SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

II. WATER QUALITY AND TREATMENT

APPENDIX A
TREATMENT ASSETS INVENTORY

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Cedar Treatment Facility Design Criteria

Landsburg Diversion Dam	
Chlorination	
System	Chorine Gas
Target Dosage	0.65 to 1.7 mg/L
Fluoridation	
System	Hydrofluosilicic Acid; Simple gravity feed
Target Dosage	1.15 mg/L
Lake Youngs	
Plant	
Type:	Raw Water Ozonation and Ultra Violet Disinfection
Capacity:	180 mgd
Intake and Raw Water Pump Station	
Pump type	Submersible
Number of units:	7
Size	2 @ 20 mgd, 5 @ 40 mgd
Ozone Generation	
Type:	LOX Feed
Number of units:	2
Design concentration of ozone	6 - 12 %
Capacity:	825 lbs/day @ 12 % each (nomimal)
	1250 lbs/day @ 6 % each (peak)
Applied ozone dose	0.3 - 0.6 mg/L (typical)
	0.8 mg/L (peak)
Ozone Contacting	
Type:	Fine bubble diffusion
Flow direction	Counter-current
Contactor type	Pipeline
Number of units:	Two parallel trains
Volume	0.61 MG
Contact time:	9.8 min @ peak capacity
Ultra Violet Disinfection	
Design basis	3-log Cryptosporidium
Method	Medium pressure
Dosage	40 mJ/sq cm
Contactor type	Closed vessel
Number	13 total, 12 @ 180 MGD
Capacity:	15 MGD each
Clearwell	
Type:	Pre-stressed Concrete
Number of units:	2
Total volume:	20 MG
Treatment Chemicals	
Gaseous chlorine:	Disinfectant residual
Lime:	pH and alkalinity adjustment
Sodium Bisulfite	Excess ozone quenching

Source: Design Criteria (Updated July 12, 2004), CH2MHILL; Kirby, January 2006

Notes:

lbs/day = pounds per day
mgd = million gallons per day
min = minutes
mg/L = milligrams per liter
LOX = Liquid Oxygen
MG = million gallons
mJ/sq cm = millijoules per square centimeter

Tolt Treatment Facility Design Parameters

Plant	
Type:	Direct Filtration with Raw Water Ozonation
Capacity:	120 mgd
Ozone Generation	
Type:	LOX Feed, High Concentration
Number of units:	Two duty, one standby
Capacity:	2,388 lbs/day each
Applied dose:	2.9 mg/l (average)
	4.8 mg/l (maximum)
Production	1,651 lbs/day (average)
	4,775 lbs/day (maximum)
Ozone Contacting	
Type:	Fine bubble diffusion w/baffled contactor
Number of units:	Two parallel trains
Capacity:	60 mgd each
Contact time:	31.6 minutes (theoretical), including dual-purpose flocculation/ozone contact basins
Flocculation	
Type:	Hydraulic flocculation w/baffled serpentine flow
	Pumped jet flash mix for chemical addition
Number of units:	Two parallel trains
Capacity:	60 mgd each
Detention time:	26.5 minutes (theoretical)
Filtration	
Type:	Anthracite mono-medium, with air/water backwash
Number of units:	Six (each with two bays)
Capacity:	24 mgd each
Rate:	12 gpm/sq ft
Bed depth:	72 inches
Clearwell	
Type:	Baffled concrete, cast-in-place
Number of units:	One (two equal halves)
Total volume:	7.4 MG
Washwater Recovery	
Type:	Settling/drying basins
Number of units:	Four
Capacity:	1.385 MG each
FTW/Equalization Basin	
Volume:	1.485 MG
Treatment Chemicals	
Ferric chloride:	Primary coagulant
Cationic polymer:	Coagulant aid
Anionic/nonionic polymer:	Filter aid and washwater solids settling aid
Gaseous chlorine:	Disinfectant residual
Carbon dioxide:	pH and alkalinity adjustment
Lime:	pH and alkalinity adjustment
Hydrofluosilicic acid:	Fluoride addition
Sodium bisulfite:	Excess ozone quenching

Source: Process Design Criteria (February 2001), CDM PHILIP, SPU updated in April 2006

Notes:

FTW = Filter to Waste
gpm/sq ft = gallons per minute per square foot
lbs/day = pounds per day
LOX = Liquid Oxygen
mgd = million gallons per day
mg/L = milligrams per liter
MG = million gallons

Prepared April 2006

Seattle Well Fields Treatment Facilities

Chlorination	System	Sodium Hypochlorite
	Target Dosage	1.0 to 1.4 mg/L
Fluoridation	System	Hydrofluosilicic Acid
	Target Dosage	1.0 mg/L
Corrosion Control	System	NaOH Addition
	Target pH	8.0

Source: Updated by SPU in April 2006

Reservoir and Well Chlorination Facilities					
Facilities	**Year [1] Chlorination Facility Constructed**	**Type of Chlorination**	**Target Chlorine Residual (mg/l)**	**Redundancy**	**Condition**
Outlet (Primary) Disinfection					
Beacon Hill Reservoir	1987	Sodium Hypochlorite	1.3	Two peristaltic pumps.Only one main storage tank	Upgraded in 2000
Maple Leaf Reservoir	1996	Sodium Hypochlorite	1.3	Excellent facility backup - two main storage tanks, peristaltic sodium hypochlorite injection equipment.	Facility is fairly new. Everything is in good shape.
Myrtle Reservoir	1957	Chlorine gas 150-lb cylinders	1.2	Only one chlorinator, to be removed in 2006 and replaced with on-site hypogeneration.	Treatment equipment is in good shape. Supplier supports equipment.
Roosevelt Reservoir	1996	Sodium Hypochlorite	1.35	Excellent facility backup - two main storage tanks, peristaltic sodium hypochlorite injection equipment.	Facility is fairly new. Everything is in good shape.
Volunteer Reservoir	1954	Chlorine gas 150-lb cylinders	1.3	Has one chlorinator and no sodium hypochlorite injection equipment or storage tanks.	Treatment equipment is in good shape. Supplier supports equipment.
West Seattle Gate House	1998	Sodium Hypochlorite	1.0	Excellent facility backup - two main storage tanks, peristaltic sodium hypochlorite injection equipment.	Facility is fairly new. Everything is in good shape.
West Seattle Reservoir	1998	Sodium Hypochlorite	1.3	Excellent facility backup - two main storage tanks, peristaltic sodium hypochlorite injection equipment.	Facility is fairly new. Everything is in good shape.
Residual Maintenance (Secondary) Disinfection					
Bitter Lake Reservoir	2001	On-site hypo generation	0.9	No redundancy/peristaltic with a spare on shelf. Can add calcium hypochlorite as a back up method.	Treatment equipment is in good shape.
Boulevard Park Well	1987	Sodium Hypochlorite	1.0	Well can be shut down if a disinfection equipmentfailure occurs.	Condition of the equipment is good. The sodium hypochlorite storage tanks were recently rebuilt.
Eastside Reservoir	1987	Sodium Hypochlorite	0.6	None. Can add calcium hypochlorite as a back up method of disinfection.	Treatment equipment is in good shape.
Lake Forest Park Reservoir	2002	On-site hypo generation	0.9	Two peristaltic pumps. Can add calcium hypochlorite as a back up method of disinfection.	Treatment equipment is in good shape.
Lincoln Reservoir	2004	On-site hypo generation	0.9	Two peristaltic pumps. Can add calcium hypochlorite as a back up method of disinfection.	Treatment equipment is in good shape.
Magnolia Reservoir	1994	Sodium Hypochlorite	0.9	Two storage tanks and two metering pumps.	Facility is fairly new. Good condition.
Riverton Well	1987	Sodium Hypochlorite	1.0	Peristalic pumps. Well can be shut down if a disinfection equipment failure occurs.	Condition of the equipment is good. The sodium hypochlorite storage tanks were recently rebuilt.

Source: Reimer, 1999; Capron, 2006; Green, 2006

(1) In some cases, the year constructed is approximate.

SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

II. WATER QUALITY AND TREATMENT

APPENDIX B

ADMINISTRATIVE RULES FOR CROSS-CONNECTION CONTROL PROGRAM

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Seattle Public Utilities - Policy & Procedure

Subject: ADMINISTRATIVE RULES FOR THE CROSS-CONNECTION CONTROL PROGRAM	Number: SPU-CS-105
	Effective: 5-18-2006
	Supersedes: 400P-64-50, 4001-64-53, 4001-64-56, 4001-64-59
Approved: Chuck Clarke Department: SPU	Page(s): 1 of 16

1.0 PURPOSE

1.1 To establish administrative rules for the implementation of a program of cross-connection control in Seattle Public Utilities' direct service water supply area to protect the health of water consumers and the potability of the public water system. This rule supersedes three Department (SPU) Operating Instructions, 4001-64-53, Cross-Connection Inspection; 4001-64-56, Pier and Waterfront Inspection; and 4001-64-59, Backflow Prevention Device Installation and Testing, which are hereby rescinded.

2.0 ORGANIZATIONS AFFECTED

2.1 Seattle Public Utilities (SPU)

2.2 Public Health – Seattle King County (PHSKC), formerly Seattle-King County Department of Public Health

2.3 Seattle Department of Planning and Development (DPD)

2.4 City of Shoreline

3.0 REFERENCES

3.1 City of Seattle Cross-Connection Control Ordinance, Council File No. 115660, May 28, 1991. (See Appendix 1.)

3.2 2000 Uniform Plumbing Code (Chapter 6) and City of Seattle Amendments (Ordinance No. 14712, effective October 23, 1989).

3.3 Land Use Code, Zoning Code, SMC Titles 23 & 24.

3.4 WAC 246-290-490, Department of Health (DOH) Drinking Water Regulations, Cross-Connection Control.

3.5 WAC 296-24-12005, Department of Labor and Industries (DLI) Boilers and Unfired Pressure Vessels Law, Backflow Protection.

3.6 Cross-Connection Control Manual: Accepted Procedure and Practice, prepared by the Cross-connection Control Committee of the Pacific Northwest Section, American Water Works Association, Latest Edition.

3.7 Manual of Cross-Connection Control published by the Foundation for Cross-Connection Control and Hydraulic Research , University of Southern California (USC), Latest Edition.

3.8 Cross-Connection Joint Program Memorandum of Understanding with PHSKC and SPU, effective July 2001.

3.9 Backflow Prevention Assemblies Approved for Installation in Washington State, Washington State Department of Health, Latest Edition.

3.10 SPU Standard, Connection, and Administrative Charges Rule (Standard Charges), latest version.

4.0 POLICY

4.1 It is the policy of Seattle Public Utilities to protect the public water supply and its water users as required and intended by state regulations by controlling each potential cross-connection as close to its source as practical.

5.0 DEFINITIONS

5.1 Approved Backflow Prevention Assemblies: Assemblies that are approved by the State and appear on their published approval list and that are approved for use in the SPU direct service area; specifically, Reduced Pressure Backflow Assemblies (RPBA), Double Check Valve Assemblies (DCVA) and Pressure Vacuum Breaker Assemblies (PVBA). This applies to assemblies that, at time of original installation, were approved by the State, appeared on their published approval list current at that time, and were approved for use in the SPU direct service area. (See the definitions and descriptions provided in the Cross-Connection Control Manual: Accepted Procedure and Practice, Pacific Northwest Section, American Water Works Association, Latest Edition.)

5.2 Backflow: The flow of any foreign liquids, gases or other substances from any source, back into the potable water supply within a facility and/or public water supply. Backflow may occur due to either backsiphonage or backpressure.

5.3 Backflow Assembly Tester (BAT): A person holding a BAT certificate issued in accordance with WAC 246-290.

5.4 Backpressure: Backflow caused by positive pressure (above the supply pressure) in the piping system downstream of the supply piping.

5.5 Backsiphonage: Backflow caused by a negative pressure (vacuum) or reduced pressure in the supply piping.

5.6 Call-back Inspection: A follow-up inspection of a direct service customer's premises, performed by SPU to monitor the customer's activities toward achieving compliance subsequent to the cross connection inspection.

5.7 Contamination: Any impairment of the quality of the water from any substance

which may adversely affect the health of the consumer.

5.8 Controlled Cross-Connection: A connection between the SPU water system and any non-potable water system with an approved backflow prevention assembly properly installed and maintained so that it will continuously afford the protection commensurate with the degree of hazard.

5.9 Cross-Connection: Any physical arrangement whereby a public water supply is connected, or has the potential for being connected, directly or indirectly, with anything that does not exclusively contain or convey potable water from a Washington State Department of Health-approved source.

5.10 Cross-Connection Inspection: An inspection of a direct service customer's premises, performed by SPU, expressly for purposes of evaluating and locating cross-connection potential inherent in supplying that customer's water system.

5.11 Degree of Hazard: The degree of hazard is derived from an evaluation of the potential risk to public health and the adverse effect of the hazard upon the potable water system. Hazards may include:

5.11.1 Health Hazard: Any condition, device or practice in the water supply system and its operation which, in the judgment of SPU, could create a danger to the health and well-being of the water customer.

5.11.2 System Hazard: An actual or potential threat to the physical properties of, or to the potability of water in SPU's water system or the customer's potable water system, which would constitute a nuisance or be aesthetically objectionable or could cause damage to the system or its appurtenances, but would not be dangerous to health.

5.12 Seattle Public Utilities (SPU): SPU, the Director of SPU, his designee or his authorized agents. Authorized agents include the Customer Service Deputy Director, the Director of Utility Service Teams, the Supervisor of Utility Service Inspection, and Senior Utility Service Inspectors.

5.13 Direct Service Water Customer (or Water Customer): Those customers receiving water through a meter installed by SPU for end uses directly from the SPU distribution system and classed as direct service or retail for billing purposes.

5.14 Pollution: Any impairment of the quality of the water which may adversely affect the aesthetic characteristics of the water.

5.15 Potable Water Supply: Any water supply system intended or used for human consumption or other domestic uses and which must meet Washington State Department of Health Public Water System Rules and Regulations.

5.16 State: Washington State Department of Health, Office of Drinking Water.

5.17 Temporary Usage Connections: Any vehicle to which a tank or container is affixed for containing water and/or chemicals or materials, or any temporary use of water for construction, cooling, testing, or other non-domestic purposes which

are capable of imparting contamination or pollution to the public water supply through a cross-connection between such points of usage and the water supply via a fire hydrant or other temporary connection.

5.18 Water Service Connection: The terminal end of a service connection from the SPU water system; the city union, i.e., where SPU loses jurisdiction and sanitary control over the water at its point of delivery to the customer's water system. Service connection shall also include water service connections from a fire hydrant and all other temporary or emergency water service connections from the public potable water system.

5.19 Water System: For the purpose of this policy and procedure, the water system is considered to be made up of two parts: the SPU system and the customer's system. The SPU system shall consist of the source and transmission facilities and the distribution system, and shall include all those facilities of the water system under the complete control of SPU, up to the point where the customer's system begins. The customer's system shall include those parts of the facilities beyond the termination of SPU's distribution system which are utilized in conveying SPU-delivered water to points of use.

6.0 RESPONSIBILITIES

6.1 Seattle Public Utilities

6.1.1 SPU, through the Utility Service Inspection Unit of its Customer Service Branch, shall prevent contamination of the water distribution system and maximize protection of on-property water consumers by maintaining surveillance over new and existing plumbing within buildings to meet the requirements of the state regulations in cross-connection control. SPU has no responsibility or authority beyond the farthest downstream installed and operable backflow assemblies.

6.2 Water Customer

6.2.1 The water customer shall be responsible for eliminating cross-connections or controlling them through the installation, regular testing and maintenance of approved backflow prevention assemblies.

6.2.2 The water customer shall be responsible for providing the necessary information, obtaining required permits (including change of use permits) and providing entry and access for inspection, to allow a determination of the cross-connection, potential and the necessary control methods.

6.2.3 The water customer is responsible for notifying SPU of any assemblies which the customer believes are no longer required.

6.2.4 The water customer is responsible for all costs associated with the installation, testing, repair and replacement of backflow prevention assemblies.

6.2.5 The water customer is responsible for providing signs at all water takeoff points downstream of backflow prevention assemblies.

7.0 PROCEDURES

7.1 The following procedures represent minimum cross-connection control operating policies:

7.1.1 General

7.1.1.1 Applicability of Regulations and References

7.1.1.1.1 The control or elimination of cross-connections shall be in accordance with the State of Washington Administrative Code on Cross-Connection Control (WAC 246-290-490) and the 2000 Edition of the Uniform Plumbing Code, Chapter 19.27 RCW, and subsequent additions.

7.1.1.1.2 The policies, procedures and criteria for determining appropriate levels of protection shall be in accordance with the Cross-Connection Control Manual: Accepted Procedure and Practice, Pacific Northwest Section, American Water Works Association, Latest Edition, and The Manual of Cross-Connection Control, Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California (latest edition), with the following major exceptions:

7.1.1.1.2.1 Double Check Detector Assemblies and Reduced Pressure Detector Assemblies are approved for use in SPU's direct service area only as backflow assemblies and are not intended to take the place of any bypass meters retired on water services.

7.1.1.1.2.2 Services (fire/domestic) to buildings over three (3) stories or over 30 feet in height shall be protected with DCVAs. Backflow protection will not be required on service lines to existing systems exceeding three stories or 30 feet in height on a retrofit basis, unless, in the judgment of SPU, significant modifications to

the customer's water system, such as an increase of the service size, installation of booster pumps, or other changes that result in an increased ability to provide water flow, are being made during rehab construction.

7.1.1.1.2.3 Fire services constructed of materials which are not approved in the Uniform Plumbing Code or the City of Seattle Amendments for use in potable water piping systems shall be protected with DCVAs.

7.1.1.1.2.4 A Reduced Pressure Backflow Assembly or Air Gap is required for all Table #9 High hazard customers as referenced and required by WAC 246-290. In-premise protection is required by the City of Shoreline and PHSKC per the Cross-Connection Joint Program Memorandum of Understanding.

7.1.1.1.2.5 An Air Gap or Reduced Pressure Backflow Assembly is required on any aspirator-type equipment capable of introducing any substance into the water line downstream of such equipment.

7.1.1.2 Guidelines for Type and Location of Protection

7.1.1.2.1 Type: The type of backflow protection required shall depend on the degree of hazard.

7.1.1.2.1.1 An air gap (AG) or Reduced Pressure Backflow Assembly (RPBA) shall be used if industrial waste or other similar toxic contamination is present that would cause a health or system hazard.

7.1.1.2.1.2 A double check valve assembly (DCVA) would be required if objectionable pollution (not hazardous to health) is present. Higher levels of protection, i.e., AG or RPBA, can be installed but would not be required.

7.1.1.2.1.3 A Pressure Vacuum Breaker Assembly (PVBA) and Spill-proof Vacuum Breaker Assembly (SVBA) would be required if objectionable pollution (not hazardous to health) is present, and there is no possibility of backpressure. Higher levels of protection, i.e., AG, RPBA or DCVA can be installed, but would not be required.

7.1.1.2.1.4 Any assembly required by these Administrative Rules shall be a model approved by the State of Washington Department of Health.

7.1.1.2.2 Location of Protection: The backflow protection shall be located as close to the hazard as practical and as required by WAC 246-290-490 and SPU. If access for inspection by SPU is denied by the water customer, in lieu of denying water service, and with the approval of PHSKC or the City of Shoreline, SPU may require that an AG or RPBA be installed at the property line or at agreed location with PHSKC or the City of Shoreline. An AG and RPBA would be required in those instances where SPU suspects sewage connected plumbing.

7.1.1.3 Personnel Certification

7.1.1.3.1 At least one SPU staff member must be certified by the state as a Cross-connection Control Specialist (CCS). Normally, the Supervisor of the Utility Service Inspectors and two Senior Inspectors will have such certification.

7.1.2 Plan Review of New and Rehab Construction

7.1.2.1 SPU's representative will review all new and rehab construction plans submitted to the Seattle Department of Planning and Development (DPD) that, by the description provided by the owner, may require cross-connection control. The cross-connection control requirements will be written on the Cross-Connection Plan Review form with attachments and returned to the architect or designer submitting the plans for review.

7.1.2.2 Water service will not be provided to new construction until the cross-connection control requirements are addressed.

7.1.2.3 NOTE: Owners are required by DPD to obtain Master Use Permits whenever the use of a building or lot changes in a way which would be regulated differently than the current use.

7.1.3 Consultation

7.1.3.1 SPU representatives in the Utility Service Inspection Unit of the Customer Service Branch are available to review plans and interpret State Regulations and SPU Administrative Rules to assist water customers in meeting the cross-connection control ordinance and minimize retrofits and revisions.

7.1.4 Inspection of Installations and Initial Assembly Testing

7.1.4.1 A SPU inspector shall jointly inspect all new installations of

backflow preventers on Table # 9 for high hazard water customers as referenced by WAC 246-290-490, and outlined in the Joint Program Memorandum of Understanding with PHSKC. All new backflow assemblies will be inspected after assemblies have been tested, and test report provided by a Washington State licensed Backflow Assembly Tester (BAT). (See Section 7.3.3 for annual testing requirements.) The owner and or installer is responsible for notifying SPU, City of Shoreline, or PHSKC of newly installed assemblies requiring inspection.

7.1.4.2 A SPU inspector shall inspect premises after the removal of any assembly which provides premise isolation. PHSKC will inspect in-premises assemblies no longer needed. An assembly no longer needed and for which the site was inspected, will be removed from SPU's records.

7.1.5 Temporary Usage Inspections

7.1.5.1 A SPU inspector shall inspect equipment or processes for which a hydrant permit (see SPU's hydrant use policy and procedures) for temporary water service that has been requested and which poses a cross-connection potential, e.g., spray and tank trucks.

7.1.5.2 Corrections of deficiencies cited at the time of inspection must be completed before a hydrant permit will be issued.

7.1.5.3 Temporary users of water requesting a hydrant permit and whose use constitutes a cross-connection hazard, must produce an inspection certificate showing a current annual inspection, certified by SPU before a hydrant permit will be issued.

7.1.6 Regular Inspections of High Hazard Sites

7.1.6.1 The Utility Service Inspection Unit shall assign priorities to and schedule high-hazard site inspections with special emphasis placed on the types of facilities listed in WAC 246-290-490. The Senior Utility Service Inspector shall notify the responsible party of the premises scheduled for inspection, and if possible, arrange a time that is convenient to the water customer.

7.1.6.1.1 NOTE: IF DURING THE INSPECTION, A CROSS-CONNECTION IS FOUND THAT PRESENTS, IN THE OPINION OF THE INSPECTOR, AN IMMINENT THREAT TO PUBLIC HEALTH, WATER SERVICE TO THE SITE SHALL BE IMMEDIATELY TERMINATED, AND SHALL REMAIN OFF UNTIL THE HAZARD IS CORRECTED.

7.1.6.2 After the inspection is complete, the Senior Utility Service Inspector shall notify the responsible party on the premises by a Site Survey letter listing the cross-connections found and

requesting their correction within a specified time. If an approved backflow prevention assembly is required on the customer's system, the type and location of the assembly shall be specified. A copy of the Site Survey shall be sent to PHSKC or the City of Shoreline, depending on the site location.

7.1.6.3 The water customer shall notify SPU at the completion of the work and a follow-up inspection will occur. If the work has been completed satisfactorily, then the Site Survey is abated and no further action will be needed.

7.1.6.4 If the water customer does not complete the work required in the letter of citation within the time specified, a second, certified letter will be sent requiring the water customer to complete the work within a shorter specified time (generally 10 days) and reminding the water customer that it is SPU's responsibility to deny water service to anyone who does not comply with backflow protection requirements.

7.1.6.5 If the water customer does not complete the work within the time specified in the second letter or does not make special arrangements with SPU for an alternate compliance date based on extenuating circumstances, SPU will give notice to the water customer of its intention to shut off water to the property on a specified date. On that date, the water service meter will be shut off and remain off until the backflow protection work has been completed.

7.2 The following represents required backflow prevention assembly installation practices.

7.2.1 General

7.2.1.1 The criteria for assembly installation practices shall be in accordance with the Cross-Connection Control Manual: Accepted Procedure and Practice, Pacific Northwest Section, American Water Works Association, Latest Edition.

7.2.1.2 All new installations shall be inspected by SPU, the City of Shoreline, or PHSKC (per the Cross-Connection Joint Program Memorandum of Understanding).

7.2.1.3 Assemblies shall be accessible for testing and maintenance. They shall be installed no higher than five (5) feet above the floor or ground surface to the center line of the assembly, or be provided with an Occupational Safety and Health Administration (OSHA) approved work platform for assembly maintenance and testing.

7.2.1.4 Assemblies shall be protected against freezing, flooding and mechanical damage.

7.2.1.5 Assemblies shall not be installed in any enclosure or area containing fumes which are corrosive or toxic.

7.2.2 Air gap

7.2.2.1 An approved air gap shall mean a physical separation, unobstructed by guards, shields, or any other coverings, between the potable water supply system, measured vertically from the terminal point of the supply pipe to the overflow rim of the receiving vessel. This vertical, physical separation must be at least twice the diameter of the supply pipe but in no case shall this distance be less than one inch.

7.2.3 Reduced Pressure Backflow Assembly and Double Check Valve Assembly

7.2.3.1 RPBAs and DCVAs shall be installed per Washington State Department of Health List of Approved Backflow Assemblies.

7.2.3.2 RPBAs and DCVAs shall be installed with minimum clearances of 6 inches in front of test cocks, check valves, and relief valve covers to facilitate testing and maintenance. If an assembly is installed in an area with limited accessibility, such as a crawl space or pipe chase, a minimum of 24 inches clearance in front of test cocks shall be provided.

7.2.3.3 RPBAs and DCVAs shall be installed a minimum of 12 inches above ground or flood level, whichever is higher.

7.2.3.4 RPBAs shall not be installed in a below grade pit, vault, box, or chamber.

7.2.3.5 RPBAs shall be installed in a location where discharge from the relief port will not be objectionable, and shall be provided with an air-gapped drain which will reasonably handle the full discharge.

7.2.3.6 DCVAs shall be installed per WAC 246-290-490 Washington State Department of Health Approved Assemblies.

7.2.4 Pressure Vacuum Breaker Assembly (PVBA) and Spill-proof Vacuum Breaker (SVBA)

7.2.4.1 Shall be installed in accordance with the Cross-Connection Control Manual: Accepted Procedure and Practice, Pacific Northwest Section, American Water Works Association, Latest Edition, with the following major exception:

Vacuum breakers shall not be installed where there are any chemical addition capabilities, e.g., dishwasher supply lines with automatic detergent dispensing, chemical proportioners or

aspirators, etc.

7.3 The following represents backflow prevention assembly testing requirements.

7.3.1 General

7.3.1.1 Annual testing of backflow assemblies shall be per WAC 246-290-490.

7.3.1.2 Backflow assembly testing procedures shall be in accordance with WAC 246-290-490 and the Cross-Connection Control Manual: Accepted Procedure and Practice, Pacific Northwest Section, American Water Works Association, Latest Edition.

7.3.2 Initial Inspection

7.3.2.1 As indicated in Section 7.1.4, initial inspection of new assemblies shall be conducted by SPU per Table # 9 WAC 246-290-490 and the Cross-Connection Joint Program Memorandum of Understanding with PHSKC and SPU.

7.3.3 Annual Testing

7.3.3.1 All mechanical assemblies (RPBA, DCVA, PVBA, SVBA) shall be tested annually by a certified Backflow Assembly Tester. Testers are to follow the acceptable testing procedures approved by Washington State Department of Health. Notification of the requirement for testing will be done annually by the department to all water customers responsible for annual testing of their assemblies. Results of the test must be forwarded to SPU within 30 days of the date of the notification.

7.3.3.2 If no test results have been received within 30 days of notification, a second letter will be sent, requesting testing reports be forwarded to the Department within 10 days.

7.3.3.3 If no test results have been received within 30 days of notification, a late fee will be charged to the water account, based on SPU Standard Charges.

7.3.3.4 Water service may be terminated unless action is satisfactorily taken to test the backflow assembly(ies) and service may be discontinued until testing is completed and test reports provided to SPU.

7.3.4 Testing After Repair or Replacement

7.3.4.1 Testing after repair or replacement is required by WAC 246-290-490 & the Uniform Plumbing Code, chapter 6.

7.3.5 Quality Control Assurance Program

7.3.5.1 Testing reports require at a minimum: BAT certification number; test kit accuracy verification and/or calibration; test kit identification number; tested assembly make, model, serial number, and size; assembly location; and site hazard. SPU shall check BAT certification and proof of test kit accuracy.

7.3.5.2 SPU staff, certified as BAT, shall conduct periodic, random field verification of water customer's BAT assembly test results and reporting.

7.4 Incident Response

7.4.1 Water quality complaints concerning possible cross-connection incidents (e.g., gasoline, petroleum smell, blue water, etc.) will be responded to jointly by SPU, and either PHSKC or the City of Shoreline, depending on site location.

7.4.1.1 SPU will lead the off-premises investigation.

7.4.1.2 SPU will test the water at the meter.

7.4.1.3 PHSKC or the City of Shoreline, depending on the site location, will lead the investigation inside the facility to determine the problem.

7.4.2 SPU shall have a utility service inspector on-standby at all times to respond to potential incidents. SPU shall maintain 24-hour telephone call center with access to inspectors.

7.4.3 SPU shall maintain 24-hour contact information for PHSKC and the City of Shoreline.

7.5 Education

7.5.1 SPU shall educate consumers about cross-connection control through customer publications and community outreach.

7.6 Recordkeeping

7.6.1 SPU shall maintain a database for recordkeeping.

7.6.1.1 The database shall include at a minimum: listing of backflow prevention assemblies, assembly address and location, details of assemblies installed, site hazards, customer contact information, and inspection and testing information and results.

7.6.1.2 SPU and PHSKC shall be responsible for entering their own data into the SPU database.

7.6.2 SPU shall maintain on file backflow incident reports and program summary reports as required by WAC 246-290-490.

8.0 APPENDIX

1) City of Seattle Cross-Connection Control Ordinance, Council File No. 115660, May 28, 1991.

APPENDIX 1

AUG 2 1991

ORDINANCE: 115660

SEATTLE WATER DEPARTMENT

AN ORDINANCE relating to the Water Department, authorizing the Superintendent of Water to administer a cross-connection control program and to issue administrative rules therefor, and amending SMC 21.04.070 to provide authority to administer such program.

WHEREAS, a cross-connection is any physical arrangement whereby a public water supply is connected, directly or indirectly, with anything that does not exclusively contain or convey potable water from a State-approved source; and

WHEREAS, Section 284-54 of the Washington Administrative Code Rules and Regulations governing Public Water Supplies requires that all cross-connections are to be eliminated or controlled; and

WHEREAS, Section 248-54 of the Washington Administrative Code requires that in order to eliminate or control cross-connections, every water purveyor is to establish a cross-connection control program; and

WHEREAS, Seattle Water Department is the water purveyor (retail supplier) for the City of Seattle and for some adjacent unincorporated areas of King County; and

WHEREAS, the Seattle Water Department must demonstrate administrative and enforcement authority for the purpose of establishing a cross-connection control program acceptable to the Department of Health; Now, Therefore,

BE IT ORDAINED BY THE CITY OF SEATTLE AS FOLLOWS:

Section 1. The Superintendent of Water is authorized and directed to administer a cross-connection control program to protect the health of water customers and the potability of the public water system and to comply with the requirements of Washington law in connection therewith. The Superintendent of Water is authorized and directed to promulgate pursuant to SMC 3.02 rules and regulations to implement a cross-connection control program consistent with this authority. Said rules and regulations shall include but not be limited to:

1. Minimum cross-connection control operating policies;

2. Backflow prevention assembly installation practices; and

3. Backflow prevention assembly testing procedures.

Section 2. That SMC 21.04.070 (Ord. 65877 § 5 (part), 1935) be amended as follows:

21.04.070 Cross Connections

A. ~~In no ease shall any cross connection be allowed between two or more City-service connections, or between any City service connection and pipe supplying water from any other source.~~ Cross connections as defined in Section 248-54 of the Washington Administrative Code (1991), or as may be amended, shall be eliminated or controlled in accordance with the administrative rules of the Water Department and any applicable rules of the State of Washington Department of Health or any other applicable City, State, or federal laws.

B. As a term and condition of all water service, the Superintendent of Water or his/her duly authorized representatives shall have a right to access at all reasonable times to all parts of the buildings or premises supplied by water from the City for the purpose of ascertaining the need to eliminate or control cross-connections.

C. The Seattle Water Department shall deny or discontinue water service to any customer failing to cooperate in the elimination of cross-connections or the control of cross-connections through the installation, maintenance, testing or inspection of backflow prevention assemblies required by the Seattle Water Department.

D. When in the discretion of the Superintendent of Water appropriate circumstances so warrant, the Superintendent may charge the account of any customer who violates any applicable rules and regulations concerning cross connections for all costs, including service calls,

and any damages incurred by the Water Department in relation to such violation.

Section 3. Any act taken pursuant to the authority and prior to the effective date of this ordinance is hereby ratified and confirmed.

Section ... This ordinance shall take effect and be in force thirty days from and after its passage and approval, if approved by the Mayor; otherwise it shall take effect at the time it shall become a law under the provisions of the city charter.

Passed by the City Council the 28th day of May, 1991

and signed by me in open session in authentication of its passage this 28th day of May, 1991.

President of the City Council.

Approved by me this 4th day of June, 1991.

Norman B. Rice
Mayor.

Filed by me this 4th day of June, 1991.

Norward J. Brooks

Attest:
City Comptroller and City Clerk.

(SEAL)

Published

By Margaret Carter
Deputy Clerk.

SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

II. WATER QUALITY AND TREATMENT

APPENDIX C
COMPREHENSIVE DRINKING WATER QUALITY MONITORING PLAN

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Seattle Public Utilities
Comprehensive Drinking Water Quality Monitoring Plan

October 2006

1.0 Overview

Providing public health protection is a primary concern in the operation and maintenance of a public drinking water system. Determining the adequacy of this protection is accomplished with a comprehensive monitoring program that covers the source of supply, treatment systems, the distribution system, and customers' taps. Sampling requirements are established by federal regulations, such as the Safe Drinking Water Act (SDWA), which are in most cases adopted by the state. Seattle Public Utilities (SPU) conducts monitoring in accordance with the Safe Drinking Water Act and Washington State Department of Health requirements, Chapter 246-290 WAC.

This monitoring plan addresses the following:

- Monitoring requirements under state and federal drinking water regulations;
- Future regulations, which are currently under development at the federal level;
- Non-regulatory monitoring, which SPU conducts for informational purposes and to assist in operating the water system;
- Sampling procedures;
- Laboratory Information Management System (LIMS); and,
- All parameters, locations, and frequency of monitoring conducted by SPU. Monitoring locations include source, treatment, transmission and distribution system, and customer taps.

A summary of SPU's monitoring requirements is shown in Table 1. This table includes source water and distribution system monitoring required by regulation. Monitoring of treatment operations required by the Surface Water Treatment Rule or Lead and Copper Rule is not included in Table 1, but is discussed below, and is reflected in Table 2.

Table 2 is a summary of the monitoring currently conducted by SPU and is organized by sampling locations, frequencies, and parameters. This table includes monitoring required by regulations, and monitoring conducted for operational or informational purposes (non-regulatory). All monitoring shown is directly related to the drinking water supply. Monitoring related to special studies, customer inquiries, disinfection of new mains, construction of facilities, environmental compliance when dewatering facilities, wellhead protection, aquifer recharge, source development, treatment chemicals, or other monitoring conducted for purposes other than drinking water quality compliance is not included in this document.

DOH has the authority to grant waivers for certain parameters, depending on vulnerability and previous sampling results. If a system is considered to have low vulnerability to contamination from a certain chemical or group of chemicals, the State may waive the requirements for

sampling, or reduce the amount of samples required. The State issued waivers for SPU for Volatile Organic Chemicals (VOCs) and Synthetic Organic Chemicals (SOCs) for the 2002 to 2004 monitoring period. SPU has applied for waivers for the 2005 to 2007 monitoring period. There are also several area-wide waivers in effect for several of the SOCs. These waivers apply to all systems within the designated area.

SPU operates its own State-certified laboratory for a majority of the parameters monitored. This includes total coliform, fecal coliform, HPC, most inorganic chemicals, trihalomethanes, haloacetic acids, lead, copper, and all SWTR parameters. Samples for VOCs, SOCs, asbestos, some inorganics, and *Cryptosporidium* and *Giardia* are sent to other laboratories certified by the state or EPA for the analysis.

Adjustments to monitoring are often required based on operational considerations, detection of organic chemicals, construction projects, or as required by the state based on a public health concern. SPU will work with the State to determine appropriate changes to the monitoring program to address any concerns that may arise.

2.0 Monitoring Requirements

The following summarizes the monitoring requirements for existing and future regulations. Existing regulations include those finalized by EPA and published in the Federal Register under 40 CFR Part 141. Any regulation the state has adopted into Chapter 246-290 WAC with changes or additions are also discussed under existing regulations. Future regulations include those currently proposed by EPA.

2.1 Existing Regulations

The existing regulations discussed below are organized by their common name with a reference to the appropriate federal and state section numbers.

Total Coliform Rule (40 CFR 141.21 and WAC 246-290-300 (3))

SPU collects and analyzes coliform samples from representative points throughout the direct service area as outlined in SPU's Coliform Monitoring Plan (attached without appendices). These samples are collected at designated sample stands according to established routes assigned by the Senior Water Quality Analyst or designee. Routes are designed to cover both the Cedar and Tolt service areas each day; with most sample stands being sampled weekly. To meet regulatory requirements, SPU must collect at least 189 coliform samples from its direct service area each month. The chlorine residual is also analyzed in the field at the time of coliform sample collection as required by state regulations. Temperature is also measured, although not required.

For any sample found to be positive for total coliform, or invalidated, follow-up action is taken according to state and federal regulations, as described in SPU's Coliform Monitoring Plan. This follow-up action may include additional sample collection, additional analyses such as fecal coliform, *E. Coli*, or HPC, and notification to the state. SPU's Coliform Monitoring Plan lists all

sample locations, schedules, test methods used, follow-up sampling requirements, and notification requirements.

Surface Water Treatment Rule (40 CFR 141.70-75 and WAC 246-290 Part 6)

The Surface Water Treatment Rule (SWTR) requires a significant amount of monitoring for SPU's filtered surface water supply, the South Fork Tolt River. This includes raw water, treated water, and distribution system water monitoring as follows.

Raw Water Monitoring – Continuous monitoring of turbidity at the inlet to the Tolt Treatment Facility occurs as required by the SWTR. Samples analyzed for fecal coliform density are collected at the inlet to the Tolt Treatment Facility daily, for at least 24 days a month.

Treated Water Monitoring – Treated water monitoring for the SWTR consists of monitoring required to determine the effectiveness of the disinfection process. This includes monitoring to determine log reduction of *Giardia* cysts and viruses. To determine the log reduction for virus, the pH, chlorine residual, temperature, clearwell volume, and peak hourly flow rate must be recorded. For the Tolt system, this monitoring is continuous, but is reported once a day at peak hourly flow. To determine the log reduction for *Giardia*, the pH, ozone residual at multiple locations along the contact chamber, temperature, and peak hourly flow are recorded. CT is calculated for each section of the ozone contact chamber. Ct is reported to the state for both the peak hourly flow and at minimum daily CT.

In addition, continuous chlorine residual monitoring for water entering the distribution system occurs at the outlet of the Tolt Treatment Facility. Turbidity is also monitored continuously at each individual filter unit and from the combined filter effluent.

Additional monitoring is conducted at the treatment plant to meet the requirements of the Service Agreement with the DBO contractor. This monitoring is summarized in Table 3.

Distribution System Monitoring – Residual disinfectant concentration is measured at the same time and location that a routine or repeat coliform sample is collected within the distribution system.

Limited Alternative to Filtration (WAC 246-290-691)

Beginning in November 2004, the Cedar water supply system was designated a Limited Alternative to Filtration status. As such, the source and treated water monitoring requirements are slightly different than an unfiltered surface water source subject to the SWTR. This includes raw water, treated water, and distribution system water monitoring as follows.

Raw Water Monitoring – Continuous turbidity monitoring occurs at the Cedar Water Treatment Facility for the raw water coming from Lake Youngs. Fecal coliform samples are also collected at this location once per day for a minimum of 24 days a month.

Treated Water Monitoring – Treated water monitoring consists of monitoring to determine inactivation of Giardia, Cryptosporidium, and viruses. This monitoring is conducted continuously for the ozonation system, UV treatment, and chlorination. For ozone inactivation of Giardia and viruses, monitoring includes temperature, pH, initial ozone concentration, ozone decay, and flow rate. For inactivation of Giardia and Cryptosporidium with UV, monitoring consists of flow rate through each reactor, UV transmission, UV dose, lamp power, and lamp hours. For inactivation of viruses with chlorine, monitoring includes flow rate, clearwell volume, pH, chlorine residual, and temperature.

Finished water entering the system is continuously monitored for chlorine residual, temperature and pH. Daily samples are also analyzed for coliform, although this is not required by regulation. Additional monitoring is required to meet the Service Agreement with the DBO contractor. Service Agreement monitoring is summarized in Table 3.

Distribution System Monitoring – Residual disinfectant concentration is measured at the same time and location that a routine or repeat coliform sample is collected within the distribution system.

Disinfectants/Disinfection By-Products Rules (40 CFR 141.130-135, 141, 142) and WAC 246-290-300 (7)

Current regulations (Stage 1) require trihalomethane (THMs) and haloacetic acids (HAAs) monitoring in the distribution system. SPU is required to collect two samples each quarter at existing sample stands within the direct service area under an approved reduced monitoring schedule. One of these stands is generally served by Cedar water and one is generally served by Tolt water. These two samples are collected at sample stands that are considered to represent the maximum residence time in the system for each source. Currently, sample stands G2 and B4 are considered to represent the maximum residence time for the Cedar and Tolt, respectively. SPU elects to collect two additional THM and HAA samples each quarter for informational purposes. The other two sites used are J-3 and A-3. These are considered average residence time and generally represent higher HAA levels.

Monitoring for chlorine residual currently conducted at total coliform sample sites in the direct service area are reported under the Stage 1 rule. Bromate and bromide monitoring are conducted for the Tolt and Cedar supplies now that ozonation facilities for each supply are in operation. The monitoring for bromate is conducted monthly at the entry to the distribution system. The bromide monitoring was conducted monthly for the source water prior to any treatment during the first year of operation of the Tolt and Cedar Treatment Facilities.

Stage 2 DBP Rule was finalized in January 2006. This new rule will require increased monitoring for DBPs, including a one year study of DBP levels at 24 distribution system locations in the direct service area. A monitoring plan must be submitted in October 2006, with monitoring beginning in 2007. Routine DBP monitoring under Stage 2 will likely require quarterly sampling at 12 locations

Lead and Copper Rule (40 CFR 141.80-91)

SPU has conducted monitoring for lead and copper at customers' taps according to the regulations and a Bilateral Compliance Agreement with DOH. Two rounds of samples were collected at 375 homes in 2003 and 2004 after completion of a corrosion control optimization study for the Tolt. Two more rounds of samples were collected at 400 homes in 2005. These homes were selected based on criteria in the Lead and Copper Rule. For the last two rounds, the homes were divided into sub regions. One hundred samples were collected from the Seattle direct service area, 100 were collected from Bellevue, 100 were collected from the participating wholesale providers receiving water from the Cedar supply, and 100 were collected from the participating wholesale providers receiving water from the Tolt supply. Compliance was based on the 90^{th} percentile for each sub-region. The next round of monitoring will be conducted in 2006. Based on previous rounds, each sub-region qualifies for reduced monitoring, which requires 50 samples per sub-region. Eventually, each sub-region will likely be required to collect 50 samples once every three years. Monitoring requirements would change if the lead or copper action levels were exceeded.

Water quality parameter monitoring is also now required for the lead and copper rule. This monitoring currently includes collecting 25 distribution system samples each month and analyzing the samples for pH and alkalinity. Under reduced monitoring, 10 locations will likely be required.

Inorganic Contaminants, VOCs, SOCs (40 CFR 141.23-23, 40 and WAC 246-290-300 (4) and (7))

Primary and Secondary inorganic contaminants (IOCs) including arsenic, volatile organic chemicals (VOCs), and synthetic organic chemicals (SOCs) are monitored according to state and federal requirements. IOCs for the Cedar and Tolt supplies are monitored on an annual basis and VOCs are monitored once every three years, with the samples collected from the entry point to the distribution system, after treatment. This frequency assumes a state waiver has been granted for VOCs. The Riverton and Boulevard Park Wells are sampled once every three years (or when in operation) for IOCs and VOCs at the entry point to the distribution system prior to the first customer. SOCs are monitored as directed by the state, and the frequency is dependent on waiver status. SPU currently has a waiver for SOC monitoring through the year 2004.

Radionuclides (40 CFR 141.26 and WAC 246-290-300 (9))

The new radionuclides rule (effective December 2003) requires monitoring for gross alpha, radium 226, radium 228, and uranium. This monitoring is conducted for each source at the entry point to the distribution system. Frequency is dependent on results. After initial monitoring, samples will likely be required once every 9 years. Two consecutive quarterly samples will be required before December 2007 for initial monitoring.

Fluoride (WAC 246-290-460)

As required by state regulations, fluoride is monitored daily at each point of fluoride addition and a report is submitted to the state monthly. In addition to fluoride monitoring at the treatment plants, a grab sample is collected daily and analyzed at SPU's Water Quality Laboratory as a check.

Unregulated Contaminants Rule (40 CFR 141.35, 40)

The Unregulated Contaminants Rule, effective January 1, 2001, required additional monitoring for SPU's source waters. Four quarterly samples were collected at the entry point to the distribution system in 2002. If future UCMR regulations require monitoring sources in the future, SPU will be prepared.

2.2. Future Regulations

The future regulations discussed below are organized by their currently accepted common name (may change in the future). *Federal Register* citations are provided for rules which have been published, either in draft or final form.

Proposed Radon Rule (40 CFR 141.20)

Monitoring for radon will be required in the future as a result of the new Radon Rule, proposed in October 1999. A final rule is expected in late 2007. This regulation may have the greatest impact on SPU's ground water supplies, as previous monitoring has not detected radon in the surface water supplies. SPU will be prepared to conduct any required monitoring for radon as a result of the new rule.

Groundwater Rule

This regulation is expected to be final in late 2006, with an effective date sometime in 2009. Additional monitoring of the disinfection treatment for the Riverton and Boulevard Park wells may be required due to this rule or a hydrogeological assessment and source water monitoring. It is not expected to have a significant impact on SPU's monitoring program.

Cryptosporidium Monitoring for LT2SWTR (40 CFR Parts 9, 141, and 142)

SPU currently conducts monthly source water monitoring for *Giardia* and *Cryptosporidium* for the Cedar and Tolt supplies. This monitoring is currently voluntary, but crypto monitoring will be required beginning in late 2006. The results of *Cryptosporidium* monitoring are reported in the annual Drinking Water Quality Report sent to customers each year. Currently, samples are collected from three locations: Landsburg forebay, Tolt Regulating Basin outlet, and Lake Youngs outlet prior to treatment.

2.3. Non-Regulatory Monitoring

Non-regulatory monitoring discussed below includes monitoring performed for informational purposes or to assist in making operational decisions. This monitoring is not required by regulation at this time, but may be required at some time in the future.

Limnology

Monthly and quarterly monitoring of various limnological parameters is conducted at Lake Youngs, Chester Morse Lake, the Tolt Reservoir proper and reservoir tributary streams, and Cedar River tributary streams upstream of Landsburg. In addition, samples are collected occasionally from the Tolt Regulating Basin. This data is collected for informational purposes, and is not required by state or federal regulations. Sample collection occurs at multiple locations and depths in Lake Youngs, Chester Morse Lake, and the Tolt Reservoir. Some of the parameters included in sampling include temperature, dissolved oxygen, transparency, turbidity, conductivity, alkalinity, calcium, pH, phosphorous, iron, manganese, ultra-violet light absorption, total organic carbon, phytoplankton, zooplankton, taste and odor, geosmin, and MIB.

Taste and Odor

Taste and Odor are analyzed on a weekly or bi-weekly basis for each of SPU's large in-town reservoirs, the source waters, and other locations as needed. This monitoring is used to make operational decisions, but is not currently required by state or federal regulations.

Reservoir Protection

Each of SPU's in-town open reservoirs, and five closed reservoirs, currently have chlorination at the outlet, prior to entry to the distribution system. The chlorine residual is monitoring continuously to ensure adequate treatment occurs at all times. In addition, weekly check samples are collected and analyzed by laboratory staff for chlorine, total coliform, fecal coliform, and HPC from the reservoir outlet and mid-reservoir. Treatment staff check each open reservoir treatment system daily. As required by WAC 246-290-470, SPU maintains and operates the open reservoirs according to a DOH approved Open Reservoir Protection Plan. In addition, DOH has approved SPU's Reservoir Covering Plan, which will replace, cover, or abandon all open reservoirs by 2018.

Treatment Processes

Existing source water treatment consists of ozonation, UV light, chlorination, fluoridation, and corrosion control on the Cedar supply. Treatment for the Tolt supply consists of ozonation, coagulation, flocculation, filtration, corrosion control, chlorination and fluoridation. Each of these processes is monitored continuously to ensure adequate treatment is maintained at all times. Portions of this monitoring are required by the regulations discussed above. Significantly more monitoring is required to meet the requirements of the Service Agreements for each DBO contractor operating the treatment plants. This monitoring is summarized in Table 3.

2.4 Sampling Procedures

Proper sample collection is important for accurate results. All laboratory assistants and other staff collecting samples in the field are trained in appropriate sample collection techniques based on parameter. Written sample collection procedures for bacteriological analyses such as total coliform are included in SPU's Coliform Monitoring Plan. Sample collection methods for all regulatory compliance samples follow standard procedures or methods listed in *Standard Methods*. In addition, training for laboratory staff conducting the analyses occurs on a regular basis.

2.5 Laboratory Information Management System (LIMS)

Beginning in 2006, SPU's Water Quality Laboratory implemented a new Laboratory Information Management System (LIMS). All water quality samples analyzed at the lab, or samples analyzed by outside laboratories for SPU's drinking water are entered into LIMS. This system provides the means to track sample status, record and validate results, and produce reports. Data from LIMS can then be extracted to other computer programs for long-term storage, analysis, or report formatting.

Table 1
Seattle Public Utilities
Summary of Drinking Water Quality Monitoring Requirements (Regulatory)

Dated: January 20, 2006

Parameter	Locations	Frequency	Monitoring Year	Lab Used	Waivers	Comments
Inorganic Chemicals						
Antimony	SO1 at CLT-4, 5	Annually for Cedar and Tolt	Every Year for SW	SPU		EPA and State allow waivers.
Arsenic	SO2 at T-FINISH			SPU		State has not granted any to date.
Barium	SO4 at BPW-T	Once every three years for wells	2007 for GW or when	SPU		
Beryllium	SO6 at RHW-T		operating	SPU		
Cadmium				SPU		
Chromium				SPU		
Copper				SPU		No MCL, AL = 1.3 mg/L
Cyanide				Outside		
Fluoride				SPU		
Lead				SPU		No MCL, Al = 0.015 mg/L
Mercury				Outside		
Nickel				SPU		
Selenium				SPU		
Sodium				SPU		Health Advisory Level = 20 mg/L
Thallium				SPU		
Nitrate Nitrite	CLT-4, 5, T-FINISH, RHW-T, BPW-T	Annually for SW and GW	Every Year, wells if operated	Outside		Sample during quarter with previous highest result (SW).
Asbestos	8426 36th Ave. SW (Cedar) 2033 NE 103rd St. (Tolt)	Once every nine years	Once in 2002-2011 period	Outside		Must be at a tap served by AC pipe. State waiver through 12/2001
Lead Copper	At 100 customer taps (almost 400 including purveyors)	After further optimization of Tolt corrosion control 2 rounds	2003 - 2004	SPU	BCA	We do roughly 100 for Tolt and 100 for Cedar
Radionuclides						
Gross Alpha Emitters Radium 226 Radium 228 Uranium	CLT-4, 5 T-FINISH, RHW-T, BPW-T	Initially 2 consecutive quarters, then frequency depends on results. Possibly once every 9 years.	By 2007 for SW Next time Wells are used.	Outside		State Not Enforcing???
Organic Chemicals						
VOCs	CLT-4, 5, T-FINISH, RHW-T, BPW-T	Once every three years	2005-2007	Outside	Yes	State waivers for some
SOCs (Includes herbicides, general pesticides, & insecticides)	CLT-4, 5, T-FINISH, RHW-T, BPW-T	Depends on waiver	??	Outside	Yes	Waiting for waiver status from state
Dioxin, endothall, Diquat, Glyphosate, EDB & other Soil Fumigants						State waivers
Bacteriological						
Total Coliform Rule	62 distribution system sample stands	240 samples per month	sampling conducted daily	SPU		Reduced monitoring for SPU may start soon
Chlorine Residual	Same locations as coliform	240 samples per month	sampling conducted daily	SPU		
Disinfection By-Products						
Trihalomethanes	G2, J3 for Cedar, A3, B4 for Tolt	Quarterly	Every Year	SPU		One sample is from extreme end of each source.
HAAs (future)	G2, J3 for Cedar, A3, B4 for Tolt	Quarterly	Every Year	SPU		Reduced monitoring for Stage 1 requires only one sample per quarter. Stage 2 IDSE in 2007/08.
Secondary Contaminants						
Chloride	CLT-4, 5, T-FINISH, RHW-T, BPW-T	Annually for Cedar and Tolt	Every Year for SW	Outside		
Color		Once every three years for wells	2007 for GW	SPU		
Fluoride				SPU		
Hardness				SPU		
Iron				SPU		
Manganese				SPU		
Silver				SPU		
Specific Conductivity				SPU		
Sulfate				Outside		
Total Dissolved Solids				SPU		Only done if conductivity > 700 μmhos/cm
Zinc				SPU		
Surface Water Treatment Rule (Tolt)						
Turbidity	TPR-5S 5N, T-CFE, T-FINISH, each filter	Continuous				All Part of DBO Contract
Fecal coliform	TPR-5S 5N	Daily, at least 24 days per month		SPU		
Chlorine Residual	T-FINISH	Continuous				
CT Complaince	Ozone contactors and clearwell	Continuous				For Giardia and Virus inactivation
Limited Alternative to Filtration (Cedar) - LAF						
Turbidity	C1-RAW, C1-FIN, C2-FIN	Continuous				All Part of DBO Contract
Fecal coliform	C1-RAW	Daily, at least 24 days per month		SPU		
Chlorine Residual	C1-FIN, C2-FIN	Continuous				
CT Complaince	Ozone contactors, UV units, and clearwell	Continuous				For Crypto, Giardia, and Virus inactivation

Table 2
Seattle Public Utilities
Drinking Water Quality Monitoring Conducted – by Parameter
Required and Optional

Parameter	Source	Monitoring Frequency and Location					
		Continuous	**Daily or M-F**	**Weekly or Biweekly**	**Monthly**	**Quarterly**	**Annually**
Turbidity	Cedar	CPR-1, C1-RAW, C1-FIN, C2-FIN	CPR-1, CT-2	Open reservoirs and checkpoints (6 sites)	10 sites on CMR, 11 sites on Lake Youngs	Part of QTR 8 sites	
	Tolt	TPR-5S 5N, T-FINISH, T-CFE, ea. Filter at plant, reclaimed water	TPR-4, TT-1, 2		10 sites Tolt Reservoir		
pH	Cedar	C1-RAW, C1-CWI, C1-FINISH	CPR-1, CLT-4, 5, CT-1, 2, 3,	Open reservoirs and checkpoints, Soos tanks, RVR-1, 41 TCR sites	CT-4, 10 sites on CMR, 11 sites on LYS, field pH at 25 TCR sites	4 DBP sites	
	Tolt	TPR-5S, T-FINISH, T-CWI	TT-1, 2, 11	TT-3, TT-22,	TPR-4, 10 sites Tolt Reservoir		
Conductivity	Cedar	WSP-1???	CPR-1, CLT-4, 5, CT-1, 2, 3,	Open reservoirs and checkpoints, Soos tanks, RVR-1, 41 TCR sites	CT-4, 10 sites on CMR, 11 sites on LYS, field pH at 25 TCR sites	4 DBP sites	
	Tolt		TT-1, 2, 11	TT-3, TT-22,	TPR-4, 10 sites Tolt Reservoir		
Fluoride	Cedar	CPT-00	CPT-00, CT-2	5 sample stands	Average of 11 seepage samples, 4 purveyors check samples	8 QTR sites	
	Tolt	T-FINISH	TT-1, 2	2 sample stands, TT-3, T-FINISH			
Chlorine Residual	Cedar	CPT-00, 4 location at CWTF, ESR, MGR, open reservoirs, Ballard firehouse	CLT-4, 5, CT-1, 2, 3, open reservoirs, CPT-00 2/shift	Closed tanks, standpipes, and reservoirs, open reservoirs and checkpoints, WSP-1, CPT-04, CT-4, almost 200 TCR sites DSA and WSA	25 PBCU sites	4 DBP sites, QTR sites	
	Tolt	T-FINISH, LFP, BLR	TT-1, 2, 11				
Total Coliform - PA	Cedar		CLT-4,5, CT-1, 2, 3, C1 and C2-FIN	Closed tanks, standpipes, and reservoirs, open reservoirs and checkpoints, CT-4, TT-3, WSP-1, almost 200 TCR sites (DSA and WSA)			
	Tolt		T-FINISH TT-1, 2, 11				

Table 2
Seattle Public Utilities
Drinking Water Quality Monitoring Conducted – by Parameter
Required and Optional

Parameter	Source	Monitoring Frequency and Location					
		Continuous	**Daily or M-F**	**Weekly or Biweekly**	**Monthly**	**Quarterly**	**Annually**
Total Coliform – Colisure QT	both		CPR-1, C1-RAW, TPR-5S	Open Reservoirs	10 sites LYR, 6 sites CMR		
Fecal Coliform	Cedar		CPR-1, C1-RAW, C1-FIN, C2-FIN	Open Reservoirs			
	Tolt		TPR-5S				
HPC	Cedar		CPR-1, C1-RAW, CLT-4, 5	Closed tanks, standpipes, and reservoirs, open reservoirs and checkpoints, WSP-1	Average of 120 TCR sites (SPU and WSA)		
	Tolt		TPR-5S, TT-1, 2, 11, T-FINISH				
Temperature	Cedar	C1-RAW, C1-FIN, C2-FIN	CPR-1, CLT-4, 5, CT-1, 2, 3, C1-FIN, C2-FIN	Closed tanks, standpipes, and reservoirs, open reservoirs and checkpoints, CT-4, TT-3, T-CFE, almost 200 TRC sites (DSA and WSA)	Pb/Cu sites (25)	DBP sites	
	Tolt	TPR-5S, 5N	TT-1, 2, 11, TPR-5S 5N, T-FINISH				
UVA	Both	CPR-1	CPR-1	TPR-5S, T-CFE	CLR-2, C1-RAW, CPT-4, CMR sites, Tolt Res sites		
TOC	Both			CPR-1, TPR-5S, T-CFE	6 sites CMR, 10 sites Tolt Res, 10 sites LYR		
Taste and Odor	Both			CPR-1, CT-2, C1-RAW, C1-FIN, C2-FIN, T-FINISH, open reservoirs	CPT-04, 05		
Giardia/Crypto	Both				CPR-1, C1-RAW, TPR-4		
Alkalinity	Both			TT-3, TT-22, T-FINISH	25 Pb/Cu sites	8 QTR sites	
Inorganics	Both					2 sample stands, CPR-1, C1-RAW, CLT-4 - 5, TPR-4, T-FINISH CMR-1	CLT-4 -5, T-FINISH

Note: Sampling for Riverton and Boulevard Park Wells is not included in this table.

Table 3
Seattle Public Utilities
Drinking Water Quality Monitoring Conducted by DBO Contractors
Continuous Monitoring

Parameter	Tolt Treatment Facility					
	Reclaimed Water	Raw Water	Ozone Contactors	Filter Effluents	Combined Filter Effluent	Clearwell Effluent
Turbidity	X	X		X	X	X
Temperature		X				
pH		X			X	X
Particle Count		X		X(1)	X	
Ozone Concentration			X			
Chlorine Residual					X	X
Fluoride					X	X

Parameter	Cedar Water Treatment Facility					
	Raw Water	Ozone Contactors	UV Reactors	Clearwell Influent	Clearwell Effluent	Finished Water
Turbidity	X					X
Temperature	X					X
pH	X			X	X	X
Ozone Concentration		X				
UV Transmission, UV Dose			X			
Chlorine Residual				X	X	X

Tolt grab sample parameters include coliform, alkalinity, bromate, iron, sodium, taste and odor, TTHMs and HAAs SDS, Color, TOC, and UVA.
Cedar grab sample parameters include coliform, bromate, iron, chlorophyll, sodium, and taste and odor.

Seattle Public Utilities

Coliform Monitoring Plan

Direct Service Area

Seattle Public Utilities
Water Quality Laboratory
800 S. Stacy Street
Seattle, WA 98134

December 2005

Table of Contents

Appendices

Background

Regulatory Background and Requirements

In 1974 the US Congress enacted the Safe Drinking Water Act (SDWA) which established national drinking water standards. The SDWA set maximum levels for particular contaminants and established monitoring requirements. In 1986 Congress expanded the SDWA to include regulation of coliforms, resulting in promulgation of the Total Coliform Rule (TCR) in 1989. State regulations were then revised to incorporate the TCR (WAC 246-290, Part 4).

Coliform testing is required on a monthly basis with the number of samples based on the population served. All samples are tested for total coliform. If total coliform is present, the sample is also tested for either fecal coliform or *E. Coli* and repeat samples are collected. In addition, chlorine residual must be tested and reported with each coliform sample.

A water quality violation occurs under any of the three following conditions: 1) more than 5 percent of samples in a month are positive for total coliform (non-acute MCL violation); 2) a total coliform positive sample that also tests positive for fecal coliforms/*E. Coli* is followed by a positive coliform repeat sample (acute MCL violation); or 3) a coliform positive sample is followed by a coliform and fecal coliform/*E. Coli* positive repeat sample (acute MCL violation).

What is Coliform Bacteria?

Total coliforms are a broad group of bacteria that is used as an indicator of possible contamination in the water system. Total coliform bacteria are usually not harmful themselves, but their presence indicates the possible presence of other, disease-causing organisms. While many total coliform bacteria are found in the intestinal tract of warm-blooded animals, other total coliform bacteria grow in aquatic and soil environments and these bacteria are not related to intestinal contamination.

If a sample is tested positive for total coliform, the sample is then also tested for fecal coliform or *E. Coli.* Fecal coliform and *E. Coli* are much more likely to have come from fecal material than total coliform; thus the presence of fecal coliform and *E. Coli* indicates a greater likelihood for the presence of disease-causing organisms.

Purpose of the Plan

A coliform monitoring plan is required by the federal TCR as adopted into state regulations (WAC 246-290-300). The purpose of this plan is to ensure that SPU's coliform testing meets or exceeds regulatory requirements. This plan identifies routine and repeat sample collection sites, provides a schedule for collection of samples, and explains how sampling locations and schedule cover the water system. This plan only covers the direct service area of SPU; it does not cover the wholesale water service areas. A separate Regional Coliform Monitoring Plan covers issues of monitoring and coordination by SPU and most of its wholesale customers.

Overview of the Water System

Seattle Public Utilities (DOH ID#77050Y) provides water to approximately 1.3 million people via direct and wholesale service. Within its direct service area, SPU serves a population of about 628,000 residents through approximately 180,000 metered service connections (2005 data). An overview of the water system facilities follows. Please refer to the water system plan for further description.

Sources of Supply

SPU operates two main sources of supply: the Cedar River and the South Fork Tolt River. In addition, the Riverton Heights Wellfield and Boulevard Park Well provide water during some peak seasons and serve as a backup supply to the river sources. The individual sources are listed in Table 1 below.

Table 1. SPU Sources of Supply

DOH Source No.	Source Name	Source Category
SO1	Cedar River	Surface
SO2	Tolt River	Surface
SO3	Riverton Heights #1	Well in a well field
SO4	Boulevard	Well
SO5	Riverton Heights #2	Well in a well field
SO6	Riverton Heights WF	Wellfield

The Cedar River supply is an unfiltered surface water that provides approximately 70 percent of the drinking water for SPU and the wholesale customers. The South Fork Tolt River supply is a filtered surface water that provides the remaining 30 percent of the drinking water. The Riverton Heights and Boulevard Wells are considered a seasonal supply and can supply up to 10 mgd.

The Cedar River begins within a protected watershed on the west side of the Cascade Mountains and eventually drains into the south end of Lake Washington. The watershed area totals about 79,700 acres of which 99.7 percent is owned by SPU. The Cedar River water supply system also consists of Chester Morse Lake, the Landsburg Facilities, the Cedar Supply Pipelines, Lake Youngs, the Cedar Water Treatment Facility, the Lake Youngs Tunnel and Pump Station, and Control Works.

The South Fork Tolt River watershed has a drainage area of approximately 12,100 acres in northeastern King County. The south fork of the river eventually flows into the Snoqualmie River. The watershed is controlled by SPU, which owns 69 percent of the area. The remainder is owned by the US Forest Service. The Tolt River water supply system consists of the Tolt Reservoir, the Tolt Penstock, the Regulating Basin, the Tolt Treatment Facilities, and the Tolt Pipelines.

The Cedar and Tolt supplies enter the system from opposite ends (south and north, respectively). Generally each supply feeds a specific distribution area, though some areas receive blended water depending on operations and demand. The wells are located south of the city limits.

Treatment

The Cedar River supply is diverted at Landsburg, where chlorine and fluoride are currently added, and discharged into Lake Youngs. Facilities installed in 2004 pump Lake Youngs water and disinfect it with ozone, ultraviolet light, and chlorine. Lime is then added for corrosion control. With the new facilities, the Cedar supply is operated as an unfiltered surface water source under a Limited Alternative to Filtration. (Prior to installation of the new facilities, treatment consisted of primary chlorination and fluoridation at Landsburg and secondary chlorination and lime addition at the Lake Younds outlet.)

The Tolt River supply is treated with ozonation, direct filtration, chlorination, fluoridation, and lime and carbon dioxide addition. (Prior to 2001, the Tolt was operated as an unfiltered surface water supply.)

The Riverton Heights and Boulevard Park wells are treated with hypochlorite for disinfection, fluoride, and sodium hydroxide for corrosion control.

See below for a description of rechlorination facilities at the reservoirs.

Pressure Zones

The service area served directly from SPU is maintained with 31 distinct pressure zones. Some of these pressure zones may be at the same elevation, but are not physically connected. There are 18 pressure zone elevations.

Finished Water Storage Facilities

The SPU system has 6 operational open reservoirs, 9 covered reservoirs, 9 standpipes, and 7 elevated tanks as listed in Table 2 below. The total volume of the finished water storage facilities listed below is 507 million gallons. SPU has a plan on file with DOH for covering, replacing, or abandoning all the open reservoirs by the year 2018. The Lake Forest Park and Bitter Lake reservoirs each have floating covers. The Lincoln reservoir is currently being reconstructed with a concrete lid.

Each open reservoir is rechlorinated at the outlet to maintain a disinfection residual in the distribution system served by the reservoir. The rechlorination facilities have been kept at the Lake Forest Park, Bitter Lake, and Lincoln reservoirs. The Eastside and Magnolia reservoirs also have rechlorination systems that can be used.

Pumping Stations and Pressure Regulating Stations

The SPU distribution system contains 31 pumping stations with a total of 96 individual pump units. There are also 176 pressure regulating stations within the service area that are separate from the pumping stations.

Table 2. SPU Distribution Storage Facilities

Storage Facility	Capacity (MG)	Storage Facility	Capacity (MG)
Open Reservoirs		Standpipes	
Beacon Hill - North	61	S.W. Barton	1.4
Beacon Hill - South[1]	49	S.W. Charleston	1.5
Green Lake	50	Foy	1.0
Maple Leaf	59	Queen Anne #1	0.3
Myrtle	7	Queen Anne #2	0.9
Volunteer Park	20	S.W. Trenton - North	1.2
West Seattle	68	S.W. Trenton - South	1.2
		Volunteer Park	0.9
		Woodland Park	1.0
Covered Reservoirs		Elevated Tanks	
Eastside	32	Beverly Park	2.0
Magnolia Manor	5.5	Magnolia Bluff	1.0
Riverton Heights	20	Maple Leaf	1.0
Soos (2)	13	S.W. Myrtle #1	0.5
View Ridge	2.5	S.W. Myrtle #2	1.0
Lake Forest[2]	60	Richmond Highlands #1	1.0
Bitter Lake[2]	21.5	Richmond Highlands #2	2.0
Lincoln Park[3]	21		

[1]Currently not in use. [2]Floating covers. [3]Under reconstruction.

Sampling Plan

Population Estimates

The number of coliform samples required per month is based on the population served by the water system. The estimated residential population for the SPU direct service area in 2005 is 628,000. DOH has indicated that non-residential population is required in this plan for determining coliform monitoring requirements. Non-residential population is estimated for the direct service area using census data for place of residence and place of work. Consistent with the SPU regional coliform monitoring plan, non-residential population is counted for people who travel from outside the SPU wholesale service area. The 2005 non-residential population estimate for the direct service area is 158,000. Thus, the 2005 total population estimate, including residents and non-residents, is 786,000.

Sampling Requirements

Under the regional coliform monitoring plan, SPU is required to collect 70 percent of the number of coliform samples from WAC 246-290-300, Table 2. Based on the total population of 786,000, the number of coliform samples from WAC 246-290-300, Table 2 is 270. With participation in the regional coliform monitoring plan, the required number of monthly coliform samples is 189.

Typically, SPU will collect more than the required number of samples. The current schedule is for 270 samples per month. In the future, SPU will likely revise the sampling schedule to a number between 189 and 270. In the past, the additional samples beyond the regulatory requirement have provided added coverage of the water system, created some flexibility in scheduling, and allowed for unexpected problems to occur while still meeting regulatory requirements.

If a routine test is positive for total coliform, then the sample must also be analyzed for fecal coliform or *E. Coli* and 3 repeat samples must be collected. Repeat samples are collected at the following locations: 1) site of previous sample with coliform presence; 2) within five service connections upstream of the site of sample with coliform presence; and 3) within five service connections downstream of the site of sample with coliform presence. Repeat samples are used to confirm the original sample results and to help determine the cause of the coliform presence. When a repeat sample has coliform presence, an additional set of repeats is required.

Chlorine residual measurement is required at the same time and location of coliform sample collection (WAC 246-290-451).

Sampling Locations

Routine Sampling Locations

SPU has 65 dedicated sample stands used for routine coliform monitoring sites. (Two of the 65 samples stands, one in downtown and one in Laurelhurst, are planned for installation following approval of this monitoring plan.) The sites are shown in Figure 1 (see separate map) and listed in Appendix A. Site locations have been based on the following criteria:

- Population sub-areas represented
- Spatially distributed throughout system
- All major pressure zones represented
- Site representative of typical piping configuration and normal operational condition
- Not on dead ends
- Safe location for staff to park and collect sample
- Close to drainage to avoid erosion, surface flow on streets
- Tapped into 8" distribution line or smaller

Further description of the first three criteria is provided below.

Population: Sub-area Representation. Seattle is divided into population sub-areas based on census tracts as shown in Figure 2. An evaluation of the population and number of sample stands in each sub-area of the SPU distribution system is shown on Table 3. Each of the 15 sub-areas has at least two sample stands, except the Shorewood Apartments, which has a relatively small population. Based on the sampling schedule, the sub-areas are sampled at a rate of 0.19 to 0.48 samples per 1000 population per month. The sampling rate for the North sub-area is unusually low at 0.19 samplers per 1000. This is because the odd shape of the Northwest sub-area happens to include sample stand C-5, but C-5 is actually more representative of the North sub-area. Generally, the range of sampling rates is due to other considerations, such as spatial distribution and coverage of pressures zones, as described below. This sampling is based on typical collection of 270 routine samples each month as mentioned above. If SPU chooses to reduce the

schedule closer to the 189 monthly samples required, the balance of sample collection for spatial and population based representation will be maintained.

Spatial Distribution and Pressure Zones. A visual inspection of the sample stand map (Figure 1) shows that the 62 sample sites used for routine TCR sample collection are relatively equally spaced throughout the distribution system. Sample stands within the same pressure zone are located at least 10 blocks apart, but no more than 25 blocks apart. Each major pressure zone has at least one sample stand. The distribution of sample sites by pressure zone is shown in Appendix B. Some of the small pressure zones served by pressure reducing valves do not have their own sample stand, but are served by a pressure zone that has a sample stand. It is estimated that these small pressure zones represent less than one percent of the population.

Appendix C contains a series of schematics showing the pressure zones, storage facilities, and associated sample stands. These schematics are not to scale, but show how each pressure zone and storage facility is represented by at least one sample stand.

Repeat Sampling Locations

Repeat samples are taken in follow up to a positive coliform sample. In addition to the original site of the sample with coliform presence, repeat samples are taken within five services upstream and five services downstream of the original sample. Appendix D contains a list of routine and repeat coliform sampling locations.

Table 3. Allocation of Sample Stands by Sub-Area Population

Sub-area	Residential Population*	Non-Residential Population†	Total Population	Land Area (Acres)	Number of Sample Stands**	Number of Samples Collected per Month	Samples per 1000 Total Pop.
Ballard	43,068	7,900	50,986	3,677	5	16	0.31
Capitol Hill	46,170	11,850	50,020	2,494	5	20	0.34
Central	31,443	11,850	43,293	2,070	2	12	0.28
Downtown	21,745	31,600	53,345	1,147	4	16	0.30
Duwamish	41,286	23,700	64,986	7,820	7	31	0.48
Lake Union	26,895	7,900	34,795	1,939	3	12	0.34
North	38,427	3,950	42,377	3,777	2	8	0.19
Northeast	71,270	15,800	87,070	5,972	8	33	0.38
Northwest	64,437	7,900	72,337	5,781	7	32	0.44
Q. Anne/Magnolia	53,543	7,900	61,443	5,107	4	16	0.26
Southeast	46,286	7,900	54,186	4,337	4	17	0.31
West Seattle	78,804	7,900	86,704	9,665	7	31	0.36
Shoreline	34,857	7,900	42,757	NA	4	17	0.40
South Unincorp.	15,000	3,950	18,950	NA	2	8	0.42
Shorewood Apts	1,600	–	1,600	NA	1	1	0.63
Totals	**614,974**	**158,000**	**772,831**	**53,786**	**65**	**270**	**0.35**

*Population data is based on 2000 census, except for South Unicorporated and Shorewood Apartments.
†Non-residential population is distributed based on zoning.
**Includes one new sample station each in Ballard, Downtown, and Northeast.

Sampling Schedule and Routes

The coliform sampling schedule is generally set for one sample per week per stand. Most samples are collected Monday through Friday, though about 10 percent of samples are collected on weekends so that the distribution system is sampled every day. A basic monthly sampling schedule is presented in Appendix A. The sampling schedule does vary slightly each month depending on which day of the week that the first of the month falls and the number of days in the month.

A series of set routes are followed for sample collection covering both the SPU direct and wholesale customer service areas. A detailed listing of routes is presented in Appendix E; note that the route schedule not only includes wholesale customers, but also non-compliance sample stations. The same routes are followed the first three weeks of the month. Altered routes are followed in the fourth and fifth weeks.

The current sampling schedule and routes represent collection of 270 samples per month. In the future, SPU may choose to reduce samples collected to a number closer the 189 required monthly samples. The same general approach to scheduling would be followed.

Sample Stands and Sampling Procedures

SPU utilizes dedicated sample stands for all routine coliform sampling. The purpose of the stands is to have sample points that: provide water representative of that in the distribution system; are under the control of SPU; are easily accessible 7 days per week; reduce time for collection; and can be located throughout the distribution system. To avoid stagnation and freezing of water in the sample lines, the sample stands flow continuously at about 1/2 gallon per minute.

Handheld field computers are used for identifying sample bottles with sample stand locations and for management of field data. Data from the field computers is then downloaded into the laboratory information management system (LIMS). Procedures for collection and transport of samples are provided in Appendix F. Details on the construction and maintenance of the sample stands are provided in Appendices G and H.

Sample Analysis

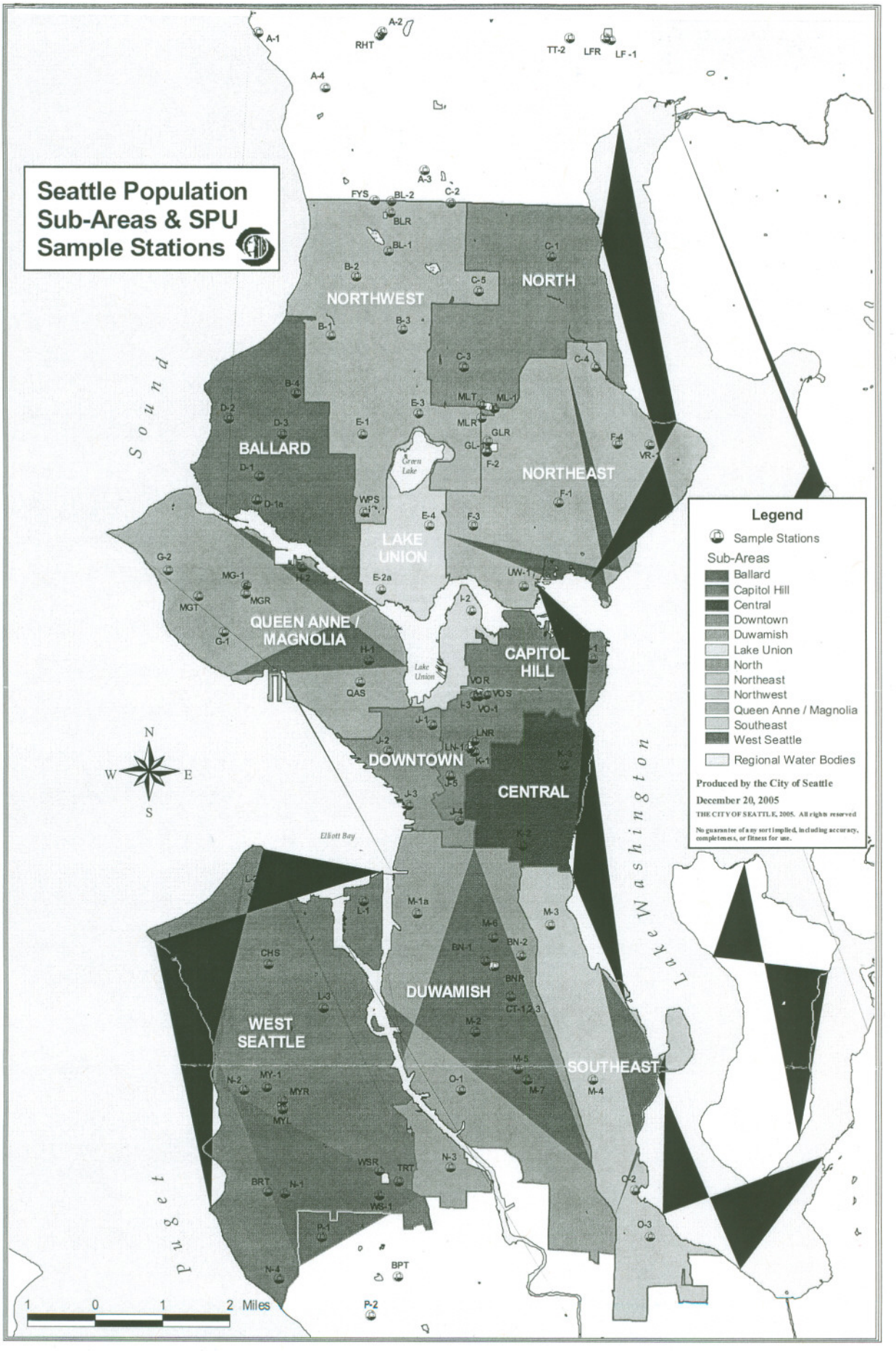
The SPU Water Quality Laboratory is certified by the State for the following total coliform, fecal coliform, and *E. Coli* analytical methods:

- Colisure (MMO/MUG, Standard Method 9223B)
- Colilert (MMO/MUG, Standard Method 9223B)
- Membrane Filtration (Standard Methods 9222B and 9222D)

Chlorine residual tests are conducted on site with the collection of each coliform sample. SPU typically tests for Heterotrophic Plate Counts (HPCs) on samples with chlorine residual less than 0.2 mg/L.

Non-Routine Sampling and Analysis

In addition to the coliform compliance monitoring, SPU routinely performs a number of non-compliance microbiological tests for water quality in the distribution system. The additional testing provides a greater level of knowledge than coliform testing alone and can aid in assessing possible problems that could arise. Open reservoirs are regularly tested for total and fecal coliform, heterotrophic plate counts (HPCs), and *Pseudomonas*. Closed storage facilities are regularly tested for total and fecal coliform and HPCs. The testing results are used to evaluate microbial activity in the reservoirs and the efficacy of operational techniques on improving water quality. Multiple coliform samples are collected daily from both the Tolt and Cedar transmission systems. SPU also conducts daily HPC testing at other distribution locations selected randomly. For additional information, the SPU laboratory has the capability of performing bacterial speciation of water samples, both by the traditional biochemical method (i.e., API 20e) and by the use of a rapid automated system of carbon utilization patterns (i.e., Micro station by BioLog Inc.).


Seattle Population
Sub-Areas & SPU
Sample Stations
NORTHWEST
NORTH
NORTHEAST
BALLARD
LAKE
UNION
QUEEN ANNE /
MAGNOLIA
CAPITOL
HILL
DOWNTOWN
CENTRAL
DUWAMISH
WEST
SEATTLE
SOUTHEAST
Green
Lake
Lake
Union
Elliott Bay
Sound
Puget
Lake Washington
A-1
A-2
A-3
A-4
RHT
TT-2
LFR
LF-1
FYS
BL-2
C-2
BLR
BL-1
C-1
B-2
C-5
B-1
B-3
C-3
C-4
B-4
D-2
D-3
E-1
E-3
MLT
ML-1
MLR
GLR
GL-1
F-2
F-4
VR-1
D-1
D-1a
WPS
F-1
E-4
F-3
G-2
MG-1
N-2
E-2a
UW-1
MGR
MGT
G-1
H-1
I-2
QAS
VOR
VOS
I-3
VO-1
J-1
LNR
J-2
LN-1
K-1
K-3
J-5
J-3
J-4
K-2
L-2
L-1
M-1a
M-6
M-3
BN-1
BN-2
CHS
BNR
CT-1,2,3
L-3
M-2
M-5
N-2
MY-1
O-1
M-7
M-4
MYR
MYL
WSR
TRT
N-3
O-2
BRT
N-1
WS-1
P-1
O-3
N-4
BPT
P-2
N
W
E
S
1 0 1 2 Miles
Legend
Sample Stations
Sub-Areas
Ballard
Capitol Hill
Central
Downtown
Duwamish
Lake Union
North
Northeast
Northwest
Queen Anne / Magnolia
Southeast
West Seattle
Regional Water Bodies
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SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

II. WATER QUALITY AND TREATMENT

APPENDIX D
WATER TREATMENT CHEMICALS

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Water Treatment Chemicals
May 2006

Facility	Chemical
Tolt Treatment Facility	Liquid Oxygen
	Carbon Dioxide
	Chlorine
	Ferric Chloride
	Hydrofluorosilicic Acid
	Lime
	Cationic Polymer
	Anionic Polymer
	Sodium Bisulfite
	Sodium Hydroxide
Cedar Treatment Facility	Liquid Oxygen
	Chlorine
	Lime
	Sodium Bisulfite
	Sodium Hydroxide
Landsburg Diversion & Pre-Treatment Facility	Chlorine
	Hydrofluorosilicic Acid
Seattle Wellfields*	Sodium Hypochlorite
	Carbon Dioxide
	Sodium Hydroxide
	Hydrofluorosilicic Acid
In-Town Reservoirs: Chlorination and Hypochlorination Facilities	Sodium Hypochlorite
	Carbon Dioxide
	Salt (used for on-site hypochlorite generation)
	Chlorine Gas

Notes:

* Indicates the facility is only used seasonally during the high demand period. Chemicals are not stored on site during the off season.

--Tolt and Cedar information provided by Tolt and Cedar Treatment Facility managers in April 2006. Other information in this table was provided by SPU staff at the same time.

--Myrtle Reservoir Chlorination Facility (currently out of service for reconstruction) will be rebuilt as a sodium hypochlorite facility instead of gaseous chlorine.

--The following facilities no longer exist since the 2001 Water System Plan was produced: 1) SW Trenton Pump Station Chlorination Facility, and 2) West Seattle Reservoir Chlorination Facility

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