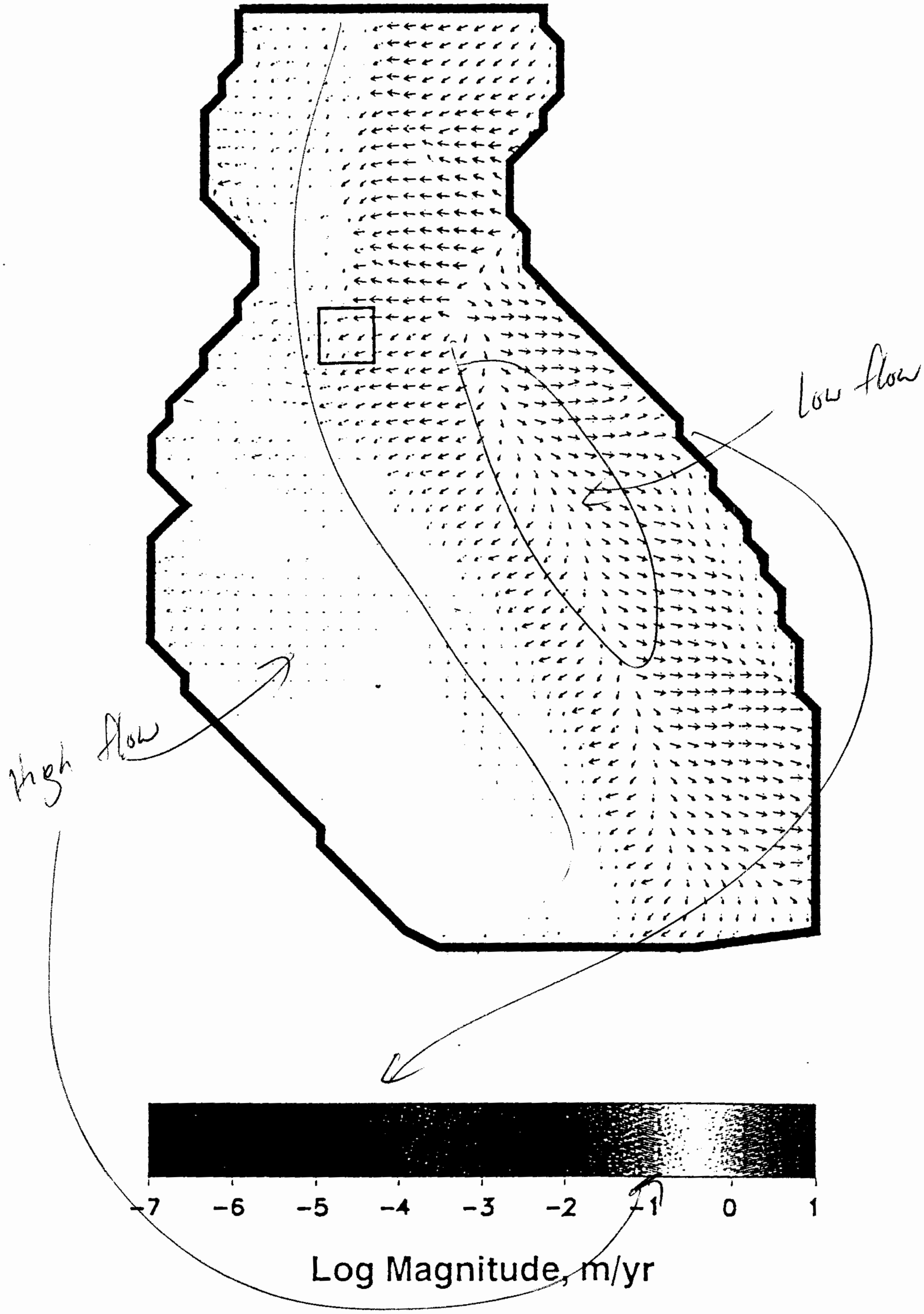



Modeled Recharge to Water Table mm/yr [ Future Scenarios II ]

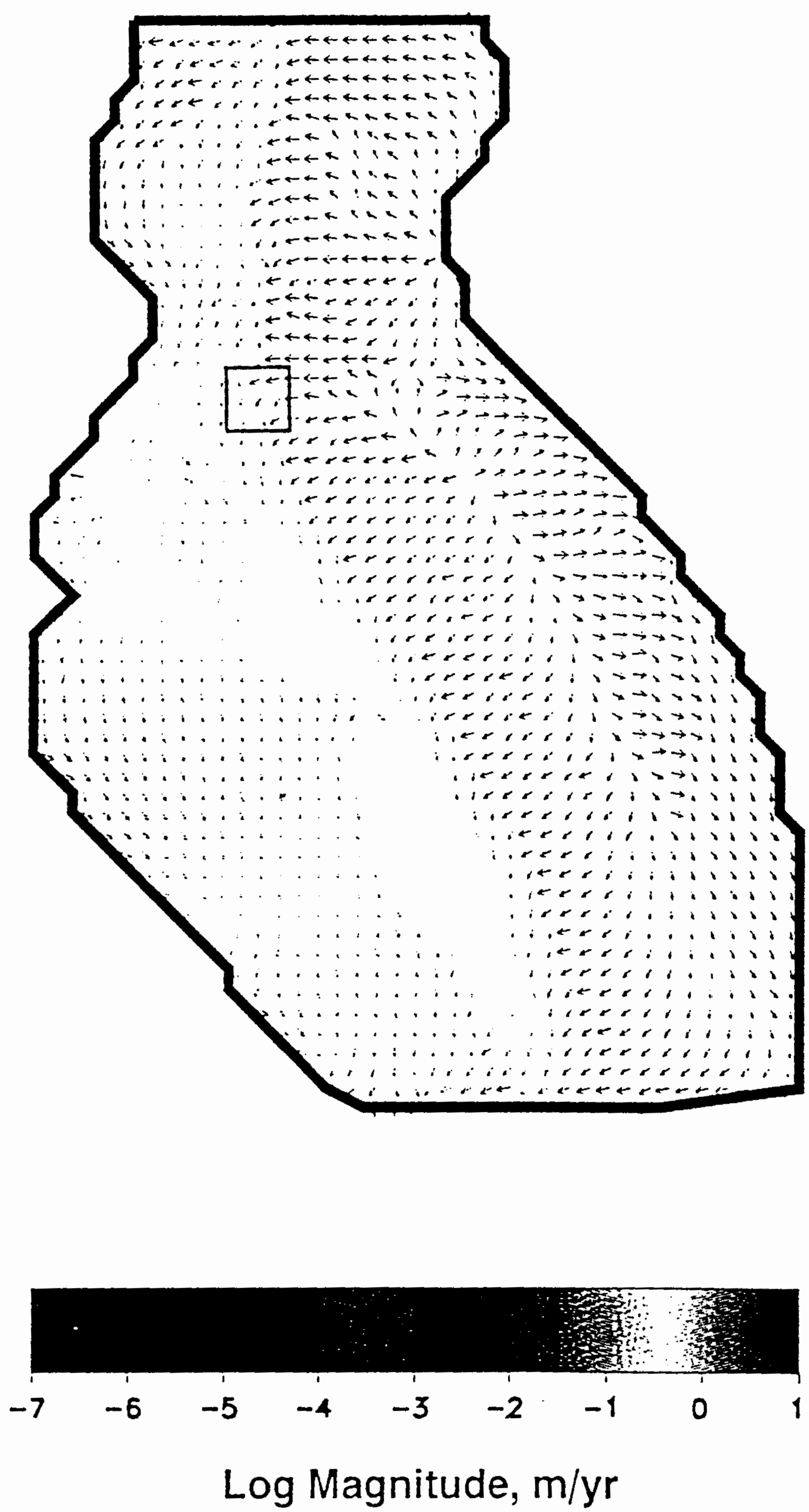



2862-0

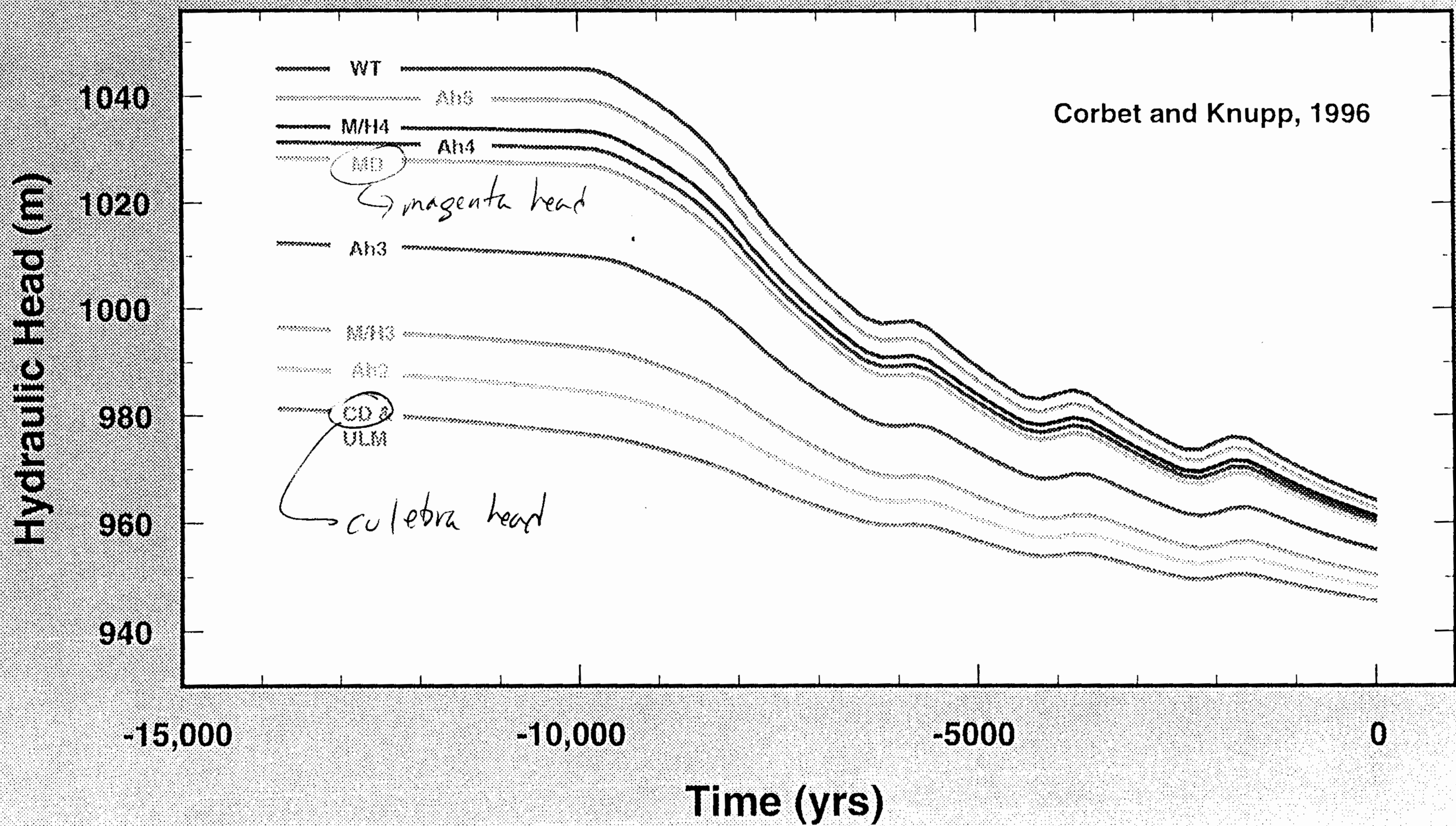
# Lateral Specific Discharge in Culebra at 14,000 Years in Past for Base Case Simulation



# Lateral Specific Discharge in Culebra at Present Time for Base Case Simulation



# Elevation of the Water Table and Heads vs. Time
## (results from center of WIPP site)




2847-0

# Use of the 2D Flow Model in PA Calculations

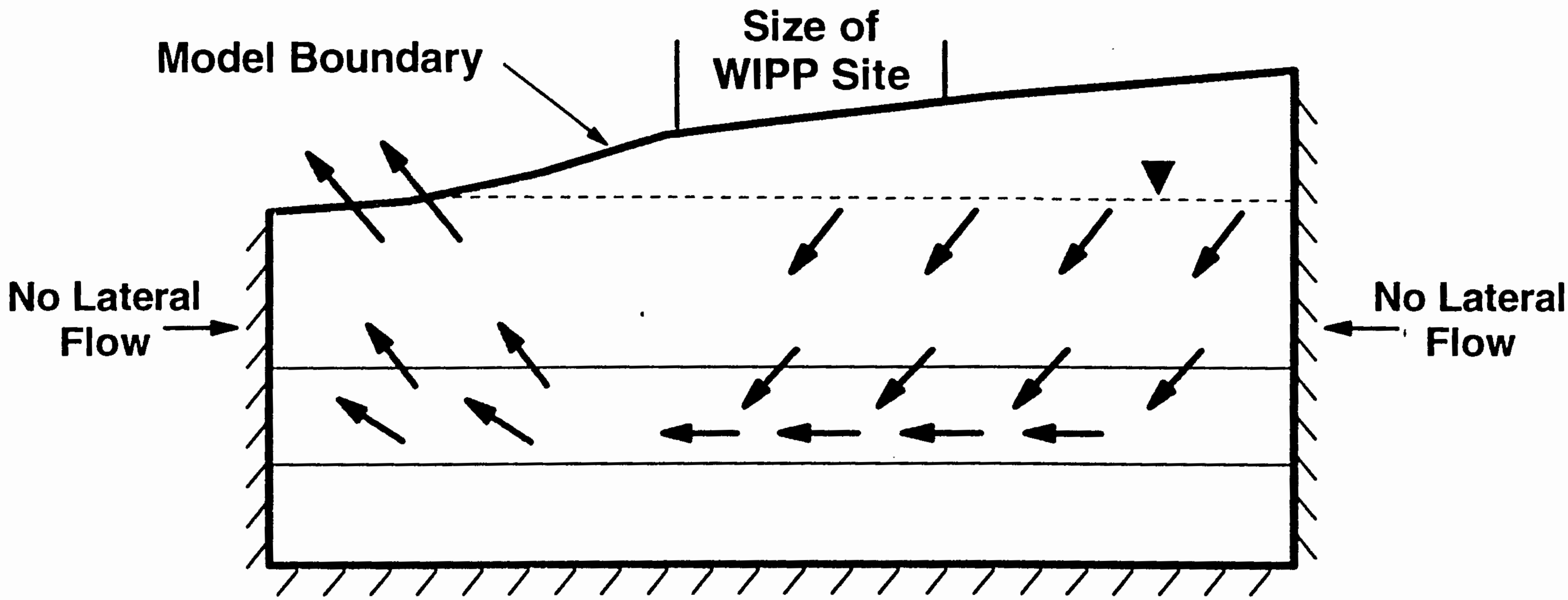
We must evaluate the validity of the 2D approximation in terms of the objective of the PA flow model:

Generate multiple realizations of the present-day flow field in the Culebra that are constrained by field observations.

# Simulations Suggest:

- All outflow from the Culebra reference volume is by lateral flow in the Culebra.
- Vertical leakage contributes between 5 and 50 percent of the total inflow to the Culebra reference volume.
- All vertical leakage across the top of the Culebra reference volume is directed downward.

# Groundwater Basin Model




- Calculation of long-term transient groundwater flow at the scale of a groundwater basin
- Hydrologic properties inferred from geologic information
- Calculated vertical flow through confining layers and lateral flow in strata other than the Culebra dolomite

# Possible Impacts of the 2D Approximation

The flow fields calculated by the 2D model will be approximate for two reasons:

1) The inverse calculation of transmissivity fields will compensate for leakage being ignored.

2) The boundary conditions for the flow fields will not include fluid sources to account for leakage.

However, these approximations are thought to be acceptably small.

# 2D Approximation is Valid for CCA Calculations

Approximation in flow fields is thought to be small because:

1) Transmissivity distribution is accurate because of data density and calibration to transient hydraulic data.
2) Constant-head boundaries provide the inflow that is actually due to vertical leakage.

However, an additional activity is planned that will provide a quantitative estimate of the approximation introduced by the 2D assumption.

# Reference for Rationale for the 2D Confined Model

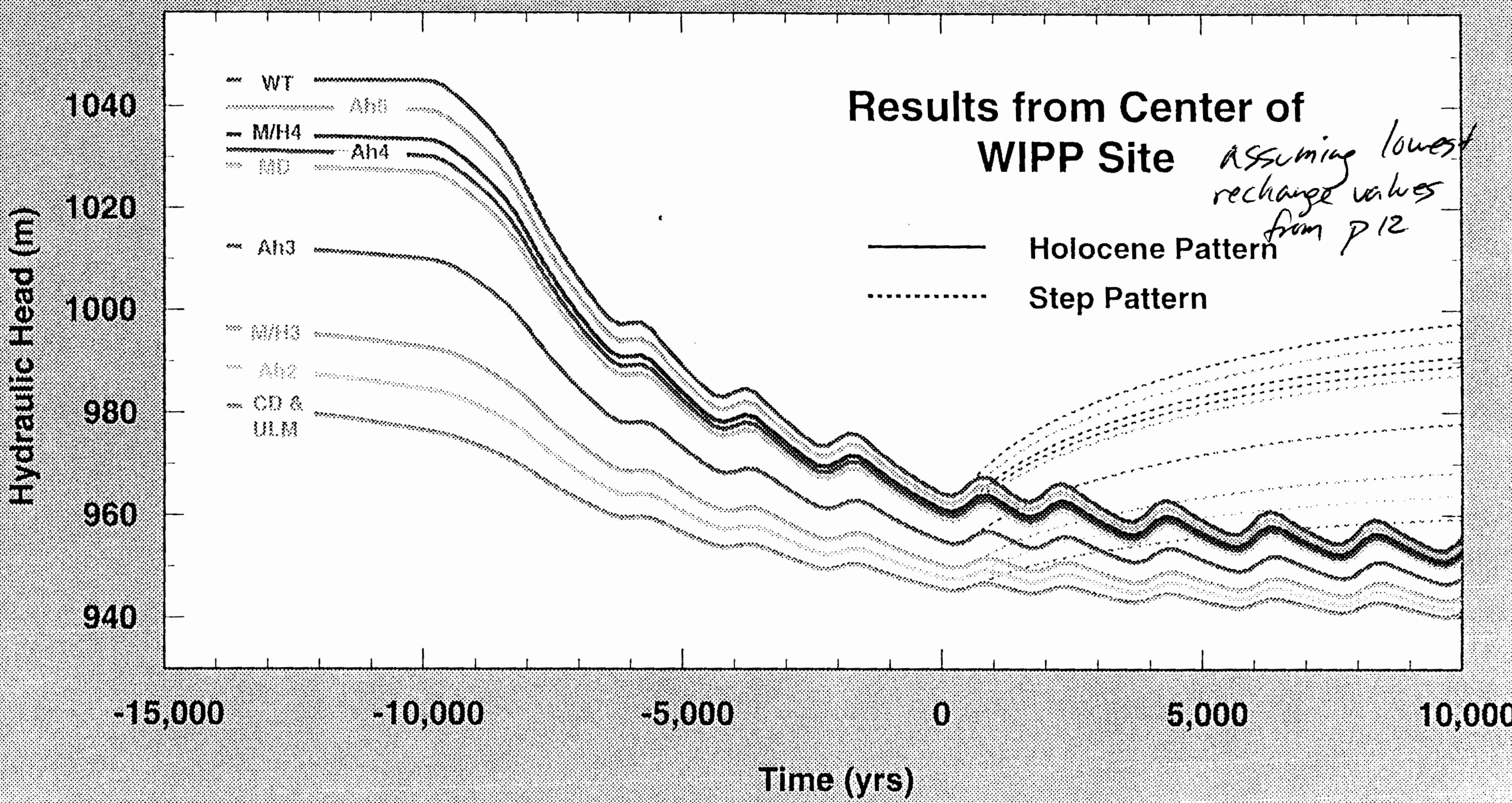
Corbet, 1995. Summary Memo of Record: FEP NS-9 Two-dimensional assumption for Culebra calculations.

# Treatment of Climate Change in CCA Calculations

**Key reference:**

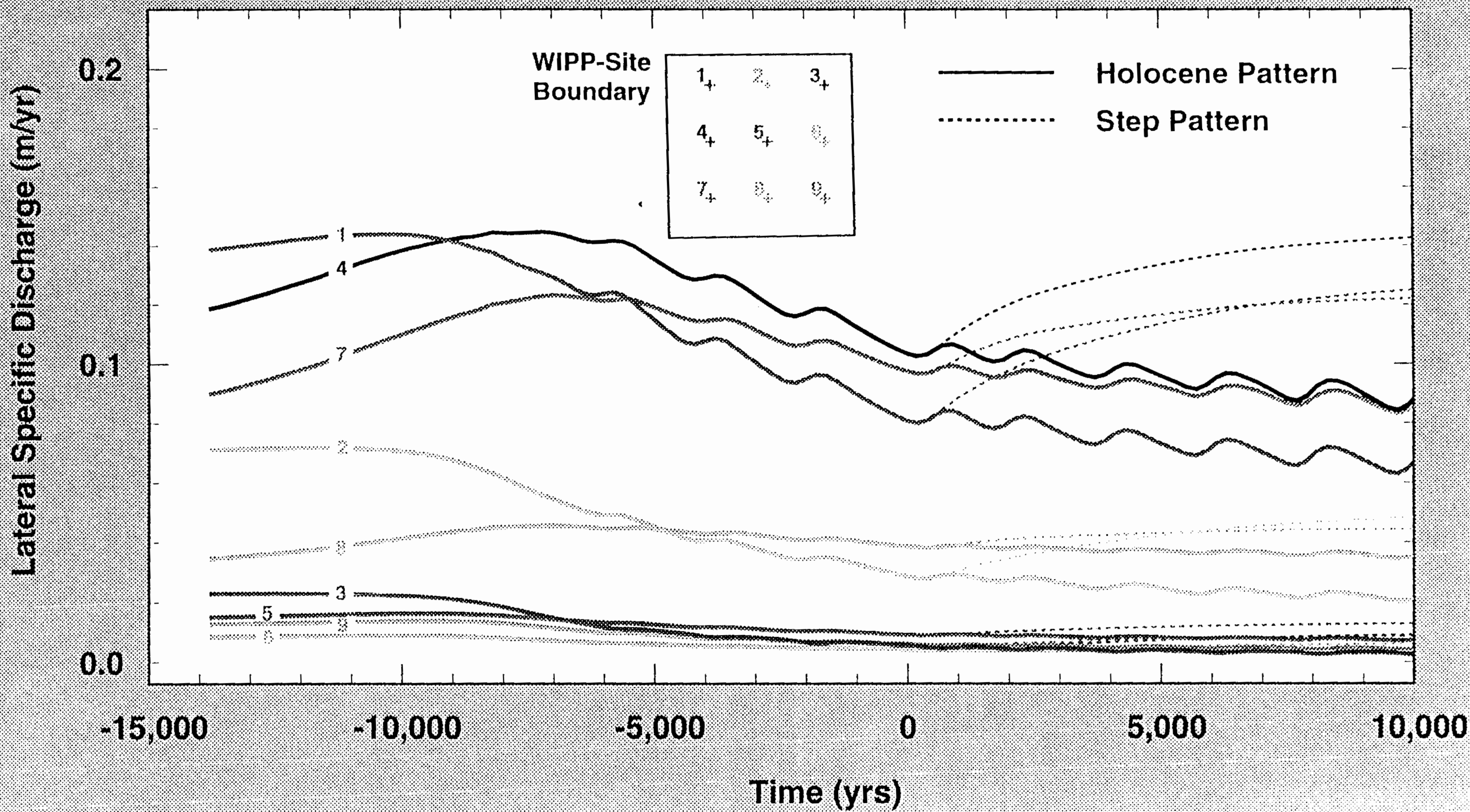
**Corbet and Swift, 1996. Records Package: Non-Salado Parameters Required for SECFL2D: Climate Index**

# Simulated Head vs. Time at the WIPP Site



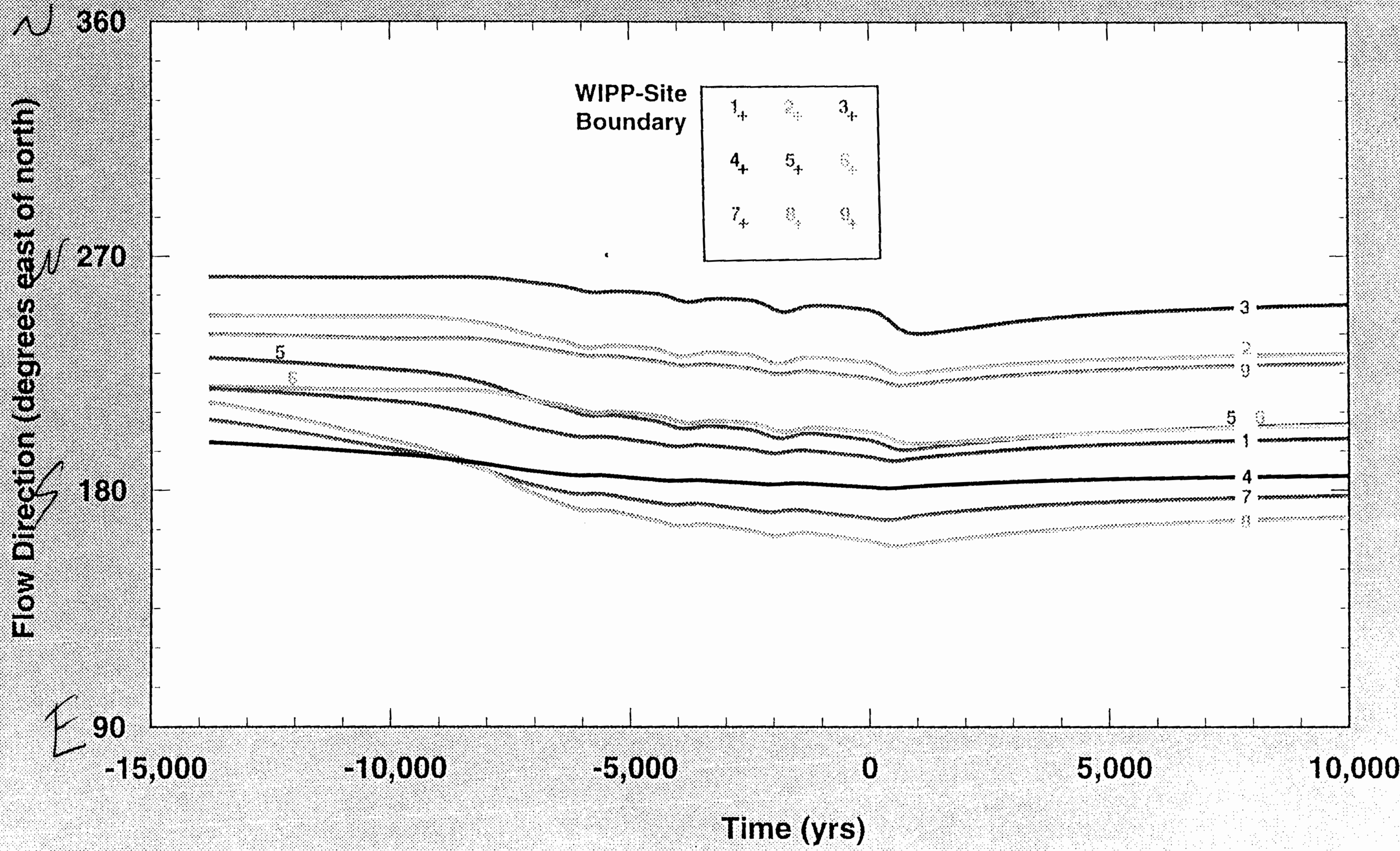

2873-0

# Simulated Flow Rate in the Culebra vs. Time




2874-0

# Simulated Flow Direction in the Culebra vs. Time

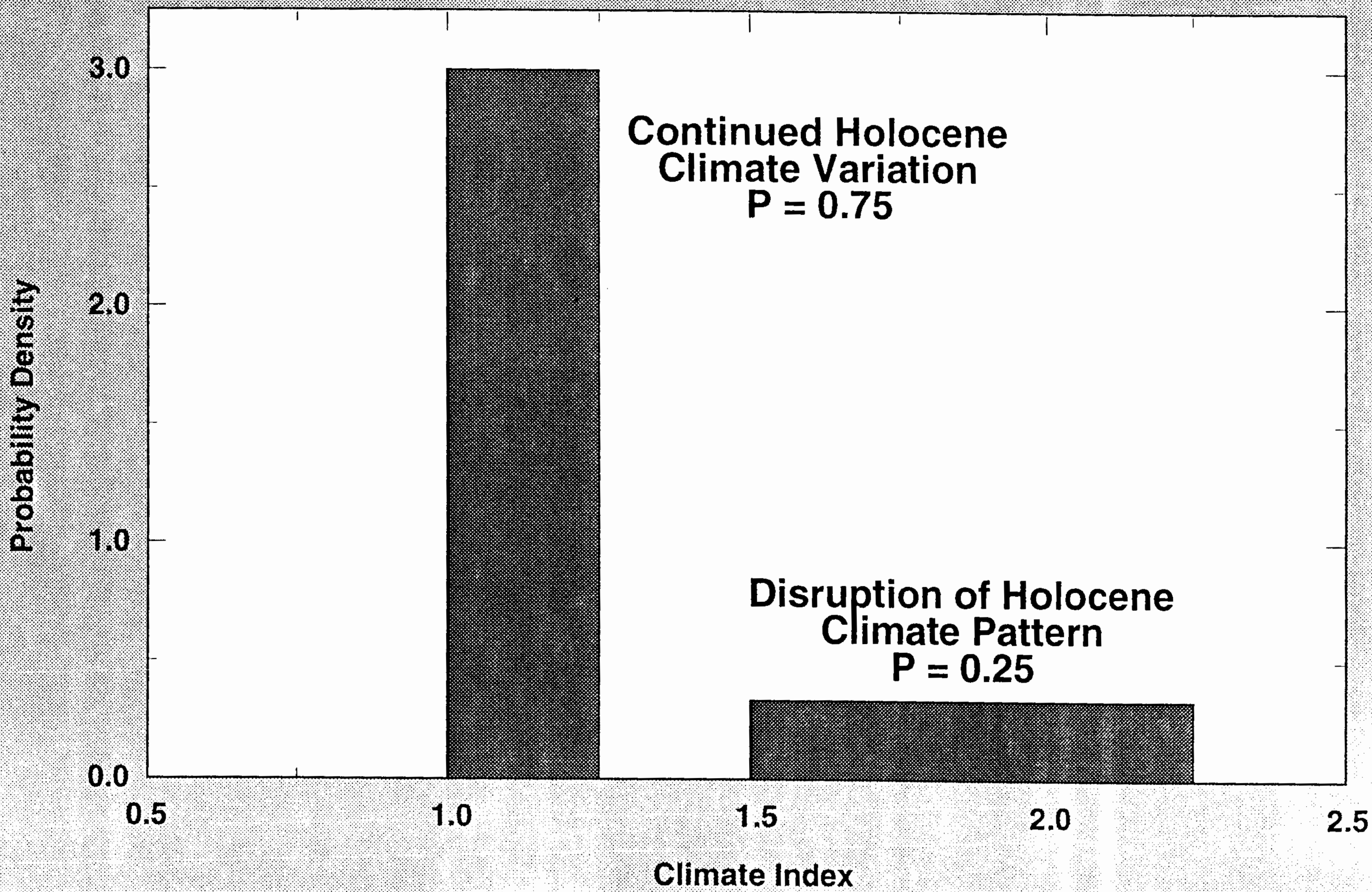



2872-0

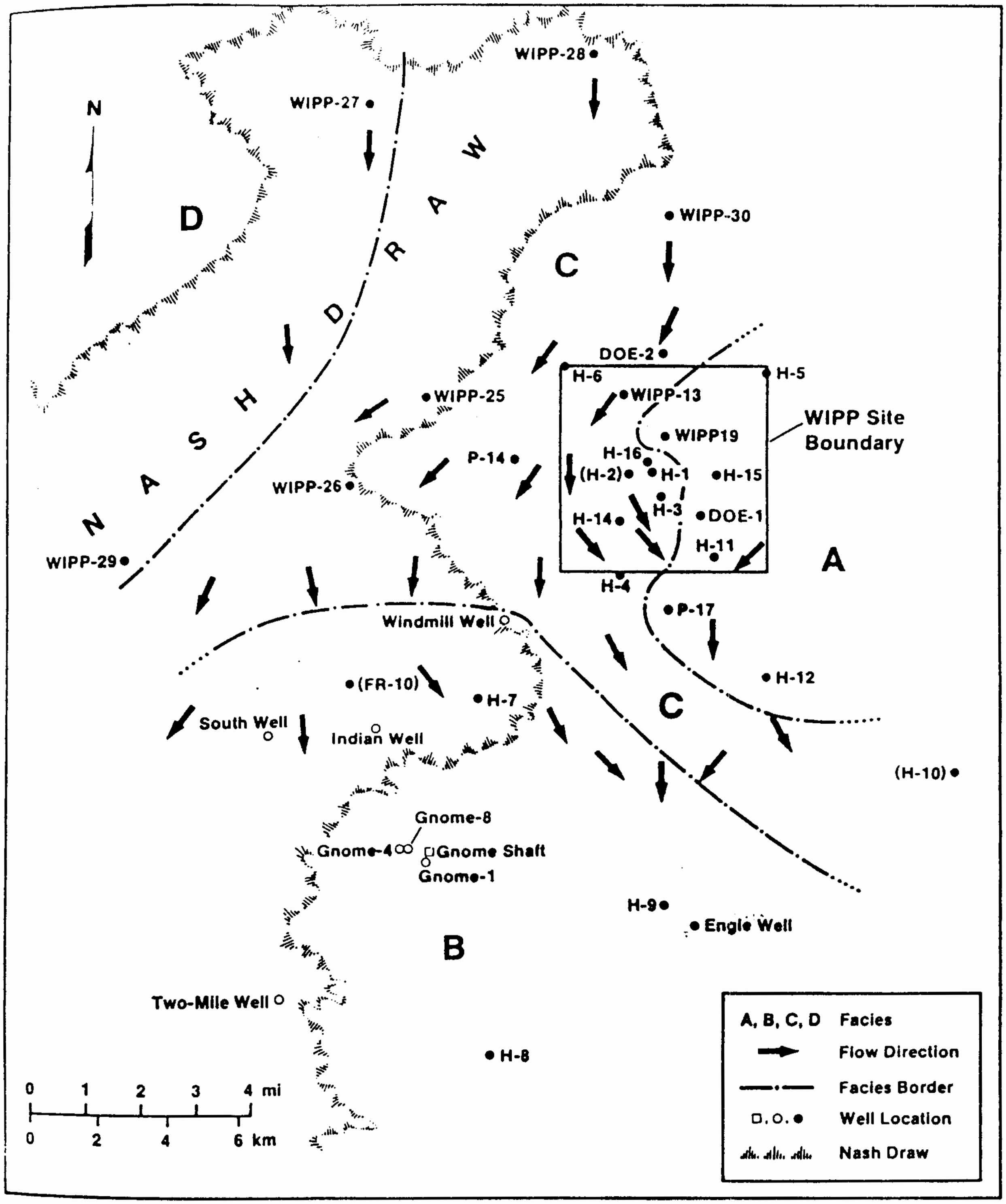
## Sources of Uncertainty in Simulations of Future Flow Conditions

- Rock properties.
- Pattern of climate change.
- Peak future recharge rates.

# Value of the Climate Index Used in the CCA




2869-0




TRI-6331-77-0

Siegel and Lambert, 1991

(EEG-32)

# Questions Concerning Present Day Flow Directions and Geochemical Observations in the Culebra (1 of 3)

- Background - previous geochemical and hydrologic analyses:
  - At time geochemical work done (late 70's/early 80's), interpretations indicated that the water is relatively old and that no young water directly recharges the Culebra in the site area.
  - Also observed that present day distribution of solutes and isotopic compositions appeared to be inconsistent with assumption of long-term, steady-state, perfectly confined flow in the Culebra (the late 70'/early 80's flow model); therefore, suggested that flow directions may have changed over time in response to climate changes.
  - Provided major motivation for reexamination of Culebra/Rustler flow system:
    - USGS 2D vertical and 2D horizontal regional-scale models (Davies, 1989)
    - Sandia 3D regional-scale modeling study (Corbet and Knupp, 1996)

# Questions Concerning Present Day Flow Directions and Geochemical Observations in the Culebra (2 of 3)

- Important observations from recently completed 3D regional flow modeling study:
  - → Significant changes in flow direction with lowering of water table due to climate change since last glacial pluvial
  - → Amounts of vertical flow into Culebra vary spatially
  - → Additional insight provided by examining configuration of the flow field in proximity to significant Rustler geologic features; highlights importance of wide variation in flux magnitude, especially very low velocities east of WIPP
  - → Preliminary examinations indicate at least two conceptual frameworks where flow and geochemistry are consistent, although these have not yet been analyzed in detail
    - Flow direction change from east → west to north → south due to climate change in southern site area
    - Present day flow directions not incompatible with geochemistry when very small fluxes (e.g. ~20 meters in 10,000 years) east of WIPP and vertical fluxes to south/southwest are considered

# Questions Concerning Present Day Flow Directions and Geochemical Observations in the Culebra (3 of 3)

- Implications for PA models used for CCA compliance calculations:
  - → Given present understanding of range of Culebra flow behaviors observed in the 3D regional flow model and the likelihood there are one ( or more) consistent conceptual ties between Culebra flow and the geochemical observations, the representation of Culebra flow incorporated into the PA calculations for the CCA is a reasonable model of flow in this unit.
  - → Additional assurance could be attained with a more detailed analysis of existing geochemical data and recently completed 3D regional flow model to confirm and/or modify the two preliminary conceptual frameworks for flow-geochemistry.

# Information on the Dewey Lake Redbeds and G-Seep

Richard L. Beauheim
Sandia National Laboratories

EEG Quarterly Meeting
26 November 1996

# Water in the Dewey Lake Redbeds

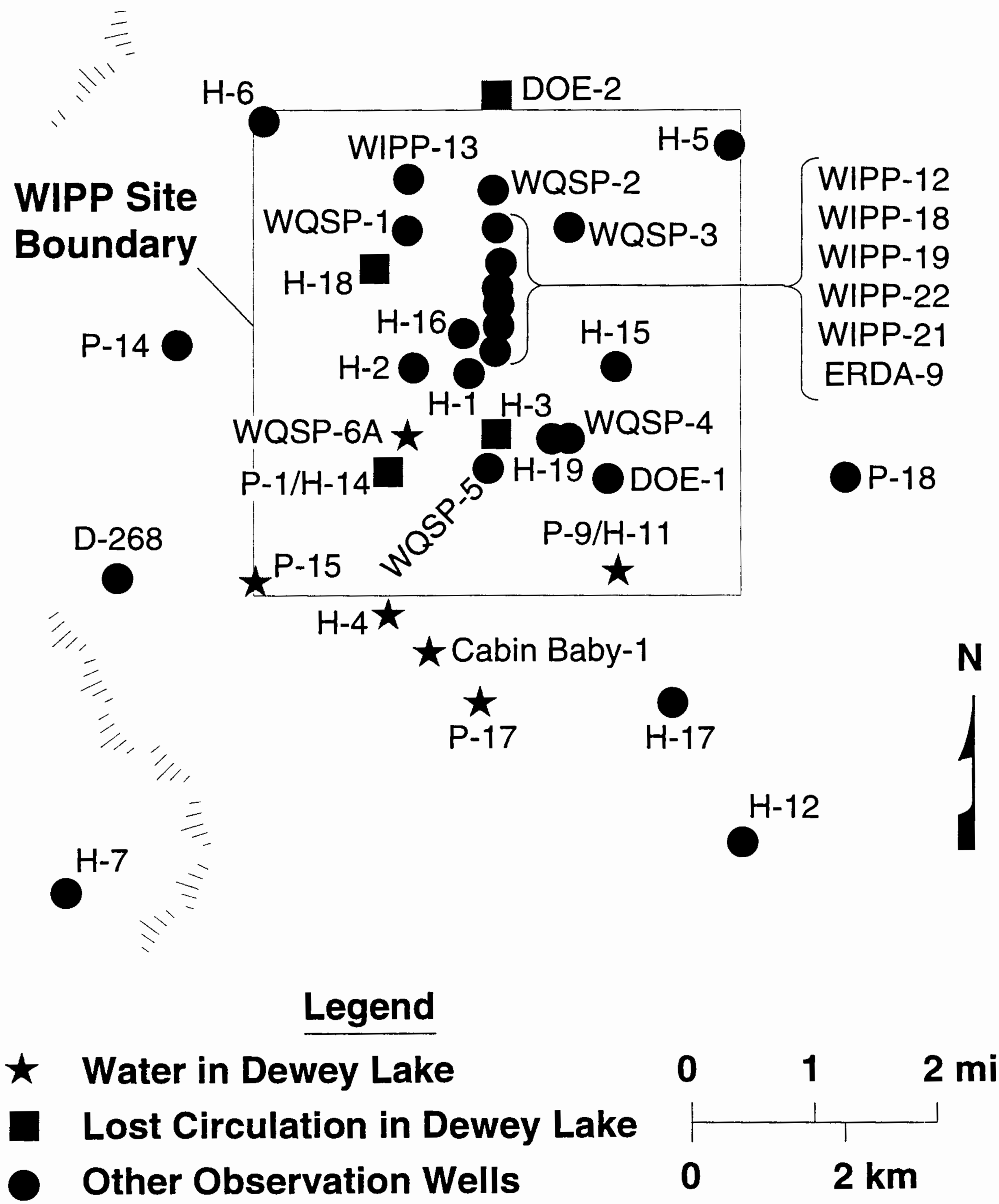
Water is found in the Dewey Lake over the southern portion of the WIPP site, typically within 10 m above the uppermost occurrence of continuous gypsum fracture filling.

The observable water appears to be associated with open fractures.

The water is under slight pressure, rising 6-15 m above the point of contact.

The water table at the Cabin Baby pad and WQSP-6A lies between 970 and 975 m amsl.

# Dewey Lake Observations




TRI-6115-192-1

# Water in Dewey Lake (contd.)

Moving north across the WIPP site, the "contact" with the gypsum fracture fillings rises above 975 m, and water is not observed in the Dewey Lake.

On the H-3 hydropad, gypsum fracture fillings extend to an elevation of 983 m. Circulation was lost near this elevation while drilling well H-3d. Return flow from the zone of circulation loss after the well was completed partially filled the hole. The water level in the Dewey Lake portion of the hole has been steadily dropping, and is now below an elevation of 937 m.

# Testing at WQSP-6A

Three-day pumping test performed at 45 L/min (12 gpm), causing 2 m of drawdown.

Specific capacity of well indicates a transmissivity of approximately $5 \times 10^{-4}$ $m^2/s$.

# Treatment of Dewey Lake in CCA

Dewey Lake treated as a homogeneous porous medium with a water table at 980 m.

Hydraulic conductivity of $4.9 \times 10^{-10}$ m/s, from H-19 core measurements of lower Dewey Lake, assigned over a saturated thickness of 106 m, giving an effective transmissivity of approximately $5 \times 10^{-8}$ $m^2/s$.

Sorption on redbeds (iron oxides) assumed to prevent release to accessible environment.

# Consequences of CCA Treatment

CCA calculations show no contaminated water reaching the elevation of the Dewey Lake in E1, E2, or E1E2 scenarios after plug degradation.

If water did reach the Dewey Lake, the effect of the modeled low transmissivity would be to minimize inflow into the Dewey Lake, maximizing inflow into the Culebra.

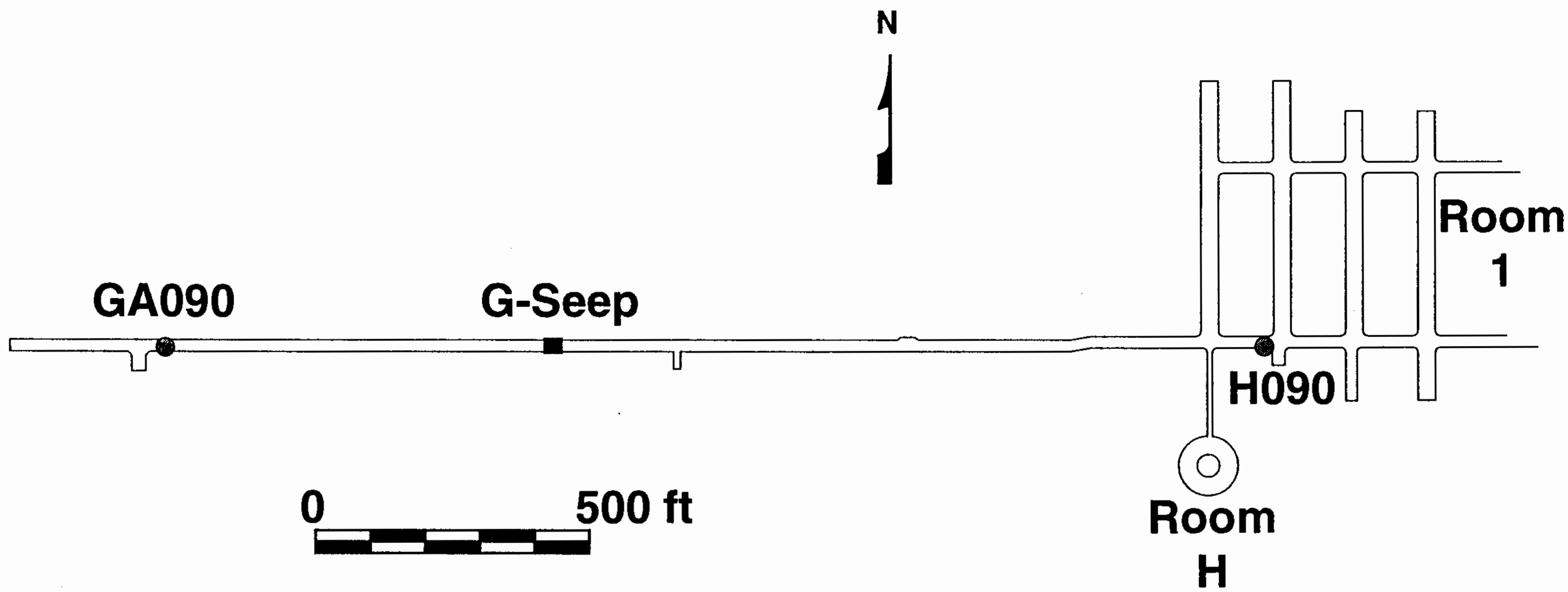
This treatment is conservative because it maximizes inflow into the unit through which release to the accessible environment is most likely.

# G-Seep

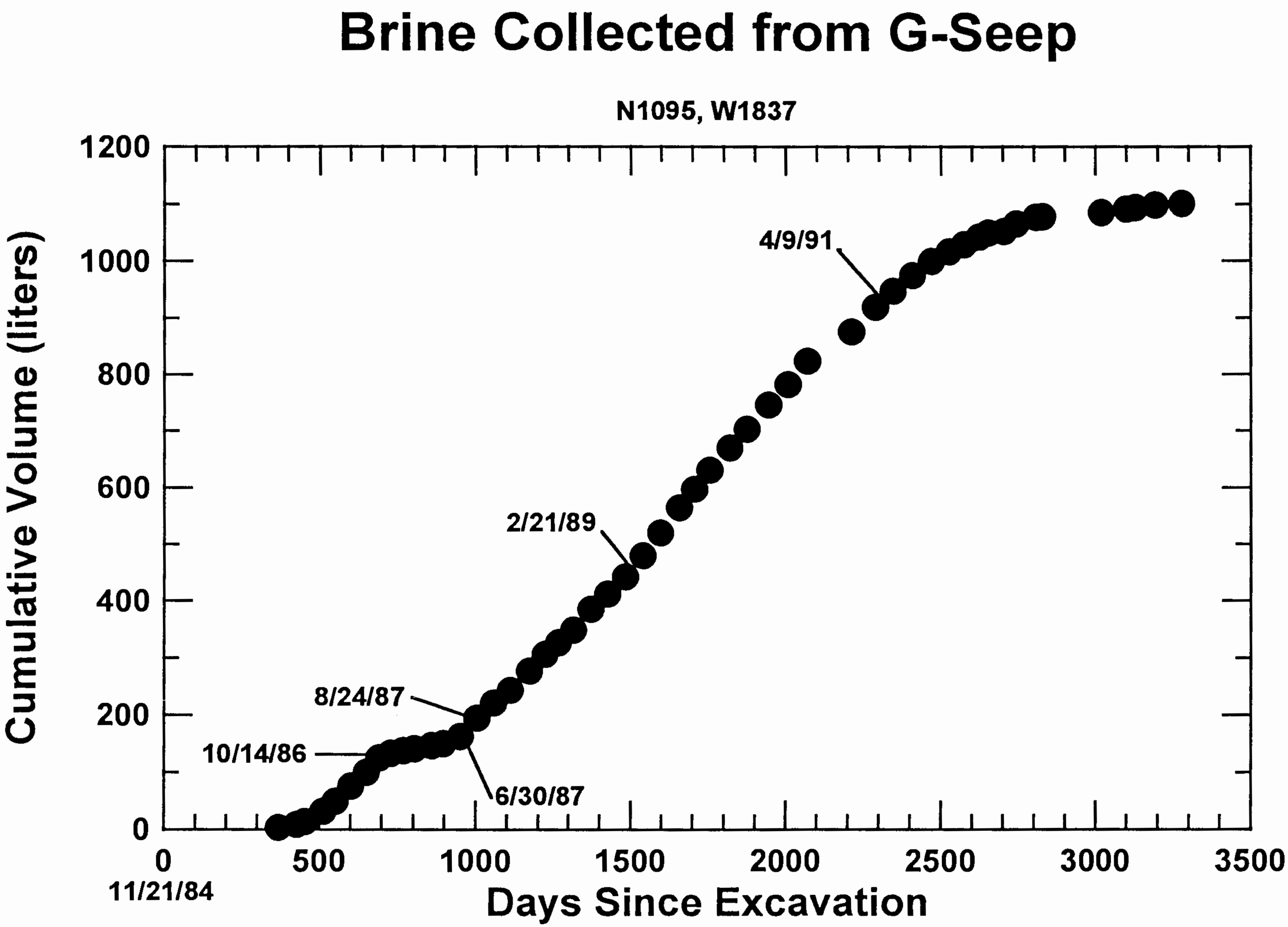
G-Seep is a location (N1095, W1837) in Room G where brine was observed to collect on the floor beginning in 1985. Through November 1993, 1100 liters of brine were collected from G-Seep.

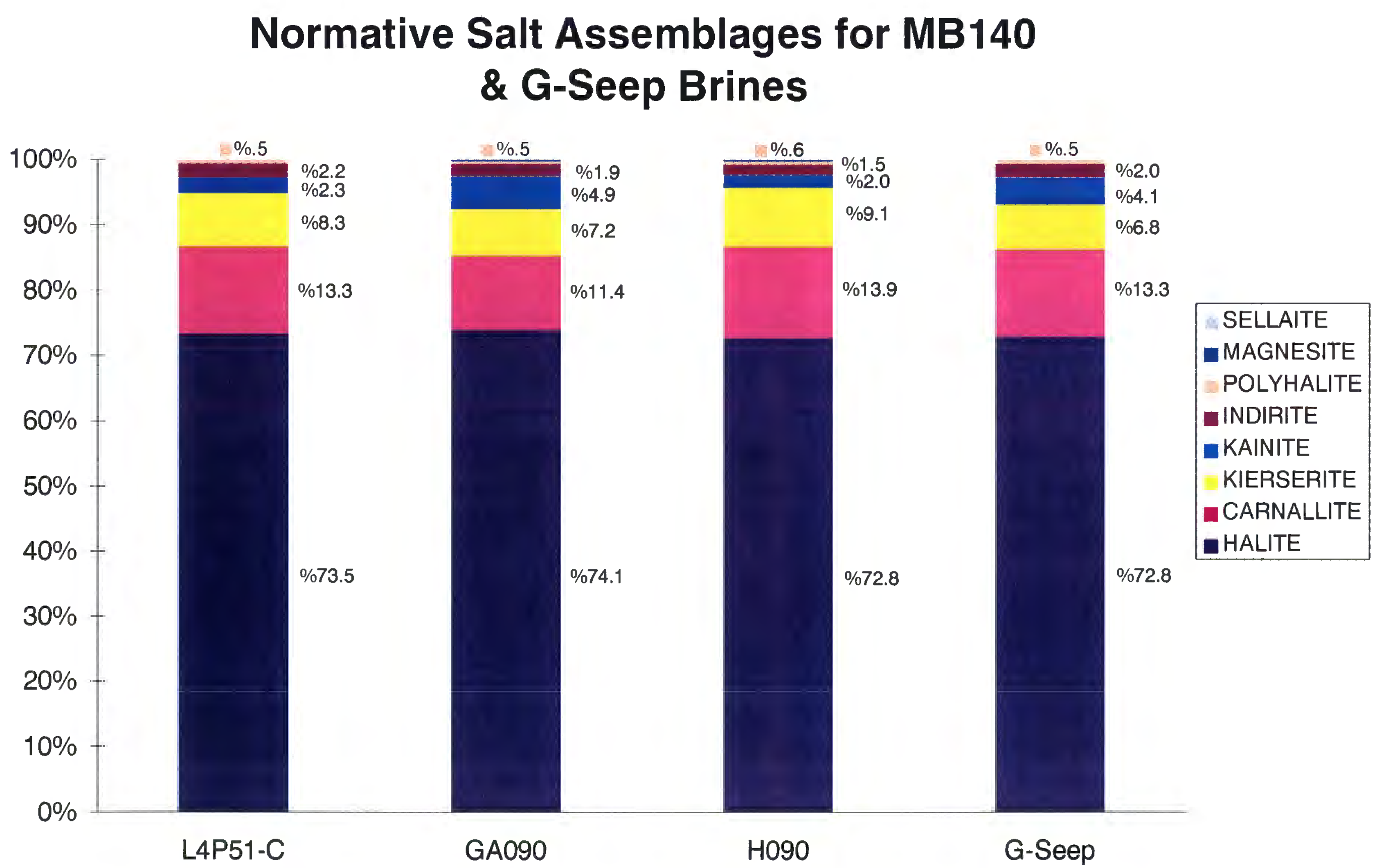
G-Seep brine chemistry is distinctly different from that of all other halite and anhydrite brines collected near the facility horizon. It is similar to the chemistry of brine collected from MB140. Mixing of facility-horizon brines with other waters cannot explain G-Seep chemistry.

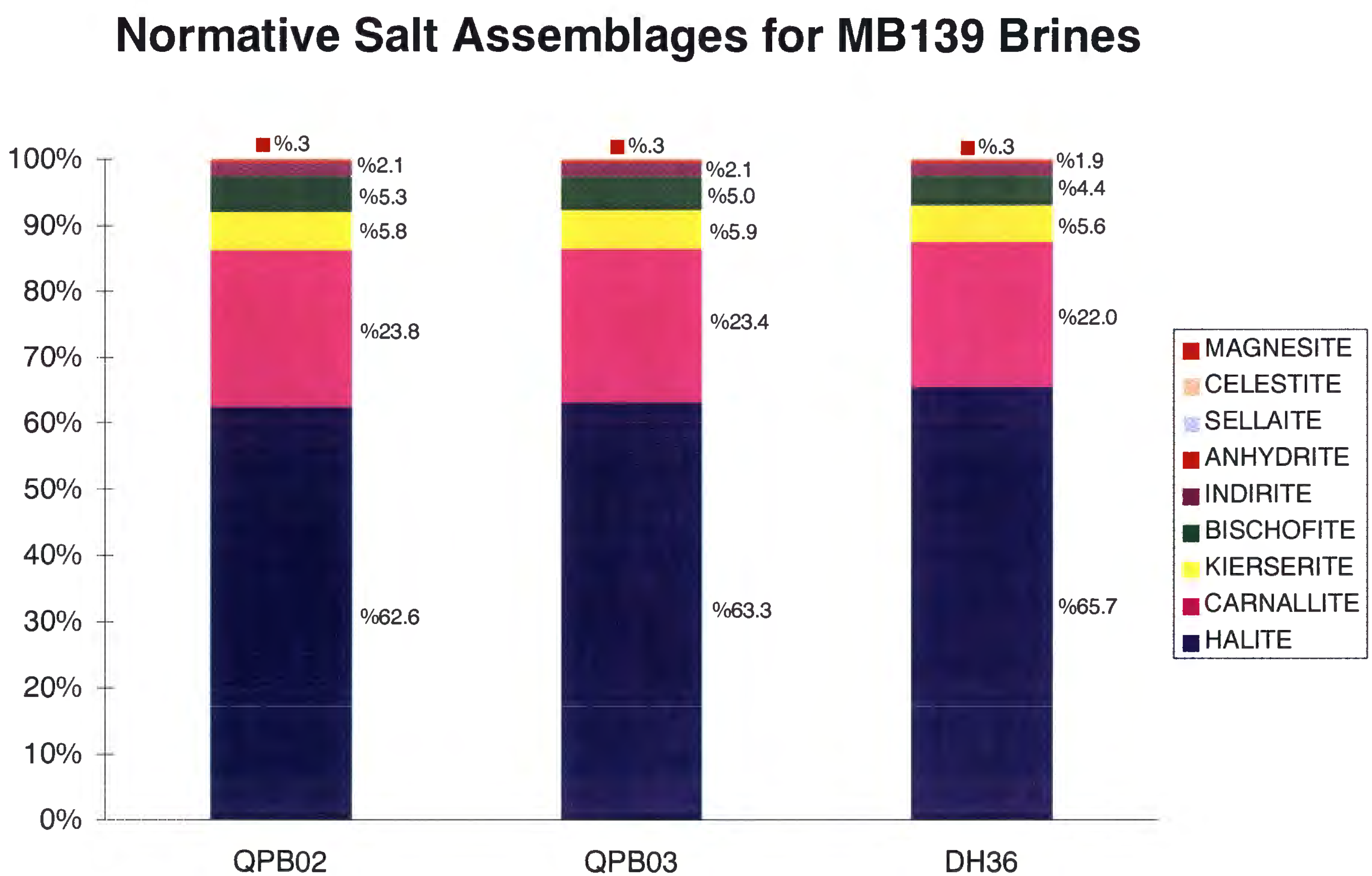
# Brine Collection Locations



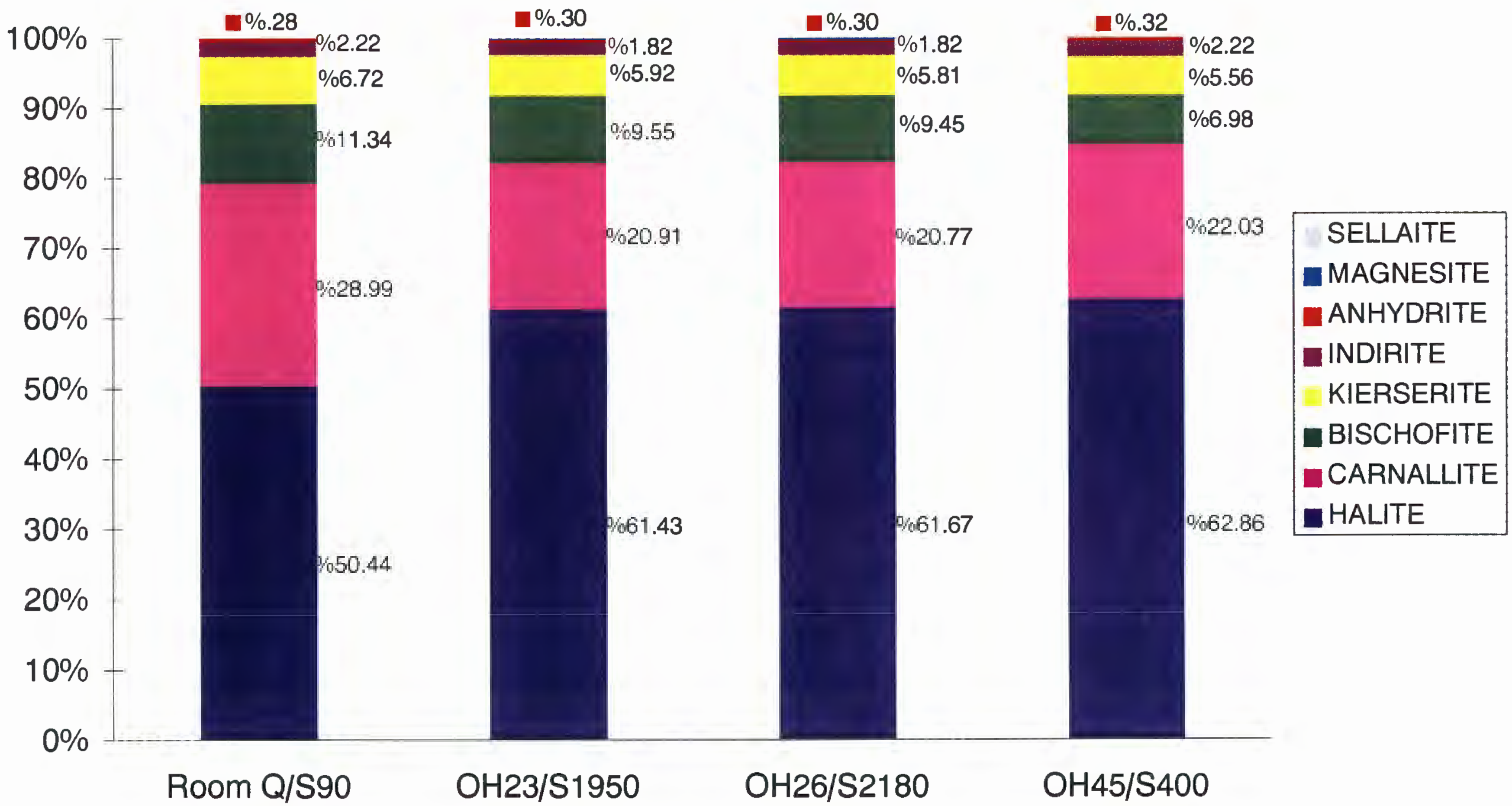

2875-0

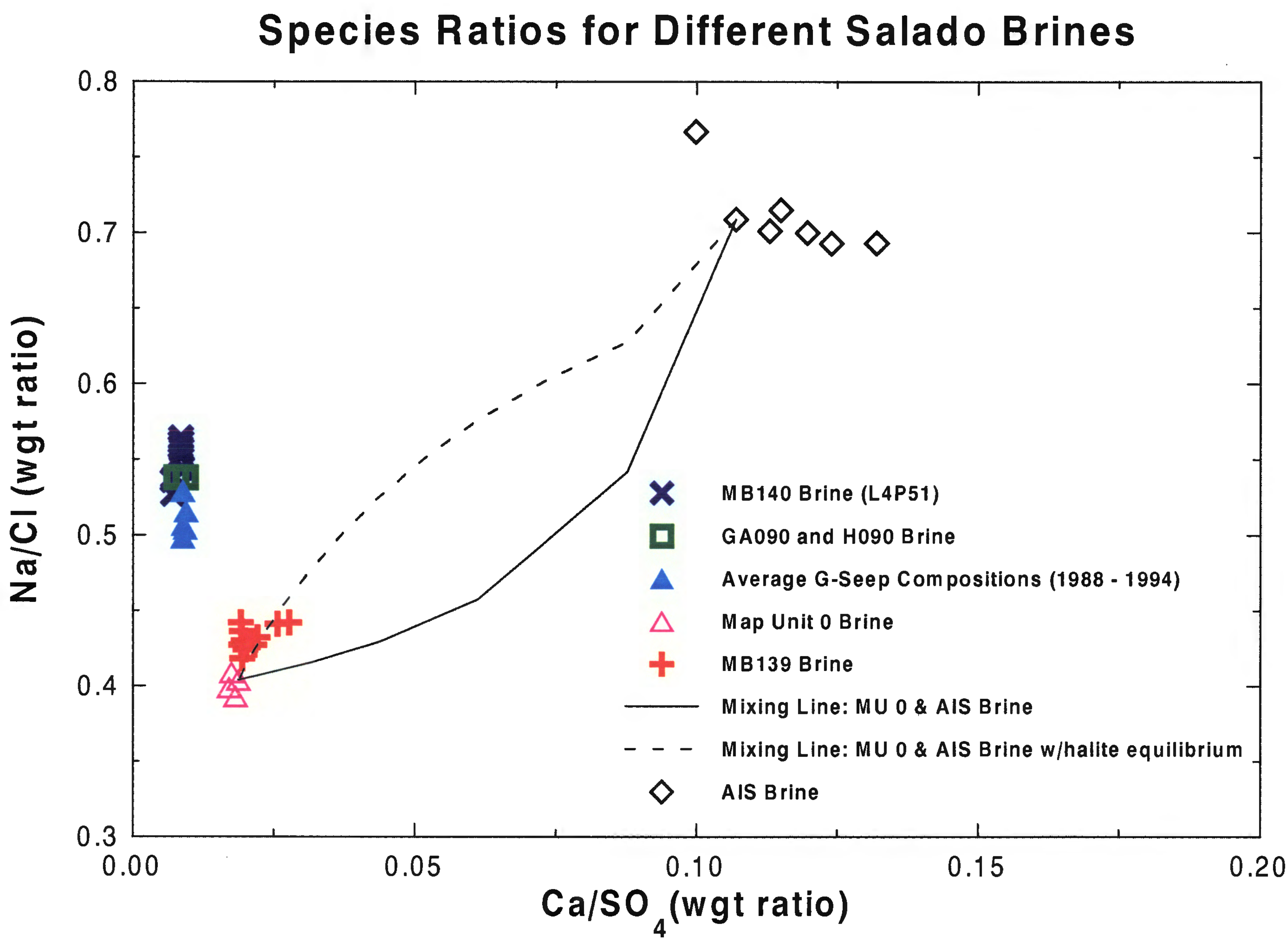

Brine Collected from G-Seep
N1095, W1837
Cumulative Volume (liters)
0
200
400
600
800
1000
1200
0
11/21/84
500
1000
1500
2000
2500
3000
3500
Days Since Excavation
10/14/86
8/24/87
6/30/87
2/21/89
4/9/91


Normative Salt Assemblages for MB140
& G-Seep Brines
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
%.5
%2.2
%2.3
%8.3
%13.3
%73.5
%.5
%1.9
%4.9
%7.2
%11.4
%74.1
%.6
%1.5
%2.0
%9.1
%13.9
%72.8
%.5
%2.0
%4.1
%6.8
%13.3
%72.8
SELLAITE
MAGNESITE
POLYHALITE
INDIRITE
KAINITE
KIERSERITE
CARNALLITE
HALITE
L4P51-C
GA090
H090
G-Seep


Normative Salt Assemblages for MB139 Brines
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
%.3
%2.1
%5.3
%5.8
%23.8
%62.6
%.3
%2.1
%5.0
%5.9
%23.4
%63.3
%.3
%1.9
%4.4
%5.6
%22.0
%65.7
QPB02
QPB03
DH36
MAGNESITE
CELESTITE
SELLAITE
ANHYDRITE
INDIRITE
BISCHOFITE
KIERSERITE
CARNALLITE
HALITE

# Normative Salt Assemblages for Halite Brines





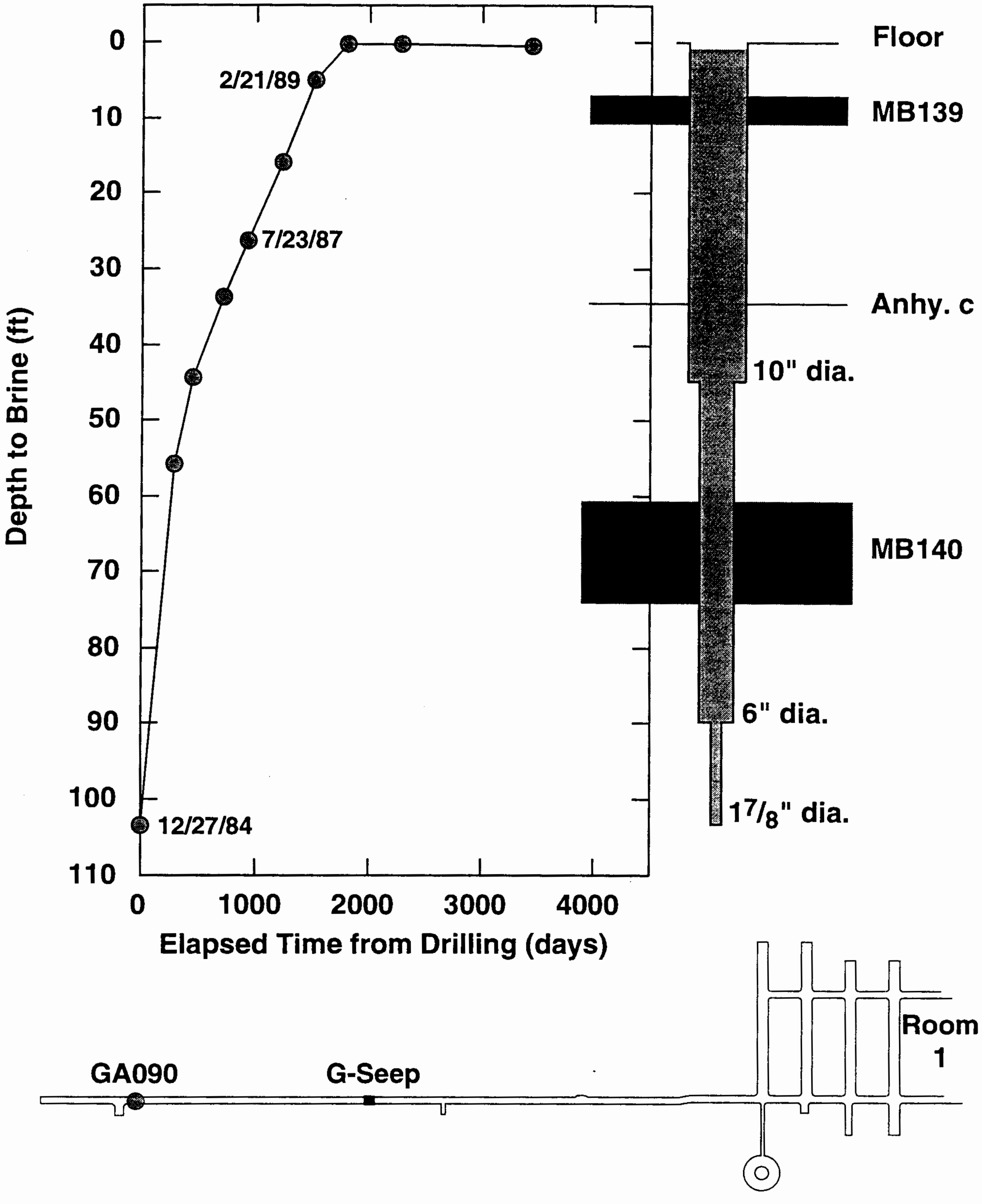
Species Ratios for Different Salado Brines
Na/Cl (wgt ratio)
Ca/SO4 (wgt ratio)
0.8
0.7
0.6
0.5
0.4
0.3
0.00
0.05
0.10
0.15
0.20
MB140 Brine (L4P51)
GA090 and H090 Brine
Average G-Seep Compositions (1988 - 1994)
Map Unit 0 Brine
MB139 Brine
Mixing Line: MU 0 & AIS Brine
Mixing Line: MU 0 & AIS Brine w/halite equilibrium
AIS Brine

# G-Seep (contd.)

Two holes in Room G penetrate MB140: GA090 (N1104, W2545) and H090 (N1103, W513)

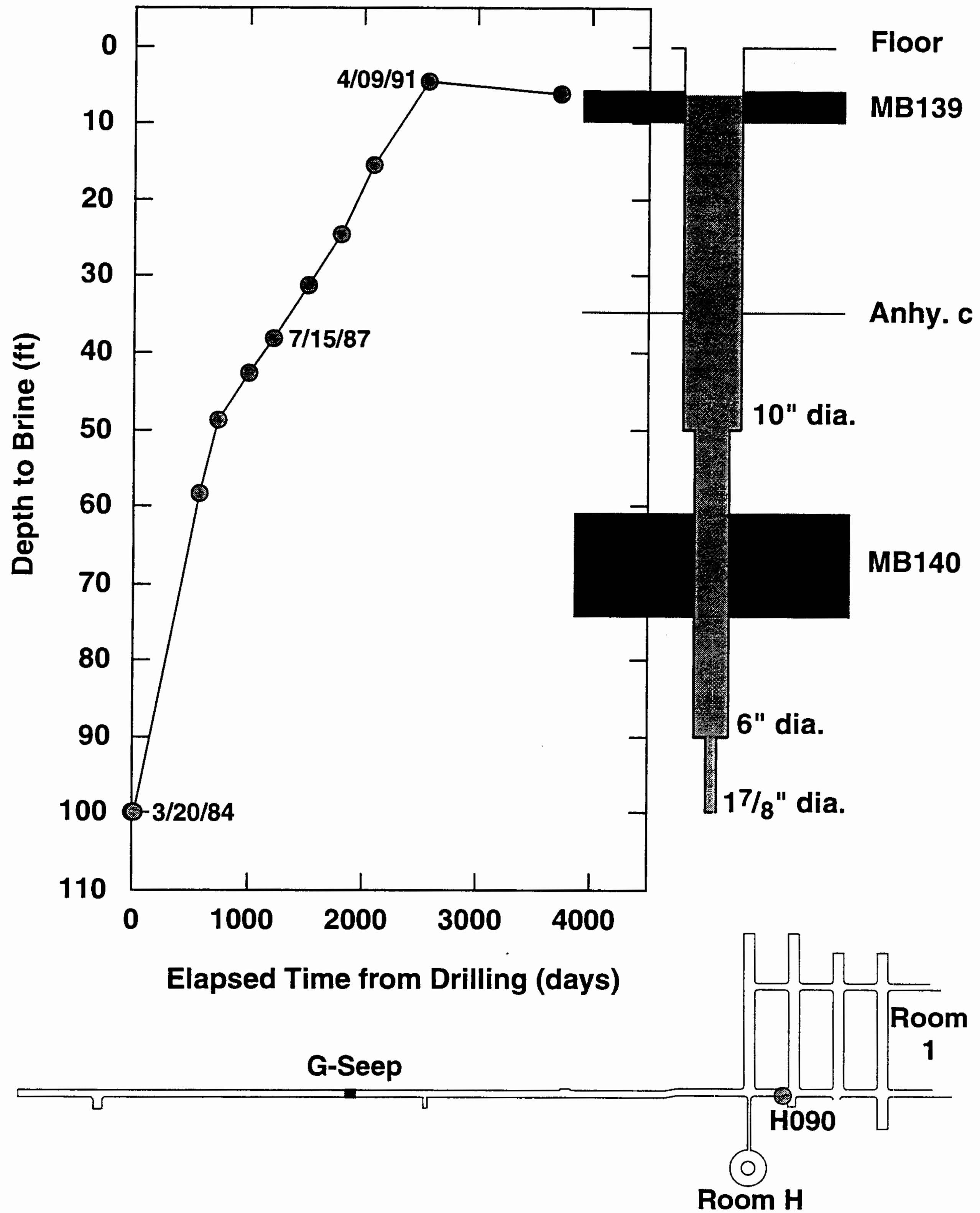
The chemistry of the brines from these holes is similar to that of G-Seep, but hydrographs of the water levels in these holes show that they could not have been supplying G-Seep during the time of its greatest flows.

# Brine Level in Hole GA090




2877-0

# Brine Level in Hole H090




2876-0

# Conclusions About G-Seep

G-Seep brine chemistry is similar to that of MB140 brines.

Source is uncertain.  Hypotheses for origin include:

1. undocumented hole through MB140 in Room G
2. water from Waste Shaft sump containing dominant component of MB140 brine spread in Room G for dust control
3. stratigraphic unit that has never been sampled with chemistry similar to MB140

# Treatment of Brine Sources in CCA

1. permeability range assigned to anhydrite interbeds incorporates data from MB140

2. halite is considered isotropic and uniformly permeable, even though layers of extremely low to nonexistent permeability are known to exist

3. permeability of DRZ remains high for 10,000 yr, allowing good connection between waste rooms and interbeds

# Impact of G-Seep on CCA

G-Seep reflects a source of brine and possibly a pathway through the DRZ

Sources of brine are conservatively accounted for in parameter ranges assigned to anhydrite interbeds and halite

Pathways through the DRZ are allowed to persist for 10,000 yr

Therefore, the phenomenon responsible for G-Seep is adequately addressed in the CCA