# Data Validation Package

## July 2015
## Groundwater Sampling at the Shirley Basin South, Wyoming, Disposal Site

**October 2015**

U.S. DEPARTMENT OF ENERGY | Legacy Management

This page intentionally left blank

# Contents

This page intentionally left blank

# Sampling Event Summary

**Site:** Shirley Basin South, Wyoming, Disposal Site

**Sampling Period:** July 7–8, 2015

The 2004 *Long-Term Surveillance Plan for the Shirley Basin South (UMTRCA Title II) Disposal Site, Carbon County, Wyoming,* requires annual monitoring to verify continued compliance with the pertinent alternate concentration limits (ACLs) and Wyoming Class III (livestock use) groundwater protection standards. Point-of-compliance (POC) wells 19-DC, 5-DC, and 5-SC, and monitoring wells 10-DC, 40-SC, 54-SC, and K.G.S. #3 were sampled as specified in the plan. POC well 51-SC and downgradient well 101-SC were dry at the time of sampling. Also sampled were five of the six newer monitoring wells installed downgradient of the disposal cell in 2008 (100-SC, 102-SC, 110-DC, 112-DC, and 113-DC). The water level was measured at each sampled well except for K.G.S. #3. A water level was not measured in K.G.S. #3 because of the possibility that the water level probe would become tangled with the dedicated pump tubing and power cable. Sampling and analyses were conducted in accordance with the *Sampling and Analysis Plan for the U. S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351, continually updated).

Monitoring wells with an "SC" suffix are completed in the upper sand aquifer of the Wind River Formation. Wells with a "DC" suffix are completed in the main sand aquifer. The upper and main sandstone units vary in thickness and lateral extent, and coalesce into one unit under the northern portion of the disposal cell and near the former open pit mine northeast of the disposal cell. Well K.G.S. #3 is completed in the lower sand aquifer, which is hydraulically separated from the overlying main sand and upper sand aquifers.

ACLs are approved for cadmium, chromium, lead, nickel, radium-226, radium-228, selenium, thorium-230, and uranium in site groundwater. ACLs were exceeded for radium-226, radium 228, and selenium as shown in Table 1.

Radium-228 concentrations remain above the ACL in well 54-SC, with no apparent trend (see page 80). The former licensee attributed elevated radium-228 levels at the site to natural thorium in the uranium ore. Consequently, the elevated concentrations in the well may represent the reestablishment of equilibrium of groundwater with naturally occurring constituents in the sand units.

*Table 1. Wells with Results Exceeding an ACL*

| Analyte | ACL | 110-DC | 54-SC |
|---|---|---|---|
| Radium-226 | 91.3 pCi/L | 129 pCi/L | ---- |
| Radium-228 | 25.7 pCi/L | ---- | 76.8 pCi/L |
| Selenium | 0.12 mg/L | | 0.14 mg/L |

ACL = alternate concentration limit
mg/L = milligram per liter
pCi/L = picocuries per liter

Radium-226 concentrations continue to exceed the ACL in downgradient well 110-DC (Table 1). There are insufficient data to definitively determine why radium-226 is elevated at well 110-DC.

The selenium concentrations in POC wells 5-DC and 5-SC and in monitoring well 54-SC have been following a general upward trend since 2010, with the concentration in well 54-SC now exceeding the ACL.

Concentrations of sulfate and total dissolved solids continue to exceed their respective Wyoming Class III groundwater protection standards for livestock use in wells 5-DC, 5-SC, and 54-SC as they have done throughout the sampling history; however, there is no livestock use of the water from these aquifers at the site, and no constituent concentrations exceed groundwater protection standards at the wells near the site boundary.

J. E. Price

Jeffrey Price, Site Lead
Navarro Research and Engineering, Inc.

10/8/2015

Date


*Shirley Basin South, Wyoming, Disposal Site, Sample Location Map*

This page intentionally left blank

# Data Assessment Summary

This page intentionally left blank

# Water Sampling Field Activities Verification Checklist

| | | | |
|---|---|---|---|
| **Project** | Shirley Basin South, Wyoming | **Date(s) of Water Sampling** | July 7–8, 2015 |
| **Date(s) of Verification** | September 29, 2015 | **Name of Verifier** | Stephen Donivan |

| | Response (Yes, No, NA) | Comments |
|---|---|---|
| 1. Is the SAP the primary document directing field procedures? | Yes | |
| List any Program Directives or other documents, SOPs, instructions. | | Work Order letter dated June 1, 2015. |
| 2. Were the sampling locations specified in the planning documents sampled? | No | Locations 51-SC and 101-SC were dry and not sampled. |
| 3. Were calibrations conducted as specified in the above-named documents? | Yes | Calibrations were performed on July 6, 2015. |
| 4. Was an operational check of the field equipment conducted daily? | Yes | |
| Did the operational checks meet criteria? | 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? | Yes | |
| Did the water level stabilize prior to sampling? | Yes | |
| Did pH, specific conductance, and turbidity measurements meet criteria prior to sampling? | Yes | |
| Was the flow rate less than 500 mL/min? | Yes | |

# 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? | Yes | |
| Was one pump/tubing volume removed prior to sampling? | Yes | |
| 9. Were duplicates taken at a frequency of one per 20 samples? | Yes | A duplicate sample was collected from well K.G.S. #3. |
| 10. Were equipment blanks taken at a frequency of one per 20 samples that were collected with non-dedicated equipment? | NA | An equipment blank was not required. |
| 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 | |
| 19. Were water levels measured at the locations specified in the planning documents? | Yes | |

## Laboratory Performance Assessment

General Information

| | |
|---|---|
| Report Number (RIN): | 15067185 |
| Sample Event: | July 7–8, 2015 |
| Site(s): | Shirley Basin South, Wyoming |
| Laboratory: | ALS Laboratory Group, Fort Collins, Colorado |
| Work Order No.: | 1507143 |
| Analysis: | Metals, Inorganic, and Radiochemistry |
| Validator: | Stephen Donivan |
| Review Date: | September 10, 2015 |

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. See attached Data Validation Worksheets for supporting documentation on the data review and 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 2.

*Table 2. Analytes and Methods*

| Analyte | Line Item Code | Prep Method | Analytical Method |
|---|---|---|---|
| Cadmium, Lead, Selenium, Uranium | LMM-02 | SW-846 3005A | SW-846 6020A |
| Chloride | MIS-A-039 | SW-846 9056 | SW-846 9056 |
| Chromium, Nickel | LMM-01 | SW-846 3005A | SW-846 6010B |
| Nitrate + Nitrite as N | WCH-A-022 | EPA 353.2 | EPA 353.2 |
| Radium–226 | GPC-A-018 | SOP712 | SOP724 |
| Radium–228 | GPC-A-020 | SOP749 | SOP724 |
| Sulfate | MIS-A-044 | SW-846 9056 | SW-846 9056 |
| Thorium Isotopes | ASP-A-008 | SOP776, SOP777 | SOP714 |
| Total Dissolved Solids | WCH-A-033 | EPA 160.1 | EPA 160.1 |

Data Qualifier Summary

Analytical results were qualified as listed in Table 3. Refer to the sections below for an explanation of the data qualifiers applied.

*Table 3. Data Qualifier Summary*

| Sample Number | Location | Analyte(s) | Flag | Reason |
|---|---|---|---|---|
| 1507143-1 | 100-SC | Lead | U | Less than 5 times the method blank |
| 1507143-3 | 10-DC | Lead | U | Less than 5 times the method blank |
| 1507143-4 | 110-DC | Lead | U | Less than 5 times the method blank |
| 1507143-6 | 113-DC | Lead | U | Less than 5 times the method blank |
| 1507143-6 | 113-DC | Selenium | U | Less than 5 times the method blank |
| 1507143-6 | 113-DC | Thorium-228 | J | Less than the Determination Limit |
| 1507143-7 | 19-DC | Lead | U | Less than 5 times the method blank |
| 1507143-7 | 19-DC | Thorium-228 | J | Less than the Determination Limit |
| 1507143-7 | 19-DC | Thorium-232 | U | Less than the Decision Level Concentration |
| 1507143-8 | K.G.S.#3 Duplicate | Lead | U | Less than 5 times the method blank |
| 1507143-9 | 40-SC | Lead | U | Less than 5 times the method blank |
| 1507143-9 | 40-SC | Radium-226 | J | Less than the Determination Limit |
| 1507143-9 | 40-SC | Radium-228 | J | Less than the Determination Limit |
| 1507143-9 | 40-SC | Thorium-232 | J | Less than the Determination Limit |
| 1507143-10 | 54-SC | Lead | U | Less than 5 times the method blank |
| 1507143-10 | 54-SC | Thorium-230 | J | Less than the Determination Limit |
| 1507143-13 | K.G.S.#3 | Lead | U | Less than 5 times the method blank |
| 1507143-13 | K.G.S.#3 | Nickel | U | Less than 5 times the calibration blank |

Sample Shipping/Receiving

ALS Laboratory Group in Fort Collins, Colorado, received 13 water samples on July 9, 2015, accompanied a Chain of Custody form. The Chain of Custody form 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 receiving documentation included copies of the air bills. The Chain of Custody form 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 2.8 °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), Decision Level Concentration (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.

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 160.1, Total Dissolved Solids*
There is no initial or continuing calibration requirement associated with the determination of total dissolved solids.

*Method SW-846 9056, Chloride and Sulfate*
Calibrations were performed on July 10, 2015, using six calibration 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. All calibration checks met the acceptance criteria.

*Method EPA 353.2, Nitrate + Nitrite as N*
Calibrations were performed on July 21, 2015, using seven calibration 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. All calibration checks met the acceptance criteria.

*Method SW-846 6010B, Chromium and Nickel*
Calibrations were performed on July 25, 2015, using three calibration standards. The calibration curve correlation coefficient values were greater than 0.995. The absolute values of the intercepts were less than or only slightly above 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. 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.

*Method SW-846 6020A, Cadmium, Lead, Selenium, and Uranium*
Calibrations were performed on July 27, 2015 and September 15, 2015, using four calibration 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. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL. 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.

Radiochemical Analysis

*Radium-226*
Prior to analysis, samples were screened for radium-226 by gas flow proportional counting. The potential for interference by other alpha-emitting radium isotopes was reduced by allowing a decay period of at least 14 days to elapse. Efficiency calibrations were performed in April–May 2015. Daily instrument checks performed on August 4, 2015, met the acceptance criteria. The chemical recoveries met the acceptance criteria of 40 to 110 percent for all samples.

*Radium–228*
Detector efficiency calibrations were performed in February 3, 2015. Daily instrument checks performed on July 22, 2015, met the acceptance criteria. The chemical recoveries met the acceptance criteria of 40 to 110 percent for all samples.

*Thorium Isotopes*
Alpha spectrometry calibrations and instrument backgrounds were performed within a month prior to sample analysis. 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. For several samples, the tracer full width at half maximum exceeded 100 kiloelectron volts, which is expected for isotopes such as thorium-229 with alpha emissions at multiple energies. These tracer peaks did not appear to compromise the data by contributing significantly to the thorium-230 region of interest. The laboratory noted that the thorium-230 results were corrected for thorium-229 contribution based on historical method blank data. All internal standard peaks were within 50 kiloelectron volts of the expected position. The regions of interest for analyte peaks were reviewed. No manual integrations were performed, and all regions of interest were satisfactory.

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.

*Metals and Wet Chemistry*
All method blank and calibration blank results associated with the samples were below the PQL 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.

*Radiochemistry*
The 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 for the metals and wet chemistry analyses. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than 4 times the spike concentration. The spikes met the recovery and precision 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. For radiochemical measurements, the relative error ratio (the ratio of the absolute difference between the sample and duplicate results and the sum of the 1-sigma uncertainties) is used to evaluate duplicate results and should be less than 3. All replicate results met these criteria, demonstrating 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.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers. The analytical report included the MDL (MDC for radiochemistry) and PQL for all analytes and all required supporting documentation.

Chromatography Peak Integration

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

Electronic Data Deliverable (EDD) File

The EDD file arrived on August 20, 2015. 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:** 15067185 **Lab Code:** PAR **Validator:** Stephen Donivan **Validation Date:** 09/10/2015

**Project:** Shirley Basin South **Analysis Type:** ☑ Metals ☑ General Chem ☑ Rad ☐ Organics

**# of Samples:** 13 **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 | All analyses were completed within the applicable holding times. |
| ☑ Detection Limits | There are 0 detection limit failures. |
| ☐ Field/Trip Blanks | |
| ☑ Field Duplicates | There was 1 duplicate evaluated. |

## SAMPLE MANAGEMENT SYSTEM

### Metals Data Validation Worksheet

**RIN:** 15067185 **Lab Code:** PAR **Date Due:** 08/06/2015

**Matrix:** Water **Site Code:** SBS01 **Date Completed:** 08/24/2015

| 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 | | | | | | | | |
| Cadmium | ICP/MS | 07/27/2015 | 0.0000 | 1.0000 | OK | OK | OK | 105.0 | 99.0 | 91.0 | 8.0 | 103.0 | | 97.0 |
| Cadmium | ICP/MS | 09/15/2015 | 0.0000 | 1.0000 | OK | OK | OK | 108.0 | 108.0 | 104.0 | 4.0 | | | |
| Chromium | ICP/ES | 07/25/2015 | 0.0000 | 1.0000 | OK | OK | OK | 95.0 | 107.0 | 105.0 | 2.0 | 108.0 | | 83.0 |
| Lead | ICP/MS | 07/27/2015 | 0.0000 | 1.0000 | OK | OK | OK | 107.0 | 102.0 | 98.0 | 5.0 | 100.0 | | 87.0 |
| Lead | ICP/MS | 09/15/2015 | 0.0000 | 1.0000 | OK | OK | OK | 109.0 | 112.0 | 106.0 | 5.0 | | | |
| Nickel | ICP/ES | 07/25/2015 | 0.0000 | 1.0000 | OK | OK | OK | 108.0 | 105.0 | 103.0 | 1.0 | 99.0 | | 111.0 |
| Selenium | ICP/MS | 07/27/2015 | 0.0000 | 1.0000 | OK | OK | OK | 99.0 | 110.0 | 110.0 | 0.0 | 105.0 | | 113.0 |
| Selenium | ICP/MS | 09/15/2015 | 0.0000 | 1.0000 | OK | OK | OK | 108.0 | 112.0 | 100.0 | 11.0 | | | |
| Uranium | ICP/MS | 07/27/2015 | 0.0000 | 1.0000 | OK | OK | OK | 108.0 | 108.0 | 103.0 | 2.0 | 102.0 | 3.0 | 85.0 |
| Uranium | ICP/MS | 09/15/2015 | 0.0000 | 1.0000 | OK | OK | OK | 112.0 | 110.0 | 107.0 | 1.0 | | | |

# SAMPLE MANAGEMENT SYSTEM
## Radiochemistry Data Validation Worksheet

**RIN:** 15067185 **Lab Code:** PAR **Date Due:** 08/06/2015

**Matrix:** Water **Site Code:** SBS01 **Date Completed:** 08/24/2015

| Sample | Analyte | Date Analyzed | Result | Flag | Tracer %R | LCS %R | MS %R | Duplicate RER |
|---|---|---|---|---|---|---|---|---|
| 100-SC | Radium-226 | 08/04/2015 | | | 91.6 | | | |
| 102-SC | Radium-226 | 08/04/2015 | | | 90.7 | | | |
| 10-DC | Radium-226 | 08/04/2015 | | | 90.2 | | | |
| 110-DC | Radium-226 | 08/04/2015 | | | 92.0 | | | |
| 112-DC | Radium-226 | 08/04/2015 | | | 90.8 | | | |
| 113-DC | Radium-226 | 08/04/2015 | | | 92.7 | | | |
| 19-DC | Radium-226 | 08/04/2015 | | | 93.0 | | | |
| 2658 | Radium-226 | 08/04/2015 | | | 89.7 | | | |
| 40-SC | Radium-226 | 08/04/2015 | | | 94.9 | | | |
| 54-SC | Radium-226 | 08/04/2015 | | | 91.8 | | | |
| 5-DC | Radium-226 | 08/04/2015 | | | 92.0 | | | |
| 5-SC | Radium-226 | 08/04/2015 | | | 92.0 | | | |
| K.G.S.#3 | Radium-226 | 08/04/2015 | | | 90.6 | | | |
| Blank_Spike | Radium-226 | 08/04/2015 | | | 92.8 | 98.10 | | |
| Blank_Spike_Du | Radium-226 | 08/04/2015 | | | 93.6 | 99.70 | | 0.09 |
| Blank | Radium-226 | 08/04/2015 | 0.0670 | U | 91.4 | | | |
| 100-SC | Radium-228 | 07/22/2015 | | | 95.2 | | | |
| 102-SC | Radium-228 | 07/22/2015 | | | 97.2 | | | |
| 10-DC | Radium-228 | 07/22/2015 | | | 96.0 | | | |
| 110-DC | Radium-228 | 07/22/2015 | | | 95.3 | | | |
| 112-DC | Radium-228 | 07/22/2015 | | | 96.6 | | | |
| 113-DC | Radium-228 | 07/22/2015 | | | 94.8 | | | |
| 19-DC | Radium-228 | 07/22/2015 | | | 96.3 | | | |
| 2658 | Radium-228 | 07/22/2015 | | | 94.1 | | | |
| 40-SC | Radium-228 | 07/22/2015 | | | 95.3 | | | |
| 54-SC | Radium-228 | 07/22/2015 | | | 98.9 | | | |
| 5-DC | Radium-228 | 07/22/2015 | | | 96.4 | | | |
| 5-SC | Radium-228 | 07/22/2015 | | | 96.9 | | | |
| K.G.S.#3 | Radium-228 | 07/22/2015 | | | 94.6 | | | |
| Blank_Spike | Radium-228 | 07/22/2015 | | | 95.7 | 103.00 | | |
| Blank_Spike_Du | Radium-228 | 07/22/2015 | | | 96.6 | 99.60 | | 0.20 |
| Blank | Radium-228 | 07/22/2015 | 0.0780 | U | 93.3 | | | |

# SAMPLE MANAGEMENT SYSTEM
## Radiochemistry Data Validation Worksheet

**RIN:** 15067185 **Lab Code:** PAR **Date Due:** 08/06/2015

**Matrix:** Water **Site Code:** SBS01 **Date Completed:** 08/24/2015

| Sample | Analyte | Date Analyzed | Result | Flag | Tracer %R | LCS %R | MS %R | Duplicate RER |
|---|---|---|---|---|---|---|---|---|
| 100-SC | Thorium-228 | 08/04/2015 | | | 83.5 | | | |
| 102-SC | Thorium-228 | 08/04/2015 | | | 80.8 | | | |
| 10-DC | Thorium-228 | 08/04/2015 | | | 81.9 | | | |
| 110-DC | Thorium-228 | 08/04/2015 | | | 83.6 | | | |
| 112-DC | Thorium-228 | 08/04/2015 | | | 85.3 | | | |
| 113-DC | Thorium-228 | 08/04/2015 | | | 67.3 | | | |
| 19-DC | Thorium-228 | 08/04/2015 | | | 84.8 | | | |
| 2658 | Thorium-228 | 08/04/2015 | | | 86.9 | | | |
| 40-SC | Thorium-228 | 08/04/2015 | | | 77.7 | | | |
| 54-SC | Thorium-228 | 08/04/2015 | | | 83.2 | | | |
| 5-DC | Thorium-228 | 08/04/2015 | | | 90.1 | | | |
| 113-DC | Thorium-228 | 08/04/2015 | | | 88.3 | | | 0.10 |
| 5-SC | Thorium-228 | 08/05/2015 | | | 85.4 | | | |
| K.G.S.#3 | Thorium-228 | 08/05/2015 | | | 77.1 | | | |
| Blank | Thorium-228 | 08/05/2015 | 0 | U | 88.2 | | | |
| 113-DC | Thorium-230 | 08/04/2015 | | | | | | 0.95 |
| Blank_Spike | Thorium-230 | 08/05/2015 | | | 90.2 | 104.00 | | |
| Blank | Thorium-230 | 08/05/2015 | -0.0340 | U | | | | |
| 113-DC | Thorium-232 | 08/04/2015 | | | | | | 0.15 |
| Blank | Thorium-232 | 08/05/2015 | 0.0070 | U | | | | |

## SAMPLE MANAGEMENT SYSTEM

### Wet Chemistry Data Validation Worksheet

**RIN:** 15067185 **Lab Code:** PAR **Date Due:** 08/06/2015

**Matrix:** Water **Site Code:** SBS01 **Date Completed:** 08/24/2015

| Analyte | Date Analyzed | CALIBRATION | | | | Method Blank | LCS %R | MS %R | MSD %R | DUP RPD | Serial Dil. %R |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Int. | R^2 | CCV | CCB | | | | | | |
| CHLORIDE | 07/20/2015 | 0.000 | 1.0000 | OK | OK | OK | 100.00 | 101.0 | 101.0 | 0 | |
| Nitrate+Nitrite as N | 07/21/2015 | 0.000 | 1.0000 | OK | OK | OK | 100.00 | 96.0 | 101.0 | 4.00 | |
| SULFATE | 07/20/2015 | 0.000 | 1.0000 | OK | OK | OK | 96.00 | 104.0 | 104.0 | 0 | |
| TOTAL DISSOLVED SOLIDS | 07/13/2015 | | | | | OK | 102.00 | | | 1.00 | |

## Sampling Quality Control Assessment

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

Sampling Protocol

With the exception of well K.G.S. #3, all wells were classified as Category I or II and sampled using the low-flow technique. The sample results from these wells are qualified with an "F" flag indicating the low-flow sampling technique. The data from wells 100-SC and 102-SC were further qualified with a "Q" flag because these are Category II wells.

Equipment Blank Assessment

Equipment blanks are prepared and analyzed to document contamination attributable to the sample collection process. An equipment blank was not required for this sampling event.

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. A duplicate sample was collected from location K.G.S. #3. For non-radiochemical measurements, the relative percent difference (RPD) for duplicate results that are greater than 5 times the PQL should be less than 20 percent. For results less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical measurements, the relative error ratio (the ratio of the absolute difference between the sample and duplicate results and the sum of the 1-sigma uncertainties) is used to evaluate duplicate results and should be less than 3. With the exception of the uranium result, the duplicate results met the criteria, demonstrating acceptable overall precision. The original uranium result for K.G.S. #3 resulted in an RPD value of 188 percent. That sample was reanalyzed (see Attachment 1) to provide a more acceptable RPD of 11 percent.

# SAMPLE MANAGEMENT SYSTEM

## Validation Report: Field Duplicates

**RIN:** 15067185 **Lab Code:** PAR **Project:** Shirley Basin South **Validation Date:** 09/29/2015

**Duplicate:** 2658 **Sample:** K.G.S.#3

| Analyte | Sample | | | | Duplicate | | | | RPD | RER | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Result | Flag | Error | Dilution | Result | Flag | Error | Dilution | | | |
| Cadmium | 0.12 | U | | 10 | 0.12 | U | | 10 | | | UG/L |
| CHLORIDE | 4.4 | | | 10 | 4.3 | | | 10 | | | MG/L |
| Chromium | 0.73 | U | | 1 | 0.73 | U | | 1 | | | UG/L |
| Lead | 0.61 | | | 10 | 0.59 | | | 10 | 3.33 | | UG/L |
| Nickel | 1.1 | J | | 1 | 0.97 | U | | 1 | | | UG/L |
| Nitrate+Nitrite as N | 0.01 | U | | 1 | 0.01 | U | | 1 | | | MG/L |
| Radium-226 | 0.602 | | 0.263 | 1 | 0.578 | | 0.264 | 1 | | 0.1 | pCi/L |
| Radium-228 | 1.85 | | 0.53 | 1 | 1.62 | | 0.481 | 1 | | 0.6 | pCi/L |
| Selenium | 0.32 | U | | 10 | 0.32 | U | | 10 | | | UG/L |
| SULFATE | 270 | | | 10 | 260 | | | 10 | 3.77 | | MG/L |
| Thorium-228 | 0.0568 | U | 0.163 | 1 | 0.0224 | U | 0.161 | 1 | | 0.3 | pCi/L |
| Thorium-230 | -0.023 | U | 0.17 | 1 | -0.12 | U | 0.165 | 1 | | 0.8 | pCi/L |
| Thorium-232 | 0.0236 | U | 0.0474 | 1 | -0.0218 | U | 0.0385 | 1 | | 1.5 | pCi/L |
| TOTAL DISSOLVED SOLIDS | 550 | | | 1 | 540 | | | 1 | 1.83 | | MG/L |
| Uranium | 0.17 | | | 10 | 0.19 | | | 10 | 11.11 | | UG/L |

## Certification

All laboratory analytical quality control criteria were met except as qualified in this report. The data qualifiers listed on the SEEPro 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 Donivan — Stephen Donivan — 10-7-2015 — Date

Data Validation Lead: Stephen Donivan — Stephen Donivan — 10-7-2015 — Date

# Attachment 1
# Assessment of Anomalous Data

This page intentionally left blank

# Potential Outliers Report

This page intentionally left blank

**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 can result from transcription errors, data-coding errors, or measurement system problems. However, outliers can also represent true extreme values of a distribution and can 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.** Do this 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 as to whether the data are normally distributed using the Shapiro-Wilk Test.
2. **Apply the appropriate statistical test.** Dixon's Test for extreme values 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.

Six laboratory results were identified as potential outliers.

On September 22, 2015, the laboratory was requested to repeat the method SW-846 6020A analysis for samples 10-DC, 113-DC, K.G.S. #3, and K.G.S. #3 duplicate. The reanalysis provided selenium results for samples 10-DC, 113-DC; and uranium results for sample K.G.S. #3 that compare more closely with the historical values.

The data associated with the other potential outliers were further reviewed. There were no errors noted. The outliers are likely due to upward or downward trends at these locations. The laboratory data are acceptable as qualified.

This page intentionally left blank

**Data Validation Outliers Report - No Field Parameters**
**Comparison: All historical Data Beginning 01/01/2005**
Laboratory: ALS Laboratory Group
RIN: 15067185
Report Date: 09/10/2015

| | | | | | Current | | | Historical Maximum | | | Historical Minimum | | | Number of Data Points | | Statistical Outlier |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Qualifiers | | | Qualifiers | | | Qualifiers | | | | |
| Site Code | Location Code | Sample ID | Sample Date | Analyte | Result | *Lab* | *Data* | Result | *Lab* | *Data* | Result | *Lab* | *Data* | N | N Below Detect | |
| SBS01 | 10-DC | 0001 | 07/07/2015 | Selenium | 0.00340 | | | 0.00028 | | JF | 0.000016 | U | F | 11 | 7 | Yes |
| SBS01 | 110-DC | N001 | 07/07/2015 | Lead | 0.00025 | J | | 0.00980 | | F | 0.00079 | | F | 9 | 0 | No |
| SBS01 | 110-DC | N001 | 07/07/2015 | Radium-228 | 6.93 | | | 6.62 | | F | 2.46 | | JF | 9 | 0 | No |
| SBS01 | 112-DC | N001 | 07/08/2015 | Chloride | 39.0 | | | 190 | | F | 45.0 | | F | 7 | 0 | NA |
| SBS01 | 112-DC | N001 | 07/08/2015 | Radium-226 | 10.9 | | | 29.1 | | FQ | 12.8 | | F | 7 | 0 | No |
| SBS01 | 112-DC | N001 | 07/08/2015 | Uranium | 0.0110 | | | 0.250 | | F | 0.0160 | | F | 7 | 0 | No |
| SBS01 | 113-DC | N001 | 07/08/2015 | Chromium | 0.00180 | J | | 0.00140 | B | UFQ | 0.00051 | U | F | 7 | 7 | NA |
| SBS01 | 113-DC | N001 | 07/08/2015 | Selenium | 0.00120 | | | 0.0001 | | UF | 0.000032 | U | F | 7 | 5 | Yes |
| SBS01 | 113-DC | N001 | 07/08/2015 | Uranium | 0.001 | | | 0.00200 | | F | 0.00110 | | F | 7 | 0 | No |
| SBS01 | 19-DC | N001 | 07/07/2015 | Chromium | 0.00490 | J | | 0.00230 | B | UF | 0.00051 | U | F | 12 | 12 | Yes |
| SBS01 | 19-DC | N001 | 07/07/2015 | Nickel | 0.460 | | | 0.340 | | F | 0.110 | | F | 12 | 0 | Yes |
| SBS01 | 40-SC | N001 | 07/08/2015 | Chromium | 0.00170 | J | | 0.00140 | U | F | 0.00051 | U | F | 18 | 18 | NA |
| SBS01 | 54-SC | N001 | 07/07/2015 | Chromium | 0.500 | | | 0.380 | | F | 0.140 | | F | 11 | 0 | No |
| SBS01 | 54-SC | N001 | 07/07/2015 | Selenium | 0.140 | | | 0.0850 | | F | 0.00014 | | UF | 11 | 2 | Yes |
| SBS01 | 54-SC | N001 | 07/07/2015 | Thorium-228 | 12.0 | | | 10.4 | | F | 5.57 | | F | 11 | 0 | No |
| SBS01 | 54-SC | N001 | 07/07/2015 | Uranium | 0.0200 | | | 0.0820 | | F | 0.0210 | | F | 11 | 0 | No |
| SBS01 | 5-DC | N001 | 07/07/2015 | Nickel | 1.80 | | | 1.40 | | F | 0.240 | | F | 11 | 0 | No |

**Data Validation Outliers Report - No Field Parameters**
**Comparison: All historical Data Beginning 01/01/2005**
Laboratory: ALS Laboratory Group
RIN: 15067185
Report Date: 09/10/2015

| | | | | | **Current** | | | **Historical Maximum** | | | **Historical Minimum** | | | **Number of Data Points** | | **Statistical Outlier** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | *Qualifiers* | | | *Qualifiers* | | | *Qualifiers* | | | | |
| Site Code | Location Code | Sample ID | Sample Date | Analyte | Result | *Lab* | *Data* | Result | *Lab* | *Data* | Result | *Lab* | *Data* | N | N Below Detect | |
| SBS01 | 5-DC | N001 | 07/07/2015 | Selenium | 0.0870 | | | 0.0200 | | F | 0.0001 | | UF | 11 | 2 | NA |
| SBS01 | 5-DC | N001 | 07/07/2015 | Sulfate | 9500 | | | 8400 | | FJ | 3600 | | F | 11 | 0 | No |
| SBS01 | 5-DC | N001 | 07/07/2015 | Total Dissolved Solids | 14000 | | | 13000 | | F | 5100 | | F | 11 | 0 | No |
| SBS01 | 5-SC | 0001 | 07/07/2015 | Chromium | 0.380 | | | 0.370 | | FJ | 0.230 | | F | 12 | 0 | No |
| SBS01 | K.G.S.#3 | N001 | 07/07/2015 | Radium-228 | 1.85 | | | 1.30 | | | 0.580 | U | F | 11 | 5 | No |
| SBS01 | K.G.S.#3 | N002 | 07/07/2015 | Radium-228 | 1.62 | | | 1.30 | | | 0.580 | U | F | 11 | 5 | No |
| SBS01 | K.G.S.#3 | N002 | 07/07/2015 | Selenium | 0.001 | | | 0.00032 | U | | 0.000016 | U | F | 11 | 9 | No |
| SBS01 | K.G.S.#3 | N001 | 07/07/2015 | Uranium | 0.00540 | | | 0.00023 | | | 0.00001 | B | F | 11 | 1 | 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

This page intentionally left blank

# Groundwater Quality Data

This page intentionally left blank

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 10-DC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | | | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 0.00012 | U | F | # | 0.00012 | |
| Chloride | mg/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 56 | | F | # | 4 | |
| Chromium | mg/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 0.00094 | J | F | # | 0.00073 | |
| Lead | mg/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 0.00007 | J | UF | # | 0.000068 | |
| Nickel | mg/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 0.00097 | U | F | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 0.015 | | F | # | 0.01 | |
| Oxidation Reduction Potential | mV | 07/07/2015 | N001 | 180.8 | - | 220.8 | -58.7 | | F | # | | |
| pH | s.u. | 07/07/2015 | N001 | 180.8 | - | 220.8 | 6.77 | | F | # | | |
| Radium-226 | pCi/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 16 | | F | # | 0.16 | 4.16 |
| Radium-228 | pCi/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 4.68 | | F | # | 0.45 | 1.17 |
| Selenium | mg/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 0.00032 | U | F | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/07/2015 | N001 | 180.8 | - | 220.8 | 2068 | | F | # | | |
| Sulfate | mg/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 1000 | | F | # | 10 | |
| Temperature | C | 07/07/2015 | N001 | 180.8 | - | 220.8 | 8.96 | | F | # | | |
| Thorium-228 | pCi/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 0.27 | U | F | # | 0.27 | 0.174 |
| Thorium-230 | pCi/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 0.3 | U | F | # | 0.3 | 0.188 |
| Thorium-232 | pCi/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 0.067 | U | F | # | 0.067 | 0.0356 |
| Total Dissolved Solids | mg/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 1900 | | F | # | 40 | |
| Turbidity | NTU | 07/07/2015 | N001 | 180.8 | - | 220.8 | 29.6 | | F | # | | |
| Uranium | mg/L | 07/07/2015 | 0001 | 180.8 | - | 220.8 | 0.015 | | F | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 100-SC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | | | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/07/2015 | N001 | 210 | - | 225 | 0.00012 | U | FQ | # | 0.00012 | |
| Chloride | mg/L | 07/07/2015 | N001 | 210 | - | 225 | 160 | | FQ | # | 4 | |
| Chromium | mg/L | 07/07/2015 | N001 | 210 | - | 225 | 0.00073 | U | FQ | # | 0.00073 | |
| Lead | mg/L | 07/07/2015 | N001 | 210 | - | 225 | 0.0001 | J | UFQ | # | 0.000068 | |
| Nickel | mg/L | 07/07/2015 | N001 | 210 | - | 225 | 0.0037 | J | FQ | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/07/2015 | N001 | 210 | - | 225 | 0.044 | | FQ | # | 0.01 | |
| Oxidation Reduction Potential | mV | 07/07/2015 | N001 | 210 | - | 225 | 120 | | FQ | # | | |
| pH | s.u. | 07/07/2015 | N001 | 210 | - | 225 | 7.23 | | FQ | # | | |
| Radium-226 | pCi/L | 07/07/2015 | N001 | 210 | - | 225 | 5.07 | | FQ | # | 0.18 | 1.41 |
| Radium-228 | pCi/L | 07/07/2015 | N001 | 210 | - | 225 | 4.63 | | FQ | # | 0.44 | 1.16 |
| Selenium | mg/L | 07/07/2015 | N001 | 210 | - | 225 | 0.00032 | U | FQ | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/07/2015 | N001 | 210 | - | 225 | 2450 | | FQ | # | | |
| Sulfate | mg/L | 07/07/2015 | N001 | 210 | - | 225 | 1100 | | FQ | # | 10 | |
| Temperature | C | 07/07/2015 | N001 | 210 | - | 225 | 10.1 | | FQ | # | | |
| Thorium-228 | pCi/L | 07/07/2015 | N001 | 210 | - | 225 | 0.32 | U | FQ | # | 0.32 | 0.182 |
| Thorium-230 | pCi/L | 07/07/2015 | N001 | 210 | - | 225 | 0.3 | U | FQ | # | 0.3 | 0.167 |
| Thorium-232 | pCi/L | 07/07/2015 | N001 | 210 | - | 225 | 0.077 | U | FQ | # | 0.077 | 0.0455 |
| Total Dissolved Solids | mg/L | 07/07/2015 | N001 | 210 | - | 225 | 2200 | | FQ | # | 40 | |
| Turbidity | NTU | 07/07/2015 | N001 | 210 | - | 225 | 3.2 | | FQ | # | | |
| Uranium | mg/L | 07/07/2015 | N001 | 210 | - | 225 | 0.0076 | | FQ | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 102-SC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | | | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 0.00012 | U | FQ | # | 0.00012 | |
| Chloride | mg/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 180 | | FQ | # | 4 | |
| Chromium | mg/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 0.00073 | U | FQ | # | 0.00073 | |
| Lead | mg/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 0.00013 | J | FQ | # | 0.000068 | |
| Nickel | mg/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 0.0023 | J | FQ | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 0.38 | | FQ | # | 0.02 | |
| Oxidation Reduction Potential | mV | 07/08/2015 | N001 | 168.5 | - | 183.5 | 50.3 | | FQ | # | | |
| pH | s.u. | 07/08/2015 | N001 | 168.5 | - | 183.5 | 7.6 | | FQ | # | | |
| Radium-226 | pCi/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 2.55 | | FQ | # | 0.17 | 0.784 |
| Radium-228 | pCi/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 2.41 | | FQ | # | 0.42 | 0.66 |
| Selenium | mg/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 0.00036 | J | FQ | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/08/2015 | N001 | 168.5 | - | 183.5 | 1801 | | FQ | # | | |
| Sulfate | mg/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 670 | | FQ | # | 10 | |
| Temperature | C | 07/08/2015 | N001 | 168.5 | - | 183.5 | 9.6 | | FQ | # | | |
| Thorium-228 | pCi/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 0.27 | U | FQ | # | 0.27 | 0.14 |
| Thorium-230 | pCi/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 0.31 | U | FQ | # | 0.31 | 0.169 |
| Thorium-232 | pCi/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 0.069 | U | FQ | # | 0.069 | 0.0425 |
| Total Dissolved Solids | mg/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 1400 | | FQ | # | 40 | |
| Turbidity | NTU | 07/08/2015 | N001 | 168.5 | - | 183.5 | 268 | | FQ | # | | |
| Uranium | mg/L | 07/08/2015 | 0001 | 168.5 | - | 183.5 | 0.014 | | FQ | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 110-DC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | | | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/07/2015 | N001 | 255 | - | 305 | 0.00012 | U | F | # | 0.00012 | |
| Chloride | mg/L | 07/07/2015 | N001 | 255 | - | 305 | 210 | | F | # | 10 | |
| Chromium | mg/L | 07/07/2015 | N001 | 255 | - | 305 | 0.0013 | J | F | # | 0.00073 | |
| Lead | mg/L | 07/07/2015 | N001 | 255 | - | 305 | 0.00025 | J | UF | # | 0.000068 | |
| Nickel | mg/L | 07/07/2015 | N001 | 255 | - | 305 | 0.0017 | J | F | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/07/2015 | N001 | 255 | - | 305 | 0.013 | | F | # | 0.01 | |
| Oxidation Reduction Potential | mV | 07/07/2015 | N001 | 255 | - | 305 | -30 | | F | # | | |
| pH | s.u. | 07/07/2015 | N001 | 255 | - | 305 | 6.61 | | F | # | | |
| Radium-226 | pCi/L | 07/07/2015 | N001 | 255 | - | 305 | 153 | | F | # | 0.15 | 38.4 |
| Radium-228 | pCi/L | 07/07/2015 | N001 | 255 | - | 305 | 6.93 | | F | # | 0.46 | 1.68 |
| Selenium | mg/L | 07/07/2015 | N001 | 255 | - | 305 | 0.00041 | J | F | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/07/2015 | N001 | 255 | - | 305 | 3590 | | F | # | | |
| Sulfate | mg/L | 07/07/2015 | N001 | 255 | - | 305 | 1900 | | F | # | 25 | |
| Temperature | C | 07/07/2015 | N001 | 255 | - | 305 | 9.56 | | F | # | | |
| Thorium-228 | pCi/L | 07/07/2015 | N001 | 255 | - | 305 | 0.67 | U | F | # | 0.67 | 0.433 |
| Thorium-230 | pCi/L | 07/07/2015 | N001 | 255 | - | 305 | 0.78 | U | F | # | 0.78 | 0.423 |
| Thorium-232 | pCi/L | 07/07/2015 | N001 | 255 | - | 305 | 0.18 | U | F | # | 0.18 | 0.11 |
| Total Dissolved Solids | mg/L | 07/07/2015 | N001 | 255 | - | 305 | 3400 | | F | # | 80 | |
| Turbidity | NTU | 07/07/2015 | N001 | 255 | - | 305 | 6.67 | | F | # | | |
| Uranium | mg/L | 07/07/2015 | N001 | 255 | - | 305 | 0.013 | | F | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 112-DC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/08/2015 | N001 | 203 - 253 | 0.00012 | U | F | # | 0.00012 | |
| Chloride | mg/L | 07/08/2015 | N001 | 203 - 253 | 39 | | F | # | 4 | |
| Chromium | mg/L | 07/08/2015 | N001 | 203 - 253 | 0.00092 | J | F | # | 0.00073 | |
| Lead | mg/L | 07/08/2015 | N001 | 203 - 253 | 0.00058 | | F | # | 0.000068 | |
| Nickel | mg/L | 07/08/2015 | N001 | 203 - 253 | 0.0024 | J | F | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/08/2015 | N001 | 203 - 253 | 0.01 | U | F | # | 0.01 | |
| Oxidation Reduction Potential | mV | 07/08/2015 | N001 | 203 - 253 | -73.2 | | F | # | | |
| pH | s.u. | 07/08/2015 | N001 | 203 - 253 | 7.24 | | F | # | | |
| Radium-226 | pCi/L | 07/08/2015 | N001 | 203 - 253 | 10.9 | | F | # | 0.15 | 2.87 |
| Radium-228 | pCi/L | 07/08/2015 | N001 | 203 - 253 | 4.24 | | F | # | 0.4 | 1.06 |
| Selenium | mg/L | 07/08/2015 | N001 | 203 - 253 | 0.0021 | | F | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/08/2015 | N001 | 203 - 253 | 2145 | | F | # | | |
| Sulfate | mg/L | 07/08/2015 | N001 | 203 - 253 | 1100 | | F | # | 10 | |
| Temperature | C | 07/08/2015 | N001 | 203 - 253 | 9.6 | | F | # | | |
| Thorium-228 | pCi/L | 07/08/2015 | N001 | 203 - 253 | 0.3 | U | F | # | 0.3 | 0.175 |
| Thorium-230 | pCi/L | 07/08/2015 | N001 | 203 - 253 | 0.3 | U | F | # | 0.3 | 0.181 |
| Thorium-232 | pCi/L | 07/08/2015 | N001 | 203 - 253 | 0.11 | U | F | # | 0.11 | 0.0611 |
| Total Dissolved Solids | mg/L | 07/08/2015 | N001 | 203 - 253 | 1900 | | F | # | 40 | |
| Turbidity | NTU | 07/08/2015 | N001 | 203 - 253 | 1.01 | | F | # | | |
| Uranium | mg/L | 07/08/2015 | N001 | 203 - 253 | 0.011 | | F | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 113-DC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/08/2015 | N001 | 235 - 285 | 0.00019 | J | F | # | 0.00012 | |
| Chloride | mg/L | 07/08/2015 | N001 | 235 - 285 | 7.2 | | F | # | 2 | |
| Chromium | mg/L | 07/08/2015 | N001 | 235 - 285 | 0.0018 | J | F | # | 0.00073 | |
| Lead | mg/L | 07/08/2015 | N001 | 235 - 285 | 0.00052 | | UF | # | 0.000068 | |
| Nickel | mg/L | 07/08/2015 | N001 | 235 - 285 | 0.00097 | U | F | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/08/2015 | N001 | 235 - 285 | 0.037 | | F | # | 0.01 | |
| Oxidation Reduction Potential | mV | 07/08/2015 | N001 | 235 - 285 | -32 | | F | # | | |
| pH | s.u. | 07/08/2015 | N001 | 235 - 285 | 7.4 | | F | # | | |
| Radium-226 | pCi/L | 07/08/2015 | N001 | 235 - 285 | 3.1 | | F | # | 0.17 | 0.916 |
| Radium-228 | pCi/L | 07/08/2015 | N001 | 235 - 285 | 2.68 | | F | # | 0.42 | 0.723 |
| Selenium | mg/L | 07/08/2015 | N001 | 235 - 285 | 0.00039 | J | UF | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/08/2015 | N001 | 235 - 285 | 1483 | | F | # | | |
| Sulfate | mg/L | 07/08/2015 | N001 | 235 - 285 | 640 | | F | # | 5 | |
| Temperature | C | 07/08/2015 | N001 | 235 - 285 | 9.94 | | F | # | | |
| Thorium-228 | pCi/L | 07/08/2015 | N001 | 235 - 285 | 0.488 | | FJ | # | 0.31 | 0.234 |
| Thorium-230 | pCi/L | 07/08/2015 | N001 | 235 - 285 | 0.37 | U | F | # | 0.37 | 0.199 |
| Thorium-232 | pCi/L | 07/08/2015 | N001 | 235 - 285 | 0.13 | U | F | # | 0.13 | 0.0835 |
| Total Dissolved Solids | mg/L | 07/08/2015 | N001 | 235 - 285 | 1100 | | F | # | 40 | |
| Turbidity | NTU | 07/08/2015 | N001 | 235 - 285 | 3.15 | | F | # | | |
| Uranium | mg/L | 07/08/2015 | N001 | 235 - 285 | 0.00099 | | F | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 19-DC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | | | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/07/2015 | N001 | 177 | - | 237 | 0.00012 | U | F | # | 0.00012 | |
| Chloride | mg/L | 07/07/2015 | N001 | 177 | - | 237 | 64 | | F | # | 10 | |
| Chromium | mg/L | 07/07/2015 | N001 | 177 | - | 237 | 0.0049 | J | F | # | 0.00073 | |
| Lead | mg/L | 07/07/2015 | N001 | 177 | - | 237 | 0.00021 | J | UF | # | 0.000068 | |
| Nickel | mg/L | 07/07/2015 | N001 | 177 | - | 237 | 0.46 | | F | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/07/2015 | N001 | 177 | - | 237 | 0.01 | U | F | # | 0.01 | |
| Oxidation Reduction Potential | mV | 07/07/2015 | N001 | 177 | - | 237 | -97.9 | | F | # | | |
| pH | s.u. | 07/07/2015 | N001 | 177 | - | 237 | 6.53 | | F | # | | |
| Radium-226 | pCi/L | 07/07/2015 | N001 | 177 | - | 237 | 4.67 | | F | # | 0.18 | 1.31 |
| Radium-228 | pCi/L | 07/07/2015 | N001 | 177 | - | 237 | 6.02 | | F | # | 0.4 | 1.46 |
| Selenium | mg/L | 07/07/2015 | N001 | 177 | - | 237 | 0.00032 | U | F | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/07/2015 | N001 | 177 | - | 237 | 3543 | | F | # | | |
| Sulfate | mg/L | 07/07/2015 | N001 | 177 | - | 237 | 2300 | | F | # | 25 | |
| Temperature | C | 07/07/2015 | N001 | 177 | - | 237 | 9.25 | | F | # | | |
| Thorium-228 | pCi/L | 07/07/2015 | N001 | 177 | - | 237 | 0.52 | | FJ | # | 0.27 | 0.214 |
| Thorium-230 | pCi/L | 07/07/2015 | N001 | 177 | - | 237 | 0.31 | U | F | # | 0.31 | 0.173 |
| Thorium-232 | pCi/L | 07/07/2015 | N001 | 177 | - | 237 | 0.0383 | | UF | # | 0.021 | 0.038 |
| Total Dissolved Solids | mg/L | 07/07/2015 | N001 | 177 | - | 237 | 3500 | | F | # | 80 | |
| Turbidity | NTU | 07/07/2015 | N001 | 177 | - | 237 | 8.52 | | F | # | | |
| Uranium | mg/L | 07/07/2015 | N001 | 177 | - | 237 | 0.00026 | | F | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 40-SC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/08/2015 | N001 | - | 0.00023 | J | F | # | 0.00012 | |
| Chloride | mg/L | 07/08/2015 | N001 | - | 34 | | F | # | 4 | |
| Chromium | mg/L | 07/08/2015 | N001 | - | 0.0017 | J | F | # | 0.00073 | |
| Lead | mg/L | 07/08/2015 | N001 | - | 0.00019 | J | UF | # | 0.000068 | |
| Nickel | mg/L | 07/08/2015 | N001 | - | 0.0082 | | F | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/08/2015 | N001 | - | 1.1 | | F | # | 0.02 | |
| Oxidation Reduction Potential | mV | 07/08/2015 | N001 | - | 85 | | F | # | | |
| pH | s.u. | 07/08/2015 | N001 | - | 6.47 | | F | # | | |
| Radium-226 | pCi/L | 07/08/2015 | N001 | - | 0.314 | | FJ | # | 0.18 | 0.189 |
| Radium-228 | pCi/L | 07/08/2015 | N001 | - | 0.81 | | FJ | # | 0.36 | 0.316 |
| Selenium | mg/L | 07/08/2015 | N001 | - | 0.0048 | | F | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/08/2015 | N001 | - | 2520 | | F | # | | |
| Sulfate | mg/L | 07/08/2015 | N001 | - | 1600 | | F | # | 10 | |
| Temperature | C | 07/08/2015 | N001 | - | 8.9 | | F | # | | |
| Thorium-228 | pCi/L | 07/08/2015 | N001 | - | 0.26 | U | F | # | 0.26 | 0.141 |
| Thorium-230 | pCi/L | 07/08/2015 | N001 | - | 0.34 | U | F | # | 0.34 | 0.22 |
| Thorium-232 | pCi/L | 07/08/2015 | N001 | - | 0.153 | | FJ | # | 0.059 | 0.0774 |
| Total Dissolved Solids | mg/L | 07/08/2015 | N001 | - | 2400 | | F | # | 40 | |
| Turbidity | NTU | 07/08/2015 | N001 | - | 2.38 | | F | # | | |
| Uranium | mg/L | 07/08/2015 | N001 | - | 0.00039 | | F | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 5-DC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/07/2015 | N001 | - | 0.0015 | | F | # | 0.00012 | |
| Chloride | mg/L | 07/07/2015 | N001 | - | 220 | | F | # | 20 | |
| Chromium | mg/L | 07/07/2015 | N001 | - | 0.025 | | F | # | 0.00073 | |
| Lead | mg/L | 07/07/2015 | N001 | - | 0.00084 | | F | # | 0.000068 | |
| Nickel | mg/L | 07/07/2015 | N001 | - | 1.8 | | F | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/07/2015 | N001 | - | 0.019 | | F | # | 0.01 | |
| Oxidation Reduction Potential | mV | 07/07/2015 | N001 | - | 116.2 | | F | # | | |
| pH | s.u. | 07/07/2015 | N001 | - | 4.72 | | F | # | | |
| Radium-226 | pCi/L | 07/07/2015 | N001 | - | 10.1 | | F | # | 0.17 | 2.67 |
| Radium-228 | pCi/L | 07/07/2015 | N001 | - | 41.6 | | F | # | 0.36 | 9.6 |
| Selenium | mg/L | 07/07/2015 | N001 | - | 0.087 | | F | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/07/2015 | N001 | - | 10591 | | F | # | | |
| Sulfate | mg/L | 07/07/2015 | N001 | - | 9500 | | F | # | 50 | |
| Temperature | C | 07/07/2015 | N001 | - | 9.36 | | F | # | | |
| Thorium-228 | pCi/L | 07/07/2015 | N001 | - | 4.05 | | F | # | 1.1 | 1.19 |
| Thorium-230 | pCi/L | 07/07/2015 | N001 | - | 1.7 | U | F | # | 1.7 | 1.09 |
| Thorium-232 | pCi/L | 07/07/2015 | N001 | - | 0.51 | U | F | # | 0.51 | 0.311 |
| Total Dissolved Solids | mg/L | 07/07/2015 | N001 | - | 14000 | | F | # | 200 | |
| Turbidity | NTU | 07/07/2015 | N001 | - | 8.09 | | F | # | | |
| Uranium | mg/L | 07/07/2015 | N001 | - | 0.21 | | F | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 5-SC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | | | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 0.04 | | F | # | 0.00012 | |
| Chloride | mg/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 310 | | F | # | 20 | |
| Chromium | mg/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 0.38 | | F | # | 0.00073 | |
| Lead | mg/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 0.00011 | J | F | # | 0.000068 | |
| Nickel | mg/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 2.9 | | F | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 0.014 | | F | # | 0.01 | |
| Oxidation Reduction Potential | mV | 07/07/2015 | N001 | 49.3 | - | 57.7 | 281 | | F | # | | |
| pH | s.u. | 07/07/2015 | N001 | 49.3 | - | 57.7 | 3.39 | | F | # | | |
| Radium-226 | pCi/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 5.17 | | F | # | 0.15 | 1.44 |
| Radium-228 | pCi/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 1.92 | | F | # | 0.54 | 0.611 |
| Selenium | mg/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 0.12 | | F | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/07/2015 | N001 | 49.3 | - | 57.7 | 11338 | | F | # | | |
| Sulfate | mg/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 12000 | | F | # | 100 | |
| Temperature | C | 07/07/2015 | N001 | 49.3 | - | 57.7 | 10.07 | | F | # | | |
| Thorium-228 | pCi/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 48.9 | | F | # | 2.3 | 8.68 |
| Thorium-230 | pCi/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 400 | | F | # | 3.7 | 62.5 |
| Thorium-232 | pCi/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 11.4 | | F | # | 0.82 | 2.68 |
| Total Dissolved Solids | mg/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 19000 | | F | # | 200 | |
| Turbidity | NTU | 07/07/2015 | N001 | 49.3 | - | 57.7 | 54.5 | | F | # | | |
| Uranium | mg/L | 07/07/2015 | 0001 | 49.3 | - | 57.7 | 3.4 | | F | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: 54-SC WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/07/2015 | N001 | - | 0.0011 | | F | # | 0.00012 | |
| Chloride | mg/L | 07/07/2015 | N001 | - | 360 | | F | # | 20 | |
| Chromium | mg/L | 07/07/2015 | N001 | - | 0.5 | | F | # | 0.00073 | |
| Lead | mg/L | 07/07/2015 | N001 | - | 0.00042 | J | UF | # | 0.000068 | |
| Nickel | mg/L | 07/07/2015 | N001 | - | 2.5 | | F | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/07/2015 | N001 | - | 0.019 | | F | # | 0.01 | |
| Oxidation Reduction Potential | mV | 07/07/2015 | N001 | - | 231 | | F | # | | |
| pH | s.u. | 07/07/2015 | N001 | - | 4.1 | | F | # | | |
| Radium-226 | pCi/L | 07/07/2015 | N001 | - | 13.8 | | F | # | 0.19 | 3.61 |
| Radium-228 | pCi/L | 07/07/2015 | N001 | - | 92.9 | | F | # | 0.35 | 21.4 |
| Selenium | mg/L | 07/07/2015 | N001 | - | 0.14 | | F | # | 0.00032 | |
| Specific Conductance | umhos /cm | 07/07/2015 | N001 | - | 9059 | | F | # | | |
| Sulfate | mg/L | 07/07/2015 | N001 | - | 8700 | | F | # | 50 | |
| Temperature | C | 07/07/2015 | N001 | - | 10.32 | | F | # | | |
| Thorium-228 | pCi/L | 07/07/2015 | N001 | - | 12 | | F | # | 1.8 | 2.71 |
| Thorium-230 | pCi/L | 07/07/2015 | N001 | - | 6.95 | | FJ | # | 2.6 | 2.22 |
| Thorium-232 | pCi/L | 07/07/2015 | N001 | - | 7.32 | | F | # | 0.85 | 1.79 |
| Total Dissolved Solids | mg/L | 07/07/2015 | N001 | - | 12000 | | F | # | 200 | |
| Turbidity | NTU | 07/07/2015 | N001 | - | 4.69 | | F | # | | |
| Uranium | mg/L | 07/07/2015 | N001 | - | 0.02 | | F | # | 0.000029 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: K.G.S.#3 WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 07/07/2015 | N001 | 420 - 450 | 0.00012 | U | | # | 0.00012 | |
| Cadmium | mg/L | 07/07/2015 | N002 | 420 - 450 | 0.00012 | U | | # | 0.00012 | |
| Chloride | mg/L | 07/07/2015 | N001 | 420 - 450 | 4.4 | | | # | 2 | |
| Chloride | mg/L | 07/07/2015 | N002 | 420 - 450 | 4.3 | | | # | 2 | |
| Chromium | mg/L | 07/07/2015 | N001 | 420 - 450 | 0.00073 | U | | # | 0.00073 | |
| Chromium | mg/L | 07/07/2015 | N002 | 420 - 450 | 0.00073 | U | | # | 0.00073 | |
| Lead | mg/L | 07/07/2015 | N001 | 420 - 450 | 0.00061 | | U | # | 0.000068 | |
| Lead | mg/L | 07/07/2015 | N002 | 420 - 450 | 0.00059 | | U | # | 0.000068 | |
| Nickel | mg/L | 07/07/2015 | N001 | 420 - 450 | 0.0011 | J | U | # | 0.00097 | |
| Nickel | mg/L | 07/07/2015 | N002 | 420 - 450 | 0.00097 | U | | # | 0.00097 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/07/2015 | N001 | 420 - 450 | 0.01 | U | | # | 0.01 | |
| Nitrate + Nitrite as Nitrogen | mg/L | 07/07/2015 | N002 | 420 - 450 | 0.01 | U | | # | 0.01 | |
| Oxidation Reduction Potential | mV | 07/07/2015 | N001 | 420 - 450 | -195 | | | # | | |
| pH | s.u. | 07/07/2015 | N001 | 420 - 450 | 8.13 | | | # | | |
| Radium-226 | pCi/L | 07/07/2015 | N001 | 420 - 450 | 0.602 | | | # | 0.15 | 0.263 |
| Radium-226 | pCi/L | 07/07/2015 | N002 | 420 - 450 | 0.578 | | | # | 0.17 | 0.264 |
| Radium-228 | pCi/L | 07/07/2015 | N001 | 420 - 450 | 1.85 | | | # | 0.38 | 0.53 |
| Radium-228 | pCi/L | 07/07/2015 | N002 | 420 - 450 | 1.62 | | | # | 0.37 | 0.481 |
| Selenium | mg/L | 07/07/2015 | N001 | 420 - 450 | 0.00032 | U | | # | 0.00032 | |
| Selenium | mg/L | 07/07/2015 | N002 | 420 - 450 | 0.00032 | U | | # | 0.00032 | |

**Groundwater Quality Data by Location (USEE100) FOR SITE SBS01, Shirley Basin South Disposal Site**

REPORT DATE: 09/30/2015

Location: K.G.S.#3 WELL

| Parameter | Units | Sample Date | Sample ID | Depth Range (Ft BLS) | Result | Qualifiers Lab | Qualifiers Data | Qualifiers QA | Detection Limit | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|
| Specific Conductance | umhos /cm | 07/07/2015 | N001 | 420 - 450 | 807 | | | # | | |
| Sulfate | mg/L | 07/07/2015 | N001 | 420 - 450 | 270 | | | # | 5 | |
| Sulfate | mg/L | 07/07/2015 | N002 | 420 - 450 | 260 | | | # | 5 | |
| Temperature | C | 07/07/2015 | N001 | 420 - 450 | 10.69 | | | # | | |
| Thorium-228 | pCi/L | 07/07/2015 | N001 | 420 - 450 | 0.28 | U | | # | 0.28 | 0.163 |
| Thorium-228 | pCi/L | 07/07/2015 | N002 | 420 - 450 | 0.28 | U | | # | 0.28 | 0.161 |
| Thorium-230 | pCi/L | 07/07/2015 | N001 | 420 - 450 | 0.31 | U | | # | 0.31 | 0.17 |
| Thorium-230 | pCi/L | 07/07/2015 | N002 | 420 - 450 | 0.31 | U | | # | 0.31 | 0.165 |
| Thorium-232 | pCi/L | 07/07/2015 | N001 | 420 - 450 | 0.085 | U | | # | 0.085 | 0.0474 |
| Thorium-232 | pCi/L | 07/07/2015 | N002 | 420 - 450 | 0.095 | U | | # | 0.095 | 0.0385 |
| Total Dissolved Solids | mg/L | 07/07/2015 | N001 | 420 - 450 | 550 | | | # | 20 | |
| Total Dissolved Solids | mg/L | 07/07/2015 | N002 | 420 - 450 | 540 | | | # | 20 | |
| Turbidity | NTU | 07/07/2015 | N001 | 420 - 450 | 7.13 | | | # | | |
| Uranium | mg/L | 07/07/2015 | N001 | 420 - 450 | 0.00017 | | | # | 0.000029 | |
| Uranium | mg/L | 07/07/2015 | N002 | 420 - 450 | 0.00019 | | | # | 0.000029 | |

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

QA QUALIFIER:

| | |
|---|---|
| # | Validated according to quality assurance guidelines. |

# Static Water Level Data

This page intentionally left blank

**STATIC WATER LEVELS (USEE700) FOR SITE SBS01, Shirley Basin South Disposal Site**
**REPORT DATE: 09/29/2015**

| Location Code | Flow Code | Top of Casing Elevation (Ft) | Measurement Date | Measurement Time | Depth From Top of Casing (Ft) | Water Elevation (Ft) | Water Level Flag |
|---|---|---|---|---|---|---|---|
| 10-DC | | 7113.1 | 07/07/2015 | 17:00:05 | 166.9 | 6946.2 | |
| 100-SC | | 7153.56 | 07/07/2015 | 09:30:56 | 208.6 | 6944.96 | |
| 101-SC | | 7168.35 | 07/07/2015 | 15:29:00 | | | D |
| 110-DC | | 7153.92 | 07/07/2015 | 11:00:11 | 206.29 | 6947.63 | |
| 19-DC | | 7112.1 | 07/07/2015 | 16:00:32 | 165.17 | 6946.93 | |
| 5-DC | | 7119.94 | 07/07/2015 | 14:00:14 | 172.67 | 6947.27 | |
| 5-SC | | 7053.31 | 07/07/2015 | 14:45:38 | 57.24 | 6996.07 | |
| 51-SC | | 7092.6 | 07/07/2015 | 16:12:00 | | | D |
| 54-SC | | 7158.74 | 07/07/2015 | 13:00:43 | 208.63 | 6950.11 | |

FLOW CODES: B BACKGROUND C CROSS GRADIENT D DOWNGRADIENT
F OFFSITE N UNKNOWN O ONSITE
U UPGRADIENT

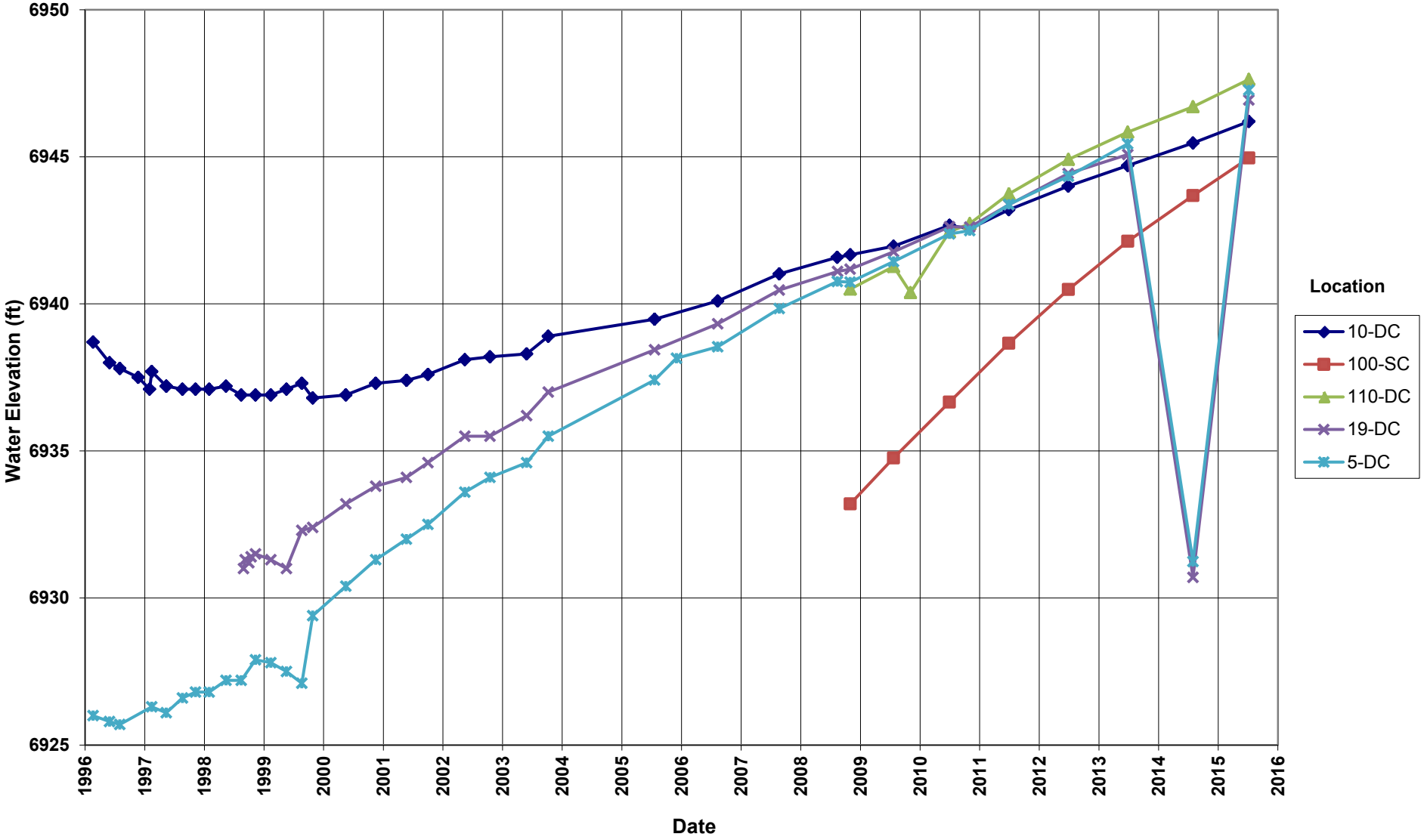
WATER LEVEL FLAGS: D Dry F Flowing B Below top of pump

This page intentionally left blank

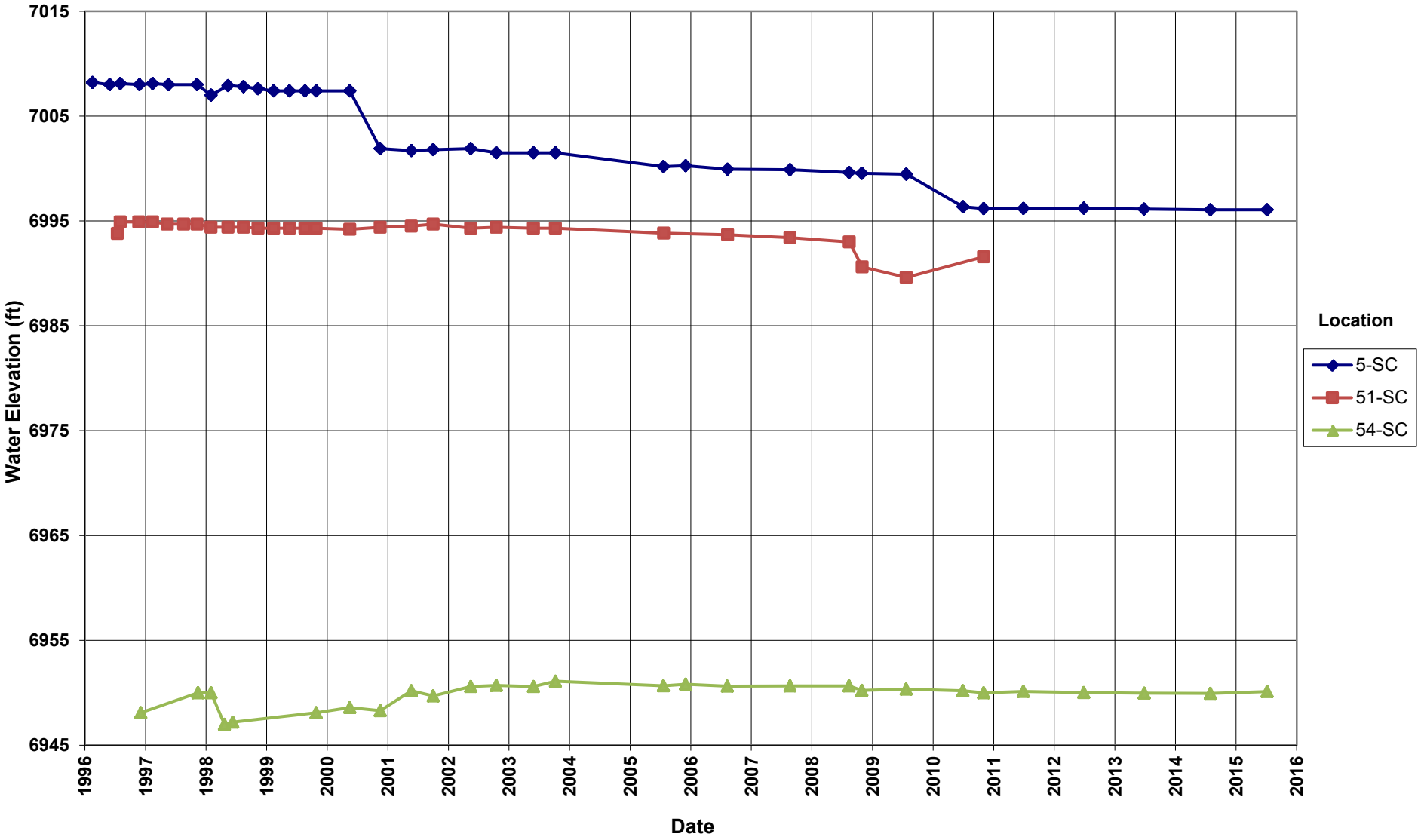
# Hydrographs

This page intentionally left blank

## Shirley Basin South Disposal Site
## Hydrograph



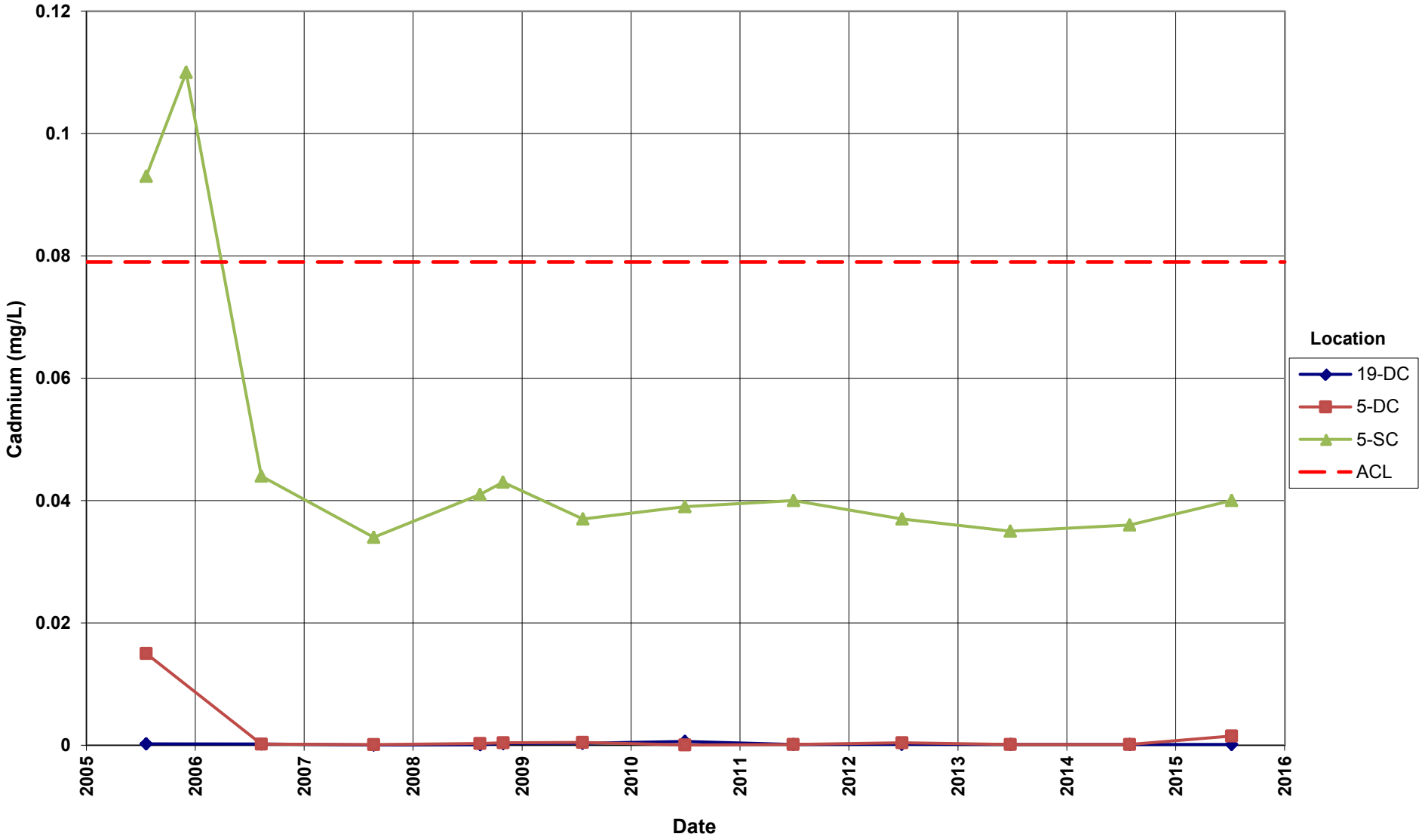
## Shirley Basin South Disposal Site
## Hydrograph



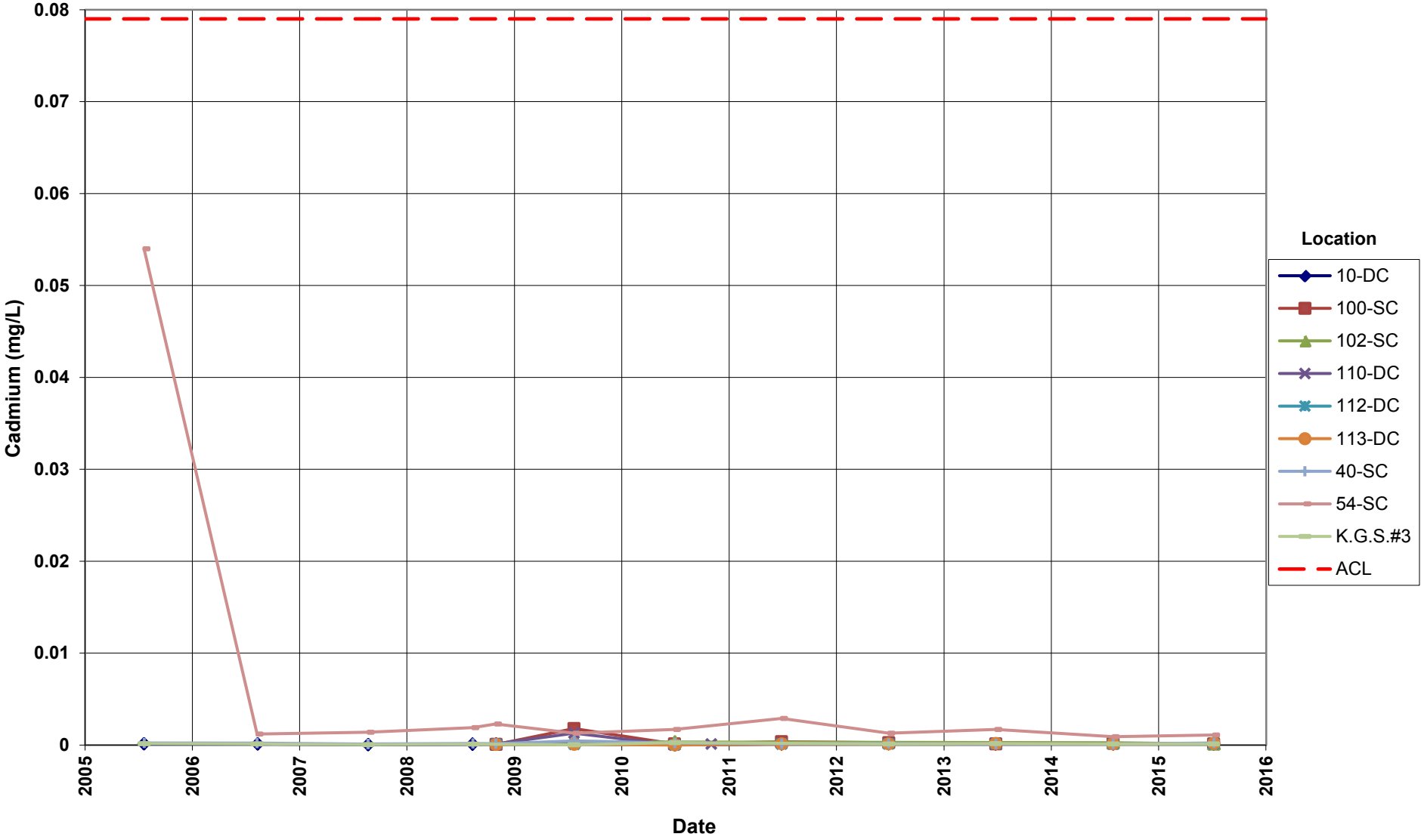
# Time-Concentration Graphs

This page intentionally left blank

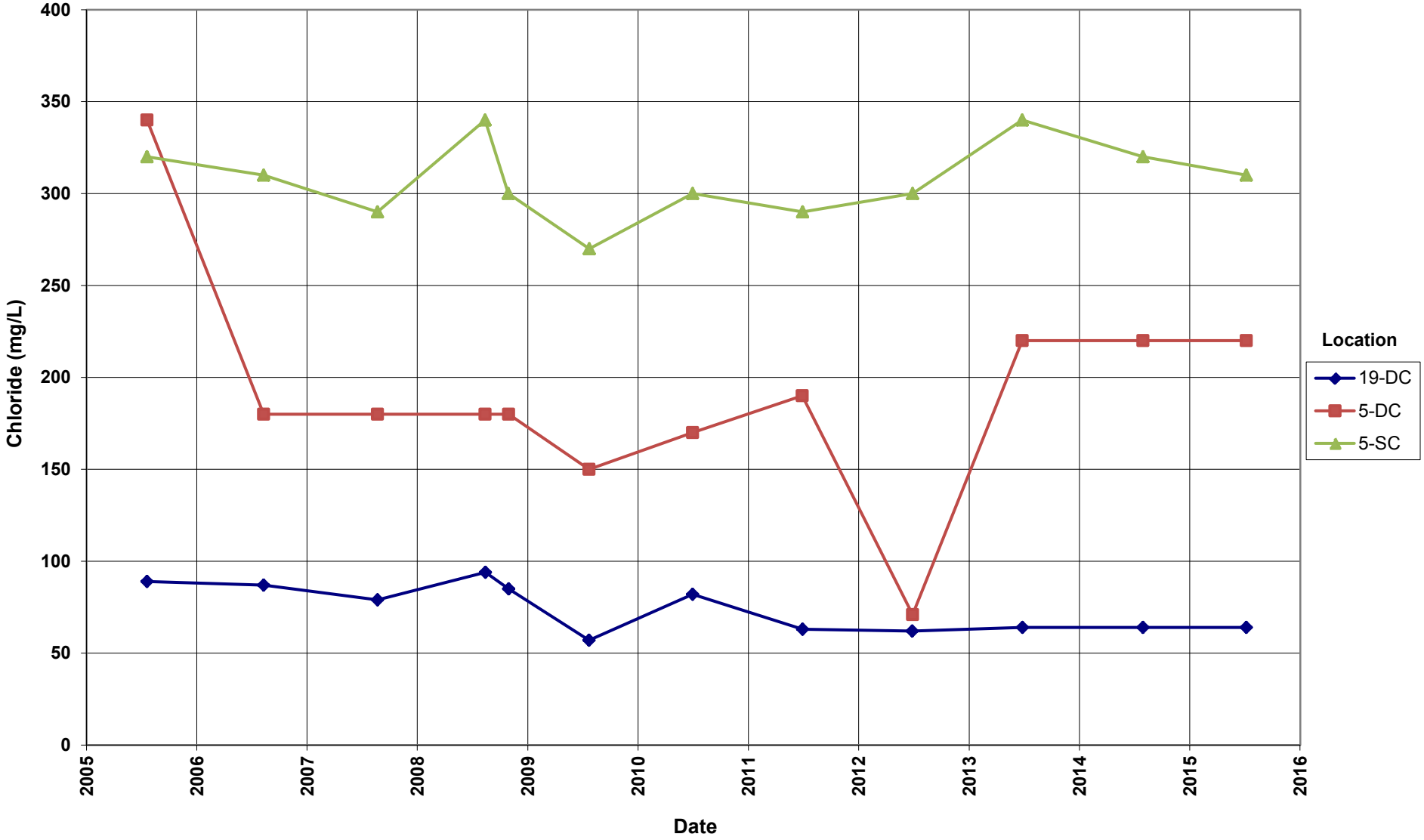
**Shirley Basin South Disposal Site**
**Cadmium Concentration**
**Point of Compliance Wells**
Alternate Concentration Limit (ACL) = 0.079 mg/L

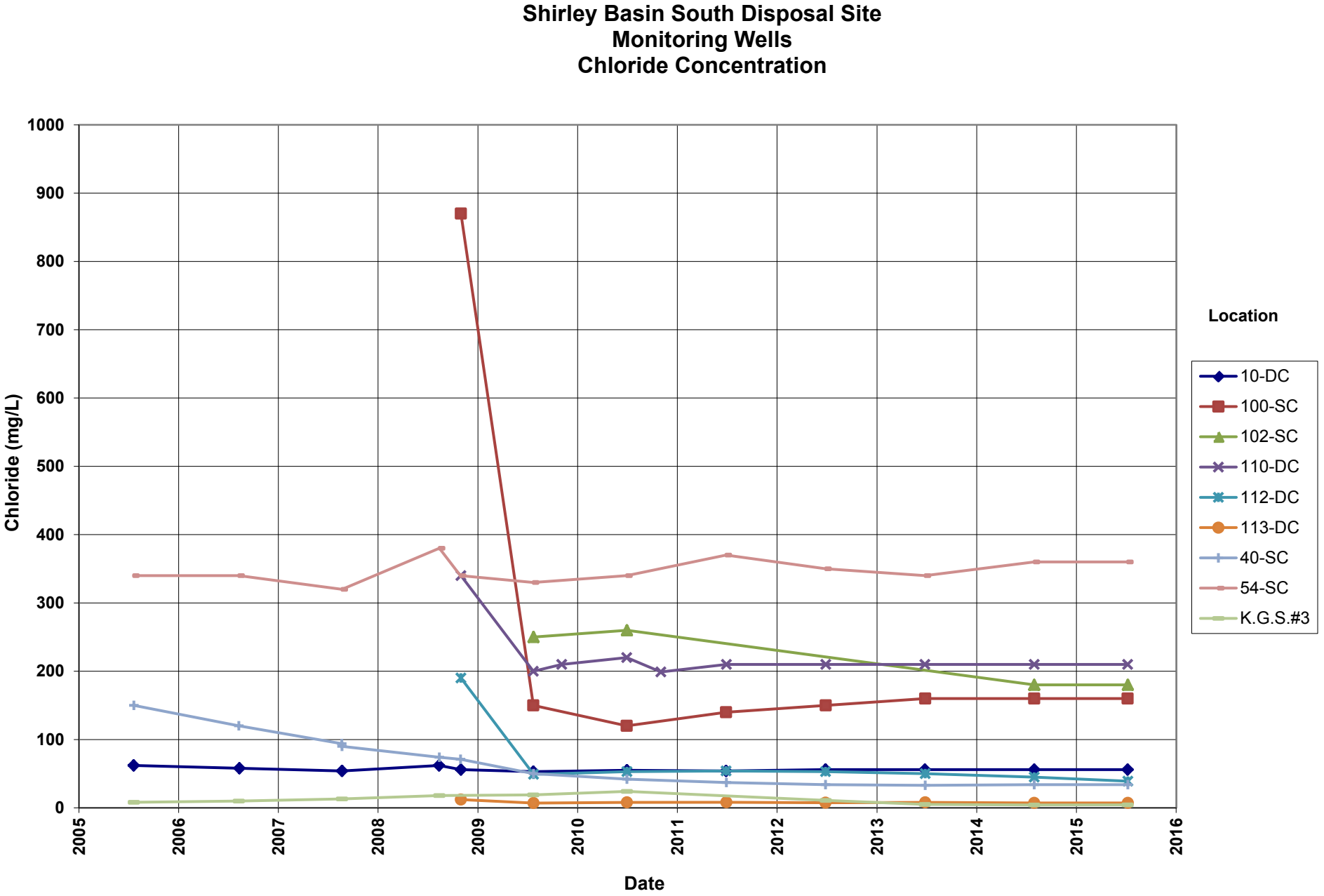


**Shirley Basin South Disposal Site**
**Cadmium Concentration**
**Monitoring Wells**
Alternate Concentration Limit (ACL) = 0.079 mg/L

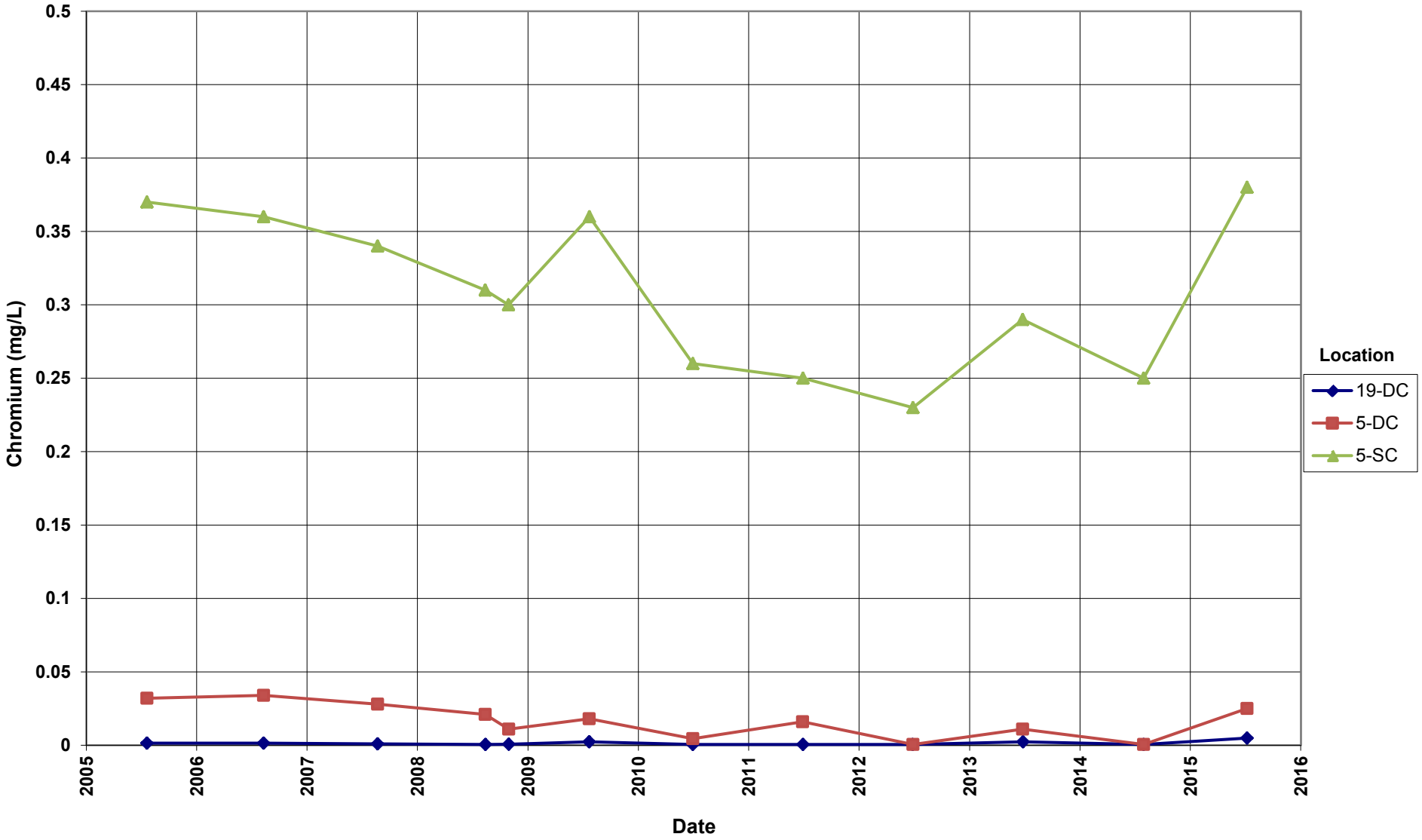


## Shirley Basin South Disposal Site
## Point of Compliance Wells
## Chloride Concentration

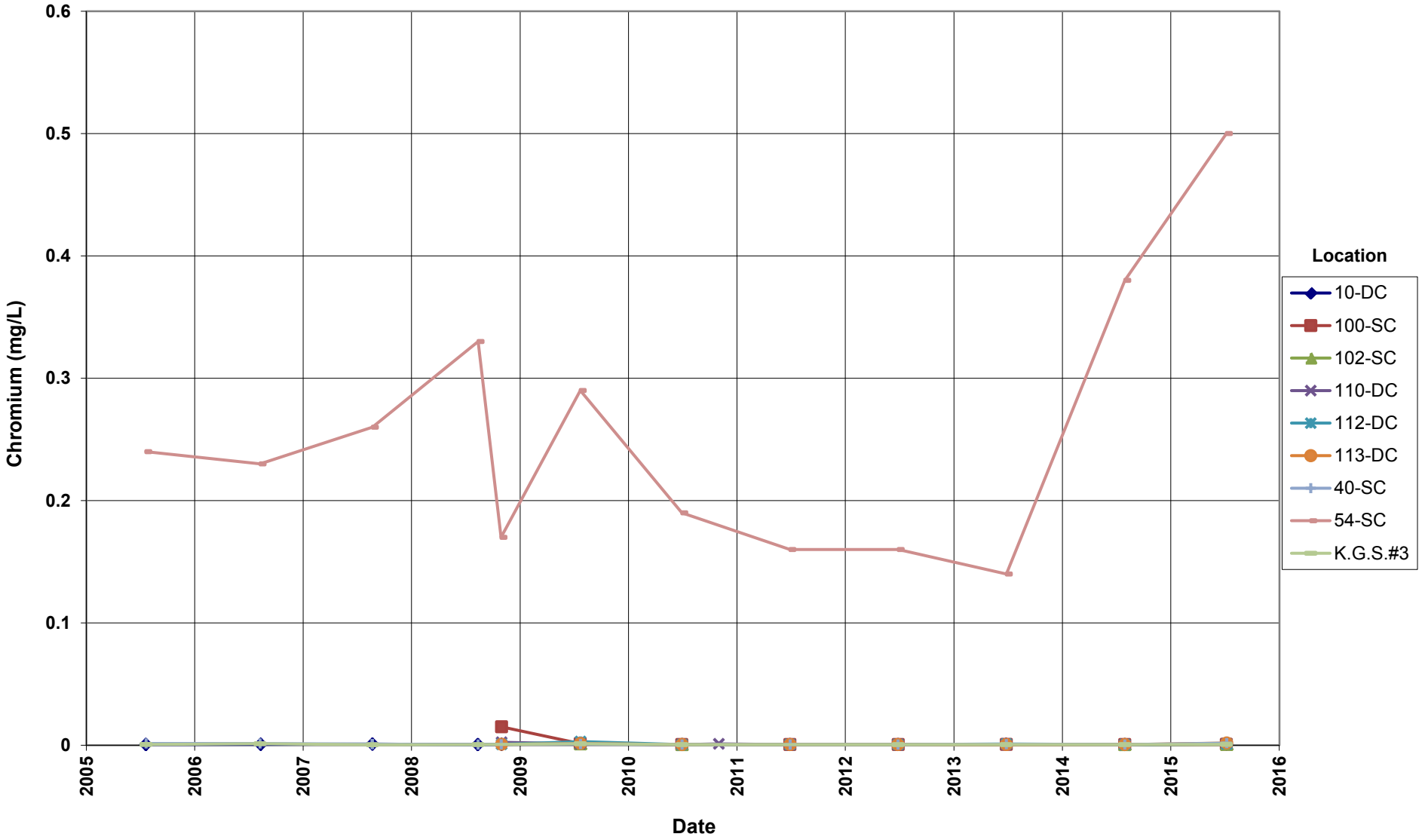



Shirley Basin South Disposal Site
Monitoring Wells
Chloride Concentration
Chloride (mg/L)
1000
900
800
700
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Date
Location
10-DC
100-SC
102-SC
110-DC
112-DC
113-DC
40-SC
54-SC
K.G.S.#3

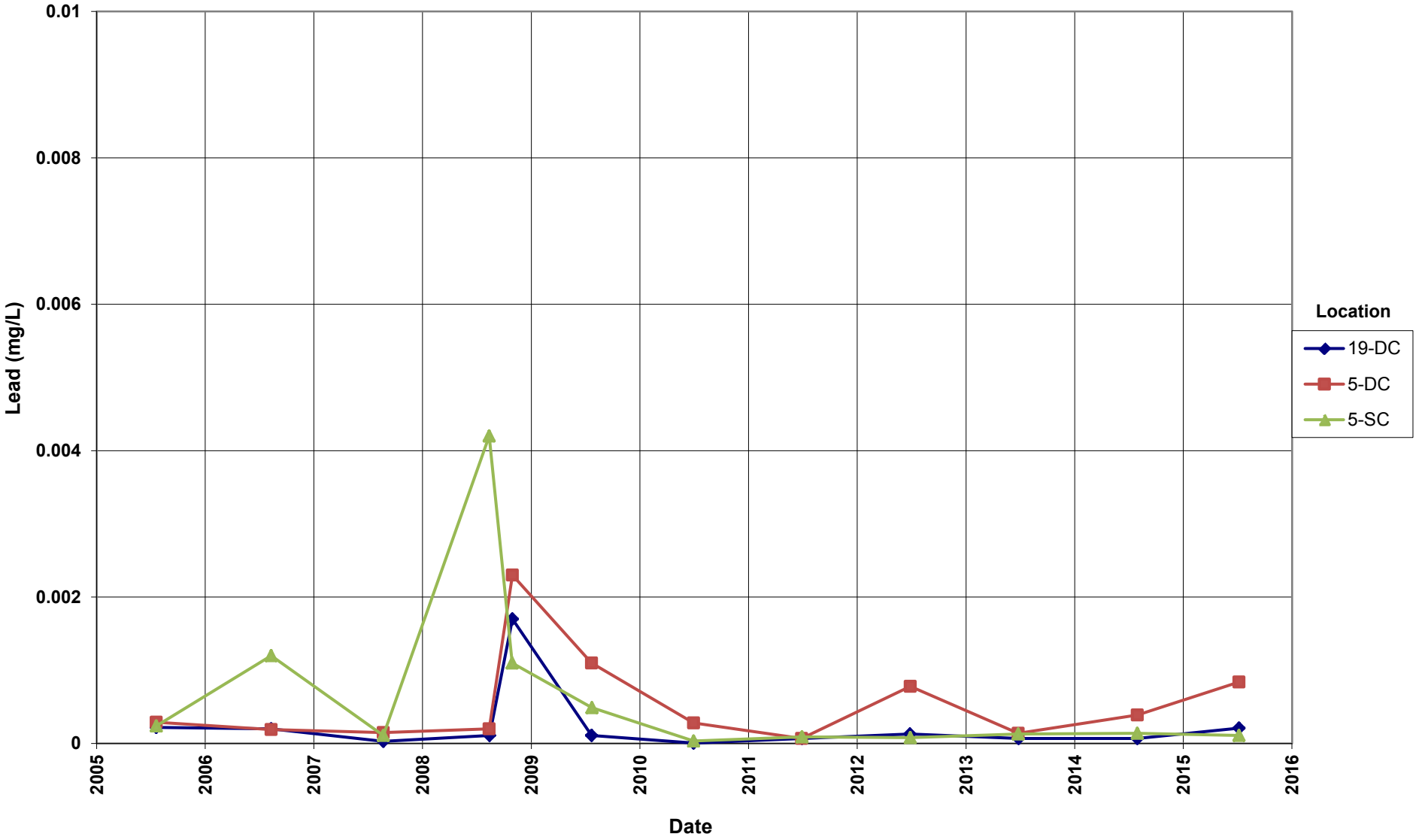
**Shirley Basin South Disposal Site**
**Chromium Concentration**
**Point of Compliance Wells**
Alternate Concentration Limit (ACL) = 1.83 mg/L



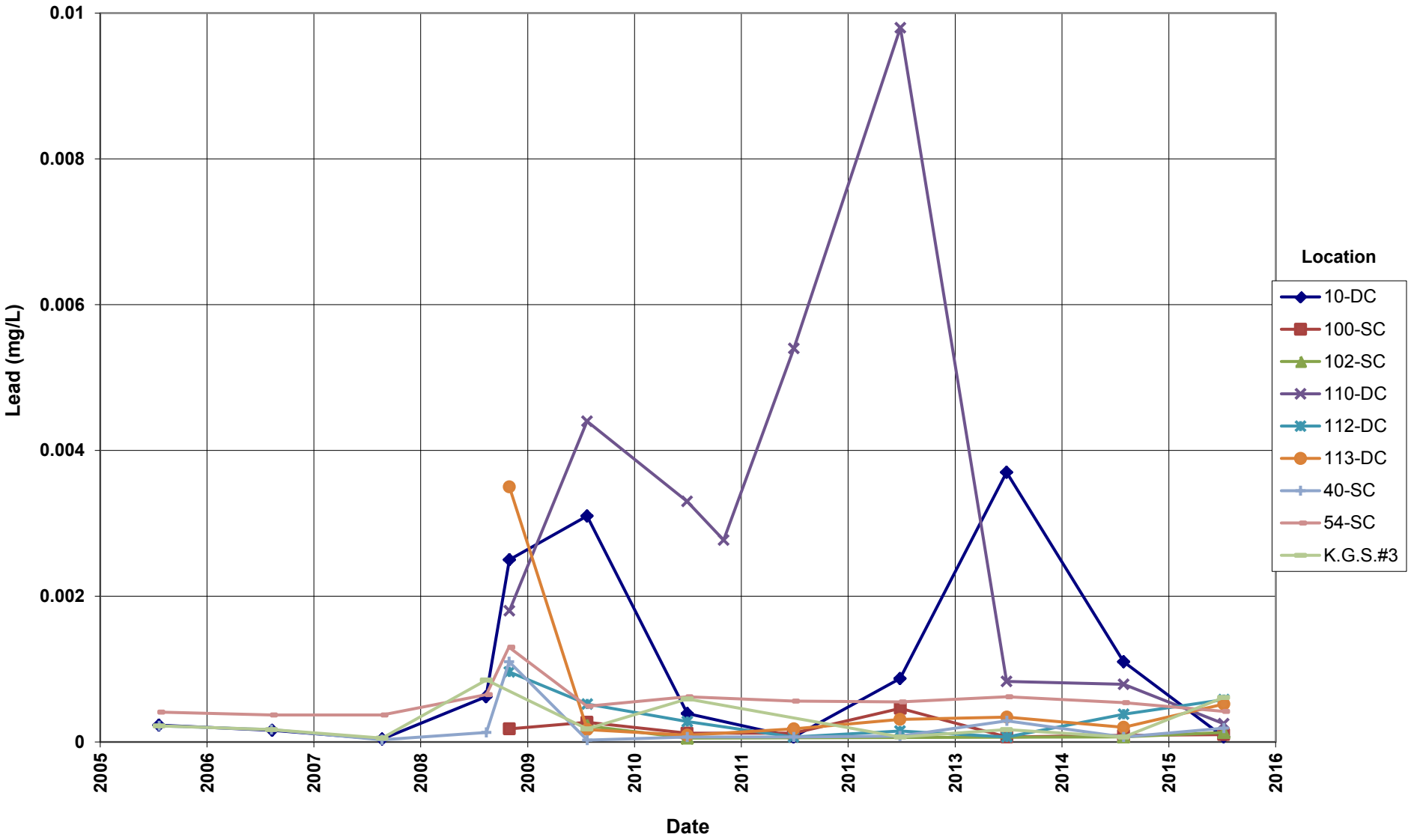
**Shirley Basin South Disposal Site**
**Chromium Concentration**
**Monitoring Wells**
Alternate Concentration Limit (ACL) = 1.83 mg/L



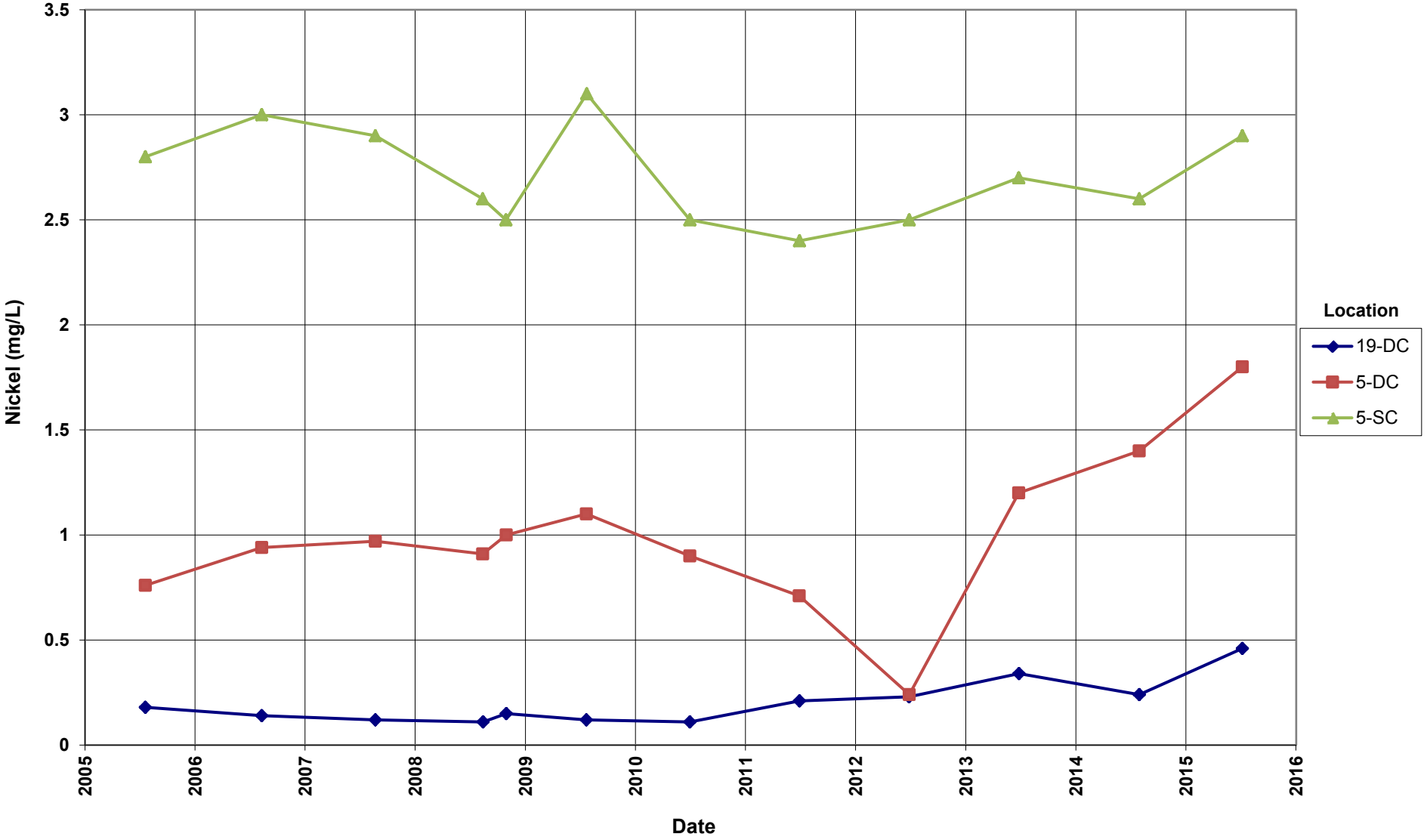
**Shirley Basin South Disposal Site**
**Lead Concentration**
**Point of Compliance Wells**
Alternate Concentration Limit (ACL) = 0.05 mg/L



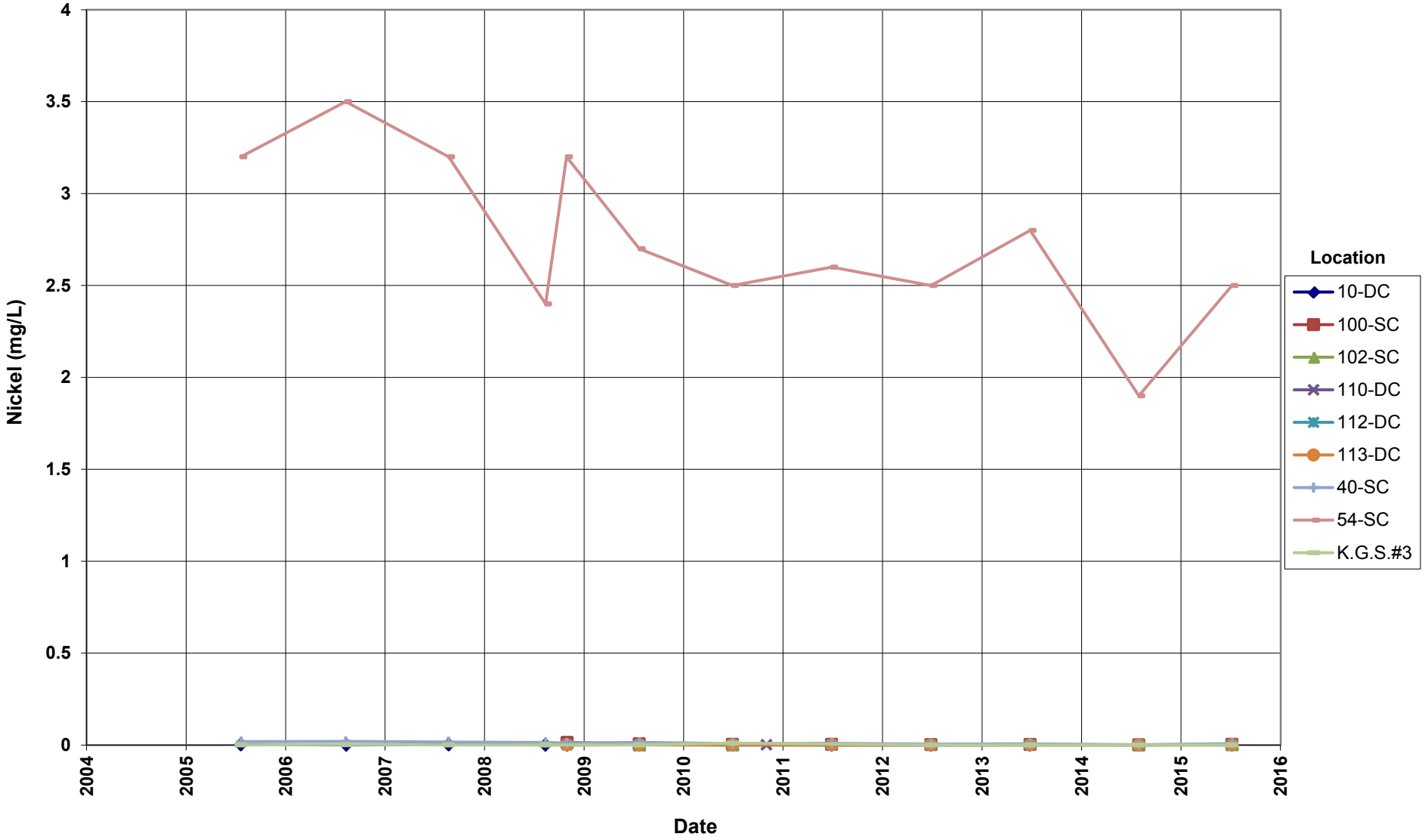
**Shirley Basin South Disposal Site**
**Lead Concentration**
**Monitoring Wells**
Alternate Concentration Limit (ACL) = 0.05 mg/L



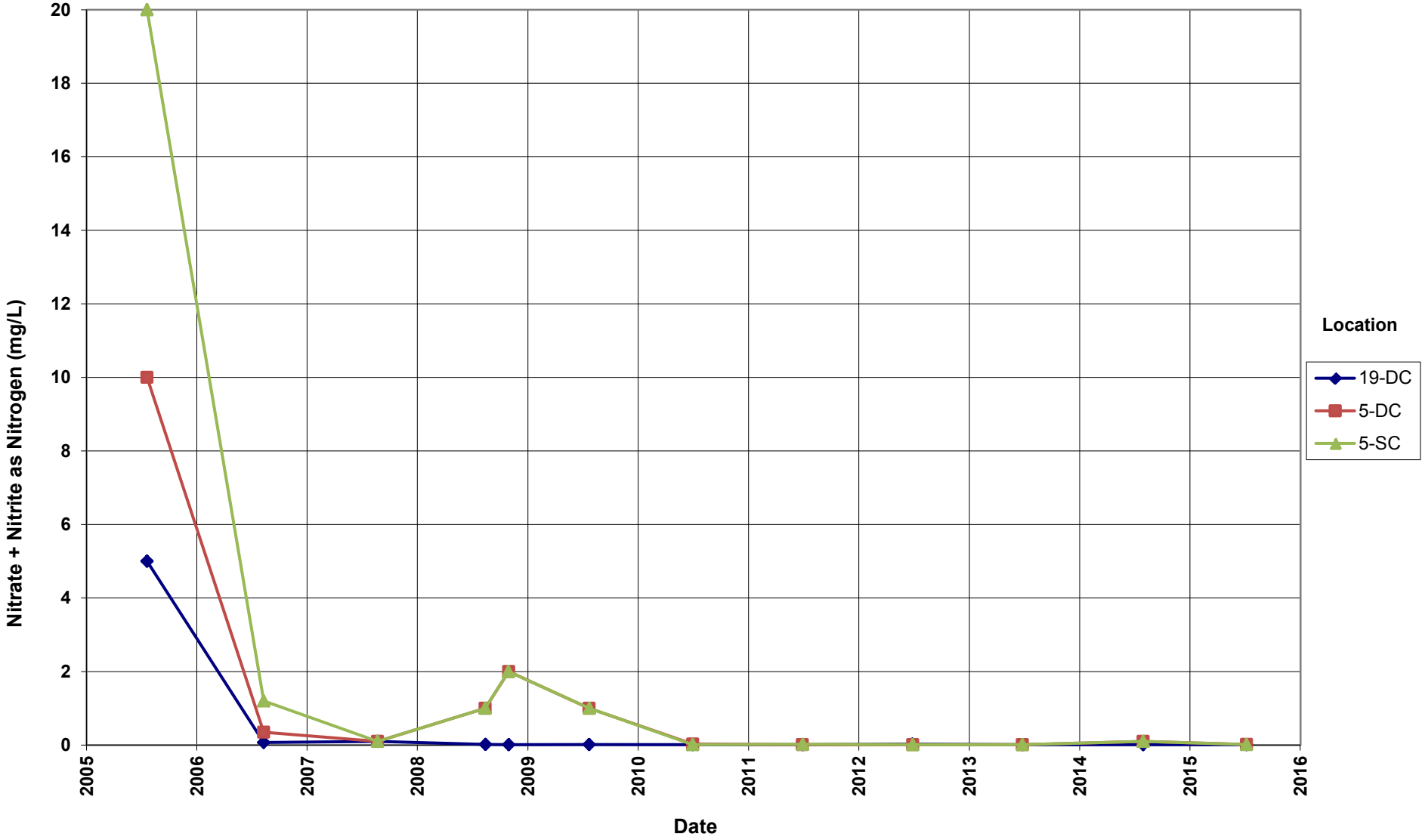
**Shirley Basin South Disposal Site**
**Nickel Concentration**
**Point of Compliance Wells**
Alternate Concentration Limit (ACL) = 6.15 mg/L



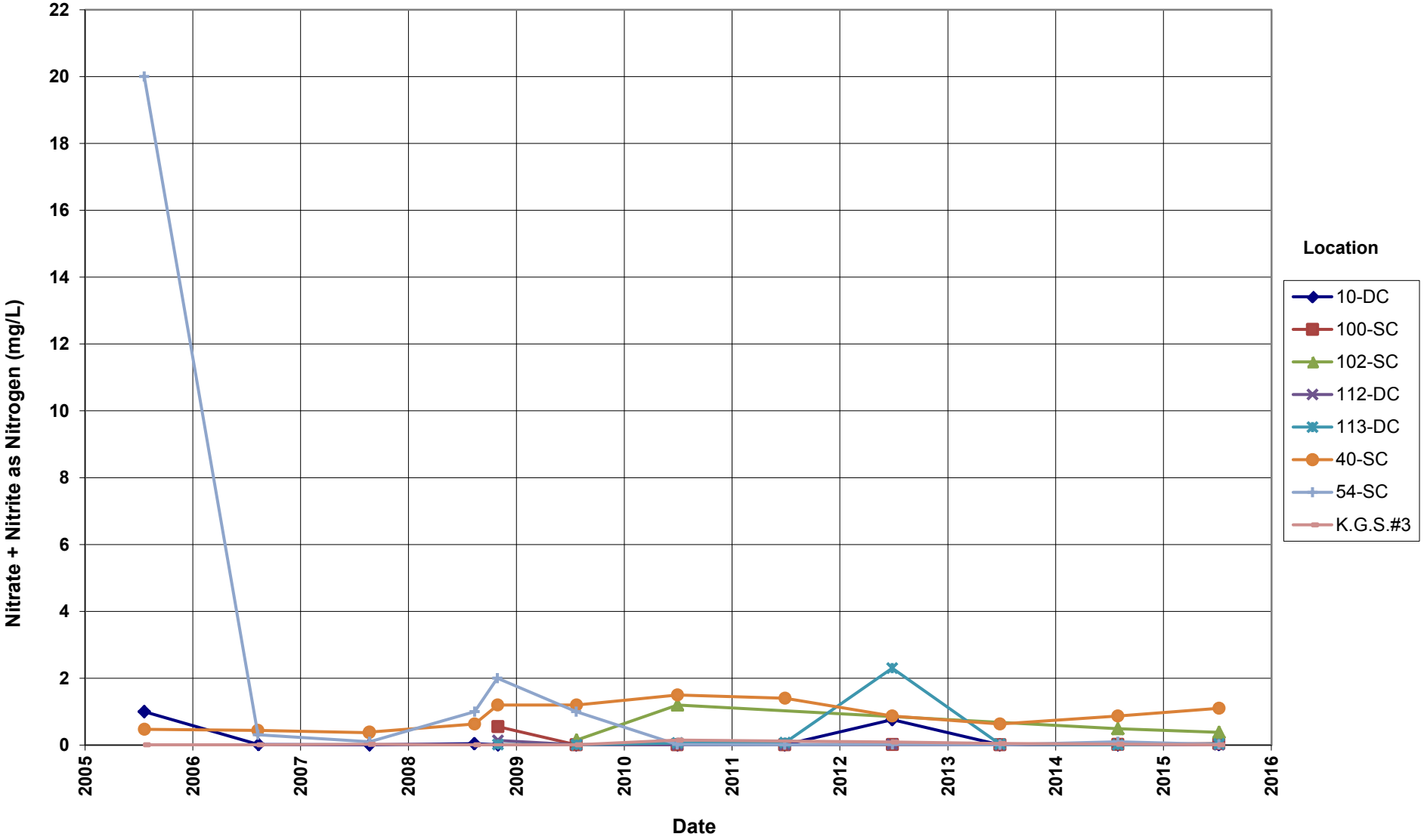
**Shirley Basin South Disposal Site**
**Nickel Concentration**
**Monitoring Wells**
Alternate Concentration Limit (ACL) = 6.15 mg/L



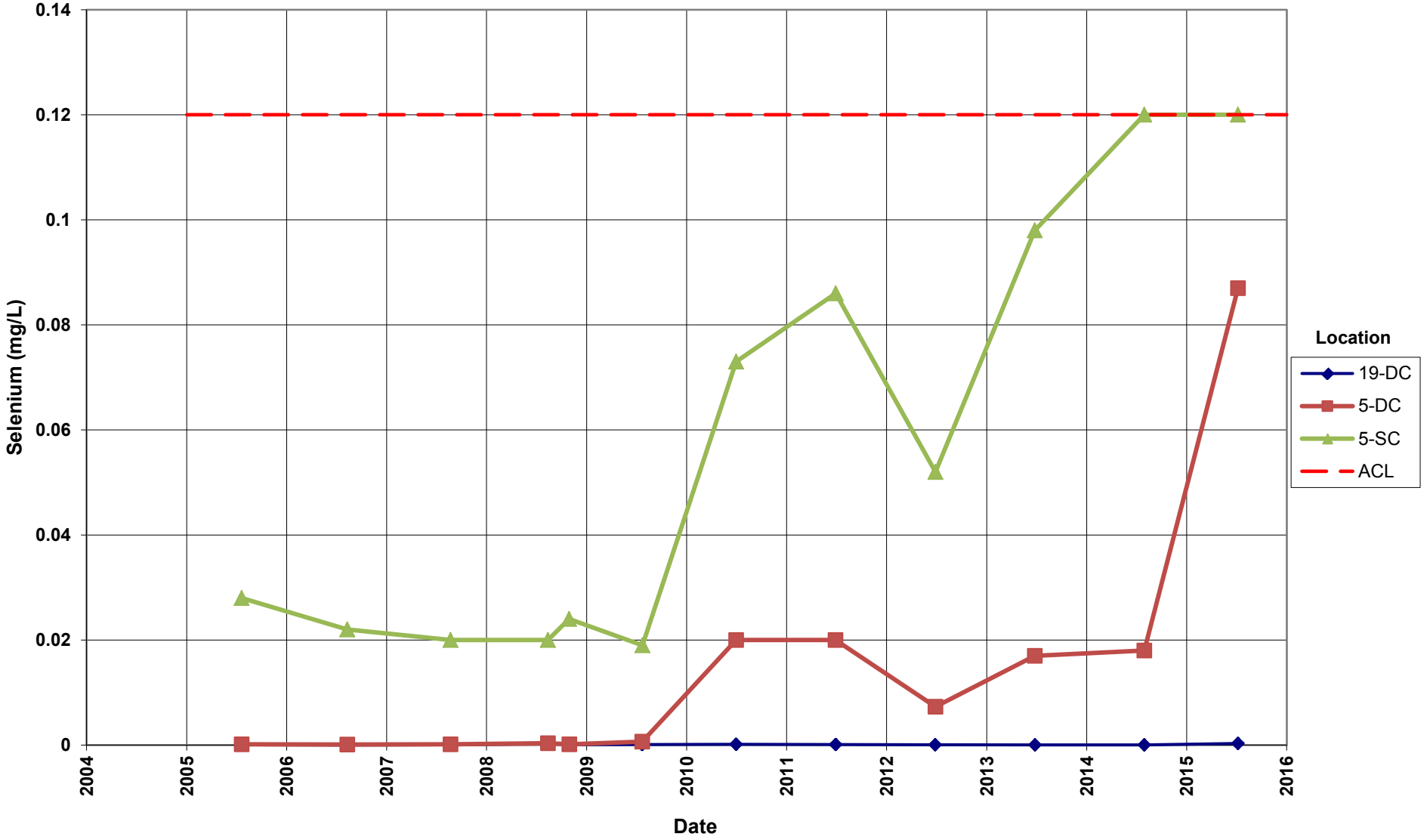
## Shirley Basin South Disposal Site
## Nitrate + Nitrite as Nitrogen Concentration
## Point of Compliance Wells



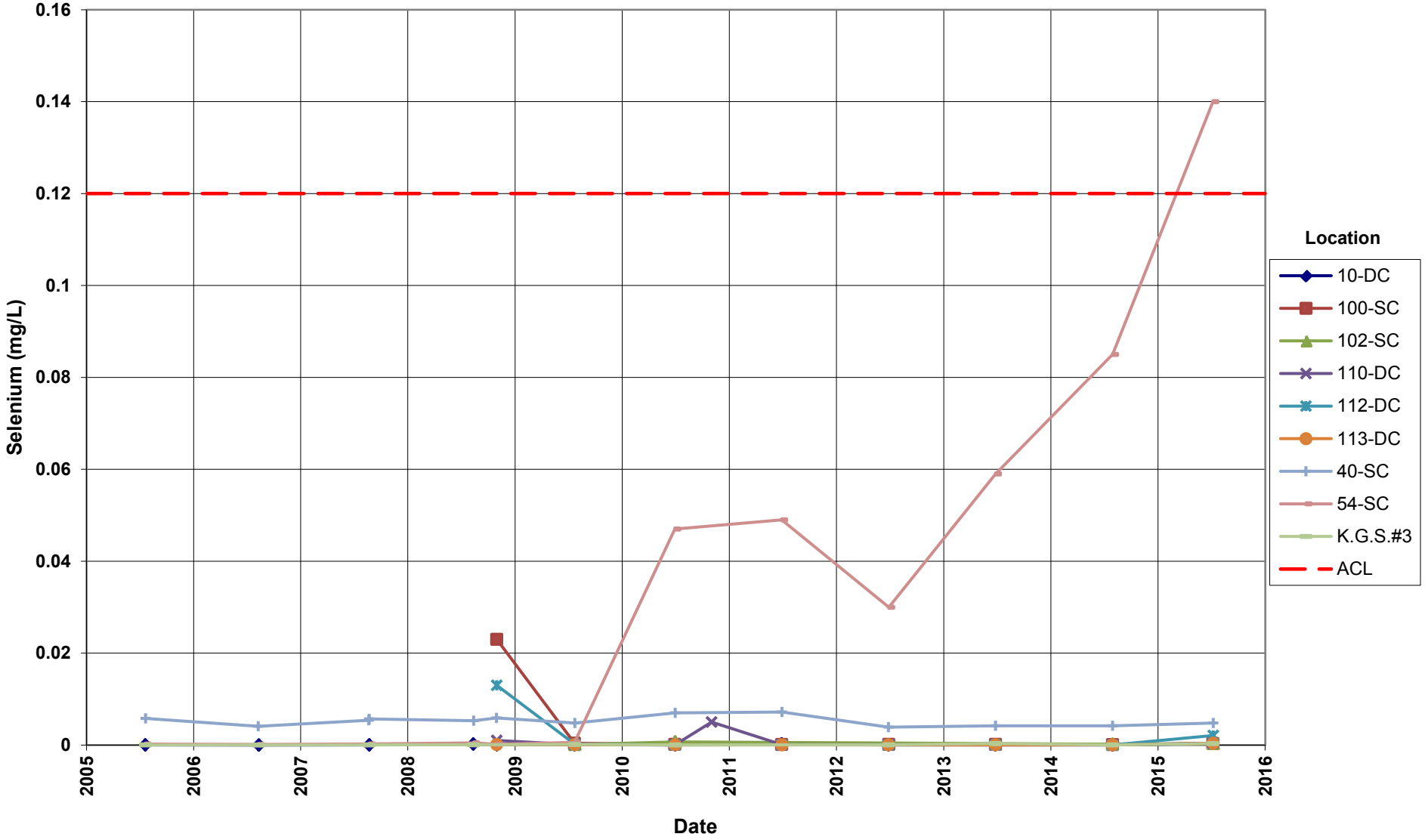
## Shirley Basin South Disposal Site
## Nitrate + Nitrite as Nitrogen Concentration
## Monitoring Wells

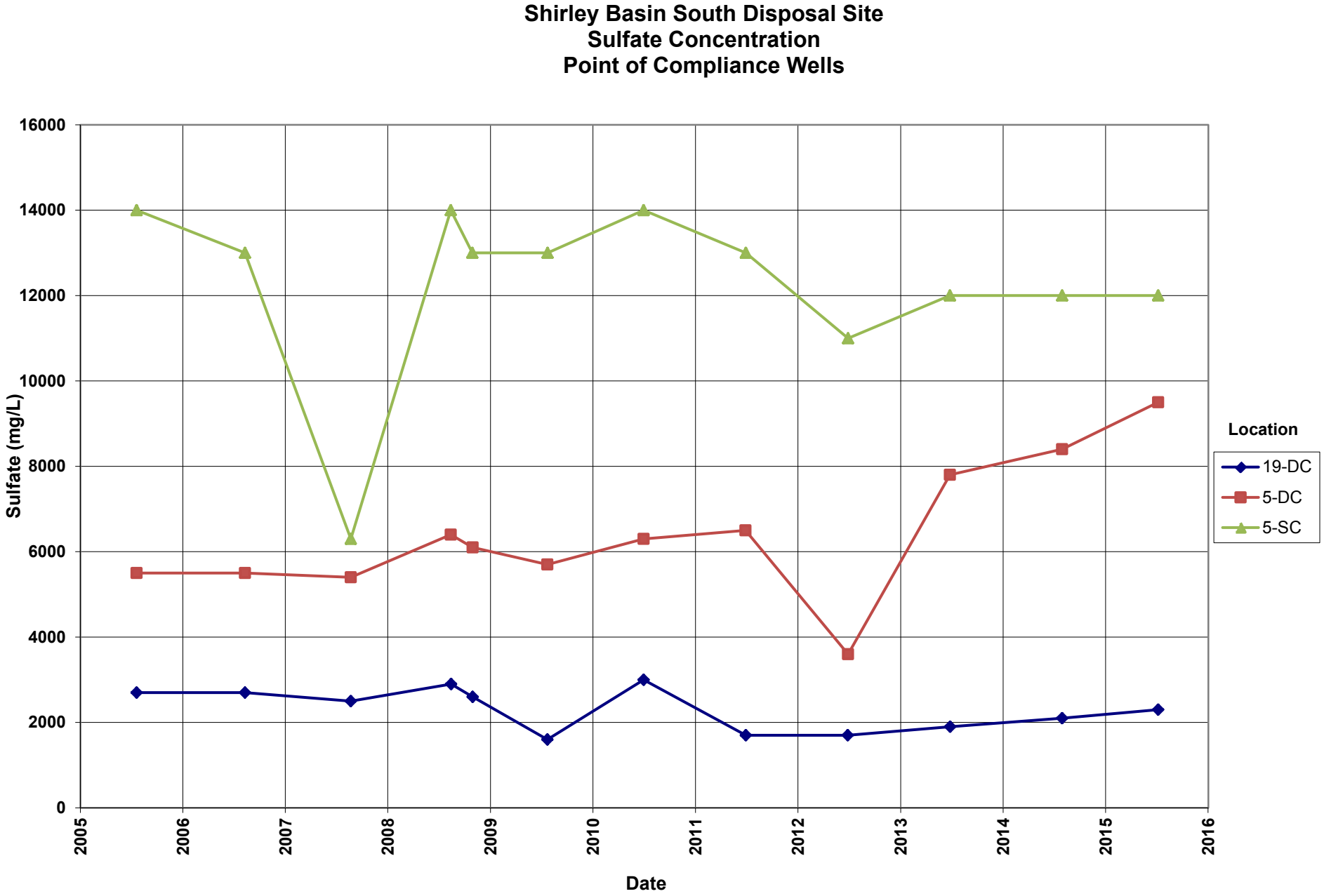


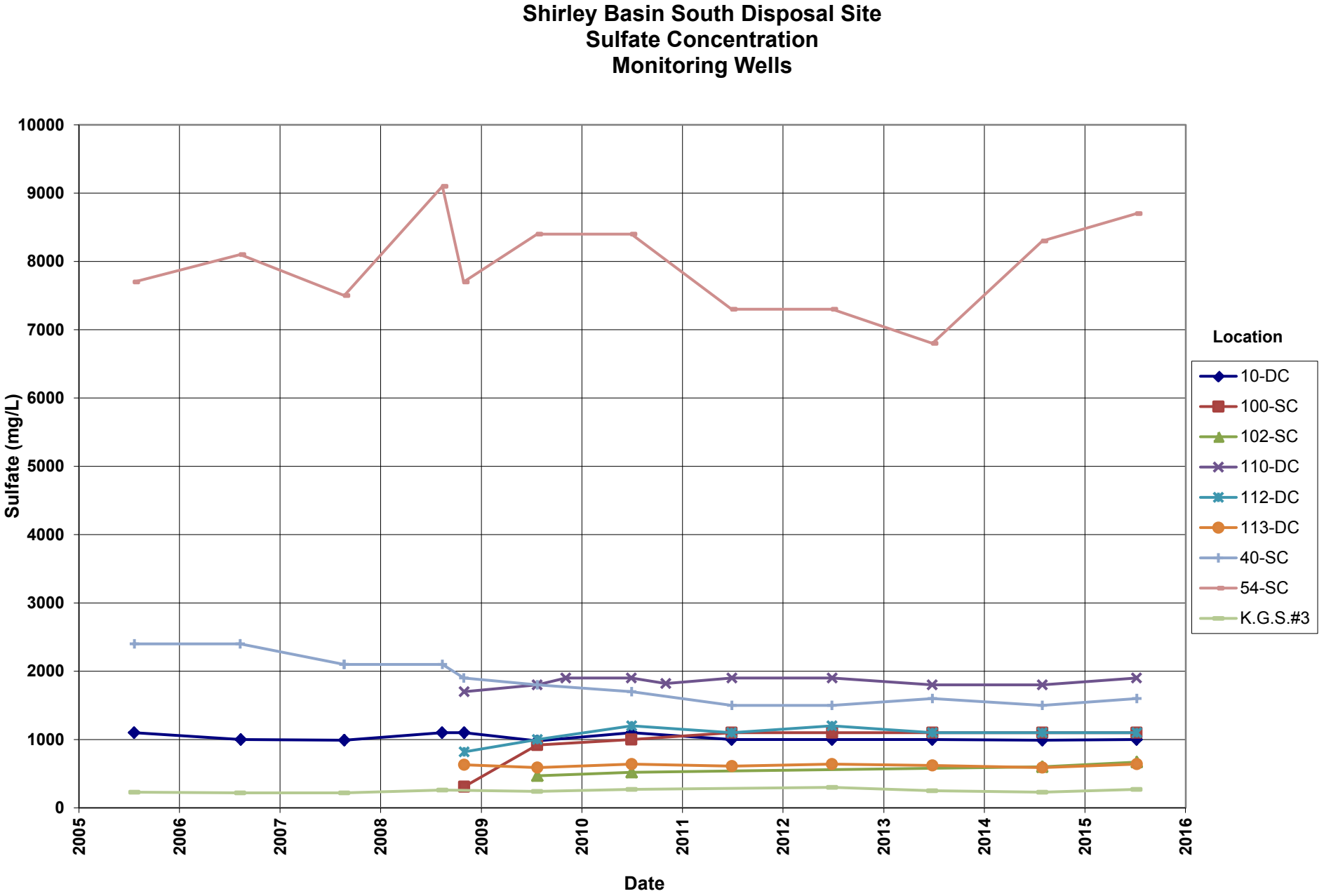
**Shirley Basin South Disposal Site**
**Selenium Concentration**
**Point of Compliance Wells**
Alternate Concentration Limit (ACL) = 0.12 mg/L



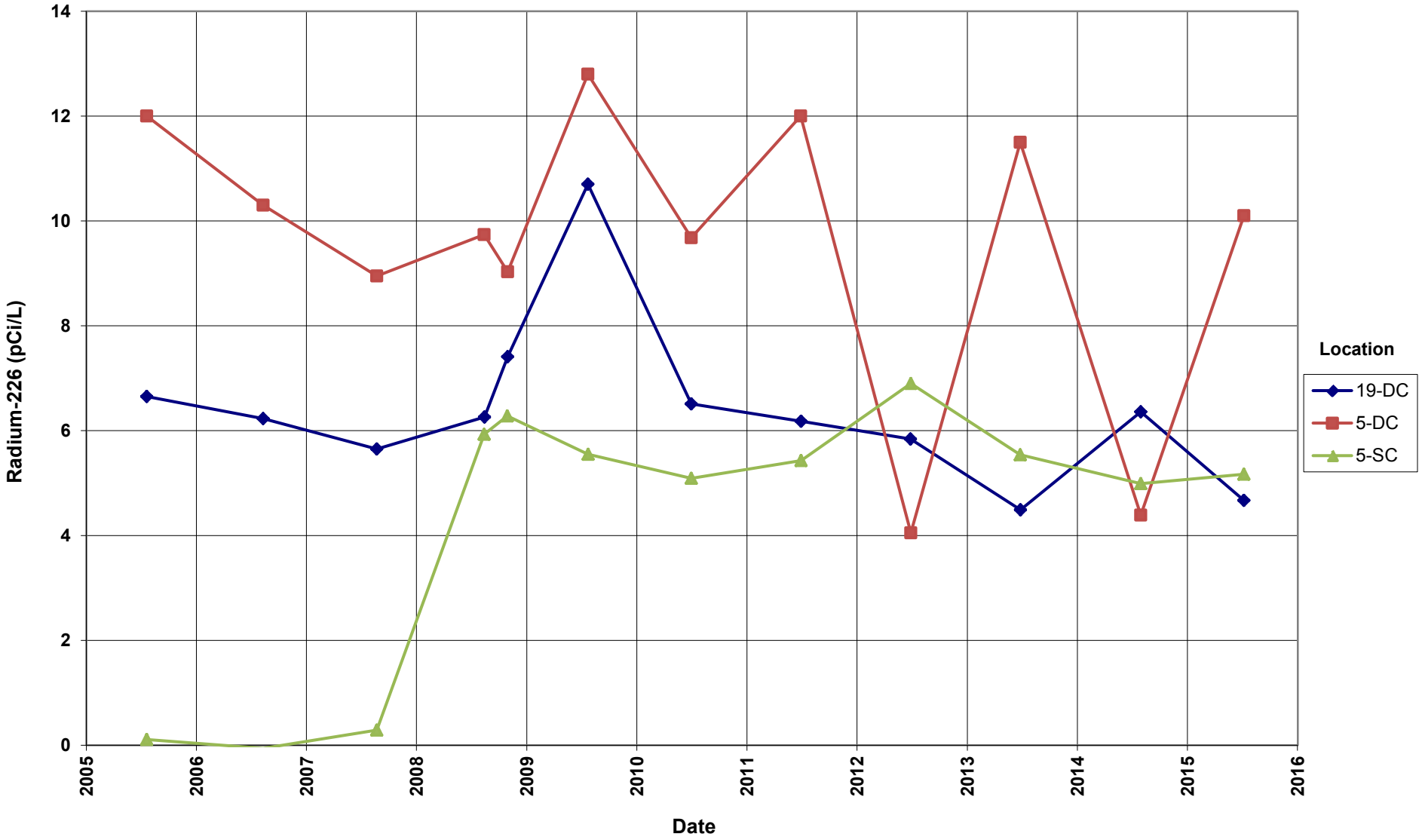
**Shirley Basin South Disposal Site**
**Selenium Concentration**
**Monitoring Wells**
Alternate Concentration Limit (ACL) = 0.12 mg/L



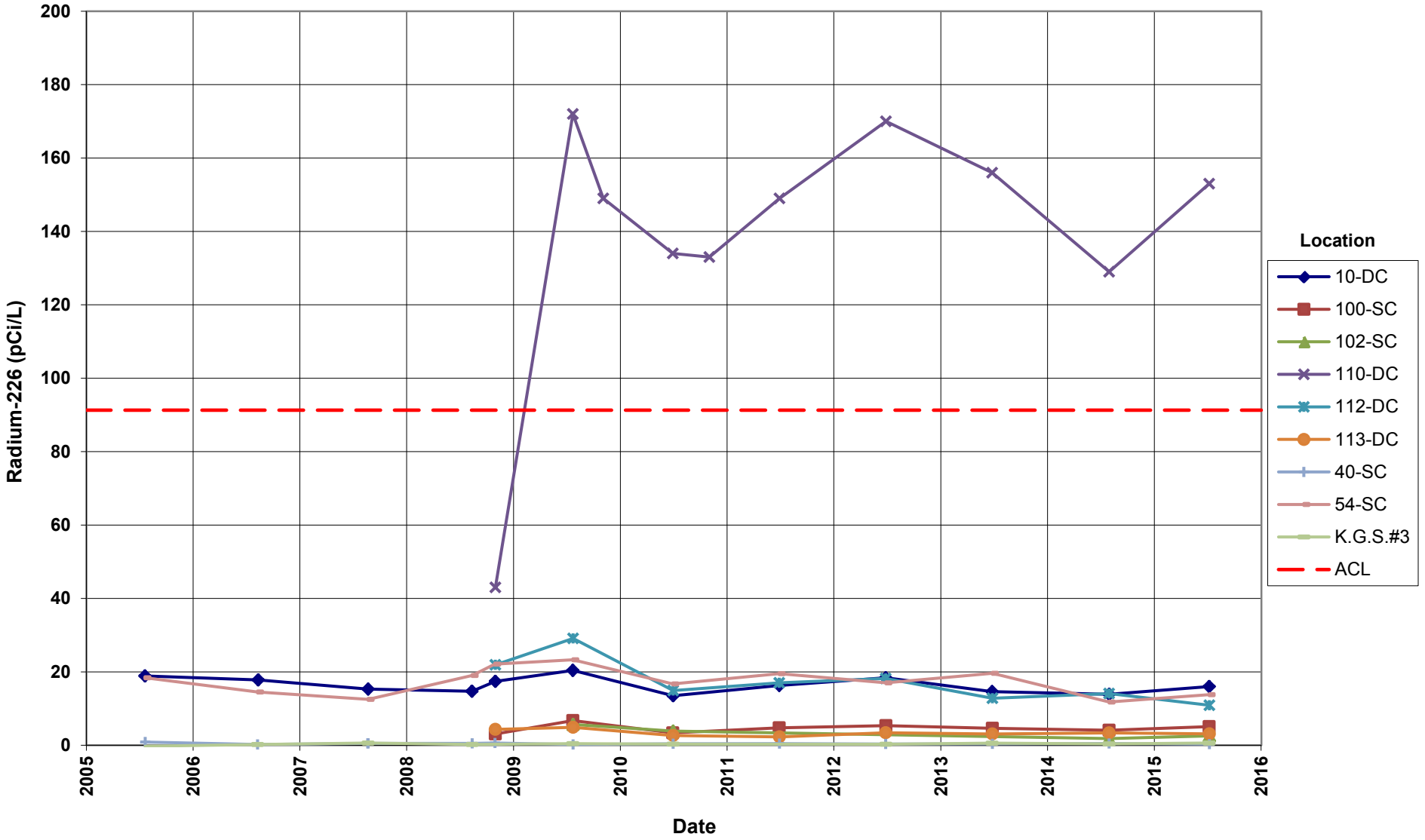

Shirley Basin South Disposal Site
Sulfate Concentration
Point of Compliance Wells
Sulfate (mg/L)
16000
14000
12000
10000
8000
6000
4000
2000
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Date
Location
19-DC
5-DC
5-SC


Shirley Basin South Disposal Site
Sulfate Concentration
Monitoring Wells
Sulfate (mg/L)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Date
Location
10-DC
100-SC
102-SC
110-DC
112-DC
113-DC
40-SC
54-SC
K.G.S.#3

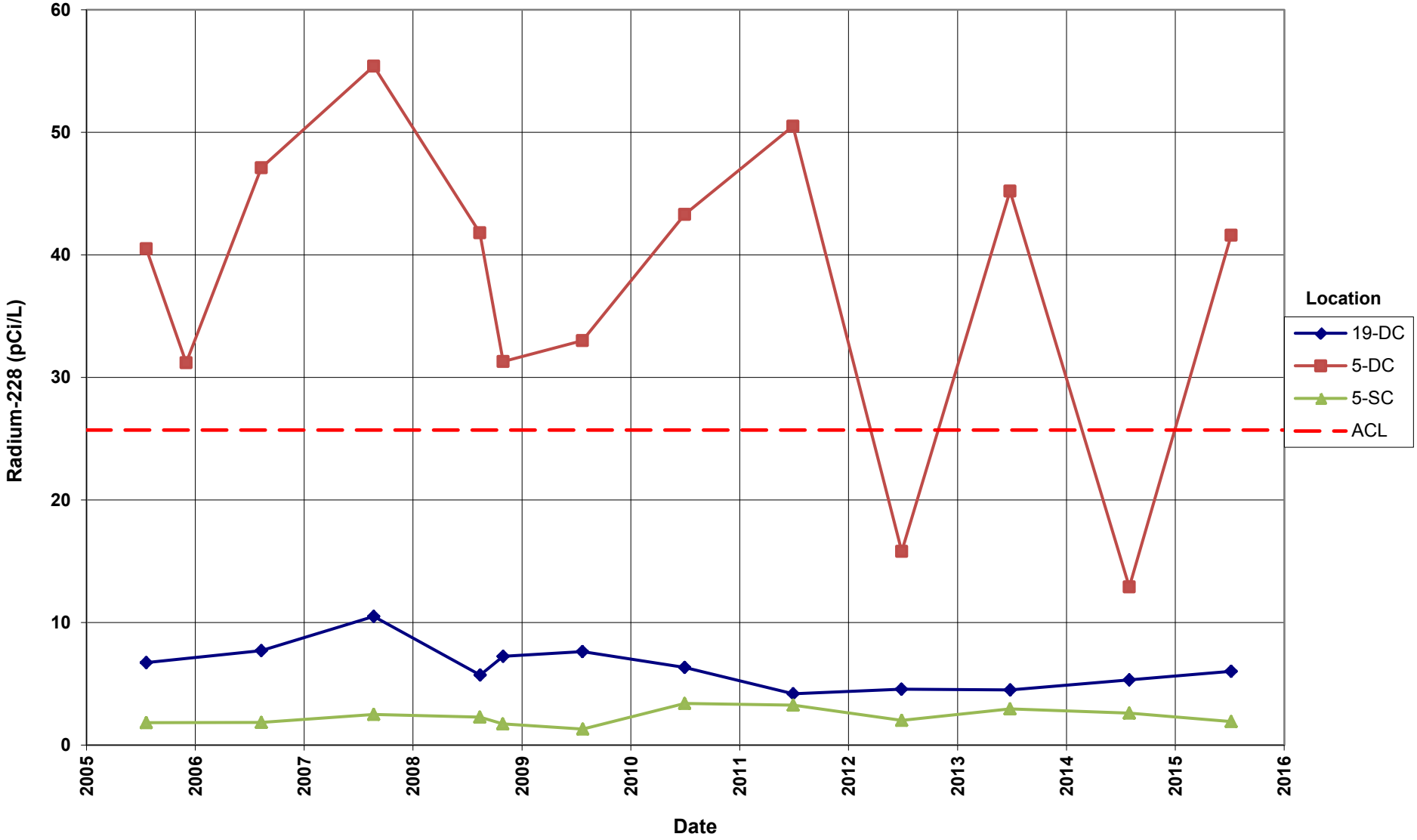
**Shirley Basin South Disposal Site**
**Radium-226 Concentration**
**Point of Compliance Wells**
Alternate Concentration Limit (ACL) = 91.3 pCi/L



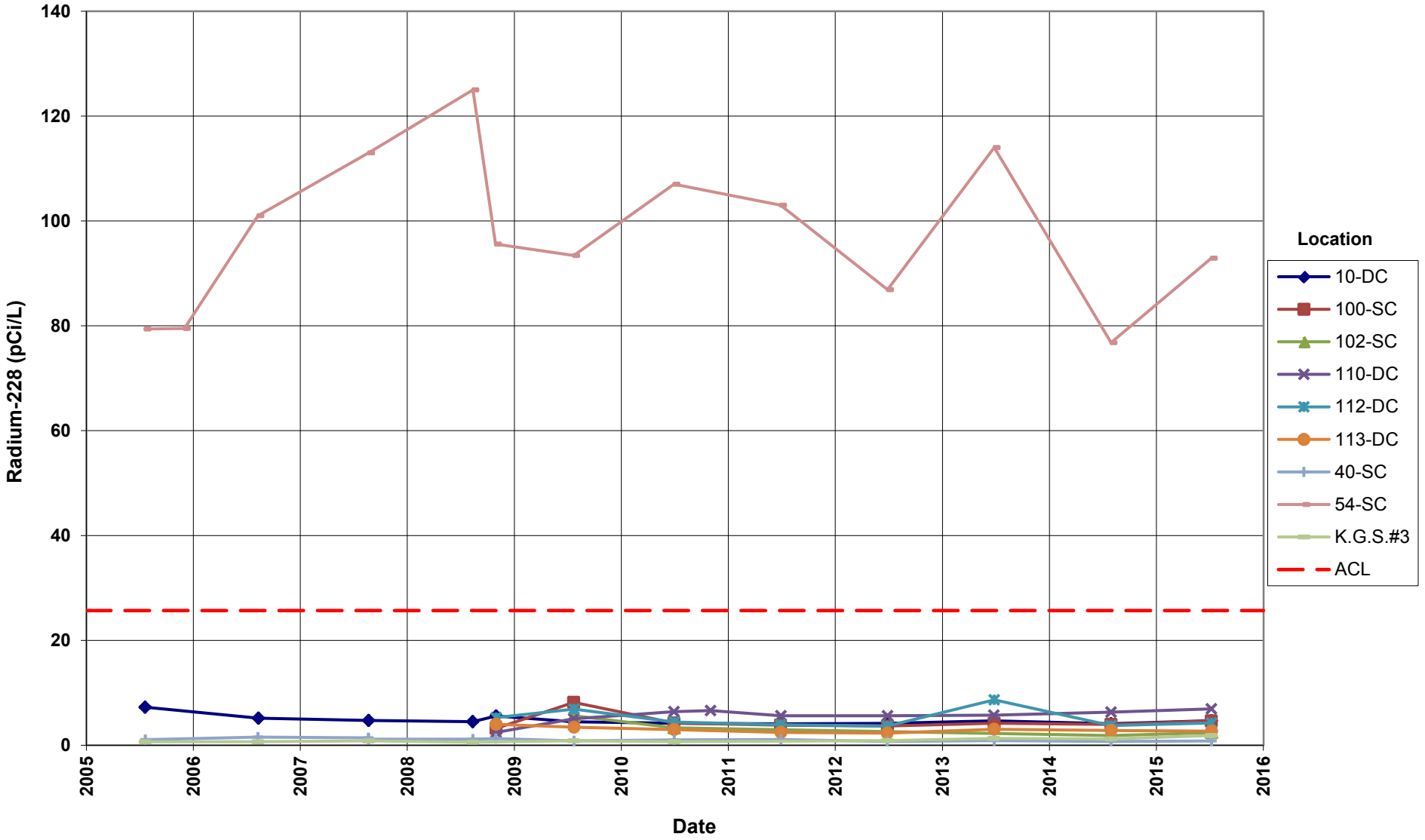
**Shirley Basin South Disposal Site**
**Radium-226 Concentration**
**Monitoring Wells**
Alternate Concentration Limit (ACL) = 91.3 pCi/L



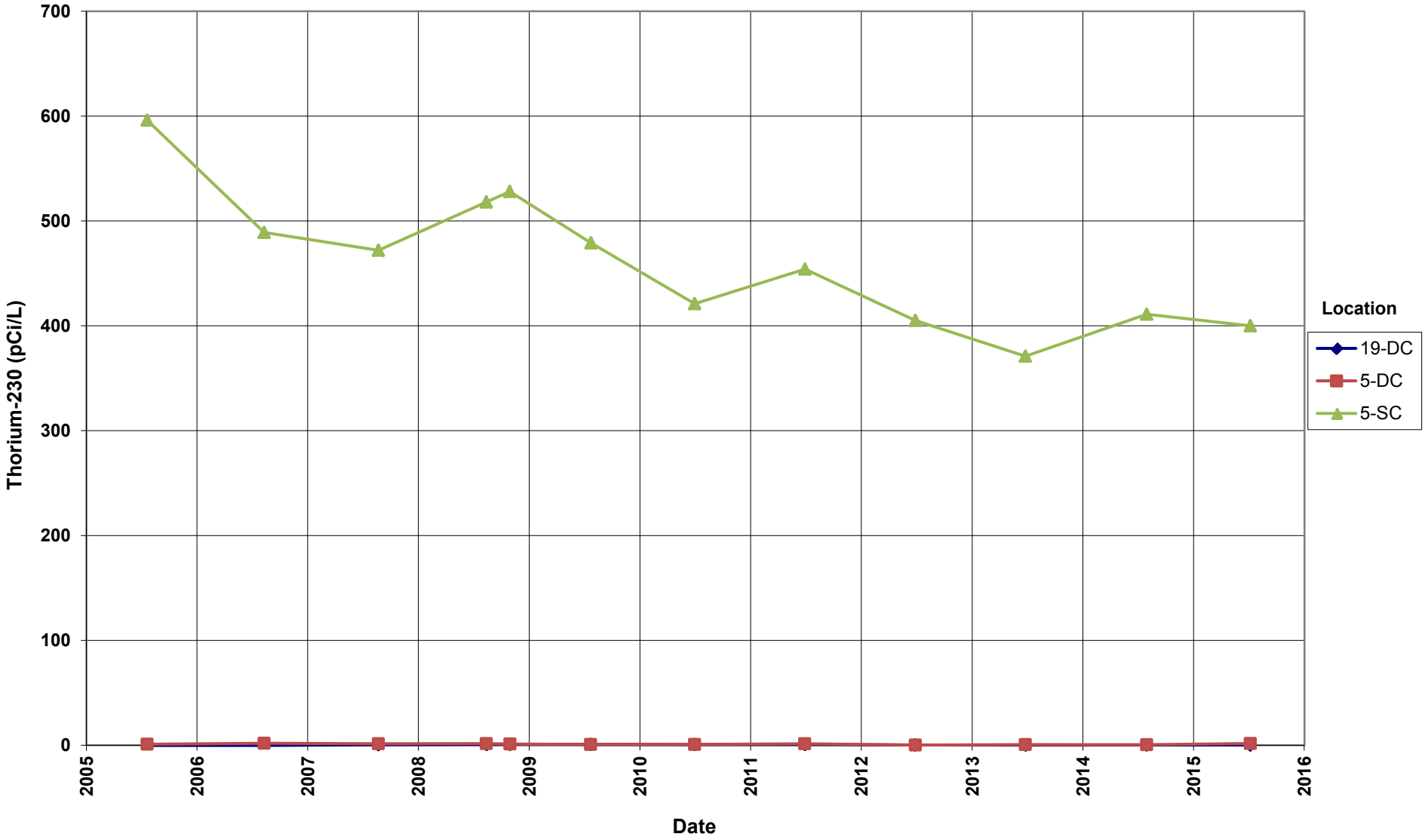
**Shirley Basin South Disposal Site**
**Radium-228 Concentration**
**Point of Compliance Wells**
Alternate Concentration Limit (ACL) = 25.7 pCi/L



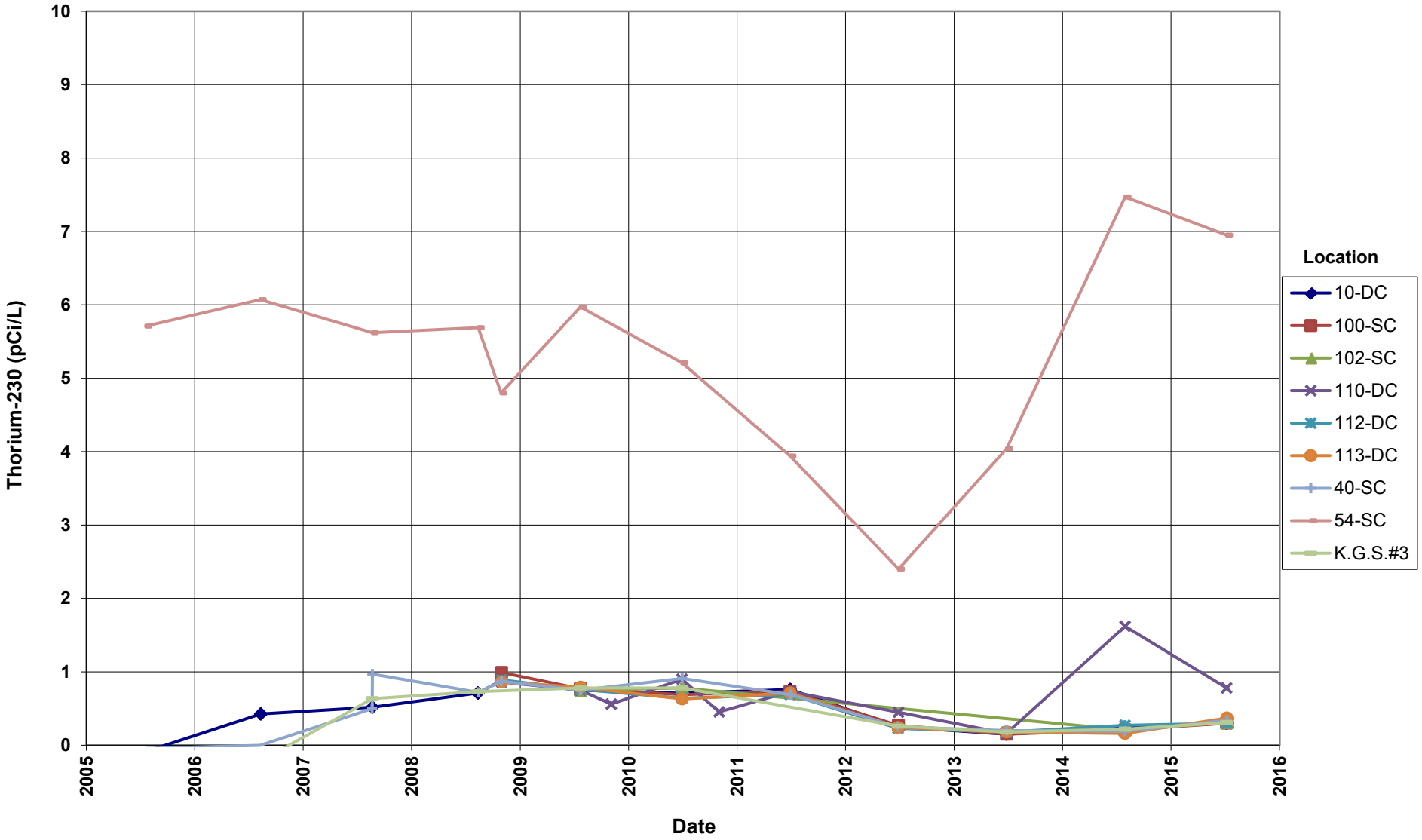
**Shirley Basin South Disposal Site**
**Radium-228 Concentration**
**Monitoring Wells**
Alternate Concentration Limit (ACL) = 25.7 pCi/L



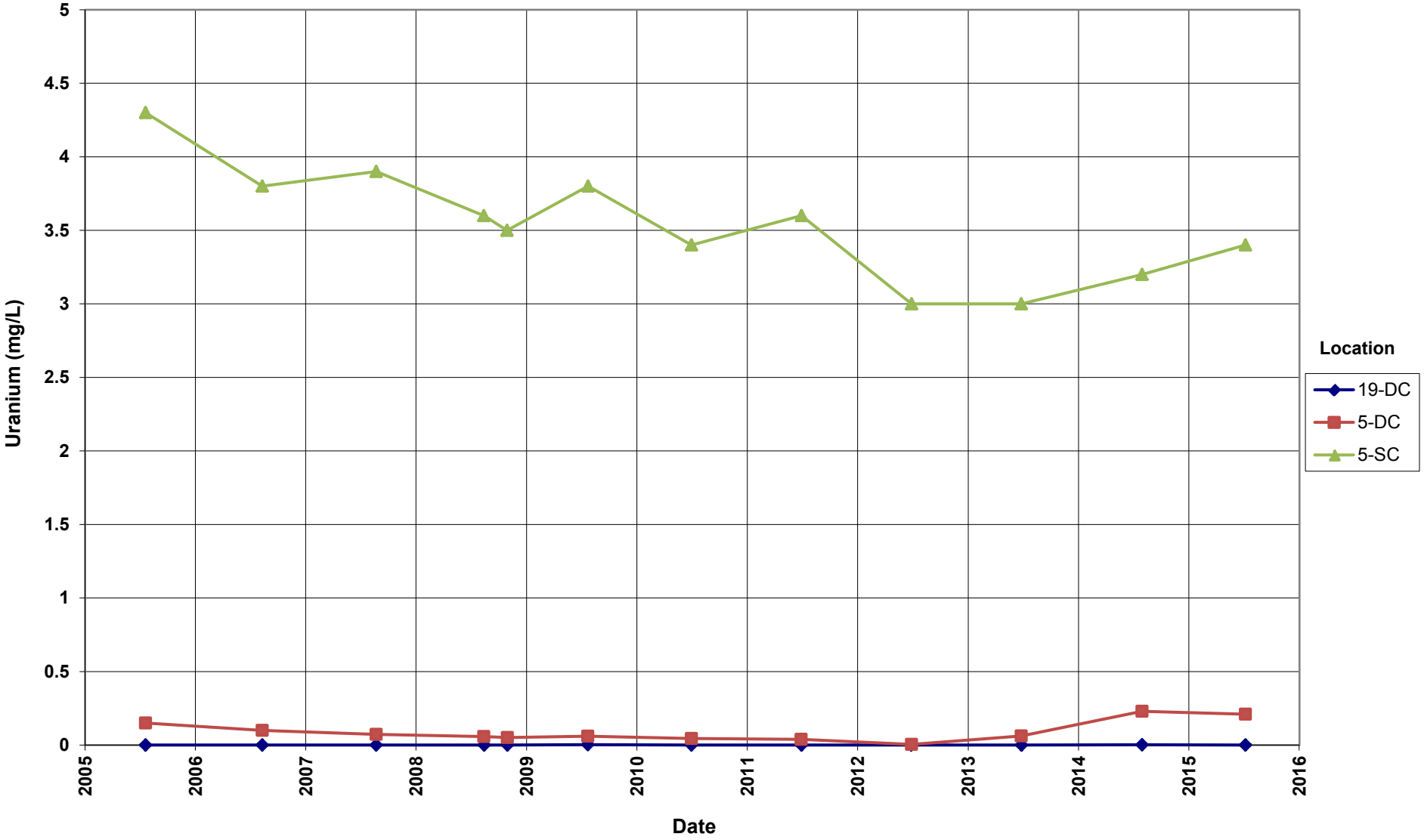
**Shirley Basin South Disposal Site**
**Thorium-230 Concentration**
**Point of Compliance Wells**
Alternate Concentration Limit (ACL) = 2409 pCi/L



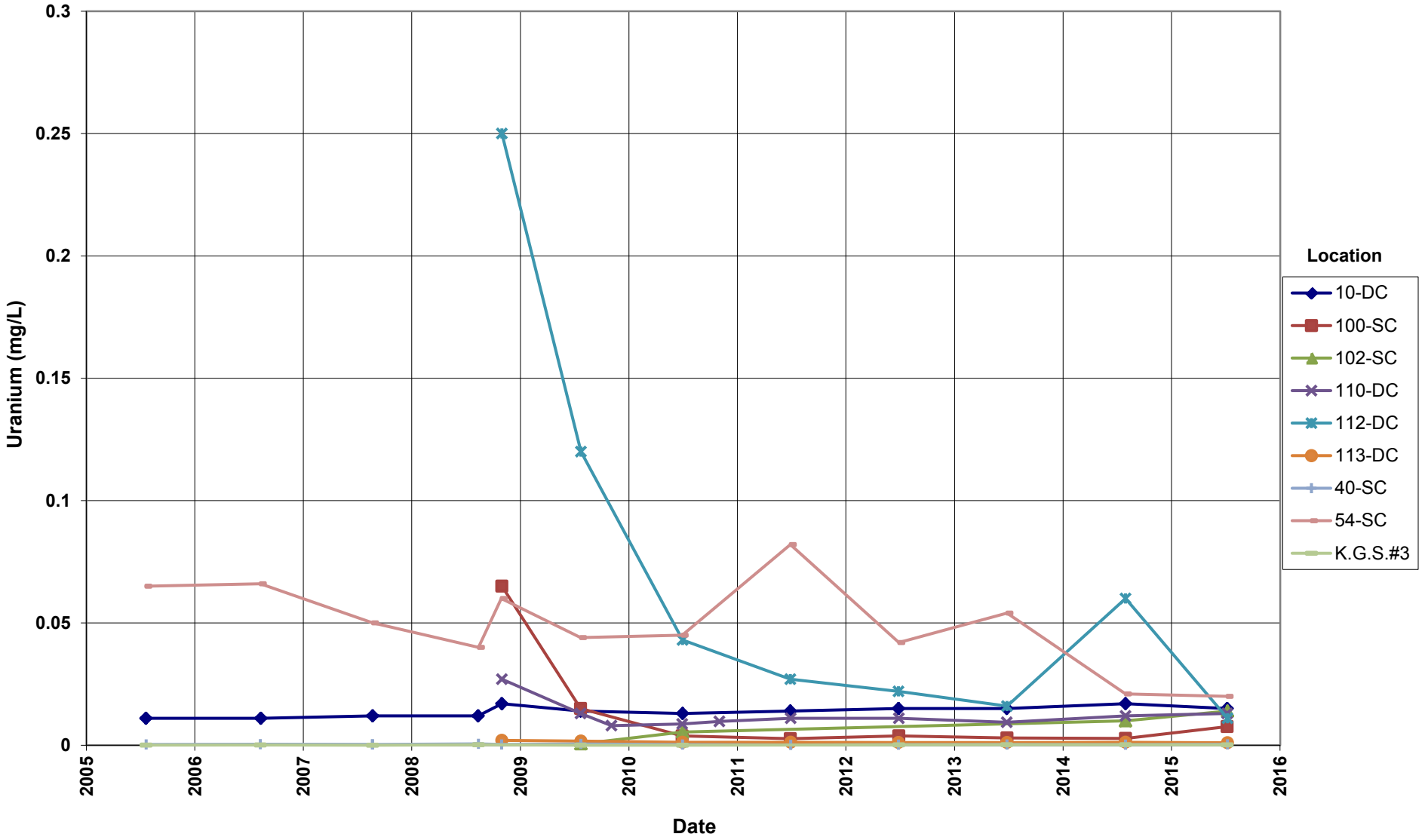
**Shirley Basin South Disposal Site**
**Thorium-230 Concentration**
**Monitoring Wells**
Alternate Concentration Limit (ACL) = 2409 pCi/L



**Shirley Basin South Disposal Site**
**Uranium Concentration**
**Point of Compliance Wells**
Alternate Concentration Limit (ACL) = 9.2 mg/L



**Shirley Basin South Disposal Site**
**Uranium Concentration**
**Monitoring Wells**
Alternate Concentration Limit (ACL) = 9.2 mg/L



# Attachment 3
# Sampling and Analysis Work Order

This page intentionally left blank

oller Newport News Nuclear

June 1, 2015

Task Assignment 103
Control Number 15-0570

U.S. Department of Energy
Office of Legacy Management
ATTN: Scott Surovchak
Site Manager
11025 Dover Street, Suite 1000
Westminster, CO 80021-5573

SUBJECT: Contract No. DE-LM0000415, Stoller Newport News Nuclear, Inc. (SN3), a wholly owned subsidiary of Huntington Ingalls Industries, Inc.
Task Assignment 103 LTS&M - UMTRCA TI & TII, D&D, Others, and AS&T
July 2015 Environmental Sampling at the Shirley Basin South, Wyoming, Disposal Site

REFERENCE: Task Assignment 103, 3-103-1-03-223, Shirley Basin South, Wyoming, Disposal Site

Dear Mr. Surovchak:

The purpose of this letter is to inform you of the upcoming sampling event at Shirley Basin South, Wyoming. Enclosed are the map and tables specifying sample locations and analytes for monitoring at the Shirley Basin South site. Water quality data will be collected from monitoring wells at this site as part of the routine environmental sampling currently scheduled to begin the week of July 6, 2015.

The following list shows the monitoring wells scheduled to be sampled during this event.

**MONITORING WELLS**

| | | | | | | |
|---|---|---|---|---|---|---|
| 40-SC | 51-SC | 10-DC | 5-DC | 19-DC | 5-SC | 54-SC |
| 100-SC | 101-SC | 102-SC | 110-DC | 112-DC | 113-DC | K.G.S.#3 |

*NOTE: SC wells are completed in the upper sand aquifer of the Wind River Formation; DC wells are completed in the main sand aquifer of the Wind River Formation.

All samples will be collected as directed in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*. Access agreements are being reviewed and are expected to be complete by the beginning of fieldwork.

Please contact me at (970) 248-6592 if you have any questions.

Sincerely,

J.E. Price

Jeffrey E. Price
Site Manager

JEP/lcg/bkb

Enclosures (3)

cc: (electronic)
Christina Pennal, DOE
Steve Donivan, SN3
Lauren Goodknight, SN3
Diana Osborne, SN3
Jeffrey Price, SN3
EDD Delivery
rc-grand.junction
File: SBS 400.02

A SUBSIDIARY OF HUNTINGTON INGALLS INDUSTRIES
2597 Legacy Way • Grand Junction, CO 81503-1789 • Telephone (970) 248-6000 • Fax (970) 248-6040

## Sampling Frequencies for Locations at Shirley Basin South, Wyoming

| Location ID | Quarterly | Semiannually | Annually | Biennially | Not Sampled | Notes |
|---|---|---|---|---|---|---|
| ***Monitoring Wells*** | | | | | | |
| 100-SC | | | X | | | |
| 101-SC | | | X | | | |
| 102-SC | | | X | | | |
| 110-DC | | | X | | | |
| 112-DC | | | X | | | |
| 113-DC | | | X | | | |
| 40-SC | | | X | | | |
| 5-SC | | | X | | | |
| 51-SC | | | X | | | |
| 54-SC | | | X | | | |
| 10-DC | | | X | | | |
| 5-DC | | | X | | | |
| 19-DC | | | X | | | |
| K.G.S.#3 | | | X | | | |

Sampling conducted in June

## Constituent Sampling Breakdown

| Site | Shirley Basin South | | | | |
|---|---|---|---|---|---|
| Analyte | Groundwater | Surface Water | Required Detection Limit (mg/L) | Analytical Method | Line Item Code |
| **Approx. No. Samples/yr** | 14 | 0 | | | |
| *Field Measurements* | | | | | |
| Alkalinity | | | | | |
| Dissolved Oxygen | | | | | |
| Redox Potential | X | | | | |
| pH | X | | | | |
| Specific Conductance | X | | | | |
| Turbidity | X | | | | |
| Temperature | X | | | | |
| *Laboratory Measurements* | | | | | |
| Aluminum | | | | | |
| Ammonia as N (NH3-N) | | | | | |
| Cadmium | X | | 0.001 | SW-846 6020 | LMM-02 |
| Calcium | | | | | |
| Chloride | X | | 0.5 | SW-846 9056 | MIS-A-039 |
| Chromium | X | | 0.005 | SW-846 6010 | LMM-01 |
| Gross Alpha | | | | | |
| Gross Beta | | | | | |
| Iron | | | | | |
| Lead | X | | 0.002 | SW-846 6020 | LMM-02 |
| Magnesium | | | | | |
| Manganese | | | | | |
| Molybdenum | | | | | |
| Nickel | X | | 0.02 | SW-846 6010 | LMM-01 |
| Nickel-63 | | | | | |
| Nitrate + Nitrite as N (NO3+NO2)-N | X | | 0.05 | EPA 353.1 | WCH-A-022 |
| Potassium | | | | | |
| Radium-226 | X | | 1 pCi/L | Gas Proportional Counter | GPC-A-018 |
| Radium-228 | X | | 1 pCi/L | Gas Proportional Counter | GPC-A-020 |
| Selenium | X | | 0.0001 | SW-846 6020 | LMM-02 |
| Silica | | | | | |
| Sodium | | | | | |
| Strontium | | | | | |
| Sulfate | X | | 0.5 | SW-846 9056 | MIS-A-044 |
| Sulfide | | | | | |
| Thorium-230 | X | | 1 pCi/L | Alpha Specrtrometry | ASP-A-008 |
| Total Dissolved Solids | X | | 10 | SM2540 C | WCH-A-033 |
| Total Organic Carbon | | | | | |
| Uranium | X | | 0.0001 | SW-846 6020 | LMM-02 |
| Vanadium | | | | | |
| Zinc | | | | | |
| **Total No. of Analytes** | 13 | 0 | | | |

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

# Attachment 4
# Trip Report

This page intentionally left blank

Stoller Newport News Nuclear

# *Memorandum*

DATE: July 28, 2015

TO: Distribution

FROM: Jeff Price

SUBJECT: Water Sampling Trip Report

**Site:** Shirley Basin South, Wyoming, Disposal Site

**Dates of Sampling Event:** July 6 – 9, 2015

**Team Members:** Eric Szabelski, Jeff Price

**Number of Locations Sampled:** Samples were collected from 12 of the 14 locations identified on the sampling notification letter.

**Locations Not Sampled/Reason:** Wells 51-SC and 101-SC were dry (normal).

**Location Specific Information:** Nothing to note.

**Quality Control Sample Cross Reference:** The following is the false identification assigned to the quality control sample:

| False ID | Ticket Number | True ID | Sample Type | Associated Matrix | Associated Samples |
|---|---|---|---|---|---|
| 2658 | NHW 663 | K.G.S. #3 | Duplicate | Groundwater | N/A |

**Requisition Index Number (RIN) Assigned:** Samples were assigned to RIN 15067185. Field data sheets can be found in \\crow\RAApps\SMS\15067185\FieldData.

**Sample Shipment:** Samples were shipped overnight via FedEx from Casper, Wyoming, to ALS Lab on July 8.

**Water Level Measurements:** Water levels were measured in all sampled wells.

**Well Inspection Summary:** No issues were identified.

**Sampling Method**: Samples were collected according to the *Sampling and Analysis Plan (SAP) for the U. S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351, continually updated).

**Field Variance:** None. Samples were collected according to the SAP. Category I wells 5-SC and 10-DC were filtered.

**Equipment:** All equipment functioned properly.

**Stakeholder/Regulatory/DOE:** John Cash of UR Energy was on site July 7 and collected water samples from wells K.G.S. #3, 110-DC, and 100-SC.

**Institutional Controls:**

**Fences, Gates, and Locks:** All gates and locks were in good condition.
**Signs**: No issues were observed.
**Trespassing/Site Disturbances:** None observed.
**Disposal Cell/Drainage Structure Integrity:** No issues were observed.

**Safety Issues:** None.

**Access Issues:** None.

**General Information:** None.

**Immediate Actions Taken:** None.

**Future Actions Required or Suggested:** None.

JP/lcg

cc: (electronic)
Scott Surovchak, DOE
Steve Donivan, SN3
Jeff Price, SN3
EDD Delivery