

# Data Validation Package

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May 2013  
Groundwater Sampling at the  
Project Shoal, Nevada, Site

December 2013



U.S. DEPARTMENT OF  
**ENERGY**

Legacy  
Management

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## **Attachment 1—Assessment of Anomalous Data**

Potential Outliers Report

## **Attachment 2—Data Presentation**

Groundwater Quality Data  
Equipment Blank Data  
Static Water Level Data  
Time-Concentration Graph

## **Attachment 3—Sampling and Analysis Work Order**

## **Attachment 4—Trip Report**

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# Sampling Event Summary

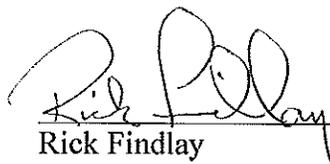
**Site:** Project Shoal Site

**Sampling Period:** May 21–23, 2013

The U.S. Department of Energy Office of Legacy Management conducted annual sampling at the Project Shoal Area (Shoal) in May 2013. Monitoring wells HC-1, HC-2, HC-3, HC-4, HC-5, HC-6, HC-7, HC-8, MV-1, MV-2, and MV-3; and water supply well HS-1 were sampled as specified in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351, continually updated). Samples were submitted for analysis as follows:

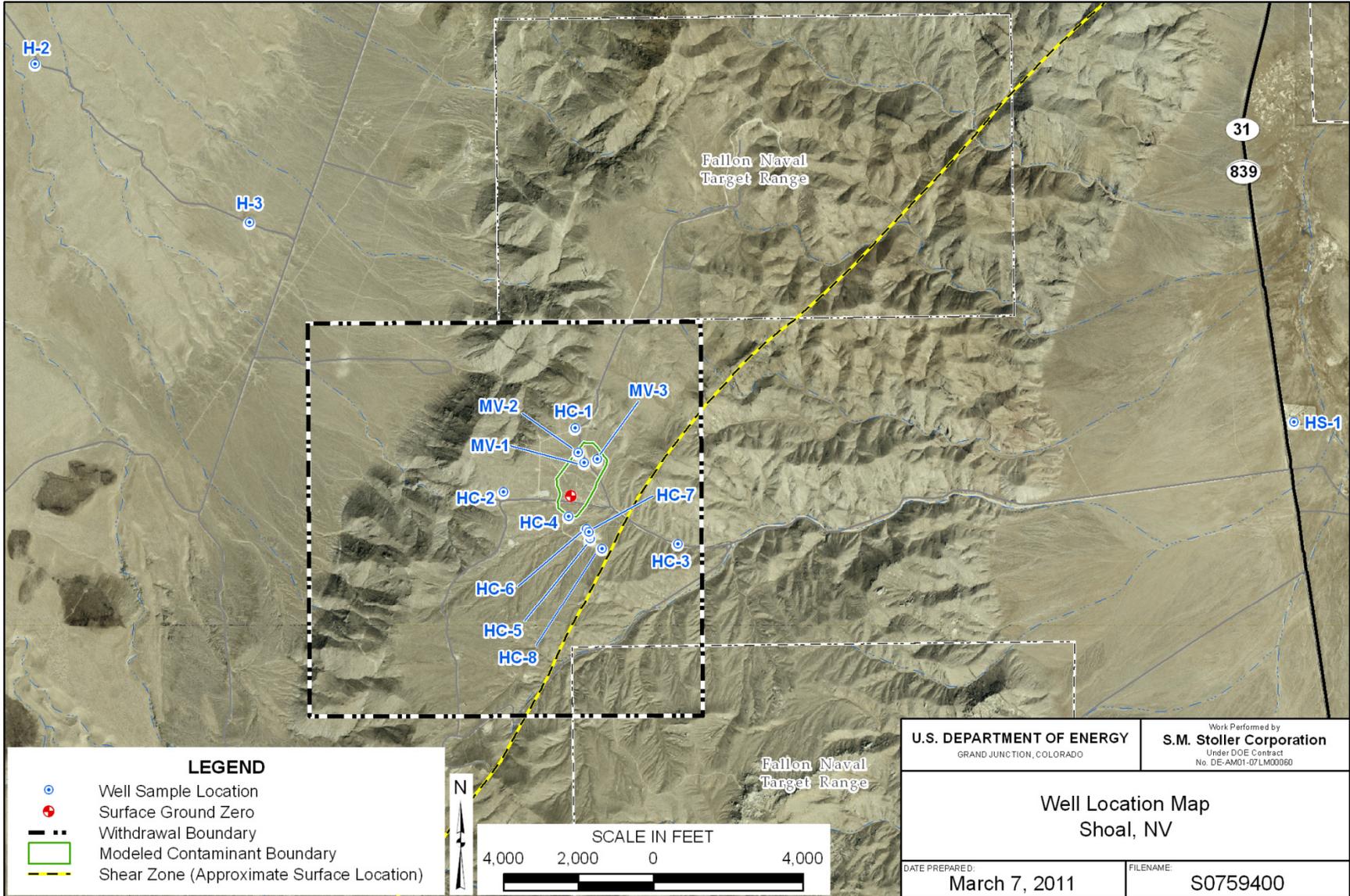
- Requisition 13055323 was submitted to the University of Arizona for the determination of carbon-14 (water supply well HS-1 only).
- Requisition 13055324 was submitted to the Reston Stable Isotope Laboratory for the determination of hydrogen and oxygen stable isotope ratios (water supply well HS-1 only).
- Requisition 13055325 was submitted to ALS Laboratory Group in Fort Collins, Colorado, for the determination of gross alpha, gross beta, tritium, uranium isotopes, and total uranium. The sample from water supply well HS-1 was also analyzed for bicarbonate alkalinity, chloride, sulfate, metals, and nitrate plus nitrite as N. A duplicate sample from location MV-3 was included with this submittal.

Constituent concentrations are consistent with concentrations previously observed. The determination of tritium detection is made by comparing sample tritium results to the decision level concentration (DLC) calculated at the 99 percent confidence level. For sample results greater than the DLC (3 times the one-sigma total propagated uncertainty) a sample concentration of zero is not a probable result. Sample tritium results did not exceed the DLC for any wells except HC-4, where the concentration was 964 picocuries per liter. Results shown on the time-concentration plot included in this report indicate that this is expected for well HC-4. The presence of tritium in HC-4 is due to its proximity to the nuclear detonation location.



Rick Findlay  
Site Lead, S.M. Stoller Corporation

12-31-2013  
Date



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*Project Shoal Site Sample Location Map*

# Data Assessment Summary

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### Water Sampling Field Activities Verification Checklist

<b>Project</b>	Project Shoal Site, Nevada	<b>Date(s) of Water Sampling</b>	May 21–23, 2013
<b>Date(s) of Verification</b>	December 16, 2013	<b>Name of Verifier</b>	Stephen Donivan

	<b>Response (Yes, No, NA)</b>	<b>Comments</b>
1. Is the SAP the primary document directing field procedures?  List any Program Directives or other documents, SOPs, instructions.	Yes	Work Order Letter dated May 1, 2013. Program Directive SHL 2013 01.
2. Were the sampling locations specified in the planning documents sampled?	Yes	
3. Were calibrations conducted as specified in the above-named documents?	Yes	Calibrations were performed May 17, 2013.
4. Was an operational check of the field equipment conducted daily?  Did the operational checks meet criteria?	Yes	Yes
5. Were the number and types (alkalinity, temperature, specific conductance, pH, turbidity, DO, ORP) of field measurements taken as specified?	Yes	
6. Were wells categorized correctly?	Yes	
7. Were the following conditions met when purging a Category I well:  Was one pump/tubing volume purged prior to sampling?  Did the water level stabilize prior to sampling? Did pH, specific conductance, and turbidity measurements meet criteria prior to sampling?  Was the flow rate less than 500 mL/min?	NA	As per Program Directive SHL 2013 01, wells were not sampled using low-flow criteria.

## Water Sampling Field Activities Verification Checklist (continued)

	Response (Yes, No, NA)	Comments
8. Were the following conditions met when purging a Category II well:		
Was the flow rate less than 500 mL/min?	NA	As per Program Directive SHL 2013 01, wells were not sampled using low-flow criteria.
Was one pump/tubing volume removed prior to sampling?		
9. Were duplicates taken at a frequency of one per 20 samples?	Yes	A duplicate sample was collected at location MV-3.
10. Were equipment blanks taken at a frequency of one per 20 samples that were collected with non-dedicated equipment?	Yes	One equipment blank was collected.
11. Were trip blanks prepared and included with each shipment of VOC samples?	NA	
12. Were the true identities of the QC samples documented?	Yes	
13. Were samples collected in the containers specified?	Yes	
14. Were samples filtered and preserved as specified?	Yes	
15. Were the number and types of samples collected as specified?	Yes	
16. Were chain of custody records completed and was sample custody maintained?	Yes	
17. Was all pertinent information documented on the field data sheets?	Yes	
18. Was the presence or absence of ice in the cooler documented at every sample location?	Yes	Icing was required at location HS-1 only.
19. Were water levels measured at the locations specified in the planning documents?	Yes	

## Laboratory Performance Assessment

### General Information

Requisition No. (RIN): 13055323  
Sample Event: May 22, 2013  
Site(s): Shoal Site  
Laboratory: NSF Arizona AMS Laboratory, Tucson, Arizona  
Analysis: Carbon-14  
Validator: Stephen Donovan  
Review Date: November 5, 2013

This validation was performed according to the *Environmental Procedures Catalog* (LMS/POL/S04325, continually updated), "Standard Practice for Validation of Environmental Data." The procedure was applied at Level 1, Data Deliverables Examination. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Carbon-14	LMR-18	NA	Mass Spectrometry

### Data Qualifier Summary

None of the analytical results required qualification.

### Sample Shipping/Receiving

The NSF Arizona AMS Laboratory in Tucson, Arizona, received one water sample on May 29, 2013 submitted for the determination carbon-14. The analytical report was checked to confirm that the scheduled sample was received and analyzed.

### Preservation and Holding Times

The sample shipment was received intact with the sample in the correct container type preserved correctly for the requested analysis. All samples were analyzed within the applicable holding times.

### Completeness

The electronic data deliverable was the only deliverable received for this RIN.

### Electronic Data Deliverable (EDD) File

The EDD file arrived on October 25, 2013.

## General Information

Requisition No. (RIN): 13055324  
Sample Event: May 22, 2013  
Site(s): Shoal Site  
Laboratory: Reston Stable Isotope Laboratory, Reston, Virginia  
Analysis: Stable Isotopes  
Validator: Stephen Donovan  
Review Date: November 5, 2013

This validation was performed according to the *Environmental Procedures Catalog* (LMS/POL/S04325, continually updated), "Standard Practice for Validation of Environmental Data." The procedure was applied at Level 1, Data Deliverables Examination. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 2.

*Table 2. Analytes and Methods*

<b>Analyte</b>	<b>Line Item Code</b>	<b>Prep Method</b>	<b>Analytical Method</b>
H-2/H-1 and O-18/O-16 Isotope Ratios	LMW-08	NA	Mass Spectrometry

## Data Qualifier Summary

None of the analytical results required qualification.

## Sample Shipping/Receiving

The Reston Stable Isotope Laboratory in Reston, Virginia, received one water sample on May 29, 2013, submitted for the determination of stable hydrogen and oxygen isotope ratios. The analytical report was checked to confirm that all of the samples scheduled were received and analyzed.

## Preservation and Holding Times

The sample shipment was received intact with the sample in the correct container type and preserved correctly for the requested analyses. The sample was analyzed within the applicable holding time.

## Laboratory Analysis

Hydrogen-isotope-ratio analysis was performed using a hydrogen equilibration technique (Coplen and others, 1991; Revesz and Coplen, 2008a) which is based on measuring the deuterium activity. Water samples are measured for delta O-18 using the CO<sub>2</sub> equilibration technique of Epstein and Mayeda (1953), which has been automated (Revesz and Coplen 2008b). Therefore, both oxygen and hydrogen isotopic ratio measurements are reported as activities.

Oxygen and hydrogen isotopic results are reported in per mill relative to VSMOW (Vienna Standard Mean Ocean Water) and normalized (Coplen 1994) on scales such that the oxygen and hydrogen isotopic values of SLAP (Standard Light Antarctic Precipitation) are -55.5 per mill and -428 per mill, respectively. The 2-sigma uncertainties of oxygen and hydrogen isotopic results are 0.2 per mill and 2 per mill, respectively, unless otherwise indicated.

### Completeness

The electronic data deliverable was the only deliverable received for this RIN.

### EDD File

The EDD file arrived on September 4, 2013.

## General Information

Report Numbers (RINs): 13055325  
 Sample Event: May 21-22, 2013  
 Site(s): Shoal Site, Nevada  
 Laboratory: ALS Laboratory Group, Fort Collins, Colorado  
 Work Order No.: 1305432  
 Analysis: Metals, Radiochemistry, and Wet Chemistry  
 Validator: Stephen Donivan  
 Review Date: August 2, 2013

This validation was performed according to the *Environmental Procedures Catalog*, (LMS/POL/S04325, continually updated) “Standard Practice for Validation of Environmental Data.” The procedure was applied at Level 3, Data Validation. All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 3.

Table 3. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Bicarbonate Alkalinity	WCH-A-003	EPA 310.1	EPA 310.1
Bromide, Chloride, Sulfate	MIS-A-045	SW-856 9056	SW-856 9056
Calcium, Magnesium, Potassium, Silica, Sodium	LMM-01	SW-846 3005A	SW-846 6010B
Gross Alpha/Beta	GPC-A-001	SOP 724	SOP 724
Nitrite + Nitrate as Nitrogen	WCH-A-022	EPA 353.2	EPA 353.2
Tritium	LSC-A-001	SOP 700	SOP 704
Uranium	LMM-02	SW-846 3005A	SW-846 6020A
Uranium Isotopes	LMR-02	SOP 776, 778	SOP 714

## Data Qualifier Summary

Analytical results were qualified as listed in Table 4. Refer to the sections below for an explanation of the data qualifiers applied.

Table 4. Data Qualifier Summary

Sample Number	Location	Analyte	Flag	Reason
1305432-1	HS-1	Potassium	J	Serial dilution result
1305432-1	HS-1	Sodium	J	Serial dilution result
1305432-1	HS-1	Uranium-235	U	Less than the Decision Level Concentration
1305432-2	HC-1	Gross Beta	J	Less than the Determination Limit
1305432-4	HC-3	Uranium-235	U	Less than the Decision Level Concentration
1305432-5	HC-4	Tritium	J	Less than the Determination Limit
1305432-5	HC-4	Gross Beta	J	Less than the Determination Limit
1305432-5	HC-4	Uranium-238	J	Less than the Determination Limit
1305432-9	HC-8	Uranium-234	J	Less than the Determination Limit
1305432-9	HC-8	Gross Alpha	J	Less than the Determination Limit
1305432-11	MV-2	Gross Beta	J	Less than the Determination Limit

### Sample Shipping/Receiving

ALS Laboratory Group in Fort Collins, Colorado, received 14 water samples on May 29, 2013, accompanied by a Chain of Custody form. Copies of the air bills were included in the receiving documentation. The Chain of Custody was checked to confirm that all of the samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The Chain of Custody was complete with no errors or omissions.

### Preservation and Holding Times

The sample shipment was received intact with the temperature inside the iced cooler at 5.4 °C, which complies with requirements. All samples were received in the correct container types and had been preserved correctly for the requested analyses. All samples were analyzed within the applicable holding times.

### Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured, and is defined as 5 times the MDL.

For radiochemical analytes (those measured by radiometric counting) the MDL and PQL are not applicable, and these results are evaluated using the minimum detectable concentration (MDC), DLC, and Determination Limit (DL). The MDC is a measure of radiochemical method performance and was calculated and reported as specified in *Quality Systems for Analytical Services*. The DLC is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, and is estimated as 3 times the one-sigma total propagated uncertainty. Results that are greater than the MDC, but less than the DLC are qualified with a “U” flag (not detected). The DL for radiochemical results is the lowest concentration that can be reliably measured, and is defined as 3 times the MDC. Results not previously “U” qualified that are less than the DL are qualified with a “J” flag as estimated values.

The reported MDLs for all metal and wet chemical analytes, and MDCs for radiochemical analytes demonstrate compliance with contractual requirements. The MDCs for gross alpha and beta at location MV-2 were slightly above the required detection limits (RDLs). These RDLs were not met because of the elevated levels of dissolved solids in the sample.

### Laboratory Instrument Calibration

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for all analytes. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear curve. Compliance requirements for

continuing calibration checks are established to ensure that the instrument continues to be capable of producing acceptable qualitative and quantitative data. All laboratory instrument calibrations were performed correctly in accordance with the cited methods. All calibration and laboratory spike standards were prepared from independent sources.

*Method EPA 310.1, Alkalinity*

There are no calibration requirements associated with the determination of alkalinity.

*Method EPA 353.2, Nitrite + Nitrate as Nitrogen*

Calibrations were performed using seven calibration standards on June 6, 2013. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria.

*Method SW-846 6010B, Calcium, Magnesium, Potassium, Silica, Sodium*

Calibrations were performed on June 4, 2013, using three standards. The correlation coefficient values were greater than 0.995. The absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range.

*Method SW-846 6020A, Uranium*

Calibrations were performed on June 4, 2013, using four standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency resulting in eight verification checks. All calibration checks met the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

*Method SW-846 9056, Bromide, Chloride, Sulfate*

Calibrations were performed using five calibration standards on April 3, 2013. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency with all calibration checks meeting the acceptance criteria.

## Radiochemical Analysis

### *Alpha Spectrometry*

Alpha spectrometry calibrations and instrument backgrounds were performed within a month prior to sample analysis. Weekly instrument checks met the acceptance criteria. The tracer recoveries met the acceptance criteria of 30 to 110 percent for all samples. The full width at half maximum was reviewed to evaluate the spectral resolution. All internal standard full width at half maximum values were below 100 kiloelectron volts demonstrating acceptable resolution. All internal standard peaks were within 50 kiloelectron volts of the expected position. The regions of

interest for analyte peaks were reviewed. All regions of interest were satisfactory and all integrations were performed correctly.

All uranium isotopic data reported are in agreement with the total uranium reported.

#### *Gross Alpha/Beta*

Plateau calibrations were performed in October 2012. Alpha and beta attenuation calibrations were performed in November 2012 and January 2013, covering a range of 0 to 156 milligrams. All standards were counted to a minimum of 10,000 counts. All calibration and background checks met acceptance criteria. The residual mass was less than 100 milligrams for all samples.

#### *Tritium*

The tritium quench calibration curve was generated on July 30, 2013, for quench indicator values ranging from 621 to 732. A high-energy window (Window 2) was established to monitor for any potential interferences that might be present due to higher energy beta emitters that would bias the results high. All samples had Window 2 count rates that were within the control limits. Daily instrument performance checks were acceptable.

#### Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All method blank and calibration blank results were below the PQLs for all analytes. In cases where a blank concentration exceeds the MDL, the associated sample results are qualified with a "U" flag (not detected) when the sample result is greater than the MDL but less than 5 times the blank concentration. For some metals, the blanks were negative and the absolute values were greater than the MDL but less than the PQL. All associated results for field samples were greater than 5 times the MDL, so no results are qualified. The radiochemistry method blank results were less than the DLC.

#### Inductively Coupled Plasma Interference Check Sample Analysis

Interference check samples were analyzed at the required frequency to verify the instrumental interelement and background correction factors. All check sample results met the acceptance criteria.

#### Matrix Spike Analysis

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than 4 times the spike concentration. The spike recoveries met the acceptance criteria for all analytes evaluated.

#### Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for non-radiochemical replicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the

range should be no greater than the PQL. The replicate results met these criteria. The relative error ratio for radiochemical replicate results (calculated using the one-sigma total propagated uncertainty) was less than 3, indicating acceptable precision.

#### Laboratory Control Sample

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

#### Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. All evaluated serial dilution data were acceptable with the following exceptions. The serial dilutions for potassium and sodium prepared from sample HS-1 did not meet the acceptance criteria. The associated sample results are qualified with a “J” flag as estimated values.

#### Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

#### Chromatography Peak Integration

The integration of analyte peaks was reviewed for all ion chromatography data. All peak integrations were satisfactory.

#### EDD File

The EDD file arrived on June 24, 2013. The Sample Management System EDD validation module was used to verify that the EDD file was complete and in compliance with requirements. The module compares the contents of the file to the requested analyses to ensure that all and only the requested data are delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflect the data contained in the sample data package.

# SAMPLE MANAGEMENT SYSTEM

## General Data Validation Report

RIN: 13055325    Lab Code: PAR    Validator: Stephen Donovan    Validation Date: 08/02/2013  
Project: Shoal Site    Analysis Type:  Metals     General Chem     Rad     Organics  
# of Samples: 14    Matrix: WATER    Requested Analysis Completed: Yes

### Chain of Custody

Present: OK    Signed: OK    Dated: OK

### Sample

Integrity: OK    Preservation: OK    Temperature: OK

### Select Quality Parameters

- Holding Times
- Detection Limits
- Field/Trip Blanks
- Field Duplicates

All analyses were completed within the applicable holding times.

There are 3 detection limit failures.

There was 1 trip/equipment blank evaluated.

There was 1 duplicate evaluated.

**SAMPLE MANAGEMENT SYSTEM**

RIN: 13055325      Lab Code: PAR

**Non-Compliance Report: Detection Limits**

Project: Shoal Site

Validation Date: 08/02/2013

Ticket	Location	Lab Sample ID	Method Code	Lab Method	Analyte Name	Result	Qualifier	Reported Detection Limit	Required Detection Limit	Units
LGT 194	HS-1	1305432-1	WCH-A-003	EPA310.1	Bicarbonate	120		20	10	MG/L
LGT 218	MV-2	1305432-11	GPC-A-001	724R11	GROSS BETA	11.9		9.9	4	pCi/L
LGT 218	MV-2	1305432-11	GPC-A-001	724R11	GROSS ALPHA	1.98	U	6	2	pCi/L

**SAMPLE MANAGEMENT SYSTEM**

**Metals Data Validation Worksheet**

RIN: 13055325      Lab Code: PAR      Date Due: 06/26/2013  
 Matrix: Water      Site Code: SHL01      Date Completed: 06/25/2013

Analyte	Method Type	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	Dup. RPD	ICSAB %R	Serial Dil. %R	CRI %R
			Int.	R^2	CCV	CCB								
Calcium	ICP/ES	06/04/2013	0.0000	1.0000	OK	OK	OK	101.0	96.0	94.0	1.0	104.0	3.0	102.0
Magnesium	ICP/ES	06/04/2013	0.0000	1.0000	OK	OK	OK	100.0	97.0	96.0	1.0	105.0	3.0	101.0
Potassium	ICP/ES	06/04/2013	0.0000	1.0000	OK	OK	OK	102.0	107.0	105.0	1.0		16.0	84.0
Silicon	ICP/ES	06/04/2013	0.0000	1.0000	OK	OK	OK	113.0			0.0	94.0	3.0	82.0
Sodium	ICP/ES	06/04/2013	0.0000	1.0000	OK	OK	OK	102.0	108.0	106.0	1.0		11.0	87.0
Uranium	ICP/MS	06/04/2013	0.0000	1.0000	OK	OK	OK	97.0	100.0	112.0	8.0	100.0	1.0	110.0

**SAMPLE MANAGEMENT SYSTEM**  
**Radiochemistry Data Validation Worksheet**

RIN: 13055325                      Lab Code: PAR                      Date Due: 06/26/2013  
 Matrix: Water                      Site Code: SHL01                      Date Completed: 06/25/2013

Sample	Analyte	Date Analyzed	Result	Flag	Tracer %R	LCS %R	MS %R	Duplicate
HS-1	GROSS ALPHA	06/07/2013						0.18
Blank_Spike	GROSS ALPHA	06/07/2013				86.4		
HS-1	GROSS ALPHA	06/07/2013					110	
HS-1	GROSS BETA	06/07/2013						1.2
Blank_Spike	GROSS BETA	06/07/2013				87		
HS-1	GROSS BETA	06/07/2013					103	
HS-1	H-3	06/12/2013						0.1
HS-1	H-3	06/12/2013					98.1	
Blank	H-3	06/13/2013	-62.0000	U				
Blank_Spike	H-3	06/13/2013				105		
2500	U-234	06/07/2013			82			
2501	U-234	06/07/2013			79.6			
HC-1	U-234	06/07/2013			82.6			
HC-2	U-234	06/07/2013			71.4			
HC-3	U-234	06/07/2013			86.9			
HC-4	U-234	06/07/2013			77.1			
HC-5	U-234	06/07/2013			72.4			
HC-6	U-234	06/07/2013			69.4			
HC-7	U-234	06/07/2013			72			
HC-8	U-234	06/07/2013			78.8			
HS-1	U-234	06/07/2013			82			
MV-1	U-234	06/07/2013			50.6			
MV-2	U-234	06/07/2013			58.9			
MV-3	U-234	06/07/2013			74.8			
HS-1	U-234	06/07/2013			70.6			0.25
Blank_Spike	U-234	06/07/2013			76.3	97.8		
Blank	U-234	06/07/2013	0.0130	U	56.2			
Blank	U-235	06/07/2013	0.0060	U				
Blank	U-238	06/07/2013	0.0289	U				
HS-1	Uranium-235	06/07/2013						0.17
HS-1	Uranium-238	06/07/2013						0.02
Blank_Spike	Uranium-238	06/07/2013				89.3		

**SAMPLE MANAGEMENT SYSTEM**  
**Wet Chemistry Data Validation Worksheet**

**RIN:** 13055325      **Lab Code:** PAR      **Date Due:** 06/26/2013  
**Matrix:** Water      **Site Code:** SHL01      **Date Completed:** 06/25/2013

Analyte	Date Analyzed	CALIBRATION				Method Blank	LCS %R	MS %R	MSD %R	DUP RPD	Serial Dil. %R
		Int.	R^2	CCV	CCB						
ALKALINITY, Total as CaCO3	05/31/2013					OK	98.00				
Bicarbonate	05/31/2013									1.00	
CHLORIDE	06/14/2013	0.000	0.9999	OK	OK	OK	102.00	94.0	92.0	1.00	
Nitrate+Nitrite as N	06/06/2013	0.000	1.0000	OK	OK	OK	104.00	104.0	105.0	0	
SULFATE	06/14/2013	0.000	0.9998	OK	OK	OK	97.00	92.0	93.0	0	

## Sampling Quality Control Assessment

The following information summarizes and assesses quality control for this sampling event.

### Sampling Protocol

As per Program Directive SHL-2013-01, wells were *not* sampled using low-flow criteria. Wells HC-4, HC-5, HC-7, HC-8, MV-1, MV-2, and MV-3 were sampled using a dedicated high-flow submersible pump, and wells HC-1, HC-2, HC-3, and HC-6 were sampled with a bailer. At all high-flow wells, the field parameters specified in the directive met the required stability criteria over the final three readings.

### Equipment Blank Assessment

Equipment blanks are prepared and analyzed to document contamination attributable to the sample collection process. An equipment blank (field ID 2501) was collected by pouring deionized water through the bailer used to collect some samples. This rinsate was then filtered before being containerized and preserved according to analytical requirements. There were no analytes detected in this blank.

### Field Duplicate Assessment

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. The relative percent difference for duplicate results that are greater than 5 times the PQL should be less than 20 percent. For results that are less than 5 times the PQL, the range should be no greater than the PQL. A duplicate sample was collected from location MV-3. The non-radiochemical duplicate results met the criteria. The relative error ratio for radiochemical duplicate results (calculated using the one-sigma total propagated uncertainty) was less than 3, indicating acceptable precision.

**SAMPLE MANAGEMENT SYSTEM**  
**Validation Report: Field Duplicates**

RIN: 13055325    Lab Code: PAR    Project: Shoal Site    Validation Date: 08/02/2013

Duplicate: 2500

Sample: MV-3

Analyte	Sample				Duplicate				RPD	RER	Units
	Result	Flag	Error	Dilution	Result	Flag	Error	Dilution			
GROSS ALPHA	5.08		1.27	1	5.84		1.37	1		0.8	pCi/L
GROSS BETA	5.93		1.5	1	6.05		1.48	1		0.1	pCi/L
H-3	131	U	206	1	8.49	U	225	1		0.8	pCi/L
U-234	3.6		0.652	1	3.58		0.639	1	0.56	0	pCi/L
Uranium	8			10	8			10	0		UG/L
Uranium-235	0.129		0.0626	1	0.136		0.0615	1		0.2	pCi/L
Uranium-238	2.73		0.509	1	2.84		0.519	1	3.95	0.3	pCi/L

### Certification

All laboratory analytical quality control criteria were met except as qualified in this report. The data qualifiers listed on the database reports are defined on the last page of each report. All data in this package are considered validated and available for use.

Laboratory Coordinator: Stephen Donovan 12-30-2013  
Stephen Donovan Date

Data Validation Lead: Stephen Donovan 12-30-2013  
Stephen Donovan Date

**Attachment 1**  
**Assessment of Anomalous Data**

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# Potential Outliers Report

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## Potential Outliers Report

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

Statistical outlier tests give probabilistic evidence that an extreme value does not "fit" with the distribution of the remainder of the data and is therefore a statistical outlier. These tests should only be used to identify data points that require further investigation. The tests alone cannot determine whether a statistical outlier should be discarded or corrected within a data set.

There are three steps involved in identifying extreme values or outliers:

1. Identify extreme values that may be potential outliers by generating the Outliers Report using the Sample Management System from data in the environmental database. The application compares the new data set (in standard environmental database units) with historical data and lists the new data that fall outside the historical data range. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test.
2. Apply the appropriate statistical test. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of 25 or more. This test also assumes that the data without the suspected outliers are normally distributed.
3. Scientifically review statistical outliers and decide on their disposition. The review should include an evaluation of any notable trends in the data that may indicate the outliers represent true extreme values.

The laboratory result for gross alpha at location MV-2 was identified as potentially anomalous. The data associated with this result were further reviewed, confirming an anomalous result. The laboratory was requested to re-analyze the sample. The result from the re-analysis was in closer agreement with historical values and replaced the anomalous result.

**Data Validation Outliers Report - No Field Parameters**

**Comparison: All Historical Data**

Laboratory: ALS Laboratory Group

RIN: 13055325

Report Date: 08/02/2013

Site Code	Location Code	Sample ID	Sample Date	Analyte	Current	Qualifiers		Historical Maximum	Qualifiers		Historical Minimum	Qualifiers		Number of Data Points		Statistical Outlier
					Result	Lab	Data	Result	Lab	Data	Result	Lab	Data	N	N Below Detect	
SHL01	HC-1	0001	05/22/2013	Gross Beta	3.24			9.81		J	3.99		J	8	0	No
SHL01	HC-1	0001	05/22/2013	Uranium	0.00094			0.0048			0.0011		J	7	0	NA
SHL01	HC-1	0001	05/22/2013	Uranium-238	0.291			6.52			0.35			10	0	No
SHL01	HC-4	0001	05/21/2013	Tritium	964			918			-62.7			28	5	No
SHL01	HC-4	0001	05/21/2013	Uranium	0.06			0.046			0.00069			10	0	No
SHL01	MV-2	N001	05/22/2013	Gross Alpha	1.98	U		17.3			9.92			7	0	Yes

**STATISTICAL TESTS:**

The distribution of the data is tested for normality or lognormality using the Shapiro-Wilk Test

Outliers are identified using Dixon's Test when there are 25 or fewer data points.

Outliers are identified using Rosner's Test when there are 26 or more data points.

See Data Quality Assessment: Statistical Methods for Practitioners, EPA QC/G-9S, February 2006.

NA: Data are not normally or lognormally distributed.

# **Attachment 2**

## **Data Presentation**

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## **Groundwater Quality Data**

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**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: HC-1 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)	Result	Qualifiers Data	Lab QA	Detection Limit	Uncertainty
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/22/2013	0001	1215 - 1215	90		#		
Dissolved Oxygen	mg/L	05/22/2013	N001	1215 - 1215	9		#		
Gross Alpha	pCi/L	05/22/2013	0001	1215 - 1215	3.91		#	1.2	1.14
Gross Beta	pCi/L	05/22/2013	0001	1215 - 1215	3.24	J	#	2.4	1.59
Oxidation Reduction Potential	mV	05/22/2013	N001	1215 - 1215	112		#		
pH	s.u.	05/22/2013	N001	1215 - 1215	7.2		#		
Specific Conductance	umhos/cm	05/22/2013	N001	1215 - 1215	382		#		
Temperature	C	05/22/2013	N001	1215 - 1215	17.5		#		
Tritium	pCi/L	05/22/2013	0001	1215 - 1215	-56.5	U	#	340	204
Turbidity	NTU	05/22/2013	N001	1215 - 1215	95.8		#		
Uranium	mg/L	05/22/2013	0001	1215 - 1215	0.00094		#	0.000029	
Uranium-234	pCi/L	05/22/2013	0001	1215 - 1215	0.425		#	0.055	0.12
Uranium-235	pCi/L	05/22/2013	0001	1215 - 1215	0.0218	U	#	0.055	0.033
Uranium-238	pCi/L	05/22/2013	0001	1215 - 1215	0.291		#	0.051	0.0946

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: HC-2 WELL

Parameter	Units	Sample		Depth Range			Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID	(Ft BLS)				Lab	Data	QA		
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/22/2013	0001	1100	-	1100	89			#		
Dissolved Oxygen	mg/L	05/22/2013	N001	1100	-	1100	6.62			#		
Gross Alpha	pCi/L	05/22/2013	0001	1100	-	1100	61.1			#	1.5	10.2
Gross Beta	pCi/L	05/22/2013	0001	1100	-	1100	19.7			#	3	3.77
Oxidation Reduction Potential	mV	05/22/2013	N001	1100	-	1100	85			#		
pH	s.u.	05/22/2013	N001	1100	-	1100	7.32			#		
Specific Conductance	umhos/cm	05/22/2013	N001	1100	-	1100	657			#		
Temperature	C	05/22/2013	N001	1100	-	1100	16.78			#		
Tritium	pCi/L	05/22/2013	0001	1100	-	1100	-9.91	U		#	330	196
Turbidity	NTU	05/22/2013	N001	1100	-	1100	15.3			#		
Uranium	mg/L	05/22/2013	0001	1100	-	1100	0.1			#	0.000029	
Uranium-234	pCi/L	05/22/2013	0001	1100	-	1100	37.2			#	0.077	6.17
Uranium-235	pCi/L	05/22/2013	0001	1100	-	1100	1.88			#	0.058	0.381
Uranium-238	pCi/L	05/22/2013	0001	1100	-	1100	37.2			#	0.056	6.17

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: HC-3 WELL

Parameter	Units	Sample		Depth Range			Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID	(Ft BLS)				Lab	Data	QA		
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/22/2013	0001	1190	-	1190	45			#		
Dissolved Oxygen	mg/L	05/22/2013	N001	1190	-	1190	4.2			#		
Gross Alpha	pCi/L	05/22/2013	0001	1190	-	1190	0.724	U		#	1.1	0.701
Gross Beta	pCi/L	05/22/2013	0001	1190	-	1190	5.91			#	1.7	1.44
Oxidation Reduction Potential	mV	05/22/2013	N001	1190	-	1190	99.2			#		
pH	s.u.	05/22/2013	N001	1190	-	1190	8.16			#		
Specific Conductance	umhos/cm	05/22/2013	N001	1190	-	1190	282			#		
Temperature	C	05/22/2013	N001	1190	-	1190	23.1			#		
Tritium	pCi/L	05/22/2013	0001	1190	-	1190	88.5	U		#	350	212
Turbidity	NTU	05/22/2013	N001	1190	-	1190	100			#		
Uranium	mg/L	05/22/2013	0001	1190	-	1190	0.0027			#	0.000029	
Uranium-234	pCi/L	05/22/2013	0001	1190	-	1190	0.932			#	0.04	0.205
Uranium-235	pCi/L	05/22/2013	0001	1190	-	1190	0.0828		U	#	0.04	0.0486
Uranium-238	pCi/L	05/22/2013	0001	1190	-	1190	0.966			#	0.034	0.211

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: HC-4 WELL

Parameter	Units	Sample		Depth Range			Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID	(Ft BLS)				Lab	Data	QA		
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/21/2013	0001	1013	-	1294	130			#		
Dissolved Oxygen	mg/L	05/21/2013	N001	1013	-	1294	0.63			#		
Gross Alpha	pCi/L	05/21/2013	0001	1013	-	1294	35.1			#	1.3	5.96
Gross Beta	pCi/L	05/21/2013	0001	1013	-	1294	13.6		J	#	1.8	2.5
Oxidation Reduction Potential	mV	05/21/2013	N001	1013	-	1294	-89.5			#		
pH	s.u.	05/21/2013	N001	1013	-	1294	7.07			#		
Specific Conductance	umhos/cm	05/21/2013	N001	1013	-	1294	710			#		
Temperature	C	05/21/2013	N001	1013	-	1294	21.76			#		
Tritium	pCi/L	05/21/2013	0001	1013	-	1294	964		J	#	380	287
Turbidity	NTU	05/21/2013	N001	1013	-	1294	20.7			#		
Uranium	mg/L	05/21/2013	0001	1013	-	1294	0.06			#	0.000029	
Uranium-234	pCi/L	05/21/2013	0001	1013	-	1294	22			#	0.041	3.69
Uranium-235	pCi/L	05/21/2013	0001	1013	-	1294	0.978			#	0.043	0.23
Uranium-238	pCi/L	05/21/2013	0001	1013	-	1294	20.8			#	0.043	3.49

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: HC-5 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range		Result	Qualifiers			Detection Limit	Uncertainty
				(Ft BLS)	(Ft)		Lab	Data	QA		
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/22/2013	N001	3385.03	- 3530.63	70			#		
Dissolved Oxygen	mg/L	05/22/2013	N001	3385.03	- 3530.63	0.35			#		
Gross Alpha	pCi/L	05/22/2013	N001	3385.03	- 3530.63	0.957	U		#	1	0.658
Gross Beta	pCi/L	05/22/2013	N001	3385.03	- 3530.63	2.38			#	1.1	0.784
Oxidation Reduction Potential	mV	05/22/2013	N001	3385.03	- 3530.63	-250.9			#		
pH	s.u.	05/22/2013	N001	3385.03	- 3530.63	8.6			#		
Specific Conductance	umhos/cm	05/22/2013	N001	3385.03	- 3530.63	916			#		
Temperature	C	05/22/2013	N001	3385.03	- 3530.63	27.26			#		
Tritium	pCi/L	05/22/2013	N001	3385.03	- 3530.63	-56.6	U		#	340	203
Turbidity	NTU	05/22/2013	N001	3385.03	- 3530.63	1.05			#		
Uranium	mg/L	05/22/2013	N001	3385.03	- 3530.63	0.0004			#	0.000029	
Uranium-234	pCi/L	05/22/2013	N001	3385.03	- 3530.63	0.24			#	0.056	0.0897
Uranium-235	pCi/L	05/22/2013	N001	3385.03	- 3530.63	0.0138	U		#	0.048	0.0267
Uranium-238	pCi/L	05/22/2013	N001	3385.03	- 3530.63	0.122			#	0.051	0.0619

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: HC-6 WELL

Parameter	Units	Sample		Depth Range			Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID	(Ft BLS)				Lab	Data	QA		
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/22/2013	0001	1175	-	1175	118			#		
Dissolved Oxygen	mg/L	05/22/2013	N001	1175	-	1175	9.99			#		
Gross Alpha	pCi/L	05/22/2013	0001	1175	-	1175	19.1			#	1.1	3.35
Gross Beta	pCi/L	05/22/2013	0001	1175	-	1175	9.87			#	1.4	1.87
Oxidation Reduction Potential	mV	05/22/2013	N001	1175	-	1175	127.6			#		
pH	s.u.	05/22/2013	N001	1175	-	1175	6.32			#		
Specific Conductance	umhos/cm	05/22/2013	N001	1175	-	1175	1145			#		
Temperature	C	05/22/2013	N001	1175	-	1175	19.16			#		
Tritium	pCi/L	05/22/2013	0001	1175	-	1175	97.7	U		#	360	219
Turbidity	NTU	05/22/2013	N001	1175	-	1175	11.4			#		
Uranium	mg/L	05/22/2013	0001	1175	-	1175	0.036			#	0.000029	
Uranium-234	pCi/L	05/22/2013	0001	1175	-	1175	15.7			#	0.067	2.67
Uranium-235	pCi/L	05/22/2013	0001	1175	-	1175	0.56			#	0.048	0.158
Uranium-238	pCi/L	05/22/2013	0001	1175	-	1175	12.6			#	0.045	2.15

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: HC-7 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range		(Ft BLS)	Result	Qualifiers			Detection Limit	Uncertainty
				Lab	Data			QA				
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/21/2013	N001	1106.47	-	1223.6	85			#		
Dissolved Oxygen	mg/L	05/21/2013	N001	1106.47	-	1223.6	0.4			#		
Gross Alpha	pCi/L	05/21/2013	N001	1106.47	-	1223.6	13.8			#	1.4	2.65
Gross Beta	pCi/L	05/21/2013	N001	1106.47	-	1223.6	10.1			#	1.4	1.9
Oxidation Reduction Potential	mV	05/21/2013	N001	1106.47	-	1223.6	-248.7			#		
pH	s.u.	05/21/2013	N001	1106.47	-	1223.6	8			#		
Specific Conductance	umhos/cm	05/21/2013	N001	1106.47	-	1223.6	1262			#		
Temperature	C	05/21/2013	N001	1106.47	-	1223.6	23.08			#		
Tritium	pCi/L	05/21/2013	N001	1106.47	-	1223.6	182	U		#	370	229
Turbidity	NTU	05/21/2013	N001	1106.47	-	1223.6	2.32			#		
Uranium	mg/L	05/21/2013	N001	1106.47	-	1223.6	0.015			#	0.000029	
Uranium-234	pCi/L	05/21/2013	N001	1106.47	-	1223.6	6.31			#	0.062	1.11
Uranium-235	pCi/L	05/21/2013	N001	1106.47	-	1223.6	0.302			#	0.05	0.107
Uranium-238	pCi/L	05/21/2013	N001	1106.47	-	1223.6	5.56			#	0.041	0.99

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: HC-8 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)		Result	Qualifiers			Detection Limit	Uncertainty
							Lab	Data	QA		
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/23/2013	N001	2294.44	- 2410.92	80			#		
Dissolved Oxygen	mg/L	05/23/2013	N001	2294.44	- 2410.92	0.41			#		
Gross Alpha	pCi/L	05/23/2013	N001	2294.44	- 2410.92	1.24		J	#	0.88	0.63
Gross Beta	pCi/L	05/23/2013	N001	2294.44	- 2410.92	3.39			#	1	0.857
Oxidation Reduction Potential	mV	05/23/2013	N001	2294.44	- 2410.92	-158.7			#		
pH	s.u.	05/23/2013	N001	2294.44	- 2410.92	8.27			#		
Specific Conductance	umhos/cm	05/23/2013	N001	2294.44	- 2410.92	794			#		
Temperature	C	05/23/2013	N001	2294.44	- 2410.92	28.76			#		
Tritium	pCi/L	05/23/2013	N001	2294.44	- 2410.92	116	U		#	380	228
Turbidity	NTU	05/23/2013	N001	2294.44	- 2410.92	3.19			#		
Uranium	mg/L	05/23/2013	N001	2294.44	- 2410.92	0.00014			#	0.000029	
Uranium-234	pCi/L	05/23/2013	N001	2294.44	- 2410.92	0.107		J	#	0.046	0.0541
Uranium-235	pCi/L	05/23/2013	N001	2294.44	- 2410.92	0.00345	U		#	0.045	0.0227
Uranium-238	pCi/L	05/23/2013	N001	2294.44	- 2410.92	0.0406	U		#	0.05	0.0371

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: HS-1 WELL

Parameter	Units	Sample Date	ID	Depth Range	(Ft BLS)	Result	Qualifiers Data	QA	Lab	Detection Limit	Uncertainty
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/22/2013	N001	14241.78 -	14241.78	145			#		
Bicarbonate	mg/L	05/22/2013	N001	14241.78 -	14241.78	120			#	20	
Calcium	mg/L	05/22/2013	N001	14241.78 -	14241.78	35			#	0.012	
Carbon-14, Dissolved Inorganic (pCi/L)	pCi/L	05/22/2013	0002	14241.78 -	14241.78	0.00207			#		
Carbon-14, Dissolved Inorganic (pMC)	pMC	05/22/2013	0002	14241.78 -	14241.78	8.23			#		
Carbon-14, Dissolved Inorganic (YBP)	years	05/22/2013	0002	14241.78 -	14241.78	20060			#		170
Chloride	mg/L	05/22/2013	N001	14241.78 -	14241.78	33			#	1	
Dissolved Oxygen	mg/L	05/22/2013	N001	14241.78 -	14241.78	2.05			#		
Gross Alpha	pCi/L	05/22/2013	N001	14241.78 -	14241.78	4.22			#	1.3	1.2
Gross Beta	pCi/L	05/22/2013	N001	14241.78 -	14241.78	7.89			#	2.5	2.04
Magnesium	mg/L	05/22/2013	N001	14241.78 -	14241.78	5.5			#	0.013	
Nitrate + Nitrite as Nitrogen	mg/L	05/22/2013	N001	14241.78 -	14241.78	0.85			#	0.01	
Oxidation Reduction Potential	mV	05/22/2013	N001	14241.78 -	14241.78	48.7			#		
pH	s.u.	05/22/2013	N001	14241.78 -	14241.78	7.98			#		
Potassium	mg/L	05/22/2013	N001	14241.78 -	14241.78	7	E	J	#	0.11	
Silica	mg/L	05/22/2013	N001	14241.78 -	14241.78	67			#	0.0095	
Silicon	mg/L	05/22/2013	N001	14241.78 -	14241.78	31			#	0.0044	
Sodium	mg/L	05/22/2013	N001	14241.78 -	14241.78	42	E	J	#	0.0066	

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: HS-1 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range	(Ft BLS)	Result	Qualifiers Data	Lab QA	Detection Limit	Uncertainty
Specific Conductance	umhos/cm	05/22/2013	N001	14241.78 - 14241.78		421		#		
Stable isotope ratio H2/H1 in Water	parts per thousand	05/22/2013	0001	14241.78 - 14241.78		-124.65		#		
Stable isotope ratio O18/O16 in Water	parts per thousand	05/22/2013	0001	14241.78 - 14241.78		-15.78		#		
Sulfate	mg/L	05/22/2013	N001	14241.78 - 14241.78		55		#	2.5	
Temperature	C	05/22/2013	N001	14241.78 - 14241.78		19.05		#		
Tritium	pCi/L	05/22/2013	N001	14241.78 - 14241.78		89.6	U	#	380	231
Turbidity	NTU	05/22/2013	N001	14241.78 - 14241.78		8.65		#		
Uranium	mg/L	05/22/2013	N001	14241.78 - 14241.78		0.0057		#	0.000029	
Uranium-234	pCi/L	05/22/2013	N001	14241.78 - 14241.78		2.99		#	0.056	0.504
Uranium-235	pCi/L	05/22/2013	N001	14241.78 - 14241.78		0.0963	U	#	0.045	0.0475
Uranium-238	pCi/L	05/22/2013	N001	14241.78 - 14241.78		1.77		#	0.038	0.316

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: MV-1 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)		Result	Qualifiers			Detection Limit	Uncertainty
							Lab	Data	QA		
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/22/2013	N001	1572.73	- 1726.54	100			#		
Dissolved Oxygen	mg/L	05/22/2013	N001	1572.73	- 1726.54	0.42			#		
Gross Alpha	pCi/L	05/22/2013	N001	1572.73	- 1726.54	13.6			#	1.6	2.7
Gross Beta	pCi/L	05/22/2013	N001	1572.73	- 1726.54	9.72			#	2.6	2.29
Oxidation Reduction Potential	mV	05/22/2013	N001	1572.73	- 1726.54	-181			#		
pH	s.u.	05/22/2013	N001	1572.73	- 1726.54	8.28			#		
Specific Conductance	umhos/cm	05/22/2013	N001	1572.73	- 1726.54	684			#		
Temperature	C	05/22/2013	N001	1572.73	- 1726.54	22.74			#		
Tritium	pCi/L	05/22/2013	N001	1572.73	- 1726.54	253	U		#	370	231
Turbidity	NTU	05/22/2013	N001	1572.73	- 1726.54	1.51			#		
Uranium	mg/L	05/22/2013	N001	1572.73	- 1726.54	0.021			#	0.000029	
Uranium-234	pCi/L	05/22/2013	N001	1572.73	- 1726.54	8.72			#	0.065	1.57
Uranium-235	pCi/L	05/22/2013	N001	1572.73	- 1726.54	0.407			#	0.072	0.144
Uranium-238	pCi/L	05/22/2013	N001	1572.73	- 1726.54	7.35			#	0.065	1.34

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: MV-2 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range (Ft BLS)		Result	Qualifiers			Detection Limit	Uncertainty
							Lab	Data	QA		
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/22/2013	N001	1819.87	- 1990.64	105			#		
Dissolved Oxygen	mg/L	05/22/2013	N001	1819.87	- 1990.64	0.64			#		
Gross Alpha	pCi/L	05/22/2013	N001	1819.87	- 1990.64	9.79			#	1.6	2.12
Gross Beta	pCi/L	05/22/2013	N001	1819.87	- 1990.64	8.25		J	#	2.9	2.29
Oxidation Reduction Potential	mV	05/22/2013	N001	1819.87	- 1990.64	-33.2			#		
pH	s.u.	05/22/2013	N001	1819.87	- 1990.64	8.38			#		
Specific Conductance	umhos/cm	05/22/2013	N001	1819.87	- 1990.64	460			#		
Temperature	C	05/22/2013	N001	1819.87	- 1990.64	22.97			#		
Tritium	pCi/L	05/22/2013	N001	1819.87	- 1990.64	-57	U		#	320	193
Turbidity	NTU	05/22/2013	N001	1819.87	- 1990.64	1.73			#		
Uranium	mg/L	05/22/2013	N001	1819.87	- 1990.64	0.022			#	0.000029	
Uranium-234	pCi/L	05/22/2013	N001	1819.87	- 1990.64	8.83			#	0.064	1.56
Uranium-235	pCi/L	05/22/2013	N001	1819.87	- 1990.64	0.338			#	0.058	0.121
Uranium-238	pCi/L	05/22/2013	N001	1819.87	- 1990.64	7.85			#	0.043	1.4

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: MV-3 WELL

Parameter	Units	Sample Date	Sample ID	Depth Range		(Ft BLS)	Result	Qualifiers			Detection Limit	Uncertainty
				Lab	Data			QA				
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	05/21/2013	N001	1463.59	-	1634.75	78			#		
Dissolved Oxygen	mg/L	05/21/2013	N001	1463.59	-	1634.75	0.45			#		
Gross Alpha	pCi/L	05/21/2013	N001	1463.59	-	1634.75	5.08			#	1.2	1.27
Gross Alpha	pCi/L	05/21/2013	N002	1463.59	-	1634.75	5.84			#	1.2	1.37
Gross Beta	pCi/L	05/21/2013	N001	1463.59	-	1634.75	5.93			#	1.8	1.5
Gross Beta	pCi/L	05/21/2013	N002	1463.59	-	1634.75	6.05			#	1.7	1.48
Oxidation Reduction Potential	mV	05/21/2013	N001	1463.59	-	1634.75	-208.3			#		
pH	s.u.	05/21/2013	N001	1463.59	-	1634.75	7.84			#		
Specific Conductance	umhos/cm	05/21/2013	N001	1463.59	-	1634.75	712			#		
Temperature	C	05/21/2013	N001	1463.59	-	1634.75	21.95			#		
Tritium	pCi/L	05/21/2013	N001	1463.59	-	1634.75	131	U		#	340	206
Tritium	pCi/L	05/21/2013	N002	1463.59	-	1634.75	8.49	U		#	380	225
Turbidity	NTU	05/21/2013	N001	1463.59	-	1634.75	1.48			#		
Uranium	mg/L	05/21/2013	N001	1463.59	-	1634.75	0.008			#	0.000029	
Uranium	mg/L	05/21/2013	N002	1463.59	-	1634.75	0.008			#	0.000029	
Uranium-234	pCi/L	05/21/2013	N001	1463.59	-	1634.75	3.6			#	0.04	0.652
Uranium-234	pCi/L	05/21/2013	N002	1463.59	-	1634.75	3.58			#	0.046	0.639
Uranium-235	pCi/L	05/21/2013	N001	1463.59	-	1634.75	0.129			#	0.038	0.0626

**Groundwater Quality Data by Location (USEE100) FOR SITE SHL01, Shoal Site**

REPORT DATE: 12/16/2013

Location: MV-3 WELL

Parameter	Units	Sample		Depth Range		(Ft BLS)	Result	Qualifiers			Detection Limit	Uncertainty
		Date	ID					Lab	Data	QA		
Uranium-235	pCi/L	05/21/2013	N002	1463.59	-	1634.75	0.136			#	0.035	0.0615
Uranium-238	pCi/L	05/21/2013	N001	1463.59	-	1634.75	2.73			#	0.043	0.509
Uranium-238	pCi/L	05/21/2013	N002	1463.59	-	1634.75	2.84			#	0.025	0.519

SAMPLE ID CODES: 000X = Filtered sample (0.45 µm). N00X = Unfiltered sample. X = replicate number.

LAB QUALIFIERS:

- \* Replicate analysis not within control limits.
- > Result above upper detection limit.
- A TIC is a suspected aldol-condensation product.
- B Inorganic: Result is between the IDL and CRDL. Organic: Analyte also found in method blank.
- C Pesticide result confirmed by GC-MS.
- D Analyte determined in diluted sample.
- E Inorganic: Estimate value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS.
- H Holding time expired, value suspect.
- I Increased detection limit due to required dilution.
- J Estimated
- N Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: Tentatively identified compound (TIC).
- P > 25% difference in detected pesticide or Aroclor concentrations between 2 columns.
- U Analytical result below detection limit.
- W Post-digestion spike outside control limits while sample absorbance < 50% of analytical spike absorbance.
- X,Y,Z Laboratory defined qualifier, see case narrative.

DATA QUALIFIERS:

- F Low flow sampling method used.
- L Less than 3 bore volumes purged prior to sampling.
- U Parameter analyzed for but was not detected.
- G Possible grout contamination, pH > 9.
- Q Qualitative result due to sampling technique.
- X Location is undefined.
- J Estimated value.
- R Unusable result.

QA QUALIFIER:

- # Validated according to quality assurance guidelines.

## **Equipment Blank Data**

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**BLANKS REPORT**

LAB: PARAGON/ALS LABORATORY GROUP (Fort Collins, CO)

RIN: 13055325

Report Date: 12/16/2013

Parameter	Site Code	Location ID	Sample Date	Sample ID	Units	Result	Qualifiers Lab Data	Detection Limit	Uncertainty	Sample Type
Gross Alpha	SHL01	0999	05/22/2013	N001	pCi/L	0.189	U	0.62	0.373	E
Gross Beta	SHL01	0999	05/22/2013	N001	pCi/L	0.631	U	0.98	0.608	E
Tritium	SHL01	0999	05/22/2013	N001	pCi/L	168	U	380	234	E
Uranium	SHL01	0999	05/22/2013	N001	mg/L	0.000029	U	0.000029		E
Uranium-234	SHL01	0999	05/22/2013	N001	pCi/L	0.01	U	0.035	0.0193	E
Uranium-235	SHL01	0999	05/22/2013	N001	pCi/L	0.0123	U	0.017	0.0227	E
Uranium-238	SHL01	0999	05/22/2013	N001	pCi/L	0.0205	U	0.035	0.0245	E

SAMPLE ID CODES: 000X = Filtered sample (0.45 µm). N00X = Unfiltered sample. X = replicate number.

## LAB QUALIFIERS:

- \* Replicate analysis not within control limits.
- > Result above upper detection limit.
- A TIC is a suspected aldol-condensation product.
- B Inorganic: Result is between the IDL and CRDL. Organic: Analyte also found in method blank.
- C Pesticide result confirmed by GC-MS.
- D Analyte determined in diluted sample.
- E Inorganic: Estimate value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS.
- H Holding time expired, value suspect.
- I Increased detection limit due to required dilution.
- J Estimated
- N Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: Tentatively identified compound (TIC).
- P > 25% difference in detected pesticide or Aroclor concentrations between 2 columns.
- U Analytical result below detection limit.

## DATA QUALIFIERS:

- F Low flow sampling method used.
- L Less than 3 bore volumes purged prior to sampling.
- U Parameter analyzed for but was not detected.
- G Possible grout contamination, pH > 9.
- Q Qualitative result due to sampling technique.
- X Location is undefined.
- J Estimated value.
- R Unusable result.

## SAMPLE TYPES:

- E Equipment Blank.

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## **Static Water Level Data**

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**STATIC WATER LEVELS (USEE700) FOR SITE SHL01, Shoal Site**  
**REPORT DATE: 12/16/2013**

Location Code	Flow Code	Top of Casing Elevation (Ft)	Measurement Time	Date	Depth From Top of Casing (Ft)	Water Elevation (Ft)
HC-1		5309.21	5/21/2013	16:44	1060.60	4248.61
HC-2		5347.12	5/21/2013	15:12	1082.40	4264.72
HC-3		5081.52	5/22/2013	13:15	1179.80	3901.72
HC-4		5260.9	05/21/2013	17:10:31	1006.52	4254.38
HC-5		5247.37	05/22/2013	08:40:43	1368.85	3878.52
HC-6		5228.68	05/22/2013	09:20:00	964.68	4264.0
HC-7		5229.72	05/21/2013	13:35:02	964.71	4265.01
HC-8		5259.91	05/23/2013	08:10:18	1371.55	3888.36
MV-1		5257.54	05/22/2013	15:40:04	989.98	4267.56
MV-2		5266.62	05/22/2013	13:10:29	999.25	4267.37
MV-3		5261.5	05/21/2013	19:10:59	970.45	4291.05

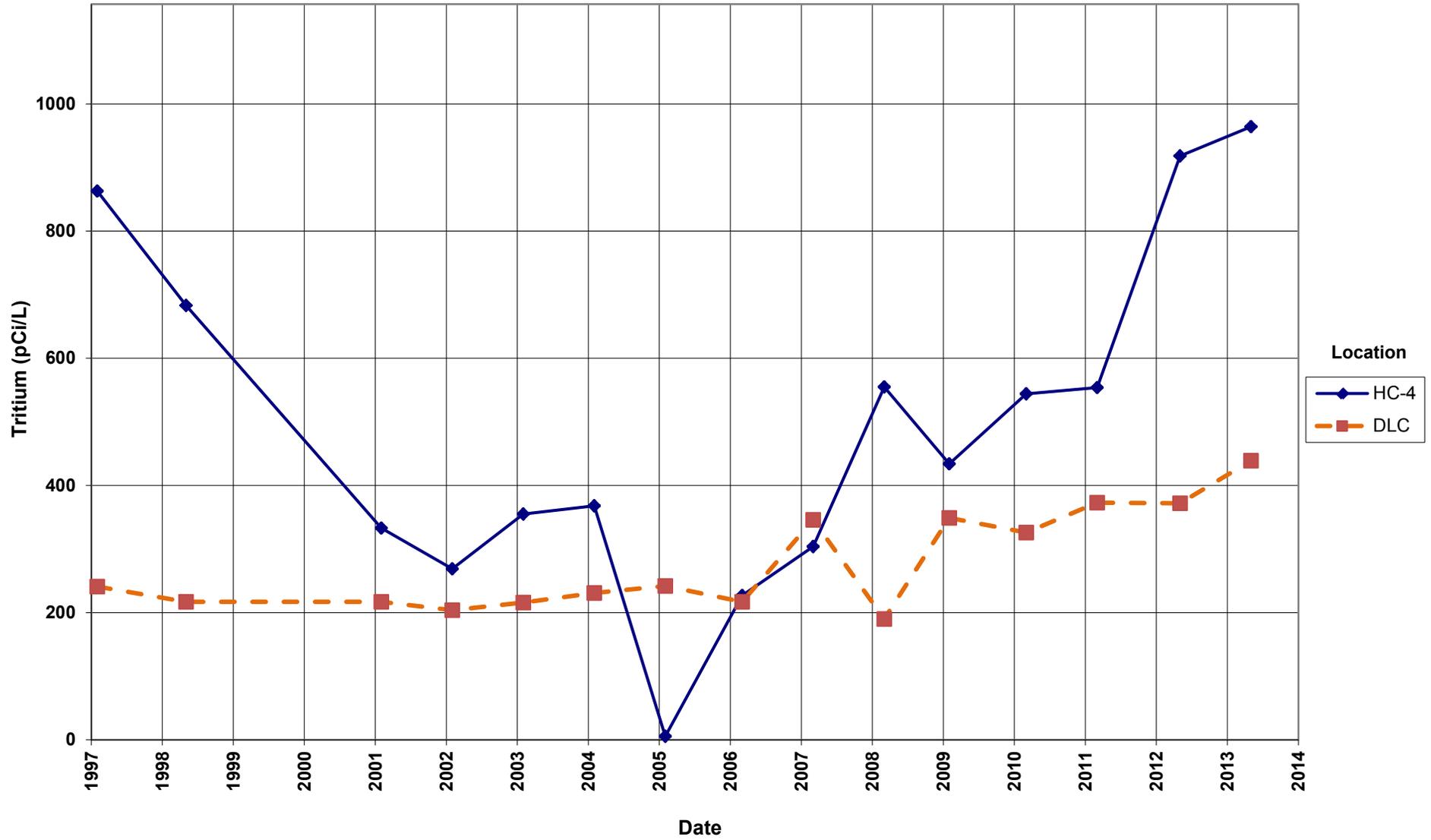
FLOW CODES: B BACKGROUND    C CROSS GRADIENT    D DOWN GRADIENT    F OFF SITE  
                   N UNKNOWN            O ON SITE            U UPGRADIENT

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## **Time-Concentration Graph**

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**Shoal Site**  
**Tritium Concentration**  
DLC - Decision Level Concentration



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**Attachment 3**  
**Sampling and Analysis Work Order**

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May 1, 2013

U.S. Department of Energy  
Office of Legacy Management  
ATTN: Mark Kautsky  
Site Manager  
2597 Legacy Way  
Grand Junction, CO 81503

SUBJECT: Contract No. DE-AM01-07LM00060, S.M. Stoller Corporation (Stoller)  
2013 Sampling Plan for Shoal Site in Nevada

REFERENCE: Task Order LM00-502-07-621, Shoal, Nevada, Site

Dear Mr. Kautsky:

The purpose of this letter is to inform you of the upcoming monitoring event at the Shoal, Nevada, Site. It is also to provide details on the sampling activities, hydraulic head monitoring, and supplemental activities that are not part of our typical annual monitoring. The annual sampling activities, as typically performed, will include the analyses of samples from select wells for tritium, uranium isotopes, gross alpha, and mass concentrations of uranium, as specified in the Corrective Action Decision Document/Corrective Action Plan and short-term data acquisition plans completed in 2009 and 2011. Supplemental activities for this monitoring event will include the collection of water samples from the groundwater supply well HS-1. Attached are a map and tables that specify the sample locations and analytes for the annual monitoring event. This monitoring event is scheduled to begin the week of May 20, 2013.

The following locations are scheduled for sampling during this event:

- **Wells**
  - HC-1, HC-2, HC-3, HC-4, HC-5, HC-6, HC-7, HC-8, MV-1, MV-2, MV-3, and HS-1

Samples will be collected from wells HC-1, HC-2, HC-3, and HC-6 using a depth-specific bailer because these wells are not completed with dedicated submersible pumps. The samples from these locations will be collected from the approximate middle of the open interval. Monitoring wells HC-4, HC-5, HC-7, HC-8, MV-1, MV-2, MV-3, and HS-1 will be sampled using the dedicated submersible pumps. At least one well volume will be removed, and field parameters (temperature, pH, and specific conductance) will be allowed to stabilize before samples are collected. Before samples are collected from the wells, the transducer will be removed and downloaded, and a water level will be determined. All samples will be collected as directed in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management*

Sites ([http://www.lm.doe.gov/Long-Term\\_Surveillance\\_and\\_Maintenance.aspx#](http://www.lm.doe.gov/Long-Term_Surveillance_and_Maintenance.aspx#)). Refer to Table 1 for a list of sample locations and Table 2 for the required analyses.

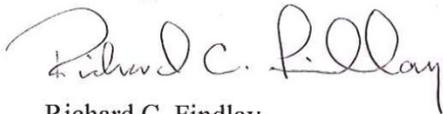
### **Supplemental Activities**

The following supplemental activities are associated with this monitoring event:

- **Well HS-1:** The supplemental activities for well HS-1 include the collection of water samples for laboratory analysis and measuring depth to groundwater in the well (if possible). Well HS-1 is in Fairview Valley approximately 4-miles east of surface ground zero (Figure 1 – Planned Sampling Map). The well is used by a local rancher to provide water for his livestock and has not been sampled to determine geochemical properties of the water since 1999. Samples collected during this sampling event will be analyzed for major ions, stable isotopes of oxygen and hydrogen, and carbon-14 to determine the age of the water. Samples will also be analyzed for tritium, uranium isotopes, gross alpha, and mass concentrations of uranium. Refer to Table 2 for the complete analytical suite for this well.

Please contact me at (970) 248-6419 if you have questions or need additional information.

Sincerely,



Richard C. Findlay  
Site Lead

RF/lcg/dc  
Enclosures (3)

Attachments: Table 1 – Sampling Frequencies for Locations at Shoal, Nevada  
Table 2 – Constituent Sampling Breakdown for Shoal, Nevada  
Figure 1 – Planned Sampling Map, Shoal, Nevada, Site

cc: (electronic)  
Steve Donovan, Stoller  
Rick Findlay, Stoller  
Bev Gallagher, Stoller  
Lauren Goodknight, Stoller  
EDD delivery  
rc-grand.junction  
File: SHL 410.02 (A)

**Table 1 - Sampling Frequencies for Locations at Shoal, Nevada**

<b>Location ID</b>	<b>Quarterly</b>	<b>Semiannually</b>	<b>Annually</b>	<b>Biennially</b>	<b>Not Sampled</b>	<b>Notes</b>
<b>Monitoring Wells</b>						
H-2					X	Download transducers
H-3					X	Download transducers
HC-1			X			Download transducers
HC-2			X			Download transducers
HC-3			X			Download transducers
HC-4			X			Download transducers
HC-5			X			Download transducers
HC-6			X			Download transducers
HC-7			X			Download transducers
HC-8			X			Download transducers
MV-1			X			Download transducers
MV-2			X			Download transducers
MV-3			X			Download transducers
<b>Piezometers</b>						
MV-1PZ					X	Download transducers
MV-2PZ					X	Download transducers
MV-3PZ					X	Download transducers
<b>Groundwater Supply Well</b>						
HS-1			X*			If possible measure depth to water

\* = This location is part of the 2013 sampling and is not planned for future sampling events.

**Table 2 - Constituent Sampling Breakdown for Shoal, Nevada**

Analyte	Measurements by Location Type		Laboratory Requirements		
	Groundwater Monitoring Wells	Groundwater Supply Well HS-1	Required Detection Limit	Analytical Method	Line Item Code
Approx. No. Samples/yr	11	1			
<i>Field Measurements</i>					
Alkalinity	X	X			
Dissolved Oxygen	X	X			
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X	X			
Temperature	X	X			
<i>Laboratory Measurements</i>					
Aluminum					
Ammonia as N (NH <sub>3</sub> -N)					
Bicarbonates		X	10 mg/L	SM2320 B	WCH-A-003
Bromide					
Calcium		X	5 mg/L	SW-846 6010	LMM-01
Carbon-14 (Dissolved Inorganic Carbon)		X	NA	AMS	LMR-18
Chloride		X	0.5 mg/L	SW-846 9056	MIS-A-045
Chromium					
Gamma Spec					
Gross Alpha	X	X	2 pCi/L	EPA 900.0	GPC-A-001
Gross Beta					
Iodine-129					
Iron					
Lead					
Magnesium		X	5 mg/L	SW-846 6010	LMM-01
Manganese					
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO <sub>3</sub> +NO <sub>2</sub> )-N		X	0.05 mg/L	EPA 353.1	WCH-A-022
Potassium		X	5 mg/L	SW-846 6010	LMM-01
Radium-226					
Radium-228					
Selenium					
Silica		X	0.2 mg/L	SW-846 6010	LMM-01
Sodium		X	1 mg/L	SW-846 6010	LMM-01
Stable Isotopes (Oxygen and Hydrogen)		X	NA	Mass Spectrometry	LMW-08
Strontium					

**Table 2 (continued) - Constituent Sampling Breakdown for Shoal, Nevada**

Analyte	Measurements by Location Type		Laboratory Requirements		
	Groundwater Monitoring Wells	Groundwater Supply Well HS-1	Required Detection Limit	Analytical Method	Line Item Code
Sulfate		X	0.5 mg/L	SW-846 9056	MIS-A-045
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Tritium	X	X	400 pCi/L	Liquid Scintillation	LSC-A-001
Tritium, enriched					
Uranium-234, -235, -238	X	X	1 pCi/L	Alpha Spectrometry	ASP-A-024
Uranium	X	X	0.0001 mg/L	SW-846 6020	LMM-02
Vanadium					
Zinc					
<b>Total No. of Analytes</b>	4	15			

**Note:** All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

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# **Attachment 4 Trip Report**

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## Memorandum

Control Number N/A

DATE: May 30, 2013  
TO: Rick Findlay  
FROM: Jeff Price  
SUBJECT: Trip Report (LTHMP Sampling)

**Site:** Shoal, Nevada

**Dates of Sampling Event:** May 20 – 23, 2013

**Team Members:** Rick Findlay, Rex Hodges and Jeff Price, Brad Lyles and Janis Klimowicz (DRI)

**Number of Locations Sampled:** 11 on-site wells and one off-site water supply well

**Locations Not Sampled/Reason:** None.

**Quality Control Sample Cross Reference:** The following are the false identifications assigned to the quality control samples:

False ID	True ID	Sample Type	Associated Matrix	Ticket Number
2500	MV-3	Duplicate	Groundwater	LGT 220
2501	NA	Equipment Blank (Collected from DRI bailer)	Groundwater	LGT 221

**RIN Number Assigned:** Samples were assigned to RINs 13055325 (ALS), 13055323 (U of A), and 13055324 (Reston Stable Isotope Lab).

**Sample Shipment:** Samples were shipped via Fed-Ex from Grand Junction on May 28, 2013.

**Trip Summary:** Rick Findlay and Rex Hodges traveled from Grand Junction to Fallon on May 20; Kent Moe and Jeff Price drove from Grand Junction to Ely on May 20. All of the Stoller crew arrived at the site and began work on May 21. Rick and Rex collected manual water levels and downloaded dedicated pressure transducers, while Kent and Jeff began sampling wells with dedicated pumps. The DRI crew (Brad Lyles and Janis Klimowicz) arrived on May 21 and collected bailed samples from HC-1, HC-2, HC-3, and HC-6.

Samples collected from the site wells including the water supply well HS-1 were sent to ALS Laboratory Group to be analyzed for tritium, uranium isotopes, gross alpha/beta, and total

uranium. Additional samples collected from well HS-1 were sent to ALS Laboratory Group to be analyzed for bicarbonate alkalinity, chloride, sulfate, metals, and nitrate plus nitrite as N; Reston Stable Isotope Lab to be analyzed for hydrogen and oxygen isotopes; and University of Arizona to be analyzed for dissolved carbon-14.

**Water Level Measurements:** The following table presents water level measurements collected prior to purging or sampling.

Well ID	Date	Time	Depth to Water	Comments
HC-1	5/21/2013	16:44	1060.60	
HC-2	5/21/2013	15:12	1082.40	
HC-3	5/22/2013	13:15	1179.80	
HC-4	5/21/2013	11:06	1006.52	
HC-5	5/21/2013	09:41	1368.85	Replaced transducer (new transducer S/N 322611)
HC-6	5/21/2013	08:37	964.68	
HC-7	5/21/2013	09:06	964.71	
HC-8	5/21/2013	10:30	1371.55	
MV-1	5/21/2013	13:10	989.98	
MV-2	5/21/2013	16:15	999.25	
MV-3	5/21/2013	14:30	970.45	
MV-1PZ	5/21/2013	12:46	973.00	
MV-2PZ	5/21/2013	15:51	975.42	
MV-3PZ	5/21/2013	14:00	970.10	
H-2	5/22/2013	12:00	110.12	Replaced transducer (new transducer S/N 322711)
H-3	5/22/2013	11:30	325.56	

(JP/lcg)

cc: (electronic)  
 Mark Kautsky, DOE  
 Paul Darr, Stoller  
 Steve Donivan, Stoller  
 Rick Findlay, Stoller  
 Rex Hodges, Stoller  
 Mark Plessinger, Stoller  
 EDD Delivery