

**Attachment Q.5 –  
Procedures for Water Quality  
Sampling and Analysis**



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## Attachment Q.5

Seattle Public Schools  
Drinking Water Quality Program

# Procedures for Water Quality Sampling and Analysis

This document provides detailed procedures for the sampling and analysis of water quality samples collected at Seattle Public Schools facilities.

## **Sample Types**

### **Standing Samples**

A standing sample represents water that has been in contact with the fixture and the plumbing connecting the faucet to the lateral pipes. The standard standing time prior to collecting samples is 16 – 18 hours, which is generally a period on non-use from the afternoon of the day prior to sampling until earlier in the morning on the day of sampling.

### **Flushed Samples**

A flushed sample is representative of the water that is in the plumbing system upstream from the faucet. The types of flushed samples are described below.

#### ***30-Second Flush Samples***

Fixtures will be turned on and flushed for 30 seconds prior to sample collection.

#### ***2-Minute Flush Samples***

Fixtures will be turned on and flushed for 2 minutes prior to sample collection at all service entry and selected bubblers/sinks locations.

#### ***5-Minute Flush Samples***

Fixtures will be turned on and flushed for 5 minutes prior to total coliform sample collection at service entry and selected bubblers/sinks locations.

**Table 1. Sample points and parameters for the Seattle Public Schools Drinking Water Quality Program.**

Points of sampling	Sample type	Sample size	Analytes to measure in sample	
			Health	Aesthetic
Service entry to school	2-minute flush	250 mL	Lead, cadmium, copper, arsenic	Iron
	5-minute flush	100 mL	Total coliform	
Kitchen/lounge	Standing	250 mL	Lead, cadmium, copper, arsenic	
Sinks and Nurse Stations	30-second flush	250 mL	Lead, cadmium, copper, arsenic	
Bubblers/sinks in classrooms and/or hallways	Standing	250 mL	Lead, cadmium, copper, arsenic	
	30-second flush	250 mL	Lead, cadmium, copper, arsenic	
Sinks and bubblers	2-minute flush	250 mL		Iron
Selected locations within a building	5-minute flush (selected sites)	100-mL	Total coliform	

## Laboratory Sample Collection

Laboratory samples will be collected in accordance with laboratory and analytical method specifications, and following guidelines by the U.S. EPA (1994) and Washington State Department of Health (1995). Sample collection procedures are described separately below for inorganic and conventional samples, and for bacteria samples. Sample types and sizes are summarized for each point of sampling in Table 1.

### Inorganic and Conventional Samples

Water samples will be collected for analysis of metals, color, and turbidity. Collection procedures are outlined below for these inorganic and conventional samples.

1. Standing water samples will be collected as follows. Hold the appropriate sample bottle near the bottom with one hand and unscrew the cap with the other. Hold the cap near the top edge in one hand and the sample bottle in the other. Turn on the cold water faucet to get a constant stream about the size of a pencil, collect the appropriate sample volume, and replace the cap.
2. Thirty-second flush samples will be collected as follows. Flush the tap for an additional 30 seconds after collecting the standing sample. Hold the appropriate sample bottle near the bottom with one hand and unscrew the cap with the other. Hold the cap near the top edge in one hand and the sample bottle in the other. Turn on the cold water faucet to get a constant

stream about the size of a pencil, collect the appropriate sample volume, and replace the cap.

3. Two-minute flush samples will be collected as follows. Flush the tap for an 2 minutes, or an additional 90 seconds if a 30-second flush sample has been collected. Hold the appropriate sample bottle near the bottom with one hand and unscrew the cap with the other. Hold on to the cap near the top edge in one hand and the sample bottle in the other. Turn on the cold water faucet to get a constant stream about the size of a pencil, collect the appropriate sample volume, and replace the cap.

### **Bacteria Samples**

Water samples will be collected for determining the presence/absence of total coliform and fecal coliform bacteria. Follow-up sampling for total coliform bacteria will be conducted if the initial sample tests positive for total coliform bacteria. Collection procedures for initial and follow-up total coliform sample collection are described below.

#### ***Initial Sample Collection***

1. Collect standing, 30-second flush, and 2-minute flush samples, for other parameters as required.
2. After the 2-minute flush sample is collected, turn off the water and remove any attachments from the faucet, including aerators, screens, hoses, and water filters.
3. Spray the fixture with isopropyl alcohol, but not in excess as to cause droplets.
4. Turn on the cold water faucet to get a full stream of water. After 4 minutes (2 minutes if other samples were collected just prior to this), partially close the cold water faucet until there is a constant stream about the thickness of a pencil. Let the water run for 1 minute.
5. Collect the total coliform sample in a 100-mL certified sterile bacteria bottle containing sodium thiosulfate ( $\text{Na}_2\text{S}_2\text{O}_3$ ). Hold the sample bottle near the bottom with one hand and unscrew the cap with the other. Hold on to the cap near the top edge in one hand and the sample bottle in the other. Do not touch any part of the cap that touches the bottle. Do not set the cap down. Do not let anything touch the cap.
6. Hold the sample bottle under the stream of water about an inch below the bottom edge of the water spout. Do not let anything touch the sample bottle. Do not adjust the flow once you have started filling the sample bottle. Do not splash water on the cap.

7. Fill the sample bottle to the shoulder or fill line. Do not let the sample bottle overflow.
8. After the sample bottle is filled to the correct level, remove it from under the flow and immediately replace the cap.
9. Shut off the cold water faucet. Replace any attachments that were removed from the faucet.

### ***Follow-up Sample Collection***

1. Flush the tap for 2 minutes. Remove any attachments from the faucet, including aerators, screens, hoses, and water filters.
2. Spray the fixture with isopropyl alcohol, but not in excess as to cause droplets.
3. Turn on the cold water faucet to get a full stream of water. After 2 minutes, partially close the cold water faucet until there is a constant stream about the thickness of a pencil. Let the water run for 1 minute.
4. Collect the total coliform sample in a 100-mL certified sterile bacteria bottle containing  $\text{Na}_2\text{S}_2\text{O}_3$ . Hold the sample bottle near the bottom with one hand and unscrew the cap with the other. Hold on to the cap near the top edge in one hand and the sample bottle in the other. Do not touch any part of the cap that touches the bottle. Do not set the cap down. Do not let anything touch the cap.
5. Hold the sample bottle under the stream of water about an inch below the bottom edge of the water spout. Do not let anything touch the sample bottle. Do not adjust the flow once you have started filling the sample bottle. Do not splash water on the cap.
6. Fill the sample bottle to the shoulder or fill line. Do not let the sample bottle overflow.
7. After the sample bottle is filled to the correct level, remove it from under the flow and immediately replace the cap.
8. Collect and analyze a residual free chlorine sample. Record result on field form.
9. Shut off the cold water faucet. Replace any attachments that were removed from the faucet.

## Compromised Standing Sample Collection

It is expected that some standing samples will not be collected before fixtures are used by students, staff, or faculty at schools scheduled for sampling at 9 am. If it is determined in the field that a fixture has been used prior to collection of a standing sample, the field crew will collect only the flushed samples. All standing samples that are not collected will be noted. If a standing sample is not collected from a fixture location then the 30-second flushed sample will be analyzed for those parameters designated for the standing sample (i.e., change the sample parameters from list A to list C for 30-second flush according to sample parameter designation list described below).

## Sample Identification and Labeling

Sample fixture identification numbers have been developed as part of the Water Quality Improvement Program and are found in the database. Sample labels will be prepared prior to the sampling event by utilizing the applicable database module. Field personnel will enter the time of sample collection on each label after the sample has been collected.

Samples collected will be identified as follows:

School identification code – fixture number – sample type – analytes list.

### School Identification Code

The school identification code is a three-letter abbreviation assigned. For the list of school identification codes, refer to the database.

### Fixture Number

Fixture numbers were assigned during previous sampling and inspection events. In general, fixtures are sequentially numbered starting with “0” at the service entry. An “X” will be added immediately after the fixture number to indicate that the sample is a field duplicate.

### Sample type

Sample types and corresponding letter codes are described below in Table 2.

**Table 2. Sample type letter codes**

Letter Code	Sample Type
A	Standing
B	30-second flush
C	2-minute flush
D	5-minute flush

## Laboratory Procedures

Laucks Testing Laboratories, Inc., the laboratory selected for this monitoring program, is certified for each parameter by Ecology, including participation in audits and interlaboratory studies by Ecology and U.S. EPA. These performance and system audits verify the adequacy of the laboratory standard operating procedures, which include preventive maintenance and data reduction procedures.

## Sample Receipt and Handling

Samples will be delivered to the laboratory by each sampling team once all samples for the day have been collected. Laboratory personnel will immediately log the samples into the laboratory information management system (LIMS) database upon their receipt at the laboratory. Samples submitted for metals analysis will be preserved using nitric acid. One-liter sample bottles submitted for metals, color, and turbidity analysis will be split into two 500-mL sample aliquots prior to preservation.

## Analytical Methods

Laboratory analytical procedures will follow U.S. EPA–approved methods (APHA et al. 1992; U.S. EPA 1983). These methods provide reporting limits that are below the state and federal regulatory criteria or guidelines, and will enable direct comparison of analytical results with these criteria. Analytical methods and reporting limits are presented in Table 3.

**Table 3. Methods and reporting limits for water quality analyses.**

Parameter	Method	Method Number <sup>a</sup>	Reporting Limit/Unit
Turbidity	Nephelometric	EPA 180.1	0.1 NTU
Cadmium, total	ICP/MS	EPA 200.8	0.001 mg/L
Copper, total	ICP/MS	EPA 200.8	0.002 mg/L
Lead, total	ICP/MS	EPS 200.8	0.001 mg/L
Total coliform	Chromogenic Substrate (Colisure)	SM 9223B	Presence or absence
Color	Colorimetric	EPA 110.2	5.0 color units
Iron, total	ICP	EPA 200.7	0.05 mg/L
Arsenic	ICP/MS	EPA 200.8	0.002 mg/L

<sup>a</sup> SM method numbers are from APHA et al. (1992); EPA method numbers are from U.S. EPA (1983).

ICP: inductively coupled plasma.

ICP/MS: inductively coupled plasma/ mass spectrometer

mg/L: milligrams per liter.

NTU: nephelometric turbidity unit.

## Data Reporting

The laboratory will report the analytical results within the specified number of days from receipt of the samples. The laboratory will provide sample and quality control data in standardized reports that are suitable for evaluating the project data. The reports will also include a case narrative summarizing any problems encountered in the analyses and electronic deliverable data (EDD) in MS Excel format.

## DATA QUALITY OBJECTIVES AND QUALITY CONTROL PROCEDURES

The overall quality assurance objective is to ensure that data of known and acceptable quality are obtained. All measurements will be performed to yield consistent results that are representative of the media and conditions measured. Specific objectives and procedures for precision, accuracy, representativeness, completeness, and comparability are identified below and summarized in Table 4. In this document, the term *reporting limit* refers to the practical quantitation level established by the laboratory, not the method detection limit.

**Table 4. Data quality objectives for water quality analyses.**

Parameter	Laboratory Duplicates <sup>a</sup>	Blanks <sup>b</sup>	Matrix Spikes <sup>c</sup>	Control Standards <sup>d</sup>
Lead, total	≤20% or ±2X RL	< ½ RL	75–125%	80–120%
Cadmium, total	≤20% or ±2X RL	< ½ RL	75–125%	80–120%
Copper, total	≤20% or ±2X RL	< ½ RL	75–125%	80–120%
Iron, total	≤20% or ±2X RL	< ½ RL	70–130%	85–115%
Arsenic	≤20% or ±2X RL	< ½ RL	70–130%	85–115%
Color	≤20% or ±2X RL	NA	NA	NA
Turbidity	≤30% or ±2X RL	<RL	NA	NA
Total coliform	NA	NA	NA	NA

<sup>a</sup> The relative percent difference (RPD) of laboratory duplicates will be less than or equal to 20 percent for values that are greater than 5 times the reporting limit, and ±2 times the reporting limit for values that are less than or equal to 5 times the reporting limit.

<sup>b</sup> The values for laboratory preparation blanks will not exceed ½ the reporting limit for metals and will not exceed the reporting limit for turbidity.

<sup>c</sup> The percent recovery of matrix spikes will be between 75 and 125 percent for lead, cadmium, and copper, and will be between 70 and 130 percent for iron and zinc.

<sup>d</sup> The percent recovery of control standards will be between 80 and 120 percent for lead, cadmium, and copper, and will be between 85 and 115 percent for iron and zinc.

NA: not applicable.

RL: reporting limit.

- **Precision.** Precision will be assessed using laboratory and field duplicates. Laboratory duplicates will be analyzed at random with every sample batch. Up to two field duplicates will be collected from each school. Field duplicates will be collected from the service entry and from one kitchen/lounge sink. Two levels of precision for duplicate analyses will be evaluated. The relative percent difference of laboratory duplicates will be less than or equal to 20 percent (30 percent for turbidity) for values that are greater than five times the reporting limit, and ±2 times the reporting limit for values that are less than or equal to five times the reporting limit. Laboratory duplicates will be analyzed with every sample batch.
- **Accuracy.** Accuracy will be assessed with analyses of laboratory preparation blanks, matrix spikes, and control standards. Where applicable, these quality control analyses will be performed for every

sample batch. The values for blanks will not exceed 1/2 the reporting limit for all parameters except turbidity. The value for turbidity blanks will not exceed the reporting limit. The percent recovery of matrix spikes will be between 75 percent and 125 percent for lead, cadmium, and copper, and will be between 70 percent and 130 percent for iron and zinc. The percent recovery of control standards will be between 80 percent and 120 percent for lead, cadmium, and copper, and will be between 85 percent and 115 percent for iron and zinc. The laboratory will analyze a preparation blank, matrix spike, and quality control standard with at least every 20 samples submitted.

- **Representativeness.** The sampling design will provide samples that represent a wide range of water quality conditions within each school. Employing consistent and standard sampling procedures will ensure sample representativeness.
- **Completeness.** A minimum of 95 percent of the samples submitted to the laboratory will be judged valid. It is anticipated that not all samples will be collected due to use of the fixtures (for standing samples) or inoperable fixtures. A field log form will be used to document loss of data resulting from fixture use prior to sample collection or inoperable fixtures.
- **Comparability.** Data comparability will be ensured through the application of standard sampling procedures, analytical methods, units of measurement, and reporting limits. The results will be tabulated in standard spreadsheets for comparison with threshold limits and background data.

Field and laboratory data will be validated by the Herrera quality assurance officer. Quality control problems and corrective actions will be summarized in a quality assurance worksheet. Values associated with minor quality control problems will be considered estimates and assigned J qualifiers. Values associated with major quality control problems will be rejected and qualified R (rejected value). Estimated values may be used for evaluation purposes, while rejected values will not be used. The following sections describe the data assessment procedures for these quality control elements:

- Completeness
- Methodology
- Holding times
- Blanks
- Reporting limits
- Laboratory duplicates
- Matrix spikes
- Control standards.

## Completeness

Completeness will be assessed by comparing valid sample data with this plan and the chain-of-custody records. Completeness will be calculated by dividing the number of valid values by the total number of values. If completeness of samples submitted to the laboratory is less than 95 percent, samples will be reanalyzed or re-collected if time permits.

## Methods

Methods for analytical procedures will follow U.S. EPA approved methods (APHA et al. 1992 and U.S. EPA 1983). Field procedures will follow the methods described in this sampling and analysis plan. Any deviations from these methods will be documented by the Herrera quality assurance officer. Deviations that are deemed unacceptable will result in rejected values (R) and will be corrected for future analyses.

## Holding Times

Holding times will be assessed by comparing analytical dates and times to sample collection dates and times. Data from samples that exceed the maximum holding time required by U.S. EPA (1992) by less than or equal to twice the maximum holding time will be considered estimates (J). Data from samples that exceed the maximum holding times by more than twice the maximum holding time will be rejected (R).

## Blanks

Method blanks consisting of deionized distilled water will be analyzed by the laboratory, and the results will be reported in each laboratory report. Sample values that are less than five times a detected blank value will be considered estimates (J).

## Reporting Limits

Detection limits will be reported in each laboratory report. If proposed reporting limits are not met by the laboratory, the laboratory will be requested to reanalyze the samples and/or revise the method, if time permits.

## Duplicates

Precision of laboratory duplicate results will be presented in each laboratory report. Data for batch samples (i.e., samples from other projects analyzed with samples from this project) will be acceptable as long as duplicates of project samples are analyzed at a frequency of at least 5 percent. Precision of field and laboratory duplicate results will be calculated according to the following equation:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2) / 2}$$

in which:

- $RPD$  = relative percent difference
- $C_1$  = larger of two values
- $C_2$  = smaller of two values.

Laboratory duplicate results exceeding the objectives will be noted in the quality assurance worksheets, and all values associated with the analysis batch will be flagged as estimates (J). If the objectives are severely exceeded (i.e., more than twice the objective), associated values will be rejected (R). Field duplicate results exceeding the objectives will be noted in the quality assurance worksheets, and the Herrera quality assurance officer may qualify either the field duplicate results or all associated values depending on results of other quality control analyses.

**Matrix Spikes**

Accuracy of matrix spike results will be presented in each laboratory report. Data for batch samples will be acceptable as long as spikes of project samples are analyzed at a frequency of at least 5 percent. Accuracy of matrix spike results will be calculated according to the following equation:

$$\%R = \frac{(S - U) \times 100\%}{C_{sa}}$$

in which:

- %R = percent recovery
- S = measured concentration in spike sample
- U = measured concentration in unspiked sample
- C<sub>sa</sub> = actual concentration of spike added.

If the analyte is not detected in the unspiked sample, then a value of zero will be used in the equation.

Results exceeding the objective (control limit) will be noted in the quality assurance worksheets, and the Herrera quality assurance officer may qualify either the matrix spike sample results or all values associated with the analysis batch as estimates (J) depending on results of other quality control analyses. However, if the percent recovery exceeds the upper control limit (125 or 130 percent) and a sample value is less than the reporting limit, then the result will not be flagged as an estimate. Nondetected values will be rejected (R) if percent recovery is less than 30 percent.

**Control Standards**

Accuracy of control standards will be presented in each laboratory report and checked by the quality assurance officer. Accuracy for these elements will be calculated according to the following equation:

$$\%R = \frac{(M - T) \times 100\%}{T}$$

in which:

- %R = percent recovery
- M = measured value
- T = true value.

Results exceeding the objective (control limit) will be noted in the quality assurance worksheets, and all values associated with the analysis batch will be flagged as estimates (J). If the objectives are severely exceeded (i.e., more than twice the objective), then associated values will be rejected (R).

