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SANDIA NATIONAL LABORATORIES
WASTE ISOLATION PILOT PLANT

AP-194
Revision 0

Analysis Plan to Evaluate and Analyze Current and Historical WIPP Groundwater Quality Data

Task 4.4.2.3.1

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1 Introduction and Objectives

This Analysis Plan (AP) directs the proposed evaluation and analysis of recently collected groundwater quality data collected from the WIPP monitoring well network. Field and laboratory water quality parameters have historically been collected in support of continued hydrogeologic characterization of the WIPP Monitoring Network, and this has continued through present day. The purpose of performing additional analyses of historical field and laboratory groundwater quality data, particularly data collected between 2017 and 2020, is to establish new and/or confirm existing water types for groundwater in the WIPP monitoring network, as well as to gain a better understanding of the spatial variation of water types and tie newly collected data to established hydrogeochemical facies across the site. In addition to analyses performed in support of water types and hydrogeochemical facies determinations, water quality data will be correlated with annual calculated density values and manually collected specific gravities. Establishing fluid densities is important for calculating freshwater heads, which are required for the calibration of the Culebra groundwater flow model used in WIPP recertification, approved through the EPA, and performance assessment (PA) baseline calculations.

The objective of the analyses proposed herein is to obtain a better understanding of the geochemistry at and surrounding the WIPP site, as well as to support the current understanding of density and hydrogeochemical data distribution across the WIPP area. The following analyses are anticipated to be conducted and documented in Analysis Reports under this Analysis Plan, where applicable:

- Calculation of Saturation Indices (SI) for key minerals,
- Analysis of the variability of measured and calculated densities across the site,
- Detailed analysis and interpretation of constituent variation and water types across the WIPP Monitoring Network,
- Evaluation of the correlation, if any, of water types and water quality constituent variation in relation to groundwater flow across the Monitoring Network,
- Comparison and correlation of TDS and other key parameters (i.e. electrical conductance, etc.), and
- Comparison of historical and recent water quality data, with an emphasis on 2017 through 2020 data.

The inherent error or uncertainty associated with each of the proposed analyses, their source data, and the results, will be addressed in the applicable Analysis Reports. Data analyzed under this AP will be used for Programmatic decisions.

2 Approach

Initially, water quality data that were collected from 2017 through 2020 and reported in water quality milestones (Bowman, D.O. 2019, Lofton, O.W. 2021) and density milestones (Vento and Bowman, 2019, Reardon, A. et al., 2021) will be compiled and evaluated. Several analyses will be performed on the data utilizing the software and codes listed in Section 3 of this report. Some of the analyses to be performed and reported include:

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- Saturation Indices (SI) calculations for key minerals,
- Development of Piper Plots and correlation of water types across the WIPP Monitoring Network,
- Correlation of updated water types with historically identified geochemical facies,
- Assessment of spatial water type relationships to identified flow patterns,
- Speciation of constituents and potential mineral formation for specific wells, and
- Calculation of ionic strength for various wells and its relationship to other relevant parameters such as Electrical Conductance (EC) and Total Dissolved Solids (TDS).

The water quality data and their analyses will provide additional information for the WIPP site area and may elucidate additional spatial characteristics of water types and correlations to known flow patterns and transmissivities. The inherent error of the data will be evaluated to determine the uncertainty associated with the analyses. Once new analyses have been completed, the results will be compared to historical data and conclusions. This AP is initially intended to cover analyses on water quality data collected from 2017 through 2020, but analyses of newly collected (post-2020) data will continue, as appropriate. The data presented in ARs associated with this AP will build on past works from Domski, P. and R.L. Beauheim (2008) (AR for AP-125), Siegel (1991), Sewards et al. (1991), and Beauheim, R.L. and R.M. Holt (1990).

3 Software List

The computer codes and software that may be used for analyses described in this AP include:

Software and code qualified under NP 19-1:

- PHREEQCi v.2.12.5-669

Commercial off-the-shelf software such as ArcGIS, Geochemist Workbench/Aquachem (or equivalent), Microsoft Excel and Grapher (or equivalent) may also be used for data manipulation and plotting.

4 Tasks

The tasks to be performed in this AP are the following:

- Assemble current collected water quality data;
- Conduct analyses of current data;
- Assemble current data related to density studies;
- Conduct analyses of current density data and conduct a comparison of calculated density data;
- Calculate and report uncertainty for analyses conducted in this AP;
- Compare results of current analyses to historical analyses; and,
- Make copies of input files and final output files.

Analysis reports documenting the analysis process and results will be prepared, reviewed, and submitted to the WIPP Records Center by the responsible analyst at the completion of each set of

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related analyses. Tasks will be completed by Leslie Kirkes and Paul Domski. Tasks related to data collected up to 2020 will be documented in an Analysis Report (AR) in 2022.

5 Special Considerations

No special considerations have been identified for this AP.

6 Applicable Procedures

All applicable WIPP quality-assurance procedures will be followed for these analyses. Training of personnel will be done in accordance with the requirements of NP 2-1, *Qualification and Training*. Analyses will be performed and documented in accordance with the requirements of NP 9-1, *Analyses*. All software used will meet the requirements of NP 19-1 *Software Requirements*. Data generated using procured and off-the-shelf software will be verified in accordance with the requirements of NP 9-1. The analyses will be reviewed following NP 6-1, *Document Review Process*.

7 References

Beauheim, R.L., and R.M. Holt. 1990. "Hydrogeology of the WIPP Site." *Geological and Hydrological Studies of Evaporites in the Northern Delaware Basin for the Waste Isolation Pilot Plant (WIPP), New Mexico* (pp. 131–79). Geological Society of America Field Trip No. 14 Guidebook. Dallas: Dallas Geological Society.

Bowman, D.O. 2019. *Milestone Report for WIPP Water Qualities Collected from 2017 to 2018. Milestone Report for Groundwater Sampling.* Sandia National Laboratories. Carlsbad, New Mexico. ERMS 571297

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Vento, A. and Bowman, D.O., 2019. *Milestone Report for H-6bR Water Density Stratification Investigation. Milestone Report for Groundwater Sampling.* Sandia National Laboratories. Carlsbad, New Mexico. ERMS 571997.

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