Data Review Memorandum

7720 N. 16th Street
Suite 100
Phoenix, Arizona 85020
602.371.1100 Tel
602.371.1615 Fax

Action **Info** **File**

To: Dan Sola, Project Manager 60437300

From: Marianne Burrus, QA/QC

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Subject : APS Four Corner's Power Plant (FCPP) - Coal Combustion Residual (CCR)

This report summarizes the review of analytical data for the 17 aqueous samples, one field duplicate, and one field blank collected at the APS FCPP as a part of the CCR groundwater monitoring program. The sample identification numbers, sample collection dates, and analyses are summarized in Table 1. The samples were analyzed by Test America (TA) located in North Canton, Ohio.

The data were reviewed in accordance with the quality assurance and control (QA/QC) objectives outlined in the project document: *Sampling and Analysis Plan* [SAP], *Coal Combustion Residual (CCR) Groundwater Monitoring, Four Corners Power Plant, Arizona Public Service, Farmington, New Mexico* (December 2015). The following comments refer to the performance of the laboratory in meeting the QA/QC specifications outlined in the project document and analytical methods and the criteria specified in the EPA document: *National Functional Guidelines for Superfund Inorganic Methods Data Review* (October 2013). The qualifiers and reason codes used to identify data that did not meet the criteria set forth in the previously referenced documents are listed in Appendix A.

A list of the data review parameters is given in Sections 1.0 through 4.0. A preceding "►" signifies areas where issues were raised during the course of the validation review, and should be considered to determine any impact on data quality and usability.

Please note that due to low sample volumes in the last five wells sampled a second field duplicate was not collected during this round. An additional duplicate was collected in March 2016 when 2 additional wells were installed and will be reflected in the validation of those data.

Executive Summary

The data are acceptable in all areas of review and are useable for their intended purpose with qualifications summarized below.

Sample ID	Analyte	Probable Bias Direction	Qualifier, Reason Code	Reference Section
FC-CCR-MW64-110515	Arsenic	High	U,z	1.3
FC-CCR-MW65-110515	Arsenic	High	U,z	1.3
FC-CCR-MW66-110515	Arsenic	High	U,z	1.3
FC-CCR-MW64-110515	Lead	High	U,z	1.3

Sample ID	Analyte	Probable Bias Direction	Qualifier, Reason Code	Reference Section
FC-CCR-MW66-110515	Lead	High	U,z	1.3
FC-CCR-FB-1-110915	Sodium	High	U,z	1.3
FC-CCR-MW61-110615 FC-CCR-FD-1-110615	Beryllium	Unknown	J,f/J,f	1.6
	Chromium	Unknown	J,f/J,f	1.6
FC-CCR-MW67-110415	Total dissolved solids	Unknown	J,h/J,q	3.2/3.8
FC-CCR-MW66-110515	Total dissolved solids	Unknown	J,h/J,q	3.2/3.8
FC-CCR-MW68-110615	Total dissolved solids	Unknown	J,h/J,q	3.2/3.8
FC-CCR-MW61-110615	Carbonate	Unknown	J,d	3.6
FCC-CCR-MW69-110415	Radium-226	Unknown	J,Q	4.3
FCC-CCR-MW69-110415	Radium-228	Unknown	J,Q	4.3

Because none of the results was rejected the analytical completeness for this data group is 100%.

1.0 Methods 200.8 and 245.1

Data Completeness
Preservation and Holding Times
►Blanks
Matrix Spike/Matrix Spike Duplicates
Laboratory Control Sample
►Field Duplicate
Sample Quantitation

1.1 Data Completeness

The analyses were performed as requested on the chain-of-custody (COC) records and in accordance with the SAP.

1.2 Preservation and Holding Times

The samples were adequately preserved and were analyzed within the method specified holding time. Therefore, data qualification was not necessary.

1.3 Blanks

The following analytes were detected in the method and/or field blanks (as indicated) and the associated samples were qualified as noted.

Blank ID	Analyte	Qualified Sample	Qualifier, Reason Code
MB 240-205567/1-A	Magnesium	None[1]	None[1]
MB 240-205567/1-A	Sodium	None[1]	None[1]

Blank ID	Analyte	Qualified Sample	Qualifier, Reason Code
MB 240-205867/1-A	Arsenic	FC-CCR-MW64-110515	U,z
		FC-CCR-MW65-110515	U,z
		FC-CCR-MW66-110515	U,z
MB 240-205867/1-A	Lead	FC-CCR-MW64-110515	U,z
		FC-CCR-MW65-110515	None[2]
		FC-CCR-MW66-110515	U,z
MB 240-206266/1-A	Magnesium	None[1]	None[1]
MB 240-206266/1-A	Sodium	FC-CCR-FB-1-110915	U,z
FC-CCR-FB-1-110915	Boron	None[1]	None[1]
MB 240-209704/1-A	Barium	None[1]	None[1]
	Sodium	None[1]	None[1]
None[1] Associated sample concentrations were >5x the blank contamination level; therefore, no qualification of the data was considered necessary. None[2] Associated sample reported as non-detect for listed analyte.			

1.4 Matrix Spike/ Matrix Spike Duplicates (MS/MSD)

As requested, the MS/MSD analyses were performed on sample FC-CCR-MW61-110615, which was assigned field sample identification FC-CCR-MS/MSD-1-110615. With the following exceptions, the MS/MSD percent recoveries and relative percent difference (RPD) values were within the control limits.

Spiked Sample	Analyte	MS/MSD % Recovery Criteria = 75-125	Qualifier, Reason Code
FC-CCR-MW61-110615	Boron	1400/1700	None[1]
	Calcium	245/95	None[1]
	Sodium	646/77	None[1]
	Magnesium	188/77	None[1]
None[1] The primary sample concentration was >4x spike value, therefore, no qualification of the associated samples was considered necessary.			

1.5 Laboratory Control Sample (LCS)

The LCS percent recoveries were within the control limits. Therefore, data qualification was not necessary.

1.6 Field Duplicate

The field duplicate for this sampling event was collected at location FC-CCR-MW61-110615 and was assigned field sample identification FC-CCR-FD-1-110615. With the following exceptions, the RPD values were within the control limits.

Analyte	Primary/FD Result (mg/L)	RPD Value Criteria = 20%	Qualifier, Reason Code
Beryllium	0.00016/0.00023	35.9	J,f/J,f
Chromium	0.00075/ 0.00028	91.3	J,f/J,f

It should be noted that due to a lack of sample volume, a second field duplicate sample was not collected as required according to the SAP.

1.7 Sample Quantitation

The values for some of the analytes were reported at levels between the method detection limit (MDL) and the laboratory reporting limit (RL). In these instances, the laboratory reported these values as estimated (with a "J" qualifier). Because the laboratory RLs were reported below the project action levels, no further qualification of this data was considered necessary.

2.0 Methods 300.0 and 353.2

Data Completeness
Preservation and Holding Times
Blanks
Matrix Spike/Matrix Spike Duplicates
Laboratory Control Sample
Field Duplicate
Sample Quantitation

2.1 Data Completeness

The analyses were performed as requested on the COC records and in accordance with the SAP.

2.2 Preservation and Holding Times

TA recorded the temperature upon receipt for the samples within laboratory ID number 240-58654 to be 1.5°C; however, no samples were noted as being frozen. Although the recorded temperature is outside the acceptable range of 4°C ± 2 °C, this slight deviation from the acceptable temperature range is not considered likely to adversely affect the quality of the analytical results. The samples were analyzed within the method specified holding time Therefore, data qualification was not necessary.

2.3 Blanks

The following analytes were detected in the method and/or field blanks (as indicated) and the associated samples were qualified as noted.

Blank ID	Analyte	Qualified Sample	Qualifier, Reason Code
MB 240-206166/3	Fluoride	None[1]	None[1]
MB 240-209929/3	Fluoride	None[2]	None[2]
MB 240-211117/4	Nitrate-nitrite	None[1]	None[1]
None[1] Associated sample concentrations were >5x the blank contamination level; therefore, no qualification of the data was considered necessary.			

Blank ID	Analyte	Qualified Sample	Qualifier, Reason Code
None[2] Associated sample reported as non-detect for listed analyte.			

2.4 Matrix Spike/ Matrix Spike Duplicates (MS/MSD)

As requested, the MS/MSD analyses were performed on sample FC-CCR-MW61-110615, which was assigned field sample identification FC-CCR-MS/MSD-1-110615. TA performed an additional MS/MSD analyses on sample FC-CCR-MW8-120115. With the following exceptions, the MS/MSD percent recoveries and RPD values were within the control limits.

Spiked Sample	Analyte	MS/MSD % Recovery Criteria = 70-130	Qualifier, Reason Code
FC-CCR-MW61-110615	Sulfate	277/180	None[1]
FC-CCR-MW8-120115	Chloride	11/7	None[1]
None[1] The primary sample concentration was >4x spike value, therefore, no qualification of the associated samples was considered necessary.			

2.5 Laboratory Control Sample (LCS)

The LCS percent recoveries were within the control limits. Therefore, data qualification was not necessary.

2.6 Field Duplicate

The field duplicate for this sampling event was collected at location FC-CCR-MW61-110615 and was assigned field sample identification FC-CCR-FD-1-110615. No significant differences were noted for the field duplicate pair, indicating acceptable field precision. However, it should be noted that the nitrate-nitrite analysis was not performed on the field duplicate sample; therefore, field precision could not be verified.

It should also be noted that due to a lack of sample volume, a second field duplicate sample was not collected as required according to the SAP.

2.7 Sample Quantitation

The values for some of the analytes were reported at levels between the method detection limit (MDL) and the laboratory reporting limit (RL). In these instances, the laboratory reported these values as estimated (with a "J" qualifier). Because the laboratory RLs were reported below the project action levels, no further qualification of this data was considered necessary.

3.0 Methods SM2540C and SM2320B

Data Completeness
►Preservation and Holding Times
Blanks
Matrix Spike/Matrix Spike Duplicates
Laboratory Control Sample
►Laboratory Duplicate
Field Duplicate
►Sample Quantitation

3.1 Data Completeness

The analyses were performed as requested on the COC records and in accordance with the SAP.

3.2 Preservation and Holding Times

TA recorded the temperature upon receipt for the samples within laboratory ID number 240-58654 to be 1.5°C; however, no samples were noted as being frozen. Although the recorded temperature is outside the acceptable range of 4°C ± 2 °C, this slight deviation from the acceptable temperature range is not considered likely to adversely affect the quality of the analytical results.

The samples were analyzed within the method specified holding time, with the following exception.

Sample ID	Analyte	Qualifier, Reason Code
FC-CCR-MW67-110415	Total dissolved solids	J,h*
FC-CCR-MW66-110515	Total dissolved solids	J,h*
FC-CCR-MW68-110615	Total dissolved solids	J,h*
*Sample also analyzed within holding time but outside calibration range (see Section 3.8)		

3.3 Blanks

The following analytes were detected in the method and/or field blanks (as indicated) and the associated samples were qualified as noted.

Blank ID	Analyte	Qualified Sample	Qualifier, Reason Code
MB 240-205730/13	Alkalinity	None[1]	None[1]
MB 240-206296/30	Alkalinity	None[1]	None[1]
MB 240-206296/5	Alkalinity	None[1]	None[1]
FC-CCR-FB-1-110915	Alkalinity	None[1]	None[1]
MB 240-206521/30	Alkalinity/Bicarbonate	None[1]	None[1]
MB 240-206521/52	Alkalinity/Bicarbonate	None[1]	None[1]
MB 240-206633/38	Alkalinity/Bicarbonate	None[1]	None[1]
MB 240-206633/5	Alkalinity	None[1]	None[1]
MB 240-210655/5	Alkalinity	None[1]	None[1]
None[1] Associated sample concentrations were >5x the blank contamination level; therefore, no qualification of the data was considered necessary.			

3.4 Matrix Spike/ Matrix Spike Duplicates (MS/MSD)

As requested, the MS/MSD analyses were performed on sample FC-CCR-MW61-110615, which was assigned field sample identification FC-CCR-MS/MSD-1-110615. The MS/MSD percent recoveries and RPD values were within the control limits.

3.5 Laboratory Control Sample (LCS)

The LCS percent recoveries were within the control limits. Therefore, data qualification was not necessary.

3.6 Laboratory Duplicate (DUP)

Within the following exception the DUP analyses were within were within the control limits.

Duplicate Sample	Analyte	RPD Value Criteria = 20	Qualifier, Reason Code
FC-CCR-MW61-110615	Carbonate	23	J,d

3.7 Field Duplicate

The field duplicate for this sampling event was collected at location FC-CCR-MW61-110615 and was assigned field sample identification FC-CCR-FD-1-110615. No significant differences were noted for the field duplicate pairs, indicating acceptable field precision.

3.8 Sample Quantitation

The values for some of the analytes were reported at levels between the method detection limit (MDL) and the laboratory reporting limit (RL). In these instances, the laboratory reported these values as estimated (with a "J" qualifier). Because the laboratory RLs were reported below the project action levels, no further qualification of this data was considered necessary, with following exception.

Sample ID	Analyte	Qualifier, Reason Code
FC-CCR-MW67-110415	Total dissolved solids	J,q*
FC-CCR-MW66-110515	Total dissolved solids	J,q*
FC-CCR-MW68-110615	Total dissolved solids	J,q*
*Sample also analyzed within the calibration range but outside the holding time (see Section 3.1)		

4.0 Methods 903.1 and 904 – Radium 226 and 228

Data Completeness
Blanks
►Carrier Spike
Laboratory Control Sample/Laboratory Control Sample Duplicate
Field Duplicate

4.1 Data Completeness

The analyses were performed as requested on the COC records and in accordance with the SAP.

4.2 Blanks

No data was qualified based on the method blank results.

4.3 Carrier Spike

The following barium carrier spike percent recoveries were outside the established limits.

Sample ID	Analyte	Barium Carrier % Rec. Criteria: 40-110%	Qualifier, Reason Code
FCC-CCR-MW69-110415	Radium-226	131	J,Q
	Radium-228	131	J,Q

4.4 Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

The LCS/LCSD percent recoveries and RPD values were within the control limits. Therefore, data qualification was not necessary.

4.5 Field Duplicate (FD)

The field duplicate for this sampling event was collected at location FC-CCR-MW61-110615 and was assigned field sample identification FC-CCR-FD-1-110615. Although the RPD values for the Radium 226 and Radium 228 were outside the criteria, no significant differences were noted for the combined Radium 226 and Radium 228 values. Therefore, data qualification was not necessary.

APPENDIX A
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY ASSIGNED BY AECOM'S DATA REVIEW TEAM

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."

NJ The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

REASON CODE DEFINITIONS

a Analytical sequence deficiency or omission.
b Gross compound breakdown (4,4'-DDT/Endrin).
c Calibration failure; poor or unstable response.
d Laboratory duplicate imprecision.
e Laboratory duplicate control sample imprecision.
f Field duplicate imprecision.
g Poor chromatography.
h Holding time violation.
i Internal standard failure.
j Poor mass spectrographic performance.
k Serial dilution imprecision.
l Laboratory control sample recovery failure.
m Matrix spike/matrix spike duplicate recovery failure.
n Interference check sample recovery failure.
o Calibration blank contamination (metals/inorganics only).
p Preparation blank contamination (metals/inorganics only).
q Quantitation outside of linear range.
r Linearity failure in initial calibration.
s Surrogate spike recovery failure (organics only).
t Instrument tuning failure.
u No confirmation column present (GC organics only).
w Retention time (RT) outside of RT window.
x Equipment blank contamination.
y Trip blank contamination.
z Method blank contamination.
Q Other

TABLE 1

Consultant: AECOM

Project: APS FCPP – CCR

Laboratory: Test America

Field Sample Identification	Laboratory Identification Number	Sample Date	Method 200.8*	Method 245.1 (Mercury)	Method 300.0 (Chloride, fluoride, sulfate)	Method 353.2 (Nitrate/nitrite)	Method SM2540C (Total dissolved solids)	Method 2320B (Alkalinity and carbonate/bicarbonate)	Method 903.1/904 (Radium 226 and 228)
FC-CCR-MW69-110415	240-57527-1	11/4/15	X	X	X	X	X	X	X
FC-CCR-MW67-110415	240-57527-2	11/4/15	X	X	X	X	X	X	X
FC-CCR-MW63-110415	240-57527-3	11/4/15	X	X	X	X	X	X	X
FC-CCR-MW64-110515	240-37606-1	11/5/15	X	X	X	X	X	X	X
FC-CCR-MW65-110515	240-37606-2	11/5/15	X	X	X	X	X	X	X
FC-CCR-MW66-110515	240-37606-3	11/5/15	X	X	X	X	X	X	X
FC-CCR-MW68-110615	240-57710-1	11/6/15	X	X	X	X	X	X	X
FC-CCR-MW61-110615	240-57710-2	11/6/15	X	X	X	X	X	X	X
FC-CCR-FD-1-110615 (Field duplicate of FC-CCR-MW61-110615)	240-57710-3	11/6/15	X	X	X	X	X	X	X
FC-CCR-MW7-110715	240-57710-4	11/7/15	X	X	X	X	X	X	X
FC-CCR-MW60-110815	240-57710-5	11/8/15	X	X	X	X	X	X	X
FC-CCR-MW70-110915	240-57710-6	11/9/15	X	X	X	X	X	X	X
FC-CCR-FB-1-110915	240-57710-7	11/9/15	X	X	X	X	X	X	X
FC-CCR-MW62-110915	240-57710-8	11/9/15	X	X	X	X	X	X	X

Field Sample Identification	Laboratory Identification Number	Sample Date	Method 200.8*	Method 245.1 (Mercury)	Method 300.0 (Chloride, fluoride, sulfate)	Method 353.2 (Nitrate/nitrite)	Method SM2540C (Total dissolved solids)	Method 2320B (Alkalinity and carbonate/bicarbonate)	Method 903.1/904 (Radium 226 and 228)
FC-CCR-MW8-120115	240-58654-1	12/1/15	X	X	X	X	X	X	X
FC-CCR-MW12R-120115	240-58654-2	12/1/15	X	X	X	X	X	X	X
FC-CCR-MW43-120115	240-58654-3	12/1/15	X	X	X	X	X	X	X
FC-CCR-MW49A-120115	240-58654-4	12/1/15	X	X	X	X	X	X	X
FC-CCR-MW50-120115	240-58654-5	12/1/15	X	X	X	X	X	X	X

Antimony, arsenic, barium, beryllium, boron, calcium, cadmium, chromium, cobalt, lead, lithium, magnesium, molybdenum, selenium, thallium, sodium, potassium, and nickel