Table 3.7.1

SUMMARY OF STATE AND FEDERAL WATER QUALITY CRITERIA
[(mg/L) unless otherwise noted.]

VARIABLE	Washington State Water Quality Criteria Class A (Excellent)[a]	Environmental Protection Agency (EPA) Recommended Guidelines[b]	State Board of Health Drinking Water Regulations[c]	Basin Plan Threshold Values[d]
Fecal Coliform	shall not exceed a geometric mean value of 100 organisms/100 mL, with not more than 10 percent of samples exceeding 200 organisms/100 mL	--	1 organism/100 mL as the average of all samples tested each month (membrane filter technique)	--
Temperature	shall not exceed 18.0° C[e]	--	--	--
pH	shall be within the range 6.5-8.5[f]	--	--	--
Dissolved Oxygen	shall exceed 8.0 mg/L	--	--	--
Total Phosphorus	currently none established	0.10[g]	--	--
Nitrate + Nitrite - Nitrogen	currently none established	10.0[h]	10.0[h]	1.25[i]
Total Suspended Solids	currently none established	Settleable and suspended solids should not reduce the depth of the compensation point for photosythetic activity by more than 10 percent from the seasonally established norm for aquatic life.	--	50[j]

VARIABLE	Washington State Water Quality Criteria Class A (Excellent)[a]	EPA Freshwater Aquatic Life[k] Acute Toxicity	EPA Freshwater Aquatic Life[k] Chronic Toxicity	State Board of Health Drinking Water Regulations[c]	Basin Plan Threshold Values[d]
Copper		0.0039	0.003	1.0	--
Lead		0.010	0.0004	0.05	--
Zinc		0.030	0.027	5.0	--

a) Chapter 173-201 WAC Water Quality Standards for Surface Waters of the State of Washington
b) U.S. EPA 1986 Gold Book Quality Criteria for Water.
c) State Board of Health-Drinking Water Regulations, Department of Health, Revised September 1989.

Table 3.7.1 (cont.)

d) Basin Plan Threshold Value (see text page 3-84).

e) Due to human activities, temperature increases shall not, at any time, exceed $t = 28/(T + 7)$. "t" represents the maximum permissable temperature increase measured at a dilution boundary; and "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge.

f) With a man-caused variation within a range of less than 0.5 units.

g) A desired goal for the prevention of plant nuisances in streams or other flowing waters not discharging directly to lakes or impoundments. To prevent the development of biological nuisances and to control accelerated or cultural eutrophication, total phosphates as phosphorus (P) should not exceed 0.05 mg/L in any stream at the point where it enters any lake or reservoir, nor 0.025 mg/L within the lake or reservoir.

h) For domestic Water Supply (health). Serious and occasionally fatal poisonings in infants have occurred following ingestion of untreated well waters shown to contain nitrate at concentrations greater than 10 mg/L nitrate nitrogen (N).

i) Basin Plan Threshold Value (see Text p. 3-84).

j) Basin Plan Threshold Value (see Text p. 3-84). In a study downstream from the discharge of a rock quarry where inert suspended solids were increased to 80 mg/L, the density of macroinvertebrates decreased by 60 percent while in areas of sediment accumulation benthic invertebrate populations also decreased by 60 percent regardless of the suspended solid concentrations (Gammon, 1970-EPA Goldbook).

k) Freshwater quality criteria for some chemicals are a function of hardness. For this table, a criteria concentration based on a hardness value of 20 mg/L calcium carbonate is provided.

-- This symbol means "not applicable for this report."

DATA GATHERING AND ANALYSIS METHODS

Background Surveys

Since the early 1980s, water quality studies have focused on the main stem of Hylebos Creek due to water quality concerns associated with industrial activities adjacent to Commencement Bay. The following section briefly describes both these studies and those conducted for the Lower Puget Sound basin.

1981-1984 <u>Water Quality in the Lower Puyallup River Valley and Adjacent Uplands, Pierce County, Washington</u> [U. S. Geological Survey (USGS)]

The USGS assessed ground and surface water quality in Hylebos Creek as part of a study of the Puyallup River, White River, and most small streams in the lower Puyallup River valley. Groundwater samples were collected in 1984 and analyzed for metals, organic compounds, nutrients, and indicator bacteria. Water column and bottom-sediment samples, collected in 1983 through 1984, were analyzed for metals and organic compounds. Water samples were also analyzed for nutrients, indicator bacteria, dissolved oxygen (DO), and biochemical oxygen demand (BOD). Suspended-sediment samples were analyzed for metals.

Fecal coliform and fecal-streptococcal densities increased downstream in Hylebos Creek. These results may have indicated the impact of agricultural activities on downstream reaches during the early- to mid-1980s. The USGS study also revealed that concentrations of nitrogen compounds (nitrate, organic nitrogen, and ammonia) and ratios of nitrogen to phosphorus were generally higher in the small streams than in the Puyallup River. Additionally, as expected, total phosphorus concentrations were generally higher during stormflows and generally increased from upstream to downstream sites within Hylebos Creek. Bed sediments from the small streams generally contained more arsenic, lead, and zinc than bed sediments from the Puyallup and White Rivers. The study concluded that the Puyallup and White Rivers are suitable in quality or, with minimum treatment, could be made suitable for fish hatchery use. An exception was Fife Ditch where fish life may not be suitably sustained.

1981-Ongoing <u>Commencement Bay Nearshore/Tideflat Superfund Surveys</u> (Various agencies/consultants)

Commencement Bay was targeted for Superfund action in 1981, when the U.S. Environmental Protection Agency (EPA) announced a national "interim priority list" of 115 top priority hazardous waste sites. At that time, Commencement Bay was the highest priority site in the State of Washington and one of the ten highest national priority sites. Industrial surveys conducted by the Tacoma-Pierce County Health Department and the Port of Tacoma identified 281 industrial activities and 480 point and nonpoint sources including drains, seeps, and open channels in Hylebos Waterway and other tributaries in Commencement Bay.

In 1985, the Commencement Bay Nearshore/Tideflats Remedial Investigation (CBRI) was completed. The Commencement Bay Nearshore/Tideflats Feasibility Study (CBFS) was completed in 1988. Finalization of the Record of Decision (ROD), which formally designates preferred remedial alternatives, was published in mid-1989. Four main categories of problems were identified: contaminated facilities, wastewater discharges, storm drains, and contaminated sediments. An Integrated Action Plan (IAP) will address these four problems. Regulatory and enforcement action to deal with these problems will utilize a number of state and federal authorities. Local governments along with the Puyallup Indian Tribe will also be involved in regulatory and management programs associated with Commencement Bay.

1983-1984 Metal Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek Drainage (Washington State Department of Ecology (DOE)--Commencement Bay/Nearshore/Tideflats Remedial Investigation

Water, sediment, and fish tissue samples collected from Hylebos Creek between 1983 and 1984 were analyzed for arsenic and other metals, with the primary aim of identifying impacts due to two industrial landfills within the drainage.

The report concluded that metal concentrations were low in Hylebos Creek during low flow with the exception of arsenic and cadmium which were high and originating from two industrial landfills (United States Gypsum and B & L). Arsenic concentrations in the Surprise Lake drainage from one identified source, B & L Landfill, were found to be potentially toxic. In addition, metal concentrations in Hylebos Creek during wet weather conditions were not substantially different than during low flow, except arsenic. Elevated concentrations in upper Hylebos Creek suggested a source in the upper basin. Substantial increases in arsenic concentrations in sediment were also observed below both landfills. Additionally, the report concluded that gill tissue from Hylebos Creek cutthroat trout showed arsenic concentrations one to two orders of magnitude above gill and whole fish samples from other western Washington streams. Furthermore, arsenic concentrations at the mouth of Hylebos Creek were typically an order of magnitude higher than in other local rivers. The report suggested Hylebos Creek and Penwalt process effluent were major sources except during storm events when runoff from log sort yards with Asarco slag ballast may predominate.

1985 Nonpoint Source Pollution in the Federal Way Community (Executive Summary and Recommendations)
Nonpoint Pollution in the Federal Way Community (Volume 2 Technical Analysis) (Resource Planning Associates)

In a 1985 report to the Federal Way Water and Sewer District, the Executive Summary and Recommendations Report assessed the types and sources of nonpoint pollution in the Federal Way area. In addition, the report documents specific sources of nonpoint pollution and provides a technical analysis of these findings.

1986-Ongoing Water Quality Monitoring of McSorley Creek (Green River Community College (GRCC) for the City of Kent)

Since January, 1986, chemistry students from the GRCC have obtained routine monthly surface water samples in McSorley Creek at 251st Street and 16th Avenue South (see Location #11) Figure 3.7.1b. Variables being sampled include nutrients, solids, bacteria, and metals. The purpose of this project is to develop a baseline database for the City of Kent's Water Quality Management Program.

1987 <u>Seattle-King County Health Department Repairs and Septic Tank Overflows</u>

The Seattle-King County Health Department has documented repairs and septic tank overflows in various areas of King County. Figures 3.7.2a and b show septic system repairs and overflows in the Federal Way area during 1987.

1988-Ongoing <u>South King County Ground Water Management Plan</u> (South King County Ground Water Advisory Committee, Economic and Engineering Services, Inc., Hart-Crowser, Inc., Pacific Groundwater Group, and Robinson & Noble, Inc.)

This plan describes groundwater quality trends in southwest King County beginning in 1970. Water quality indicator parameters were chosen based on land use characteristics. Water quality trends for indicator parameters were analyzed for data within the Federal Way subarea, one of four subareas evaluated also including Des Moines, Green River Valley, and Covington. A total of 24 wells, 17 shallow (i.e., wells completed at a depth of less than or equal to 250 feet) and 7 deep (i.e., a depth greater than 250 feet) were used in the analysis. No significant trends were observed for any of the indicator parameters for either the shallow or deep wells.

Recent Surveys

1987-1988 <u>Hylebos Creek and Lower Puget Sound Drainage Basin Water Quality Report</u> (Metro)

The primary purpose of this report was to provide water quality data for the Hylebos Creek and Lower Puget Sound Basin Plan. Streams in the Hylebos Creek and Lower Puget Sound basins were sampled monthly from May 1987 through April 1988. Seven stations were monitored, all at flow gaging sites near the mouths of Joes (QJ1), McSorley (QM1), Cold (QC1), and Lakota (QL1) Creeks, respectively, and East Hylebos (QEH1), West Hylebos (QWH3), and North Fork of West Hylebos (QWH8) Creeks respectively (see Figures 3.7.1a and b). Baseflow grab (hand-dipped) samples were obtained near the mouths of these creeks during non-storm conditions.

Staff gage height and twelve water quality variables were measured. The water quality variables included: temperature, pH, conductivity, turbidity, total suspended solids, dissolved oxygen, ammonia, nitrate + nitrite, soluble reactive phosphorus, total phosphorus, and bacteria. Bacteria levels are an indication of the water quality relative to physical contact by humans and were estimated by two parameters, fecal coliforms and <u>Enterococcus</u>. Neither group of bacteria cause illness itself, rather, they are both indicators of the presence of organisms which do or have the potential to cause illness. The Washington State criteria set by Ecology are for fecal coliforms. Epidemiological studies have defined correlations between concentrations in water and increased probabilities of illness in swimmers for <u>Enterococcus</u>, but not for fecal coliforms.

Eight trace metals--cadmium, chromium, copper, iron, mercury, nickel, lead, and zinc--were measured quarterly. Steel Lake was sampled twice during late winter or early spring by Metro staff and twice per month from May through October by a trained volunteer as part of the Metro Small Lakes Program. The following

Figure 3.7.1a

Hylebos Creek Basin Planning Area

WATER QUALITY SAMPLING LOCATIONS

- ■ Metro Baseflow Monitoring Site (1987 - 1988)
- ● SWM Storm Event Monitoring Site (1989 - 1990)
- ◆ Suspended Solids Only
- VH9 Subcatchment Boundary, Number
- Wetland

King County
Surface Water Management Division

0 1/2 1 mile

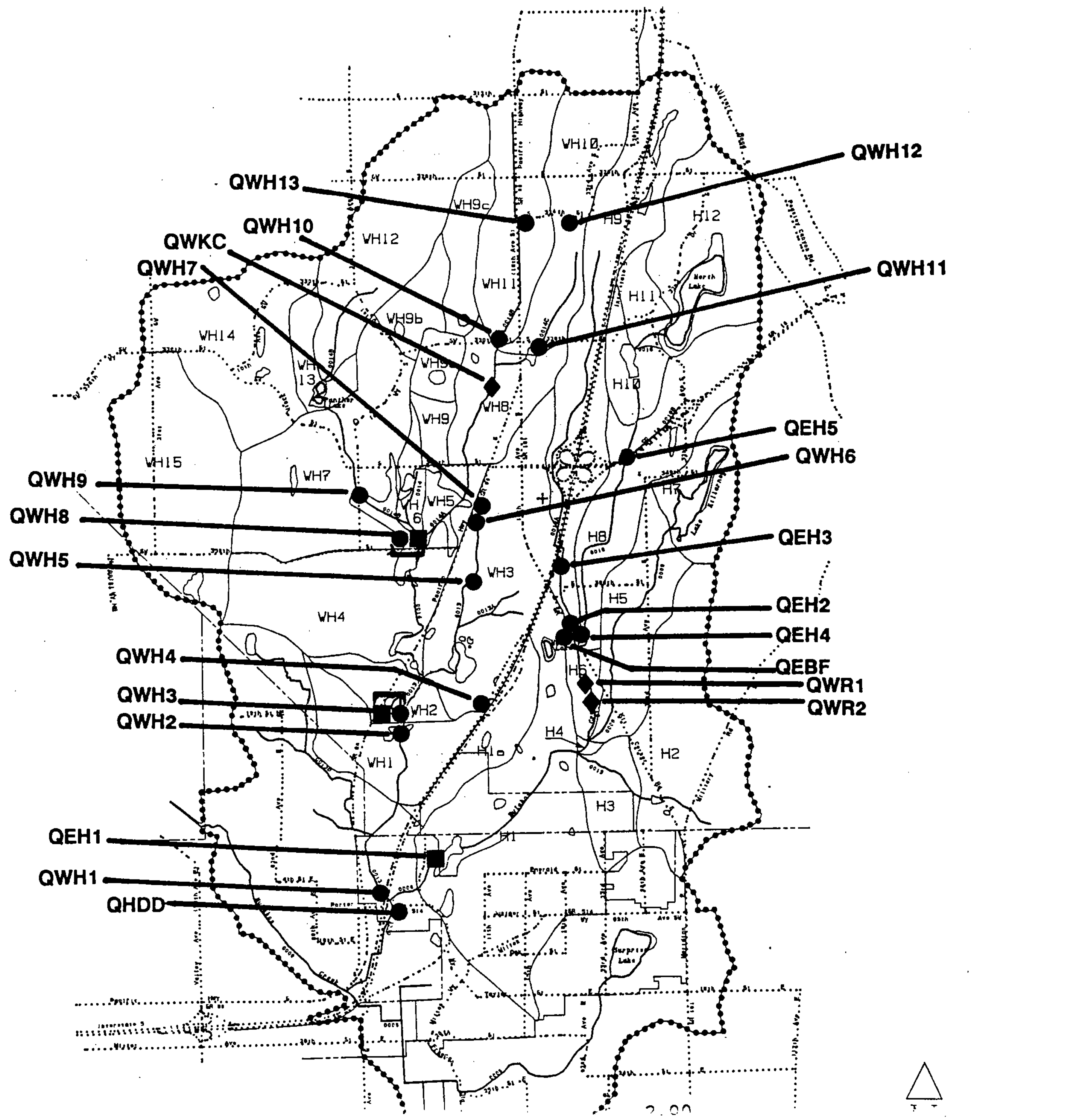


Figure 3.7.1b

Lower Puget Sound Basin

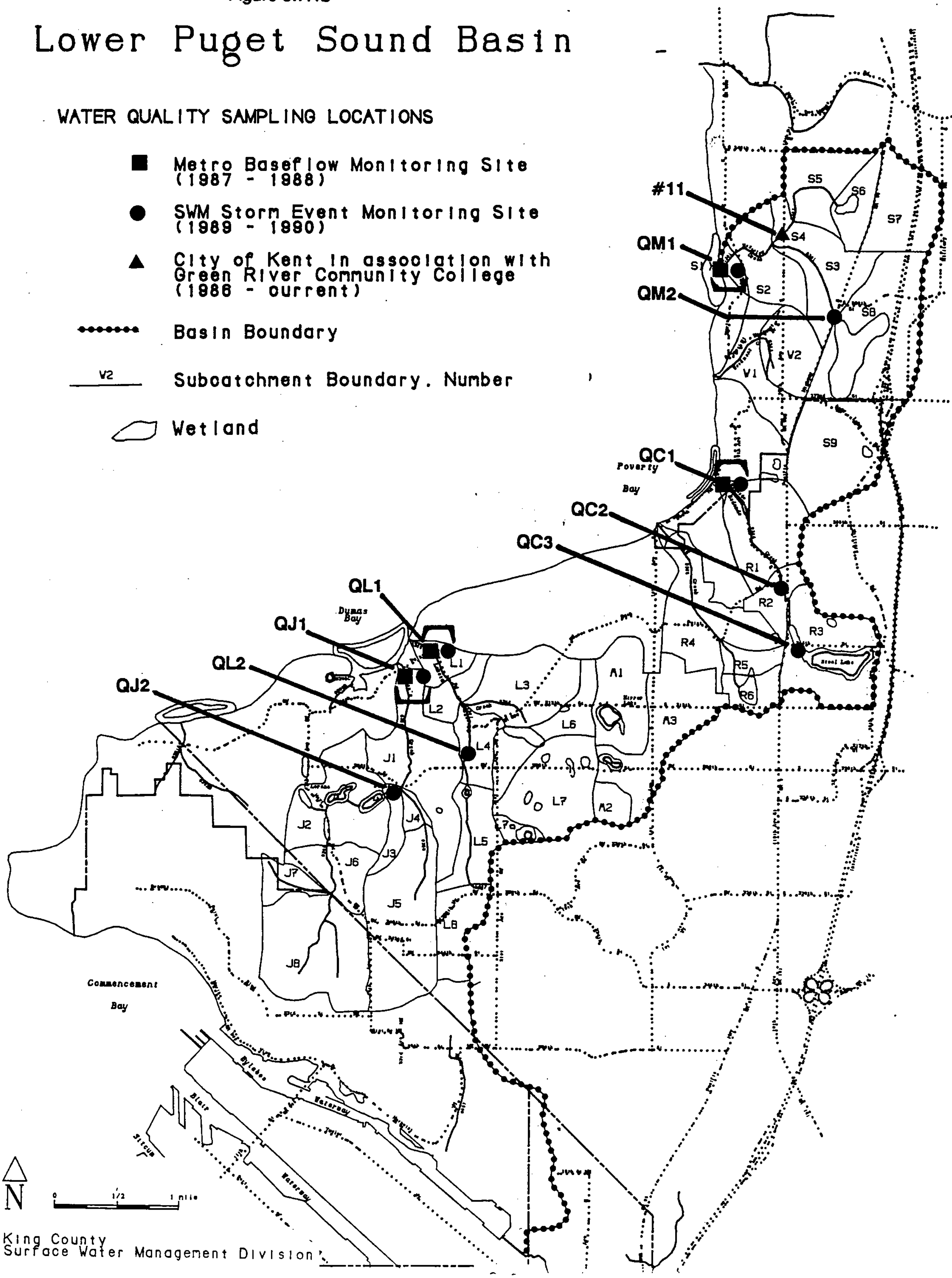


Figure 3.7.2a

Hylebos Creek Basin Planning Area

●REPAIRS AND SEPTIC TANK OVERFLOWS IN FEDERAL WAY IN 1987*

*From Seattle - King County Health Dept. 1987

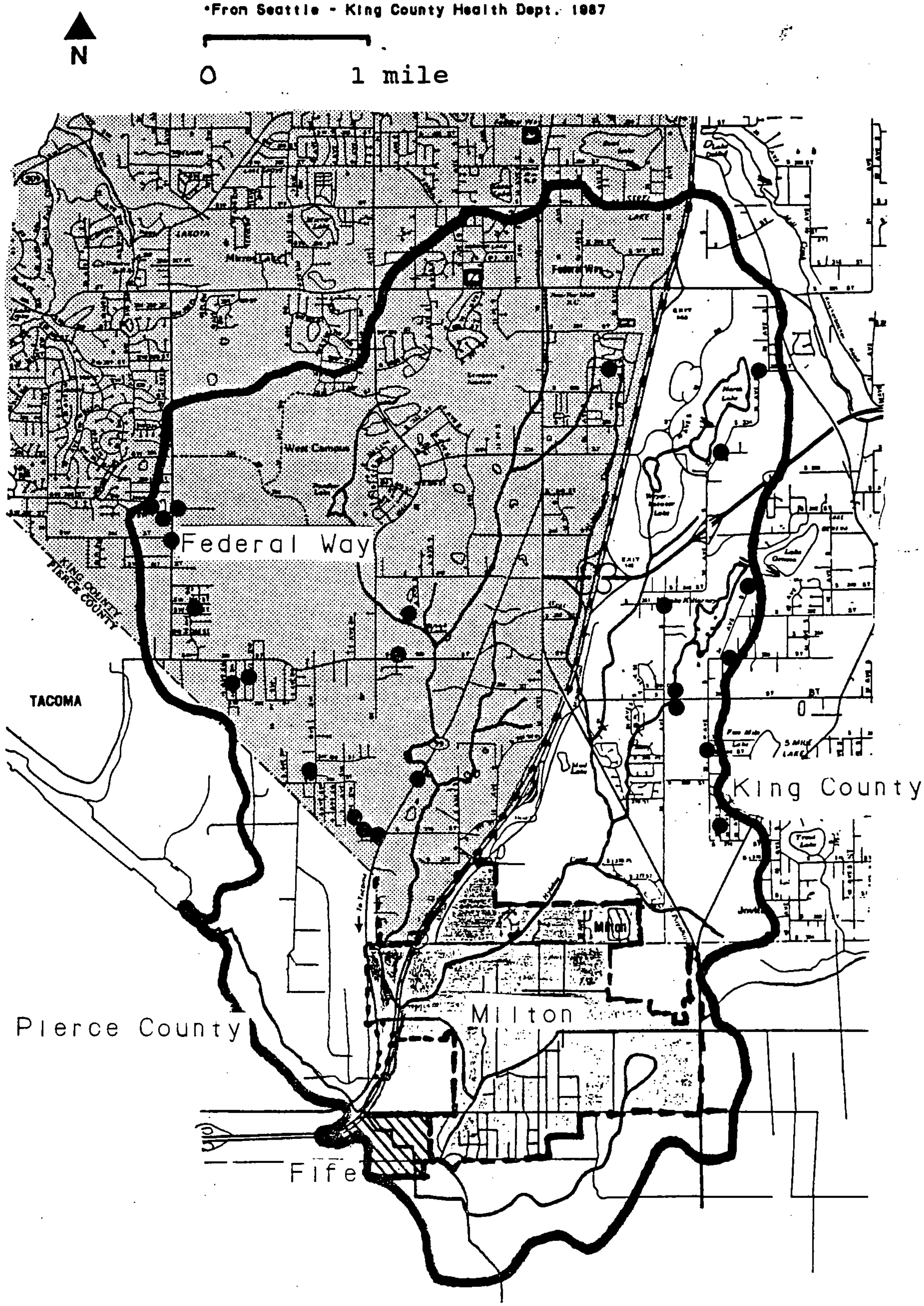
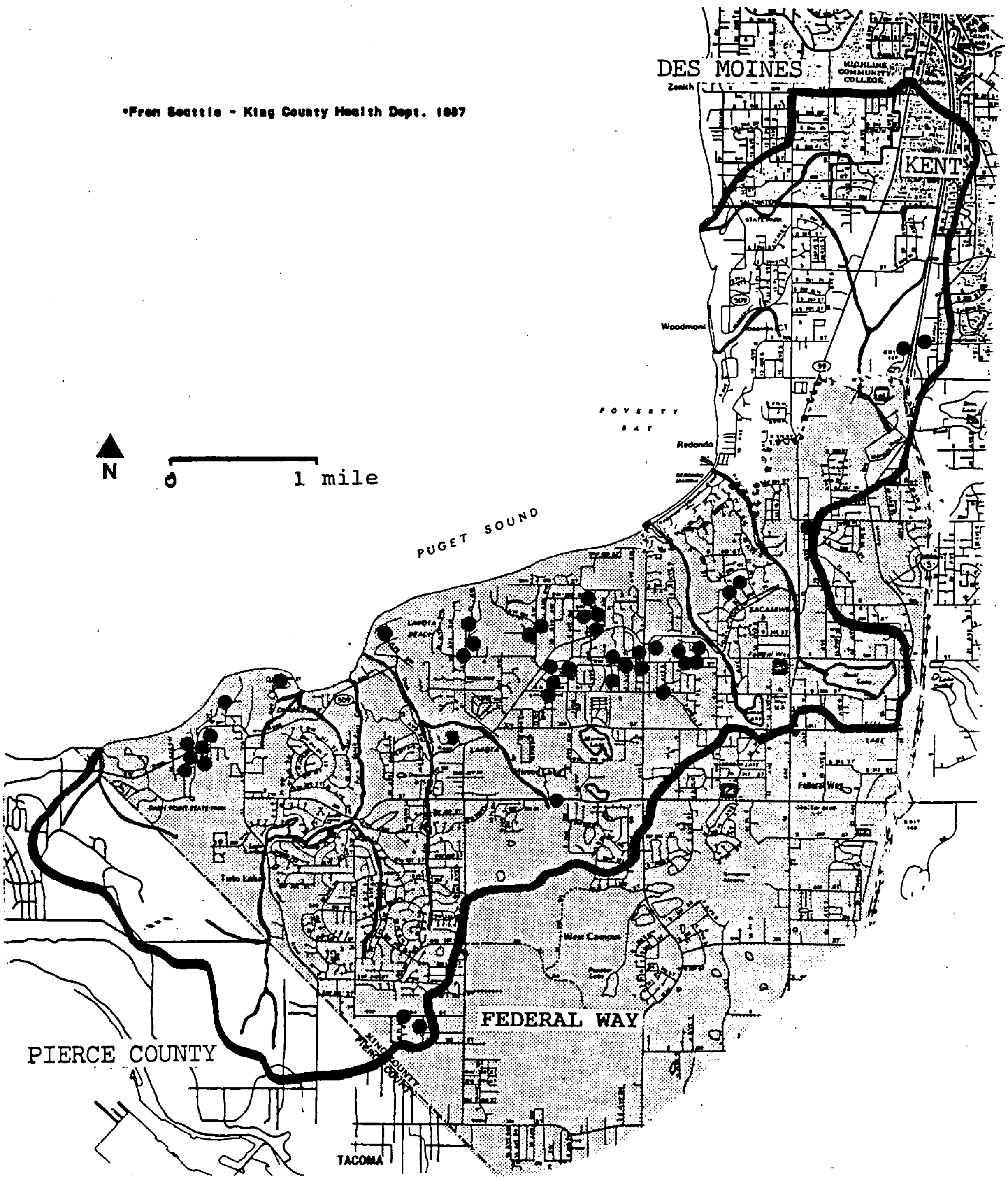


Figure 3.7.2b

Lower Puget Sound Basin

● REPAIRS AND SEPTIC TANK OVERFLOWS IN FEDERAL WAY IN 1987*

*From Seattle - King County Health Dept. 1987



variables were analyzed by Metro staff: total phosphorus, chlorophyll a, transparency, conductivity, pH, temperature, and dissolved oxygen at depths of 1, 3, and 6 meters. The volunteer sampled at a depth of 1 meter, measuring temperature and transparency *in situ*, and obtained a sample to be analyzed at the Metro laboratory for total phosphorus and chlorophyll a.

1989-1990 Hylebos Creek and Lower Puget Sound Supplemental Storm Event Monitoring Program [King County Surface Water Management (KCSWM)]

To better characterize nonpoint pollutants during storm conditions in both basins, KCSWM implemented a limited program to sample storm runoff events. Seven variables were chosen for study: fecal coliform, nitrate + nitrite - nitrogen, total phosphorus, total suspended solids, copper, lead, and zinc. The purpose of the program was to supplement storm runoff water quality data that the Metro baseflow study did not collect and to characterize water quality in upper reaches of tributaries not previously sampled by Metro.

Sample locations were based on field reconnaissance visits and chosen according to the following criteria:

- existing water quality data (Metro and King County Basin Reconnaissance reports)
- proximity to known nonpoint pollution sources
- accessibility

Various storm runoff samples were obtained at up to 32 sampling locations (Figure 3.7.1a and b) during October 26, 1990 (precipitation = 0.50 in. recorded at Sea-Tac Airport), December 2, 1989 (precipitation = 1.18 in. recorded at Mr. Ted Enticknap's residence - 36817 - 12th Avenue S, Federal Way), and January 7, 1990 (precipitation = 1.25 in., recorded at Mr. Ted Enticknap's residence). Grab samples were usually obtained early in or near the peak of each storm event. Three teams composed of KCSWM staff and a Citizen Advisory Committee member, Federal Way Water and Sewer District personnel, and Tacoma-Pierce County Health Department personnel were involved in the supplemental storm event monitoring program. A number of nonpoint pollutant sources were identified and isolated, however, a more in depth monitoring program will be needed to reliably identify nonpoint sources of pollution in both basins.

1990-Ongoing Additional Storm Event Monitoring Program (Federal Way Water and Sewer District (FWWSD))

FWWSD personnel will obtain samples during two additional storm runoff events during the spring of 1990. Sampling at 18 stations is expected.

CONDITIONS

Current Conditions

Baseflow

The monthly values (obtained during Metro's 1987-1988 baseflow study) for the variables: dissolved oxygen, temperature and pH were usually within the state water quality criteria values listed in Table 3.7.1. For all stations the fecal coliform geometric mean was less than 100 organisms/100 mL. Samples exceeded 200 organisms/100 mL once on Hylebos Creek, twice each on Cold Creek and Lakota Creek, three times on McSorley Creek, and four times on the north fork of West Branch Hylebos Creek during the sampling period. The maximum value for fecal coliform during the baseflow study was 350 organisms/100 mL on Cold Creek. EPA has established criteria for Enterococcus bacteria based on human health effects. For swimming, the maximum allowable level is 89 organisms/100 mL. All samples obtained in November and most in October 1987, exceeded these criteria (Table 3.7.2). These criteria were exceeded three times on the north fork of West Branch Hylebos Creek and twice at the other stations. The median values ranged from 32 to 58 organisms/100 mL. The highest value was 1120 organisms/100 mL, was obtained from Cold Creek.

Table 3.7.2

BASEFLOW WATER QUALITY SUMMARY RESULTS
(Exceedances of State Standards and Federal Recommended Criteria)

Station		Variable: Dissolved Oxygen	Temperature	pH	Fecal Coliform	Enterococcus
East Hylebos	(QEH1)	0	0	0	1	2
West Hylebos	(QWH3)	0	0	0	0	2
	(QWH8)	1	0	0	4	3
Joes	(QJ1)	0	0	0	0	2
McSorley	(QM1)	0	0	1	3	2
Cold	(QC1)	0	0	0	2	2
Lakota	(QL1)	0	0	0	2	2

Metal concentrations obtained during the baseflow study were quite low and frequently below detection limits.

The monthly values for the seven stations monitored (during baseflow conditions) within the Hylebos Creek and Lower Puget Sound basins were compared to values for 44 routine stream and river sites monitored during the same period (May 1987 to April 1988) in the Metro Freshwater Assessment Program. Table 3.7.3 lists a summary comparison of these data.

Table 3.7.3

HYLEBOS CREEK AND LOWER PUGET SOUND
MINIMUM, MEDIAN, AND MAXIMUM VALUES FOR FIVE VARIABLES VERSUS
METRO'S 44 ROUTINE MONITORING STATIONS

	Dissolved Oxygen (mg/L)			Turbidity (ntu)		
Station	Min	Med	Max	Min	Med	Max
7 Hylebos/ Lower Puget Sound Stations	7.8	10.9	12.9	0.6	1.2	14.0
44 Stream Stations	3.4	10.5	13.7	0.3	2.1	75.0

	Total Suspended Solids (mg/L)			Nitrate+nitrite-nitrogen (mg/L)		
Station	Min	Med	Max	Min	Med	Max
7 Hylebos/ Lower Puget Sound Stations	0.6	3.2	153.0	0.09	0.32	3.02
44 Stream Stations	0.3	4.5	305.0	0.001	0.67	2.05

	Total Phosphorus (mg/L)		
Station	Min	Med	Max
7 Hylebos/ Lower Puget Sound Stations	0.018	0.053	0.14
44 Stream Stations	0.002	0.058	1.02

The seven Hylebos Creek and Lower Puget Sound basin stations were usually very close to the median value observed at Metro's 44 stream stations.

The baseflow water quality was generally good in the Hylebos Creek and Lower Puget Sound basins during 1987-1988. Water quality appeared sufficient to support beneficial uses in both basins. Stations sampled were cool, clear, and well oxygenated and had relatively low bacteria levels. Some stations did have relatively high nitrate + nitrite levels. This can be a concern during summer months when these high levels along with high temperatures and lower DO concentrations, may impact fish populations and increase the frequencies of algal blooms and aquatic macrophyte (i.e., aquatic vegetation) biomasses that may impact recreational uses.

Storm Event

Storm event monitoring data were analyzed from both basins. A basin comparison of water quality constituents is listed in Table 3.7.4. The Hylebos Creek basin had higher maximum concentrations in five out of six variables; however, the Lower Puget Sound basin had higher mean concentrations in four of the six constituents. Nevertheless, only fecal coliform bacteria densities in the Lower Puget Sound basin (see Figure 3.7.3a) and nitrate + nitrite - nitrogen concentrations in the Hylebos Creek basin (see Table 3.7.5) are substantially higher, when comparing one basin to the other. The first significant storm in the fall, commonly referred to as a "first flush" storm event, usually contains some of the highest pollutant concentrations of any given year. This is a result of a "build-up" of pollutants along roadways and adjacent to water courses during the dry periods of summer months. Figures 3.7.3a-c reflect this "build-up" and "first flush" effect with three selected contaminants (fecal coliforms, total suspended solids, and zinc).

Figures 3.7.4a-f highlight the significant surface water quality problems observed during the 1989-1990 SWM storm event monitoring program. The most significant problem identified in West Branch Hylebos Creek sub-basin is metals. Nutrients (e.g., nitrogen and phosphorus) are the most serious surface water quality problems in East Branch Hylebos Creek sub-basin (see Figure 3.7.4b). Contaminant loading to Commencement Bay from an accumulation of upstream sources in Hylebos Creek is the surface water quality problem of concern in Lower Hylebos Creek sub-basin. Figure 3.7.4c highlights the only two stations monitored in this sub-basin during the 1989-1990 SWM storm event program. In the North Lower Puget Sound sub-basin, total phosphorus is identified as the most significant water quality concern from the 1989-1990 SWM storm event monitoring program (Figure 3.7.4d). Copper and fecal coliform bacteria are also significant water quality concerns in this sub-basin. Total suspended solids are the major surface water quality problem in the Central Lower Puget Sound sub-basin (see Figure 3.7.4e). While the chief surface water quality issue in the South Lower Puget Sound sub-basin is fecal coliform bacteria (see Figure 3.7.4f). In addition, total suspended solids and total phosphorus are significant water quality concerns in this sub-basin.

Figure 3.7.3a

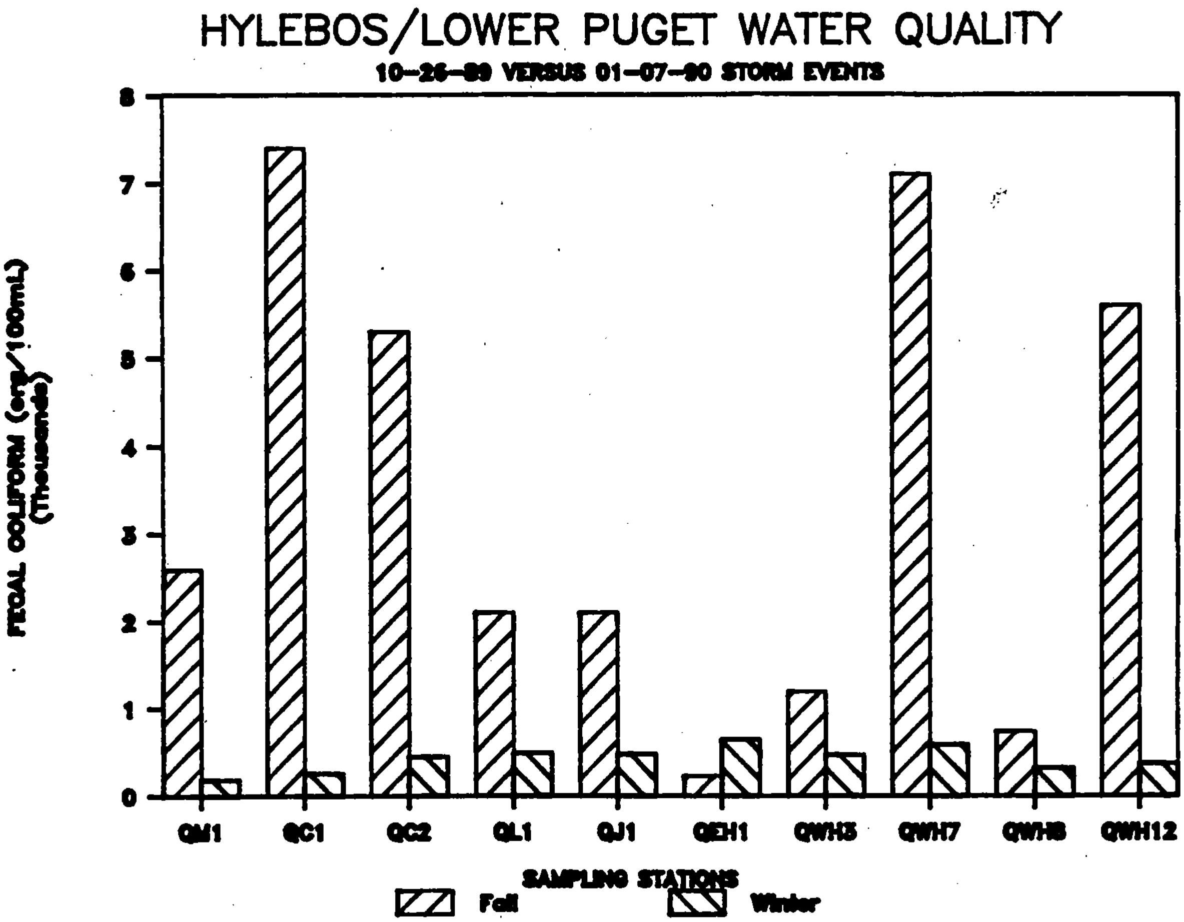


Figure 3.7.3b

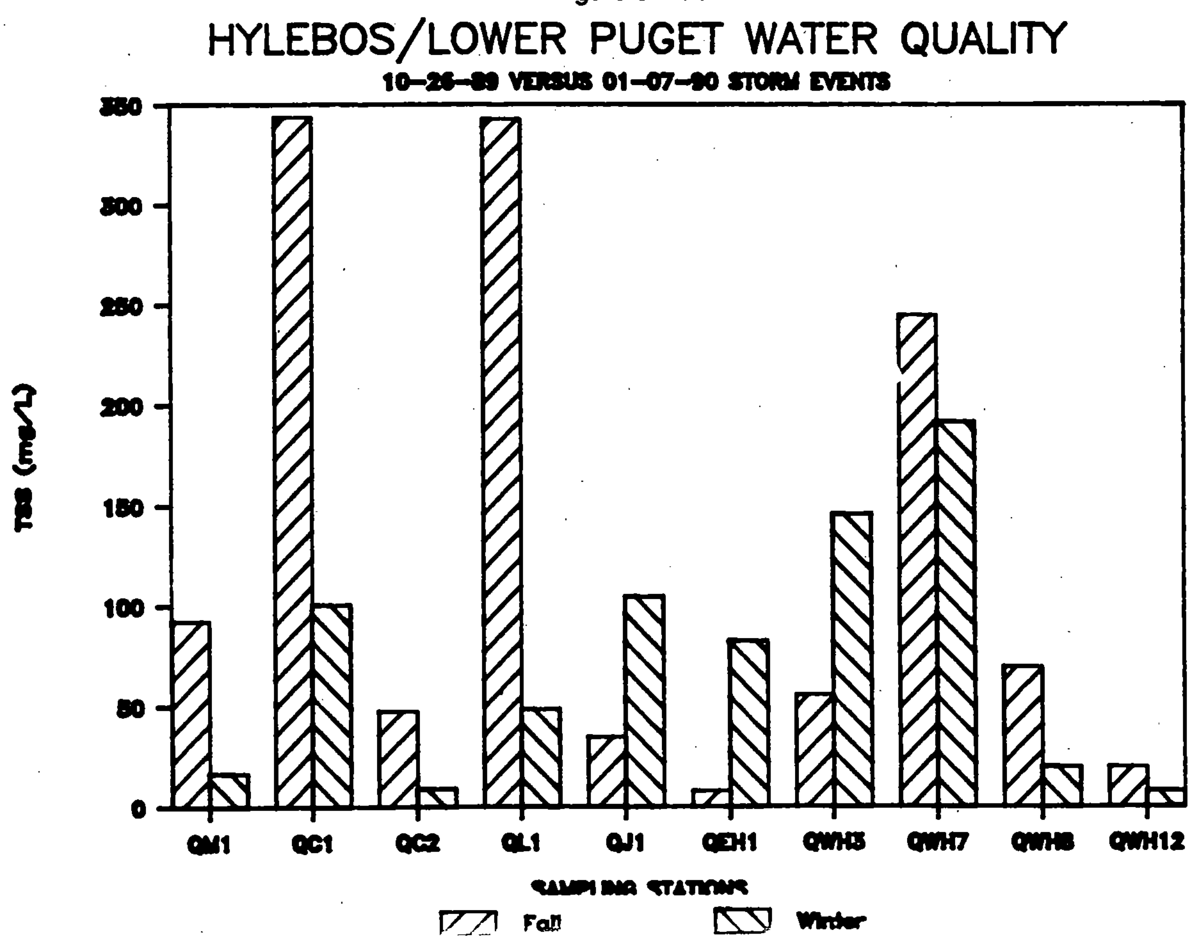
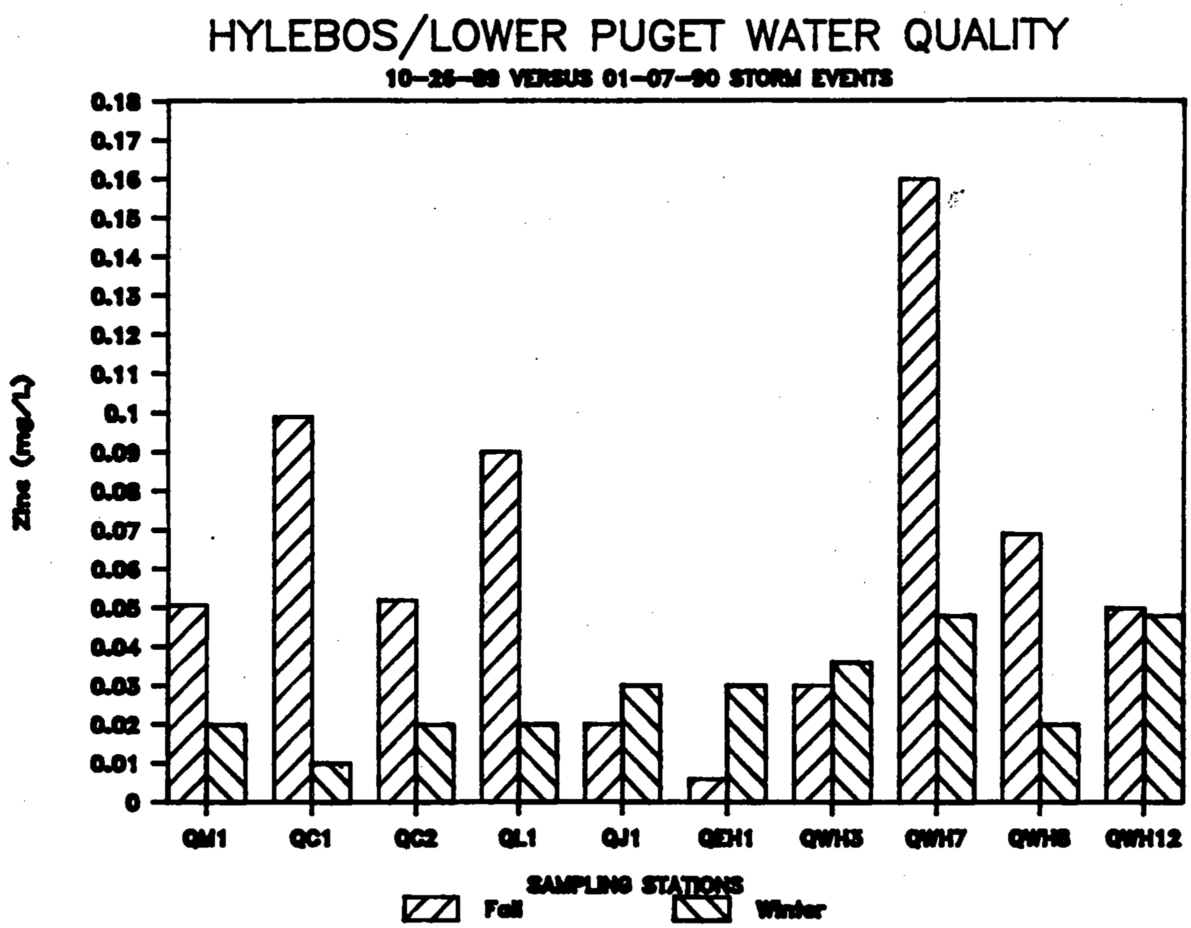


Figure 3.7.3c



HYLEBOS/LOWER PUGET WATER QUALITY
10-26-89 VERSUS 01-07-90 STORM EVENTS
Zinc (mg/L)
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
QM1
QC1
QC2
QL1
QJ1
QEH1
QWH3
QWH7
QWH8
QWH12
SAMPLING STATIONS
Fall
Winter

Table 3.7.4

BASIN SUMMARY STORM WATER QUALITY RESULTS

VARIABLE		HYLEBOS CREEK BASIN	LOWER PUGET SOUND BASIN
Fecal Coliform	Average Geometric Mean*	594	801
	Range	30-39,300	100-7,400
Total Phos-phorus	Average Mean (mg/L)*	0.17	0.19
	Range	0.03-0.76	0.04-0.61
Nitrate + nitrite - nitrogen	Average Mean (mg/L)*	0.80	0.53
	Range	0.06-2.54	0.08-0.88
Total Suspended Solids	Average Mean (mg/L)*	57	66
	Range	4-297	6-344
Copper	Average Mean (mg/L)*	0.009	0.011
	Range	0.002-0.067	0.005-0.028
Zinc	Average Mean (mg/L)*	0.036	0.031
	Range	0.005-0.16	0.007-0.099

* This number was obtained by averaging the means listed in Table 3.7.8.

Figure 3.7.4a

West Branch Hylebos Creek Sub-basin

SIGNIFICANT SURFACE WATER QUALITY PROBLEMS

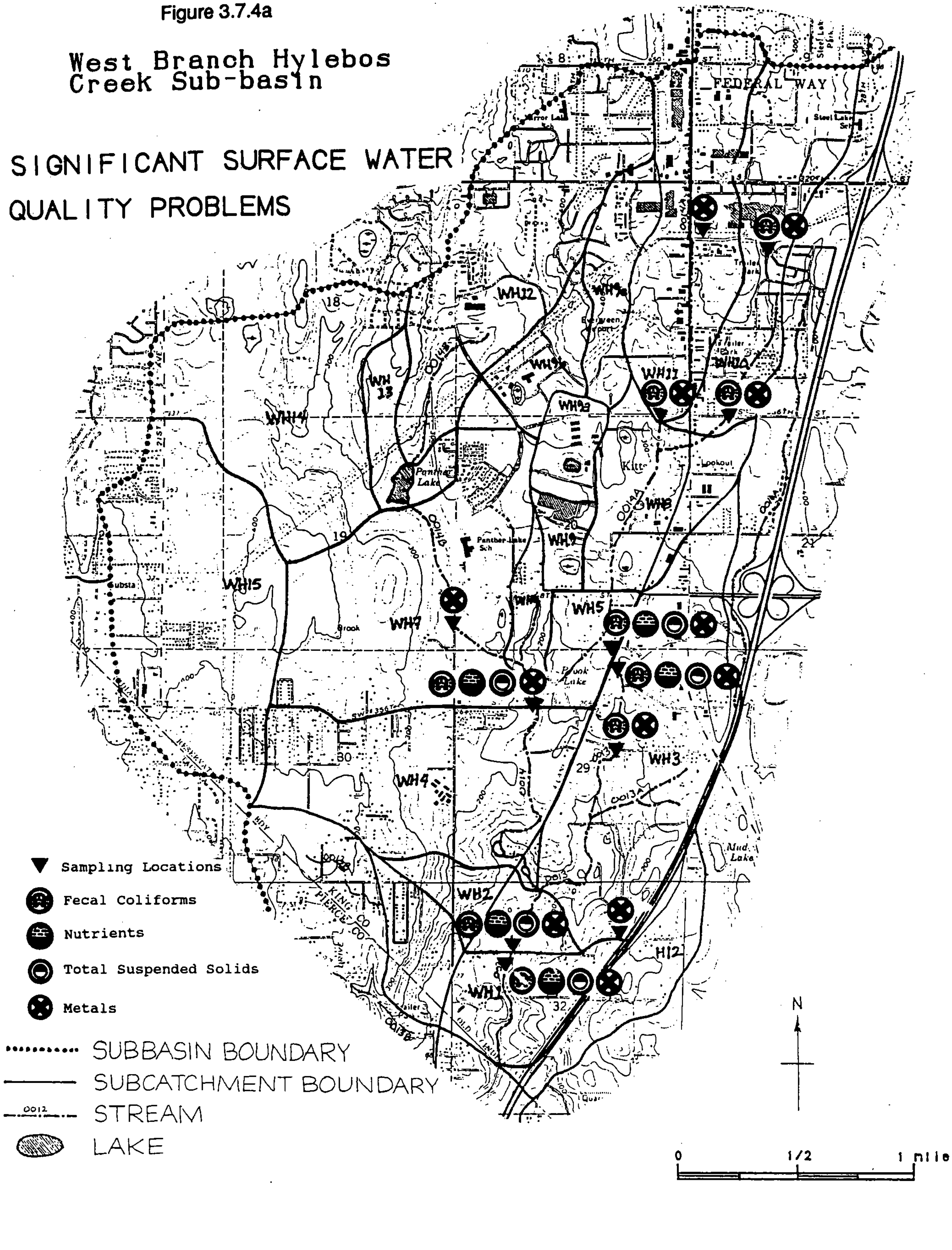


Figure 3.7.4b

East Branch Hylebos Creek Sub-basin

SIGNIFICANT SURFACE WATER QUALITY PROBLEMS

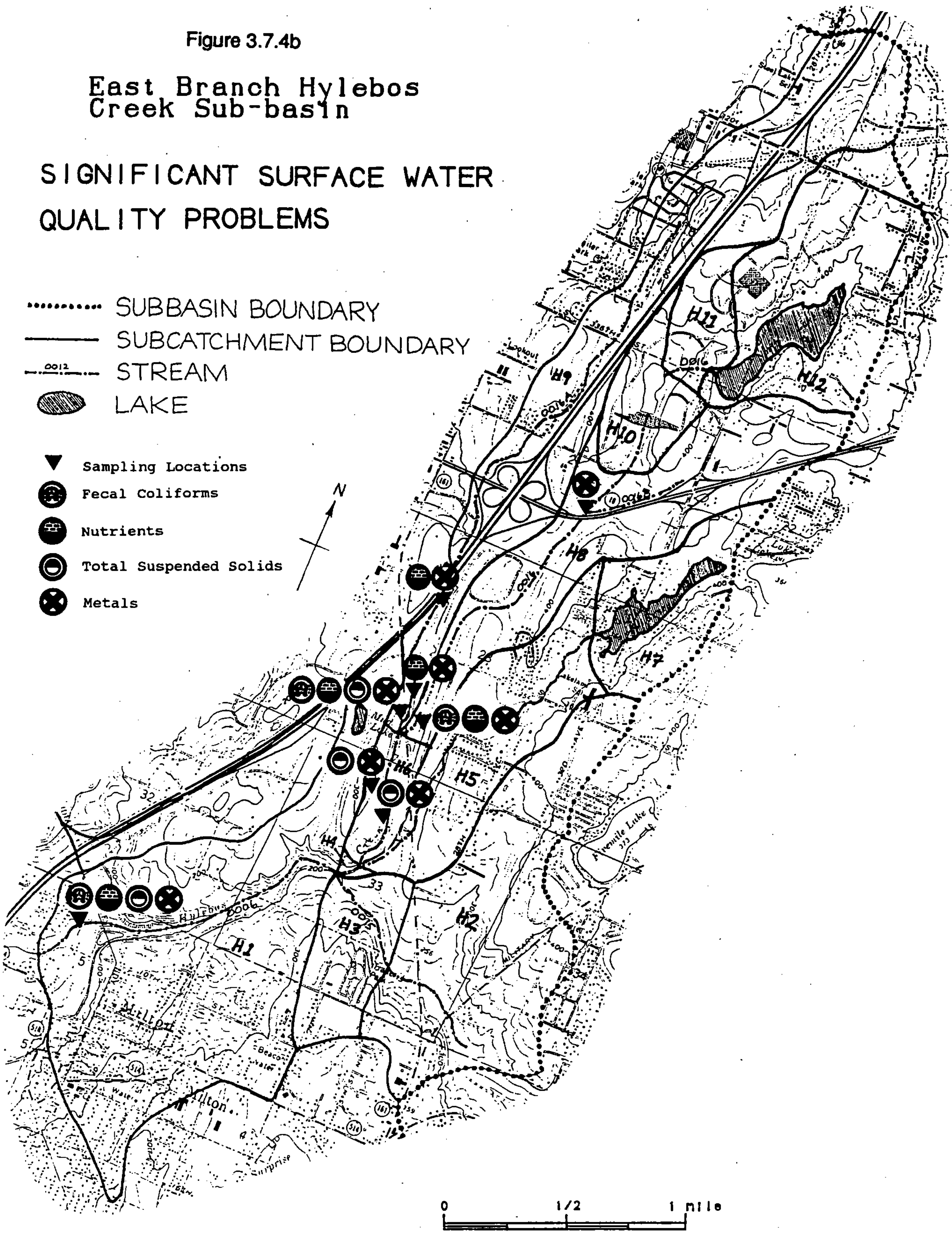


Figure 3.7.4c

Lower Hylebos Creek Sub-basin

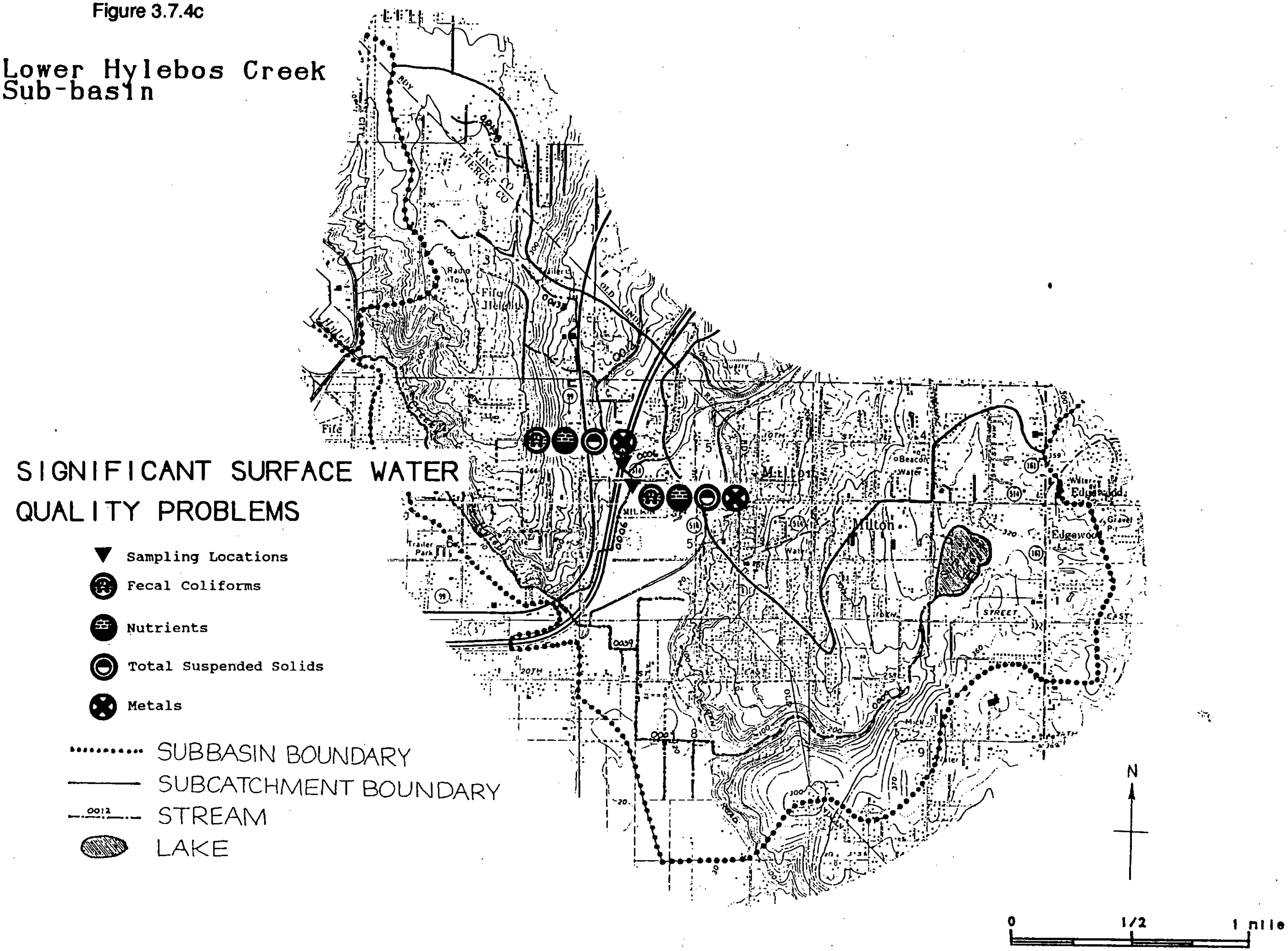


Figure 3.7.4d

North Lower Puget Sound Sub-basin

SIGNIFICANT SURFACE WATER QUALITY PROBLEMS

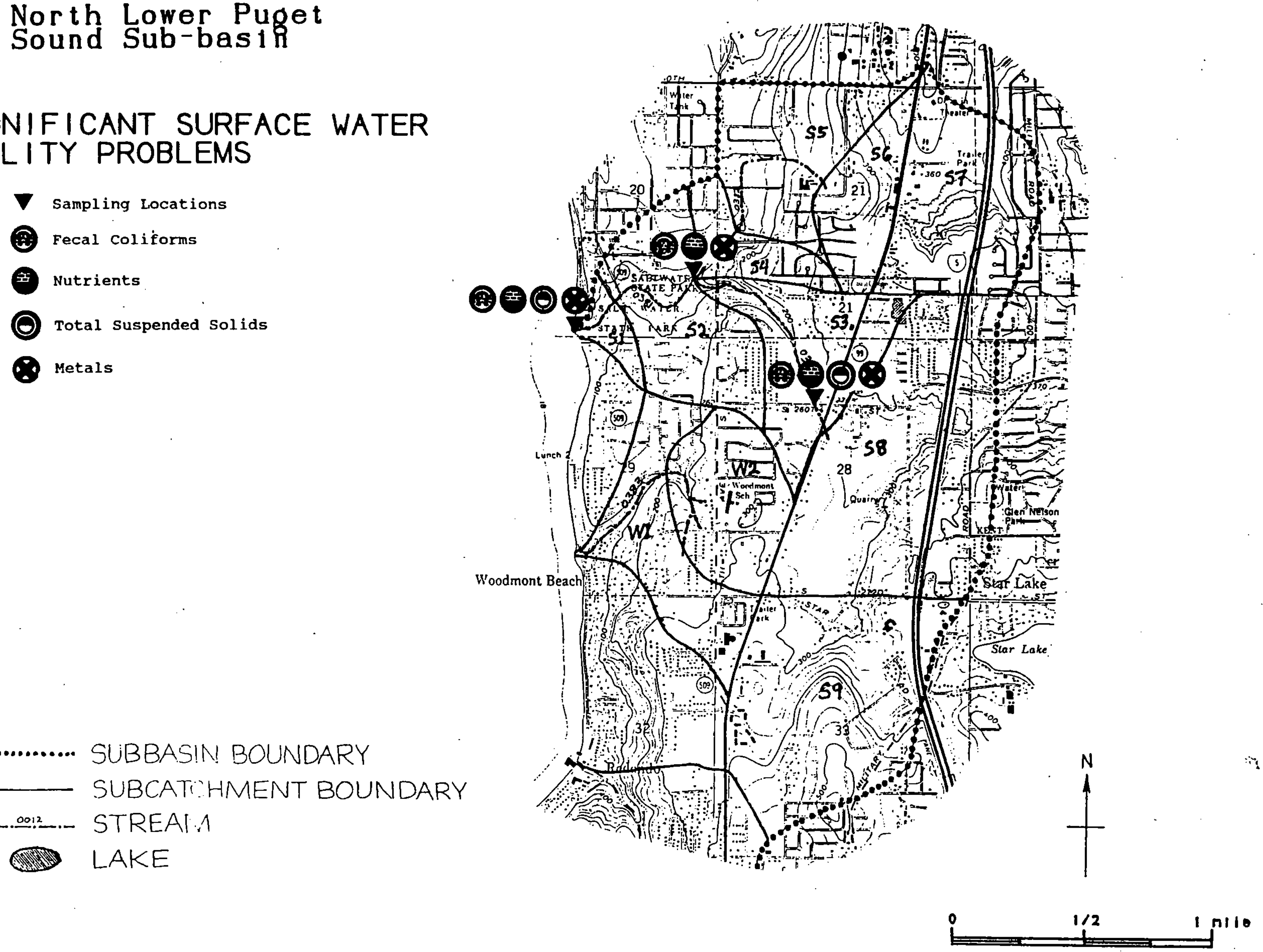
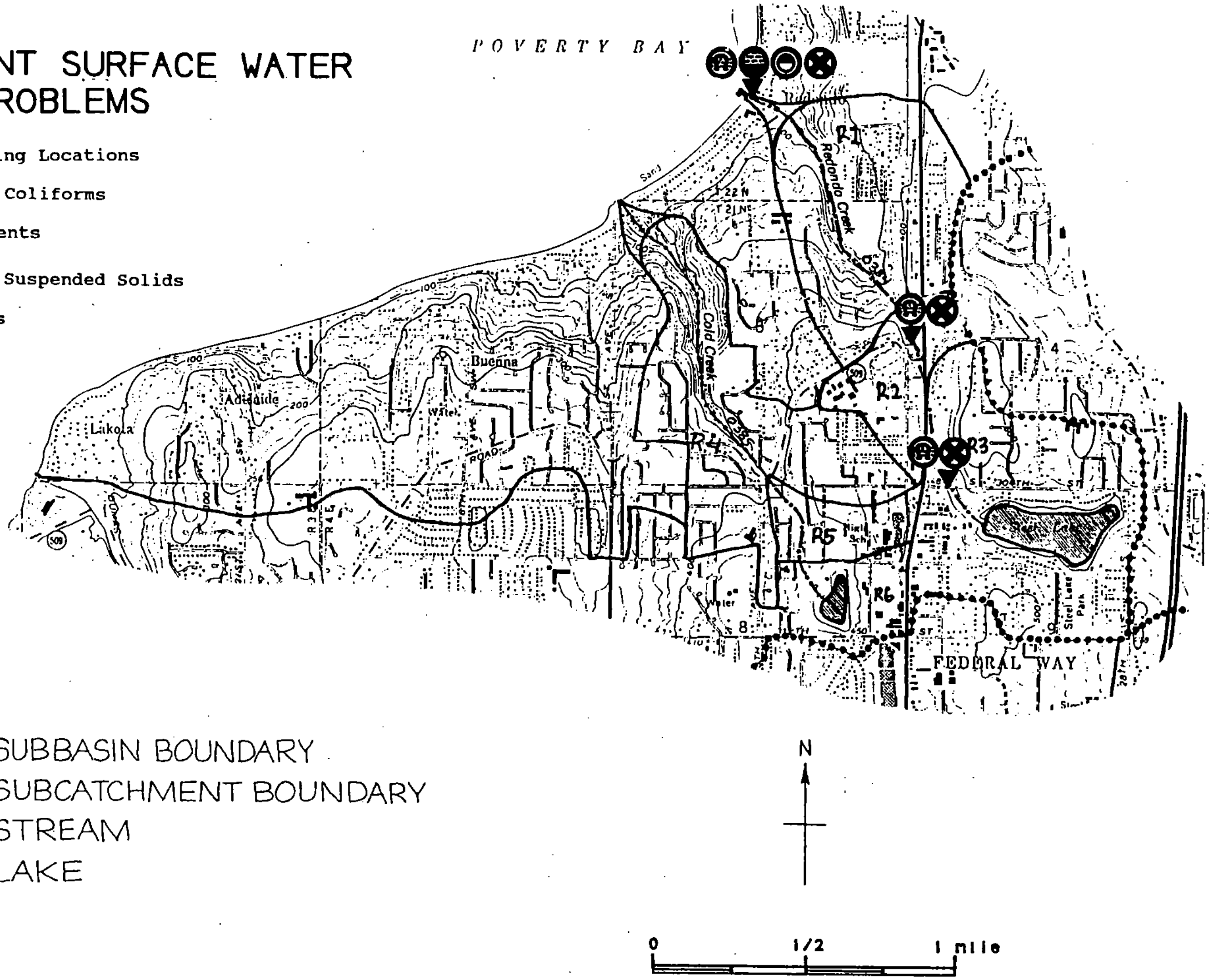


Figure 3.7.4e

Central Lower Puget Sound Sub-basin

SIGNIFICANT SURFACE WATER QUALITY PROBLEMS

▼ Sampling Locations
Fecal Coliforms
Nutrients
Total Suspended Solids
Metals



SUBBASIN BOUNDARY
SUBCATCHMENT BOUNDARY
STREAM
LAKE

Figure 3.7.4f

South Lower Puget Sound
Sub-basin

SIGNIFICANT SURFACE WATER
QUALITY PROBLEMS

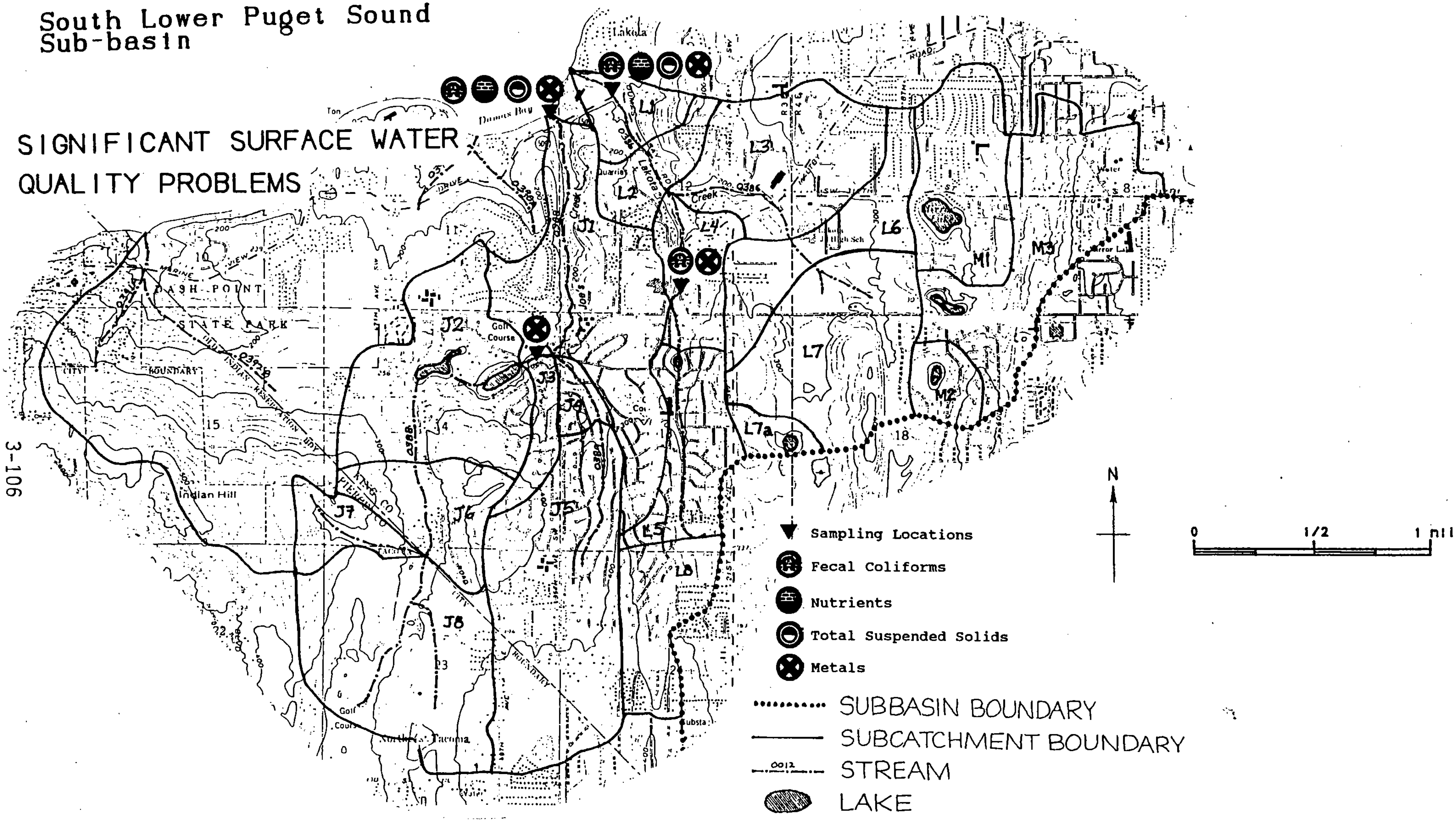


Table 3.7.5 lists mean concentrations and number of samples exceeding criteria for six out of seven variables. Mean concentrations are broken down by sub-basin for comparisons.

Table 3.7.6 lists a summary of the total number of samples exceeding water quality criteria both by basin and by variable. A total of 53 percent of the samples exceeded water quality criteria in the Hylebos Creek basin compared to 47 percent in the Lower Puget Sound basin. It is interesting to note that these percentages are similar, even though more than twice as many samples were obtained within the Hylebos Creek Basin.

"Pollution points" (2-12) were assigned to each sub-basin based on ranking of mean concentrations (i.e., the higher the mean concentration, the higher the pollution points assigned to a sub-basin). The Lower Puget Sound basin had 139 total "pollution points" versus 113 for the Hylebos Creek basin based on their rankings of mean concentrations (Table 3.7.7).

Table 3.7.5

STORM EVENT WATER QUALITY RESULTS SUMMARY

Fecal Coliform

Sub-basin	Geometric Mean (colonies/100 mL)	Number of Samples Exceeding Criteria (100 colonies/100mL)
South Lower Puget	869	8/8
Lower Hylebos	825	4/4
North Lower Puget	819	4/4
Central Lower Puget	716	6/7
West Hylebos	586	25/26
East Hylebos	372	10/13

Total Phosphorus

Sub-basin	Mean (mg/L)	Number of Samples Exceeding Recommended Guide-lines (0.10 mg/L)
North Lower Puget	0.22	3/4
East Hylebos	0.20	6/13
South Lower Puget	0.19	4/8
Lower Hylebos	0.17	4/4
Central Lower Puget	0.16	3/7
West Hylebos	0.15	14/26

Table 3.7.5 (continued)

Nitrate + Nitrite - Nitrogen

Sub-basin	Mean(mg/L)	Number of Samples Exceeding Basin Plan "Threshold Value" (1.25 mg/L)
East Hylebos	1.01	3/13
Lower Hylebos	0.98	2/4
South Lower Puget	0.60	0/8
North Lower Puget	0.54	0/4
Central Lower Puget	0.45	0/7
West Hylebos	0.40	0/26

Total Suspended Solids

Sub-basin	Mean(mg/L)	Number of Samples Exceeding Basin Plan "Threshold Value" (50 mg/L)
Central Lower Puget	75	2/7
South Lower Puget	73	2/8
East Hylebos	67	6/17
West Hylebos	58	9/28
North Lower Puget	49	2/4
Lower Hylebos	45	2/4

Copper

Sub-basin	Mean(mg/L)	Number of Samples Exceeding Chronic 4-day* Criteria	Number of Samples Exceeding Acute 1-hr** Criteria
West Hylebos	0.014	19/20	19/20
North Lower Puget	0.013	3/4	3/4
Central Lower Puget	0.012	5/5	5/5
South Lower Puget	0.009	6/6	5/5
East Hylebos	0.007	13/15	12/13
Lower Hylebos	0.006	3/4	3/4

Table 3.7.5 (continued)

Lead

Detection limits of 0.03 mg/L or parts per million (ppm) used in this supplemental monitoring program is above EPA toxicity criteria and typical freshwater concentrations. However, lead concentrations obtained from Metro of Seattle (Stormwater Runoff Data) typically exceeded USEPA acute and chronic criteria 100% of the time (Resource Planning Associates, 1985).

Zinc

Sub-Basin	Mean(mg/L)	Number of Samples Exceeding Chronic 4-day* Criteria	Number of Samples Exceeding Acute 1-hr** Criteria
West Hylebos	0.058	23/27	23/27
Central Lower Puget	0.037	4/7	4/7
South Lower Puget	0.030	3/8	3/8
East Hylebos	0.026	6/15	6/15
North Lower Puget	0.025	1/4	1/4
South Hylebos	0.025	1/4	1/4

* Chronic 4-day Criteria: EPA recommend guidelines for deriving Numerical National Water Quality Criteria for the protection of aquatic organisms and their uses indicate that, except possibly where a locally significant species is very sensitive, freshwater aquatic organisms and their uses should not be affected unacceptably if the 4-day average concentration is not exceeded more than once every 3 years on the average.

** Acute 1-hour Criteria: EPA recommend guidelines for deriving Numerical National Water Quality Criteria for the protection of aquatic organisms and their uses indicate that, except possibly where a locally significant species is very sensitive, freshwater aquatic organisms and their uses should not be affected unacceptably if the 1-hour average concentration is not exceeded more than once every 3 years on the average. Three years is the EPA's best scientific judgement of the average amount of time aquatic ecosystems should be provided between excursions.

Table 3.7.6

BASIN SUMMARY OF WATER QUALITY CRITERIA EXCEEDANCES

Total number of samples exceeding criteria

Basin	Total Number of Samples Exceeding Criteria		Percent
Hylebos	136/258	=	53%
Lower Puget Sound	52/110	=	47%

Percent of samples exceeding criteria by water quality variable

Variable	Hylebos	Lower Puget Sound
Fecal Coliform	91%	99%
Copper (chronic)	90%	94%
Zinc (acute)	65%	42%
Total Phosphorus	56%	53%
Total Suspended Solids	35%	32%
Copper (acute)	16%	8%
Nitrate + nitrite - nitrogen	12%	0%

Table 3.7.7

TOTAL POLLUTION POINTS

Sub-Basin		Basin	n
South Lower Puget	52		(8)
Central Lower Puget	44		(7)
North Lower Puget	43	Total 139	(4)
East Hylebos	42		(13)
West Hylebos	38		(26)
Lower Hylebos	33	Total 113	(4)

n = total number of samples used in analysis

Comparison of Baseflow and Storm Event Conditions

Water quality data collected in the Hylebos Creek and Lower Puget Sound Basins during baseflow conditions were compared to storm event data (Table 3.7.8). As expected, total suspended solids and fecal coliforms showed the greatest increases. In general, the Lower Puget Sound basins tended to have larger increases in concentrations during storm events than the Hylebos Basin.

Table 3.7.8

COMPARISON OF BASEFLOW TO STORM EVENT SAMPLES IN HYLEBOS/LOWER PUGET SOUND BASINS

Fecal Coliform Bacteria (colonies/100mL)

Sampling Station	Baseflow (Geometric Mean)	Storm Event (Geometric Mean)	Storm Event Geometric Mean Times as High as Baseflow (Geometric Mean)
QEH1 (E. Hylebos)	42	386	9 X more
QWH3 (W. Hylebos)	92	751	8 X more
QWH8 (N. Hylebos)	44	487	11 X more
QJ1 (Joes Creek)	42	1,004	24 X more
QM1 (McSorley Creek)	80	703	9 X more
QC1 (Cold Creek)	65	1,387	21 X more
QL1 (Lakota Creek)	24	1,014	42 X more

Total Phosphorus (mg/L)

Sampling Station	Baseflow Median	Storm Event Range	(Storm Event Conc.) Mean Times as High as Baseflow Conditions
QEH1 (E. Hylebos)	0.037	0.06-0.20	2-6 X more
QWH3 (W. Hylebos)	0.062	0.15-0.24	2-4 X more
QWH8 (N. Hylebos)	0.07	0.13-0.17	2 X more
QJ1 (Joes Creek)	0.065	0.20-0.22	3-3.5 X more
QM1 (McSorley Creek)	0.053	0.16-0.47	3-9 X more
QC1 (Cold Creek)	0.052	0.14-0.61	2.5-12 X more
QL1 (Lakota Creek)	0.050	0.15-0.56	3-11 X more
(44) Stream Stations (Baseflow)	0.058		
(7) Hylebos Creek and Lower Puget Sound Stations (Storm Event)	0.185		

TABLE 3.7.8 (continued)

Total Suspended Solids (mg/L) Sampling Station	Baseflow Median	Storm Event Range	(Storm Event Conc.) Mean Times as High as Baseflow Conditions
QEH1 (E. Hylebos)	3.2	8-83	2.5-26 X more
QWH3 (W. Hylebos)	6.8	56-146	8-21 X more
QWH8 (N. Hylebos)	3.8	20-70	5-18 X more
QJ1 (Joes Creek)	3.0	35-105	11-35 X more
QM1 (McSorley Creek)	2.7	17-93	6-34 X more
QC1 (Cold Creek)	4.3	101-344	23-80 X more
QL1 (Lakota Creek)	3.2	49-343	15-107 X more
(44) Stream Stations (Baseflow)	4.5		
(7) Hylebos Creek and Lower Puget Sound Stations (Storm Event)	76.5		

Nitrate + Nitrite - Nitrogen (mg/L) Sampling Station	Baseflow Median	Storm Event Range	(Storm Event Conc.) Mean Times as High/ Low as Baseflow Conditions
QEH1 (E. Hylebos)	1.24	0.57-0.71	2 X less
QWH3 (W. Hylebos)	0.65	0.57-0.69	--
QWH8 (N. Hylebos)	0.23	0.42-0.60	2-3 X more
QJ1 (Joes Creek)	1.26	0.61-0.64	2 X less
QM1 (McSorley Creek)	0.31	0.37-0.82	1-2.5 X more
QC1 (Cold Creek)	0.33	0.64-0.71	2 X more
QL1 (Lakota Creek)	2.56	0.69-0.88	3-3.5 X less
(44) Stream Stations (Baseflow)	0.67		
(7) Hylebos Creek and Lower Puget Sound Stations (Storm Event)	0.185		

Future Conditions

Conversion of existing open space to commercial and residential impervious areas will negatively impact water quality in both the Hylebos Creek and Lower Puget Sound basins. One way to qualitatively evaluate the impact on beneficial uses in the basins is to examine effects from urban developments in other drainage basins and existing problems mentioned previously in this chapter.

Changes in water quality with increased urbanization have been studied in Kelsey Creek in Bellevue (Richey, 1982). In general, the concentrations of several selected variables (e.g., nutrients and suspended solids) were greater in the urban stream than the rural stream.

Metro collected storm event samples from Springbrook, McAleer, Kelsey, and Juanita Creeks during 1988. Table 3.7.9 lists mean concentrations in comparison to stations within the Hylebos Creek and Lower Puget Sound basins.

Table 3.7.9

STORM EVENT WATER QUALITY FROM REGIONAL VS. HYLEBOS CREEK AND LOWER PUGET SOUND SAMPLING

Stations	Fecal Coliform (geometric mean colonies/ 100mL)	Total Phosphorus (mg/L Mean)	Total Suspended Solids (mg/L Mean)	Nitrate + Nitrite - Nitrogen (mg/L Mean)
Metro: Springbrook, McAleer, Kelsey, and Juanita Creeks	345	0.29	109	0.76
King County SWM: Hylebos Creek and Lower Puget Sound (7 stations)	819	0.19	77	0.64

Although extremely limited, these data appear to indicate that with the exception of fecal coliform, measured concentrations (for these variables) were generally lower in the Hylebos Creek and Lower Puget Sound basins in comparison to Metro's data.

The Seattle Engineering Department collected storm runoff samples from Pipers and Longfellow Creeks during 1988-1990. Table 3.7.10 lists selected water quality results in comparison to Hylebos Creek and Lower Puget Sound basin concentrations.

Table 3.7.10

STORM EVENT WATER QUALITY IN PIPERS AND LONGFELLOW CREEK VS. STUDY AREA

Basin	Fecal Coliform Geometric Mean (Organisms/100mL)	Total Phosphorus mg/L(Mean)	Total Suspended Solids mg/L(Mean)	Copper mg/L(Mean)	Zinc mg/L(Mean)	n
Pipers Creek[a]	20,000[d]	0.14	40	0.0009	0.080	3
Longfellow Creek[b]	1,818[d]	0.22	177	0.019	0.096	21
Hylebos/Lower Puget[c] (7 stations during three storm events)	819[e]	0.19	77	0.012	0.038	14

a = from 3 sample sites during one storm event
b = from 5 sample sites during four storm events (composites)
c = from 7 sample sites during three storm events (grabs)
d = MPN (most probable number method)
e = MF (membrane filter method)
n = number of samples

Although extremely limited, these data appear to indicate that with the exception of fecal coliform bacteria and zinc, storm event water quality data collected recently in the Hylebos Creek and Lower Puget Sound basins may have generally higher concentrations than Pipers Creek. In comparison to Longfellow Creek, water quality concentrations in the Hylebos Creek and Lower Puget Sound basins appear to be much lower. This is much more evident when one considers that data from Longfellow Creek consisted of composited samples which tend to dilute the peak concentrations usually appearing in the early periods of a storm event up through the peak of the storm.

In addition, the City of Seattle collected stormwater runoff samples in storm drains during 1986 through 1988. Selected water quality results are presented in Table 3.7.11.

Table 3.7.11

STORM EVENT WATER QUALITY IN SEATTLE STORM DRAINS VS. STUDY AREA

STUDY	Geometric Mean Values Total Suspended Solids mg/L	Copper mg/L	Zinc mg/L
City of Seattle Storm Drains	49	0.031	0.117
Hylebos/Lower Puget Sound Basin	34	0.008	0.027

Although extremely limited, these data appear to indicate copper and zinc concentrations measured in Seattle storm drains were about 4 times as high as the concentrations detected in the Hylebos Creek and Lower Puget Sound basins. It is important to point out that direct comparisons of water quality data from other basins/studies during different periods, are difficult to make due to the wide variety in conditions (e.g., land use, soils, build-out conditions, precipitation levels) that can exist.

The EPA's typical national values for stormwater pollutant concentrations as a function of land use are displayed in Table 3.7.12:

Table 3.7.12

STORMWATER POLLUTANT CONCENTRATIONS FROM URBAN USES

Urban Land Use	Pollutant Concentrations (mg/L) Total Suspended Solids (TSS)	Biochemical Oxygen Demand (BOD)
Residential	240	12
Commercial	140	20
Industrial	215	9
Other developed areas	17	1

Reference: (Sullivan, 1977)

These TSS data are similar to those observed during the Hylebos Creek and Lower Puget Sound basin storm event monitoring program where residential land use was the largest contributing sediment sources (see TSS Table 3.7.8).

The combined sewer overflow plan for the City of Everett, Washington lists average stormwater runoff concentrations relative to land use as follows:

Variable	Pollutant Concentrations (mg/L) Industrial	Commercial	Residential
BOD	5	11	7
TSS	45	30	50
Pb	0.22	0.38	0.21
Zn	0.35	0.32	0.21

These data also support findings in West Branch Hylebos Creek where industrial and commercial land use contributes higher metal concentrations (see Figure 3.7.3c).

It can be concluded that without mitigation, increases in these urbanized land uses within both the Hylebos Creek and Lower Puget Sound basins will lead to increased concentrations of these pollutants as well as others.

As discussed previously, there are indications of water quality problems presently in both basins that could be exacerbated in the future. A few instances during baseflow conditions documented low dissolved oxygen and pH readings. These water quality constituents, when low, can create stress levels for salmonids and may indicate future potential limitations for these fish populations. These limitations can include reduced growth (metabolic stress), possible migration blockages, and potential mortality, if contaminant concentration levels reach lower limits of an aquatic species suitable range.

Population increases and associated development in both basins will likely result in loss of open space. As a result, without mitigation, temporary increases in turbidity and sedimentation can be expected from construction activity and long-term streambank erosion from increased flows. Increases in fine sediment can limit the success of salmonid spawning and reduce available rearing habitat.

Increased levels of fecal coliforms could be associated with a more urbanized area as well. Pet (e.g., dog and cat) wastes can be a significant source of fecal coliforms in heavy use areas (e.g., trails, parks, etc.). As onsite septic systems age, failure rates tend to increase, especially without proper maintenance. The same can be said for sewer line systems. Onsite septic systems and sewer lines might be two probable major sources of fecal contamination in the basins. Increased impervious surface areas will lead to increased volumes of surface water runoff. Without mitigation, this will result in increased contaminant concentrations and pollutant loadings.

Heavy metals in highway runoff originate from highway materials and various aspects of vehicle operations (Wang et al., 1982). Sources and the metals they contribute include gasoline and exhaust emissions (lead, nickel), lubricating oils (lead, nickel, zinc), grease (zinc, lead), tire wear (cadmium, zinc), concrete paving wear (various metals depending on aggregate source), asphalt paving wear (nickel), bearing wear (copper, lead), brake lining wear (copper, chromium, nickel) and wear of moving engine parts (iron, manganese, chromium, copper) (after Kerri et al., 1976; Hopke et al., 1980; and Novotny and Chesters, 1981).

In a report entitled, "Effects of Seattle Area Highway Stormwater Runoff on Aquatic Biota," (Portele, et al., 1982), impacts of stormwater runoff from freeways on aquatic species was investigated. Algae and zooplankton were adversely affected by metal concentrations in the runoff, while suspended solids caused high mortalities of rainbow trout fry. Results from this study demonstrated that draining highway runoff directly to receiving waters via pipes or bare channels should be avoided. Grassy drainage channels were shown to effectively capture and retain metals. Mud or paved channels, however, demonstrated little or no ability to remove metals from runoff.

Metro conducted bioassay toxicity tests on stormwater during 1987-1989. Toxicity tests were performed on three different organisms (Ceriodaphnia dubia - water flea, Salmo gairdneri - rainbow trout, and Selenastrum capricornutum - freshwater green alga). Two concentrations, 10% and 60% sample, and a dilution water control (0%) were used in conjunction with toxicity tests for rainbow trout.

Five of 17 (29%) of the samples tested with rainbow trout either were acutely toxic or caused stress. Five of 13 (38%) of the samples tested with Ceriodaphnia either were acutely toxic or caused behavior indicative of stress. Results from four samples tested with the algal organism (Selenastrum) indicated that stormwater generally stimulates growth. Stormwater tested in this study was more toxic than treated sewage tested over the same period.

Differing responses were observed at stations that were retested during various storm events. This study suggested the variation in response could result from chance deposition or accumulation of toxic substances during an antecedent dry period or may result from pollutant loads that are not delivered at a constant rate throughout the storm period (Metro, 1990).

Metro is also currently conducting toxicity tests at selected transit base facilities. Data results from these studies were not available at the time of this writing. It is important to point out that toxicity testing using metals (total) is not a good index for assessing the bioavailability of various metals. This is due to the fact that there are currently no real good analytical methods for measuring bioavailable speciation. Total metals are generally bound up in nonbioavailable forms and as such it is difficult to determine the fate and effects of these contaminants (Buckley, 1990).

The Wisconsin Department of Natural Resources (DNR) (Bureau of Water Resources Management) conducted stormwater bioassay toxicity tests at seven sites between September 1989 and March 1990. Two organisms, juvenile fathead minnow (Pimephates promelas) and Daphnia magna were tested with undiluted stormwater. At two locations, both representative of medium density residential land use, percent mortality (at 24 hours) for Daphnia magna was 95 and 100 respectively (Wisconsin DNR, 1990). It is interesting to note that both stations exhibited 0% mortality for the juvenile flathead minnow during these same storm events. In general, metals (i.e., copper, lead, and zinc) typically exceeded acute toxicity criteria for warm water fish (Bannerman, 1990).

Without additional detention and treatment, runoff from impervious areas such as the six miles of state and interstate highways, other roads and streets, major shopping/commercial areas, and similar sources in the future planning area, will likely contribute increased levels of suspended sediments and heavy metals. It is interesting to note that six miles of interstate highway that dissects the

Hylebos Creek Basin are approximately equivalent to 90 impervious acres, which is about twice the size of the Sea Tac Mall and its parking lots.

The water quality in both the Hylebos Creek and Lower Puget Sound basins is generally good during baseflow conditions. As such, both basins are able to support most beneficial uses. During storm events, high sediment and fecal coliforms in the Lower Puget Sound basin and high metal and fecal coliforms in the Hylebos basin are impacting beneficial uses. Storm events for the most part are usually short-lived; however, the long-term impacts associated with these accumulated toxins in receiving water bodies may seriously alter habitat and their ecosystems.

The general impacts of nonpoint sources on beneficial uses that are likely to be of concern in the Hylebos Creek and Lower Puget Sound basins are indicated in Table 3.7.12.

KEY FINDINGS

° Several areas of undeveloped wetlands and riparian corridors still exist throughout the planning area. These areas are providing shade which keeps stream temperatures low and water oxygenated. Streamside vegetation is also providing biofiltration that is filtering out contaminants to water bodies downstream.

° Relatively high concentrations of heavy metals (e.g., copper, lead, and zinc) are transported during storm events from road runoff and automobiles to waterbodies, particularly in the Hylebos Creek basin. A relatively large number of samples were found to contain sufficient concentrations that are toxic to aquatic species. This is especially true when combined with total suspended solids from construction sites, roadway dust, and erosional processes associated with high runoff periods that can build up over time in bottom habitat areas. With each storm event, these accumulated toxins in bottom sediments can contribute to the contamination now present in Hylebos Waterway and Commencement Bay. This will continue to occur even on top of freshly capped contaminated sediment. Contaminated bottom fish and shellfish that may be routinely consumed from this area are a public health hazard.

° Uncontrolled large sediment loads and their associated contaminants may impact commerce and navigation activities, stock watering, industrial operations (e.g., cooling water), and fish and wildlife.

° Relatively high concentrations of fecal coliforms, particularly in the Lower Puget Sound basin, are likely to be originating from sewer line leaks, failing onsite septic systems, farm animal access to creeks, and pet wastes. These bacteria are a potential threat to human contact with surface waters and effect recreational shellfish harvesting while contributing to the decertification of commercial shellfish beds in Puget Sound. Wildlife probably contribute a very minor loading of microbial pollution to these water bodies based on the minimal remaining habitat.

° Relatively high concentrations of nutrients from fertilizers, failing sewage systems, decomposing organic matter from leaves and grass clippings, agricultural runoff, urban street refuse, and atmospheric deposition are probably contributing to algal blooms in lakes and lowered oxygen levels in both lakes and streams.

Table 3.7.13

GENERAL IMPACT OF NONPOINT SOURCES ON BENEFICIAL USES LIKELY TO BE OF CONCERN IN THE HYLEBOS CREEK AND LOWER PUGET SOUND BASINS

Body	Key Pollutants	Effect on Water	Affected Uses (a)
Lakes	Bacteria/viruses	Contamination	Contact recreation
	Phosphorus	Algae growth	Contact recreation, nuisance odors, visual pollution
	Sediment/ suspended solids	Visual turbidity, creates shallows	Aesthetic pollution by silts, weed growth in shallow areas
	Metals	Bioaccumulation	Fishing
Streams	Sediment/ suspended solids	Turbidity deposition in stream pools and wetlands	Loss of flood control capacity, fishing, loss of wetland cleaning ability, visual pollution
	Hydraulic erosion	Streambank loss, sediment deposit downstream	Damage of private and public property
	Bacteria/viruses	Contamination	Swimming(b)
Puget Sound	Bacteria/viruses	Contamination	Loss of recreational and commercial shell fishing
	Metals	Bioconcentration	Same as above
	Sediment/ suspended solids	Shellfish loss	Same as above
Ground water	Nitrates	Loss of use as a drinking water supply	
	Toxic organics	Cancer, related diseases	
	Bacteria/viruses	Contamination	

(a) For all three types of water bodies a loss in property values for properties abutting the water body have been found in several research studies.

(b) The only stream in which swimming may occur is the Hylebos and probably at a very low frequency given its smallness.

Source: Resource Planning Associates, Nonpoint Source Pollution in the Federal Way Community (Executive Summary and Recommendations), 1985, p. 2.

SECTION 3.8 HABITAT

INTRODUCTION

The Hylebos Creek system is composed of over 25 miles of streams, five named lakes, and over 30 identified wetlands totalling more than 250 acres. The basin also contains a number of other small unnamed ponds and uninventoried wetland areas.

Hylebos Creek originates at Lake Killarney and North Lake on the northeast border of the basin and flows south and west to the confluence of West Branch Hylebos Creek in Pierce County. The original headwaters of the West Branch were situated within a complex of wetlands in the vicinity of S 320th Street and within the West Hylebos Wetland, whose present approximate boundaries lie between S 348th Street, S 356th Street, 1st Avenue S, and SR 99. Altogether, there are 28.2 river miles in the Hylebos stream system: 18.5 miles on the mainstem and East Branch, and their tributaries, and 9.7 miles on the West Branch and its tributaries (see Figure 3.8.1).

Many of these headwater wetland areas were eliminated during construction of commercial areas in the vicinity of S 320th Street. Other prominent alterations of the stream system occurred when drainage from the headwaters of the north fork of the West Branch was routed into the East Branch in the mid-1960s during construction of I-5, and when runoff from Panther Lake was routed into the West Branch in the mid-1980s. South of the confluence with the West Branch, the mainstem turns northwest, flowing through a broad floodplain that extends to Hylebos Waterway which in turn empties into Commencement Bay.

The eight independent Lower Puget Sound drainages together comprise over 18 miles of stream channels, five named lakes, and 30 inventoried wetlands--including over 250 acres of shallow intertidal and subtidal areas in adjacent waters of Puget Sound.

Historical Information

Hylebos Creek may have at one time been among the most productive small stream systems in central Puget Sound. Accounts of early settlers and Puyallup tribal elders indicate that prior to settlement of the basin the system might have supported annual returns of several thousand adult coho (*Oncorhynchus kisutch*) and chum (*O. keta*) salmon, plus hundreds of chinook (*O. tshawytscha*) salmon, steelhead trout, (*O. mykiss*) and cutthroat trout (*O. clarkii*). Like most Puget Sound lowland streams (Gonor et al., 1988), lower Hylebos Creek consisted of a network of sloughs, beaver ponds, and driftwood dams grading into steeper segments of the stream system flowing through ravines forested with old growth conifers. Large organic debris played an important role in the ecology of the stream system by forming diverse sequences of riffles and pools used by salmon and trout as spawning and rearing areas. By comparison, fish habitat within present-day Hylebos Creek contains only remnant areas of productive fish and wildlife habitat. Fish populations are small due to the basinwide influences of urbanization on the remaining productive fish habitat within the system.

In the West Branch, historic spawning and rearing habitat extended from the area behind what is now Gethsemene Cemetery up to the West Hylebos Wetland. Additional rearing habitat existed in the lower reaches of the West Branch and mainstem (see Figures 3.8.2a and b). Because of its moderate gradient and

Figure 3.8.1

HYLEBOS CREEK AND LOWER PUGET SOUND BASINS REFERENCE MAP

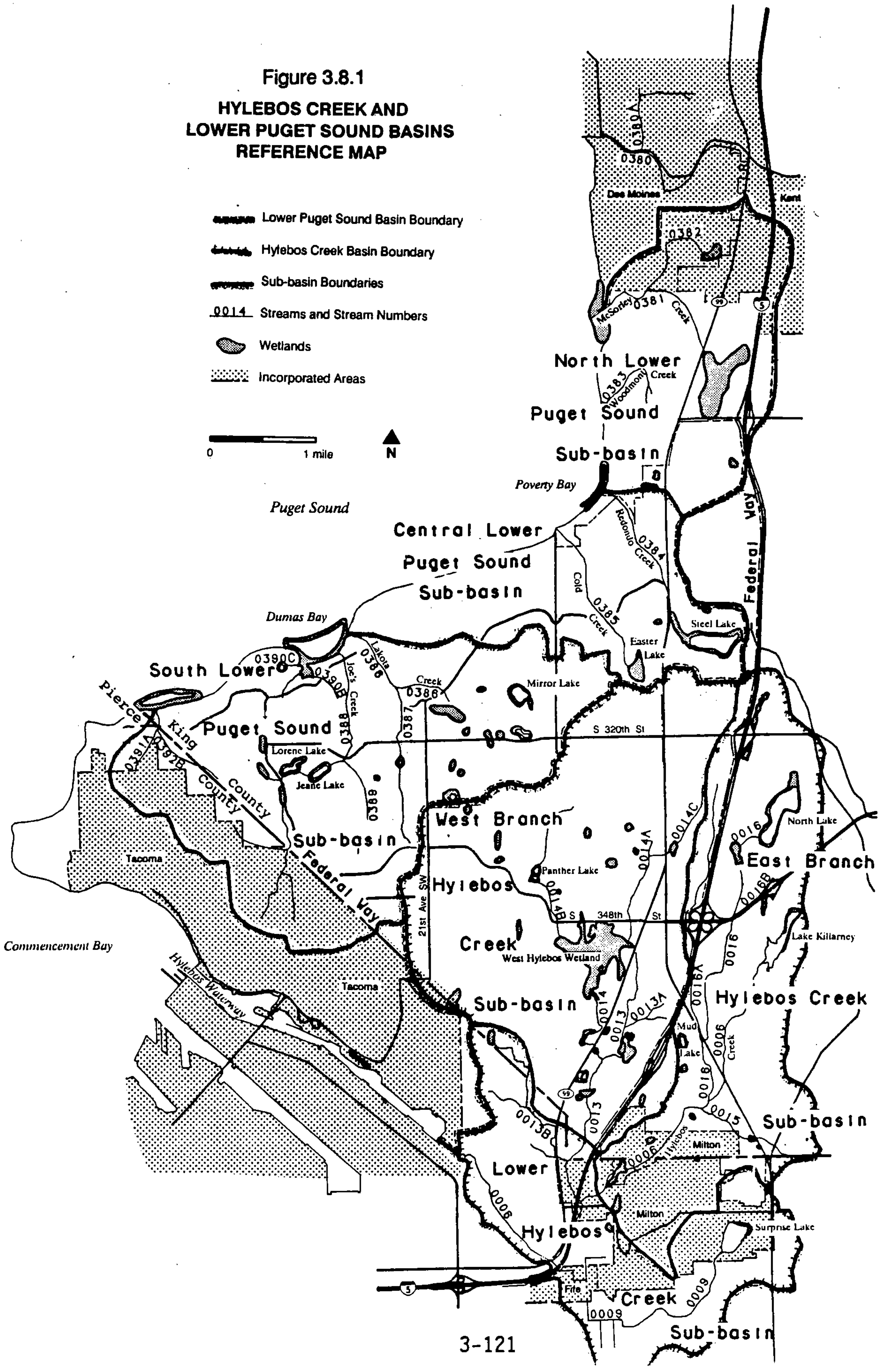


Figure 3.8.2a

West Branch Hylebos Creek Sub-basin

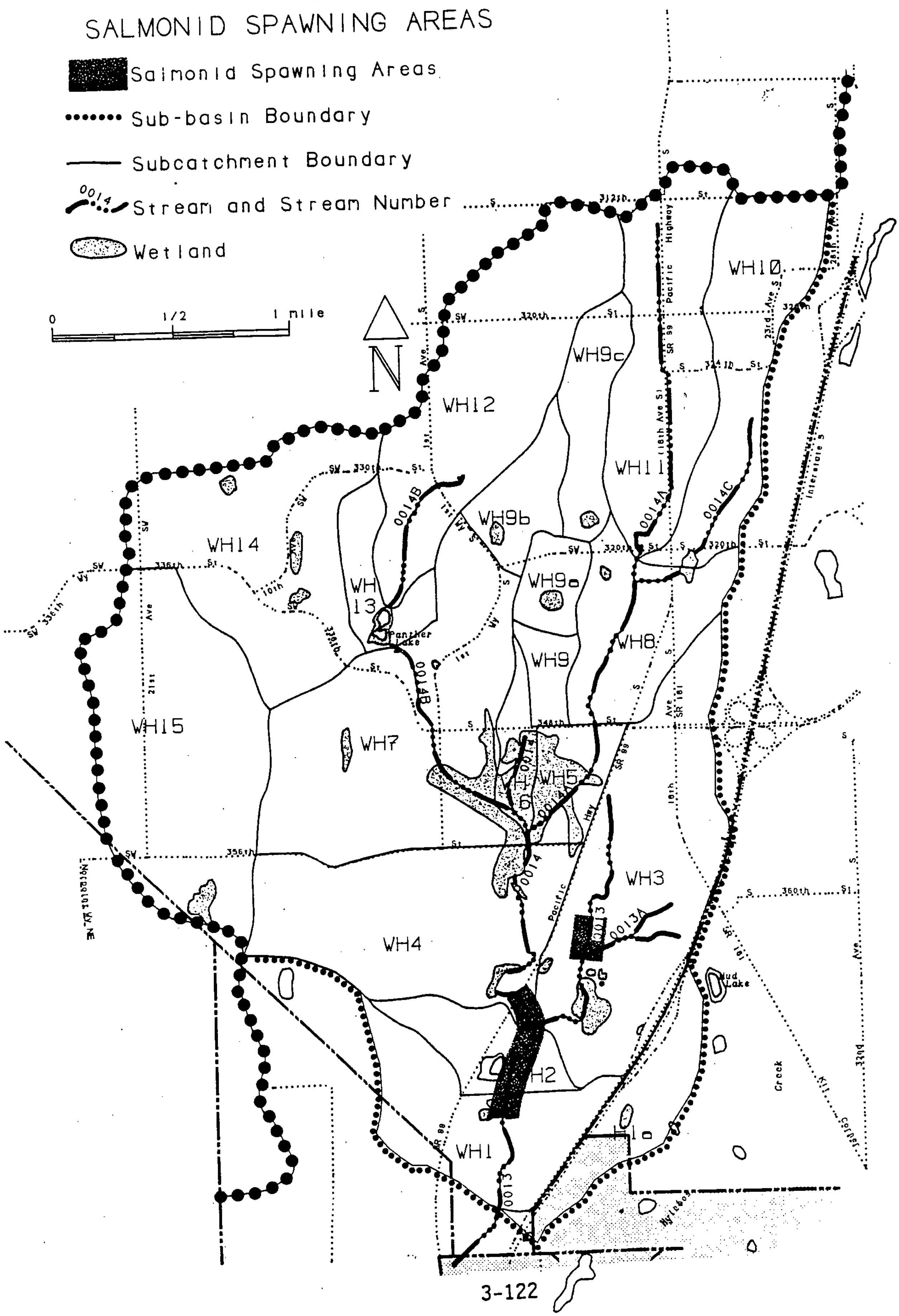
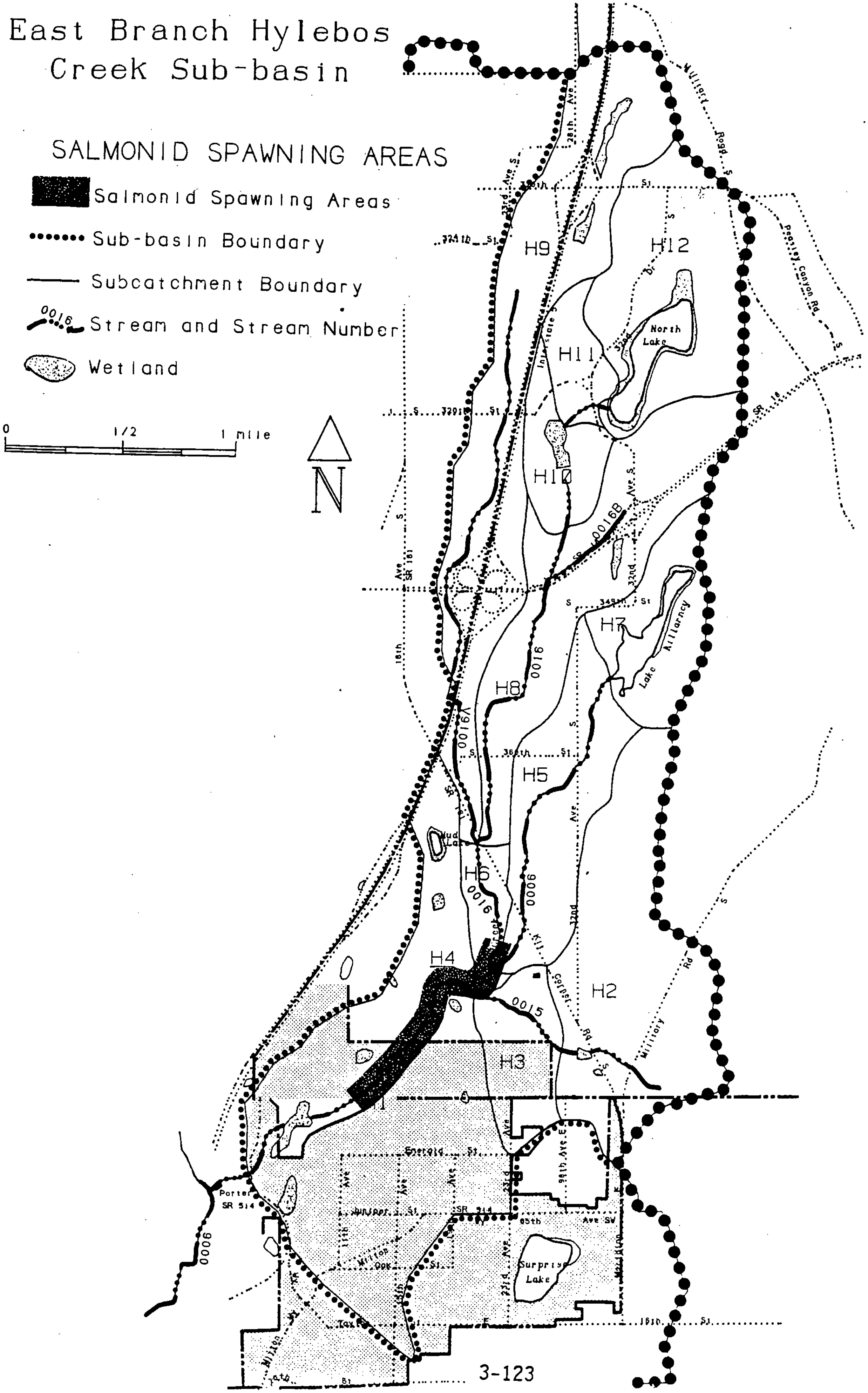


Figure 3.8.2b


East Branch Hylebos
Creek Sub-basin
SALMONID SPAWNING AREAS
Salmonid Spawning Areas
Sub-basin Boundary
Subcatchment Boundary
0016 Stream and Stream Number
Wetland
0
1/2
1 mile
N
H2
H3
H4
H5
H6
H7
H8
H9
H10
H11
H12
North Lake
Lake Killarney
Surprise Lake
0016
0016A
0016B
0015
0006
Interstate 5
Porter
SR 514
Military Rd
SR 18
Peasley Canyon Rd
Emerald St
Juniper St
Milton
Oak St
65th Ave SW
Milton

glacially-derived geology, the East Branch used to provide excellent spawning and rearing habitat for anadromous fish up to approximately RM 7.0 on tributary 0006, RM 0.5 on tributary 0015, and RM 0.4 on tributary 0016, with some resident fish and cutthroat habitat in upstream headwaters.

Each of the Lower Puget Sound tributaries is considerably shorter, steeper, and conveys less flow than Hylebos Creek and its main tributaries. As a consequence, even in pre-settlement times none of these streams supported large populations of salmonids, although collectively their contribution to local fish abundances may have been important.

Due to past habitat damage caused by filling of headwater wetlands; channel alterations; excessive peak flows and severe erosion; and disruptions to year-around streamflow, only McSorley, Lakota, and Joes Creeks at present support residual fish populations of any significance. All of these streams, however, are important for support of local wildlife and because of their potential for adverse impacts on Puget Sound water quality and sensitive estuarine and coastal bluff habitats.

HABITAT CONCEPTS

The ability of the Hylebos Creek and Lower Puget Sound stream systems to support resident and anadromous salmonid fish is directly related to the quality and quantity of instream and riparian habitat. Before discussing detailed habitat findings, some background information on fish and wildlife habitat is presented.

Stability of Riparian Ecosystems

Riparian ecosystems evolve naturally under conditions of dynamic change punctuated by occasional catastrophic events caused by floods, fires, and impacts from beaver activity. The occurrence of large floods--those that occur during 25-, 50-, or 100-year storms--is the major environmental factor that shapes riparian and instream habitats by causing bank cutting, debris torrents, landsliding, and sediment deposition (Hall, 1988). While periodic natural disturbance is normal in riparian ecosystems, human-caused impacts from logging, grazing, dredging, and the use of streams as conveyances for stormwater can chronically increase the magnitude and frequency of disturbance in the riparian environment, making it less suitable as habitat for fish and wildlife (Leopold, 1971; Meehan, et al., 1977).

Habitat Structure

The two primary fish habitat types are riffles and pools. Riffles are shallow, gravelly, fast-water areas that are the main food production areas of streams. Riffles provide habitat for aquatic insect species that make up most of the diet of salmon and trout, although insects of terrestrial origin falling into the stream also constitute an important source of food. Riffles also provide spawning areas for all salmonids and rearing habitat for early life stages of certain species, such as steelhead. Pools, which form in deeper, slower flowing areas or downstream from obstructions such as logs, rootwads, and boulders, are the main fish rearing and resting areas for most salmonids, including coho (Reeves, et al, 1989).

Riparian Vegetation and Large Organic Debris

Good fish habitat depends to a great degree on the many useful functions of riparian trees, shrubs, and ground cover (Sedell, et al., 1988). Root masses along stream banks help prevent erosion and maintain channel stability. As trees die and topple into the water or are dislodged due to windthrow, large organic debris (LOD) in the form of logs and stumps is added to streams. In addition to its role in pool and riffle formation, LOD provides cover, a source of nutrients, and sediment storage sites. Riparian vegetation also helps trap and filter sediments, debris, and pollutants from surface runoff. During high flows, riparian vegetation slows and disperses floodwaters, reducing water velocity and erosion that damage fish spawning and aquatic insect production areas. Riparian vegetation also buffers streams from temperature extremes that are stressful to fish. It also benefits many wildlife species by providing food, cover, migration corridors, and places for nesting and perching that are close to water, an essential habitat requirement for wildlife.

Different riparian tree and shrub species support typical groups of terrestrial insect species that are important sources of food for fish; 266 insect species have been recorded from willow, 90 from alder, and 16 from fir (Mundie, 1969, and Mundie, no date). Leaves, needles, cones, and other small woody debris entering streams from trees and shrubs are a principal source of food for many aquatic insects that are in turn eaten by young salmonids (Meehan et al., 1977). Some categories of aquatic insects are very sensitive to disturbance and tend to disappear when streamside vegetation is removed by logging, construction, or landscaping. Their disappearance can damage vital links in the food web of stream-dwelling organisms on which fish depend.

Streamflow Maintenance

All juvenile and adult salmonids need adequate flows of clean, cold (50-55 degrees Fahrenheit), well-oxygenated water for migration, spawning, and rearing. Survival of their food supply--mainly aquatic insects found in cold, fast-running water--also depends on adequate streamflows. Different salmonid species vary in their dependence on year-around streamflow, depending on how long they reside in the freshwater environment. Chum salmon, for example, spend a relatively short period of time in freshwater during incubation and development to the fry stage. Young chum fry swim downstream to feed in nearshore areas of Puget Sound almost immediately after hatching and absorbing their egg sac nutrients. Coho salmon, and steelhead and cutthroat trout, on the other hand, spend much longer periods in freshwater, and thus are much more susceptible to the damaging impacts of low flows and high temperatures. Chinook juveniles spend an intermediate amount of time in freshwater and are almost as dependent on estuarine food resources as are chum.

Urbanization alters streamflow patterns by increasing flows during storms and decreasing infiltration of rainflow into groundwater, the major source of summer streamflows (Leopold, 1971). Groundwater discharge in turn affects thermal habitat space. The size of fish and benthic invertebrate populations in a stream depends strongly on the amount of near-optimal thermal habitat available during the critical warm periods of summer. Moreover, some salmonid species select groundwater discharge areas for redd (egg nest) construction and rely on relatively stable temperatures for egg and larval development (Meisner et al., 1988). As flows decrease, juvenile fish tend to crowd into upstream groundwater discharge areas, downstream rearing areas, or get trapped and die in pools due to lack of food and/or oxygen. Stream corridors also lose much of their value as wildlife habitat when streamflows disappear.

Wetlands

Wetlands are marshes, bogs, swamps, intertidal areas, and shallow waters of lakes and ponds. They are identified by saturated soils or by the presence of plants that require wet soils for their survival. Wetlands serve as critical fish and wildlife habitat by providing food, cover, water, refuge from predation, breeding and rearing areas, and migration paths for many animals. Wildlife diversity in wetlands is high. More than 230 species of wildlife in western Washington depend on wetlands and riparian areas for survival during one or more stage of their life cycle (Brown, 1985). As much as 90 percent of the biological energy (food for fish) produced in a stream corridor comes from adjacent wetlands and riparian vegetation. Wetlands store water in rainy periods and release it slowly during periods of dry weather. By acting as sponges during peak stormflows, wetlands protect streams from erosion and scouring. Wetlands also help filter silt and pollutants, thereby protecting water quality in streams and in Puget Sound.

Upland buffers next to streams and wetlands also provide significant resource benefit. Such buffers contain cover and nesting habitat for birds and mammals that depend on wetlands, such as bald eagles, osprey, various duck species, and beavers. Upland buffers also protect sensitive wetlands from noise, light, glare, pollutants, and predation of their inhabitants by house pets.

The King County Wetland Inventory (King County, 1983) documents 30 wetlands each in the Hylebos Creek and Lower Puget Sound basins, ranging in size from from the unique and outstanding 93 acre West Hylebos Wetland and the extensive intertidal sand flats of Dumas Bay, to remnant wetlands under one acre in size. Most of the Hylebos wetlands are smaller than five acres. The freshwater Lower Puget Sound basin wetlands average somewhat larger, just over five acres. Additional uninventoried wetlands can be found in both basins. An example of an uninventoried wetland area is the large forested wetland in Spring Valley along the north fork of the West Branch of Hylebos Creek.

Coastal Habitats

High bluffs occur along much of the Lower Puget Sound basin shoreline. These areas serve as important habitat for a number of wildlife species. They provide perching and nesting areas for birds, including bald eagles and several species of owls, swallows, and pigeon guillemots. They also provide habitat for small mammals, such as mice, shrews, and voles that are favored prey items of bluff-dwelling raptors. In addition, bluffs generally represent valuable "edge" habitat because they contain borders between terrestrial and marine habitats. Forested areas atop steep bluffs or ravines also provide nesting and roosting areas for colonies of great blue herons. A long-standing heron colony near Dumas Bay currently supports over three dozen nesting birds and their offspring, which forage in nearby estuarine habitats that contain a rich source of food.

As mentioned in Section 3.2, Geology, of this report, bluffs are prone to erosion and landslides due to a variety of natural and and human-caused forces. Erosion may occur when vegetation is disturbed or removed, when construction occurs too close to the edge, or when runoff is carelessly routed over the face of a bluff. Landsliding may occur due to wave action or groundwater, and is a fairly common occurrence after heavy rainfall or in locations containing springs and poorly defined soil strata. Natural erosion of bluffs along beaches is important to sediment-dependent habitats on associated beaches and in shallow intertidal and subtidal areas. However, excessive erosion and landsliding related to development can be extremely damaging to coastal habitats.

Effects of Urbanization on Habitat

The effects of development on watersheds are pervasive and generally damaging to fish and wildlife habitats. As discussed in Section 3.3., Hydrology, the magnitude and frequency of floods may be doubled or more by future urbanization of the basins. With increased flows and especially where protective riparian vegetation is absent, stream channels tend to be widened and stream beds scoured by the erosive forces of high velocity water and transported sediments. Scouring flows also remove much of the habitat-stabilizing LOD within streams, reducing habitat diversity and sediment storage capacity. Urbanization also increases the total amount of sediment, dissolved solids, and pathogenic bacteria entering streams from terrestrial sources (Leopold, 1971). Even in fully developed watersheds, suspended sediment loads are chronically increased by runoff from roads, parking lots, and other impervious surfaces (Whipple, et al., 1981). These impacts lead to loss of spawning and rearing habitat for fish due to filling in of pools and siltation and compaction of spawning gravels. Frequent and prolonged high flows also result in replacement of spawning gravels by cobble too large to be used by fish for spawning. In extreme cases, all gravels may be scoured down to bare glacial till or bedrock.

Other effects of urbanization include riparian corridor and channel alterations such as removal of streamside vegetation and instream LOD, channel straightening and dredging, construction of roads and bridges, stream bank armoring, and the loss of off-channel areas that are a refuge for fish during extreme flood events. While these activities may be viewed as necessary for full use of property or to protect against flood flows, they also fragment riparian corridors and open them up to disturbances by humans, domestic animals, and influxes of pollutants. They also cause loss of habitat and food-chain support for both fish and wildlife. Some alterations such as bank armoring and channelization decrease the roughness of channels and accelerate flows, while others, such as bridges and culverts can cause local flow constrictions and flooding during storms.

Another prominent effect of urbanization is destruction of wetlands, resulting in losses of fish and wildlife habitats, flood storage, sediment trapping, biofiltration, and groundwater exchange areas. These changes amplify the effects of urbanization listed above. Some of the most severe losses of wetland habitats in the Hylebos Creek and Lower Puget Sound basins have occurred in forested and scrub-shrub swamps. These areas are frequently overlooked because their wetland characteristics are more difficult to identify, inventory, and map.

DATA GATHERING METHODS

Information in this section was gathered from several sources. All stream channels were walked in 1986 and 1987 during the Basin Reconnaissance Program (King County, 1987) in order to collect data on habitat conditions. All fish-bearing stream segments in the Hylebos Creek basin were walked again in 1989 and

1990 for this report. Where habitat problems were found, additional stream segments above fish-bearing reaches were walked to investigate causes of habitat damage. This report also incorporates observations contained in a Hylebos/Lower Puget Sound habitat study performed by Metro in 1987 (Ridge-Cooney, 1988) and information supplied by the Puyallup Tribe of Indians and local residents.

Recent History of Fish Use

At the present time, most salmon spawning in the Hylebos Creek system takes place in the West Branch, although small numbers of fish--mostly coho--still spawn in the East Branch where it flows through a wooded ravine north of Milton. Until the mid-1980s moderate numbers of chum and coho, plus a few steelhead, chinook, and cutthroat also spawned in the north fork of the West Branch. Chinook and steelhead have virtually disappeared in this tributary since an oil spill thought to have occurred in 1986, and spawning by other species has been greatly reduced due to episodes of severe sedimentation from excessive peak flows and poor erosion control at upstream construction sites. Losses of spawning habitat due to erosive peak flows have also recently occurred in the lower half mile of tributary 0015.

Annual salmon spawner counts have been conducted in Hylebos Creek and its tributaries by the Puyallup Tribe of Indians since 1980, and a few counts were made before that by the Washington Department of Fisheries (WDF). Figures 3.8.1a and b identify salmonid spawning areas in the West and East Branches of Hylebos Creek. These counts document that the West Branch now supports mainly chum salmon, with smaller numbers of coho and chinook and occasional steelhead also present. Mainstem Hylebos Creek supports small numbers of coho, although a few chum spawn there as well. As shown in Tables 3.8.1a and b, chum salmon spawner survey counts have varied considerably over the past 15 years; the highest weekly peak survey count was 90 chum salmon in the West Branch in January 1987. By contrast, coho spawner counts have fallen off sharply in both Hylebos sub-basins since the late 1970s; the highest peak weekly count was 84 fish in the West Branch in January 1977. At the present time, populations of both chum and coho are believed to be sustained largely by the out-planting of salmon fry reared at the Puyallup tribal hatchery. Table 3.8.2 summarizes the fry out-planting records for the Hylebos Creek system. It can be presumed that substantial numbers of returning fish from these out-plantings are harvested by Indian and non-Indian fisheries in Canadian and Puget Sound waters during their migration as adults back to Hylebos Creek.

Table 3.8.1a

SPAWNER SURVEYS OF WEST BRANCH HYLEBOS CREEK (0013, RM 1.5-1.7)

PEAK SPAWNER COUNTS*

YEAR	SURVEYED BY**	COHO	CHUM	CHINOOK	PEAK COUNT SURVEY DATE	
1976-77	WDF	84	--	--	01-03-77	
1979-80	WDF	7	2	--	11-16-79	
1980-81	PT	20	20	--	12-09-80	
1981-82	PT	2	1	--	12-08-81	
1982-83	PT	6	22	--	01-20-82	
1983-84	PT	8	46	--	12-15-83	Chum
1984-85	PT	5	78	7	12-06-84;	10-02-
1985-86	PT	4	11	0	12-04-85	84
1986-87	PT	0	90	0	01-23-87	Chum
1987-88	PT	5	13	8	11-19-87;	10-28-
1988-89	PT	5	3	0	11-30-88	87

* These counts represent maximum spawners observed during a single survey, within a series of weekly surveys.

** WDF = Washington Department of Fisheries
PT = Puyallup Tribe of Indians

Table 3.8.1b

SPAWNER SURVEYS OF
EAST BRANCH HYLEBOS CREEK
(0006, RM 5.5-5.7; 0015, RM 0.0-0.5)

PEAK SPAWNER COUNTS*

YEAR	SURVEYED BY**	COHO	CHUM	PEAK COUNT SURVEY DATE
1980-81	PT	15	1	12-17-80
1981-82	PT	4	1	12-17-81 Coho 11-17-81 Chum
1982-83	PT	2	0	12-08-82
1983-84	PT	3	0	12-06-83
1986-87	PT	0	7	12-29-86
1989-90	KC	6	0	12-13-89

* These counts represent maximum spawners observed during a single survey within a series of weekly surveys.

** WDF = Washington Department of Fisheries
PT = Puyallup Tribe of Indians

Table 3.8.2

FISH PLANTED IN HYLEBOS TRIBUTARIES
BY PUYALLUP TRIBE OF INDIANS

WRIA	SPECIES	BROOD YEAR	PLANTING DATE	APPROX. NO./FISH POUND	POUNDS PLANTED	NO. FISH PLANTED
0006	Chum	1976	4/26/77	450	239.7	107,865
0013	Chum	1976	4/26/77	480	302.8	145,350
0006	Chum	1977	4/27/78	400	109.1	43,625
0013	Chum	1977	4/27/78	375	34.4	12,900
0006	Coho	1977	4/11/78	550	33.0	18,150
0006	Coho	1977	4/11/78	650	30.5	19,825
0013	Coho	1977	4/11/78	650	34.5	22,425
0013	Steelhead	1980	1/22-23/81	13	412.5	5,363
0006	Coho	1981	3/30/82	321	91.8	29,452
0013	Coho	1981	3/30/82	321	81.5	26,060
0006	Coho	1982	4/12/83	398	69.0	27,402
0013	Coho	1982	4/12/83	398	89.0	35,352
0006	Coho	1984	3/07/85	629	54	33,966
0013	Coho	1984	3/07/85	689	53	33,337
0006	Coho	1985	4/09/86	1,400	16	22,400
0013	Coho	1985	4/09/86	1,400	16	22,400
0013	Chum	1986	5/07/87	694	63	43,722
0006	Coho	1986	2/17/87	927	20	18,540
0013	Coho	1986	2/17/87	927	21	19,467
0006	?	1987	2/25/88	1,050	20	19,480
0013	?	1987	2/25/88	974	20	21,000
0013	Chum	1988	4/04/89	1,090	26	28,340

CONDITIONS

Current Habitat Conditions

At present, fish and wildlife habitats in the Hylebos Creek and Lower Puget Sound basins vary from good to very poor. While some good instream, riparian, and wetland habitats remain, development-related habitat problems are common. For example, instream habitat in the East Branch was damaged when part of the West Branch was diverted into its headwaters in the mid-1960s during construction of I-5. Fish habitat in the East Branch has since been affected by high-volume flows, erosion, and pollution. Much of what was the most productive spawning habitat in the system--in the vicinity of S 373rd Street on the West Branch--has been devastated by sedimentation of the stream channel by gravel, sand and silt from erosional areas upstream. This reach has also been repeatedly disturbed by channelization and dredging, removal of habitat-forming LOD and riparian vegetation, and bank trampling by cattle.

Habitat in the headwaters of the Hylebos Creek and Lower Puget Sound systems has been decreased or eliminated by the routing of long stream segments inside culverts, and by alterations in flow regimes that cause headwater areas to dry up in the summer and during low flow winter periods in dry years. Habitat in the lower mainstem of Hylebos Creek has been harmed by channelization and dredging, and by encroachment into the riparian zone by roads, bridges, and inadequate building setbacks.

Several tributaries of the Hylebos Creek and Lower Puget Sound systems are at present ephemeral (e.g., tributaries 0014A, 0014C) or intermittent (tributaries 0016 and 0016A and upper 0386 and 0387). The cause is unknown but suspected to be due at least in part to a decrease in upland groundwater recharge, groundwater withdrawals for water-supply use, or disconnection of these headwater areas from former perennial groundwater discharge zones. In terms of fish habitat, low or non-existent summer flows have resulted in severe limitations in the quantity and volume of juvenile rearing areas during the summer months.

Intertidal habitat at the former mouth of Hylebos Creek originally consisted of a network of small, dendritic channels draining through vast mudflats fringing Commencement Bay. Starting in the 1920s, over 90 percent of this habitat was filled or dredged during construction of docks and industrial sites on Hylebos Waterway. Since then, the waterway has been regularly dredged to accommodate marine vessel traffic. Restoration of wood-waste and arsenic-contaminated areas at the head and outlet of the waterway is currently planned as part of the ongoing EPA Superfund cleanup of Commencement Bay (see Section 3.7 for further discussion). Intertidal habitat has also been lost along the Puget Sound shoreline due to bulkheading of marine shoreline areas streambank armoring near the mouths of streams that has disrupted formation of alluvial tideflats.

At least half the freshwater wetlands in both basins have been eliminated or significantly altered by filling and removal of native vegetation. Examination of aerial photographs from 1936 and 1988 shows a 30 percent loss of wetlands in the Hylebos Creek basin and a 21 percent loss in the Lower Puget Sound basin during this period alone. A prime example of the complex consequences of wetland loss is illustrated by alterations to Panther Lake that have degraded habitat not only in the lake itself, but far downstream as well. Over the years about half of the 18 acres of palustrine wetlands within and surrounding the lake have been filled to convert this formerly hydrologically isolated, shallow, seasonal pond into a retention/detention facility with an outlet routed into West Branch Hylebos Creek. Over this same period of time, several other wetlands in nearby subcatchments were also partially or completely filled, with runoff from the resulting impervious surfaces routed into Panther Lake. With the influx of stormwater and erosion from construction sites, water quality in the lake has declined due to turbidity and other pollutants, and sediments have accumulated on the lake bottom, decreasing the lake's flood storage capacity. The accumulation of bottom sediments also appears to be interfering with the lake's ability to infiltrate stormwater back into the underlying groundwater. As a result, the lake discharges high volumes of poor-quality water into Hylebos Creek during storms, causing flooding, erosion, and siltation of wetlands and streambeds for miles downstream. The lake may also be an important groundwater recharge area for subsurface flows that discharge within the West Hylebos Wetland. Disruption of these hydrological connections could cause this important wetland to dry up in the summer, further stressing its plant community, which is already experiencing stress from increased frequencies and durations of flooding during winter storms.

Although urbanization has taken a heavy toll, good habitats can still be found in a few places. For example, there is productive rearing habitat for fish and good wildlife habitat within a wide, relatively undisturbed riparian corridor on West Branch Hylebos Creek between I-5 and SR 99 south of S 373rd Street. In tributary 0013 downstream from S 359th Street to the confluence of the West Branch, fish and wildlife habitats are buffered by a large forested wetland that helps absorb excessive stormflows and dampens the erosive forces that have crippled habitat elsewhere in the basin. This segment of tributary 0013 currently represents the only remaining portion of the Hylebos Creek stream system containing both spawning and rearing habitat, although, as mentioned above, it is currently underutilized by anadromous fish. Small patches of excellent estuarine habitat can be found at the outlet of Inner Hylebos Waterway and in Dumas Bay.

Dumas Bay

Dumas Bay is a 253 acre intertidal sandflat that receives discharge from five small streams that drain the upland plateau: Joes and Lakota Creeks, and three unnamed streams (0390A, 0390B, 0390C). The three unnamed streams drain into Dumas Bay through a freshwater emergent wetland with adjacent deep marsh and forested habitats. Both wetlands are considered unique and outstanding by King County.

Dumas Bay and similar estuarine embayments throughout Puget Sound provide important nursery, breeding and feeding areas for a variety of species, many of commercial interest, others of importance for their ecological role. Such estuarine bays are extraordinarily productive areas for marine algae, seagrasses, plankton, and the creatures that feed upon them, including crab and juvenile fish. Dumas Bay contains extensive eelgrass (<u>Zostera marina</u>) beds that are critical habitat areas for juvenile fish. Native seagrass is of much concern to scientists as its extent seems to be declining in Puget Sound for as yet unknown reasons. An estimated 90% of commercial species of crab, shellfish and finfish harvested from Puget Sound depend on estuarine bays for some phase of their life cycle. Commercially important species known to reside in Dumas Bay include: dungeness crab, littleneck clam, manila clam, geoduck, English sole, sand sole and juveniles of pink, chum, coho and chinook salmon. Other species of interest that occur in Dumas Bay and are dependent upon its productivity are:

the great blue heron--a rookery of some 30 to 40 nests occurs adjacent to the bay and herons can regularly be observed feeding on the flats; black brant which feed on the eelgrass beds of the bay and are a "species of national concern" to the US Fish and Wildlife Service, and a "sensitive species" to the Washington Department of Wildlife; bald eagle, which has "threatened" status in Washington; and harbor seals and occasional northern sea lions.

The deep marsh habitat of the freshwater marsh is dominated by cattail, yellow iris, nightshade, softstem bulrush, and various species of willow. The forested habitat contains stands of western red cedar, western hemlock, and red alder. Avian species observed in the marsh include: belted kingfisher, sharp-shinned hawk, green heron, rufous hummingbird, and red-winged blackbird.

During the last decade, extensive development on the bluffs and slopes surrounding the bay has encroached on the bay's shoreline and on the northern edge of the freshwater marsh. In particular, delivery of sediment to the marsh has increased with increasing disturbance of the uplands and slopes surrounding the ravines of streams 0390A and 0390B. The easternmost portions of the marsh and forested areas continue to receive significant amounts of fine sand with each winter storm. The ravines have become increasingly unstable and will continue to erode for some time, particularly as the volume of stormwater increases from the developed areas on the uplands. The deep marsh, with its open water habitat, is particularly vulnerable to this deposition. The change in bottom elevation with deposition will cause loss of the deepwater habitat in a much shorter time than would occur under natural conditions. Encroachment on the northern edge of the marsh occurred in 1987 when fill was placed for single family dwellings. No further filling is expected in this area and the southern border of the marsh is protected as a King County park and wildlife preserve.

The bay itself has suffered direct impact from shoreline protection measures such as bulkheading and rip-rapping, especially along its northern shoreline near the mouths of Lakota and Joes Creeks. Bulkheading has been employed in an attempt to stabilize the toe of the steep bluffs that rise above the beach. Slope failures remain quite common in this area, however, and may be exacerbated by slope clearing and improper drainage over the bluff edge. Recent slope clearing, presumably for improved views, can affect the diversity and stability of surrounding fish and wildlife habitat.

In the northeastern quadrant of Dumas Bay, near the mouth of Lakota Creek, a wastewater treatment plant discharges some 1,000 million gallons per year of secondary sewage effluent into the bay. Until 1988, the plant discharged wastewater which had undergone only primary treatment. Dumas Bay lies at the end of south-trending surface and sub-surface currents, and is a major depositional area for sand conveyed south by longshore transport. It may also be on the eastern edge of a local tidal/current gyre in lower East Passage which tends to provide sediment deposition as well as nutrient recirculation. Though convincing evidence is lacking, the plant outfall may be a contributer of nutrients, metals and coliform bacteria to the bay. The Puget Sound Environmental Atlas lists five heavy metals found in Dumas Bay sediments:

METAL	CONCENTRATION
Cadmium	85 ppb*
Copper	3 ppm**
Mercury	6 ppb
Lead	5 ppm
Zinc	24 ppm

* ppb = parts per billion
** ppm = parts per million

These concentrations are not considered harmful to humans, but that they were found at all is somewhat disturbing, although not altogether unexpected. How these metals are transmitted through the food web of the bay, if they are, is largely unknown. The bay is permanently closed to commercial shellfish harvesting, as are all eastern Puget Sound beaches from Meadowdale in Snohomish County to Commencement Bay in Pierce County, due to water quality degradation.

KEY FINDINGS

Summary of Current Habitat Conditions

° Approximately 90 percent of the estuarine habitat formerly associated with lower Hylebos Creek has been eliminated due to construction of docks and industrial sites on Hylebos Waterway. Estuarine habitats in Dumas Bay are threatened by excessive sedimentation from upstream erosional areas.

° The filling of wetlands has directly reduced the quality and quantity of areas for fish and wildlife breeding, nesting, feeding, and predator escape. Numerous habitats have also been damaged indirectly by loss of wetland functions such as flood storage, sediment trapping, water quality protection, groundwater exchange, and resulting impacts of increased peak flows on instream and riparian habitats.

° Elimination of native riparian vegetation to the stream edge has occurred in many segments of the Hylebos and Lower Puget Sound stream systems due to logging, agricultural practices, channelization for flood control, construction of stream crossings and buildings, and landscaping. Even where dense riparian vegetation remains there has been wholesale replacement of conifers by smaller deciduous trees and shrubs in many areas.

- The quality and quantity of instream habitat in many parts of the Hylebos and Lower Puget Sound stream systems has been degraded or eliminated by channelization and removal of LOD, resulting in loss of channel diversity and sediment storage capacity.

- Damage to habitats from excessive peak flows is widespread in the drainages. In many portions of the Hylebos and Lower Puget Sound stream systems, low or non-existent summer flows have resulted in severe limitations in the volume and quality of juvenile fish rearing areas and wildlife habitats during the summer months and during winter low flow periods of dry years. The cause is unknown but suspected to be due at least in part to a decrease in upland groundwater recharge, groundwater withdrawals for water-supply use, or disconnection of these headwater areas from former perennial groundwater discharge zones.

- Continued increases in the intensity and magnitude of peak flows will reduce or eliminate remaining instream habitats. Over the long term these impacts to habitat may be compounded by the combined effect from rising sea level and land subsidence.

SECTION 3.9 PUBLIC/PRIVATE SECTOR ACTIONS AND FUTURE DIRECTIONS

INTRODUCTION

There are many local, state, and federal agencies, as well as tribal and community programs, working to prevent and correct surface and groundwater problems in the Hylebos Creek and Lower Puget Sound basins. Among them are the Conservation Districts, the Soil Conservation Service, the State Departments of Ecology, Fisheries, Game, Natural Resources, the King County Cooperative Extension Service, Environmental Protection Agency; local governments; citizens' groups; and many separate other indiviuals and agencies. However, despite some gains made from these many efforts, conditions have continued to deteriorate. A major reason for the decline is the lack of a common blueprint of objectives and actions for the basins that a basin plan can provide. Entities at all levels are focused on their mandates to protect specific resources or provide specific services to their service area. This condition is a principal factor in the absence of a clear direction for the basins, and therefore, the lack of a unified effort to resolve its problems.

This section discusses factors that underlie the physical conditions in the basins including the roles government agencies, development activity, and the general public have in the Hylebos Creek and Lower Puget Sound basins. This discussion also identifies the functions of the basin plan as a means of improving past approaches to surface water management in these basins. Table 3.9.1 lists and describes the roles the federal and state agencies, tribes, special purpose districts, and other resource agencies with a role in surface water management in the basins.

CONDITIONS

Local Governments

One of the most important factors contributing to the current conditions in the basins are local land use plans and development codes. The intensity and density of land uses allowed and the ability of codes to effectively mitigate development impacts, are crucial elements of preventive surface water management. However, there are broad differences among local entities in the effectiveness of these plans and codes in managing surface water problems.

The planning area includes eight local governments: Des Moines, Federal Way, Fife, Kent, King County, Milton, Pierce County, and Tacoma. While all of these jurisdictions have land use plans and regulations for stormwater detention and some regulations for protecting steep slopes and for filling and grading activities, the land use plans and ordinances of some jurisdictions are more restrictive than others. This is especially true for stream and wetlands management. Resource managers have learned only relatively recently that protecting stream systems and wetlands often necessitates strict setback requirements and low-density zoning to be effective. Most local land use plans and codes in the basins were developed prior to this information becoming generally available; therefore, many codes do not include these types of provisions. However, some local entities are attempting to reverse this trend, including Federal Way, who has enacted several important sensitive area requirements that will help conserve these resource areas and mitigate future storm flows. Des Moines is

Table 3.9.1

ROLES OF STATE AND FEDERAL AGENCIES, TRIBES, REGIONAL AGENCIES, AND SPECIAL PURPOSE DISTRICTS IN MANAGING RESOURCES IN THE HYLEBOS CREEK AND LOWER PUGET SOUND BASINS

Federal Agencies:	
Federal Emergency Management Administration (FEMA)	Provide technical assistance on flood prevention and management to local governments; determine requirements for participation in the federal flood insurance program; administers flood insurance funds.
U.S. Army Corps of Engineers	Administers regulations for dredging in Hylebos Waterway, Commencement Bay, and Puget Sound; administers regulations for projects involving placement of dredged and fill material in wetlands and waters of the United States Environmental Protection Agency.
U.S. Environmental Protection Agency	Develops and jointly enforces federal wetlands regulations administered with the U.S. Army Corps of Engineers; funds and manages the Commencement Bay Superfund Clean-up.
U.S. Fish and Wildlife Service	Administers resource protection regulations for federally protected threatened and endangered species; reviews and comments on actions affecting wetlands and waters of the United States, including Commencement Bay and Puget Sound.
U.S. Soil Conservation Service	Provides technical service and financial assistance to commercial agriculture operators for preventing and correcting soil erosion problems.
Indian Tribes:	
Muckelshoot Tribe	Receiving waters in Commencement Bay and Puget Sound are part of the Tribe's usual and accustomed fishing grounds.
Puyallup Tribe	Receiving waters in Commencement Bay and Puget Sound are part of the Tribe's usual and accustomed fishing grounds; monitor spawning activity in the basins, and conduct a fish enhancement program in Hylebos Creek.
Regional Agencies:	
Metro	Monitors water quality in the planning area; monitors water quality in Steel Lake; participates in the Southwest King County Groundwater study.
Special Purpose Districts:	
Federal Way Water and Sewer District	Provides sewer and water service to its service area; monitors surface water quality; participates in the development of the South King County Groundwater Management Plan.

Table 3.9.1 (Cont.)

Pierce County Drainage Districts 21 and 23	Implement drainage projects to prevent stormwater from flooding properties within the District service areas.
Port of Tacoma	Manages development of Port lands and facilities and maintains navigation corridors within their jurisdiction; participates in the Lower Puyallup River Watershed Action Plan and Commencement Bay Superfund Clean-up.
<u>State Agencies</u>:	
Department of Ecology (Ecology)	Administers state water quality regulations; provides technical assistance and oversight to local governments in the administration of the State Shoreline Management Act; reviews and comments on actions affecting wetlands; provides technical assistance to local governments in wetlands management of wetlands, nonpoint source pollution, and stormwater; approves local groundwater management plans.
Department of Social and Health Services	Administers drinking water standards and septic system permit requirements for large developments.
Departments of Fisheries and Wildlife	Administer regulations for activities within the ordinary high water mark of streams and lakes, and Puget Sound.
Department of Natural Resources	Owns and regulates activities in the aquatic lands of Commencement Bay and Puget Sound; administers commercial forest practices regulations.
Department of Wildlife	Administers regulations to protect threatened and endangered wildlife species.
Pierce and King County Conservation Districts	Provide technical services and public educational programs for preventing and correcting sedimentation and water quality problems from soil erosion and animal keeping practices.
Puget Sound Water Quality Authority (PSWQA)	Develops and oversees implementation plans to protect and restore water quality from point and nonpoint sources in Puget Sound and its tributary areas, including requirements for local governments to develop stormwater management programs and basinwide nonpoint source management plans; provides funding for public information and education programs.
Washington State Department of Transportation	Constructs and maintains state highways, including I-5, SR 18, SR 99, SR 161, SR 509, and SR 514.
Washington State Parks and Recreation Commission	Operates Dash Point and Saltwater State Parks; is developing an environmental interpretive center in the West Hylebos Wetland.

considering a comprehensive sensitive area ordinance, while King County is also considering major amendments to its sensitive areas ordinance.

Another factor contributing to conditions in the basins is the level and effectiveness of enforcement of regulations. Local enforcement programs can also vary according to the jurisdiction. For example, some entities may have more personnel than others to enforce sensitive areas ordinances or construction and maintenance standards for stormwater systems. Another variable among local stormwater management programs is that some jurisdictions may have a dedicated source of funds, such as the King County or a Federal Way stormwater utility, which enables them to more readily provide needed facilities and services for the public stormwater system.

Due to the wide variation in surface water management programs among local governments, efforts to improve conditions in the basins at this level must be well coordinated. For example, what may be done by upstream jurisdictions to reduce surface water volumes or improve its quality, if not highly coordinated, may be unintentionally undone by the policies and actions of downstream entities. In the same way, preventive or corrective measures taken by downstream entities may be compromised by upstream actions as well.

Prior to initiating the Hylebos Creek and Lower Puget Sound Basin Plan, no vehicle was available to systematically coordinate both local actions in the basins and those of state and federal agencies and Indian tribes. This basin plan provides the framework through which common objectives and solutions can be agreed upon and implemented in a unified way.

State and Federal Agencies

Of the many state and federal agencies identified in Table 3.9.1, most function to protect natural resources from the effects of development activity by conditioning permits according to agency policies and regulations and through enforcement actions. For example, the State Department of Ecology, the U.S. Environmental Protection Agency, and the U.S. Corps of Engineers regulate water quality or wetlands-related actions. Some agencies, such as the Department of Ecology, have no regulatory authority for certain actions, such as wetlands protection, but they often provide important research and technical assistance roles in these areas.

Table 3.9.1 shows that different agencies address different resource concerns; however, for some resource issues, there may be gaps where little or no regulatory direction exists, as is the case with nonpoint water quality and wetlands management. Sometimes an agency's ability to correct problem conditions may result from insufficient technical know-how to mitigate for development impacts, but all too often it results from the lack of adequate fiscal resources to keep pace with rapidly expanding development pressures. Also, different agencies can operate under divergent objectives that may conflict. For example, the Department of Natural Resources issues permits for forest practices as part of its mandate to manage commercial forest activities; such practices, however, can result in increases in sediment loading to nearby streams, which conflict with the water quality objectives of the Department of Ecology. A multiplicity of the regulations and objectives in some cases can lead to inconsistent management of the resources.

While procedures are in place for coordinating permit activities among local, state, and federal entities, a consistent unifying direction to manage basin resources among these entities does not exist. The basin planning process provides the means to achieve that objective.

Development Activity

Development activity has influenced surface water conditions in the planning area significantly. For example, construction practices in which erosion and sedimentation measures and other types of Best Management Practices are not properly installed or maintained have enabled large volumes of soil to be carried to nearby surface waters, adding to the heavy loads of sediment from instream erosion in the basins.

A recent study to assess the effectiveness of Best Management Practices on construction sites throughout King County was conducted by the King County Conservation District (Tiffany et al., 1990). Eighty-six site visits were made to sixty construction sites. The study found that three sites (5%) had effective controls in place during the study period. The primary reasons specified for the remaining 95 percent having ineffective controls included inadequate installation, poor timing of installation with respect to weather conditions, and insufficient maintenance.

In the past ten years, King County has issued over 6,000 construction permits in the planning area with requirements for erosion and sedimentation controls (King County Planning Division, 1989). On the basis of the King County Conservation District findings, a likely conclusion is that the vast majority of these sites may have contributed to the erosion and sedimentation in the basins during this period.

It is recognized that much of the problem of poor soil conservation practices in construction sites may stem from insufficient knowledge on the part of developers and construction workers in the use of Best Management Practices. In many instances, however, this information has been available, but has not been implemented in practice due to inadequate enforcement staff, a lack of attention to the conditions by the development community, or both.

Individual Actions

In addition to regulatory considerations and development-related activities, the decline in these basins can be traced to the daily activities of the thousands of individuals in the general public whose often inadvertent or well-intentioned actions can harm stream and wetland systems. Filling of wetlands, rerouting of stream channels, removal of instream habitat forming debris or streamside vegetation, heavy reliance on automobiles, excessive use of fertilizers and pesticides, poor animal-keeping practices, and poor handling of toxics and other contaminants, have collectively had a substantial impact on the quality and flow conditions of the streams and wetlands in the basins today.

Comprehensive Planning

In the future, it will be essential to ensure that the preventive and corrective actions of all entities and the public in the basins are well integrated to improve on historic approaches to surface water management. The Hylebos Creek and Lower Puget Sound Basin Plan is one of several major planning and action-oriented efforts under way in the basins to achieve this objective. The other endeavors described in Table 3.9.2 include the South King County Groundwater

Management Plan, the Pierce County Public Works Hylebos Creek Basin Surface Water Management Plan, the Lower Puyallup River Watershed Action Plan, and the U.S. Environmental Protection Agency Commencement Bay Superfund Clean-Up. Each of these projects addresses a specific aspect of surface- or groundwater-conditions in a portion of the basins. For example, the Superfund Clean-Up is working to reduce nonpoint source pollution in the vicinity of Hylebos Waterway, which flows into Commencement Bay, while the Pierce County Stormwater Master Plan is focused on solutions to storm flows in the Pierce County portion of Hylebos Creek.

The Hylebos Creek and Lower Puget Sound Basin Plan will compliment these efforts by providing comprehensive surface water management solutions to stormwater flows, as well as water quality degradation, and habitat conditions in both basins. The recommendations will include capital improvement projects, development codes, and public education programs. The plan recommendations will be closely coordinated with the other planning projects in the basins for consistency. The combined results of these projects will significantly affect how regulatory agencies, development community, and the general public will directly and indirectly affect the conditions in Hylebos Creek and the Lower Puget Sound basins in the future.

Implementation of each of these planning efforts has the potential to provide an important framework for future cooperative action among the entities, the general public, and the private sector in the affected portions of the Hylebos Creek and Lower Puget Sound basins. However, it is not clear whether the sustained resources needed will be made available to implement these efforts. In addition, while there currently appears to be a movement among the public to change individual life styles that harm the environment, it is unclear whether this trend will continue to take hold, or that it will be sufficiently strong to help these more comprehensive efforts succeed.

KEY FINDINGS

- Among the local governments in the basins, there are varying regulations and surface water management programs that without a high degree of coordination have the potential to conflict with each other. This can create inefficiencies in the delivery of stormwater facilities and services which could be avoided with joint or coordinated actions.

- Many local, state, and federal regulations are in place to deal with stormwater problems; however, insufficient funding, lack of regulatory authority in some cases, and the rapid pace of development are hampering their effectiveness.

- Conditions in the basins have been degraded not only by development activity, but also by the daily activities of residents who can unknowingly contribute to the problems. Public education throughout the basins is needed to overcome this problem.

- Several major watershed based plans are in progress, in addition to the Hylebos Creek and Lower Puget Sound Basin Plan, and each has the potential of guiding future actions in the basins more effectively than in the past.

Table 3.9.2

SURFACE AND GROUNDWATER MANAGEMENT PROJECTS IN THE HYLEBOS CREEK AND LOWER PUGET SOUND BASIN PLAN AREA

The South King County Groundwater Management Plan: The South King County Groundwater Management Plan is a cooperative effort by water purveyors and local and state agencies that is being prepared in two phases. In Phase I, information is being collected on the quality and quantity of groundwater in the project area. This phase was expected to be completed in 1989. Phase II will identify the policies and programs needed to manage groundwater supplies and protect their quality in the future. The Hylebos Creek and Lower Puget Sound basins are both within this planning area. See also Section 3.5, Groundwater, and Section 3.7, Water Quality, for further information on this study.

The Pierce County Public Works Department Stormwater Master Plan: The Pierce County Storm-Water Master Plan is a cooperative planning process among entities in Pierce and King County to identify surface water management needs within the Pierce County portion of the Hylebos Creek basin. This study is part of an initial countywide assessment intended to provide preliminary cost estimates for purposes of establishing a stormwater utility and rate structure in Pierce County. It is expected that a more detailed study of this portion of the Hylebos Creek basin will be needed prior to implementation of this plan. (In contrast, the Hylebos Creek and Lower Puget Sound Basin Plan, being developed for the King County/Federal Way portion of the Hylebos Creek basin, is an intentionally more detailed study that will identify solutions which can be designed and implemented following plan adoption.) The Pierce County Hylebos Creek Basin Plan portion of the countywide plan is expected to be completed in August 1990.

The Lower Puyallup River Watershed Action Plan: The Pierce County Planning and Natural Resource Management Department is the lead agency for the Lower Puyallup Watershed Action Plan. This is a highly coordinated effort among all jurisdictions, agencies, and the public to develop a framework of strategies for managing nonpoint source pollution in the watersheds of Lower Puyallup River, including all of the Hylebos Creek basin in King and Pierce County. Completion of the study is expected in mid-1992. All entities in the planning area will be asked to authorize a statement of concurrence which commits that entity to implementing specific actions. The nonpoint sources to be addressed include failing onsite septic systems, agricultural practices, stormwater, forest practices, and marinas and boats.

U.S. Environmental Protection Agency Commencement Bay Nearshore/Tideflats Integrated Action Plan (commonly known as the Commencement Bay Superfund Clean-up): The Commencement Bay Superfund Clean-up is a cooperative effort by the State Department of Ecology, the Port of Tacoma, the City of Tacoma, and the Tacoma-Pierce County Health Department to clean-up toxic sediments and sources of hazardous pollutants entering Commencement Bay, including those from the industrial area in the vicinity of Hylebos Waterway. The project has identified numerous point and nonpoint sources contributing to the pollution in Commencement Bay. This information was used to develop a clean-up plan for each identified source. The clean-up plans are currently being implemented. Full implementation of the action plan is expected to be completed by 1995 and monitoring will continue indefinitely. Therefore, significant new sources of pollution contributed by Hylebos Creek will be cause for concern by these agencies. See also Section 3.7, Water Quality, for further information on this study.