Annual Water Quality Report
Statistical Methodology

Heidelberg Materials US Cement CKD Monofill
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STATISTICAL METHODOLOGY

Statistical Method

The Department of Natural Resources comment letter to the 2025 Annual Water Quality Report dated July 24, 2026, (Doc #117708) proposed the use of parametric and non-parametric prediction limits for statistical evaluation in lieu of the control limits required by Iowa Administrative Code 567-115. Prediction limits are the recommended approach of the "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities - Unified Guidance," as published by the United States Environmental Protection Agency. The following statistical methodology summaries the methodology to be used for statistical evaluations in future Annual Water Quality Reports.

Diagnostic and Exploratory Evaluations and Tests of Assumptions

The statistical program includes diagnostic and exploratory evaluations and statistical tests of assumptions, as appropriate, including the following:

- Time series plots
- Ohio EPA Method for Outliers

Management of Non-Detect Data

Non-detect values in the dataset are managed using simple substitution or the Kaplan-Meier estimator. If less than 15% of the data are non-detects, simple substitution is used, where non-detect values are assigned a concentration of one-half (½) of the practical quantification limit (PQL). If greater than 15% but less than 50% of the data are non-detects, the Kaplan-Meier estimator is used to define the distribution for the dataset. If non-detects comprise greater than 50% of the available data, non-parametric statistical methods are used.

Management of Outliers

Background datasets are evaluated for outliers using the Ohio EPA Method as included in the statistical software program Sanitas™ and described below, which included the use of Dixon's, Rosner's, and Tukey's outlier tests, as appropriate based on the diagnostic tests, for the datasets containing less than 75% of the measured concentrations below the practical quantification limit (PQL).

Management of Data (ND data < 75%)

If less than 75% of the background dataset is below the PQL, outliers are statistically evaluated using the following guidelines.

- Parametric datasets with $n < 20$ are evaluated using Dixon's outlier test.
- Parametric datasets with $n \geq 20$ are evaluated using Rosner's outlier test.
- Non-parametric datasets are evaluated using Tukey's outlier test.

In accordance with the Ohio EPA Method, if a statistically significant outlier is not found using the above tests, but the highest value data point exceeds the second highest data point by an order of magnitude, the highest point is considered an outlier.

Management of Data (ND data ≥ 75%)

If greater than or equal to 75% of the background dataset is less than the PQL, outliers are statistically evaluated using the following guidelines.

- Single detection ≥ PQL:
  - If ≥ 50% of the background dataset has detections ≥ method detection limit (MDL), any value ≥ two times PQL of background is considered an outlier.
  - If < 50% of the background dataset has detections ≥ MDL, any value ≥ PQL of background is considered an outlier.
- Two or more detections ≥ PQL:
  - If ≥ 50% of the background dataset has detections ≥ MDL, any value ≥ three times PQL of background is considered an outlier.
  - If < 50% of the background dataset has detections ≥ MDL, any value ≥ two times the PQL of background is considered an outlier.

Interwell Prediction Limits

Interwell prediction limits were selected as the appropriate statistical method for the determination of constituents statistically above background. Prediction limits are established using the process below. Data from the most recent sampling events is compared to the prediction limits for the determination of constituents above background.

- If the dataset has a normal distribution (or can be transformed to a normal distribution using Ladder of Powers) and has less than 50% non-detects, parametric interwell prediction limits are calculated if at least five data sets have been collected.
- If the dataset does not have a normal distribution (and cannot be transformed to a normal distribution using Ladder of Powers) or has greater than 50% non-detects, non-parametric interwell prediction limits are calculated if at least five data sets have been collected.

Double Quantification Method

The quasi-statistical “double quantification” method was used for constituents not detected in the associated background data set. If a constituent was detected in the compliance dataset during two consecutive years that has not been historically detected in the background dataset, the SSI is confirmed.