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Gibbons Creek Remnant Channel Receiving Water Study

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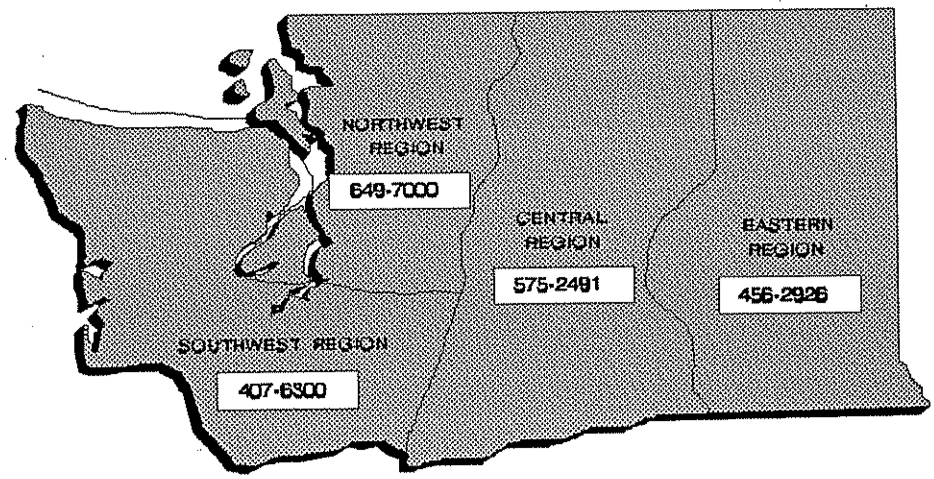

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Gibbons Creek Remnant Channel Receiving Water Study

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Acknowledgments

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Abstract

The remnant Gibbons Creek channel, located in eastern Clark County, is a 1-1/2 mile abandoned channel formed when Gibbons Creek was rerouted in 1992. This remnant channel serves as the receiving water body for wastewater from five industrial facilities, and stormwater runoff from many more facilities. Since rerouting, the amount of water available for dilution for these discharges has been substantially reduced, prompting concerns that discharges may be adversely impacting water quality and wildlife from the adjacent Steigerwald Lake Wildlife Refuge.

Three water and sediment quality sampling surveys were conducted from September 1994 to January 1995 at four receiving water and one storm sewer site. The results show that the remnant channel exceeds state water quality criteria for pH, temperature, fecal coliform, turbidity, and dissolved oxygen. The storm sewer water violates criteria for pH, hexavalent chromium, total chromium, copper, zinc, and arsenic. Metal concentrations are also elevated in sediment samples in the lower channel, including arsenic, chromium, copper, zinc, cadmium, and lead.

Organic compounds detected in surface water samples downstream of the 32nd Street culvert have also been detected in Burlington Environmental's upper aquifer monitoring wells. The upper aquifer ground water flow direction in the vicinity of the Burlington Environmental Washougal facility appears to be unchanged by the rerouting of the creek.

Recommendations are made to continue to address the contaminated ground water beneath the Burlington Environmental site through their RCRA permit. Further investigations of the lower channel sediments contaminated with high levels of chromium should be addressed jointly by Ecology's sediment management unit in the Toxics Cleanup Program, and the industrial unit of the Water Quality Program to identify ongoing sources and determine the need for cleanup actions. The two wood-treating facilities need to substantially improve their stormwater runoff controls to reduce the amount of chromium, copper, and arsenic being contributed to the channel. Further source identification is needed for elevated zinc levels found in the 32nd Street storm sewer discharge. It is recommended that the storm sewer be upgraded and connected to the wastewater treatment plant or discharged directly to the Columbia River. If this is not done, all discharges will need to meet water quality criteria at "end-of-pipe" due to the lack of mixing and dilution in the remnant channel.

Introduction

Setting

The remnant Gibbons Creek channel is located in eastern Clark County, southeast of the town of Washougal (Figure 1). This remnant channel was formed when Gibbons Creek was rerouted in 1992 to flow southeasterly into the Columbia River, thereby abandoning its previous lowermost 1-1/2 mile channel that paralleled the Columbia River towards the west. This abandoned channel now drains an area of about 4.5 square miles instead of its previous approximately 12 square miles. The water flowing through the remnant channel discharges into the Columbia River at the western end of the project area.

The study area is located on the north side of the Columbia River Valley, between Columbia River miles 123 and 128. Most of the area is nearly flat lowlands on the valley floor, although the northern portion of the area includes part of the sloping valley wall. The level portion of the study area was originally covered by Steigerwald Lake and associated wetlands. In recent times the lake was partially drained, a dike was built along the Columbia River to prevent flooding, the western portion of the study area was filled, and the Port of Camas-Washougal Industrial Park was built on the filled area.

The predominant land uses in the study area are the Port of Camas-Washougal Industrial Park and the Steigerwald Lake Wildlife Refuge. The industrial facilities in the study area are listed in Table 1 and their locations shown in Figure 2. The land between the wildlife refuge and the watershed's eastern boundary is agricultural land used for grazing cattle and growing hay. The town of Washougal extends into the northeastern portion of the study area. The Washougal wastewater treatment plant is also located in the study area; effluent from the plant's sewage lagoon is discharged directly to the Columbia River.

The proximity of the wildlife refuge to the remnant Gibbons Creek channel makes the area sensitive to contamination. Pollution from the industrial park could threaten the health of wildlife species using the channel. Contaminants could also be bioaccumulated by these organisms and contribute to environmental threats off-site. A complete list of animals that have been observed at the wildlife refuge and are likely to have exposure to the remnant channel are listed in Materna et al. (1992). The list includes many types of birds (raptors, geese, waterfowl, riparian woodland birds), fish, and mammals, and includes birds that are considered unusual or rare in western Washington and Oregon. There is not an operational fish screen blocking access from the Columbia River to the remnant channel.

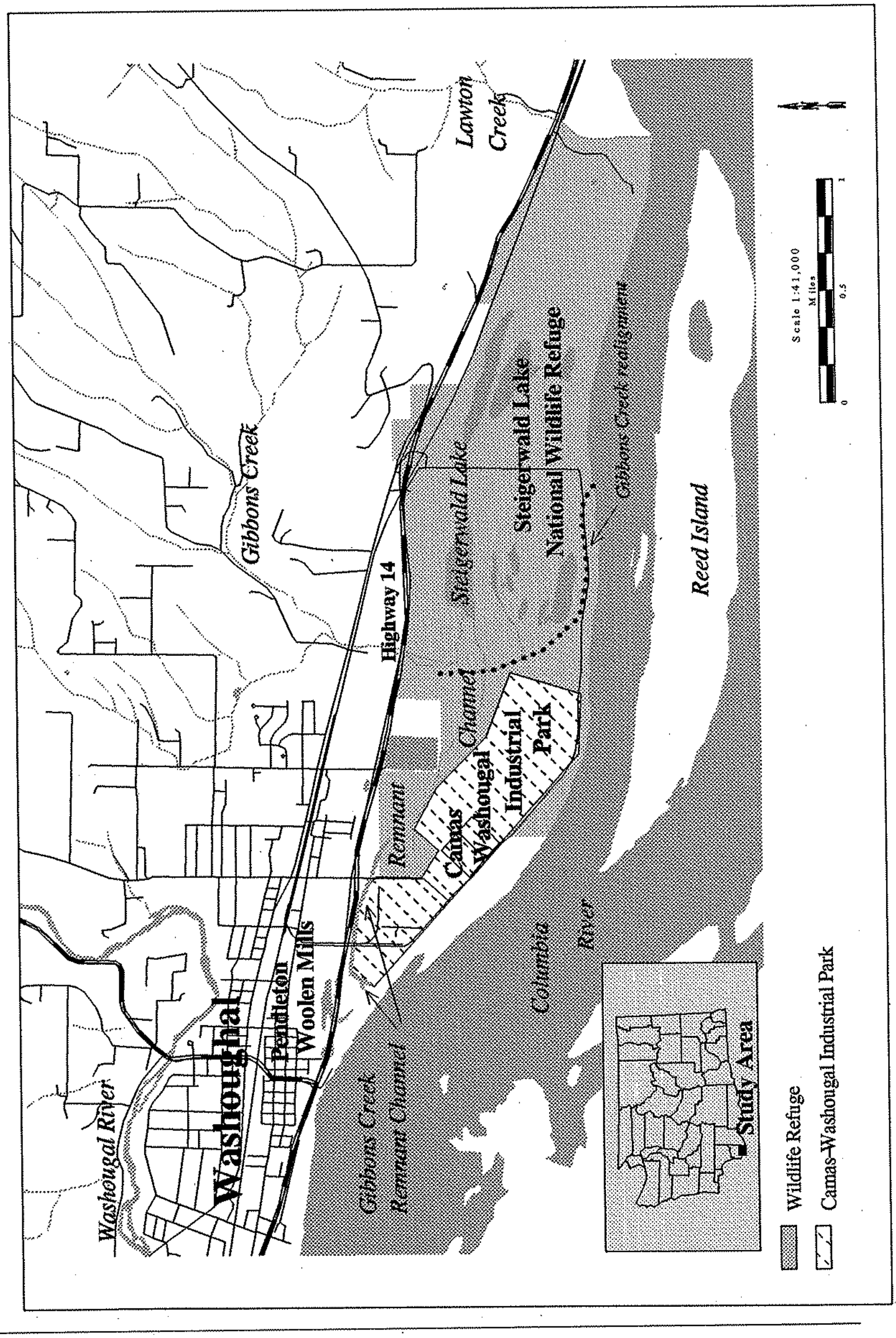


Figure 1 Gibbons Creek Remnant Channel Vicinity Map

Table 1. Industrial facilities discharging to Gibbons Creek remnant channel (Map locations refer to Figure 2).

Facility (map location)	Type of Industry	Type of discharge
Facilities with individual NPDES permits for discharging into the remnant channel:		
Allweather Wood Treaters (3)	Wood preserving	Stormwater runoff from treated and untreated product storage areas.
Burlington Environmental (2)	Solvent recycling	Treated wastewater originating inside the tank farm and process area and consisting of washdown water, contact washwater for the purification of chlorinated solvents, and stormwater.
Exterior Wood (19)	Wood preserving	Stormwater runoff from treated and untreated product storage areas, and treated vehicle wash water
Fiberweb (28)	Production of nonwoven polypropylene fabric	Stormwater, once-through cooling water, wasted water from the cooling tower, and compressor condensate
Pendleton Woolen Mills (located north of Highway 14, not in industrial park)	Wool finishing	Stormwater and cooling water
Union Carbide (21)	Silicon purification, electronic crystals, manufacturing	Stormwater, cooling tower blowdown
Facilities covered by the general stormwater permit:		
Advanced Drainage Systems (27)	Manufacturing & Distribution Plastic Corrugated Tubing & Fittings	Stormwater runoff
Allen Brown Woodwaste (23)	Trucking of Wood/Wood Residuals	Stormwater runoff
Betz Laboratories (20)	Industrial Water Treatment	Stormwater runoff
Burkes Paint Company (18)	Paint Manufacturer & Retailing	Stormwater runoff
Container Management Svs. (25)	Refurbish Storage Drums	Stormwater runoff
Corrosion Controllers (16)	Reinforced Fiberglass products	Stormwater runoff
High Cascade (1)	Lumber Remanufacturer - Planer Mill	Stormwater runoff
Industrial Plastics (17)	Machine Plastics for Industries	Stormwater runoff
Intech (11)	Refurbishing Palletizer Equipment	Stormwater runoff
Orbit Industries/Dura Wound, Inc. (6)	Manufacture Filament Winding Machines	Stormwater runoff
Pillar Plastics (14)	Plastic Wedges - Logging Tools	Stormwater runoff
Sharp (24)	Electronic Components Warehouse	Stormwater runoff
Textured Forest Products (7)	Plywood Siding	Stormwater runoff
Vancouver Manufacturing (4)	Pallet Manufacturing Plant	Stormwater runoff
Vinings West, Inc. (26)	Chemical Blending	Stormwater runoff
Other facilities:		
Advanced Silicon Materials (21)	Manufacturer of Polysilicon & Analysis Lab	Stormwater runoff
Coastal Oil Filtering (15)	Oil Filtering/Disposal	Stormwater runoff
Columbia Fibre, Ltd. (29)	Log Purchasing/Chipping	Stormwater runoff
Columbia Storage, Inc. (5)	Industrial Storage	Stormwater runoff
Fern Prairie Modelers Club (30)	Model Airplane Field	Stormwater runoff
Industrial Power Services (15)	Turbine/Machinery Overhaul & Repair	Stormwater runoff
Portland Tractor (22)	Heavy Equipment Sales and Repair	Stormwater runoff
Spar Group (10)	Fastener Distribution	Stormwater runoff

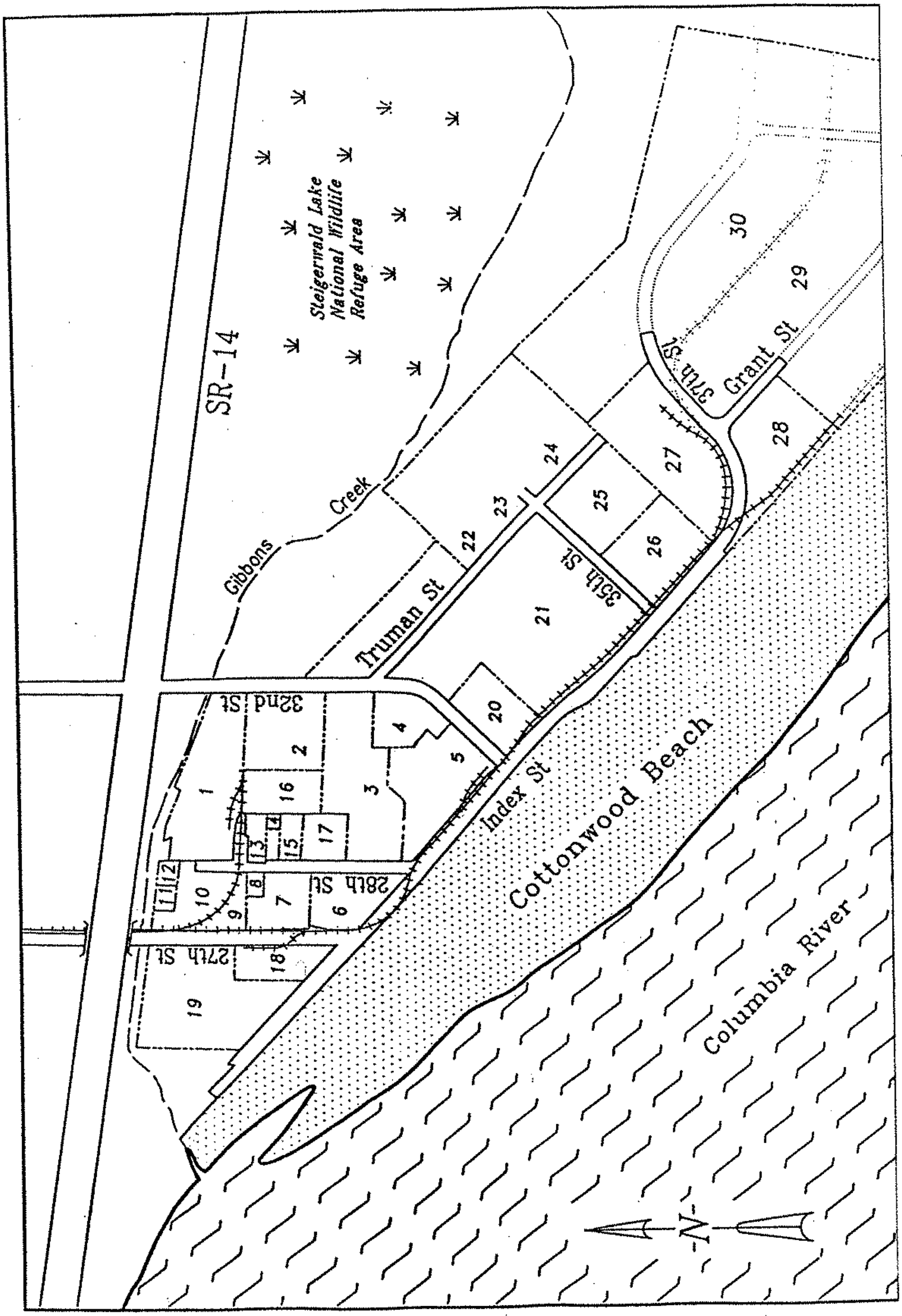


Figure 2. Facility locations within the Port of Camas-Washougal Industrial Park.

There are two principal aquifers within the Camas-Washougal Industrial Park. The upper aquifer is formed by Columbia River dredge spoils placed on top of the Columbia River floodplain within portions of the diked industrial park. This is underlain by the old floodplain which forms a silt layer. Below this silt layer lies a sand and gravel aquifer which is hydraulically connected to the Columbia River.

Problem Statement

The remnant Gibbons Creek channel is the receiving water body for treated process wastewater or cooling water from five facilities, and stormwater runoff from the industrial park and a portion of the Pendleton Woolen Mills facility. Since Gibbons Creek was rerouted in 1992, the amount of water available for dilution for these discharges has been substantially reduced. These discharges may be adversely impacting the water quality of the remnant Gibbons Creek channel and thereby adversely affecting wildlife from the adjacent refuge and other areas.

Staff from the Washington State Department of Ecology (Ecology) Water Quality Program, Southwest Regional Office requested this study to analyze whether Gibbons Creek is an appropriate receiving water body for the six facilities with NPDES permits within the study area. In addition, they wanted to know if there was evidence that stormwater runoff from the non-permitted facilities is adversely affecting the water quality of the channel.

Objectives

The objectives of the project, as defined in the project plan (Erickson, 1994) were:

1. Inventory potential sources of pollution to the remnant Gibbons Creek channel.

2. Characterize the water and sediment quality of the remnant channel and the water quality of accessible stormwater outfalls, and ground water flow directions during summer, winter, and storm conditions.

3. Assess the appropriateness of the remnant channel as a receiving water body for the wastewater and stormwater discharges in terms of water quality standards violations and quantity of dilution water available.

4. Evaluate effects of decreased Gibbons Creek flow to ground water flow patterns and the potential for contaminant transport to the stream.

5. Recommend follow-up actions.

Water Quality Standards

The remnant Gibbons Creek channel is classified as Class A in the state's water quality standards (Chapter 173-201A WAC). Class A water quality criteria for metals and conventional parameters are given in Appendix A. The metals criteria used in this report are those described in EPA's "interim final rule" published in May 1995. The state intends to adopt these criteria during the next water quality standards revision process.

Class A waters shall meet or exceed the requirements for all or substantially all of the following characteristic uses: domestic, industrial, and agricultural water supply; stock watering; salmonid and other fish migration, rearing, spawning, and harvesting; clam, oyster, and mussel rearing, spawning, and harvesting.

The immediate proximity of the wildlife refuge to the remnant channel makes protection of wildlife-related beneficial uses a high priority. Many types of animals are in contact with the remnant channel water through a variety of pathways. A complete description of species using the refuge is given in Materna *et al.* (1992).

Historical Data Review

There are three types of historical data available for the remnant channel:

- Data collected as part of investigations of contaminated ground water sites. Site investigations have been done for Burlington Environmental and Pendleton Woolen Mills.
- Monitoring conducted by NPDES-permitted facilities as part of their permit requirements.
- A study conducted by the U. S. Fish and Wildlife Service (Materna *et al.*, 1992).

These historical data are described briefly below.

Facility Investigations

Burlington Environmental

Operation at the Burlington Environmental Washougal facility began under previous ownership in 1978. The facility initially operated as a phenolic resin manufacturing facility. In January 1979 the facility expanded to include production of de-foamers and water-treatment chemicals for use in the paper industry. In November 1979 phenolic resin production ended and processing of waste oil and boiler fuel began. In 1980 waste oil processing ended and solvent recycling began.

Initial characterization of the site began in 1984 following allegations of illegal discharges to the environment and a poor compliance history (Sweet-Edwards/EMCON, Inc. 1991; Washington State Department of Ecology, 1991). Extensive site characterization has occurred as part of a Resource Conservation and Recovery Act (RCRA) Facility Investigation. Quarterly water-level measurements, and volatile and semi-volatile monitoring are ongoing.

The RCRA Facility Investigation (RFI) reported that a dense nonaqueous phase liquid plume (DNAPL) was located in the tank farm area of the facility (Sweet-Edwards/EMCON, Inc. 1991). Analyses from an October 20, 1986, DNAPL sample (20A) showed the following composition:

38%	tetrachloroethylene
29.5%	1,1,1- trichloroethane
18.4%	trichlorotrifluoroethane
5.8%	trichloroethylene
1%	toluene
0.8%	xylene
0.7%	methylene chloride

Ground water samples from May 1994 showed detection of 1,1,1-trichloroethane, 1,1,2- trichlorotrifluoroethane, 1,1-dichloroethane, 1,2-dichloro-1,1,2-trifluoroethane, cis-1,2-dichloroethene, dichlorodifluoromethane, ethylbenzene, naphthalene, tetrachloroethylene, toluene, trichloroethene, vinyl chloride, m-xylene, o-xylene, and p-xylene. Samples also showed detection of total and dissolved arsenic, zinc, and nickel. Appendix B, Tables B1 to B4, show targeted and detected compounds from the May 1994 quarterly sampling.

Quarterly water-level measurements, volatile and semi-volatile organics monitoring, and total and dissolved metals monitoring are continuing currently.

Pendleton Woolen Mills

The Pendleton Woolen Mills Washougal facility has been in continuous operation since 1909. Previous investigations indicate that organic and inorganic constituents may have been released into the soil and ground water as a result of poor wastewater management practices. Dieldrin and several Volatile Organic Compounds (VOC) have been detected in wells completed within the lower sand and gravel aquifer. Of the detected compounds, dieldrin is the most pervasive of the contaminants. Appendix B, Table B5, contains sampling results from the May 1993 semi-annual ground water monitoring.

As part of the remedial investigation and feasibility study for Pendleton Woolen Mills, extensive sediment sampling was conducted in the lower remnant channel (CH_2M HILL, 1992). Figure 3 shows the results for chromium. In two sites (G-3, south bank and G-2, south bank) sediment chromium levels may exceed levels requiring clean-up (no numeric clean-up criteria exist for freshwater sediments; each site is handled on a case-by-case basis). Pendleton Woolen Mills argued that the north-bank to south-bank gradient indicates that the chromium sources originated from the south bank and not Pendleton. The U.S. Environmental Protection Agency (EPA) is not currently requiring Pendleton to address sediment chromium contamination as part of their remedial actions.

NPDES Permit-related Data

The six facilities with NPDES permits are required to do periodic monitoring of their discharges. Table 2 shows permit limits for discharges into the remnant channel. For the two wood-treating facilities, lower permit limits for copper and chromium will go into effect June 30, 1996. The basis for these limits is given in Ecology (1993). The NPDES permit for Burlington Environmental is out-of-date; revisions are pending approval of clean-up actions of the contaminated ground water.

Monitoring data from Allweather Wood Treaters and Exterior Wood from the last three years show that runoff from the facilities usually meets the existing permit limits with occasional violations, but stricter source controls will be necessary to meet the new limits (Figure 4). Monitoring data for Union Carbide and Pendleton Woolen Mills show consistent compliance with their respective permit limits for discharges into the remnant channel. Ecology files contain monitoring data for Fiberweb for only one period (3/1/95 to 5/31/95) for oil and grease, temperature, and pH (additional records exist for bioassay data). The maximum temperature of the discharge water was reported to be 23.9°C (75°F), which exceeded the permit limit of 20°C (64.4°F). Permit limits for oil and grease and pH were not violated.

U.S. Fish and Wildlife Study

In 1989 (prior to the realignment of Gibbons Creek) the U.S. Fish and Wildlife Service conducted a study in the lower channel and sampled water, sediment, fish tissue, and bird tissue (Materna *et al.*, 1992). Samples of water, sediment, and tissue were taken from four sites following a storm event in the fall of 1989, and analyzed for the parameters listed in Table 3. Three sites were selected to represent possible routes of pollution into the wildlife refuge and one site was selected as a reference site upstream of influence from the industrial site.

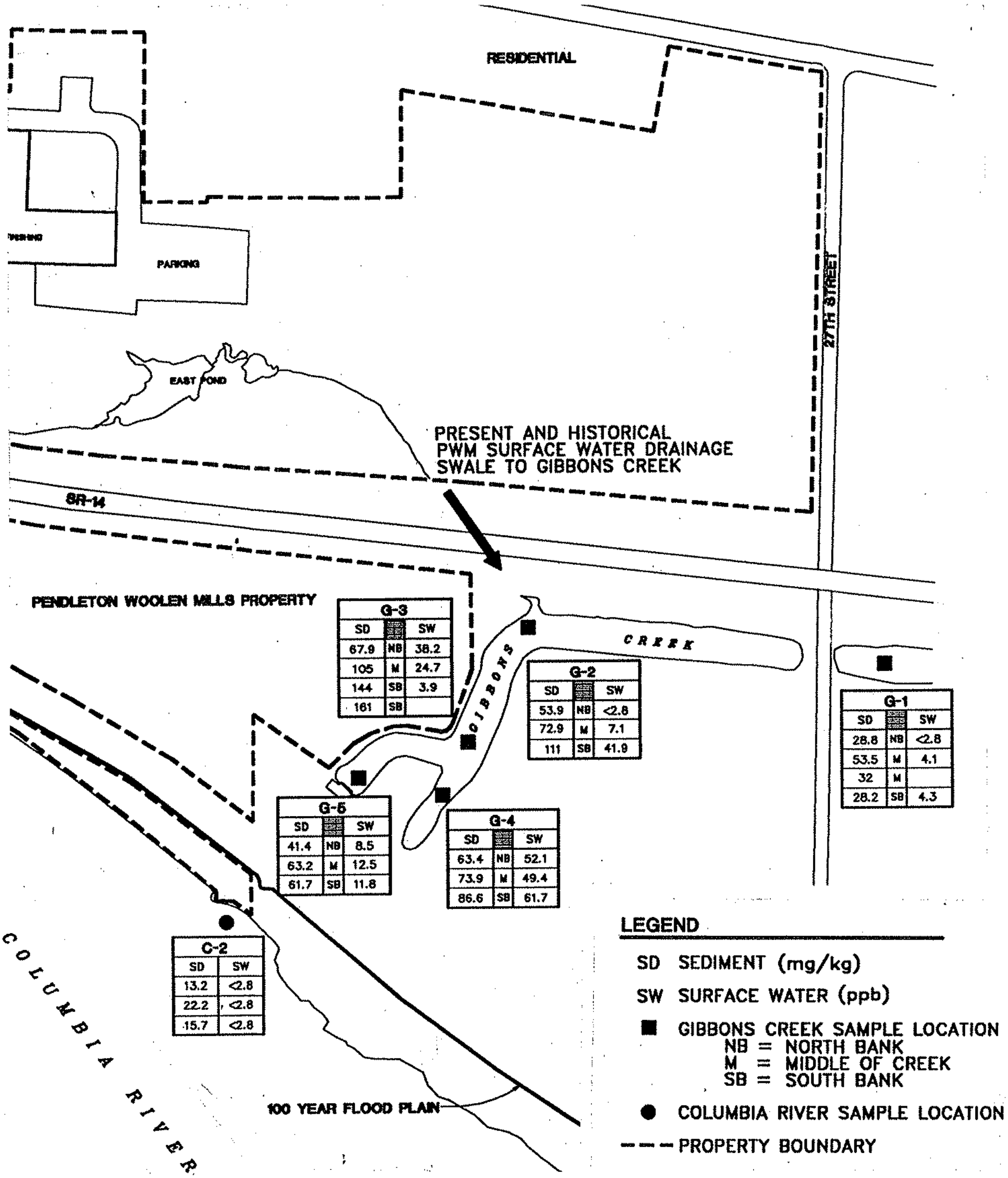


Figure 3. Chromium levels in Gibbons Creek remnant channel sediments (from CH2MHILL, 1992).

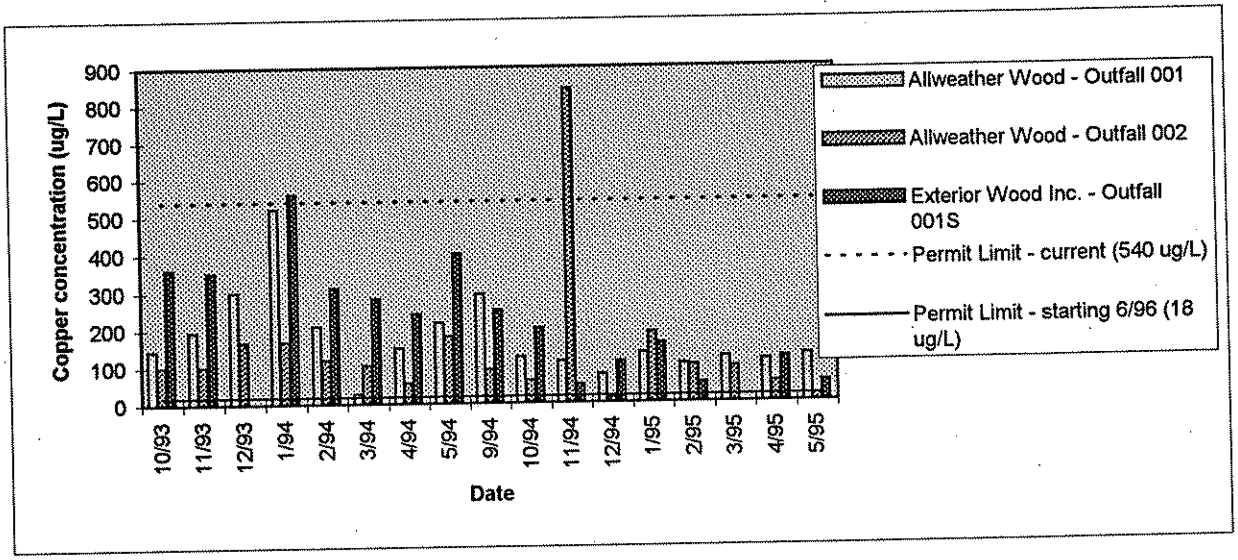
Table 2. NPDES permit limits of discharges to the remnant channel.

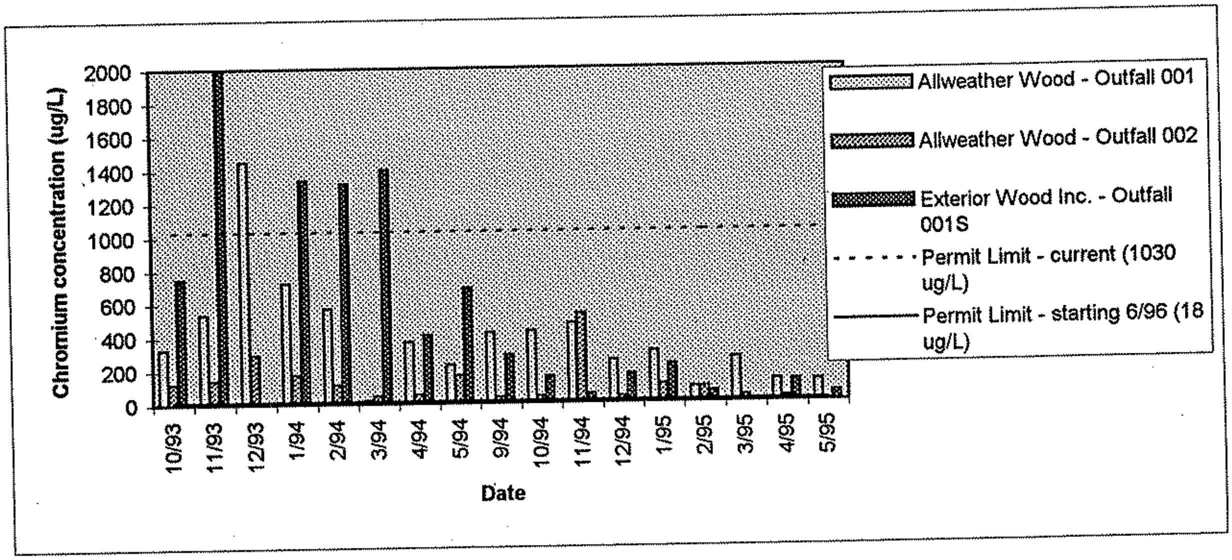
Facility	Parameter	Daily maximum[1] (current limit)	Daily maximum (starting 6/30/96)
Allweather Wood Treaters and Exterior Wood Inc.	Oil and Grease (µg/L)	10	10
	Arsenic (µg/L)	360	360
	Chromium (µg/L)	1030	16
	Copper (µg/L)	540	18
	pH (standard units)	6 - 9	6 - 9
Facility	**Parameter**	**Daily Maximum**	**Daily Average[2]**
Fiberweb	Oil and Grease (mg/L)	15	10
	pH (standard units)	6 - 9	6 - 9
	Temperature (°C)	18	N/A
Pendleton Woolen Mills	Oil and Grease (mg/L)	No visible sheen	
	pH (standard units)	6 - 9	6 - 9
Union Carbide	pH (standard units)	6 - 9	6 - 9
Burlington Environmental	Permit is out-of-date pending cleanup of contaminated groundwater		

[1] The daily maximum is defined as the greatest allowable value for any calendar day.
[2] The daily average is defined as the average of the measured values obtained over a calendar month's time.

In general, concentrations of certain trace elements were higher in the downstream sites than the reference site. Water concentrations of boron, iron, magnesium, manganese, nickel, strontium, and zinc from one downstream site were two times higher than at the reference site. Sediment concentrations of arsenic, chromium, copper, magnesium, manganese, mercury, nickel, strontium, and zinc were 1.5 times greater in lower channel sediments than at the reference site.

Based on an assumed hardness of 80 mg/L as $CaCO_3$, concentrations of chromium, copper, and iron approached or exceeded state and federal criteria for protection of freshwater life. Levels of 2,3,7,8 TCDD and 2,3,7,8 TCDF also were detected in sediment and fish samples collected downstream of the industrial park. The report stated that two fish samples had tissue concentrations eight times and almost 100 times higher than the concentration applied by the U. S. Environmental Protection Agency to judge compliance with state narrative criteria for protection of human health.





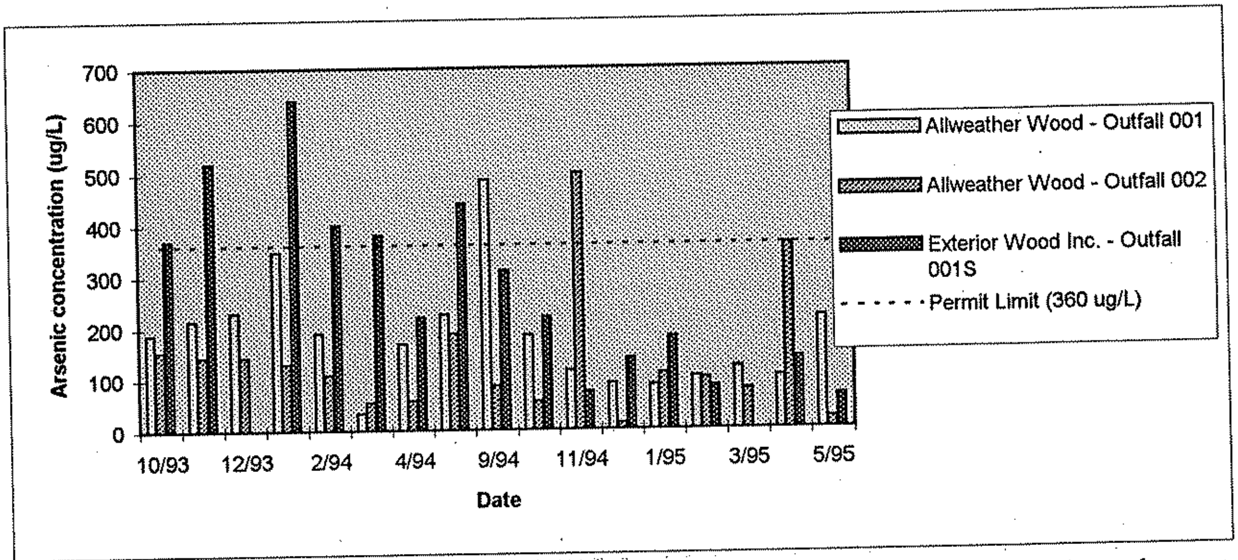


Figure 4. NPDES-required monitoring data for copper, chromium, and arsenic at the two wood-treating facilities discharging into Gibbons Creek remnant channel.

Table 3. U. S. Fish and Wildlife study: media and parameters analyzed.

Parameter	Water	Sediment	Whole body fish	Bird livers	Bird carcasses
Trace elements: antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, tin, vanadium, and zinc.	X	X	X	X	
Organochlorine pesticides	X	X	X		X
Polychlorinated biphenyls (PCBs)	X	X	X		X
Polycyclic aromatic hydrocarbons (PAHs)	X	X	X		
Aliphatic hydrocarbons	X	X			
2,3,7,8 tetrachlorodibenzo-*para*-dioxin (TCDD)		X	X		
2,3,7,8 tetrachlorodibenzo-*para*-furan (TCDF)		X	X		

Methods

Hydrologic Investigations

A water-level recorder (2-meter capacitive probe and data logger) was installed at the mouth of the remnant channel to record water-level fluctuations over the study period.

Upper aquifer water levels and remnant channel water surface elevations were measured on September 13, 1994 and January 11, 1995. These were used to characterize low water-table conditions and high water-table conditions, respectively. Water levels were measured at 11 wells within the Burlington Environmental facility, one within Allweather Wood Treaters, and four within or near the Exterior Wood facility. Five surface water elevation points within Gibbons Creek were also measured as part of these surveys. Figure 5 shows the ground water study site locations.

All water-level measurements were made with a calibrated electric well probe. The elevations of monitoring wells at the Burlington Environmental facility were surveyed by a registered land surveyor during May 1994 and tied to a National Geodetic Vertical Datum 1988 verified benchmark. The elevation of other well and surface water measuring points were surveyed by Ecology staff and tied to the Burlington Environmental vertical datum.

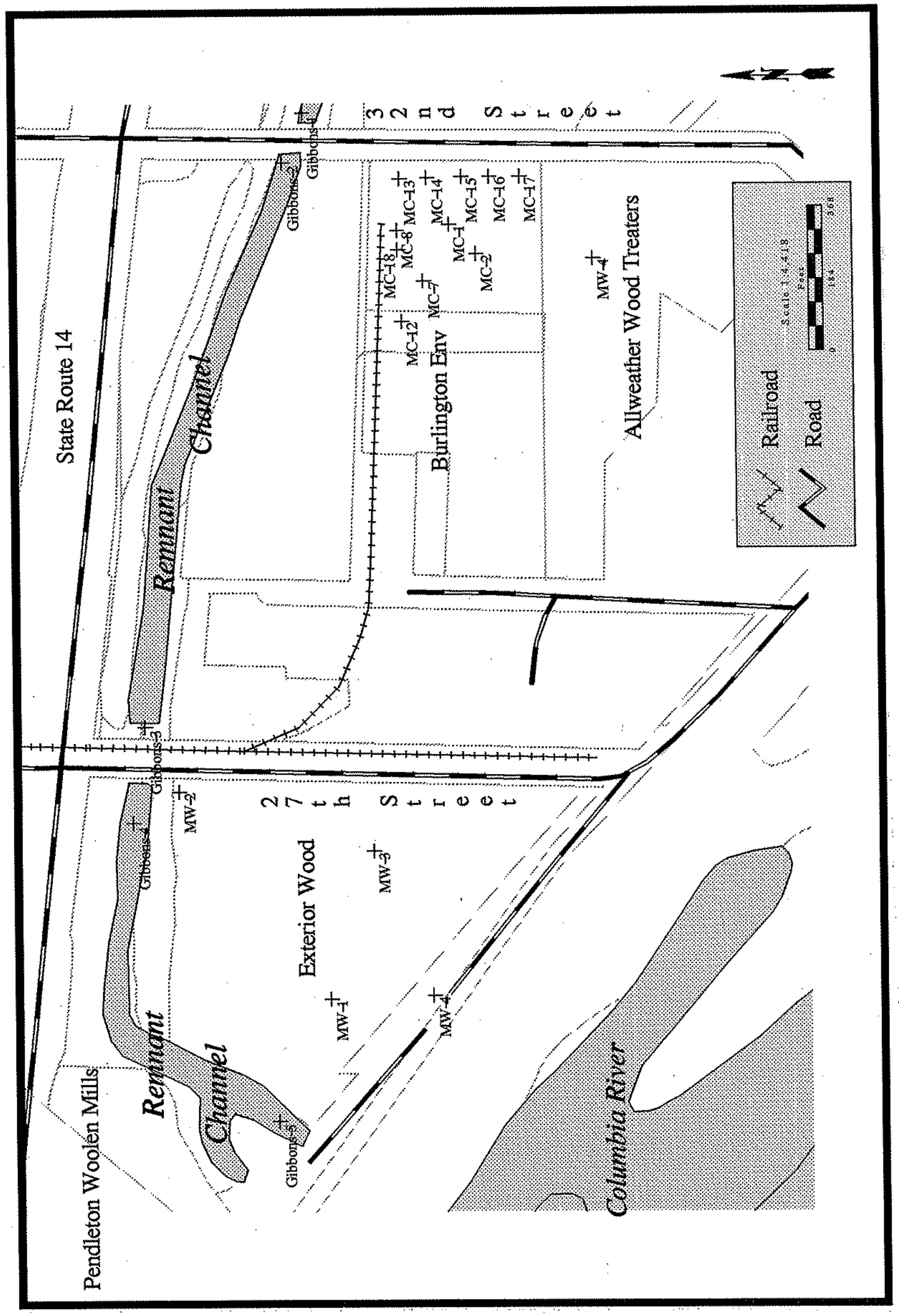


Figure 5. Gibbons Creek remnant channel ground water study sites.

Sampling Design

Sampling surveys were conducted on the following three dates: September 7, 1994; November 29, 1994; and January 30, 1995. Water samples were collected during each survey; sediment samples were collected during the first survey only. A screening sample was also collected from the 32nd Street storm sewer on August 16, 1994, to determine the appropriate metals analysis method for this site (ICP vs. ICP/MS).

The three sampling surveys were originally intended to be conducted during summer, winter, and storm conditions, respectively. However, because there is usually no discharge through the storm sewer during dry conditions, both winter surveys were conducted during rain events. Figure 6 shows precipitation during the study period and on the survey dates.

Sampling sites are shown in Figure 7. The uppermost site (RC4), near the new Gibbons Creek channel, was intended to serve as a reference site; it is well upstream of the industrial park. The lower three receiving water sites (RC1-3) represented conditions at different locations adjacent to the industrial park.

Several storm sewer outfalls were to be sampled for this project; however, most were found to be inaccessible. The storm sewer running below 32nd Street, which serves Burlington Environmental, Allweather Wood, and Union Carbide, was sampled in November and January when water was present (site SS1).

All samples were tested for general chemistry parameters and priority pollutants. Sediments were sampled for priority pollutant parameters as well as total organic carbon (TOC), oil and grease, grain size, and cyanide. Water and sediment quality parameters measured are shown in Table 4. All laboratory analyses were performed by Manchester Laboratory except sediment grain size and TOC, which were contracted to Soil Technology.

Sample Collection

All receiving water samples were simple grabs collected by hand approximately six inches below the water surface. At RC1, samples were collected by wading about two feet out from the point of land separating the two small bays that form the "mouth" of the channel. At RC2, samples were collected from a rubber raft mid-stream about 30 feet down-stream of 32nd Street and the storm sewer outfall (the storm sewer outfall is located within the 32nd Street culvert). At RC3 and RC4, samples were collected near the left bank by wading. The storm sewer was sampled where the effluent discharges into the remnant channel.

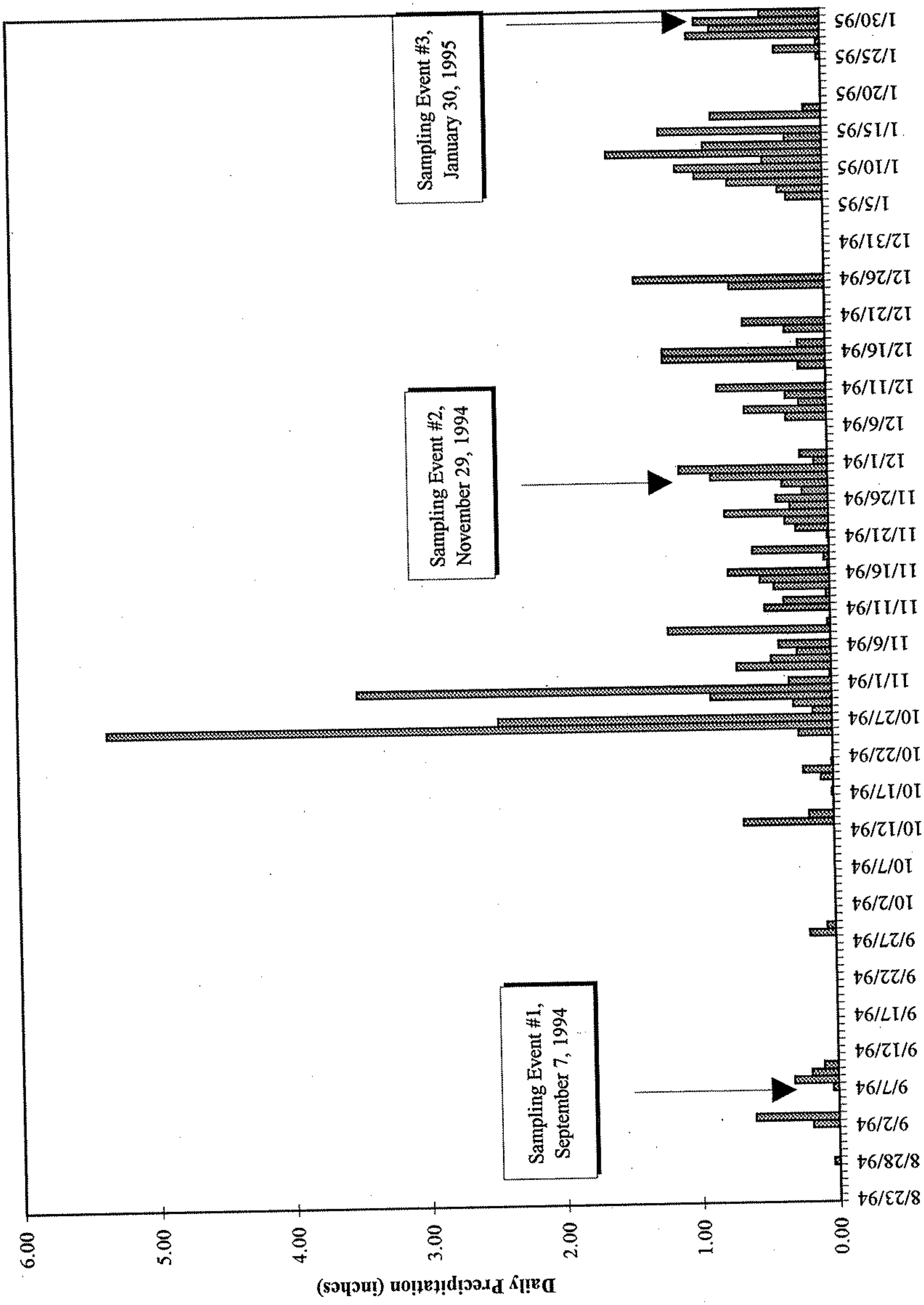


Figure 6. Precipitation during the study period and sampling dates.

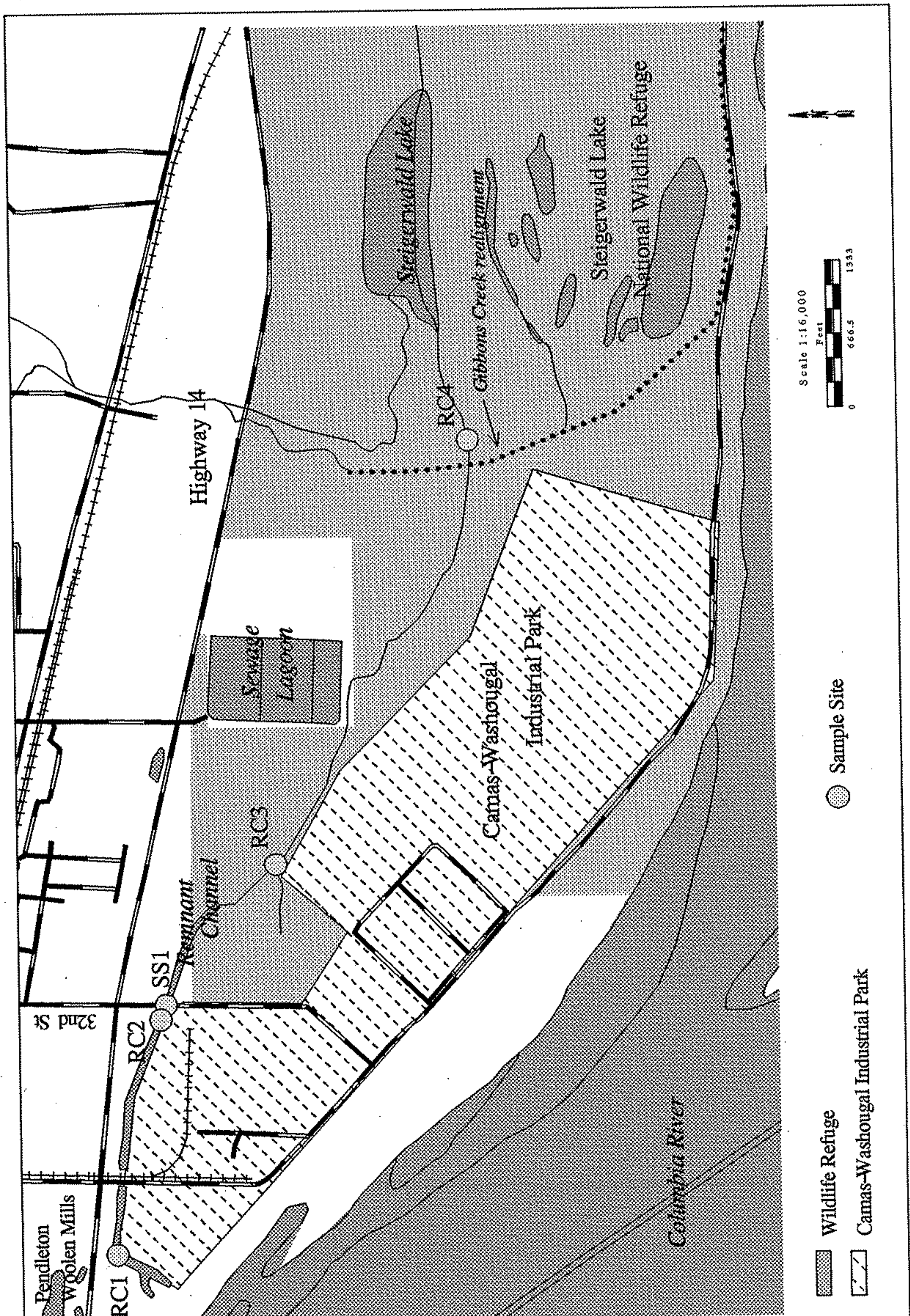


Figure 7. Water and Sediment Sampling Sites in Gibbons Creek Remnant Channel

Table 4. Summary of field and laboratory measurements of water and sediment, target reporting limits, and methods.

Parameter (all measurements are of water except where sediment is indicated)	Precision Limit (for field measurements and turbidity) or Detection Limit (all others)	Method[1]
Field Measurements		
Velocity	± 0.05 f/s	Current meter
pH	± 0.1 SU	Field Meter/Electrode
Temperature	± 0.2 °C	Electronic thermometer
Dissolved Oxygen	± 0.06 mg/L	Gas Probe/Winkler Titration
Specific Conductivity	± 20 µmhos/cm	Field Meter/Conductivity Bridge
General Chemistry		
Fecal coliform	1/100 mL	SM 18 Membrane Filter 9222D
Total suspended solids	1 mg/L	EPA 160.2
Ammonia nitrogen	0.01 mg/L	EPA 350.1
Nitrate + nitrite nitrogen	0.01 mg/L	EPA 353.2
Total persulfate nitrogen	0.01 mg/L	SM 4500 NO3-F Modified
Orthophosphate	0.01 mg/L	EPA 365.3
Total phosphorus	0.01 mg/L	EPA 365.3
Turbidity	± 1 NTU	EPA 180.1
Hardness	1 mg/L	EPA 130.2
Total organic carbon (water and sediment)	1 mg/L	EPA 415.1
Biochemical oxygen demand - 5 day	2 mg/L	EPA 405.1
Oil and grease (water and sediment)	1 mg/L	EPA 413.1
Cyanide (water and sediment)	0.002 mg/L	SM 4500CN-C, 4500CN-E, 4500CN-I
Grain size (sediment only)		Puget Sound Estuary Program, 1986
Percent solids (sediment only)		SM 2540

Priority Pollutants		
Base/Neutrals/Acids (water and sediment)	Water: 0.1 - 5 µg/L Sediment: 100 - 200 µg/kg	Capillary GC/MS, EPA 625
Volatile Organic Analysis (water and sediment)	Water: 1 - 5 µg/L Sediment: 1 - 20µg/kg	Purge and trap capillary GC/MS, EPA 624
Pesticides Screen (water and sediment)	Water: 0.05 - 1.0 µg/L Sediment: 10 - 100 µg/kg, with some exceptions (see WDOE, 1994)	Gas Chromatography Atomic Emission Detector, EPA 1618
Polychlorinated Biphenyls (water and sediment)	Water: 0.3 - 1 µg/L Sediment: 30 - 1000 µg/kg	Gas Chromatography Electron Capture Detector, EPA 608
Metals in water[2]		
Dissolved Cadmium, Chromium (all states), Copper, Lead, Nickel, Silver, Zinc	Cd 0.04, Cr 0.05, Cu 0.05, Pb 0.02, Ag 0.03, Ni 1, Zn 1 (all µg/L)	ICP/MS - EPA 200.8
Hexavalent Chromium	5 µg/L	UV-VIS spectroscopy
Mercury	0.005 µg/L	Cold vapor atomic Fluorescence (CVAF) - WA HGFL, draft EPA 245.7
Total Recoverable (Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, Thallium, Zinc)	Reporting limits determined by the analytical blanks, and are as low as possible (0.1 - 1 µg/L).	ICP/MS - EPA 200.2, 200.8
Metals in sediment		
Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, Thallium, Zinc	See WDOE (1994) for detection limits	EPA 600/4-79-020

[1]Method references:

EPA: U.S. EPA, 1983
SM: APHA, 1992

[2]"Ultra-trace" low-level metals methods (ICP/MS) were used to detect metals in the receiving water. For the storm sewer samples, the ICP method was used due to high levels of arsenic, chromium, copper, and zinc. The detection limits for the ICP method, listed in WDOE (1994), are significantly higher than ICP/MS.

Sampling and preservation procedures for conventional and organic parameters were in accordance with WAS (1993) and Ecology (1994).

Water metal samples were collected in 500 mL teflon bottles. Samples for dissolved metals were vacuum-filtered in the field through a 0.45 µm cellulose nitrate filter unit. In samples with high levels of solids, two filters were required. Both total and dissolved samples were preserved with 5 mL concentrated nitric acid. The acid was carried in small teflon vials, one per sample. Bottles and vials were pre-cleaned at Manchester Laboratory by soaking in 1:1 nitric acid for 72 hours and rinsing with deionized (DI) water. The cleaned bottles were filled with DI water and placed in zip-lock bags. The filters were pre-cleaned by allowing 1:1 nitric acid to gravity filter, then vacuum filtering 500 mL DI water. The dissembled pieces air-dried, reassembled, filter lids secured with lab tape, and placed in zip-lock bags.

Sediment samples were collected with a Petit Ponar sampler at approximately the same locations as the water samples (sited so that water quality sampling would not be affected). Sediments from the top 2 cm were used for analysis. All sampling equipment and utensils were pre-cleaned with hot water and Liquinox detergent, followed by sequential rinses with deionized water, dilute nitric acid, deionized water, hexane, and acetone. Samples were obtained upstream to downstream, in anticipated order of increasing contamination. In addition, sediment was taken from the interior of the sampler, about one inch in from all surfaces. Samples were homogenized in stainless steel beakers and transferred into jars cleaned for priority pollutant sampling. Samples to be analyzed for volatile organic compounds were taken from the first grab prior to homogenizing.

All samples were placed on ice upon collection and transported to Manchester Laboratory the next morning.

Field Procedures to Assess Data Quality

For metals samples, filter blanks were analyzed during each sampling survey to detect contamination arising from sample containers, the filtering process, preservation, and handling. Filter blanks were prepared in the field by filtering deionized water through the Nalgene units and acidifying. Filter blanks were also collected for ortho-phosphate by filtering deionized water, using the same procedure as for the field samples.

Replicate samples and field measurements were taken at RC1 during each sampling survey for all parameters to assess both field and laboratory variability.

Results and Discussion

Quality Assurance

A detailed quality assurance review is presented in Appendix D. The data were found to be acceptable for use in this report as qualified.

Hydrology

Surface Water

The remnant channel drainage area is bounded to the east by the Lawton Creek watershed; however, water diverted from Lawton Creek for irrigation and stock watering also drains to the Gibbons Creek remnant channel. The drainage area is bounded to the north by the upper Gibbons Creek watershed which drains through the new channel into the Columbia River, except during high flows, when water in excess of 70 cfs flows into the remnant channel by design. The land immediately to the west and northwest of the remnant channel drainage area either drains into the Washougal River, or directly into the Columbia River. This boundary is not well-defined because it is affected by storm drains within the city of Washougal. It is not known if the groundwater drainage area is coincident with the surface water drainage area.

A flood-control dike built along the Columbia River blocks the natural "mouth" of the remnant channel. When the Columbia River water level is low enough, the remnant channel water flows via a manually-controlled "gravity gate" through the dike into the river. When the Columbia River level is higher than the water in the remnant channel, water is pumped through the dike. When the gravity gate is open, the remnant channel water level is affected by tidal changes in the Columbia River. When the gate is closed, the remnant channel water level is affected by the pumping schedule. Figure 8 illustrates water-level changes over time for an example period, 8/16/94 to 9/27/94.

Streamflow in the remnant channel is dependent on both the amount of water draining into the channel (from both surface and ground water sources) and the status of the outlet (gravity gate open or closed, pumping or not). When the gravity gate is closed and the pumps are not operating, there is no flow out of the channel. Also, when the gravity gate is open and the Columbia River water is rising, water in the remnant channel could be flowing upstream. Therefore, there are extended periods of no flow, or reverse flow. A longer data record would be required to estimate the 7-day, 10-year low flow condition; however, it can be assumed that it would be very close to no flow.

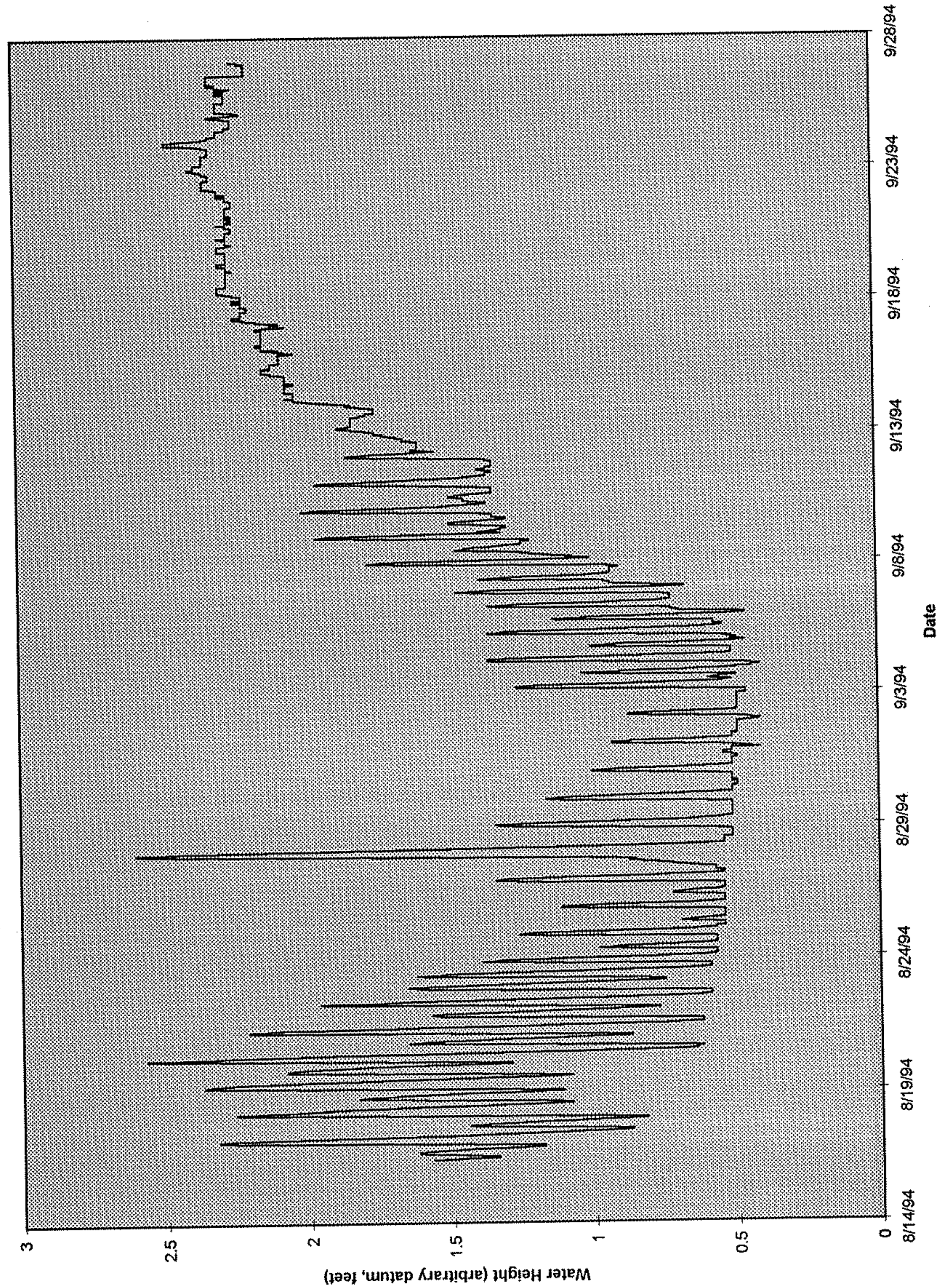


Figure 8. Gibbons Creek remnant channel water level time series, 8/16/94 - 9/27/94.

Ground Water Inflow

Surface water flow-balance surveys were conducted on August 16, and September 14, 1994, to estimate the magnitude of ground water inflow to the remnant channel during the summer low flow period. During these surveys no measurable streamflow occurred upstream of the 32nd Street culvert. Below the 32nd Street culvert flow was measured at two points in Gibbons Creek and at two tributaries. Table 5 describes the measured flow. Based on the flow balance, Gibbons Creek gained 1.9 and 3.1 cfs over this 2,800 ft. stream reach. This represents a 44% to 53% increase in flow attributable to ground water inflow to the stream during this summer low flow period.

Table 5. Streamflow and calculated ground water inflow of lower Gibbons Creek remnant channel.

Site ID	Surface Water Flow Site	Streamflow 8/16/94	Streamflow 9/14/94
Gibbons-1	Remnant Channel downstream side 32nd Street Culvert	0.7 ft^3/sec	1.7 ft^3/sec
Gibbons-2	Remnant Channel Tributary	1.6 ft^3/sec	0.8 ft^3/sec
Gibbons-4	Pendleton Tributary	0.1 ft^3/sec	0.2 ft^3/sec
Gibbons-5	Remnant Channel at Outflow Gate	4.3 ft^3/sec	5.8 ft^3/sec
	Calculated Ground Water Inflow	1.9 ft^3/sec	3.1 ft^3/sec

Upper Aquifer

The upper, unconfined saturated unit consists of Columbia River dredge material placed over the floodplain. This well sorted, medium to fine sand varies in thickness from 7 feet to 11 feet, according to well log information. The lateral extent of this aquifer is defined by the dredge filled areas of the industrial park, that is, developed areas within the diked perimeter. Lithologic cross-sections indicate that the upper aquifer is bounded by Gibbons Creek on the north side. Aquifer properties have been reported in several sources (Ecology, 1991; Sweet-Edwards/EMCON, Inc., 1991; CH2M HILL, 1992) The hydraulic properties are summarized in Table 6 .

Table 6. Upper aquifer hydraulic properties.

	Maximum	Minimum
Hydraulic Conductivity (the ease with which water moves through an aquifer)	2.4 * 10^-2 cm/sec	5.7 * 10^-4 cm/sec
Hydraulic Gradient	3.45%	0.3%
Depth to Water	6 ft.	1 ft.

The RCRA facility investigation for Burlington Environmental (then Chemical Processors) indicated that there were two site-engineering factors which may influence the direction of ground water flow in the upper aquifer. First there is a storm sewer under-drain which was installed beneath the 32nd Street storm drain. This under-drain discharges directly to Gibbons Creek through a discharge point in the west side of the 32nd Street culvert fill. During site visits on August 8, 1994 and September 14, 1994 there was observed discharge from the west side of the culvert fill. Unfortunately because of tidal influence, the discharge point was submerged during the low-flow water quality sampling trip on September 7, 1994. Consultants for Chemical Processors speculated that all shallow aquifer flow was intercepted by the underdrain since only trace amounts of contaminants were found east of 32nd Street (Sweet-Edwards/EMCON, Inc. 1991). This hypothesis was neither verified nor disproven during this investigation.

Ground water flow is apparently also influenced by the existence of a buried silt berm along the south side of the Gibbons Creek remnant channel. It was constructed to prevent dredge fill from entering Gibbons Creek during placement of the fill within the park. A low hydraulic conductivity berm would help explain flow directions observed both during high flow and low flow seasons.

Hydraulic communication between the upper aquifer and the lower aquifer may also influence ground water movement. Recent water-level monitoring also suggest that the tidal stage and water level of the Columbia River has an apparent effect on the upper aquifer as well as the lower aquifer (Stiller, 1994b).

Flow directions and water-level contours were calculated using ARC/INFO Geographic Information System (GIS) Triangular-Irregular Network (TIN) surface-analysis techniques. The TIN surface-analysis approach was chosen since it effectively models combined irregularly spaced points and linear features, as is the case with the facility monitoring wells and Gibbons Creek boundary. Within the TIN model, all measurement points (well locations and remnant channel elevation sites) were connected to their two nearest neighboring points to form a triangle. The surface of each triangle intersects the measuring point at the measured z-value, in this case, the water level. Each triangle has a calculated slope and azimuth, with azimuth being used for flow direction calculations. Water-level contours were also developed from the TIN model. Figure 9 shows the water-level contours and resulting flow directions for these two sample periods.

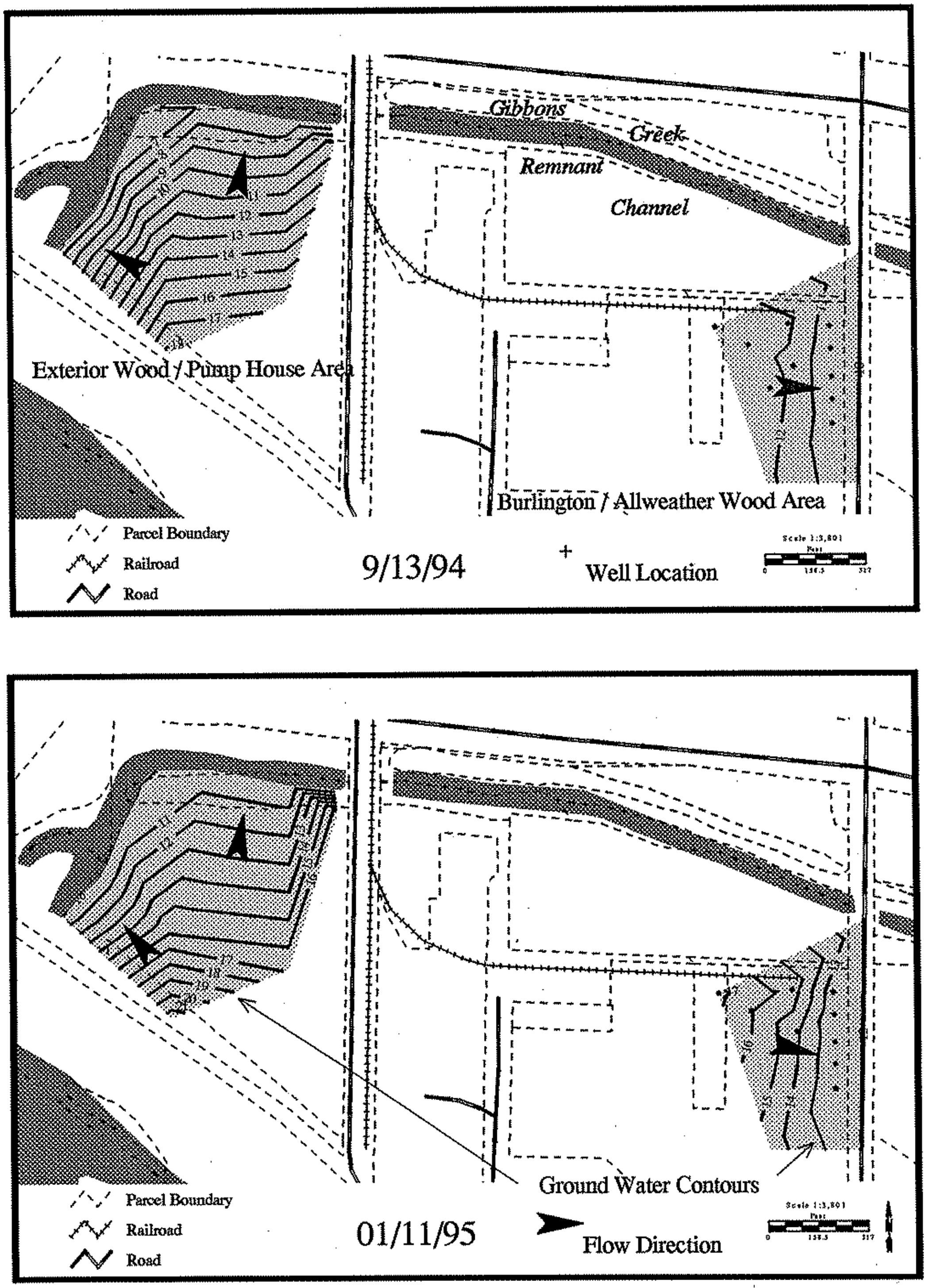


Figure 9. Water Level Countours and Resulting Flow Direction
For Two Sample Periods

Upper aquifer ground water in the vicinity of the Burlington Environmental and Allweather Wood Treaters Facilities flows from West to East towards 32nd Street. Upper aquifer ground water in the vicinity of the Exterior Wood/Gibbons Creek pump-house area flows from southeast to northwest towards Gibbons Creek.

Silt Layer

A silt layer, composed of Columbia River alluvium, underlies the upper aquifer. This silt layer thickens from north to south. Wells north of State Route 14 indicate a thickness of five feet, while wells south of the highway indicate a thickness of 19 feet near the Columbia River. Thickness within the Burlington Environmental facility ranges from 6 feet to 15.5 feet (Sweet-Edwards/EMCON, Inc., 1991). The hydraulic properties of this silt are important to understanding the vertical movement of contamination from the upper unconfined (and in some areas contaminated) aquifer to the lower aquifer. Vertical hydraulic conductivity has been reported to be $5.2 * 10^{-7}$ cm/s, with an average porosity of 0.5 (Sweet-Edwards/EMCON, Inc. 1991).

More recent data indicate hydraulic communication between the overlying aquifer and the sand and gravel aquifer below. This is indicated by a syncronous tidal reponse in the two aquifers.

Sand and Gravel Aquifer

A sand and gravel aquifer underlies the silt layer. This aquifer is hydraulically connected to the Columbia and Washougal Rivers. The hydraulic continuity between the aquifer and the Columbia River in the vicinity of the industrial park is confirmed by a diurnal fluctuation in water levels, in phase with tidal cycles of the Columbia River. At the Burlington Environmental site this fluctuation was monitored and appears to lag approximately four hours later than the tide (Sweet-Edwards/EMCON, Inc., 1991). The magnitude of these fluctuations is about one-third of those seen in the Columbia River.

The flow direction of this aquifer is generally to the south and southwest towards the Columbia River. At the Pendleton facility the flow is towards the southwest with flow more westerly in the western portion of the facility (CH2M-HILL, 1992).

Impacts of Gibbons Creek Diversion on Upper Aquifer Flow Direction at Burlington Environmental Facility

The Gibbons Creek diversion, and the resulting change in remnant channel flow, could alter the ground water flow direction in the upper aquifer. A significant change in ground water movement in the contaminated portion of the aquifer could result in a change in the lateral extent of the contaminant plume. A test, described in Appendix C, was devised to assess whether ground water flow had changed direction following the diversion of Gibbons Creek. The test concluded that there was not a significant change in flow direction after diversion.

Water Quality

Conventional Parameters

Water samples were tested for the conventional parameters of temperature, pH, conductivity, dissolved oxygen, fecal coliform, BOD_5, nutrients, turbidity, TSS, and hardness. Additional parameters of total organic carbon, cyanide, and oil and grease were also tested. The results for these parameters are shown in Table 7. For the summary statistics presented below, values less than reporting limit were assumed to one-half the reporting limit.

Results showed that the water in the remnant channel at sites RC1 and RC2 was generally high in fecal coliform, low in dissolved oxygen, warm in the late summer, somewhat alkaline, and moderately high in nutrients.

Fecal coliform levels ranged from 2100 organisms/100 mL at RC2 (in September) to 40 org./100 mL at RC4. The water quality standard for fecal coliform was exceeded at RC1, RC2, and RC3 (geometric means of 174, 173, and 138 org./100 mL, respectively), but not at RC4 (geometric mean of 43 org./100 mL). The storm sewer was not a significant contributor of fecal coliform (geometric mean of 22 org./100 mL). Most of the cattle grazing in the drainage area are upstream of RC4; therefore the sources of fecal coliform do not appear to be grazing cattle. Sources of fecal coliform from the lower end of the drainage area are unknown.

Dissolved oxygen levels were supersaturated at RC1 and RC2 in September, indicating algal photosynthesis activity. However, dissolved oxygen levels were below the water quality standard of 8.0 mg/L at all sites in November and at the upper sites in September as well. The storm sewer dissolved oxygen levels were high, but storm sewer water had BOD concentrations of 7 and 10 mg/L in November and January, respectively, probably contributing to dissolved oxygen depletion in the lower reach. BOD levels in the receiving water were consistently at or below the reporting limit.

Temperatures were high in September, violating the state water quality criterion of 18° C at RC1, RC3 and RC4. The pH of the storm sewer in January, 9.8, exceeded the state criterion of 6.5 to 8.5. pH values in the receiving water, although on the alkaline side, were always within the state criteria range. However, the state criteria also specify that human-caused variation be less than 0.5 pH units. During the January survey, the pH of the receiving water jumped from 7.9 at RC3 to 8.3 at RC2, due to the high pH of the storm sewer effluent (9.8), representing a violation of the criteria.

Nitrate levels were as high as 2.04 mg/L at RC2 in January but generally were not at levels of concern. Phosphorus levels were proportionately higher, with total phosphorus and orthophosphorus levels as high as 139 (RC2) and 60 µg/L (RC1), respectively. Ammonia levels ranged from less than 10 to 49 µg/L and did not violate state water quality criteria.

Table 7. General water quality parameters for Gibbons Creek remnant channel.

Station ID	Date	Time	pH (std. units)	Cond. (µmhos/sec)	Temp. (° C)	Diss. Oxygen (mg/L)	DO % Sat	Fecal coliform (org./100 mL)	TSS (mg/L)	BOD5 (mg/L)	NH_3 (mg/L)	$NO_3 + NO_2$	Total Nit. (mg/L)	Ortho-phosphate (mg/L)	Total Phos. (mg/L)	Turb. (NTU)	Total organic carbon (mg/L)	Oil & grease (mg/L)	Hardness (mg/L)	Cyanide (mg/L)
RC1	9/7/94	1600	7.3	130	20.0	15.65	172	1,000	4	2 U	0.012	0.90	1.01	0.030	0.070	2.2	1.2	1 U	48.2	0.01 U
RC1	9/7/94	1600	7.2	130	20.1	15.45	170	640	3	2 U	0.019	0.912	1.07	0.027	0.070	2.2	1.2	2	48.9	0.010 U
RC1	11/29/94	1530	7.1	109	8.2	7.95	67	100	17	3 U	0.043	0.614	0.811	0.040	0.123	33	6.7	1 U	43.2	0.01 U
RC1	11/29/94	1530	8.2	111	8.2	8.00	68	120	20	3 U	0.049	0.615	0.836	0.043	0.124	33	6.7	1	45.2 E	0.01 U
RC1	1/30/95	1410	7.9	112	9.5	10.0	88	62	6	3 U	0.028	0.808	1.01	0.060	0.061	8.7	4	2	42.7	0.01 U
RC1	1/30/95	1430	7.6	110	-----	-----	-----	54	6	3 U	0.026	0.838	1.07	0.059	0.086	8.6	3.9	1 U	41.4	0.01 U
RC2	9/7/94	1400	7.1	180	16.1	11.95	121	2100	16	2	0.036	1.18	1.25	0.040	0.086	11	2.7	1 U	76.3	0.010 U
RC2	11/29/94	1130	7.2	118	7	6.9	56	54	25	3 U	0.046	0.411	0.642	0.033	0.139	60	8	1 U	46.8	0.01 U
RC2	1/30/95	1115	8.3	128	9.0	10.9	94	46	7.0	3 U	0.01 U	2.04	1.99	0.050	0.031	3	1.2	1 U	47	0.01 U
SS1	9/7/94	- DRY -	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SS1	11/29/94	1030	7.9	15	7.2	12.00	99	38	60	7	0.012	0.015	0.139	0.049	0.135	38	6.8	2	5.7 J	0.01 U
SS1	1/30/95	1030	9.8	42	8.5	10.9	93	25 U	39	10	0.014	0.01 U	0.244	0.190	0.304	75	11.4	6	11 J	0.01 U
RC3	9/7/94	1245	7.5	270	20.3	7.55	84	89	8	2	0.01 U	0.01 U	0.203	0.012	0.078	17	6.0	1 U	92.9	0.010 U
RC3	11/29/94	1330	7.4	107	6.4	6.85	56	110	13	3 U	0.033	0.03	0.368	0.040	0.215	13	7.7	1 U	43.5	0.01 U
RC3	1/30/95	1340	7.9	113	9.8	10.1	89	270	9	3 U	0.049	0.198	0.592	0.029	0.036	14	5.8	1 U	42.7	0.01 U
RC4	9/7/94	1110	7.5	147	21.9	6.15	70	45	18	2 U	0.035	0.010 U	0.322	0.012	0.100	22	8.0	1	59.7	0.010 U
RC4	11/29/94	1430	7.4	103	7.2	7.70	64	40	3	3 U	0.039	0.096	0.34	0.036	0.097	6	6.9	1 U	40.8	0.01 U
RC4	1/30/95	1300	7.6	112	9.8	9.95	88	43	7	3 U	0.039	0.119	0.46	0.026	0.025	9.5	5.9	1 U	41.8	0.01 U
Field blank	11/29/94	1700												0.01 U						
Field blank	1/30/95	1500												0.01 U						

Key:
U - The analyte was not detected at or above the reported result.
E - Reported result is an estimate because of the presence of interference.
J - The analyte was positively identified. The associated numerical result is an estimate.
----- No measurement taken

Both turbidity and total suspended solids (TSS) levels were high at times. The turbidity reading of 60 NTU at RC2 exceeded the upstream (RC3) reading of 13 NTU by far more than the five NTU the state water quality criteria allow. The turbidity of the storm sewer water was 75 that date and was probably responsible for the exceedence. TSS levels were 25 mg/L at RC2 and 60 mg/L in the storm sewer on the same date.

Cyanide levels were always below reporting limits. Oil and grease levels were as high as 6 mg/L in the storm sewer and were highest in the receiving water at RC1. Oil and grease levels were at or below reporting limits at RC2, RC3, and RC4.

Metals

All metal results are shown in Appendix E, Table E-1. Table 8 shows the range of values encountered for metals with state water quality criteria defined. The metals of most concern were arsenic, copper, chromium, and zinc, because they were found at elevated levels in the storm sewer effluent and in the receiving water at stations RC1 and RC2. Concentrations of lead, mercury, and nickel were found above reporting limits in the receiving water, but there was no discernible pattern of higher concentrations at downstream sites versus the upstream reference site. Cadmium was found above reporting limits at RC1 in November.

Table 8. Range of measured values for hardness and selected metals. Units in μg/L except hardness in mg/L.

		Range in receiving water		Range in storm sewer	
Analyte		Min	Max	Min	Max
Hardness (mg/L)		40.8	92.9	5.7	11
Arsenic	Tot.	0.74	8.17	74	270
Cadmium	Tot.	≤ 0.1	0.12	≤ 3	≤ 3
Cadmium	Dis.	≤ 0.03	0.073	-	-
Chromium	Tot.	≤ 0.1	11.1	96.8	511
Chromium, Hex	Tot.	≤ 2	10.3	124	396
Copper	Tot.	0.59	5.88	65.3	232
Copper	Dis.	≤ 0.05	3.35	-	-
Lead	Tot.	0.12	1.16	≤ 20	≤ 20
Lead	Dis.	≤ 0.02	0.078	-	-
Mercury	Tot.	≤ 0.001	0.005	-	-
Nickel	Tot.	≤ 1	1.5	≤ 10	11
Nickel	Dis.	≤ 1	1.24	-	-
Selenium	Tot.	≤ 0.1	≤ 2	≤ 40	≤ 40
Silver	Tot.	≤ 0.1	≤ 0.1	≤ 3	≤ 3
Silver	Dis.	≤ 0.02	≤ 0.03	-	-
Zinc	Tot.	3.3	28.9	125	415
Zinc	Dis.	≤ 0.4	17.5	-	-

Table E-2 shows the dissolved fraction measured at each site for copper, lead, nickel, and zinc. The average fractions in the dissolved state for these for metals were 0.59, 0.11, 0.76, and 0.39 percent, respectively.

In the receiving water, the chronic criterion for hexavalent chromium was very close to being exceeded at RC1 in January (10.3 µg/L measured versus 11.0 µg/L criterion). The chronic criterion for copper was also approached at RC1 (3.4 versus 5 µg/L criterion). However, no criteria violations were actually observed in the receiving water.

Violations of the state water quality criteria for metals were observed in the storm sewer. Table 9 compares metals results to state water quality criteria for the storm sewer water (exceedences shown in bold type). Included in this table are the results from the August 16, 1995, screening sample, described in the "sampling design" section. The criteria were applied to the stormwater effluent without dilution, because during times of no flow in the channel there is minimal mixing at the point of discharge into the channel. When applying criteria to the storm sewer effluent, the receiving water hardness (at site RC2) for that date was used. (No hardness value was measured in August, so the September hardness at RC2 was used for that date.) For copper and zinc, whose criteria apply to the dissolved fraction, the average percent dissolved at RC2 was used. In the storm sewer effluent, both chronic and acute criteria were exceeded for hexavalent chromium, copper, and zinc, and the chronic criterion was exceeded for arsenic and total chromium.

Organics

All water samples were tested for organic compounds with the following priority pollutant scans: volatile organics; base, neutral, acids; organochlorine pesticides, and PCBs. The complete results of the organic analyses are presented in Appendix E, Table E-3.

The volatile organic analysis (VOA) revealed several compounds at low levels in the receiving water at stations RC1 and RC2, as shown in Table 10. No volatile organic compounds were detected at stations RC3 and RC4, nor from the storm sewer. Nearly all of the detected compounds are the same as those documented in ground water beneath the Burlington Environmental Washougal facility (Sweet-Edwards/EMCON, Inc. 1991, Stiller, J. 1994a, Ecology, 1991).

Table 11 shows the results of the base-neutral-acid (BNA) test that were above the reporting limit (not including Tentatively Identified Compounds). Several compounds were found in trace amounts in the storm sewer both times it was sampled, including pentachlorophenol and several other phenolic compounds, nitrosamines, and phthalates. No compounds exceeded EPA criteria for aquatic life effects.

The test for organochlorine pesticides and PCBs did not reveal any compounds above reporting limits at any sites.

Table 9. Metals concentrations in the Gibbons Creek remnant channel 32nd street storm sewer compared to state water quality criteria (Ch. 173-201A WAC). Exceedences shown in bold type.

Hardness - RC2 (mg/L)	8/16/94	11/29/94	1/30/95
	76.3	46.8	47.0

Criteria that apply to the total recoverable metal concentration:

	8/16/94			11/29/94			1/30/95		
Date	Result - Tot. rec.	Chronic criterion	Acute criterion	Result - Tot. rec.	Chronic criterion	Acute criterion	Result - Tot. rec.	Chronic criterion	Acute criterion
Arsenic (µg/L)	270	**190**	360	74	190	360	190	**190**	360
Chromium - (VI) (µg/L)	-----	-	-	124	**11**	**16**	396	**11**	**16**
Chromium (tot.) (µg/L)	96.8	166	1391	181	**111**	932	511	**111**	936

Criteria that apply to the dissolved fraction:

		8/16/94				11/29/94				1/30/95			
Date	Fraction dissolved at RC2	Result - Tot. rec.	Diss. conc.	Chronic criterion	Acute criterion	Result - Tot. rec.	Diss. conc.	Chronic criterion	Acute criterion	Result - Tot. rec.	Diss. conc.	Chronic criterion	Acute criterion
Copper (µg/L)	0.49	232	114	**8**	**12**	65	32	**5**	**7**	134	66	**5**	**8**
Zinc (µg/L)	0.29	415	120	**75**	**83**	125	36	50	55	208	60	**50**	**55**

---- No sample

Sediment Quality

Complete sediment quality results are given in Appendix E, Table E-4.

General Physical/Chemical Characteristics

The sediment samples collected from the remnant channel at stations RC1, RC2, and RC4 were roughly similar in composition, comprised of mostly sand and silt, each with about five percent clay, although RC2 contained a significant amount of gravel (Figure 10). Sediment from RC3, however, was nearly all sand (98%) with no clay. Smaller grain-sized sediment has more surface area on which metals and other compounds can sorb.

TOC is also an important factor in determining the bioavailability of sediment contaminants. As with grain size, RC3 differing markedly in TOC content from the other three sites (0.1 percent TOC at RC3, as compared to 2.5, 4.0, and 4.2 percent for RC1, RC2, and RC4, respectively). Therefore, the chemical results from RC3 may not be directly comparable to the other three sites.

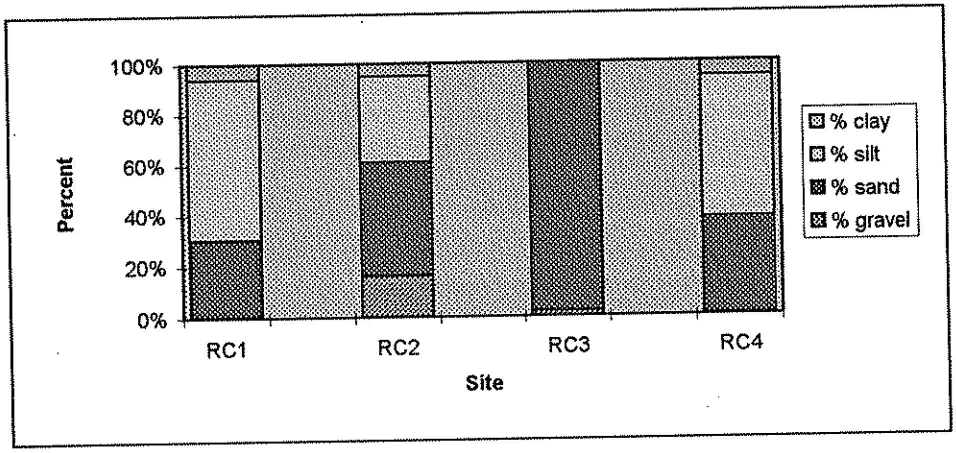


Figure 10. Sediment grain-size analysis.

Table 10. Detected volatile organic analysis compounds in the Gibbons Creek remnant channel and 32nd street stormsewer.
units = mg/L

CAS number[1]	Analyte	RC1 (average of field replicates) 9/7/94	RC1 11/29/94	RC1 1/30/95	RC2 9/7/94	RC2 11/29/94	RC3 9/7/94	RC3 11/29/94	RC3 1/30/95	RC4 9/7/94	RC4 11/29/94	RC4 1/30/95	SS1 11/29/94	Suspected BEI contaminants
127184	Tetrachloroethene	0.17	0.16	0.093	0.19	0.50								X
156592	Cis-1,2-Dichloroethene	1.2	0.41	0.33	1.4	1.9								X
71556	1,1,1-Trichloroethane	4.6	1.0	0.96	4.7	9.3								X
*1330207	m & p-Xylene				1.3[2]	1.8								X
100414	Ethylbenzene			0.052	0.27	0.39								X
108883	Toluene	0.23[2]			0.72	0.42								X
1330207	Total Xylenes				1.7	2.5								X
75343	1,1-Dichloroethane	0.82		0.0865	0.80	1.0								X
75354	1,1-Dichloroethene					0.57								
79016	Trichloroethene	0.32		0.16	0.33	0.73								X
95476	o-Xylene				0.40	0.77								X
95636	1,2,4-Trimethylbenzene					0.32								
620144	Benzene, 1-Ethyl-3-Methyl-					0.40								
556672	Cyclotetrasiloxane, Octamethyl-												0.23	
76131	1,1,2-Trichlorotrifluoroetha	0.63			0.60									X
29812791	Hydroxylamine, O-Decyl-				0.28									

[1] Chemical abstract number
[2] Analyte appears in the sample at a level < 5 times the level found in the lab blank

Table 11. Detected base-neutral-acid compounds in the Gibbons Creek remnant channel and 32nd street stormsewer.
units = mg/L

	RC1			RC1-duplicate			RC2			SS1		RC3			RC4		
	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95
Phenol										0.48	0.15 J						
Benzyl Alcohol										0.28							
2-Methylphenol										0.26 J	0.080 J						
N-Nitrosodiphenylamine										0.21 J	0.27						
4-Methylphenol					0.035 J						0.16 J		0.035 J			0.035 J	
2,4-Dimethylphenol										0.11 J							
Benzoic Acid											0.66 J						
Naphthalene							0.039 J					0.017 J					
2-Methylnaphthalene							0.011 J			0.06 J							
Dimethyl Phthalate					0.091 J		0.015 J										
Dibenzofuran										0.048 J							
Pentachlorophenol										0.45 J	0.45 J						
Phenanthrene							0.016 J				0.14 J						
Anthracene										0.034 J							
Caffeine	0.046 J			0.17 J	0.039 J					0.25 J	0.25 J				0.025 J		
Carbazole										0.06 J	0.029 J						
Di-n-Butyl Phthalate			0.046 J			0.056 J			0.046 J	12.0 J	0.34			0.035 J			0.047 J
Fluoranthene							0.030 J			0.54							
Pyrene							0.031 J			0.57	0.21 J		0.014 J				
Butylbenzyl Phthalate										0.40 J	0.27						
Chrysene							0.016 J			0.47							
Bis(2-Ethylhexyl)Phthalate											1.8						13.4
Di-n-Octyl Phthalate															0.029 J		
Benzo(k)Fluoranthene										0.39							
Benzo(b)Fluoranthene										0.15 J							
Benzo(a)Pyrene										0.22 J	0.041 J						
3B-Coprostanol															0.19 J		
Indeno(1,2,3-cd)Pyrene										0.22 J							
Benzo(g,h,i)Perylene										0.03 J							

To identify chemicals of potential concern, the sediment sampling results were compared to contaminant levels identified in *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario* (Persaud *et al.*, 1993), as summarized in *Summary of Guidelines for Contaminated Freshwater Sediments* (Batts and Cubbage, 1995). The guidelines identify three levels of chronic, long-term effects on benthic organisms:

1) No-Effect Level - No toxic effects have been observed on fish or sediment-dwelling organisms; there is no expected food chain biomagnification, and all water quality guidelines will be met.

2) Lowest-Effect Level - Indicates a level of sediment contamination that can be tolerated by most benthic organisms (95% of the benthic infaunal species).

3) Severe-Effect Level - Pronounced disturbance of sediment-dwelling organisms can be expected. Contaminant concentration would be detrimental to the majority of benthic species (level of contaminant concentration that can be tolerated by 5% of the benthic infaunal species). Acute toxicity testing is required when contamination exceeds this level.

Metals

In general, metals concentrations showed a pattern of elevated levels in the lower channel. Specific findings include:

- Chromium levels at both RC1 and RC2 (65.4 and 56.1 mg/kg, respectively) were above the "lowest effect." Chromium levels at RC3 and RC4 were below levels of concern.

- The arsenic levels of 19 and 24 mg/kg in RC1 and RC2, respectively, exceeded the "lowest effect"(6 mg/kg), but were less than the 33 mg/kg "severe effect" level. Arsenic levels at RC3 and RC4 were not of concern.

- Copper levels were similar at RC1 and RC2 (47 and 44 mg/kg), but were also appreciable at RC4 (20 mg/kg). All three sites were above the "lowest effect" level of 16 mg/kg.

- Lead levels were highest at RC3 (33 mg/kg) which exceeded the "lowest effect" level (31 mg/kg). Levels at all other sites were less than this threshold.

- Zinc levels were highest at RC1 (138 mg/kg); levels at both RC1 and RC2 (127 mg/kg) were above the threshold for "lowest effect" (120 mg/kg).

- Cadmium levels were highest at RC1 (1.3 mg/kg), but were also elevated at RC2 and RC4 (0.86 and 0.75 mg/kg). Levels at all three sites above Ontario's "lowest effect level" of 0.6 mg/kg.

- Mercury levels were below guidelines for concern. However, levels at RC1 and RC2 were about two times that of RC4. Selenium was above the reporting limit at RC4 (0.73 mg/kg); no guidelines for selenium were given in Batts and Cubbage (1995).

- Nickel levels were consistently below levels of concern. Concentrations of antimony, thallium, and silver were below reporting limits.

Organics

None of the organic compounds listed in Batts and Cubbage (1995) were found at levels of concern.

Other Parameters

Cyanide levels were below the reporting limit of 0.50 mg/kg at all sites. Oil and grease levels at RC1 and RC2 were above Ontario's "lowest effect" level.

Summary and Conclusions

Objective 1. Inventory potential sources of pollution to the remnant Gibbons Creek channel.

The potential sources of pollution to the remnant channel consist primarily of:

- The five NPDES-permitted facilities with discharges to the remnant channel (Allweather Wood, Burlington Environmental, Exterior Wood, Pendleton Woolen Mills, and Union Carbide)
- Stormwater runoff from other facilities within the industrial park
- Stormwater runoff from the town of Washougal
- Contaminated ground water discharge to the remnant channel

Objective 2. Characterize the water and sediment quality of the remnant channel and the water quality of accessible stormwater outfalls, and ground water flow directions during summer, winter, and storm conditions.

Water and sediment quality sampling results show that the Gibbons Creek remnant channel exhibits poor water quality in terms of conventional water chemistry and also is contaminated with both metals and organics.

The remnant channel water violates state water quality criteria for pH, temperature, fecal coliform, turbidity, and dissolved oxygen; the storm sewer water violates criteria for pH.

Storm sewer water violated state water quality criteria (both chronic and acute) for hexavalent chromium, total chromium, copper, and zinc, and the chronic criterion for arsenic. The receiving water was very close to violating the state chronic criterion for hexavalent chromium at RC1.

Metal concentrations were also elevated in sediment samples in the lower channel, with levels of arsenic, chromium, copper, zinc, cadmium, and lead being above Ontario's threshold of "lowest effect." Cadmium and lead were not found in the storm sewer effluent, but are associated with industrial sources.

Most of the organic compounds detected in the lower channel receiving water were also measured, often at high concentrations, in the ground water beneath the Burlington Environmental facility. One likely contaminant pathway from the facility to the remnamt channel is through the eastward movement of ground water off of the Burlington site, and subsequent interception by the 32nd Street storm-sewer underdrain. The drain reportedly discharges into the remnant channel through the downstream side of the 32nd Street culvert fill. At this time it is unknown whether contaminated ground water is moving past 32nd Street and into the ajoining marsh.

Water and sediment sampling results are consistent with historical data. Data collected in conjunction with the investigation of Pendleton Woolen Mills found sediment chromium levels in the lower channel to exceed Ontario's threshold for "severe effect" (measurements of 144, 161, and 111 mg/kg vs. the threshold of 110 mg/kg). NPDES-required monitoring of the wood-treating facilities has shown significant contributions to the channel of chromium, copper, and arsenic. Other facilities may also be contributing metals and other organics but are not currently being monitored.

Contamination in the sediments is representative of current or past practices. Samples were taken from the top 2 cm of sediment to represent recent deposition. However, lacking the sediment deposition rate, the actual age of these sediments is not known. Sampled sediments could also represent redeposition of older sediment from upstream sources.

Objective 3. Assess the appropriateness of the remnant channel as a receiving water body for the wastewater and stormwater discharges in terms of water quality standards violations and quantity of dilution water available.

The volume of water flowing through the remnant channel has decreased substantially since the realignment of Gibbons Creek. The channel is essentially stagnant when the gravity gate is closed and pumping is not taking place. Water can flow up-channel when the gravity gate is open and tides are rising on the Columbia River. This hydrologic setting is not desirable for industrial discharges and stormwater runoff, especially in light of the close proximity to a wildlife refuge.

No mixing zone is appropriate for discharges into the remnant channel, due to essentially stagnant water and lack of mixing. Therefore, discharges to the remnant channel should meet water quality criteria at "end-of-pipe." The single storm-sewer discharge which could be sampled in this study did not meet state water quality criteria for hexavalent chromium, total chromium, copper, and zinc (both chronic and acute), nor the chronic criterion for arsenic.

The sampling dates for this study do not represent the "critical condition" for Gibbons Creek remnant channel. The critical condition for continuous point sources is generally defined as the 7-day, 10-year low flow condition, when dilution is very low. The critical condition for stormwater pollutants has not been established; however, it can be assumed that it would occur during a rainfall event after a long dry period, when pollutants have accumulated on the land surface. This condition was not met by any of the sampling dates, as shown in Figure 6 (on September 7, sampling occurred before any significant rainfall occurred, and the storm sewer was dry). Contaminant levels would probably be significantly higher during a critical period than were observed in this study.

Objective 4. Evaluate effects of decreased Gibbons Creek flow to ground water flow patterns and the potential for contaminant transport to the stream.

The upper aquifer ground water flow direction in the vicinity of Burlington Environmental appears to be unchanged by the realignment of Gibbons Creek. The flow direction continues to be eastward towards 32nd Street. At this time it is unknown whether the flow continues past 32nd Street or is completely intercepted by the 32nd Street storm sewer sub drain.

Recommendations

Objective 5. Recommend follow-up actions.

The contaminated ground water beneath the Burlington Environmental site should continue to be addressed through the RCRA permit for that facility.

Sediments in the lower channel are contaminated with high levels of chromium. EPA is not requiring Pendleton Woolen Mills to address this issue as part of their remedial actions because the cause of the elevated levels is believed to be sources other than Pendleton. Further investigations of the lower channel sediments should be addressed jointly by Ecology's sediment management unit in the Toxics Cleanup Program, and the industrial unit of the Water Quality Program. The objectives of the investigations should be to identify ongoing sources and determine the need for cleanup actions. The investigations may be required to be conducted through NPDES permits for facilities that contribute chromium to the remnant channel.

New water-quality-based permit limits for chromium and copper will go into effect June 30, 1996 for the two wood-treating facilities (16 and 18 µg/L, respectively). These facilities will need to substantially improve stormwater runoff controls to meet these limits. The controls would also be expected to improve the levels of arsenic being discharged.

Additional monitoring should be conducted by facilities within the industrial park or by Ecology to identify sources of zinc in the 32nd Street storm sewer discharge, the source of arsenic in ground water beneath the Burlington Environmental facility, and sources of fecal coliform in the lower channel in summer.

The storm sewer system for the industrial park is antiquated and very difficult to monitor. Hook-ups are not well documented and outfalls are not located. The portion running under 32nd Street is buried beneath the street with no access points. It is recommended that the industrial park and city of Washougal evaluate routing and treatment options, including connecting to the treatment plant effluent pipeline as it crosses the industrial park before discharging to the Columbia River.

If the stormwater effluent is not moved out of the remnant channel, additional efforts need to be made to improve the water quality of the stormwater runoff from the industrial park. For the facilities covered under the general stormwater permit (listed in Table 1), compliance with the permit requirements should be made a high priority. Monitoring should be conducted during the next 5-year permitting cycle to determine if these permit requirements are sufficient to bring the stormwater into compliance with water quality criteria.

NPDES permit-required self-monitoring should be checked regularly to ensure compliance with both monitoring requirements and permit limits.

Ecology's ability to conduct environmental assessments of areas like the Camas-Washougal Industrial Park would be enhanced by consolidation of facility information and well information within an agency-maintained data base system.

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Appendix A. Water Quality Criteria for Class A Waters (Ch. 173-201A WAC)

Appendix A. Water Quality Criteria for Class A Waters (Ch. 173-201A WAC)

General Characteristic: Shall meet or exceed the requirements for all or substantially all uses.

Characteristic Uses: Shall include, but not be limited to, the following: domestic, industrial, and agricultural water supply; stock watering; salmonid and other fish, clam, oyster, mussel, crustacean and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing, spawning and harvesting; salmonid and other fish migration; wildlife habitat; primary contact recreation, sport fishing, boating, and aesthetic enjoyment; and commerce and navigation.

<u>Water Quality Criteria</u>

Fecal coliform: Organism levels shall both not exceed a geometric mean value of 100 colonies/100 mL, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 mL.

Dissolved oxygen: Shall exceed 8.0 mg/L.

Temperature: Shall not exceed 18.0°C due to human activities. When natural conditions exceed 18.0°C, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C. Incremental temperature increases resulting from nonpoint source activities shall not exceed 2.8°C.

pH: Shall be within the range of 6.5 to 8.5 with a human-caused variation within a range of less than 0.5 units.

Ammonia: Ammonia criteria for chronic (4-day average) and acute (1-hour average) are dependent on pH and temperature.

Turbidity: Shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

Toxic, radioactive, or deleterious material:	Concentrations shall be below those which have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health, as determined by the Department of Ecology.
Aesthetic values:	Aesthetic values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

Freshwater metals criteria:

	chronic[1]	*acute*[2]
Dissolved:		
Cadmium	$0.865[e^{(0.7852[\ln(hardness)]-3.490)}]$	$0.865[e^{(1.128[\ln(hardness)]-3.828)}]$
Copper	$0.862[e^{(0.8545[\ln(hardness)]-1.465)}]$	$0.862[e^{(0.9422[\ln(hardness)]-1.464)}]$
Lead	$0.687[e^{(1.273[\ln(hardness)]-4.705)}]$	$0.687[e^{(1.273[\ln(hardness)]-1.460)}]$
Nickel	$0.95[e^{(0.8460[\ln(hardness)]+1.1645)}]$	$0.95[e^{(0.8460[\ln(hardness)]+3.3612)}]$
Silver[3]		$0.531[e^{(1.72[\ln(hardness)]-6.52)}]$
Zinc	$0.891[e^{(0.8473[\ln(hardness)]+0.7614)}]$	$0.891[e^{(0.8473[\ln(hardness)]+0.8604)}]$
Total Recoverable:		
Arsenic	190.0	360.0
Chromium (III)[4]	$e^{(0.8190[\ln(hardness)]+1.561)}$	$e^{(0.8190[\ln(hardness)]+3.688)}$
Chromium (VI)	11.0	16.0
Mercury	0.012	2.4
Selenium	5.0	20.0

[1] A 4-day average concentration not to be exceeded more than once every three years on the average.
[2] A 1-hour average concentration not to be exceeded more than once every three years on the average
[3] An instantaneous concentration not to be exceeded at any time.
[4] Where methods to measure trivalent chromium are unavailable, these criteria are to be represented by total-recoverable chromium.

Appendix B. Historical Data

Appendix B. Historical Data

The following tables list detected metals and organic compounds from RCRA ground water monitoring wells at the Burlington Environmental Washougal facility and at the Pendleton Woolen Mills Washougal facility. These data were tabulated to identify potential ground water source contaminant loading to the Gibbons Creek remnant channel.

Table B1. Burlington Environmental May 1994 Ground Water Samples With Detected Organic Compounds (Stiller, 1994a).

Sample ID	Well ID	Date	CAS No	Compound	Detection limit	rmk	Analyte Value	Units	EPA Method
MC-1-0494	MC-1	5/4/94 8:20	91-20-3	Naphthalene	10		33	UG/L	625/8270
MC-1-0494	MC-1	5/4/94 8:20	75-34-3	1,1-Dichloroethane	10		61	UG/L	624/8260
MC-1-0494	MC-1	5/4/94 8:20	156-59-2	cis-1,2-Dichloroethene	10		100	UG/L	624/8260
MC-1-0494	MC-1	5/4/94 8:20	76-13-1	1,1,2-Trichlorotrifluoroethane	50		160	UG/L	624/8260
MC-1-0494	MC-1	5/4/94 8:20	71-55-6	1,1,1-Trichloroethane	10		650	UG/L	624/8260
MC-1-0494	MC-1	5/4/94 8:20	79-01-6	Trichloroethene	20		67	UG/L	624/8260
MC-1-0494	MC-1	5/4/94 8:20	108-88-3	Toluene	20		11	UG/L	624/8260
MC-1-0494	MC-1	5/4/94 8:20	95-47-6	P-Xylene	10		63	UG/L	624/8260
MC-1-0494	MC-1	5/4/94 8:20	108-38-3	M-Xylene	10		63	UG/L	624/8260
MC-1-0494	MC-1	5/4/94 8:20	106-42-3	O-Xylene	10		61	UG/L	624/8260
MC-13-0494	MC-13	5/4/94 14:00	71-55-6	1,1,1-Trichloroethane	1		1	UG/L	624/8260
MC-13-0494	MC-13	5/4/94 14:00	108-88-3	Toluene	2		5	UG/L	624/8260
MC-13-0494	MC-13	5/4/94 14:00	95-47-6	P-Xylene	1		2	UG/L	624/8260
MC-13-0494	MC-13	5/4/94 14:00	108-38-3	M-Xylene	1		2	UG/L	624/8260
MC-13-0494	MC-13	5/4/94 14:00	106-42-3	O-Xylene	1		2	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	105-67-9	2,4-Dimethylphenol	10		31	UG/L	625/8270
MC-14-0494	MC-14	5/4/94 14:20	91-20-3	Naphthalene	10		32	UG/L	625/8270
MC-14-0494	MC-14	5/4/94 14:20	75-01-4	Vinyl Chloride	10		49	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	75-00-3	Chloroethane	10		150	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	75-34-3	1,1-Dichloroethane	10		280	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	156-59-2	cis-1,2-Dichloroethene	10		530	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	75-71-8	Dichlorodifluoromethane	10		96	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	76-13-1	1,1,2-Trichlorotrifluoroethane	50		360	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	71-55-6	1,1,1-Trichloroethane	10		340	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	108-88-3	Toluene	100	*	11000	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	100-41-4	Ethylbenzene	10		1100	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	95-47-6	P-Xylene	2000	*	2500	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	108-38-3	M-Xylene	2000	*	2500	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	106-42-3	O-Xylene	50	*	2300	UG/L	624/8260
MC-14-0494	MC-14	5/4/94 14:20	354-23-4	1,2-Dichloro-1,1,2-Trifluoroethane		TIC	360	UG/L	624/8260
MC-15-0494	MC-15	5/3/94 14:20	67-66-3	Chloroform	1		3	UG/L	624/8260
MC-15-0494	MC-15	5/3/94 14:20	75-71-8	Dichlorodifluoromethane	1		2	UG/L	624/8260
MC-15-0494	MC-15	5/3/94 14:20	76-13-1	1,1,2-Trichlorotrifluoroethane	5		22	UG/L	624/8260
MC-15-0494	MC-15	5/3/94 14:20	354-23-4	1,2-Dichloro-1,1,2-Trifluoroethane		TIC	29	UG/L	624/8260
MC-2-0494	MC-2	5/3/94 11:50	75-71-8	Dichlorodifluoromethane	1	*	17	UG/L	624/8260
MC-2-0494	MC-2	5/3/94 11:50	76-13-1	1,1,2-Trichlorotrifluoroethane	5	*	12	UG/L	624/8260
MC-2D-0494	MC-2D	5/3/94 11:20	75-71-8	Dichlorodifluoromethane	1		6	UG/L	624/8260

MC-2D-0494	MC-2D	5/3/94 11:20	76-13-1	1,1,2-Trichlorotrifluoroethane	5	*	85	UG/L	624/8260
MC-2D-0494	MC-2D	5/3/94 11:20	354-23-4	1,2-Dichloro-1,1,2-Trifluoroethane		TIC	50	UG/L	624/8260
MC-7-0494	MC-7	5/4/94 10:10	156-59-2	cis-1,2-Dichloroethene	1		4	UG/L	624/8260
MC-7-0494	MC-7	5/4/94 10:10	76-13-1	1,1,2-Trichlorotrifluoroethane	5		18	UG/L	624/8260
MC-M1-0494	MC-8	5/2/94 15:15	67-66-3	Chloroform	1		3	UG/L	624/8260
MC-M18-0494	MC-18	5/3/94 9:20	75-35-4	1,1-Dichloroethene	1		170	UG/L	624/8260
MC-M18-0494	MC-18	5/3/94 9:20	156-59-2	cis-1,2-Dichloroethene	1		45	UG/L	624/8260
MC-M18-0494	MC-18	5/3/94 9:20	75-71-8	Dichlorodifluoromethane	25	*	2100	UG/L	624/8260
MC-M18-0494	MC-18	5/3/94 9:20	76-13-1	1,1,2-Trichlorotrifluoroethane	125	*	7700	UG/L	624/8260
MC-M18-0494	MC-18	5/3/94 9:20	79-01-6	Trichloroethene	10		18	UG/L	624/8260
MC-M18-0494	MC-18	5/3/94 9:20	127-18-4	Tetrachloroethylene	5		31	UG/L	624/8260
MC-M18-0494	MC-18	5/3/94 9:20	106-42-3	O-Xylene	5		51	UG/L	624/8260
MC-M18S-0494	MC-18	5/3/94 9:20	354-23-4	1,2-Dichloro-1,1,2-Trifluoroethane		TIC	6500	UG/L	624/8260
MC-M8-0494	MC-8	5/2/94 15:15	156-59-2	cis-1,2-Dichloroethene	1		4	UG/L	624/8260
MC-M8-0494	MC-8	5/2/94 15:15	76-13-1	1,1,2-Trichlorotrifluoroethane	5		220	UG/L	624/8260
MC-M8-0494	MC-8	5/2/94 15:15	127-18-4	Tetrachloroethylele	1		1	UG/L	624/8260
MC-M8-0494	MC-8	5/2/94 15:15	108-88-3	Toluene	2		180	UG/L	624/8260
MC-M8-0494	MC-8	5/2/94 15:15	100-41-4	Ethylbenzene	1		8	UG/L	624/8260
MC-M8-0494	MC-8	5/2/94 15:15	95-47-6	P-Xylene	1		9	UG/L	624/8260
MC-M8-0494	MC-8	5/2/94 15:15	108-38-3	M-Xylene	1		9	UG/L	624/8260
MC-M8-0494	MC-8	5/2/94 15:15	106-42-3	O-Xylene	1		17	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	75-35-4	1,1-Dichloroethene	1		3	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	156-59-2	cis-1,2-Dichloroethene	1		130	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	76-13-1	1,1,2-Trichlorotrifluoroethane	5		110	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	71-55-6	1,1,1-Trichloroethane	1		4	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	79-01-6	Trichloroethene	2		5	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	127-18-4	Tetrachloroethylene	1		7	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	108-88-3	Toluene	2		48	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	100-41-4	Ethylbenzene	1		28	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	95-47-6	P-XYLENE	1		30	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	108-38-3	M-XYLENE	1		30	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	106-42-3	O-XYLENE	1		58	UG/L	624/8260
MC-M8S-0494	MC-8S	5/2/94 16:40	354-23-4	1,2-Dichloro-1,1,2-Trifluoroethane		TIC	6	UG/L	624/8260

Table B2. List Of Volatile And Semi-Volatile Organic Target Compounds From Burlington Environmental May 1994 Quarterly Ground Water Sampling.

CAS-No	Compound	Detection/Quantification Limit	units	EPA Method
74-87-3	Chloromethane	1	ppb	624/8260
74-83-9	Bromomethane	1	ppb	624/8260
75-01-04	Vinyl Chloride	1	ppb	624/8260
75-00-3	Chloroethane	1	ppb	624/8260
75-09-2	Methylene Chloride	1	ppb	624/8260
67-64-1	Acetone	5	ppb	624/8260
75-15-0	Carbon Disulfide	1	ppb	624/8260
75-35-4	1,1-Dichloroethene	1	ppb	624/8260
75-34-3	1,1-Dichloroethane	1	ppb	624/8260
156-59-2	cis-1,2-Dichloroethene	1	ppb	624/8260
156-60-5	trans-1,2-Dichloroethene	1	ppb	624/8260
67-66-3	Chloroform	1	ppb	624/8260
75-71-8	Dichlorodifluoromethane	1	ppb	624/8260
75-69-4	Trichlorofluoromethane	1	ppb	624/8260
76-13-1	1,1,2-Trichlorotrifluoroethane	5	ppb	624/8260
107-06-2	1,2,dichloroethane	1	ppb	624/8260
78-93-3	2-Butanone	5	ppb	624/8260
71-55-6	1,1,1-Trichloroethane	1	ppb	624/8260
56-23-5	Carbon Tetrachloride	1	ppb	624/8260
108-05-4	Vinyl Acetate	1	ppb	624/8260
75-27-4	Bromodichloromethane	1	ppb	624/8260
78-87-5	1,2-Dichloropropane	1	ppb	624/8260
10061-01-5	cis-1,3-Dichloropropene	1	ppb	624/8260
10061-02-6	trans-1,3-Dichloropropene	1	ppb	624/8260
79-01-6	Trichloroethene	2	ppb	624/8260
124-48-1	Dibromochloromethane	1	ppb	624/8260
79-00-5	1,1,2-Trichloroethane	1	ppb	624/8260
71-43-2	Benzene	1	ppb	624/8260
110-75-8	2-Chloroethylvinylether	1	ppb	624/8260
75-25-2	Bromoform	1	ppb	624/8260
108-10-1	4-Methyl-2-Pentanone	5	ppb	624/8260
591-78-6	2-Hexanone	5	ppb	624/8260
127-18-4	Tetrachloroethylene	1	ppb	624/8260
79-34-5	1,1,2,2-Tetrachloroethane	3	ppb	624/8260
108-88-3	Toluene	2	ppb	624/8260
108-90-7	Chlorobenzene	1	ppb	624/8260
100-41-4	Ethylbenzene	1	ppb	624/8260
100-42-5	Styrene	1	ppb	624/8260
91-20-3	Naphthalene	5	ppb	624/8260
95-47-6	p-Xylene	1	ppb	624/8260
108-38-3	m-Xylene	1	ppb	624/8260
106-42-3	o-Xylene	1	ppb	624/8260
95-50-1	1,2,-Dichlorobenzene	1	ppb	624/8260
541-73-1	1,3,-Dichlorobenzene	1	ppb	624/8260
106-46-7	1,4,-Dichlorobenzene	1	ppb	624/8260
306-83-2	1,1-Dichloro-1,2,2-Trifluoroethane	5	ppb	624/8260
107-83-5	2-Methylpentane	5	ppb	624/8260
96-14-0	3-Methylpentane	5	ppb	624/8260
96-37-7	Methylcyclopentane	5	ppb	624/8260
96-12-8	1,2-Dibromo-3-Chloropropane	5	ppb	624/8260
108-95-2	Phenol	10	ppb	625/8270
111-44-4	bis(2-Chloroethyl)ether	10	ppb	625/8270
95-57-8	2-Chlorophenol	10	ppb	625/8270
541-73-1	1,3-Dichlorobenzene	10	ppb	625/8270
106-46-7	1,4-Dichlorobenzene	10	ppb	625/8270
100-51-6	Benzyl alcohol	20	ppb	625/8270
95-50-1	1,2-Dichlorobenzene	10	ppb	625/8270
95-48-7	2-Methlylphenol	10	ppb	625/8270
108-60-1	bis(2-Chloroisopropyl)ether	10	ppb	625/8270
106-44-5	4-Methylphenol	10	ppb	625/8270

621-64-7	N-Nitrosodi-n-propylamine	10	ppb	625/8270
67-72-1	Hexachloroethane	10	ppb	625/8270
98-95-3	Nitrobenzene	10	ppb	625/8270
78-59-1	Isophorone	10	ppb	625/8270
88-75-5	2-Nitrophenol	10	ppb	625/8270
105-67-9	2,4-Dimethylphenol	10	ppb	625/8270
65-85-0	Benzoic acid	50	ppb	625/8270
111-91-1	bis(2-chloroethoxy)methane	10	ppb	625/8270
120-83-2	2,4-Dichlorophenol	10	ppb	625/8270
120-82-1	1,2,4-Trichlorobenzene	10	ppb	625/8270
91-20-3	Naphthalene	10	ppb	625/8270
106-47-8	4-Chloroaniline	20	ppb	625/8270
87-68-3	Hexachlorobutadiene	10	ppb	625/8270
59-50-7	4-Chloro-3-methylphenol	20	ppb	625/8270
91-57-6	2-Methylnaphthalene	10	ppb	625/8270
77-47-4	Hexachlorocyclopentadiene	10	ppb	625/8270
88-06-2	2,4,6-Trichlorophenol	10	ppb	625/8270
95-95-4	2,4,5-Trichlorophenol	10	ppb	625/8270
91-58-7	2-Chloronaphthalene	10	ppb	625/8270
88-74-4	2-Nitroaniline	50	ppb	625/8270
131-11-3	Dimethyl phthalate	10	ppb	625/8270
208-96-8	Acenaphthylene	10	ppb	625/8270
606-20-2	2,6-Dinitrotoulene	10	ppb	625/8270
99-09-2	3-Nitroaniline	50	ppb	625/8270
83-32-9	Acenaphthene	10	ppb	625/8270
51-28-5	2,4-Dinitrophenol	50	ppb	625/8270
100-02-7	4-Nitrophenol	50	ppb	625/8270
132-64-9	Dibenzofuran	10	ppb	625/8270
121-14-2	2,4-Dinitrotoluene	10	ppb	625/8270
84-66-2	Diethyl phthalate	10	ppb	625/8270
7005-72-3	4-Chlorophenylphenyl ether	10	ppb	625/8270
86-73-7	Fluorene	10	ppb	625/8270
100-01-6	4-Nitroaniline	50	ppb	625/8270
534-52-1	4,6-Dinitro-2-methylphenol	50	ppb	625/8270
86-30-6	N-Dinitrosodiphenylamine	10	ppb	625/8270
101-55-3	4-Bromophenyl phenyl ether	10	ppb	625/8270
118-74-1	Hexachlorobenzene	10	ppb	625/8270
87-86-5	Pentachlorophenol	50	ppb	625/8270
85-01-8	Phenanthrene	10	ppb	625/8270
120-12-7	Anthracene	10	ppb	625/8270
84-74-2	Di-n-butyl phthalate	10	ppb	625/8270
206-44-0	Fluoranthene	10	ppb	625/8270
129-00-0	Pyrene	10	ppb	625/8270
85-68-7	Butyl benzyl phthalate	10	ppb	625/8270
91-94-1	3,3'-Dichlorobenzidine	20	ppb	625/8270
56-55-3	Benzo(a)anthracene	10	ppb	625/8270
218-01-9	Chrysene	10	ppb	625/8270
117-81-7	bis(2-ethylhexyl)phthalate	10	ppb	625/8270
117-84-0	Di-n-octyl phthalate	10	ppb	625/8270
205-99-2	Benzo(b)fluoranthene	10	ppb	625/8270
207-08-9	Benzo(k)fluoranthene	10	ppb	625/8270
50-32-8	Benzo(a)pyrene	10	ppb	625/8270
193-39-5	Indeno(1,2,3-cd)pyrene	10	ppb	625/8270
53-70-3	Dibenz(a,h)anthracene	10	ppb	625/8270
191-24-2	Benzo(gh)perylene	10	ppb	625/8270

Table B3. Burlington Environmental May 1994 Ground Water Samples With Detected Metals.

Sample ID	Well ID	Date	Analyte	Detection Limit	Analyte Value	Units	EPA Method
MC-8-0494	MC-8	5/2/94	total zinc	0.020	0.037	mg/L	SW-846,3005,6010,7000
MC-8-0494	MC-8	5/2/94	dissolved zinc	0.020	0.020	mg/L	SW-846,3005,6010,7000
MC-M18-0494	MC-18	5/3/94	total zinc	0.020	0.024	mg/L	SW-846,3005,6010,7000
MC-M18-0494	MC-18	5/3/94	total nickel	0.040	0.048	mg/L	SW-846,3005,6010,7000
MC-M18-0494	MC-18	5/3/94	dissolved nickel	0.040	0.041	mg/L	SW-846,3005,6010,7000
MC-15-0494	MC-15	5/3/94	total arsenic	.010	.030	mg/L	SW-846,3005,6010,7000
			dissolved arsenic	.010	.026	mg/L	SW-846,3005,6010,7000
MC-17-0494	MC-17	5/3/94	total arsenic	.010	.023	mg/L	SW-846,3005,6010,7000
			dissolved arsenic	.010	.026	mg/L	SW-846,3005,6010,7000
MC-12-0494	MC-12	5/4/94	total arsenic	.010	.018	mg/L	SW-846,3005,6010,7000
			dissolved arsenic	.010	.016	mg/L	SW-846,3005,6010,7000
MC-7-0494	MC-7	5/4/94	total arsenic	.010	.021	mg/L	SW-846,3005,6010,7000
			dissolved arsenic	.010	.022	mg/L	SW-846,3005,6010,7000
MC-1-0494	MC-1	5/4/94	total arsenic	.010	.037	mg/L	SW-846,3005,6010,7000
			dissolved arsenic	.010	.033	mg/L	SW-846,3005,6010,7000
MC-16-0494	MC-16	5/4/94	total arsenic	.010	.029	mg/L	SW-846,3005,6010,7000
			dissolved arsenic	.010	.028	mg/L	SW-846,3005,6010,7000
MC-14-0494	MC-14	5/4/94	total arsenic	.010	.023	mg/L	SW-846,3005,6010,7000
			dissolved arsenic	.010	.053	mg/L	SW-846,3005,6010,7000
MC-2-0494	MC-2	5/3/94	total arsenic	0.010	0.033	mg/L	SW-846,3005,6010,7000
MC-2-0494	MC-2	5/3/94	dissolved arsenic	0.010	0.036	mg/L	SW-846,3005,6010,7000

Table B4. Target Dissolved And Total Metal Analytes From Burlington Environmental May 1994 Quarterly Ground Water Sampling.

Analyte	Detection Limit	Units	EPA Method
Arsenic, dissolved	0.010	mg/L	SW-846 3005,6010,7000
Arsenic, total	0.010	mg/L	SW-846 3005,6010,7000
Barium, dissolved	0.2	mg/L	SW-846 3005,6010,7000
Barium, total	0.2	mg/L	SW-846 3005,6010,7000
Cobalt, dissolved	0.050	mg/L	SW-846 3005,6010,7000
Cobalt, total	0.050	mg/L	SW-846 3005,6010,7000
Nickel, dissolved	0.040	mg/L	SW-846 3005,6010,7000
Nickel, total	0.040	mg/L	SW-846 3005,6010,7000
Zinc, dissolved	0.020	mg/L	SW-846 3005,6010,7000
Zinc, total	0.020	mg/L	SW-846 3005,6010,7000

Table B5. Pendleton Woolen Mills May 1993 Ground Water Samples With Detected Target Compounds.

Well ID	Date	Compound	Method quantification limit	rmk	Analyte value	Units	EPA Method
MW-1	May-93	Tetrachloroethene	5		2	ug/L	EPA 8240
MW-6	May-93	Tetrachloroethene	5		5	ug/L	EPA 8240
MW-6	May-93	1,1,1,-Trichloroethane	5		2	ug/L	EPA 8240
MW-10	May-93	Acetone	5		11	ug/L	EPA 8240
MW-16(40)	May-93	Tetrachloroethene	5		10	ug/L	EPA 8240
MW-16(40)	May-93	1,1,1,-Trichloroethane	5		7	ug/L	EPA 8240
MW-16(40)	May-93	1,1,-Dichloroethene	5		2	ug/L	EPA 8240
MW-16(40)	May-93	1,1-Dichloroethane	5		4	ug/L	EPA 8240
MW-16(40)	May-93	1,2-Dichloroethene	5		1	ug/L	EPA 8240
MW-17	May-93	1,1,1,-Trichloroethane	5		4	ug/L	EPA 8240
MW-19	May-93	Tetrachloroethene	5		3	ug/L	EPA 8240
MW-19	May-93	1,1,1-Trichloroethane	5		2	ug/L	EPA 8240
MW-19	May-93	Tetrachloroethene	5		2	ug/L	EPA 8240
MW-19	May-93	1,1,1,-Trichloroethane	5		2	ug/L	EPA 8240
MW-19	May-93	1,1,-Dichloroethane	5		1	ug/L	EPA 8240
MW-19	May-93	1,2-Dichloroethene	5		2	ug/L	EPA 8240
MW-19	May-93	Toluene	5		3	ug/L	EPA 8240
MW-19	May-93	Total Xylenes	5		1	ug/L	EPA 8240
MW-1	May-93	dieldrin	0.02		28	ug/L	EPA 8080
MW-17	May-93	dieldrin	0.02		0.06	ug/L	EPA 8080
MW-19	May-93	dieldrin	0.02		0.061	ug/L	EPA 8080
MW-20	May-93	dieldrin	0.02		0.59	ug/L	EPA 8080

Appendix C. Impacts of Gibbons Creek Diversion on Upper Aquifer Flow Direction at Burlington Environmental Facility

Appendix C. Impacts of Gibbons Creek Diversion on Upper Aquifer Flow Direction at Burlington Environmental Facility

Upper aquifer ground water flow directions were calculated from water-level measurements at the Burlington Environmental facility. Twenty four sets of measurements were used in this analysis; twenty-two historical sets, plus the September 1994 and January 1995 measurements mentioned above. Each was from the same 11 wells, which were completed in the upper aquifer. These measurements were grouped into two sets: one representing the pre-stream diversion period July 16, 1990, to December 12, 1991; the second representing the post-diversion period from May 12, 1993, to January 11, 1995.

The measuring-point elevation of the monitoring wells were resurveyed in May 1994 significant discrepencies were noted on those wells completed in the sand and gravel aquifer. Elevation corrections for the shallow wells were typically .01 to .03 ft., with one showing a correction of .12 ft. With such a small error, no attempt was made to correct those water levels prior to May 1994.

Flow directions were calculated using GIS surface-analysis techniques described in the hydrology section of this report. For each measurement date, a surface was fit to the water-level measurements, and the azimuth for each triangle was recorded. An area-weighted azimuth was calculated based on the planimetric area of the TIN triangles. The water levels used in the analysis and the calculated azimuth are shown in Table C-1. These water-level data were obtained from the Burlington RCRA Facility Investigation report (Sweet-Edwards/EMCON, Inc., 1991), from Quarterly monitoring reports (Stiller, J., 1994b), and from field measurements obtained during this project.

Table C-1 Upper aquifer water-level measurements and calculated flow direction at the Burlington Environmental Washougal facility.

					Water	Levels	(feet)				
Date	**Azimuth (deg)**	**MC-1**	**MC-2**	**MC-7**	**MC-8**	**MC-12**	**MC-13**	**MC-14**	**MC-15**	**MC-16**	**MC-17**
pre diversion											
10/17/88		11.27		12.44	11.44	12.88	10.28	10.21	10.27	10.30	10.38
11/17/89		11.86		13.23	12.25	14.17	10.81	10.83	11.06	10.98	11.00
4/23/90		12.43	13.44	13.85	12.93		10.96	10.94	11.14	11.05	11.06
6/5/90		12.75	13.83	14.53	13.21		11.32	11.29	11.37	11.36	11.35
7/16/90	89	12.37	13.43	13.92	12.79	14.37	10.98	10.94	11.02	11.00	11.03
8/2/90	89	12.00	13.00	13.46	12.45	13.90	10.64	10.68	10.74	10.74	10.79
8/8/90	90	11.93	12.88	13.30	12.40	13.78	10.70	10.66	10.71	10.69	10.73
8/16/90	90	11.81	12.77	13.20	12.34	13.67	10.54	10.60	10.63	10.61	10.66
8/27/90	95	11.71	12.61	13.85	12.23	13.50	10.56	10.49	10.48	10.75	10.59
9/19/90	91	11.58	12.32	12.77	12.05	13.18	9.40	10.41	10.41	10.41	10.46
10/8/90	97	11.94	12.45	12.99	12.33	13.44	10.55	10.56	10.57	10.55	10.55
10/30/90	100	12.09	13.17	12.80	13.03	14.87	10.83	10.85	11.26	11.18	11.07
12/27/90	96	12.77	13.72	14.22	13.46	15.08	11.44	11.41	11.98	11.84	11.46
2/12/91	78	14.01	14.36	14.14	13.44	15.49	11.39	11.38	11.49	11.59	11.75
post diversion											
5/12/93	92	13.19	14.19	15.00	13.63	15.51	11.49	11.49	11.55	11.60	11.71
5/15/93	91	13.06	14.09	14.82	13.51	15.31	11.41	11.14	11.45	11.50	11.62
8/25/93	99	12.23	13.01	13.72	12.96	14.18	10.88	10.82	10.82	10.78	10.87
8/26/93	99	12.22	12.97	13.68	12.94	14.16	10.85	10.81	10.81	10.77	10.86
11/17/93	115	12.02	12.11	12.73	12.51	13.15	10.94	10.97	10.95	10.89	10.89
11/19/93	118	12.09	12.13	12.75	12.59	13.15	11.05	11.11	11.11	11.06	11.03
2/16/94	110	12.87	13.56	14.16	14.24	15.63	11.15	11.15	11.01	11.01	11.01
2/17/94	116	12.85	13.50	14.09	14.26	14.58	11.17	11.21	11.09	10.90	10.95
5/2/94	81	13.09	14.00	14.31	13.03	14.84	11.70	11.82	11.88	11.87	11.85
5/3/94	84	13.09	13.84	14.28	13.08	14.81	11.75	11.85	11.91	11.90	11.90
8/2/94	90	11.67	12.67	13.04	12.19	13.46	10.56	10.48	10.52	10.47	10.57
8/3/94	90	11.62	12.61	12.98	12.17	13.43	10.53	10.52	10.44	10.52	10.52
9/13/94	93	11.64	12.51	12.54	12.18	12.92	10.43	10.34	10.36	10.31	10.39
1/11/95	105	14.19	15.23	16.05	15.53	17.22	12.41	12.21	12.25	12.08	12.06

Figure C-1 shows the variation in flow direction over time. The flow directions shown are compass bearing azimuths measured clockwise from North (*i.e.*, 90 represents flow directly towards the east). Clearly the post-diversion measurements have more variability than the pre-diversion measurements. A Watson U^2 two-sample, non-parametric, angular distribution test was performed on the two groups of calculated flow directions (Zar, 1984). The intent was to test whether the pre-diversion and post-diversion samples of flow direction came from two populations with different flow directions. This test was unable to prove that the samples came from two populations with different flow directions at a 0.05 level of significance.

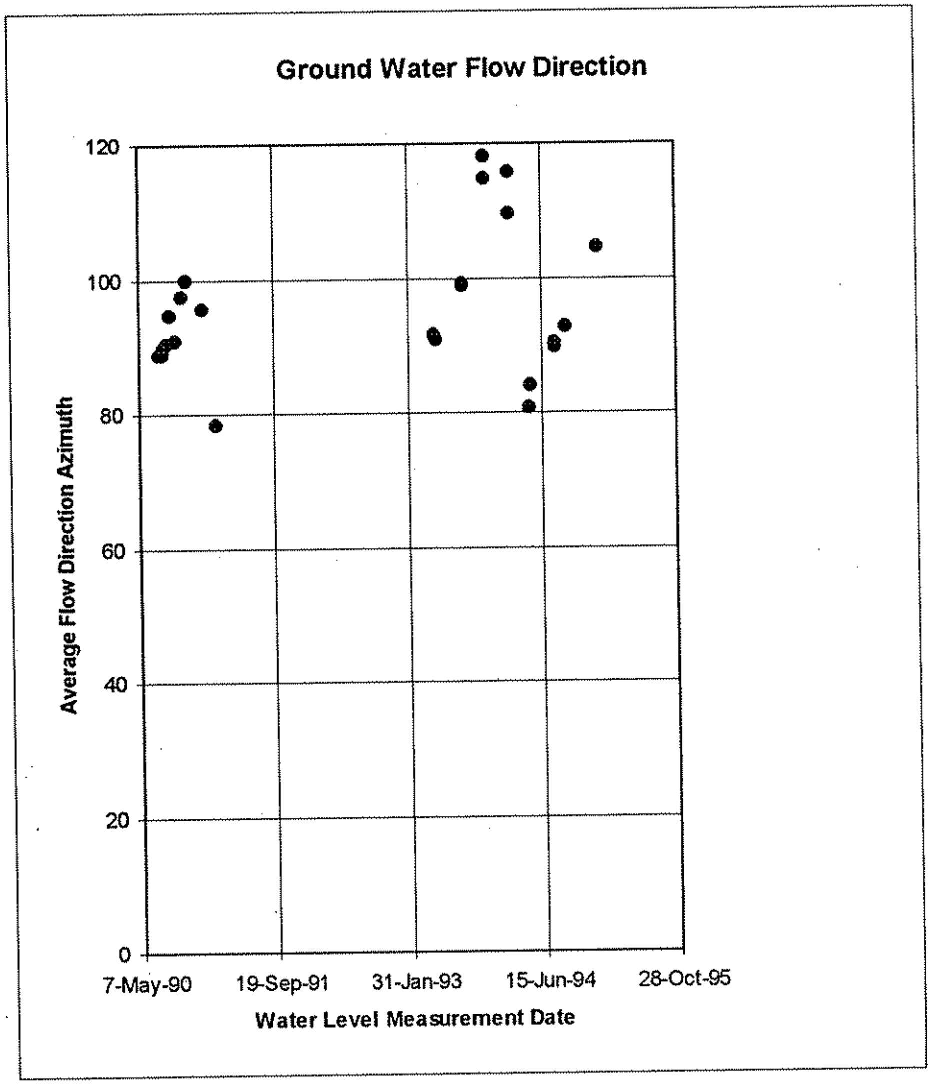

Figure C-1. Calculated Flow Direction in Upper Aquifer at Burlington Environmental Facility.

Appendix D. Quality Assurance

Appendix D. Quality Assurance

Staff at the Manchester Laboratory prepared written quality assurance reviews for all metals and organics data (both water and sediment analyses), including an evaluation of holding times, instrument calibration, procedural (method) blanks, matrix spikes, precision data, and laboratory control sample analyses. The data contained in this report are considered acceptable for their intended use as qualified. Additional quality assurance details are provided below for metals, organics, and other parameters.

Water Quality

Conventional Parameters

Replicate samples collected at RC1 were analyzed for precision. The average coefficient of variation (CV) for most parameters was less than 5 percent. The CV for ammonia was 15%, total phosphorus 8%, and total suspended solids 11%, which were considered acceptable considering that higher CV values were associated with analyte levels near the limit of detection. Oil and grease is difficult to measure precisely, given its immiscibility with water; the CV was 72%, with all values near the reporting limit. The CV for fecal coliform was 18%, which is typical for fecal coliform levels. Orthophosphate blanks were always below reporting limits, showing that the field filtering process did not introduce contamination to the samples.

Metals

All metal analyses were performed within USEPA Contract Laboratory Program (CLP) holding times, with the exception of one mercury spike sample which was run after the holding time expired (this spike result, which showed an adequate recovery value, was qualified with a "J"). All initial and continuing calibration verification standards were within relevant CLP control limits.

One procedural blank showed a significant level of analyte. Zinc in the total recoverable ICP/MS digestion during the analysis of the September samples was found at 4.5 µg/L . Total recoverable zinc values for September were qualified with a "B"; these were not considered valid data because the analyte level did not exceed ten times the level in the blank. Analyte levels for all other procedural blanks and analytes were below the reporting limit.

Spike and duplicate spike sample analyses were performed on each of the three data sets to assess precision. The Relative Percent Difference (RPD) for all analytes was within the 20% CLP acceptance window for duplicate analyses.

Laboratory control sample (LCS) analyses were all within the windows established for each parameter. Boron, molybdenum, silica, and titanium did not have certified values in the LCS and therefore the sample results are qualified with a "J" as estimates.

Filtered field blanks were submitted with each set of samples to detect any contamination from filtering, preserving, and transport. All analytes were below reporting limits in the field blanks with the exception of copper, which was reported to be 0.077 and 0.062 µg/L for the September and November surveys, respectively, which are close to the reporting limit of 0.050 µg/L. All of the field samples showed copper levels more than ten times the highest level found in the field blank and so were considered to be valid data. The otherwise "clean" field blanks indicate that the field sampling, filtering, and transport procedures did not introduce significant contamination to the samples.

Replicate samples were collected at RC1 during each sampling survey to assess the combined effects of short-term field, sampling, and analytical variability. The duplicate sample results for the January sampling event showed no analyte above reporting limits; this sample was re-run by the lab for verification, with the same results. Therefore it was assumed that this sample was a mislabeled blank and the results were discarded. Table D-1 shows a summary of the coefficients of variation (standard deviation as percent of the mean) for metals that were measured above reporting limits. The coefficients of variation for arsenic, cobalt, and lead and were between 20 and 31 percent; all other values were less than 10 percent. For the low levels of metals being measured, these results were considered adequate for the purposes of this report.

Table D-1. Coefficient of variation for selected metals results.

	Total Recoverable	Dissolved.
Arsenic	21	
Cadmium	2	
Chromium	5	
Chromium, Hex.	5	
Cobalt	20	
Copper	9	3
Lead	31	27
Manganese	2	
Mercury	3	
Nickel	2	
Zinc	7	5

The values of hexavalent chromium at RC2 as originally reported by the lab were larger than the total recoverable chromium concentrations for all sampling dates. James Ross of Manchester Laboratory re-analyzed the results, concluded that background effects were masking the hexavalent chromium response at RC2, and stated "Site RC2 has very little chrome, and I believe the hexachrome values to be erroneous" (Ross, 1995). Therefore the hexavalent chromium values for RC2 were rejected. The hexavalent chromium values for the other sites (RC1 and the storm sewer) were considered valid.

Organics

The following organic analyses were run on all samples: VOAs, BNAs, pesticides, and PCBs. The laboratory reported on quality assurance of the data as follows.

Low levels of the common laboratory solvent methylene chloride were detected in the laboratory blanks. Compounds that were found in the sample and in the blank were considered real and not the result of contamination if the levels in the sample are greater or equal to five times the amount of compound in the associated method blank.

Surrogate recoveries were within acceptable limits for water samples. The water samples were analyzed within the recommended 14 day holding time.

Water matrix spikes for VOAs were within acceptable QC limits for both percent recovery and RPD for all compounds with the following exceptions. Bromomethane in the November sample had no recovery. The results for bromomethane in the matrix source sample (488285) were therefore rejected. The following compounds had low recoveries in the January samples and were qualified with a "J": 1,1-dichloroethene, acetone, methylene chloride, naphthalene, and 1,2,3-trichlorobenzene. (Several "J" qualifiers were also given for BNA results due to low matrix spike recoveries or high relative percent differences.)

Sediment quality

According to the QA analysis from Manchester Laboratory, these samples contained a matrix interference that slightly affected the recovery of arsenic, thallium, and silver. Results were qualified with an "N" if there was a substantial amount of analyte present in the sample and all other QA was in control. If the analyte was close to the method detection limit, or the precision of the spikes or recovery of the LCS were out of control, the results were qualified with a "J" indicating that the results were estimated.

The relative percent difference (RPD) for all analytes was within the 20% CLP acceptance window for duplicate analysis, with the exception of antimony.

For the VOA sediment analyses, several compounds were qualified with a "J" due to matrix spike recoveries being outside of acceptable QC limits. For chlorinated pesticides analysis, soil surrogate and matrix spike recoveries were generally low, with the highest recoveries in the laboratory blanks, which could indicate possible matrix effects.

No problems were reported with the grain size analysis.

As stated by Manchester Laboratory, the data generated by the analyses of the sediment samples can be used noting the qualifications discussed above.

Appendix E. Water and Sediment Quality Sampling Results

Table E-1. Water quality metals data for Gibbons Creek remnant channel.
Units = µg/L except hardness in mg/L
Sample results above the reporting limit are shown in bold.

Analyte		RC1 9/7/94	RC1 11/29/94	RC1 1/30/95	RC1-duplicate 9/7/94	RC1-duplicate 11/29/94	RC1-duplicate 1/30/95	RC2 9/7/94	RC2 11/29/94	RC2 1/30/95	RC3 9/7/94	RC3 11/29/94	RC3 1/30/95	RC4 9/7/94	RC4 11/29/94	RC4 1/30/95	SS1 8/16/94[1]	SS1 11/29/94	SS1 1/30/95
Hardness (mg/L)		48.2	43.2	42.7	48.9	45.2	41.4	76.3	46.8	47.0	92.9	43.5	42.7	59.7	40.8	41.8		5.7 J	11.0
Aluminum	Tot.			217			31.3			95.5			469			269	1540	496	1550
Aluminum	Dis.			21.1			1 U			14.3			64.6			56.4			
Antimony	Tot.	0.2 U	1 U	0.5	0.2 U	1 U	0.2 U	0.2 U	1 U	0.2 U	0.2 U	1 U	0.2 U	0.2 U	1 U	0.24	30 U	30 U	30 U
Antimony	Dis.			0.51			0.4 U			0.4 U			0.4 U			0.4 U			
Arsenic	Tot.	1.6	6.99	8.17	1.5 U	7.18	7.11	1.7	1.6	1.5	2.8	0.95	0.88	1.5	0.75	0.74	270	74	190
Arsenic	Dis.			7.47			0.2 U			0.87			0.68			0.73			
Barium	Tot.																77.6	15.4	38.8
Beryllium	Tot.	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	1 U	1 U	1 U
Beryllium	Dis.			0.05 U			0.05 U			0.05 U			0.05 U			0.05 U			
Boron	Tot.																110 J	15 UJ	180 J
Cadmium	Tot.	0.1 U	0.12	0.1 U	0.1 U	0.11	0.1 U	0.1 U	0.11	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	3 U	3 U	3 U
Cadmium	Dis.	0.04 U	0.04 U	0.03 U	0.04 U	0.04 U	0.03 U	0.04 U	0.04 U	0.03 U	0.073	0.04 U	0.031	0.04 U	0.04 U	0.03 U			
Calcium	Tot.																12,200 J	1010	3690
Chromium	Tot.	0.43	10.9	10.9	0.47	11.1	8.74	0.687	2.02	1.91	0.1 U	0.27	0.75	0.47	0.29	0.59	96.8	181	511
Chromium	Dis.			9.23			0.4 U			0.89			0.4 U			0.4 U			
Chromium, Hex.	Tot.	2 U	20 U	10.3			9.59	4.4 R	27.6	6.06								124	396
Cobalt	Tot.			0.4			0.3			0.2			0.61			0.43	5.2	3 UJ	3 U
Cobalt	Dis.			0.268			0.02 U			0.069			0.39			0.298			
Copper	Tot.	0.793	5.7	4.4	0.932	5.88	3.69	1.24	3.23	1.04	0.59	2.28	1.9	1.32	1.77	1.69	232	65.3	134
Copper	Dis.	0.495	3.28	3.35	0.533	3.2	0.05 U	0.577	2.13	0.35	0.398	1.27	1.24	0.607	1.23	1.42			
Iron	Tot.																11,500	703	2260
Lead	Tot.	0.18	1.09	0.53	0.18	1.16	0.12	0.36	1.02	0.3	0.33	0.65	0.45	0.609	0.20	0.44	20 U	20 U	20 U
Lead	Dis.	0.02 U	0.034	0.065	0.02 U	0.03 U	0.02 U	0.02 U	0.031	0.02 U	0.06	0.036	0.064	0.063	0.03 U	0.078			
Magnesium	Tot.																2,530 J	261	714
Manganese	Tot.			68.7			66.6			32.8			92.9			60.4	1,100	26.4	79.5
Manganese	Dis.			63.6			0.02 U			11.7			76.4			53.3			
Mercury	Tot.	0.002 U	0.005	0.0010 U	0.002 U	0.0044	0.0010 U	0.002 U	0.0049	0.0010 U	0.002 U	0.0042	0.0010 U	0.0022	0.0040	0.0010 U			
Molybdenum	Tot.																5 UJ	5 UJ	5 J
Nickel	Tot.	1 U	1.5	1 U	1 U	1.4	1 U	1 U	1.5	1 U	1.1	1.4	1.4	1.3	1.4	1.4	11	10 U	10 U
Nickel	Dis.	1 U	1 U	0.744	1 U	1 U	0.05 U	1 U	1 U	0.15	1 U	1 U	1.11	1 U	1 U	1.24			
Potassium	Tot.																5450 J	1200	2600
Selenium	Tot.	2.0 U	0.2 U	0.1 U	2.0 U	0.2 U	0.1 U	2.0 U	0.2 U	0.1 U	2.0 U	0.2 U	0.1 U	2.0 U	0.2 U	0.1 U	40 U	40 U	40 U
Selenium	Dis.			0.2 U			0.2 U			0.2 U			0.2 U			0.2 U			
Silicon	Tot.																12100 J	951 J	2930 J
Silver	Tot.	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	3 U	3 U	3 U
Silver	Dis.	0.03 U	0.03 U	0.02 U	0.03 U	0.03 U	0.02 U	0.03 U	0.03 U	0.02 U	0.03 U	0.03 U	0.02 U	0.03 U	0.03 U	0.02 U			
Sodium	Tot.																10600 J	631	1590
Strontium	Tot.																55.9	5.1	16.9
Thallium	Tot.	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	40 U	40 U	40 U
Thallium	Dis.			0.082			0.05 U			0.053			0.05 U			0.05 U			
Titanium	Tot.																106 J	34 J	111 J
Uranium	Tot.			0.1 U			0.1 U			0.1 U			0.11			0.1 U			
Uranium	Dis.			0.057			0.01 U			0.029			0.068			0.057			
Vanadium	Tot.			2.45			1.75			3.85			3.2			2.82	11	2 U	3.9
Vanadium	Dis.			1.74			0.1 U			3.92			1.72			2.05			
Zinc	Tot.	3.9 B	27.4	23.3 J	4.5 B	28.9	21 J	8.82 B	12.6	8.2 J	3.3 B	11.0	24.4 J	3.3 B	3.9	5.5 J	415	125	208
Zinc	Dis.	1.2	17.5	17.1	1.1	16.6	0.4 U	1.9	4.9	1.5	1.3	4.9	1.8	1 U	1.1	1.1			

[1] Screening sample - taken at SS1 only on this date. No values for 9/7/94 because storm sewer was dry.
U = Below reporting limit
J = Estimate
B = Analyte appeared in blank
R = Rejected as per memo from lab staff

Table E-2. Ratio of dissolved to total recoverable metal concentrations for copper, lead, nickel, and zinc in Gibbons Creek remnant channel.

Stn.			Copper			Lead			Nickel			Zinc		
ID	Date	TSS	Diss.	Tot. Rec.	Ratio	Diss.	Tot. Rec.	Ratio	Diss.	Tot. Rec.	Ratio	Diss.	Tot. Rec.	Ratio
RC1	9/7/94	4	0.495	0.793	0.62	0.020 U	0.180		1 U	1 U		1.2	3.9 B	
DRC	9/7/94	3	0.533	0.932	0.57	0.020 U	0.180		1 U	1 U		1.1	4.5 B	
RC1	11/29/94	17	3.280	5.700	0.58	0.034	1.090	0.03	1 U	1.5	0.67	17.5	27.4	0.64
DRC	11/29/94	20	3.200	5.880	0.54	0.030 U	1.160		1 U	1.4	0.71	16.6	28.9	0.57
RC1	1/30/95	6	3.350	4.400	0.76	0.065	0.530	0.12	0.744	1 U		17.1	23.3	0.73
DRC	1/30/95	6	0.050 U	3.690		0.020 U	0.120		0.05 U	1 U		0.4 U	21	
RC2	9/7/94	2	0.577	1.240	0.47	0.020 U	0.360		1 U	1 U		1.9	8.82 B	
RC2	11/29/94	3	2.130	3.230	0.66	0.031	1.020	0.03	1 U	1.5	0.67	4.9	12.6	0.39
RC2	1/30/95	3	0.350	1.040	0.34	0.020 U	0.300		0.15	1 U		1.5	8.2	0.18
RC3	9/7/94	8	0.388	0.590	0.66	0.060	0.330	0.18	1 U	1.1	0.91	1.3	3.3 B	
RC3	11/29/94	13	1.270	2.290	0.55	0.036	0.650	0.06	1 U	1.4	0.71	4.9	11.0	0.45
RC3	1/30/95	9	1.240	1.900	0.65	0.064	0.450	0.14	1.11	1.4	0.79	1.8	24.4	0.07
RC4	9/7/94	18	0.607	1.320	0.46	0.063	0.609	0.10	1 U	1.3	0.77	1 U	3.3 B	
RC4	11/29/94	3	1.230	1.770	0.69	0.030 U	0.200		1 U	1.4	0.71	1.1	3.9	0.28
RC4	1/30/95	7	1.420	1.890	0.75	0.078	0.440	0.18	1.24	1.4	0.89	1.1	5.5	0.20
Average					0.59			0.11			0.76			0.39
Average for RC2					0.49									0.29

DRC = field duplicate of RC1
U = The analyte was not detected at or above the reported result.

Table E-3, page 1 of 10. Water Quality Organic Analyis Results for Gibbons Creek remnant channel.
Units = µg/L. Sample results above the reporting limit are shown in bold type.

	RC1			RC1-duplicate			RC2			SS1		
VOA Compounds	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95
Dichlorodifluoromethane	1.0 UJ	1.0 U	1.0 UJ	1.0 UJ	----	1.0 UJ	1.0 UJ	1.0 U	----	----	1.0 U	----
Chloromethane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Vinyl Chloride	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Bromomethane	1.0 U	1.0 UJ	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 UJ	----	----	1.0 UJ	----
Chloroethane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Trichlorofluoromethane	1.0 UJ	1.0 U	1.0 UJ	1.0 UJ	----	1.0 UJ	1.0 UJ	1.0 U	----	----	1.0 U	----
Acetone	10.0 UJ	1.9 UJ	2.1 UJ	10.0 UJ	----	2.0 U	10.0 UJ	20.0 UJ	----	----	4.0 UJ	----
1,1-Dichloroethene	1.0 U	1.0 U	1.0 UJ	1.0 U	----	1.0 UJ	1.0 U	**0.57 J**	----	----	1.0 U	----
Carbon Disulfide	1.0 U	1.0 U	1.0 UJ	1.0 U	----	1.0 UJ	1.0 U	1.0 U	----	----	1.0 U	----
Methylene Chloride	1.0 U	1.0 UJ	1.0 UJ	1.0 U	----	1.0 UJ	1.0 U	2.0 U	----	----	1.0 UJ	----
Trans-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,1-Dichloroethane	**0.78 J**	1.0 U	**0.086 J**	**0.85 J**	----	0.087 J	**0.8 J**	**1.0**	----	----	1.0 U	----
2-Butanone (MEK)	1.0 U	1.0 UJ	1.0 UJ	1.0 U	----	2.0 UJ	1.0 U	1.0 UJ	----	----	1.0 UJ	----
Cis-1,2-Dichloroethene	**1.2**	**0.41 J**	**0.32 J**	**1.2**	----	0.34 J	**1.4**	**1.9**	----	----	1.0 U	----
2,2-Dichloropropane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Bromochloromethane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Chloroform	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,1,1-Trichloroethane	**4.5**	**1.0**	**0.96 J**	**4.7**	----	0.96 J	**4.7**	**9.3**	----	----	1.0 U	----
1,1-Dichloropropene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Carbon Tetrachloride	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,2-Dichloroethane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Benzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Trichloroethene	**0.30 J**	1.0 U	**0.17 J**	**0.33 J**	----	0.15 J	**0.3 J**	**0.73 J**	----	----	1.0 U	----
1,2-Dichloropropane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Dibromomethane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Bromodichloromethane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Cis-1,3-Dichloropropene	1.1 U	1.1 U	1.1 U	1.1 U	----	1.1 U	1.1 U	1.1 U	----	----	1.1 U	----
4-Methyl-2-Pentanone	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Toluene	**0.22 J**	1.0 U	1.0 UJ	**0.24 J**	----	1.0 UJ	**0.7 J**	**0.42 J**	----	----	1.0 U	----
Trans-1,3-Dichloropropene	0.94 U	0.94 U	0.94 U	0.94 U	----	0.94 U	0.94 U	0.94 U	----	----	0.94 U	----
1,1,2-Trichloroethane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,3-Dichloropropane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
2-Hexanone	1.0 U	1.0 UJ	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 UJ	----	----	1.0 UJ	----
Tetrachloroethene	**0.17 J**	**0.2 J**	**0.093 J**	**0.17 J**	----	0.093 J	**0.19 J**	**0.50 J**	----	----	1.0 U	----
Dibromochloromethane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,2-Dibromoethane (EDB)	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Chlorobenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Ethane, 1,1,1,2-Tetrachloro-	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Ethylbenzene	1.0 U	1.0 U	**0.052 J**	1.0 U	----	1.0 U	0.27 J	**0.39 J**	----	----	1.0 U	----
m & p-Xylene	2.0 U	2.0 U	1.0 UJ	1.0 UJ	----	2.0 UJ	**1.3 J**	**1.8 J**	----	----	2.0 U	----
o-Xylene	1.0 U	1.0 U	1.0 UJ	1.0 U	----	1.0 UJ	**0.40 J**	**0.77 J**	----	----	1.0 U	----
Total Xylenes	3.0 U	3.0 U	1.0 UJ	1.0 UJ	----	3.0 UJ	**1.7 J**	**2.5 J**	----	----	3.0 U	----
Benzene, Ethenyl-(Styrene)	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Bromoform	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Isopropylbenzene (Cumene)	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Ethane, 1,1,2,2-Tetrachloro-	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,2,3-Trichloropropane	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----

Table E-3, page 2 of 10. Water Quality Organic Analyis Results for Gibbons Creek remnant channel.
Units = µg/L. Sample results above the reporting limit are shown in bold type.

	RC1			RC1-duplicate			RC2			SS1		
	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95
Bromobenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
n-Propylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
2-Chlorotoluene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,3,5-Trimethylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
4-Chlorotoluene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Tert-Butylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,2,4-Trimethylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	**0.32 J**	----	----	1.0 U	----
Sec-Butylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
p-Isopropyltoluene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,3-Dichlorobenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,4-Dichlorobenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Butylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,2-Dichlorobenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	1.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,2-Dibromo-3-Chloropropane	1.0 U	1.0 U	1.0 U	1.0 U	----	2.0 U	1.0 U	1.0 U	----	----	1.0 U	----
1,2,4-Trichlorobenzene	1.0 U	1.0 U	1.0 U	1.0 U	----	5.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Hexachlorobutadiene	1.0 U	1.0 U	1.0 U	1.0 U	----	5.0 U	1.0 U	1.0 U	----	----	1.0 U	----
Naphthalene	1.0 UJ	1.0 U	10.0 UJ	1.0 UJ	----	10.0 UJ	1.0 UJ	1.0 UJ	----	----	1.0 U	----
1,2,3-Trichlorobenzene	1.0 UJ	1.0 U	10.0 UJ	1.0 UJ	----	10.0 UJ	1.0 UJ	1.0 UJ	----	----	1.0 U	----
Tentatively Identified Compounds:												
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)				**0.63 NJ**			**0.60 NJ**					
Hydroxylamine, 0-decyl-							**0.28 NJ**					
Benzene, 1-Ethyl-3-Methyl-								**0.4 NJ**				
Cyclotetrasiloxane, Octamethyl-											**0.23 NJ**	
BNA Compounds												
Dimethylnitrosamine	0.13 U	0.27 U	0.52 U	0.17 UJ	0.26 U	0.52 U	0.12 U	0.26 U	0.52 U	----	0.27 U	0.53 U
Pyridine	0.66 U	0.27 U	0.52 U	0.87 U	0.53 U	0.52 U	0.61 U	0.26 U	0.52 U	----	0.54 U	0.53 U
Aniline	0.13 U	0.27 UJ	0.26 U	0.17 U	0.26 UJ	0.26 U	0.12 U	0.26 UJ	0.26 U	----	0.27 UJ	0.26 U
Phenol	0.13 U	0.27 U	0.26 UJ	0.17 U	0.26 UJ	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.48**	0.15 J
Bis(2-Chloroethyl)Ether	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
2-Chlorophenol	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
1,3-Dichlorobenzene	0.13 U	0.27 U	0.26 UJ	0.17 UJ	0.26 U	0.26 UJ	0.12 U	0.26 U	0.26 UJ	----	0.27 UJ	0.26 UJ
1,4-Dichlorobenzene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
1,2-Dichlorobenzene	0.13 U	0.27 U	0.26 U	0.17 UJ	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 UJ	0.26 U
Benzyl Alcohol	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.28**	0.26 U
2-Methylphenol	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.26 J**	0.080 J
Bis(2-Chloroisopropyl)Ether	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
N-Nitrosodiphenylamine	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.21 J**	**0.27**
4-Methylphenol	0.13 U	0.27 U	0.26 U	0.17 U	**0.035 J**	0.26 U	0.12 U	0.26 U	0.26 U	----	0.53	0.16 J
Hexachloroethane	0.13 U	0.27 U	0.26 UJ	0.17 UJ	0.26 U	0.26 UJ	0.12 U	0.26 U	0.26 UJ	----	0.27 UJ	0.26 UJ
Nitrobenzene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
Isophorone	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
2-Nitrophenol	0.13 U	0.27 UJ	0.26 U	0.17 U	0.26 UJ	0.26 U	0.12 U	0.26 UJ	0.26 U	----	0.27 UJ	0.26 U
2,4-Dimethylphenol	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.11 J**	0.26 U
Bis(2-Chloroethoxy)Methane	0.13 U	0.27 U	0.26 U	0.17 UJ	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
Benzoic Acid	1.3 U	2.7 UJ	5.2 UJ	1.7 U	2.6 UJ	5.2 UJ	1.2 U	2.6 UJ	5.2 UJ	----	2.7 UJ	0.66 J
2,4-Dichlorophenol	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U

Table E-3, page 3 of 10. Water Quality Organic Analyis Results for Gibbons Creek remnant channel.
Units = µg/L. Sample results above the reporting limit are shown in bold type.

	RC1			RC1-duplicate			RC2			SS1		
	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95
1,2,4-Trichlorobenzene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
Naphthalene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	**0.039 J**	0.26 U	0.26 U	----	0.27 U	0.26 U
4-Chloroaniline	0.13 U	0.27 U	0.26 UJ	0.17 UJ	0.26 U	0.26 UJ	0.12 U	0.26 U	0.26 UJ	----	0.27 UJ	0.26 UJ
Hexachlorobutadiene	0.13 U	0.27 U	0.26 UJ	0.17 UJ	0.26 U	0.26 UJ	0.12 U	0.26 U	0.26 UJ	----	0.27 UJ	0.26 UJ
4-Chloro-3-Methylphenol	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
2-Methylnaphthalene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	**0.011 J**	0.26 U	0.26 U	----	**0.06 J**	0.26 U
Hexachlorocyclopentadiene	0.26 U	1.3 U	2.6 UJ	0.35 UJ	1.3 U	2.6 UJ	0.24 U	1.3 U	2.6 UJ	----	1.4 UJ	2.6 UJ
2,4,6-Trichlorophenol	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
2,4,5-Trichlorophenol	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
2-Chloronaphthalene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
2-Nitroaniline	0.13 U	2.7 UJ	0.26 U	0.17 UJ	2.6 UJ	0.26 U	0.12 U	2.6 UJ	0.26 U	----	2.7 UJ	0.26 U
Dimethyl Phthalate	0.13 U	0.27 U	0.26 U	0.17 U	0.091 J	0.26 U	**0.015 J**	0.26 U	0.26 U	----	0.27 U	0.26 U
2,6-Dinitrotoluene	0.13 U	2.7 U	0.26 U	0.17 U	2.6 U	0.26 U	0.12 U	2.6 U	0.26 U	----	2.7 U	0.26 U
Acenaphthylene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
3-Nitroaniline	0.13 U	2.7 U	0.52 U	0.17 U	2.6 U	0.52 U	0.12 U	2.6 U	0.52 U	----	2.7 U	0.53 U
Acenaphthene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
2,4-Dinitrophenol	1.3 UJ	5.4 UJ	10.4 UJ	1.7 UJ	5.3 UJ	10.5 UJ	1.2 UJ	5.2 UJ	10.4 UJ	----	5.4 UJ	10.6 UJ
4-Nitrophenol	0.66 U	2.7 U	1.3 UJ	0.87 UJ	2.6 U	1.3 UJ	0.61 UJ	2.6 U	1.3 UJ	----	2.7 U	1.3 UJ
Dibenzofuran	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.048 J**	0.26 U
2,4-Dinitrotoluene	0.13 U	2.7 UJ	1.3 U	0.17 UJ	2.6 UJ	1.3 U	0.12 U	2.6 UJ	1.3 U	----	2.7 UJ	1.3 U
Diethyl Phthalate	0.13 U	0.27 UJ	0.52 UJ	0.17 U	0.26 U	0.26 UJ	0.12 U	0.26 UJ	0.52 UJ	----	0.27 UJ	0.26 UJ
Fluorene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
4-Chlorophenyl Phenylether	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
4-Nitroaniline	0.13 U	0.27 UJ	0.26 U	0.17 UJ	0.26 UJ	0.26 U	0.12 U	0.26 UJ	0.26 U	----	0.27 UJ	0.26 U
4,6-Dinitro-2-Methylphenol	1.3 U	2.7 UJ	5.2 UJ	1.7 U	2.6 UJ	5.2 UJ	1.2 U	2.6 UJ	5.2 UJ	----	2.7 UJ	5.3 UJ
N-Nitroso-di-n-Propylamine	0.13 U	0.27 U	0.26 U	0.17 UJ	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
1,2-Diphenylhydrazine	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
4-Bromophenyl Phenylether	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
Hexachlorobenzene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
Pentachlorophenol	0.13 U	2.7 U	0.52 U	0.17 U	2.6 U	0.52 U	0.12 U	2.6 U	0.52 U	----	**0.45 J**	**0.45 J**
Phenanthrene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	**0.016 J**	0.26 U	0.26 U	----	0.36	**0.14 J**
Anthracene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.034 J**	**0.26 U**
Caffeine	**0.046 J**	0.27 U	0.26 U	**0.17 J**	**0.039 J**	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.25 J**	**0.25 J**
Carbazole	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.08 J**	**0.029 J**
Di-n-Butyl Phthalate	0.13 U	0.27 U	**0.048 J**	0.17 U	0.26 UJ	**0.056 J**	0.12 U	0.26 UJ	**0.046 J**	----	**12.0 J**	**0.34**
Fluoranthene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	**0.030 J**	0.26 U	0.26 U	----	**0.54**	0.26 U
Benzidine	0.26 UJ	0.27 U	0.52 UJ	0.35 UJ	0.53 U	0.52 UJ	0.24 UJ	0.26 U	0.52 UJ	----	0.54 U	0.53 UJ
Pyrene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	**0.031 J**	0.26 U	0.26 U	----	**0.57**	**0.21 J**
Retene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
Butylbenzyl Phthalate	0.13 U	1.3 UJ	0.26 UJ	0.17 U	0.26 UJ	0.26 UJ	0.12 U	1.3 UJ	0.26 UJ	----	**0.40 J**	**0.27**
Benzo(a)Anthracene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
3,3'-Dichlorobenzidine	0.26 U	0.54 U	0.52 U	0.35 U	0.53 U	0.52 U	0.24 U	0.52 U	0.52 U	----	0.54 U	0.53 U
Chrysene	0.13 U	0.27 U	0.26 U	0.17 U	0.26 U	0.26 U	**0.016 J**	0.26 U	0.26 U	----	**0.47**	0.26 U
Bis(2-Ethylhexyl)Phthalate	0.13 UJ	0.54 U	0.26 UJ	0.17 U	2.0 UJ	0.26 UJ	0.12 U	2.3 UJ	0.30 UJ	----	4.0 UJ	**1.8**
Di-n-Octyl Phthalate	0.13 U	**0.18 J**	0.26 U	0.17 UJ	1.3 UJ	0.26 U	0.12 U	1.3 UJ	0.26 U	----	0.27 UJ	0.26 U
Benzo(k)Fluoranthene	0.13 U	0.27 U	0.26 U	0.17 UJ	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.39**	0.26 U
Benzo(b)Fluoranthene	0.13 U	0.27 U	0.26 U	0.17 UJ	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.15 J**	0.26 U
Benzo(a)Pyrene	0.13 U	0.27 U	0.26 U	0.17 UJ	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.22 J**	**0.041 J**

Table E-3, page 4 of 10. Water Quality Organic Analyis Results for Gibbons Creek remnant channel.
Units = µg/L. Sample results above the reporting limit are shown in bold type.

	RC1			RC1-duplicate			RC2			SS1		
	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95
3B-Coprostanol	1.3 UJ	5.4 U	5.2 U	1.7 UJ	5.3 U	5.2 U	1.2 UJ	5.2 U	5.2 U	----	5.4 U	5.3 U
Indeno(1,2,3-cd)Pyrene	0.13 U	0.27 U	0.26 U	0.17 UJ	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.22 J**	0.26 U
Dibenzo(a,h)Anthracene	0.13 U	0.27 U	0.26 U	0.17 UJ	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	0.27 U	0.26 U
Benzo(g,h,i)Perylene	0.13 U	0.27 U	0.26 U	0.17 UJ	0.26 U	0.26 U	0.12 U	0.26 U	0.26 U	----	**0.03 J**	0.26 U
Tentatively Identified Compounds:												
o-Xylene	**0.38 NJ**				**0.16 NJ**		**0.35 NJ**					
Ethylbenzene	**0.21 NJ**											
Ethanol, 1-(2-Butoxyethoxy)-	**0.14 NJ**			**1.1 NJ**	**0.27 NJ**						**5.5 NJ**	
Toluene							**0.53 NJ**					
m-Xylene		**0.16 NJ**		**0.38 NJ**			**1.2 NJ**					
p-Xylene				**0.22 NJ**			**0.87 NJ**					
Decanoic Acid, Tetra-							**0.3 NJ**					
Cholesterol							**1.0 NJ**					
Stigasterol							**0.95 NJ**					
Gamma.-Sitosterol							**2.6 NJ**					
1H-Imidazole, 1-methyl-5-ni												
Hexanedioic Acid, Bis(2-ethylhexyl) Ester		**5.7 NJ**				**0.39 NJ**						
Cyclopentene, 1-ethenyl-3-m		**0.19 NJ**										
Benzoic Acid, 2-Hydroxy-,Met											**0.82 NJ**	
3-Cyclohexene-1-Methanol, .Alpha.,.Alpha.4-Trimethyl-					**0.57 NJ**						**2.5 NJ**	
Benzaldehyde, 4-Hydroxy-3-Methoxy-			**0.18 NJ**								**2.8 NJ**	**1.7 NJ**
Octadecanoic Acid											**2.0 NJ**	**4.0 NJ**
2(3h)-Furanone, Dihydro-3,4-bis[94-Hydrozy-3-Methoxyph											**5.8 NJ**	**12.7 NJ**
Phenol,4-Chloro-3,5-Dimethyl-												
Triclosan												
[1,1'-Biphenyl]-2-Ol			**0.19 NJ**		**0.15 NJ**							
2,5-dimethyl-1-nitrobenzene			**0.55 NJ**									
Benzenebutanoic acid, 2,5-d			**0.58 NJ**			**0.82 NJ**						**2.8 NJ**
Naptho[2,3-C]furan-1(3h)-One, 3a,4,9,9a-Tetrahydro-6			**1.2 NJ**			**2.0 NJ**						
Propanoic Acid, 2-Methyl-, 2,2-Dimethyl-1-(2-Hydroxy-1												**3.4 NJ**
Propanoic Acid, 2-Methyl-, 2-Ethyl-3-Hydroxyhexyl Est												**2.2 NJ**
1,4-Benzenediol, 2-methoxy												**0.53 NJ**
1-Naphthalenepropanol, .Alpha.-Ethenyldecahydro-.Alpha...(R*)												**2.5 NJ**
9(10H)-Anthracenone												**6.9 NJ**
1-Hexadecanol												
Pesticide/PCB Compounds												
alpha-BHC	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
beta-BHC	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
gamma-BHC (Lindane)	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
delta-BHC	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
Heptachlor	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
Aldrin	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
Heptachlor Epoxide	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
Endosulfan I	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
4,4'-DDE	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
Dieldrin	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U

Table E-3, page 5 of 10. Water Quality Organic Analyis Results for Gibbons Creek remnant channel.
Units = μg/L. Sample results above the reporting limit are shown in bold type.

	RC1			RC1-duplicate			RC2			SS1		
	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95
Endrin	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
Endosulfan II	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
4,4'-DDD	0.070 U	0.10 UJ	0.098 U	0.045 U	0.10 UJ	0.098 U	0.045 U	0.098 UJ	0.098 U		0.10 UJ	0.10 U
Endrin Aldehyde	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
4,4'-DDT	0.14 UJ	0.10 UJ	0.098 U	0.091 UJ	0.10 UJ	0.098 U	0.091 UJ	0.098 UJ	0.098 U		0.10 UJ	0.10 UJ
Endosulfan Sulfate	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
Endrin Ketone	0.070 U	0.10 U	0.098 U	0.045 U	0.10 U	0.098 U	0.045 U	0.098 U	0.098 U		0.10 U	0.10 U
Methoxychlor	0.14 UJ	0.10 UJ	0.098 U	0.091 UJ	0.10 UJ	0.098 U	0.091 UJ	0.098 U	0.098 U		0.10 UJ	0.10 UJ
Chlordane	0.47 U	0.67 U	0.65 U	0.30 U	0.66 U	0.66 U	0.30 U	0.66 U	0.65 U		0.68 U	0.66 U
Toxaphene	1.4 U	2.0 U	2.0 U	0.91 U	2.0 U	2.0 U	0.91 U	2.0 U	2.0 U		2.0 U	2.0 U
gamma-Chlordane	0.070 U			0.045 U			0.045 U					
PCB - 1221	0.47 U	0.67 U	0.65 U	0.30 U	0.66 U	0.66 U	0.30 U	0.66 U	0.65 U		0.68 U	0.66 U
PCB - 1232	0.93 U	0.67 U	0.65 U	0.61 U	0.66 U	0.66 U	0.61 U	0.66 U	0.65 U		0.68 U	0.66 U
PCB - 1016	0.47 U	0.67 U	0.65 U	0.30 U	0.66 U	0.66 U	0.30 U	0.66 U	0.65 U		0.68 U	0.66 U
PCB - 1242	0.47 U	0.67 U	0.65 U	0.30 U	0.66 U	0.66 U	0.30 U	0.66 U	0.65 U		0.68 U	0.66 U
PCB - 1248	0.47 U	0.67 U	0.65 U	0.30 U	0.66 U	0.66 U	0.30 U	0.66 U	0.65 U		0.68 U	0.66 U
PCB - 1254	0.47 U	0.67 U	0.65 U	0.30 U	0.66 U	0.66 U	0.30 U	0.66 U	0.65 U		0.68 U	0.66 U
PCB - 1260	0.47 U	0.67 U	0.65 U	0.30 U	0.66 U	0.66 U	0.30 U	0.66 U	0.65 U		0.68 U	0.66 U
Tentatively Identified Compounds:												
Phenol, 4-Chloro-3,5-Dimethyl-		**0.097 NJ**										
Triclosan												

Table E-3, page 6 of 10. Water Quality Organic Analyis Results for Gibbons Creek remnant channel. Units = µg/L. Sample results above the reporting limit are shown in bold type.

	RC3			RC4			EPA Water Quality Criteria Summary	
VOA Compounds	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	Acute (ug/L)	Chronic (ug/L)
Dichlorodifluoromethane	1.0 UJ	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 UJ	11,600 *(b)	
Chloromethane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	11,000 *(a)	
Vinyl Chloride	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	11,600 *(b)	
Bromomethane	1.0 U	REJ	1.0 U	1.0 U	1.0 UJ	1.0 UJ	11,000 *(a)	
Chloroethane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	11,600 *(b)	
Trichlorofluoromethane	1.0 UJ	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 UJ		
Acetone	10.0 UJ	20.0 UJ	1.4 UJ	10.0 UJ	20.0 UJ	2.0 U	9,320 *(f)	2,400 *
1,1-Dichloroethene	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 UJ	28,900 *	1,240 *
Carbon Disulfide	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 UJ		
Methylene Chloride	1.0 U	2.0 U	1.0 UJ	1.0 U	2.0 U	1.0 UJ	11,000 *(a)	
Trans-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
1,1-Dichloroethane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	23,000 *(d)	5,700 *(d)
2-Butanone (MEK)	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 UJ	2.0 UJ	9,320 *(f)	
Cis-1,2-Dichloroethene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	118,000 *	20,000 *
2,2-Dichloropropane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	18,000 *(c)	9,400 *
Bromochloromethane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
Chloroform	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
1,1,1-Trichloroethane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	35,200 *	
1,1-Dichloropropene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	6,060 *(e)	244 *(e)
Carbon Tetrachloride	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
1,2-Dichloroethane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	11,000 *(a)	
Benzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
Trichloroethene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
1,2-Dichloropropane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	11,000 *(a)	
Dibromomethane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
Bromodichloromethane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	11,000 *(a)	
Cis-1,3-Dichloropropene	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	11,000 *(a)	
4-Methyl-2-Pentanone	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	17,500 *	
Toluene	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 UJ		
Trans-1,3-Dichloropropene	0.94 U	0.94 U	0.94 U	0.94 U	0.94 U	0.94 U		
1,1,2-Trichloroethane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	6,060 *(e)	244 *(e)
1,3-Dichloropropane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
2-Hexanone	1.0 U	1.0 UJ	1.0 UJ	1.0 U	1.0 UJ	1.0 UJ	250 *(g)	50 *(g)
Tetrachloroethene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	11,000 *(a)	
Dibromochloromethane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	11,000 *(a)	
1,2-Dibromoethane (EDB)	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	45,000 *	21,900 *
Chlorobenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
Ethane, 1,1,1,2-Tetrachloro-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	11,000 *(a)	
Ethylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
m & p-Xylene	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U		
o-Xylene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	238,000 *(j)	
Total Xylenes	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U		
Benzene, Ethenyl-(Styrene)	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	11,600 *(b)	
Bromoform	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
Isopropylbenzene (Cumene)	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
Ethane, 1,1,2,2-Tetrachloro-	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	23,000 *(d)	5,700 *(d)
1,2,3-Trichloropropane	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	23,000 *(d)	5,700 *(d)

Table E-3, page 7 of 10. Water Quality Organic Analyis Results for Gibbons Creek remnant channel. Units = μg/L. Sample results above the reporting limit are shown in bold type.

	RC3			RC4			EPA Water Quality Criteria Summary	
	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	Acute	Chronic
Bromobenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
n-Propylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
2-Chlorotoluene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
1,3,5-Trimethylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
4-Chlorotoluene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
Tert-Butylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
1,2,4-Trimethylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	250 *(g)	50 *(g)
Sec-Butylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
p-Isopropyltoluene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
1,3-Dichlorobenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1,120 *(h)	763 *(h)
1,4-Dichlorobenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	250 *(g)	50 *(g)
Butylbenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		
1,2-Dichlorobenzene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1,120 *(h)	763 *(h)
1,2-Dibromo-3-Chloropropane	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	2.0 U	5,300 *	
1,2,4-Trichlorobenzene	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	90 *	9.3 *
Hexachlorobutadiene	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U		
Naphthalene	1.0 UJ	1.0 U	10.0 UJ	1.0 UJ	1.0 U	10.0 UJ		
1,2,3-Trichlorobenzene	1.0 UJ	1.0 U	10.0 UJ	1.0 UJ	1.0 U	10.0 UJ	2,300 *	620 *
Tentatively Identified Compour								
1,1,2-Trichloro-1,2,2-Trifluoroe							6,060 *(e)	244 *(e)
Hydroxylamine, 0-decyl-								
Benzene, 1-Ethyl-3-Methyl-								
Cyclotetrasiloxane, Octamethy								
BNA Compounds								
Dimethylnitrosamine	0.12 U	0.26 U	0.51 U	0.13 U	0.26 U	0.51 U		
Pyridine	0.60 U	0.52 U	0.51 U	0.64 U	0.52 U	0.51 U		
Aniline	0.12 U	0.26 UJ	0.25 U	0.13 U	0.26 UJ	0.25 U		
Phenol	0.12 U	0.26 UJ	0.25 U	0.13 U	0.26 U	0.25 U	10,200 *	2,560 *
Bis(2-Chloroethyl)Ether	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	238,000 *(j)	
2-Chlorophenol	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	4,380 *	2,000 *
1,3-Dichlorobenzene	0.12 U	0.26 U	0.25 UJ	0.13 U	0.26 U	0.25 UJ	1,120 *(h)	763 *(h)
1,4-Dichlorobenzene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	1,120 *(h)	763 *(h)
1,2-Dichlorobenzene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	1,120 *(h)	763 *(h)
Benzyl Alcohol	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
2-Methylphenol	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Bis(2-Chloroisopropyl)Ether	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	238,000 *(j)	
N-Nitrosodiphenylamine	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	5,850 *(k)	
4-Methylphenol	0.12 U	**0.035 J**	0.25 U	0.13 U	**0.035 J**	0.25 U		
Hexachloroethane	0.12 U	0.26 U	0.25 UJ	0.13 U	0.26 U	0.25 UJ	980 *	540 *
Nitrobenzene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	27,000 *	
Isophorone	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	117,000 *	
2-Nitrophenol	0.12 U	0.26 UJ	0.25 U	0.13 U	0.26 UJ	0.25 U	230 *(l)	150 *(l)
2,4-Dimethylphenol	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	2,120 *	
Bis(2-Chloroethoxy)Methane	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	238,000 *(j)	
Benzoic Acid	1.2 U	2.6 UJ	5.1 UJ	1.3 U	2.6 UJ	5.1 UJ		
2,4-Dichlorophenol	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	2,020 *	365 *

Table E-3, page 8 of 10. Water Quality Organic Analyis Results for Gibbons Creek remnant channel. Units = μg/L. Sample results above the reporting limit are shown in bold type.

	RC3			RC4			EPA Water Quality Criteria Summary	
	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	Acute	Chronic
1,2,4-Trichlorobenzene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	250 *(g)	50 *(g)
Naphthalene	**0.017 J**	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	2,300 *	620 *
4-Chloroaniline	0.12 U	0.26 U	0.25 UJ	0.13 U	0.26 U	0.25 UJ		
Hexachlorobutadiene	0.12 U	0.26 U	0.25 UJ	0.13 U	0.26 U	0.25 UJ	90 *	9.3 *
4-Chloro-3-Methylphenol	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	30 *	
2-Methylnaphthalene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Hexachlorocyclopentadiene	0.24 U	1.3 U	2.5 UJ	0.26 U	1.3 U	2.5 UJ	7 *	5.2 *
2,4,6-Trichlorophenol	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		970 *
2,4,5-Trichlorophenol	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
2-Chloronaphthalene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	1,600 *(m)	
2-Nitroaniline	0.12 U	2.6 UJ	0.25 U	0.13 U	2.6 UJ	0.25 U		
Dimethyl Phthalate	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	940 *(i)	3 *(i)
2,6-Dinitrotoluene	0.12 U	2.6 U	0.25 U	0.13 U	2.6 U	0.25 U	330 *(o)	230 *(o)
Acenaphthylene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
3-Nitroaniline	0.12 U	2.6 U	0.51 U	0.13 U	2.6 U	0.51 U		
Acenaphthene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	1,700 *	520 *
2,4-Dinitrophenol	1.2 UJ	5.2 UJ	10.2 UJ	1.3 UJ	5.2 UJ	10.2 UJ	230 *(l)	150 *(l)
4-Nitrophenol	0.60 UJ	2.6 U	1.3 UJ	0.64 UJ	2.6 U	1.3 UJ	230 *(l)	150 *(l)
Dibenzofuran	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
2,4-Dinitrotoluene	0.12 U	2.6 UJ	1.3 U	0.13 U	2.6 UJ	1.3 U	330 *(o)	230 *(o)
Diethyl Phthalate	0.12 U	0.26 UJ	0.25 U	0.13 U	0.26 UJ	0.25 UJ	940 *(i)	3 *(i)
Fluorene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
4-Chlorophenyl Phenylether	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	360 *(p)	122 *(p)
4-Nitroaniline	0.12 U	0.26 UJ	0.25 U	0.13 U	0.26 UJ	0.25 U		
4,6-Dinitro-2-Methylphenol	1.2 U	2.6 UJ	5.1 UJ	1.3 U	2.6 UJ	5.1 UJ	230 *(l)	150 *(l)
N-Nitroso-di-n-Propylamine	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	5,850 *(k)	
1,2-Diphenylhydrazine	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	270 *	
4-Bromophenyl Phenylether	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	360 *(p)	122 *(p)
Hexachlorobenzene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	250 *(g)	50 *(g)
Pentachlorophenol	0.12 U	2.6 U	0.51 U	0.13 U	2.6 U	0.51 U	20 **	13 **
Phenanthrene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Anthracene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Caffeine	0.12 U	0.26 U	0.25 U	**0.025 J**	0.26 U	0.25 U		
Carbazole	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Di-n-Butyl Phthalate	0.12 U	0.26 UJ	**0.035 J**	0.13 U	0.26 UJ	**0.047 J**	940 *(i)	3 *(i)
Fluoranthene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U	3,980 *	
Benzidine	0.24 UJ	0.52 U	0.51 UJ	0.26 UJ	0.52 U	0.51 UJ	2,500 *	
Pyrene	0.12 U	**0.014 J**	0.25 U	0.13 U	0.260 U	0.25 U		
Retene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Butylbenzyl Phthalate	0.12 U	1.3 UJ	0.25 UJ	0.13 U	1.3 UJ	0.25 UJ	940 *(i)	3 *(i)
Benzo(a)Anthracene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
3,3'-Dichlorobenzidine	0.12 U	0.52 U	0.51 U	0.26 U	0.52 U	0.51 U		
Chrysene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Bis(2-Ethylhexyl)Phthalate	0.12 U	0.5 U	0.25 U	0.15 UJ	2.9 UJ	**13.4**	940 *(i)	3 *(i)
Di-n-Octyl Phthalate	0.12 U	1.3 UJ	0.25 U	**0.029 J**	1.3 UJ	0.25 U	940 *(i)	3 *(i)
Benzo(k)Fluoranthene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Benzo(b)Fluoranthene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Benzo(a)Pyrene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		

Table E-3, page 9 of 10. Water Quality Organic Analyis Results for Gibbons Creek remnant channel.
Units = μg/L. Sample results above the reporting limit are shown in bold type.

	RC3			RC4			EPA Water Quality Criteria Summary	
	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	Acute	Chronic
3B-Coprostanol	1.2 UJ	5.2 U	5.1 U	**0.19 J**	5.2 U	5.1 U		
Indeno(1,2,3-cd)Pyrene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Dibenzo(a,h)Anthracene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Benzo(g,h,i)Perylene	0.12 U	0.26 U	0.25 U	0.13 U	0.26 U	0.25 U		
Tentatively Identified Compour								
o-Xylene								
Ethylbenzene							5,280 *	840 *
Ethanol, 1-(2-Butoxyethoxy)-							940 *(i)	3 *(i)
Toluene								
m-Xylene								
p-Xylene								
Decanoic Acid, Tetra-	**0.11 NJ**							
Cholesterol	**0.97 NJ**			**1.8 NJ**		**0.52 NJ**		
Stigasterol								
Gamma.-Sitosterol			**0.66 NJ**	**1.8 NJ**				
1H-Imidazole, 1-methyl-5-ni				**0.080 NJ**				
Hexanedioic Acid, Bis(2-ethylh				**9.3 NJ**		**0.32 NJ**		
Cyclopentene, 1-ethenyl-3-m								
Benzoic Acid, 2-Hydroxy-,Met								
3-Cyclohexene-1-Methanol, .Al								
Benzaldehyde, 4-Hydroxy-3-Me								
Octadecanoic Acid								
2(3h)-Furanone, Dihydro-3,4-b								
Phenol,4-Chloro-3,5-Dimethyl-		**0.48 NJ**						
Triclosan		**0.15 NJ**						
[1,1'-Biphenyl]-2-Ol								
2,5-dimethyl-1-nitrobenzene								
Benzenebutanoic acid, 2,5-d								
Naptho[2,3-C]furan-1(3h)-One								
Propanoic Acid, 2-Methyl-, 2,2								
Propanoic Acid, 2-Methyl-, 2-E								
1,4-Benzenediol, 2-methoxy								
1-Naphthalenepropanol, .Alpha								
9(10H)-Anthracenone								
1-Hexadecanol						**1.1 NJ**		
Pesticide/PCB Compounds								
alpha-BHC	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	100 *(q)	
beta-BHC	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	100 *(q)	
gamma-BHC (Lindane)	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	2.0	0.08
delta-BHC	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	100 *(q)	
Heptachlor	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	0.52 (r)	0.0038 (r)
Aldrin	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	3.0	
Heptachlor Epoxide	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	0.52 (r)	0.0038 (r)
Endosulfan I	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	0.22 (s)	0.056 (s)
4,4'-DDE	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	1,050 *	0.001 (u)
Dieldrin	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	2.5	0.0019

Table E-3, page 10 of 10. Water Quality Organic Analyis Results for Gibbons Creek remnant channel.
Units = μg/L. Sample results above the reporting limit are shown in bold type.

	RC3			RC4			EPA Water Quality Criteria Summary	
	9/7/94	11/29/94	1/30/95	9/7/94	11/29/94	1/30/95	Acute	Chronic
Endrin	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	0.18 (t)	0.0023 (t)
Endosulfan II	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	0.22 (s)	0.056 (s)
4,4'-DDD	0.045 U	0.097 UJ	0.095 U	0.046 U	0.097 UJ	0.095 U	0.6 *	0.001 (u)
Endrin Aldehyde	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	0.18 (t)	0.0023 (t)
4,4'-DDT	0.090 UJ	0.097 UJ	0.095 U	0.092 UJ	0.097 UJ	0.095 U	1.1 (u)	0.001 (u)
Endosulfan Sulfate	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	0.22 (s)	0.056 (s)
Endrin Ketone	0.045 U	0.097 U	0.095 U	0.046 U	0.097 U	0.095 U	0.18 (t)	0.0023 (t)
Methoxychlor	0.090 UJ	0.097 UJ	0.095 U	0.092 UJ	0.097 UJ	0.095 U		0.03
Chlordane	0.30 U	0.65 U	0.63 U	0.31 U	0.65 U	0.63 U	2.4 (v)	0.0043 (v)
Toxaphene	0.90 U	1.9 U	1.9 U	0.92 U	1.9 U	1.9 U	0.73	0.0002
gamma-Chlordane	0.045 U			0.046 U			2.4 (v)	0.0043 (v)
PCB - 1221	0.30 U	0.65 U	0.63 U	0.31 U	0.65 U	0.63 U		
PCB - 1232	0.60 U	0.65 U	0.63 U	0.62 U	0.65 U	0.63 U		
PCB - 1016	0.30 U	0.65 U	0.63 U	0.31 U	0.65 U	0.63 U		
PCB - 1242	0.30 U	0.65 U	0.63 U	0.31 U	0.65 U	0.63 U		
PCB - 1248	0.30 U	0.65 U	0.63 U	0.31 U	0.65 U	0.63 U		
PCB - 1254	0.30 U	0.65 U	0.63 U	0.31 U	0.65 U	0.63 U		
PCB - 1260	0.30 U	0.65 U	0.63 U	0.31 U	0.65 U	0.63 U		
Tentatively Identified Compour								
Phenol, 4-Chloro-3,5-Dimethyl-		**0.40 NJ**			**0.077 NJ**			
Triclosan		**0.22 NJ**			**0.070 NJ**			

'NOTE: SOME INDIVIDUAL COMPOUND CRITERIA OR LOELS MAY NOT AGREE WITH GROUP CRITERIA OR LOELS. REFER TO APPROPRIATE EPA DOCUMENT ON AMBIENT WATER QUALITY CRITERIA FOR FULL DISCUSSION.

U The analyte was not detected at or above the reported result.
UJ The analyte was not detected at or above the reported estimated result.
J The analyte was positively identified. The associated numerical result is an estimate.
NJ There is evidence that the analyte is present. The associated numerical result is an estimate.
B Analyte was found in the analytical method blank, indicating the sample may have been contaminated.
* Insufficient data to develop criteria. Value presented is the LOEL - Lowest Observed Effect Level.
** pH dependent criteria (7.8 pH used).
a Total Halomethanes
b Total Dichloroethenes
c Total Trichloroethanes
d Total Dichloropropanes
e Total Dichloropropenes
f Total Tetrachloroethanes
g Total Chlorinated Benzenes (excluding Dichlorobenzenes)
h Total Dichlorobenzenes
i Total Phthalate Esters
j Total Chloroalkyl Ethers
k Total Nitrosamines
l Total Nitrophenols
m Total Chlorinated Naphthalenes
n Total Polynuclear Aromatic Hydrocarbons
o Total Dinitrotoluenes
p Total Haloethers
q Total BHCs
r Heptachlor
s Endosulfan
t Endrin
u DDT plus metabolites
v Total Chlordane
w Total Aroclors (PCBs)

Table E-4, page 1. Sediment quality concentrations and physical characteristics for Gibbons Creek remnant channel (dry weight).

	RC1	RC2	RC3	RC4
Metals (mg/Kg):				
Arsenic	19.1 N	23.7 N	1.2 J	4.34 N
Lead	14.9	18.7	33.2	13.0
Selenium	0.40 U	0.40 U	0.40 U	0.73
Thallium	0.50 UN	0.50 UN	0.50 UN	0.50 UN
Mercury	0.045	0.051	0.014	0.028
Berylium	0.59	0.68	0.15	0.65
Cadmium	1.3	0.86	0.3 U	0.75
Chromium	65.4	56.1	8.05	18
Copper	46.8	44.4	6	20.2
Nickel	14.2	14.5	9.6 P	16.4
Silver	0.3 UJ	0.3 UJ	0.3 UJ	0.3 UJ
Zinc	138	127	44.2	77.2
Antimony	3 UJ	3 UJ	3 UJ	3 UJ
Cyanide (mg/Kg)	0.50 U	0.50 U	0.50 U	0.50 U
Oil & Grease (mg/Kg)	1560	1860	16	921
Total Organic Carbon (mg/Kg)	25,000	40,000	1,100	42,000
Total Organic Carbon (%)	2.5	4.0	0.1	4.2
Percent solids (%)	40.1	30.5	7.03 J	27.1
Grain size:				
% gravel	0	16	2	0
% sand	31	45	98	38
% silt	63	34	0	56
% clay	6	5	0	6
% solids	43	39	79	39
Organic analyses (values above reporting limits shown in bold)				
VOA Compounds (µg/Kg)				
Dichlorodifluoromethane	3.2 U	4.4 U	1.1 U	3.8 U
Chloromethane	3.2 U	4.4 U	1.1 U	3.8 U
Vinyl Chloride	3.2 U	4.4 U	1.1 U	3.8 U
Bromomethane	3.2 U	4.4 U	1.1 U	3.8 U
Chloroethane	6.4 U	8.8 U	1.1 U	7.5 U
Trichlorofluoromethane	6.4 U	8.8 U	1.1 U	7.5 U
1,1-Dichloroethene	3.2 U	4.4 U	1.1 U	3.8 UJ
Acetone	20.1 UJ	87.9 U	7.8 UJ	19.9 UJ
Carbon Disulfide	3.3 U	5.4 UJ	2.2 U	3.8 UJ
Methylene Chloride	3.2 U	4.4 U	1.1 U	3.8 U
Trans-1,2-Dichloroethene	3.2 U	4.4 U	1.1 U	3.8 U
1,1-Dichloroethane	**2.9 J**	**0.63 J**	1.1 U	3.8 U
2,2-Dichloropropane	3.2 U	4.4 U	1.1 U	3.8 U
Cis-1,2-Dichloroethene	**0.58 J**	4.4 U	1.1 U	3.8 U
2-Butanone	7.4 UJ	10.6 UJ	2.6 UJ	8.3 UJ
Bromochloromethane	3.2 U	4.4 U	1.1 U	3.8 U
Chloroform	3.2 U	4.4 U	1.1 U	3.8 U
1,1,1-Trichloroethane	3.2 U	4.4 U	1.1 U	3.8 U
1,1-Dichloropropene	3.2 U	4.4 U	1.1 U	3.8 U
Carbon Tetrachloride	3.2 U	4.4 U	1.1 U	3.8 U
Benzene	3.2 U	4.4 UJ	1.1 U	3.8 U
1,2-Dichloroethane	3.2 U	4.4 U	1.1 U	3.8 U
Trichloroethene	3.2 U	4.4 U	1.1 U	3.8 U
1,2-Dichloropropane	3.2 U	4.4 U	1.1 U	3.8 U
Dibromomethane	3.2 U	4.4 U	1.1 U	3.8 U
Bromodichloromethane	3.2 U	4.4 U	1.1 U	3.8 U
Cis-1,3-Dichloropropene	3.4 U	4.7 U	1.2 U	4.0 UJ
4-Methyl-2-Pentanone	3.2 U	4.4 U	1.1 U	3.8 U
Toluene	3.2 U	4.4 U	1.1 U	3.8 U
Trans-1,3-Dichloropropene	3.0 U	4.1 U	1.0 U	3.5 UJ
1,1,2-Trichloroethane	3.2 U	4.4 U	1.1 U	3.8 U
Tetrachloroethene	3.2 U	**0.52 J**	1.1 U	3.8 U
1,3-Dichloropropane	3.2 U	4.4 U	1.1 U	3.8 U
2-Hexanone	6.4 U	8.8 U	2.2 U	7.5 UJ

Table E-4, page 2. Sediment quality concentrations and physical characteristics for Gibbons Creek remnant channel (dry weight).

	RC1	RC2	RC3	RC4
Dibromochloromethane	3.2 U	4.4 U	1.1 U	3.8 UJ
1,2-Dibromoethane (EDB)	3.2 U	4.4 U	1.1 U	3.8 U
Chlorobenzene	3.2 U	4.4 U	1.1 U	3.8 U
Ethane, 1,1,1,2-Tetrachloro-	3.2 U	4.4 U	1.1 U	3.8 UJ
Ethylbenzene	3.2 U	4.4 U	1.1 U	3.8 U
m & p-Xylene	6.4 U	8.8 U	2.2 U	7.5 UJ
o-Xylene	3.2 U	4.4 U	1.1 U	3.8 U
Total Xylenes	9.5 U	13.2 U	3.4 U	11.3 U
Benzene, Ethenyl-(Styrene)	3.2 U	4.4 U	1.1 U	3.8 UJ
Bromoform	3.2 U	4.4 U	1.1 U	3.8 UJ
Isopropylbenzene (Cumene)	3.2 U	4.4 U	1.1 U	3.8 U
Ethane, 1,1,2,2-Tetrachloro-	3.2 U	4.4 U	1.1 U	3.8 U
Bromobenzene	3.2 U	4.4 U	1.1 U	3.8 U
1,2,3-Trichloropropane	3.2 U	4.4 U	1.1 U	3.8 U
n-Propylbenzene	3.2 U	4.4 U	1.1 U	3.8 U
2-Chlorotoluene	3.2 U	4.4 U	1.1 U	3.8 U
1,3,5-Trimethylbenzene	3.2 U	4.4 U	1.1 U	3.8 U
4-Chlorotoluene	3.2 U	4.4 U	1.1 U	3.8 U
Tert-Butylbenzene	3.2 U	4.4 U	1.1 U	3.8 U
1,2,4-Trimethylbenzene	3.2 U	4.4 U	1.1 U	3.8 U
Sec-Butylbenzene	3.2 U	4.4 U	1.1 U	3.8 U
1,3-Dichlorobenzene	3.2 U	4.4 U	1.1 U	3.8 U
p-Isopropyltoluene	3.2 U	4.4 U	1.1 U	3.8 U
1,4-Dichlorobenzene	3.2 U	4.4 U	1.1 U	3.8 U
1,2-Dichlorobenzene	3.2 U	4.4 U	1.1 U	3.8 U
Butylbenzene	3.2 U	4.4 U	1.1 U	3.8 U
1,2-Dibromo-3-Chloropropane (I	3.2 U	4.4 U	1.1 U	3.8 UJ
1,2,4-Trichlorobenzene	15.9 U	22.0 U	5.6 U	18.8 UJ
Hexachlorobutadiene	3.2 U	4.4 U	1.1 U	3.8 U
Naphthalene	6.4 U	8.8 U	2.2 U	7.5 UJ
1,2,3-Trichlorobenzene	3.2 U	4.4 U	1.1 U	3.8 UJ
Tentatively Identified Compounds:				
Cyclotetrasiloxane, Octamethyl	**9.7 NJ**			
Cyclotetrasiloxane, Hexamethyl-		3.7 NJ		
2-penten-1-ol, (E)			**0.78 NJ**	
5-Undecene, (E)			27.2 NJ	
BNA Compounds (µg/Kg)				
Dimethylnitrosamine	149 U	173 U	79.0 U	200 U
Pyridine	745 U	864 U	395 U	1000 U
Aniline	149 U	173 U	79.0 U	200 U
Phenol	149 U	173 U	79.0 U	200 U
Bis(2-Chloroethyl)Ether	149 U	173 U	79.0 U	200 U
2-Chlorophenol	149 U	173 U	79.0 U	200 U
1,3-Dichlorobenzene	149 U	173 U	79.0 U	200 U
1,4-Dichlorobenzene	149 U	173 U	79.0 U	200 U
1,2-Dichlorobenzene	149 U	173 U	79.0 U	200 U
Benzyl Alcohol	149 U	173 U	79.0 U	200 U
2-Methylphenol	149 U	173 U	79.0 U	200 U
Bis(2-Chloroisopropyl)Ether	149 U	173 U	79.0 U	200 U
N-Nitrosodiphenylamine	149 U	173 U	79.0 U	200 U
4-Methylphenol	149 U	173 U	**259**	200 U
Hexachloroethane	149 UJ	173 U	79.0 U	200 U
Nitrobenzene	149 U	173 U	79.0 U	200 U
Isophorone	149 U	173 U	79.0 U	200 U
2-Nitrophenol	149 UJ	173 U	79.0 U	200 U
2,4-Dimethylphenol	149 U	173 U	79.0 U	200 U
Bis(2-Chloroethoxy)Methane	149 U	173 U	79.0 U	200 U
Benzoic Acid	1490 U	1730 U	790 U	2000 U
2,4-Dichlorophenol	149 U	173 U	79.0 U	200 U
1,2,4-Trichlorobenzene	149 U	173 U	79.0 U	200 U
Naphthalene	149 U	173 U	79.0 U	200 U
4-Chloroaniline	149 UJ	173 UJ	79.0 U	200 U

Table E-4, page 3. Sediment quality concentrations and physical characteristics for Gibbons Creek remnant channel (dry weight).

	RC1	RC2	RC3	RC4
Hexachlorobutadiene	149 U	173 U	79.0 U	200 U
4-Chloro-3-Methylphenol	149 U	173 U	79.0 U	200 U
2-Methylnaphthalene	149 U	173 U	79.0 U	200 U
Hexachlorocyclopentadiene	298 UJ	346 UJ	158 UJ	400 UJ
2,4,6-Trichlorophenol	149 U	173 U	79.0 U	200 U
2,4,5-Trichlorophenol	149 U	173 U	79.0 U	200 U
2-Chloronaphthalene	149 U	173 U	79.0 U	200 U
2-Nitroaniline	149 U	173 U	79.0 U	200 U
Dimethyl Phthalate	**83.4 J**	**37.4 J**	79.0 U	200 U
2,6-Dinitrotoluene	149 UJ	173 U	79.0 U	200 U
Acenaphthylene	149 U	173 U	79.0 U	200 U
3-Nitroaniline	149 UJ	173 U	79.0 U	200 U
Acenaphthene	149 U	**18.7 J**	79.0 U	200 U
2,4-Dinitrophenol	1490 UJ	1730 UJ	790 UJ	2000 UJ
4-Nitrophenol	745 UJ	864 UJ	395 UJ	1000 UJ
Dibenzofuran	149 U	**14.5 J**	79.0 U	200 U
2,4-Dinitrotoluene	149 U	173 U	79.0 U	200 U
Diethyl Phthalate	149 U	173 U	79.0 U	200 U
Fluorene	149 U	**25.1 J**	79.0 U	200 U
4-Chlorophenyl Phenylether	149 U	173 U	79.0 U	200 U
4-Nitroaniline	149 UJ	173 UJ	79.0 U	200 U
4,6-Dinitro-2-Methylphenol	1490 UJ	1730 U	790 U	2000 U
N-Nitroso-di-n-Propylamine	149 U	173 U	79.0 U	200 U
1,2-Diphenylhydrazine	149 U	173 U	79.0 U	200 U
4-Bromophenyl Phenylether	149 U	173 U	79.0 U	200 U
Hexachlorobenzene	149 U	173 U	79.0 U	200 U
Pentachlorophenol	149 U	173 U	79.0 U	200 U
Phenanthrene	**72.5 J**	**277**	79.0 U	200 U
Anthracene	149 U	**46.4 J**	79.0 U	200 U
Caffeine	149 U	173 U	79.0 U	200 U
Carbazole	149 U	173 U	79.0 U	200 U
Di-n-Butyl Phthalate	149 U	173 U	79.0 U	200 U
Fluoranthene	**125 J**	**449**	79.0 U	200 U
Benzidine	298 U	346 U	158 U	400 U
Pyrene	111 U	**377**	79.0 U	200 U
Retene	**73.1 J**	173 U	79.0 U	200 U
Butylbenzyl Phthalate	149 U	173 U	79.0 U	200 U
Benzo(a)Anthracene	149 U	**160 J**	79.0 U	200 U
3,3'-Dichlorobenzidine	298 UJ	346 UJ	158 UJ	400 UJ
Chrysene	**71.5 J**	**221**	79.0 U	200 U
Bis(2-Ethylhexyl)Phthalate	181 UJ	283 UJ	79.0 U	200 U
Di-n-Octyl Phthalate	149 U	173 U	79.0 U	200 U
Benzo(b)Fluoranthene	149 U	**222**	79.0 U	200 U
Benzo(k)Fluoranthene	149 U	**108 J**	79.0 U	200 U
Benzo(a)Pyrene	149 U	**173 J**	**79.0 J**	200 U
3B-Coprostanol	1490 UJ	**1320 J**	**178 J**	**1210 J**
Indeno(1,2,3-cd)Pyrene	149 U	**113 J**	79.0 U	200 U
Dibenzo(a,h)Anthracene	149 U	**25.4 J**	79.0 U	200 U
Benzo(g,h,i)Perylene	149 U	**116 J**	79.0 U	200 U
Pesticides/PCBs (µg/Kg)				
alpha-BHC	11 U	13 U	5.9 U	15 UJ
beta-BHC	11 U	13 U	5.9 U	15 UJ
gamma-BHC (Lindane)	11 U	13 U	5.9 U	15 UJ
delta-BHC	11 U	13 U	5.9 U	15 UJ
Heptachlor	11 U	13 U	5.9 U	15 UJ
Aldrin	11 U	13 U	5.9 U	15 UJ
Heptachlor Epoxide	11 U	13 U	5.9 U	15 UJ
Endosulfan I	11 U	13 U	5.9 U	15 UJ
4,4'-DDE	11 U	13 U	5.9 U	15 UJ
Dieldrin	11 U	13 U	5.9 U	15 UJ
Endrin	11 U	13 U	5.9 U	15 UJ
Endosulfan II	11 U	13 U	5.9 U	15 UJ

Table E-4, page 4. Sediment quality concentrations and physical characteristics for Gibbons Creek remnant channel (dry weight).

	RC1	RC2	RC3	RC4
4,4'-DDD	11 U	13 U	5.9 U	15 UJ
Endrin Aldehyde	11 U	13 U	5.9 U	15 UJ
4,4'-DDT	22 UJ	26 UJ	12 UJ	30 UJ
Endosulfan Sulfate	11 U	13 U	5.9 U	15 UJ
Endrin Ketone	11 U	13 U	5.9 U	15 UJ
Methoxychlor	22 UJ	26 UJ	12 UJ	30 UJ
Chlordane	75 U	86 U	40 U	100 UJ
Toxaphene	224 U	259 U	119 U	300 UJ
gamma-Chlordane	11 U	13 U	5.9 U	15 UJ
PCB - 1221	75 U	86 U	40 U	100 UJ
PCB - 1232	149 U	173 U	79 U	200 UJ
PCB - 1016	75 U	86 U	40 U	100 UJ
PCB - 1242	75 U	86 U	40 U	100 UJ
PCB - 1248	75 U	86 U	40 U	100 UJ
PCB - 1254	75 U	86 U	40 U	100 UJ
PCB - 1260	75 U	86 U	40 U	100 UJ

Key to qualifiers:
U - The analyte was not detected at or above the reported limit.
J - The analyte was positively identified. The associated numerical result is an estimate.
UJ - The analyte was not detected at or above the reported estimated result.
N - The spike sample recovery is not within control limits.