

## TECHNICAL MEMORANDUM

---

TO: Jim Bet, The Boeing Company

FROM: Sarah Fees and Jennifer Wynkoop

DATE: September 25, 2014

RE: **ALGONA NEIGHBORHOOD YARD SAMPLING INVESTIGATION  
BOEING AUBURN FACILITY  
AUBURN, WASHINGTON**

### INTRODUCTION

This technical memorandum presents and evaluates surface water data collected from yards in the northern residential area of Algona, Washington as part of the remedial investigation (RI) for The Boeing Company (Boeing) Auburn Fabrication Division property (facility) located in Auburn, Washington. The RI is part of the corrective action requirements documented in an Agreed Order (Order; No. DE 01HWTRNR-3345) dated August 14, 2002 and the First Amended Agreed Order dated February 21, 2006 both between Washington State Department of Ecology (Ecology) and Boeing. The Order includes a requirement to conduct an RI under Ecology's oversight. The location of the Boeing Auburn property and the northern Algona residential area are shown on Figure 1.

This yard sampling investigation was conducted to address concerns of residents in Algona, as part of the RI, in accordance with the *City of Algona Yard and Ditch Surface Water Sampling Work Plan*, (work plan; Landau Associates 2013a). The ditch and yard water sampling investigation objectives identified in the work plan are as follows:

1. To evaluate whether constituents of concern from the Boeing groundwater plumes are discharging to shallow surface water features within Algona
2. To assist with interpretation of shallow groundwater data collected in Algona as part of the direct-push shallow groundwater investigation (Landau Associates 2013b)
3. To assist with scoping a surface water sampling program to evaluate risks to human health and ecological receptors<sup>1</sup>.

The work plan was implemented in two phases. The first phase consisted of ditch sampling in the northern Algona residential area and the second phase consisted of yard water sampling in a specific portion of the northern Algona residential area (yard sampling investigation area) that coincides with shallow groundwater contamination and the vapor intrusion study area (Landau Associates 2013b). The yard sampling investigation area is shown on Figure 2. This technical memorandum describes the second phase (yard water sampling) of the investigation. The scope of the yard sampling investigation consisted

---

<sup>1</sup> Potential surface water receptors and exposure pathways were identified by Ecology in comments on the first draft of the yard and ditch sampling work plan (Ecology 2013).

of surveying property owners in the investigation area; compiling a list of sampling locations and completing access agreements; and collecting grab samples from ponded yard water where access was granted.

## **BACKGROUND**

Boeing has been implementing RI activities to characterize the nature and extent of two groundwater plumes (western plume and Area 1 plume) that originate on the Boeing facility and extend off Boeing property to the north and northwest. The primary plume-related constituents found in offsite groundwater are the volatile organic compounds (VOCs) trichloroethene (TCE) and its breakdown products: cis-1,2-dichloroethene (cis-1,2-DCE); trans-1,2-dichloroethene; and vinyl chloride (VC).

In January 2013, groundwater investigation results showed that TCE-impacted shallow groundwater was present in the northeast portion of the Algona residential area. A direct-push investigation was conducted in April 2013 to more fully characterize the extent of groundwater contamination in the area (Landau Associates 2013b).

Groundwater and surface water interaction northwest of the Boeing facility is complex. In the northern Algona residential area, ground surface elevations are generally lower than in surrounding commercial areas and as a result, ground water is located within a few feet of the ground surface. Consequently, many of the surface water features, such as ditches, appear to intersect groundwater and may represent groundwater discharge locations. Groundwater discharge also has an influence on groundwater flow direction and contributes to the westerly component of shallow groundwater flow in the northern Algona residential area.

It is possible that ponded yard water in some portions of the northern Algona residential area may reflect groundwater discharge when groundwater levels are high. This could result in detectable levels of constituents of concern in ponded yard water in areas near the defined plumes.

Phase I of the work plan (roadside ditch sampling) was presented in a separate technical memorandum. The ditch sampling field investigation took place on November 25 and 26, 2013. Detections of TCE, cis-1,2-DCE, and VC in ditches appeared to be correlated with shallow groundwater detections and were mainly in the northeast portion of residential Algona. The ditch sampling technical memorandum was submitted to Ecology on June 19, 2014 (Landau Associates 2014).

## **SCREENING LEVELS**

Boeing submitted a technical memorandum, *Screening Levels for Yard and Ditch Surface Water* (Landau Associates 2013c), which provides site-specific health based screening levels for exposure to surface water. The technical memorandum evaluated TCE and VC screening levels for two exposure scenarios: 1) reasonable maximum exposure for children in a residential setting and 2) reasonable

maximum exposure for workers who clean the ditches. Ecology approved screening levels for TCE and VC (Ecology 2013) based on the most protective screening level for each compound in each scenario. Yard water screening levels are based on the exposure of children who might play in ponded water in yards. The northern Algona yard water screening levels for TCE and VC are shown in the table below.

Compound	Screening Level (µg/L)
TCE	77
VC	15

µg/L = micrograms per liter

The child exposure scenario used for calculating the screening levels assumes that a child plays in surface water from 1 to 16 years of age, with a variable exposure duration and frequency for two age brackets: 1) children aged 1 to less than 6 and 2) children aged 6 to less than 16 years old. For the younger age group, exposure is evaluated for an average of 30 minutes per day, 156 days per year. For the older age group, exposure is evaluated for an average of 30 minutes per day, 104 days per year.

Exposure pathways are assumed to include dermal exposure, incidental water ingestion, and inhalation of vapors. The exposed skin surface area used in evaluating dermal exposure for both age groups includes hands, feet, and lower legs, using the assumption that lower legs are approximately 40 percent of the surface area of the entire leg. The TCE and VC screening levels provided above are the most conservative based on an acceptable risk level of one in one million ( $1 \times 10^{-6}$ ) for carcinogenic effects.

## YARD WATER SURVEYS

Yard water surveys were sent to all of the residents and property owners identified in the yard sampling investigation area; there were 32 parcels identified. Some of the parcels were owned by the same property owner and as a result, a total of 27 property owners were identified. Parcels owned by the same person were grouped and identified with a single residence code number. The residence code number is made up of a prefix (RES) followed by three digits (e.g. RES025) to help protect the privacy of residents. These residence codes were assigned to correlate with residence codes created for vapor intrusion. The investigation area is shown on Figure 2.

Boeing mailed cover letters and surveys to the owners and residents of all properties within the yard sampling investigation area on November 27, 2013 and sent a follow-up letter with a final request to complete the survey on December 12, 2013. Eleven property owners or residents responded to the yard water surveys. Two residents responded that there was no water in their yard; therefore, yard water sampling was not requested. Nine property owners requested yard water sampling. Eight of the nine

property owners who requested yard water sampling signed access agreements allowing Boeing to collect samples from their yards.

## **SUMMARY OF FIELD INVESTIGATION ACTIVITIES**

Sampling was scheduled with property owners in accordance with the work plan (Landau Associates 2013a). Sampling was conducted during a dry period, with no trace of precipitation occurring in the previous 48 hours (King County website 2014). Sampling was targeted for at least 48 hours after precipitation to minimize the influence of stormwater on ponded water during sample collection.

Two of the initial respondents (one respondent who had signed an access agreement and the respondent who did not sign the access agreement) decided that they did not wish to participate in yard water sampling, and so samples were not collected from these properties. Two properties did not have enough water in the yard for sample collection when sampling was attempted. Yard water samples were collected at the remaining five properties. Properties where yard water samples were collected are shown on Figure 2.

### **Yard Water Samples**

A total of 12 yard water samples and 2 duplicate samples were collected from 5 properties (RES010, RES011, RES025, RES026, and RES027). The number of samples collected at each property depended on the total area of the property that contained water. For example, at some properties (i.e., RES027) only one small area of ponded yard water was present and at other properties (i.e., RES010) ponded yard water was present at multiple locations. Samples were collected from four of the properties (RES010, RES011, RES025, and RES026) on January 16, 2014. Samples were collected from the remaining property (RES027) on March 13, 2014. The other two properties (RES019 and RES022) were visited a number of times to attempt yard water sampling, and during each visit, not enough water was present to sample. RES019 was visited on January 16, February 27, and March 13 and RES022 was visited on February 27 and March 13.

Yard water samples were collected using a composite liquid waste sampler (COLIWASA) when the water column depth was greater than 4 inches. When the water column depth was less than 4 inches, a stainless steel ladle was used to collect the water sample. COLIWASA samplers were dedicated and disposed of after one use. Ladles were decontaminated by a manual wash with Alconox<sup>®</sup> solution followed by a de-ionized water rinse.

Samples were collected no more than 2 inches above the bottom of the ponded yard water and at least 2 inches below the water surface. If less than 4 inches of water was present, the sample was collected from the approximate mid-point of the water column. The approximate water column depth was measured with a measuring tape and was recorded on the sample collection form. Field parameters (pH,

conductivity, dissolved oxygen, temperature, and oxidation-reduction potential) were measured at the time of sampling by submerging a multi-parameter probe (YSI 556 MPS) directly into the yard water. The multi-parameter probe was decontaminated between sampling locations.

Samples were collected in laboratory-provided 40-milliliter volatile organic analysis (VOA) glass vials preserved with hydrochloric acid. Five VOA containers of water were collected at each sample location. Samples were preserved in a cooler on ice and submitted under chain-of-custody protocols to Eurofins Lancaster Laboratories, Inc. of Lancaster, Pennsylvania. Samples were analyzed for TCE, cis-1,2-DCE, trans-1,2-DCE, and VC by Environmental Protection Agency Method 8260. Selected ion monitoring analysis was performed for TCE and VC for the lowest achievable reporting limits, as requested by Ecology (Ecology 2013). Trip blanks, blind duplicates and matrix spike/matrix spike duplicate samples were analyzed for quality assurance.

In order to report the results as soon as possible to the participants, yard water samples were analyzed on a 3-day turnaround time rather than the standard 2-week turnaround time. Once results were received, data quality assurance and validation were performed to evaluate laboratory accuracy and precision. A table of results was provided to Ecology within 7 days of sample collection. In accordance with the work plan (Landau Associates 2013a), data letters were prepared for each property owner summarizing results of sampling at that property. Data letters summarized the sample locations, data results, and human health risk assessment.

## **ANALYTICAL RESULTS**

No target constituents were detected in any samples collected at four of the properties. TCE; cis-1,2-DCE; and VC were detected in the sample and duplicate sample collected at one of the five properties sampled. The TCE; cis-1,2-DCE; and VC concentrations detected do not exceed health based screening levels approved by Ecology. Yard water sampling results are presented in Table 1.

## **DISCUSSION**

At all but one of the locations sampled, there were no detections of constituents of concern. Since constituents of concern were not detected in those yards during the time of the year when groundwater levels are high (i.e., winter and early spring), it is likely that ponded yard water is not affected by groundwater discharge at the majority of properties sampled. Ponded water in the yards sampled is likely to be rainwater that remains ponded on the surface for more than 48-hours. Shallow groundwater and fine-grained soil conditions limit infiltration of rainwater and contribute to ponded water in the northern Algona residential area.

In the location where constituents of concern were detected, the ground surface elevation appeared to be lower than in surrounding areas and therefore, more likely for shallow groundwater to

reach the ground surface and form ponded water. The yard where constituents of concern were detected is also near a location where these constituents were detected in the Chicago Avenue ditch and in shallow groundwater samples. This suggests that groundwater containing constituents of concern may be discharging to areas where the ground surface is lower than the groundwater elevation. Detected TCE, cis-1,2-DCE, and VC concentrations are low and are well below health based screening levels approved by Ecology.

## **CONCLUSIONS AND RECOMMENDATIONS**

TCE, cis-1,2-DCE, and VC were detected at low concentrations at one of the twelve sample locations in the investigation area. The TCE and VC concentrations are below site-specific, health-based yard water screening levels. Site-specific screening levels have not been developed for cis-1,2-DCE in yard water; however, the concentration detected is below the Model Toxics Control Act Method B cleanup level state standard set to be protective of human health for groundwater used as a drinking water source.

Currently, no further yard water sampling in the northern Algona residential area is recommended. However, Boeing is continuing quarterly sampling at the Chicago Avenue ditch along the western boundary of the northern Algona residential area. Boeing also plans to continue sampling existing monitoring wells, including additional monitoring wells recently installed in the northern Algona residential area. The need for additional yard water sampling in the northern Algona residential area will be re-assessed if groundwater or surface water concentrations of constituents of concern in the investigation area increase or if the groundwater plume expands significantly.

SEF/JWW/jrc

## **REFERENCES**

Ecology 2013. Letter: *Ecology review and approval of site-specific surface water screening levels for evaluation of the Yard and Ditch SW sampling in residential north Algona; FSID # 2018, CSID # 5049, and WAD041337130*. From Robin Harrover, Washington State Department of Ecology to James Bet, The Boeing Company. November 22.

Landau Associates 2014. Technical Memorandum: *Algona Neighborhood Ditch Sampling Investigation, Boeing Auburn Facility, Auburn, Washington*. Prepared for The Boeing Company. June 19.

Landau Associates 2013a. Work plan: *City of Algona Yard and Ditch Surface Water Sampling Work Plan, Boeing Auburn Facility, Auburn, Washington*. Prepared for The Boeing Company. June 6.

Landau Associates 2013b. Technical Memorandum: *Algona Neighborhood Direct-Push Boring Investigation, Boeing Auburn Facility, Auburn, Washington*. Prepared for The Boeing Company. May 28.

Landau Associates 2013c. Technical Memorandum: *Screening Levels for Yard and Ditch Surface Water, Boeing Auburn Plant, Auburn Washington*. Prepared for The Boeing Company. October 21.

King County website. 2014. *Lakeland Hills–Orvitz Pump Station I&I Rain Gauge*. <http://green.kingcounty.gov/WLR/Waterres/hydrology/GaugeMap.aspx>. Accessed March 15.

## **ATTACHMENTS**

Figure 1: Vicinity Map

Figure 2: Yard Water Sampling Area and Sampled Properties

Table 1: Yard Water Analytical Results

G:\Projects\025164\1101\Yard & Ditch Sampling\Figure\_1\_VicinityMap.mxd 7/1/2014 NAD 1983 StatePlane Washington North FIPS 4601 Feet



Data Source: Esri 2012

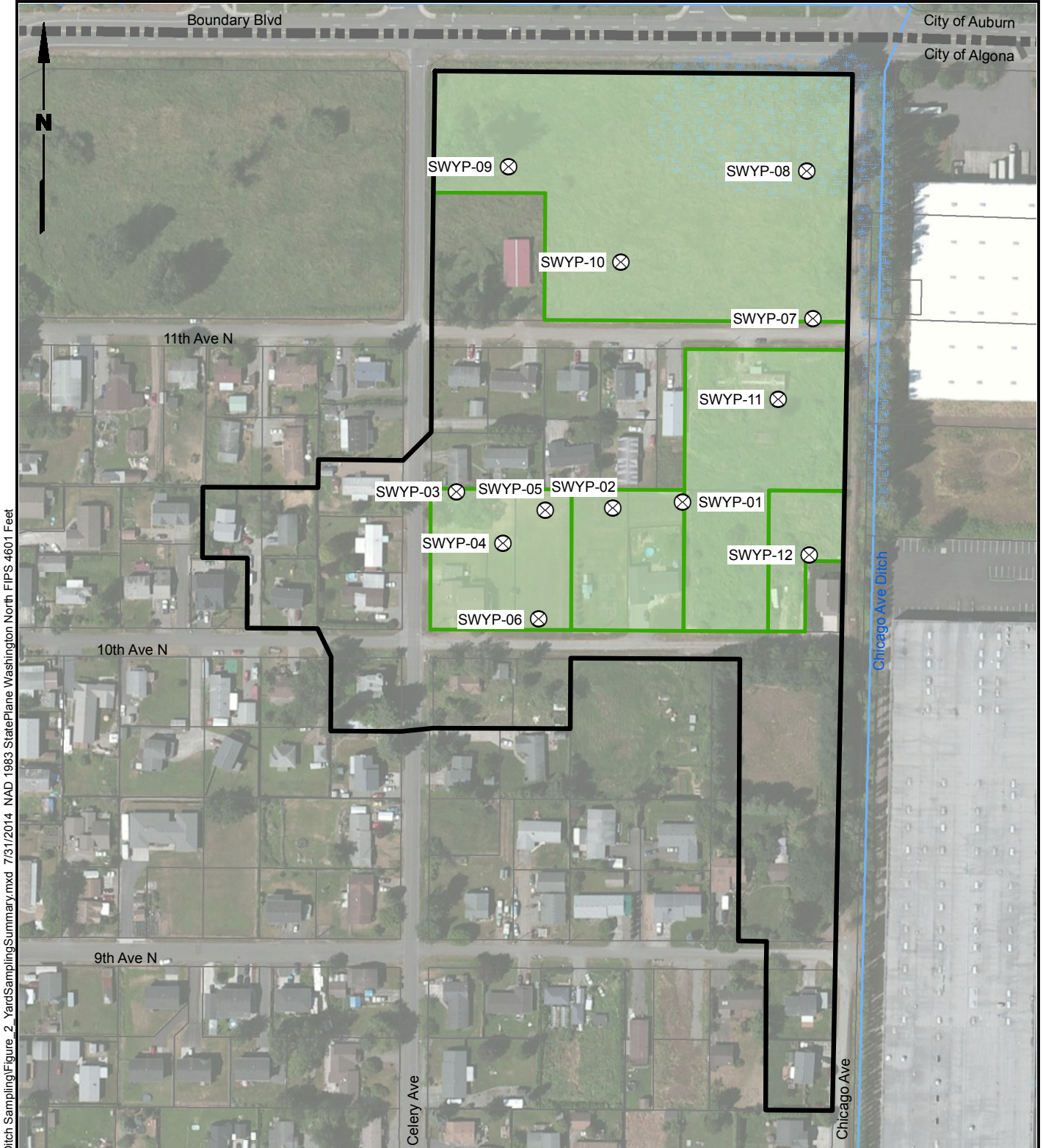


Boeing Auburn  
Auburn, Washington

Vicinity Map

Figure  
1





G:\Projects\025164\1101\01\Yard & Ditch Sampling\Figure\_2\_YardSamplingSummary.mxd 7/31/2014 NAD 1983 StatePlane Washington North FIPS 4601 Feet

**Legend**

- ⊗ Surface Water Sample Location
- ▭ Yard Water Sampling Completed
- ▭ Yard Water Sampling Area



Data Source: King County GIS 2013



Boeing Fabrication Auburn  
Auburn, Washington

**Yard Water Sampling Area and  
Sampled Properties**

Figure  
**2**

**TABLE 1  
YARD WATER ANALYTICAL RESULTS  
ALGONA YARD SAMPLING  
BOEING AUBURN**

Residence Code Number	RES010	RES010	RES010	RES010	RES011	RES011	RES025	RES025
Field Sample ID	SWYP-03	SWYP-04	SWYP-05	SWYP-06	SWYP-01	SWYP-02	SWYP-07	Dup of SWYP-07 SWYP-900
Laboratory Data Package ID	1446676	1446676	1446676	1446676	1446675	1446675	1446677	1446677
Laboratory Sample ID	7339443	7339444	7339445	7339446	7339440	7339441	7339450	7339451
Sample Date	1/16/2014	1/16/2014	1/16/2014	1/16/2014	1/16/2014	1/16/2014	1/16/2014	1/16/2014

**VOLATILES (µg/L)**

**Method SW8260C**

cis-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

**VOLATILES (µg/L)**

**Method SW8260C-SIM**

Trichloroethene	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Vinyl Chloride	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U

**TABLE 1  
YARD WATER ANALYTICAL RESULTS  
ALGONA YARD SAMPLING  
BOEING AUBURN**

Residence Code Number	RES025	RES025	RES025	RES026	RES027	RES027
Field Sample ID	SWYP-08	SWYP-09	SWYP-10	SWYP-11	SWYP-12	Dup of SWYP-12 SWYP-900
Laboratory Data Package ID	1446677	1446677	1446677	1446678	1459446	1459446
Laboratory Sample ID	7339449	7339448	7339447	7339452	7393811	7393812
Sample Date	1/16/2014	1/16/2014	1/16/2014	1/16/2014	03/13/2014	03/13/2014

**VOLATILES (µg/L)****Method SW8260C**

cis-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U	1.0 U	<b>1.0</b>	<b>1.0</b>
trans-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U
Trichloroethene	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U
Vinyl Chloride	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U

**VOLATILES (µg/L)****Method SW8260C-SIM**

Trichloroethene	0.10 U	0.10 U	0.10 U	0.10 U	<b>0.055</b>	<b>0.049</b>
Vinyl Chloride	0.10 U	0.10 U	0.10 U	0.10 U	<b>0.039</b>	<b>0.038</b>

U = Indicates the compound was not detected at the reported concentration.

Bold = Detected compound.