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Sandia National Laboratories Annual Compliance Monitoring Parameter Assessment For 2004

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Sandia National Laboratories
Annual Compliance Monitoring
Parameter Assessment for 2004

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Executive Summary

This document reports the sixth annual (2004) derivation and assessment of the Waste Isolation Pilot Plant (WIPP) Compliance Monitoring Parameters (COMPs). The COMPs program is a requirement of the Environmental Protection Agency (EPA) disposal regulations (EPA 1993 and 1996). The concept of deriving and assessing COMPs is explained in Sandia National Laboratories (SNL) Nuclear Waste Management Program Analysis Plan, AP-069 titled: *An Analysis Plan for Annually Deriving Compliance Monitoring Parameters and their Assessment Against Performance Expectations to Meet the Requirements of 40 CFR 194.42* (SNL 2000a).

The WIPP has many monitoring programs, each designed to meet various regulatory and operational safety requirements. The comprehensive WIPP monitoring effort is not under the auspice of one program, but is comprised of many discrete elements, one of which was designed to fulfill the EPA's long-term disposal requirements found at 40 CFR Part 191 Subparts B and C, and the Certification Criteria at 40 CFR 194. Monitoring parameters that are related to the long-term performance of the repository were identified in a monitoring analysis[1] (since these parameters fulfill a regulatory function, they were termed Compliance Monitoring Parameters so that they would not be confused with similar PA parameters).

The Department of Energy (DOE) uses performance assessment (PA) to predict the containment performance of the WIPP. COMPs are then used to indicate conditions that are not within PA expectations and to alert the project of conditions not accounted for or expected. COMPs values and ranges were developed such that exceedance of these values indicate a condition that is potentially outside PA expectations. These values were appropriately termed "trigger values." Deriving COMPs trigger values (TV) was the first step in assessing the monitoring data. TVs were derived in 1999 and are documented in the *Trigger Value Derivation Report* (SNL 2002a). In some instances a COMP will not have a TV because it has been shown to be insensitive to PA results though EPA's sensitivity analysis (EPA 1998).

As the quantity of information in the monitoring database grows over time, the data will become more useful for assessing the monitoring program's performance. With each annual assessment and knowledge gained through ongoing activities, the basis for assessing COMPs and assigning TVs will undergo improvements as appropriate. The *Trigger Value Derivation Report* (SNL 2002a) was revised in 2002 to include values for groundwater composition and flow COMPs. Additionally, each recertification PA may change the way COMPs are assessed since PA assumptions, parameters and conceptual models may be updated, thus potentially changing PA expectations used to assess monitoring parameters. With each recertification, new inventory estimate will be used to include actual waste emplacement and new waste information. This inventory information affects the waste activity COMP. Therefore, a monitoring program analysis will be conducted whenever a new compliance baseline is established during the recertification to evaluate the impacts on the compliance monitoring program. If necessary, the monitoring program will be revised and new TVs will be derived.

In the final Certification Ruling (EPA 1998), EPA approved ten COMPs: two relating to human activities, five relating to geotechnical performance, two relating to regional hydrogeology and one

[1] Attachment MONPAR to Appendix MON in the CCA (DOE 1996) documents the analysis of monitoring parameters. The analysis was performed to fulfill 40 CFR 194.42 requirements.

relating to the radioactive components of the waste. The EPA also requires the DOE to report any condition that would indicate the repository would not function as predicted or a condition that is substantially different from the information contained in the most recent compliance application. Annual assessments of COMPs will allow the DOE to monitor the predicted performance of the repository and report any condition adverse to the containment performance. This compliance monitoring program is described in greater detail in DOE's *40 CFR Parts 191 and 194 Compliance Monitoring Implementation Plan* (MIP; DOE 1999).

As outlined in the MIP, the Management and Operating Contractor (M&OC), currently Westinghouse TRU Solutions (WTS) is responsible for implementing the monitoring programs that collect and report the monitoring data. The Scientific Advisor (SA) is responsible for assessing these data and compiling the results as they pertain to performance expectations. The SA is also responsible for making recommendations to improve or change the monitoring programs based on the results. This document reports these results and the recommendations based on the 2004 Annual COMPs Assessment. This assessment concludes that the COMP values assessed in this annual report do not indicate a condition for which the repository will perform in a manner other than that represented in WIPP PAs.

1 Introduction

The WIPP is governed by the EPA's long-term radioactive waste disposal regulations at 40 CFR Part 191 Subparts B and C (EPA 1993) and the WIPP-specific certification criteria at 40 CFR Part 194 (EPA 1996). Monitoring WIPP performance is an "assurance requirement" of these regulations and is intended to provide additional assurance that the WIPP will protect the public and environment (see 40 CFR § 191.14).. In the WIPP Compliance Certification Application (CCA; DOE 1996), the DOE made commitments to conduct a number of monitoring activities to comply with the criteria at 40 CFR § 194.42 and to ensure that deviations from the expected long-term performance of the repository are identified at the earliest possible time. These DOE commitments are represented by ten COMPs, which are listed in Section 2.

The COMPs are an integral part of the overall WIPP monitoring strategy. The DOE's MIP (DOE 1999) describes the overall monitoring program and responsibilities for COMPs derivation and assessment. Collecting and reporting data from the WIPP monitoring programs are the responsibilities of the M&OC. The SA then uses these monitoring data and observations to derive data values which indicate potential issues (termed "trigger values") for the ten COMPs and evaluate the COMPs against performance expectations for the disposal system. The performance expectations are based on scenarios, conceptual models and computational results using the WIPP PA methodology and its associated codes and parameter values that form part of the DOE's Compliance Baseline. The results of the SA's evaluation of COMPs are reported to the DOE Carlsbad Field Office (CBFO) via the Compliance Certification Manager. This report documents the results of the reporting year 2004 COMPs assessment (September 16th 2003 to June 30th 2004). The reporting period has changed to match the reporting period of the 194.4(b)(4) report (EPA 2003). This is the last reporting cycle prior to WIPP recertification. After the recertification baseline is complete, a new analysis similar to that performed to comply with 40 CFR § 194.42 will be used to determine if new parameters should be monitored or if other changes should be made to the COMP program. The next COMPs report is expected to be derived under the new program pending completion of the recertification, establishment of a new baseline and completion of a monitoring assessment. If these activities are not completed before the next reporting cycle, the COMPs assessment shall follow the program used for this report.

1.2 Monitoring and Evaluation Strategy

The MIP illustrates the process for evaluation of COMP-related monitoring data and observations (Fig 4.2; DOE 1999). Figure 1.1 (of this document) graphically describes the three basic Compliance Monitoring Program elements which include the trigger value (TV) generation and reporting function, the annual COMP reporting cycle and the five-year recertification element. The Compliance Monitoring Program is an integrated effort between the M&OC, the SA and the CBFO. The CBFO oversees and directs the monitoring program to ensure compliance with the EPA monitoring and reporting requirements. The SA is also responsible for the development and maintenance of the TVs. Exceedance of these values represents a condition that requires further actions, but does not indicate an out-of-compliance condition. This approach assures that conditions that are not consistent with expected repository performance are recognized as early as possible. These conditions may include data inconsistent with the conceptual models implemented in PA, or invalidation of assumptions and arguments used in the screening of Features, Events and Processes (FEPs) screened into PA.

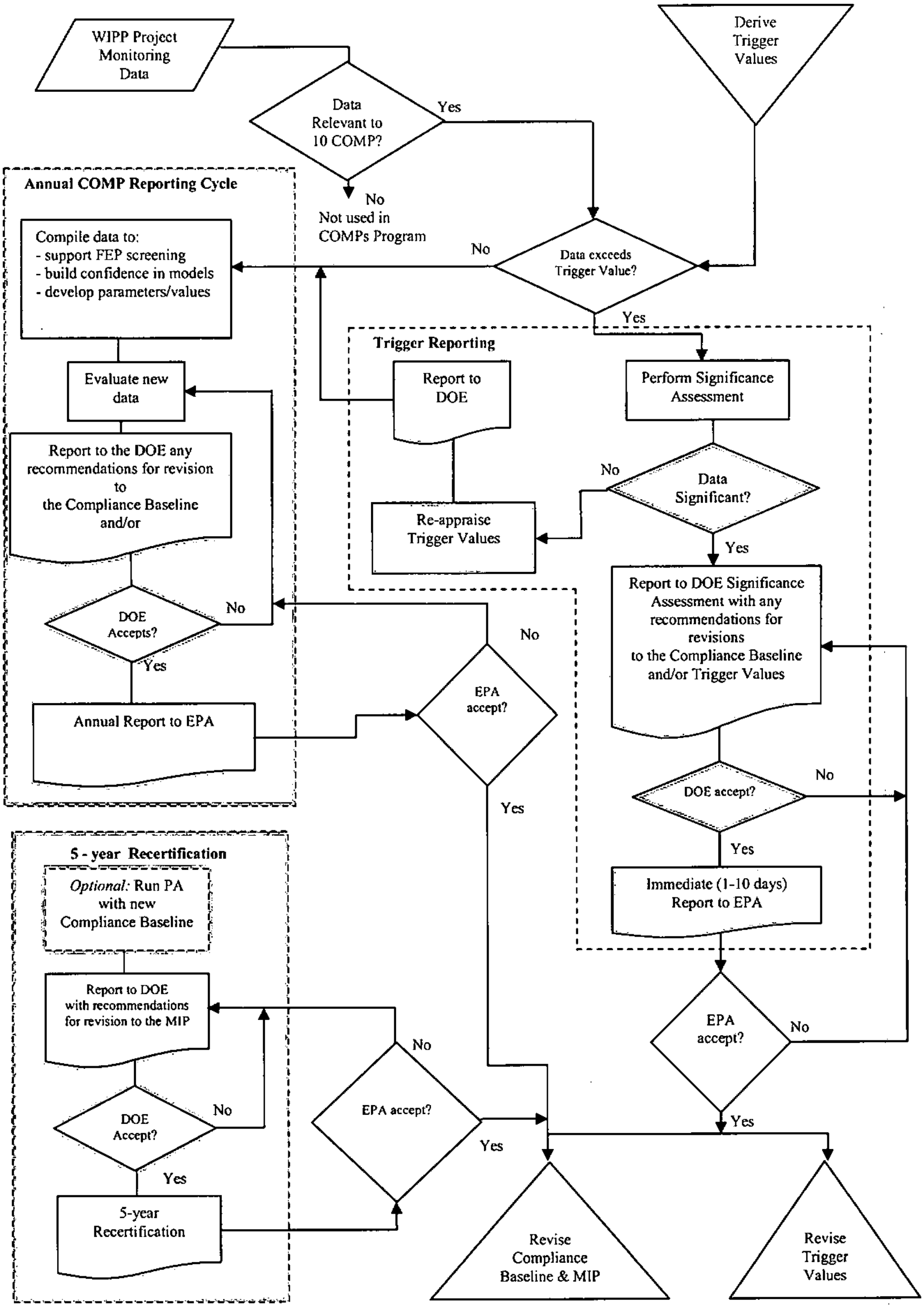

Figure 1.1 Activities evaluating and reporting compliance monitoring parameters

1.3 Annual Reporting Cycle

Reporting results of the annual COMPs assessment is necessary to meet the EPA monitoring requirements. Under 40 CFR §194.4, the DOE is required to report significant, and non-significant, changes to the EPA. Additionally, the recertification requirements at 40 CFR §194.15(a)(2) also require inclusion of all additional monitoring data, analysis and results in DOE's documentation of continued compliance submittal.

Changes to monitoring data, associated parameter values and monitoring information must be reported even if the assessment concludes there is no impact on the repository regardless of whether or not the monitoring data agree with expectations. The monitoring data will be compiled and reported to the DOE to assist in DOE's annual reporting cycle to the EPA. The SA's role in this reporting cycle is to use the monitoring data to derive the COMPs, and to use the new and updated information to make any recommendations for modification to the Compliance Baseline.

2 Assessment of COMPs

The compliance monitoring program tracks the following ten COMPs:

1. Drilling Rate
2. Probability of Encountering a Castile Brine Reservoir
3. Waste Activity
4. Subsidence
5. Changes in Culebra Groundwater Flow
6. Change in Culebra Groundwater Composition
7. Creep Closure
8. Extent of Deformation
9. Initiation of Brittle Deformation
10. Displacement of Deformation Features

An annual review of these COMPs is necessary to meet the intent of 40 CFR §191.14 assurance requirements, which states:

> "(b) Disposal systems shall be monitored after disposal to detect substantial and detrimental deviations from expected performance. This monitoring shall be done with techniques that do not jeopardize the isolation of the wastes and shall be conducted until there are no significant concerns to be addressed by further monitoring."

In the following section, each COMP is evaluated and compared to the applicable TV. This assessment is performed under Analysis Plan AP-069 (SNL 2000a). This section summarizes the results of the 2004 calendar year assessment. Specifically, AP-069 contains five steps to derive TVs and assess COMPs. Steps 1 and 2 generate a table that maps COMP-related data to PA parameters, FEPs screening arguments, conceptual models, model assumptions and the M&OC organization that generates the data used to derive each COMP. Table 2.1 identifies PA relationships with COMPs.

Table 2.1 Monitoring parameters

40 CFR 194 Monitoring Parameter	Responsible Program M&OC/*SA* (SA in italics)	Trigger Value(s)	Related Performance Assessment Parameter	Major FEPs Screening Decisions Related to Monitoring
Creep Closure and Stresses	Geotechnical Monitoring Program *Rock Mechanics Program*	Greater than 1 order of magnitude increase in the rate.	Not directly related to a PA Parameter. *Provides a short-term (operational) observation of the deformational properties of halite and anhydrite. Can provide confidence in the CCA creep closure model.*	*Salt creep, room closure, excavation-induced stress changes, changes in stress field, pressurization, consolidation of waste.*
Extent of Deformation	Geotechnical Monitoring Program *Rock Mechanics Program*	Greater than 1 meter per year increase.	Not directly related to a PA Parameter. *Provides a short-term observation of the extent of deformation. Can provide confidence in the long-term behavior of Disturbed Rock Zone (DRZ) as modeled in CCA and DRZ parameters (e.g., permeability and porosity). Intrinsic shaft DRZ permeability.*	*DRZ, roof falls, consolidation of seal elements, compaction of waste.*
Initiation of Brittle Deformation	Geotechnical Monitoring Program *Seals and Rock Mechanics Programs*	None	Not directly related to a PA parameter. *Provides related repository observation data on initiation or displacement of major brittle deformation features in the roof or surrounding rock.*	*Disruption due to gas effects.*

40 CFR 194 Monitoring Parameter	Responsible Program M&OC/*SA* (SA in italics)	Trigger Value(s)	Related Performance Assessment Parameter	Major FEPs Screening Decisions Related to Monitoring
Displacement of Deformation Features	Geotechnical Monitoring Program *Rock Mechanics Program*	Obscured borehole (qualitative)	Not directly related to a PA Parameter. *Provides related repository operational data on initiation or displacement of major brittle deformation features in the roof or surrounding rock.*	*Seismic activity, creep closure, consolidation of waste.*
Culebra Ground Water Compositions	Ground Water Monitoring Program *Far Field Monitoring Program*	Both duplicate analyses for any major ion falling outside the 95% Confidence Intervals given in Table 4.2 for three consecutive sampling periods.	Average Culebra brine composition and matrix distribution coefficient for U (IV,VI), Pu(III,IV), Th(IV), Am(III). *Matrix distribution coefficient is not a sensitive parameter for the CCA PA. Can provide information on well integrity around the site.*	*Groundwater geochemistry, actinide sorption.*
Change in Culebra Ground Water Flow (Water Level)	Ground Water Monitoring Program *Far Field Monitoring Program*	Comparison to ranges of freshwater heads used in CCA T-Fields (Table 4.1 of Trigger Report)	Culebra transmissivity, fracture & matrix porosity, fracture spacing, dispersivity, & climate Index. *The CCA modeling allowed the water level to rise to the land surface. Can provide information on well integrity around the site.*	*Groundwater flow and recharge/discharge; Infiltration and Precipitation.*

40 CFR 194 Monitoring Parameter	**Responsible Program M&OC/*SA*** (SA in italics)	**Trigger Value(s)**	**Related Performance Assessment Parameter**	**Major FEPs Screening Decisions Related to Monitoring**
Drilling Rate	Delaware Basin Monitoring Program *Direct Release Program*	53.5 boreholes per square kilometer per 10,000 yrs.	Drilling rate per unit area. *In the CCA the drilling rate was determined to be 46.8 boreholes per square kilometer per 10,000 yrs.*	*Drilling.*
Probability of Encountering a Castile Brine Reservoir	Delaware Basin Monitoring Program *Direct Release Program*	None	Probability of encountering a Castile brine reservoir, reservoir pressure, and volume. *In the CCA, 8% was used; in the Performance Assessment Validation Test, a range of 1 - 60% was used.*	*Drilling fluid flow, drilling fluid loss, blowout and brine reservoirs.*
Subsidence Measurements	Subsidence Monitoring Program *Rock Mechanics Program*	10 millimeters per Year	Not directly related to a PA Parameter. *Can provide spatial information on surface subsidence (if any) over the influence area of the underground openings during operations.*	*Changes to ground water flow due to mining effects, subsidence baseline.*

40 CFR 194 Monitoring Parameter	Responsible Program M&OC/*SA* (SA in italics)	Trigger Value(s)	Related Performance Assessment Parameter	Major FEPs Screening Decisions Related to Monitoring
Waste Activity	WIPP Waste Information System (WWIS) *PA Methodology*	5.1 million curies (RH Only)	Radionuclide inventory. *In the CCA, the SA used the Baseline Inventory Report information scaled to the Land Withdrawal Act (LWA) limits of 6.2 million cubic ft for CH TRU waste and 5.1 million curies for RH TRU waste (limits are listed in table WCA-1 in the CCA)*	*Waste characteristics, radiological characteristics, consolidation of waste, actinide source term.*

2.1 Human Activities COMPs

The CCA identifies ten COMPs that the DOE is required to monitor and assess during the WIPP operational period. Two of these parameters monitor "Human Activities" in the WIPP vicinity which include:

- Probability of Encountering a Castile Brine Reservoir
- Drilling Rate

2.1.1 Probability of Encountering a Castile Brine Reservoir

Monitoring activities for Castile brine encounters have identified one new brine encounter during this reporting period bringing the total of encounters identified since the CCA to six.

Data used for the CCA were compiled from drilling record searches for the region surrounding the WIPP. The results of this initial search recorded 27 drilling encounters with pressurized brine (water) in the Castile Formation. Of these encounters, 25 were hydrocarbon wells scattered over a wide area in the vicinity of the WIPP site; two wells, ERDA 6 and WIPP 12, were drilled in support of the WIPP site characterization effort (see DOE 2004a, Table 11 for a complete listing of brine encounters). The Delaware Basin Drilling Surveillance Program reviews the well files of all new wells drilled in the New Mexico portion of the Delaware Basin each year looking for instances of Castile brine encounters. The program also sends out an annual survey to operators of new wells to determine if pressurized brine was encountered. Since the CCA, data have been compiled through August 2004. No pressurized Castile brine encounters have been reported in the official drilling records for wells drilled in the New Mexico portion of the Delaware Basin (DOE 2004a).

As reported in WID 2001, there were two Castile Brine encounters reported by area drillers to WIPP Site personnel that do not appear in records on file at New Mexico Oil Conservation District (NMOCD) offices. The following year, WID 2002 reported three additional brine encounters reported to site personnel that do not appear in the well records at the NMOCD offices. Two encounters were located near ERDA 6 northeast of the WIPP Site that reported encountering brine at an initial rate of several hundred barrels per hour. All brine was contained within the drilling pits and therefore did not require reporting to the NMOCD. The third encounter was to the southwest of the WIPP Site reporting an initial rate of 400 to 500 barrels per hour that dissipated in a matter of minutes.

During this reporting period, WIPP Site personnel were informed of a possible Castile Brine encounter during the drilling of the Apache "13" Federal #3 located in T22S-R30E-13. Strong water flow with blowing air was encountered at 2,850-3,315 ft. Hydrogen sulfide was recorded at 362 ppm. At the first encounter of hydrogen sulfide, the well was shut in for several hours while additional monitoring equipment was installed. The water flow had no impact on drilling operations (DOE 2004a).

Of the six Castile Brine encounters recorded since the 1996 CCA, five were identified when WIPP Site personnel performing field work talked to area drillers. The other encounter was reported by an operator in the Annual Survey of area drillers. All the new encounters are located in areas where Castile Brine is expected to be encountered during the drilling process. Table 2.2 shows all known Castile Brine encounters in the vicinity of the WIPP Site since the CCA.

The impacts of brine encounters are modeled in the PA. The CCA used a 0.08 probability of encountering brine reservoirs. In the Performance Assessment Verification Test (PAVT), the EPA mandated a range of 0.01 to 0.6. These higher values did not influence the predicted performance of the repository. Thus, the EPA determined that this parameter (PBRINE) does not have a significant impact on PA results (EPA 1998). Additionally, the PAVT parameter values have been incorporated into the compliance baseline and have been used in recertification calculations.

Table 2.2 Well Locations Encountering Brine Since the CCA

Number	Location	Well Name and Location	Spud Date	Well Information
1	21S-31E-35	Lost Tank "35" State #4	09/11/2000	Oil Well: Estimated several hundred barrels per hour. Continued drilling.
2	21S-31E-35	Lost Tank "35" State #16	02/06/2002	Oil Well: At 2,705 ft., encountered 1,000 B/H. Shut-in to get room in reserve pit with pressure of 180 psi. Shut-in next
3	22S-31E-02	Graham "AKB"State #8	04/12/2002	Oil Well: Estimated 105 barrels per hour. Continued drilling.
4	23S-30E-01	James Ranch Unit #63	12/23/1999	Oil Well: Sulfur water encountered at 2,900 ft. 35 ppm was reported but quickly dissipated to 3 ppm in a matter of minutes. Continued drilling.
5	23S-30E-01	Hudson "1" Federal #7	01/06/2001	Oil Well: Estimated initial flow at 400 to 500 barrels per hour with a total volume of 600 to 800 barrels. Continued drilling.
6	22S-30E-13	Apache "13" Federal #3	11/26/2003	Oil Well: Encountered strong water flow with blowing air at 2,850-3,315 ft. No impact on drilling process

Probability of Encountering a Brine Reservoir - 2004:

Trigger Value Derivation				
COMP Title:	Probability of Encountering a Castile Brine Reservoir			
COMP Units:	Unitless			
Related Monitoring Data				
Monitoring Program	Monitoring Parameter ID	Characteristics (e.g., number, observation)	Compliance Baseline Value	
DBMP[1]	NA	Driller's survey – Field observations	0.08 constant – CCA 0.01 to .60 - PAVT	
COMP Derivation Procedure				
Analysis of encounters of pressurized brine recorded and reported by industry in the 9-township area centered on WIPP.				
Year 2004 COMP Assessment Value				
No new data reported in State record during the reporting period; One new report from Field Observations. 33 Total Brine Encounters 27 CCA total occurrences before 1996 0 State Record occurrences since 1996 6 Site Personnel/ Drillers Survey occurrences since 1996				
Related Performance and Compliance Elements				
Element Title	Parameter Type & ID or Model Description	Derivation Procedure	Compliance Baseline	Impact of Change
Probability of Encountering Brine	Parameter PRBRINE	CCA MASS Attachment 18-6 geostatistical study based on area occurrences. EPA TSD justified the upper value in their range by rounding up the upper value interpreted from the TDEM survey, which suggested a 10 to 55% areal extent.	0.08 0.01 to 0.60	Not a sensitive parameter.
Monitoring Data Trigger Values				
Monitoring Parameter ID	Trigger Value	Basis		
Probability of Encountering a Castile Brine Reservoir	None	After the DOE proposed the brine reservoir probability as potentially significant in the CCA Appendix MONPAR, the EPA conducted analyses that indicate a lack of significant effects on performance from changes in this parameter. For this reason and since the parameter is evaluated for significant changes at least once annually, no TV is needed.		

(1) Delaware Basin Monitoring Program

2.1.2 Drilling Rate

The drilling rate COMP tracks deep drilling (> 2150 ft in depth) activities relating to resource exploration and extraction. Boreholes relating to resources include potash and sulfur core holes, hydrocarbon exploration wells, saltwater disposal wells and water wells drilled in the Delaware Basin. The drilling rate that was reported in the CCA was determined using an equation provided in 40 CFR Part 194. The formula is as follows: number of deep holes times 10,000 years divided by 23,102.1 square kilometers (area of the Delaware Basin) divided by 100 years equals the number of boreholes per square kilometer per 10,000 years. The number of deep boreholes over the last 100 years is used in the equation (1896 – 1996 for the CCA value). The rate reported in the CCA using this equation was 46.8 boreholes per square kilometer over 10,000 years. Including the time period after the CCA (June 1995 to August 2004) increases the rate to 54.2 boreholes per square kilometer per 10,000 years (DOE 2004a).

The data cut-off date for the CRA was in 2002. Therefore, the CRA used a new drilling rate of 52.5. Although the drilling rate in 2004 has exceeded the TV, the exceedance was expected. As discussed in the Delaware Basin Monitoring Annual Report, the drilling rate will continue to rise with each new well drilled until the 100 year window moves to a time where older wells are no longer considered in the rate. No wells will drop out of the count until 2011 at which it is theoretically possible for the drilling rate to decline. Additionally, the recertification PA has used a new drilling rate of 52.5, demonstrating compliance with a greater margin than the CCA. A new TV should be developed post-recertification to account for the new rate. Exceedance of the TV does not indicate an unexpected condition since the rate can only increase each year with each new well drilled. Studies have demonstrated that much higher drilling rates are needed to impact compliance (EEG 1998). For example, in response to a recent request from EPA (EPA 2004), the SA has analyzed the impact of increases in modeled drilling rates on repository performance. This analysis shows that even if the drilling rate were doubled relative to that used for the CRA 2004-PA, the disposal system performance would be well within the release limits set forward in EPA regulations (Kanney and Kirchner 2004).

Table 2.3 Drilling Rates for Each Year since the CCA

Year	Number of Boreholes Deeper than 2,150 ft	Drilling Rate (bore holes per square kilometer per 10,000 years)
1996 (CCA Value)	10,804	46.8
1997	11,444	49.5
1998	11,616	50.3
1999	11,684	50.6
2000	11,828	51.2
2001	12,056	52.2
2002	12,219	52.9
2002 (revised)	12,139	52.5
2003	12,316	53.3
2004	12,531	54.2

As shown in Table 2.3, the drilling rate has risen from 46.8 holes per square kilometer to 54.2 holes per square kilometer since 1996. The rate will continue to climb because of the method used to calculate the rate. Since the first well drilled in the area occurred in 1911, it will be 2011 before one well is dropped from the count and 2014 before the next well is dropped from the count. In the meantime, numerous wells will have been added, increasing the drilling rate. For this reason, other methods and approaches are being investigated to derive a more meaningful TV or to justify the elimination of a value altogether.

Drilling Rate - 2004:

<table>
<tr><td colspan="5">Trigger Value Derivation</td></tr>
<tr><td>COMP Title:</td><td colspan="4">Drilling Rate</td></tr>
<tr><td>COMP Units:</td><td colspan="4">Deep boreholes (i.e., > 2,150 ft deep)/square kilometer/10,000 years</td></tr>
<tr><td colspan="5">Related Monitoring Data</td></tr>
<tr><td>Monitoring Program</td><td>Monitoring Parameter ID</td><td>Characteristics (e.g., number, observation)</td><td colspan="2">Compliance Baseline Value (CRA)</td></tr>
<tr><td>DBMP</td><td>Deep hydrocarbon boreholes drilled</td><td>Integer per year</td><td colspan="2">12,139 per 100 years</td></tr>
<tr><td colspan="5">COMP Derivation Procedure</td></tr>
<tr><td colspan="5">(Total number of deep boreholes drilled/number of years of observations (100)) x (10,000/23,102.1) [i.e., over 10,000 years divided by the area of the Delaware Basin in square kilometers]</td></tr>
<tr><td colspan="5">Year 2004 COMP Assessment Value</td></tr>
<tr><td colspan="5">(12,531 boreholes on record for the Delaware Basin) Drilling Rate = 54.2 boreholes per square kilometer per 10,000 yrs.</td></tr>
<tr><td colspan="5">Related Performance and Compliance Elements</td></tr>
<tr><td>Element Title</td><td>Parameter Type & ID or Model Description</td><td>Derivation Procedure</td><td>Compliance Baseline</td><td>Impact of Change</td></tr>
<tr><td>Drilling rate</td><td>Parameter LAMBDAD</td><td>COMP/10,000 years</td><td>4.68E-03 per square kilometer per year (CCA)[2]</td><td>23-fold increase over 10,000 years exceeds release limits at 0.1 probability (EEG, 1998). Proportional increase in cuttings/cavings releases.</td></tr>
<tr><td colspan="5">Monitoring Data Trigger Values</td></tr>
<tr><td>Monitoring Parameter ID</td><td>Trigger Value</td><td colspan="3">Basis</td></tr>
<tr><td>Deep boreholes drilled (derived from the sum of the five monitoring parameters given above)</td><td>53.5 boreholes per square kilometer per 10,000 yrs.</td><td colspan="3">CCA direct releases are influenced by drilling rate changes, however only a dramatic and improbable change in drilling rate could affect compliance with the containment requirements. There is little information upon which to justify the choice of a TV based on FEP screening decisions. A change of drilling rate greater than approximately 15% (i.e., greater than 53.5 boreholes per square kilometer per 10,000 years) is considered prudent as a TV to revisit the low-consequence assumptions associated with the effects of abandoned boreholes on fluid flow and climatic changes used to construct the PA calculations.</td></tr>
</table>

2 CRA value is 5.25E-03 per square kilometer per year

2.2 Geotechnical COMPs

The CCA lists ten monitoring parameters that the DOE is required to monitor and assess during the WIPP operational period. Five of these parameters are considered "geotechnical" in nature and include:

- Creep Closure
- Extent of Deformation
- Initiation of Brittle Deformation
- Displacement of Deformation Features
- Subsidence

Data needed to derive and evaluate the geotechnical COMPs are available from the most recent annual Geotechnical Analysis Report (GAR; DOE 2004b) and the annual Subsidence Monument Leveling Survey (DOE 2003a). Three of the geotechnical parameters lend themselves to quantification: creep closure, displacement of deformation features and subsidence. In contrast, the extent of deformation and initiation of brittle deformation are qualitative or observational parameters.

The WIPP GARs have been available since 1983 and are currently prepared by the M&OC on an annual basis. The purpose of the GAR is to present and interpret geotechnical data from the underground excavations. These data are obtained as part of a regular monitoring program and are used to characterize current conditions, to compare actual performance to the design assumptions, and to evaluate and forecast the performance of the underground excavations during operations. Additionally, the GAR fulfills various regulatory requirements and through the monitoring program, provides early detection of conditions that could affect operational safety, data to evaluate disposal room closure, and guidance for design changes. Data are presented for specific areas of the facilities including: (1) Shafts and Keys, (2) Shaft Stations, (3) Northern Experimental Area, (4) Access Drifts, and (5) Waste Disposal Areas. Data are acquired using a variety of instruments including convergence points and meters, multipoint borehole extensometers, rockbolt load cells, pressure cells, strain gauges, piezometers and joint meters. All of the geotechnical COMPs involve analyses of deformations/displacements, so the most pertinent data derived from the GAR are convergence and extensometer data. The most recent GAR (DOE 2004b) summarizes data collected from July 2002 through June 2003.

Subsidence monitoring leveling survey reports are also prepared by the M&OC on an annual basis and present the results of leveling surveys performed for nine vertical control loops comprising approximately 18 linear miles traversed over the ground surface of the WIPP site. Elevations are determined for 51 monuments and 14 National Geodetic Survey vertical control points using digital leveling techniques to achieve Second-Order Class II loop closures or better. The data are used to estimate total subsidence and subsidence rates in fulfillment of regulatory requirements. The most recent survey (DOE 2003a) summarizes data collected during September 2003. These data were reviewed and evaluated for the previous annual COMPs report (SNL 2004) so no additional analysis of subsidence data is presented here.

Geotechnical experimental programs conducted by the SA are currently underway to characterize the DRZ that develops around underground openings in salt. Data from the program are used primarily for PA and for assessing improvements to seal design, but also provide useful information for characterizing extent of deformation, initiation of brittle deformation and possibly displacement of deformation features. One such investigation is the measurement of ultrasonic velocities in the salt surrounding the Air Intake Shaft using the method developed by Hardy and Holcomb (2000). This method is described below in greater detail.

Comparisons between available data and the TVs allow evaluation of the most recent geotechnical observations for the COMPs program. The cited reports and programs provide a good evaluation of all observations where deviations from historical normal occurrences are recorded. This process, as engaged for COMPs assessments, not only focuses attention on monitored parameters, it allows for reassessment of the proposed TVs. Notable deviations are addressed in the GAR and other references, and are reexamined here in the context of COMPs and TVs.

Geotechnical COMPs can be derived from or related to the repository's operational safety monitoring program, which has been implemented to ensure worker and mine safety. By nature, changes in geotechnical conditions evolve slowly; however, they are monitored continuously and reported annually. Since pertinent data from the underground reflect slowly evolving conditions, relationships that correlate to geotechnical COMPs also evolve slowly. Therefore, geotechnical conditions warranting action for operational safety will become evident before such conditions would impact long-term waste isolation. Monitoring underground response allows continuing assessment of conceptual geotechnical models supporting certification. In effect, these annual comparisons of actual geotechnical response with expected response serve to validate or improve models.

Annual reviews allow discovery of conditions or trends that lay outside expectations. In principal, the annual geotechnical analysis seeks trends or conditions that are "off normal." At this early stage of the repository history, the WIPP monitoring program is establishing parametric values, rates, conditions or observations that would identify a need for further evaluation. Conditions beyond normal or outside expectations do not automatically impact compliance determinations, but instead alert geotechnical program personnel to scrutinize incoming data more closely and to make assessments of possible performance impacts.

Displacement, deformation, closure, and fracturing evolve slowly. Therefore, annual assessment of the geotechnical COMPs will adequately address conditions that would be of concern for predicting repository performance or that are related to long-term regulatory compliance. This assessment contains the sixth geotechnical monitoring report since disposal operations began. Implementation and evaluation of possible trigger events, features, phenomena, trends, and conditions that would warrant further actions will be refined as experience is gained.

2.2.1 Creep Closure

The GAR compiles all geotechnical operational safety data gathered from the underground. The most readily quantifiable geomechanical response in the WIPP underground is creep closure. The GAR routinely measures and reports creep deformation, either from rib-to-rib, roof-to-floor, or extensometer borehole measurements. Rates of closure are relatively constant within each zone of interest and usually range from about 1-5 cm/yr. A closure rate in terms of cm/yr can be expressed as a global or nominal creep rate by dividing the displacement by the room dimension and converting time into seconds. Nominally these rates are of the order of 1×10^{-10}/s and are quite steady over significant periods. From experience, increases and decreases of rates such as these might vary by 20 percent without undue concern. Therefore, the "trigger value" for creep deformation was set as one order of magnitude (or 900%) increase in creep rate. Such a rate increase would alert the M&OC geotechnical staff to scrutinize the area exhibiting accelerating creep rates. Tertiary creep is an expected (eventually) phenomenon and its manifestation would help validate predictive capabilities of the computational models.

Extensive GAR data suggest that possible TV could be derived from creep rate changes. The WIPP underground is very stable, relative to most operating production mines, and deformation is steady for long periods. However, under certain conditions creep rates accelerate, indicating a change in the deformational processes. Arching of microfractures to an overlying clay seam might create the onset of the roof beam de-coupling and increase the measured closure rate. Phenomena of fracture coalescence and DRZ growth comprise important elements of PA assumption confirmation. Therefore, a measured creep rate change over a yearly period constitutes the COMP TV for creep closure. Rate changes are necessarily evaluated on a case-by-case basis since closure is related to many factors such as age of the opening, location in the room or drift, convergence history, recent excavations, and geometry of the excavations.

The creep deformation COMP is addressed by examining the deformations measured in specific regions of the underground including: (1) Shafts and Shaft Stations, (2) the Northern Experimental Area, and (3) Access Drifts and Waste Disposal Areas. Figure 2.1 shows the current configuration of the WIPP underground with specific elements and regions annotated for reference. Panels 1 and 2 have been fully excavated and are being used for waste disposal. Panel 1 has been filled with waste and the entry drifts have been sealed to prevent access. Presently, waste disposal is occurring in Panel 2. To date, Panel 3 is only partially excavated and is located 2.4-m higher in the stratigraphic sequence as indicated in Figure 2.1 by the ramps shown in the long North-South haulage drifts.

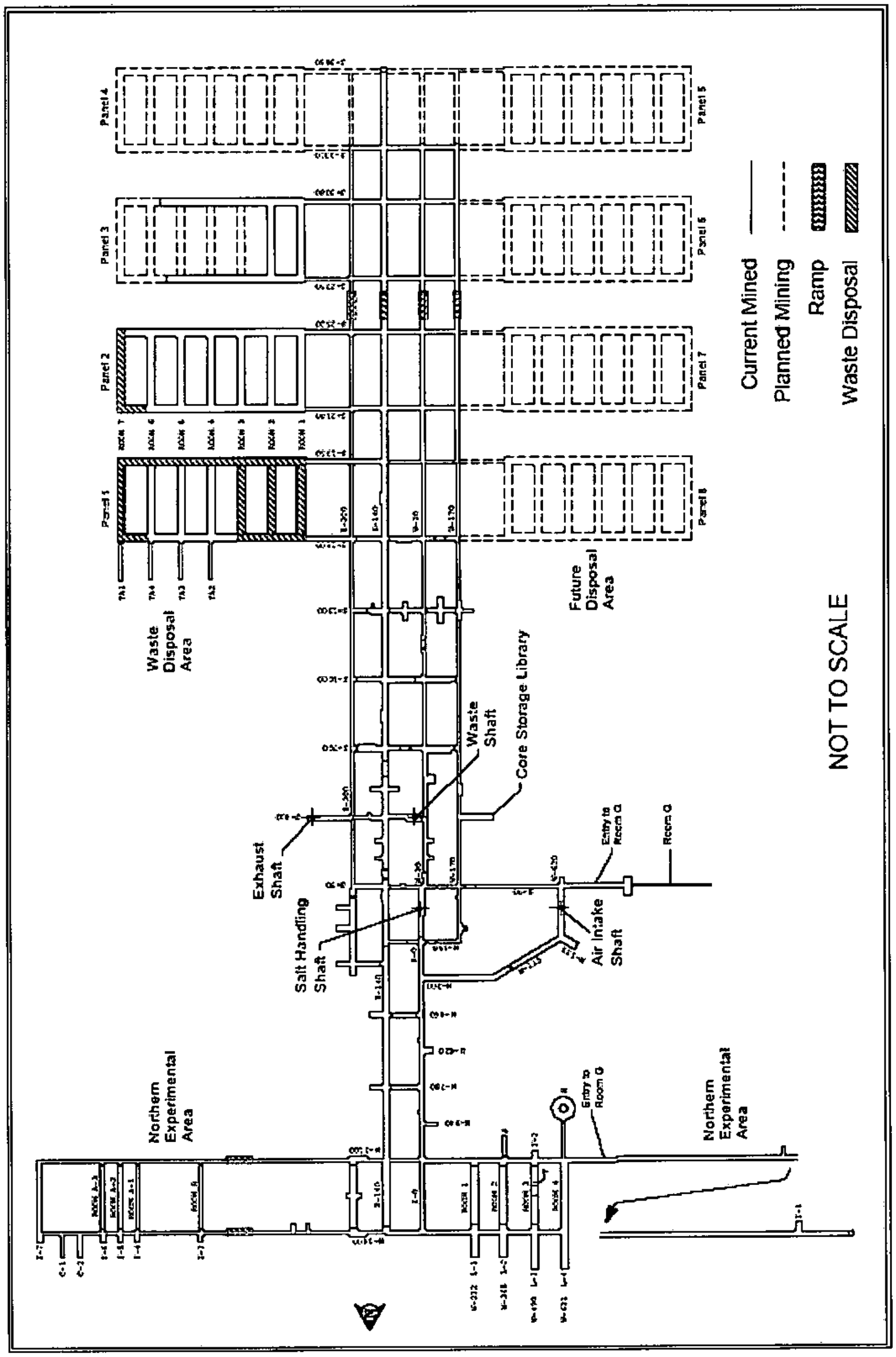

Figure 2.1 Configuration of the WIPP Underground for Geotechncial COMPs (after DOE 2004b – Reporting Period July 2002 through June 2003).

Shafts and Shaft Stations

The WIPP underground is serviced by four vertical shafts including the following: (1) Salt Handling Shaft, (2) Waste Shaft, (3) Exhaust Shaft, and (4) Air Intake Shaft. At the repository level (approximately 650 m below ground surface), enlarged rooms have been excavated around the Salt Handling and Waste shafts to allow for movement of equipment, personnel, mined salt and waste into or out of the facility. The enlarged rooms are called shaft stations and assigned designations consistent with the shaft they service, e.g., Salt Handling Shaft Station.

Shafts. With the exception of the Salt Handling Shaft, the shafts are configured nearly identically. From the ground surface to the top of the Salado Formation, the shafts are lined with unreinforced concrete. Reinforced concrete keys are cast at the Salado/Rustler interface with the shafts extending through the keys to the Salado. Below the keys, the shafts are essentially "open holes" through the Salado Formation and terminate either at the repository horizon or at sumps that extend approximately 40 m below the repository horizon. In the Salt Handling Shaft, a steel liner is grouted in place from the ground surface to the top of the Salado. Similar to the three other shafts, the Salt Handling Shaft is configured with a reinforced concrete key and is "open-hole" to its terminus. For safety purposes, the portions of the open shafts that extend through the Salado are typically supported using wire mesh anchored with rock bolts to contain rock fragments that may become detached from the shaft walls. Within the Salado Formation, the shaft diameters range from 3.65 m to 7.0 m.

Data available for assessing creep deformations in the salt surrounding the shafts are derived exclusively from routine inspections and extensometers extending radially from the shaft walls. These data are reported in the GAR. The Salt Handling Shaft, Waste Shaft, and Air Intake Shaft are inspected weekly by underground operations personnel. Although the primary purpose of these inspections is to assess the conditions of the hoisting and mechanical equipment, observations are also made to determine the condition of the shaft walls, particularly with respect to water seepage, loose rock, and sloughing. In contrast to the other three shafts, the Exhaust Shaft is inspected quarterly using remote-controlled video equipment. Based on these visual observations, all four shafts are in satisfactory condition and have required no significant ground-control support during the reporting period.

Shortly after its construction, each shaft was instrumented with extensometers to measure the inward movement of the salt at three levels within the Salado Formation. In addition to COMPs assessment, measurements of shaft closure are used periodically as a calibration of calculational models and have been used in shaft seal system design. The approximate depths corresponding to the three instrumented levels are 330 m, 480 m and 630 m. Three extensometers are emplaced at each level to form an array. The extensometers comprising each array extend radially outward from the shaft walls and are equally spaced around the perimeter of the shaft wall. Over the years, some of these extensometers have malfunctioned. As a result, reliable data are not available at some locations. The DOE currently has no plans to replace failed instrumentation installed in any of the shafts because monitoring data acquired to date have shown no unusual shaft movements or displacements.

Table 2.4 provides a summary of the current (July 2002 – June 2003) displacement rates of the shaft walls based on extensometer data reported in the GAR (DOE 2004b). The rates make use of collar displacement measured relative to the deepest anchor for individual extensometers. Rates range from 0.006 in/yr to 0.088 in/yr (0.015 cm/yr to 0.224 cm/yr) and increase with depth, as expected, because of the higher stress levels associated with the overburden at greater depth. Dividing the displacement rates by the typical shaft radius (approximately three meters) and expressing the results in units of 1/sec yields creep rates that range from $1.6x10^{-12}$/s to $2.4x10^{-11}$/s. These creep rates are very low and are typical of rates for stable openings mined from salt. Table 2.4 also gives displacement rates for the previous reporting period (2001 to 2002) and the percentage change in these rates compared to the current rates. In general, the rate changes are small and all are negative indicating creep rates are slowing. Based on visual observations and quantitative displacement measurements, creep deformations associated with the WIPP shafts are acceptable and meet the TV requiring creep deformation rates to change by less than one-order of magnitude in a one-year period.

Shaft Station. Shaft station openings are typically rectangular in cross-section with heights ranging from approximately 4 to 6 m and widths ranging from 6 to 10 m. Over the life-time of the individual shaft stations, modifications have been made that have altered the dimensions of the openings. For example, portions of the Salt Handling Shaft Station have been enlarged by removing the roof beam that extended up to anhydrite "b". In the Waste Handling Shaft Station, the walls have been trimmed to enlarge the openings for operational purposes.

The effects of creep on the shaft stations are assessed through visual observations and displacement measurements made using extensometers and convergence points. Because of the modifications made over the years, some of the original instrumentation has been removed or relocated. In addition, some instruments have malfunctioned or been damaged and no longer provide reliable data. Displacement rates available from the GAR for the current reporting period (2002-2003) and the previous reporting period (2001-2002) are summarized in Table 2.4. Creep data are available only for the Salt Handling and Waste Shaft Stations (data for the Air Intake Shaft Station are reported below under the Access Drift section of this report). Most of the measurements are for vertical closure. Based on convergence data, current vertical displacement rates range from 0.334 to 1.820 in/yr (0.85 to 4.62 cm/yr), while current horizontal displacement rates range from 0.900 to 0.980 in/yr (2.3 to 2.5 cm/yr). Dividing convergence rates by the average room dimension (approximately six meters) and expressing the results in units of 1/sec yields vertical and horizontal creep rates between approximately $5x10^{-11}$/s to $2x10^{-10}$/s. These rates are somewhat higher than those measured in the shafts but are still low and represent typical creep rates for stable openings in salt. An examination of the percentage changes in displacement rates shown in Table 2.4 suggests the current shaft station displacement rates are essentially identical to those measured during the previous reporting period. Based on the extensometer and convergence data, as well as the limited maintenance required in the shaft stations during the last year, creep deformations associated with the WIPP shaft stations are considered acceptable and meet the TV requiring creep deformation rates to change by less than one-order of magnitude in a one-year period.

Table 2.4 Summary of Closure Rates for WIPP Shafts and Shaft Stations

Location	Inst. Type[(a)]	Displacement Rate (in/yr)		Change In Rate (%)
		2001–2002	2002–2003	
Salt Handling Shaft	No extensometers remain functional			
Waste Handling Shaft				
1071 ft (326 m) level, S15W	Ext	0.010	0.006	-40
1566 ft (477 m) level, N45W	Ext	0.037	0.026	-30
1566 ft (477 m) level, N75E	Ext	0.033	0.023	-30
1566 ft (477 m) level, S15W	Ext	0.037	0.027	-27
2059 ft (628 m) level, N45W	Ext	0.092	nr[(c)]	–
2059 ft (628 m) level, N75E	Ext	0.080	0.074	-8
2059 ft (628 m) level, S15W	Ext	0.097	0.088	-9
Exhaust Shaft				
1573 ft (479 m) level, N75E	Ext	0.024	0.019	-21
1573 ft (479 m) level, N45W	Ext	0.026	0.020	-23
1573 ft (479 m) level, S15W	Ext	0.027	0.022	-26
2066 ft (630 m) level, N75E	Ext	0.087	0.086	-1
2066 ft (630 m) level, S15W	Ext	0.068	nr	–
Salt Handling Shaft Station				
E0 Drift – N39 (Vert. CL[(b)])	CP	1.816	nr	–
E0 Drift – N39 (Horiz. CL)	CP	1.109	nr	–
E0 Drift – W12 (Vert CL)	CP	0.891	0.927	4
E0 Drift – S18 (Vert. CL)	CP	1.653	1.738	5
E0 Drift – S30 (Vert. CL)	CP	1.725	1.820	6
E0 Drift – S65 (Vert. CL)	CP	1.335	1.341	~0
Waste Shaft Station				
S400 Drift – W30 (Vert. CL)	Ext	0.350	0.334	-5
S400 Drift – E140 (Vert. CL)	Ext	0.826	0.692	-16
S400 Drift – E30 (Horiz. CL)	CP	0.934	0.900	-4
S400 Drift – E90 (Horiz. CL)	CP	1.002	0.980	-2
Air Intake Shaft Station	Information provided below under access drift discussion			

(a) Instrument Type: Ext = extensometer; CP = convergence point.
(b) CL = Centerline
(c) nr = no reading available

Northern Experimental Area
The Northern Experimental Area, defined as all excavations north of the N1100 drift (see Figure 2.1), was constructed in the early 1980's to characterize the site and obtain in situ geotechnical data from underground excavations. During the experiments, the area was heavily instrumented to examine the structural response of the openings. Following completion of the experiments, access to the area was blocked in 1996. As a result, only a few of the instruments (primarily extensometers and convergence meters) remained active and were monitored remotely because of restricted access to the area.

During the period from July 1999 to June 2000, portions of the Northern Experimental Area were reopened to assess ground conditions. Following spot bolting, systematic pattern bolting in SPDV

Test Room 4 and activation of ventilation, operational use of the area for salt storage was established. Subsequently, during the current reporting period (July 2002 – June 2003),

- The roof in the East 0, East 140, and East 300 drifts was removed from North 1100 to North 1400
- Mined salt was placed in the North 1100 and North 1400 drifts from about West 550 to about West 50
- A re-entry into the North 1100 and North 1400 drifts east of East 300 was made to assess the area for operational use.

Given these activities, as well as the removal of the data logging used to remotely monitor the few remaining extensometers still active in the area, no displacement or creep data were recorded in the Northern Experimental Area during the current reporting period. Thus, no comparison of observed creep rates to trigger values can be made.

Access Drifts and Waste Disposal Area

Access Drifts. The access drifts comprise the four major North-South drifts extending southward from near the Salt Handling Shaft to the entries into the waste disposal panels and several short cross-drifts intersecting these major drifts. The access drifts are typically rectangular in cross-section with heights ranging from 2.4 m to 6.4 m and widths ranging from 4.3 m to 9.2 m. During the current reporting period (July 2001 to June 2002), three drifts were rough-cut to approximately S3141 (with ramps between S2520 and S2750) and final cut to S2758 to provide access for mining of Waste Disposal Panel 3 (see Figure 2.1). Panel 3 is currently being excavated, albeit at a slightly higher stratigraphic position (2.4 m) than either Panels 1 or 2. Upon completion, the Panel 3 roof will be coincident with Clay G.

Assessment of creep deformations in the access drifts is made through the examination of extensometer and convergence point data reported annually in the GAR. Tables 2.5 and 2.6 summarize, respectively, the vertical and horizontal displacement data reported in the most recent GAR (DOE 2004b). Each table examines percentage changes between displacement rates measured during the current and previous annual reporting periods and breaks these percentage changes into ranges (e.g, 0 to 25%). Only data from instruments located along the drift centerlines are reported here. In addition, extensometer data are based only on the displacements of the collar relative to the deepest anchor. The numbers shown in the tables represent the number of instrumented locations that fall within the range of the indicated percentage change. For example, data from thirty nine vertically-oriented extensometers installed in the access drifts were assessed with sixteen of these instruments showing percentage changes < 0% (i.e., the rate decreased or slowed), fourteen showing changes between 0 and 25%, eight showing changes between 25 and

50%, none showing changes between 50 and 75% and 75 and 100%, and one showing changes between 100 and 200%. The maximum displacement rates corresponding to these data are given below:

Maximum Vertical Displacement Rates Along Access Drift Centerlines:

8.65 cm/yr – based on extensometer data
17.22 cm/yr – based on convergence point data

Maximum Horizontal Displacement Rate Along Access Drift Centerlines:

6.11 cm/yr – based on convergence point data

Using a typical average drift dimension of 5 m and the maximum displacement rates shown above, the inferred maximum creep rate is approximately $10x10^{-10}$/s. This rate is relatively high so further analyses were performed as described below.

Most (approximately 97% of all data) of the changes in vertical and horizontal displacement rates fall within three categories or subdivisions shown in Tables 2.5 and 2.6, i.e., < 0%, 0 to 25%, and 25 to 50% indicating that current creep deformations in the access drifts are approximately the same as they were for the previous reporting period. The few remaining data show relatively large changes in rate and indicate accelerations of displacement in some locations. As a general rule, accelerations in displacement would be cause for concern; however, a careful examination of these relatively large accelerations in displacement reveals that the extensometers/convergence points associated with these accelerations are either experiencing anchor problems (e.g., E140 S900) or have been recently replaced (e.g., E0 N300 for E0 N290).

The largest displacements notwithstanding, creep deformations associated with the Access Drifts are acceptable and meet the TV requiring creep deformation rates to change by less than one-order of magnitude in a one-year period. High displacement rates observed at a few locations have little effect on safety as geotechnical engineering provides continuous ground-control monitoring and remediation on an as-needed basis.

Waste Disposal Area: The Waste Disposal Area is located at the extreme southern end of the WIPP facility and is serviced by the access drifts described above. Eventually, the Waste Disposal Area will include eight disposal panels, each comprising seven rooms (the major north-south access drifts servicing the eight panels will also be used for waste disposal and will make up the ninth and tenth panels). Currently however, only two panels have been completely excavated including Panel 1 constructed in the late 1980s and Panel 2 constructed during the 1999-2000 reporting period. Excavation of Panel 3 is progressing at the time of this report. Waste emplacement operations are complete in Panel 1 and have recently moved into Panel 2. The waste emplacement rooms are rectangular in cross-section with a height of 4 m and a width of 10 m. Entry drifts that provide access into the disposal rooms are also rectangular with heights of 3.65 m and widths of 4.3 m.

Table 2.5 Summary of Changes in Vertical Displacement Rates Measured Along the Centerlines of the WIPP Access Drifts and Waste Disposal Area Openings

Location	Number of Instrument Locations Where the Indicated Percentage Change has Occurred					
	Percentage Increase in Displacement Rate for Measurements Made During the 2001-2002 and 2002-2003 Reporting Periods					
	< 0%	0 – 25%	25 – 50%	50 – 75%	75 – 100%	100 – 200%
Access Drifts						
Extensometers[a]	16	14	8	0	0	1
Convergence Points	78	40	1	3	0	2
Waste Disposal Area						
Panel 1:						
Extensometers[a]	10	11	2	2	1	1
Convergence Points	15	6	1	1	1	0
Panel 2:						
Extensometers[a]	9	2	0	0	0	0
Convergence Points	39	2	0	0	1	0

(a) Based on displacement of collar relative to deepest anchor.

Table 2.6 Summary of Changes in Horizontal Displacement Rates Measured Along the Centerlines of WIPP Access Drifts and Waste Disposal Area Openings

Location	Number of Instrument Locations Where the Indicated Percentage Change has Occurred				
	Percentage Increase in Displacement Rate for Measurements Made During the 2001-2002 and 2002-2003 Reporting Periods				
	< 0%	0 – 25%	25 – 50%	50 – 75%	75 – 100%
Access Drifts					
Extensometers[a]	0	0	0	0	0
Convergence Points	40	21	5	0	0
Waste Disposal Area					
Panel 1:					
Extensometers[a]	8	4	0	0	0
Convergence Points	19	1	0	0	0
Panel 2:					
Extensometers[a]	0	0	0	0	0
Convergence Points	27	2	0	0	0

(a) Based on displacement of collar relative to deepest anchor.

Assessment of creep deformation in the waste disposal area is made through the examination of extensometer and convergence point data reported annually in the GAR. Tables 2.5 and 2.6 (presented previously) summarize, respectively, the vertical and horizontal displacement data reported in the most recent GAR (DOE 2004b) for both Panels 1 and 2. Each table examines percentage changes between displacement rates measured during the current and previous annual reporting periods and breaks these percentage changes into ranges. Only data from instruments located along the drift centerlines are reported here. In addition, extensometer data are based only on displacements of the collar relative to the deepest anchor. The maximum displacement rates corresponding to these data are given below.

Maximum Vertical Displacement Rates Along Waste Disposal Area Centerlines:

5.30 cm/yr – based on extensometer data
10.91 cm/yr – based on convergence point data

Maximum Horizontal Displacement Rates Along Waste Disposal Area Centerlines:

2.76 cm/yr – based on extensometer data
5.77 cm/yr – based on convergence point data

Using a nominal disposal-area-opening dimension of 8 m and the maximum displacement rates shown above yields an inferred maximum creep rate of approximately 4.3×10^{-10}/sec. Maximum creep rates for the waste disposal area are less than the maximum creep rates observed for the access drifts and are considered acceptable. Furthermore, most of the changes in creep rate are negative even though nearby Panel 3 is being excavated.

Creep deformations associated with the Waste Disposal Area are acceptable and meet the TV requiring creep deformation rates to change by less than one-order of magnitude in a one-year period.

Creep Closure - 2004:

Trigger Value Derivation				
COMP Title:	Creep Closure			
COMP Units:	Closure Rate (sec^{-1})			
Related Monitoring Data				
Monitoring Program	Monitoring Parameter ID	Characteristics (e.g., number, observation)	Compliance Baseline Value	
Geotechnical	Closure	Instrumentation throughout the underground.	Munson-Dawson (MD) Constitutive Model	
COMP Derivation Procedure				
Annually evaluate GAR for centerline closure rates, compare to previous year's rate. If closure rate increases by greater than one order of magnitude, initiate technical review.				
Related Performance and Compliance Elements				
Element Title	Parameter Type & ID or Model Description	Derivation Procedure	Compliance Baseline	Impact of Change
Repository Fluid Flow	Creep Closure	Porosity Surface, waste compaction, characteristics, waste properties, evolution of underground setting	SANTOS, surface porosity calculations	Provides validation of the CCA creep closure model.
Monitoring Data Trigger Values				
Monitoring Parameter ID	Trigger Value	Basis		
Creep Closure	Greater than one order of magnitude increase in closure rate.	The closure rate increase signals potential de-coupling of rock.		

2.2.2 Extent of Deformation

The extent of brittle deformation can have important implications to PA. As modeled in PA, the DRZ releases brine to the disposal room while properties of the DRZ control hydrologic communication between disposal panels. Therefore, extent of deformation relates directly to a conceptual model used in performance determination. If characteristics could be tracked from inception, the spatial and temporal evolution of the DRZ would provide a validation benchmark for damage calculations.

Measurements in the GAR include borehole inspections, fracture mapping and borehole logging. These observations are linked closely to other monitoring requirements concerned with initiation of brittle deformation and displacement of deformation features. These monitoring requirements define the characteristics of the DRZ, which help validate the baseline conceptual model, and its flow characteristics. The extent of deformation quantifies the DRZ, a significant element of PA analyses.

The Geotechnical Engineering Department at WIPP has compiled back-fracturing data into a database. The supporting data for the GAR (Volume 2, DOE 2004b) consists of plan and isometric plots of fractures. Fracture development is most continuous parallel to the rooms and near the upper corners. These fractures are designated "low angle fractures" relative to the horizontal axis. The original excavation horizon results in a 2.4-m thick beam of halite between the roof and Clay Seam G. Low angle fractures arch over rooms and asymptotically connect with Clay Seam G. Although the preponderance of monitoring information derives from the roof (back), buckling extends into the floor to the base of Marker Bed 139, which is located about 2 m below the disposal room floors. Fracture mapping thus far is consistent with expectations and tracks stress trajectories derived from computational work. At this time, a comprehensive model and supporting data for model parameters for damage evolution has not been developed for PA.

The SA is conducting independent field investigations to understand the spatial and temporal development of the DRZ. In 1988, when the Air Intake Shaft (AIS) was constructed, three acoustic transducer arrays were installed in the shaft at depths of 343 m, 480 m, and 626 m below ground surface (Hardy and Holcomb 2000). Each array consists of transducers permanently installed in three holes drilled parallel to each other. Two holes are aligned in the vertical plane and two in the horizontal plane, forming an "L" shape and angled upward at 45°. Multiple transmitter-receiver transducer pairs were installed in each hole which allowed the measurement of transmitted signal velocities and amplitudes along 216 paths parallel, perpendicular, and tangential to the shaft walls. Velocity measurements have been made continuously since the arrays were installed and data were acquired using a stand-alone data logger. Velocity is considered a good metric for estimating the extent of the DRZ because as microfractures initiate and grow in geologic media such as salt, velocity is known to decrease. In 2000, Hardy and Holcomb presented the results of nine years of velocity measurements taken at the deepest array (626 m) and determined that a DRZ had formed around the AIS, but it only extended into the salt about 0.5 to 1 m. During the last year, the M&OC has indicated that it no longer has the resources to maintain data logging capability for the three acoustic transducer arrays. As a result, the SA is decommissioning the experiment and analyzing the nearly 15 years of data. Preliminary analysis suggests that the DRZ at the 626-m level of the AIS has grown, although not significantly, perhaps from 1 to 2 m. These data, together with the data from the shallower arrays, will be presented during the next reporting period.

In 2000 – 2001, the SA also conducted similar ultrasonic velocity measurements in parallel boreholes drilled normal to the ribs of the Q Room Alcove and in angled boreholes drilled in an inside corner of the Q Room Alcove (Holcomb and Hardy 2001). In contrast to the AIS investigation, the Q Room Alcove tests made used of acoustic tools that were not permanently installed in the holes but could be moved and positioned at any location along the lengths of the holes. Velocity measurements made with these tools indicated the development of a DRZ that extended approximately 1 to 2 m into the room ribs. Plans have been developed to use this technique to measure the extent of the DRZ around the Q Room Alcove on an annual basis. These data will then provide a direct assessment of this COMP against the extent of deformation TV.

Excavation of Panel 3 raises the waste disposal panels by 2.4 m such that the roof of the disposal rooms will be coincident with Clay Seam G and the floor will be an additional 2.4 m above Marker Bed 139. This planned change will likely alter the typical fracture patterns observed to date and may cause subtle changes in how the DRZ develops. Effects of excavation to Clay G have been evaluated by finite element analyses to assess possible impact to PA (Park and Holland 2003). Their modeling shows that the DRZ does not extend below MB139 at the new horizon, as it does at the original horizon. The rise in repository elevation otherwise causes no discernable change to the porosity surface used in PA.

Data provided in the GAR (DOE 2004b) suggest that brittle deformation extends at least 2.4 m (to Clay Seam G) and perhaps as much as 4.5 m (to Clay Seam H) above the roof of the WIPP openings. In addition, brittle deformation extends below the floor of the openings to at least the base of Marker Bed 139 (approximately 2 to 3 m). Previous studies and ongoing studies performed by the SA to characterize the DRZ have shown that the extent of brittle deformation is about 1 to 2 m; however, these results are for a single snapshot in time providing little information on how brittle deformation evolves with time. Therefore, it is evident that the preliminary TV of 1 m of growth per year is neither tractable nor quantitatively meaningful with the current data set. The TV shall be reassessed during the monitoring program analysis after the new compliance baseline is established.

Extent of Deformation - 2004:

Trigger Value Derivation				
COMP Title:	Extent of Deformation			
COMP Units:	Areal extent (length, direction)			
Related Monitoring Data				
Monitoring Program	Monitoring Parameter ID	Characteristics (e.g., number, observation)	Compliance Baseline Value	
Geotechnical	Displacement	Meters	Not Established	
COMP Derivation Procedure				
Extent of deformation deduced from borehole extensometers, feeler gauges, and visual inspections are examined yearly for active cross sections. Anomalous growth is determined by comparison.				
Related Performance and Compliance Elements				
Element Title	Parameter Type & ID or Model Description	Derivation Procedure	Compliance Baseline	Impact of Change
DRZ Conceptual Model	Micro- and macro-fracturing in the Salado Formation	Constitutive model from laboratory and field databases.	Permeability around panel closures was assigned a constant value of $10^{-15} m^2$ for the CCA and a uniform distribution from 3.16 x $^{-13}$ to 3.98 x 10^{-20} m^2 for the PAVT (current baseline)	DRZ spatial and temporal properties have important PA implications for permeability to gas, brine, and two-phase flow.
Monitoring Data Trigger Values				
Monitoring Parameter ID	Trigger Value	Basis		
Fractures at depth	Growth of 1 m/y[(a)]	Coalescence of fractures at depth in rock surrounding drifts will control panel closure functionality and design, as well as discretization of PA models.		

(a) TV to be re-evaluated.

2.2.3 Initiation of Brittle Deformation

Initiation of brittle deformation around WIPP openings is not being directly measured and is therefore a qualitative observational parameter. By definition, qualitative COMPs can be subjective and are not prone to the development of well-defined TVs. This COMP is not directly related to a PA parameter. Brittle deformation eventually leads to features that are measured as part of geotechnical monitoring requirements, such as the extent and displacement of deformation features. Initiation of brittle deformation is expected to begin immediately upon creation of an opening. Initiation and growth of the DRZ are fundamental observational goals of the DRZ investigations currently being conducted under the geotechnical experimental programs, as discussed above. The ongoing geophysical program will help quantify damage evolution around WIPP openings. Initiation and growth of damaged rock zones are important considerations to operational period panel closures as well as compliance PA calculations. As stated previously, this COMP is qualitative and is not directly related to PA parameters. Because of the difficulty in obtaining relevant data for assessing this COMP, the SA recommends that continued monitoring of this parameter be re-evaluated.

Initiation of Brittle Deformation - 2004:

Trigger Value Derivation				
COMP Title:	Initiation of Brittle Deformation			
COMP Units:	Qualitative			
Related Monitoring Data				
Monitoring Program	Monitoring Parameter ID	Characteristics (e.g., number, observation)	Compliance Baseline Value	
Geotechnical	Closure	Observational	Not Established	
COMP Derivation Procedure				
Qualitative and pertinent to operational considerations. Captured qualitatively in association with other COMPs				
Performance and Compliance Elements				
Element Title	Parameter Type & ID or Model Description	Derivation Procedure	Compliance Baseline	Impact of Change
Not directly related to PA as currently measured	NA	NA	NA	NA
Monitoring Data Trigger Values				
Monitoring Parameter ID	Trigger Value	Basis		
Initiation of Brittle Deformation	None[(a)]	Qualitative COMPs can be subjective and are not prone to the development of meaningful TVs.		

(a) Recommendation could be considered to add acoustic emissions for brittle monitoring or to replace this parameter with another more directly tied to PA.

2.2.4 Displacement of Deformation Features

The displacement of deformation features primarily focuses on those features located in the immediate vicinity of the underground openings, e.g., mining-induced fractures and lithological units within several meters of the roof and floor. As discussed previously, fracture development is most continuous parallel to the openings and near the upper corners. These fractures tend to propagate or migrate by arching over and under the openings and, thus are designated "low angle fractures" relative to the horizontal axis. Typically, the fractures intersect or asymptotically approach lithologic units such as clay seams and anhydrite stringers. As a result, salt beams are formed. In the roof, the beams are de-coupled from the surrounding formation requiring use of ground support. In the floor, the beams sometimes buckle into the openings requiring floor milling and trimming. Lithologic units of primary interest are Clay G and H. These features are located approximately 2.4 m and 4.5 m respectively, above the roof of Panels 1, 2, 7 and 8. Marker Bed 139 (anhydrite) is located approximately 2 m below the floor of these panels. For Panels 3 through 7, the panels are mined up to Clay G. Clay H is therefore located 2.1 m above the roof of these panels and Marker Bed 139 is located approximately 4.4 m below the panel floors.

Monitoring of these deformation features is accomplished through visual inspection of nearly 400 observation boreholes (OBH) drilled from the openings through the feature of interest. In general, these boreholes are aligned vertically (normal to the roof and floor surfaces) because of the location and orientation of the fractures and lithological units of interest. All of the OBH are 7.6-cm (3-in) in diameter, and many intersect more than one deformation feature. The ages of the OBH vary from more than 20 years to about two years. Many of these OBH are no longer accessible for monitoring purposes. For example, boreholes drilled in the floor have become filled with crushed-salt over time and thus, visual observations cannot be made without continual maintenance of the boreholes. In addition, observation boreholes drilled in the roof of Panel 1 cannot be inspected because seals placed in the access drifts prevents monitoring personnel from entering the panel.

During the current reporting period, only thirty-six OBH were inspected including twenty eight located in Panel 2 and eight located in the access drifts servicing the disposal panels. The deformation features in these OBH are classified as: 1) offsets, 2) separations, and 3) hang-ups. Of the thirty-six OBH, two had no observable deformation features. In the other thirty-four, a total of 119 features were identified including sixty-three offsets, forty-six separations and ten hang-ups. The deepest features where about 4 m into the roof, roughly coincident with Clay H.

Of the three features, offsets are the principle metric for this COMP and are quantified by visually estimating the degree of borehole occlusion created by the offset. The direction of offset along displacement features is defined as the movement of the stratum nearer the observer relative to the stratum farther from the observer. Typically, the nearer stratum moves toward the center of the excavation. Based on previous observations in the underground, the magnitude of offset is usually greater in boreholes located near the ribs as compared to boreholes located along the centerline of openings.

In the eight OBH located in the access drifts, all of which were drilled in 1992, five were 100% occluded at a depth of about 2 m. In the other three, the degree of occlusion was 0%, 8% and 57% with offsets occurring at a depth of about 1.7 m. In contrast, none of the twenty-eight OBS in Panel 2 were fully occluded, a result attributed to their younger age (~ 2 years). All but three OBH in Panel 2 had occlusions of 25% or less. In one OBH, the occlusion was 33%, while in the other two the occlusion was 75%.

The TV for displacement of deformation features is the observation of a fully occluded borehole. *Based on the limited data available from the current GAR, approximately 14% of all the OBH being monitored meet or exceed the TV.* Exceedence of the TV, in and of itself, is not necessarily a cause for concern, particularly given that no significant impact on safety or performance has occurred in those locations where the TV has been exceeded. However, to limit the formation of low angle fractures and de-coupled beams over the roof, the elevation of future disposal panels (i.e., Panels 3, 4, 5, 6, and 7) will be raised approximately 2.4 m so the roof will then coincide with Clay G. This horizon change was implemented to improve ground control. As such, the horizon change will change the expected deformation and displacement behavior necessitating a reanalysis of the TV.

Displacement of deformation features has been useful for implementation of ground control alternatives (i.e., horizon change to Clay G). Displacement features complement observation of brittle deformation initiation and corroborate estimates of the extent of deformation.

Displacement of Deformation Features - 2004:

Trigger Value Derivation				
COMP Title:	Displacement of Deformation Features			
COMP Units:	Length			
Related Monitoring Data				
Monitoring Program	Monitoring Parameter ID	Characteristics (e.g., number, observation)	Compliance Baseline Value	
Geotechnical	Delta D/D_o	Observational	Not established	
COMP Derivation Procedure				
Observational – Lateral deformation across boreholes.				
Related Performance and Compliance Elements				
Element Title	Parameter Type & ID or Model Description	Derivation Procedure	Compliance Baseline	Impact of Change
Not directly related to PA	N/A	N/A	N/A	N/A
Monitoring Data Trigger Values				
Monitoring Parameter ID	Trigger Value	Basis		
Borehole diameter closure	Obscured observational borehole.	If lateral displacement is sufficient to close diameter of observational borehole, technical evaluation of consequences will be initiated.		

2.2.5 Subsidence

The subsidence monitoring program changed their schedule for publishing data in 2003. As a result, the 2003 COMPs report (SNL 2003a) assessed two years of subsidence data. There has not been a new survey to assess for the 2004 report. Reference the 2003 COMPs report (SNL 2003a) for the latest subsidence information.

2.3 Hydrological COMPs

As stated in the previous sections, the CCA lists ten monitoring parameters that the DOE is required to monitor and assess during the WIPP operational period. Two of these parameters are considered hydrological in nature and include:

- Changes in Culebra Water Composition
- Changes in Culebra Groundwater Flow

The SA has reviewed the data collected by the M&OC in 2003 under the Groundwater Surveillance Program (GSP). The GSP has two components:

- The Water Quality Sampling Program (WQSP)
- The Water-Level Monitoring Program (WLMP)

WQSP and WLMP data are reported in the Waste Isolation Pilot Plant Site Environmental Report Calendar Year 2003 (DOE 2004c) and WLMP data are also reported in monthly memoranda from the M&OC to the SA.

2.3.1 Change in Culebra Water Composition

Water Quality Sampling Program

Under the WQSP, the M & OC collected water samples twice (sampling rounds 16 and 17) in 2003 from seven wells, denoted WQSP-1 through WQSP-6 and WQSP-6a. WQSP-1 through WQSP-6 are completed to the Culebra Dolomite Member of the Rustler Formation and WQSP-6a is completed to the Dewey Lake Formation. Flow and transport in the Dewey Lake are not modeled explicitly in PA because the sorptive quality of the Dewey Lake is expected to contain any radionuclides that may reach the unit. Nevertheless, the Dewey Lake water quality is monitored because it might help to increase the understanding of the Dewey Lake hydrology. The water samples were analyzed in duplicate for major and minor elements and hazardous constituents per the WIPP Ground Water Monitoring Program Plan (GWMP; WID 1999).

The Culebra is not a source of drinking water, so Culebra water quality is not of concern in an immediate health sense. Instead, Culebra water quality is important because of what it implies about the nature of the flow system. Solute concentrations differ widely among wells across the WIPP site, reflecting local equilibrium, diffusion, and perhaps most importantly, slow transport. The conceptual model for the Culebra presented in the CCA and implemented in PA numerical models is that of a confined aquifer with solute travel times across the WIPP site on the order of tens of thousands of years. In such a system, no changes in water quality at an individual well outside the range of normal analytical uncertainty and noise should be observed during the WIPP operational phase of a few decades duration. If sustained and statistically significant changes in the concentrations of major ionic species (Na^+, Ca^{2+}, Mg^{2+}, K^+, Cl^-, SO_4^{2-}, HCO_3^-) were observed, this would imply that water was moving faster through the Culebra than was consistent with PA models. Stability of major ion concentrations, on the other hand, is consistent with and supports the SA's models. Thus, this evaluation of the water-quality data focuses on the stability of major ion concentrations. Based on these considerations, the TV for Culebra groundwater composition is defined as a condition where both duplicate analyses for any major ion fall outside the 95% C.I.s for three consecutive sampling periods. When and if this criterion is met, the project will evaluate the sampling and analytical procedures to see if the apparent change in groundwater composition can be explained by procedural changes or irregularities. If the change appears to reflect conditions in the Culebra accurately, the SA will investigate what effects the changes might have on the conceptualization and modeling of the Culebra and, if appropriate, the model will be revised to be consistent with the new information.

In this COMP evaluation, stability is defined as a condition where the concentration of an ion remains within the 95% confidence interval (C.I.) (mean +/- two standard deviations) established from the baseline measurements at a well, assuming a normal distribution of concentrations. The original baseline was defined by the first five rounds of sampling in the WQSP wells conducted between July 1995 and September 1997 (Crawley and Nagy 1998). The baseline was revised in 2000, expanding from the first five rounds to the first ten rounds of sampling, which were performed between July 1995 and May 2000, before the first receipt of RCRA-regulated waste at WIPP. The baseline data are presented in the WIPP Resource Conservation and Recovery Act Background Quality Baseline Report (Crawley and Nagy 1998) and in Addendum 1 to that report (IT Corporation 2000). For the purposes of this evaluation, a small number of measurements have been eliminated from the baselines for WQSP-3, 5, 6, and 6a. The reasons for eliminating these values are discussed in detail in the COMPs assessment report for data collected in the year 2000 (SNL 2000b). The elimination of these values is always conservative in that it reduces the "stable" range of concentrations for the affected parameters.

A charge-balance error, defined as the difference between the positive and negative charges from the ions in solution divided by the sum of the positive and negative charges, was also calculated for each analysis (Freeze and Cherry 1979). Charge-balance errors are useful in evaluating the reliability of an analysis because water must be electrically neutral. Charge-balance errors are rarely zero because of inherent inaccuracy in analytical procedures, but a reliable analysis should not have a charge-balance error exceeding five percent (Freeze and Cherry 1979). Charge-balance errors in excess of five percent imply either that the analysis of one or more ions is inaccurate (most common) or that a significant ion has been overlooked (rare). The variation between the values obtained for the "sample" and "duplicate" analyses of individual ions is also considered. Generally speaking, this variation should be less than ten percent. Greater variation indicates a potential problem with one or both analyses. Analytical results and charge-balance errors for rounds 16 and 17 of sampling are presented in Table 2.7 with the 95% confidence intervals derived from the baseline data. The charge-balance errors are calculated using the averages of the sample and duplicate analyses.

The only ion that has shown significant variation over the duration of the WQSP is potassium. Potassium concentrations in all wells showed little variation for the first six rounds of sampling. TRACE Analysis of Lubbock, Texas, has been the WQSP analytical laboratory since round 7, and potassium analyses have been problematic ever since. Beginning with the round 7 results for WQSP-1, 2, 4, 5, and 6a, and the round 8 results for WQSP-3 and 6, potassium concentrations became generally higher than they were in previous rounds and also highly variable (Figures 2.2-2.8). In the case of WQSP-3, potassium concentrations from rounds 1 through 7 appear to constitute a separate population from the concentrations from rounds 8 through 10, with no overlap of the 95% confidence intervals (1200 to 1730 versus 2060 to 3150 mg/L). A similar situation is seen at WQSP-4 with respect to potassium, except the two populations comprise rounds 1 through

6 and 7 through 10 with no overlap of the 95% confidence intervals (627 to 805 versus 832 to 1550 mg/L). We now evaluate potassium concentrations at WQSP-3 and WQSP-4 against the 95% confidence intervals established from rounds 8-10 and 7-10, respectively, but note that three or four rounds of sampling do not provide an adequate statistical sampling of the possible variation we might expect.

Potassium is also the ion that showed the greatest variation between rounds 16 and 17, especially in WQSP-1, WQSP-2, and WQSP-4. Round 16 potassium concentrations were lower in all wells than they had been in round 15, and concentrations then rebounded in round 17. The reasons for these variations are uncertain at this time.

Table 2.7 Rounds 16 and 17 ion concentrations and baseline 95% confidence intervals.

Well I.D.	Sample	Cl^- Conc. (mg/L)	SO_4^{2-} Conc. (mg/L)	HCO_3^- Conc. (mg/L)	Na^+ Conc. (mg/L)	Ca^{2+} Conc. (mg/L)	Mg^{2+} Conc. (mg/L)	K^+ Conc. (mg/L)	Charge-Balance Error (%)
WQSP-1	Round 16	*35100/**40100***	4910/4820	52/50	*19600/16400*	1730/1700	1170/1130	539/497	**-8.7**
	Round 17	35000/34200	4440/4660	48/48	17800/17800	1680/1650	1080/1040	**825/850**	**-5.2**
	95% C.I.	31100-39600	4060-5600	45-54	15900-21100	1380-2030	939-1210	322-730	
WQSP-2	Round 16	39000/37900	**6570/7280**	44/46	17100/17100	*1350/1540*	**1130**/1120	455/501	**-14.3**
	Round 17	34300/33100	5710/5510	48/50	17600/16900	1460/1440	970/965	**852/813**	**-7.3**
	95% C.I.	31800-39000	4550-6380	43-53	14100-22300	1230-1770	852-1120	318-649	
WQSP-3	Round 16	134000/131000	7870/**7890**	34/36	82600/**87800**	1460/1520	2090/2030	**1550/1530**	1.1
	Round 17	126000/134000	7670/7660	36/34	67000/67800	1280/1300	2070/1960	**1900/1920**	**-8.7**
	95% C.I.	114000-145000	6420-7870	23-51	62600-82700[c]	1090-1620	1730-2500	2060-3150[a]	
WQSP-4	Round 16	54500/57400	6930/7330	32/34	32800/30000	1440/1500	1160/1150	**695/690**	**-5.3**
	Round 17	***49000/55000***	6120/6080	40/42	30800/30200	1550/1470	1150/1110	1350/1270	-2.1
	95% C.I.	53400-63000	5620-7720	31-46	28100-37800	1420-1790	973-1410	832-1550[b]	
WQSP-5	Round 16	15400/14900	4900/5010	50/50	10100/**10500**	1130/1100	485/481	322/304	1.9
	Round 17	14700/14700	4770/4860	44/46	8960/8760	1030/1010	449/445	411/396	-3.2
	95% C.I.	13400-17600	4060-5940	42-54	7980-10400[c]	902-1180	389-535	171-523	
WQSP-6	Round 16	**5410/5360**	4670/4710	48/48	4120/4110	662/659	218/213	175/171	-3.3
	Round 17	**4910/4980**	4520/4590	48/50	**3440/3440**	714/714	214/216	200/194	**-6.1**
	95% C.I.	5470-6380[c]	4240-5120[c]	41-54	3610-5380[c]	586-777	189-233[c]	113-245	
WQSP-6a	Round 16	**384/370**	1950/1970	104/104	290/286	588/588	159/164	5.7/5.4	2.0
	Round 17	**391/394**	2090/2090	106/106	**231/226**	616/608	164/162	6.2/6.1	0.4
	95% C.I.	444-770[c]	1610-2440	97-111	253-354	554-718	146-185	1.8-9.2	

Bold signifies outside 95% confidence interval or charge-balance error >5%
Italics signifies sample and duplicate analyses differ by more than 10%
[a]baseline defined from rounds 8-10
[b]baseline defined from rounds 7-10
[c]baseline definition excludes anomalous values

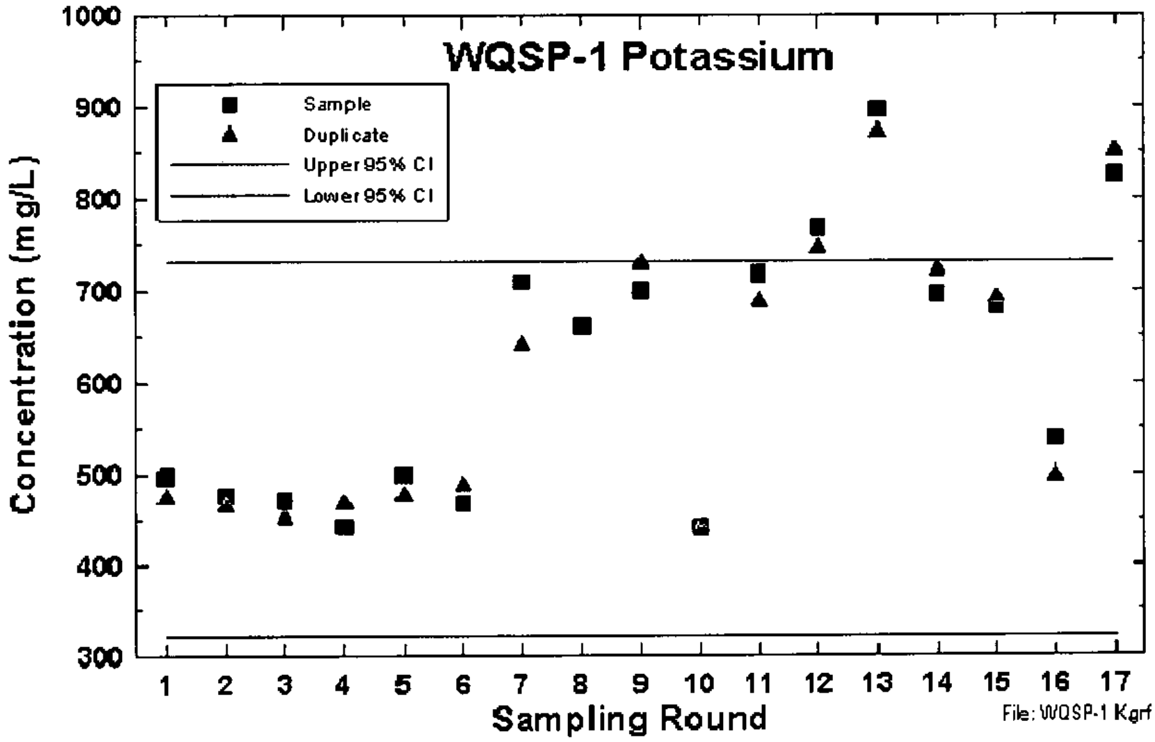

Figure 2.2 WQSP-1 potassium concentrations.

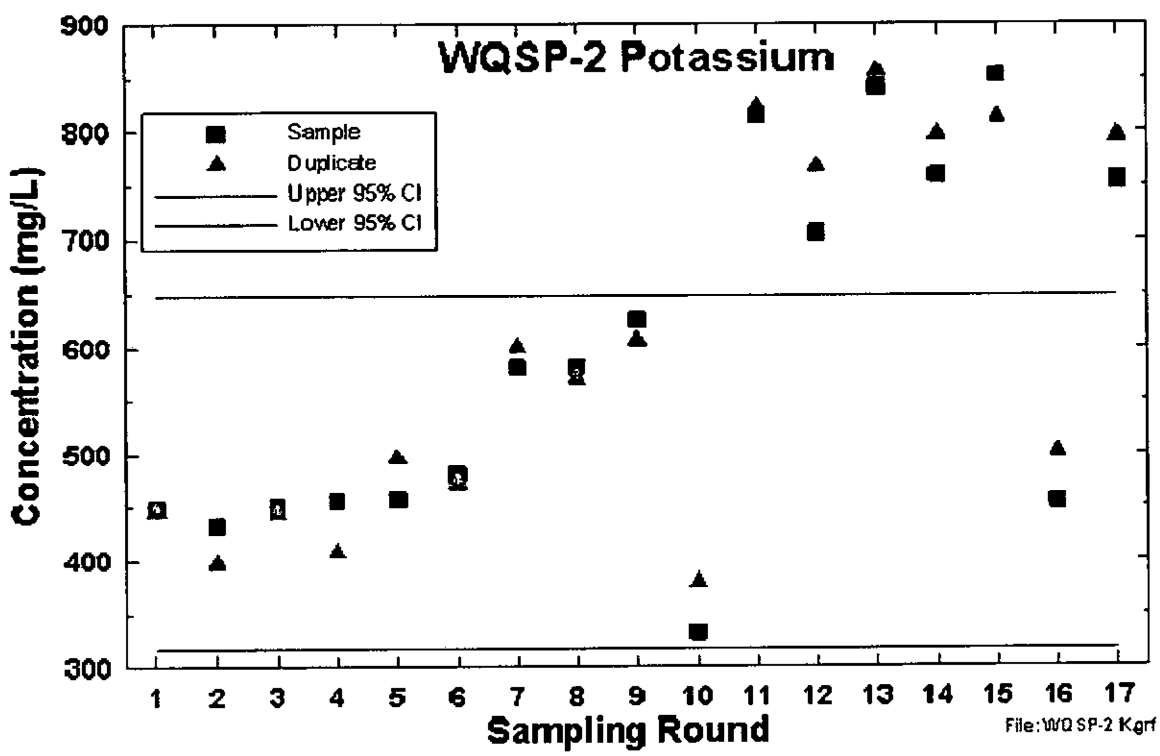

Figure 2.3 WQSP-2 potassium concentrations.

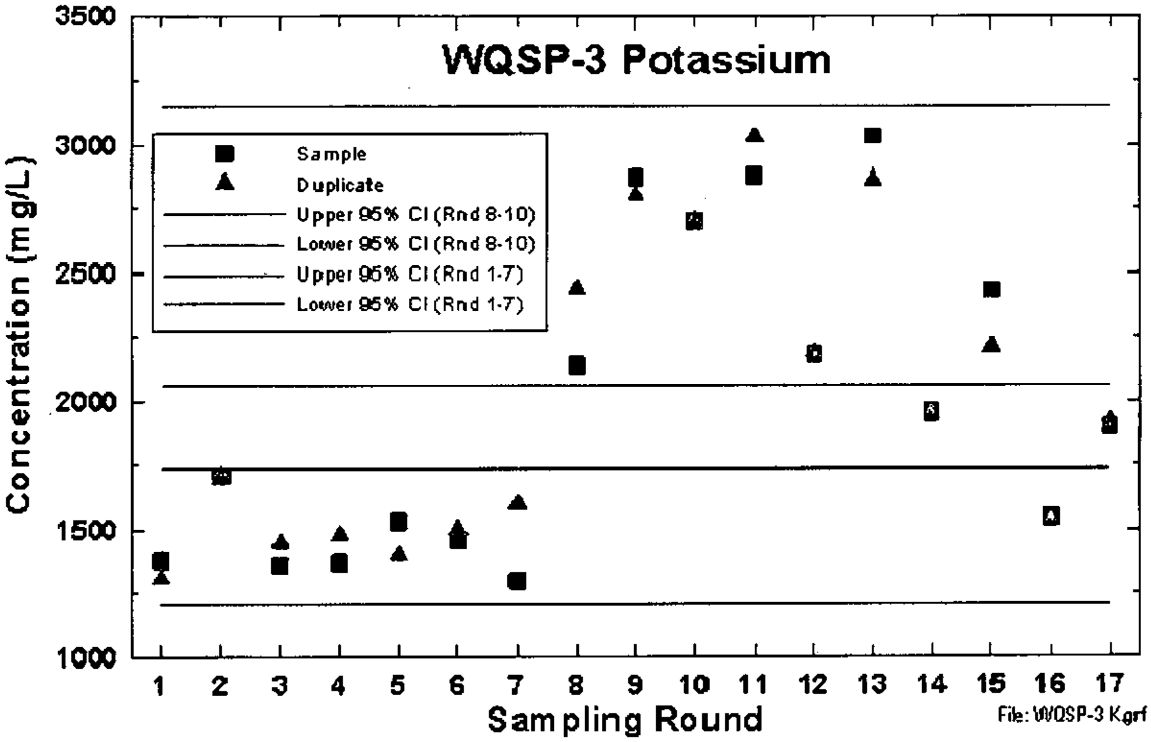

Figure 2.4 WQSP-3 potassium concentrations.

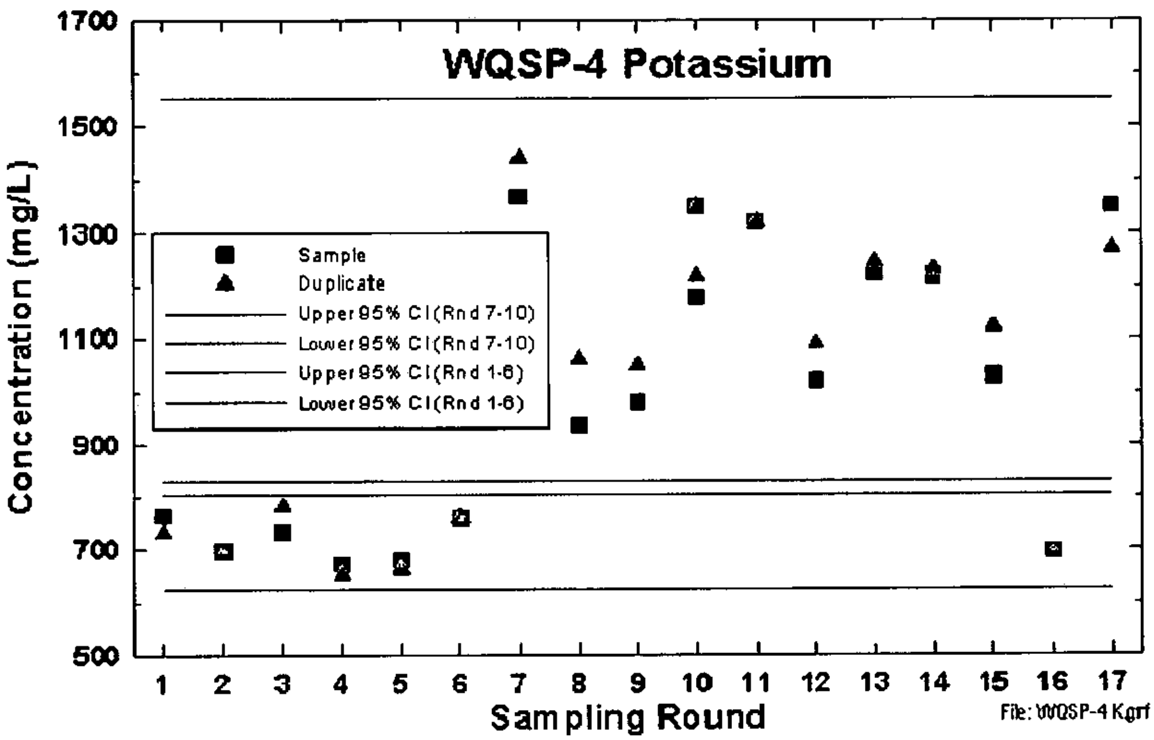

Figure 2.5 WQSP-4 potassium concentrations.

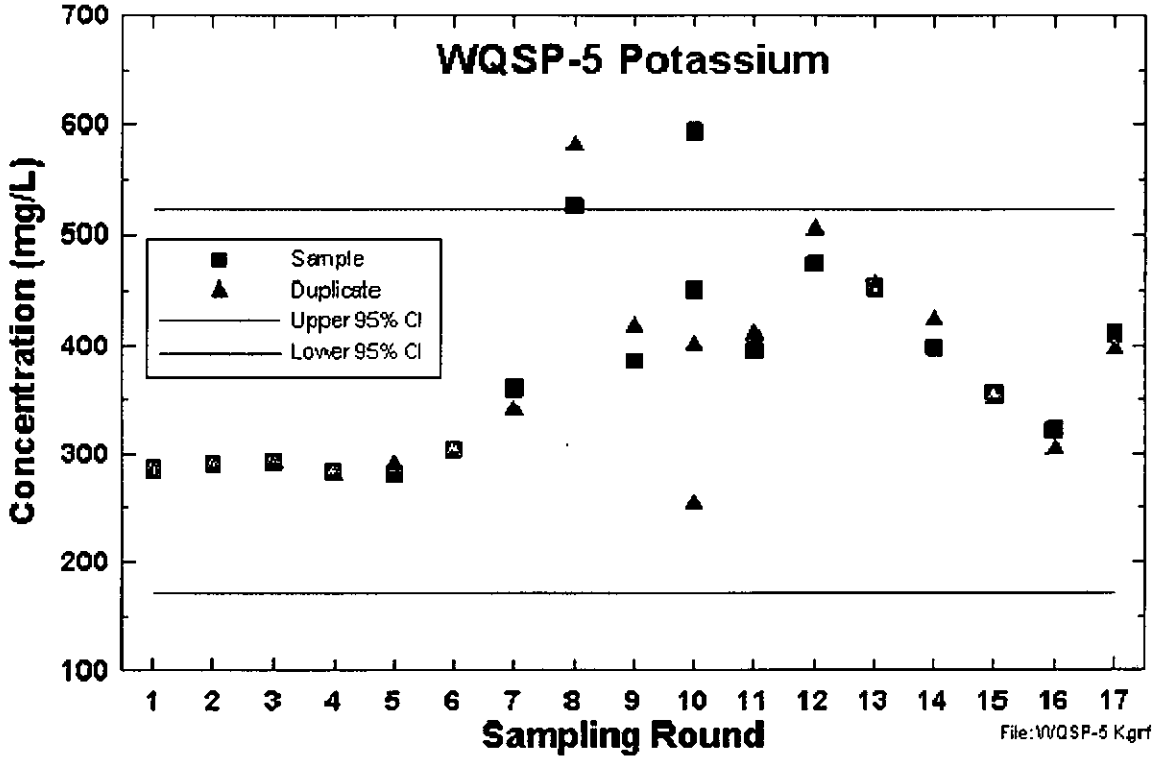

Figure 2.6 WQSP-5 potassium concentrations.

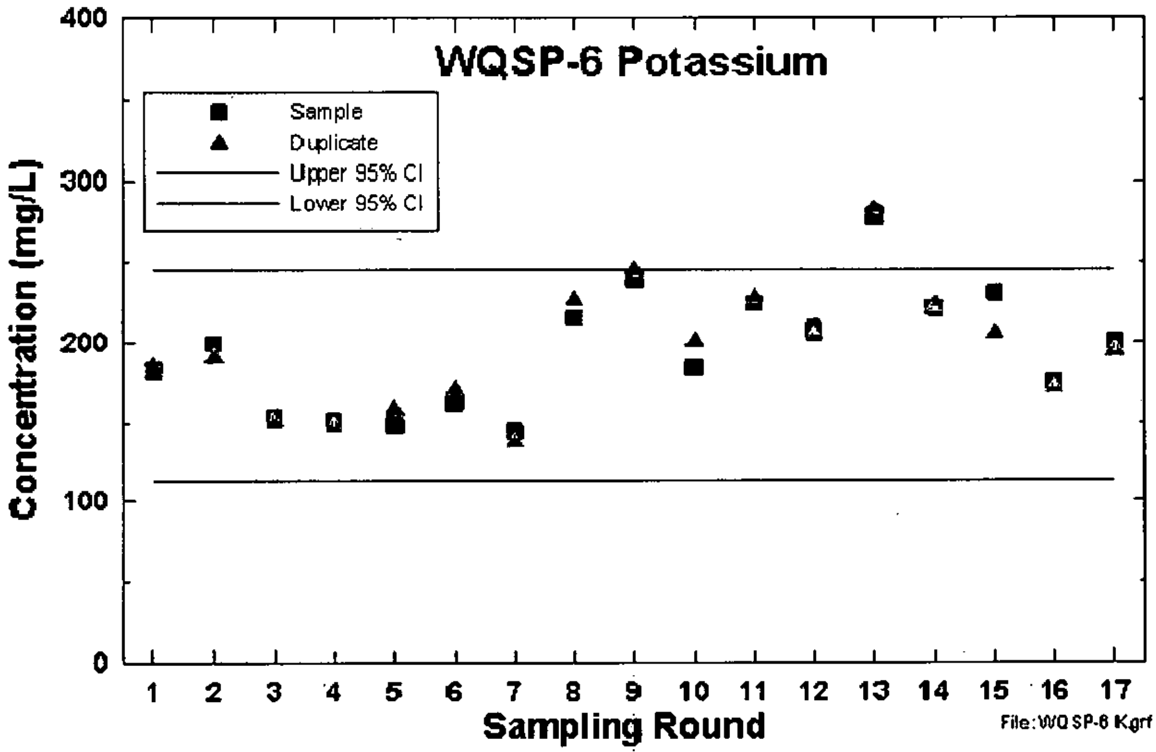

Figure 2.7 WQSP-6 potassium concentrations.

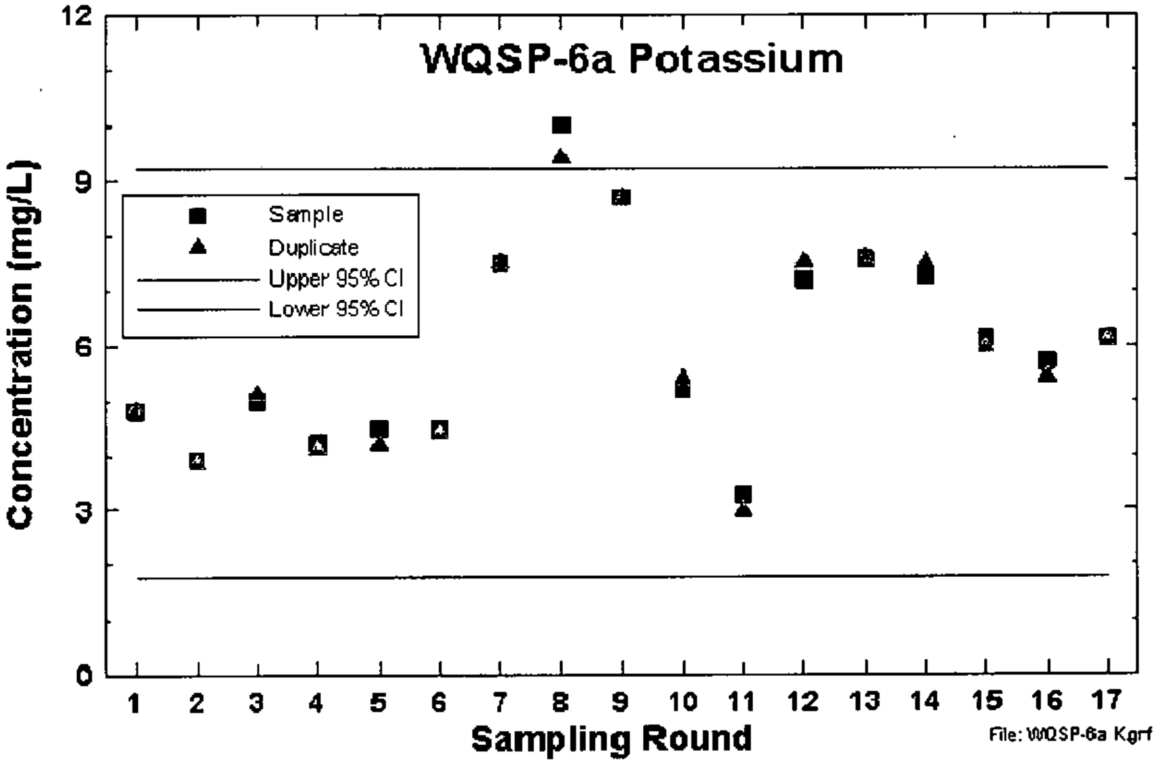

Figure 2.8 WQSP-6a potassium concentrations.

WQSP-1

Concentrations of all major ions were within the 95% confidence intervals for round 16 sampling at WQSP-1 except for the duplicate chloride analysis, which was ~15% higher than the sample chloride analysis (Table 2.7). This suggests that the duplicate analysis is in error. The results for the sodium sample and duplicate differed by greater than 16%, indicating potential laboratory error. For round 17, concentrations of all major ions were within the 95% confidence intervals except for both potassium analyses, which were high. Charge-balance errors were –8.7% and –5.2% for rounds 16 and 17, respectively, indicating a surplus of anions and/or deficit of cations. Figure 2.9 shows that the WQSP-1 hydrochemical facies in 2003 were consistent with previous results. Overall, the water quality at WQSP-1 appears to be stable.

WQSP-2

Concentrations of all major ions were within the 95% confidence intervals for round 16 sampling at WQSP-2 except for both sulfate analyses and the sample magnesium analysis, which were high (Table 2.7). The sample calcium concentration was 12% lower than the duplicate concentration. The round 16 charge-balance error was –14.3%, indicating a significant surplus of anions and/or deficit of cations in the analysis. For round 17, only the potassium concentrations exceeded the 95% confidence intervals. The charge-balance error was –7.3%. Figure 2.9 shows that the WQSP-2 hydrochemical facies in 2003 were consistent with previous results. Overall, the water quality at WQSP-2 appears to be stable.

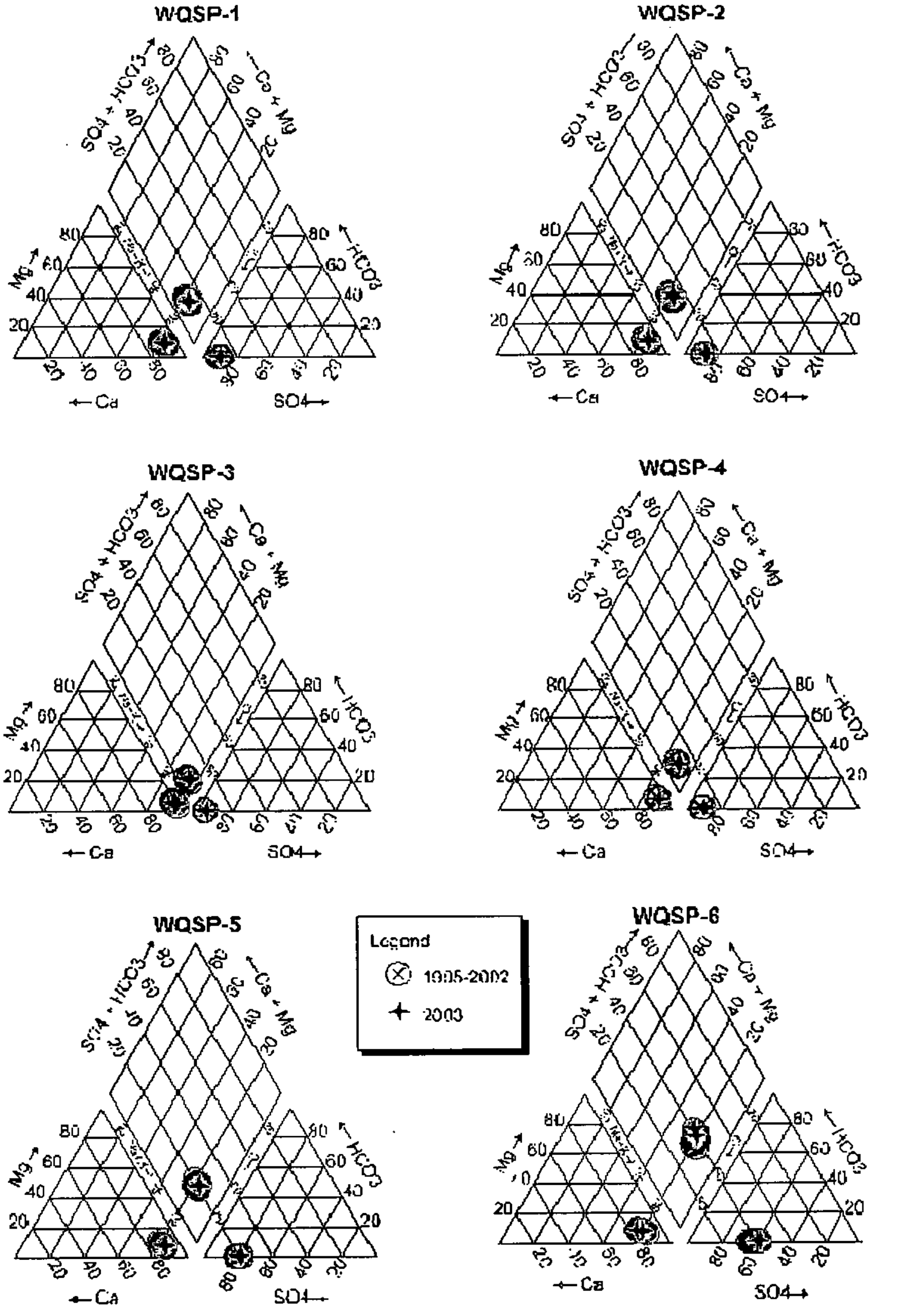

Figure 2.9 Trilinear diagrams of hydrochemical facies at WQSP Culebra wells.

WQSP-3

For round 16 sampling at WQSP-3, concentrations of all major ions were within the rounds 1-10 95% confidence intervals except for the sulfate and sodium duplicate analyses, which were high (Table 2.7). As discussed above, potassium concentrations from rounds 1 through 7 appear to constitute a separate population from the concentrations from rounds 8 through 10, with no overlap of confidence intervals (1200 to 1730 mg/L versus 2060 to 3150 mg/L). Potassium concentrations in WQSP-3 fell within the rounds 1-7 95% confidence intervals for round 16, and between the two separate confidence intervals for sampling round 17 (Figure 2.4). The round 16 charge-balance error was an acceptable 1.1%, but the error for round 17 was too large at –8.7%. Figure 2.9 shows that the WQSP-3 hydrochemical facies in 2003 were consistent with previous results. Overall, the water quality at WQSP-3 appears to be stable.

WQSP-4

For round 16 sampling at WQSP-4, concentrations of all major ions fell within the 95% confidence intervals except for potassium concentrations (Table 2.7). As discussed above, potassium concentrations from rounds 1 through 6 appear to constitute a separate population from the concentrations from rounds 7 through 10, with no overlap of the 95% confidence intervals (627 to 805 mg/L versus 832 to 1550 mg/L). The round 16 potassium concentrations dropped significantly from round 15 levels, falling into the rounds 1-6 confidence interval (Figure 2.5). For round 17, however, potassium concentrations were back up in the rounds 7-10 confidence interval. All other ion concentrations from round 17 were within the 95% confidence intervals except the chloride sample analysis, which was over 10% lower than the chloride duplicate analysis. The charge-balance error for round 16 was greater than desired at –5.3%, while the round 17 charge-balance error was acceptable at –2.1%, in part because of the low chloride concentration. Figure 2.9 shows that the WQSP-4 hydrochemical facies in 2003 were consistent with previous results. Overall, the water quality at WQSP-4 appears to be stable.

WQSP-5

For rounds 16 and 17 at WQSP-5, all ion concentrations were within the 95% confidence intervals except for the round 16 sodium duplicate, which was slightly high (Table 2.7). The charge-balance error for round 16 was an acceptable 1.9% and that for round 17 was –3.2%. Figure 2.9 shows that the WQSP-5 hydrochemical facies in 2003 were consistent with previous results. Overall, the water quality at WQSP-5 appears to be stable.

WQSP-6

For round 16 at WQSP-6, all ion concentrations were within the 95% confidence intervals except for both chloride analyses, which were low (Table 2.7). Chloride concentrations were also below the 95% confidence interval in round 17, as were both sodium concentrations. This marks six consecutive sampling rounds in which the chloride concentrations in WQSP-6 were below the 95% confidence interval (Figure 2.10). Thus, the TV for chloride remains exceeded at WQSP-6. Magnesium concentrations, which had been high in rounds 13-15, returned to the normal range. The charge-balance error for round 16 was an acceptable –3.3%, while the error for round 17 was larger at –6.1% due to the low sodium concentrations. The SA is currently evaluating possible sources of the changes in Culebra groundwater quality that are being observed in several of the WQSP wells. Figure 2.9 shows that the WQSP-6 hydrochemical facies in 2003 were consistent with previous results. Overall, ion concentrations at WQSP-6 appear to be stable, with the exception of chloride.

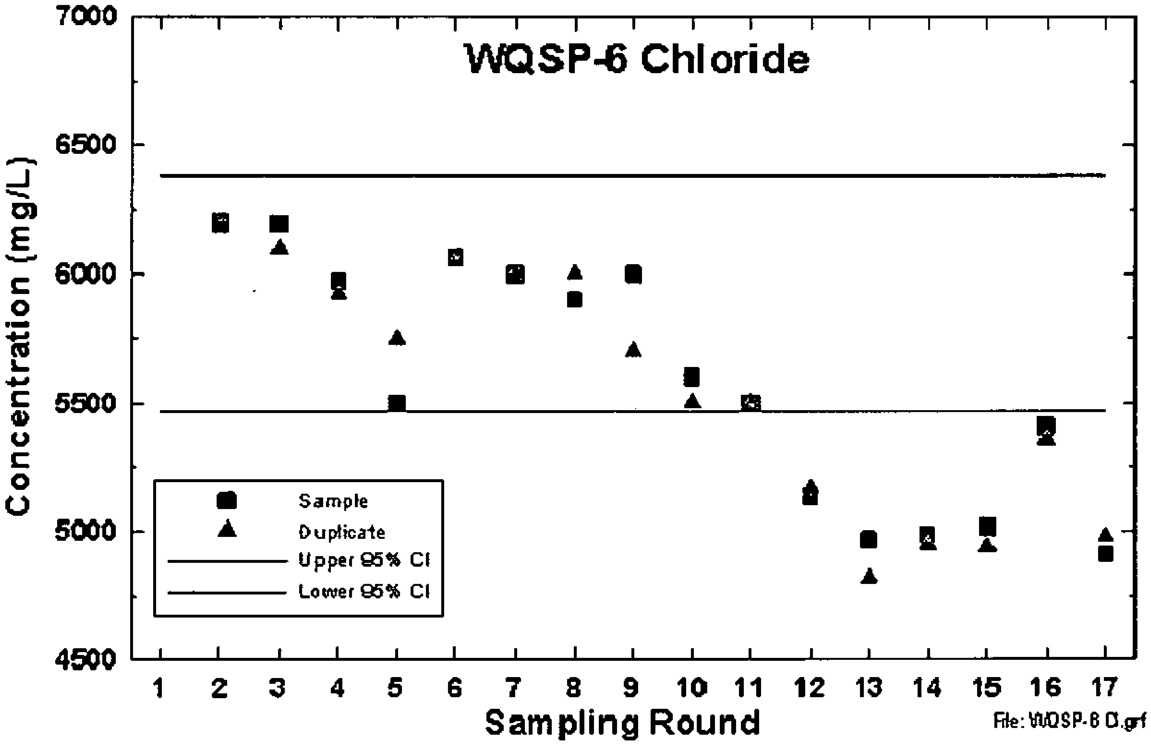

Figure 2.10 WQSP-6 chloride concentrations.

WQSP-6a

For round 16 at WQSP-6a, all ion concentrations were within the 95% confidence intervals except for both chloride analyses, which were low (Table 2.7). Chloride concentrations were also low in round 17, as were both sodium analyses. Figure 2.11 provides a clear sense of chloride concentrations decreasing with time in the Dewey Lake at WQSP-6a. Similarly, Figure 2.12 provides an indication of possible evolution of the hydrochemical facies at WQSP-6a towards increasing sulfate dominance of the anions and decreasing chloride. No TV has been defined for Dewey Lake water quality because it plays no role in WIPP's compliance. Nevertheless, the Dewey Lake will continue to be monitored due to the insight that may be gained with respect to the overall hydrology of the Dewey Lake. The charge-balance errors were acceptable for both rounds, being 2.0% for round 16 and 0.4% for round 17. At the present time, ion concentrations, with the possible exception of chloride, are stable at WQSP-6a.

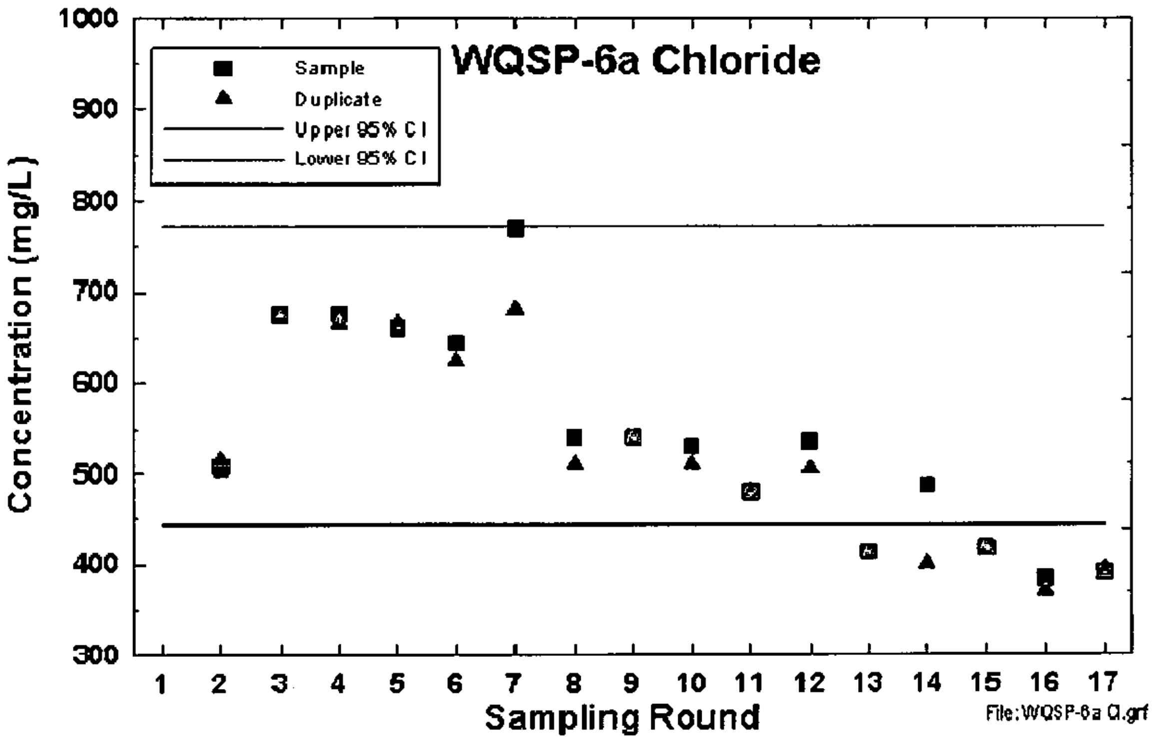

Figure 2.11 WQSP-6a chloride concentrations.

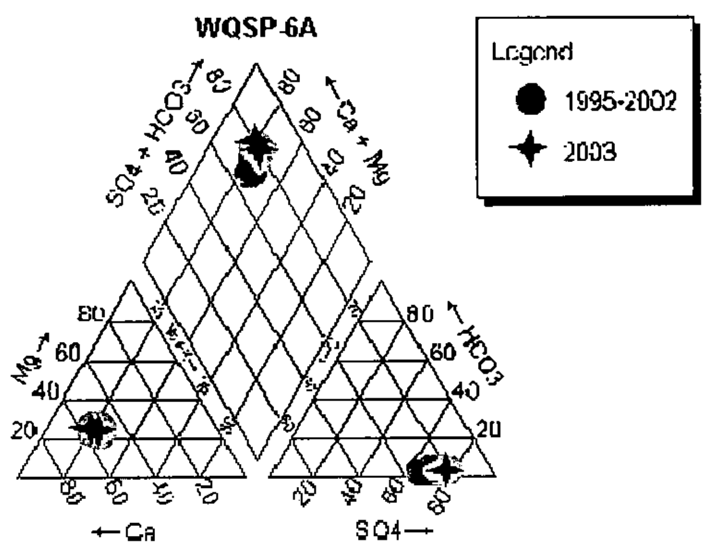

Figure 2.12 Trilinear diagram of WQSP-6a Dewey Lake hydrochemical facies.

Summary

With the exception of chloride at WQSP-6 and WQSP-6a, major ion concentrations are stable in all wells and within the TVs. Analytical error is believed to be the most probable cause for sporadic variations in water quality data. Because the WQSP-6 and 6a chloride concentrations have been below the 95% confidence intervals for six and five consecutive sampling rounds, respectively, the SA is investigating possible explanations.

Change in Groundwater Composition - 2004:

Trigger Value Derivation				
COMP Title:	Groundwater Composition			
COMP Units:	mg/L			
Related Monitoring Data				
Monitoring Program	Monitoring Parameter ID	Characteristics (e.g., number, observation)	Compliance Baseline Value	
Groundwater Monitoring	Composition	Semi-annual chemical analysis	RCRA Background Water Quality Baseline	
COMP Derivation Procedure				
Annually evaluate ASER data and compare to previous years and baseline information				
Related Performance and Compliance Elements				
Element Title	Type & ID	Derivation Procedure	Compliance Baseline	Impact of Change
Groundwater conceptual model, brine chemistry, actinide solubility	Indirect	Conceptual models	Indirect – The average Culebra brine composition is not used.	Provides validation of the various CCA models, potentially significant with respect to flow, transport, and solubility and redox assumptions.
Monitoring Data Trigger Values				
Monitoring Parameter ID	Trigger Value	Basis		
Change in Culebra groundwater composition	Both duplicate analyses for any major ion falling outside the 95% confidence interval (see Table 2.7) for three consecutive sampling periods	The 95% confidence interval for a particular analyte defines the range of concentrations that 19 out of 20 analyses, on average, should fall within. Therefore, TVs should not be set so that a single analysis falling outside the 95% confidence interval is significant. In addition, analysis of solutes in the concentrated brines of the Culebra is not a routine procedure, and occasional analytical errors are to be expected, particularly when a new laboratory is contracted to perform the analyses (SNL 2002b).		

2.3.2 Changes in Groundwater Flow (Water Level)

Assessment of the COMP "Changes in Groundwater Flow" involves TVs derived from the steady-state freshwater heads estimated for Culebra flow modeling in the CCA. The Culebra transmissivity (T) fields that were used to simulate the transport of radionuclides through the Culebra were considered calibrated when, among other things, the modeled heads at 32 wells fell within the ranges of uncertainty estimated for steady-state freshwater heads at those wells. If monitoring shows that heads at these wells are outside the ranges used for T-field calibration (hereafter called the "CCA range"), the cause(s) and ramifications of the deviations must be investigated.

The freshwater head is the elevation of the column of freshwater (density = 1.0 g/cm^3) that would exert the same pressure at the midpoint of the Culebra as that exerted by the column of fluid actually in the well. Thus, once the ground-surface elevation at a well site is surveyed, determination of freshwater head requires two sets of information:

1) The height of the water column in the well above the midpoint of the Culebra.
2) The density of the water in that water column.

Under the WLMP in 2003, the M & OC made monthly water-level measurements in 34 Culebra wells (down from 41 in 2001 due to P&A activities and well obstructions), and quarterly in 13 "redundant" Culebra wells located on the same drilling pads as eight of the wells monitored monthly (down from 17 in 2001 due to P&A activities and well obstructions). The M & OC began an annual program of pressure-density surveys in monitoring wells in 2000. Pressure-density surveys were performed in 10 Culebra wells in 2003 (DOE 2004c). Fluid-density data from other wells come from pressure-density surveys over a range of years and from water-quality sampling in 2003. Table 2.8 gives the most recent results available at the current time for the wells in which water levels were monitored in 2003.

Water levels were also measured in wells completed in horizons other than the Culebra. These other horizons are not currently monitored as COMPs and do not have TVs. The water-level measurements in these units do, however, provide information used in the development of the conceptual model of site hydrology. Water levels in the Magenta Member of the Rustler Formation were measured monthly in 16 wells. Water levels in the Los Medaños Member of the Rustler Formation and across the Rustler-Salado contact were measured monthly in one well. Monthly water levels were measured in two Dewey Lake wells and two Bell Canyon wells.

Table 2.8 Fluid densities in monitored wells.

Well	Date	Unit	Density (g/cm^3)	Method
AEC-7	·2000	Culebra	1.0888	P-D Survey
C-2737	7/12/02	Culebra	1.0013	P-D Survey
DOE-1	10/28/03	Culebra	1.0886	P-D Survey
H-2b2	2000	Culebra	1.0117	P-D Survey
H-3b2	12/2/03	Culebra	1.0360	P-D Survey
H-4b	11/18/03	Culebra	1.0030	P-D Survey
H-5b	11/17/03	Culebra	1.0892	P-D Survey
H-6b	11/17/03	Culebra	1.0343	P-D Survey
H-9c	12/18/02	Culebra	1.0029	P-D Survey
H-10c	9/26/02	Culebra	1.000	P-D Survey
H-11b4	12/2/03	Culebra	1.0640	P-D Survey
H-12	2000	Culebra	1.0833	P-D Survey
H-17	11/18/03	Culebra	1.1291	P-D Survey
H-19b0	6/5/01	Culebra	1.0620	P-D Survey
P-17	2000	Culebra	1.0912	P-D Survey
WIPP-12	10/29/02	Culebra	1.0987	P-D Survey
WIPP-19	10/22/02	Culebra	1.0506	P-D Survey
WIPP-21	2000	Culebra	1.0759	P-D Survey
WIPP-22	10/15/02	Culebra	1.0614	P-D Survey
WIPP-26	12/2/03	Culebra	1.0190	P-D Survey
WIPP-29	12/2/03	Culebra	1.2210	P-D Survey
WQSP-1	3/5/03 & 9/4/03	Culebra	1.039	Sampling
WQSP-2	3/19/03 & 9/17/03	Culebra	1.039	Sampling
WQSP-3	3/27/03 & 10/1/03	Culebra	1.140	Sampling
WQSP-4	4/9/03 & 10/15/03	Culebra	1.070	Sampling
WQSP-5	4/23/03 & 10/29/03	Culebra	1.020	Sampling
WQSP-6	5/7/03 & 11/12/03	Culebra	1.009	Sampling
DOE-2	7/11/01	Magenta	1.0553	P-D Survey
H-5c	10/8/01	Magenta	1.0045	P-D Survey
H-6c	9/26/01	Magenta	1.003	P-D Survey
H-11b2	5/31/01	Magenta	1.070	P-D Survey
H-14	7/9/01	Magenta	1.0294	P-D Survey
H-15	7/9/01	Magenta	1.0760	P-D Survey
H-18	7/11/01	Magenta	1.0054	P-D Survey
WIPP-18	7/12/01	Magenta	1.0423	P-D Survey
WQSP-6a	5/21/03 & 11/19/03	Dewey Lake	0.999	Sampling

Culebra Data

Table 2.9 provides a comparison of Culebra water levels in feet above mean sea level (ft amsl) from December 2002 to December 2003 at the 34 wells monitored monthly (DOE 2004c). In a significant change from previous years, water levels decreased in 21 wells in 2003. The declines were greatest in WIPP-25 and WIPP-27 (2.56 and 2.01 ft, respectively), wells which are in Nash Draw and might be most sensitive to variations in the discharge of potash refining effluent. The water level in WIPP-25 began to decline in June and fell 2.64 ft by December. The water level in WIPP-27 declined 2.8 ft from April to October, and then rose 0.38 ft over the next two months. Potash mining operations were suspended at the Mississippi (now Intrepid) West facility (near WIPP-27) from June to September 2003, and at the East facility (upgradient of WIPP-25) from June to October 2003. Associated decreases in potash refining effluent discharge may have contributed to the observed declines in water levels, but detailed discharge data are not available.

Water levels in 13 of the wells rose in 2003. In all but two of those wells, water levels rose by less than two feet. Water levels rose by 105.43 ft in CB-1 and by 3.50 ft in H-10c. Anomalous water-level readings began in CB-1 in 1999 after the well was recompleted as a dual Culebra-Bell Canyon monitoring well. The Culebra is accessed through perforations in the casing in that well. It is believed that the perforations were plugged during the clean-out and circulation of the Bell Canyon section at the bottom of the well, and that subsequent water-level measurements reflect the leakage of Salado and/or Castile fluids past the packer set in the casing below the Culebra. After being recompleted in August 1999, the water level in the casing (which should have been open to the Culebra) was left at 93.7 ft below top of casing (btc), from which level it was expected to decline approximately 250 ft to a level representative of the Culebra. Instead, from August 1999 until May 2002, the water level rose from 93.7 to 34.6 ft btc. The water level was pumped down to 495.3 ft btc in May 2002, after which the rise to 261.7 ft btc monitored through 2003 occurred. If this rise truly reflected conditions in the Culebra, elevated heads in the two closest Culebra wells would be expected as well (H-4b and P-17, 3020 and 3080 ft from CB-1, respectively). Instead, water levels in H-4b and P-17 declined in 2003, indicating that the CB-1 water levels were not representative of the Culebra.

The change in water level at H-10c may be related to nearby drilling because the water level rose 4.3 ft from one monthly reading to the next, and then declined in subsequent months.

Table 2.9 also compares the December 2003 freshwater heads to the CCA ranges for the 21 wells used in the generation of the CCA T fields that were monitored in 2003. Freshwater heads in 17 of the 21 wells appear to be outside the CCA ranges at the end of 2003, all higher than expected. The heads at CB-1 can be discounted for the reasons discussed above, leaving 16 wells with unexpectedly high freshwater heads.

Table 2.9 Summary of 2003 Culebra water-level changes and freshwater heads.

Well I.D.	12/02 W.L. (ft AMSL)	12/03 W.L. (ft AMSL)	2003 Change (ft)	12/03 FWH (ft AMSL)	CCA FWH Range (ft AMSL)	Outside CCA Range?
AEC-7	3038.13	3039.47	1.34	3062.53	3055.1-3060.4	Y
C-2737	3016.91	3017.14*	0.23	3017.14	N/A	N/A
CB-1	2961.26	3066.69	105.43	3073.18	2986.9-2991.5	Y
DOE-1	2978.10	2979.71	1.61	3008.44	2992.5-3013.8	N
DOE-2	Recompleted as Magenta well (April 2001)				3061.7-3071.5	N/A
ERDA-9	3009.83	3009.99	0.16	3025.51	N/A	N/A
H-1	Plugged and abandoned (February 2001)				3017.1-3030.2	N/A
H-2b2	3038.92	3039.20	0.28	3041.56	3033.8-3040.0	Y
H-3b2	3000.06	2999.91	-0.15	3011.29	2995.1-3007.5	Y
H-4b	3002.01	3000.47	-1.54	3004.04	2988.2-2992.1	Y
H-5b	3028.90	3029.66	0.76	3074.67	3060.4-3069.6	Y
H-6b	3054.24	3052.31	-1.93	3064.48	3054.5-3061.0	Y
H-7b2	2997.45	2997.63	0.18	2997.54	2994.1-2996.1	Y
H-9c	2991.56*	2991.76	0.20	2992.01	2973.4-2977.7	Y
H-10c	3025.71	3029.21	3.50	3029.21	3015.4-3029.9	N
H-11b4	2984.17	2983.57	-0.60	3003.60	2990.2-3003.3	Y
H-12	2970.72	2971.23**	0.51	3008.64	2993.1-3001.0	Y
H-14	Recompleted as Magenta well (April 2001)				3007.9-3021.0	N/A
H-15	Recompleted as Magenta well (April 2001)				3005.2-3019.4	N/A
H-17	2963.15	2962.54	-0.61	3011.86	2985.9-2991.8	Y
H-18	Recompleted as Magenta well (April 2001)				3055.4-3067.3	N/A
H-19b0	2990.96	2990.52	-0.44	3012.34	N/A	N/A
P-15		Plugged and abandoned (February 2002)			3008.5-3013.8	N/A
P-17	2984.39	2983.66	-0.73	2997.86	2981.0-2985.6	Y
WIPP-12	3033.29	3032.67	-0.62	3069.52	3062.7-3070.2	N
WIPP-13	3058.00	3056.73	-1.27	3067.28	3059.1-3068.2	N
WIPP-18	Recompleted as Magenta well (April 2001)				3048.9-3062.7	N/A
WIPP-19	3041.22	3040.99	-0.23	3078.90	N/A	N/A
WIPP-21	3017.33	3017.31	-0.02	3041.54	N/A	N/A
WIPP-22	3031.51	3031.46	-0.05	3062.65	N/A	N/A
WIPP-25	3062.32	3059.76	-2.56	3056.69	3043.6-3050.2	Y
WIPP-26	3023.01	3022.24	-0.77	3022.38	3013.1-3014.8	Y
WIPP-27	3082.39	3080.38	-2.01	3086.42	3075.5-3080.1	Y
WIPP-29	2967.20	2966.86	-0.34	2969.99	N/A	N/A
WIPP-30	3070.56	3070.53	-0.03	3077.66	3060.4-3067.6	Y
WQSP-1	3055.28	3054.15	-1.13	3070.86	N/A	N/A
WQSP-2	3060.89	3059.57	-1.32	3079.32	N/A	N/A
WQSP-3	3012.61	3012.87	0.26	3070.16	N/A	N/A
WQSP-4	2988.42	2987.85	-0.57	3012.83	N/A	N/A
WQSP-5	3003.97	3003.73	-0.26	3010.81	N/A	N/A
WQSP-6	3016.45	3016.83	0.38	3020.57	N/A	N/A

*April 2003 measurement

**November 2003 measurement

NA = not applicable; data from well not used in CCA T-field calibration or data unavailable

Water levels were not measured in C-2737 after April 2003 because of ongoing testing and test equipment in the well. H-12 became obstructed in December 2003.

Although Culebra heads in excess of the respective CCA ranges are not likely to affect compliance calculations, the cause(s) of the change needs to be understood to provide confidence in the conceptual understanding of the Culebra. The SA began an investigation of possible causes of the high heads in 2000 (SNL 2001a). In 2002, the SA began formalizing an integrated hydrology program plan, in conjunction with both the M & OC and the DOE CBFO that outlines the path forward with respect to this investigation. The Strategic Plan for Groundwater Monitoring at the Waste Isolation Pilot Plant (DOE 2003b) was published in early 2003 and is the authorization document for groundwater activities. The integrated hydrology program plan further details the completion of a number of strategically placed new Culebra wells as well as several wells replacing Culebra wells that have been lost to deterioration. The new wells will be sited in order to investigate possible sources of the rising Culebra heads as well as to fill gaps in existing Culebra information. The WIPP Integrated Groundwater Hydrology Program Plan (SNL 2003b) was completed in March 2003 and the SA, in conjunction with the M & OC and DOE CBFO, have initiated this plan by drilling and completing four new wells (SNL-2, SNL-3, SNL-9, and SNL-12) in the Culebra in 2003. Hydraulic testing and water quality sampling of these new Culebra wells is currently being conducted by the SA. Three additional Culebra wells are scheduled to be drilled and tested in FY04. Data collected from these new Culebra wells will provide information with respect to the, as yet, unexplained Culebra water-level rises and the variable water quality.

Preliminary findings indicate that Culebra water levels are generally rising across the entire monitoring region. One cause of this rise appears to be leakage from the Intrepid East tailings pile seven miles north of the WIPP site. Water-level data compiled from various sources and dating back to 1977 indicate that regional water levels were rising when Culebra monitoring began and that this trend continues today. This new information and the water level data generated since the CCA were incorporated into the T-fields used for CRA-2004 PA..

Data from Other Units

Table 2.10 provides a comparison of water levels from units other than the Culebra from December 2002 to December 2003. Testing and/or groundwater sampling of the Magenta was conducted at H-11b2, H-15, H-18, DOE-2, WIPP-18, and H-9c, explaining the variations in water levels in these wells. The remainder of the Magenta well water levels changed by less than 2 ft.

Water levels were stable within one foot in the Dewey Lake well WQSP-6a and in the Los Medaños/Rustler-Salado well H-8c. The Dewey Lake water level in H-3d continued a slow rise that began in approximately 2000. Since January 2000, the water level has risen 4.7 ft, 1.5 ft of which occurred in 2003. Access to the Forty-niner in H-3d was lost in February 2002 due to an unknown obstruction in the well.

The Bell Canyon water level behavior in AEC-8 was unusual in 2003. A monotonic rise of unknown origin began in approximately 1993, with water levels rising from 2954.9 ft amsl in January 1993 to 3068.7 ft amsl in May 2003. We suspect that this rise in water levels was caused by a casing failure allowing water from a horizon above the Salado, possibly the Culebra, to enter the well. From May to December 2003, however, water levels dropped to 3060.1 ft amsl. The cause of this change in behavior is unknown, but will be investigated.

The Bell Canyon water level in well Cabin Baby-1 (CB-1) was stable in 2003 (Table 2.10).

Table 2.10 Summary of 2003 water-level changes in units other than the Culebra.

Well I.D.	12/02 W.L. (ft AMSL)	12/03 W.L. (ft AMSL)	2003 Change (ft)
Magenta Wells			
C-2737	3141.61	3141.02*	-0.59
DOE-2	3068.99*	3068.72*	-0.27
H-2b1	3146.74	3145.50	-1.24
H-3b1	3130.39	3132.14	1.75
H-4c	3143.29	3142.02	-1.27
H-5c	3157.00	3156.74	-0.26
H-6c	3065.52	3066.33	0.81
H-8a	3026.94	3027.06	0.12
H-9c	3133.30*	3134.64	1.34
H-10a	3220.04	3221.54	1.50
H-11b2	3127.91*	3132.62	4.71
H-14	3107.69*	3109.02	1.33
H-15	3113.06*	3109.02[1]	-4.04
H-18	3079.37*	3075.27	-4.10
WIPP-18	3141.09*	3142.57	1.48
WIPP-25	3052.09	3051.28[2]	-0.81
Dewey Lake Wells			
H-3d	3074.92	3076.42	1.50
WQSP-6a	3198.22	3197.99	-0.23
Los Medaños Well			
H-8c	2979.81	2980.55	0.74
Forty-niner Well			
H-3d	Well obstructed as of February 2002	Well obstructed as of February 2002	N/A
Bell Canyon Wells			
AEC-8	3062.35	3060.15	-2.20
CB-1	3014.51	3014.79	0.28

N/A = not available
*measured by SNL
[1]November 2003
[2]August 2003

Changes in Groundwater Flow - 2004:

Trigger Value Derivation				
COMP Title:	Changes in Groundwater Flow			
COMP Units:	Inferred from water-level data			
Related Monitoring Data				
Monitoring Program	Monitoring Parameter ID	Characteristics (e.g., number, observation)	Compliance Baseline Value	
Groundwater Monitoring	Head and Topography	Monthly water-level measurements; annual pressure-density surveys.	Indirect	
COMP Derivation Procedure				
Annual assessment from ASER data.				
Related PA Elements				
Element Title	Type & ID	Derivation Procedure	Compliance Baseline	Impact of Change
Groundwater conceptual model, Transmissivity fields	NA	NA	NA	Provides validation of the various CCA models - T-field assumptions and groundwater basin model.
Monitoring Data Trigger Values				
Monitoring Parameter ID	Trigger Value	Basis		
Change in Culebra Groundwater Flow	CCA range; see Table 2.9	Annual comparisons with ranges of undisturbed steady-state freshwater heads used to calibrate Culebra T fields for CCA.		

2.4 Waste Activity

To date, Panel 1 has been filled with waste and Panel 2 waste emplacement has progressed to four of its seven rooms. Waste emplacement in Panel 1 ceased in September, 2002. Panel 1 final utilization is shown in Figure 2.13. Underutilizing the panel eliminated approximately 30% of the available area. As such, this panel's waste activity assessment is not representative of other panels in the repository. Panel 2 waste emplacement started during final Panel 1 emplacement. Figure 2.14 shows waste emplaced during the reporting period for Panel 2. Panel 2 is expected to be fully utilized.

As of June 30, 2004, a total of 57,821 containers (representing 21,850 m^3) of CH TRU and dunnage are currently stored at WIPP. No RH waste canisters have been emplaced in WIPP. Table 2.11 details the numbers and volumes of the various container types.

Table 2.11 Container numbers and volumes

Container Type	Number of Containers	Volume (cubic meters)
55 gallon drums	31,232	6,558.72
Standard Waste Box (SWB)	2,971	5,585.48
SWB overpack	173	325.24
Pipe overpacks	21,429	4,500.09
85 gallon overpack	2	0.64
Ten Drum Overpack (TDOP)	1,039	4,675.50
Dunnage	975	204.75
Total[3]	57,821	21,850.42

Radionuclide inventory information is contained in Table 2.12. A comparison of the tracked actinides and the total repository inventory used in the CCA is detailed in Table 2.13. No other activity-related assessment has been made at this time.

As discussed in the Trigger Value Derivation Report, Waste Activity COMPs assessments are not performed until half the panel is filled since small quantities do not yield statistically valid assessments. There are no TVs for CH activity, only RH. There are no recognized reportable issues associated with this COMP. No changes to the monitoring program are recommended at this time. A detailed waste inventory assessment has been provided in the CRA. A new actinide COMP assessment process may be evaluated prior to the first COMPs assessment after the CRA.

[3] Total volume reported in this table include volume of dunnage.

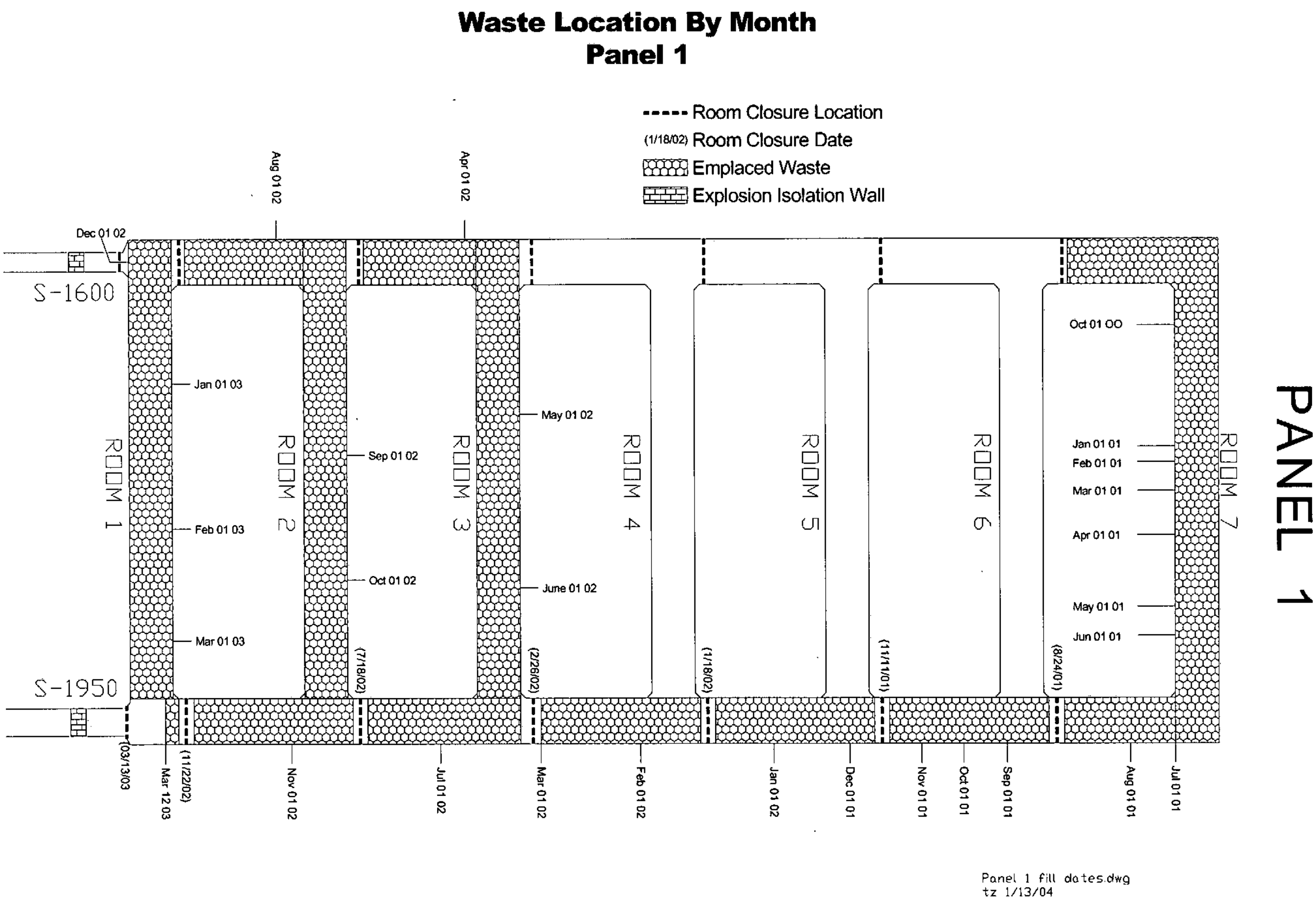

Figure 2.13 Panel 1 utilization

Waste Location By Month
Panel 2

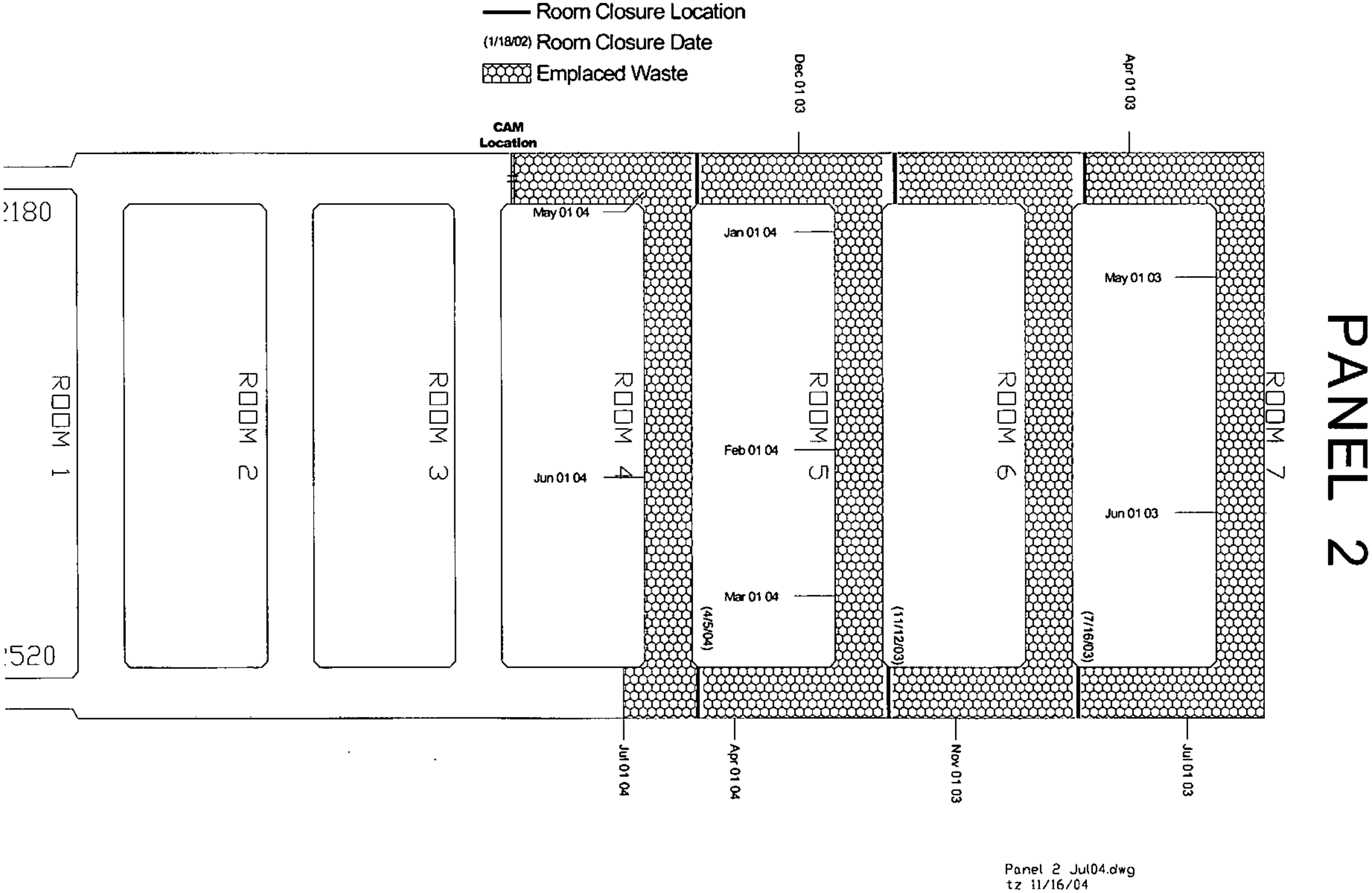

Figure 2.14 Panel 2 Utilization

Table 2.12 Radionuclide inventory information

Radiological Activity Inventory (curies)					
Radionuclide	Cumulative Activity in FY 2003 Annual Change Report	Reporting Period Activity	Total Activity as of June 30, 2004	Panel 1 Total	Panel 2 Total
^{227}Ac	2.2204E-03	1.6477E-03	3.8681E-03	6.6635E-04	3.2017E-03
^{241}Am	1.2230E+05	1.7334E+04	1.3963E+05	1.2016E+05	1.9470E+04
^{243}Am	4.5952E-01	4.7857E-01	9.3809E-01	1.3099E-02	9.2499E-01
^{60}Co	2.5371E-05	1.8904E-01	1.8906E-01	4.6696E-07	1.8906E-01
^{40}K	6.8063E-05	1.1193E-03	1.1873E-03	3.2699E-05	1.1546E-03
^{22}Na	3.1598E-02	2.9649E-02	6.1247E-02	5.3435E-06	6.1241E-02
^{237}Np	4.5284E-01	5.2317E-01	9.7601E-01	4.1511E-01	5.6090E-01
^{231}Pa	7.1284E-03	3.2449E-03	1.0373E-02	1.1926E-03	9.1807E-03
^{238}Pu	6.7912E+03	3.6792E+03	1.0470E+04	6.1858E+03	4.2846E+03
^{239}Pu	1.6316E+05	4.3014E+04	2.0617E+05	1.5198E+05	5.4190E+04
^{240}Pu	3.6870E+04	1.2009E+04	4.8879E+04	3.4288E+04	1.4590E+04
^{241}Pu	5.2304E+05	1.9733E+05	7.2037E+05	4.8203E+05	2.3834E+05
^{242}Pu	3.6606E+00	3.1129E+00	6.7735E+00	3.3183E+00	3.4552E+00
^{226}RA	8.0077E-06	1.0883E-03	1.0963E-03	7.8785E-06	1.0885E-03
^{230}Th	9.3834E-02	2.7700E-05	9.3862E-02	5.3370E-04	9.3328E-02
^{232}Th	4.4858E-05	1.7078E-05	6.1936E-05	1.4455E-05	4.7481E-05
^{233}U	4.2639E-01	7.2417E-02	4.9881E-01	4.1378E-01	8.5027E-02
^{234}U	2.3925E+00	1.3378E+00	3.7303E+00	1.5681E+00	2.1622E+00
^{235}U	1.4180E-01	6.7152E-02	2.0895E-01	1.3493E-01	7.4027E-02
^{238}U	8.0000E+00	6.7459E-01	8.6746E+00	7.5371E+00	1.1374E+00
^{90}Sr	7.5317E-01	6.3261E-01	1.3858E+00	3.8096E-05	1.3857E+00
^{137}Cs	6.1614E-01	6.0681E-01	1.2229E+00	5.0823E-04	1.2224E+00
Totals	**8.5218E+05**	**2.7337E+05**	**1.1256E+06**	**7.9467E+05**	**3.3088E+05**

Information from M & OC, WWIS. Reporting period includes emplacement that occurred between 7-1-2003 and 6-30-2004 (DOE 2004d)

Table 2.13 Comparison of tracked radionuclide inventory to CCA inventory (from DOE 2004d and SNL 2004)

Radionuclide CCA Table 4-10)	Non-Decayed Inventory as of June 30, 04	CCA Total Inventory at Closure	Percentage
^{241}Am	1.40E+05	4.48E+05	31.2%
^{238}Pu	1.05E+04	2.61E+06	0.40%
^{239}Pu	2.06E+05	7.95E+05	25.91%
^{240}Pu	4.89E+04	2.15E+05	21.74%
^{242}Pu	6.77E+00	1.17E+03	0.58%
^{233}U	4.99E-01	1.95E+03	0.03%
^{234}U	3.73E+00	5.08E+02	0.73%
^{238}U	8.67E+00	50.1	17.31%
^{90}Sr	1.39E+00	2.16E+05	0.00%
^{137}Cs	1.22E+00	2.24E+05	0.00%

Waste Activity - 2004:

Trigger Value Derivation	
COMP Title:	Waste Activity
COMP Units:	Curies

Related Monitoring Data

Monitoring Program	Monitoring Parameter ID	Characteristics (e.g., number, observation)	Compliance Baseline Value
WWIS	Radionuclide activity per container and volume	Curies per container. Container volume.	Appendix P of CCA Appendix BIR (DOE 1996) by waste stream.
Waste emplacement records	Location of waste in panels	Coordinates and number of containers (or volume in cubic meters).	None.

COMP Derivation Procedure

Tabulation of waste activity in each panel.
Total curie content of emplaced CH-TRU and RH-TRU waste.
[Total radionuclide inventories reported annually by WWIS]

Year 2004 COMP Assessment Value

A comparison of emplaced and PA waste parameters is found in Table 2.13. No RH has been emplaced. Actinide totals and CPR totals are found in Appendix A of this document.

EPA letters (EPA 2002a, 2002b and 2003) directed DOE to evaluate waste emplacement for Panel 1 and homogeneity issues in the CRA. Results of these ongoing activities will be used in the CRA and will redefine the COMP assessments process. EPA has acknowledged that the differences in Panel 1 waste inventory from CCA average characteristics are not significant, however EPA expects the CRA to examine the waste inventory impacts for emplaced and expected waste (EPA 2003).

Element Title	Type and ID	Derivation Procedure	Compliance Baseline	Impact of Change
Radionuclide inventories	Parameter	Product of waste stream content and volume scaled up to the LWA limits.	Table PAR-41 and Table 4-8 of the CCA.	May affect direct brine releases for those radionuclides that become inventory-limited during a PA simulation.
Activity of waste intersected for cuttings and cavings releases.	Parameter	Function of waste stream volumes and activities	Figure 6-31 of the CCA	Cuttings are a significant contributor to releases. Therefore, an increase in activity of intersected waste is potentially significant.
WIPP-scale average activity for spallings releases	Parameter	Average of all CH-TRU waste only.	NA	Spallings are a significant contributor to releases. Therefore, an increase in average activity of intersected waste is potentially significant.

Monitoring Data Trigger Values		
Monitoring Parameter ID	Trigger Value	Basis
Waste emplacement records	Panel half-full	Check that PA assumptions about waste activity will remain valid as remainder of panel is filled and verify random emplacement assumptions.
Total emplaced RH-TRU waste activity	5.1 million curies	LWA emplacement limit reached. Administrative controls address these limits.

3 COMPs Assessment Conclusion

The operational period monitoring program designed to meet the Assurance Requirements of 40 CFR 191.14 and the terms of WIPP certification was initiated in 1999. This monitoring program is useful to further validate the assumptions and conceptual models that were used to predict WIPP performance and identify conditions that could potentially cause radioactive release above the limits established in 40 CFR § 191.13. Since releases above these limits cannot occur during the operational period of WIPP, the monitoring program looks at other potential performance indicators of the disposal system and compares these data to PA performance expectations. Specifically, ten monitoring parameters are assessed and compared annually to PA expectations and assumptions. The CRA contains the results of an updated PA that, upon acceptance from EPA, will become the new compliance baseline. As such, the compliance monitoring program will be reassessed and updated to reflect the conclusions of the new PA baseline. The results of this year's assessment are documented in this report and conclude that there are no COMPs data or results that indicate a reportable event or condition adverse to predicted performance.

4 References

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Appendix A – 1

Panel 2 Report

Waste emplaced in Panel 2 from Opening to June 30, 2004

WIPP Waste Information System

Nuclide Report

Report	***RP0380***
Version	***1.4***
Instance	*PRD01*
Run by	***STANDID***
Report Date	***09/16/2004 10:36***
Total Pages	***6***

Selection Criteria

Site id :	*%*
Nuclide :	*%*
Start Date :	*12-MAY-03*
End Date:	*30-JUN-04*
Panel Number :	*%*
Room Number :	*%*
Handling Code :	*%*
Show Uncertainty :	*NO*
TRU Nuclides Only :	*%*
EPA Tracked Nuclides Only:	*%*

Nuclide Report

WIPP Waste
Information System

Waste Isolation Pilot Plant

Panel Number : 2 **Room Number : 4**

Radionuclide	Activity (Ci)	Mass(G)
AC-227 - ACTINIUM	2.4040E-08	3.2834E-10
AC-228 - ACTINIUM 228	3.5014E-06	8.1635E-13
AM-241 - AMERICIUM 241	1.0134E+04	2.9452E+03
AM-243 - AMERICIUM 243	1.6116E-03	8.0019E-03
BA-133 - BARIUM - 133	3.7700E-09	1.4901E-11
BI-214 - BISMUTH 214	3.1569E-05	5.9832E-14
CF-252 - CALIFORNIUM 252	9.1936E-05	1.6900E-07
CM-243 - CURIUM 243	1.7490E-05	3.3506E-07
CO-60 - COBALT 60	1.6611E-06	1.4559E-09
CS-134 - CESIUM-134	7.9375E-06	6.0582E-09
CS-137 - CESIUM 137	7.2188E-03	8.2032E-05
EU-152 - EUROPIUM 152	1.8999E-06	1.0680E-08
EU-154 - EUROPIUM-154	3.8757E-05	1.4515E-07
K-40 - POTASSIUM-40	4.5570E-06	6.4930E-01
NA-22 - SODIUM 22 (NA-22)	5.0359E-03	2.0980E-04
NP-237 - NEPTUNIUM 237	3.2761E-01	4.5972E+02
PB-214 - LEAD -214	4.2233E-05	3.6120E-13
PU-238 - PLUTONIUM 238	2.0157E+03	1.1738E+02
PU-239 - PLUTONIUM 239	1.7383E+04	2.7760E+05
PU-240 - PLUTONIUM 240	5.9523E+03	2.6038E+04
PU-241 - PLUTONIUM 241	1.0081E+05	9.7287E+02
PU-242 - PLUTONIUM 242	1.5890E+00	4.9733E+02
SB-125 - ANTIMONY-125	7.1632E-05	6.8876E-08
SR-90 - STRONTIUM 90	7.0377E-03	5.1018E-05
TH-232 - THORIUM 232	3.5244E-06	3.1297E+01
TL-208 - THALLIUM 208	1.5845E-04	3.9652E-13
U-232 - URANIUM 232	2.1259E-04	9.8422E-06
U-233 - URANIUM 233	2.3376E-03	2.3951E-01
U-234 - URANIUM 234	9.1803E-01	1.7186E+02
U-235 - URANIUM 235	5.5624E-02	1.3366E+04
U-238 - URANIUM 238	5.4818E-01	1.6163E+06
Totals:	1.3630E+05	1.9385E+06

Nuclide Report

WIPP Waste
Information System

Waste Isolation Pilot Plant

Panel Number : 2 **Room Number : 5**

Radionuclide	Activity (Ci)	Mass(G)
AC-227 - ACTINIUM	8.2390E-08	1.1260E-09
AC-228 - ACTINIUM 228	3.6251E-06	.0000E+00
AM-241 - AMERICIUM 241	3.5808E+03	1.0358E+03
AM-243 - AMERICIUM 243	3.0794E-03	1.5347E-02
BA-133 - BARIUM - 133	3.0163E-06	1.1923E-08
BI-214 - BISMUTH 214	3.5684E-05	1.7700E-10
CF-252 - CALIFORNIUM 252	.0000E+00	.0000E+00
CM-243 - CURIUM 243	9.0447E-04	1.7874E-05
CM-244 - CURIUM 244	7.4074E+00	9.1410E-02
CM-245 - CURIUM 245	2.7119E-04	1.5759E-03
CO-60 - COBALT 60	5.2661E-06	4.6170E-09
CS-134 - CESIUM-134	1.6927E-05	1.2898E-08
CS-137 - CESIUM 137	1.1485E-02	1.3052E-04
EU-152 - EUROPIUM 152	2.0980E-06	1.1801E-08
EU-154 - EUROPIUM-154	2.4041E-02	1.0053E-04
K-40 - POTASSIUM-40	1.1044E-05	1.7132E+00
NA-22 - SODIUM 22 (NA-22)	8.7411E-05	1.3782E-08
NP-237 - NEPTUNIUM 237	6.2603E-02	8.1114E+01
PB-214 - LEAD -214	3.8626E-05	.0000E+00
PU-238 - PLUTONIUM 238	7.4854E+02	4.3335E+01
PU-239 - PLUTONIUM 239	1.0395E+04	1.6538E+05
PU-240 - PLUTONIUM 240	2.5087E+03	1.1560E+04
PU-241 - PLUTONIUM 241	4.3511E+04	4.1874E+02
PU-242 - PLUTONIUM 242	3.5391E-01	8.9201E+01
SB-125 - ANTIMONY-125	5.3129E-05	1.5205E-04
SR-90 - STRONTIUM 90	1.1005E-02	7.9974E-05
TH-232 - THORIUM 232	3.5839E-06	3.2265E+01
TL-208 - THALLIUM 208	1.1378E-04	.0000E+00
U-232 - URANIUM 232	4.7189E-04	2.1847E-05
U-233 - URANIUM 233	3.3817E-02	3.4649E+00
U-234 - URANIUM 234	2.3047E-01	3.3657E+01
U-235 - URANIUM 235	6.7316E-03	3.0789E+03
U-238 - URANIUM 238	5.9750E-02	1.7579E+05
Totals:	6.0752E+04	3.5755E+05

Nuclide Report

Panel Number : 2 **Room Number : 6**

Radionuclide	Activity (Ci)	Mass(G)
AC-227 - ACTINIUM	1.6407E-03	2.2682E-05
AC-228 - ACTINIUM 228	5.9939E-03	1.3324E+00
AG-110M - SILVER 110 METASTABLE	1.3800E-02	2.9100E-06
AM-241 - AMERICIUM 241	2.7238E+03	7.8500E+02
AM-243 - AMERICIUM 243	3.4721E-01	1.7188E+00
BA-133 - BARIUM – 133	1.0753E-08	4.4000E-11
BI-212 - BISMUTH 212	3.6739E-05	2.0000E-12
BI-213 - BISMUTH 213	2.1138E-06	.0000E+00
BI-214 - BISMUTH 214	2.5678E-01	5.8220E-09
CD-109 - CADMIUM-109	3.2200E-02	1.2337E-05
CF-249 - CALIFORNIUM 249	7.3202E-02	1.7688E-02
CF-252 - CALIFORNIUM 252	7.5986E-05	1.3968E-07
CM-243 - CURIUM 243	1.2890E-02	2.4817E-04
CM-244 - CURIUM 244	1.2200E-02	1.4914E-04
CM-245 - CURIUM 245	1.9309E-05	1.1102E-04
CO-60 - COBALT 60	1.8704E-01	1.1315E-03
CS-134 - CESIUM-134	1.4866E-04	1.1411E-07
CS-137 - CESIUM 137	4.0833E-02	4.6896E-04
EU-152 - EUROPIUM 152	2.5734E-03	1.4162E-05
EU-154 - EUROPIUM-154	2.0647E-04	7.7282E-07
K-40 - POTASSIUM-40	1.0537E-03	1.5127E+02
MN-54 - MANGANESE 54	1.5300E-02	1.9700E-06
NA-22 - SODIUM 22 (NA-22)	1.6626E-02	2.7888E-06
NP-237 - NEPTUNIUM 237	8.7305E-02	1.2230E+02
NP-239 - NEPTUNIUM-239	6.1700E-06	2.7000E-11
PA-231 – PROTACTINIUM 231	3.2266E-03	6.6799E-02
PB-212 - LEAD 212	2.7138E-05	1.9000E-11
PB-214 - LEAD -214	4.9560E-02	1.5100E-09
PU-238 – PLUTONIUM 238	7.6993E+02	4.5509E+01
PU-239 – PLUTONIUM 239	1.2276E+04	1.9518E+05
PU-240 – PLUTONIUM 240	2.8469E+03	1.2378E+04
PU-241 – PLUTONIUM 241	4.2616E+04	4.0894E+02
PU-242 – PLUTONIUM 242	1.0934E+00	2.7537E+02
RA-226 - RADIUM 226	6.5862E-05	6.5862E-05
SB-125 – ANTIMONY-125	4.0500E-07	3.8900E-10
SR-90 – STRONTIUM 90	4.2601E-02	3.0816E-04
TH-229 - THORIUM 229	5.3513E-04	2.5123E-03
TH-232 - THORIUM 232	8.2396E-06	7.3999E+01
TL-208 – THALLIUM 208	1.0054E-04	7.5000E+01

Nuclide Report

Panel Number : 2 **Room Number : 6** **Continued**

Radionuclide	Activity (Ci)	Mass(G)
U-232 - URANIUM 232	3.8682E-04	1.8581E-05
U-233 - URANIUM 233	3.6032E-02	3.6929E+00
U-234 - URANIUM 234	1.5879E-01	2.5122E+01
U-235 - URANIUM 235	3.3822E-03	1.5886E+03
U-238 - URANIUM 238	2.3569E-02	6.9323E+04
ZN-65 - ZINC 65	5.7300E-03	6.9400E-07
Totals:	6.1235E+04	2.8044E+05

Panel Number : 2 **Room Number : 7**

Radionuclide	Activity (Ci)	Mass(G)
AC-227 - ACTINIUM	8.2500E-04	1.1278E-05
AC-228 - ACTINIUM 228	9.7353E-03	4.3450E-09
AM-241 - AMERICIUM 241	2.1551E+03	6.2057E+02
AM-243 - AMERICIUM 243	5.6824E-01	2.8128E+00
BI-212 - BISMUTH 212	2.1911E-04	1.5000E-11
BI-213 - BISMUTH 213	2.7194E-04	1.4000E-11
BI-214 - BISMUTH 214	2.7902E+00	6.3268E-08
CF-249 - CALIFORNIUM 249	4.3077E-03	1.0405E-03
CF-252 - CALIFORNIUM 252	1.3620E-04	2.5038E-07
CM-243 - CURIUM 243	3.2015E-01	6.1332E-03
CM-244 - CURIUM 244	1.0503E-02	1.2839E-04
CO-60 - COBALT 60	2.0133E-03	1.7660E-06
CS-134 - CESIUM-134	1.1591E-03	8.8481E-07
CS-137 - CESIUM 137	1.1570E+00	1.3148E-02
EU-152 - EUROPIUM 152	2.6390E-01	1.4826E-03
EU-154 - EUROPIUM-154	8.2593E-04	3.0934E-06
FR-221 - FRANCIUM-221	4.9200E-02	2.7800E-10
K-40 - POTASSIUM-40	7.6036E-05	1.1499E+01
NA-22 - SODIUM 22 (NA-22)	3.9492E-02	6.2488E-06
NP-237 - NEPTUNIUM 237	7.5422E-02	1.0578E+02
PA-231 - PROTACTINIUM 231	5.1074E-03	4.3028E-02
PB-212 - LEAD 212	7.6934E-05	5.3000E-11
PB-214 - LEAD -214	2.5200E+00	7.6829E-08
PU-238 - PLUTONIUM 238	5.1703E+02	3.0230E+01
PU-239 - PLUTONIUM 239	9.4059E+03	1.4940E+05
PU-240 - PLUTONIUM 240	2.1840E+03	9.4873E+03

Panel Number : **2** **Room Number :** **7** **Continued**

Radionuclide		Activity (Ci)	Mass(G)
PU-241 - PLUTONIUM 241		3.5255E+04	5.7369E+02
PU-242 - PLUTONIUM 242		2.8416E-01	7.1606E+01
RA-226 - RADIUM 226		1.0226E-03	1.0226E-03
SB-125 - ANTIMONY-125		3.1591E-06	3.0380E-09
SR-90 - STRONTIUM 90		1.3192E+00	9.5595E-03
TH-229 - THORIUM 229		5.2069E-03	2.4445E-02
TH-230 - THORIUM		2.8300E-05	1.3900E-03
TH-232 - THORIUM 232		8.5204E-06	7.6683E+01
TL-208 - THALLIUM 208		5.5870E-03	1.8000E-11
U-233 - URANIUM 233		6.0883E-03	6.2376E-01
U-234 - URANIUM 234		7.9053E-01	1.2514E+02
U-235 - URANIUM 235		3.4635E-03	1.5814E+03
U-238 - URANIUM 238		1.2779E-01	3.7461E+05
	Totals:	4.9527E+04	5.3670E+05
	Grand Totals:	3.0781E+05	3.1132E+06

Appendix A - 3
Container Report

Emplaced waste for panel 2, first waste emplaced in room 7 on 5/12/03

Start Date (MM/DD/YY):5/12/03
End Date (MM/DD/YY):06/30/04

EMPLACED WASTE CONTAINERS:

Site	Shipments	Container Type	Containers	Weight(kg)	Volume(m3)
BN	23	TEN DRUM OVERPACK (TDOP)	46		207.00
C1	285	TEN DRUM OVERPACK (TDOP)	854	1329.00	3843.00
C2	10	55 GAL DRUM	273	21280.00	57.33
C2	5	TEN DRUM OVERPACK (TDOP)	11		49.50
C3	7	55 GAL DRUM	294	15754.56	61.74
IN	1	SWB	4	4777.23	7.52
IN	17	55 GAL DRUM	433	61703.55	90.93
LA	1	SWB	1	431.75	1.88
LA	27	55 GAL DRUM	834	52552.89	175.14
LA	4	SWB - USED TO OVERPACK 4 - 55 GAL. DRUMS	18		33.84
RF	285	SWB	1557	1111203.08	2927.16
RF	242	55 GAL DRUM	6107	501027.04	1282.47
RF	30	SWB - USED TO OVERPACK 4 - 55 GAL. DRUMS	51	22506.85	95.88
RF	107	55 GALLON PIPE OVERPACK - 12 INCH PIPE OVERPACK	2800	450241.70	588.00
RL	44	55 GAL DRUM	1226	84848.51	257.46
RL	47	55 GALLON PIPE OVERPACK - 12 INCH PIPE OVERPACK	1232	197525.10	258.72
WI	0	55 GAL DRUM	1	35.42	.21
		Totals:	15742	2525216.68	9937.78

EMPLACED DUNNAGE CONTAINERS:

Site	Shipments	Container Type	Containers	Weight(kg)	Volume(m3)
IN	1	55 GAL DRUM	1	29.00	.21
LA	15	55 GAL DRUM	48	1392.00	10.08
RF	20	55 GAL DRUM	109	3161.00	22.89
RL	13	55 GAL DRUM	69	2001.00	14.49
WI	0	55 GAL DRUM	154	4466.00	32.34

		Totals:	381	11049.00	80.01

Waste emplaced from 3/01/99 to 6/30/04

Start Date (MM/DD/YY):3/01/99
End Date (MM/DD/YY):6/30/04

EMPLACED WASTE CONTAINERS:

Site	Shipments	Container Type	Containers	Weight(kg)	Volume(m3)
BN	23	TEN DRUM OVERPACK (TDOP)	46		207.00
C1	39	55 GAL DRUM	1638	95755.40	343.98
C1	329	TEN DRUM OVERPACK (TDOP)	982	1329.00	4419.00
C1	17	SWB - USED TO OVERPACK 4 - 55 GAL. DRUMS	98		184.24
C2	10	55 GAL DRUM	273	21280.00	57.33
C2	5	TEN DRUM OVERPACK (TDOP)	11		49.50
C3	7	55 GAL DRUM	294	15754.56	61.74
IN	40	SWB	152	180513.01	285.76
IN	563	55 GAL DRUM	15014	2612181.90	3152.94
IN	1	SWB - USED TO OVERPACK 4 - 55 GAL. DRUMS	6		11.28
LA	27	SWB	148	60238.44	278.24
LA	43	55 GAL DRUM	1360	87207.97	285.60
LA	4	SWB - USED TO OVERPACK 4 - 55 GAL. DRUMS	18		33.84
LA	1	55 GALLON PIPE OVERPACK - 12 INCH PIPE OVERPACK	2	351.60	.42
RF	477	SWB	2671	1994717.74	5021.48
RF	372	55 GAL DRUM	10105	780133.39	2122.05
RF	30	SWB - USED TO OVERPACK 4 - 55 GAL. DRUMS	51	22506.85	95.88
RF	739	55 GALLON PIPE OVERPACK - 12 INCH PIPE OVERPACK	20195	3205384.00	4240.95
RL	61	55 GAL DRUM	1916	133504.81	402.36
RL	47	55 GALLON PIPE OVERPACK - 12 INCH PIPE OVERPACK	1232	197525.10	258.72
SR	15	55 GAL DRUM	630	37066.10	132.30

Site	Shipments	Container Type	Containers	Weight(kg)	Volume(m3)
WI	0	55 GAL DRUM	2	66.92	.42
WI	0	85 GALLON DRUM - OVERPACK	2		.64
		Totals:	56846	9445516.79	21645.67

EMPLACED DUNNAGE CONTAINERS:

Site	Shipments	Container Type	Containers	Weight(kg)	Volume(m3)
IN	228	55 GAL DRUM	519	15051.00	108.99
LA	22	55 GAL DRUM	80	2320.00	16.80
RF	37	55 GAL DRUM	150	4350.00	31.50
RL	15	55 GAL DRUM	72	2088.00	15.12
WI	0	55 GAL DRUM	154	4466.00	32.34
		Totals:	975	28275.00	204.75

SW 2/7/05

Wagner, Steve

From: Pfeifle, Tom W
Sent: Thursday, February 03, 2005 5:59 PM
To: Rigali, Mark J
Cc: Wagner, Steve
Subject: Signature Authorization

Mark,

The purpose of this email is to give you signature authorization for the 2004 COMPs report. I believe Steve Wagner has the cover sheet. Also, would you have Steve email me a copy of the final report. I like to keep those documents in case I need them for future work efforts.

- tom

Tom W. Pfeifle
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