DEPARTMENT OF
ECOLOGY
State of Washington

# Addendum to
# Quality Assurance Project Plan

# Control of Toxic Chemicals in Puget Sound Phase 3: Characterization of Loadings via Surface Runoff

July 2011

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## Publication Information

**Addendum** (Environmental Assessment Program)

This addendum is an addition to an original Quality Assurance Project Plan.

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Ecology's Activity Tracker Code for this study is 10-199.

**Original Publication** (Water Quality Program)

Quality Assurance Project Plan: Control of Toxic Chemicals in Puget Sound Phase 3: Characterization of Loadings Via Surface Runoff

The Quality Assurance Project Plan is available on the Department of Ecology's website at
www.ecy.wa.gov/biblio/0910052.html

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# DEPARTMENT OF ECOLOGY

Environmental Assessment Program

## Memorandum

**DATE** June 22, 2011

**TO** Jim Maroncelli, Puget Sound Toxics Task 2 Manager, Water Quality Program
Dewey Weaver, Unit Supervisor, Water Quality Program
Bill Moore, Section Manager, Water Quality Program

**THROUGH** Dale Norton, Unit Supervisor, Environmental Assessment Program
Will Kendra, Section Manager, Environmental Assessment Program

**FROM** Mindy Roberts, Environmental Assessment Program
John Lenth, Herrera Environmental Consultants, Inc. (Herrera)

**SUBJECT** **Addendum #1 to:**
**Quality Assurance Project Plan for Control of Toxic Chemicals in Puget Sound Phase 3: Characterization of Loadings Via Surface Runoff**

Activity Tracker Code: 10-199

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The Washington Department of Ecology (Ecology) is collaborating with the Puget Sound Partnership and other local, state, and federal agencies to conduct scientific studies of toxic chemicals discharged to Puget Sound from surface runoff.

Phase 3 of this effort includes a monitoring project to characterize toxic loadings to Puget Sound in surface runoff from four major land uses: commercial/industrial, residential, agricultural, and forest/field/other (Herrera et al., 2009). Results from this study will be used to reduce the uncertainty of loading estimates to Puget Sound via surface runoff relative to the estimates determined in the Phase 1 and Phase 2 studies.

This document is Addendum #1 to the Quality Assurance Project Plan (QAPP) that was finished by the Water Quality Program in July 2009. It documents modifications to the monitoring equipment installations for data collection, processing, and analysis procedures made to address unforeseen issues or improve the quality of collected data. This information is organized herein under each relevant section heading from the original QAPP.

MR:jl

cc: Joy Michaud, Dylan Ahearn, and Peter Steinberg, Herrera Environmental Consultants
Andrew Hafferty and David Ikeda, Ecology and Environment, Inc.
Bill Kammin, Ecology Quality Assurance Officer
Rob Duff, Program Manager, Environmental Assessment Program
Stuart Magoon, Laboratory Director, Manchester Environmental Laboratory

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# Organization and Schedule

The following changes in key staff and project organization have occurred since the original QAPP was issued:

- David Yu replaced Peter Stienberg in the role of Flow Data Management Lead.
- Mark Woodke replaced Andy Hafferty as the Water Quality Data Quality Assurance (QA) lead.
- Project oversight at Ecology has been transferred from the Water Quality Program to the Environmental Assessment Program (EAP) in January 2010. With this transfer, Mindy Roberts of Ecology replaced James Maroncelli as Project Manager.

Table 1 in this addendum summarizes the schedule and supplements the original QAPP.

# Sampling Process Design

Sampling process design changes from the original QAPP are identified below.

## Monitoring Locations

Based on information obtained during field work performed to establish monitoring locations, more accurate data on monitoring location coordinates, basin drainage areas, and land use breakdowns are now available. Table 2 in this addendum summarizes these data and replaces Table 4 in the original QAPP.

Based on these updated data, maps showing the following information for each monitoring location are also shown in Attachment A:

- Monitoring location relative to delineated basin boundaries
- Land use breakdown within the delineated basin boundaries
- Stream channel networks within the delineated boundaries

These maps replace the maps in Appendix E of the original QAPP.

## Water Quality Sampling

The original QAPP indicated the project team would collect two separate samples from each monitoring station in consecutive rounds during a single storm event. After collection, these two samples were to be composited into a single sample in proportion to the flow measured when the two samples were collected. However, due to the short duration of some events and the time required to complete each round of sampling (6 to 8 hours), the second round of sampling could not always be completed during a single storm event.

To avoid sampling water that was unrepresentative of storm events, the second sample was not collected at a particular monitoring location if both the following conditions were present:

- Field observations and Doppler radar images indicated the storm event was waning or over.
- Staff gauge readings from the first and second round of sampling indicated the hydrograph was falling.

The original QAPP also indicated that teams of samplers were to collect one grab sample at each monitoring location following a predetermined route, return to the first location to collect the second grab sample, and then follow the same route for the remaining locations. However, the QAPP provided no guidance on how to select the first monitoring location for sampling during each monitoring event. To avoid introducing bias in the data by starting at the same monitoring location during every event, the first monitoring location was selected at random starting halfway through the winter-storm flow monitoring period.

## Monitoring Parameters

The sampling design in the original QAPP would result in a total of 128 samples for any given parameter, if sampling occurred at all 16 monitoring locations across all the baseflow and storm flow events (16 locations × 8 events = 128 samples). However, due to cost considerations, some parameters were analyzed only at a subset of the locations, while others were analyzed only during a subset of the events. Monitoring for some parameters was also suspended when results from early monitoring indicated no useful information was being obtained.

Tables 3 and 4 in this addendum identify the target number of samples collected for each parameter during baseflow and storm events at each monitoring location, based on these considerations. Tables 3 and 4 replace Table 5 in the original QAPP. Note that the actual number of samples available for each monitoring location may be less than the target number if data were rejected during the data validation process.

## Stream Gauging

The project team established stream gauging stations at each monitoring location in late July and early August of 2009. Reports documenting these gauging station installations are provided in Attachment B.

The original QAPP also indicated that the project team would perform site visits every two weeks to check the operational status of the data loggers at each monitoring location and upload data. Manual discharge measurements were also to be made during these site visits to facilitate development of discharge rating curves for each gauging station. The original goal was to obtain approximately 20 manual discharge measurements for this purpose. However, to reduce overall project costs and streamline field logistics, these site visits were made at approximately three-week intervals. To the extent possible, these site visits were also timed to coincide with storm and baseflow sampling events. Using this approach, between 15 and 21 manual measurements were

obtained over a broad range of flow rates to develop stream discharge rating curves for each gauging station.

# Sampling Procedures

The original QAPP indicated polychlorinated biphenyl (PCB) samples from successive round of storm sampling were to be collected and temporarily stored in a 12-liter stainless steel vessel. However, quality control results following the first few rounds of sampling indicate these vessels were a potential source of contamination. Beginning with the Spring Storm Flow sampling events that began in March 2010, PCB samples were subsequently collected directly into 1-liter amber glass bottles with Teflon lids as grabs. Table 5 in this addendum summarizes this change and replaces Table 6 in the original QAPP.

The original QAPP also indicated that samples collected in the Puyallup watershed would be processed in Herrera's Olympia office while samples collected in the Snohomish watershed would be processed in Herrera's Seattle office. However, to simplify logistics, all samples were processed at Herrera's Seattle office**.**

## Measurement Procedures

Corrections or changes to measurement procedures identified in the original QAPP are as follows:

- The preparation method for polycyclic aromatic hydrocarbons (PAHs) was erroneously listed as method 3510 in the QAPP; it should have been reported as method 3535.
- The reporting limit for pesticides was also listed as 0.002 to 0.025 ug/L. This value is correct for samples collected before March 2010. After this date, the same preparation method was used; however, the injection volume was increased resulting in a lower detection limit of 0.21 to 11 ng/L.
- The reporting limit identified for PCBs was 0.0001 ug/L; however, actual reporting limits for some congeners were as low as 9.5 pg/L.

Table 6 in this QAPP addendum summarizes these changes and replaces Table 3 in the original QAPP.

# Quality Control

Corrections or changes to quality-control sample collection identified in the original QAPP are as follows:

- The QAPP identified that one matrix spike/matrix spike duplicate (MS/MSD), matrix spike/duplicate (MS/Dup), or duplicate would be collected per each event. Because only one watershed was sampled at a time, MS/MSD, MS/Dup, and duplicate samples were collected from each watershed per event.

- The QAPP indicated rinsate samples would be collected per each event. However, only three composite rinsate blanks were collected, and one grab blank was collected.

Table 7 in this addendum summarizes these changes and replaces Table 6 in the original QAPP.

# Data Quality (Usability) Assessment

Changes or corrections to the data quality (usability) assessment procedures from the original QAPP are identified below.

## Data Usability Assessment

The original QAPP stated that data quality assessments and reports would be prepared after all monitoring activities are complete. However, data quality assessment reports were prepared with each sample "batch" rather than after all monitoring activities are completed. This allowed for more timely identification of potential data quality problems so that corrective actions could be taken immediately.

## Data Analysis Procedures

Data analysis procedures identified in the original QAPP are being reviewed and revised by the project team with input from an external planning committee that includes representatives from the City of Tacoma, King County, and the U.S. Geological Survey. The actual data analyses procedures used for the study are described in the final project data report.

# References

Herrera Environmental Consultants, Inc.; Ecology and Environment, Inc.; Practical Stats; and Washington State Department of Ecology, 2009. Quality Assurance Project Plan Control of Toxic Chemicals in Puget Sound Phase 3: Characterization of Loadings via Surface Runoff. June 5, 2009. Ecology Publication No. 09-10-052. www.ecy.wa.gov/biblio/0910052.html

# Tables

Table 1. Key staff assigned to the Phase 3 characterization of toxic loadings via surface runoff study.

| Name | Organization | Role | Responsibilities | Phone |
|---|---|---|---|---|
| Mindy Roberts | Ecology | Project Manager | Overall monitoring program including fiscal resources and personnel. Approves QAPP. | Office: (360) 407-6588 |
| John Lenth | Herrera | Consultant Project Manager | Ensures tasks and other requirements of this QAPP are executed on time. Verifies the QAPP is followed and the study is producing data of known and acceptable quality. Ensures adequate training and supervision of all monitoring and data collection activities. Supervises all assigned study personnel. Tracks project schedule and budgets. Provides regular status updates to the Ecology project manager. | Office: (206) 441-9080 x8265<br>Mobile: (206) 245-7539 |
| Joy Michaud | Herrera | Principal-in-charge | Provides senior QA review of all project technical work and deliverables. | Office: (360) 754-1344 x501<br>Mobile: (360) 790-5789 |
| Mark Woodke | E & E | Water Quality Data QA Lead | Oversees the review of all analytical laboratory data to verify they meet quality objectives specified in this QAPP. | Office: (206) 624-9537 |
| Dylan Ahearn | Herrera | Flow Data QA Lead | Coordinates field work related to continuous flow monitoring. Oversees the review of all flow monitoring data to verify they meet quality objectives specified in this QAPP. Coordinates the development of discharge rating curves for individual monitoring locations. | Office: (206) 441-9080 x8244<br>Mobile: (206) 407-9538 |
| David Ikeda | E & E | Water Quality Data Management Lead | Processes analytical data obtained from the laboratory for subsequent analyses and entry into the EIM. | Office: (206) 624-9537 |
| David Yu | Herrera | Flow Data Management Lead | Processes continuous flow data. Applies corrections to these data as necessary based on routine calibration checks. | Office: (503) 228-4301 x105 |
| Jennifer Schmidt | Herrera | GIS Analysis Support | Provides GIS support during QAPP development and preparation of the final project report. | Office: (206) 441-9080 x8257 |
| Dennis Helsel | Practical Stats | Statistical Analysis Support | Provides statistical analysis support during QAPP development and preparation of the final project report. | Office: (303) 870-4921 |

Table 1 (continued). Key staff assigned to the Phase 3 characterization of toxic loadings via surface runoff study.

| Name | Organization | Role | Responsibilities | Phone |
|---|---|---|---|---|
| Stuart A. Magoon | Ecology | Laboratory Director | Supervises lab personnel involved in generating analytical data for this study. Ensures that lab personnel involved in generating analytical data have adequate training and a thorough knowledge of the QAPP and all SOPs specific to the analyses or task performed and/or supervised. Oversees all operations, ensuring that all QA/QC requirements are met, and documentation related to the analysis is completely and accurately reported. Enforces corrective action, as required. Develops and facilitates monitoring system audits. | Office: (360) 871-8801 |

Ecology: Washington State Department of Ecology
E & E: Ecology and Environment, Inc.
EIM: Environmental Information Management database
GIS: geographic information system
Herrera: Herrera Environmental Consultants
QA: quality assurance
QAPP: quality assurance project plan
QC: quality control
SOP: standard operating procedure

Table 2. Summary information for selected monitoring locations and their associated drainage basins in the Snohomish River watershed and Puyallup River watershed.

| Monitoring Location ID | Monitoring Location Coordinates (UTM) | Drainage Basin Representative Land Use | Drainage Basin Area (hectares) | Land Use Breakdown (%) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Commercial/ Industrial | Residential | Agricultural | Forest/Field/ Other |
| Snohomish River Watershed | | | | | | | |
| CB335 | 554014.728964, 5309812.65922 | Commercial/Industrial | 213.6 | 62.7% | 29.2% | 0.0% | 7.5% |
| CBX | 555699.664563, 5309826.5359 | Commercial/Industrial | 219.4 | 26.4% | 64.0% | 0.0% | 7.9% |
| RB111 | 569280.125094, 5311635.31379 | Residential | 556.3 | 0.2% | 58.8% | 3.4% | 37.6% |
| RB202 | 568103.716954, 5299312.08525 | Residential | 334.1 | 0.4% | 64.0% | 0.0% | 35.6% |
| AG174 | 569460.091694, 5302197.60046 | Agricultural | 290.4 | 0% | 11.8% | 57.1% | 31.1% |
| AGG | 559528.446036, 5330820.43366 | Agricultural | 246.4 | 0.0% | 25.8% | 49.0% | 25.2% |
| FB200 | 577729.711516, 5318011.24222 | Forest/Field/Other | 174.4 | 0.0% | 9.3% | 0.0% | 90.7% |
| FB203 | 588161.362388, 5299897.77717 | Forest/Field/Other | 1656.9 | 0.0% | 2.9% | 0.0% | 95.8% |
| Puyallup River Watershed | | | | | | | |
| CBA | 557134.530396, 5234155.0863 | Commercial/Industrial | 656.5 | 31.8% | 62.1% | 0.0% | 6.2% |
| CBB | 551484.812353, 5238023.54968 | Commercial/Industrial | 436.6 | 38.1% | 48.4% | 0.0% | 13.4% |
| RB53 | 551168.088855, 5231526.86235 | Residential | 376.3 | 5.1% | 81.7% | 1.1% | 9.8% |
| RB209 | 548616.293597, 5228040.37359 | Residential | 549.2 | 4.5% | 81.6% | 0% | 13.9% |
| AG143 | 576488.827227, 5225382.62099 | Agricultural | 164.8 | 0.4% | 10.6% | 81.5% | 7.5% |
| AG62 | 571169.400258, 5232968.32363 | Agricultural | 292.7 | 0.1% | 23.3% | 50.7% | 25.9% |
| FB130 | 590848.135546, 5225066.88834 | Forest/Field/Other | 80.4 | 0.0% | 3.5% | 0.0% | 96.5% |
| FB372 | 563043.022045, 5214260.42147 | Forest/Field/Other | 528.4 | 0.0% | 2.5% | 0.0% | 97.5% |

Table 3. Monitoring parameters and target number of samples collected during baseflow events for the Phase 3 study of toxics in surface runoff to Puget Sound.

| Parameter | Snohomish Watershed | | | | | | | | Puyallup Watershed | | | | | | | | Total Number of Baseflow Event Samples [a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CB335 | CBX | RB111 | RB202 | AG174 | AGG | FB200 | FB203 | CBA | CBB | RB53 | RB209 | AG143 | AG62 | FB130 | FB372 | |
| Dissolved As, Cd, Cu, Pb, Zn | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Total As, Cd, Cu, Pb, Zn | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Dissolved Al, Ba, Be, Co, Mn, Ni, Se, Sn, Tl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Al, Ba, Be, Co, Mn, Ni, Se, Sn, Tl | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dissolved Mercury | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Total Mercury | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| PCBs (209 congeners) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| PBDE (35 congeners) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| PAHs | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| BNAs (plus Bisphenol A and Nonylphenol) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Herbicides (plus Triclopyr) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Pesticides | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| TPH - Gas (first grab only) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| TPH - Diesel (first grab only) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| TPH – Lube Oil (first grab only) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Oil & Grease (first grab only) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Oil &Grease – Lube Oil (first grab only) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Total Hardness | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Ammonia Nitrogen | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Nitrate & Nitrite Nitrogen | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Total Nitrogen | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Dissolved Organic Carbon | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Total Organic Carbon | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Orthophosphate Phosphorus | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Total Phosphorus | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Total Suspended Solids | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Dissolved Oxygen (*in situ*) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| pH (*in situ*) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Specific Conductance (*in situ*) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Temperature (*in situ*) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |
| Flow (*in situ*) | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 30 |

[a] Total number does not include samples collected for quality assurance purposes. Actual number of samples available for each monitoring location may be less if data were rejected during the data validation process.

BNAs: base/neutral/acid extractable compounds

PAH: polycyclic aromatic hydrocarbons

PBDEs: polybrominated diphenyl ethers

PCBs: polychlorinated biphenyls

TPH: total petroleum hydrocarbons

Al: aluminum

As: arsenic

Ba: barium

Be: beryllium

Cd: cadmium

Cu: copper

Mn: manganese

Ni: nickel

Pb: lead

Se: selenium

Sn: tin

Tl: thallium

Zn: zinc

Table 4. Monitoring parameters and target number of samples collected during storm events for the Phase 3 study of toxics in surface runoff to Puget Sound.

| Parameter | Snohomish Watershed | | | | | | | | Puyallup Watershed | | | | | | | | Total Number of Storm Event Samples [a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CB335 | CBX | RB111 | RB202 | AG174 | AGG | FB200 | FB203 | CBA | CBB | RB53 | RB209 | AG143 | AG62 | FB130 | FB372 | |
| Dissolved As, Cd, Cu, Pb, Zn | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Total As, Cd, Cu, Pb, Zn | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Dissolved Al, Ba, Be, Co, Mn, Ni, Se, Sn, Tl | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 12 |
| Total Al, Ba, Be, Co, Mn, Ni, Se, Sn, Tl | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 12 |
| Dissolved Mercury | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Total Mercury | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| PCBs (209 congeners) | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 40 |
| PBDE (35 congeners) | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 64 |
| PAHs | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| BNAs (plus Bisphenol A and Nonylphenol) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Herbicides (plus Triclopyr) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Pesticides | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| TPH – Gas (first grab only) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| TPH – Diesel(first grab only) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| TPG 0 Lube Oil (first grab only) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Oil & Grease (first grab only) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Oil & Grease – Lube Oil (first grab only) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Total Hardness | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Ammonia Nitrogen | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Nitrate & Nitrite Nitrogen | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Total Nitrogen | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Dissolved Organic Carbon | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Total Organic Carbon | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Orthophosphate Phosphorus | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Total Phosphorus | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Total Suspended Solids | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Dissolved Oxygen (i*n situ)* | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| pH (i*n situ)* | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Specific Conductance (i*n situ)* | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Temperature (i*n situ)* | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |
| Flow (i*n situ)* | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 96 |

[a] Total number does not include samples collected for quality assurance purposes. Actual number of samples available for each monitoring location may be less if data were rejected during the data validation process.

BNAs: base/neutral/acid extractable compounds
PAH: polycyclic aromatic hydrocarbons
PBDEs: polybrominated diphenyl ethers
PCBs: polychlorinated biphenyls
TPH: total petroleum hydrocarbons
Al: aluminum
As: arsenic
Ba: barium
Be: beryllium
Cd: cadmium
Cu: copper
Mn: manganese
Ni: nickel
Pb: lead
Se: selenium
Sn: tin
Tl: thallium
Zn: zinc

Table 5. Volume requirement, bottle type, bottle filling method, and sample processing requirements for monitoring parameters during baseflow and storm flow sampling events.

| Parameters | Required Volume for Analysis | Bottle Type | Filling Method | Baseflow Event | Storm Event | | Processing Prior to Laboratory Delivery |
|---|---|---|---|---|---|---|---|
| | | | | | Round 1 | Round 2 | |
| PAHs<br>BNA<br>Pesticides<br>Herbicides<br>PBDEs<br>PCBs[a]<br>Ammonia Nitrogen<br>Nitrate & Nitrite Nitrogen<br>Total Nitrogen<br>Total Organic Volume<br>Total Phosphorus<br>Total Suspended Solids | 9.5 L | Stainless steel<br>12 L | Transfer sample from stream to container with a stainless steel pitcher | Yes | Yes | Yes | Flow composite storm-event samples |
| PCBs [a] | 1 L | Amber glass, Teflon lid<br>1 L | Direct immersion of container in stream | Yes | Yes | Yes | Flow composite storm-event samples |
| Gasoline | 120 ml | Glass, Teflon lid, zero headspace<br>3 × 40 ml | Direct immersion of container in stream | Yes | Yes | No | None |
| Diesel<br>Lube Oil | 1 L | Amber glass, Teflon lid<br>1 L | Direct immersion of container in stream | Yes | Yes | No | None |
| Oil & Grease<br>Diesel & Lube Oil | 1 L | Amber glass, Teflon lid<br>1 L | Direct immersion of container in stream | Yes | Yes | No | None |
| Oil & Grease – Low Detection Limit | 4 L | Amber glass, Teflon lid<br>4 × 1 L | Direct immersion of container in stream | Yes [b] | Yes | No | None |
| Total Metals<br>Mercury<br>Hardness | 0.5 L | 0.5 L Teflon | Direct immersion of container in stream | Yes | Yes | Yes | Flow composite storm-event samples |

Table 5 (continued). Volume requirement, bottle type, bottle filling method, and sample processing requirements for monitoring parameters during base and storm flow sampling events.

| Parameters | Required Volume for Analysis | Bottle Type | Filling Method | Baseflow Event | Storm Event | | Processing Prior to Laboratory Delivery |
|---|---|---|---|---|---|---|---|
| | | | | | Round 1 | Round 2 | |
| Dissolved Metals<br>Dissolved Organic Carbon<br>Orthophosphate Phosphorus | 0.5 L | 0.5 L Teflon | Direct immersion of container in stream | Yes | Yes | Yes | Field filter;<br>Flow composite storm event samples |

[a] At the onset of the project, PCB samples were to be collected and temporarily stored in a 12-liter stainless steel vessel. However, quality control procedures following the first few rounds of sampling indicate these vessels were a potential source of contamination. Beginning with the spring storm-flow sampling events that began in March 2010, PCB grab samples were subsequently collected directly into 1-liter amber glass bottles with Teflon lids. Single samples were submitted for analysis when the site was visited once during an event. For sites visited twice during an event, the samples were mixed in separate bottles in proportion to the flow.

[b] Oil & Grease will be analyzed with lower detection limit during the fall first-flush event and first winter-storm flow event. At the discretion of the project team, additional samples may also be analyzed at select locations during additional events.

L: liter

ml: milliliter

Table 6. Analytical methods, reporting limits, and quality control limits.

| Priority Pollutant Scans for 10 POTWs – Laboratory Quality Control Limits | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Analysis Method | Preparation Method | Parameter | Reporting Limit | MS/MSD %R | MS/MSD RPD | Calibration %RSD††† | CCV | LCS | Others (specify) Surrogate %Recovery |
| 8270 SIM | 3535 | PAHs | 0.01 ug/g | ** see below | ** see below | † see below | ±15% | 40-140 | 20-200 |
| 8270 | 3510 | BNAs | 0.25 – 5 ug/L | 50-150 | 40 | † see below | ±20% | 50-150 | *see below |
| 8270 | 3535 or 3510 | Herbicides | 0.062 ug/L | 40-130 | 40 | † see below | ±20% | 40-130 | 40-130 |
| GC/HRMS 1668 | GC/HRMS 1668 | PBDEs | 0.00001–0.0001 ug/L | ** see below | ** see below | ±20% target, ±35% labeled | 70-130 target, 50-150 labeled | 50-150 target, 30-140 labeled | 10-150 |
| 8081 | 3535 or 3510 | Pesticides | 2 – 25 ng/L[a] 0.21-11 ng/L[b] | 50-150 | 40 | †† | ±15% | 50-150 | 50-150 |
| MLA060 (AXYS 2008) | MLA060 (AXYS 2008) | PFOAs and PFOSs | 0.0001 ug/L | ** see below | ** see below | $R^2 > 0.990$ | ±30% for a maximum of three compounds; remainder ±20% | 80-120, 70-130, depending on analyte | 20-150, 40-150, depending on analyte |
| GC/HRMS 1668 | GC/HRMS 1668 | PCBs | 9.5 - 100 pg/L | ** see below | ** see below | ±20% target, ±35% labeled | 70-130 target, 50-150 labeled | 50-150 target, 30-140 labeled | 10-150 |
| 200.8 | 200.8 | Metals | 0.002 - 50 ug/L | 75-125 | 20 | ††† | ±10% | 85-115 | NA |
| 245.7 | 245.7 | Mercury | 0.002 ug/L | 75-125 | 20 | ††† | ±10% | 85-115 | NA |
| NWTPH-GX | NWTPH-GX | Gasoline | 140 ug/L | 70-130 | 40 | $R^2 > 0.99$ | ±15% | 70-130 | 70-130 |
| NWTPH-Dx | NWTPH-Dx | Diesel | 150 ug/L | 70-130 | 40 | $R^2 > 0.99$ | ±15% | 70-130 | 50-150 |
| NWTPH-Dx | NWTPH-Dx | Lube Oil | 380 ug/L | NA | NA | $R^2 > 0.99$ | ±20% | NA | 50-150 |
| 1664 | 1664 | Oil & Grease | 5,000 (MDL = 1,400) ug/L | 78-114 | 20 | NA | NA | RPD 18 %R 78-114 | NA |
| NWTPH-Dx | 1664 | Oil & Grease | 150 ug/L | NA | NA | NA | NA | NA | 70-130 |
| 1664 | 1664 large sample | Oil & Grease | 1,250 (MDL = 350) ug/L | 78-114 | 20 | NA | NA | RPD 18 %R 78-114 | NA |
| 2340B | 200.7 | Hardness | 300 ug/L | 75-125 | 20 | NA | NA | 85-115 | NA |
| 4500-NH3 H | 4500-NH3 H | Ammonia Nitrogen | 10 ug/L | 75-125 | 20 | 10 | 10 | 80-120 | NA |
| 4500-NO3 I | 4500-NO3 I | Nitrate & Nitrite Nitrogen | 10 ug/L | 75-125 | 20 | 10 | 10 | 80-120 | NA |
| 4500-N B | 4500-N B | Total Nitrogen | 25 ug/L | 75-125 | 20 | 10 | 10 | 80-120 | NA |
| 5310 B | 5310 B | Dissolved Organic Carbon | 1,000 ug/L | 75-125 | 20 | 10 | 10 | 80-120 | NA |
| 5310 B | 5310 B | Total Organic Carbon | 1,000 ug/L | 75-125 | 20 | 10 | 10 | 80-120 | NA |

Table 6 (continued). Analytical methods, reporting limits, and quality control limits.

| Priority Pollutant Scans for 10 POTWs – Laboratory Quality Control Limits | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Analysis Method | Preparation Method | Parameter | Reporting Limit | MS/MSD %R | MS/MSD RPD | Calibration %RSD††† | CCV | LCS | Others (specify) Surrogate %Recovery |
| 5310 B | 5310 B | Total Organic Carbon | 1,000 ug/L | 75-125 | 20 | 10 | 10 | 80-120 | NA |
| 4500-P G | 4500-P G | Orthophosphate Phosphorus | 3 ug/L | 75-125 | 20 | 10 | 10 | 80-120 | NA |
| 4500-P F | 4500-P F | Total Phosphorus | 5 ug/L | 75-125 | 20 | 10 | 10 | 80-120 | NA |
| 2540 D | 2540 D | Total Suspended Solids | 1,000 ug/L | NA | NA | NA | NA | RPD 20 %R 80-120 | NA |
| YSI 556 meter | NA | Dissolved Oxygen | NA | NA | NA | NA | NA | NA | NA |
| YSI 556 meter | NA | pH | NA | NA | NA | NA | NA | NA | NA |
| YSI 556 meter | NA | Specific Conductivity | NA | NA | NA | NA | NA | NA | NA |
| YSI 556 meter | NA | Temperature | NA | NA | NA | NA | NA | NA | NA |

Key to Table 6

| | |
|---|---|
| *1,2-Dichlorobenzene-D4 | 16-110% |
| *2-Fluorobiphenyl | 43-116% |
| *2-Fluorophenol | 21-110 |
| *D4-2-Chlorophenol | 33-110% |
| *D5-Nitrobenzene | 35-114% |
| *D5-Phenol | 10-110% |
| *Pyrene-D10 | 50 -150% |
| *Terphenyl-D14 | 33-141% |

** These are isotopic dilution methods: no MS/MSD required.

† Calibration Model — Requirement
- Average response: %RSD < 15%
- Linear curve: $r^2 > 0.995$; %RSD < 20%
- Quadratic curve: coefficient of determination (cod) > 0.99, at least 6 calibration points

†† Calibration Model — Requirement
- Average response: %RSD < 20%
- Linear curve: $r^2 > 0.99$; %RSD < 20%
- Quadratic curve: coefficient of determination (cod) > 0.99, at least 6 calibration points

††† Calculated concentration of each standard must be ±20% (lowest cal may be ±50%); except for PFOA/PFOS: ±25 % of actual (lowest cal may be ±30%) and metals ± 10% of actual (lowest cal may be ±20%)

[a] Reporting limit for samples collected prior to March 2010

[b] Reporting limit for samples collected during and after to March 2010

Acronyms and Abbreviations:

| | |
|---|---|
| %R | percent recovery |
| BNAs | Base/Neutral/Acid Extractable Compounds (semivolatiles) |
| CCV | Continuing Calibration Verification |
| GC | Gas Chromatograph |
| HRMS | High Resolution Mass Spectrometry |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| NA | Not Applicable |
| PAHs | Polycyclic Aromatic Hydrocarbons |
| PBDEs | Polybrominated diphenyl ethers |
| PCBs | Polychlorinated biphenyls |
| PFOAs | Perfluoroorganic acids |
| PFOSs | Perfluorosulfonates |
| POTWs | Publicly Owned Treatment Works |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| RSD | Relative Standard Deviation |
| SIM | Selected Ion Monitoring |
| ug/L | micrograms per liter (parts per billion [ppb]) |

Table 7. Field quality control samples for each parameter.

| Method | Parameter | Equipment / Rinsate Blank | MS | MSD | Duplicate |
|---|---|---|---|---|---|
| 8270 SIM | PAHs | 3 / project | 1/watershed/ event | 1/watershed/ event | NA |
| 8270 | BNAs | 3 / project | 1/watershed/ event | 1/watershed/ event | NA |
| 8270 | Herbicides | 3 / project | 1/watershed/ event | 1/watershed/ event | NA |
| GC/HRMS 1668 | PBDEs | 3 / project | NA | NA | 1/watershed/ event |
| 8081 | Pesticides | 3 / project | 1/watershed/ event | 1/watershed/ event | NA |
| GC/HRMS 1668 | PCBs | 3 / project | NA | NA | 1/watershed/ event |
| 200.8 | Metals | 1 / project | 1/watershed/ event | NA | 1/watershed/ event |
| 245.7 | Mercury | 1 / project | 1/watershed/ event | NA | 1/watershed/ event |
| NWTPH-Gx | Gasoline | NA | 1/watershed/ event | 1/watershed/ event | NA |
| NWTPH-Dx | Diesel & Lube Oil | NA | 1/watershed/ event | 1/watershed/ event | NA |
| 1664 | Oil & Grease | NA | 1/watershed/ event | NA | 1/watershed/ event |
| NWTPH – Dx of 1664 residue | Oil & Grease | NA | 1/watershed/ event | NA | 1/watershed/ event |
| 1664 large sample | Oil & Grease | NA | 1/watershed/ event | NA | 1/watershed/ event |
| 2340B | Hardness | NA | 1/watershed/ event | 1/sampling event | NA |
| 4500-NH3 H | Ammonia Nitrogen | NA | 1/watershed/ event | NA | 1/watershed/ event |
| 4500-NO3 I | Nitrate & Nitrite Nitrogen | NA | 1/watershed/ event | NA | 1/watershed/ event |
| 4500-N B | Total Nitrogen | NA | 1/watershed/ event | NA | 1/watershed/ event |
| 5310 B | Dissolved Organic Carbon | NA | 1/watershed/ event | NA | 1/watershed/ event |
| 5310 B | Total Organic Carbon | NA | 1/watershed/ event | NA | 1/watershed/ event |
| 4500-P G | Orthophosphate Phosphorus | NA | 1/watershed/ event | NA | 1/watershed/ event |
| 4500-P F | Total Phosphorus | NA | 1/watershed/ event | NA | NA |
| 2540 D | Total Suspended Solids | NA | NA | NA | 1/watershed/ event |

Table 7 (continued). Field quality control samples for each parameter.

| Method | Parameter | Equipment / Rinsate Blank | MS | MSD | Duplicate |
|---|---|---|---|---|---|
| YSI 556 meter | Dissolved Oxygen (field measurement) | NA | NA | NA | NA |
| YSI 556 meter | pH (field measurement) | NA | NA | NA | NA |
| YSI 556 meter | Specific Conductivity (field measurement) | NA | NA | NA | NA |
| YSI 556 meter | Temperature (field measurement) | NA | NA | NA | NA |

Key:

NA – Not Applicable.
PAHs – Polycyclic Aromatic Hydrocarbons.
BNAs – Base/Neutral/Acid Extractable Compounds (semivolatiles).
PBDEs – Polybrominated diphenyl ethers.
PCBs – Polychlorinated biphenyls.
Metals – Aluminum, arsenic, barium, beryllium, cadmium, calcium, cobalt, copper, lead, magnesium, manganese, nickel, selenium, thallium, tin, and zinc.

# Appendix A. Color Figures

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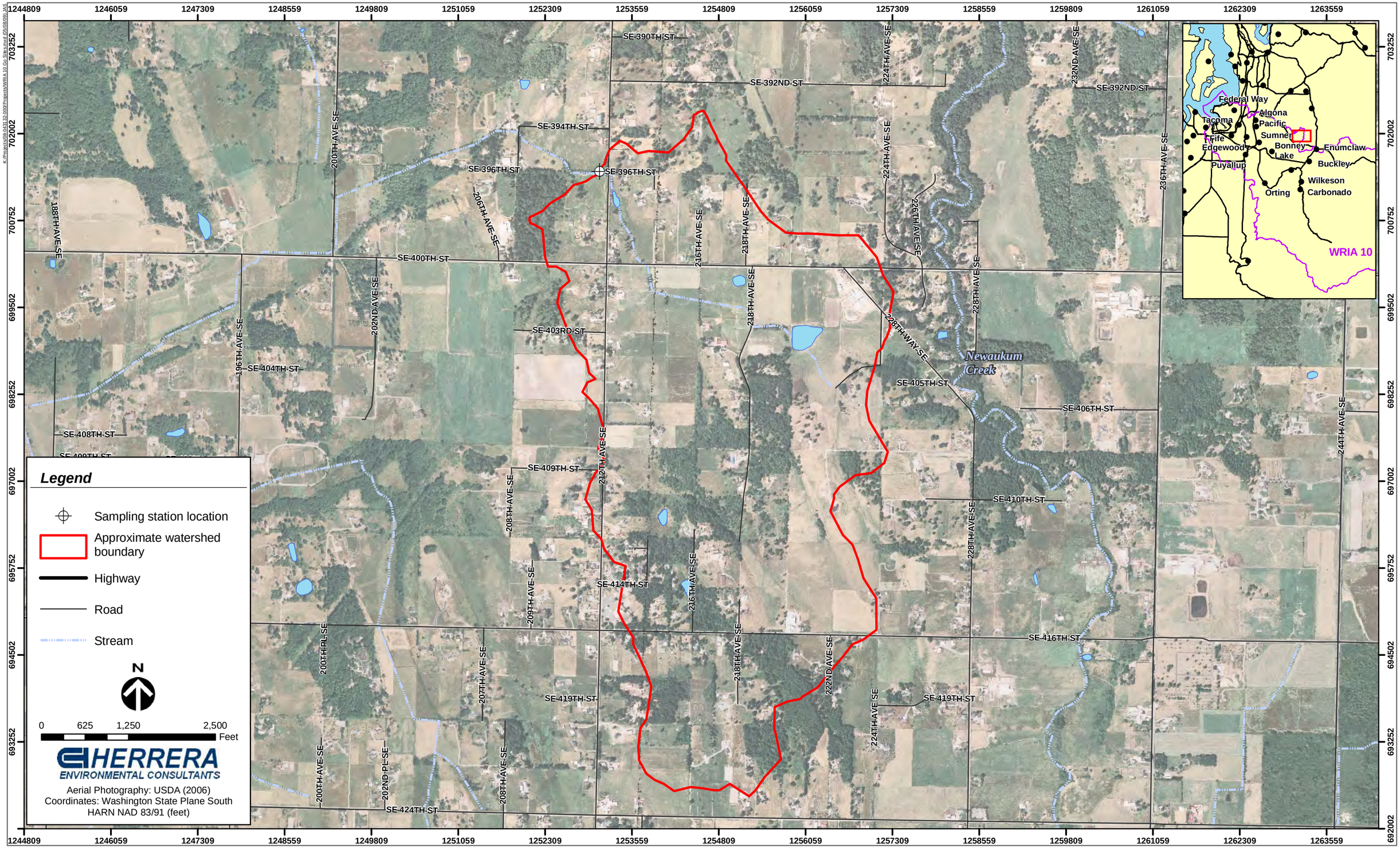


**Figure A-1. Monitoring location AG62 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the agricultural land use category.**

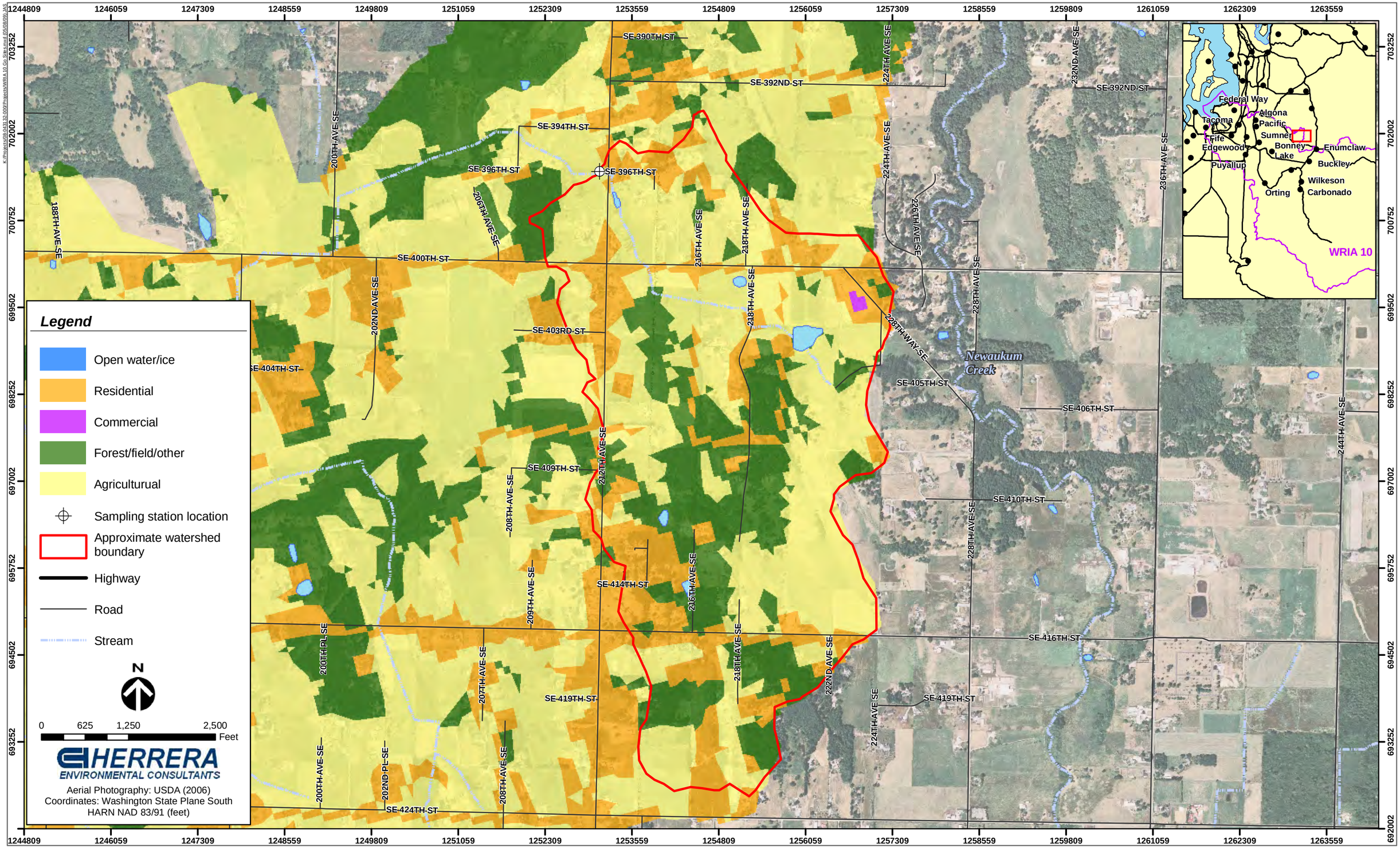


**Figure A-2. Monitoring location AG62 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the agricultural land use category.**

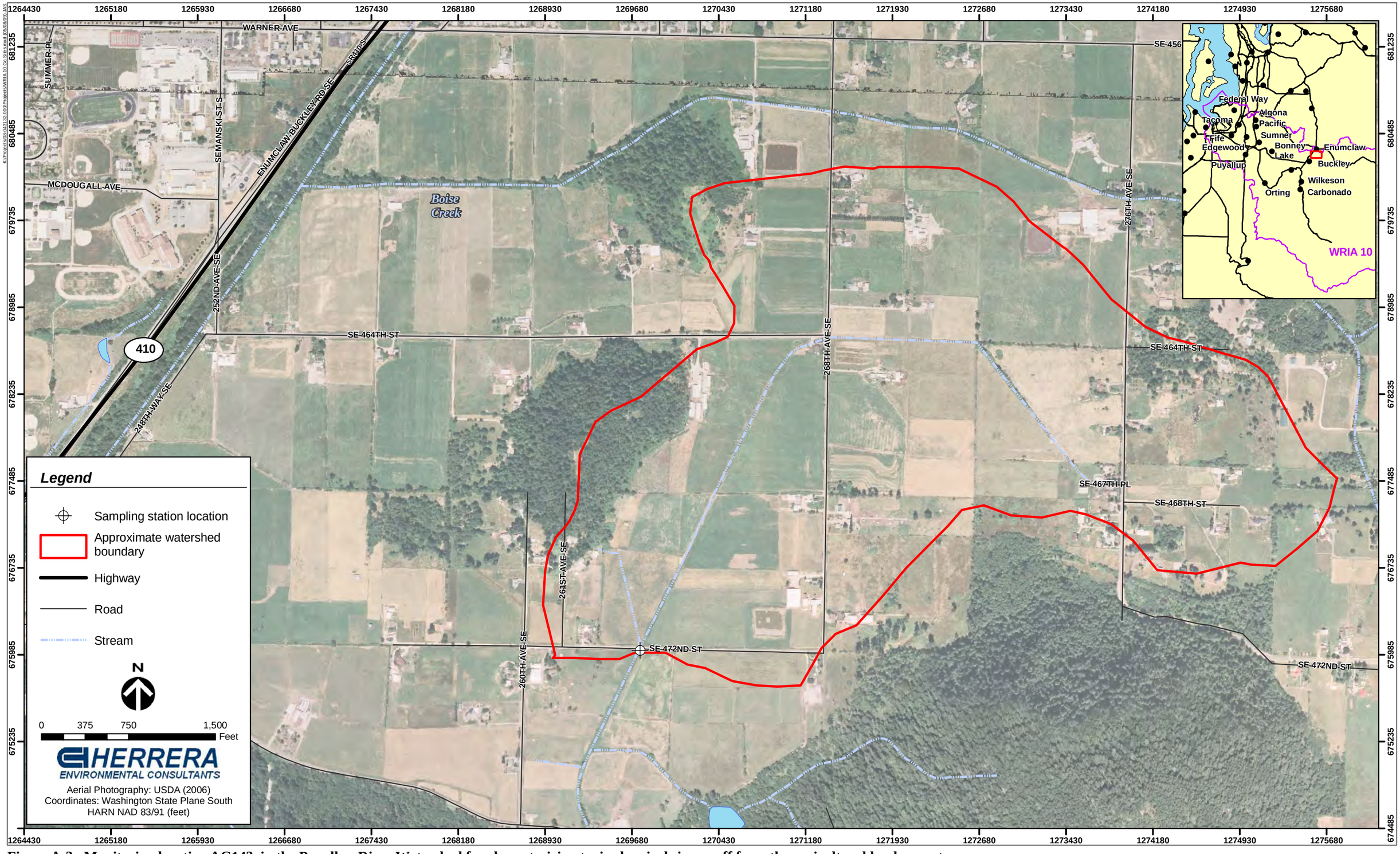


**Figure A-3. Monitoring location AG143 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the agricultural land use category.**

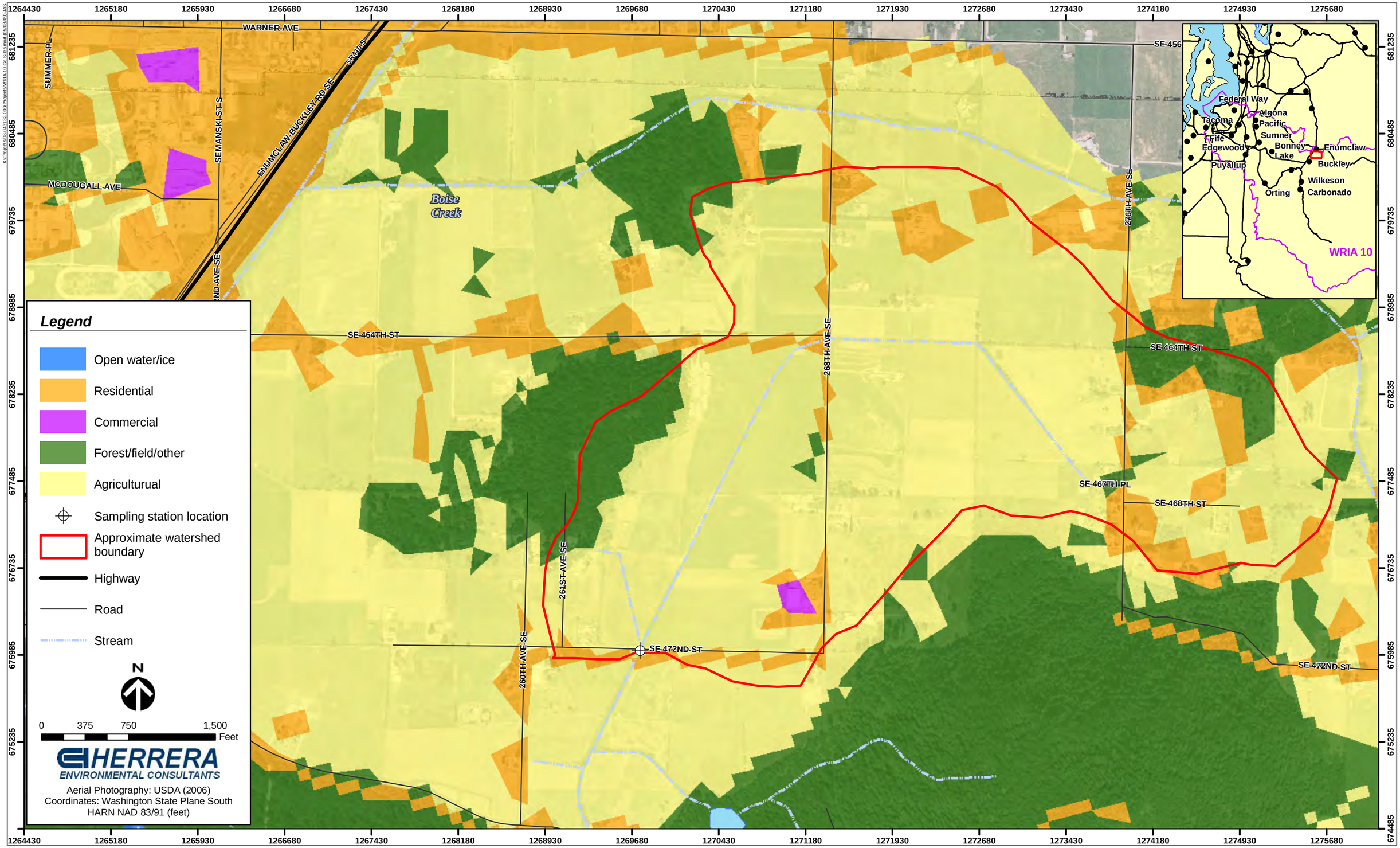


**Figure A-4. Monitoring location AG143 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the agricultural land use category.**

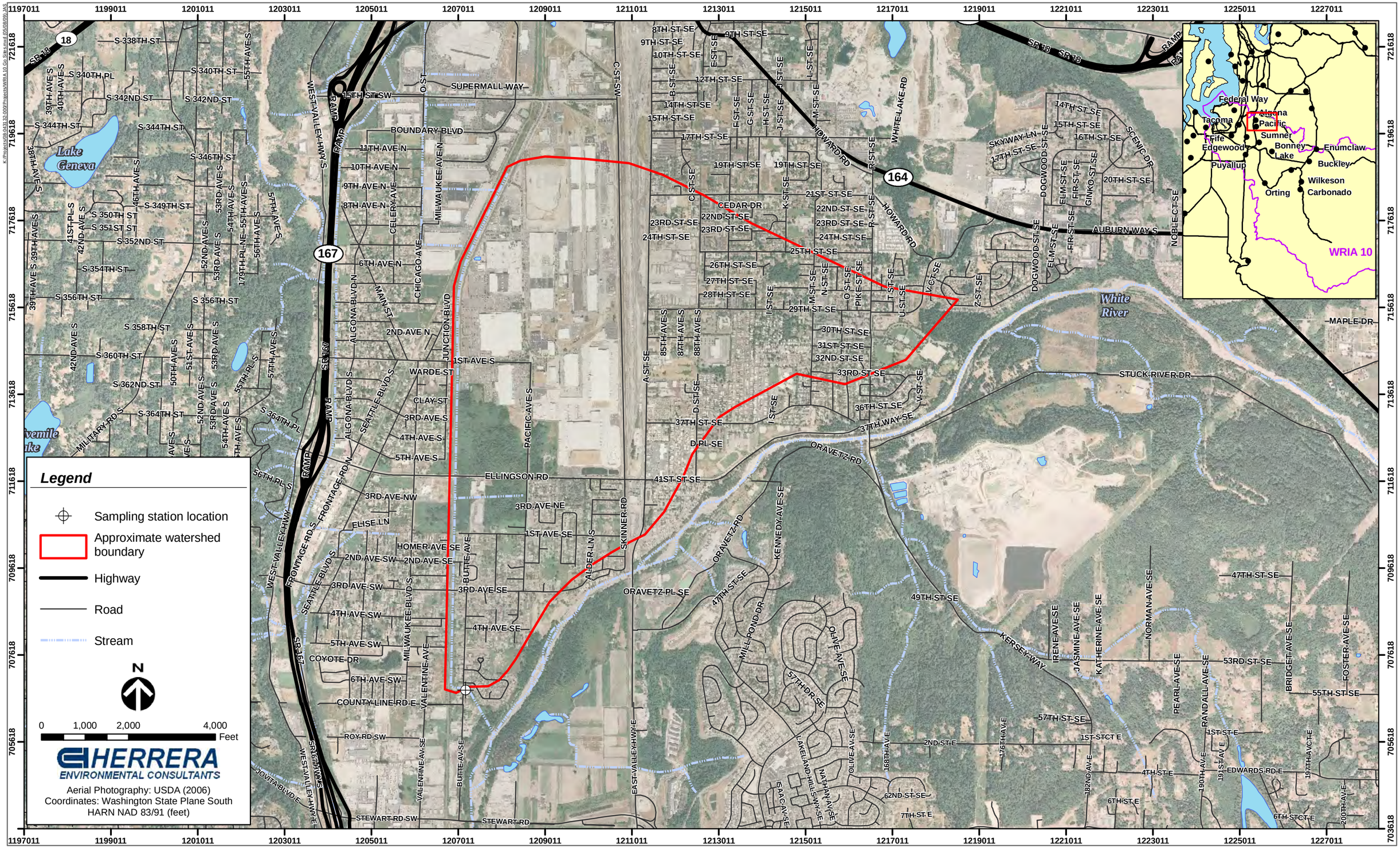


**Figure A-5. Monitoring location CBA in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the commercial land use category.**

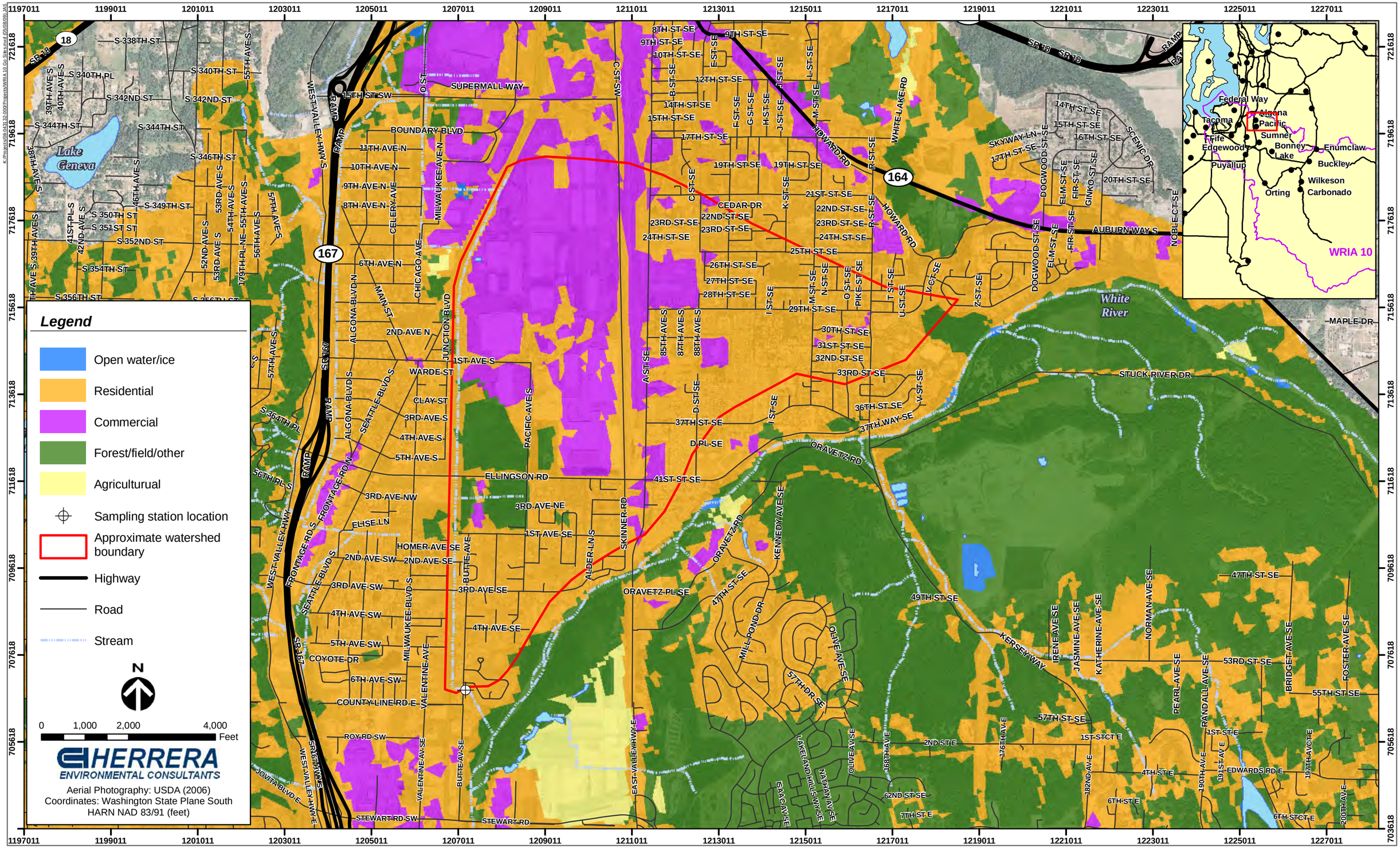


**Figure A-6. Monitoring location CBA in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the commercial land use category.**

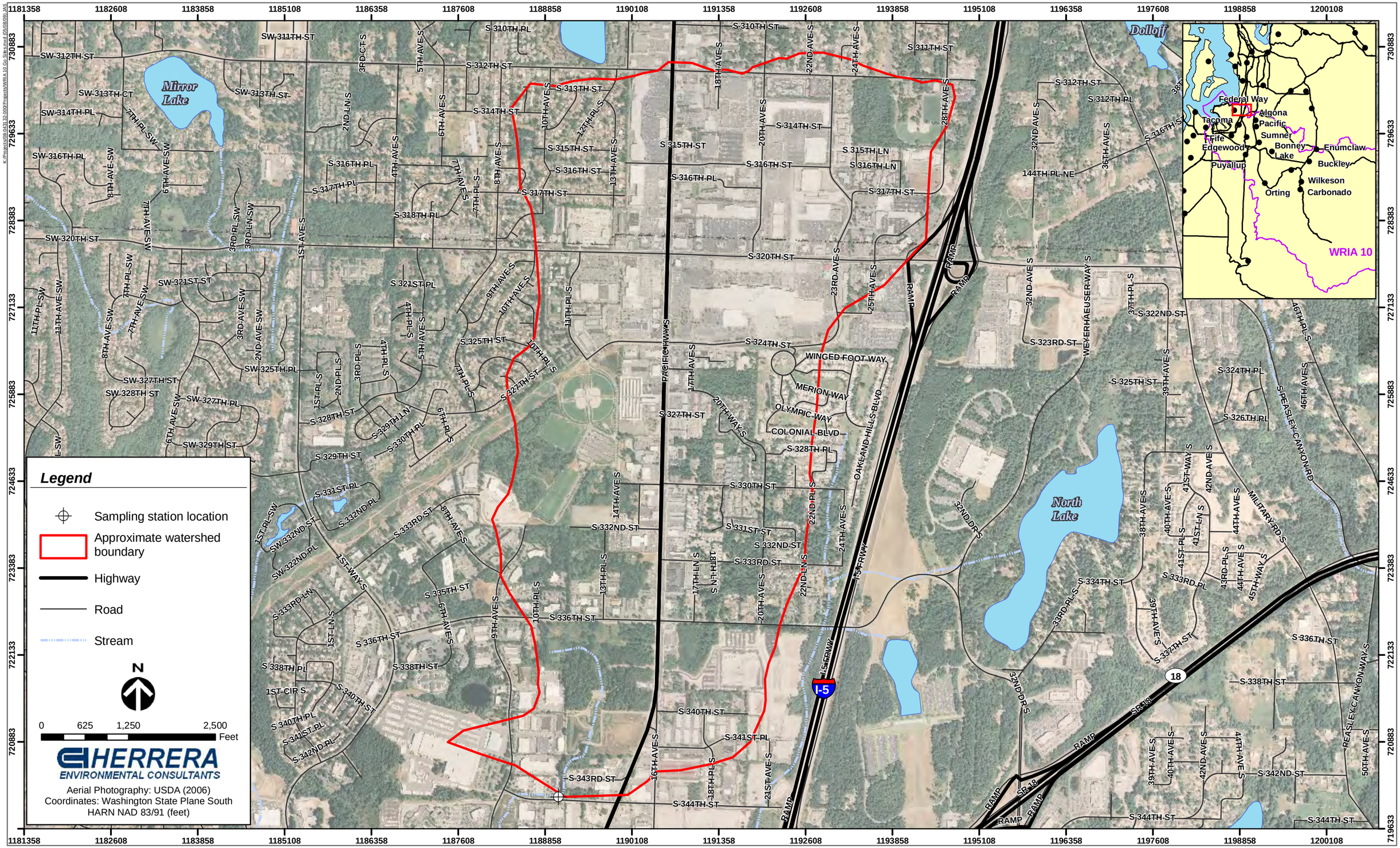


**Figure A-7. Monitoring location CBB in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the commercial land use category.**

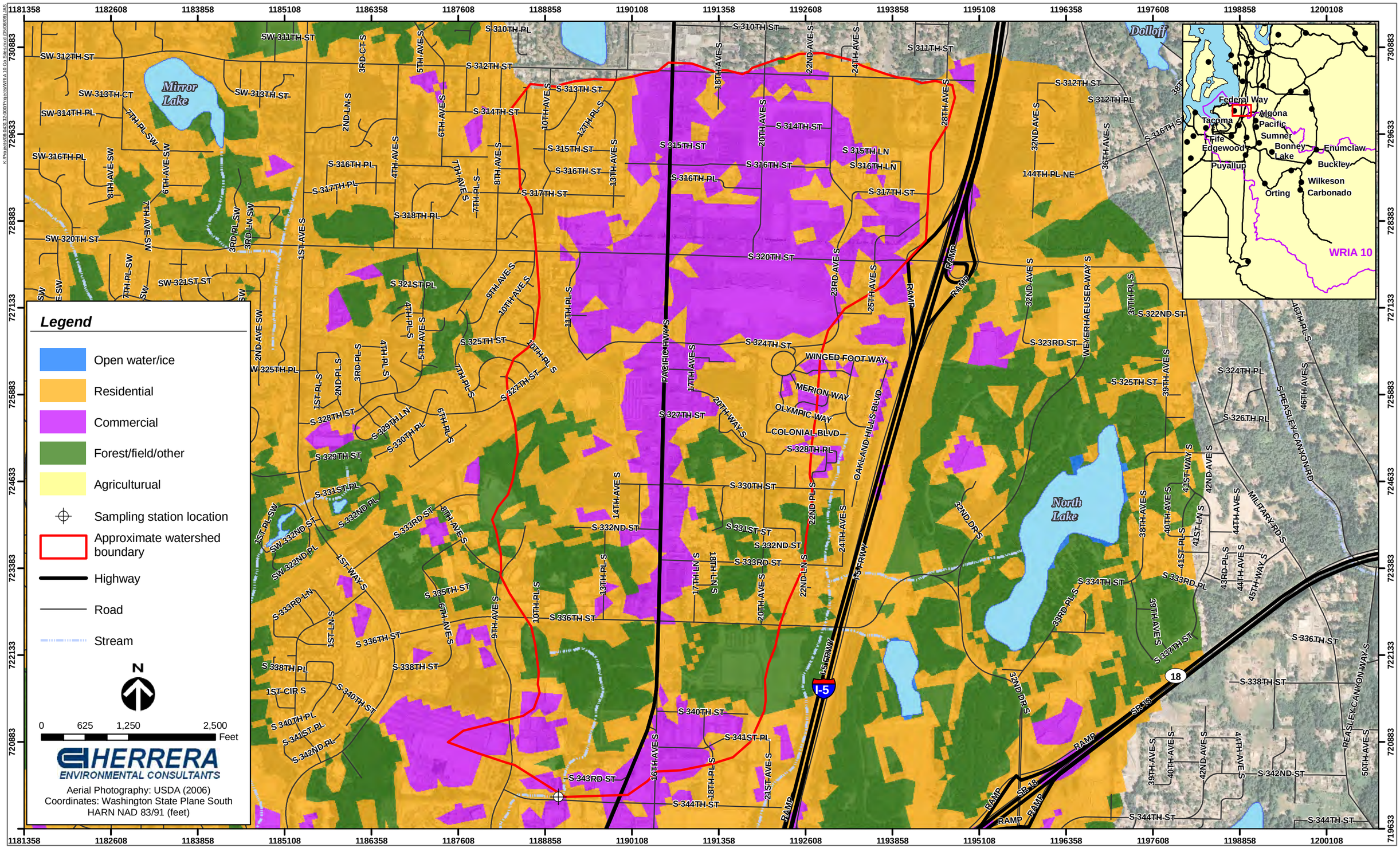


**Figure A-8. Monitoring location CBB in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the commercial land use category.**

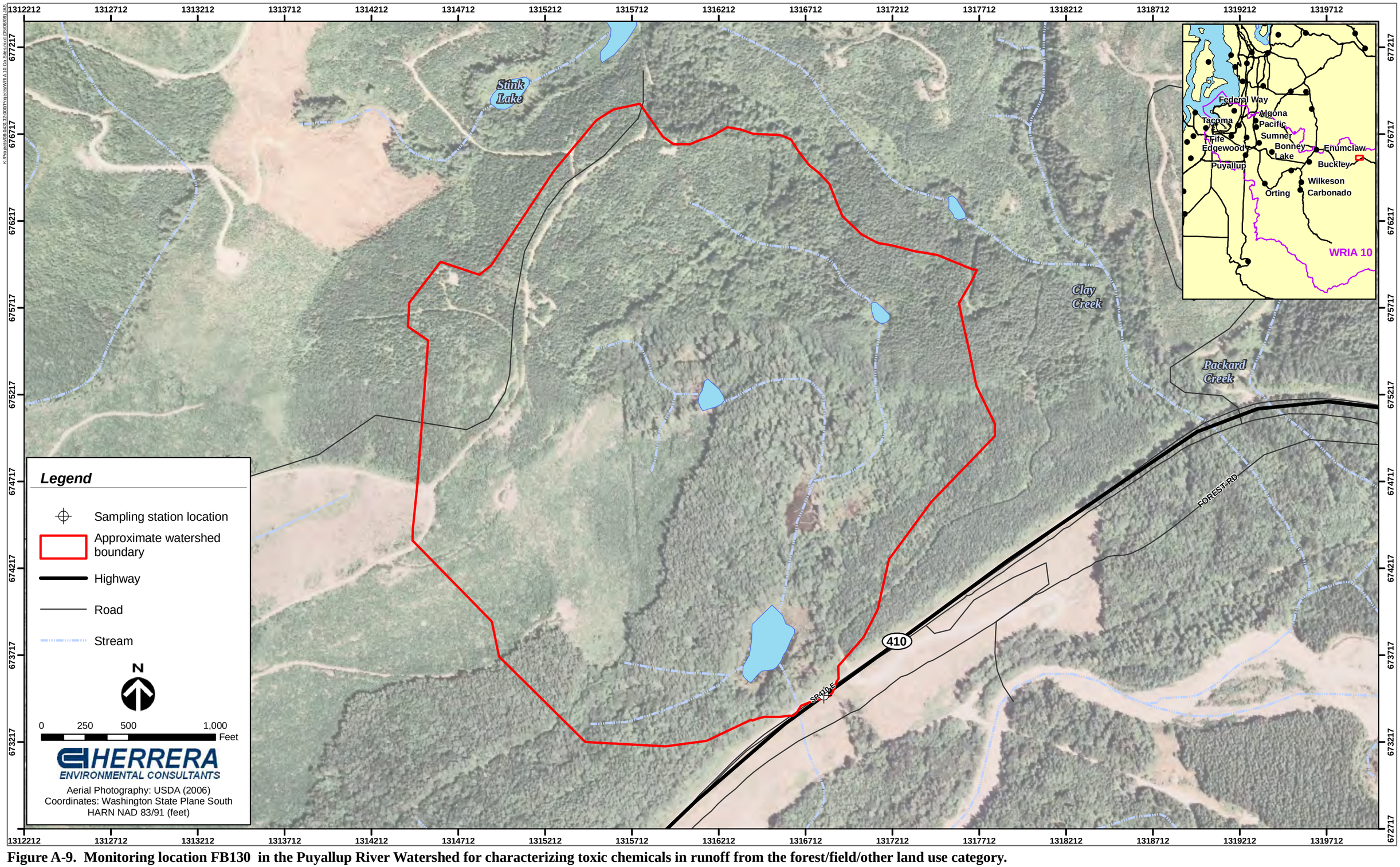


**Figure A-9. Monitoring location FB130 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the forest/field/other land use category.**

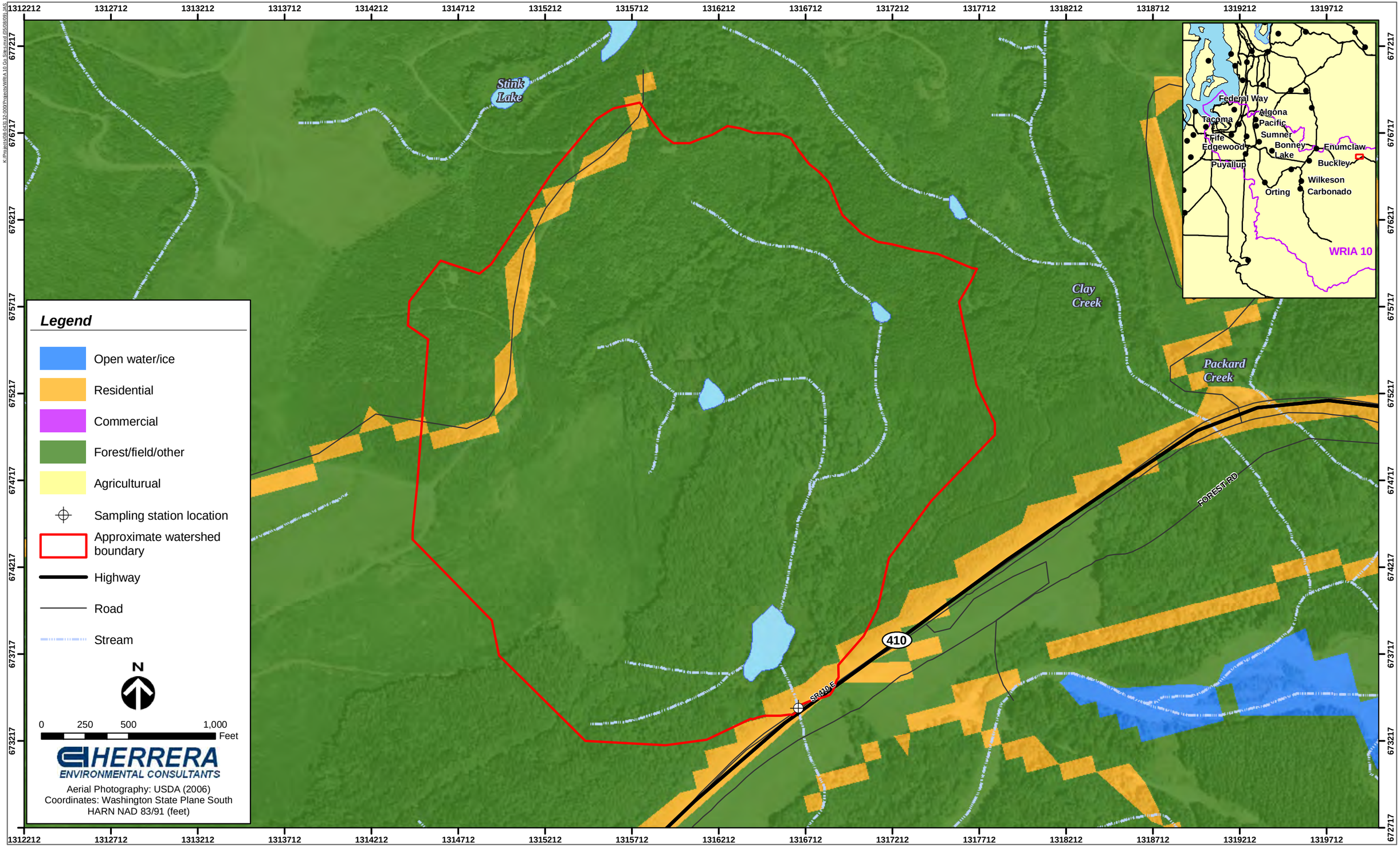


**Figure A-10. Monitoring location FB130 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the forest/field/other land use category.**

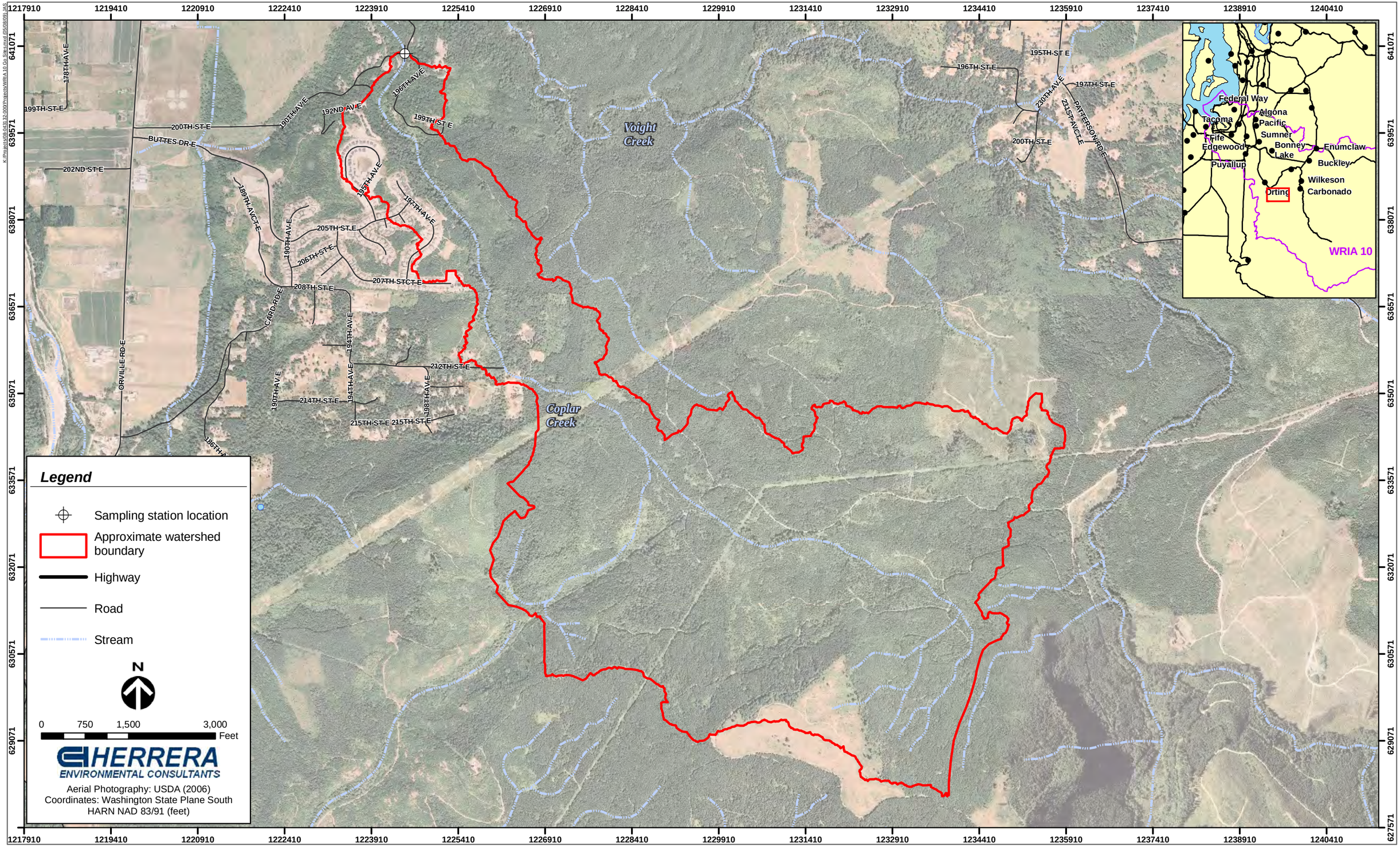


**Figure A-11. Monitoring location FB357 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the forest/field/other land use category.**

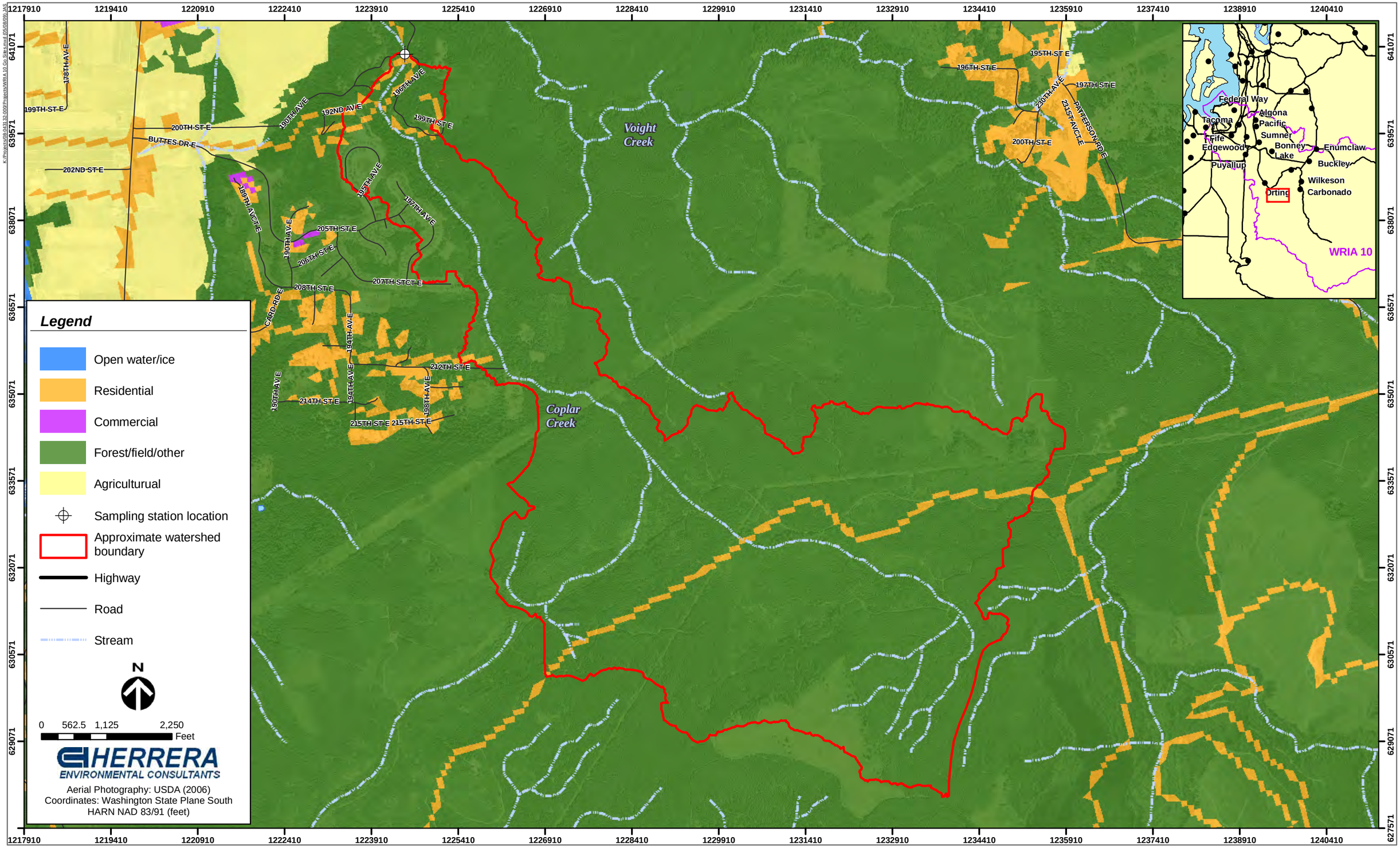


**Figure A-12. Monitoring location FB357 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the forest/field/other land use category.**

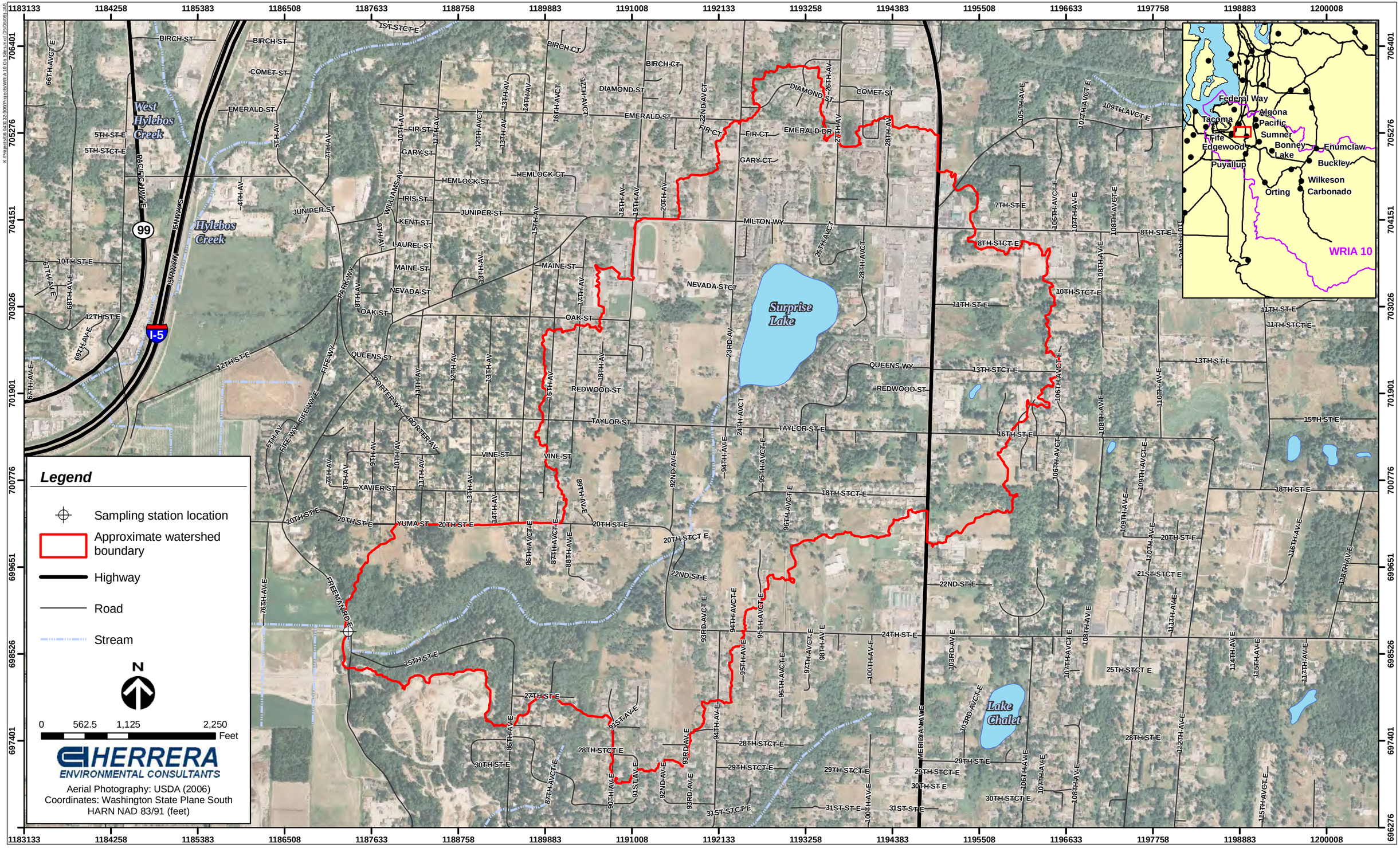


**Figure A-13. Monitoring location RB53 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the residential land use category.**

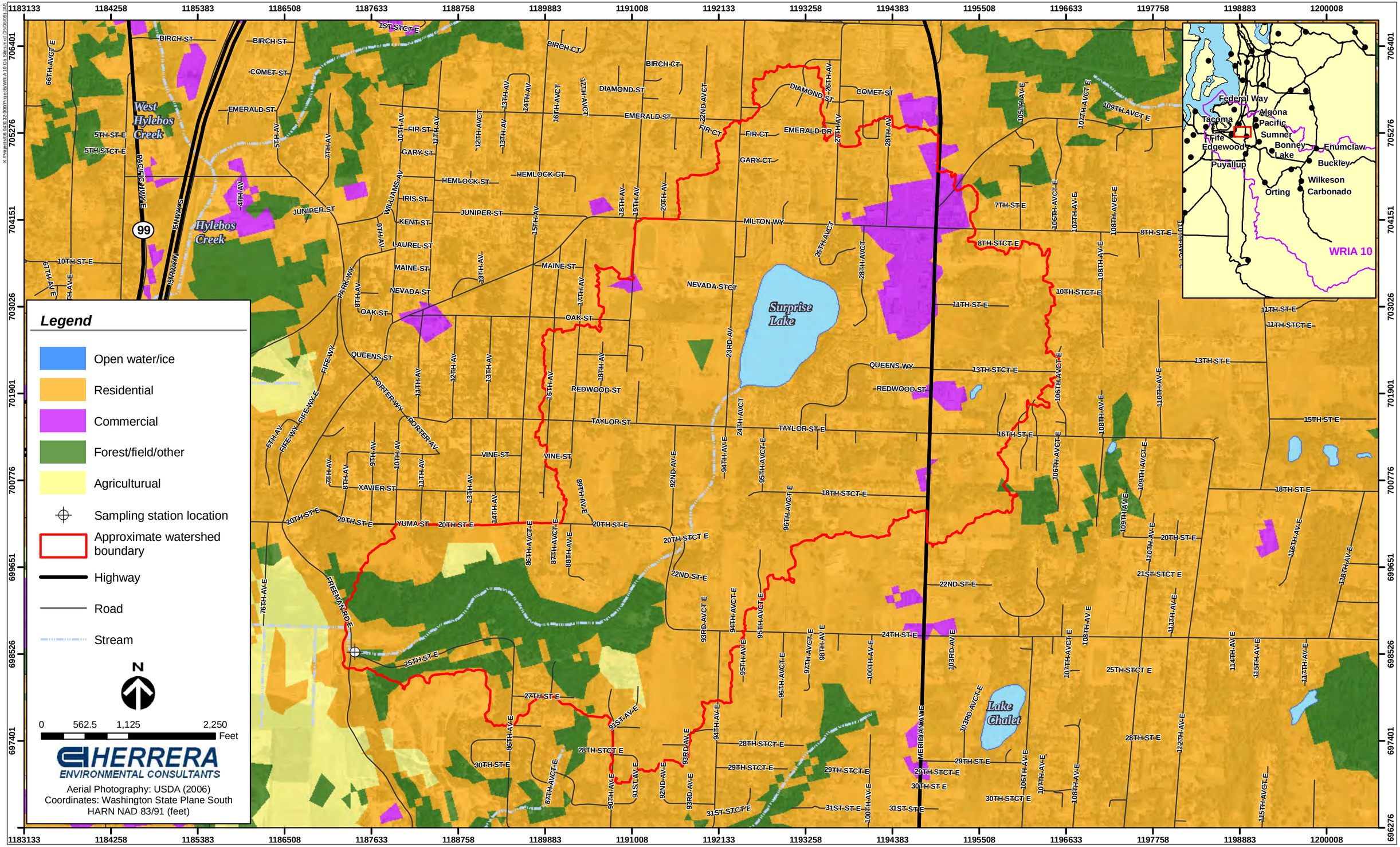


**Figure A-14. Monitoring location RB53 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the residential land use category.**

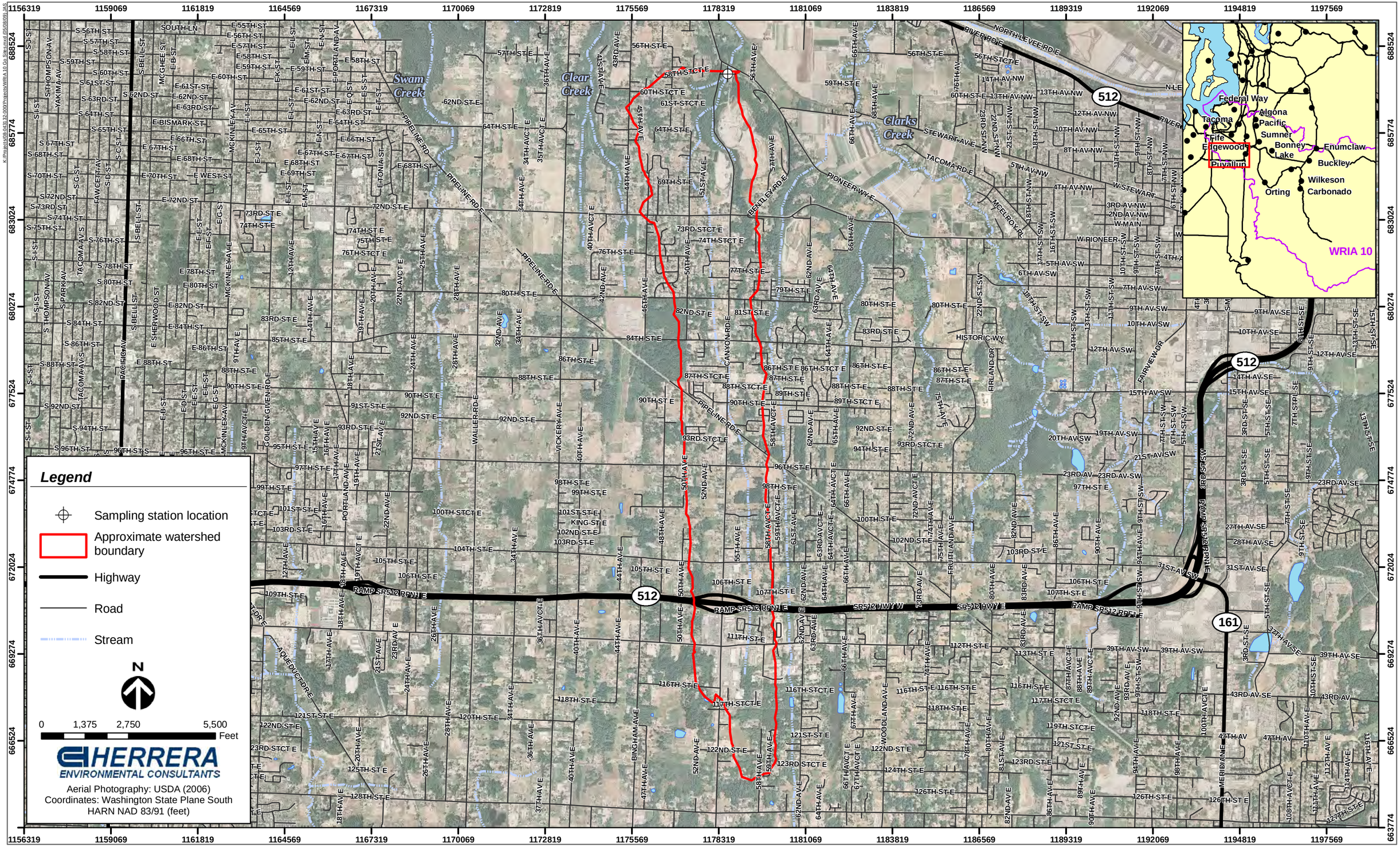


**Figure A-15. Monitoring location RB209 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the residential land use category.**

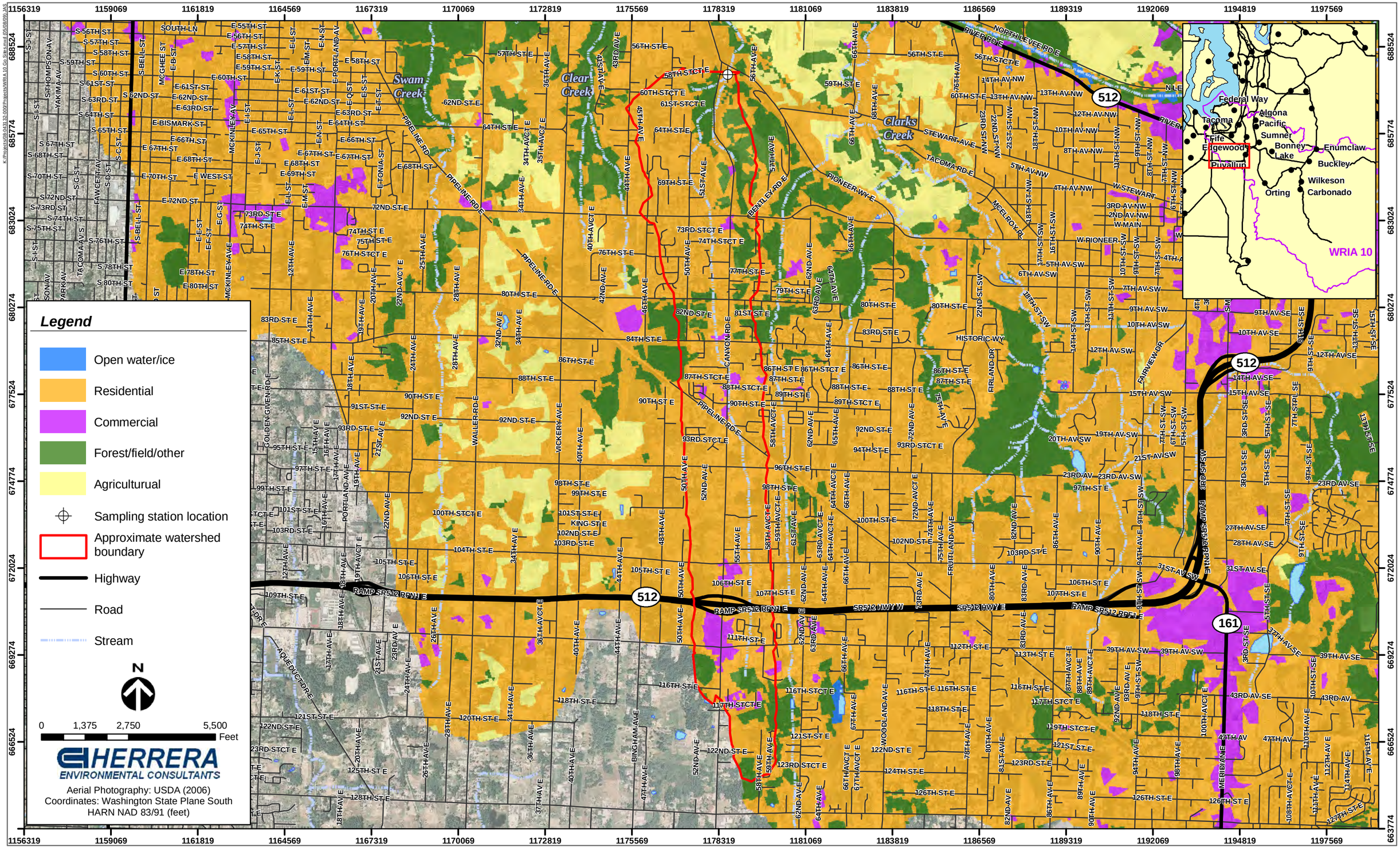


**Figure A-16. Monitoring location RB209 in the Puyallup River Watershed for characterizing toxic chemicals in runoff from the residential land use category.**

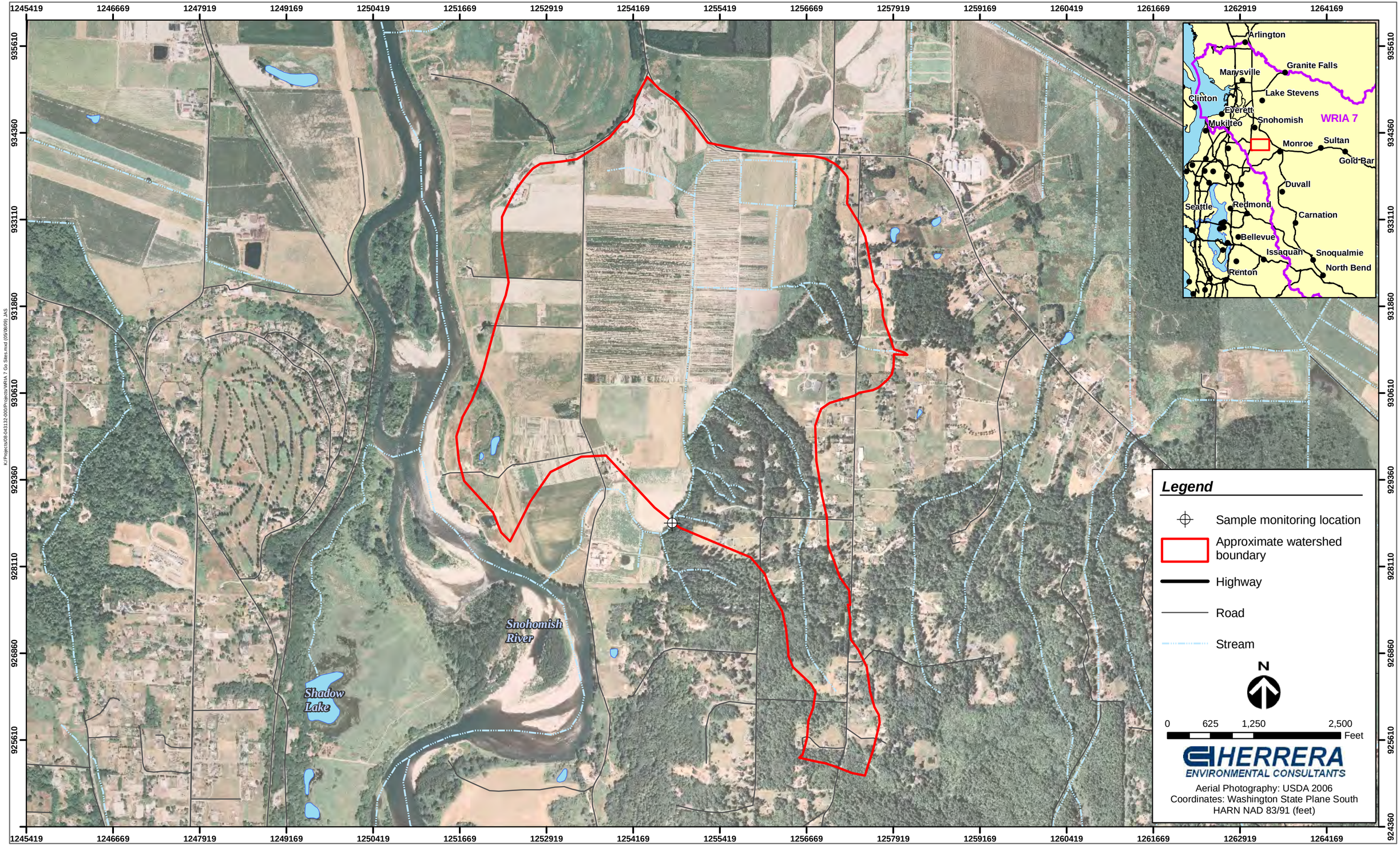


**Figure A-17. Monitoring location AG174 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the agricultural land use category.**

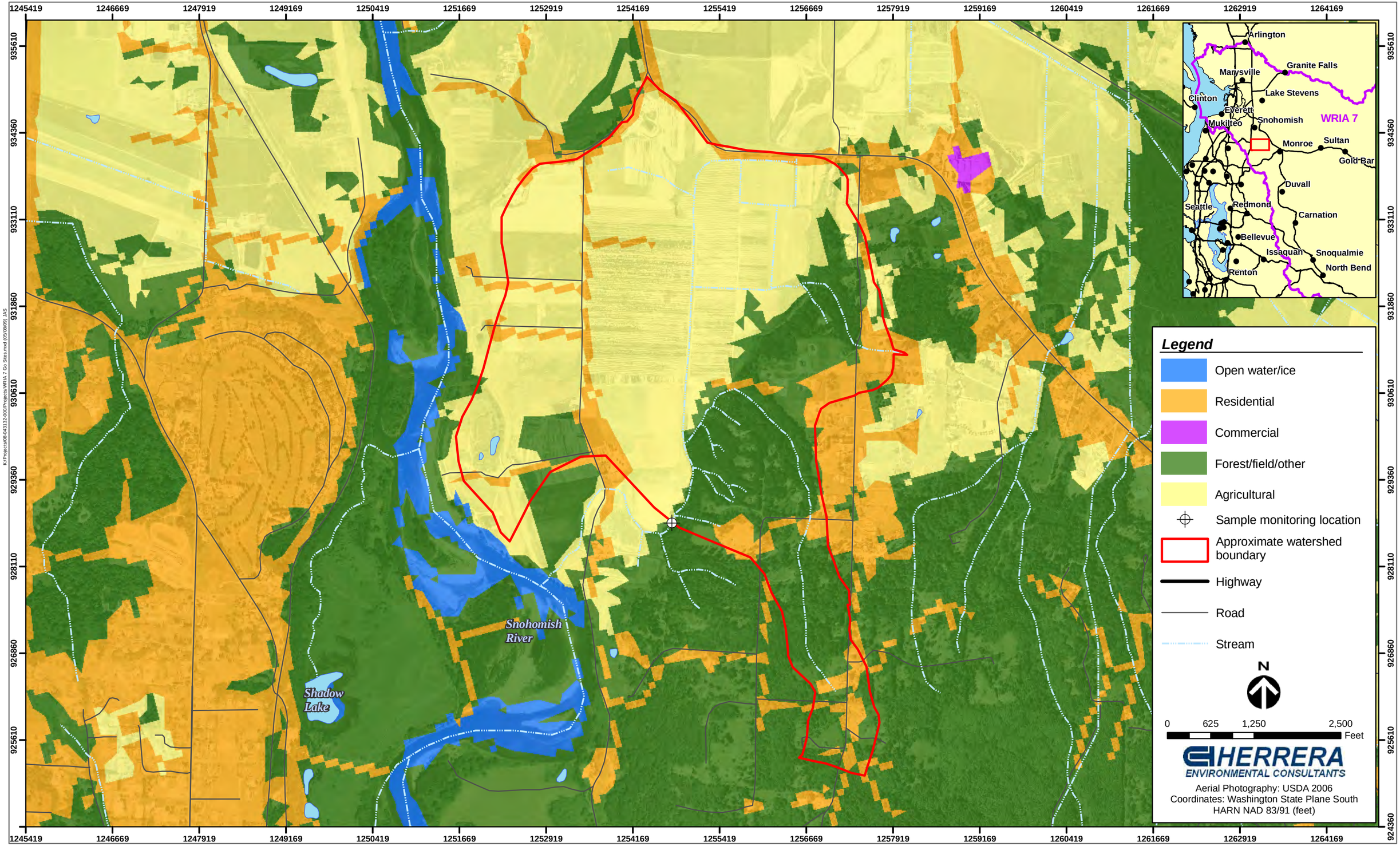


**Figure A-18. Monitoring location AG174 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the agricultural land use category.**

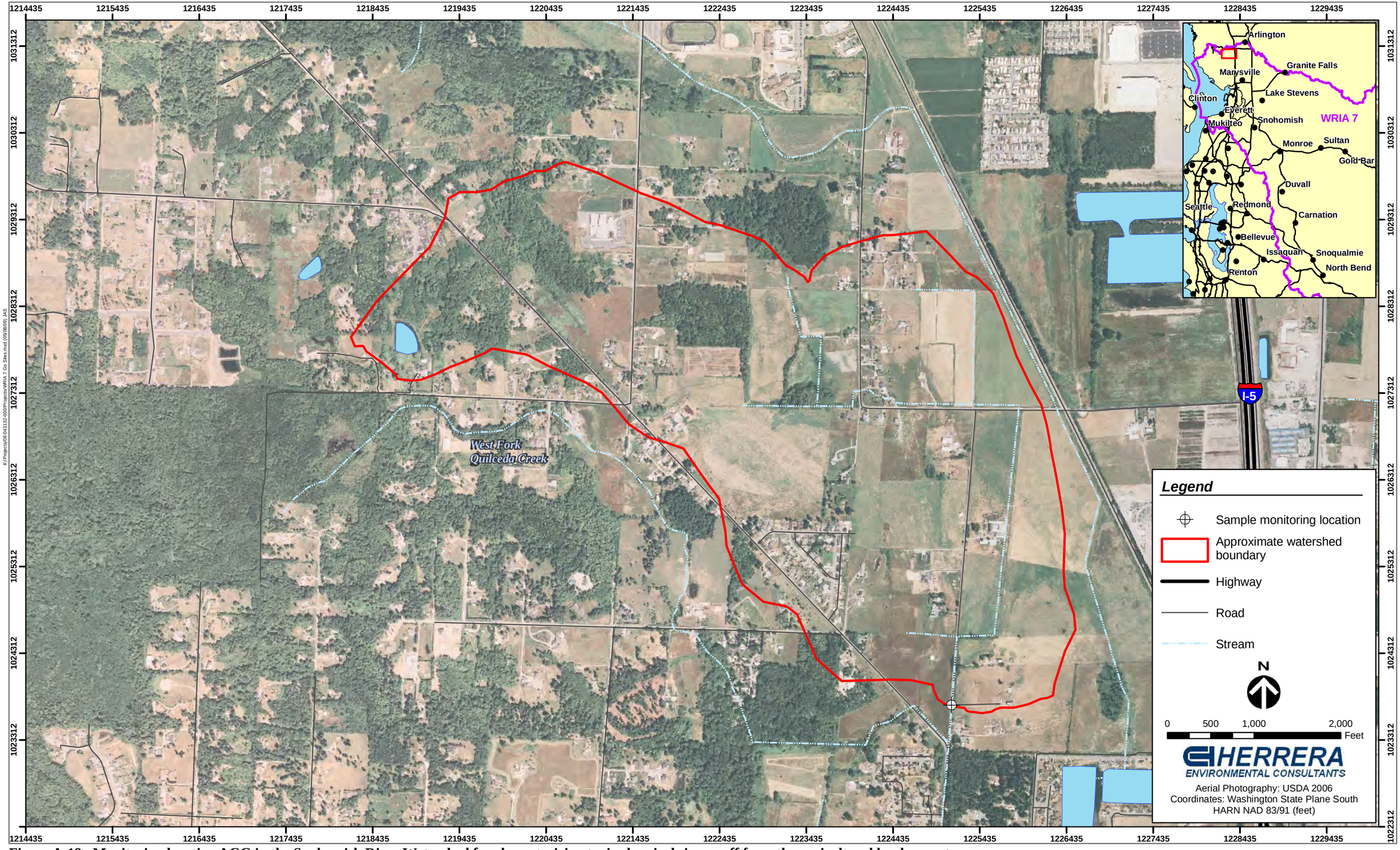


**Figure A-19. Monitoring location AGG in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the agricultural land use category.**

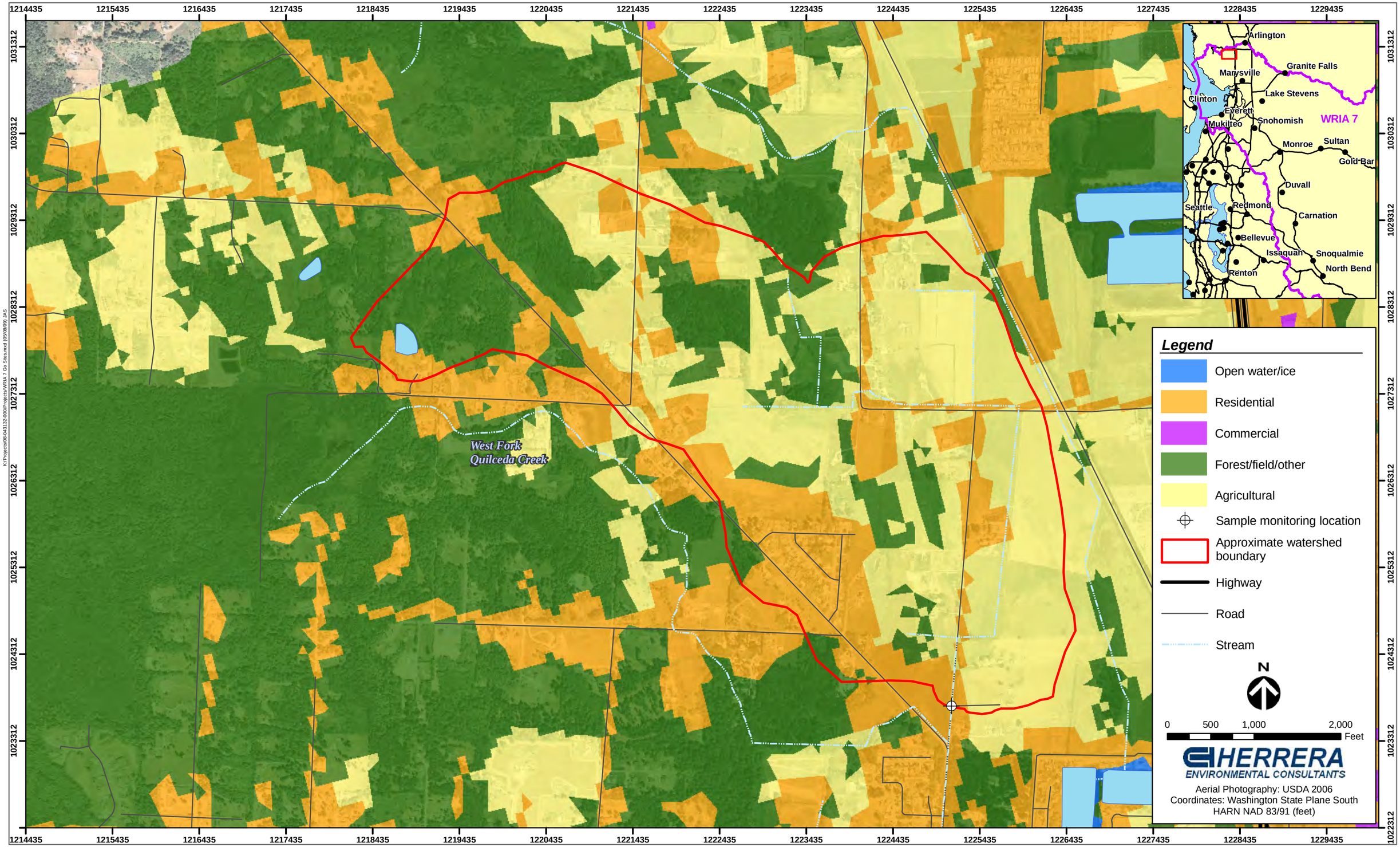


**Figure A-20. Monitoring location AGG in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the agricultural land use category.**

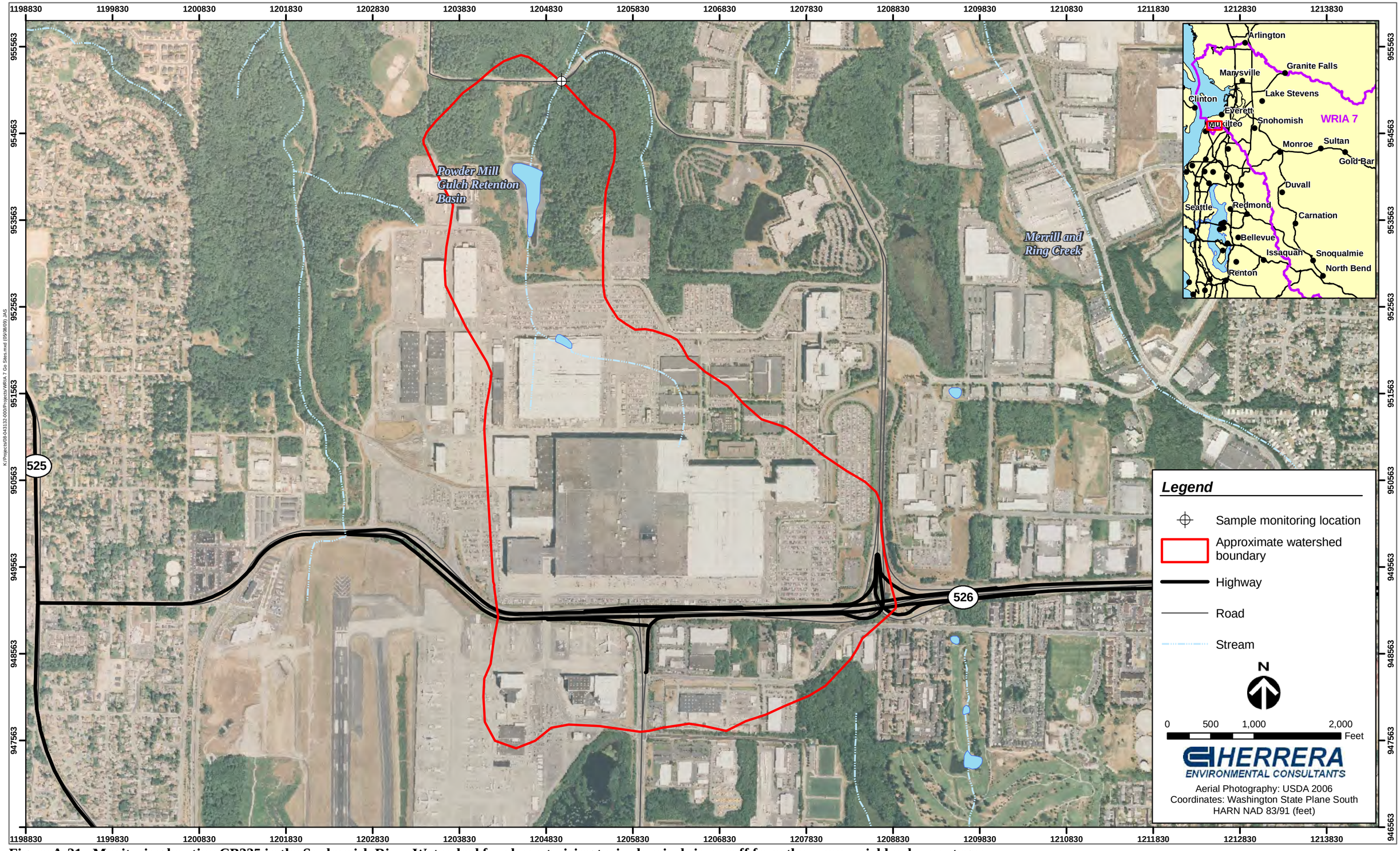


**Figure A-21. Monitoring location CB335 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the commercial land use category.**

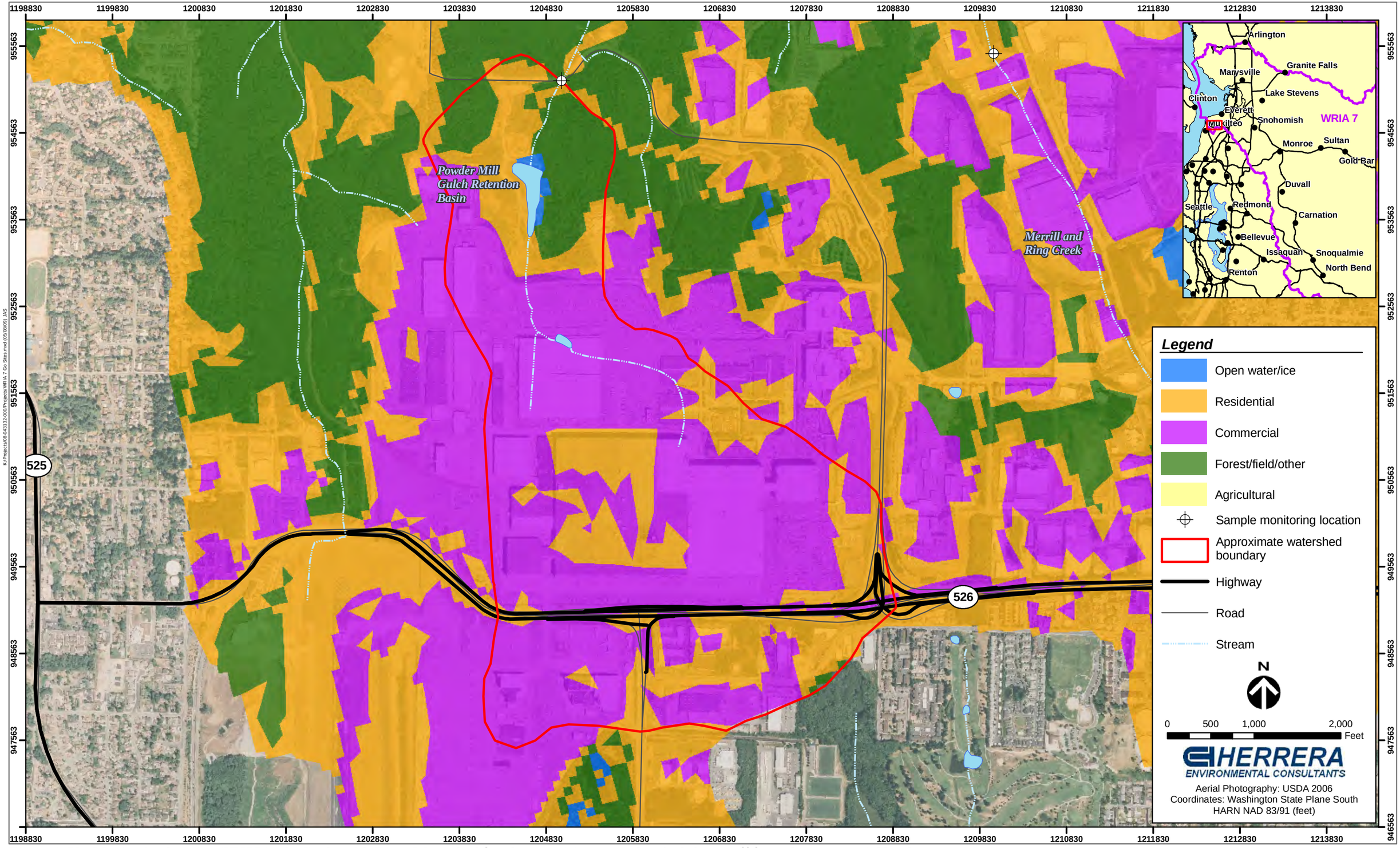


**Figure A-22. Monitoring location CB335 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the commercial land use category.**

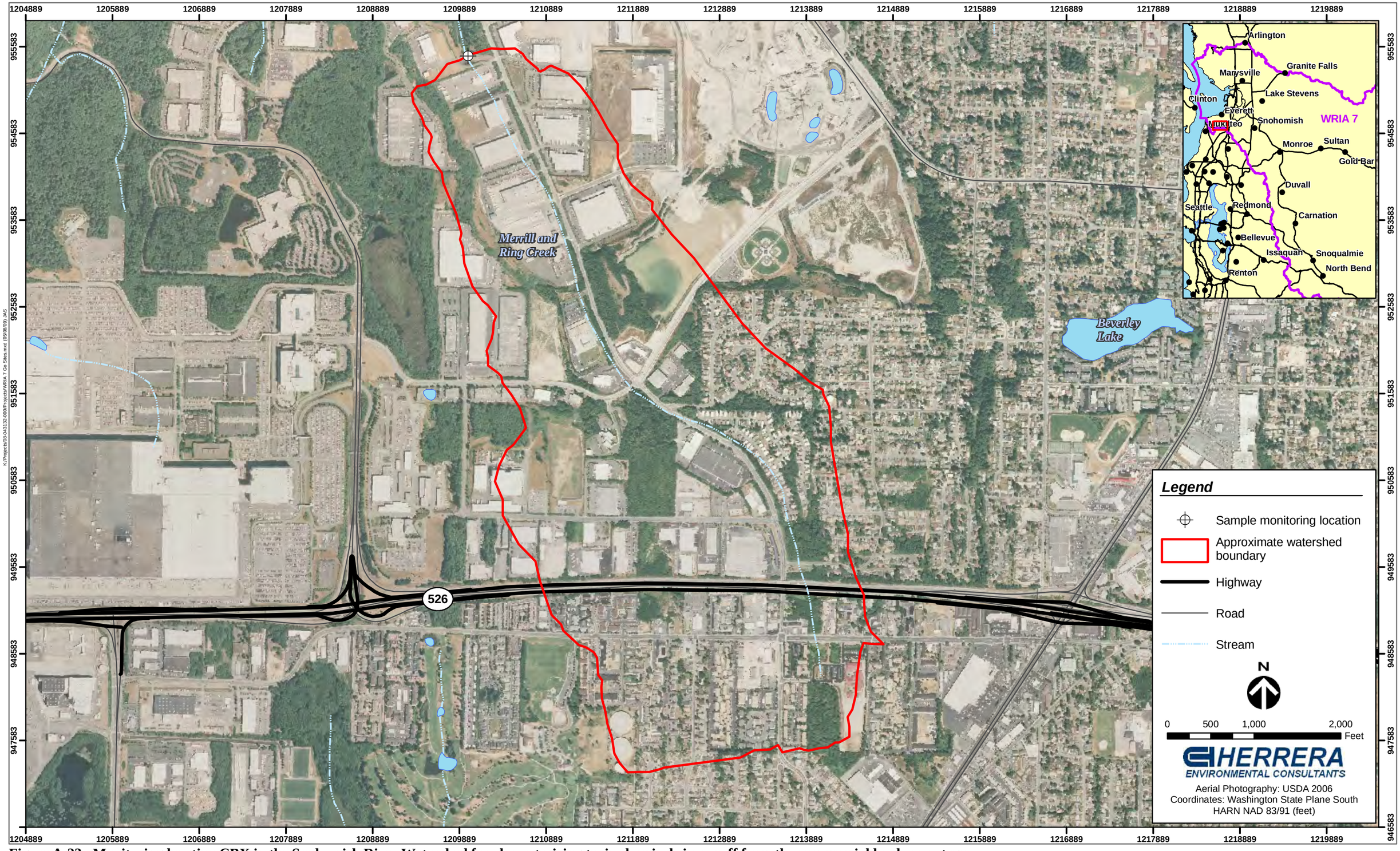


**Figure A-23. Monitoring location CBX in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the commercial land use category.**

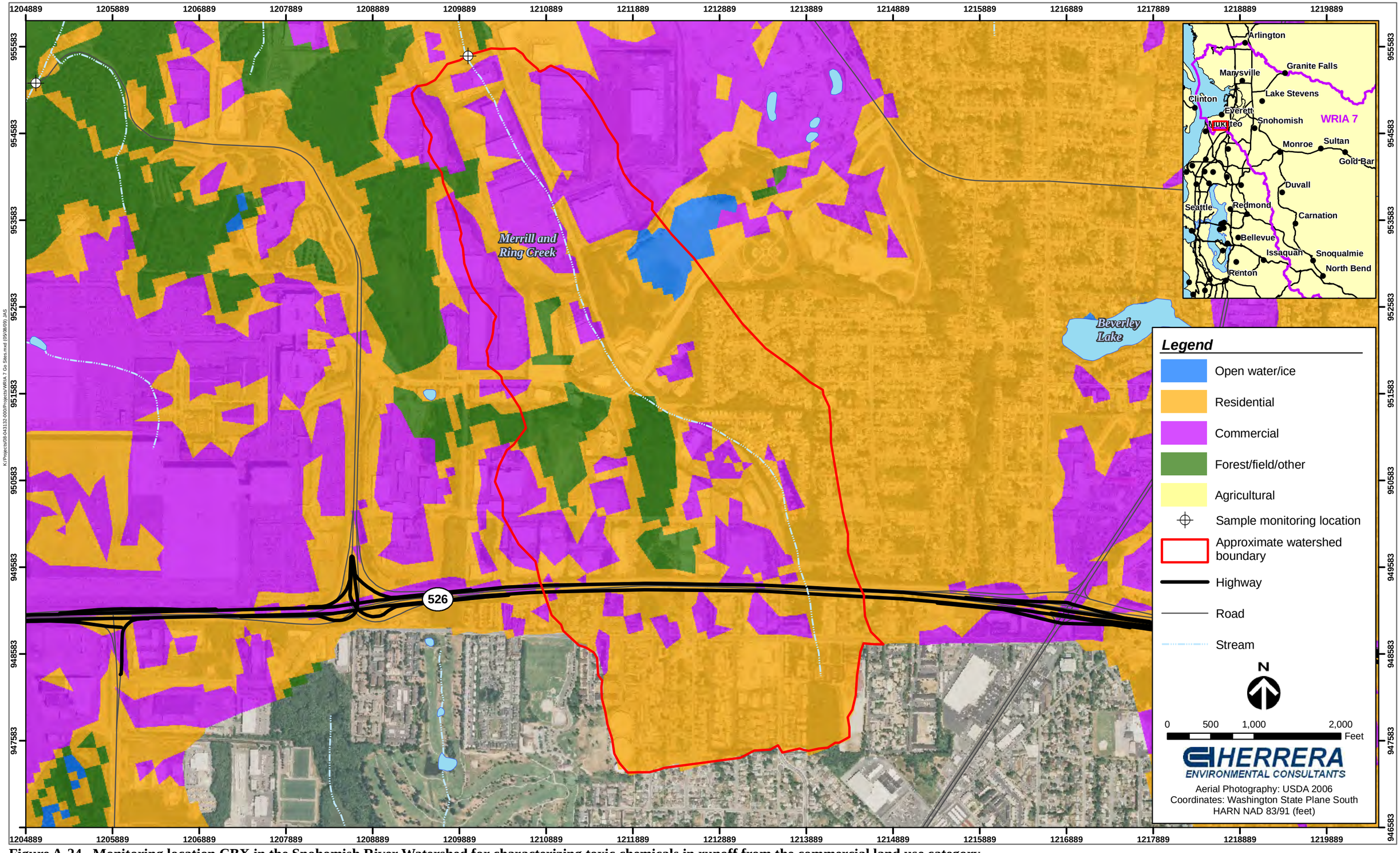


**Figure A-24. Monitoring location CBX in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the commercial land use category.**

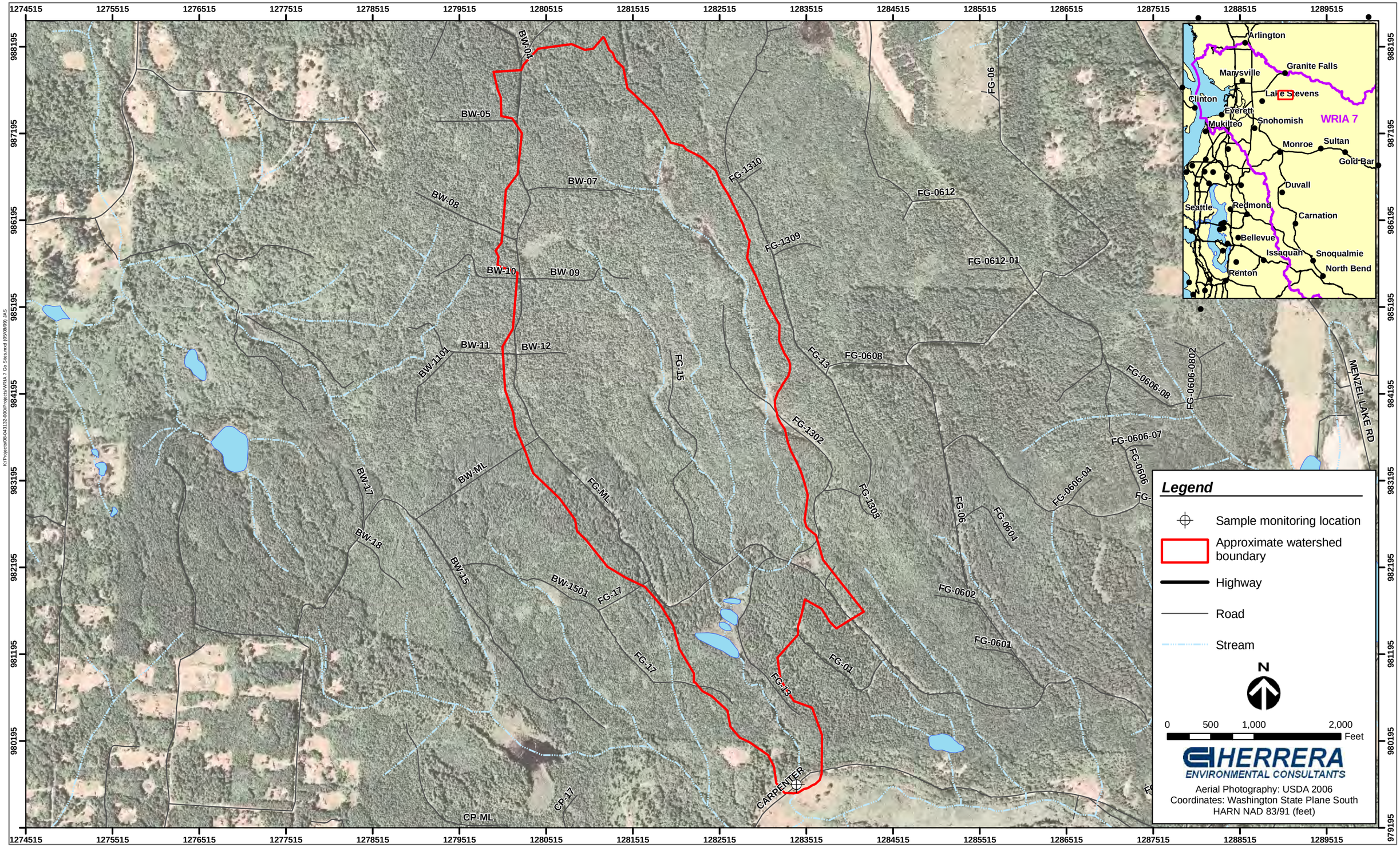


**Figure A-25. Monitoring location FB200 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the forest/field/other land use category.**

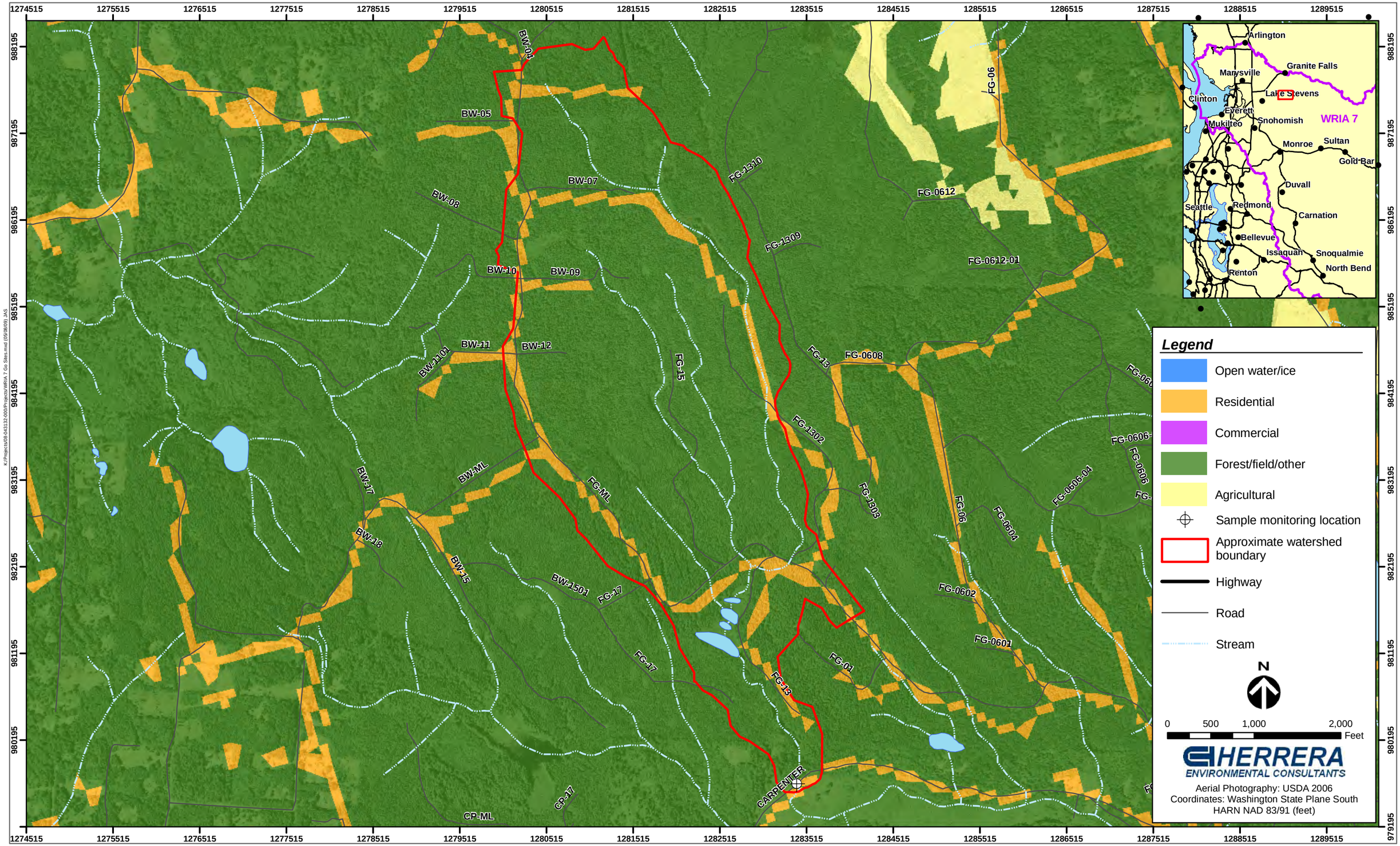


**Figure A-26. Monitoring location FB200 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the forest/field/other land use category.**

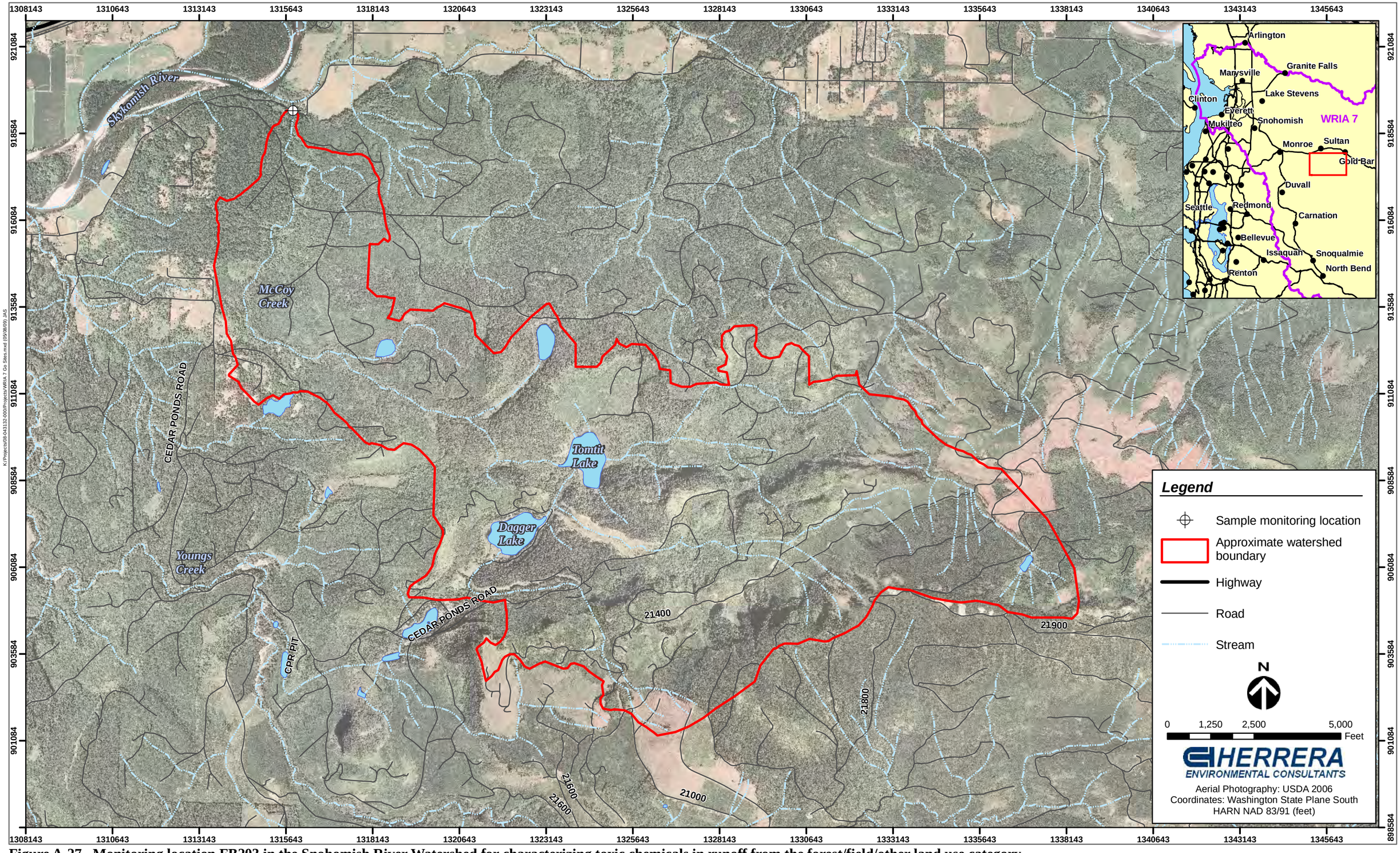


**Figure A-27. Monitoring location FB203 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the forest/field/other land use category.**

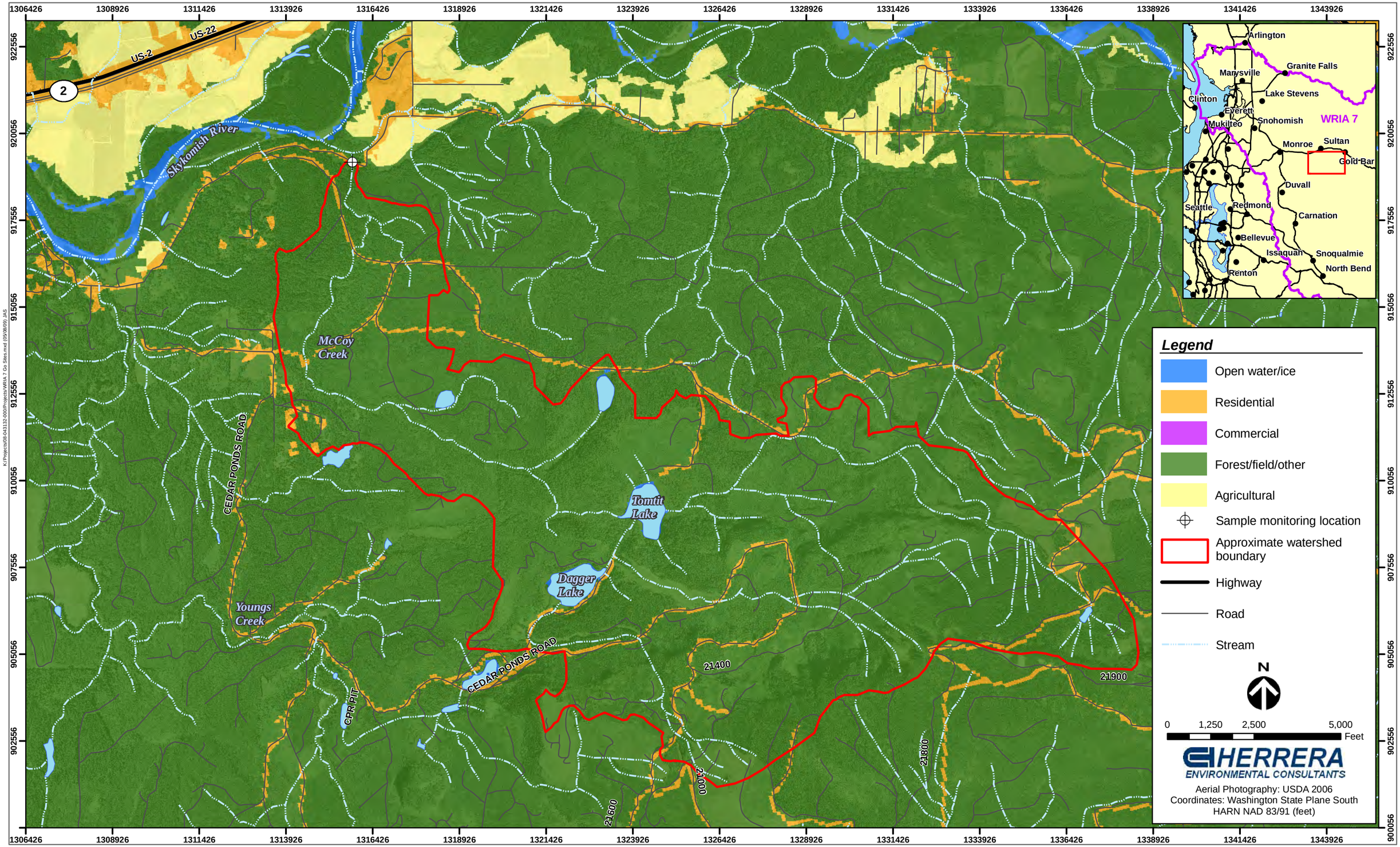


**Figure A-28. Monitoring location FB203 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the forest/field/other land use category.**

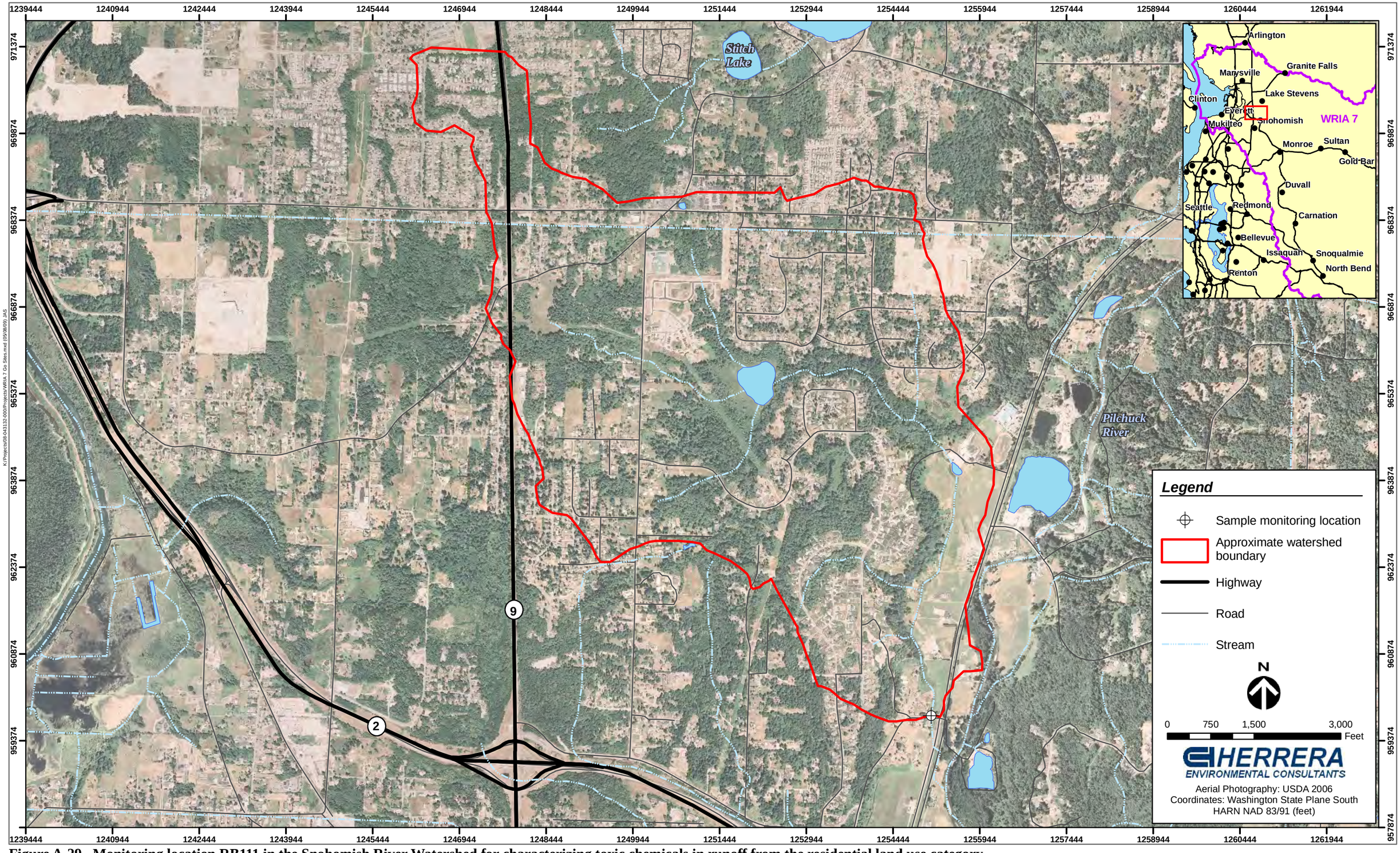


**Figure A-29. Monitoring location RB111 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the residential land use category.**

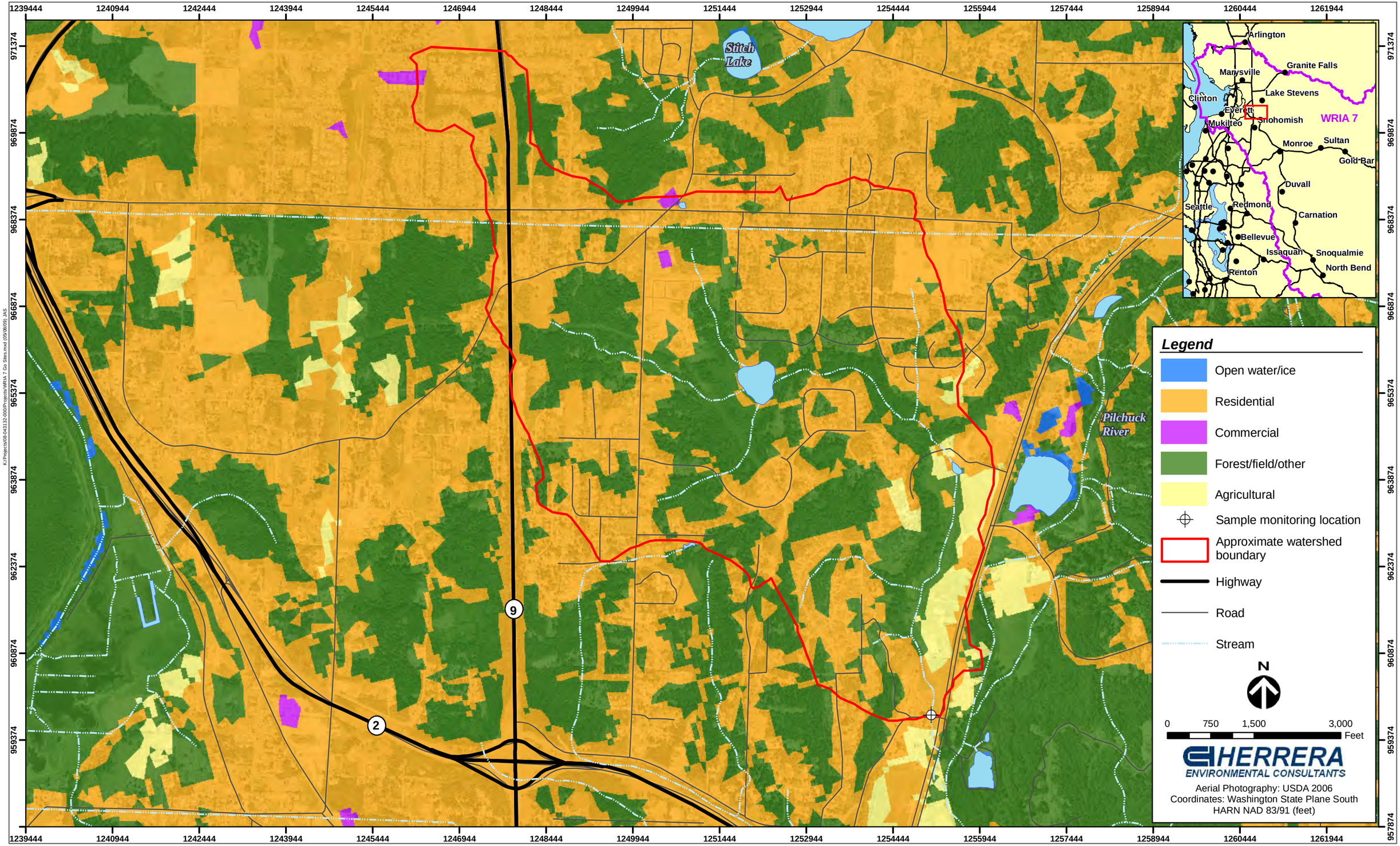


**Figure A-30. Monitoring location RB111 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the residential land use category.**

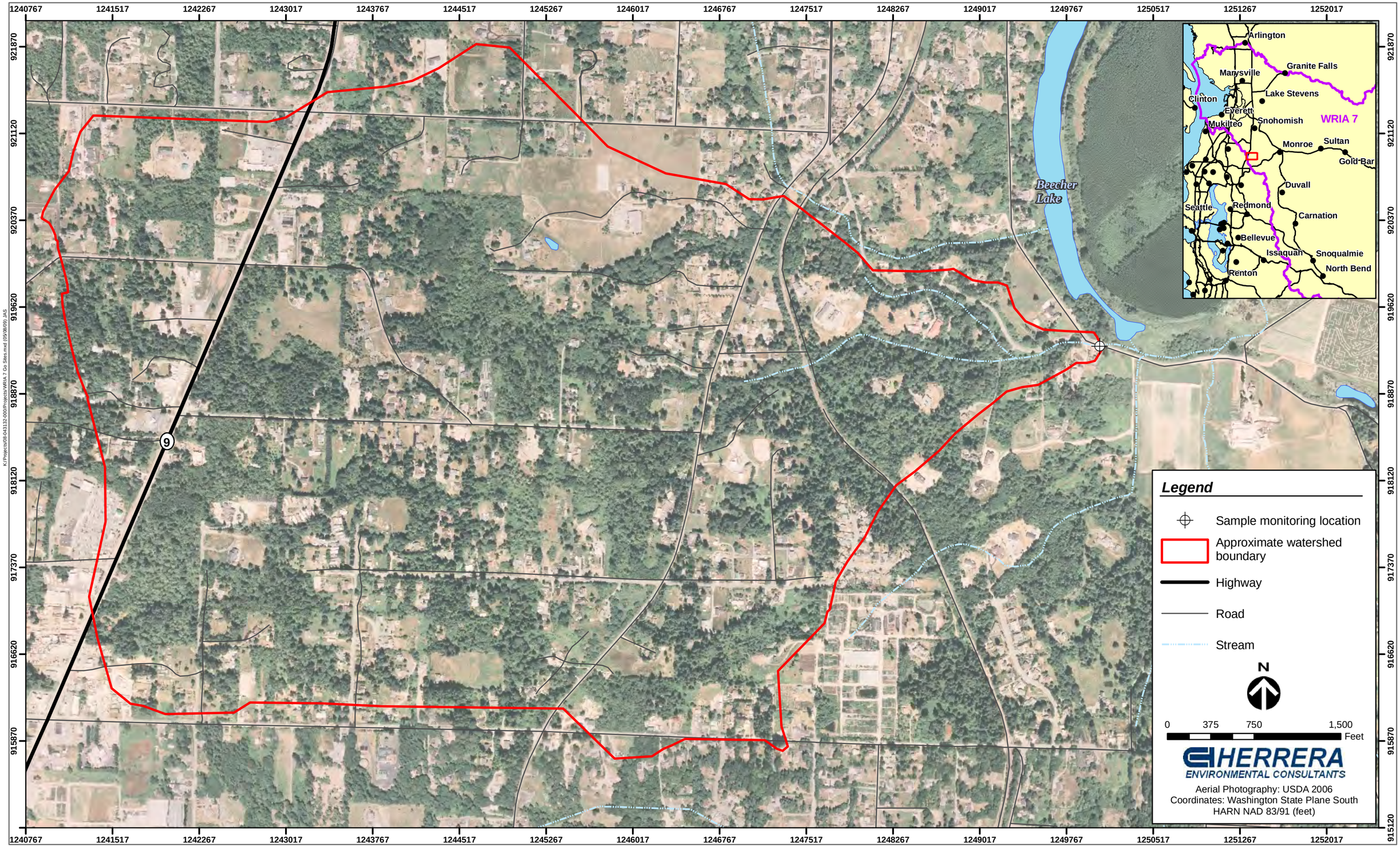


**Figure A-31. Monitoring location RB202 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the residential land use category.**

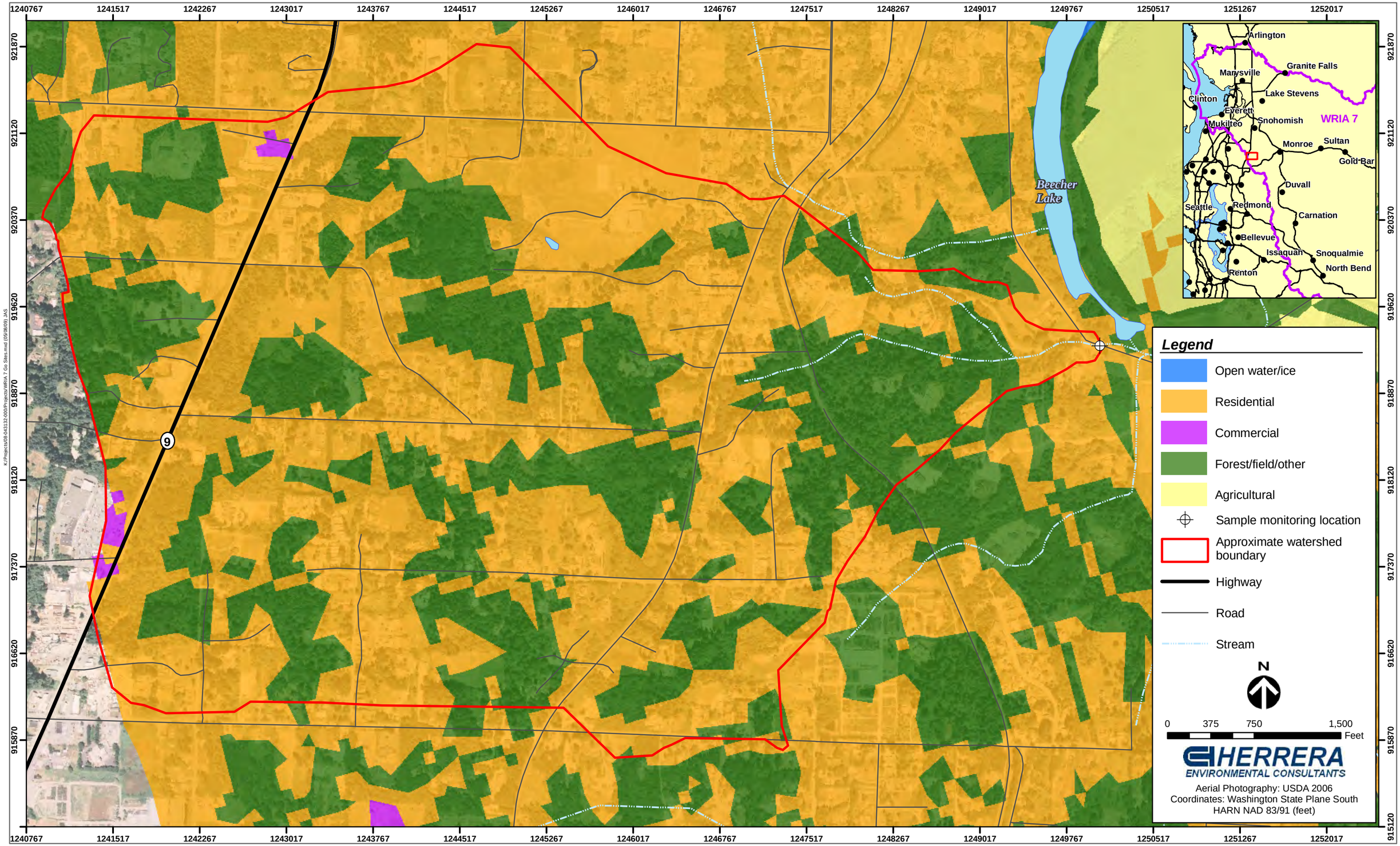


**Figure A-32. Monitoring location RB202 in the Snohomish River Watershed for characterizing toxic chemicals in runoff from the residential land use category.**

# Appendix B.  Installation Reports

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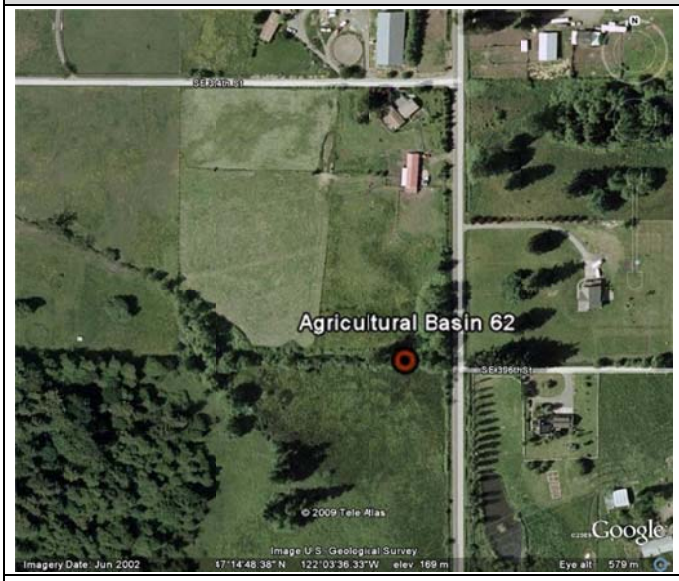
# INSTALLATION REPORT
## Installation Overview

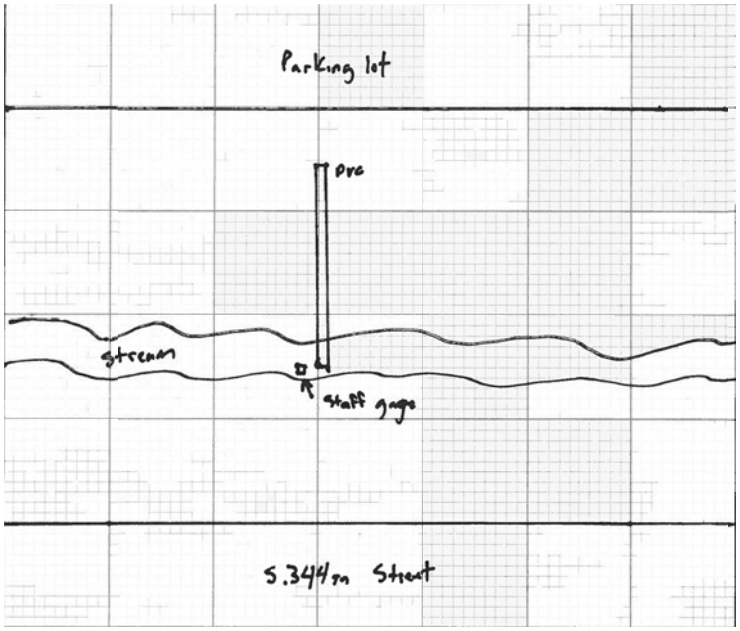
| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 8/3/2009 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/30/2010 |
| WRIA: | 10 | Field Personnel: | Dan Bennett |
| Station ID: | Agricultural Basin 62 | Weather: Sunny, Dry | |
| Location: | 0.2 miles north of 400th street on 212th Ave SE, where 396th street is shown on the map, but is in reality a driveway. | Site Description: The stream flow in a roadside ditch, north of 212th Ave SE. It flows in a 36 inch culvert beneath 212th Ave. The steam then flows in a 6 foot wide constrained ditch through a field. The equipment was installed 50 feet downstream of the culvert at a point where the bank is stabilized by large tree roots. | |

**Vicinity Map of Site**




Lat: 47°14'46.84"N
Long: 122° 3'34.40"W

**Site Drawing (Plan View)**




**Description of Installation**

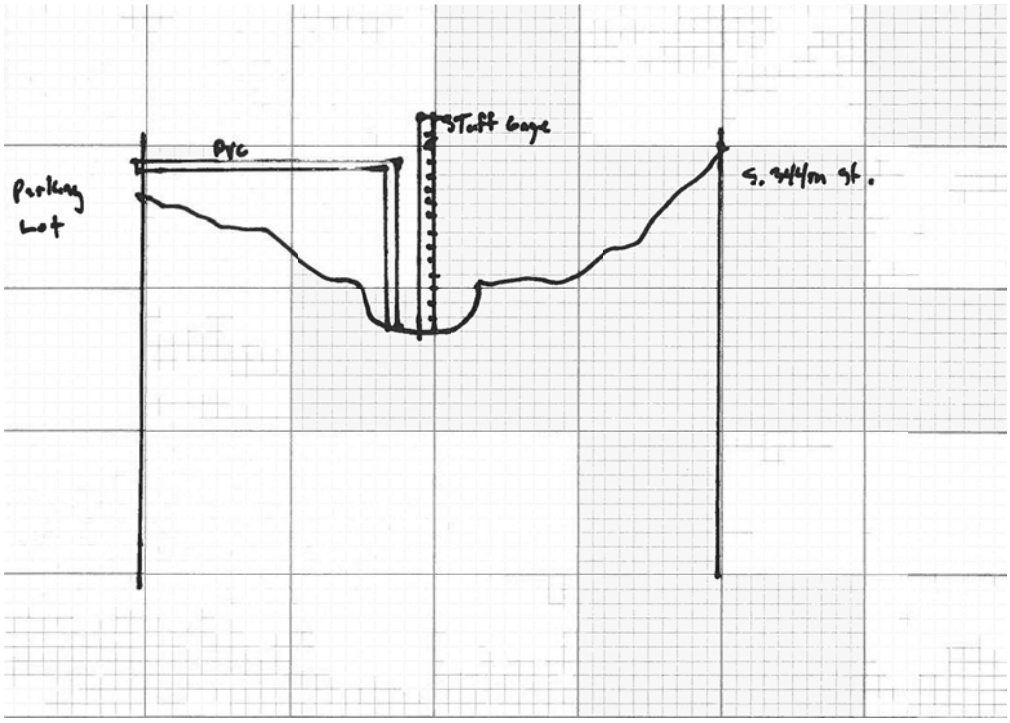
The pressure transducer and staff gage were installed together in a location about 50 feet downstream of the culvert beneath 212th Street, on the western edge of the stream, in a point where the stream is constrained by trees on the bank. A stilling well consisting of a drivable wellhead was driven into the streambed about 2.5 feet deep. The transducer cable is run up to the stream bank in a straight PVC pipe, and secured to a tree on the bank. The staff gage is installed across the stream from the pressure transducer at the eastern edge of the stream.

**Safety Issues/Access Restrictions**

There is no parking available on the shoulder. Park in the driveway on the north side of 212th Street and walk across the street. Be cautious of traffic. There are rusty abandoned farm implements hidden in the brush and thick blackberry brambles. Proceed with caution.

# INSTALLATION REPORT
## Installation Overview

### Station Installation Diagram




### Photo Log

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 8/3/2009 Time: 10:00 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: 50 feet south of 212th Street on west side of stream, attached to log. | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928006 |
| Length of Cable (ft): | 9 |
| Desiccant Type/Condition: | Blue to Pink, 100% |

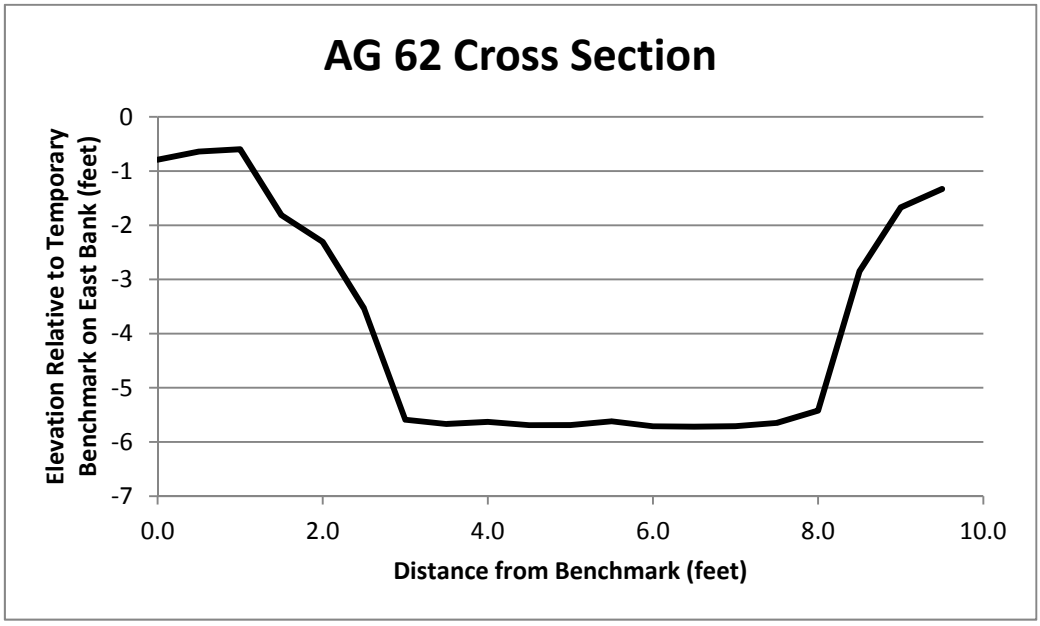
### Description of Hydraulic Conditions

| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☐ Free Flowing | ☒ Dry | ☐ Stagnant |
| Base Flow Depth (ft): | 1 | Estimated Storm Flow Depth (ft): | **2.5** | |
| Base Flow Velocity (ft): | 1 | Estimated Storm Flow Velocity (ft/s): | **3** | |
| Sediment Depth (in): | 2 | Staff Gauge: | **2.5** | |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 6 |
| Bankfull Depth (ft): | 4 |
| Substrate: | cobble |
| Slope: | 2 |
| Vegetation: | Blackberry brambles, Alder |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Equipment is well off the beaten path, located 50 feet through brush downstream of an inconvenient parking space. It was also installed in a camouflage PVC pipe with a locking well-cap.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 8/17/2009 | 13:21 | 0.19 | 1.7652 | -1.574 | 0.186 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## Notes

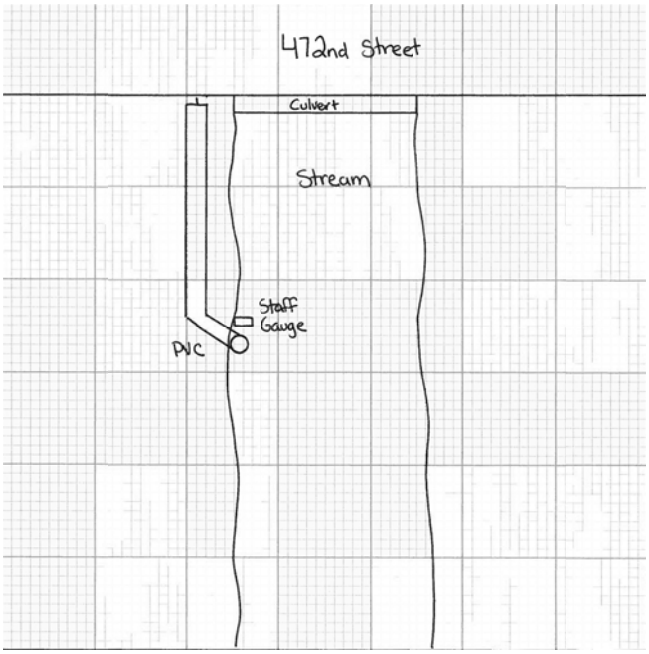
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 8/30/2009 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/30/2010 |
| WRIA: | 10 | Field Personnel: | Dan Bennett, Brian Tornow |
| Station ID: | Agricultural Basin 143 | Weather: | Sunny, Dry |
| Location: | 0.2 miles east of 260th Ave SE on SE 472nd Street, | Site Description: The stream runs through ditch in farm field, and crosses under SE 472nd St. in a squashed 2 foot diameter culvert. It then flows in a very low gradient linear ditch with a mucky bottom and blackberry bramble bank. | |

**Vicinity Map of Site**


Lat: 47°10'38.99"N
Long: 121°59'26.05"W

**Site Drawing (Plan View)**




### Description of Installation

A drivable well point was driven into the streambed to a depth of about 2.5 feet in soft muck. The transducer cable was run straight up for 5 feet, and then bends at a 90 degree angle through a T and is run about ten feet to the road. The staff gage was installed immediately adjacent to the pressure transducer.

### Safety Issues/Access Restrictions

The only available parking is on the shoulder at a gated entrance to the farm field. The parking area is narrow and there is occasional traffic on the street. Proceed with caution. Use safety cones.

# INSTALLATION REPORT
## Installation Overview

**Station Installation Diagram**

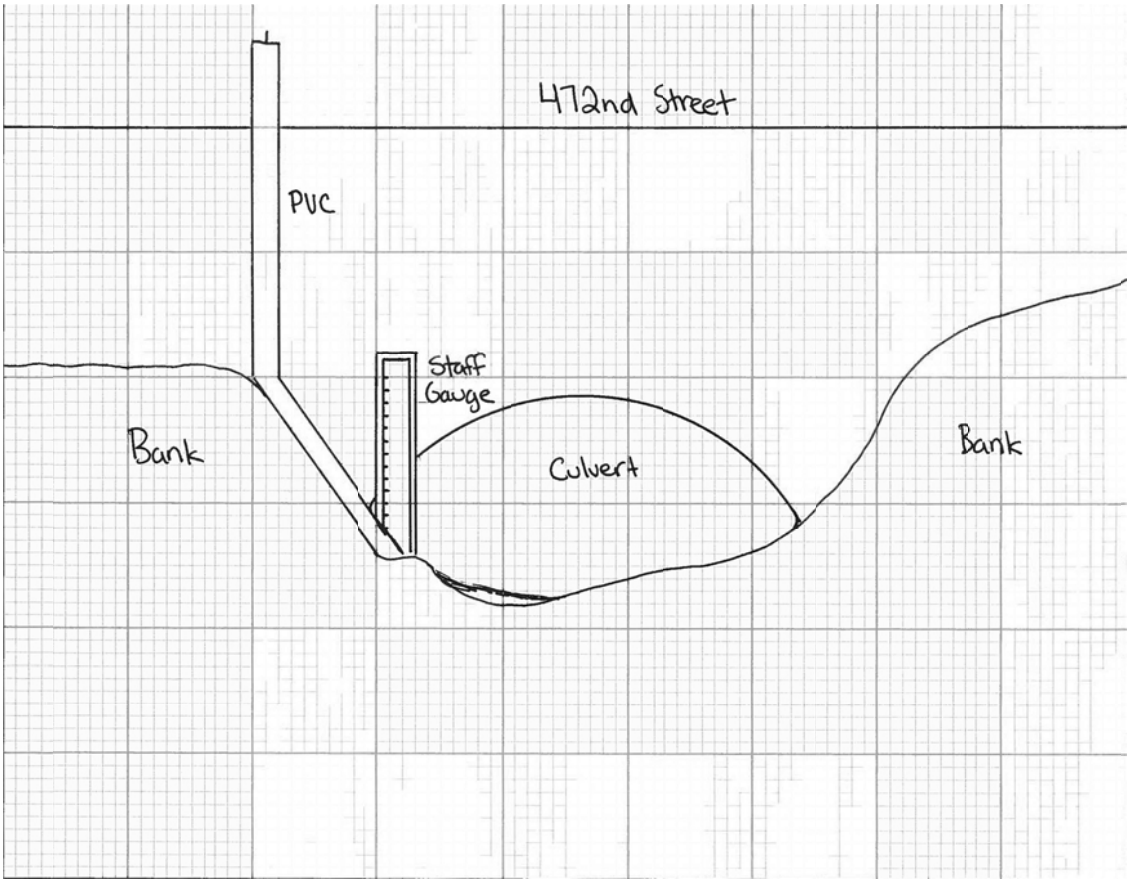



**Photo Log**

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 8/3/09 Time: 13:00 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: Downstream mouth of culvert | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928005 |
| Length of Cable (ft): | 19 |
| Desiccant Type/Condition: | Blue to Pink/ 100% |

### Description of Hydraulic Conditions

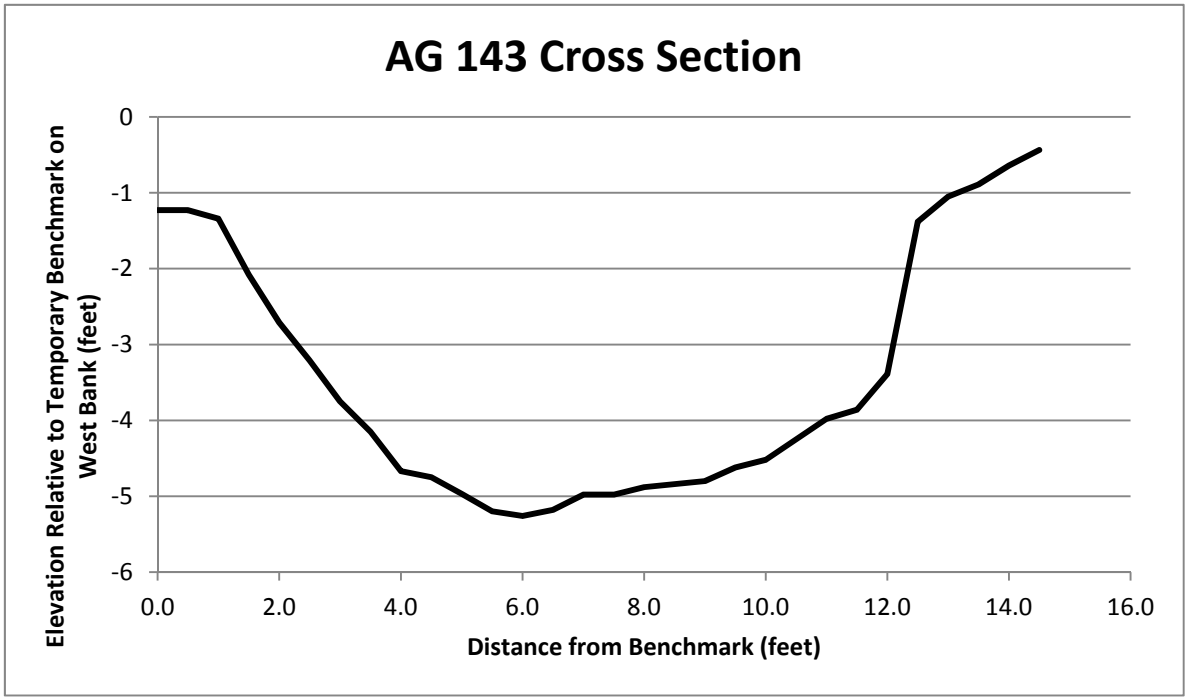
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☐ Free Flowing | ☒ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 1 | Estimated Storm Flow Depth (ft): | 2.5 |
| Base Flow Velocity (ft): | 0.5 | Estimated Storm Flow Velocity (ft/s): | 2 |
| Sediment Depth (in): | 10 | Staff Gauge: | 0 |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 9 |
| Bankfull Depth (ft): | 3 |
| Substrate: | muck |
| Slope: | 1 |
| Vegetation: | Grass, Blackberry brambles |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

The PVC pipe containing the transducer cable was camouflaged and secured with a locking well-cap.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## Notes

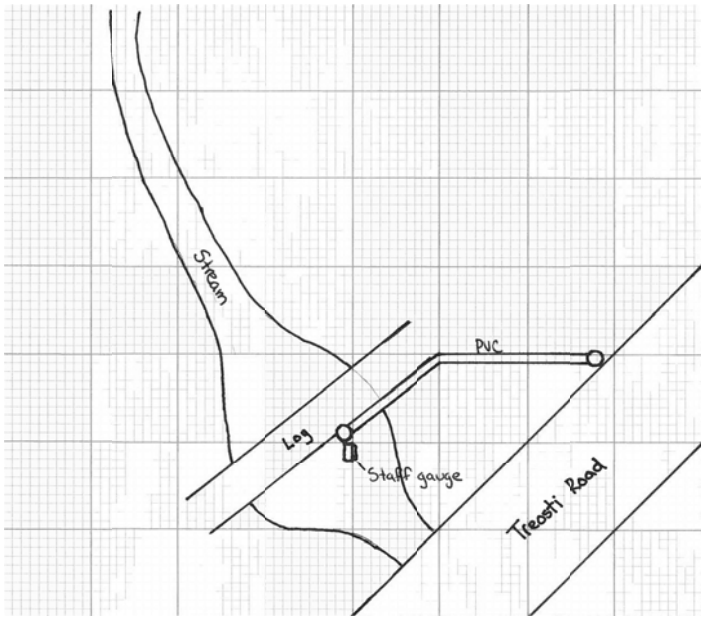
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 7/30/09 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/27/10 |
| WRIA: | 7 | Field Personnel: | Dan Bennett |
| Station ID: | Agricultural Basin 174 | Weather: | Sunny, Dry |
| Location: | 0.1 Miles south of Old Snohomish Monroe Rd., on Treosti Road. 50 feet north of road shoulder, down a steep embankment. | Site Description: | The stream emerges from a 24" culvert at the base of a steep 25 foot high bank. |

**Vicinity Map of Site**


Latitude: 47°53'8.23"N
Longitude: 122° 4'28.22"W

**Site Drawing (Plan View)**




### Description of Installation

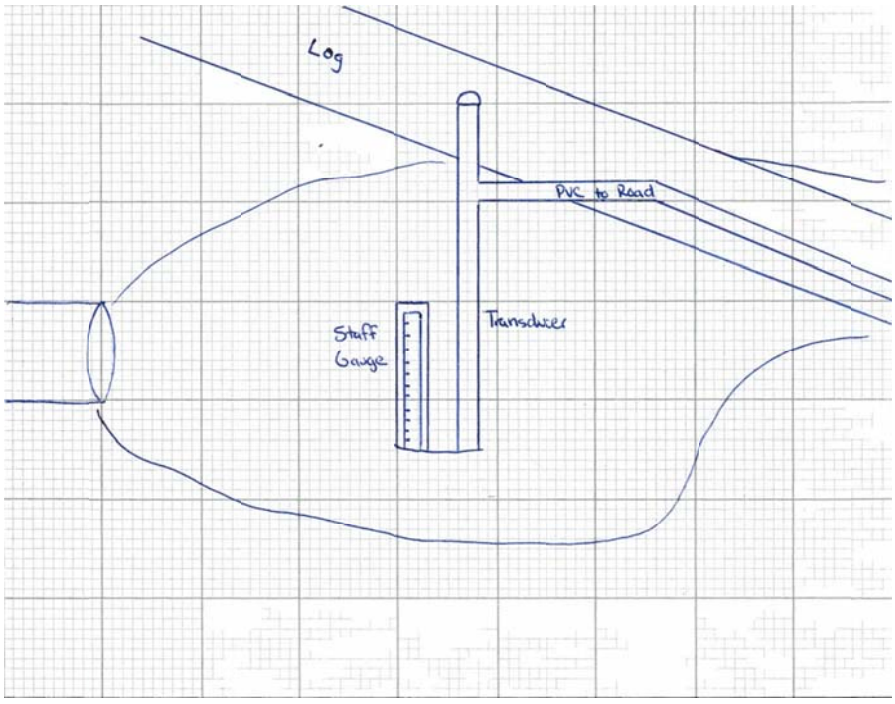
The stream flows out of a 24" culvert at the base of a steep bank that leads to the road. The stream cascades for a few feet and then runs in a pool for a few feet before descending to a marshy area where it widens for a 20 foot stretch in tall grass. It then joins another stream. The pressure transducer and staff gage were installed in the pool about 8 feet downstream of the culvert discharge point. The pressure transducer has a 28 foot cable, which was run high up the bank to avoid possible flooding of the Snohomish River. It may still be impacted by an extreme flooding event.

### Safety Issues/Access Restrictions

The vehicle should be parked across the street on the farm property where we have gained permission to park. Caution should be used while crossing the street. The path down the bank is very steep and extremely slippery when it is raining. There may also be barbed wire and rusted scrap metal obscured by overgrown blackberries. Proceed with caution.

# INSTALLATION REPORT
## Installation Overview

### Station Installation Diagram




### Photo Log

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 7/30/2009 Time: 12:24 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: AG 174 | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X |
| Serial Number: | 2928003 |
| Length of Cable (ft): | 28 |
| Desiccant Type/Condition: | 1mm balls, dark blue |

### Description of Hydraulic Conditions

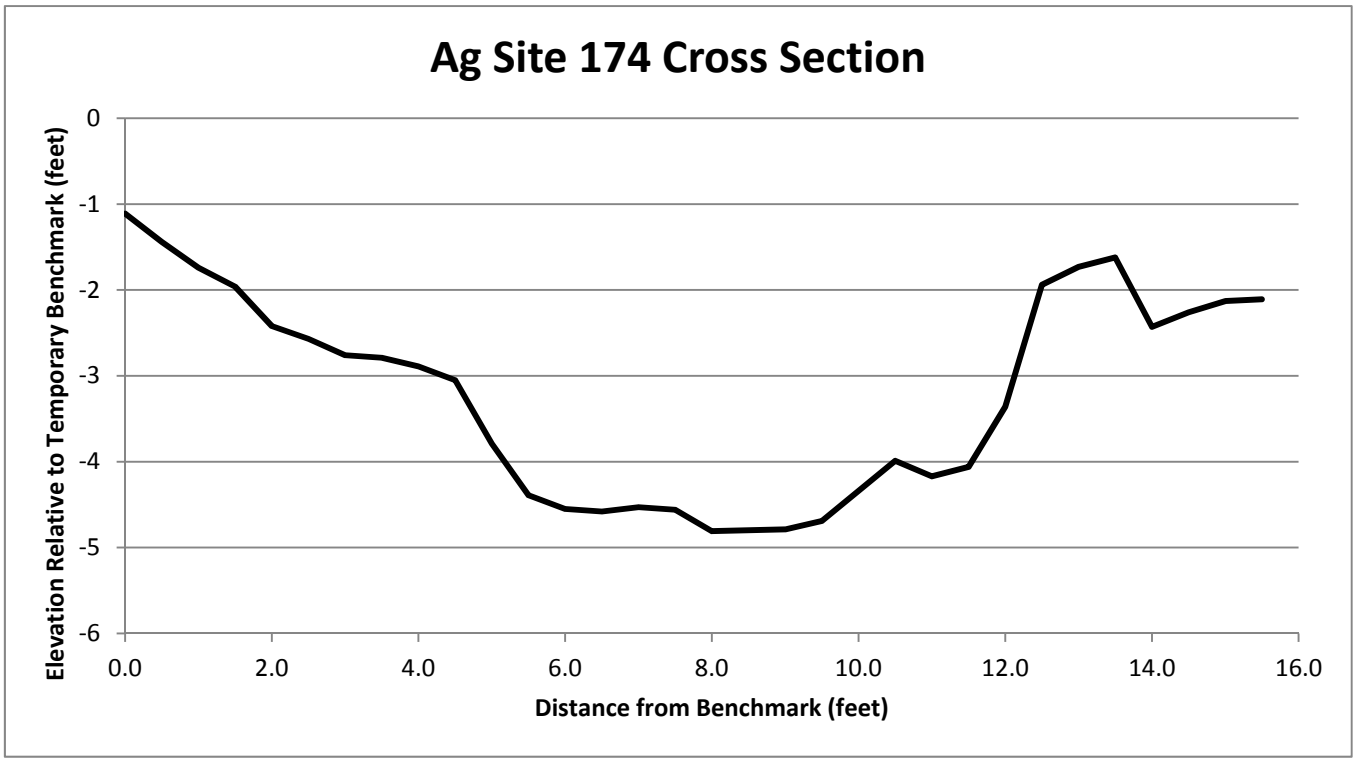
| Hydraulic Conditions: | ☐ Backwater | ☒ Free Flowing | ☐ Dry | ☐ Stagnant |
|---|---|---|---|---|

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 0.64 | Estimated Storm Flow Depth (ft): | 2.5 |
| Base Flow Velocity (ft): | 0.04 | Estimated Storm Flow Velocity (ft/s): | 1 |
| Sediment Depth (in): | NA | Staff Gauge: | 0.78 |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | **9** |
| Bankfull Depth (ft): | **3** |
| Substrate: | Muck and Cobble |
| Slope: | 2% |
| Vegetation: | Blackberry and Canary Grass |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Pressure Transducer is secured in a PVC Stilling Well with a locking well cap.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 7/30/2009 | 12:24 | 0.78 | 2.2084 | -1.428 | 0.78 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

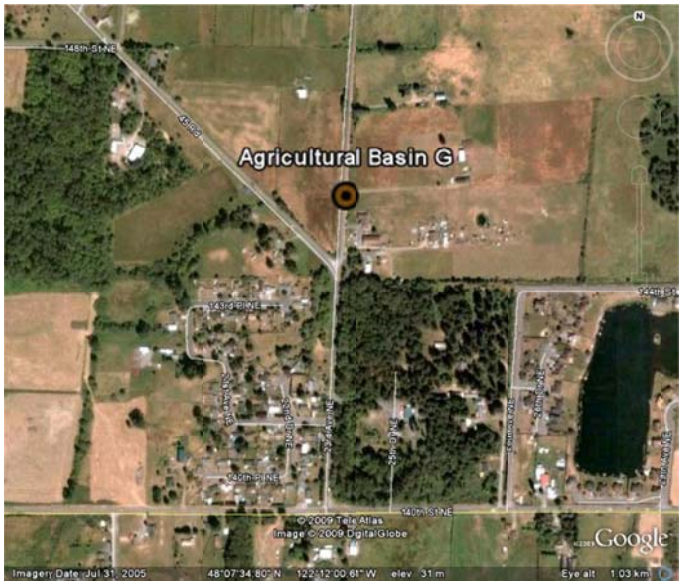
## Notes

The tile pipe/culvert is unfortunately, broken 4 feet up the pipe, making it an inappropriate place for flow measurements. Flow should be measured in the straightaway 5 feet downstream of the pool containing the staff gage.

# INSTALLATION REPORT
## Installation Overview

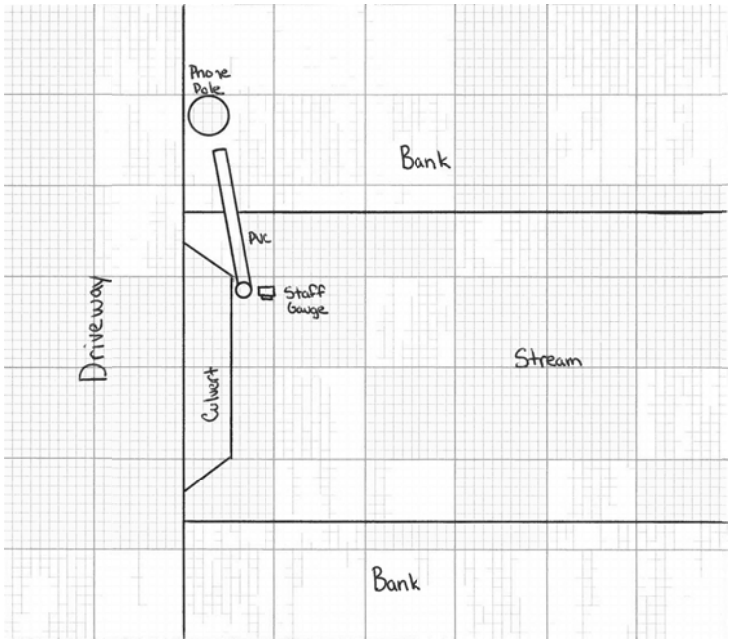
| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 7/31/2009 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/27/2010 |
| WRIA: | 7 | Field Personnel: | BT, NC |
| Station ID: | Agricultural Basin G | Weather: | Sunny , Dry |
| Location: | The 2nd driveway north of 45 Road on 23rd Ave NE | Site Description: The stream flows south along the east side of 23rd Ave Ne in a roadside ditch which is conveyed in short culverts across driveways. The stream is very low gradient. | |

**Vicinity Map of Site**




Latitude: 48° 7'40.30"N
Longitude: 122°12'0.06"W

**Site Drawing (Plan View)**




### Description of Installation

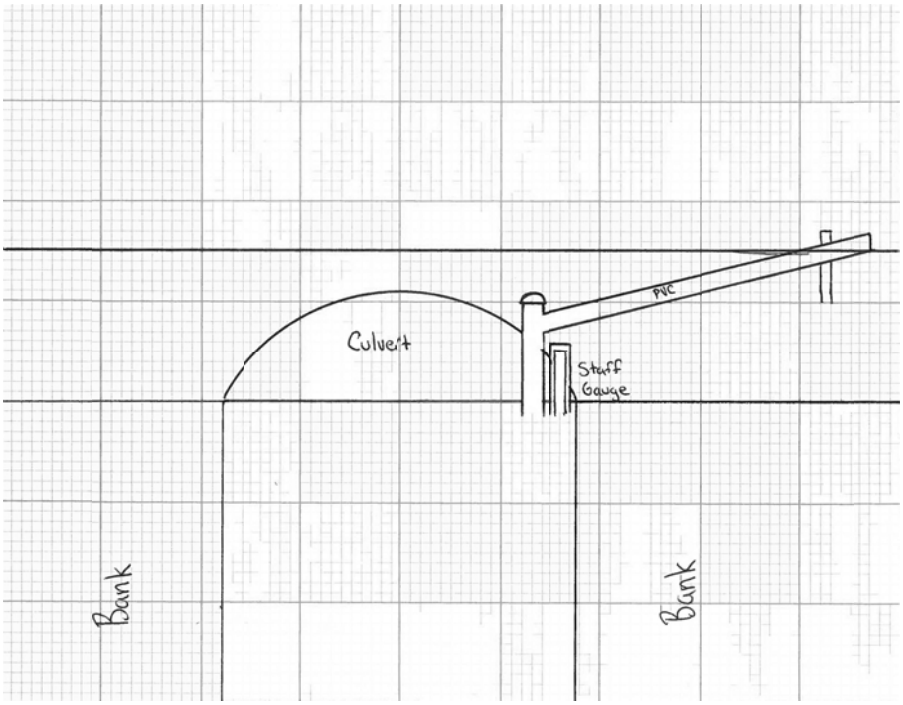
A stilling well consisting of a drivable wellhead was driven into the streambed at the mouth of the culvert conveying the stream beneath a driveway, at the eastern edge of the culvert. The well was driven about 2.5 feet deep. There was standing water (calculated a slight negative flow). The transducer cable is run up to road level, than takes a 45 degree Tee to the east for four feet. The staff gage is installed 0.5 feet downstream of the pressure transducer at the eastern edge of the streams as well.

### Safety Issues/Access Restrictions

The Van should park in the driveway allowing room for residents to pass, as 23rd is a high traffic road. The stream is mucky and should be sampled from above without entering if possible.

# INSTALLATION REPORT
## Installation Overview

### Station Installation Diagram




### Photo Log

# INSTALLATION REPORT
## Pressure Transducer

| | | |
|---|---|---|
| ☒ Installation Date: 7/31/09 Time: 8:54 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
| Location: AG G | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928007 |
| Length of Cable (ft): | 9 |
| Desiccant Type/Condition: | 95% |

### Description of Hydraulic Conditions

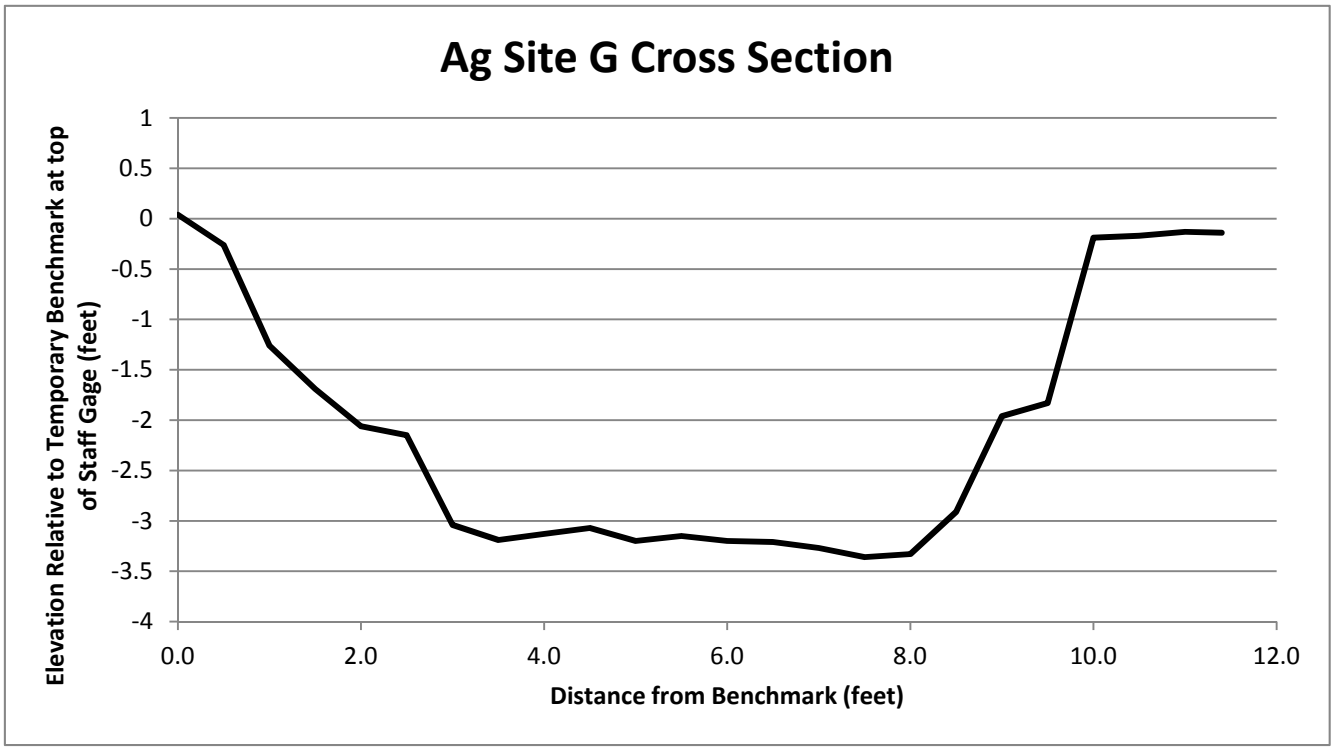
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☐ Free Flowing | ☐ Dry | ☒ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 0.40 | Estimated Storm Flow Depth (ft): | 2.5 |
| Base Flow Velocity (ft): | 0 | Estimated Storm Flow Velocity (ft/s): | 4 |
| Sediment Depth (in): | 2 | Staff Gauge: | 0.48 |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 8 |
| Bankfull Depth (ft): | 3 |
| Substrate: | muck |
| Slope: | 1 |
| Vegetation: | grass |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Locking well cap, camouflaged pvc tubing. An inconvenient place for vandals to stop.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 7/31/09 | 8:54 | 0.48 | 2.9796 | -2.5 | 0.48 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

## Notes

The transducer cord was just long enough, so be careful not to pull up when connecting.

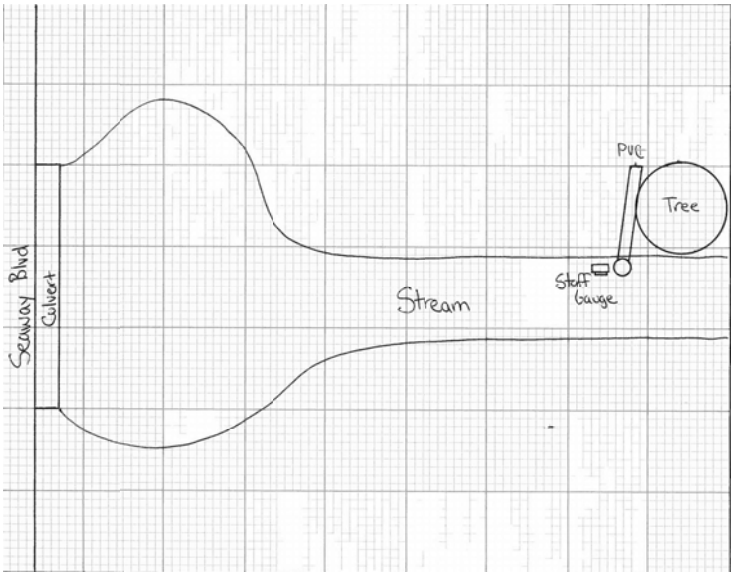
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 7/31/2009 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/27/2010 |
| WRIA: | 7 | Field Personnel: | Dan Bennett. Brian Tornow |
| Station ID: | Commercial Basin 35 | Weather: | Sunny, Dry |
| Location: | Seaway Blvd, east of 36th Ave West | Site Description: The stream emerges out of a 5 foot diameter culvert, flows into a large pool, and then flows down a straight confined channel. The site is located about 20 feet down the straight channel. | |

**Vicinity Map of Site**


Lat: 47°56'21.69"N
Long: 122°16'36.33"W

**Site Drawing (Plan View)**




## Description of Installation

The pressure transducer and staff gage were installed together in a location about 20 feet downstream of the large pool into which the culvert discharges. A stilling well consisting of a drivable wellhead was driven into the streambed . The well was driven about 2.5 feet deep. There was low flow at the time. The transducer cable is run up to waste level, then takes a 90 degree Tee to the east about ten feet. The staff gage is installed 0.5 feet downstream of the pressure transducer at the eastern edge of the streams as well.

## Safety Issues/Access Restrictions

The quarry spall road descending from the "Exotic Tools Welding" parking area to the stream, is unstable and should not be driven on. Despite the inconvenience, the van should be parked at the top parking lot, and gear should be carried down.

# INSTALLATION REPORT
## Installation Overview

**Station Installation Diagram**

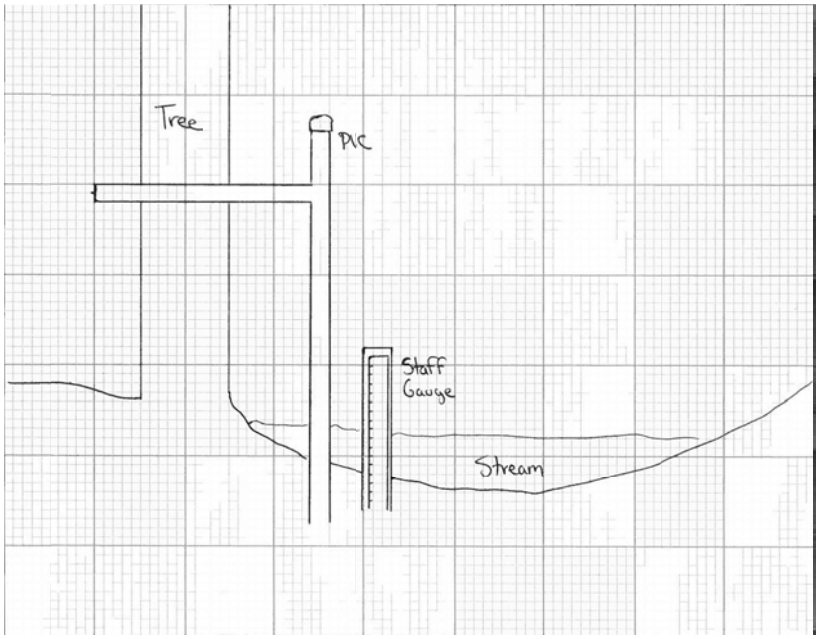



**Photo Log**

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 7/31/2009 Time: 12:57 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: CB 335 | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928015 |
| Length of Cable (ft): | 17 |
| Desiccant Type/Condition: | Blue to Pink/ 100% |

### Description of Hydraulic Conditions

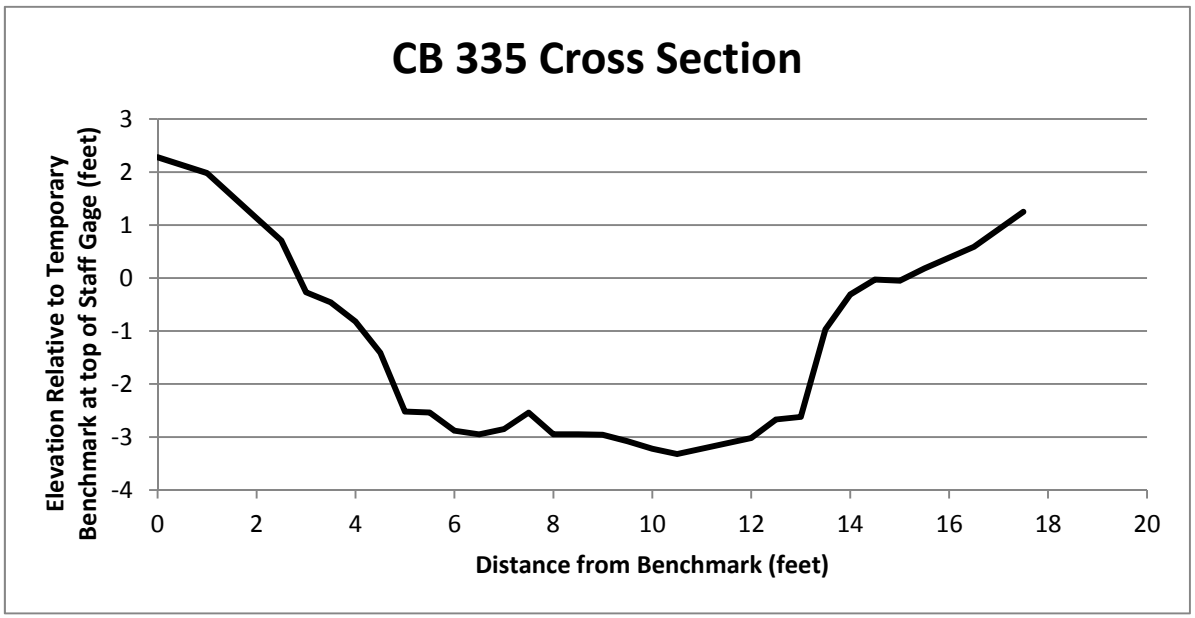
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☒ Free Flowing | ☐ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 0.5 | Estimated Storm Flow Depth (ft): | 1.5 |
| Base Flow Velocity (ft): | 0.5 | Estimated Storm Flow Velocity (ft/s): | 5 |
| Sediment Depth (in): | Cobbles | Staff Gauge: | 0.62 |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 10 |
| Bankfull Depth (ft): | 2 |
| Substrate: | Cobbles |
| Slope: | 2 |
| Vegetation: | Alders, Stinging Nettles, Blackberries, Grasses. |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Locking well cap, camouflaged pvc tubing. An unlikely place for vandals to notice.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 7/31/09 | 12:57 | 0.62 | 1.9273 | -1.307 | 0.62 |
| | | | | | |
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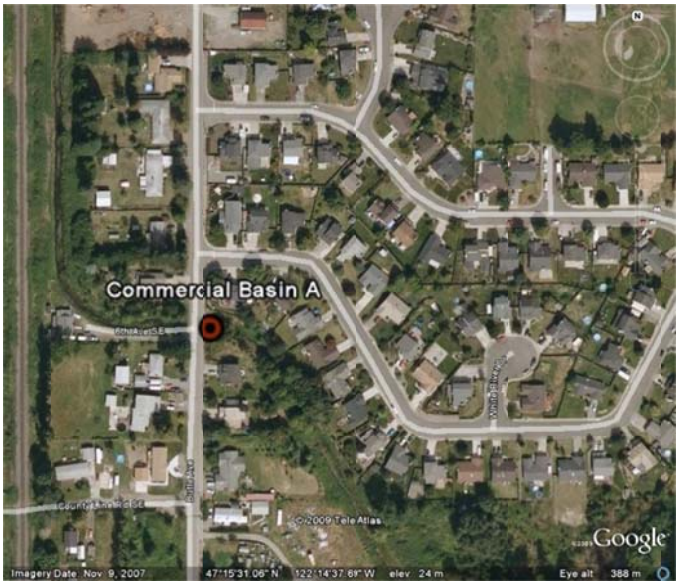
## Notes

# INSTALLATION REPORT
## Installation Overview

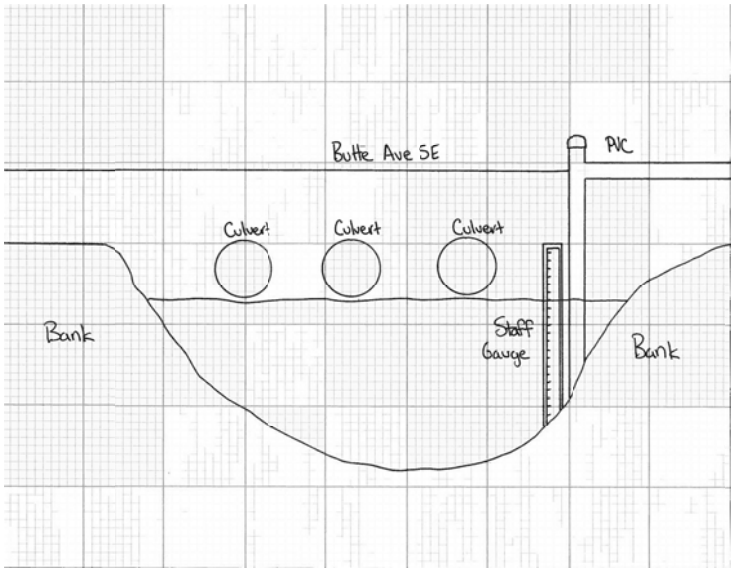
| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 7/28/09 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/30/2010 |
| WRIA: | 10 | Field Personnel: | Dan Bennett, Brian Tornow |
| Station ID: | Commercial Basin A | Weather: | Sunny, Dry |
| Location: | 0.8 miles south of 3rd Avenue SW on Butte Ave SE | Site Description: The stream is slough-like. It is about 25 feet wide, and It flows along train tracks in a constrained channel. It then follows a bend to the west and crosses beneath Butte Ave in a series of 4, 2-foot diameter culverts. It then becomes a 25 foot wide stream again. The equipment is installed 50 feet downstream of the culverts (east). | |

**Vicinity Map of Site**




Lat: 47°15'30.22"N
Long: 122°14'41.45"W

**Site Drawing (Plan View)**




### Description of Installation

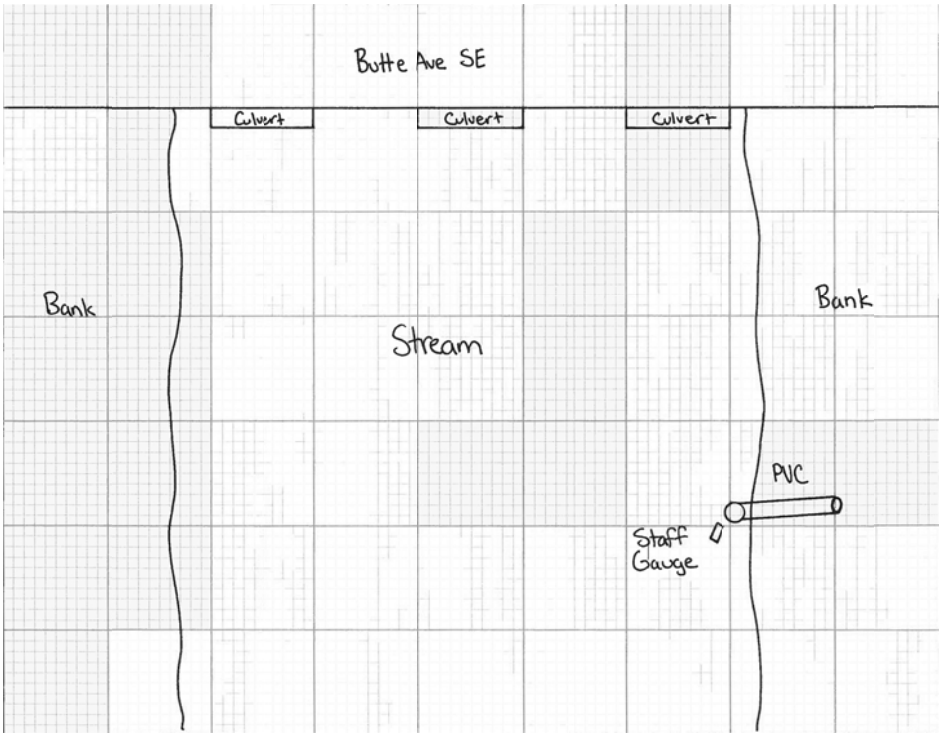
The pressure transducer and staff gage were installed adjacent to each other on the north side of the stream, 50 feet downstream of the culverts. A stilling well consisting of a drivable well point was pounded into the stream bed to a depth of approximately 2.5 feet. A PVC pipe was attached to the well point, conveying the transducer cable first up five feet, and then with a series of shorter pipes and tees, twenty feet to the north. Discharge will be measured in the four culverts beneath Butte Ave.

### Safety Issues/Access Restrictions

Parking is standard parallel parking on an arterial street. Use safety cones and proceed with caution.

# INSTALLATION REPORT
## Installation Overview

### Station Installation Diagram




### Photo Log

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 7/28/09 Time: 11:00 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: North side of stream, 50 feet east of culverts beneath Butte Ave. | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928011 |
| Length of Cable (ft): | 30 |
| Desiccant Type/Condition: | Blue to Pink/ 100% |

### Description of Hydraulic Conditions

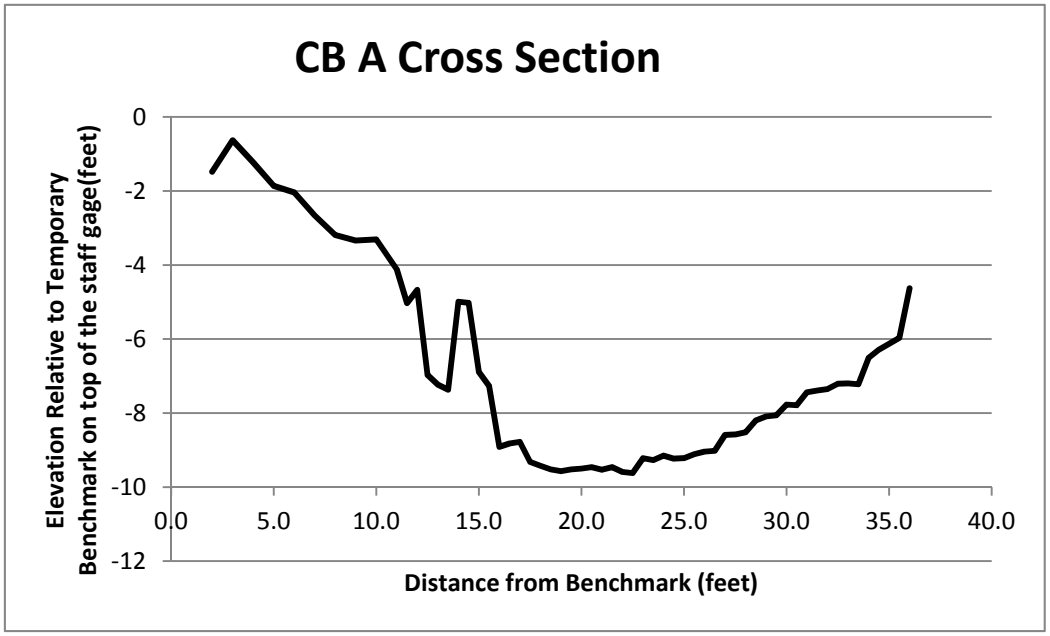
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☒ Free Flowing | ☐ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 2.5 | Estimated Storm Flow Depth (ft): | 3.5 |
| Base Flow Velocity (ft): | 1 | Estimated Storm Flow Velocity (ft/s): | 2 |
| Sediment Depth (in): | 2 | Staff Gauge: | 3.5 |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 25 |
| Bankfull Depth (ft): | 4 |
| Substrate: | Coblle, gravel, silt |
| Slope: | 1 |
| Vegetation: | Alders, grasses, brush |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Installed in camouflage PVC tube with locking wellcap.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 7/28/098 | 11:12 | 2.53 | 4.2739 | -1.744 | 2.528 |
| | | | | | |
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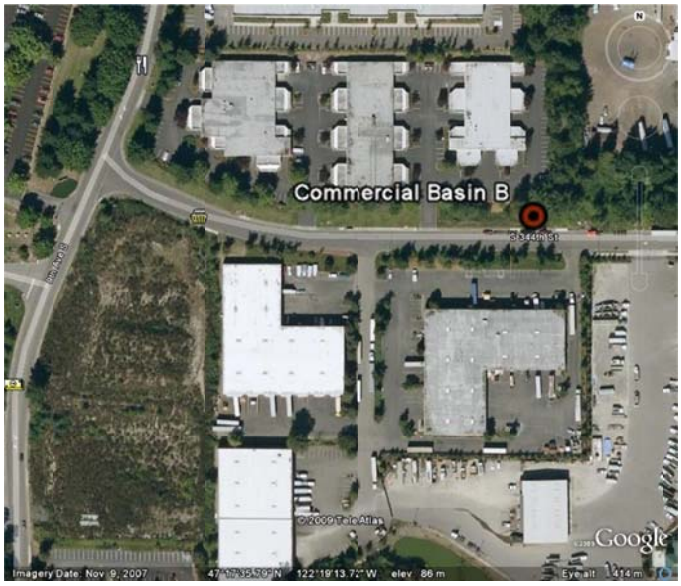
## Notes

# INSTALLATION REPORT
## Installation Overview

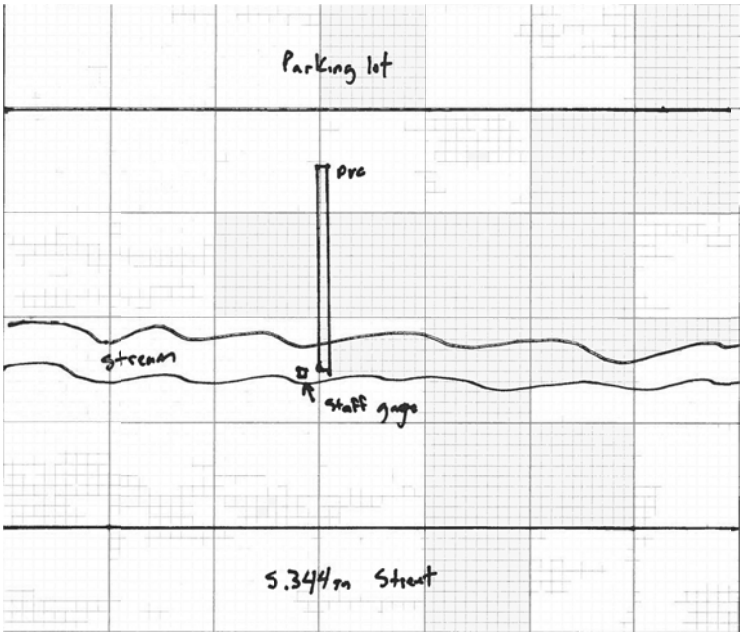
| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 7/27/2009 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/30/2010 |
| WRIA: | 10 | Field Personnel: | Dan Bennett, Brian Tornow |
| Station ID: | Commercial Basin B | Weather: | Sunny, Dry |
| Location: | 0.3 miles west of 16th Ave S, on South 344th Street | Site Description: This is part of Hylebos Creek. The creek runs along 344th Ave in a constrained ditch before entering a pipe that conveys it beneath an office park. The monitoring site is in the 2 foot wide ditch. | |

**Vicinity Map of Site**




Lat: 47°17'37.21"N
Long: 122°19'8.65"W

**Site Drawing (Plan View)**




## Description of Installation

The pressure transducer and staff gage were installed together in a location about midway in the 100 foot section of ditch that conveys the creek west along 344th Street. A stilling well consisting of a drivable wellhead was dug and driven into the streambed to a depth of 2 feet. There was no flow at the time. The transducer cable is run up to waste level, then takes a 45 degree tee to the north about fifteen feet. The staff gage is installed adjacent to the pressure transducer.

## Safety Issues/Access Restrictions

Steep slippery slope down to pressure transducer. Urban area, could encounter transients.

# INSTALLATION REPORT
## Installation Overview

**Station Installation Diagram**

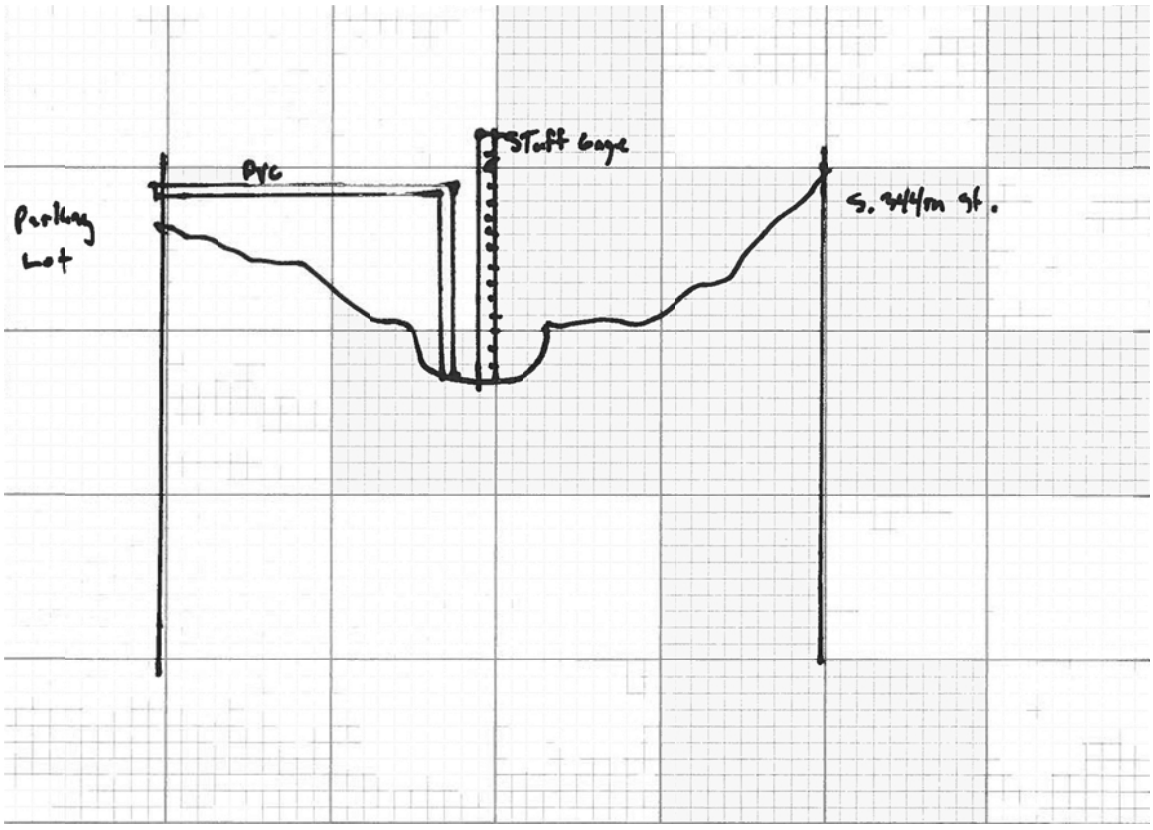



**Photo Log**

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 8/4/09 Time: 10:00 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: Midway in the ditch conveying the stream along 344th Street | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928013 |
| Length of Cable (ft): | 17 |
| Desiccant Type/Condition: | Blue to Pink/ 100% |

### Description of Hydraulic Conditions

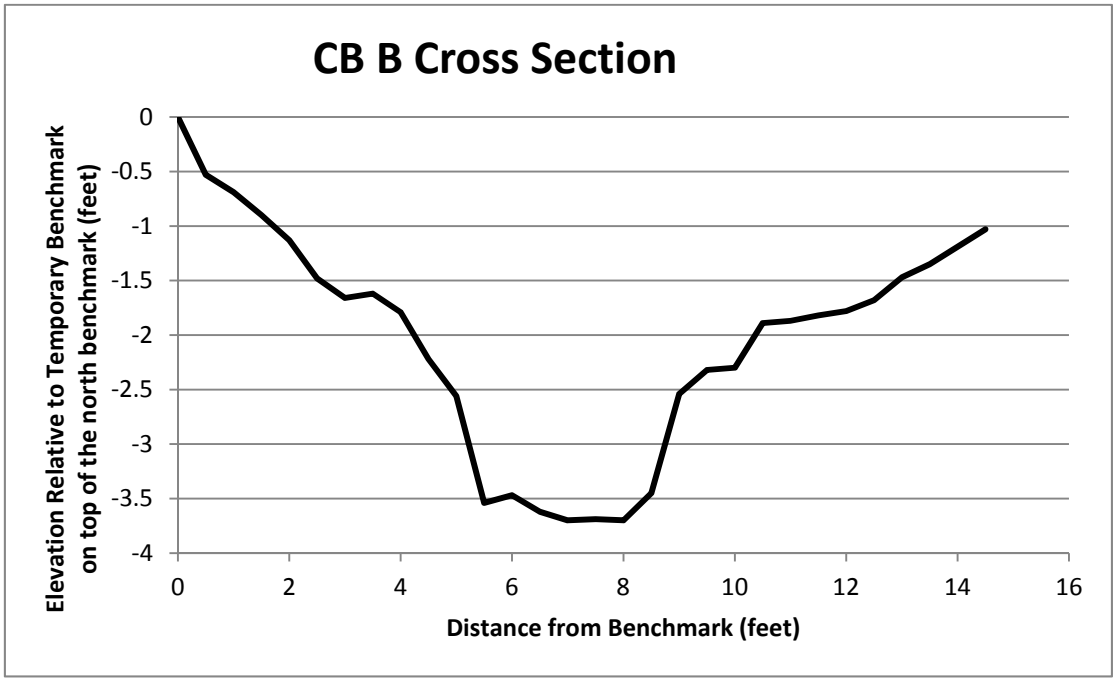
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☐ Free Flowing | ☒ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 0.5 | Estimated Storm Flow Depth (ft): | **1.5** |
| Base Flow Velocity (ft): | 1 | Estimated Storm Flow Velocity (ft/s): | **3** |
| Sediment Depth (in): | 1 | Staff Gauge: | **0** |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 5 |
| Bankfull Depth (ft): | 2 |
| Substrate: | cobble |
| Slope: | 2 |
| Vegetation: | Alders, Grass |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Installed in camouflage PVC tube with locking wellcap.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| | | | | | |
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## Notes

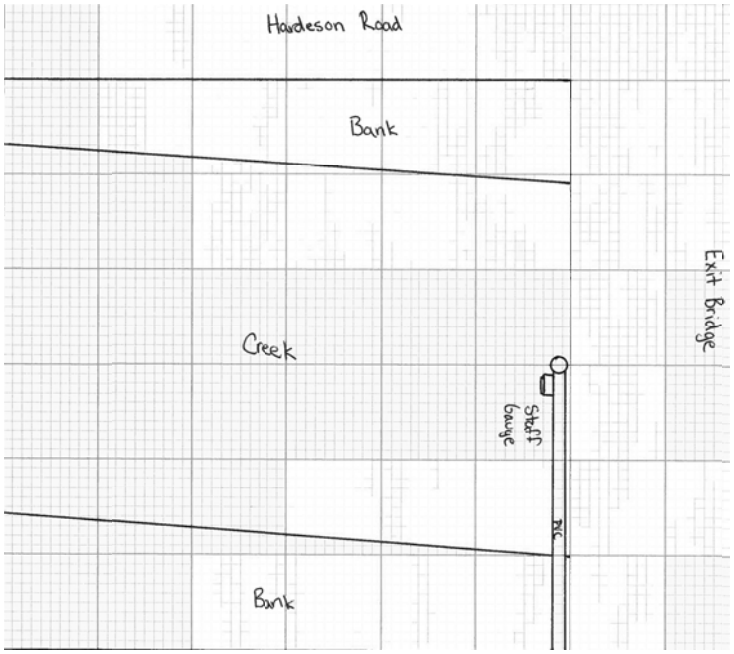
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 7/31/2009 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/27/2010 |
| WRIA: | 7 | Field Personnel: | Dan Bennett, Brian Tornow |
| Station ID: | Commercial Basin X | Weather: | Sunny, Dry |
| Location: | 0.2 miles north of Merrill Creek Parkway on Hardeson Road. Site is located downstream of exit drive bridge rom Federal Express onto Hardeson Road. | Site Description: Stream flows north along west side of Hardeson Road. Crosses in box culvert beneath exit drive from Federal Express. | |

**Vicinity Map of Site**


Coordinates:
Lat: 47°56'21.62"N
Long: 122°15'15.11"W

**Site Drawing (Plan View)**




### Description of Installation

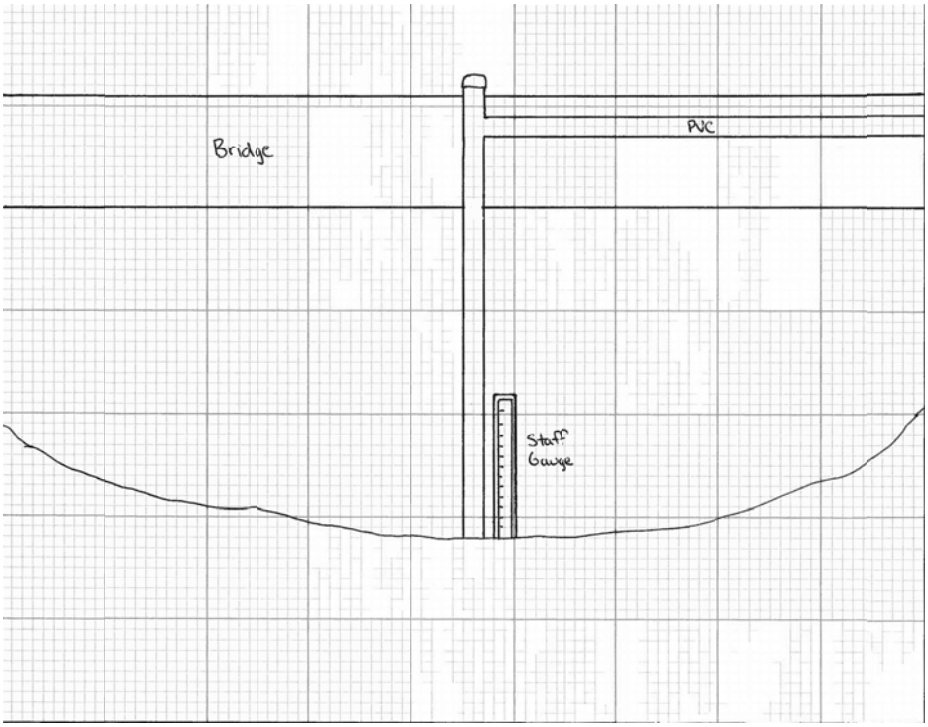
Pressure transducer and staff gage were installed directly at mouth of box culvert beneath Federal Express exit drive in the center of the stream. A stilling well consisting of a drivable wellhead was dug. into the streambed at the mouth of the culvert conveying the stream beneath the driveway, at the northern edge of the culvert. The well was installed about 1.5 feet deep. There was no water at the time. The transducer cable is run up to road level, and then takes a 90 degree tee to the west for ten feet. The staff gage is installed adjacent to the pressure transducer in the middle of the streams as well.

### Safety Issues/Access Restrictions

Station is located at the exit drive drive of Federal Express warehouse. Large trucks exiting constantly, Be cautious walking from parking area to stream.

# INSTALLATION REPORT
## Installation Overview

### Station Installation Diagram




### Photo Log

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 7/31/2009 Time: | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928012 |
| Length of Cable (ft): | 18 |
| Desiccant Type/Condition: | Blue to Pink/ 100% |

### Description of Hydraulic Conditions

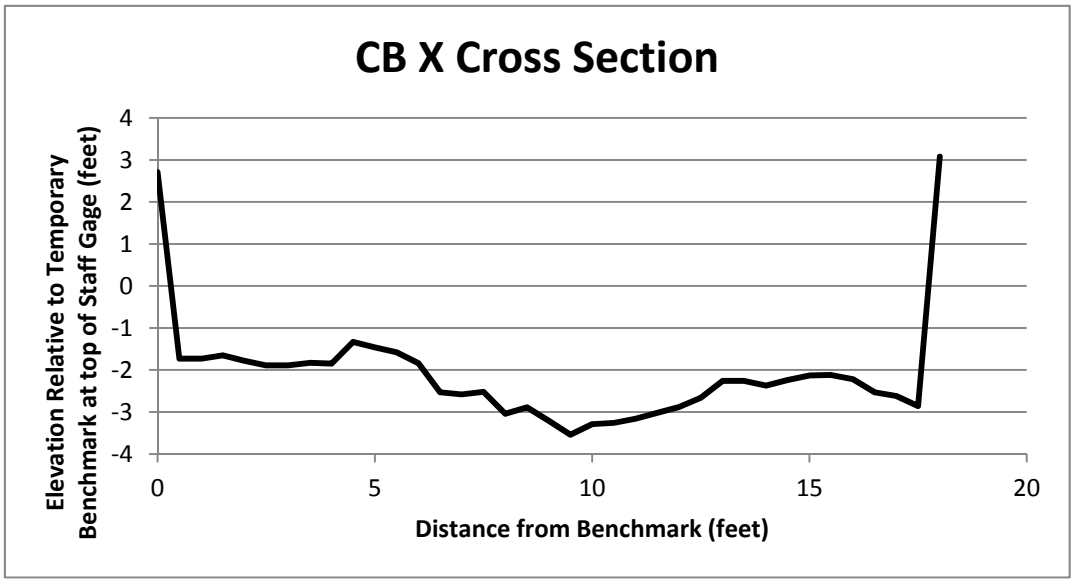
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☐ Free Flowing | ☒ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 0.7 | Estimated Storm Flow Depth (ft): | 1.5 |
| Base Flow Velocity (ft): | 1 | Estimated Storm Flow Velocity (ft/s): | 2.5 |
| Sediment Depth (in): | NA | Staff Gauge: | **0-dry** |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 12 |
| Bankfull Depth (ft): | 2 |
| Substrate: | Cobble |
| Slope: | 2% |
| Vegetation: | Maple, Alder, Grasses |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Locking well cap, camouflaged PVC tubing. An inconvenient place for vandals to stop due to Federal Express security.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
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## Notes

A small amount of mud may have gotten in well during installation, which seems to be causing the PT to read 1 foot depth. 2.5" spacer installed. Depth reads 0.03. this seems to have fixed the problem.

(It was later discovered, when the water rose, that the spacer was not shoved all the way down the stilling well)

HERRERA ENVIRONMENTAL CONSULTANTS

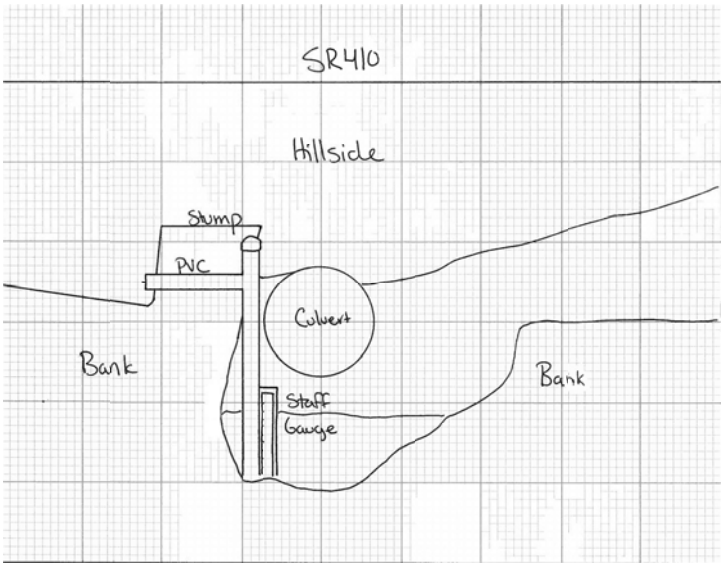
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 28-Jul-09 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/30/2010 |
| WRIA: | 10 | Field Personnel: | Dan Bennett |
| Station ID: | Forest Basin 130 | Weather: | Sunny, Dry |
| Location: | 10.4 miles east of SR164 on SR410. Park in Hansen Forestry logging landing gated road entrance. Stream is 50 feet west of forest road gate. | Site Description: | The stream flows beneath SR 410 in a 4 foot diameter culvert. The culvert discharges into a pool, and the stream is constrained in a short run for 20 feet, before entering a cascade. |

**Vicinity Map of Site**


Lat: 47°10'22.76"N
Long: 121°48'2.91"W

**Site Drawing (Plan View)**




**Description of Installation**

The pressure transducer and staff gage were installed together in a location about 10 feet downstream of the culvert beneath SR410 on the western edge of the stream, in a point where the stream is constrained by trees on the bank. A stilling well consisting of a drivable wellhead was driven into the streambed about 2.5 feet deep. The transducer cable is run up to the stream bank in a PVC pipe and then takes a 90 degree tee, and runs through a second pipe 10 feet west. The staff gage is installed adjacent to the pressure transducer at the eastern edge of the stream.

**Safety Issues/Access Restrictions**

The site may be snowed in during the winter. Proceed with caution.

# INSTALLATION REPORT
## Installation Overview

**Station Installation Diagram**

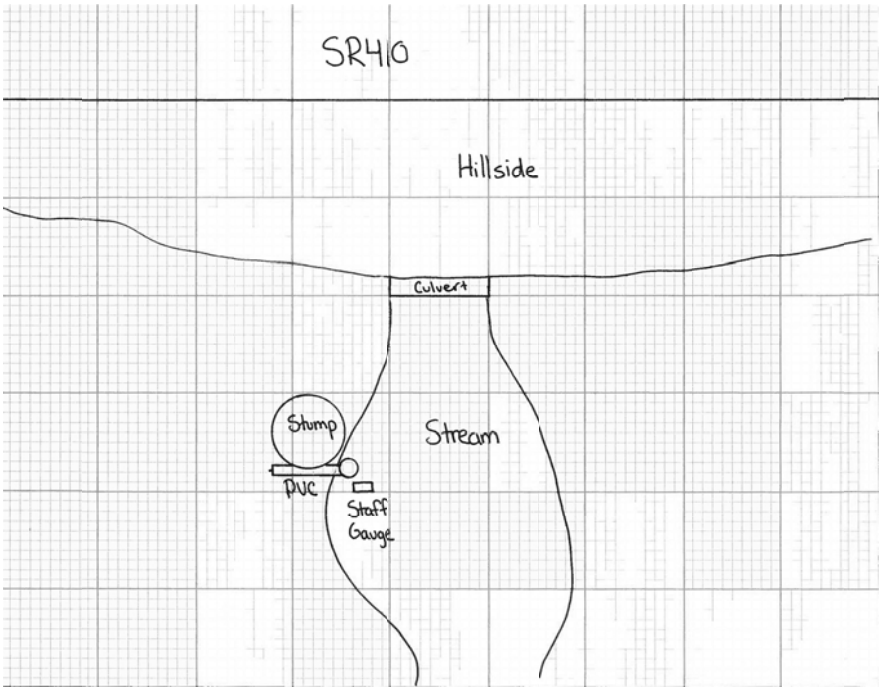



**Photo Log**

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 7/28/09 Time: 13:36 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928009 |
| Length of Cable (ft): | 13 |
| Desiccant Type/Condition: | Blue to Pink/ 100% |

### Description of Hydraulic Conditions

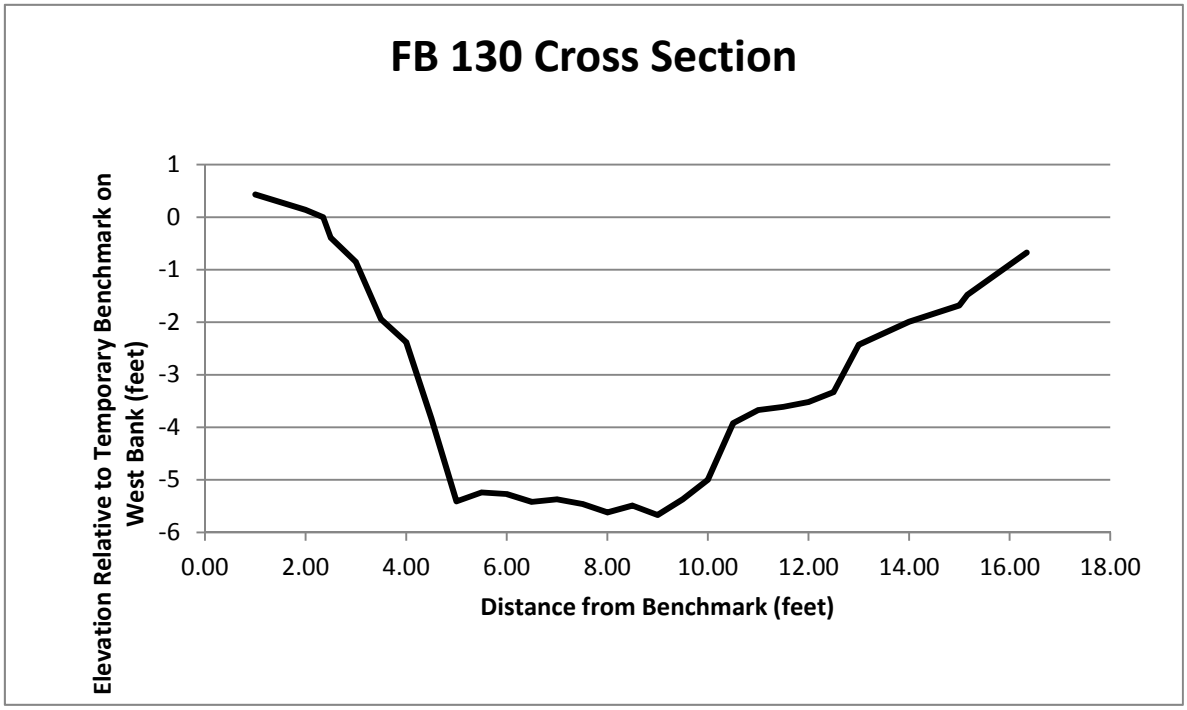
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☒ Free Flowing | ☐ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 1 | Estimated Storm Flow Depth (ft): | **2** |
| Base Flow Velocity (ft): | 1 | Estimated Storm Flow Velocity (ft/s): | **3** |
| Sediment Depth (in): | 2 | Staff Gauge: | **1** |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 6 |
| Bankfull Depth (ft): | 3 |
| Substrate: | cobble |
| Slope: | 2 |
| Vegetation: | brush |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

**Description of Security Precautions/Concerns**

Equipment is well off the beaten path, located 25 feet through brush downstream of an inconvenient parking space. It was also installed in a camouflage PVC pipe with a locking well-cap.

**Description of Secondary Measurement Device Calibration**

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 7/28/09 | 13:26 | 1.01 | 2.5166 | -1.507 | 1.00 |
| | | | | | |
| | | | | | |
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**Notes**

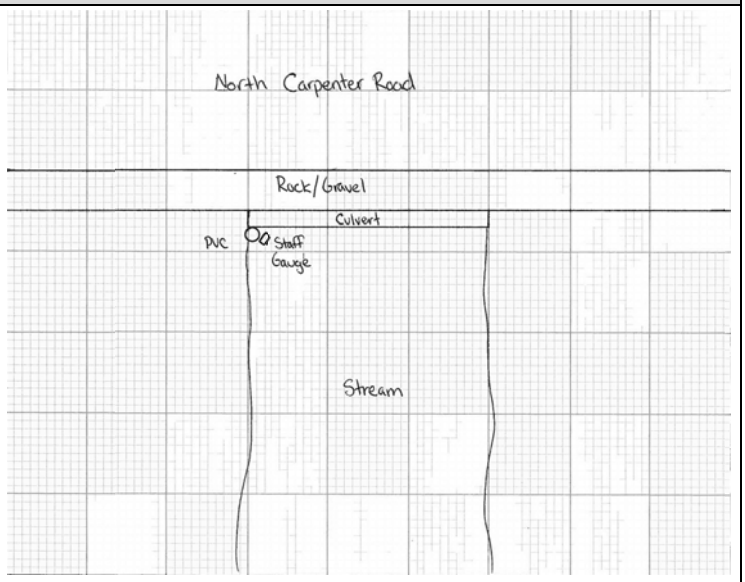
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 7/30/09 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/27/10 |
| WRIA: | 7 | Field Personnel: | Dan Bennett |
| Station ID: | Forest Basin 200 | Weather: | Sunny |
| Location: | The site is located 2.5 miles north of O.K. Mill Road on North Carpenter Road. | Site Description: | The stream flows beneath carpenter road in a 10 foot wide box culvert. It then flows into a manmade channel along the roadside for a quarter of a mile. The monitoring location is at the mouth of the culvert. |

**Vicinity Map of Site**


Lat: 48° 0'38.42"N
Long: 121°57'28.00"W

**Site Drawing (Plan View)**




**Description of Installation**

The pressure transducer and staff gage were installed at the downstream mouth of the box culvert beneath North Carpenter Road at the western edge of the culvert in the deepest part of the stream. A stilling well consisting of a drivable wellhead was driven 2.5 feet into the streambed There was no water at the time of installation. The transducer cable is run up to road level in a straight tube and capped with a locking well cap. The staff gage is installed adjacent to the pressure transducer.

**Safety Issues/Access Restrictions**

The only parking available is on the narrow shoulder of North Carpenter Rd. Place safety cones, Use flasher light on van. Proceed with caution.

# INSTALLATION REPORT
## Installation Overview

**Station Installation Diagram**

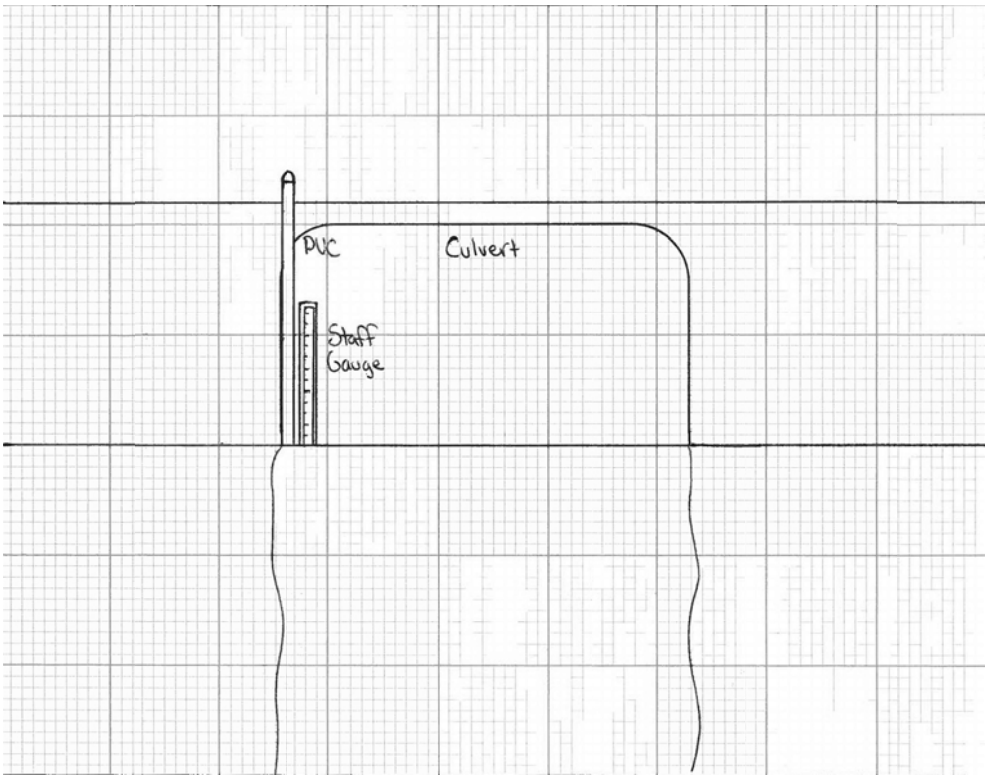



**Photo Log**

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 7/30/09 Time: 15:00 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: East side of mouth of box culvert. | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928002 |
| Length of Cable (ft): | 8.5 |
| Desiccant Type/Condition: | Blue/ 100 percent available |

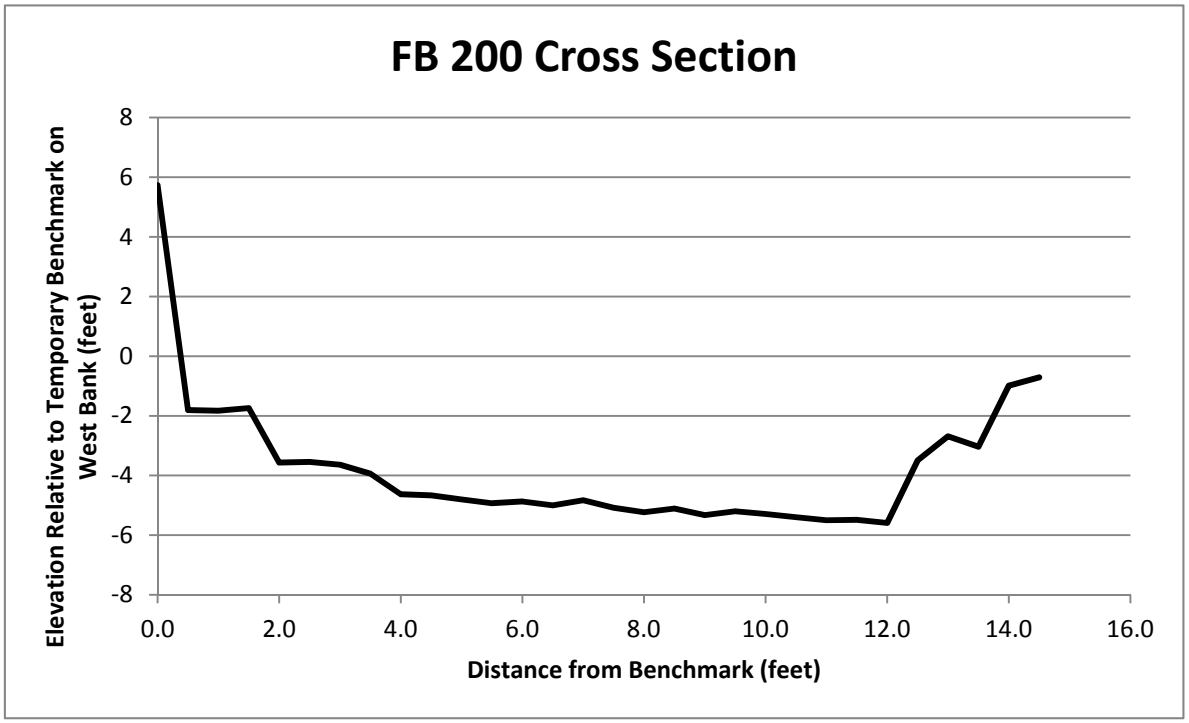
### Description of Hydraulic Conditions

| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☐ Free Flowing | ☒ Dry | ☐ Stagnant |
| Base Flow Depth (ft): | na | Estimated Storm Flow Depth (ft): | **2** | |
| Base Flow Velocity (ft): | na | Estimated Storm Flow Velocity (ft/s): | **5** | |
| Sediment Depth (in): | None, armored cobble | Staff Gauge: | **0.** | |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | **11** |
| Bankfull Depth (ft): | **3** |
| Substrate: | **2-6 inch cobble** |
| Slope: | **3** |
| Vegetation: | **Alder, blackberry** |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Locking well cap, camouflaged PVC tubing. An inconvenient place for vandals to stop.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| | | | | | |
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## Notes

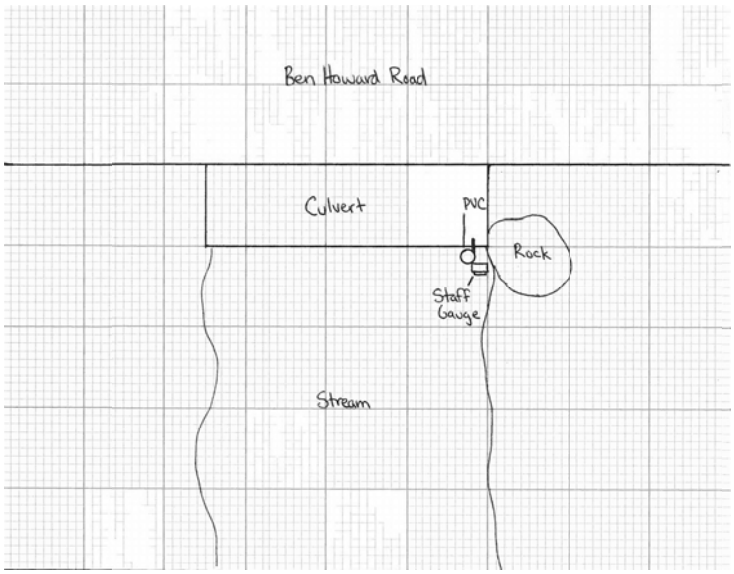
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 7/30/09 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/27/10 |
| WRIA: | 7 | Field Personnel: | Dan Bennett |
| Station ID: | Forest Basin 203 | Weather: | Sunny, Dry |
| Location: | The stream crosses Ben Howard Road 0.5 miles west of Mann Road | Site Description: Upstream of the Ben Howard Road crossing, the stream flows as a cascade in a steep v-notch. It crosses beneath the road in a 10 foot half pipe culvert. Downstream of the road, the stream is slightly more gradual in gradient, but also seems to have the potential to braid. | |

**Vicinity Map of Site**


Lat: 47°50'46.
Long: 121°49'17.91"W

**Site Drawing (Plan View)**




**Description of Installation**

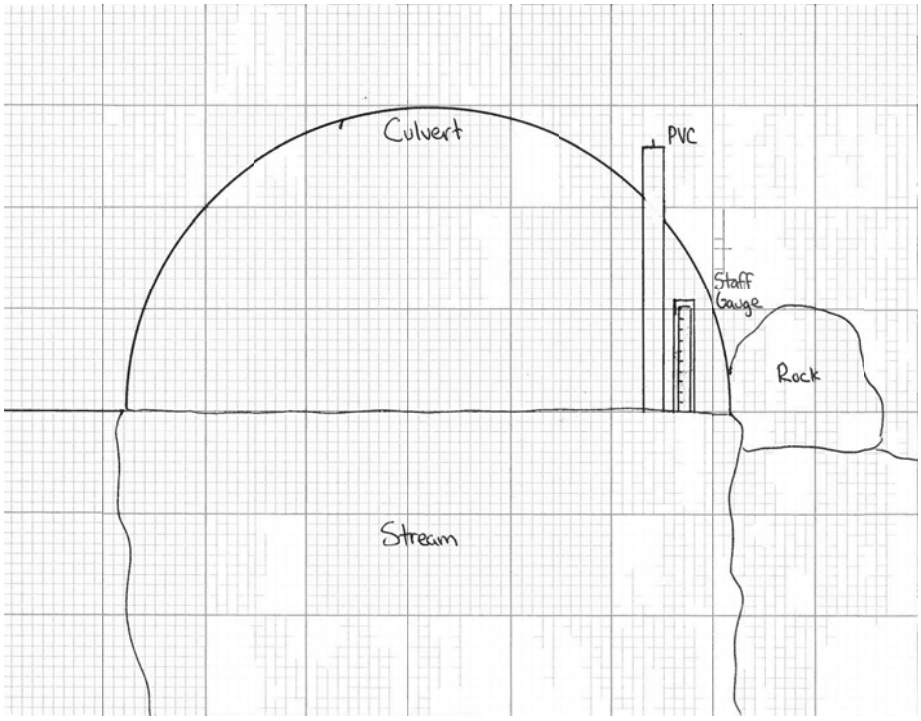
The pressure transducer and staff gage were installed at the downstream mouth of the half-pipe culvert beneath Ben Howard Road at the western edge of the culvert in the deepest part of the stream. A stilling well consisting of a drivable wellhead was driven 2.5 feet into the streambed. The transducer cable is run up to road level in a straight tube and capped with a locking well cap. The staff gage is installed adjacent to the pressure transducer.

**Safety Issues/Access Restrictions**

None.

# INSTALLATION REPORT
## Installation Overview

### Station Installation Diagram




### Photo Log

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: Time: | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: West side of mouth of culvert downstream of Ben Howard Road. | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928004 |
| Length of Cable (ft): | 8 |
| Desiccant Type/Condition: | Blue to Pink, 100% |

### Description of Hydraulic Conditions

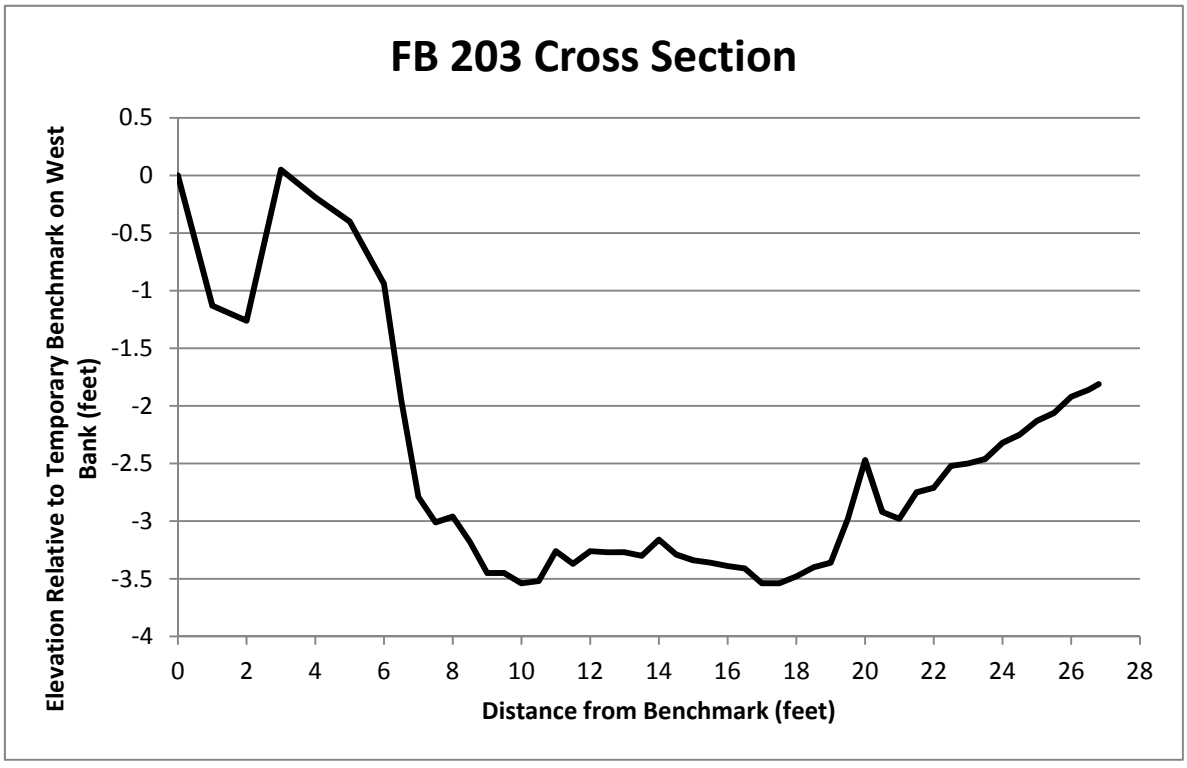
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☒ Free Flowing | ☐ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 0.7 | Estimated Storm Flow Depth (ft): | **2** |
| Base Flow Velocity (ft): | 0.15 | Estimated Storm Flow Velocity (ft/s): | **2** |
| Sediment Depth (in): | 2 | Staff Gauge: | **0.77** |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | **14 ft culvert mouth** |
| Bankfull Depth (ft): | **2** |
| Substrate: | **cobble** |
| Slope: | **2** |
| Vegetation: | **Forested** |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 7/30/2009 | 8:51 | 0.77 | 2.222 | -1.452 | 0.77 |
| | | | | | |
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## Notes

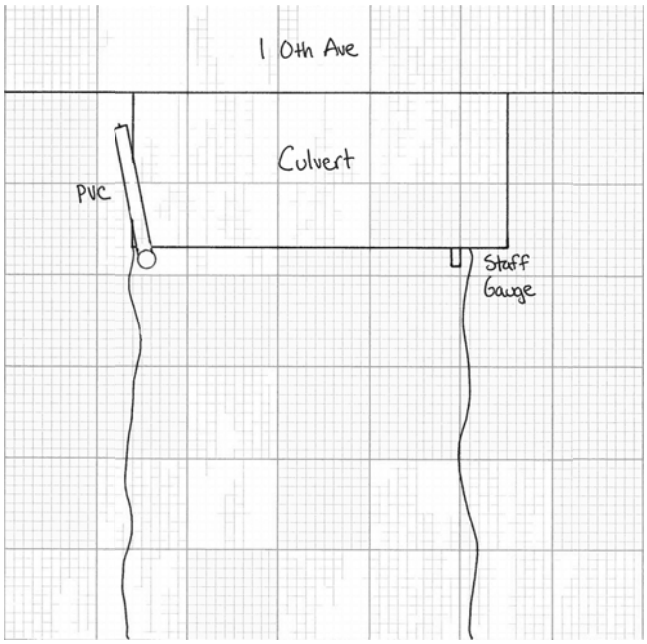
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 8/3/2009 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/30/2010 |
| WRIA: | 10 | Field Personnel: | Dan Bennett, Brian Tornow |
| Station ID: | Forest Basin 372 | Weather: | Sunny, Dry |
| Location: | Located 1.0 miles east of Orville Road East on 190th Ave (200th Ave becomes 190th after 0.5 miles), at the intersection of 190th Ave and 196th Ave. | Site Description: | This stream, known as Coppler Creek, flows from a forested mountainside upstream, through a 10 foot diameter culvert beneath 190 Ave E, and begins to braid a short distance downstream. The monitoring site is located at the downstream mouth of the culvert. |

**Vicinity Map of Site**


Lat: 47° 4'43.86"N
Long: 122°10'10.40"W

**Site Drawing (Plan View)**




**Description of Installation**

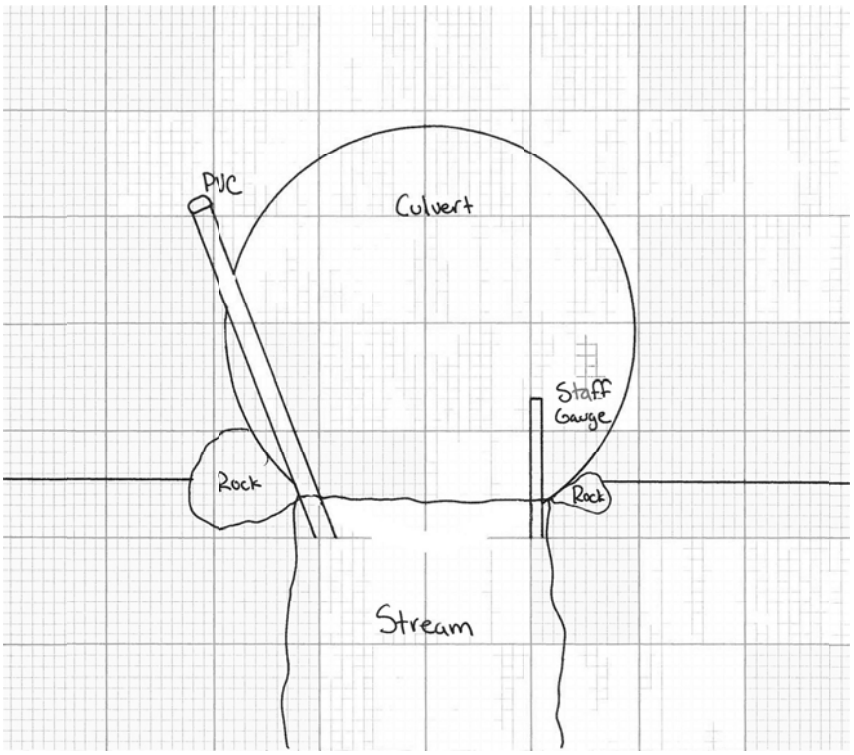
The pressure transducer is installed together at the downstream mouth of the ten foot diameter half-pipe culvert beneath 190th Street, on the east side of the stream. A stilling well consisting of a drivable well point was driven 2.5 feet into the stream bed. The transducer cable was run from the well point up to 5 feet in height inside a PVC pipe, It then takes a 90 degree turn in a tee, and is run through another 10 feet of PVC pipe. The pipe was secured with a locking wellcap. The staff gage was installed across the stream on the west side of the stream, in the same cross-section.

**Safety Issues/Access Restrictions**

The path down to 190th Street is steep and consists of exposed soil that will become slippery in the rain. Proceed with caution.

# INSTALLATION REPORT
## Installation Overview

### Station Installation Diagram




### Photo Log

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 8/3/09 Time: 12:44 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: Mouth of culvert beneath 190th | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928009 |
| Length of Cable (ft): | 20 |
| Desiccant Type/Condition: | Blue to Pink/ 100% |

### Description of Hydraulic Conditions

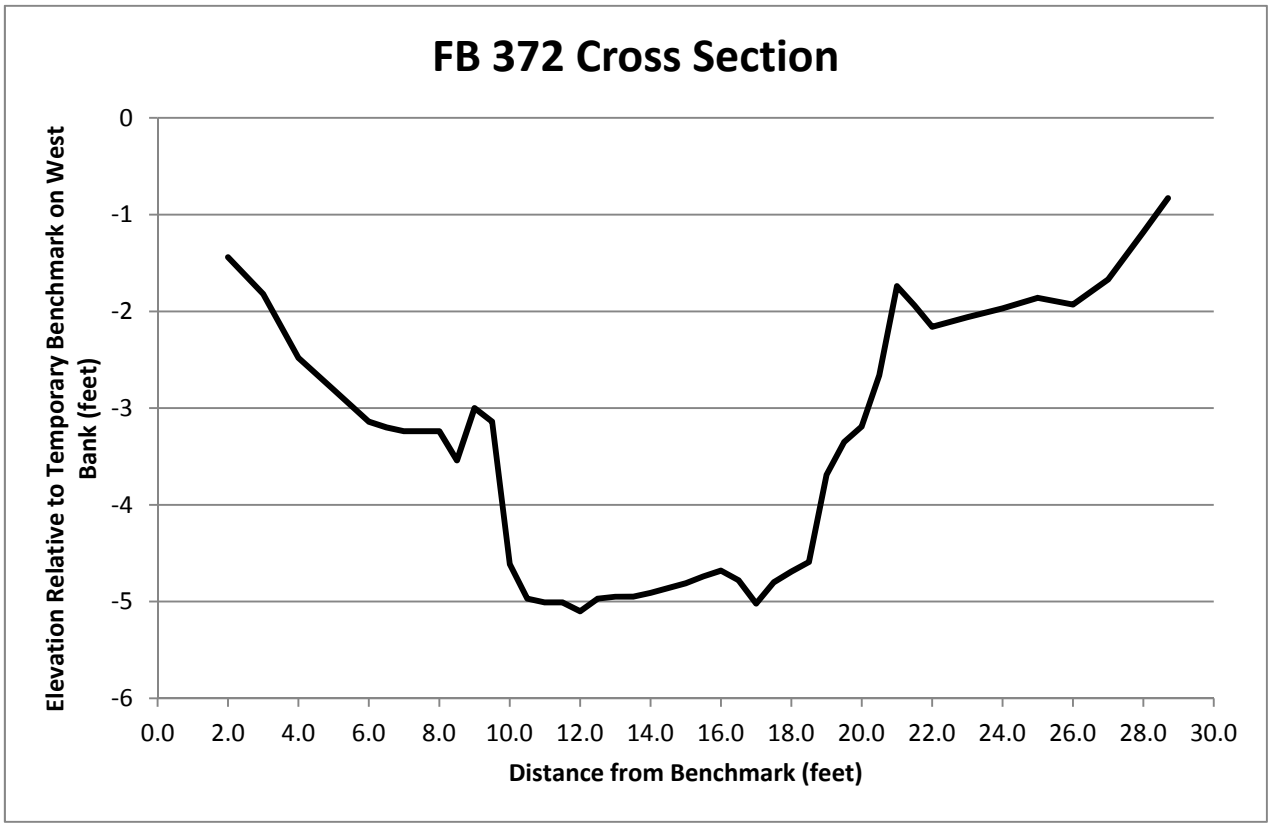
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☒ Free Flowing | ☐ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 0.5 | Estimated Storm Flow Depth (ft): | 1.5 |
| Base Flow Velocity (ft): | 0.5 | Estimated Storm Flow Velocity (ft/s): | 2 |
| Sediment Depth (in): | 2 | Staff Gauge: | 0.48 |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 10 |
| Bankfull Depth (ft): | 2 |
| Substrate: | cobble |
| Slope: | 2 |
| Vegetation: | Forested |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

PVC pipe was camouflaged and secured with a locking well-cap.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 8/3/09 | 12:44 | 0.48 | 1.9450 | -1.465 | 0.48 |
| | | | | | |
| | | | | | |
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## Notes

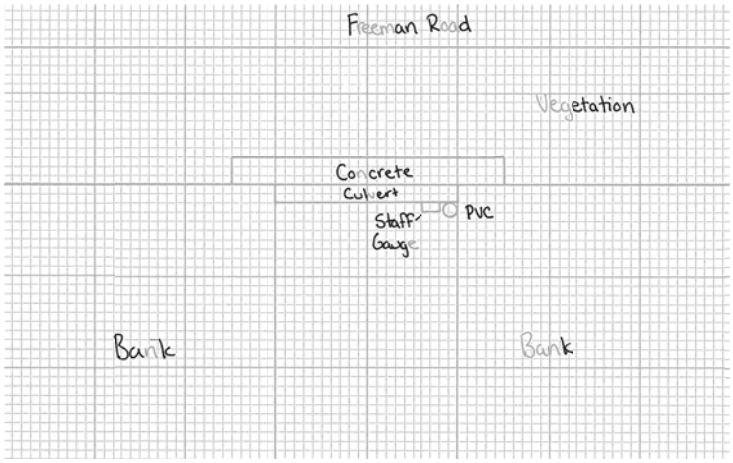
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 8/3/09 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/30/10 |
| WRIA: | 10 | Field Personnel: | Dan Bennett, Brian Tornow |
| Station ID: | Residential Basin 53 | Weather: | Sunny, dry |
| Location: | 0.3 miles south of 20th Street East, on Freeman Road. | Site Description: The stream flows beneath Freeman Road in a 2 foot diameter culvert into a man-made ditch about 5 feet wide, which conveys it linearly through a field. | |

**Vicinity Map of Site**


Lat: 47°14'6.86"N
Long: 122°19'26.41"W

**Site Drawing (Plan View)**




### Description of Installation

The pressure transducer and staff gage were installed together adjacent to the mouth of the culvert on the south side of the stream. A stilling well consisting of a drivable wellhead was driven into the streambed to a depth of about 2 feet. The transducer cable is run up to the road level in a PVC pipe. The staff gage is installed adjacent to the pressure transducer.

### Safety Issues/Access Restrictions

The location is accessed by parking in a roadside turnout and walking down a gentle bank to the culvert. No major safety issues.

# INSTALLATION REPORT
## Installation Overview

**Station Installation Diagram**

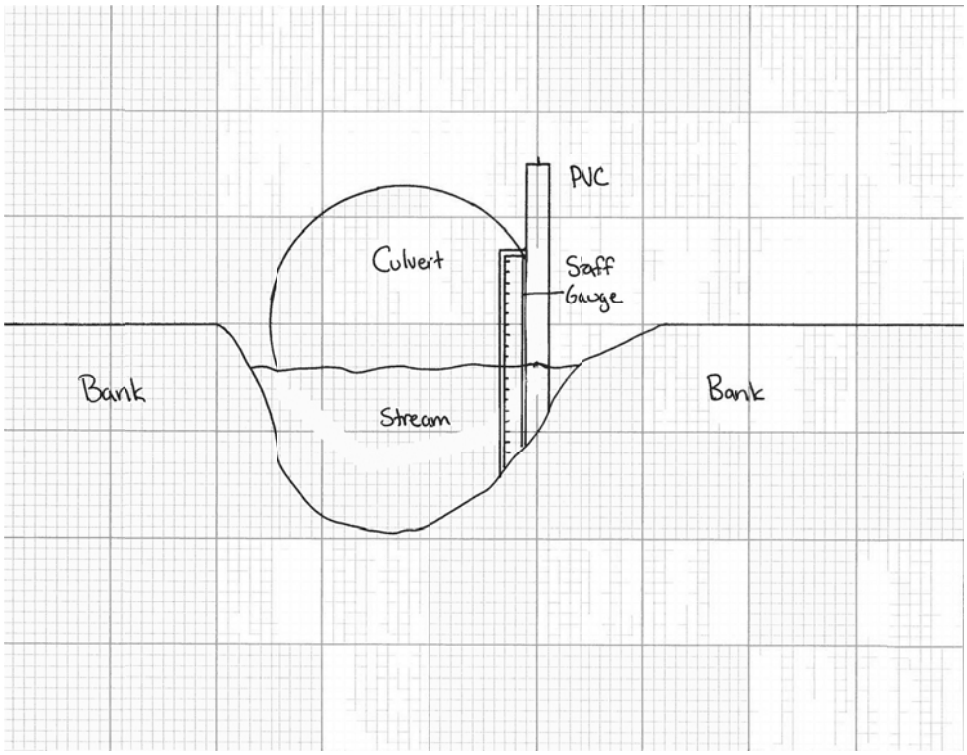



**Photo Log**

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 8/3/09 Time: 15:00 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: Mouth of culvert beneath Freemen Road | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928010 |
| Length of Cable (ft): | 5 |
| Desiccant Type/Condition: | Blue to Pink/ 100% |

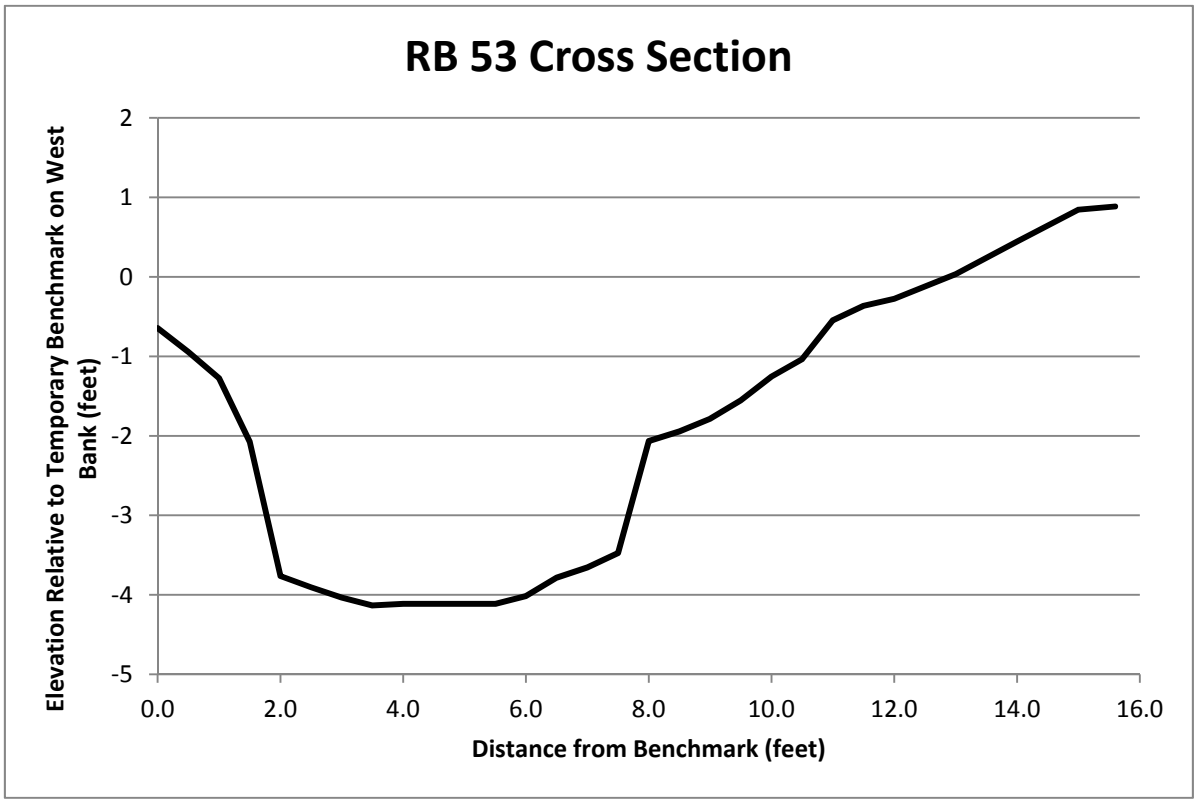
### Description of Hydraulic Conditions

| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☒ Free Flowing | ☐ Dry | ☒ Stagnant |
| Base Flow Depth (ft): | 0.5 | Estimated Storm Flow Depth (ft): | **2** | |
| Base Flow Velocity (ft): | 0.1 | Estimated Storm Flow Velocity (ft/s): | **2** | |
| Sediment Depth (in): | 5 | Staff Gauge: | **0.51** | |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 5.5 |
| Bankfull Depth (ft): | 2 |
| Substrate: | muck |
| Slope: | 1 |
| Vegetation: | grass |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Equipment is clearly visible from the road. It was also installed in a camouflage PVC pipe with a locking well-cap.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 8/3/09 | 15:00 | 0.51 | 2.5561 | -2.046 | 0.51 |
| | | | | | |
| | | | | | |
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| | | | | | |
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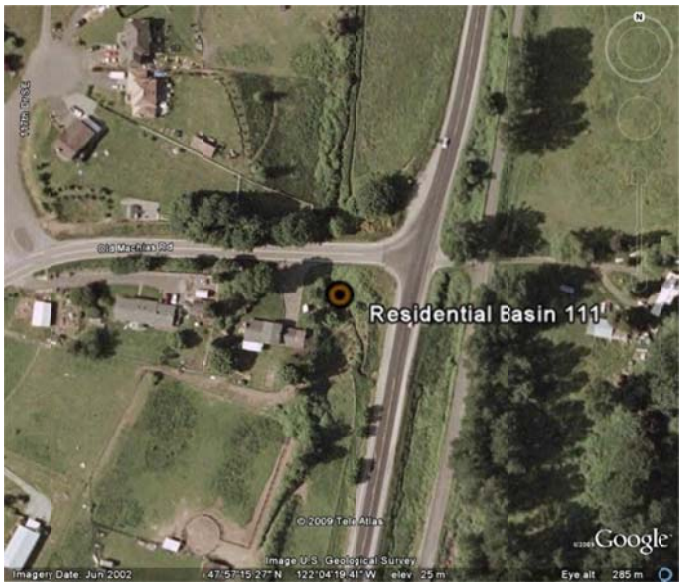
## Notes

# INSTALLATION REPORT
## Installation Overview

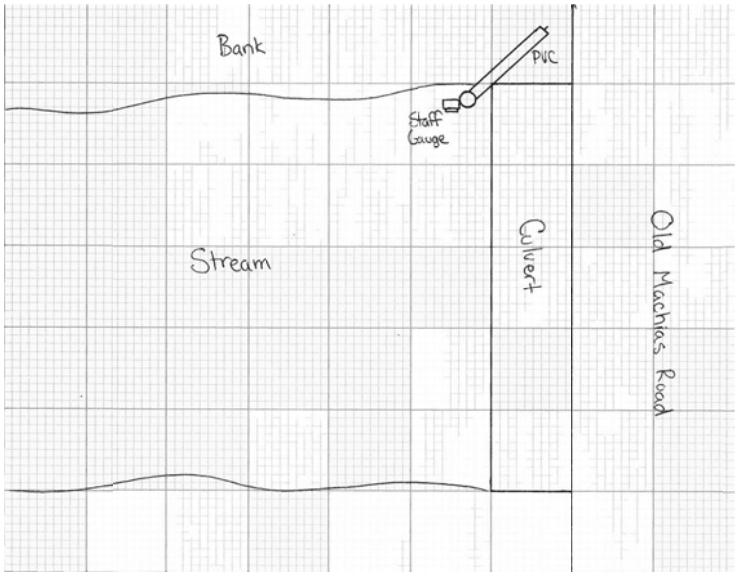
| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 7/30/2009 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/27/2010 |
| WRIA: | 7 | Field Personnel: | Dan Bennett, Brian Tornow |
| Station ID: | Residential Basin 111 | Weather: | Sunny, dry |
| Location: | Located 50 feet west of South Machias Road on Old Machias Road. | Site Description: The stream emerges from a 10' diameter half pipe culvert and flows into a median area between a home and S. Machias Road. There are engineered LWD cabled into place in the channel. | |

**Vicinity Map of Site**




Lat: 47°57'15.43"N
Long: 122° 4'19.51"W

**Site Drawing (Plan View)**




## Description of Installation

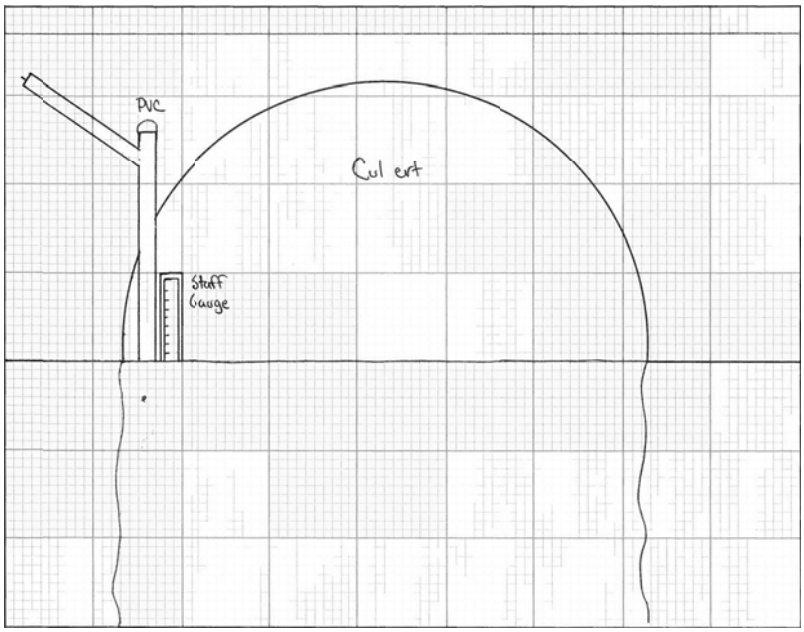
The pressure transducer and staff gage were installed adjacent to each other on the west side of the mouth of the half pipe culvert. A stilling well consisting of a drivable well point was pounded into the stream bed to a depth of approximately 2.5 feet. A PVC pipe was attached to the well point, conveying the transducer cable first up 5 feet, and then with a 90 degree, 10 feet to the west.

## Safety Issues/Access Restrictions

The only available parking is across Old Machias Road, on the northwest corner of South Machias Road and Old Machias Road. Use caution when crossing this busy street. The slope leading down to the stream is steep, proceed with caution.

# INSTALLATION REPORT
## Installation Overview

### Station Installation Diagram




### Photo Log

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 7/30/2009 Time: 14:00 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: west side of mouth of culvert. | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X |
| Serial Number: | 2928016 |
| Length of Cable (ft): | 15 |
| Desiccant Type/Condition: | Blue to pink, 100% |

### Description of Hydraulic Conditions

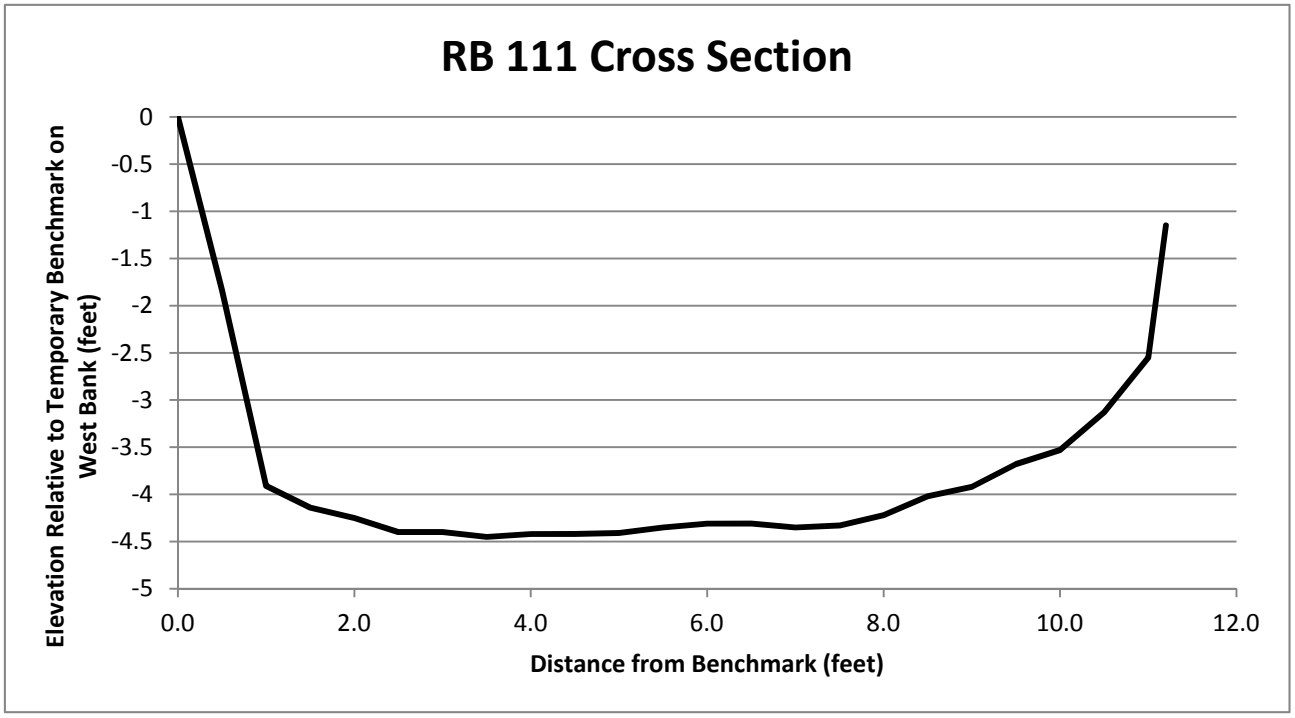
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☐ Free Flowing | ☒ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 1 | Estimated Storm Flow Depth (ft): | 2 |
| Base Flow Velocity (ft): | 0.5 | Estimated Storm Flow Velocity (ft/s): | 2 |
| Sediment Depth (in): | 2 | Staff Gauge: | **0** |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 10 |
| Bankfull Depth (ft): | 2 |
| Substrate: | Cobble and silt |
| Slope: | <1 |
| Vegetation: | Grasses |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Installed in camouflage PVC tube with locking wellcap.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
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| | | | | | |
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## Notes

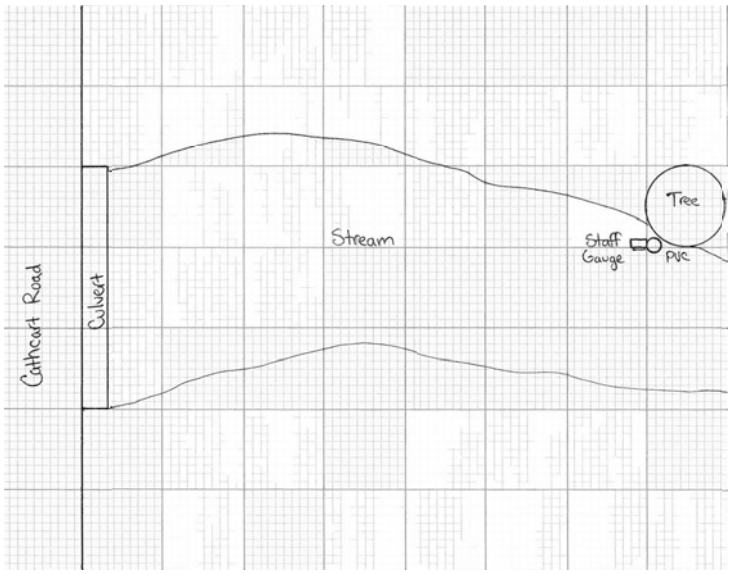
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 7/30/2009 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/27/2010 |
| WRIA: | 7 | Field Personnel: | Dan Bennett |
| Station ID: | Residential Basin 202 | Weather: | Sunny, Dry |
| Location: | At the intersection of Elliot road and Cathcart River Road, | Site Description: The stream winds down along a steep road (Riverside Rd), in a roadside ditch. It crosses beneath another road in a set of stacked culverts, and emerges into a fairly constrained stream. The equipment is installed 50 feet downstream of Cathcart River Road. | |

**Vicinity Map of Site**


Lat: 47°50'36.78"N
Long: 122° 5'23.23"W

**Site Drawing (Plan View)**




**Description of Installation**

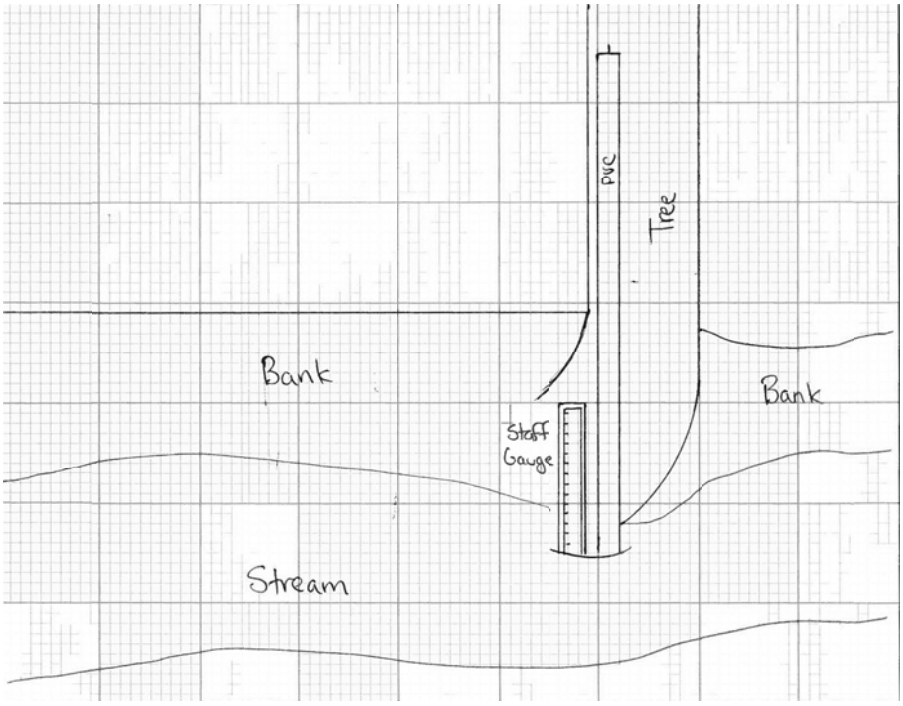
The pressure transducer and staff gage were installed together in a location about 50 feet downstream of the culvert beneath the intersection, on the western edge of the stream, in a point where the stream is constrained by trees on the bank. A stilling well consisting of a drivable wellhead was driven into the streambed about 2.5 feet deep. The transducer cable is run up to the stream bank in a straight PVC pipe, and secured to a tree on the bank. The staff gage is installed adjacent to the pressure transducer.

**Safety Issues/Access Restrictions**

Parking is available on the shoulder.

# INSTALLATION REPORT
## Installation Overview

### Station Installation Diagram




### Photo Log


# INSTALLATION REPORT
## Pressure Transducer

| | | |
|---|---|---|
| ☒ Installation Date: 7/30/09 Time: 10:48 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
| Location: West side of stream 50 feet downstream of intersection. | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928008 |
| Length of Cable (ft): | 12 |
| Desiccant Type/Condition: | Blue to Pink, 100% |

### Description of Hydraulic Conditions

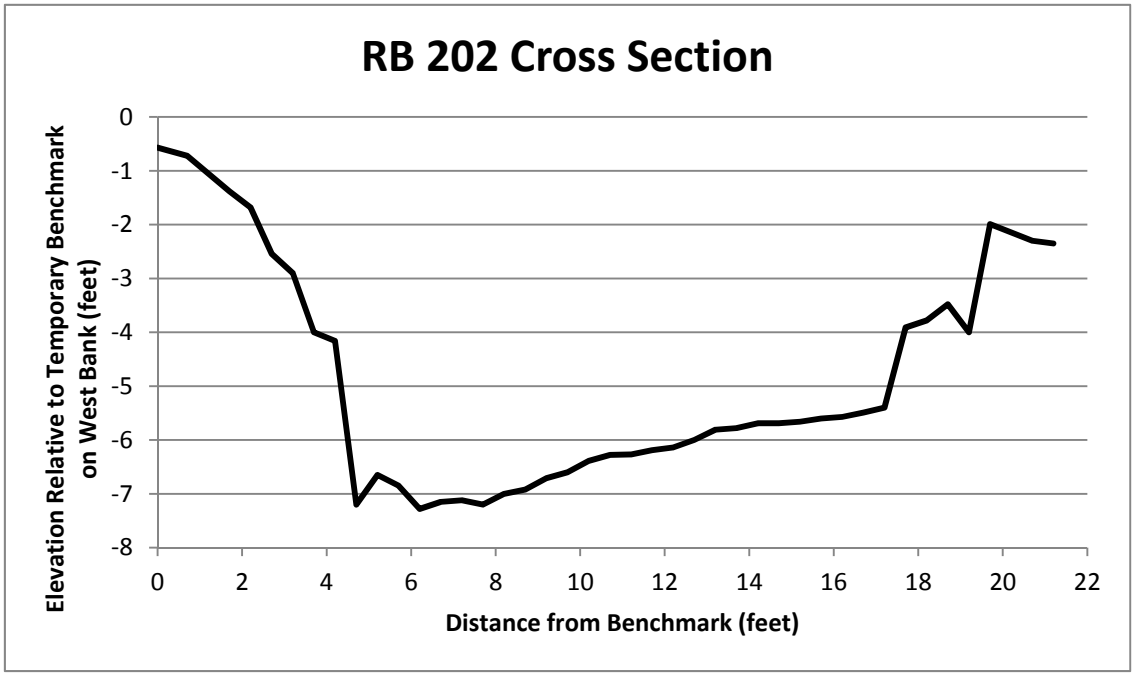
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☒ Free Flowing | ☐ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 0.2 | Estimated Storm Flow Depth (ft): | 1 |
| Base Flow Velocity (ft): | 0.2 | Estimated Storm Flow Velocity (ft/s): | 2 |
| Sediment Depth (in): | 2 | Staff Gauge: | 0.97 |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 13 |
| Bankfull Depth (ft): | 3.5 |
| Substrate: | Cobbles and Gravel |
| Slope: | 2% |
| Vegetation: | Forested, Alders |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Equipment is well off the beaten path, located 50 feet through brush downstream of an inconvenient parking space. It was also installed in a camouflage PVC pipe with a locking well-cap.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 7/30/09 | 10:48 | 0.97 | 3.065 | -2.087 | 0.97 |
| | | | | | |
| | | | | | |
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## Notes

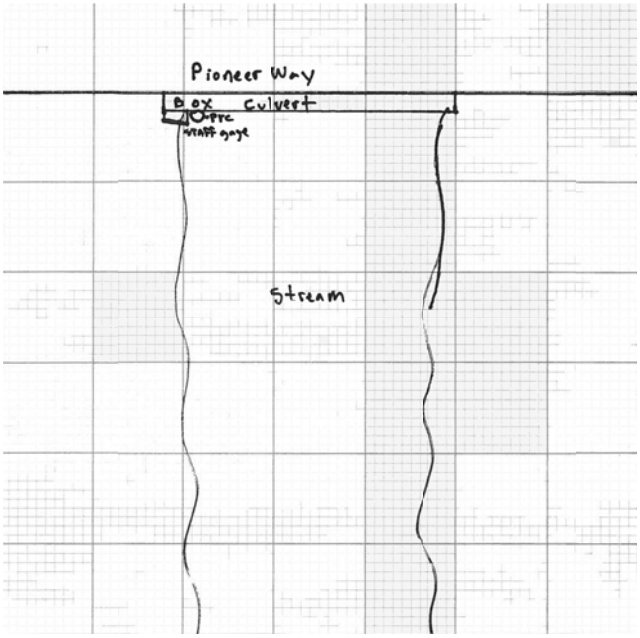
# INSTALLATION REPORT
## Installation Overview

| | | | |
|---|---|---|---|
| Project Name: | Ecology Surface Loading | Station Occupation Date: | 8/4/2009 |
| Project Number: | 06-03509-002 | Station Abandonment Date: | 8/30/2010 |
| WRIA: | 10 | Field Personnel: | Dan Bennett, Alex Svendsen |
| Station ID: | Residential Basin 209 | Weather: | Sunny, dry |
| Location: | Located at the intersection of Canyon Drive and Pioneer Way East. | Site Description: The stream flows along the east side of Canyon Drive, then crosses beneath Pioneer Way in a 4 foot wide box culvert. Upstream it's a braided channel and wetlands. Downstream is quite brushy, and the channel is not very constrained 50 feet downstream of the culvert. | |

**Vicinity Map of Site**


Lat: 47°12'18.35"N
Long: 122°21'30.08"W

**Site Drawing (Plan View)**




### Description of Installation

The pressure transducer and staff gage were installed directly at mouth of box culvert beneath Pioneer Way at the eastern edge of the culvert. A stilling well consisting of a drivable wellhead was driven into the streambed 2.5 feet. The transducer cable is run up to road level in a straight pipe with a locking well cap. The staff gage is installed directly on the face of the concrete box culvert.

### Safety Issues/Access Restrictions

Parking is only available on the shoulder. Proceed with caution due to traffic.

# INSTALLATION REPORT
## Installation Overview

**Station Installation Diagram**

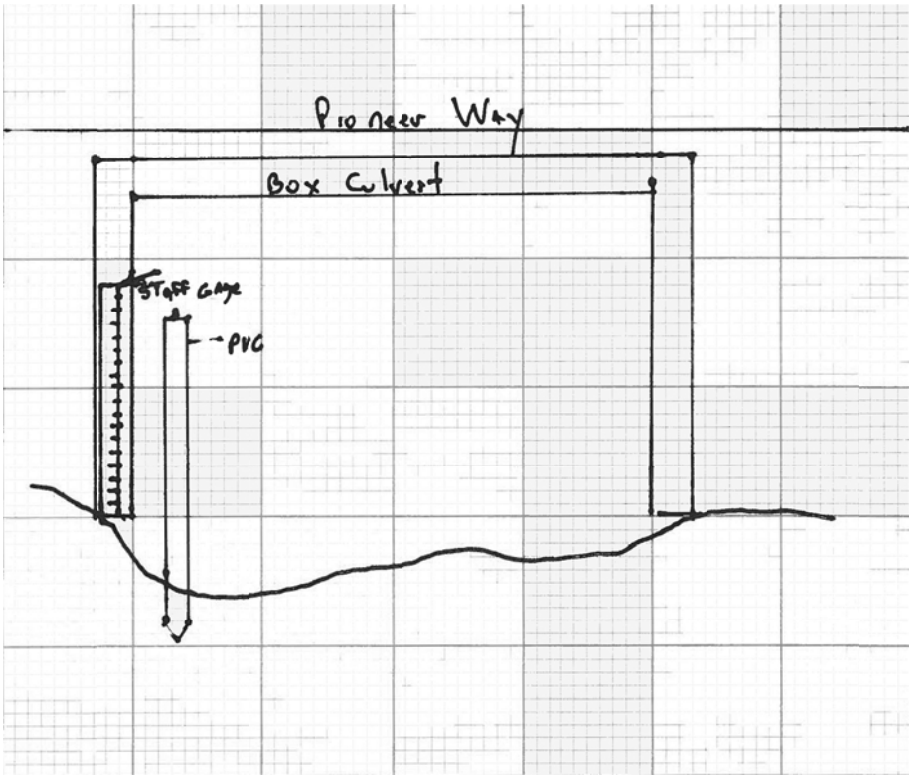



**Photo Log**

# INSTALLATION REPORT
## Pressure Transducer

| ☒ Installation Date: 8/4/2009 Time: 10:00 | ☐ Reconfiguration Date: Time: | ☐ Removal Date: Time: |
|---|---|---|
| Location: | Describe Reconfiguration:<br>Location: | Reason:<br>Location: |

### Description of Secondary Measurement Device

| | |
|---|---|
| Manufacturer: | Instrumentation Northwest |
| Model: | PT2X 5psi |
| Serial Number: | 2928017 |
| Length of Cable (ft): | 9 |
| Desiccant Type/Condition: | Blue to Pink/ 100% |

### Description of Hydraulic Conditions

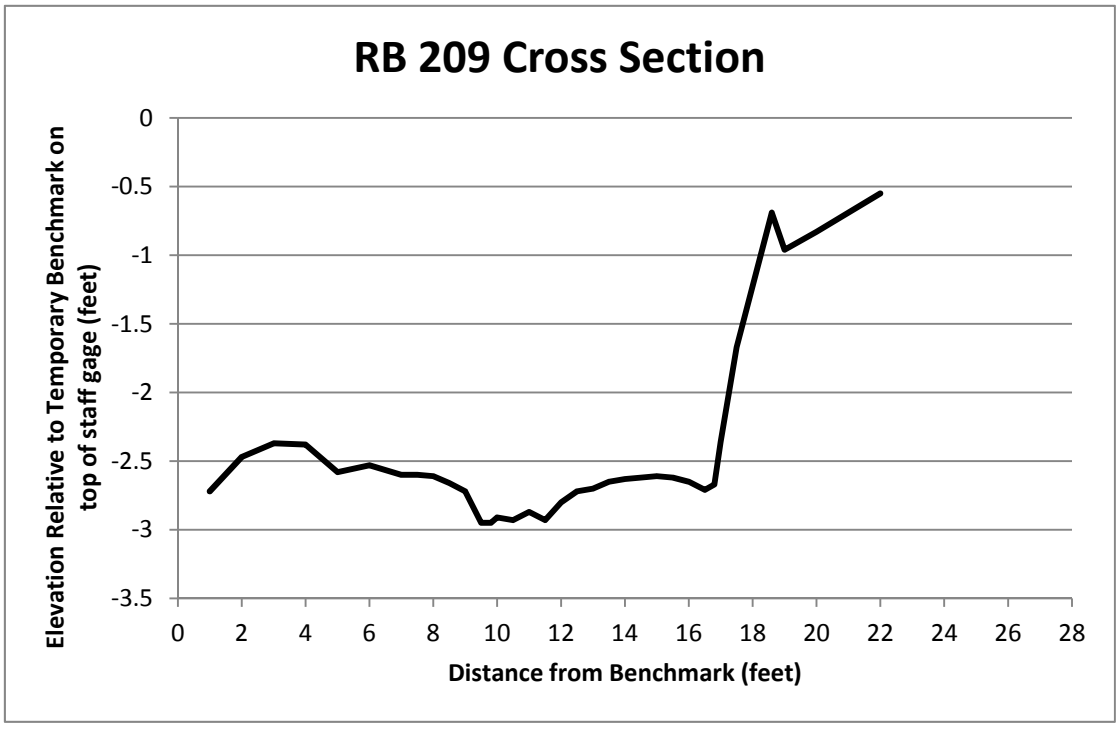
| | | | | |
|---|---|---|---|---|
| Hydraulic Conditions: | ☐ Backwater | ☒ Free Flowing | ☐ Dry | ☐ Stagnant |

| | | | |
|---|---|---|---|
| Base Flow Depth (ft): | 1 | Estimated Storm Flow Depth (ft): | **2** |
| Base Flow Velocity (ft): | 1 | Estimated Storm Flow Velocity (ft/s): | **5** |
| Sediment Depth (in): | 6 | Staff Gauge: | **1** |

### Description of Sensor Location

| | |
|---|---|
| Bankfull Width (ft): | 7 |
| Bankfull Depth (ft): | 2.5 |
| Substrate: | Deep sand |
| Slope: | 1-2 |
| Vegetation: | Blackberry, reed canary grass, alders. |

### Channel Profile :



# INSTALLATION REPORT
# Secondary Measurement Device

## Description of Security Precautions/Concerns

Equipment is easily visible from road, but parking is difficult, and pedestrians are unlikely to be here. A locking well cap was secured on the stilling well containing the pressure transducer, and the stilling well was camouflaged.

## Description of Secondary Measurement Device Calibration

| Date | Time | Staff Gage Reading | Measured Depth | Offset | Instrument Reading After Adjustment |
|---|---|---|---|---|---|
| 8/4/2009 | 9:31 | 0.97 | 2.80 | -1.83 | 0.97 |
| | | | | | |
| | | | | | |
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## Notes

Sandy bottom may make channel profile unstable even though it is essentially contained in the box culvert.