

Compliance Monitoring Implementation Plan for 40 CFR §191.14(b), Assurance Requirement

**U. S. Department of Energy
Carlsbad Field Office**

Revision 9

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Compliance Monitoring Implementation Plan for 40 CFR §191.14(b), Assurance Requirement

U. S. Department of Energy
Carlsbad Field Office

Revision 9

Effective Date: May 25, 2023



Approved by: /Signature on File/
Michael Gerle, Director
Environmental Regulatory Compliance Division
Carlsbad Field Office

5/23/2023
Date

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ABBREVIATIONS AND ACRONYMS

CARD	Certification Application Review Document
CBFO	Carlsbad Field Office
CCA	Compliance Certification Application
CRA	Compliance Recertification Application
CFR	<i>Code of Federal Regulations</i>
CMP	Compliance Monitoring Program
DBDSP	Delaware Basin Drilling Surveillance Program
DOE	U.S. Department of Energy
DRZ	disturbed rock zone
EPA	U.S. Environmental Protection Agency
FEP	Features, Events and Processes
GWMP	Groundwater Monitoring Program
M&OC	Management and Operating Contractor
PA	performance assessment
QA	quality assurance
SMP	Subsidence Monitoring Program
TRU	transuranic
WDS	Waste Data System
WIPP	Waste Isolation Pilot Plant
WQSP	Water Quality Sampling Program

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CHANGE HISTORY SUMMARY

REVISION NUMBER	DATE ISSUED	DESCRIPTION OF CHANGES
7	04/09/12	<ul style="list-style-type: none">• Editorial changes to enhance readability• Add new information from CRA-2009• Incorporate changes from a HWFP Class 2 Groundwater change• Global deletion of the term “WIPP Waste Information System (WWIS)”• Correct CBFO titles
8	10/07/14	<ul style="list-style-type: none">• Every section of this plan has been extensively rewritten to align it with Appendix MON of the 2014 Compliance Recertification Application. The majority of the changes involve rearranging and reformatting the document. Table 3.1 was revised to make it easier to read and add information. Changes to reporting requirements in the Groundwater Monitoring Program are also identified in this plan.
9	05/25/23	<ul style="list-style-type: none">• This plan has been extensively updated to align with the Appendix MON of the 2019 Compliance Recertification Application. The major changes include alignment of references and an update to the ground water monitoring Figure 1.• Due to the extensive changes, no change bars present.

1.0 INTRODUCTION

This Compliance Monitoring Implementation Plan implements the pre-closure and post-closure monitoring activities described in Appendix MON of the Compliance Recertification. These monitoring activities are conducted by the U.S. Department of Energy (DOE) at the Waste Isolation Pilot Plant (WIPP) to demonstrate compliance with disposal regulations. These regulations include U.S. Environmental Protection Agency (EPA) disposal regulations at Title 40 *Code of Federal Regulations* (CFR) Part 191, "Environmental Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," Subparts B and C (EPA, 1993); and the EPA criteria for certifying compliance at 40 CFR Part 194, "Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations," Certification Decision, Final Rule (EPA, 1998).

The Waste Isolation Pilot Plant is a mined underground repository designed for the permanent disposal of defense-related transuranic (TRU) waste. It is located in the Chihuahuan Desert, 26 miles east of Carlsbad, New Mexico. The suitability of the WIPP Site for TRU waste disposal is supported by more than four decades of environmental studies. Monitoring the WIPP facility is one of the DOE's top priorities. Monitoring activities will continue at WIPP through the operational period and until well after closure of the facility.

In 40 CFR §194.42 (EPA, 1996), the U.S. Environmental Protection Agency (EPA) provides criteria to demonstrate compliance with the assurance requirement at 40 CFR §191.14(b) (EPA, 1993) to monitor the Waste Isolation Pilot Plant (WIPP) disposal system. The purpose of this Compliance Monitoring Implementation Plan is, "to detect substantial and detrimental deviations from expected performance," with the expected performance predicted by performance assessment (PA). The criteria also require both a pre-closure and post-closure monitoring program using techniques that do not jeopardize the containment of waste in the disposal system.

The pre-closure monitoring program will be conducted until the shafts are sealed. After the shafts are sealed, post-closure monitoring will be initiated in accordance with the specifications described in section 4.0 of this plan and continue until the DOE demonstrates to the EPA there are no significant concerns to be addressed by further monitoring. The long-term performance expectations for the disposal system are derived from conceptual models, scenarios, parameters, and assumptions developed for the WIPP performance assessment (PA). Monitoring is performed to determine if deviations from these expectations occur and to validate the basis of PA.

The monitoring program outlined in this Compliance Monitoring Implementation Plan implements the monitoring identified in Appendix MON of the current Recertification Applications, which documents the monitoring criteria of 40 CFR § 194.42.

This plan implements a monitoring program focused on demonstrating compliance with 40 CFR §191.14(b) which reads as follows:

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

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wastes and shall be conducted until there are no significant concerns to be addressed by further monitoring.

The EPA provides criteria for demonstrating compliance with this assurance requirement in 40 CFR §194.42. The criteria identify disposal system features that may have an effect on waste containment in the disposal system and require the DOE to conduct an analysis to identify parameters considered significant to waste containment in the disposal system. These criteria also require the DOE to conduct pre-closure and post-closure monitoring of the significant parameters. The parameters chosen for monitoring were determined by a DOE parameter analysis documented in the Compliance Certification Application (CCA), Chapter 7.0, and Appendix MON, Attachment MONPAR (DOE, 1996). The EPA documented its approval of the DOE monitoring approach in the compliance certification decision (EPA, 1998) and Compliance Application Review Document (CARD) 42 (EPA, 1997).

For the Compliance Recertification Application (CRA)-2004, CRA-2009, CRA-2014, and CRA-2019 (U.S. DOE 2004, 2009, 2014, 2019), the DOE reassessed the analysis in the CCA, Appendix MON, Attachment MONPAR, and determined that the conclusions of the original MONPAR assessment remained valid; therefore, no changes were needed to the program (Kirkes and Wagner 2003, Wagner 2008, Wagner 2013, Wagner 2018). The compliance monitoring report also concluded that no changes are needed to the program (Kirkes and Bowman 2020). Section 2.0 of this plan discusses the parameters selected for monitoring.

The objectives of this plan are to:

- Identify the 10 disposal system parameters that are monitored to detect substantial and detrimental deviations from expected performance in compliance with 40 CFR Part 191(Subparts B and C), 40 CFR §194.42, and the terms and conditions of the EPA Certification/Recertification Decision.
- Implement a Compliance Monitoring Program (CMP) that identifies the disposal system parameters being monitored, the organizations responsible for monitoring the parameters, and the frequency for conducting the monitoring.
- Describe how monitoring data are assessed against repository performance expectations.
- Define the quality assurance process used to ensure the validity of the monitoring data.
- Define the process for reporting compliance monitoring results.
- Provide documentation of continued compliance for the DOE recertification program as described in DOE/CBFO 99-2296, *Waste Isolation Pilot Plant Certification Management Plan* (DOE, 2012).

The remainder of this document is organized in the following manner:

- Section 2.0 describes the CMP identifying disposal system parameters and the responsibilities of WIPP organizations in monitoring the parameters.
- Section 3.0 describes the pre-closure monitoring program.
- Section 4.0 describes the planned post-closure monitoring program.
- Section 5.0 describes the quality assurance requirements applicable to the CMP.
- Section 6.0 describes the reporting of monitoring data.

2.0 COMPLIANCE MONITORING PROGRAM

The purpose of the CMP is to demonstrate compliance with the requirement of 40 CFR §191.14(b), in accordance with the criteria at 40 CFR §194.42, to monitor disposal system parameters most useful in gauging the performance of the repository. The EPA approved the selection of these monitoring parameters in its Certification Decision (EPA, 1998) and as part of the most recent EPA Recertification Decision (EPA, 2017). The appropriateness of the monitoring parameters will continue to be evaluated, at a minimum, once every five years as a part of each recertification effort. The ten monitored parameters are:

- Creep closure and stresses
- Extent of brittle deformation
- Initiation of brittle deformation
- Displacement of deformation features
- Waste activity
- Culebra groundwater composition
- Change in Culebra groundwater flow
- Drilling rate in the Delaware Basin
- Probability of encountering a Castile brine reservoir
- Subsidence in the vicinity of the repository

All of these parameters are being monitored during the pre-closure period.

The ten monitoring parameters can be divided into those relating to performance assessment parameters and those relating to conceptual models, features, events, and processes (FEPs), and confirmation of related modeling assumptions. The monitoring parameters related to performance assessment parameters are:

- Waste activity
- Culebra groundwater composition
- Change in Culebra groundwater flow
- Drilling rate in the Delaware Basin
- Probability of encountering a Castile brine reservoir

The monitoring parameters related to either the EPA's list of potential monitoring parameters in 40 CFR 194.42 or screening decisions for repository FEPs are;

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- Creep closure and stresses
- Extent of brittle deformation
- Initiation of brittle deformation
- Displacement of deformation features
- Subsidence in the vicinity of the repository

The relationship of each of the ten parameters to performance assessment and to the FEPs is described in Table 2.1.

Data are collected to monitor the ten parameters of the CMP by the following WIPP programs:

- Geotechnical Engineering Program
- Groundwater Monitoring Program
- Delaware Basin Drilling Surveillance Program
- Subsidence Monitoring Program
- Waste Inventory Monitoring Based on the Waste Data System (WDS)

Data from the monitoring programs are submitted periodically to the WIPP scientific advisor. The scientific advisor refers to this collection of data from the five monitoring programs as Compliance Monitoring Parameters.

The scientific advisor, upon receiving the Compliance Monitoring Parameters, reviews, analyzes, and evaluates them using procedure, SP 9-8, titled: *Monitoring Parameter Assessment Per 40 CFR 194.42*. This procedure prescribes the scientific advisor's process used to meet the 40 CFR 94.42 regulatory requirement to monitor WIPP performance against WIPP Performance Assessment expectations. The procedure is used to

- Derive and revise Trigger Values
- Prepare the annual assessment of WIPP monitoring data against Performance Assessment expectations and document the results in the Compliance Monitoring Annual Report and
- Periodically assess the impact of changes to WIPP programs on the Compliance Monitoring Parameters program and provide DOE with recommendations for changes to the program, a requirement for WIPP recertification.

This procedure is governed by scientific advisor's assurance and document control procedures and determines whether the results are within performance assessment expectations. The scientific advisor then documents the evaluation in a Compliance Monitoring Parameter Assessment report issued to the DOE.

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Table 2.1 – Compliance Monitoring Program Parameters Relationship to Performance Assessment and Features, Events, and Processes					
Monitoring Parameter	Monitoring Program	Frequency of Data Collection and Reporting	Related PA Parameter	Related FEPs	Evaluation Cycle
Creep Closure and Stresses	Geotechnical Monitoring Program	Various data calls from weekly to monthly based on repository conditions, instrumentation, and data collection system. Data are reported annually.	Elastic properties of halite and anhydrite (e.g., Young’s Modulus, shear modulus, Poisson’s ratio, specific heat). Creep constitutive model Plastic constants for consolidation of the waste/backfill.	Salt creep, excavation-induced stress changes, changes in stress field, pressurization. Consolidation of waste.	Data are evaluated annually and during recertification.
Extent of Brittle Deformation	Geotechnical Monitoring Program	Various data calls from weekly to monthly based on repository conditions, instrumentation, and data collection system. Data are reported annually.	Disturbed rock zone (DRZ) parameters (e.g., extent, permeability). Intrinsic shaft DRZ permeability.	DRZ, roof falls, underground boreholes, consolidation of seals.	Data are evaluated annually and during recertification.
Initiation of Brittle Deformation	Geotechnical Monitoring Program	Various data calls from weekly to monthly based on repository conditions, instrumentation, and data collection system. Data are reported annually.	Anhydrite fracturing model parameters (e.g., fracture initiation pressure, increment for full fracturing, fracture permeability enhancement). DRZ Properties.	Disruption due to gas effects.	Data are evaluated annually and during recertification.
Displacement of Deformation Features	Geotechnical Monitoring Program	Various data calls from weekly to monthly based on repository conditions, instrumentation, and data collection system. Data are reported annually.	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.	Stability of open panel.	Data are evaluated annually and during recertification.

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Table 2.1 - Compliance Monitoring Program Parameters Relationship to Performance Assessment and Features, Events, and Processes (continued)					
Monitoring Parameter	Monitoring Program	Frequency of Data Collection and Reporting	Related PA Parameter	Related FEPs	Evaluation Cycle
Culebra Groundwater Composition	Groundwater Monitoring Program	Data are collected annually and reported annually.	Average Culebra brines composition and matrix distribution coefficient for uranium (IV, VI), plutonium (III, IV), thorium (IV), americium (III). Matrix distribution coefficient is not a sensitive PA parameter.	Groundwater geochemistry, actinide sorption.	Data are evaluated annually and during recertification.
Change in Culebra Groundwater Flow	Groundwater Monitoring Program	Data are collected monthly and reported annually.	Culebra transmissivity, fracture and matrix porosity, fracture spacing, dispersivity, and climate index. Changes in Culebra groundwater flow are important to performance and incorporated into the PA.	Groundwater flow and recharge, groundwater discharge, infiltration, changes in groundwater recharge and discharge, precipitation and temperature.	Data are evaluated annually and during recertification.
Drilling Rate	Delaware Basin Drilling Surveillance Program	As well records are received (weekly and monthly basis). Data are reported annually.	Required PA parameter per 40 CFR § 194.33. The Drilling Rate is important to performance and incorporated into the PA.	Drilling Fluid Flow	Data are evaluated annually and during recertification.
Probability of Encountering a Castile Brine Reservoir	Delaware Basin Drilling Surveillance Program	As drilling records are received. Data are reported annually.	Probability of Encountering a Castile Brine Reservoir	Drilling Fluid Flow	Data are evaluated annually and during recertification.

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Table 2.1 - Compliance Monitoring Program Parameters Relationship to Performance Assessment and Features, Events, and Processes (continued)					
Monitoring Parameter	Monitoring Program	Frequency of Data Collection and Reporting	Related PA Parameter	Related FEPs	Evaluation Cycle
Subsidence	Subsidence Monitoring Program	Data are reported annually or as determined necessary by the DOE.	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 groundwater flow due to mining effects; subsidence baseline.	Data are evaluated annually or as determined necessary by the DOE.
Waste Activity	Waste Inventory Monitoring Based on the Waste Data System	Continually updated as waste is approved for shipment to the WIPP and emplaced. Data are reported annually.	Waste Activity	Waste Inventory, heterogeneity of waste forms.	Data are evaluated annually and during recertification.

3.0 PRE-CLOSURE COMPLIANCE MONITORING

This section describes the pre-closure CMP including the resulting data from the ten parameters and associated monitoring program for each, and the frequency of data collection and reporting.

3.1 Geotechnical Engineering Program Plan

The WIPP Geotechnical Engineering Program Plan (WP 07-1) defines the field programs and investigations carried out by the Management and Operating Contractor's (M&OC) Geotechnical and Mine Engineering section. The Geotechnical Engineering Program provides geologic information related to geotechnical characteristics and assesses the stability and performance of the underground WIPP facility. The geotechnical monitoring activities defined in the WIPP Geotechnical Engineering Program Plan that collects data related to the parameters described in Table 2.1 are divided into the Geomechanical Monitoring Program and the Geosciences Program.

3.1.1 Geomechanical Monitoring Program

The data collected as part of the Geomechanical Monitoring Program are used to validate the WIPP design, track short-term and long-term geotechnical performance of underground openings, and support routine safety and stability evaluations of the excavations. From an operational point of view, geomechanical data are used to identify areas of potential instability and allow corrective action to be taken in a timely manner. For underground opening behavior, in-situ data were used to model long-term disposal system performance. Geomechanical monitoring instrumentation generates data related to the following four parameters:

- Creep closure and stresses
- Extent of brittle deformation
- Initiation of brittle deformation
- Displacement of deformation features

3.1.1.1 Scope

The activities associated with the Geomechanical Monitoring Program are designed to:

- Maintain and augment the geotechnical instrumentation system in the WIPP underground and upgrade the automatic data acquisition system as necessary.
- Monitor geotechnical instrumentation on a regular basis and maintain a current database of instrument readings.
- Evaluate the geotechnical instrumentation data and prepare regular reports that document the data and analyses describing the stability and performance of underground openings.
- Recommend corrective or preventive measures to ensure excavation stability and safe operation of the facility.

3.1.1.2 Schedule

Scheduling of geomechanical monitoring of an area may vary as part of operational excavation monitoring or research testing. Installation and monitoring of the instruments are governed by approved WIPP procedures. Instrumentation is monitored remotely using data loggers, or is read manually. Routine tasks are carried out according to approved WIPP procedures. Activities which are in development, or which are not expected to be performed routinely, are performed in accordance with test plans that include or reference the appropriate procedures to ensure all necessary steps for completion are carried out. Remotely polled instruments are connected to a surface computer through a system of cables, termination boxes, and data loggers. Manually read instruments are monitored using electronic read-out boxes and mechanical measuring devices. Instrumentation is located in the shafts and drifts, and other underground openings, including tape extensometer stations, convergence meters, borehole extensometers, piezometers, embedment strain gauges, stress gauges, inclinometers, load cells, and crack meters. Monitoring data are collected on a monthly basis, at a minimum, from functional instruments that are not malfunctioning or abandoned, but more frequent readings may be collected as determined by the cognizant engineer or manager.

3.1.1.3 Program Output

Data analysis is performed on an annual basis and a report is published annually in the Geotechnical Analysis. An assessment of convergence measurements and geotechnical observations is made after each round of data collection by Geotechnical Engineering. The results of each assessment are distributed to affected underground repository operations, engineering, and safety managers.

3.1.2 Geosciences Monitoring Program

Geosciences activities document existing geologic conditions and characteristics, and changes resulting from the WIPP excavations. These activities generate data related to the following four parameters:

- Creep closure and stresses
- Extent of brittle deformation
- Initiation of brittle deformation
- Displacement of deformation features

3.1.2.1 Scope

The Geosciences Program implements field activities such as geologic mapping of the facility and near-surface stratigraphic horizons, core logging, and geophysical surveys. These activities generate data used in monitoring the repository and in rock mechanics studies. Information from the Geosciences Program is used to document the existing geologic conditions and characteristics and to monitor for changes resulting from excavations. Activities associated with this program include geologic and fracture mapping, and other activities performed as needed. These activities characterize, demonstrate the continuity of, and document the geology at the Site.

3.1.2.2 Schedule

The following activities are performed on the indicated schedule:

- Geologic mapping is conducted in newly excavated areas and in other areas when deemed necessary by the cognizant engineer or Geotechnical and Mine Engineering Manager.
- At a minimum, data analysis is performed annually. The geotechnical activities will continue throughout the operational period.

3.1.2.3 Program Output

Data analysis is performed on an annual basis and is published annually in the Geotechnical Analysis Report.

3.2 Groundwater Monitoring Program (GWMP)

Groundwater monitoring at WIPP is carried out under the WIPP Groundwater Monitoring Program Plan (GWMPP) (WP 02-1). This GWMPP addresses requirements for sample collection and analysis, groundwater surface elevation monitoring, groundwater flow rate and direction determination, data management, and reporting of groundwater monitoring data. It also describes plugging and abandonment (P&A) of monitoring wells, as well as quality assurance/quality control (QA/QC) elements and associated data acceptance criteria.

Groundwater monitoring at the WIPP facility is focused on the nearest water-bearing unit above the repository in the Culebra Dolomite Member of the Rustler Formation (Culebra) because it represents the most significant hydrologic contaminant migration

pathway to the accessible environment or point for any release caused by an inadvertent human intrusion.

Data obtained through the GWMP are also used to support the following two monitoring parameters:

1. Culebra groundwater composition
2. Culebra groundwater flow parameters

Details on how the program is implemented are provided in the WIPP GWMP (WP 02-1).

3.2.1 Scope

The GWMP addresses requirements for sample collection, groundwater surface elevation monitoring, groundwater flow direction monitoring, data management, and reporting of groundwater monitoring data. It also identifies analytical parameters selected to assess groundwater quality.

Six Culebra wells were drilled as part of the WIPP GWMP: Water Quality Sampling Program (WQSP) wells WQSP-1 through WQSP-6. Water samples are collected from these wells and analyzed for certain chemical and physical parameters. This activity generates data in support of the Culebra Groundwater Composition parameter, which calls for analysis of the following ions:

Cations: Ca^{2+} , K^+ , Na^+ , Mg^{2+}

Anions: Cl^- , HCO_3^- , SO_4^{2-}

The WIPP GWMP also collects samples for other parameters required by the WIPP Hazardous Waste Permit.

Water level data are collected to assess changes in Culebra groundwater flow. Water level measurements are tracked over time using WQSP wells and other wells that are widely distributed across the WIPP area to monitor potentiometric surface and groundwater flow directions (Figure 1). If changes in water level(s) occur, the cause is investigated, and any potential impact on the long-term performance of the repository is assessed.

3.2.1.1 Sampling and Analyzing Water Quality

Sampling for water quality in the Culebra is performed in six monitoring wells, three upgradient, WQSP-1, WQSP-2, and WQSP-3, and three downgradient, WQSP-4, WQSP-5, and WQSP-6 (Figure 1). Background Culebra water quality has been established for the WIPP in both the upgradient and downgradient monitoring wells.

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Culebra groundwater monitoring requires qualified field personnel to purge the well being sampled to no more than three well-bores volumes or until field parameters stabilize, whichever comes first. Groundwater parameters are measured in a field laboratory until the indicator parameters, pH, specific gravity, specific conductance, and temperature, are stable (representative of undisturbed native-GW). Well stabilization occurs when the field-analyzed parameters are within $\pm 5\%$ for three consecutive measurements, which is determined by the field parameter monitoring. A well-bore volume is defined as the volume of water from static water level to the bottom of the well sump. A final sample of the stable Culebra well water is collected in the appropriate type of container for the specific analysis to meet state and federal groundwater requirements. The final samples are submitted to an analytical laboratory for analysis. Samples are also collected for submittal to WIPP Labs for radiological analysis. Section 3.2.1 lists the analytes needed to support the PA parameter

The sample tracking system at the WIPP facility uses chain-of-custody/request for analysis (CofC/RFA) forms. The primary consideration for storage or transportation is that samples shall be analyzed within the prescribed holding times for the analytes of interest. WP 02-EM1010, *Field Parameter Measurements and Final Sample Collection*, provides instructions to ensure proper sample tracking and shipment protocol, to assure samples are analyzed within prescribed time periods.

3.2.1.2 Measured Water Level Fluctuations

Water level measurements are taken in the six groundwater monitoring wells WQSP-1 through WQSP-6 and other available WIPP wells in the monitoring network (Figure 1) in accordance with WP 02-EM1014, *Groundwater Level Measurement*. The water level monitoring is used to identify water level fluctuations.

In addition to the water level measurements, groundwater density is determined. This density is used to convert the water level measurements to equivalent freshwater heads for developing potentiometric surface maps.

3.2.2 Schedule

The six WQSP monitoring wells constructed for the GWMP are sampled for the analytes listed in section 3.2.1, on an annual basis to compare to the baseline water quality (DOE 1998). In addition, groundwater density is determined in the wells on an annual basis.

The groundwater level is measured by monitoring the wells on a monthly basis. Groundwater level measurements are also measured in other WIPP wells (Figure 1). The water levels are measured monthly in at least one accessible Culebra completed interval at each available well pad, and quarterly in redundant wells at well pads where two or more wells are completed in the same interval. Groundwater level measurements are primarily used to examine changes in groundwater flow rate and direction to identify any changes pertinent to compliance.

The characteristics of the GWMP, such as the frequency of sampling and the location of the sampled wells, will be evaluated by the Scientific Advisor, if changes are observed

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in the groundwater flow direction or gradient. Reporting frequencies are listed in Table 3.1.

Table 3.1 – WIPP GWMP Sample Collection and Water-Level Reporting Frequency	
Type of Well	Frequency
Water Quality Sampling	
WQSP wells (six)	Annually
Water-Level Monitoring	
Other available WIPP wells (39)*	May be measured monthly, quarterly, or periodically depending on program needs
Other available WIPP Culebra wells (37)*	Monthly and quarterly on Redundant wells on H-19 pad, measured quarterly
WQSP Culebra wells (six)*	Monthly and before sampling events

*Note: The number of wells is subject to change due to plugging and abandonment see Figure 1- Groundwater Wells.

3.2.3 Program Output

The groundwater samples are analyzed to quantify Culebra groundwater parameters and water quality parameters listed in Section 3.2.1. The GWMP also generates Culebra water level data. The data and results of the GWMP are summarized and published on an annual basis in the WIPP Annual Site Environmental Report.

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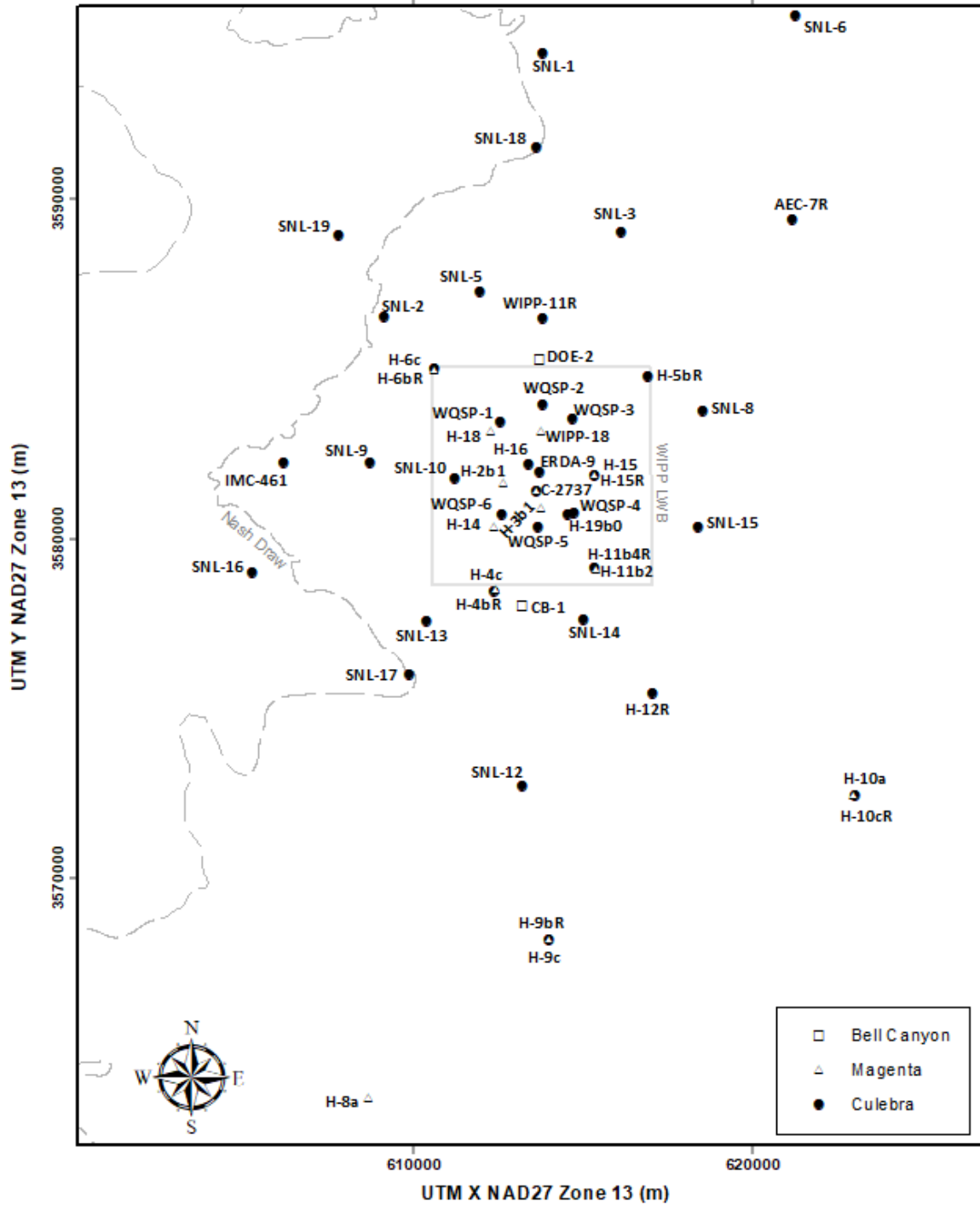


Figure 1- Groundwater Wells

3.3 Delaware Basin Drilling Surveillance Program

The Delaware Basin Drilling Surveillance Program (DBDSP) is described in the Delaware Basin Drilling Surveillance Plan (WP 02-PC.02). This plan provides for the surveillance of drilling activities within the Delaware Basin, with specific emphasis on the nine-township area surrounding the WIPP Site.

The DBDSP mandates the collection of information related to the following two parameters:

1. Probability of encountering a Castile brine reservoir
2. Drilling rate

In addition to the parameters listed above, the DBDSP collects information on the following activities:

- Borehole plugging
- Enhanced recovery
- Natural gas storage
- Solution mining
- Potash mining
- Seismic events

3.3.1 Scope

The DBDSP provides for active surveillance of drilling activities within the entire Delaware Basin, which is a sub-basin of the Permian. The WIPP PA includes the potential impacts of drilling on the performance of the disposal system. The number of deep boreholes drilled per square kilometer is a parameter used in PA calculations for WIPP inadvertent intrusion scenarios. This parameter is based on actual drilling rates within the Delaware Basin over the last 100 years, as required by 40 CFR §194.33 (EPA, 1996).

The DBDSP continues to collect new data, thus expanding the existing database. The results of this program are used to detect any substantial deviations from the assumptions used in the previous PA (see Table 3.2). Collecting additional information about resource exploration and resource activities and practices in the Delaware Basin, provides information to determine whether the drilling scenarios, assumptions, and probabilities used in the PA will continue to be valid for each five-year recertification of the WIPP disposal system.

Drilling information for the study area is obtained through commercially available electronic databases and the records of government agencies; the Texas RRC, the NMOCD, New Mexico and Texas State Engineers, the BLM, and from surveys sent to area drillers and interviews with drillers. The electronic database is updated weekly to reflect drilling activities in the Delaware Basin. Records of government agencies are updated as they become available.

3.3.2 Schedule

Table 3.2 shows the frequency of DBDSP data collection.

Table 3.2 – Delaware Basin Drilling Surveillance Plan Data Collection	
Information Collected	Frequency
Borehole Plug	Weekly
Enhanced Recovery	Monthly
Gas Storage	Annually
Solution Mining	Annually
Potash Mining	Annually
Seismic Events	Quarterly
Drilling-Related	Weekly
Probability of Encountering a Castile Brine Reservoir	Weekly
Drilling Rate Calculations	Quarterly
Natural gas and CO2 pipeline construction	Biennial
Field Visits	Unscheduled

3.3.3 Program Outputs

The DBDSP results are used to update and maintain a database of drilling activities and related practices in the Delaware Basin. This activity will continue until 100 years after closure or until the DOE can demonstrate to the EPA that there are no significant concerns to be addressed by further surveillance. For the nine-township area surrounding the WIPP disposal system, the DBDSP updates and maintains a database containing the following information:

- Plugging and abandonment activities, including descriptions of plugging configurations
- The fraction of plugged and abandoned boreholes that are sealed
- Well-conversion activities (injection, disposal, and water)
- Injection well operation (disposal and secondary recovery)
- Drilling activities, including borehole depth, diameter, and type and amount of drilling fluid
- Ownership of state and federal minerals and hydrocarbon leases within the area
- Occurrences of pressurized brine within the Castile

Data collected and recorded, as a result of the DBDSP, are reported annually in the Delaware Basin Monitoring Annual Report.

3.4 Subsidence Monitoring Program

The Subsidence Monitoring Plan (SMP) is described in detail in the WIPP Underground and Surface Surveying Program (WP 09-ES.01). Subsidence monitoring measures vertical movement of the land surface relative to a reference location using state-of-the-art leveling equipment. The technique used to monitor subsidence involves measuring

the vertical height difference between two or more markers placed on a surface a known distance away from each other using a leveling survey. A reference benchmark is used as the standard and the relative movement of the other benchmark(s) is measured to detect vertical movement over time. Subsidence measurements are relative because the reference is fixed only with respect to the subsidence marker(s).

3.4.1 Scope

The activities associated with the SMP are designed to:

- Provide time-related spatial information on surface subsidence within 152.4 meters (500 feet) surrounding the waste shaft during the operational phase of the repository.
- Provide time-related spatial information on surface subsidence over the influence area of the underground openings for comparison with subsidence predictions.
- Maintain a database of subsidence data.

Subsidence monitoring was chosen by the DOE, as a long-term monitoring tool because it effectively meets the requirements in 40 CFR §191.14(b). Subsidence monitoring is conducted to detect substantial and detrimental deviations from expected repository performance by comparing actual subsidence to predicted subsidence. With current technology, vertical elevation can be measured at a precision of 0.0305 centimeters (cm) (0.001 ft).

Subsidence data currently being compiled will be compared to subsidence predictions. In addition, subsidence monitoring during the operational phase generates data to establish a baseline against which long-term subsidence data and information may be evaluated.

3.4.2 Schedule

Subsidence surveys are performed annually throughout the operations period. After closure of the repository, subsidence surveys will be performed at ten-year intervals for the next 100 years, or until the DOE demonstrates to the EPA there are no significant concerns to be addressed by further monitoring.

3.4.3 Program Outputs

The SMP generates annual surface subsidence data for 24.14 kilometers (km) (15 miles [mi]) of leveling loops on approximately 48 monuments. Results are reported annually in the WIPP Subsidence Monument Leveling.

3.5 Waste Inventory Monitoring Based on WIPP Waste Data System

Information on the waste activity parameter is measured or estimated by generator sites through waste characterization activities. Sites are required to report certain information in the WIPP Waste Data System (WDS). Reports are generated to tabulate key waste parameters for waste that has been emplaced in the WIPP repository. The waste activity parameter includes tracking the total waste material parameter weights;

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Cellulose, plastic, rubber and ferrous materials, and curie content of the 10 radionuclides listed in Section 3.5.1.

3.5.1 Scope

- Radionuclide inventory data and material parameter weights for every container of waste placed in the WIPP underground repository are submitted to the WDS database at the time waste is certified for shipment to the WIPP facility. The waste activity parameters being tracked and reported include radiological activity (in curies) emplaced during the 40 CFR § 194.4(b)(4) reporting period and the cumulative activity since waste was first emplaced in the repository. The radionuclides being tracked (in curies) include; americium-241, plutonium-238, plutonium-239, plutonium-240, plutonium-242, uranium-233, uranium-234, uranium-238, strontium-90, cesium-137.

The material parameter weights that are annually tracked and reported in the 40 CFR § 194.4(b)(4) report include:

- A repository maximum limit for emplaced cellulose, plastic, and rubber materials of 2.2×10^7 kg
- A repository minimum for emplaced ferrous metals of 2×10^7 kg
- A repository minimum for emplaced nonferrous metals of 2×10^3 kg

3.5.2 Schedule

A current collection of radionuclide inventory data and material parameter weights for the WIPP is maintained within the WDS, and data reports can be generated at any time.

3.5.3 Program Outputs

The data collected for the waste activity parameter is tracked by the WDS. The WDS annually generates a Waste Emplacement Summary Report that is submitted each November to the EPA in the annual 40 CFR 194.4(b)(4). In addition to the annual summary report, DOE provides EPA with a Dashboard on the WDS for their use that allows them to call up any of the following reports at their discretion:

- Container Query
- Nuclide Report
- Waste Emplacement Report
- Summary of Waste Emplacement Inventory Report
- Emplacement by Container Type Report
- Emplacement History Overview

DOE also provides the public with access to the WDS via the Public Access System for WDS at <http://www.wipp.energy.gov/WDS/PA/>. This service provides the ability to query the WDS for information on disposed containers of transuranic (TRU) waste. Container Data is available 14 days after emplacement in the WIPP repository.

4.0 POST-CLOSURE MONITORING

In CARD 42, the EPA stated the CCA's descriptions of the Post-closure Monitoring programs were adequate to show that DOE provided the information required by 194.42 (d) and (e). A final Post-closure Monitoring Plan will be developed prior to final facility closure (sealing of the shafts), but will not be implemented until after facility closure. When the final Post-closure Monitoring Plan is written, the historic monitoring data collected per the requirements of the Pre-closure Monitoring Plan that will support post-closure monitoring will be analyzed.

5.0 MONITORING PROGRAMS QUALITY ASSURANCE REQUIREMENTS

Work performed under the DOE CMP meets the (quality standards) by complying with the requirements of the criteria of 40 CFR §194.22(a)(ii) (EPA, 1996) and controlled by the application of the Carlsbad Field Office (CBFO) *Quality Assurance Program Document* (QAPD), DOE/CBFO-94-1012 (DOE, 2017). Waste information is controlled by implementing the relevant quality assurance requirements at generator sites.

In addition to the management requirements, such as document and record control established in the QAPD, requirements related to sampling and monitoring activities are specified. In particular, the following two sections of the QAPD are directly related to the performance of monitoring work and the control of samples:

Section 2.4 – Inspection and Testing

- Qualification of personnel
- Inspection
- Test requirements
- Monitoring, measuring, testing, and data collection
- Use and control of measuring and test equipment
- Calibration

Section 4.0 – Sample Control Requirements

- Sample control
- Sample identification
- Handling, storing, and shipping samples
- Disposition of nonconforming samples

The WIPP monitoring programs are subject to EPA inspections in accordance with 40 CFR §194.21 (EPA, 1996).

The Compliance Monitoring Implementation Plan relies on the individual monitoring plan's quality assurance (QA) program to ensure compliance with DOE WIPP requirements for data quality assessments, objectives, and analyses. Each sampling and monitoring program is implemented through individual implementation plans, which include the QA descriptions, objectives, and references to the applicable governing QA documents.

6.0 REPORTING AND ASSESSMENT

Monitoring results are communicated to the appropriate individuals and groups.

6.1 Monitoring Data Reporting

The monitoring programs that generate data used in the CMP are implemented and coordinated by the M&OC.

6.2 Compliance Monitoring Program Assessment Report

The results of the CMP are reported in the Compliance Monitoring Parameter Assessment Report. The Sandia National Laboratories Annual Compliance Monitoring Parameter Assessment Reports are provided to the EPA with each recertification as references to Appendix DATA.

The CMP results may indicate two general cases: 1) normal or expected conditions in which results are generally consistent with existing data, parameter values, and conceptual models, and 2) anomalous conditions in which results are inconsistent with existing data, parameter values, or conceptual models.

The Scientific Advisor determines whether these results are consistent with expected conditions modeled in the PA or screening decisions used to support the compliance determination. The report also recommends if the CMP should be modified based on results of the monitoring programs.

6.2.1 External Reporting

The DOE reviews the recommendations of the M&OC and the Scientific Advisor to evaluate their significance. Significance is determined based on consideration of the following criteria:

- The containment requirements established pursuant to 40 CFR §191.13 are, or are expected to be, exceeded.
- Releases from already emplaced waste that lead to committed effective doses that are, or are expected to be, in excess of those established pursuant to 40 CFR §191.15 (EPA, 1993) (not including emissions from operations covered pursuant to 40 CFR Part 191 Subpart A).
- Releases that have caused, or are expected to cause, concentrations of radionuclides (or estimated doses due to radionuclides in underground sources of drinking water in the accessible environment) to exceed the limits established pursuant to 40 CFR Part 191 Subpart C.

If monitoring results meet any of these criteria, the results are considered significant. Significant monitoring results are promptly reported to the EPA. The report is accompanied by a plan of corrective action, including the appropriate external reporting. If the monitoring results exceed or possibly exceed containment requirements or release limits as specified in 40 CFR §194.4(b)(3)(ii), the CBFO will immediately cease emplacement of waste in the WIPP and notify the EPA within 24 hours.

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If the DOE discovers a condition or activity that differs significantly from what is indicated in the most recent compliance application, but does not involve conditions or activities listed in 40 CFR 194.4(b)(3)(ii), then the difference shall be reported in writing to the EPA within 10 calendar days of discovery. For normal conditions where monitoring results are within expectations, the Sandia National Laboratories assessment documents these conditions.

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