MONTGOMERY & ASSOCIATES
Water Resource Consultants

REPORT

September 19, 2017

Prepared for: aps

Cholla Power Plant Coal Combustion Residuals Program - Statisitical Method Selected for Evaluation of Groundwater Monitoring Data Navajo County, Arizona

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ARIZONA PUBLIC SERVICE, NAVAJO COUNTY, ARIZONA

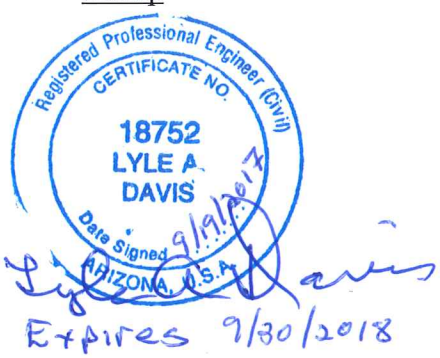
CERTIFICATION STATEMENT

I, Lyle Davis, P.E., have reviewed Montgomery & Associates' report for the Arizona Public Service Cholla Power Plant entitled Cholla Power Plant Coal Combustion Residuals Program – Statistical Method Selected for Evaluation of Groundwater Monitoring Data (Report), dated September 18, 2017, and can attest to the fact that the statistical approach selected to evaluate groundwater monitoring data for the Cholla CCR Units is consistent with requirements of § 257.91 (f)(1) through (5) of the U.S. Environmental Protection Agency Coal Combustion Residual Rule.

Signed: Lyle A Davis

Dated: September 19, 2017

Stamp



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1 PURPOSE

The purpose of this report is to describe the statistical analysis method selected by Montgomery & Associates (M&A) to evaluate groundwater monitoring data from the Arizona Public Service (APS) Cholla Power Plant (Cholla) as part of the requirements for the U.S. Environmental Protection Agency (EPA) Coal Combustion Residual (CCR) Rule (the Rule). The Cholla facility is located near Joseph City in Navajo County, Arizona, along the north bank of the Little Colorado River (LCR). The methodology would be applied to water quality data collected from groundwater monitoring networks for each of four Cholla CCR Units that are subject to the Rule. The CCR Units include: the Fly Ash Pond (FAP), Bottom Ash Pond (BAP), Bottom Ash Monofill (BAM), and Sedimentation Pond (SEDI. Additional information on the CCR Units and associated monitoring networks is included in the report entitled *Cholla Power Plant Coal Combustion Residuals Program – Design, Installation, and Evaluation of Completeness of Groundwater Monitoring Networks* (M&A, 2017).

The goal of the groundwater monitoring program is to establish the quality of background groundwater and groundwater passing the waste boundaries at each CCR Unit. The statistical approach proposed for evaluating water quality data and establishing background for each CCR Unit will be certified by Lyle Davis, P.E. in a certification statement to accompany this report.

2 GROUNDWATER SAMPLING

Parameters requiring analysis in samples obtained from CCR Unit monitoring wells are divided into two categories in the Rule – detection and assessment monitoring parameters. Detection parameters are indicators that are used to determine whether groundwater is potentially being contaminated in the area downgradient from a CCR Unit. Assessment monitoring parameters are CCR constituents of concern that must be sampled for and tracked once detection monitoring has indicated that a statistically significant increase in one or more of the detection parameters over background has occurred in an aquifer downgradient of a CCR Unit.

The Rule requires that a minimum of eight (8) statistically independent and spatially invariant samples be collected from each upgradient (background) and each downgradient well for each detection and assessment monitoring parameter during the 30-month period following publication of the Rule in the federal register.

3 STATISTICAL METHODOLOGY FOR EVALUATING WATER QUALITY

In accordance with the Rule, background concentrations must be established in hydraulically upgradient wells for each of the constituents required in the particular groundwater monitoring program that applies to each of the CCR Units. The Rule allows non-upgradient wells to be used to establish background concentrations if upgradient background locations do not exist.

Background concentrations are intended to represent the water quality that would be present if the Unit never existed and serve as a baseline from which impacts can be determined. The EPA's *Unified Guidance for Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (EPA, 2009) recommends statistical procedures for determination of background concentrations. The methods used to analyze the groundwater monitoring data were developed in accordance with the Unified Guidance, as described in the CCR SAP.

Data will be evaluated to ensure that observations are statistically independent, spatially and temporally stationary, contain no outliers, and fit a distribution that is appropriate for the statistical method, if parametric methods are employed (EPA, 2009). Additionally, non-detect data will be correctly used within the selected statistical method. For the purposes of this discussion a *sample* is considered a dataset composed of at least eight independent observations of an analyte at a well.

The software ProUCL will be used to analyze the chemistry data. This software was developed to compute rigorous statistics on environmental datasets and is well-suited to the procedure described below.

The following steps, as described in the CCR SAP, will be implemented with data from CCR program monitor wells:

1. Collect a minimum of eight observations of each analyte from each background and downgradient monitoring well (EPA, 2009)

2. To ensure that observations are independent, analyze the autocorrelation function for each sample to determine if autocorrelation is observed. If observations are autocorrelated, remove autocorrelated observations and collect additional data until a minimum of eight observations has been reached for each well. Test well-constituent pairs for temporal dependence using plots of the sample autocorrelation function.

3. Use Dixon's outlier test to evaluate each sample for statistical outliers. If outliers are identified, determine if the outlier can be traced to a likely cause (e.g., lab error, groundwater sampling error, etc.). Remove outliers that can be traced to a likely cause from the sample. Flag and retain outliers that cannot be traced to a likely cause in the dataset. Test each sample for a significant trend using the Mann-Kendall, seasonal Mann-Kendall, or Theil-Sen trend test, as appropriate. The Theil-Sen trend test is used for samples with non-detects and those which fail normality tests.

4. Test each sample to determine if it fits a normal distribution. Due to the presence of non-detects in the datasets, use the Shapiro-Wilk test to evaluate the datasets for non-normality.

5. Background samples will be established for each analyte, for each CCR Unit. Prediction intervals are highly regarded within the Unified Guidance and will be the preferred approach. Additionally, if non-detect data is present in the sample, the Kaplan-Meier method will be used to ensure that the non-detect data is examined appropriately.

6. Once prediction intervals have been established for background detection monitoring samples for each CCR Unit, each detection monitoring observation at a downgradient well will be compared to the relevant background upper prediction limit. For each CCR Unit, a test will be carried out to determine if a statistically significant increase above background has occurred at a 99 percent confidence level for any detection monitoring constituent at any downgradient monitor well. If such an increase above background is observed, follow-up actions will be taken in accordance with the Rule.

4 REFERENCES CITED

Montgomery & Associates, 2017, Cholla Power Plant Coal Combustion Residuals Program – Design, Installation, and Evaluation of Completeness of Groundwater Monitoring Networks, September 18, 2017.

U.S. Environmental Protection Agency, 2009, Statistical Analysis of groundwater monitoring data at RCRA facilities, Unified Guidance; EPA/530/R-09/007, March 2009.