TECHNICAL MEMORANDUM

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TO: James Bet, The Boeing Company

FROM: Sarah Fees and Jennifer Wynkoop

DATE: November 25, 2014

RE: CHICAGO AVENUE DITCH OVER-WATER AIR INVESTIGATION
AUGUST 2014
BOEING AUBURN FACILITY
AUBURN, WASHINGTON

INTRODUCTION

This technical memorandum presents and evaluates air quality and surface water data collected during the August 2014 over-water air investigation at the Chicago Avenue ditch located in the residential area in the northern part of Algona, Washington. This work was conducted as part of the remedial investigation (RI) for The Boeing Company's (Boeing's) Auburn Fabrication Division property (facility) located in Auburn, Washington. The RI is part of the corrective action requirements that are 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 with Washington State Department of Ecology (Ecology). The Order includes a requirement to conduct an RI under Ecology's oversight. The Boeing Auburn property is shown on Figure 1.

The August 2014 over-water air investigation was conducted to address data gaps as part of the RI in accordance with the *Over-water Air Quality Sampling, Chicago Avenue Ditch, Auburn Fabrication Division Facility, Auburn, Washington* (Work Plan; Landau Associates 2014a). Ecology provided approval to initiate field activities on July 30, 2014 (Ecology 2014a) and provided approval for the Work Plan on August 14, 2014 (Ecology 2014b). Data from this investigation are used to evaluate whether water quality in the Chicago Avenue ditch is affecting over-water air quality at the ditch.

BACKGROUND AND SITE CONDITIONS

Boeing has been implementing RI activities to characterize the nature and extent of two groundwater plumes (the western plume and the Area 1 plume) that originate on the Boeing facility and extend off Boeing property to the northwest and north. The western plume extends northwest from under the Boeing facility to the northeast portion of Algona. The primary constituents of concern are the volatile organic compounds (VOCs) trichloroethene (TCE) and vinyl chloride (VC). VC and cis-1,2-dichloroethene (cis-1,2-DCE) are breakdown products of TCE. However, cis-1,2-DCE is not included as

a constituent of concern in this investigation because of its lower toxicity and because there are presently no Model Toxics Control Act air cleanup levels specified for this constituent.

The northern portion of the Chicago Avenue ditch overlies the western edge of the western plume. Based on the VOCs detected in surface water, it appears that shallow groundwater is discharging to the Chicago Avenue ditch in this area. Initial surface water sampling at the Chicago Avenue ditch was conducted in June 2012 and additional sampling was conducted in September 2012 and July 2013. These results were described in the *Surface Water Investigation Technical Memorandum* (Landau Associates 2012a), the third quarter 2012 status report (Landau Associates 2012b), and *July 2013 Surface Water Investigation Technical Memorandum* (Landau Associates 2014b), respectively. Quarterly surface water sampling in the Chicago Avenue ditch was initiated in December 2013 and was completed in September 2014. The quarterly sampling data has been presented in the corresponding quarters' status reports and the data will be evaluated in the 2014 surface water report. Sampling location SW-CD4 (also identified as SW-4) historically had the highest concentration of TCE in surface water [1.7 micrograms per liter (µg/L) in June 2012] and was selected as the location for the August 2014 over-air investigation location for that reason. This sampling location is presented on Figure 2.

In March 2013, the Washington State Department of Health (WDOH) issued a health consultation for surface water in the Chicago Avenue ditch and concluded that the VOC concentrations detected are not high enough to pose a health risk to workers who routinely perform maintenance on the ditch or to children who may occasionally play in the ditch (WDOH 2013). WDOH also did preliminary calculations to determine if TCE and VC in ditch surface water could potentially volatilize into the air at concentrations that could pose a health risk to individuals who may work or play in the ditch. WDOH concluded that VOC concentrations in ditch surface water were too low to present an inhalation health risk, but recommended that over-water air sampling be completed to confirm their conclusion. In the March 2013 health consultation, WDOH also recommended ambient air sampling in the Algona residential neighborhood to verify that contaminated surface water was not affecting ambient air quality.

Boeing recently completed a vapor intrusion sampling program in the northern Algona residential neighborhood. Ambient air samples were collected as part of the vapor intrusion investigation. With the exception of one sample, TCE was not detected in ambient air; the one detection was attributed to an unidentified source elsewhere in the neighborhood, based on prevailing wind direction. VOC concentrations in the ditch do not appear to affect ambient air in the neighborhood.

The purpose of this investigation was to evaluate the air quality directly above the ditch (over-water air). Surface water samples were collected to determine whether TCE and VC were present in ditch surface water at the time of sampling and to evaluate whether detected air concentrations could be a result of volatilization from the ditch.

SUMMARY OF FIELD INVESTIGATION ACTIVITIES

The approved Work Plan scope consisted of the collection of over-water air, ambient air, and surface water samples at one location, on 3 separate days. Conditions required by the Work Plan included no measurable rainfall for 5 days prior to sampling, predicted temperatures over 80 degrees Fahrenheit (80º F) during sampling, and predicted wind speeds of 10 miles per hour (mph) or less in the vicinity and calm winds observed at the time of sampling. These favorable conditions were met August 11, 26, and 27, 2014 (Weather Underground website 2014) and sampling was completed on those dates. The sampling location is presented on Figure 2.

Over-water air samples were collected from a height of 1.5 feet (ft) above the surface water level in the ditch. Simultaneously, an ambient air sample was collected upwind of the of the over-water sample, approximately 5 ft above ground surface. The canisters were calibrated to collect a composite air sample over approximately 1 hour. Air samples were collected in laboratory-certified evacuated 6-liter Summa canisters with a flow controller set to collect air at a rate of 83 milliliters per minute which allowed for approximately a 1-hour sample. Samples were shipped under appropriate chain-of-custody procedures to Eurofins Air Toxics, Inc. in Folsom, California. Samples were analyzed for total concentrations of TCE and VC by U.S. Environmental Protection Agency (EPA) Method TO-15 selected ion monitoring (SIM).

During the collection of air samples, a surface water sample was collected from the ditch using a sampling pole and peristaltic pump. The depth of surface water located in the ditch was less than 4 inches at each sampling event; therefore, the samples were collected from the approximate midpoint of the water column. Field parameters (pH, conductivity, dissolved oxygen, temperature, and oxidation-reduction potential) were measured with a multi-parameter probe (YSI 556 MPS) via a peristaltic pump and flow-through cell. Surface water samples were collected in laboratory-provided 40-milliliter volatile organic analysis (VOA) glass vials and preserved with hydrochloric acid. Five VOA vials were collected at the sample location for each sample event. Samples were preserved in coolers on ice and submitted under chain-of-custody protocols to Eurofins Lancaster Laboratories, Inc. in Lancaster, Pennsylvania for delivery within 48 hours of collection. Samples were analyzed for VOCs by EPA Methods 8260C and 8260C SIM for VC. Trip blanks and blind duplicate samples were analyzed for quality assurance.

ANALYTICAL RESULTS

TCE and VC were detected at low concentrations in surface water samples during all three sampling events. However, TCE and VC were not detected in any of the air samples (over-water air or ambient air) during all three sampling events. TCE concentrations in surface water ranged from 1.2 µg/L

to 1.7 µg/L and VC concentrations ranged from 0.087 µg/L to 0.13 µg/L. These concentrations are consistent with previous surface water sample results at this location.

Cis-1,2-DCE was also detected in the surface water samples collected during all three sampling events. However, cis-1,2-DCE is not a constituent of concern in air because of its lower toxicity, so it is not discussed as part of this analysis. Acetone and chloroform were detected in the surface water sample collected during the final sampling event on August 27, 2014. Acetone and chloroform are likely due to runoff and are not associated with the VOC plume; therefore, acetone and chloroform are not discussed as part of this analysis. Air sampling results are presented in Table 1 and surface water sampling results are presented in Table 2. Surface water and air sampling results for TCE and VC are also presented on Figure 2. Laboratory data packages are provided in Attachment 1.

CONCLUSIONS AND RECOMMENDATIONS

Conditions for the volatilization of VOCs from surface water in the ditch into air were ideal during the August 11, 26, and 27, 2014 sampling events; there had been no measurable rain in the past 5 days, temperatures exceeded 80º F, and wind speeds were below 10 mph.

TCE and VC have historically been detected in the northern portion of the Chicago Avenue ditch and are most likely associated with VOC-impacted groundwater that discharges to the ditch. Concentrations of TCE and VC detected in the ditch surface water were consistent with previous sampling results from this location. Although TCE and VC were present in surface water in the ditch and conditions were ideal for volatilization of TCE and VC into the air, TCE and VC were not detected in any of the air samples. Over-water air, ambient air, and surface water sampling results from August 2014 support the WDOH's original conclusion that concentrations of TCE and VC in surface water bodies such as the Chicago Avenue ditch are too low in to cause an inhalation health risk to those who work or play in or around the ditch (WDOH 2013).

Results of this study indicate that TCE and VC in surface water in the ditch do not result in the presence of TCE or VC in air directly above the ditch or in ambient air. No additional over-water air testing is warranted at this time.

SMM/SEF/KJH/jrc

REFERENCES

Ecology. 2014a. Email message from Neal Hines, Washington State Department of Ecology, to Jennifer Wynkoop, Landau Associates. Re: *Chicago Ave. ditch air space sampling*. July 30.

Ecology. 2014b. Letter: *Ecology Comment and Approval of the Work Plan Over-water Air Quality Sampling, Chicago Avenue Ditch; by Landau Associates Inc. for the Boeing Company, July 29th, 2014; FS ID #2018; CS ID #5049; EPA ID # WAD041337130*. From Neil Hines, Washington State Department of Ecology, to James Bet, The Boeing Company. August 14.

Landau Associates. 2014a. Report: *Work Plan, Over-water Air Quality Sampling, Chicago Avenue Ditch, Auburn Fabrication Division Facility, Auburn, Washington*. Prepared for The Boeing Company. August 20.

Landau Associates. 2014b. Technical Memorandum: *July 2013 Surface Water Investigation, Boeing Auburn Facility, Auburn, Washington.* From Sarah Fees and Jennifer Wynkoop of Landau Associates to James Bet of The Boeing Company. July 19.

Landau Associates. 2012a. Technical Memorandum: *Surface Water Investigation, Second Addendum, Boeing Auburn Facility, Auburn, Washington.* From Sarah Weeks and Jennifer Wynkoop of Landau Associates to James Bet of The Boeing Company. August 8.

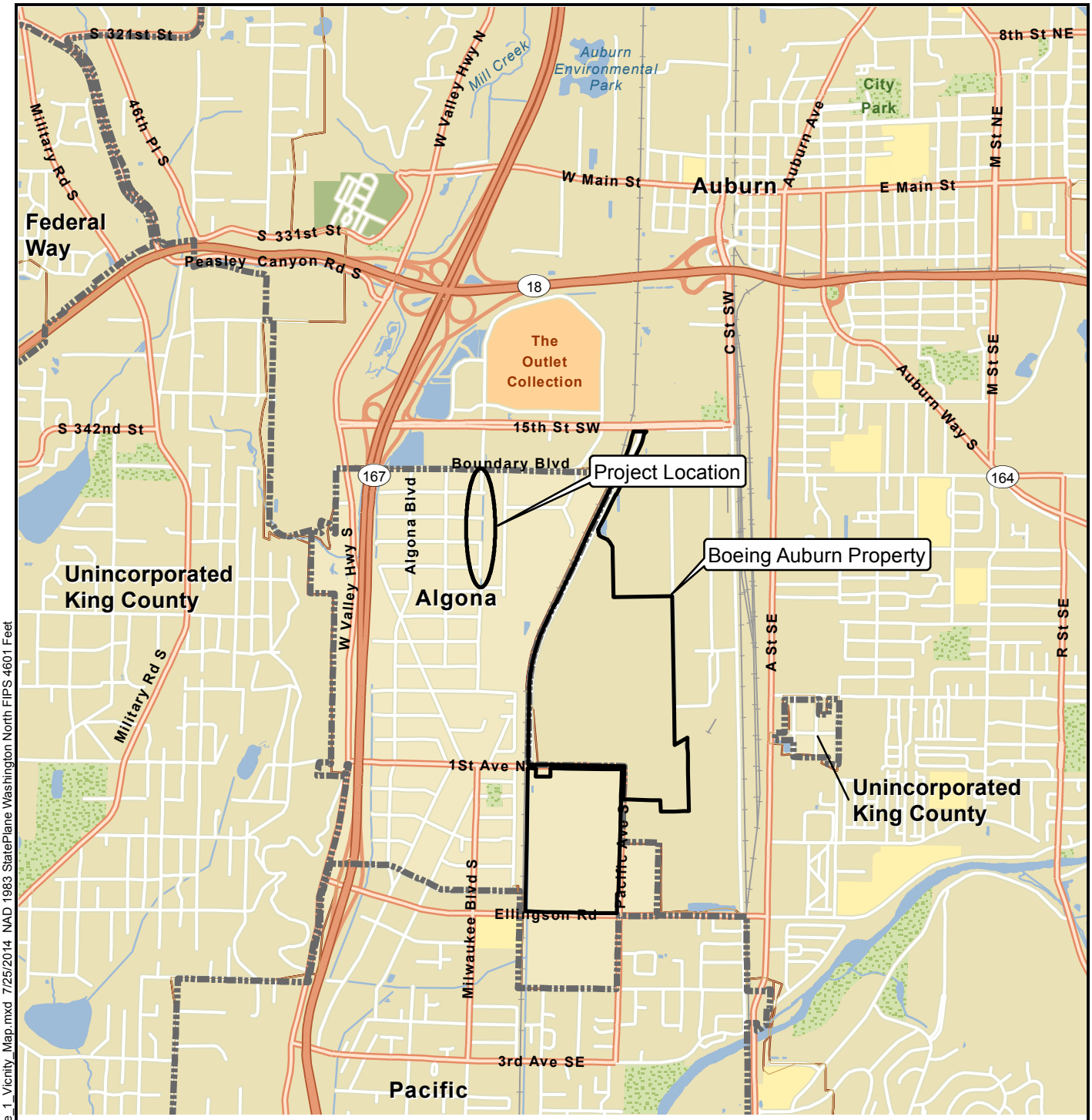
Landau Associates. 2012b. Letter: *Status Report: No. 40, July Through September 2012 Activity Period, Boeing Auburn Facility, WAD041337130, RCRA Corrective Action Agreed Order, No. 01HWTRNR-3345*. From Eric Weber, Landau Associates, to Robin Harrover, Washington State Department of Ecology. October 15.

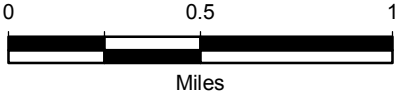
WDOH. 2013. Letter: *Health Consultation, Boeing Commercial Airplane Fabrication Division, Auburn Plant Exposures to Surface Water in Chicago Avenue Ditch and Government Canal Algona, King County, Washington.* Publication No. DOH 334-325. March 28.

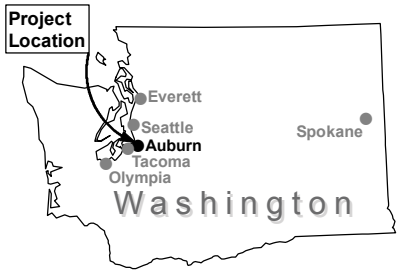
Weather Underground website. 2014. http://www.wunderground.com/cgi-bin/findweather/hdfForecast?query=algona%2C+wa. Accessed August 11, 26, and 27.

ATTACHMENTS

Figure 1: Vicinity Map
Figure 2: Chicago Avenue Ditch Over-water Air and Surface Water Sampling Locations
Table 1: Over-water Air and Ambient Air Results, August 2014
Table 2: Surface Water Results August 2014
Attachment 1: Laboratory Data Package (on DVD)







Data Source: Esri 2012

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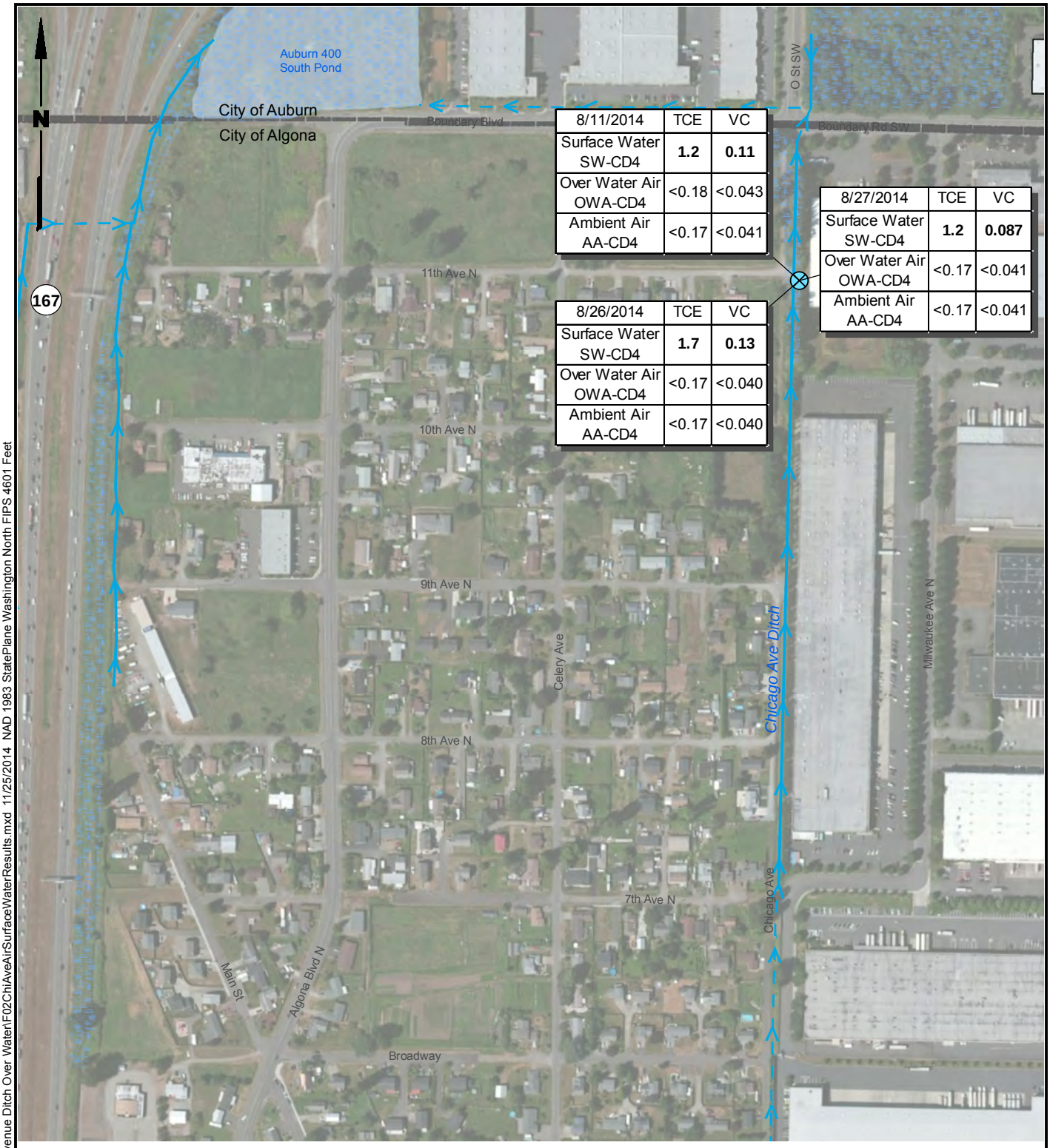
Boeing Auburn Auburn, Washington	**Vicinity Map**	Figure 1



Legend

- Co-Located Air and Surface Water Sample Location
- Open Waterways
- Piped Waterways

0 400 800

Scale in Feet

Note

1. OWA = over-water air; AA = ambient air
2. Air results are shown in µg/m³ and surface water results are shown in µg/L.
3. Ambient air location was variable depending on wind direction.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Source: Esri World Imagery 2010, King County GIS 2012

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Auburn, Washington

Chicago Avenue Ditch Air and Surface Water Sampling Results

Figure 2

TABLE 1
OVER-WATER AIR AND AMBIENT AIR RESULTS, AUGUST 2014
CHICAGO AVENUE DITCH CITY OF ALGONA
BOEING AUBURN

Sample ID:	AA-CD4	OWA-CD4	AA-CD4	OWA-CD4	AA-CD4	OWA-CD4
Lab ID:	1408173-02A	1408173-01A	1408486-02A	1408486-01A	1408486-04A	1408486-03A
Sample Date:	8/11/2014	8/11/2014	8/26/2014	8/26/2014	8/27/2014	8/27/2014
VOLATILES (ppbV)						
Method TO-15						
Vinyl Chloride	0.016 U	0.017 U	0.016 U	0.016 U	0.016 U	0.016 U
Trichloroethene	0.032 U	0.034 U	0.031 U	0.032 U	0.032 U	0.032 U
VOLATILES (µg/m3)						
Method TO-15						
Vinyl Chloride	0.041 U	0.043 U	0.040 U	0.040 U	0.041 U	0.041 U
Trichloroethene	0.17 U	0.18 U	0.17 U	0.17 U	0.17 U	0.17 U

AA = ambient air
OWA = over-water air
U = Indicates the compound was undetected at the reported concentration.

TABLE 2
SURFACE WATER RESULTS, AUGUST 2014
CHICAGO AVENUE DITCH CITY OF ALGONA
BOEING AUBURN

Sample ID:	SW-CD4	Dup of SW-CD4 SW-CD4900	SW-CD4	Dup of SW-CD4 SW-CD4900	SW-CD4
SDG:	1495307	1495307	1499481	1499481	1499481
Lab ID:	7561781	7561782	7581435	7581436	7581438
Sample Date:	8/11/2014	8/11/2014	8/26/2014	8/26/2014	8/27/2014
VOLATILES (µg/L)					
Method SW8260C					
Acetone	5.0 U	5.0 U	5.0 U	5.0 U	**6.4**
Benzene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Carbon Disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon Tetrachloride	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.2 U	0.2 U	0.2 U	0.2 U	**0.4**
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
cis-1,2-Dichloroethene	**1.2**	**1.2**	**1.2**	**1.2**	**0.9**
trans-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
trans-1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Hexanone	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-Pentanone (MIBK)	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Methylene Chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Styrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Tetrachloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Toluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-Trichloro-1,2,2-trifluoroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Trichloroethene	**1.2**	**1.3**	**1.7**	**1.5**	**1.2**
Trichlorofluoromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Acetate	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
m,p-Xylene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
o-Xylene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
VOLATILES (µg/L)					
Method 8260C SIM					
Vinyl Chloride	**0.11**	**0.12**	**0.13**	**0.12**	**0.087**

U = Indicates the compound was undetected at the reported concentration.
Bold = Detected compound.

ATTACHMENT 1

Laboratory Data Package (on DVD)