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MEMORANDUM

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TO Ron Devitt

FROM: Bill Yake and Greg Cloud

SUBJECT: The Impact of Enumclaw Trickling Filter Effluent on Boise Creek (March 21, 22, 1978)

DATE: April 27, 1978

State of Washington Department of Ecology

Introduction

A survey of Boise Creek was conducted by Greg Cloud and Shirley Prescott of the Washington State Department of Ecology (DOE) on March 21 and 22, 1978. This stream survey coincided with a Class II inspection of the Enumclaw sewage treatment facility conducted by Bill Yake (DOE). The results of the Class II inspection are contained in a memorandum of April 25, 1978 from Bill Yake to Ron Devitt of the Northwest Regional Office of the DOE. Both effluent discharge data and stream survey data are reported here.

Three stations on Boise Creek were sampled. Station #1 is located approximately 200 feet upstream from the plant discharge. Station #2 is located approximately 0.4 mile downstream from the discharge near an abandoned highway bridge. Station #3 is located approximately 0.8 mile below the plant discharge. Figure #1 illustrates the study area and station locations.

Biological and physio-chemical parameters were sampled at each of these stations to assess the impact of the Enumclaw trickling filter effluent discharge (1.5-2.0 cfs) on Boise Creek (15-20 cfs). Enumclaw is anticipating a treatment facility upgrade with discharge to the White (Stuck) River, rather than to Boise Creek. These results, therefore, can also serve as baseline data to assess the changes in Boise Creek water quality once the municipal discharge is routed directly to the White River.

A Weyerhaeuser sawmill, located approximately five river miles above the municipal discharge, is responsible for the only other major point discharge to Boise Creek. The mill effluent includes settled, aerated hydraulic debarker wastes and will be characterized by a Class II inspection performed on April 11-12, 1978.

Methods

This memorandum reports the results of field and laboratory analyses of effluent and receiving water samples. Stream flows were obtained from stream velocity profiles which were measured using a magnetic flowmeter. The treatment plant had no valid operating flow measuring device; therefore, the same method was used to quantify influent flow in the influent grit channels. Temperature, pH, specific conductivity and dissolved oxygen

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Figure 1. Boise Creek Study Area

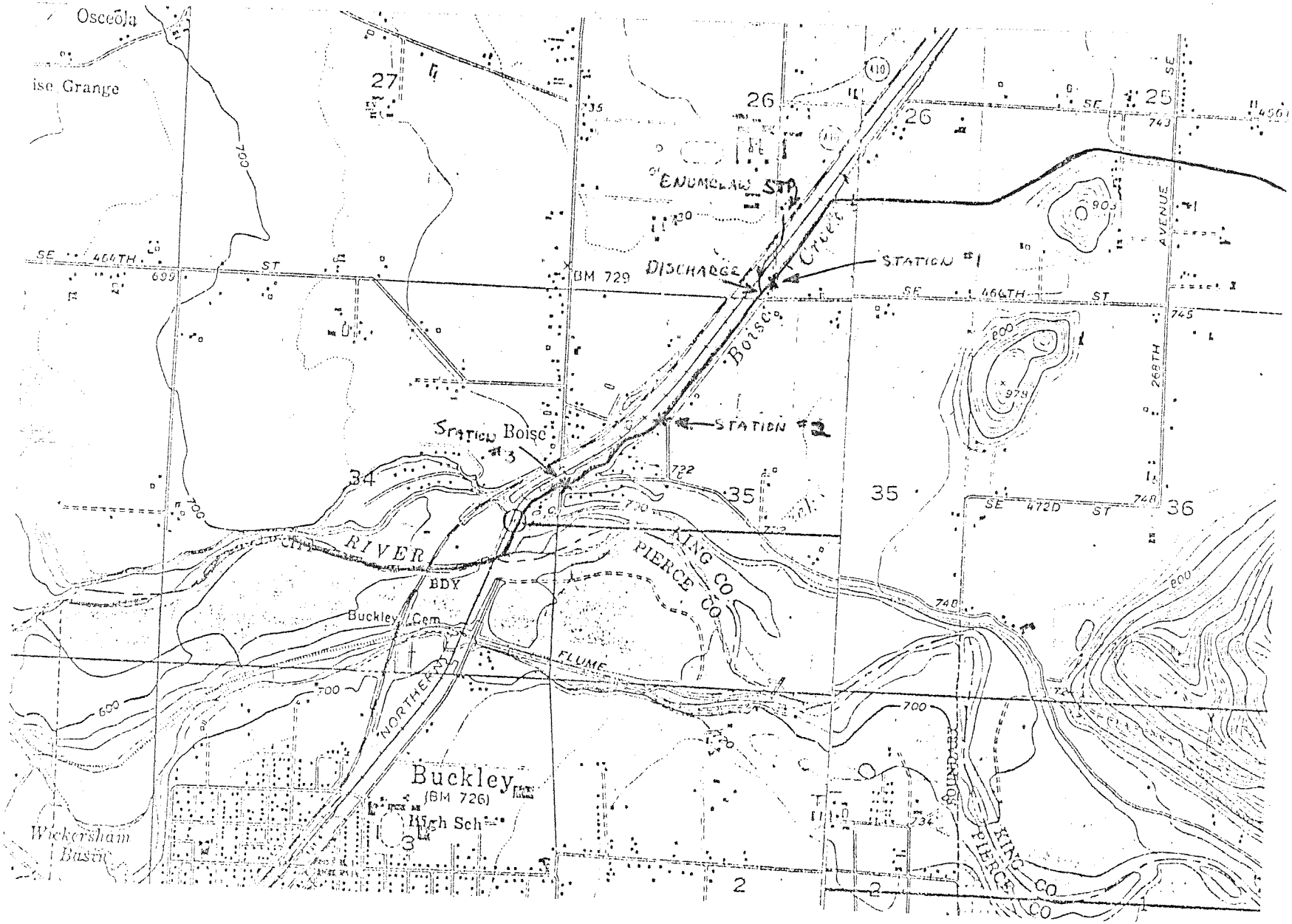

Table 1. Analytical Results: Enumclaw STP and Boise Creek

Parameter	Station #1		Enumclaw STP Effluent		Station #2		Station #3	
Date	3/21	3/22	3/21	3/22	3/21	3/22	3/21	3/22
Flow (cfs)	18.6	12.1	1.75	- -	26.5	- -	22.4	22.8
Dissolved O_2 (mg/l)	11.4	11.2	- -	- -	10.8	10.7	10.5	10.8
COD (mg/l)	27	23	260		43	27	39	27
BOD_5 (mg/l)	- -	2	78		- -	5	- -	7
Turbidity (NTU's)	10	6	34		8	7	8	8
pH	6.8*	6.7*	7.3*	7.0*	7.6*	7.2*	7.8*	7.3*
	7.1	7.0	7.2		7.3	7.2	7.5	7.3
Specific Conductivity (μmhos/cm)	63*	75*	570*	750*	110*	110*	95*	100*
	73	61	1170		105	94	93	98
Temperature (°C)	7.8*	8.6*	14.0*	14.0*	10.4*	9.4*	11.8*	9.2*
Total Coliform (#/100 ml)	4200	6100	7000	- -	1200 est.	3200	2200 est.	3500
Fecal Coliform (#/100 ml)	600	490	50	25	220	290	160	430
NH_3-N (mg/l)	.02	.02	22		1.2	.72	.80	.62
NO_2-N (mg/l)	<.02	<.02	<.02		<.02	<.02	<.02	.02
NO_3-N (mg/l)	.38	.38	<.02		.42	.42	.43	.44
O-PO_4-P (mg/l)	.04	.02	4.8		.32	.23	.22	.37
T-PO_4-P (mg/l)	.06	.04	6.2		.36	.26	.27	.28
Total Solids (mg/l)	94	70	670		90	94	97	92
T. Non-Vol. Solids (mg/l)	69	50	538		65	65	59	63
T. Sus. Solids (mg/l)	32	8	45		10	10	11	11
TNVSS (mg/l)	20	1	4		2	3	2	4

* Field analysis

(Winkler-azide Method) were analyzed in the field. A composite sampler was installed at the outfall of the final clarifier. This sampler was left in place for 24 hours and collected 250 ml every 30 minutes. Grab samples were collected at each stream station on March 21 and 22. Each sample was iced immediately on collection and during transport to the Department's laboratories in Tumwater. Nutrient samples were acidified immediately. All analyses were conducted in accordance with Standard Methods (14th Edition).

Macroinvertebrate samples were collected at each of the stream stations. A relatively homogeneous stretch of stream with a maximum depth of 1.25 to 2 feet was chosen, and twelve rocks were sampled at each station. Similar rounded rocks were removed with a fine mesh net placed below and behind the rock. Attached material was removed from the rock by hand and placed in ethyl alcohol. The rock was then rinsed in alcohol and water to remove remaining benthos. The net contents were washed to the sample bottle using alcohol. The longest two right angle dimensions of the rock were measured and recorded. These measurements were later multiplied to provide a rough measure of stream bottom area occupied by individual rocks. In the laboratory the samples were randomly selected to represent each station. This was necessary because of limited available lab time and very high individual counts for most samples. Macroinvertebrates were keyed to the most precise taxonomic group readily ascertained. Counts are reported by taxonomic group, number of individuals, individuals per square foot of stream bottom and species diversity using the Shannon-Weaver diversity index:

Eq. 1 $$d = {}^{c}/_{N} \left(N \log_{10} N - \Sigma n_i \log_{10} n_i\right)$$

where: d = species diversity
c = 3.3219
N = Total number of organisms
n_i = Total number of individuals in the i th taxonomic group

Coho salmon (Oncorhynchus kisutch) fry were observed near Station 1. Ten of these fry averaging 4 cm. in length and weighing about 0.6 g. were placed in a livebox at 1130 on March 22, 1978. The livebox was placed in Boise Creek about 100 feet above Station #2 behind a large dead-fall. Flow was slow and the area shaded, making conditions optimal for fry survival. The box was checked again after 24 hours.

Results

The results of the physical and chemical analyses are presented in Table 1. At the time of the study the plant effluent was increasing the upstream loading of the following parameters:

2: POLLUTANT LOADING ON BOISE CREEK - AS % OF LOAD IMMEDIATELY AFTER [illegible] STP DISCHARGE

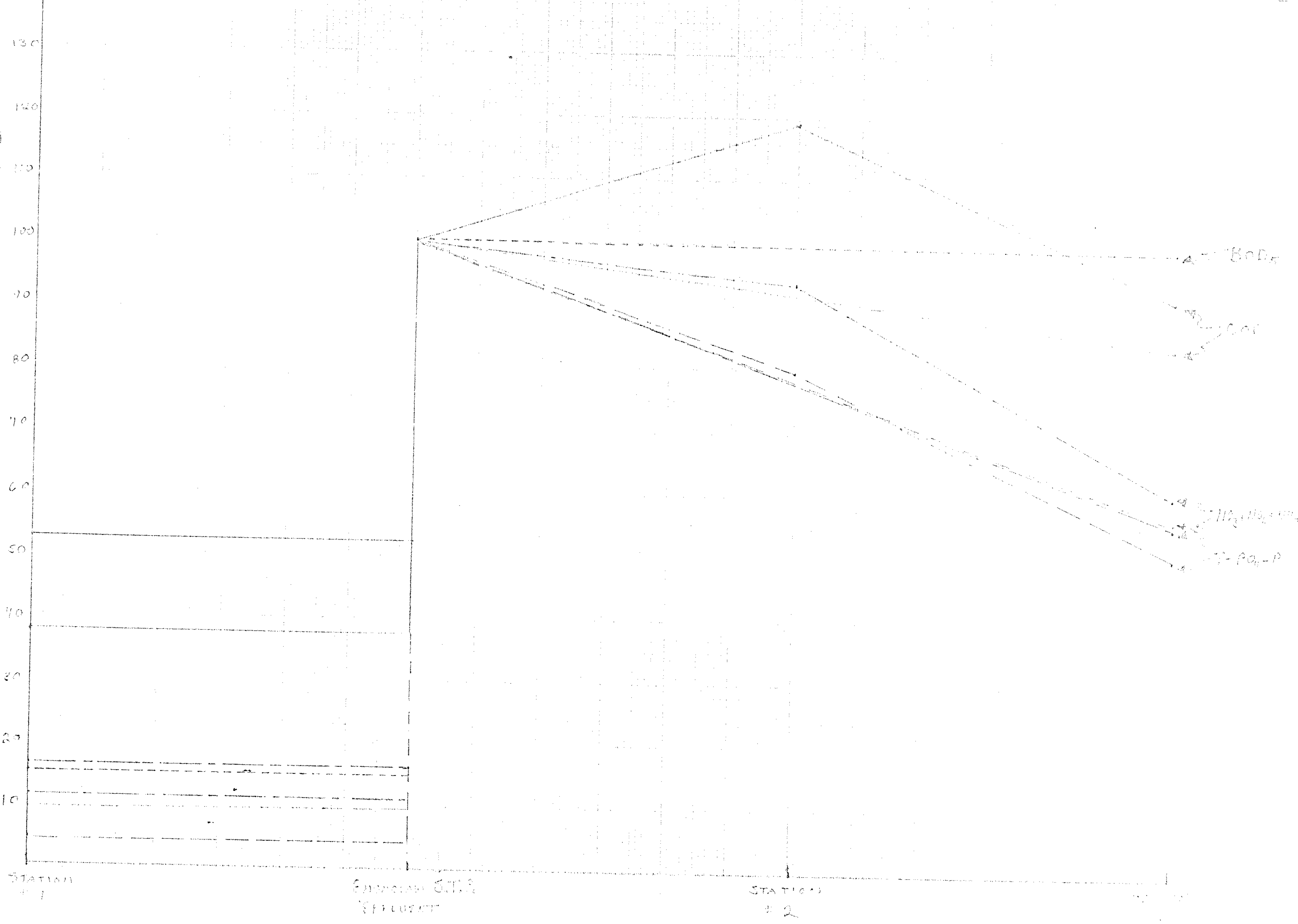

Table #2. Discharge Impact on Pollutant Loading

Pollutant	Date	$\frac{\text{loading below discharge}}{\text{loading above discharge}}$ X 100, i.e. [% increase]
BOD_5	3/21	663%
COD	3/21	210%
	3/22	263%
$T\text{-}PO_4\text{-}P$	3/21	1072%
	3/22	2345%
$NH_3+NO_2+NO_3\text{-}N$	3/21	617%
	3/22	897%

It is clear that the plant discharge is substantially increasing the organic and nutrient loading to Boise Creek. This effect is also shown by Table 3 and Figure 2 which present the loadings of each of these parameters at each of the stations. Nutrient loadings drop between the discharge and Stations 2 and 3, probably indicating nutrient uptake by periphyton and an increased trophic status.

COD is only moderately increased by the discharge, due to substantial upstream concentratons. These upstream concentrations are probably due to discharges at the Weyerhaeuser sawmill located about five miles above the STP outfall.

BOD_5 did not appear to be significantly degraded in the 0.8 mile flow from the discharge to Station 3. This is not surprising as the detention time in this stretch of stream was less than one hour.

Dissolved oxygen showed a drop of 0.4 to 0.9 mg/l, probably due primarily to the low dissolved oxygen concentration of the treated effluent.

The results of macroinvertebrate collection are presented in Table 4. Ten generic groups are represented at Station 1, while this drops to three and five groups at Stations 2 and 3 respectively. This drop in diversity is reflected in the species diversities of 1.53, 0.76, and 0.94 recorded at Stations 1, 2, and 3 respectively. The diversity at Station 1 is indicative of marginal water quality, while the diversities below the plant discharge indicated degraded water quality. This, in conjunction with the results of physiochemical analyses, indicates the severity of Enumclaw STP discharge on the quality of Boise Creek.

In addition to the species noted in Table 4, large numbers of leeches were noted in the slow backwaters of Station 3. The presence of leeches often indicates degraded water quality with high organic loadings. Because the leeches were not attached to stones in the rapid waters where sampling was carried out, they were not collected.

Table 3. Mass Loadings on Boise Creek

Parameter	Date	A. Station #1 lbs/day	B. Enumclaw STP lbs/day	C. Station #2 lbs/day	D. Station #3 lbs/day	$[\frac{A}{A+B}] \times 100$ % of A+B	$[\frac{C}{A+B}] \times 100$ % of A+B	$[\frac{D}{A+B}] \times 100$ % of A+B
BOD_5 (lbs/day)	3/22	131	737	- -	861	15.1%	- -	99.2%
COD (lbs/day)	3/21	2712	2457	6153	4717	52.5%	119%	91.3%
	3/22	1503	2457	- -	3324	37.9%	- -	83.9%
$T\text{-}PO_4\text{-}P$ (lbs/day)	3/21	6.03	58.6	51.5	32.7	9.3%	79.7%	50.6%
	3/22	2.61	58.6	- -	34.5	4.3%	- -	56.4%
$NH_3+NO_2+NO_3\text{-}N$ (lbs/day)	3/21	40.2	208	231	149	16.2%	93.7%	60.1%
	3/22	26.1	208	- -	130	11.2%	- -	93.7%

Table 4. Macroinvertebrate Populations in Boise Creek

Phylum Family Genus species	Station 1		Station 2		Station 3	
	count	d *	Count	d	Count	d
Diptera						
Tendipedidae						
unidentified species (larval)	288	95.7	249	120.3	197	130.5
unidentified (pupal)	13	4.3	39	18.8	12	8.0
Tipulidae						
unidentified species (larval)	1	.33				
Trichoptera						
Rhyacophilidae						
Rhyacophila sp.	2	.7				
Glossosoma sp.	47	15.6				
Ephemeroptera						
Heptageniidae						
Rhithrogena decora	1	.33				
Baetidae						
Baetis sp.	13	4.32				
Oligochaeta						
unidentified species	27	9.0	10	4.8	30	20.0
Malacostraca						
Gammaridae						
Gammarus lacustris	1	.33			3	2.0
Mollusca						
Ancylidae						
Ferrissia caurina caurina	11	3.7				
Planorbidae						
Planorbis operc ularis planulatus					1	.7
Total Count	404		298		243	
Total density		134.31		143.90		161.2
Species diversity	1.53		0.76		0.94	

* density per square ft.

The livebox retention of native coho salmon fry indicated no mortality in 24 hours. Fry were active after 24 hours and dissection of a single specimen indicated that it had been actively feeding. The presence of fry near Station #1 reveals successful spawning by adults during the previous season. No fry were observed at Stations 2 or 3.

Conclusions:

Although Boise Creek is in somewhat marginal condition by the time it reaches the Enumclaw STP (moderately high turbidities and COD) the STP discharge substantially increases nutrient, BOD, and COD loadings. The dissolved oxygen concentration in the stream is decreased by about 0.5 mg/l. Macroinvertebrate diversity drops pointing out the biological effects of this effluent.

Disinfection of the effluent appears to be adequate as no increase in fecal coliforms was noted.

The removal of this dischage from Boise Creek sho ld result in a noticeable improvement in water quality.

BY:ee

cc: Dick Cunningham
Central Files