

Investigation of a Sustainable Approach to In-situ Remediation of Arsenic Impacted Groundwater APPENDICES

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Appendix A

Metals by EPA 6000/7000 Series Methods and
Sequential Extraction Results for ASB-1 and ASB-2



USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

13 July 2016

Joe Loeper
Philadelphia District
Wanamaker Building, 100 Penn Square East
Philadelphia, PA 19107-3390
RE: Vineland

Enclosed are the results of analyses for samples received by the laboratory on 07-Apr-2016. The samples associated with this report will be held for 90 days from the date of this report. The raw data associated with this report will be held for 5 years from the date of this report. If you need us to hold onto the samples or the data longer than these specified times, you will need to notify us in writing at least 30 days before the expiration dates. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jenifer Milam For Dale Rosado, Ph. D.
Chemist



USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
Wanamaker Building, 100 Penn Square East
Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
13-Jul-2016

WORK ORDER SUMMARY

Sample ID	Laboratory ID	Matrix	Date Sampled	Date of Work Order
ASB-2 26-27	6040703-01	Soil/Sediment	05-Apr-2016	07-Apr-2016
ASB-2 30-31	6040703-02	Soil/Sediment	05-Apr-2016	07-Apr-2016
ASB-2 31-32	6040703-03	Soil/Sediment	05-Apr-2016	07-Apr-2016
ASB-1 26-27	6040703-04	Soil/Sediment	05-Apr-2016	07-Apr-2016
ASB-1 27-28	6040703-05	Soil/Sediment	05-Apr-2016	07-Apr-2016
ASB-1 28-29	6040703-06	Soil/Sediment	05-Apr-2016	07-Apr-2016
ASB-1 29-30	6040703-07	Soil/Sediment	05-Apr-2016	07-Apr-2016



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Case Narrative

No issues were experienced during the analysis of Work Order 6040703 unless specified below.



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Notes and Definitions

U	Analyte included in the analysis, but not detected
RPD-06	RPD exceeds acceptance limit.
RPD-01	Analyses are not controlled on RPD values from sample concentrations less than the reporting limit.
QM-11	The spike recovery was outside of QC acceptance limits for the MS and/or MSD due to inherent analyte concentration greater than the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.
J	Detected but below the Reporting Limit; therefore, result is an estimated concentration.
B	Analyte is found in the associated blank as well as in the sample.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference



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ASB-2 26-27

6040703-01 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals by EPA 6000/7000 Series Methods

Aluminum	2240	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Antimony	ND	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Arsenic	94.7	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Barium	4.10	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Beryllium	ND	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Boron	7.59	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cadmium	0.612	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Calcium	79.9	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Chromium	5.42	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cobalt	ND	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Copper	2.89	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	B
Iron	22000	1.58	7.91	mg/kg	18-Apr-2016	20-Apr-2016	SW 846/6010	
Lead	3.10	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Lithium	ND	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Magnesium	24.0	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Manganese	4.83	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Nickel	0.416	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Phosphorus	85.4	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Potassium	82.1	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Selenium	ND	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Silver	ND	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Sodium	ND	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Strontium	0.996	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Sulfur	28.5	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Thallium	0.817	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Tin	1.32	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Titanium	15.4	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Vanadium	26.0	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Zinc	4.06	0.396	1.98	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	

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ASB-2 26-27

6040703-01 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Carbonate

Aluminum	8.38	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	10.9	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	0.665	0.0395	0.197	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Exchangeable

Aluminum	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Lead	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	9.87	49.3	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U

Metals Sequential Extractions Oxide

Aluminum	163	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	817	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	6.42	0.395	1.97	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

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ASB-2 26-27

6040703-01 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Residual

Aluminum	463	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	20.1	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	4250	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	3.05	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic-75 [2]	18.0	0.197	0.987	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Soluble

Aluminum	17.5	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	34.6	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	8.34	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic-75 [2]	ND	0.197	0.987	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U

Metals Sequential Extractions Sulfide / Organic

Aluminum	35.7	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	35.2	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	0.395	1.97	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U



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Reported:
 13-Jul-2016

ASB-2 30-31

6040703-02 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals by EPA 6000/7000 Series Methods

Aluminum	696	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Antimony	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Arsenic	88.3	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Barium	2.36	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Beryllium	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Boron	3.97	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cadmium	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Calcium	50.0	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Chromium	1.68	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Cobalt	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Copper	2.42	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	B
Iron	11800	1.59	7.96	mg/kg	18-Apr-2016	20-Apr-2016	SW 846/6010	
Lead	0.434	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Lithium	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Magnesium	10.3	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Manganese	2.32	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Nickel	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Phosphorus	31.4	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Potassium	5.83	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Selenium	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Silver	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Sodium	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Strontium	0.703	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Sulfur	16.4	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Thallium	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Tin	0.600	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Titanium	15.7	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Vanadium	3.57	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Zinc	1.70	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J

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ASB-2 30-31

6040703-02 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Carbonate

Aluminum	7.25	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	7.46	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	0.636	0.0391	0.196	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Exchangeable

Aluminum	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Lead	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	9.78	48.9	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U

Metals Sequential Extractions Oxide

Aluminum	60.3	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	8.83	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Iron	412	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	6.15	0.391	1.96	mg/kg	27-May-2016	31-May-2016	SW 846/6020	



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ASB-2 30-31

6040703-02 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Residual

Aluminum	119	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	14.9	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	2090	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	3.50	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic-75 [2]	18.5	0.196	0.978	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Soluble

Aluminum	11.6	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	35.9	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	0.196	0.978	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U

Metals Sequential Extractions Sulfide / Organic

Aluminum	12.5	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	30.2	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	0.391	1.96	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U



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Reported:
 13-Jul-2016

ASB-2 31-32

6040703-03 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals by EPA 6000/7000 Series Methods

Aluminum	536	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Antimony	ND	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Arsenic	83.9	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Barium	3.44	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Beryllium	ND	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Boron	2.82	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cadmium	ND	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Calcium	57.1	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Chromium	1.55	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Cobalt	ND	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Copper	2.89	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	B
Iron	10100	1.53	7.63	mg/kg	18-Apr-2016	20-Apr-2016	SW 846/6010	
Lead	2.07	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Lithium	ND	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Magnesium	8.16	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Manganese	1.85	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Nickel	ND	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Phosphorus	27.4	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Potassium	5.59	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Selenium	ND	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Silver	ND	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Sodium	ND	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Strontium	2.18	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Sulfur	16.1	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Thallium	0.868	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Tin	0.564	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Titanium	12.3	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Vanadium	2.84	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Zinc	1.21	0.382	1.91	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J

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USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
 Wanamaker Building, 100 Penn Square East
 Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
 13-Jul-2016

ASB-2 31-32
6040703-03 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Carbonate

Aluminum	8.46	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	11.2	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	3.66	0.0393	0.197	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Exchangeable

Aluminum	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Lead	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	9.83	49.1	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U

Metals Sequential Extractions Oxide

Aluminum	61.2	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	9.57	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Iron	427	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	23.2	0.393	1.97	mg/kg	27-May-2016	31-May-2016	SW 846/6020	



USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
 Wanamaker Building, 100 Penn Square East
 Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
 13-Jul-2016

ASB-2 31-32
6040703-03 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Residual

Aluminum	102	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	14.4	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	1850	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	2.51	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic-75 [2]	14.1	0.197	0.983	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Soluble

Aluminum	22.6	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	2.41	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Iron	78.8	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	1.70	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic-75 [2]	1.40	0.197	0.983	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Sulfide / Organic

Aluminum	13.1	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	38.7	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	0.393	1.97	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U



USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
 Wanamaker Building, 100 Penn Square East
 Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
 13-Jul-2016

ASB-1 26-27

6040703-04 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals by EPA 6000/7000 Series Methods

Aluminum	3120	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Antimony	ND	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Arsenic	170	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Barium	7.23	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Beryllium	ND	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Boron	5.44	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cadmium	0.625	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Calcium	89.2	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Chromium	8.20	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cobalt	0.394	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Copper	1.15	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J, B
Iron	22600	1.52	7.59	mg/kg	18-Apr-2016	20-Apr-2016	SW 846/6010	
Lead	2.01	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Lithium	0.809	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Magnesium	97.8	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Manganese	7.35	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Nickel	0.772	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Phosphorus	111	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Potassium	137	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Selenium	ND	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Silver	ND	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Sodium	ND	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Strontium	1.70	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Sulfur	20.4	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Thallium	1.56	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Tin	ND	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Titanium	59.2	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Vanadium	7.04	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Zinc	7.05	0.379	1.90	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	

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USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
Wanamaker Building, 100 Penn Square East
Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
13-Jul-2016

ASB-1 26-27

6040703-04 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Carbonate

Aluminum	8.65	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	4.85	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Iron	7.95	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	7.02	0.0393	0.196	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Exchangeable

Aluminum	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Lead	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	9.81	49.1	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U

Metals Sequential Extractions Oxide

Aluminum	218	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	21.7	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	1150	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	44.8	0.393	1.96	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

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USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
Wanamaker Building, 100 Penn Square East
Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
13-Jul-2016

ASB-1 26-27

6040703-04 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Residual

Aluminum	658	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	35.8	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	4530	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	1.58	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Sulfur	3.86	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic-75 [2]	33.4	0.196	0.981	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Soluble

Aluminum	52.3	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	3.50	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Iron	54.4	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	4.74	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic-75 [2]	2.92	0.196	0.981	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Sulfide / Organic

Aluminum	69.8	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	44.1	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	0.393	1.96	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U



USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
 Wanamaker Building, 100 Penn Square East
 Philadelphia PA, 19107-3390

Project: Vineland
 Project Manager: Joe Loeper

Reported:
 13-Jul-2016

ASB-1 27-28
6040703-05 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals by EPA 6000/7000 Series Methods

Aluminum	2410	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Antimony	ND	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Arsenic	519	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Barium	2.16	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Beryllium	ND	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Boron	10.3	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cadmium	1.35	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Calcium	44.1	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Chromium	12.8	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cobalt	ND	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Copper	ND	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Iron	50200	1.57	7.86	mg/kg	18-Apr-2016	20-Apr-2016	SW 846/6010	
Lead	4.85	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Lithium	ND	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Magnesium	7.44	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Manganese	16.0	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Nickel	ND	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Phosphorus	173	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Potassium	48.3	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Selenium	ND	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Silver	ND	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Sodium	ND	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Strontium	0.856	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Sulfur	40.1	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Thallium	2.28	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Tin	2.40	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Titanium	33.7	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Vanadium	4.21	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Zinc	13.6	0.393	1.97	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	

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USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
 Wanamaker Building, 100 Penn Square East
 Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
 13-Jul-2016

ASB-1 27-28

6040703-05 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Carbonate

Aluminum	7.27	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	14.7	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Iron	20.9	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	19.4	0.0400	0.200	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Exchangeable

Aluminum	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Lead	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	10.6	9.99	50.0	mg/kg	27-May-2016	31-May-2016	SW 846/6020	J

Metals Sequential Extractions Oxide

Aluminum	172	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	50.4	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	923	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	104	0.400	2.00	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

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USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
 Wanamaker Building, 100 Penn Square East
 Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
 13-Jul-2016

ASB-1 27-28

6040703-05 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Residual

Aluminum	343	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	69.5	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	6780	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	2.43	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Sulfur	5.56	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic-75 [2]	62.9	0.200	0.999	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Soluble

Aluminum	4.37	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	8.93	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	25.9	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	2.51	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic-75 [2]	8.18	0.200	0.999	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Sulfide / Organic

Aluminum	29.7	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	49.9	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	0.400	2.00	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U

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USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
 Wanamaker Building, 100 Penn Square East
 Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
 13-Jul-2016

ASB-1 28-29

6040703-06 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals by EPA 6000/7000 Series Methods

Aluminum	4110	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Antimony	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Arsenic	567	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Barium	7.00	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Beryllium	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Boron	7.56	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cadmium	1.23	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Calcium	51.0	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Chromium	32.1	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cobalt	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Copper	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Iron	45300	1.59	7.96	mg/kg	18-Apr-2016	20-Apr-2016	SW 846/6010	
Lead	3.03	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Lithium	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Magnesium	32.7	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Manganese	11.7	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Nickel	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Phosphorus	174	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Potassium	331	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Selenium	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Silver	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Sodium	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Strontium	2.30	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Sulfur	41.5	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Thallium	2.76	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Tin	ND	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Titanium	125	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Vanadium	37.9	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Zinc	10.2	0.398	1.99	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	

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USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
Wanamaker Building, 100 Penn Square East
Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
13-Jul-2016

ASB-1 28-29

6040703-06 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Carbonate

Aluminum	10.7	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	18.0	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Iron	10.8	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	24.3	0.0393	0.197	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Exchangeable

Aluminum	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Lead	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	9.83	49.1	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U

Metals Sequential Extractions Oxide

Aluminum	244	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	46.2	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	1270	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	92.9	0.393	1.97	mg/kg	27-May-2016	31-May-2016	SW 846/6020	



USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
Wanamaker Building, 100 Penn Square East
Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
13-Jul-2016

ASB-1 28-29

6040703-06 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Residual

Aluminum	887	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	122	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	8750	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	2.78	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Sulfur	6.88	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic-75 [2]	108	0.197	0.983	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Soluble

Aluminum	7.14	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	10.3	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	5.58	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Lead	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	10.0	0.197	0.983	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Sulfide / Organic

Aluminum	75.0	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	49.2	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	0.393	1.97	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U



USACE ERDC-EP-C
3909 Halls Ferry Road
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Philadelphia District
 Wanamaker Building, 100 Penn Square East
 Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
 13-Jul-2016

ASB-1 29-30

6040703-07 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals by EPA 6000/7000 Series Methods

Aluminum	1220	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Antimony	ND	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Arsenic	229	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Barium	1.85	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Beryllium	ND	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Boron	3.50	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cadmium	0.554	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Calcium	71.7	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Chromium	5.78	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Cobalt	ND	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Copper	0.531	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J, B
Iron	21600	1.54	7.70	mg/kg	18-Apr-2016	20-Apr-2016	SW 846/6010	
Lead	1.47	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Lithium	ND	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Magnesium	6.28	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Manganese	3.31	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Nickel	ND	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Phosphorus	107	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Potassium	26.7	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Selenium	ND	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Silver	ND	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Sodium	ND	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Strontium	0.529	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Sulfur	20.0	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Thallium	1.36	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	J
Tin	ND	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	U
Titanium	51.3	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Vanadium	6.35	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	
Zinc	4.01	0.385	1.92	mg/kg	18-Apr-2016	18-Apr-2016	SW 846/6010	

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Philadelphia District
 Wanamaker Building, 100 Penn Square East
 Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
 13-Jul-2016

ASB-1 29-30

6040703-07 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Carbonate

Aluminum	9.10	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic	10.2	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Iron	9.78	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	13.7	0.0398	0.199	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Exchangeable

Aluminum	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Lead	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	80.0	400	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	9.95	49.8	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U

Metals Sequential Extractions Oxide

Aluminum	85.9	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	33.4	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	524	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	74.9	0.398	1.99	mg/kg	27-May-2016	31-May-2016	SW 846/6020	



USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
Wanamaker Building, 100 Penn Square East
Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
13-Jul-2016

ASB-1 29-30

6040703-07 (Soil/Sediment)

Analyte	Result	Detection Limit	Reporting Limit	Units	Prepared	Analyzed	Method	Notes
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ERDC-EL-EP-C

Metals Sequential Extractions Residual

Aluminum	243	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	40.9	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Iron	4400	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	5.30	0.800	4.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic-75 [2]	38.6	0.199	0.995	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Soluble

Aluminum	17.2	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	5.64	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Iron	24.0	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	4.95	1.60	8.00	mg/kg	09-May-2016	10-May-2016	SW 846/6010	J
Arsenic-75 [2]	5.31	0.199	0.995	mg/kg	27-May-2016	31-May-2016	SW 846/6020	

Metals Sequential Extractions Sulfide / Organic

Aluminum	20.8	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Arsenic	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Iron	27.3	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	
Lead	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Manganese	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Sulfur	ND	4.00	20.0	mg/kg	09-May-2016	10-May-2016	SW 846/6010	U
Arsenic-75 [2]	ND	0.398	1.99	mg/kg	27-May-2016	31-May-2016	SW 846/6020	U

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USACE ERDC-EP-C
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Project: Vineland

Project Manager: Joe Loeper

Reported:
 13-Jul-2016

Metals by EPA 6000/7000 Series Methods - Quality Control

ERDC-EL-EP-C

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B604066 - Default Prep Metals

Blank (B604066-BLK1)

Prepared & Analyzed: 18-Apr-2016

Aluminum	1.71	0.400	2.00	mg/kg							J
Antimony	ND	0.400	2.00	mg/kg							U
Arsenic	ND	0.400	2.00	mg/kg							U
Barium	ND	0.400	2.00	mg/kg							U
Beryllium	ND	0.400	2.00	mg/kg							U
Boron	1.58	0.400	2.00	mg/kg							J
Cadmium	ND	0.400	2.00	mg/kg							U
Calcium	0.878	0.400	2.00	mg/kg							J
Chromium	ND	0.400	2.00	mg/kg							U
Cobalt	ND	0.400	2.00	mg/kg							U
Copper	8.46	0.400	2.00	mg/kg							
Iron	1.12	0.400	2.00	mg/kg							J
Lead	ND	0.400	2.00	mg/kg							U
Lithium	ND	0.400	2.00	mg/kg							U
Magnesium	ND	0.400	2.00	mg/kg							U
Manganese	ND	0.400	2.00	mg/kg							U
Nickel	ND	0.400	2.00	mg/kg							U
Phosphorus	1.35	0.400	2.00	mg/kg							J
Potassium	ND	0.400	2.00	mg/kg							U
Selenium	ND	0.400	2.00	mg/kg							U
Silver	ND	0.400	2.00	mg/kg							U
Sodium	ND	0.400	2.00	mg/kg							U
Strontium	ND	0.400	2.00	mg/kg							U
Sulfur	ND	0.400	2.00	mg/kg							U
Thallium	ND	0.400	2.00	mg/kg							U
Tin	0.592	0.400	2.00	mg/kg							J
Titanium	ND	0.400	2.00	mg/kg							U
Vanadium	ND	0.400	2.00	mg/kg							U
Zinc	ND	0.400	2.00	mg/kg							U

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Reported:
 13-Jul-2016

Metals by EPA 6000/7000 Series Methods - Quality Control

ERDC-EL-EP-C

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B604066 - Default Prep Metals

LCS (B604066-BS1)

Prepared & Analyzed: 18-Apr-2016

Aluminum	4620	0.400	2.00	mg/kg	5000		92.3	80-120			
Antimony	96.5	0.400	2.00	mg/kg	100.0		96.5	80-120			
Arsenic	48.5	0.400	2.00	mg/kg	50.00		97.0	80-120			
Barium	188	0.400	2.00	mg/kg	200.0		94.1	80-120			
Beryllium	47.2	0.400	2.00	mg/kg	50.00		94.5	80-120			
Boron	49.0	0.400	2.00	mg/kg	50.00		98.0	80-120			
Cadmium	49.8	0.400	2.00	mg/kg	50.00		99.6	80-120			
Calcium	4920	0.400	2.00	mg/kg	5000		98.4	80-120			
Chromium	101	0.400	2.00	mg/kg	100.0		101	80-120			
Cobalt	118	0.400	2.00	mg/kg	100.0		118	80-120			
Copper	106	0.400	2.00	mg/kg	100.0		106	80-120			
Iron	5030	0.400	2.00	mg/kg	5000		101	80-120			
Lead	91.8	0.400	2.00	mg/kg	100.0		91.8	80-120			
Lithium	91.6	0.400	2.00	mg/kg	100.0		91.6	80-120			
Magnesium	4710	0.400	2.00	mg/kg	5000		94.3	80-120			
Manganese	239	0.400	2.00	mg/kg	250.0		95.6	80-120			
Nickel	90.4	0.400	2.00	mg/kg	100.0		90.4	80-120			
Phosphorus	99.5	0.400	2.00	mg/kg	100.0		99.5	80-120			
Potassium	4370	0.400	2.00	mg/kg	5000		87.4	80-120			
Selenium	44.3	0.400	2.00	mg/kg	50.00		88.6	80-120			
Silver	48.9	0.400	2.00	mg/kg	50.00		97.9	80-120			
Sodium	4620	0.400	2.00	mg/kg	5000		92.3	80-120			
Strontium	48.9	0.400	2.00	mg/kg	50.00		97.9	80-120			
Sulfur	95.6	0.400	2.00	mg/kg	100.0		95.6	80-120			
Thallium	44.5	0.400	2.00	mg/kg	50.00		89.0	80-120			
Tin	50.8	0.400	2.00	mg/kg	50.00		102	80-120			
Titanium	51.9	0.400	2.00	mg/kg	50.00		104	80-120			
Vanadium	103	0.400	2.00	mg/kg	100.0		103	80-120			
Zinc	183	0.400	2.00	mg/kg	200.0		91.5	80-120			

B

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 13-Jul-2016

Metals by EPA 6000/7000 Series Methods - Quality Control

ERDC-EL-EP-C

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B604066 - Default Prep Metals

Duplicate (B604066-DUP1)		Source: 6040702-10			Prepared & Analyzed: 18-Apr-2016						
Aluminum	748	0.378	1.89	mg/kg	695				7.26	20	
Antimony	ND	0.378	1.89	mg/kg	ND					20	U
Arsenic	9.48	0.378	1.89	mg/kg	8.62				9.51	20	
Barium	2.47	0.378	1.89	mg/kg	2.34				5.05	20	
Beryllium	ND	0.378	1.89	mg/kg	ND					20	U
Boron	ND	0.378	1.89	mg/kg	ND					20	U
Cadmium	ND	0.378	1.89	mg/kg	ND					20	U
Calcium	55.6	0.378	1.89	mg/kg	49.5				11.6	20	
Chromium	2.39	0.378	1.89	mg/kg	2.17				9.73	20	
Cobalt	ND	0.378	1.89	mg/kg	ND					20	U
Copper	4.93	0.378	1.89	mg/kg	2.12				79.6	20	RPD-06, B
Iron	2260	0.378	1.89	mg/kg	1950				14.9	20	
Lead	1.05	0.378	1.89	mg/kg	1.01				3.29	20	J
Lithium	ND	0.378	1.89	mg/kg	ND					20	U
Magnesium	23.2	0.378	1.89	mg/kg	21.6				7.21	20	
Manganese	2.62	0.378	1.89	mg/kg	2.49				4.87	20	
Nickel	0.443	0.378	1.89	mg/kg	0.448				1.15	20	J
Phosphorus	20.8	0.378	1.89	mg/kg	19.4				7.19	20	
Potassium	17.1	0.378	1.89	mg/kg	15.6				9.12	20	
Selenium	ND	0.378	1.89	mg/kg	ND					20	U
Silver	ND	0.378	1.89	mg/kg	ND					20	U
Sodium	ND	0.378	1.89	mg/kg	ND					20	U
Strontium	0.780	0.378	1.89	mg/kg	0.744				4.75	20	J
Sulfur	ND	0.378	1.89	mg/kg	ND					20	U
Thallium	0.812	0.378	1.89	mg/kg	0.927				13.2	20	J
Tin	5.41	0.378	1.89	mg/kg	ND					20	
Titanium	30.7	0.378	1.89	mg/kg	29.5				3.94	20	
Vanadium	2.52	0.378	1.89	mg/kg	2.14				16.3	20	
Zinc	1.60	0.378	1.89	mg/kg	1.05				41.3	20	RPD-01, J

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Reported:
 13-Jul-2016

Metals by EPA 6000/7000 Series Methods - Quality Control

ERDC-EL-EP-C

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B604066 - Default Prep Metals

Matrix Spike (B604066-MS1)		Source: 6040702-10			Prepared & Analyzed: 18-Apr-2016						
Aluminum	5730	0.394	1.97	mg/kg	4919	695	102	80-120			
Antimony	39.1	0.394	1.97	mg/kg	98.39	ND	39.7	80-120			QM-11
Arsenic	56.9	0.394	1.97	mg/kg	49.19	8.62	98.2	80-120			
Barium	187	0.394	1.97	mg/kg	196.8	2.34	93.9	80-120			
Beryllium	45.9	0.394	1.97	mg/kg	49.19	ND	93.2	80-120			
Boron	46.0	0.394	1.97	mg/kg	49.19	ND	93.4	80-120			
Cadmium	47.5	0.394	1.97	mg/kg	49.19	ND	96.6	80-120			
Calcium	4770	0.394	1.97	mg/kg	4919	49.5	95.9	80-120			
Chromium	99.9	0.394	1.97	mg/kg	98.39	2.17	99.4	80-120			
Cobalt	97.8	0.394	1.97	mg/kg	98.39	ND	99.4	80-120			
Copper	97.8	0.394	1.97	mg/kg	98.39	2.12	97.3	80-120			B
Iron	7000	0.394	1.97	mg/kg	4919	1950	103	80-120			
Lead	90.8	0.394	1.97	mg/kg	98.39	1.01	91.3	80-120			
Lithium	89.5	0.394	1.97	mg/kg	98.39	ND	90.9	80-120			
Magnesium	4600	0.394	1.97	mg/kg	4919	21.6	93.0	80-120			
Manganese	235	0.394	1.97	mg/kg	246.0	2.49	94.4	80-120			
Nickel	87.5	0.394	1.97	mg/kg	98.39	0.448	88.5	80-120			
Phosphorus	113	0.394	1.97	mg/kg	98.39	19.4	95.4	80-120			
Potassium	4310	0.394	1.97	mg/kg	4919	15.6	87.2	80-120			
Selenium	41.9	0.394	1.97	mg/kg	49.19	ND	85.3	80-120			
Silver	42.8	0.394	1.97	mg/kg	49.19	ND	87.0	80-120			
Sodium	4500	0.394	1.97	mg/kg	4919	ND	91.5	80-120			
Strontium	48.0	0.394	1.97	mg/kg	49.19	0.744	96.1	80-120			
Sulfur	84.0	0.394	1.97	mg/kg	98.39	ND	85.4	80-120			
Thallium	43.2	0.394	1.97	mg/kg	49.19	0.927	86.0	80-120			
Tin	37.9	0.394	1.97	mg/kg	49.19	ND	77.0	80-120			QM-11
Titanium	68.0	0.394	1.97	mg/kg	49.19	29.5	78.2	80-120			QM-11
Vanadium	101	0.394	1.97	mg/kg	98.39	2.14	100	80-120			
Zinc	176	0.394	1.97	mg/kg	196.8	1.05	88.7	80-120			

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Project Manager: Joe Loeper

Reported:
13-Jul-2016

Metals Sequential Extractions Carbonate - Quality Control

ERDC-EL-EP-C

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B606014 - Default Prep Metals

Blank (B606014-BLK1)

Prepared: 09-May-2016 Analyzed: 10-May-2016

Aluminum	ND	0.400	2.00	mg/kg							U
Arsenic	ND	0.400	2.00	mg/kg							U
Iron	ND	0.400	2.00	mg/kg							U
Lead	ND	0.400	2.00	mg/kg							U
Manganese	ND	0.400	2.00	mg/kg							U
Sulfur	ND	0.400	2.00	mg/kg							U

Duplicate (B606014-DUP1)

Source: 6040703-01

Prepared: 09-May-2016 Analyzed: 10-May-2016

Aluminum	8.14	4.00	20.0	mg/kg		8.38			3.01	20	J
Arsenic	ND	4.00	20.0	mg/kg		ND				20	U
Iron	11.4	4.00	20.0	mg/kg		10.9			4.61	20	J
Lead	ND	4.00	20.0	mg/kg		ND				20	U
Manganese	ND	4.00	20.0	mg/kg		ND				20	U
Sulfur	ND	4.00	20.0	mg/kg		ND				20	U

Batch B606057 - Default Prep Metals

Blank (B606057-BLK1)

Prepared: 27-May-2016 Analyzed: 31-May-2016

Arsenic-75 [2]	ND	0.0400	0.200	mg/kg							U
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Metals Sequential Extractions Exchangeable - Quality Control

ERDC-EL-EP-C

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B606013 - Default Prep Metals

Blank (B606013-BLK1)

Prepared: 09-May-2016 Analyzed: 10-May-2016

Aluminum	ND	80.0	400	mg/kg							U
Arsenic	ND	80.0	400	mg/kg							U
Iron	ND	80.0	400	mg/kg							U
Lead	ND	80.0	400	mg/kg							U
Manganese	ND	80.0	400	mg/kg							U
Sulfur	ND	80.0	400	mg/kg							U

Batch B606058 - Default Prep Metals

Blank (B606058-BLK1)

Prepared: 27-May-2016 Analyzed: 31-May-2016

Arsenic-75 [2]	ND	10.0	50.0	mg/kg							U
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Metals Sequential Extractions Oxide - Quality Control

ERDC-EL-EP-C

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B606015 - Default Prep Metals

Blank (B606015-BLK1)

Prepared: 09-May-2016 Analyzed: 10-May-2016

Aluminum	ND	0.400	2.00	mg/kg							U
Arsenic	ND	0.400	2.00	mg/kg							U
Iron	ND	0.400	2.00	mg/kg							U
Lead	ND	0.400	2.00	mg/kg							U
Manganese	ND	0.400	2.00	mg/kg							U
Sulfur	ND	0.400	2.00	mg/kg							U

Duplicate (B606015-DUP1)

Source: 6040703-01

Prepared: 09-May-2016 Analyzed: 10-May-2016

Aluminum	165	4.00	20.0	mg/kg		163			1.14	20	
Arsenic	ND	4.00	20.0	mg/kg		ND				20	U
Iron	827	4.00	20.0	mg/kg		817			1.17	20	
Lead	ND	4.00	20.0	mg/kg		ND				20	U
Manganese	ND	4.00	20.0	mg/kg		ND				20	U
Sulfur	ND	4.00	20.0	mg/kg		ND				20	U

Batch B606059 - Default Prep Metals

Blank (B606059-BLK1)

Prepared: 27-May-2016 Analyzed: 31-May-2016

Arsenic-75 [2]	ND	0.400	2.00	mg/kg							U
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USACE ERDC-EP-C
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Metals Sequential Extractions Residual - Quality Control

ERDC-EL-EP-C

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B606017 - Default Prep Metals

Blank (B606017-BLK1)

Prepared: 09-May-2016 Analyzed: 10-May-2016

Aluminum	ND	0.400	2.00	mg/kg							U
Arsenic	ND	0.400	2.00	mg/kg							U
Iron	ND	0.400	2.00	mg/kg							U
Lead	ND	0.400	2.00	mg/kg							U
Manganese	ND	0.400	2.00	mg/kg							U
Sulfur	ND	0.400	2.00	mg/kg							U

Duplicate (B606017-DUP1)

Source: 6040703-01

Prepared: 09-May-2016 Analyzed: 10-May-2016

Aluminum	494	0.800	4.00	mg/kg		463			6.44	20	
Arsenic	20.9	0.800	4.00	mg/kg		20.1			3.71	20	
Iron	4460	0.800	4.00	mg/kg		4250			4.97	20	
Lead	ND	0.800	4.00	mg/kg		ND				20	U
Manganese	ND	0.800	4.00	mg/kg		ND				20	U
Sulfur	3.42	0.800	4.00	mg/kg		3.05			11.3	20	J

Batch B606060 - Default Prep Metals

Blank (B606060-BLK1)

Prepared: 27-May-2016 Analyzed: 31-May-2016

Arsenic-75 [2]	ND	0.200	1.00	mg/kg							U
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Project Manager: Joe Loeper

Reported:
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Metals Sequential Extractions Soluble - Quality Control

ERDC-EL-EP-C

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B606012 - Default Prep Metals

Blank (B606012-BLK1)

Prepared: 09-May-2016 Analyzed: 10-May-2016

Aluminum	ND	1.60	8.00	mg/kg							U
Arsenic	ND	1.60	8.00	mg/kg							U
Iron	ND	1.60	8.00	mg/kg							U
Lead	ND	1.60	8.00	mg/kg							U
Manganese	ND	1.60	8.00	mg/kg							U
Sulfur	ND	1.60	8.00	mg/kg							U

Batch B606061 - Default Prep Metals

Blank (B606061-BLK1)

Prepared: 27-May-2016 Analyzed: 31-May-2016

Arsenic-75 [2]	ND	0.200	1.00	mg/kg							U
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USACE ERDC-EP-C
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Philadelphia District
Wanamaker Building, 100 Penn Square East
Philadelphia PA, 19107-3390

Project: Vineland

Project Manager: Joe Loeper

Reported:
13-Jul-2016

Metals Sequential Extractions Sulfide / Organic - Quality Control

ERDC-EL-EP-C

Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B606016 - Default Prep Metals

Blank (B606016-BLK1)

Prepared: 09-May-2016 Analyzed: 03-Jun-2016

Aluminum	ND	0.400	2.00	mg/kg							U
Arsenic	ND	4.00	20.0	mg/kg							U
Iron	ND	0.400	2.00	mg/kg							U
Lead	ND	4.00	20.0	mg/kg							U
Manganese	ND	0.400	2.00	mg/kg							U
Sulfur	ND	4.00	20.0	mg/kg							U

Duplicate (B606016-DUP1)

Source: 6040703-01

Prepared: 09-May-2016 Analyzed: 10-May-2016

Aluminum	37.0	4.00	20.0	mg/kg		35.7			3.52	20	
Iron	37.5	4.00	20.0	mg/kg		35.2			6.28	20	
Manganese	ND	4.00	20.0	mg/kg		ND				20	U

Batch B606062 - Default Prep Metals

Blank (B606062-BLK1)

Prepared: 27-May-2016 Analyzed: 31-May-2016

Arsenic-75 [2]	ND	0.400	2.00	mg/kg							U
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6040702

CHAIN OF CUSTODY RECORD

PROJ. NO.		PROJECT NAME		NO. OF CON-TAINERS		REMARKS					
SAMPLERS: (Signature)		Vineland, NJ									
STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION						
3/31	0920	X			MW755-TC(3/31)	3	1	1	1	Dissolved Samples were filtered upon collection with a 0.45µm syringe filter. Samples for As (III) + As(V) were preserved with EDTA and acetic acid.	
4/1	0950	X			No Soil #1	2	1	1			
	1000	X			Sand #2	2	1	1			
	1010	X			Sand #3	2	1	1			
	1020	X			Sand #4	2	1	1			
	1030	X			Sand #5	2	1	1			
	1040	X			Sand #6	2	1	1			
	1050	X			Sand #7	2	1	1			
	1100	X			Sand #8	2	1	1			
4/10	0940	X			MP-1 (22.5-25)	1	1	1			
Relinquished by: (Signature)		Date / Time		Received by: (Signature)		Relinquished by: (Signature)		Date / Time		Received by: (Signature)	
Thia Nea		4/10/10 1200		Fedex				4/1/10 11:30		J. J. J. J.	
Relinquished by: (Signature)		Date / Time		Received by: (Signature)		Relinquished by: (Signature)		Date / Time		Received by: (Signature)	
Relinquished by: (Signature)		Date / Time		Received for Laboratory by: (Signature)		Date / Time		Remarks			
								2 week turn around time for water samples			

11768

Items for Project Manager Review

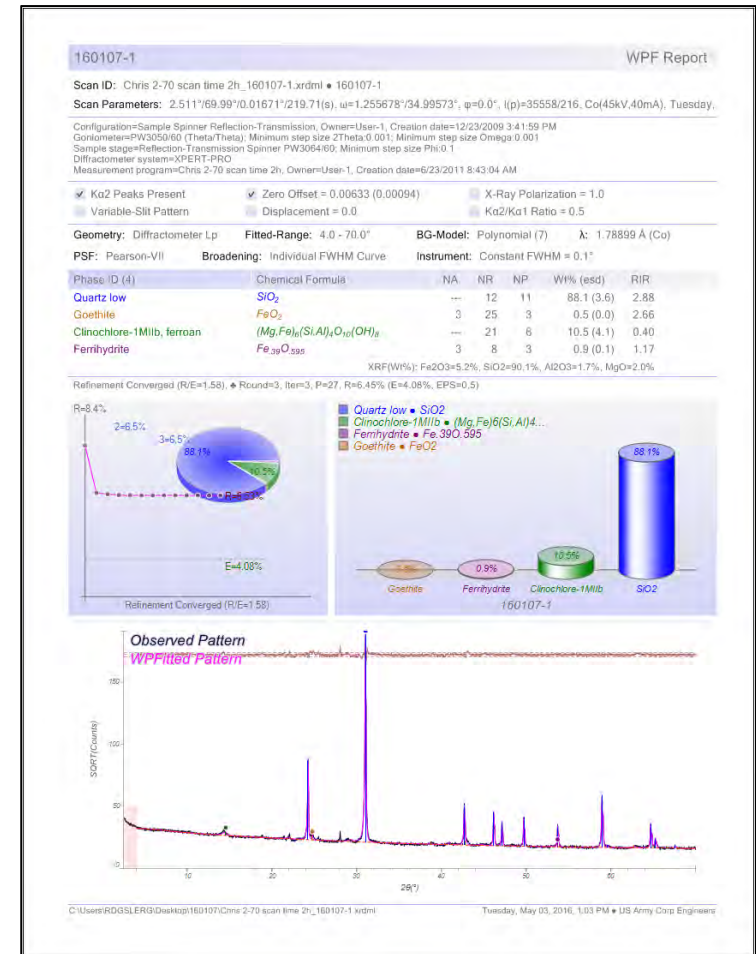
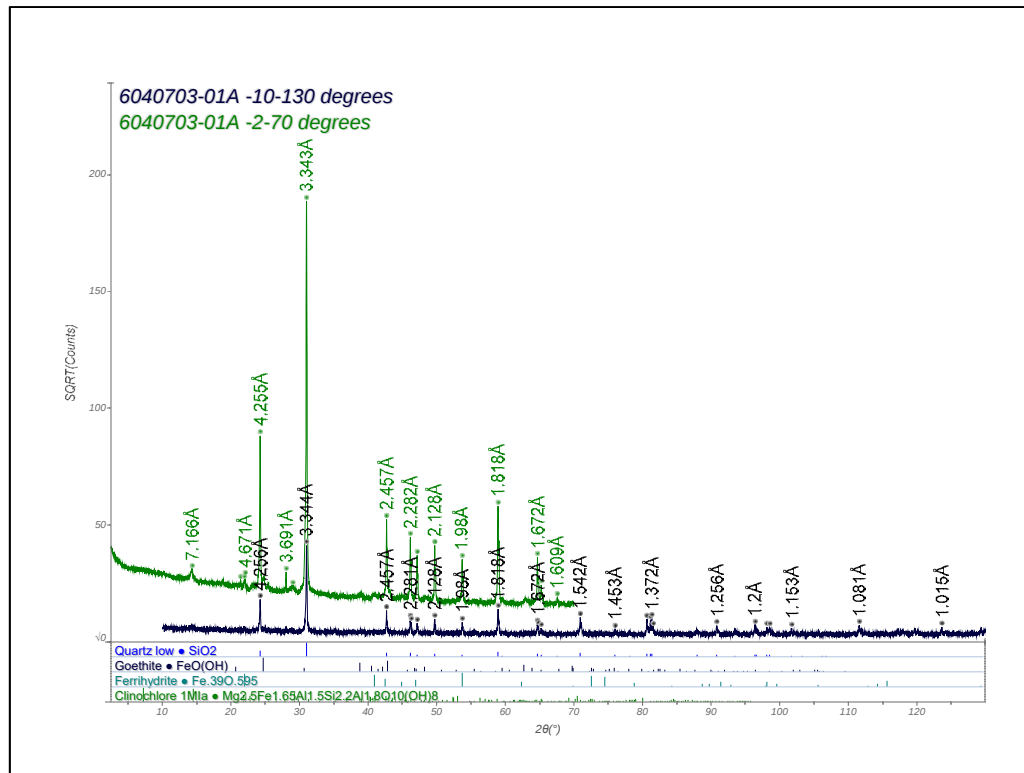
LabNumber	Analysis	Analyte	Exception
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Appendix B

XRD Analysis for ASB-1 and ASB-2
ERDC-EL

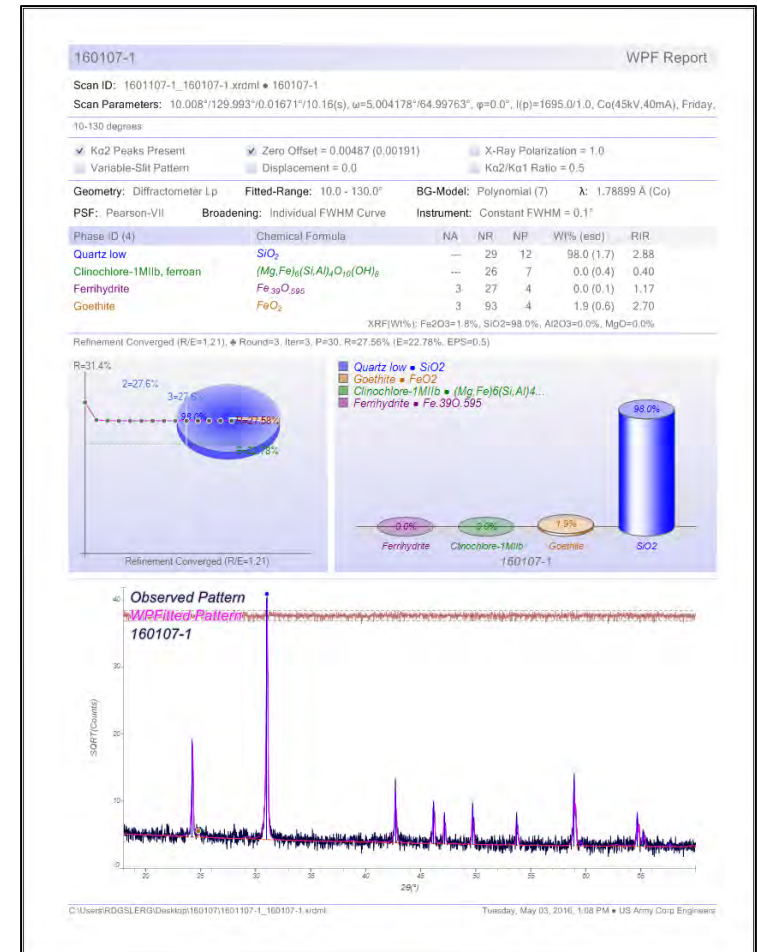
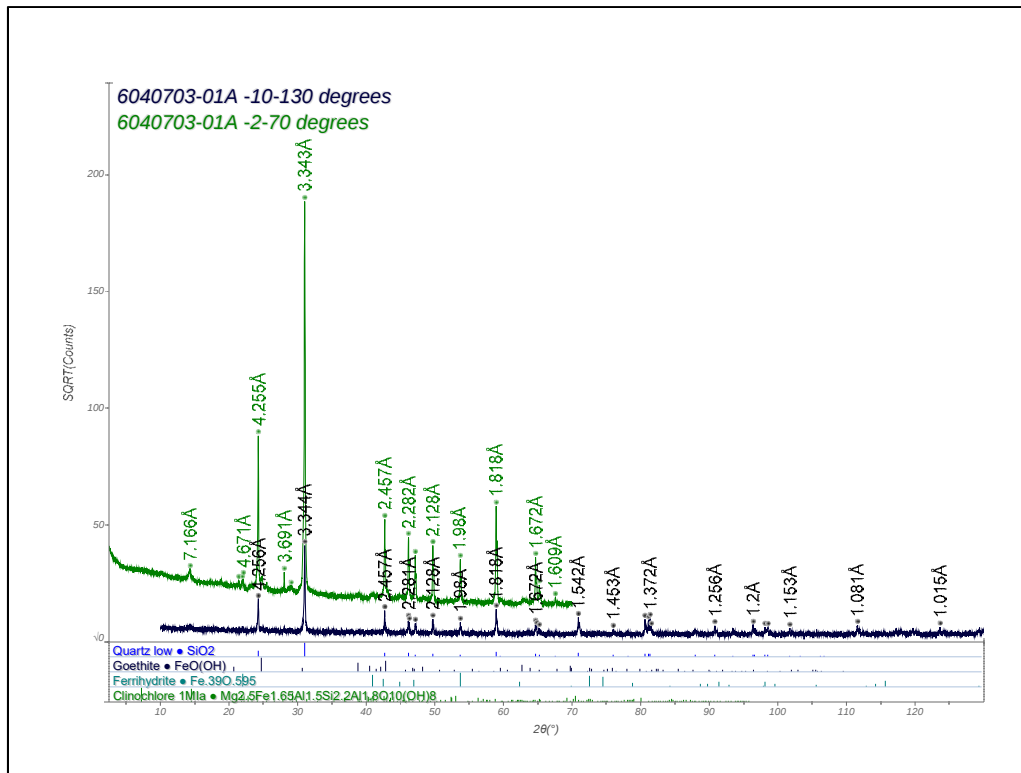
EBC ID: 6040703-01A

ASB-2 26-27



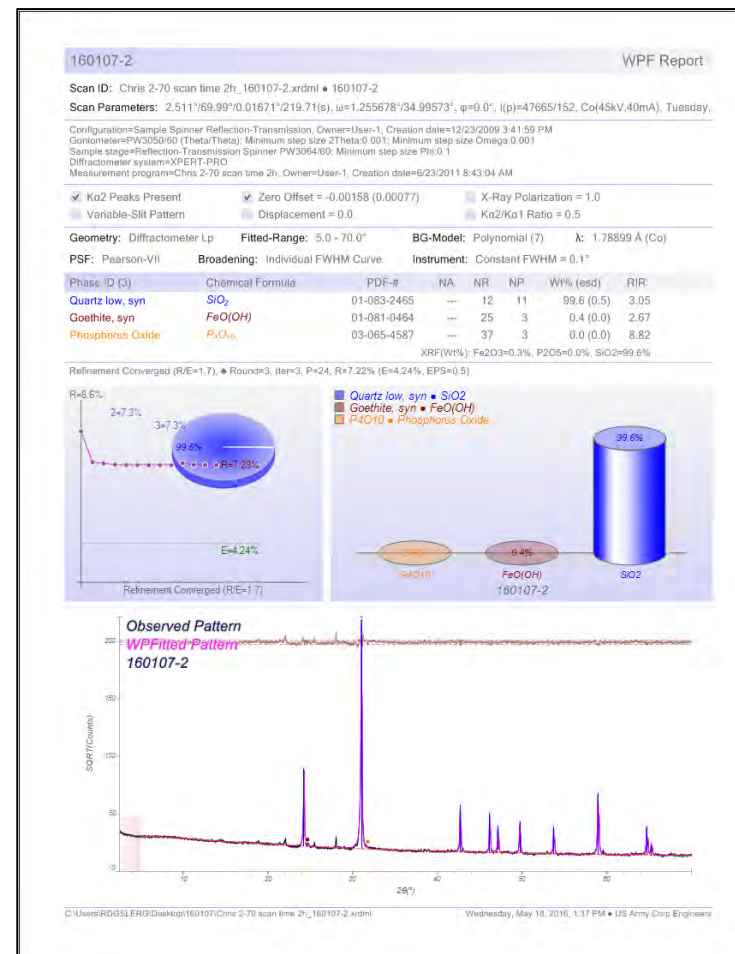
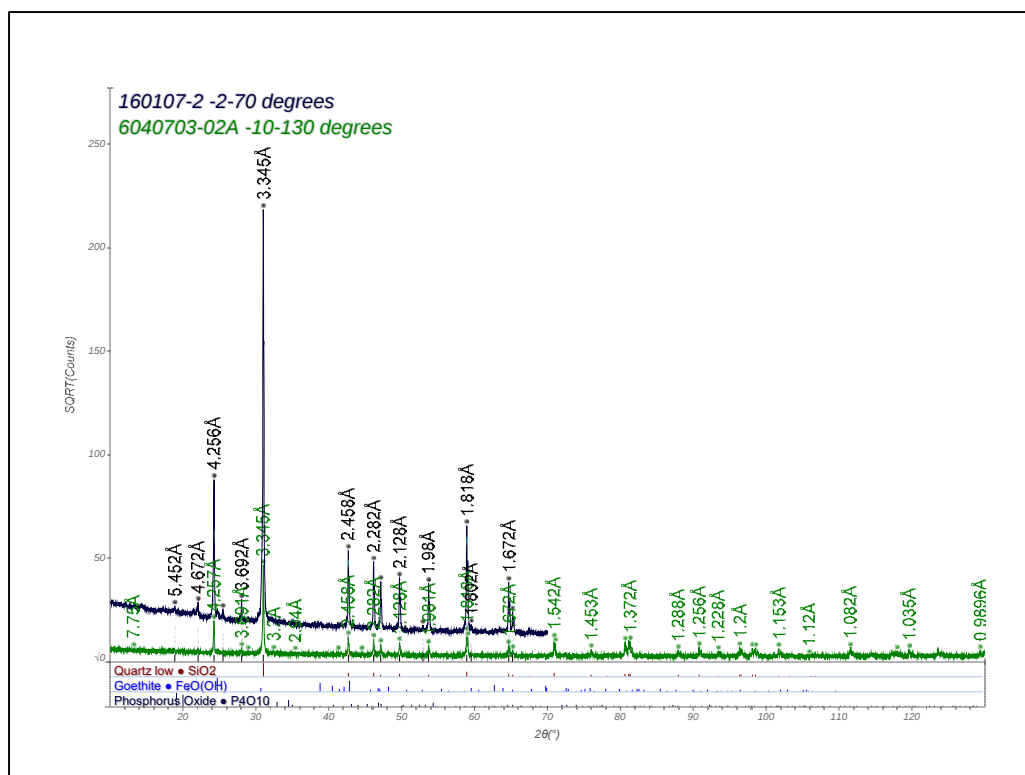
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ASB-2 26-27



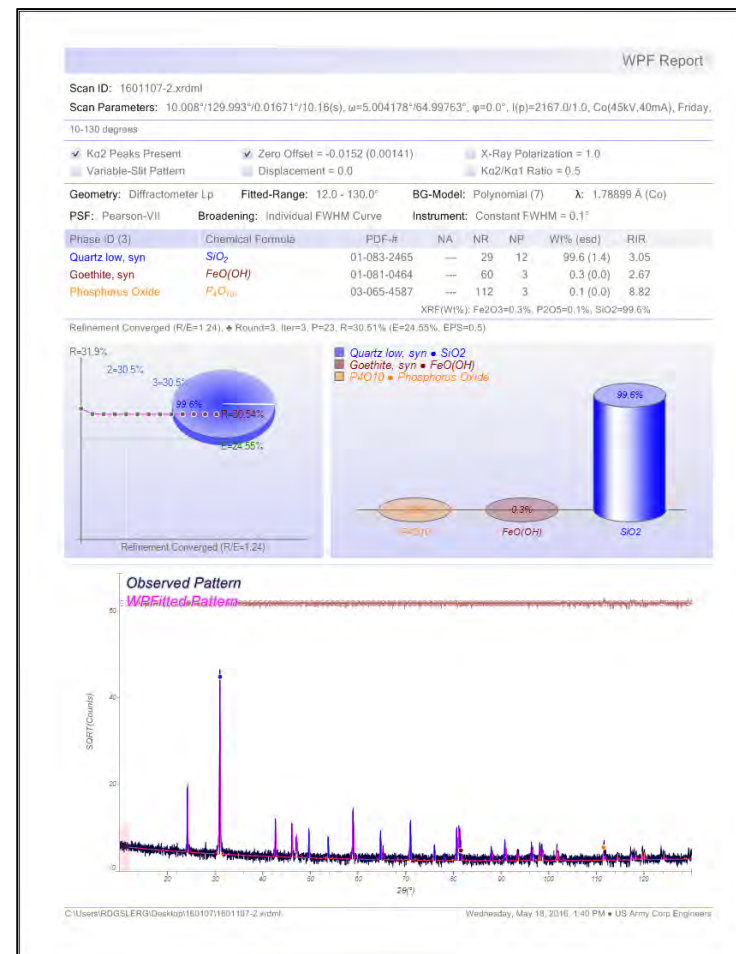
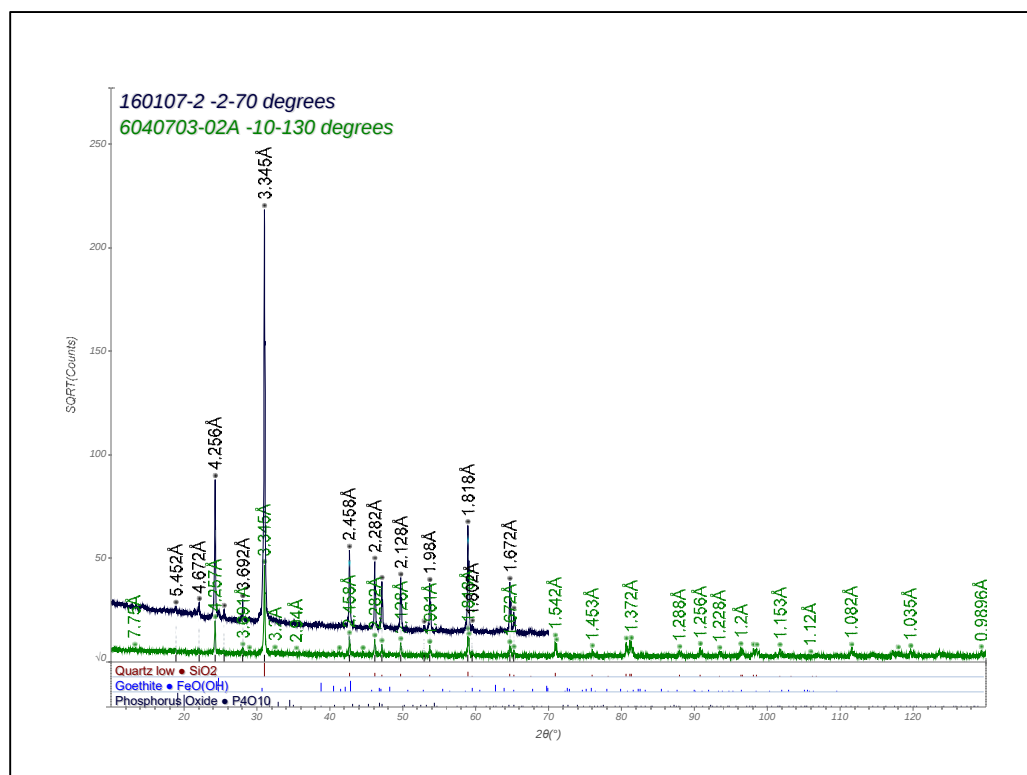
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ASB-2 30-31



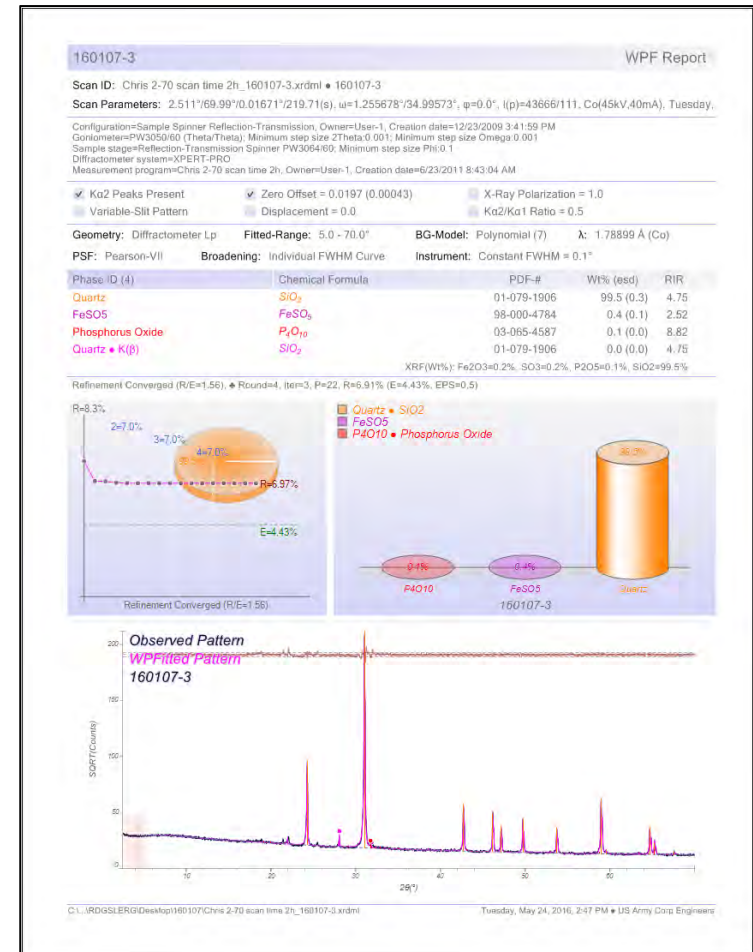
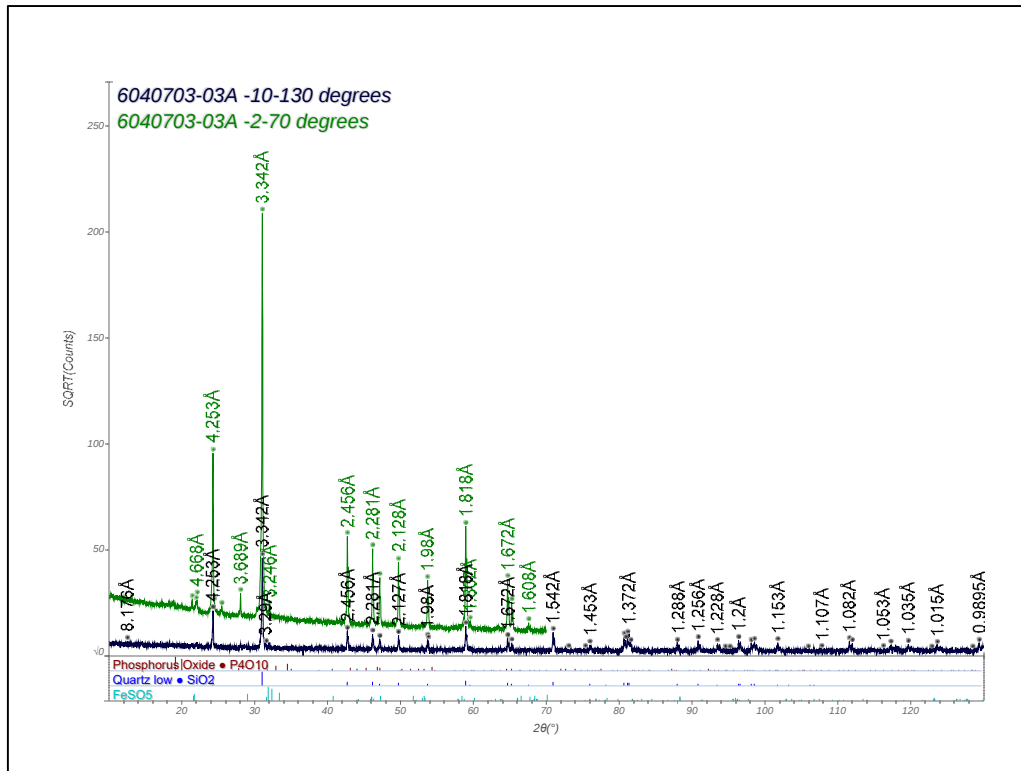
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ASB-2 30-31



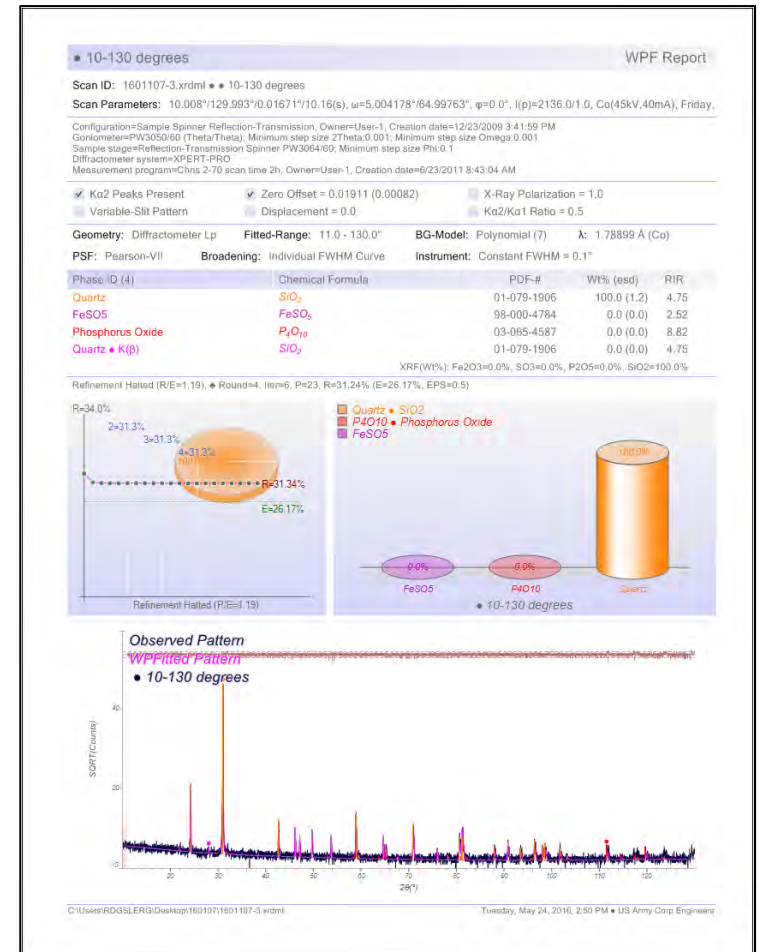
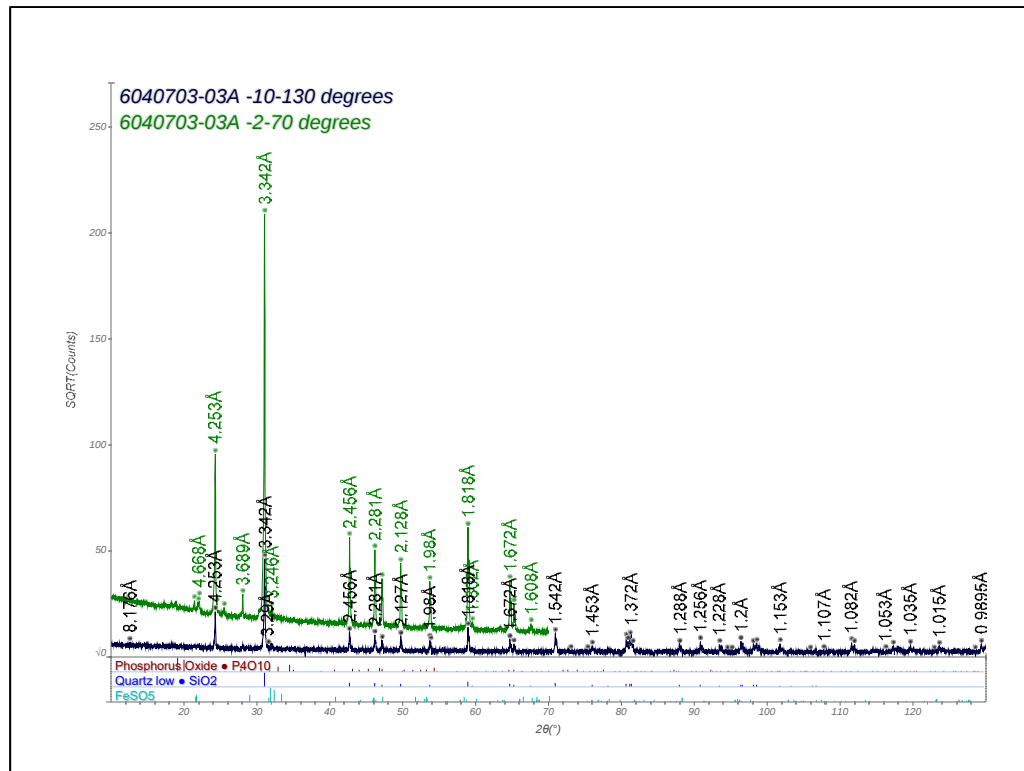
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ASB-2 31-32



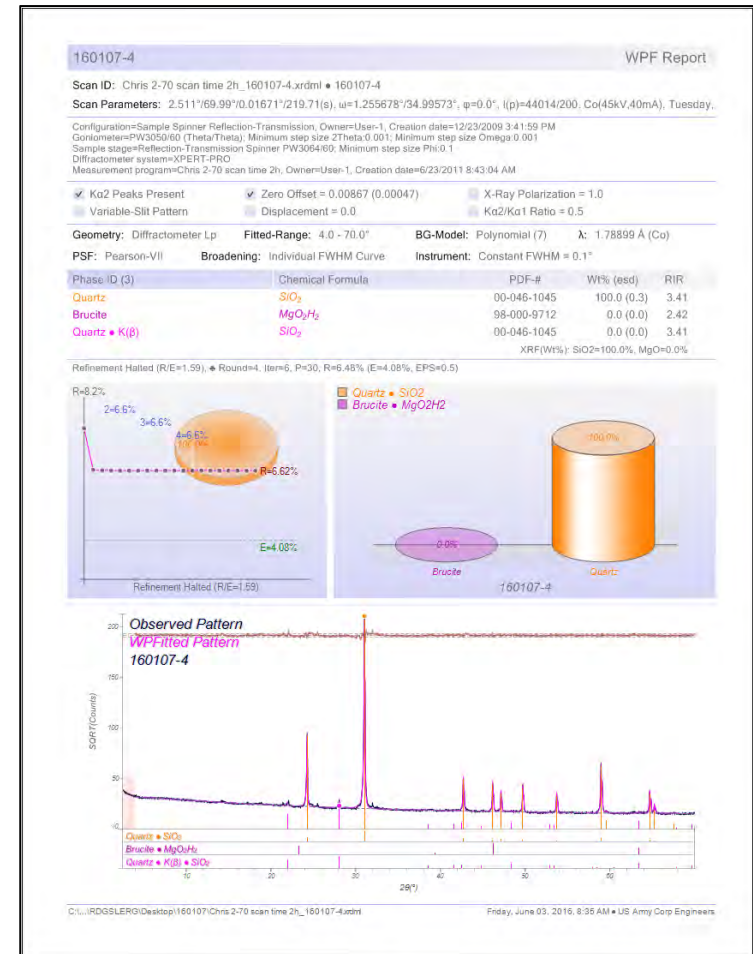
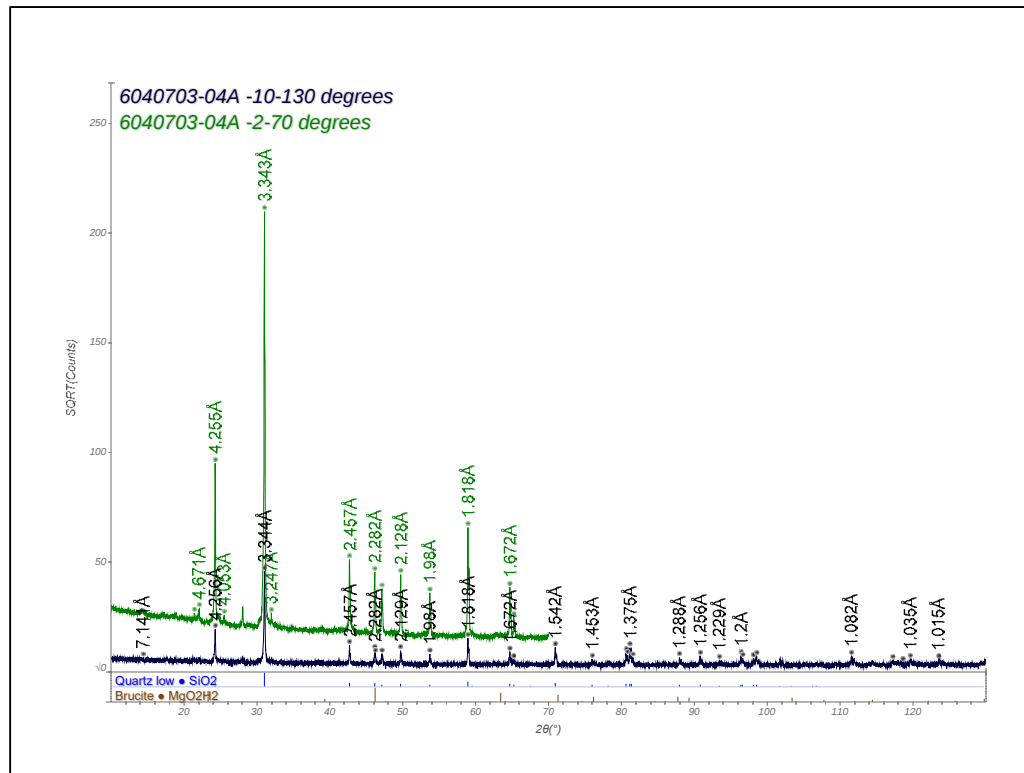
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ASB-2 31-32



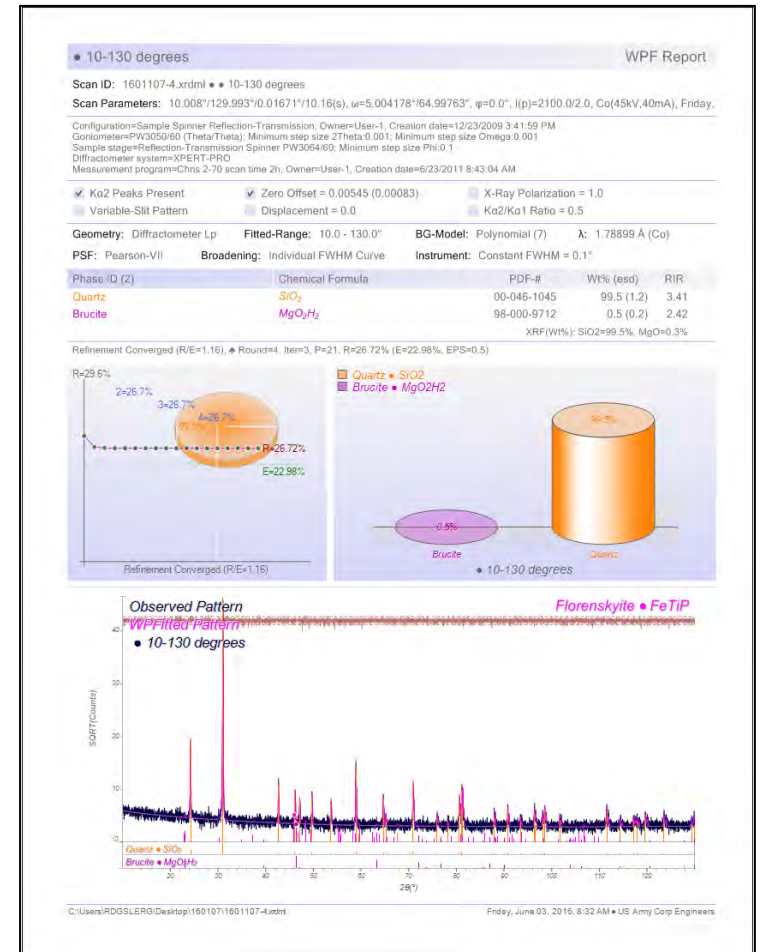
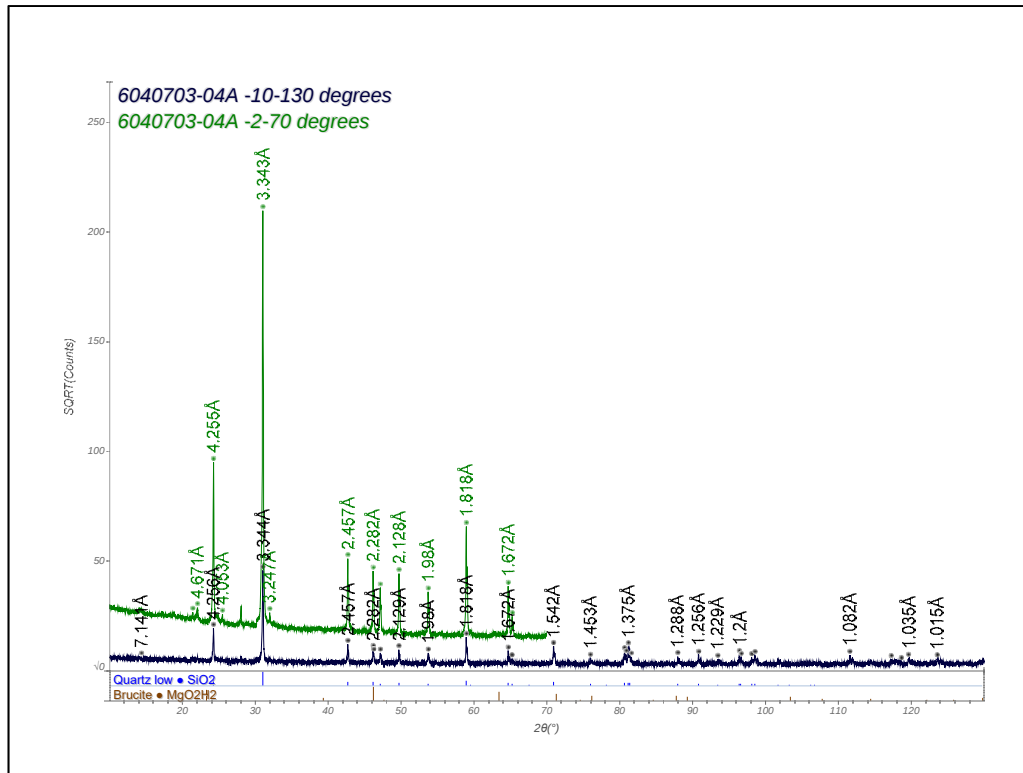
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ABS-1 26-27



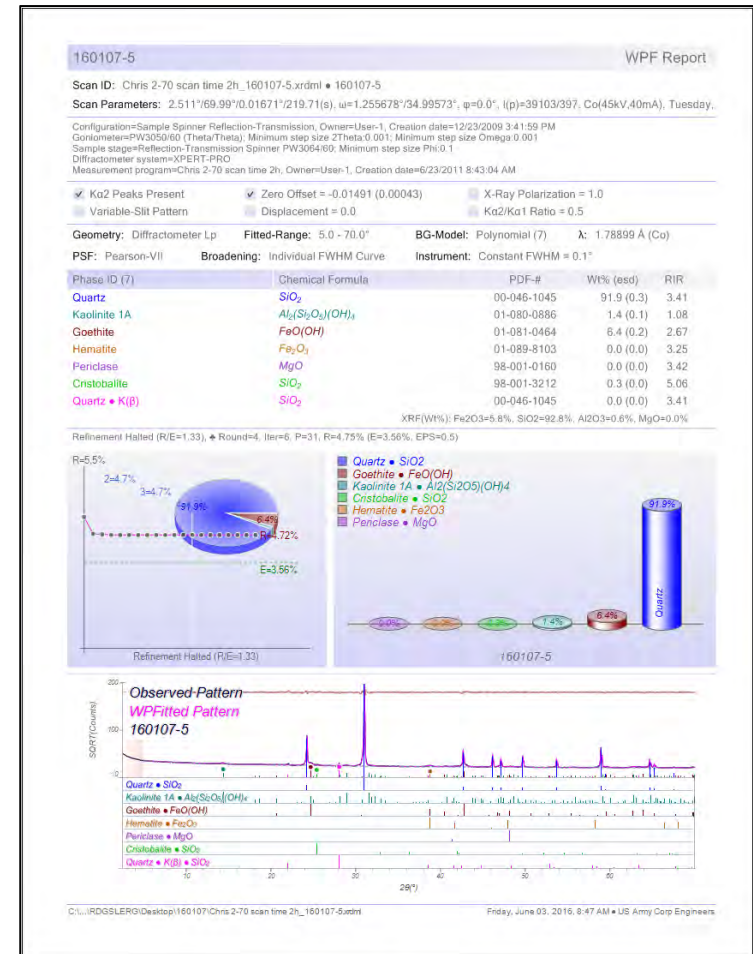
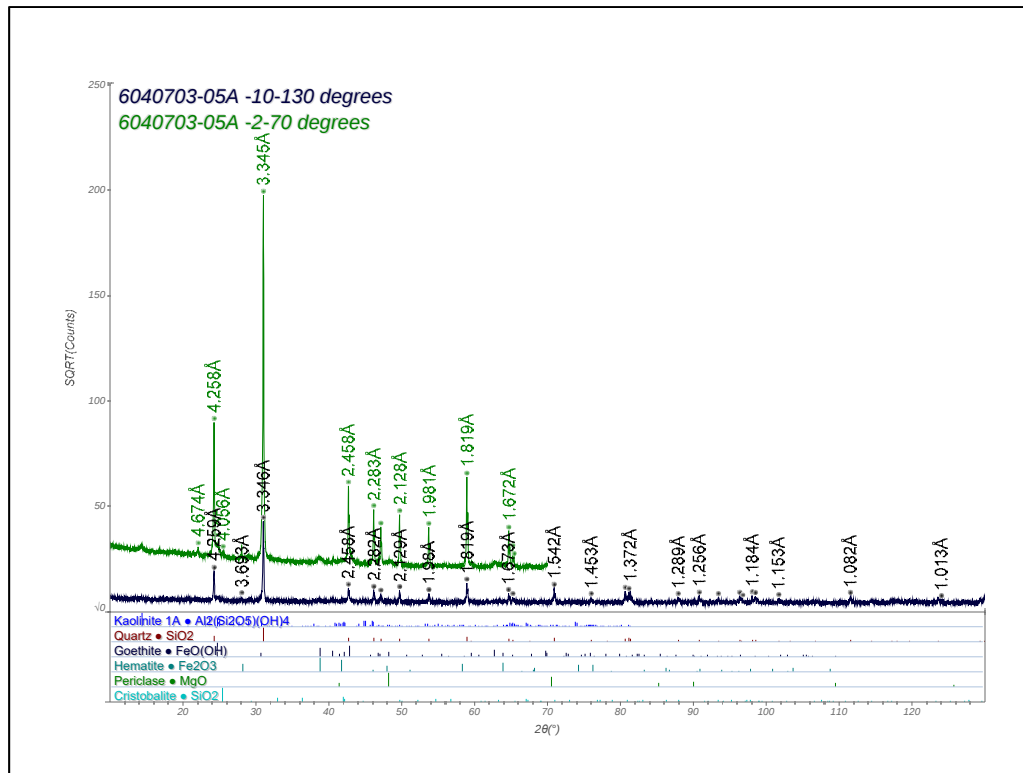
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ABS-1 26-27



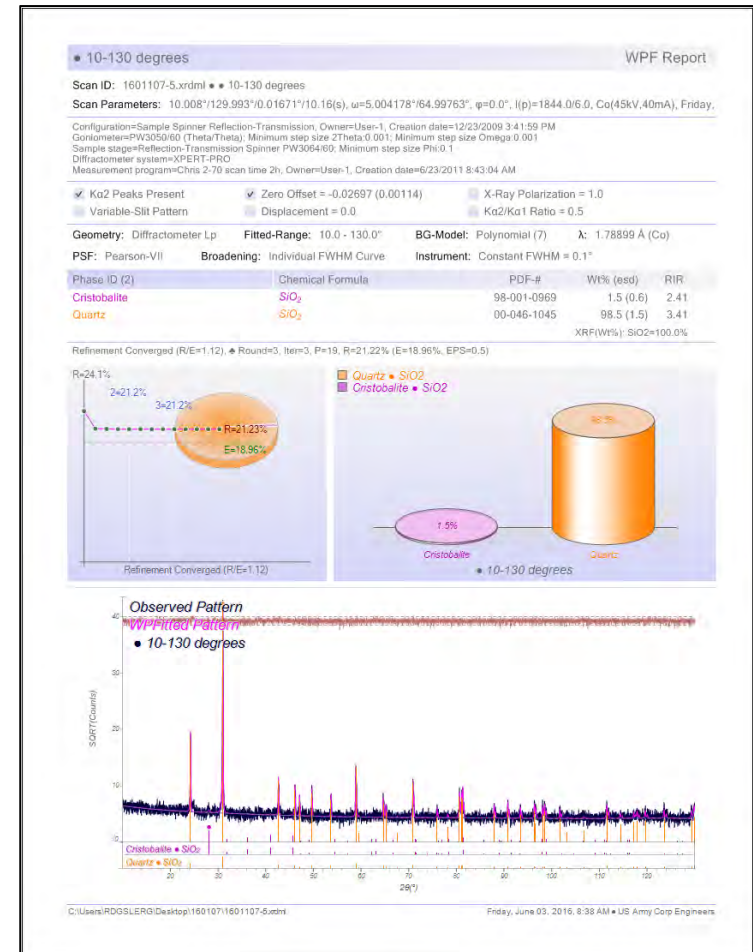
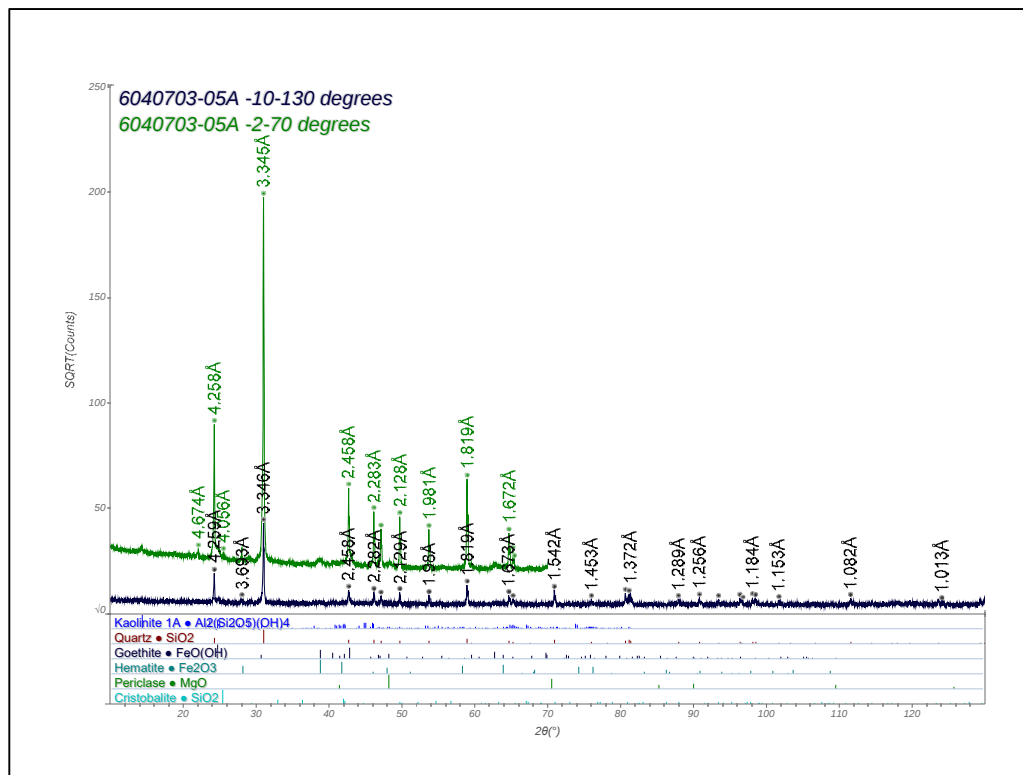
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ABS-1 27-28



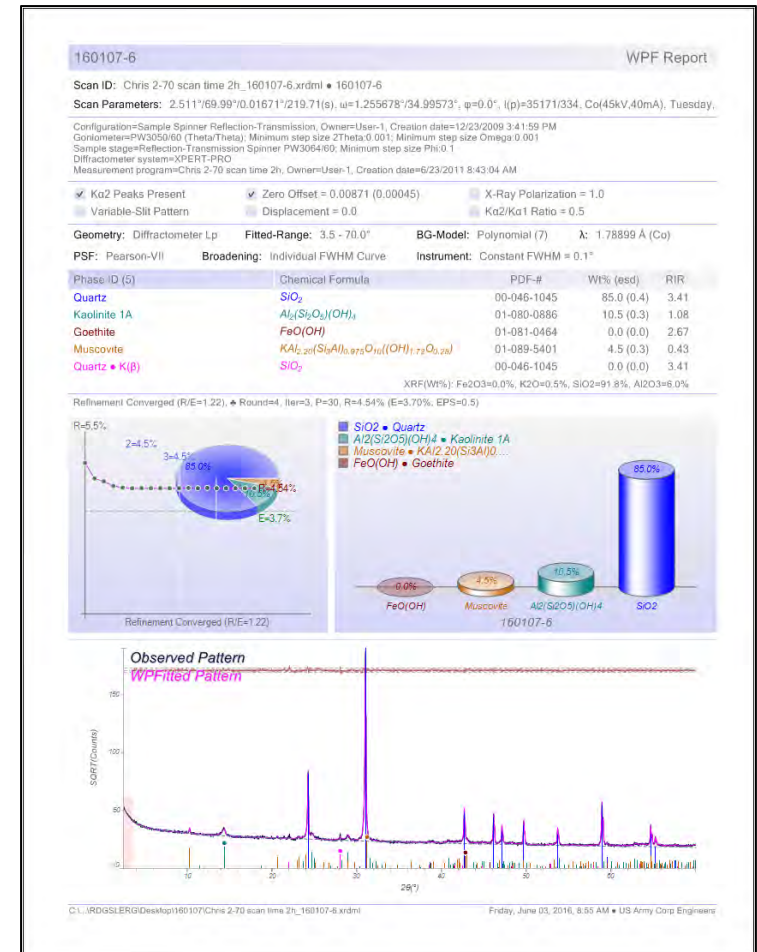
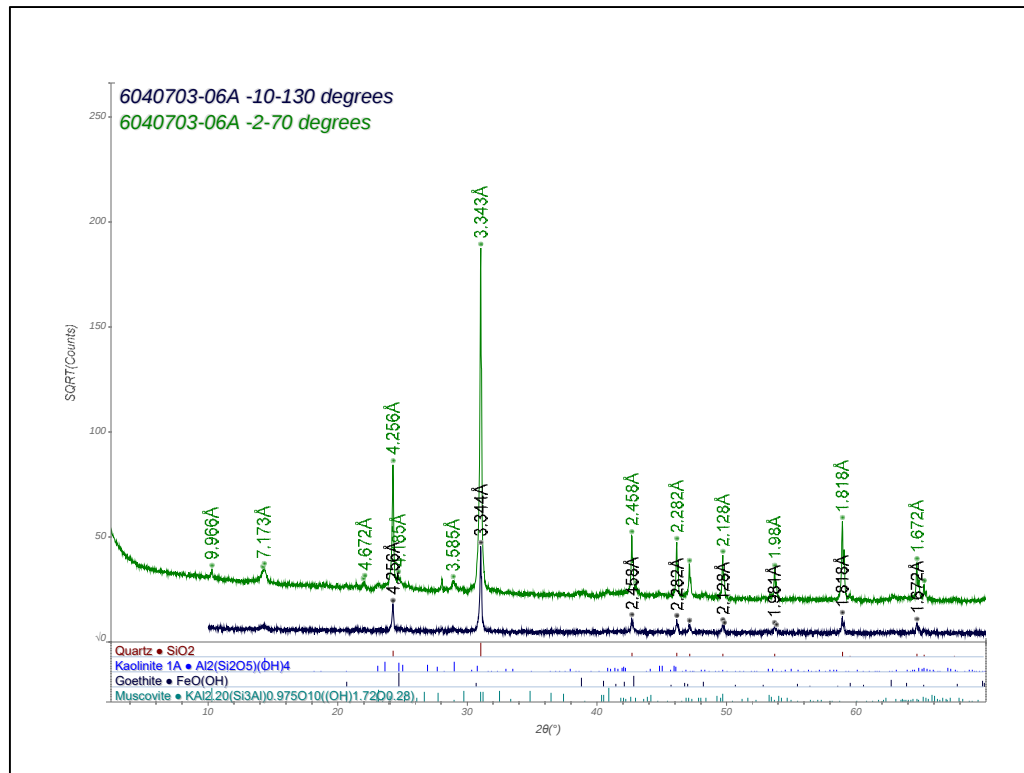
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ABS-1 27-28



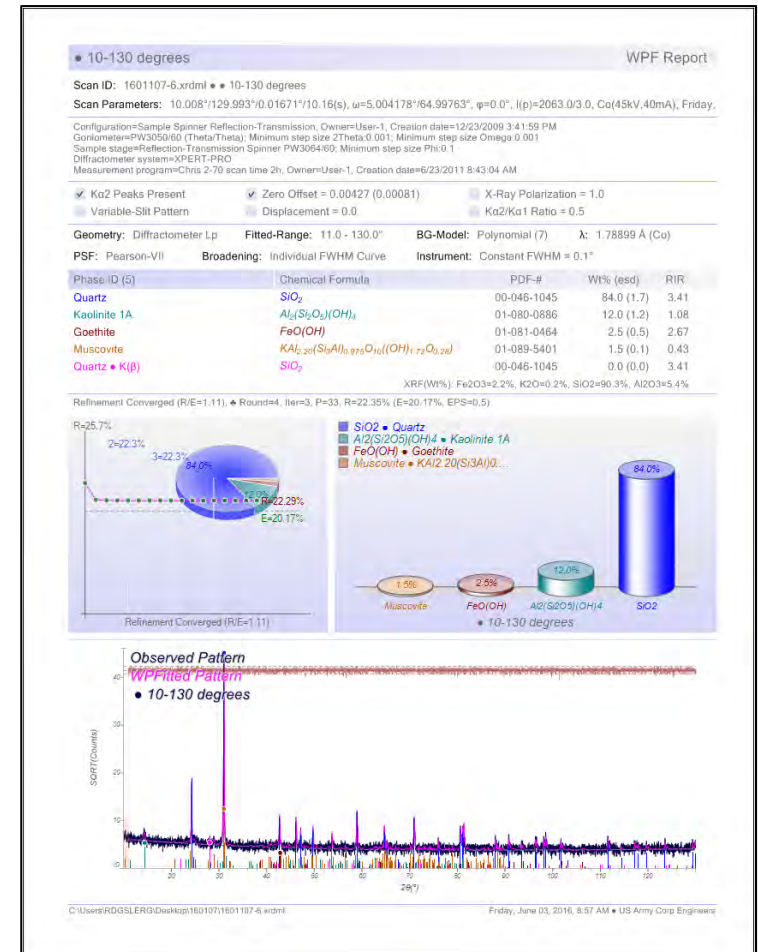
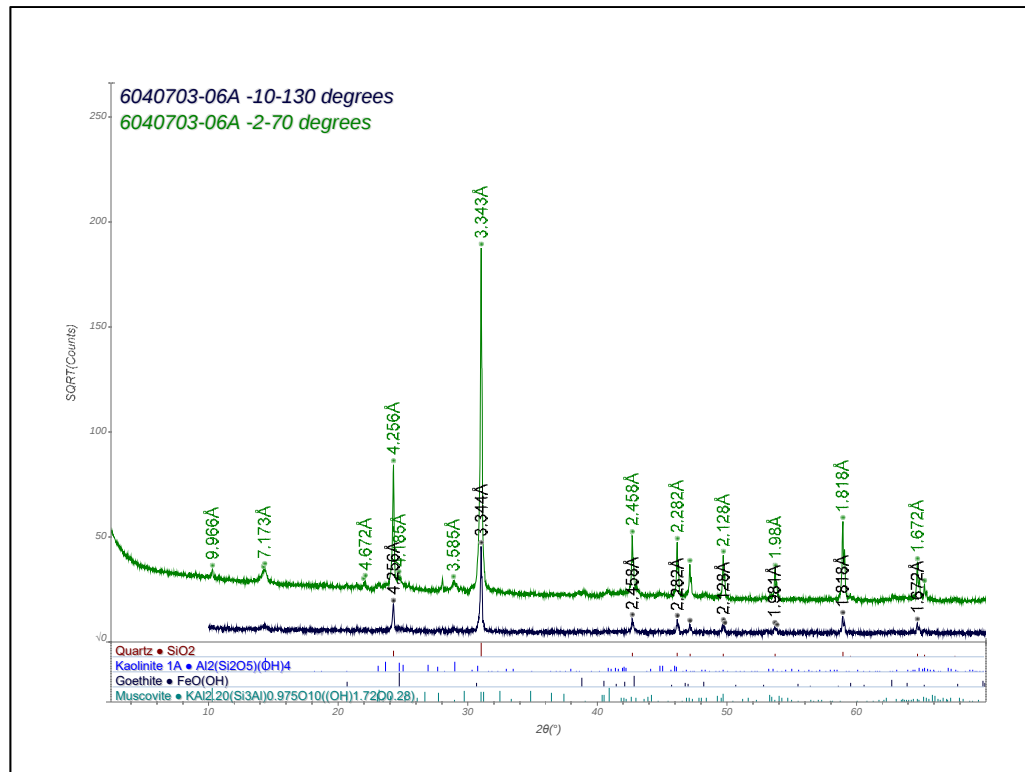
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ABS-1 28-29



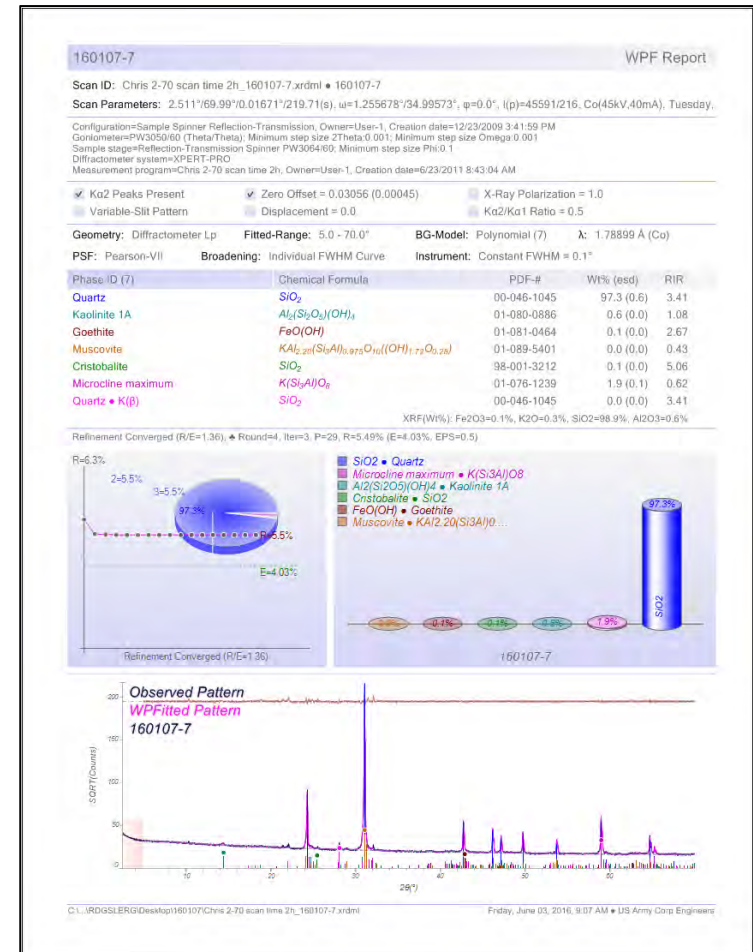
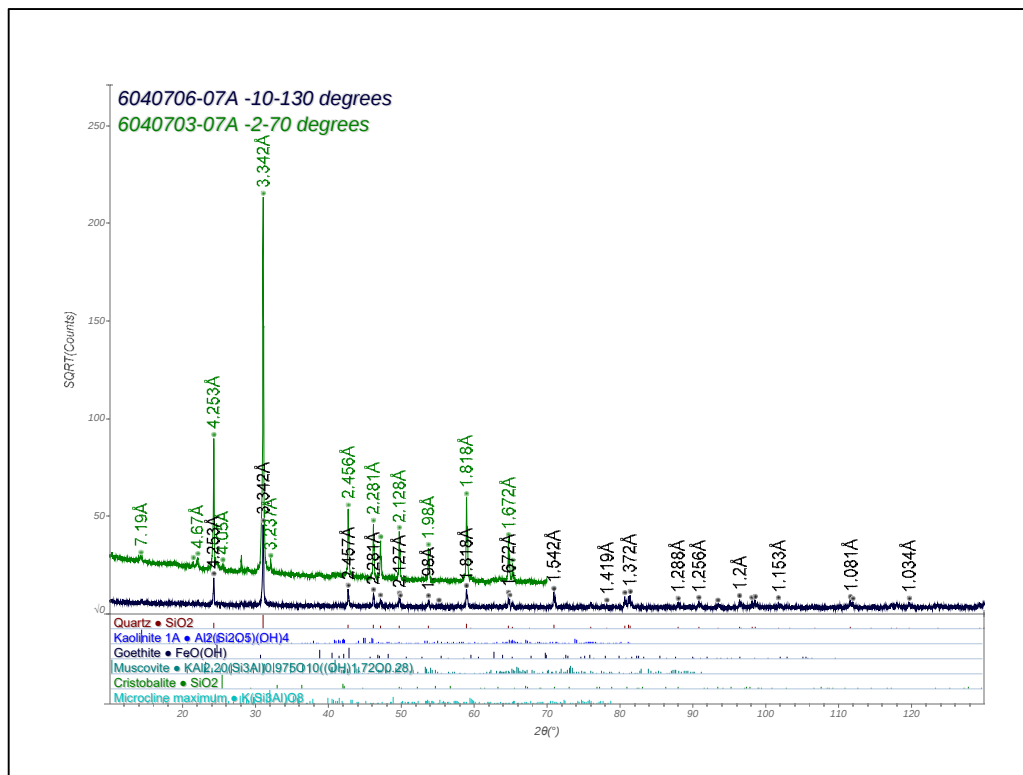
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ABS-1 28-29



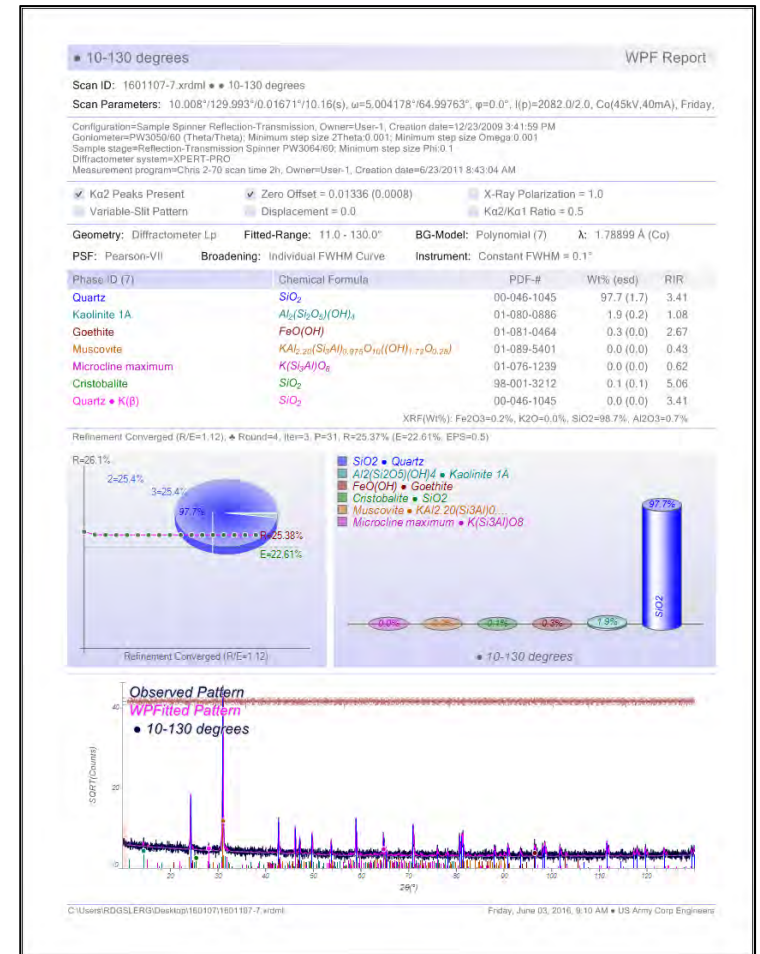
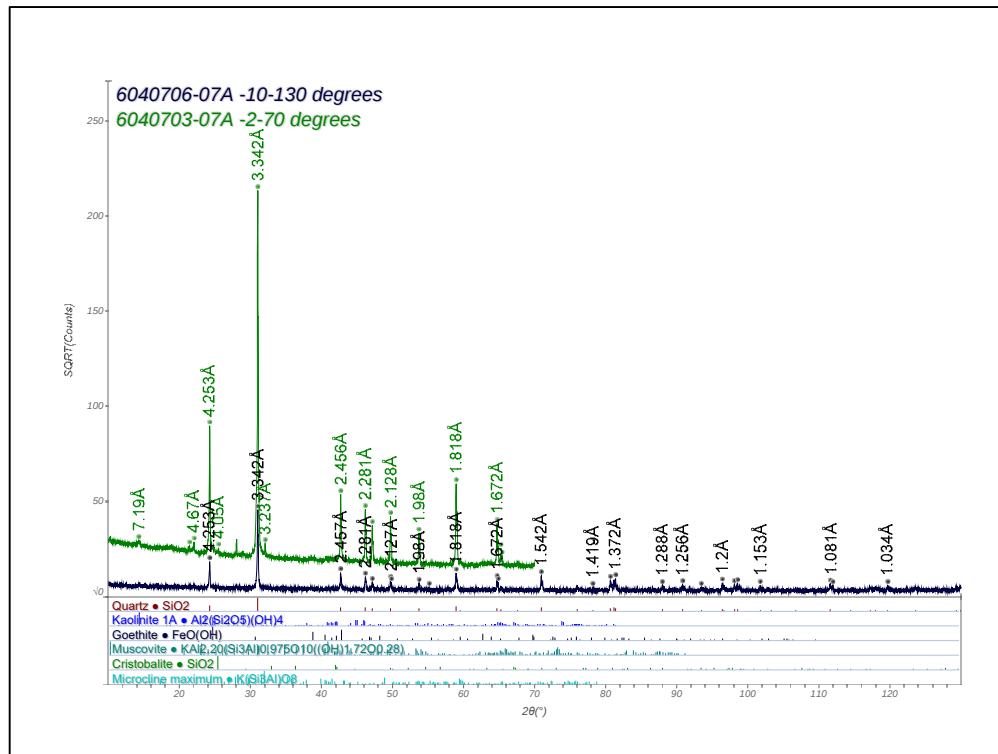
6040703-07A

ASB-1 29-30



6040703-07A

ASB-1 29-30



Appendix C

Final Report

Survey of arsenite biotransformation potential in contaminated soils
and groundwater affected by the Vineland Chemical Company
contamination around Vineland, NJ.

ERDC-EL

FINAL REPORT

Survey of arsenite biotransformation potential in contaminated soils and groundwater affected by the Vineland Chemical Company contamination around Vineland, NJ

Carina M. Jung

U.S. Army Engineer Research and Development Center

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1. Purpose. Determine the overall physiological potential for microbiological transformation of Arsenite (As(III)) in soils and groundwater site samples affected by the Vineland Chemical Company contamination around Vineland, NJ.

2. Background. Preliminary determinations from field efforts conducted through 2015 for the purpose of remediating As contamination from soils and groundwater in sites affected by the Vineland Chemical Company contamination around Vineland, NJ, indicated a role for microbiological transformation of As(III). As(III) is soluble but uncharged and typically more difficult to remove from solution, while the oxidized species, As(V) can be collected via reverse osmosis, anion exchange, or through precipitation and immobilization onto soil particles. Determination of effective and appropriate remediation of the site(s) is needed to meet environmental cleanup goals. Among potential remedial efforts, effective biotransformation may be enhanced through understanding the physiological potential of the microbiological community and how to better manage the site(s) as a means to encourage transformation of As(III) to As(V).

2.1 General Requirement. The sponsor requires a PCR-directed genomic survey of up to 20 contaminated groundwater and 20 contaminated soil samples. Genes of interest to be targeted for PCR will be *aiuA* and *arxA*, which are involved in oxidation of As(III) to As(V), and *dsr1* which is a likely candidate for providing an electron acceptor for As(III) oxidation via dissimilatory sulfate reduction.

Validation of the PCR reaction would require that control bacterial strains be purchased and parameters of the PCR reaction be established so that a definitive yes or no answer regarding the detection of a gene in the samples can be given. A final report of the findings and general conclusions about the physiological potential of each sample/site toward biological transformation of As(III) to As(V) will be presented to the sponsor in an agreed upon time frame.

2.2 Project History. Previous analyses and studies at the site(s) have led to suppositions regarding a biological role for transformation of As(III) to As(V). Management of the microbiological constituent of the site(s) may enhance ongoing and future efforts for meeting environmental cleanup goals.

3. Materials and Methods. In order to assess the physiological potential of sponsor-selected samples toward the oxidative biotransformation of As(III) to As(V) PCR-based surveys targeting three relevant genes were employed. Samples were processed by standard DNA extraction techniques and traditional PCR was performed. Qualitative results represented as +/- are presented herein.

Sampling protocol (sponsor). Soil samples (15 at ~15 g each) were taken at the discretion of the sponsor from the contaminated site(s). Sterile sampling tubes and alcohol swabs were provided by ERDC. Gloves were to be worn and

either replaced or wiped clean with alcohol swabs between each sampling. Collection instruments (spatula, spoon, etc.) were to be wiped with alcohol swabs between each sample to ensure no sample carryover. Sampling tubes (15 ml) were filled to the top with sample to minimize air space and placed immediately on ice in the field. Samples were placed in a 4°C refrigerator once back at the lab and shipped to ERDC via overnight express on ice. The ice had melted by the time the samples arrived at ERDC and the bag with the sample tubes was filled with water, causing the labels to begin detaching. The labels were reattached, and to our knowledge all tubes were properly relabeled.

Groundwater samples (11 at ~ 1 L each) were taken at the discretion of the sponsor from the contaminated site(s). Gloves were to be worn and either replaced or wiped clean between sampling to avoid cross-contamination. Samples were collected by in-line filtration with a 0.22µm PES filter unit, placed on ice in the field, stored at -20°C once back in the lab, and then shipped to ERDC via overnight express on ice. As with the soil samples, the filtration units were floating in water that had not been completely filtered or that had breached each bag from the melted ice in the cooler.

DNA Extraction and Sample Preparation. Each soil sample was extracted with MoBio Power Soil DNA extraction kit and quantified spectrophotometrically. Each sample was then PCR amplified with 16S rDNA primers (Table 1) as a quality control check for amplification of the isolated DNA (this targets ribosomal DNA and is always present if bacteria are present; a negative reaction means the sample may need to be re-extracted). Fourteen samples failed to amplify and were thus extracted twice more, followed by another 16S rDNA PCR amplification. The same 14 samples failed each time and were thus pooled and processed with a Microcon DNA concentrating and cleanup filter. These samples were again 16S rDNA PCR amplified and all were determined to be suitable for PCR (Figure 1). Soil DNA samples were then amplified with the primer sets specific for three gene targets (Table 1).

The water samples were concentrated in the field with a non-retrievable filter. This led to difficulties in sample processing. Sterile water (~ 10 ml) was added via pipette to the top of the filter, both ends were capped with parafilm, and the filter unit was vortexed vigorously. Liquid was allowed to pour out from the top of the filter into a 50 ml Falcon tube and this process was repeated twice more. The debris/cells were then separated from each water/filter sample by centrifugation and extracted with a MoBio Power Water DNA extraction kit following the manufacturer's instructions. DNA was quantified spectrophotometrically and 16S rDNA PCR reactions were performed as a quality control check for amplification of the isolated DNA. Each of the 11 water samples successfully amplified (Figure 2). Water DNA samples were then amplified with the primer sets specific for three gene targets (Table 1).

PCR Parameters. PCR amplification was performed using published methods for the following PCR primer sets for the three genes of interest:

Table 1. Primers and conditions for targeted PCR.

Primer	Primers (5'-3')	PCR parameters	Reference
<i>aioA</i>	F - CCACTTCTGCATCGTGGG R - TGTCGTTGCCCCAGATGA	95°C for 10 min, 35 cycles of 95°C for 1 min, 70°C for 1 min, 72°C for 2:30 min, and final extension at 72°C for 10 min	Ghosh 2014
<i>arxA</i>	F - ACGGCAACGACTCCTACAAC R - CGCACATCAATGGTGGTTAC	95°C for 1 min; 29 cycles of 55°C for 30 s and 72°C for 1 min; and a final extension of 72°C for 10 min	Zarger 2010
<i>dsr1</i>	F - ACSCACTGGAAGCACG R - GTGGAGCCGTGCATGTT	95°C for 10 min, 40 cycles of 15 s at 94°C, 1 min at 59°C, 45 s at 72°C	Leloup 2007
16S rRNA	F - AGAGTTTGATCATGGCTCAG R - TACGGYTACCTTGTTACGACTT	95°C for 5 min; 32 cycles of 94°C for 45 s 55°C for 45 s and 72°C for 1 min; and a final extension of 72°C for 10 min	krause 2000

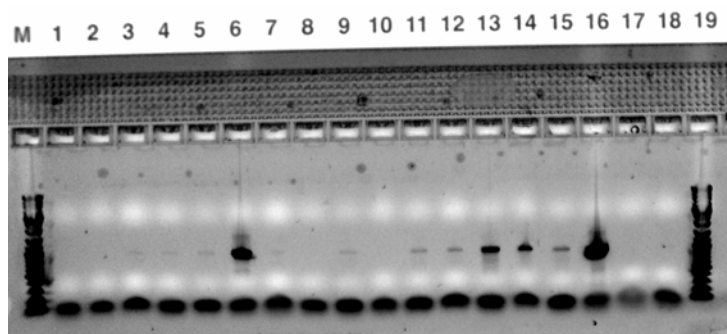


Figure 1. Gel showing positive results for 16S rRNA with bands (some very faint) for soil samples 1-15 in sequence. Lane 16 is a positive control and 17 and 18 are negative controls.

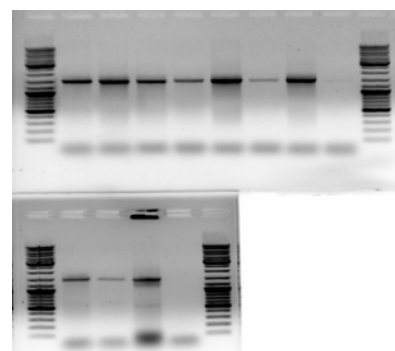


Figure 2. Gel showing positive results for 16S rDNA with bands (some very faint) for water samples 1-8 on the top gel and 9-11 on the bottom, in sequence.

4. Results and Discussion. Samples were PCR amplified with primers for *aioA* and *arxA*, which are involved in oxidation of As(III) to As(V) via aerobic and anaerobic mechanisms, respectively. Primers for the dissimilatory sulfate reduction pathway, *dsr1* were also assessed since this pathway/mechanism is a likely candidate for providing an electron acceptor for As(III) oxidation.

There was no visual amplification of any of the soil or water samples with either the *aioA* and *arxA* primers (Table 2). These results indicate the organisms responsible for

oxidation of As(III) to As(V) by specific physiological mechanisms are either not present or are in extremely low concentration. Conversely, 6 soil samples and all of the water samples were visually positive for PCR amplification with primers for the dissimilatory sulfate reduction pathway, *dsr1* (Table 2; Figures 3-4). These results indicate that oxidation of As(III) to As(V) may be occurring anaerobically via coupling of AS(III) oxidation with SO₄ reduction. Sulfate is thought to play a critical role in the site geochemistry and is therefore a likely mechanism for AS(III) oxidation.

Table 2. PCR results for Vineland soil and water samples using three different primer sets.

Sample	<i>aioA</i>	<i>arxA</i>	<i>dsr1</i>
Soil1 – MP1 25-26	-	-	-
Soil2 – MP1 27-28	-	-	-
Soil3 – MP1 31-32	-	-	+
Soil4 – MP1 42-43	-	-	+
Soil5 – MP1 50-51	-	-	-
Soil6 – MP4 18-19	-	-	-
Soil7 – MP4 28-29	-	-	+
Soil8 – MP4 31-32	-	-	+
Soil9 – MP4 38-39	-	-	-
Soil10 – MP4 43-44	-	-	-
Soil11 – AS1 32-32.5	-	-	-
Soil12 – AS2 28-29	-	-	-
Soil13 – AS2 34-34.5	-	-	+
Soil14 – AS3 29-30	-	-	-
Soil15 – AS4 29-30	-	-	+
Water1 – PZ9_1245	-	-	+
Water2 – MW755_0945	-	-	+
Water3 – ASMP4L_1338	-	-	+
Water4 – WW25M_1055	-	-	+
Water5 – PZ10_0935	-	-	+
Water6 – ASMP9L_1238	-	-	+
Water7 – ASMP1L_1025	-	-	+
Water8 – WP225A_0938	-	-	+
Water9 – PZ17_1340	-	-	+
Water10 – MW525_1110	-	-	+
Water11 – PZ12_1152	-	-	+

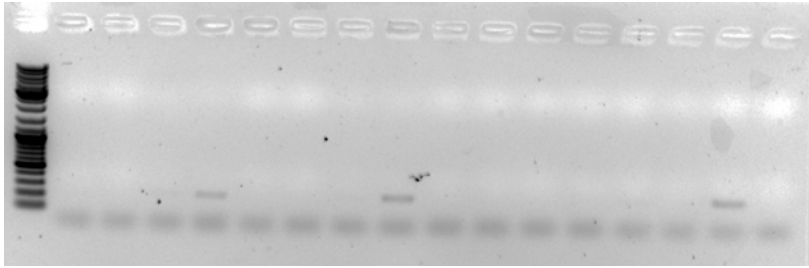


Figure 3. Gel of soil samples PCR-amplified with *dsr* primers in sequence, 1-15. Sample 3, 7, and 13 are faint while 4, 8, and 15 amplified strongly.

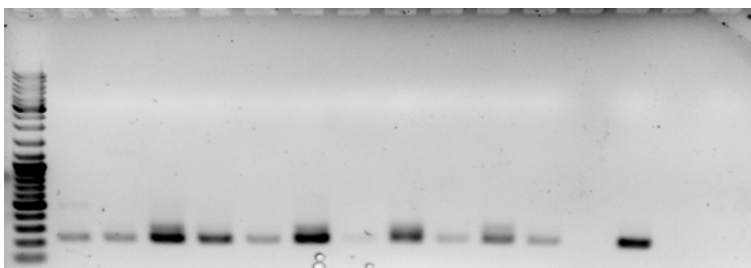


Figure 4. Gel of water samples PCR-amplified with *dsr* primers in sequence, 1-11 plus a positive control in lane 14. Samples 7, and 9 weakly amplified while the others exhibited stronger reactions.

5. References.

- Ghosh, D., P. Bhadury, and J. Routh. 2014. Diversity of arsenite oxidizing bacterial communities in arsenic-rich deltaic aquifers in West Bengal, India. *Front. Microbiol.* 5:(602).
- Krause, D.O., W.J. Smith, F.M. Ryan, R.I. Mackie, C.S. McSweeney. 1999. Use of 16S-rRNA based techniques to investigate the ecological succession of microbial populations in the immature lamb rumen: tracking of a specific strain of inoculated *Ruminococcus* and interactions with other microbial populations *in vivo*. *Micob. Ecol.* 38(4):365-376.
- Leloup, J., A. Loy, N.J. Knab, C. Borowski, M. Wagner and B.B. Jørgensen. 2007. Diversity and abundance of sulfate-reducing microorganisms in the sulfate and methane zones of a marine sediment, Black Sea. *Environ. Microbiol.* 9(1):131–142.
- Zargar, K., S. Hoeft, R. Oremland, and C.W. Saltikov. 2010. Identification of a novel arsenite oxidase gene, *arxA*, in the haloalkaliphilic, arsenite-oxidizing bacterium *Alkalilimnicola ehrlichii* strain MLHE-1. *J. Bacteriol.* 192(14):3755-3762.

Biotic Oxidation : PCR-directed genomic survey

PCR results for Vineland soil and water samples using three different primer sets.

Sample	<i>aioA</i>	<i>arxA</i>	<i>dsr1</i>
Soil1 – MP1 25-26	-	-	-
Soil2 – MP1 27-28	-	-	-
Soil3 – MP1 31-32	-	-	+
Soil4 – MP1 42-43	-	-	+
Soil5 – MP1 50-51	-	-	-
Soil6 – MP4 18-19	-	-	-
Soil7 – MP4 28-29	-	-	+
Soil8 – MP4 31-32	-	-	+
Soil9 – MP4 38-39	-	-	-
Soil10 – MP4 43-44	-	-	-
Soil11 – AS1 32-32.5	-	-	-
Soil12 – AS2 28-29	-	-	-
Soil13 – AS2 34-34.5	-	-	+
Soil14 – AS3 29-30	-	-	-
Soil15 – AS4 29-30	-	-	+
Water1 – PZ9_1245	-	-	+
Water2 – MW755_0945	-	-	+
Water3 – ASMP4L_1338	-	-	+
Water4 – WW25M_1055	-	-	+
Water5 – PZ10_0935	-	-	+
Water6 – ASMP9L_1238	-	-	+
Water7 – ASMP1L_1025	-	-	+
Water8 – WP225A_0938	-	-	+
Water9 – PZ17_1340	-	-	+
Water10 – MW525_1110	-	-	+
Water11 – PZ12_1152	-	-	+

The polymerase chain reaction (**PCR**) is a technique used in molecular biology to amplify a single copy or a few copies of a piece of DNA across several orders of magnitude, generating thousands to millions of copies of a particular DNA sequence.

Samples were PCR amplified with primers for *aioA* and *arxA*, which are involved in oxidation of As(III) to As(V) via aerobic and anaerobic mechanisms, respectively. Primers for the dissimilatory sulfate reduction pathway, *dsr1* were also assessed since this pathway/mechanism is a likely candidate for providing an electron acceptor for As(III) oxidation.

There was no visual amplification of any of the soil or water samples with either the *aioA* and *arxA* primers. These results indicate the organisms responsible for oxidation of As(III) to As(V) by specific physiological mechanisms are either not present or are in extremely low concentration.

Biotic Oxidation : PCR-directed genomic survey

PCR results for Vineland soil and water samples using three different primer sets.

Sample	<i>aioA</i>	<i>arxA</i>	<i>dsr1</i>
Soil1 – MP1 25-26	-	-	-
Soil2 – MP1 27-28	-	-	-
Soil3 – MP1 31-32	-	-	+
Soil4 – MP1 42-43	-	-	+
Soil5 – MP1 50-51	-	-	-
Soil6 – MP4 18-19	-	-	-
Soil7 – MP4 28-29	-	-	+
Soil8 – MP4 31-32	-	-	+
Soil9 – MP4 38-39	-	-	-
Soil10 – MP4 43-44	-	-	-
Soil11 – AS1 32-32.5	-	-	-
Soil12 – AS2 28-29	-	-	-
Soil13 – AS2 34-34.5	-	-	+
Soil14 – AS3 29-30	-	-	-
Soil15 – AS4 29-30	-	-	+
Water1 – PZ9_1245	-	-	+
Water2 – MW755_0945	-	-	+
Water3 – ASMP4L_1338	-	-	+
Water4 – WW25M_1055	-	-	+
Water5 – PZ10_0935	-	-	+
Water6 – ASMP9L_1238	-	-	+
Water7 – ASMP1L_1025	-	-	+
Water8 – WP225A_0938	-	-	+
Water9 – PZ17_1340	-	-	+
Water10 – MW525_1110	-	-	+
Water11 – PZ12_1152	-	-	+

6 soil samples and all of the water samples were visually positive for PCR amplification with primers for the dissimilatory sulfate reduction pathway, *dsr1*. These results indicate that oxidation of As(III) to As(V) may be occurring anaerobically via coupling of AS(III) oxidation with SO₄ reduction.

Appendix D

Modifications to Wateq4f

Arsenic species (arsenate and arsenite) and iron species (ferric iron and ferrous iron) were redefined in the database as shown below. Values of equilibrium constants were not changed.

SOLUTION_MASTER_SPECIES

Fe_di	Fe_di+2	0.0	Fe_di	55.847
Fe_tri	Fe_tri+3	0.0	Fe_tri	55.847
Arsenate	H3Arsenate	-1	74.9216	74.9216
Arsenite	H3Arsenite	0	74.9216	74.9216

SOLUTION_SPECIES

```

Fe_di+2 = Fe_di+2
    log_k    0.0
Fe_tri+3 = Fe_tri+3
    log_k    0.0
#
# Fe+2 species
#
Fe_di+2 + H2O = Fe_diOH+ + H+
    log_k    -9.5
    delta_h  13.20    kcal
Fe_di+2 + Cl- = Fe_diCl+
    log_k    0.14
Fe_di+2 + CO3-2 = Fe_diCO3
    log_k    4.38
Fe_di+2 + HCO3- = Fe_diHCO3+
    log_k    2.0
Fe_di+2 + SO4-2 = Fe_diSO4
    log_k    2.25
    delta_h  3.230    kcal
Fe_di+2 + HS04- = Fe_diHS04+
    log_k    1.08
Fe_di+2 + 2HS- = Fe_di(HS)2
    log_k    8.95
Fe_di+2 + 3HS- = Fe_di(HS)3-
    log_k    10.987
Fe_di+2 + HP04-2 = Fe_diHP04
    log_k    3.6
Fe_di+2 + H2P04- = Fe_diH2P04+
    log_k    2.7
Fe_di+2 + F- = Fe_diF+
    log_k    1.0
#
# Fe+3 species
#
Fe_tri+3 + H2O = Fe_triOH+2 + H+
    log_k    -2.19
    delta_h  10.4    kcal
Fe_tri+3 + 2 H2O = Fe_tri(OH)2+ + 2 H+
    log_k    -5.67
    delta_h  17.1    kcal
Fe_tri+3 + 3 H2O = Fe_tri(OH)3 + 3 H+
    log_k    -12.56
    delta_h  24.8    kcal

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Fe_tri+3 + 4 H2O = Fe_tri(OH)4- + 4 H+
    log_k    -21.6
    delta_h  31.9    kcal
2 Fe_tri+3 + 2 H2O = Fe_tri2(OH)2+4 + 2 H+
    log_k    -2.95
    delta_h  13.5    kcal
3 Fe_tri+3 + 4 H2O = Fe_tri3(OH)4+5 + 4 H+
    log_k    -6.3
    delta_h  14.3    kcal
Fe_tri+3 + Cl- = Fe_triCl+2
    log_k     1.48
    delta_h   5.6    kcal
Fe_tri+3 + 2 Cl- = Fe_triCl2+
    log_k     2.13
Fe_tri+3 + 3 Cl- = Fe_triCl3
    log_k     1.13
Fe_tri+3 + S04-2 = Fe_triS04+
    log_k     4.04
    delta_h   3.91    kcal
Fe_tri+3 + HS04- = Fe_triHS04+2
    log_k     2.48
Fe_tri+3 + 2 S04-2 = Fe_tri(S04)2-
    log_k     5.38
    delta_h   4.60    kcal
Fe_tri+3 + HP04-2 = Fe_triHP04+
    log_k     5.43
    delta_h   5.76    kcal
Fe_tri+3 + H2P04- = Fe_triH2P04+2
    log_k     5.43
Fe_tri+3 + F- = Fe_triF+2
    log_k     6.2
    delta_h   2.7    kcal
Fe_tri+3 + 2 F- = Fe_triF2+
    log_k    10.8
    delta_h   4.8    kcal
Fe_tri+3 + 3 F- = Fe_triF3
    log_k    14.0
    delta_h   5.4    kcal

#
# Arsenate and Arenite species
#
H3Arsenate = H3Arsenate
    log_k     0
H3Arsenite = H3Arsenite
    log_k     0
H3Arsenite = H2Arsenite- + H+
    log_k    -9.15
    delta_h  27.54 kJ
H3Arsenite = HArsenite-2 + 2H+
    log_k    -23.85
    delta_h  59.41 kJ
H3Arsenite = Arsenite-3 + 3H+
    log_k    -39.55
    delta_h  84.73 kJ
H3Arsenite + H+ = H4Arsenite+
    log_k    -0.305
H3Arsenate = H2Arsenate- +H+

```

log_k -2.3
 delta_h -7.066 kJ
 $\text{H3Arsenate} = \text{HArsenate-2} + 2\text{H}^+$
 log_k -9.46
 delta_h -3.846 kJ
 $\text{H3Arsenate} = \text{Arsenate-3} + 3\text{H}^+$
 log_k -21.11
 delta_h 14.354 kJ
 SURFACE_SPECIES
 $\text{Hfo_wOH} + \text{Arsenate-3} + 3\text{H}^+ = \text{Hfo_wH2Arsenate} + \text{H2O}$
 log_k 29.31
 $\text{Hfo_wOH} + \text{Arsenate-3} + 2\text{H}^+ = \text{Hfo_wHArseenate-} + \text{H2O}$
 log_k 23.51
 $\text{Hfo_wOH} + \text{Arsenate-3} = \text{Hfo_wOHArseenate-3}$
 log_k 10.58
 $\text{Hfo_wOH} + \text{H3Arsenite} = \text{Hfo_wH2Arsenite} + \text{H2O}$
 log_k 5.41

PHASES

Goethite
 $\text{Fe_tri0OH} + 3 \text{H}^+ = \text{Fe_tri+3} + 2 \text{H2O}$
 log_k -1.0
 Siderite 9
 $\text{Fe_diC03} = \text{Fe_di+2} + \text{C03-2}$
 log_k -10.45
 Mackinawite 67
 $\text{Fe_diS} + \text{H}^+ = \text{Fe_di+2} + \text{HS-}$
 log_k -4.648
 Magnetite 107
 $\text{Fe_di0Fe_tri203} + 8\text{H}^+ = 2\text{Fe_tri+3} + \text{Fe_di+2} + 4\text{H2O}$
 log_k 3.737
 delta_h -50.460 kcal
 Hematite 108
 $\text{Fe_tri203} + 6\text{H}^+ = 2\text{Fe_tri+3} + 3\text{H2O}$
 log_k -4.008
 delta_h -30.845 kcal
 Maghemite 109
 $\text{Fe_tri203} + 6\text{H}^+ = 2\text{Fe_tri+3} + 3\text{H2O}$
 log_k 6.386
 Fe(OH)3(a) 112
 $\text{Fe_tri(OH)3} + 3\text{H}^+ = \text{Fe_tri+3} + 3\text{H2O}$
 log_k 4.891
 Pyrite 114
 $\text{Fe_diS2} + 2\text{H}^+ + 2\text{e-} = \text{Fe_di+2} + 2\text{HS-}$
 log_k -18.479
 delta_h 11.3 kcal
 FeS(ppt) 119
 $\text{Fe_diS} + \text{H}^+ = \text{Fe_di+2} + \text{HS-}$
 log_k -3.915

Appendix E

Model assumptions and results

Batch Tests with pH Adjustment

Description	Date	MW75S Ground- water (mL)	Soil (g)	H2SO4 (mL)	NaOH (mL)	Measured Values			Modeled Values			As Error (mg/L)	Fe Error (mg/L)	pH Error
						As (mg/L)	Fe (mg/L)	pH	As (mg/L)	Fe (mg/L)	pH			
3.) Sorption/ Rxn, Low Fe Sand, variable pH	3/31/2016	N/A-Initial Condition				2.05	10	5.7	N/A-Initial Condition					
	4/1/2016	552	0	0	0	1.41	6	5.68	1.45	6.02	5.83	0.040	0.020	0.15
	4/1/2016	517	67.5	0	0	1.34	6.34	5.81	1.38	6.34	5.86	0.040	0.000	0.05
	4/1/2016	505	67.5	10	0	1.43	8.77	5.38	1.485863	8.833562	5.34	0.056	0.064	-0.04
	4/1/2016	503	67.5	20	0	1.56	13.7	4.73	1.53	13.74	4.73	-0.030	0.040	0.00
	4/1/2016	492	67.5	30	0	1.61	15.2	4.41	1.65	15.24	4.41	0.040	0.040	0.00
	4/1/2016	487	67.5	40	0	1.64	15.2	4.19	1.7	15.23	4.19	0.060	0.030	0.00
	4/1/2016	475	67.5	50	0	1.65	17.9	4.01	1.71	17.91	4.01	0.060	0.010	0.00
	4/1/2016	515	67.5	0	5	1.33	2.65	6.83	0.812	2.64	6.83	-0.518	-0.010	0.00
4.) Sorption/ Rxn, Red/ orange sand, variable pH	3/23/2016	N/A-Initial Condition				1.54	7.81	6.01	N/A-Initial Condition					
	3/24/2016	550	67.5	0	0	0.896	3.14	5.57	0.86	3.15	5.95	-0.036	0.010	0.38
	3/24/2016	508	67.5	0	0	0.176	15.9	5.92	0.106	15.92	6.39	-0.070	0.019	0.47
	3/24/2016	507	67.5	5	0	0.256	18.5	5.84	0.208	18.52	5.84	-0.048	0.019	0.00
	3/24/2016	505	67.5	10	0	0.24	21.4	5.89	0.201	21.35	5.89	-0.039	-0.050	0.00
	3/24/2016	498	67.5	20	0	0.284	22.6	5.45	0.345	22.58	5.45	0.061	-0.021	0.00
	3/24/2016	481	67.5	30	0	0.26	28.3	5.00	0.311	28.29	5	0.051	-0.006	0.00
	3/24/2016	515	67.5	0	4	0.179	1.4	6.27	0.114	2.529	6.27	-0.065	1.13	0.00

Batch Tests with pH Adjustment

Description	Date	MW75S Ground- water (mL)	Soil (g)	H2SO4 (mL)	NaOH (mL)	Model Assumptions				
						Initial O2 (mg/L)	% CO2 Degassing	%Fe in soil used for Fe3+ in rate eq	% Fe in sand used for sorption	Assumed Equilibrium Phases
3.) Sorption/ Rxn, Low Fe Sand, variable pH	3/31/2016	N/A-Initial Condition								
	4/1/2016	552	0	0	0	0.8	41%	N/A	N/A	None
	4/1/2016	517	67.5	0	0	0.8	40%	0.2%	0.5%	0.55% Fe in soil as siderite
	4/1/2016	505	67.5	10	0	0.8	65%	0.2%	2.0%	0.28% Fe in soil as siderite
	4/1/2016	503	67.5	20	0	0.8	41%	0.2%	5.0%	2.9% Fe in soil as siderite
	4/1/2016	492	67.5	30	0	0.8	41%	0.2%	5.0%	2.9% Fe in soil as siderite
	4/1/2016	487	67.5	40	0	0.8	50%	0.2%	5.0%	3.9% Fe in soil as siderite
	4/1/2016	475	67.5	50	0	0.8	42%	0.2%	5.0%	5.8% Fe in soil as siderite
	4/1/2016	515	67.5	0	5	1.04	67%	0.2%	0.5%	None
4.) Sorption/ Rxn, Red/ orange sand, variable pH	3/23/2016	N/A-Initial Condition								
	3/24/2016	550	67.5	0	0	1.0	17%	N/A	N/A	None
	3/24/2016	508	67.5	0	0	0.8	17%	0.20%	2.0%	Magnetite and 1.2% Fe in soil as siderite
	3/24/2016	507	67.5	5	0	0.8	17%	0.20%	2.0%	Magnetite and 1.4% Fe in soil as siderite
	3/24/2016	505	67.5	10	0	0.8	17%	0.20%	2.0%	Magnetite and 1.6% Fe in soil as siderite
	3/24/2016	498	67.5	20	0	0.8	17%	0.20%	2.0%	Magnetite and 1.56% Fe in soil as siderite
	3/24/2016	481	67.5	30	0	0.8	17%	0.20%	5.0%	Magnetite and 1.77% Fe in soil as siderite
	3/24/2016	515	67.5	0	4	0.8	17%	0.20%	2.0%	None

Batch Tests without pH Adjustment

Description	Date	MW75S Groundwater (mL)	Soil (g)	Measured Values			Modeled Values			As Error (mg/L)	Fe Error (mg/L)	pH Error
				As (mg/L)	Fe (mg/L)	pH	As (mg/L)	Fe (mg/L)	pH			
1.) Sorption/ Reaction, sand, no pH adjustment	10/1/2015	N/A-Initial Condition		1.87	10.2	5.64						
	10/1/2015	575	0	1.72	9.57	5.74	1.78	9.53	5.72	0.060	-0.040	-0.02
	10/1/2015	550	100	1.57	9.46	5.81	1.61	9.45	5.72	0.040	-0.010	-0.09
2.) Sorption/ Reaction, Red/orange sand, no pH adjustment	12/3/2015	N/A-Initial Condition		1.832	9.247	5.66						
	12/3/2015	575	None	1.422	6.896	5.58	1.504	6.92	5.71	0.082	0.022	0.13
	12/3/2015	550	33.25	0.428	6.283	5.50	0.418	6.24	5.61	-0.010	-0.048	0.11
	12/3/2015	550	67.5	0.267	5.855	5.46	0.206	5.80	5.63	-0.061	-0.055	0.17
	12/3/2015	500	133	0.118	9.379	5.64	0.076	9.37	5.86	-0.042	-0.014	0.22
	12/3/2015	450	266	0.054	11.5	5.47	0.063	11.49	5.95	0.009	-0.008	0.48
	12/3/2015	350	399	0.03	13.81	5.51	0.012	13.79	6.1	-0.018	-0.021	0.59

Batch Tests without pH Adjustment

Description	Date	MW75S Groundwater (mL)	Soil (g)	Model Assumptions				Assumed Equilibrium Phases
				Initial O2 (mg/L)	% CO2 Degassing	%Fe in soil used for initial Fe3+ in rate eq	% Fe in soil used for sorption	
1.) Sorption/ Reaction, sand, no pH adjustment	10/1/2015	N/A-Initial Condition						
	10/1/2015	575	0	0.2	21%	N/A	N/A	None
	10/1/2015	550	100	0.2	21%	0.20%	0.50%	None
2.) Sorption/ Reaction, Red/orange sand, no pH adjustment	12/3/2015	N/A-Initial Condition						
	12/3/2015	575	None	0.8	23%	N/A	N/A	None
	12/3/2015	550	33.25	0.8	23%	0.20%	2.0%	Magnetite and 0.016% of Fe as siderite
	12/3/2015	550	67.5	0.8	23%	0.20%	2.0%	Magnetite and 0.033% of Fe as siderite
	12/3/2015	500	133	0.8	23%	0.20%	2.0%	Magnetite and 0.3% of Fe as siderite
	12/3/2015	450	266	0.8	23%	0.20%	2.0%	Magnetite and 0.17% of Fe as siderite
	12/3/2015	350	399	0.8	23%	0.20%	2.0%	Magnetite and 0.11% of Fe as siderite

Column Tests

Column	Pore Volume	Time Collected	Measured Values			Modeled Values			As Error (mg/L)	Fe Error (mg/L)	pH Error
			As (mg/L)	Fe (mg/L)	pH	As (mg/L)	Fe (mg/L)	pH			
1	1	8/24/2016 10:15	0.393	0.437	6.35	0.411	0.381	6.51	0.018	-0.056	0.16
1	3	8/24/2016 11:35	0.987	0.225	6.34	1.018	0.228	6.55	0.031	0.003	0.21
1	5	8/24/2016 12:40	1.67	1.97	6.19	1.663	2.036	6.41	-0.007	0.066	0.22
1	7	8/24/2016 14:00	1.8	6.28	6.09	1.79	6.34	6.20	-0.011	0.057	0.11
1	9	8/24/2016 15:29	1.75	9.08	6.31	1.688	9.018	5.99	-0.062	-0.062	-0.32
2	1	8/24/2016 10:40	0.204	13.5	5.61	0.238	13.465	6.14	0.034	-0.035	0.53
2	3	8/24/2016 11:43	0.387	5.99	5.84	0.320	5.993	6.08	-0.067	0.003	0.24
2	5	8/24/2016 12:44	0.257	6.05	6.2	0.338	6.060	6.06	0.081	0.010	-0.14
2	7	8/24/2016 14:05	0.0026	4.64	5.63	0.078	4.588	6.30	0.075	-0.052	0.67
2	9	8/24/2016 15:36	0.337	3.77	6.03	0.360	3.751	6.32	0.023	-0.019	0.29

Column Tests

Column	Pore Volume	Time Collected	Model Assumptions				
			Initial O2 (mg/L)	% CO2 Degassing	%Fe in soil used for initial Fe3+ in rate eq	% Fe in soil used for sorption	Assumed Equilibrium Phases
1	1	8/24/2016 10:15	2	92%	0.20%	0.10%	none
1	3	8/24/2016 11:35	2	90%	0.20%	< precip amt	none
1	5	8/24/2016 12:40	1.45	79%	0.20%	< precip amt	none
1	7	8/24/2016 14:00	0.85	48%	0.20%	< precip amt	none
1	9	8/24/2016 15:29	0.2	18%	none	0.05%	none
2	1	8/24/2016 10:40	0.85	8%	0.20%	0.10%	0.02% Fe in soil as siderite
2	3	8/24/2016 11:43	0.88	27%	0.20%	0.03%	none
2	5	8/24/2016 12:44	0.85	27%	0.20%	0.03%	none
2	7	8/24/2016 14:05	0.83	59%	0.20%	0.10%	none
2	9	8/24/2016 15:36	0.83	59%	0.57%	0.02%	none