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STATE OF WASHINGTON
Dixy Lee Ray
Governor

DEPARTMENT OF ECOLOGY
7272 Cleanwater Lane, Olympia, Washington 98504

MEMORANDUM
February 14, 1980

To: John Hodgson

From: Shirley Prescott/Art Johnson

Subject: Receiving Water Studies at Omak and Oroville Sewage Treatment Plants, September 1979

INTRODUCTION

In response to Public Law 92-500, several towns in the Okanogan basin have upgraded their sewage treatment plants. Two of these towns, Omak, on the Okanogan River, and Oroville, on the Similkameen River, completed activated sludge plants in 1978 and 1977, respectively.

To document resulting changes in river water quality, receiving water surveys were conducted at these facilities on September 25-26, 1979 during summer low flow.* This memorandum reports the results of those surveys and compares them to a similar survey made in October 1977 prior to upgrade.

METHODS

At both Omak and Oroville, grab samples were collected of the STPs' effluent and of river water at control stations above the outfall and at three or four stations below (Figures 1 and 2). Five parameters were measured in situ: temperature (°C); pH; specific conductance (μmhos/cm); dissolved oxygen (Winkler-Azide modification); and chlorine residual (DPD method). The following additional parameters were determined from analysis of samples returned to the DOE Tumwater Laboratory:

1. Turbidity (NTU)
2. BOD_5 (mg/l)
3. Fecal coliform (col/100 ml)
4. Nitrate-nitrogen (mg/l)
5. Nitrite-nitrogen (mg/l)
6. Ammonia-nitrogen (mg/l)
7. Kjeldahl-nitrogen (mg/l)
8. Ortho phosphate-phosphorus (mg/l)
9. Total phosphate-phosphorus (mg/l)
10. Total solids (mg/l)
11. Total suspended solids (mg/l)

Benthic macroinvertebrate samples were collected at sites of similar habitat located close to the water quality stations cited above. Five

*Harold Porath, Department of Ecology (DOE) Central Regional Office, conducted a Class II inspection of the Omak STP on September 18-19, 1979. A similar inspection is scheduled for the Oroville STP.

stones (three at Omak) were removed at each site and all attached macroscopic invertebrates removed through rinsing and cleaning by hand, and placing in 70 percent ethyl alcohol. All organisms were later keyed to family (genera or species where possible) and the Shannon-Weaver diversity index computed.

RESULTS AND DISCUSSION

Okanogan River at the Omak STP

Table 1 summarizes data collected during the September 25, 1979 and October 3-6, 1977 receiving water studies of the Okanogan River at the Omak STP. An August 1979 failure of the new plant's sludge return screw pump was causing an abnormally high load of solids to be discharged to the river and interfering with effective chlorination. In spite of this, both total and suspended solids returned to background levels within 500 feet of the outfall. Fecal coliform concentrations, however, remained considerably above Class A standards at the most downstream station sampled.

Data from DOE's routine monitoring station 49A070 on the Okanogan River at Okanogan show no fecal coliform violations for WY 1979 although background levels at the time of this study were 280 col/100 mls (Table 1). This may be attributable to heavy rains in the area prior to sample collection.

With the exception of specific conductance and phosphate-phosphorus, which remained slightly elevated 1000 feet below the outfall, all other September 1979 parameters either peaked at station 2 immediately below the outfall and then rapidly returned to background levels, or were little affected by the effluent.

Okanogan River samples collected on October 3-6, 1977, prior to upgrade, were limited to within 200 feet of the outfall. The effluent was receiving secondary treatment via a conventional trickling filter and secondary clarifier. Comparison of receiving water quality before and after upgrade is of limited value in light of the above-mentioned inoperable screw pump and resulting inefficient sewage treatment. The lack of solids, coliform, BOD, and turbidity data on river water from 1977 also limits comparison. However, it was apparent that the impacts of ammonia-nitrogen and chlorine on the river had been significantly reduced. A mixing zone concentration of chlorine in excess of levels protective of aquatic life was the major adverse receiving water impact detected in 1977. On the other hand, inefficient chlorination, due to excessive solids as mentioned above, was resulting in fecal contamination at least 1000 feet downstream in September 1979. Most other parameters measured returned to background levels and met with Class A standards within several hundred feet of the outfall for both periods sampled. Average river water:STP effluent dilution ratios in October 1977 and September 1979 were 896:1 and 1763:1, respectively.

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Diversity indices calculated from benthic macroinvertebrate samples taken above and below the Omak STP outfall were as follows: 100 feet above, 2.74; 100 feet below, 2.77; 200 feet below, 2.71; and 500 feet below, 2.44. No evidence of pollution-depressed invertebrate populations is shown. A similar conclusion was reached from biological data collected prior to the upgrade.

Omak STP's sludge return screw pump has been repaired as of this writing and the plant is presently functioning as designed. Additional receiving water samples collected under standard operating conditions would give a better assessment of benefits resulting from the upgrade.

Similkameen River at the Oroville STP

Table 2 summarizes the September 26, 1979 and October 10-13, 1977 data from receiving water studies of the Similkameen River at the Oroville STP. The apparent progressive increase in nitrate-nitrogen, phosphate-phosphorus, total solids, and specific conductance within the first 200 feet below the outfall in 1979 indicate these samples were either not centered in the effluent plume or reflect incomplete mixing of plant effluents and river water. Complete mixing was probably realized about 500 feet downstream from the outfall since, at the existing dilution ratio (1050:1), conductance after mixing should return to near control levels. The other above-mentioned parameters also approach control levels at this point. No river water impact was seen for the remaining parameters measured. These results are comparable to data from DOE's routine monitoring station 49B070 (Figure 2), Similkameen River at Oroville.

Comparison of the September 1979 STP effluent grab sample with results from the October 1977 24-hour composite show siginficant plant improvements in BOD, coliforms, nitrite-nitrogen, ammonia-nitrogen, Kjeldahl-nitrogen, and suspended solids. The new facility's improved contact time was giving good disinfection at lower chlorine concentrations.

Receiving water quality comparisons before and after upgrade are limited to the nutrient data collected in 1977. Reduced amounts of nitrogen present in the mixing zone of the Similkameen River as ammonia, nitrate, and Kjeldahl-nitrogen were the major improvements seen. Treatment plant wastes appeared to be assimilated within about 400 to 500 feet for both periods studied.

Benthic macroinvertebrate diversity indices were calculated from four samples collected in fast-flowing riffles located 500 feet above the outfall and 150, 600, and 800 feet below. The lowest diversity, 1.29, was seen above the outfall and may have been the result of silt generated by modifications of the nearby river bank. Diversity indices

below the outfall were 1.55 at 150 feet, 2.53 at 600 feet, and 1.92 at 800 feet. Evidence of pollutant stressed stream organisms had been shown in the survey prior to upgrade - diversity indices of 2.68 at the above control station and 1.37 at 400 feet below the outfall. It appears that benthic macroinvertebrates have responded positively to improvements in river water quality although low control station diversity in the present survey masks the extent of this response.

SUMMARY

Results of these receiving water surveys can be summarized as follows:

1. Okanogan River at the Omak STP

   A. Improvements after upgrade were seen in reduced amounts of ammonia-nitrogen and chlorine discharged to the Okanogan River.

   B. Failure of the Omak STP sludge return screw pump in August 1979 was causing an abnormally high load of solids in the effluent and interfering with chlorination.

   C. September 1979 fecal coliform concentrations were considerably above Class A standards 1000 feet downstream from the outfall.

   D. No adverse effects of Omak STP effluent on benthic macroinvertebrates were seen.

2. Oroville STP at the Similkameen River

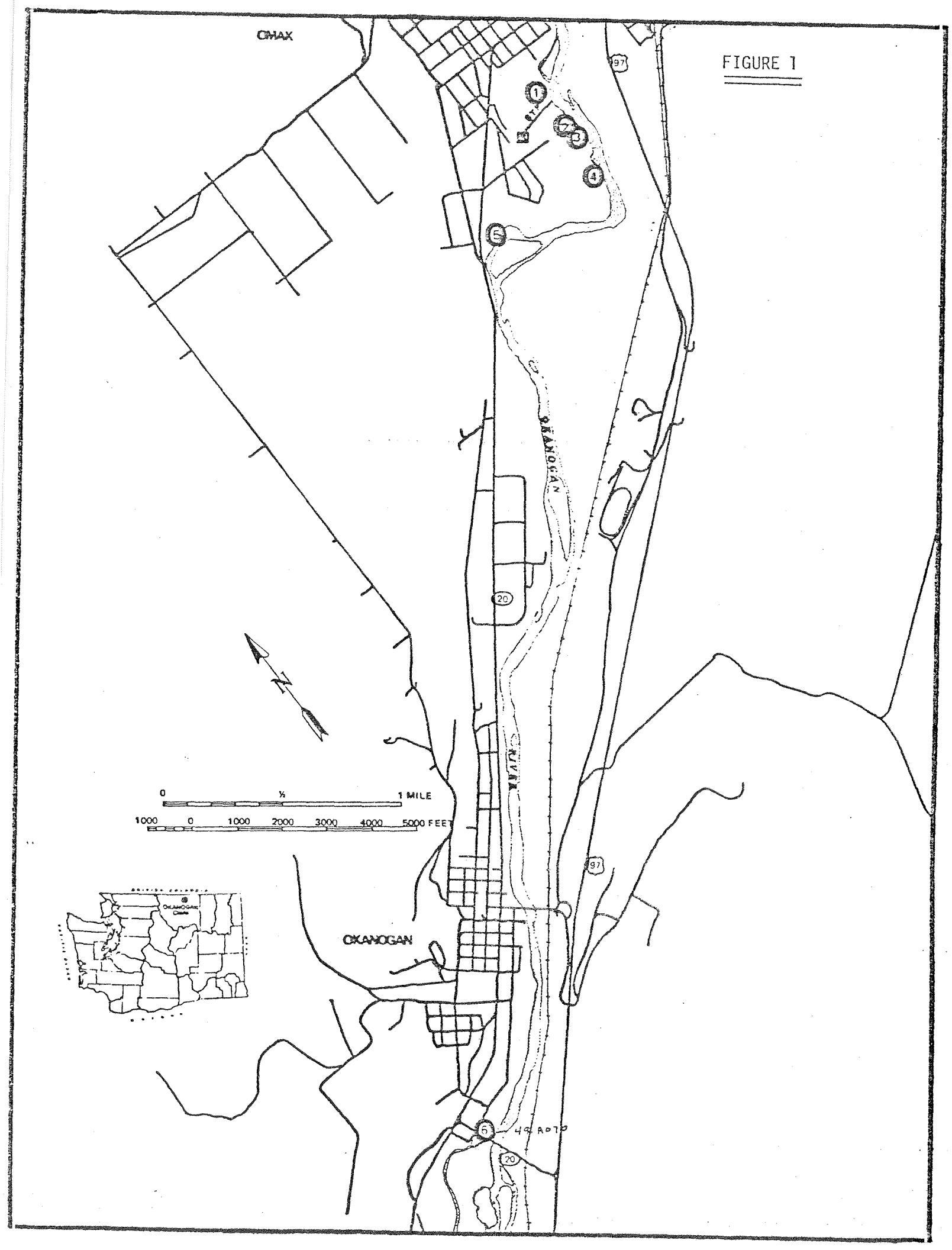
   A. Plant effluent after upgrade showed significant improvements in BOD, fecal coliforms, nitrite-nitrogen, ammonia-nitrogen, and suspended solids.

   B. Receiving water mixing zone concentrations of ammonia-nitrogen, nitrite-nitrogen, and Kjeldahl-nitrogen had been reduced.

   C. Pollutant stresses on benthic macroinvertebrate populations below the Oroville STP outfall were not evident.

SP:AJ:cp

FIGURE 1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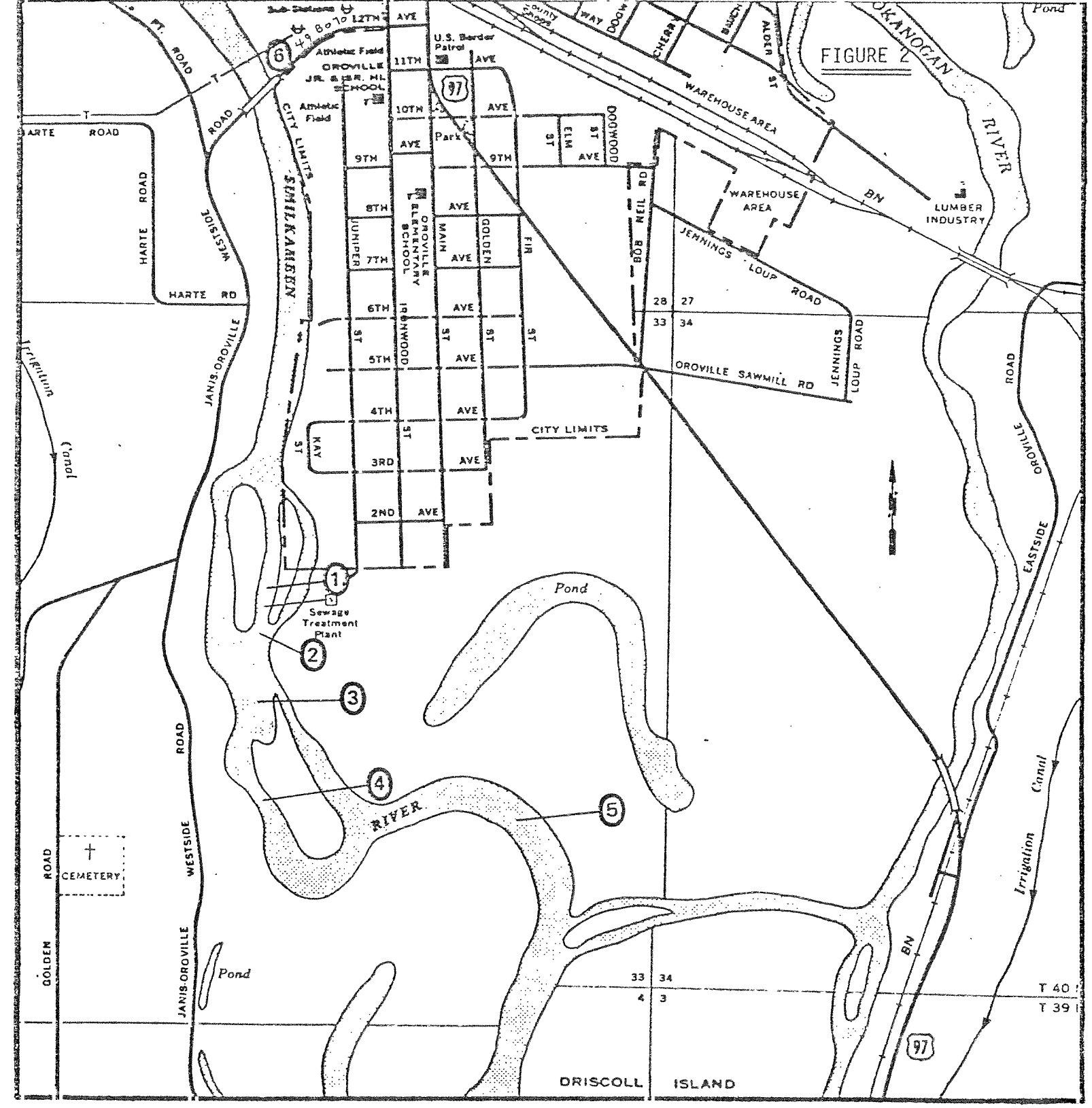


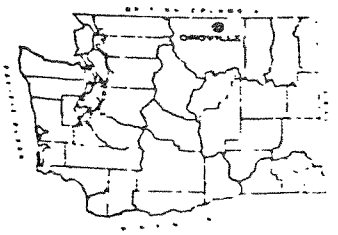
CITY MAP

OROVILLE

OKANOGAN COUNTY

1975

WASHINGTON STATE HIGHWAY COMMISSION
DEPARTMENT OF HIGHWAYS
PLANNING DIVISION
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION



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FEET

Table 1. Okanogan River Receiving Water Quality and Omak STP Effluent data, September 25, 1979 and October 3-6, 1977.

Station	Flow (MGD)	Temp. (°C)	Conductance (μmhos/cm)	pH	Turbidity (NTU)	D.O. (mg/l)	BOD_5 (mg/l)	Fecal Coliforms (Col/100 ml)	NO_3-N (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	T. Kjeld-N (mg/l)	O-PO_4-P (mg/l)	T-PO_4-P (mg/l)	Total Solids (mg/l)	T.S.S. (mg/l)	Cl_2 (mg/l)
September 25, 1979																	
25 feet above outfall	379	17.7	275	8.2	1	11.4	<4	280	<.01	<.01	.02	.20	<.01	<.01	200	12	N/A
STP Eff. (grab)	.215	20.5	830	7.3	30	1.4	62	>2,000	13	.2	.3	9.0	5.5	7.0	710	140	.1
200 feet below outfall		17.7	310	8.3	7	11.0	8	---	.13	<.01	.15	1.6	.08	.42	230	24	ND
500 feet below outfall		17.5	301	8.4	1	10.9	<4	>2,000	<.01	<.01	.03	.24	.02	.04	200	12	ND
1000 feet below outfall		17.9	303	8.5	2	11.3	<4	2,200 est.	<.01	<.01	.03	.35	.02	.05	200	13	ND
October 3-6, 1977																	
Upstream control	553	12.2	312	7.2	--	11.2	--	---	<.02	<.02	<.02	.22	<.02	<.03	---	---	N/A
STP Eff. (24-hr. comp)	.617	16.7	1058	7.2	--	---	37	85	.60	<.02	1.77	16.0	6.4	7.8	602	237	10.6
100 feet below outfall		12	330	7.0	--	11.2	--	---	.08	<.02	.54	.78	.17	.26	---	---	.3
200 feet below outfall		12.2	---	7.0	--	11.2	--	---	.02	<.02	.30	.40	.09	.08	---	---	ND

N/A = Not applicable
ND = None detected

Table 2. Similkameen River Receiving Water and Oroville STP Effluent data, September 26, 1979 and October 10-13, 1977.

Station	Flow (MGD)	Temp. (°C)	Conductance (μmhos/cm)	pH	Turbidity (NTU)	D.O. (mg/l)	BOD_5 (mg/l)	Fecal Coliforms (Col/100 ml)	NO_3-N (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	T. Kjeld-N (mg/l)	O-PO_4-P (mg/l)	T-PO_4-P (mg/l)	Total Solids (mg/l)	T.S.S. (mg/l)	Cl_2 (mg/l)
September 26, 1979																	
25 feet above outfall	231	16.2	198	8.2	1	10.8	5	<5	<.01	<.01	<.01	.05	.01	.03	140	<1	N/A
STP Eff. (grab)	.22	18.9	850	7.4	1	4.1	<4	15	9.9	<.01	.04	.3	7.6	6.2	570	4	.4
50 feet below outfall		16.4	210	8.2	1	10.7	<4	<5	.02	<.01	.01	.12	.04	.04	140	<1	ND
100 feet below outfall		16.3	213	8.3	1	10.7	<4	<5	.06	<.01	<.01	.14	.11	.10	150	1	ND
200 feet below outfall		16.4	225	8.3	1	11.1	<4	<5	.18	<.01	.01	.15	.22	.19	150	<1	ND
500 feet below outfall		16.4	205	8.3	1	11.0	<4	<5	.01	<.01	<.01	.08	.02	.03	140	1	ND
October 10-13, 1977																	
Upstream control	564	16.5	207	7.5	--	11.1	--	--	<.02	<.02	<.02	.13	<.02	<.02	---	--	N/A
STP Eff. (24-hr. comp)	.198	15.6	1017	7.2	--	---	54	3.1×10^5	1.10	.27	11.4	16	3.43	5.27	569	20	5.25
200 feet below outfall		15.6	228	7.3	--	10.9	--	--	.04	.03	.47	.55	.14	.20	---	--	ND
400 feet below outfall		15.6	209	7.3	--	10.9	--	--	<.02	<.02	.06	.09	<.02	<.02	---	--	ND

N/A = Not applicable
ND = None detected