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MEMORANDUM
August 5, 1985

To: Roger Ray

From: John Bernhardt

Subject: Impacts of the Spokane Wastewater Treatment Plant on the Spokane River Including Recommended NPDES Limits for Chlorine and Ammonia

INTRODUCTION

During 1981-83, a series of intensive water quality surveys were performed on the Spokane River. The purpose was to evaluate receiving water impacts associated with the Spokane Wastewater Treatment Plant (WTP). Emphasis of the study was on total residual chlorine and ammonia, although consideration also was given to other potential problems in the receiving stream. The information collected will be used, as required, to develop NPDES limitations for these two parameters based on plant flow, season, and river quality and flow. The survey results including recommended permit limits are documented in this report.

LOCATION AND DESCRIPTION

The Spokane WTP is located adjacent to the Spokane River at river mile (r.m.) 67.4 (Figure 1). The survey area extends from this point downstream for approximately nine miles to Nine Mile Dam. These are Class "A" waters according to the State of Washington Water Quality Standards (State of Washington, 1982). Such waters should meet or exceed the requirements of essentially all beneficial uses including water supply; stock watering; rearing, spawning, and harvesting of fish and shellfish; fish migration; wildlife habitat; various recreational activities; and aesthetics. Further information regarding the water quality standards applicable to this area is given in Appendix 1.

The plant discharges at about 32 million gallons per day (MGD) during the summer months. A concrete flume transports the effluent down a steep embankment to the river. The flume measures about 30 feet in length and the face is embedded with cobble to promote aeration. Effluent attains a fairly high velocity by the time it reaches the river and discharges as a surface stream, resulting in substantial turbulence at the point of inflow.

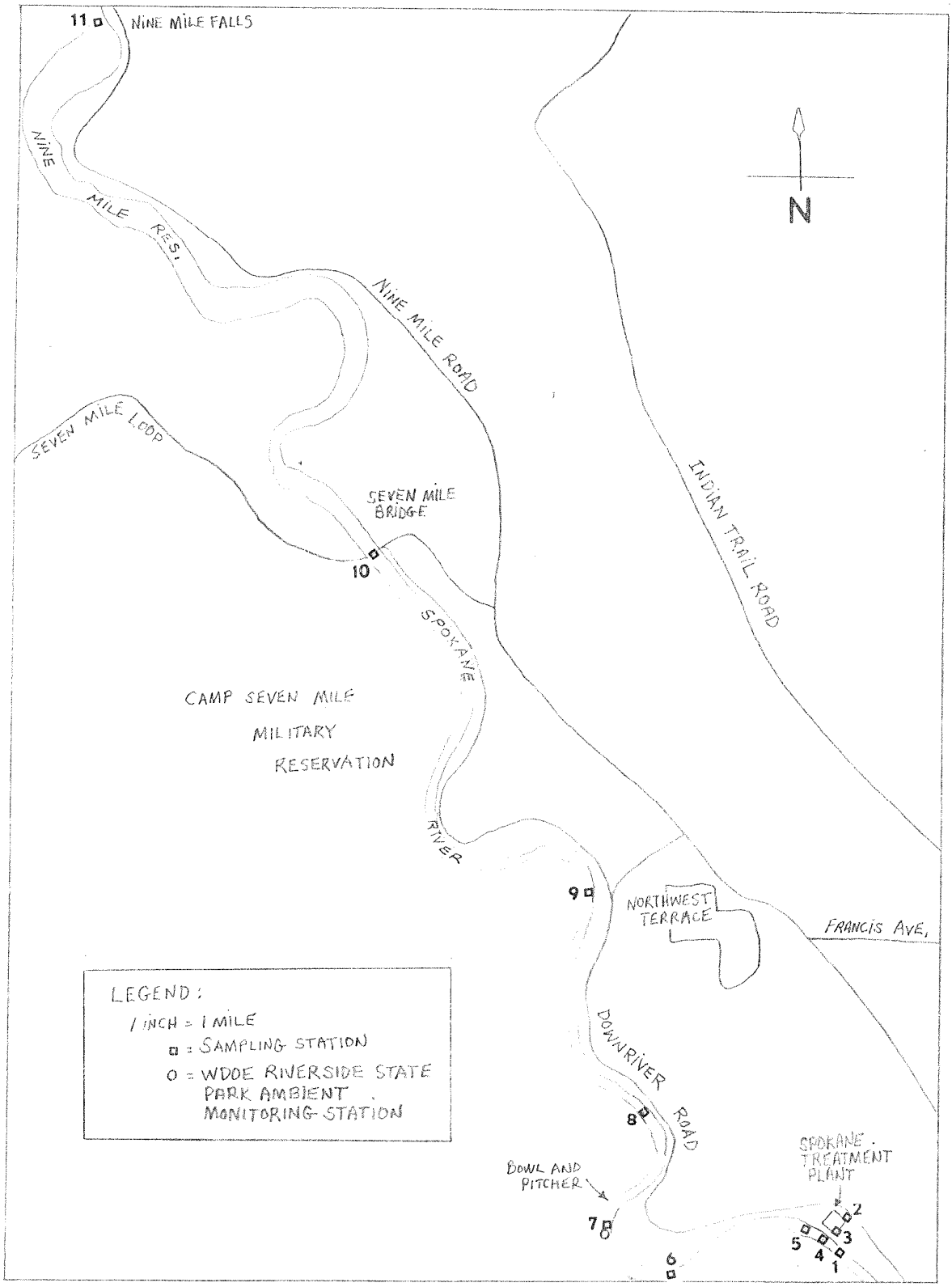

Figure 1. Map of Spokane River showing WDOE water quality sampling sites included in 1981-83 stream surveys.

The Spokane River below the plant is free-flowing, followed by impounded waters. For the first three miles the width averages about 200 feet and depth about 5 feet. Flow velocities through this stretch are moderate and the gradient gentle, with the exception of some constricted areas like the "Bowl and Pitcher" where large, basaltic outcroppings predominate and flow velocities are high. The river bottom consists mainly of large boulders and rubble. For the next six miles the river is impounded. The channel gradually widens, depth increases, and flow velocities decrease. Maximum width (1,200 feet) and depth (25 feet) occur several hundred yards upstream of Nine Mile Dam. Bottom substrate along this lower section consists mostly of sand and mud.

Most of the survey area lies within the confines of Riverside State Park. For this reason, private homes are present only in a few areas such as near Seven Mile Bridge and Nine Mile Falls. Northwest Terrace WTP is the only point-source discharge in the study area other than the Spokane WTP (Figure 1). It is a small activated sludge facility (package plant) serving a community of 1,200 (0.15 MGD flow rate) located on uplands about 1/3 mile from the river. All of the wastewaters treated are of domestic origin. The chlorinated effluent is discharged at r.m. 64.3.

Northwest Terrace WTP is scheduled to be taken off line in 1985 or 1986. The wastewaters will be routed to the Spokane treatment plant for treatment and discharge.

Ground water is an important consideration in the survey area. USGS evaluated 1949-50 flow data for the section of river between the city of Spokane and Seven Mile Bridge (Broom, 1951). The river was found to gain an average of 242 cfs from the Spokane-Rathdrum Aquifer from July through September. A similar analysis performed on 1984 data by Harper-Owes showed an average gain of 167 cfs for the same area and time period (Harper-Owes, 1985). A gain of 200 cfs approximating the average of these two studies is used for the purpose of this report. Spokane River flow is not gaged in the vicinity of the treatment plant. Thus, summer flows obtained from gaging stations located upriver must be adjusted upward (by 200 cfs in this case) if river flow at the treatment plant is to be accurately represented.

Ground water may have another impact in the survey area. Evidence suggests that the city of Spokane's northside landfill, via ground water transport, may be a source of nutrients and possibly other pollutants. The potential is greatest during the summer when ground water flow from the landfill to the river is the highest percent of river flow (C. Patmont, personal communication).

METHODS

Field surveys were performed during three periods of low flow: September 15-17, 1981; August 25-26, 1982; and August 31, 1983. Samples for priority pollutant analyses were collected at the treatment plant during December 15-16, 1981.

The sampling stations are shown in Figure 1. A wide array of analyses were performed at each station even though the main focus was on chlorine and ammonia:

Field Analyses	Laboratory Analyses
Temperature (°C)	Specific Conductance (umhos/cm)
Specific Conductance (umhos/cm)	pH (S.U.)
pH (S.U.)	Nitrate-N (mg/L)
Oxidation Reduction Potential (volts)	Nitrite-N (mg/L)
Dissolved Oxygen (mg/L)	Ammonia-N (mg/L)
Total Residual Chlorine (mg/L)	Orthophosphate-P (mg/L)
Secchi Disc (feet)	Total Phosphate-P (mg/L)
	Total Solids (mg/L)
	Total Non-vol. Susp. Solids (mg/L)
	Total Suspended Solids (mg/L)
	Total Non-vol. Solids (mg/L)
	Total Hardness (as $CaCO_3$) (mg/L)
	Total Alkalinity (as $CaCO_3$) (mg/L)
	Chemical Oxygen Demand (mg/L)
	Biochemical Oxygen Demand (mg/L)

Not all of the analyses were performed at every station during each survey.

For those parameters measured in the field, the Winkler method (azide modification) was used to determine dissolved oxygen (APHA, 1980). Total residual chlorine was determined by the ferrous DPD Titrametric Method (Ibid.) or Chlortech Amperometric field monitor. The remaining field parameters were measured with a model 3000 Hydrolab probe. The samples for laboratory analyses were packed in ice, as required, and transported to the WDOE Environmental Laboratory in Tumwater. All analyses were performed using procedures outlined in Standard Methods (Ibid.) or Methods for the Examination of Water and Wastes (EPA, 1979).

The treatment plant effluent and receiving waters were sampled during each stream survey. A WDOE Class II facility inspection was performed during the September 1981 survey (Yake, 1982). During the remaining surveys, treatment plant sampling was limited to effluent and influent 24-hour composites. Receiving water samples were collected between the treatment plant and Nine Mile Dam during all three surveys. During the September 1981 survey, intensive sampling was performed near the outfall to evaluate dilution and dispersion characteristics in the river.

Seasonal limitations for effluent ammonia were calculated using the method described by Yake and James (1983). This method establishes monthly loading limits based on an assessment of the ability of the receiving stream to assimilate the waste load. Consideration is given to in-stream water quality criteria, flow, temperature, and pH. An "exceedance allowance" is included allowing for occasional excursions above the criteria due to temperature and pH variations in the river. The main advantage of this approach is that ammonia loading restrictions are required only during those months of the year when receiving water conditions dictate a need.

The Spokane River was evaluated using historical data from the WDOE Riverside State Park ambient monitoring station (12424000). This station is located about one mile below the Spokane WTP and has been in operation since 1970. Monitoring data collected at this station include river water quality changes induced by the treatment plant effluent. However, this problem is considered minor because the impact of the plant's effluent only marginally affects in-stream temperature and pH during the summer months (Ibid.).

Flow for the Spokane River near the treatment plant was estimated by summing the flows for two USGS gaging stations located upriver; Spokane at Spokane (12322500) and Hangman Creek at Mouth (12424000). During July through September, 200 cfs was added to account for ground water inflow. Plant flow was obtained from Daily Monitoring Reports (DMRs).

RESULTS

Dilution and Dispersion

The WDOE Dilution Zone Guidelines use the 7-day, 10-year low flow (7Q10) for design purposes (WDOE, 1978). The 7Q10 for the Spokane River at Spokane WTP was estimated as follows (Table 1):

Table 1. 7Q10 for Spokane River at Seven Mile Bridge.

Location	7Q10 (cfs)
Spokane at Spokane USGS Gaging Station	888
Hangman Creek at Mouth USGS Gaging Station	4
Ground Water Inflow	200
Spokane WTP Existing Flow (32 MGD)	50
Total	1,142

As previously noted, the ground water inflow occurs between the city of Spokane and Seven Mile Bridge. Thus, in reality the flow given is for the river at Seven Mile Bridge. The flow is assumed to be the same at the treatment plant.

As previously noted, the treatment plant effluent enters the river as a surface discharge. Turbulent mixing occurs at the point of inflow, initially extending across about one-third the river channel. As it moves downstream,

the effluent remains near the right bank (looking downriver) with lateral dispersion generally weak. Specific conductivity measurements indicated that dilution was not complete at the El Paso pipeline bridge located about 0.3 mile below the outfall (Figure 2). The effluent may become completely mixed in the large riffle just below the bridge.

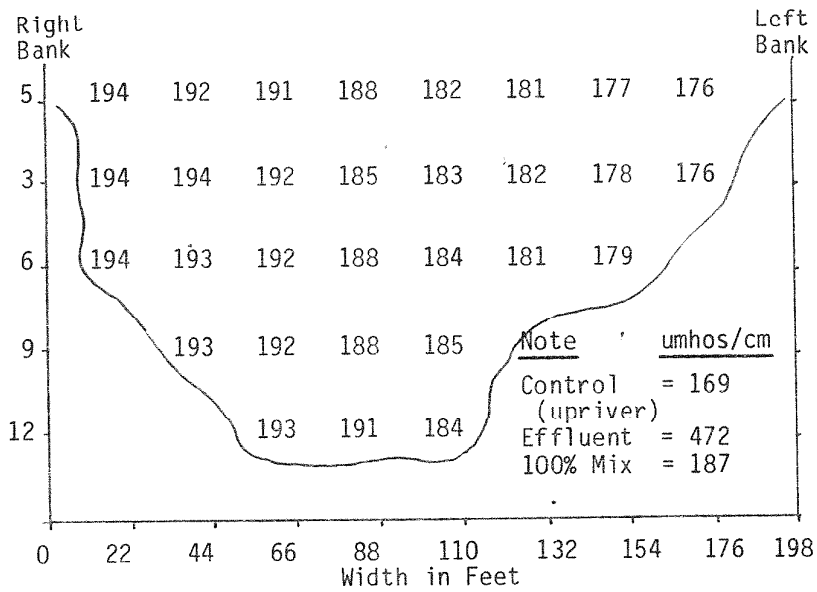

Figure 2. Specific conductivity (umhos/cm) readings collected from the Spokane River at the El Paso Natural Gas foot-bridge located 0.3 mile below Spokane WTP, August 25, 1982.

Dilution ratios (river flow:effluent flow) are one means of estimating the potential for adverse receiving water impacts. The WDOE Dilution Zone Guidelines do not permit dilution zones for new facilities or developments when the dilution ratio is less than 20:1. Below this point, the receiving stream is not considered adequately protected even by stringent treatment requirements because the potential for pollution problems resulting from plant upsets or bypasses cannot be eliminated.

The dilution ratio is specifically defined as the ratio of river flow below the outfall to effluent flow, expressed by the following relationship:

$$D = (QE+QS)/QE$$

where:

D = dilution ratio
QS = River flow above the plant
QE = Effluent flow

Dilution ratios calculated for the three surveys performed during this effort are given in Table 2. Also included are ratios for three assumed flows:

Table 2. Calculated dilution ratios, Spokane treatment plant.

Date	Flow Event	River Flow Below Plant MGD (cfs)*	Effluent Flow MGD (cfs)	Dilution Ratio
9/15/81	Survey 1	1456 (2254)	32.3 (50.0)	45:1
8/25/82	Survey 2	956 (1480)	32.4 (50.1)	30:1
8/31/83	Survey 3	1488 (2303)	32.3 (50.0)	46:1
Design	7Q10	738 (1142)	32.3 (50.0)	23:1
Design	7Q10	749 (1160)	44.0 (68.1)	17:1
Design	7Q10	744 (1152)	37.2 (57.6)	20:1

*Spokane at Spokane + Hangman Creek + ground water + WTP

The 7Q10 changes slightly for each design condition because it includes treatment plant flow which is different for each condition.

The 20:1 guideline was met during all three field surveys, but not when design criteria of 7Q10 and 44 MGD conditions are assumed. The 20:1 guideline will be reached at about 37 MGD plant flow, assuming 7Q10 conditions.

The Dilution Zone Guidelines include several considerations other than the dilution ratio:

1. The boundaries shall not encompass more than 15 percent of the volume of a stream or include more than 15 percent of river flow. For rivers less than 680 feet wide, the dilution zone boundary with respect to the waterline at low flow (7Q10) shall begin at a point from the shore that is a minimum of 15 percent of the stream width.

2. The upper limit of the dilution zone shall be one foot below the surface of the water. The length of the dilution zone shall extend laterally (downriver) 300 feet from the center line of the diffuser.

3. The width of the dilution zone shall not extend into the shoreline areas described above and will be either:

   a. The length of the diffuser plus 100 feet, or

   b. Fifteen percent of stream width or less.

4. No exposed discharge will be permitted.

Some of these requirements are not met. The discharge is exposed, the zone of initial dilution is too wide, and the outfall is located too close to shore.

From a regulatory perspective, WDOE considers the guidelines generally applicable to all dischargers; however, the permit writer is to use his/her own discretion in their application on a case-by-case basis (Hildebrandt, 1974). Such discretion was used in the case of this outfall which is located in a river section not frequented by people, other than some who drift the river during the warm-weather months. The outfall appears to be reasonably placed even through it does not meet all of the criteria.

Total Residual Chlorine

The EPA "Red Book" criterion is 0.002 mg/L Total Residual Chlorine (EPA, 1976). This represents the maximum allowable concentration for chronic exposure of salmonid fishes. EPA is updating the criterion and anticipates it will be replaced by a two-part standard sometime in 1985 (EPA, 1984). The proposed criteria state that freshwater organisms and their uses should not be affected unacceptably if:

(1) The 4-day average total residual chlorine concentration does not exceed 0.011 mg/L more than once every 3 years, and if

(2) The 1-hour average total residual chlorine concentration does not exceed 0.019 mg/L more than once every 3 years.

The proposed criteria are discussed to provide a preliminary indication of impacts. They should not be used to set NPDES permit limits until formally published in the Federal Register.

Effluent limitations based on both the existing and proposed criteria are given in Table 3. Both cases assume 7Q10 flow in-stream and 100 percent mix of river and effluent. The 0.046 mg/L effluent limit calculated using 0.002 mg/L as the receiving water goal is very restrictive and well below what the plant could be expected to achieve without dechlorination. This translates to 12.3 lbs/day. During summer 1984, the treatment plant used an average of about 450 pounds of chlorine per day (Arnold, 1985). This resulted in about 200 pounds discharged to the Spokane River daily (Spokane WTP DMRs).

Table 3. Total residual chlorine limits. Spokane Treatment Plant.

	Option 1 Existing In-stream Chronic Criterion (0.002 mg/L)	Option 2 Proposed In-stream Criteria 4-day average (0.011 mg/L)	Option 2 Proposed In-stream Criteria 1-hour average (0.019 mg/L)
Effluent Concentration Limit (mg/L):			
at 32 MGD1/	0.046	0.253	0.438
at 35 MGD	0.042	0.233	0.402
at 40 MGD	0.037	0.205	0.354
at 44 MGD	0.034	0.188	0.324
Effluent Load Limit (lbs/day)2/	12.3	67.5	116.8

Calculations

Design flow: 7Q10 cfs (888 + 4 + 200 + effluent)

Equation 1: $C_d = (C_r)(Q_r)/Q_d$

where: C_d = effluent limit (mg/L)
C_r = in-stream criterion (mg/L)
Q_d = effluent flow (cfs)
Q_r = river flow below STP (cfs)

Equation 2 - Effluent load limit = $(Q_d)(C_d)(5.39)$

1/cfs = (1.547)(MGD)

2/Based on 32 MGD effluent flow.

The proposed criteria limits are less restrictive, but problems still exist. At 0.253 mg/L, the four-day average concentration (approximates a chronic criterion) for the 32 MGD discharge would be very difficult to achieve on a regular basis without dechlorination. This is also true with the "1-hour average" limitation which should be regarded as a "never-to-exceed" category.

Criteria violations are occurring in the Spokane River under existing conditions. This applies to the existing chronic criterion as well as the proposed criteria (Figure 3).

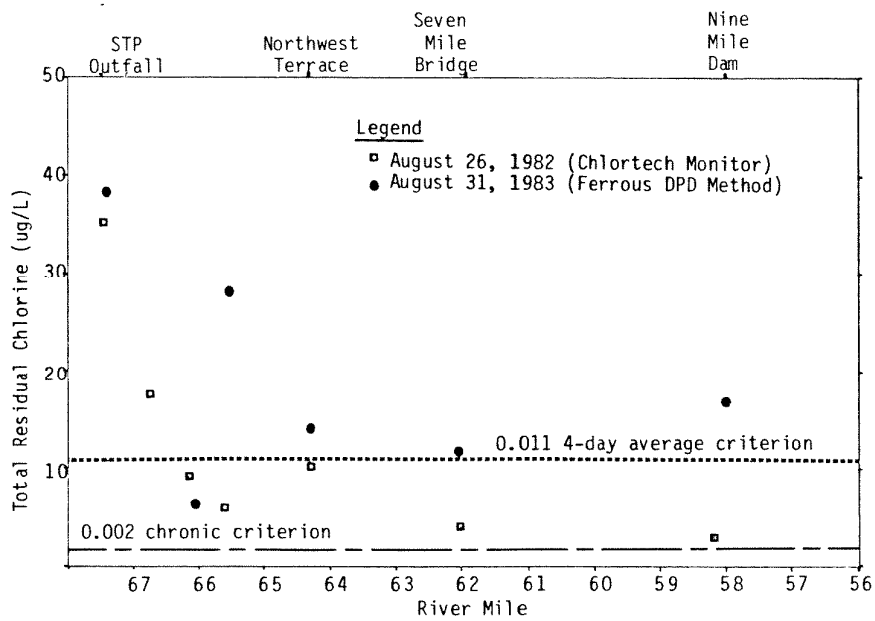

Figure 3. Total residual chlorine sampling data collected from the Spokane River during WDOE water quality surveys, August 26, 1982, and August 31, 1983.

In-stream chlorine measurements were made using the Chlortech Unit (sensitive to 0.001 mg/L) during the August 26, 1982, survey. The concentration measured 0.2 mile below the outfall (average of 0.034 mg/L for three sites spaced at equal intervals across the river) was close to the 0.030 mg/L value calculated for this same area based on river flow and WTP effluent data. The chlorine concentration declined to 0.017 mg/L at the station located 0.6 mile below the outfall. This would be expected and to some extent probably reflects chlorine demand exerted in-stream. The August 31, 1983, in-stream data (Ferrous DPD method) reflected the same general trend, but the results varied. The field personnel reported some problems determining exactly when color disappeared when near the detection limit of 0.01 mg/L for this test procedure.

It is recommended that the proposed EPA criteria for total residual chlorine be used for the NPDES permit update if published in time. The effluent limitations presented can be modified without substantial effort if the proposed criteria are revised in the final form. If the new criteria are not finalized in time, the existing criterion should be used. Regardless of which criteria are used, it appears that dechlorination will be necessary if the treatment plant is to consistently meet the limits.

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Ammonia

The need for seasonal ammonia limitations at the Spokane WTP was evaluated based on existing and proposed in-stream criteria. The existing EPA "Red Book" criterion for un-ionized ammonia is 0.02 mg/L (0.0165 mg/L as ammonia-N) for chronic exposure of freshwater aquatic life (EPA, 1976). The proposed criteria do not include a chronic criterion per se; however, a comparable category allows about 0.035 mg/L (0.029 mg/L as ammonia-N) for long-term exposure (EPA, 1984; R. Erickson, personal communication). In effect, the proposed criteria are about one-half as restrictive as the existing criterion. EPA cites several reasons for the change. The new criteria account for the results of bioassay studies performed since the existing criterion was published. Changes in toxicity induced by temperature and pH also are now accounted for. The toxicity of un-ionized ammonia has been shown to generally decrease as these two parameters increase.

The proposed criteria state that "except possibly where there are multiple discharges, multiple pollutants, or unusually stressful conditions or where a locally important species is very sensitive, freshwater organisms should not be affected unacceptably if:

(1) The 4-day average concentration of un-ionized ammonia (mg/L NH_3) does not exceed, more often than once every three years on the average, the numerical value given by 0.80/fT/fpH/acute-to-chronic ratio, where:

0.8 = Constant

fT = $10^{(0.03)(20-T)}$ if temperature less than 15 degrees C

fT = 1.4 if ambient temperature between 15 C and 30 degrees C

fpH = $(1 + 10^{7.4-pH})/1.25$ if pH less than 8 but 6.5 or greater

fpH = 1 if pH 8 to 9

Ratio = $(24 \times 10^{7.7-pH})/(1 + 10^{7.4-pH})$; if pH 7.7 or less but greater than 6.5

Ratio = 16 if pH 7.7 to 9

(2) The one-hour average concentration of un-ionized ammonia (in mg/L NH_3) does not exceed, more often than once every three years on the average, the numerical value given by 0.52/fT/fpH/2, where:

0.52 = Constant

fT = Same as for chronic but use 20 degrees C instead of 15 degrees C for capping temperature

fpH = Same as for chronic"

As previously stated, the effluent limitations for ammonia were determined as described by Yake and James (1983). Based on this approach, the following information and data were used to perform the required calculations for the Spokane treatment plant:

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1. The existing criterion is 0.02 mg/L (0.0165 mg/L as NH_3-N). Matrices showing the proposed criteria under different temperature and pH conditions are given in Appendix II.

2. The 1970-1982 data base for the WDOE-operated Riverside State Park ambient monitoring station are used to reflect water quality conditions in the Spokane River below the treatment plant. The design conditions for flow, temperature, and pH are given in Appendix III.

3. The background (upstream) ammonia concentration is set at zero.

4. River flow available for effluent dilution is the sum of four inputs: (a) Spokane River at Spokane (USGS gaging station); (b) Hangman Creek at Mouth (USGS gaging station); (c) Spokane treatment plant effluent; and (d) ground water infiltration between the city of Spokane and Seven Mile Bridge.

5. For design purposes, the 4-day, 3-year low flow (4Q3) for the Spokane River was estimated to be 1400 cfs (Spokane at Spokane + Hangman Creek + ground water using USGS data for 1-, 3-, and 7-day recurrence intervals) (Figure 4). The computer software required to determine mean 4Q3 flows for each month is not available. However, USGS software can generate such data for some design flows. Based on a review of options, it was determined that the monthly one-in-five-year low flow would be the most appropriate. Using this approach, the lowest mean monthly flow of the year is 1302 cfs during August, slightly less than the 4Q3.

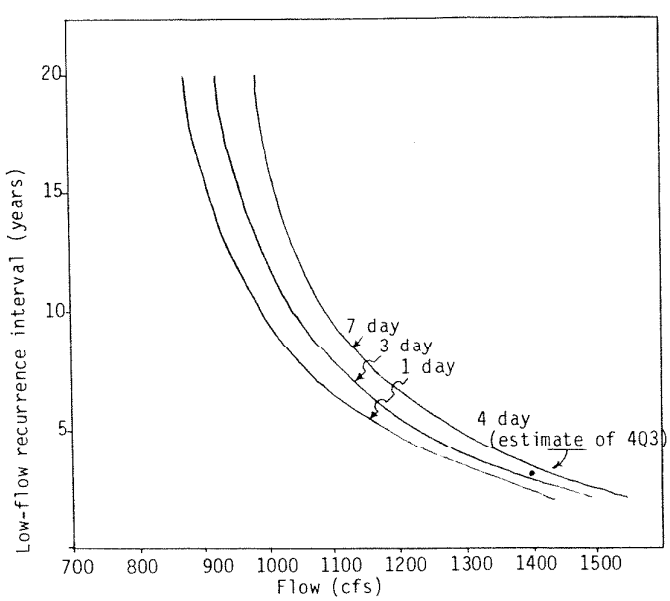

Figure 4. Estimated 4Q3 for Spokane River (Spokane at Spokane + Hangman Creek + ground water) from USGS low-flow data.

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For the next few years the treatment plant may be able to meet the 4-day limitations through internal process control. The proposed criteria should be used to establish permit limits only if published by the time the permit is put into effect.

The "not to exceed as a 1-hour average" part of the proposed criteria would be very difficult to address without requiring continuous monitoring in-stream. One alternative to this requirement is to set a maximum allowable limit for the effluent. This was done using the following information (worst-case conditions):

River flow = 673 cfs (Spokane at Spokane)*
3 cfs (Hangman Creek at Mouth)*
200 cfs (Ground water)
Total = 876 cfs

Effluent flow = 49.5 cfs (32 MGD)

pH = 8.8 (highest recorded at Riverside State Park for period of record)

Temperature = 19.8 (highest recorded at Riverside State Park for period of record)

Percent un-ionized NH_3-N = 21.3 percent (based on temperature and pH extremes in the receiving water)

Criterion = 0.214 mg/L as NH_3-N (EPA proposed not to exceed as 1-hour average, based on temperature and pH extremes)

*Obtained from USGS records.

The Spokane River at Spokane and Hangman Creek flows are the 1-day, 20-year low flows. By using these conditions and the highest temperature and pH measured during the period of record, the "not to exceed as a 1-hour average" criterion approaches a "never to exceed" requirement. Using the equation from Appendix III results in the following maximum allowable limits for total ammonia in the effluent:

Concentration = 18.8 mg/L; lbs/day limit = 5,000.

A violation would occur if any sample (concentration) or calculated daily load (lbs/day) exceeded the allowable limit.

The never-to-exceed limits become more restrictive than the 4-day limits during October. This occurs because the never-to-exceed category assumes that extreme conditions could occur during any of the four summer months, and therefore remains constant during the course of the summer. Since the 4-day limits are dependent on flow, pH, and temperature, these requirements are less restrictive during early and late summer. The never-to-exceed limit becomes limiting during October.

6. The criteria must be met after 100 percent mix of effluent and river water.

7. A 10 percent exceedance value for percent un-ionized ammonia is used.

Using 0.0165 mg/L (NH_3-N) as the in-stream goal, the effluent concentration limits that the treatment plant must meet are given in Table 4.

Table 4. Effluent ammonia limits using existing 0.0165 mg/L criteria - Spokane Treatment Plant.

Month	Effluent Concentration Limit (mg/L) 32 MGD	35 MGD	40 MGD	44 MGD	lbs/day Limit*
July	10.6	9.7	8.6	7.8	5,000
August	4.4	4.0	3.5	3.2	2,100
September	5.7	5.2	4.6	4.2	2,700
October	13.8	12.6	11.1	10.1	5,800

*Based on 32 MGD.

The effluent limits are calculated using the equation given in Appendix III.

Only four months are included because the limits for the remainder of the year are high and not of concern. The August and September limitations probably would require ammonia removal at the plant.

Effluent limits (as total ammonia-N) that the treatment plant must achieve to meet the proposed "4-day average" in-stream criteria are given in Table 5.

Table 5. Effluent ammonia limits using EPA proposed "4-day average" criteria - Spokane Treatment Plant.

Month	Criterion	Effluent Concentration Limits (mg/L) 32 MGD	35 MGD	40 MGD	44 MGD	lbs/day Limit*
July	0.029	18.7	17.1	15.0	13.7	5,000
August	0.029	7.7	7.0	6.2	5.6	2,100
September	0.029	10.0	9.2	8.0	7.3	2,700
October	0.026	21.7	19.9	17.4	15.9	5,800

*Based on 32 MGD.

An indication of river impacts associated with the treatment plant under current conditions was obtained from the monthly monitoring data collected at Riverside State Park (Figure 5). Violations of the 0.0165 mg/L chronic criterion have occurred in-stream during two of the last three summers. Violations would not have occurred had the proposed criteria been in effect, but these limits were approached during the summer of 1984.

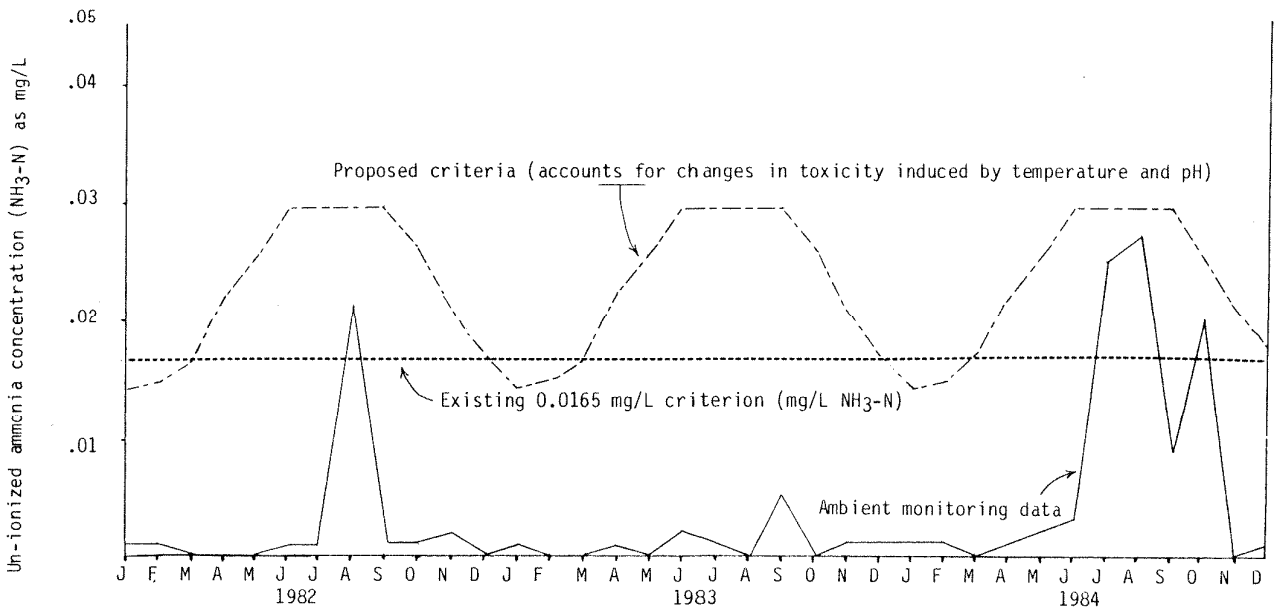

Figure 5. Comparison of existing and EPA proposed criteria with ambient monitoring data collected at Riverside State Park during 1982-1984.

Conventional Water Quality Parameters

The water quality data collected during the three field surveys are presented in Tables 6, 7, and 8. In each case, the river was experiencing predictable, moderate impacts due to treated wastewaters discharged from the treatment plant. Estimated effluent loads for selected pollutants are given in Table 9.

Table 9. Effluent loads for selected pollutants - Spokane Treatment Plant.

	Effluent Load lbs/day (percent river load below Spokane WTP)		
Parameter	9/15-16/81	8/25-26/82	8/31/83
Chlorine (TRC)	269 (100)	236 (100)	74 (100)
COD	4,576 (5)	8,640 --	-- --
BOD_5	323 (<1)	<1,080 --	-- --
Nitrate-N	1,104 (20)	2,322 (29)	2,342 (33)
Ammonia-N	1,292 (76)	648 (81)	199 (80)
Total phosphate-P	175 (36)	162 (68)	183 (74)

Table 6. Summary of WDOE water quality sampling data collected during Spokane River intensive survey, September 15 and 16, 1981.

Sampling Results	Control - 100 Feet Above SWTP	SWTP Infl. at Headworks	SWTP Effluent	Near Aeration Basins 0.10 Mile Below Outfall			El Paso Foot Bridge 0.2 Mile Below Outfall			Bowl & Pitcher Pk. Ft. Bridge 1.3 mi. Below Outfall	Access Road 1.8 mi. Below Outfall	Seven-Mile Bridge 5.4 Miles Below Outfall		Nine-Mile Dam 9.3 Miles Below Outfall	
				LB	M	RB[1]	LB	M	RB[1]						
STATION DESCRIPTION															
Station number	1	2	3	4a	4b	4c	5a	5b	5c	7	8	10		11	
Time Collected	1259	-/-	-/-	1320	1316	1307	1340	1335	1330	1511	1540	1730		1800	
Depth	surface	--	--	surface	surface	surface	surface	surface	surface	surface	surface	surface	bottom	surface	bottom
River Mile	67.3		67.3		67.2			67.1		66.0	65.5	61.9		58.0	
FIELD MEASUREMENTS (collected on September 16)															
Flow (MGD/cfs)	1424(2,203)[2]	--	32.3(50.0)	--	--	--	--	--	--	--	--	--	--	--	--
Temperature (°C)	17.9	19.6	19.8	18.0	17.9	17.9	18.1	18.0	18.0	18.5	17.8	18.0	--	21.0	--
Spec. Cond. (umhos/cm)	130	660/690[3]	650/825[3]	158	136	132	160	140	135	158	158	156	153	160	154
pH (S.U.)	8.3	7.7	7.4	8.2	8.3	8.3	8.2	8.2	8.2	8.3	8.4	8.2	8.2	8.5	8.4
Dissolved Oxygen (mg/L)	10.3	--	--	9.6	10.1	9.5	10.0	9.9	9.9	10.0	9.7	10.0	--	10.8	9.4
Secchi (feet)	--	--	--	--	--	--	--	--	--	--	--	--	--	3.7	--
TRC (mg/L)	--	--	1.1, 1.0, 1.0	--	--	--	--	--	--	--	--	--	--	--	--
LABORATORY ANALYSES (grab samples collected on September 16 except for stations 2 and 3 which were 24-hr. composite in place during September 15-16,1981)															
Spec. Cond. (umhos/cm)	127	598	736	151	--	130	150	--	128	137	147	149	154	147	154
pH (S.U.)	8.5	7.3	7.8	8.4	--	8.3	8.3	--	8.3	8.4	8.4	8.2	8.3	8.6	8.3
Turbidity (NTU)	1	87	4	1	--	2	4	--	1	4	2	2	2	6	3
F.C. (col/100 mL)[4]	23	--	<1	<1	--	6	7	--	2	1	<1	1	--	11	--
COD (mg/L)	17	290	17	8	--	8	8	--	4	8	4	4	8	8	4
BOD (mg/L)	<2	--	1.2[5]	--	--	--	<2	--	--	<2	2	2	<2	<2	<2
Nitrate-N (mg/L)	0.29	0.20	4.1	0.59	--	0.44	0.58	--	0.41	0.45	0.49	0.45	0.47	0.41	0.45
Nitrite-N (mg/L)	<0.01	<0.01	<0.05	<0.01	--	<0.01	<0.01	--	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonia-N (mg/L)	0.12	9.0	4.8	0.25	--	0.07	0.30	--	0.19	0.14	0.12	0.07	0.11	0.16	0.32
Un. Ammonia (mg/L)[6]	0.005	0.171	0.047	0.013	--	0.004	0.016	--	0.010	0.009	0.009	0.004	--	0.018	--
Orthophosphate-P (mg/L)	<0.01	3.6	0.35	0.03	--	0.01	0.03	--	0.01	0.02	0.02	0.02	0.02	0.02	0.02
T. phosphate-P (mg/L)	0.03	5.4	0.65	0.06	--	0.05	0.06	--	0.03	0.04	0.04	0.04	0.04	0.04	0.04
Total Solids (mg/L)	80[7]	510	510	--	--	--	110	--	--	90	97	94	110	86	81
TNVS (mg/L)	64[7]	300	430	--	--	--	89	--	--	68	66	71	80	66	56
TSS (mg/L)	<1	110	<1	1	--	2	<1	--	<1	<1	<1	2	3	2	<1
TNVSS (mg/L)	<1[7]	13	<1	--	--	--	<1	--	--	<1	<1	<1	1	<1	<1
T. Hardness as $CaCO_3$ (mg/L)	74	160	200	72	--	76	76	--	72	82	80	70	80	84	76
Chloride as Cl (mg/L)	0.8	42	77	2.3	--	1.5	3.1	--	1.5	1.5	3.1	1.5	1.5	1.5	2.3
T. alk. as $CaCO_3$ (mg/L)	59	200	160	69	--	59	63	--	57	63	67	71	65	65	69

1/ Quarter-point transect; LB = left bank; M = mid-stream; RB = right bank; facing upriver.
2/ Includes 200 cfs for groundwater inflow.
3/ Field analysis grab/field analysis of composite.
4/ Fecal coliform counts not in the 20 to 60 range are estimates.
5/ Approximate value
6/ Calculated value.
7/ September 15, 1981, sample.

Memo to Roger Ray
Impacts of the Spokane Wastewater Treatment Plant on the Spokane River
Including Recommended NPDES Limits for Chlorine and Ammonia

Table 7. Summary of WDOE water quality sampling data collected during Spokane River intensive survey, August 25 and 26, 1982.

Sampling Results	Control - 100 Feet Above Outfall	SWTP Influent at Head-works	SWTP Effluent	El Paso Foot Bridge 0.2 Mile Below Outfall LB	M	RB1[1]	Bowl & Pitcher Park - Upper End - 0.6 mi. Below Outfall	Bowl & Pitcher Park Foot Bridge 1.3 mi. Below Outfall	Access Road 1.8 mi. Below Outfall	Spokane Rifle Club 3.0 mi. Below Outfall	Seven-Mile Bridge 5.4 mi. Below Outfall	Nine-Mile Dam 9.3 mi. Below Outfall
STATION DESCRIPTION												
Station number	1	2	3	5a	5b	5c	6	7	8	9	10	11
Time Collected	1415	1654	1540	1608	1621	1631	1716	1739	1804	--	1826	1924
River Mile	67.3		67.3		67.1		66.7	66.0	65.5	64.3	61.9	58.0
FIELD MEASUREMENTS (collected on August 25)												
Flow (MGD/cfs)	924(1,429)[2]	--	32.4(50.1)	--	--	--	--	--	--	--	--	--
Temperature (°C)	17.9	20.3	19.8	17.3	17.3	17.2	17.4	17.3	16.7	--	16.5	18.6
Spec. Cond. (umhos/cm)	169	525	472	192	188	181	186	185	189	--	186	191
pH (S.U.)	7.6	6.9	6.3	7.9	8.1	8.1	8.0	8.1	8.1		7.9	8.0
Oxidation Reduction Potential	270	66	416	276	256	242	183	219	230	--	234	237
Dissolved Oxygen (mg/L)	10.8	--	8.7	10.8	11.0	11.0	11.1	10.7	10.1	--	10.4	10.3
LABORATORY ANALYSES (grab samples collected on August 25 except for stations 2 and 3 which were 24-hr. composite in place during August 25-26, 1982)[3]												
Spec. Cond. (umhos/cm)	210	608	591	234	218	213	219	220	223	--	222	226
pH (S.U.)	8.5	6.9	7.4	8.6	8.5	8.5	8.7	8.6	8.4	--	8.4	8.4
Nitrate-N (mg/L)	0.58	<0.10	8.6	1.3	1.1	0.94	1.1	1.0	1.0	--	0.94	0.96
Nitrite-N (mg/L)	<0.01	<0.10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	--	<0.01	<0.01
Ammonia-N (mg/L)	0.05	12.0	2.4	0.14	0.11	0.08	0.11	0.10	0.05	--	0.16	0.07
Un. Ammonia-N (mg/L)[4]	0.001	0.039	0.002	0.004	0.004	0.003	0.003	0.004	0.002	--	0.004	0.002
Orthophosphate-P (mg/L)	<0.01	3.4	0.4	0.03	0.02	0.02	0.02	0.02	0.02	--	0.01	0.01
T. phosphate-P (mg/L)	0.01	4.6	0.6	0.05	0.04	0.03	0.04	0.03	0.03	--	0.02	0.02
Total Solids (mg/L)	140	620	390	160	140	120	130	130	130	--	140	140
TNVS (mg/L)	100	320	290	110	100	78	94	99	86	--	85	86
TSS (mg/L)	2	160	2	1	<1	<1	<1	4	<1	--	<1	<1
TNVSS (mg/L)	<1	53	2	<1	<1	<1	<1	1	<1	--	<1	<1
T. Hardness as $CaCO_3$ (mg/L)	100	160	170	100	100	100	100	100	100	--	100	100
T. alk. as $CaCO_3$ (mg/L)	92	180	95	92	90	90	90	92	94	--	90	92
COD (mg/L)	--	300	32	--	--	--	--	--	--	--	--	--
BOD (mg/L)	--	160	<4	--	--	--	--	--	--	--	--	--
CHLORTECH SURVEY (August 26, 1982)												
Time Collected	1230	--	1255	1320	1325	1332	1406	1430	1445	1453	1510	1548
TRC (mg/L)	N.D.[5]	--	0.873	0.047	0.036	0.018	0.017	0.009	0.006	0.011	0.004	0.003

[1] Quarter-point transect; LB = left bank; M = mid-river; RB = right bank; facing upriver.
[2] Includes 200 cfs for groundwater inflow.
[3] Influent compositor operated during 1000 August 26 to 1040 August 27.
Effluent compositor operated during 1000 August 26 to 1103 August 27.
[4] Calculated value.
[5] N.D. = None detected.

Table 8. Summary of WDOE water quality sampling data collected during Spokane River intensive survey, August 31, 1983 (all samples were grabs).

Sampling Results	Control - 100 Feet Above Outfall	SWTP Effluent	El Paso Foot Bridge 0.2 Mile Below Outfall			Bowl & Pitcher Park - Upper End - 0.6 mi. Below Outfall	Bowl & Pitcher Park Foot Bridge 1.3 mi. Below Outfall	Access Road 1.8 mi. Below Outfall	Spokane Rifle Club 3.0 mi. Below Outfall	Seven-Mile Bridge 5.4 Mi. Below Outfall		Nine-Mile Dam 9.3 Miles Below Outfall	
			LB	M	RB1/								
STATION DESCRIPTION													
Station number	1	3	5a	5b	5c	6	7	8	9	10		11	
Depth	surface	surface	surface	surface	surface	surface	surface	surface	surface	surface	bottom	surface	bottom
River Mile	67.3	67.3	--	67.1	--	66.7	66.0	65.5	54.3	61.9		53.0	
FIELD MEASUREMENTS													
Flow (MGD/cfs)	1456(2252)2/	32.3(50.0)											
Temperature (°C)	17.7	20.8	18.6	18.4	18.3	18.2	18.4	18.1	18.2	18.5	17.8	19.4	18.4
Spec. Cond. (umhos/cm)	153	630	175	168	160	168	169	165	172	170	175	178	178
pH (S.U.)	7.8	6.9	7.9	7.9	7.9	8.0	7.5	7.9	7.9	7.9	7.8	8.0	8.0
Dissolved oxygen (mg/L)	9.7	8.3	9.7	10.2	9.9	10.0	9.7	9.8	9.6	9.6	--	--	--
TRC mg/L)	0.0	0.273	0.033	0.053	0.008	0.016	0.005 3/	0.028	0.013	0.011	0.012	0.017	0.016
LABORATORY ANALYSES													
pH (S.U.)	8.4	7.3	8.4	8.4	8.4	8.5	8.5	8.4	8.4	8.3	8.4	8.4	8.3
Spec. Cond. (umhos/cm)	147	581	164	155	152	157	157	166	163	163	165	168	168
Nitrate-N (mg/L)	0.36	8.7	0.67	0.61	0.53	0.62	0.58	0.65	0.62	0.64	0.66	0.72	0.72
Nitrite-N (mg/L)	<0.01	0.14	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.02
Ammonia-N (mg/L)	<0.01	0.74	0.04	0.02	0.01	0.02	0.02	0.02	0.01	<0.01	0.01	0.08	0.08
Orthophosphate-P (mg/L)	<0.01	0.59	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
T. phosphate-P (mg/L)	0.01	0.68	0.04	0.05	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

1/ Quarter-point transect; LB = left bank; M = mid-stream; RB = right bank, facing upriver.
2/ Includes 200 cfs for groundwater inflow.
3/ Average of two samples.

The percentages are based on the total river load below the outfall. The in-stream load was calculated based on flow and the water quality data collected at the "Bowl and Pitcher" foot bridge (Station 7).

Organic Pollutants

Generally low levels of organic pollutants were observed during the December 15-16, 1981, sampling effort. Of 13 EPA priority pollutants detected in the influent, four were detected in the effluent in sufficient quantity to calculate a load (Table 10). Two of these were phthalate acid esters (PAEs) bis(2-ethylhexyl phthalate) and di-n-octyl phthalate, common pollutants in secondary-treated wastewaters, although not normally at concentrations as high as observed in this case (Table 11):

Table 11. Effluent priority pollutants compared with commonly observed concentrations and water quality criteria - Spokane Treatment Plant.

Parameter	9/15-16/81 Concentation (ug/L)	Commonly Observed Concentration* (ug/L)	Water Quality Criteria Acute (ug/L)	Water Quality Criteria Chronic (ug/L)
bis(2-ethylhexyl) phthalate	150	10	940	3
n-butylbenzyl phthalate	2.4	--	--	--
tetrachloroethylene	8.7, 3.0	10	5,280	840
beta-BHC	0.107	0.001u	100	--
gamma-BHC (Lindane)	0.055	0.005	2.0**	0.08***

*Source: Joy, 1985
**Never to exceed
***Not to exceed as 24-hour average
u = less than

The pesticides Lindane and beta-BHC also exceeded levels normally seen in secondary municipal effluents.

Eighteen tentatively identified compounds also were detected in the influent; however, none were observed in the final effluent (Table 10).

Metals

Metals levels in the final effluent were generally lower than normally observed at municipal secondary treatment plants (Table 12):

Table 10. Organic compounds detected in WDOE samples collected at the Spokane Treatment Plant, during December 15-16, 1981.

Category	Influent (ug/L)	Effluent (ug/L)	Effluent Load to Spokane River*** (lbs/day)
EPA PRIORITY POLLUTANTS:			
Base/Neutral Compounds (24-hr. Composite)			
naphthalene	0.4	1.0u	--
bis(2-ethylhexyl) phthalate	7.3	150	34.1
butylbenzyl phthalae	1.0	1.0u	--
di-n-octyl phthalate	4.0	2.4	0.55
Acid Compounds (24-hr. Composite)			
phenol	1.4	1.0u	--
Volatiles (grab samples)			
benzene*	[2.0u, 2.0m], 2.0m	2.0u, 2.0u	--
1,1,1-trichloroethane	[2.0m, 2.0m], 2.0m	2.0m, 2.0m	--
chloroform*	[25.0, 24.0], 2.0m	2.0m, 2.0m	--
1,2-trans-dichloroethylene	[2.7, 2.6], 2.0m	2.0m, 2.0m	--
ethylbenzene	[2.0m, 2.0m], 2.0m	2.0u, 2.0m	--
methylene chloride*	[6.5, 17.0], 2.0u	2.0u, 2.0u	--
tetrachloroethylene	[13.0, 13.0], 7.3	8.7, 3.0	1.33
toluene*	[2.6, 2.7], 2m	2u, 2u	--
Pesticides and PCBs (24-hr. composite)			
beta-BHC	0.005u	0.107	0.024
gamma-BHC (Lindane)	0.08	0.055	0.013
Tentatively Identified Compounds			
2-butoxyethanol	+	ND	--
2,6-dimethyl octane	+	ND	--
1,2,4-trimethyl benzene	+	ND	--
decane	+	ND	--
4-methyl decane	+	ND	--
1 ethyl-2-methyl benzene	+	ND	--
1-methyl-4-(1-methyl ethenyl)--(R)-cyclohexane	+	ND	--
2-methyl phenol	+	ND	--
undecane	+	ND	--
1-methanol,alpha,alpha,4-trimethyl-(S)-3-cyclohexane	+	ND	--
2,5-dimethyl dodecane	+	ND	--
3,3-dimethyl hexane	+	ND	--
1-hexadecane	+	ND	--
hexadecanoic acid	+	ND	--
1,2-benzenedicarboxylic acid, diisooctyl ester	+	ND	--
ethanol	[+, ND], ND	ND	--
2-bromo,2-chloro-1,1,1-trifluorrroethane	[30, 25], ND	ND	--
3-carene	[ND, ND], +	ND	--

*Possible contamination indicated by quality control samples (blanks)
**Estimated Values
***Effluent load = (mg/L)(27.3 MGD)/0.12

u = Value is less than level of detection
m = Value is greter than detection limit but less than level of quantification
[ ] = Dulicate samples collected
+ = Present
ND = None detected

Table 12. Effluent metals - Spokane Treatment Plant.

Parameter	Effluent Concentration (ug/L Total Metal) 9/15-16/81*	12/15-16/81	Commonly Observed Concentration** (ug/L)	Load to River*** (lbs/day)
Cadmium	<1, <1	<1	10	<0.27; <0.23
Copper	4, 2	5	30	0.78; 1.14
Nickel	<2, 4	9	30	<0.76; 2.05
Lead	<3, <3	8	30	<0.77; 1.82
Chromium (+3)	4, 2	3	50	0.78; 0.68
Zinc	38, 40	75	100	9.81; 17.06
Arsenic	-- --	13	5	--; 2.96
Mercury	<0.2, <0.2	0.43	0.2	<0.05; 0.05

*24-hour composites were collected during 9/15-16 and 12/15-16/81.
**Source: Joy, 1985.
***Average of two September samples; December sample.

Violations of the EPA water quality criteria for cadmium, copper, lead, zinc, and mercury were observed in the Spokane River below the treatment plant during the December priority pollutant sampling effort (Table 13).

Table 13. Metals (total) detected in WDOE samples collected during December 15-16, 1981 (all values are ug/L).

Sampling Results	Control - 100 feet Above STP	STP Influent at Headworks	STP Effluent	El Paso Foot Bridge 0.2 Mile Below Outfall	Bowl and Pitcher Pk. Foot Bridge 1.3 Miles Below Outfall	Spokane Rifle Club 3.0 Miles Below Outfall	Seven-Mile Bridge 5.4 Miles Below Outfall	Nine-Mile Dam 9.3 Miles Below Outfall	In-Stream Criteria* 24-hr.	Anytime
Station Description										
Number	1	2	3	5	7	8	10	11		
River Mile	67.3	--	67.3	67.1	66.0	64.3	61.9	58.0		
Parameter										
Cadmium	<1	<1	<1	<1	<1	<1	<1	/1/	0.012	1.5
Copper	<1	39	5	/15/	3	<1	/12/	/7/	5.6	12
Nickel	<5	10	9	<5	<5	<5	28	<5	56	1100
Lead	/2/	44	8	/57/	/4/	/1/	/11/	/9/	0.75	74
Chromium	<2	22	3	2	<2	5	<2	<2	44**	2200
Zinc	/110/	260	75	/150/	/110/	/110/	/130/	/110/	47	180
Arsenic	8	14	13	6	4	<3	<3	<3	40**	440
Mercury	/0.63/	0.32	0.43	/0.47/	/0.55/	/0.59/	/0.47/	/0.47/	0.2	4.1

*Calculated based on 50 mg/L hardness (as $CaCO_3$). **chronic toxicity value.

/ / = Violation of in-stream criterion.

Metals violations below the treatment plant appear to occur routinely based on the historical monitoring records maintained for the WDOE Riverside State Park station (Appendix IV). The treatment plant contributes to the problem, but the loads appear to be negligible compared to the base load in the river (Table 14):

Table 14. Metals contribution to river base load - Spokane Treatment Plant.

	September 15-17, 1981*			December 15-16, 1981		
Parameter	River Load** (lbs/day)	Effluent Load (lbs/day)	Percent	River Load (lbs/day)	Effluent Load (lbs/day)	Percent
Cadmium	12.2	<0.27	<2.2	<17.9	<0.23	1.3
Copper	121.6	0.78	0.6	53.8	1.14	2.1
Nicel	--	<0.76	--	<89.6	2.05	>2.3
Lead	875.6	0.77	0.1	71.7	1.82	2.5
Chromium	121.6	0.78	0.6	<35.8	0.68	>1.9
Zinc	851.3	9.81	1.2	1,970.9	17.06	0.9
Arsenic	12.2	--	--	71.7	2.96	4.1
Mercury	2.4	<0.05	<2.1	9.9	0.05	0.5

*September 15 river flow = 2,253 cfs; December 15 river flow = 3,318 cfs.

**In-stream concentrations based on September 17 routine monitoring data for Riverside State Park station.

For this reason, effluent limits for metals are not recommended at this time. However, the facility is one of a number of dischargers contributing to a chronic toxicity problem in the river. An effort is needed aimed at developing a WDOE policy for NPDES situations where dischargers represent small loads to river systems and background metals exceed water quality criteria.

SUMMARY AND DISCUSSION

The major findings are summarized below:

1. The outfall does not meet all requirements of the WDOE Dilution Zone Guidelines. Noteworthy deficiencies are size (dilution zone exceeds 15 percent of river flow), depth (dilution zone should be one foot below the water surface), and the outfall is exposed (discharge should be below the water surface). However, considering the remote location of the treatment plant and physical characteristics of the river, the outfall may be reasonably sited.

2. River-to-effluent dilution ratios were 45:1, 30:1, and 46:1 during the three summer low-flow surveys. The 20:1 WDOE guideline was met in each case; however, the ratio would be 23:1 under 7Q10 design conditions. The 20:1 ratio will be reached at 37.2 MGD plant flow, assuming 7Q10 conditions.

3. Dechlorination appears to be necessary whether or not the effluent limits are based on the EPA existing or proposed in-stream criteria. At 32 MGD plant flow, the recommended limitations are (Table 15):

Table 15. Recommended total residual chlorine limitations - Spokane Treatment Plant.

Effluent Parameter	Option 1 Existing Criterion (0.002 mg/L)	Option 2 Proposed Criteria 4-day average (0.011 mg/L)	never-to-exceed (0.019 mg/L)
mg/L	0.046	0.253	0.438
lbs/day	12.3	67.5	116.8

The limitations would be in effect throughout the year. An example of a dechlorination system that can regularly meet or exceed the limits proposed here is at the Renton Treatment Plant

4. Ammonia removal may be necessary during August and September if the need is evaluated based on the existing criterion. The plant should be able to comply with the recommended limits during the rest of the year through internal process control. Ammonia removal may not be necessary if the limitations are based on the EPA proposed criteria. The plant should be able to comply through internal process control. Based on 32 MGD effluent flow, the recommended limitations as total ammonia-N are (Table 16):

Table 16. Recommended total ammonia (NH_3-N) limitations - Spokane Treatment Plant.

Effluent Parameter	Option 1 Existing Criterion (0.0165 mg/L)	Option 2 Proposed Criteria 4-day average (0.029 mg/L)	never-to-exceed (0.214 mg/L)
July:			
mg/L	10.6	18.7	18.8
lbs/day	2800	5000	5000
August:			
mg/L	4.4	7.7	18.8
lbs/day	1200	2100	5000
September:			
mg/L	5.7	10.0	18.8
lbs/day	1500	2700	5000
October:			
mg/L	13.8	*	18.8
lbs/day	3700	*	5000

*The never-to-exceed category becomes limiting during October.

It is recommended that the proposed EPA criteria be used to establish limitations for the new NPDES permit if published in time.

5. The poundage limitations for both total residual chlorine and total ammonia are more convenient to use than the concentration limits because such limits remain the same as plant flow increases. This approach is recommended.

6. Organic pollutants were present at generally low levels in the effluent and did not appear to be a problem. Three compounds appeared to exceed the concentrations normally expected in secondary municipal wastewaters: bis(2-ethylhexyl) phthalate, beta-BHC, and gamma-BHC (Lindane).

7. Effluent metals concentrations were lower than commonly observed in secondary-treated wastewaters. This may be partially attributed to alum used for phosphorus removal. Metals loading from the plant represented about 2 percent of the total river load below the outfall. Metals removal is not recommended at this time because of the small contribution by the plant; however, WDOE policy should be developed addressing the issue of NPDES permits as related to receiving waters where background metals exceed criteria for the protection of aquatic life.

8. A treatment plant the size of the Spokane facility should include priority pollutant monitoring. Sampling once during summer and winter every two years is recommended. The samples should be 24-hour composites for organics and metals, including grab samples for volatile organics. The final effluent is the primary concern although influent and sludge sampling are considerations.

Overall, the Spokane Treatment Plant is well operated and this is reflected by the high quality of the wastewaters discharged. It also appears that the Spokane River below the plant is at, or near, its capacity to safely assimilate the effluent. When the 20:1 guidelne is reached, aquatic life and other beneficial uses will no longer be considered adequately protected even by a high degree of treatment, since periodic plant upsets or bypasses cannot always be avoided. The increased need for NPDES limitations addressing specific wastewater constituents further alludes to this fact. Based on the information presented, it appears that discharge options other than the Spokane River need to be considered for at least part of the wastewaters when flow reaches about 37 MGD during the summer months.

JB:cp

Attachments

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APPENDIX I

State of Washington
Department of Ecology
Water Quality Standards for Class A Waters

(a) General characteristic. Water quality of this class shall meet or exceed the requirements for all or substantially all uses.

(b) Characteristic uses. Characteristic uses shall include, but not be limited to, the following:

(i) Water supply (domestic, industrial, agricultural).

(ii) Stock watering.

(iii) Fish and shellfish:

Salmonid migration, rearing, spawning, and harvesting.

Other fish migration, rearing, spawning, and harvesting.

Clam, oyster, and mussel rearing, spawning, and harvesting.

Crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing, spawning, and harvesting.

(iv) Wildlife habitat.

(v) Recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment).

(vi) Commerce and navigation.

(c) Water quality criteria.

(i) Fecal coliform organisms.

(A) Freshwater – Fecal coliform organisms 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.

(B) Marine water – Fecal coliform organisms shall not exceed a geometric mean value of 14 organisms/100 mL, with not more than 10 percent of samples exceeding 43 organisms/100 mL.

(ii) Dissolved oxygen.

(A) Freshwater – Dissolved oxygen shall exceed 8.0 mg/L.

(B) Marine water – Dissolved oxygen shall exceed 6.0 mg/L . When natural conditions, such as upwelling, occur, causing the dissolved oxygen to be depressed near or below 6.0 mg/L, natural dissolved oxygen levels can be degraded by up to 0.2 mg/L by man-caused activities.

(iii) Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection.

(iv) Temperature shall not exceed 18.0° C (freshwater) or 16.0° C (marine water) due to human activities. Temperature increases shall not, at any time, exceed $t=28/(T+7)$ (freshwater) or $t=12/(T-2)$ (marine water).

When natural conditions exceed 18.0° C (freshwater) and 16.0° C (marine water), no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3° C.

For purposes hereof, "t" represents the permissive temperature change across the dilution zone; and "T" represents the highest existing temperature in this water classification outside of any dilution zone.

Provided that temperature increase resulting from nonpoint source activities shall not exceed 2.8° C, and the maximum water temperature shall not exceed 18.3° C (freshwater).

(v) pH shall be within the range of 6.5 to 8.5 (freshwater) or 7.0 to 8.5 (marine water) with a man-caused variation within a range of less than 0.5 units.

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

(vii) Toxic, radioactive, or deleterious material concentrations shall be below those of public health significance, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect any water use.

(viii) Aesthetic values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

APPENDIX II

(2) 4-day average concentrations for ammonia.*

pH	0 C	5 C	10 C	15 C	20 C	25 C	30 C
A. Salmonids ~~and~~ OR Other Sensitive Coldwater Species Present							
			Un-ionized Ammonia (mg/liter NH_3)				
6.50	0.0007	0.0009	0.0013	0.0019	0.0019	0.0019	0.0019
6.75	0.0012	0.0017	0.0023	0.0033	0.0033	0.0033	0.0033
7.00	0.0021	0.0029	0.0042	0.0059	0.0059	0.0059	0.0059
7.25	0.0037	0.0052	0.0074	0.0105	0.0105	0.0105	0.0105
7.50	0.0066	0.0093	0.0132	0.0186	0.0186	0.0186	0.0186
7.75	0.0109	0.0153	0.022	0.031	0.031	0.031	0.031
8.00	0.0126	0.0177	0.025	0.035	0.035	0.035	0.035
8.25	0.0126	0.0177	0.025	0.035	0.035	0.035	0.035
8.50	0.0126	0.0177	0.025	0.035	0.035	0.035	0.035
8.75	0.0126	0.0177	0.025	0.035	0.035	0.035	0.035
9.00	0.0126	0.0177	0.025	0.035	0.035	0.035	0.035
			Total Ammonia (mg/liter NH_3)				
6.50	2.5	2.4	2.2	2.2	1.49	1.04	0.73
6.75	2.5	2.4	2.2	2.2	1.49	1.04	0.73
7.00	2.5	2.4	2.2	2.2	1.49	1.04	0.74
7.25	2.5	2.4	2.2	2.2	1.50	1.04	0.74
7.50	2.5	2.4	2.2	2.2	1.50	1.05	0.74
7.75	2.3	2.2	2.1	2.0	1.40	0.99	0.71
8.00	1.53	1.44	1.37	1.33	0.93	0.66	0.47
8.25	0.87	0.82	0.78	0.76	0.54	0.39	0.28
8.50	0.49	0.47	0.45	0.44	0.32	0.23	0.17
8.75	0.28	0.27	0.26	0.27	0.19	0.15	0.11
9.00	0.16	0.16	0.16	0.16	0.13	0.10	0.08
B. Salmonids and Other Sensitive Coldwater Species Absent							
			Un-ionized Ammonia (mg/liter NH_3)				
6.50	0.0007	0.0009	0.0013	0.0019	0.0026	0.0026	0.0026
6.75	0.0012	0.0017	0.0023	0.0033	0.0047	0.0047	0.0047
7.00	0.0021	0.0029	0.0042	0.0059	0.0083	0.0083	0.0083
7.25	0.0037	0.0052	0.0074	0.0105	0.0148	0.0148	0.0148
7.50	0.0066	0.0093	0.0132	0.0186	0.026	0.026	0.026
7.75	0.0109	0.0153	0.022	0.031	0.043	0.043	0.043
8.00	0.0126	0.0177	0.025	0.035	0.050	0.050	0.050
8.25	0.0126	0.0177	0.025	0.035	0.050	0.050	0.050
8.50	0.0126	0.0177	0.025	0.035	0.050	0.050	0.050
8.75	0.0126	0.0177	0.025	0.035	0.050	0.050	0.050
9.00	0.0126	0.0177	0.025	0.035	0.050	0.050	0.050
			Total Ammonia (mg/liter NH_3)				
6.50	2.5	2.4	2.2	2.2	2.1	1.46	1.03
6.75	2.5	2.4	2.2	2.2	2.1	1.47	1.04
7.00	2.5	2.4	2.2	2.2	2.1	1.47	1.04
7.25	2.5	2.4	2.2	2.2	2.1	1.48	1.05
7.50	2.5	2.4	2.2	2.2	2.1	1.49	1.06
7.75	2.3	2.2	2.1	2.0	1.98	1.39	1.00
8.00	1.53	1.44	1.37	1.33	1.31	0.93	0.67
8.25	0.87	0.82	0.78	0.76	0.76	0.54	0.40
8.50	0.49	0.47	0.45	0.44	0.45	0.33	0.25
8.75	0.28	0.27	0.26	0.27	0.27	0.21	0.16
9.00	0.16	0.16	0.16	0.16	0.17	0.14	0.11

* To convert these values to mg/liter N, multiply by 0.822.

(1) One-hour average concentrations for ammonia.*

pH	0 C	5 C	10 C	15 C	20 C	25 C	30 C
A. Salmonids or Other Sensitive Coldwater Species Present							
Un-ionized Ammonia (mg/liter NH_3)							
6.50	0.0091	0.0129	0.0182	0.026	0.036	0.036	0.036
6.75	0.0149	0.021	0.030	0.042	0.059	0.059	0.059
7.00	0.023	0.033	0.046	0.066	0.093	0.093	0.093
7.25	0.034	0.048	0.068	0.095	0.135	0.135	0.135
7.50	0.045	0.064	0.091	0.128	0.181	0.181	0.181
7.75	0.056	0.080	0.113	0.159	0.22	0.22	0.22
8.00	0.065	0.092	0.130	0.184	0.26	0.26	0.26
8.25	0.065	0.092	0.130	0.184	0.26	0.26	0.26
8.50	0.065	0.092	0.130	0.184	0.26	0.26	0.26
8.75	0.065	0.092	0.130	0.184	0.26	0.26	0.26
9.00	0.065	0.092	0.130	0.184	0.26	0.26	0.26
Total Ammonia (mg/liter NH_3)							
6.50	35	33	31	30	29	20	14.3
6.75	32	30	28	27	27	18.6	13.2
7.00	28	26	25	24	23	16.4	11.6
7.25	23	22	20	19.7	19.2	13.4	9.5
7.50	17.4	16.3	15.5	14.9	14.6	10.2	7.3
7.75	12.2	11.4	10.9	10.5	10.3	7.2	5.2
8.00	8.0	7.5	7.1	6.9	6.8	4.8	3.5
8.25	4.5	4.2	4.1	4.0	3.9	2.8	2.1
8.50	2.6	2.4	2.3	2.3	2.3	1.71	1.28
8.75	1.47	1.40	1.37	1.38	1.42	1.07	0.83
9.00	0.86	0.83	0.83	0.86	0.91	0.72	0.58
B. Salmonids ~~or~~ AND Other Sensitive Coldwater Species Absent							
Un-ionized Ammonia (mg/liter NH_3)							
6.50	0.0091	0.0129	0.0182	0.026	0.036	0.051	0.051
6.75	0.0149	0.021	0.030	0.042	0.059	0.084	0.084
7.00	0.023	0.033	0.046	0.066	0.093	0.131	0.131
7.25	0.034	0.048	0.068	0.095	0.135	0.190	0.190
7.50	0.045	0.064	0.091	0.128	0.181	0.26	0.26
7.75	0.056	0.080	0.113	0.159	0.22	0.32	0.32
8.00	0.065	0.092	0.130	0.184	0.26	0.37	0.37
8.25	0.065	0.092	0.130	0.184	0.26	0.37	0.37
8.50	0.065	0.092	0.130	0.184	0.26	0.37	0.37
8.75	0.065	0.092	0.130	0.184	0.26	0.37	0.37
9.00	0.065	0.092	0.130	0.184	0.26	0.37	0.37
Total Ammonia (mg/liter NH_3)							
6.50	35	33	31	30	29	29	20
6.75	32	30	28	27	27	26	18.6
7.00	28	26	25	24	23	23	16.4
7.25	23	22	20	19.7	19.2	19.0	13.5
7.50	17.4	16.3	15.5	14.9	14.6	14.5	10.3
7.75	12.2	11.4	10.9	10.5	10.3	10.2	7.3
8.00	8.0	7.5	7.1	6.9	6.8	6.8	4.9
8.25	4.5	4.2	4.1	4.0	3.9	4.0	2.9
8.50	2.6	2.4	2.3	2.3	2.3	2.4	1.81
8.75	1.47	1.40	1.37	1.38	1.42	1.52	1.18
9.00	0.86	0.83	0.83	0.86	0.91	1.01	0.82

* To convert these values to mg/liter N, multiply by 0.822.

APPENDIX III

In-stream design conditions used to calculate total effluent ammonia limits for the Spokane Wastewater Treatment Plant.

Month	Mean Monthly One-in-5-year low flow (5Q30) (cfs)	Background $T\text{-}NH_3\text{-}N$ (mg/L)	Percent Un-ionized Ammonia at 10 Percent Probability	Design Temperature (°C)	Design pH (S.U.)
January	3398.8	0.000	0.804	4.59	7.82
February	4506.1	0.000	1.206	5.32	7.98
March	5495.5	0.000	1.095	6.71	7.89
April	10060.2	0.000	1.145	11.07	7.76
May	14275.9	0.000	1.712	13.07	7.87
June	7039.5	0.000	3.376	17.55	8.02
July	2122.5*	0.000	6.804	19.95	8.26
August	1301.6*	0.000	10.341	19.04	8.49
September	1559.4*	0.000	19.443	17.70	8.49
October	2034.3	0.000	5.050	13.36	8.34
November	2505.6	0.000	2.137	10.18	8.06
December	2830.3	0.000	1.521	7.19	8.01

*Includes 200 cfs for ground water.

To calculate effluent limits:

Design flow = 5Q30 (Spokane at Spokane + Hangman Creek + ground water) + effluent flow

Effluent concentration limit (C_d) = $(C_r)(Q_r)/Q_d/\%$

where C_d = effluent limit (mg/L)
C_r = in-stream criterion (mg/L)
Q_d = effluent flow (cfs)
Q_r = river flow (cfs) (monthly 5Q30)
% = % un-ionized ammonia at 10% probability

Effluent load limit (lbs/day) = $(Q_d)(C_d)(5.39)$

APPENDIX IV

DEPARTMENT OF ECOLOGY

AGENCY 21540000 RETRIEVAL --- 02 AUGUST 1985

OFFICE OF WATER PROGRAMS
WATER QUALITY MANAGEMENT DIVISION
WATER QUALITY INVESTIGATIONS SECTION

54A120 SPOKANE R AT RIVERSIDE STATE PK 12424200

STORET MINOR BASIN: SPOKANE STORET SUB BASIN: LOWER SPOKANE

LATITUDE: 47 41 48.0 ELEVATION (FEET): 1640 WATER CLASS: A
LONGITUDE: 117 29 48.0 COUNTY: SPOKANE SEGMENT: 24-54-01

AGENCY: 21540000 STATE: WASHINGTON STA TYPE: RMP

TERMINAL STREAM	1ST LEV MILES	2ND LEV MILES	3RD LEV MILES	4TH LEV MILES	5TH LEV MILES	6TH LEV MILES
1310001	643.00	066.00	.	.	.	.

DATE FROM TO	TIME	DEPTH METERS	00060 STREAM FLOW CFS-AVG	00010 WATER TEMP DEG-C	00300 DISSOLVED OXYGEN mg/l	00301 DO PERCENT SATURATN	00400 pH STANDARD UNITS	00095 CONDUCTVY @ 25 C MICROMHOS	00530 SOLIDS SUSPENDED mg/l	31504 TOTAL COLIFORM /100ml MF	31616 FECAL COLIFORM /100ml MF	31672 FECAL STREP /100ml PC
72/02/22	1310			5.8								
72/10/10	1815			12.0	10.2		8.0	140		40K	40K	
72/10/31	1350		1940.0	8.0	11.6		7.9	150		20K	20K	
72/11/19	1415		2630.0	8.0	10.3		7.3	125		44	20K	
72/11/29	1255			5.9	11.3		7.1	150		120	20K	
72/12/12	1350			2.0	13.2		6.6	94		40K	20K	
72/12/27	1205		4600.0	5.6	12.2		7.0	90		800	40K	
73/01/18	1310		4660.0	3.6	12.6		7.6	98		1000	100K	
73/02/06	1415			2.8			7.0	110		200	40K	
73/02/22	1310		4800.0	5.8	12.8		7.7	130		200K	40K	
73/02/27	1345		4100.0	7.0	12.5		7.7	130		400	100K	
73/03/13	1105		5780.0	4.0	12.8		7.6	97		280	40K	
73/03/20	1215			5.6	12.0		7.7	99		100K	40K	
73/03/27	1520		5470.0	5.4	12.4		7.6	100		40	40K	
73/04/10	1200		5650.0	10.0	11.9		7.9	90		40K	40K	
73/04/24	1510		7740.0	9.2	12.9		7.8	90		40K	20K	
73/06/12	1430		4450.0	17.4	10.0		8.0	112		200	20K	
73/06/26	1000		2850.0	17.8	9.7		8.0	140		250	20K	
73/07/11	1145		450.0	18.0	10.0		8.2	180		140	20K	
73/07/24	1130		850.0	17.0	9.3		8.0	258		40	20K	
73/08/07	1245		770.0	18.8	8.6		8.0	300		0M	21000B	
73/08/21	1200		930.0	19.1	8.9		7.7	220		4900		
73/09/12	1240		2100.0	18.4	9.3		7.8	150		40000L	4000L	
73/09/25	1135		2400.0	14.3	9.5		7.4	99		2000K	400K	
73/12/07	0910		6080.0	6.5	12.3		7.4	98				
73/12/20	0935		16500.0	5.5	11.0		6.4	64				
74/01/08	1050		5360.0	2.0	13.6		7.6	107				
74/01/21	1330		45200.0	3.0	13.8		7.0	67				
74/02/05	0840		23500.0	4.0	13.6		7.7	74				
74/02/22	1350		11400.0	5.5	10.0		7.2	89				
74/03/06	0930		10600.0	3.6	13.2		7.6	97				
74/03/26	0845		12400.0	4.1	12.9		7.1	78				
74/04/11	0825		21000.0	4.8	12.5		7.1	71				

74/04/22 1030	21600.0	4.5	12.8	7.1	68
74/05/07 0745	28700.0	9.2	11.9	7.9	57
74/05/22 0840	21400.0	10.6	12.2	7.0	64
74/06/04 0840	26900.0	11.6	10.8	7.6	56
74/06/25 0730	26800.0	7.8	9.3	7.3	47
74/07/10 1135	3970.0	14.4	9.4	7.7	185
74/07/26 0930	3700.0	7.8	9.0	8.8	136
74/08/07 0900	2700.0	18.2	8.5	8.8	144
74/08/22 0945	1830.0	15.2	9.5	8.0	193
74/09/10 1000	1980.0	14.2	9.1	7.8	203
74/09/25 1100	2490.0	14.8	9.2	7.8	128
74/10/08 0820	2160.0	10.5	10.1	7.8	148
74/10/21 1015	2490.0	10.8	10.0	8.0	150
74/11/11 0915	2550.0	8.6	10.7	7.8	130
74/11/25 0930	3190.0	8.5	10.8	7.6	142
74/12/09 0930	2950.0	6.6	11.2	7.4	135
74/12/23 0930	2620.0	5.4	11.6	7.6	137
75/01/06 0930	2540.0	4.4	10.2	7.6	157
75/01/23 0945	4720.0	4.2	12.2	7.3	126
75/02/12 0945	3760.0	4.5	12.1	9.4	145
75/02/20 0850	4490.0	3.2	12.0	7.6	123
75/03/27 1015	6900.0	4.7	12.7	7.9	86
75/04/07 1000	5890.0	5.0	11.8	7.2	114
75/05/05 0900	17000.0	6.4	12.6	8.2	84
75/05/20 1125	32600.0	8.8	13.0	7.2	55
75/06/09 1100	25200.0	14.4	11.7	7.1	62
75/06/23 1100	15800.0	14.4	11.1	7.4	59
75/07/10 1040	6510.0	18.9	9.1	7.3	78
75/07/22 1000	3270.0	17.6	9.0	7.9	140
75/08/07 0915	1980.0	16.4	8.4	7.2	185
75/08/25 1000	2500.0	16.0	9.0	7.9	121
75/09/08 0945	2390.0	15.6	9.0	7.4	139
75/09/25 1000	2300.0	14.4	7.3	7.3	122
75/10/08 1000	2670.0	11.7	9.0	7.1	145
75/11/13 0815	4160.0	6.7	11.2	7.2	92
75/12/10 0930	17700.0	6.1	13.2	7.2	45
76/01/05 0930	13300.0	4.0	12.2	7.1	139
76/02/05 1430	7050.0	1.9	13.8	7.1	100
76/03/11 1330	7530.0	3.9	12.2	6.8	139
76/04/13 0845	20800.0	4.3	14.2	7.2	54
76/05/11 1300	27400.0	10.6	12.2	7.2	61
76/06/22 1310	8860.0	15.1	10.4	7.6	74
76/07/06 1415	4330.0	18.4	9.4	7.6	105
76/08/02 1145	2000.0	18.6	8.6	7.9	160
76/09/02 1430	2020.0	17.5	9.0	8.4	170
76/10/05 1000	2270.0	13.0	9.5	7.3	156
76/10/12 1100	2520.0	13.7	8.9		140
76/11/04 0945	2520.0	9.2	10.4	7.5	125
76/11/15 1110	2480.0	14.5	9.0		140
76/11/30 1330	2020.0	5.8	12.0	7.9	183
76/12/13 1330	2010.0	5.8	9.1		160
77/01/07 1215	2250.0	2.7	11.8	7.5	154
77/01/24 1045	2160.0	3.6	12.0		128
77/01/25 1130	2170.0	4.8	12.1	7.6	155
77/02/14 1140	2030.0	6.3	9.8		120
77/02/22 1300	2050.0	6.6	13.0	8.0	167
77/03/21 1005	2050.0	5.7	12.3		140
77/03/22 0930	2890.0	5.2	11.8	7.1	152
77/04/18 1100	4370.0	8.2	10.1		89
77/04/19 1000	4550.0	6.4	12.2	7.6	73

77/05/16 1145	5730.0	11.6	11.6			100	
77/05/17 1440	5760.0	11.4	11.1		7.4	113	
77/06/15 1030	4090.0	17.6	11.3		8.2	97	
77/06/20 1145	2750.0	18.1				140	
77/07/14 1000	1770.0	16.6	8.5		8.0	140	
77/07/25 1150	1250.0	19.0				140	
77/08/12 1500	1020.0	19.8	9.5		8.2	190	
77/08/22 1010	946.0	18.4	11.2			140	
77/09/26 0950	1710.0	12.4	9.4			180	
77/09/29 1115	2120.0	12.0	9.5		7.7	139	
77/10/19 1200	1930.0	11.5	10.3	99.9	7.5	147	
77/11/30 1300	3150.0	6.6	11.6	100.2	7.8	116	
78/01/02 1300	6760.0	1.6	13.4	101.6	7.8	96	
78/02/07 1415	7060.0	4.2	12.9	104.9	7.4	117	
78/03/10 1245	7970.0	4.2	13.4	108.9	7.6	89	
78/04/06 1500	22400.0	4.8	15.1	124.6	7.8	67	
78/05/02 1530	14700.0	9.0	12.6	115.3	7.5	64	
78/05/11 1430	13100.0	11.4				67	
78/05/23 1115	18100.0	10.8	12.2	116.4	7.8	55	
78/06/22 0900	5130.0	17.0	7.2	78.5	7.6	90	
78/08/01 1030	1400.0	18.6	8.6	96.9	8.0	173	
78/08/24 1415	2210.0	16.9	9.3	101.2	8.4	127	
78/09/12 1145	2150.0	15.2	9.2	96.7	7.9	132	
78/10/18 1200	2220.0	11.6	10.5	102.0	8.2	140	
78/11/21 1130	2020.0	4.4	12.0	98.1	8.0	149	
78/12/18 1045	2080.0	4.1	11.7	94.9	7.9	136	
79/01/17 1300	2100.0	2.4	12.7	98.5	7.8	138	
79/02/21 1320	4360.0	3.2	12.2	96.6	7.8	125	
79/03/22 1200	10600.0	5.1	13.7	114.0	7.8	69	
79/04/25 1050	13800.0	6.7	13.2	114.3	7.8	75	
79/05/16 1110	24700.0	11.3	12.2	117.7	7.8	56	
79/06/12 1155	3180.0	16.0	9.6	102.6	8.2	156	
79/07/26 1345	1070.0	19.0	9.8	111.3	8.0	214	6
79/08/20 1130	784.0	17.4	8.2	90.2	8.3	205	
79/09/18 1245	1630.0	16.8	9.5		8.3	150	
79/10/11 0900	1650.0	12.2	9.8	96.5	7.9	154	0
79/11/13 1215	2240.0	7.4	11.5	101.3	7.8	130	4
79/12/19 1305	2410.0	5.9	10.2	86.6	7.8	123	0
80/01/23 1100	4420.0	3.2	10.4	82.3	7.4	103	2
80/02/20 1115	3950.0	5.0	10.3	85.4	7.6	126	710
80/03/13 1155	7170.0	4.2	11.6	94.3	7.4	88	18
80/04/09 0930	5310.0	5.5	12.0	100.8	7.5	113	0
80/05/19 1150	9910.0	12.8	10.8	107.7	7.2	74	
80/05/20 1030	4330.0	12.6	9.9	98.3	7.6	110	
80/05/21 1030	4290.0	13.8	9.9	100.9	7.8	91	
80/05/22 1030	4370.0	13.7			7.7	125	
80/05/27 1135	15900.0	11.9	11.1	108.5	7.7	79	
80/05/28 1200	17600.0	12.7	11.3	112.5	7.8	65	
80/06/06 0815	6080.0	12.4	10.2	100.9	7.7	105	
80/06/12 1040	8590.0	14.6	10.5	108.9	7.7	74	6
80/06/19 1110	13700.0	16.2	10.6	113.7	7.6	64	
80/06/25 0930	5910.0	17.3	9.2	100.9	7.9	100	
80/07/08 0900	3680.0	18.0	9.0	100.1	7.6	115	0
80/07/30 1030	1870.0	18.8	9.9	111.9	8.0	163	
80/08/21 0845	1530.0	17.7	8.5	94.0	7.7	149	4
80/09/22 0745	2110.0	13.6	9.0	91.4	7.8	137	7
80/10/21 1230		11.5	9.7	94.1	8.1	152	3
80/11/19 1300		7.8	11.2	99.6	8.0	138	
80/12/17 1245		6.0	11.9	101.3	8.0	111	2
81/01/21 1300		5.0			7.8	100	2

81/02/23	1200		4.0			8.1	76	1			
81/03/1/	1030		5.8			8.0	97	9			
81/04/23	1100		5.6			7.3	80	0			
81/05/20	1330		11.5			7.1	83	1			
81/11/10	0915	2620.0	8.8	10.8	98.2	8.1	138	1K		1K	
81/12/09	0930	4470.0	7.1	12.0	106.7	7.5	105	10		9B	
82/01/27	0855	5820.0	2.4	12.5	95.5	7.5	121	230		150	
82/02/16	1405	14700.0	3.4	10.9	92.1	7.7	92	1300		180	
82/03/16	1230	22300.0	3.8			7.4	74	18		930B	
82/04/20	1215	19100.0	8.5	13.8	121.2	7.1	60	10		9B	
82/05/11	1200	18400.0	13.0	11.1	110.0	7.1	72	4		5B	
82/06/07	1430	16000.0	14.5	11.1	113.4	7.8	63	4		3B	
82/07/11	1450	3760.0	19.8	9.6	109.3	8.0	138	1K		14B	
82/08/17	1645	1250.0	17.8	10.2	114.4	8.6	198	1		1K	
82/09/14	1435	1980.0	14.2	10.3	105.7	8.5	155	1		1B	
82/10/19	1350	2490.0	10.3	11.6	107.1	8.3	160	2		1B	
82/11/16	1405	3200.0	7.2	11.3	102.7	8.1	132	3		1B	
82/12/28	1355	5610.0	4.5	13.2	106.4	7.3	93	1		3B	
83/01/25	1410	6430.0	5.0	12.3	100.9	7.6	98	2		2B	
83/02/22	1450	14400.0	5.5	14.1	119.1	7.3	76	16		14B	
83/03/23	0835	14200.0	5.5	14.5	123.7	7.5	78	5		3B	
83/04/19	1525	8380.0	9.9	12.1	116.2	7.8	92	6		1B	
83/05/24	1525	12100.0	14.6	11.0	114.9	7.7	77	6		17B	
83/06/28	1520	6090.0	18.0	10.4	114.6	8.1	86	2		20	
83/07/19	1510	5210.0	19.0	9.9	111.7	7.8	94	2		9B	
83/08/23	1540	495.0	15.0	10.1	106.6	7.9	250	1K		330B	
83/09/27	1540	2400.0	14.8	10.7	112.8	8.2	140	2		1K	
83/10/25	1500	2420.0	10.9	11.7	111.8	7.6	152	2		1B	
83/11/29	1505	5390.0	7.2	12.6	110.8	7.8	105	1		2B	
83/12/20	1505	5380.0	3.2	13.8	109.0	7.7	100	3		7B	
84/01/17	1350	6040.0	2.7	13.9	107.5	7.9	94	2		21	
84/02/07	1320	8480.0	3.7	14.4	115.1	7.8	86	3		2B	
84/03/06	1355	6580.0	4.8	13.7	113.4	7.4	99	12		18B	
84/04/10	1335	12100.0	5.7	14.1	121.9	7.8	81	10		9	
84/05/08	1335	11500.0	8.7	12.8	117.2	8.1	85	3		3J	
84/06/12	1345	17000.0	13.3	12.2	124.6	8.0	69	4		2B	
84/07/10	1530	3420.0	19.0	10.7	122.8	8.4	137	3		1K	
84/08/14	1410	1650.0	17.4	10.2	113.5	8.4	209	2		4J	
84/09/11	1545	2280.0	14.9	10.3	110.1	8.1	157	11		5J	
84/10/09	1350	2290.0	13.2	11.1	113.2	8.1	196	1		1K	
84/11/13	1410	3220.0	8.6	11.5	93.6	7.7	129	3		62J	
84/12/11	1435	4470.0	4.8	12.2	102.0	7.5	104	57		28	
85/01/15	1415	2500.0	3.8	12.4	98.8	7.5	152	1		3	
85/02/05	1430	1820.0	2.4	13.1	102.1	7.6	170	2		1K	
85/03/12	1450	3340.0	5.6	12.2	102.7	7.5	142	26		80	
85/04/02	1400		6.6	12.5	108.0	7.6	95	110		100	

DATE FROM TO	TIME	DEPTH METERS	00070 TURBIDITY TURBMETER NTU	00080 COLOR PT-CO UNITS	00625 KJELDAHL NITROGEN T mg/l N	00630 NITROGEN NO2 + NO3 mg/l	00620 NITRATE T NO3-N mg/l	00615 NITRITE T NO2-N mg/l	00610 AMMONIA T NH3-N mg/l	00671 DIS-ORTHO PHOSPHRUS mg/l P	00665 TOTAL PHOSPHRUS mg/l P	00410 ALKALINE T CaCO3 mg/l
72/02/22	1310											
72/10/10	1815		2.0	16	0.700		0.36	0.00	0.49	0.14	0.32	
72/10/31	1350		2.0	16	0.880		0.39	0.00	0.66	0.10	0.22	
72/11/19	1415		2.0	2	0.660		0.34	0.01	0.43	0.08	0.13	
72/11/29	1255		0.0	2	0.850		0.42	0.00	0.60	0.06	0.16	
72/12/12	1350		1.0	13	0.430		0.17	0.00	0.31	0.04	0.08	
72/12/27	1205		15.0	25	0.330		0.20	0.01	0.19	0.02	0.09	

73/01/18 1310	100.0	101	0.840		0.49	0.00	0.23	0.03	0.11	
73/02/06 1415	30.0	22								
73/02/22 1310	48.0	59	1.000		0.42	0.03	0.65	0.03	0.20	
73/02/27 1345	76.0	81	1.400		0.47	0.02	0.47	0.06	0.31	
73/03/13 1105	35.0	46	0.760		0.23	0.02	0.43	0.03	0.13	
73/03/20 1215	9.0	19	0.510		0.49	0.01	0.27	0.01	0.09	
73/03/27 1520	4.0	16	0.250		0.17	0.00	0.22	0.01	0.09	
73/04/10 1200	4.0	15	0.300		0.15	0.00	0.19	0.03	0.06	
73/04/24 1510	4.0	19	0.340		0.09	0.00	0.17	0.02	0.07	
73/06/12 1430	1.0	16	0.350		0.16	0.00	0.34	0.08	0.13	
73/06/26 1000	1.0	11	0.500		0.26	0.00	0.30	0.06	0.08	
73/07/11 1145	3.0	14	2.100		0.38	0.01	0.71	0.14	0.21	
73/07/24 1130	3.0	17	1.300		0.59	0.03	0.66	0.19	0.25	
73/08/07 1245	10.0	29	2.300		0.68	0.02	1.60	0.18	0.33	
73/08/21 1200	6.0	13	2.000		0.48	0.02	0.99	0.15	0.19	
73/09/12 1240	5.0	12	1.500		0.22	0.01	0.75	0.01	0.14	
73/09/25 1135	2.0	17	0.870		0.25	0.01	0.48	0.05	0.10	
73/12/07 0910	7.0		0.670	0.74			0.26	0.07	0.11	31
73/12/20 0935	3.0		0.210	0.42			0.07	0.01	0.03	
74/01/08 1050	0.0		0.360	0.51			0.16	0.04	0.05	
74/01/21 1330	8.0		0.390	0.56			0.11	0.04	0.07	
74/02/05 0840	30.0		2.300	0.60					0.09	
74/02/22 1350	20.0		0.410	0.78			0.31	0.09	0.11	
74/03/06 0930	20.0		2.500	0.79			0.12		0.06	31
74/03/26 0845	20.0		0.890	0.40			0.24	0.04	0.11	
74/04/11 0825	20.0		0.330	0.36			0.16	0.04	0.09	
74/04/22 1030	9.0		0.260	0.27			0.16	0.03	0.06	
74/05/07 0745	7.0		2.500	0.12			0.07	0.02	0.05	
74/05/22 0840	3.0		0.240	0.11			0.07	0.01	0.03	
74/06/04 0840	2.0		0.860	0.05			0.07	0.00	0.02	20
74/06/25 0730	3.0		0.140	0.06			0.02	0.01	0.02	
74/07/10 1135	1.0		3.100	0.68			0.56	0.06	0.07	
74/07/26 0930	1.0		0.520	0.39			0.18	0.04	0.06	
74/08/07 0900	1.0			0.43			0.20	0.06	0.07	
74/08/22 0945	1.0		0.470	0.61			0.35	0.08	0.11	
74/09/10 1000	1.0		0.640	0.63			0.39	0.09	0.11	84
74/09/25 1100	1.0		0.520	0.42			0.37	0.08	0.11	
74/10/08 0820	3.0		0.460	0.45			0.33	0.07	0.00	
74/10/21 1015	1.0		0.510	0.38			0.36	0.00	0.12	
74/11/11 0915	6.0		0.980	0.40			0.50	0.08	0.00	
74/11/25 0930	1.0		0.520	0.32			0.33	0.09	0.11	
74/12/09 0930	2.0		0.730	0.38			0.36	0.08	0.11	51
74/12/23 0930	2.0		0.360	0.40			0.24	0.05	0.08	
75/01/06 0930	2.0		0.440	0.38			0.25	0.07	0.09	
75/01/23 0945	10.0		0.630	0.41			0.36	0.07	0.11	
75/02/12 0945	2.0		0.640	0.50			0.31	0.05	0.00	
75/02/20 0850	5.0		0.690	0.70			0.29	0.07	0.11	
75/03/27 1015	3.0		0.670	0.57			0.18	0.01	0.05	33
75/04/07 1000	14.0		0.430	0.87			0.20	0.04	0.08	
75/05/05 0900	4.0		0.310	0.08			0.00	0.02	0.06	
75/05/20 1125	5.0		0.250	0.02			0.09	0.01	0.04	
75/06/09 1100	2.0		0.260	0.05			0.12	0.03	0.04	18
75/06/23 1100	2.0		0.150	0.00			0.09	0.01	0.03	
75/07/10 1040			0.240	0.15			0.11	0.02	0.04	
75/07/22 1000	0.0		0.310	0.37			0.21	0.04	0.06	
75/08/07 0915	1.0		0.500	0.53			0.30	0.08	0.00	
75/08/25 1000	1.0		0.400	0.28			0.19	0.04	0.07	
75/09/08 0945	1.0		0.710	0.41			0.52	0.08	0.11	62
75/09/25 1000	1.0		0.630	0.30			0.43	0.07	0.00	
75/10/08 1000	2.0		0.620	0.33			0.50	0.06	0.12	

75/11/13 0815	0.0		0.350	0.25			0.15	0.04	0.06	
75/12/10 0930	13.0		0.260	0.22			0.14	0.02	0.06	
76/01/05 0930	3.0		0.250	0.29			0.09	0.01	0.04	30
76/02/05 1430	2.0		0.330	0.23			0.14	0.03	0.06	
76/03/11 1330	170.0		3.200	0.92			0.29	0.03	0.97	33
76/04/13 0845	1.0		0.260	0.01			0.00	0.01	0.05	
76/05/11 1300	3.0		0.200	0.02			0.07	0.01	0.04	
76/06/22 1310	1.0		0.310	0.14			0.12	0.03	0.05	34
76/07/06 1415	0.0		0.410	0.23			0.22	0.06	0.00	
76/08/02 1145	0.0		0.710	0.22			0.42	0.08	0.12	
76/09/02 1430	0.0		0.810	0.50			0.47	0.12	0.15	71
76/10/05 1000	1.0		0.620	0.30			0.25	0.06	0.12	
76/10/12 1100	25.0	6	0.990		0.37	0.01	0.38	0.06	0.11	
76/11/04 0945	1.0		0.480	0.35			0.21	0.08	0.11	
76/11/15 1110	8.0	8	0.610		0.35	0.01	0.34	0.06	0.10	
76/11/30 1330	1.0		0.820	0.43			0.48	0.11	0.16	
76/12/13 1330	23.0		0.910		0.43	0.01	0.50	0.10	0.17	
77/01/07 1215	1.0		0.900	0.47			0.79	0.00	0.15	62
77/01/24 1045	6.0	17	1.900		0.45	0.01	0.62	0.08	0.16	
77/01/25 1130	2.0		0.690	0.42			0.38	0.11	0.15	
77/02/14 1140	18.0	11	0.780		1.00	0.01	0.48	0.09	0.15	
77/02/22 1300			0.860	0.40			0.51	0.11	0.17	
77/03/21 1005	15.0	11	0.440		0.26	0.00	0.20	0.02	0.09	
77/03/22 0930	2.0		0.360	0.26			0.26	0.07	0.00	48
77/04/18 1100	19.0	11	0.480		0.12	0.01	0.24	0.04	0.08	
77/04/19 1000	1.0		0.450	0.13			0.14	0.05	0.08	
77/05/16 1145	9.0	18	0.410		0.13	0.00	0.22	0.02	0.06	
77/05/17 1430	1.0		0.420	0.09			0.23	0.04	0.08	
77/06/15 1030	0.0		0.320	0.17			0.15	0.04	0.07	36
77/06/20 1145	18.0		0.740		0.38	0.01	0.35	0.03	0.11	
77/07/14 1000	1.0		0.660	0.31			0.30	0.09	0.12	
77/07/25 1150	4.0	13	1.100		0.46	0.01	0.58	0.09	0.17	
77/08/12 1500			1.300	0.56			0.94	0.18	0.29	
77/08/22 1010	8.0		0.740		0.44	0.01	0.43	0.13	0.19	
77/09/26 0950	2.0		0.220		0.36	0.01	0.08	0.12	0.13	
77/09/29 1115			0.220	0.29			0.03	0.03	0.05	50
77/10/19 1200	0.0		0.420	0.36			0.13	0.13	0.19	54
77/11/30 1300	5.0		0.950	0.30			0.26	0.10	0.36	40
78/01/02 1300	1.0		0.260	0.16			0.02	0.03	0.04	32
78/02/07 1415	30.0		1.400	2.10			0.28	0.08	0.52	33
78/03/10 1245	20.0		0.480	0.68			0.23	0.02	0.08	29
78/04/06 1500	4.0		0.290	0.16			0.07	0.00	0.04	21
78/05/02 1530	4.0		0.280	0.04			0.08	0.00	0.04	24
78/05/11 1430							0.08	0.00		
78/05/23 1115	2.0		0.230	0.04			0.06	0.00	0.02	23
78/06/22 0900	2.0		0.230	0.22			0.05	0.00	0.02	38
78/08/01 1030	4.0		0.270	0.60			0.06	0.01	0.02	64
78/08/24 1415	1.0		0.290	0.01			0.13	0.01	0.02	50
78/09/12 1145	1.0			0.44			0.08	0.02	0.04	49
78/10/18 1200	0.3		0.240	0.50			0.01	0.01	0.05	53
78/11/21 1130	0.5		0.480	0.68			0.34	0.01	0.04	59
78/12/18 1045	0.4		0.170	0.57			0.00	0.01	0.01	48
79/01/17 1300	1.0		0.330	0.35			0.36	0.01	0.04	51
79/02/21 1320	14.0		0.650	1.20			0.20	0.04	0.05	39
79/03/22 1200	4.7		0.260	0.15			0.07	0.01	0.01	25
79/04/25 1050	1.0		0.220	0.05			0.01	0.01	0.02	19
79/05/16 1110	4.5		0.250	0.03			0.00	0.00	0.01	21
79/06/12 1155	0.7		0.310	0.57			0.02	0.00	0.02	60
79/07/26 1345	1.1		0.970	0.85			0.03	0.04	0.09	80
79/08/20 1130	0.4		0.650	0.92			0.00	0.03	0.03	82

79/09/18 1245	1.0		0.370	0.79			0.20	0.05	0.05	50
/9/10/11 0900	1.5		0.570	0.60			0.05	0.05	0.00	55
79/11/13 1215	0.5		0.520	0.52			0.18	0.01	0.04	52
79/12/19 1305	0.7		0.420	0.50			0.09	0.01	0.29	48
80/01/23 1100	1.5		0.670	0.45			0.12	0.03	0.05	34
80/02/20 1115	340.0		2.600	1.30			0.28		0.66	34
80/03/13 1155	30.0		0.520	0.37			0.10	0.01	0.06	28
80/04/09 0930	2.0		0.800	0.40			0.26	0.00	0.05	32
80/05/19 1150	15.0		0.330	0.18			0.13		0.06	21
80/05/20 1030	12.0		0.660	0.07			0.01		0.04	37
80/05/21 1030	7.4		0.550	0.18			0.06		0.05	34
80/05/22 1040										
80/05/27 1135	270.0		3.700	0.31			0.20		0.29	15
80/05/28 1200										
80/06/06 0815										
80/06/12 1040	1.9		0.570	0.15			0.09	0.01	0.03	27
80/06/19 1110	4.5		0.570	0.10			0.04		0.04	21
80/06/25 0930	3.8		0.370	0.18			0.03		0.05	36
80/07/08 0900	1.8		0.430	0.21			0.00	0.02	0.03	43
80/07/30 1030	1.3		0.780	0.59			0.10		0.06	65
80/08/21 0845	1.6		3.000	0.62			0.35	0.01	0.03	57
80/09/22 0745	1.2		0.370	0.33			0.00	0.01	0.04	48
80/10/21 1230	0.4		0.950	0.50			0.10	0.02	0.04	55
80/11/19 1300	0.8		0.370	0.52			0.04	0.02	0.06	
80/12/17 1245	0.4		0.640	0.42			0.03	0.01	0.03	
81/01/21 1300	0.8		0.600	0.51			0.06	0.01	0.03	
81/02/23 1200	3.9		0.550	0.17			0.00	0.01	0.12	
81/03/17 1030	2.0		0.340	0.32			0.04	0.01	0.05	
81/04/23 1100	1.7		0.590	0.22			0.10	0.01	0.04	
81/05/20 1330	1.6		0.500	0.16			0.18	0.04	0.06	
81/11/10 0915	1.0	8			0.40	0.05K	0.08	0.04	0.07	
81/12/09 0930	20.0	25			0.26	0.01	0.22	0.05	0.08	
82/01/27 0855	160.0	71			2.40	0.02	0.21	0.06	0.14	
82/02/16 1405	1000.0	150			2.90	0.02	0.17	0.01K	0.07	
82/03/16 1230	24.0	38			0.23	0.01	0.06	0.03	0.03	
82/04/20 1215	9.0	21			0.13	0.01	0.07	0.01K	0.06	
82/05/11 1200	4.0	21			0.13	0.02	0.08	0.01	0.03	
82/06/07 1430	3.0	17			0.06	0.01K	0.05	0.03	0.03	
82/07/11 1450	2.0	13			0.34	0.01	0.02	0.03		
82/08/17 1645	3.0	8			0.60	0.01	0.18	0.03	0.03	
82/09/14 1435	2.0	4			0.52	0.02	0.02	0.01	0.04	
82/10/19 1350	1.0	4			0.39	0.01	0.02	0.03	0.04	
82/11/16 1405	3.0	8			0.31	0.01	0.12	0.06	0.08	
82/12/28 1355	3.0	13			0.26	0.01K	0.13	0.03	0.05	
83/01/25 1410	6.0	17			0.40	0.01	0.15		0.05	
83/02/22 1450	16.0	33			0.35	0.02	0.04		0.05	
83/03/23 0835	7.0	17			0.25	0.01K	0.06	0.01	0.03	
83/04/19 1525	4.0	13			0.23	0.01K	0.06	0.01	0.02	
83/05/24 1525	2.0	46			0.10	0.01K	0.03	0.02	0.04	
83/06/28 1520	3.0	4			0.20	0.01K	0.04	0.02	0.03	
83/07/19 1510	1.0	8			0.16	0.01K	0.03	0.01	0.03	
83/08/23 1540	5.0	13			1.40	0.03	0.02	0.04	0.04	
83/09/27 1540	1.0	13			0.40	0.01K	0.13	0.02	0.02	
83/10/25 1500	1.0	4			0.61	0.01K	0.04	0.02	0.03	
83/11/29 1505	5.0	17			0.64	0.01	0.12	0.06	0.06	
83/12/20 1505	4.0	8			0.40	0.01K	0.12	0.05	0.06	
84/01/17 1350	2.0	8			0.38	0.01K	0.08	0.04	0.05	
84/02/07 1320	5.0	13			0.26	0.01K	0.08		0.04	
84/03/06 1355	11.0	21			0.44	0.01	0.10	0.05	0.06	
84/04/10 1335	14.0	33			0.29	0.01K	0.12	0.02	0.04	

84/05/08 1335	4.0	13	0.16	0.01K	0.08	0.02	0.06		
84/06/12 1345	7.0	17	0.06	0.01K	0.12	0.02	0.08		
84/07/10 1530	1.0	8	0.38	0.01K	0.30		0.06		
84/08/14 1410	2.0	8	0.62	0.02	0.36	0.06	0.08		
84/09/11 1545	1.0	4	0.40	0.01K	0.28	0.06	0.06		
84/10/09 1350	3.0	4	0.50	0.02	0.70	0.02	0.06		
84/11/13 1410	2.0	17	0.32	0.01K	0.02	0.08	0.10		
84/12/11 1435	81.0	71	0.55	0.01K	0.20	0.06	0.06		
85/01/15 1415	4.0	8	0.51	0.01K	0.35	0.08	0.10		
85/02/05 1430	4.0	8	0.60	0.01K	0.18	0.05	0.10		
85/03/12 1450	34.0	50	1.80	0.02K	0.16	0.08	0.12		
85/04/02 1400	77.0	63	1.40	0.02K	0.09		0.02		

DATE FROM TO	TIME	DEPTH METERS	00440 BICARB HCO3 ION mg/l	00445 CARBONATE CO3 ION mg/l	00900 HARDNESS TOT CaCO3 mg/l	00902 HARDNESS NC CaCO3 mg/l	00915 CALCIUM DIS Ca mg/l	00925 MAGNESIUM DIS Mg mg/l	00930 SODIUM DIS Na mg/l	00935 POTASSIUM DIS K mg/l	00940 CHLORIDE Cl mg/l	00945 SULFATE TOT SO4 mg/l
72/02/22	1310											
72/10/10	1815				58.0		14.0	5.5				9.6
72/10/31	1350				61.0		15.0	5.7				10.0
72/11/19	1415				58.0		14.0	5.5				22.0
72/11/29	1255				66.0		16.0	6.3				10.0
72/12/12	1350				36.0		9.5	3.1				7.9
72/12/27	1205				34.0		8.7	3.0				7.9
73/01/18	1310				37.0		9.4	3.4				10.0
73/02/06	1415											
73/02/22	1310				44.0		11.0	4.1				10.0
73/02/27	1345				49.0		12.0	4.5				11.0
73/03/13	1105				36.0		9.1	3.2				9.8
73/03/20	1215				37.0		9.5	3.3				9.5
73/03/27	1520				35.0		9.2	3.0				9.3
73/04/10	1200				36.0		9.4	3.1				9.3
73/04/24	1510				31.0		8.4	2.4				9.0
73/06/12	1430				41.0		10.0	3.8				9.3
73/06/26	1000				52.0		13.0	4.8				11.0
73/07/11	1145				65.0		16.0	6.2				11.0
73/07/24	1130				96.0		23.0	9.4				12.0
73/08/07	1245				110.0		25.0	11.0				13.0
73/08/21	1200				79.0		19.0	7.6				13.0
73/09/12	1240				53.0		13.0	4.9				10.0
73/09/25	1135				48.0		12.0	4.3				10.0
73/12/07	0910		38	0	37.0	6	9.7	3.2	3.80	1.40	3.1	10.0
73/12/20	0935											
74/01/08	1050											
74/01/21	1330											
74/02/05	0840											
74/02/22	1350											
74/03/06	0930		38	0	41.0	10	11.0	3.3	3.30	1.30	2.0	9.5
74/03/26	0845											
74/04/11	0825											
74/04/22	1030											
74/05/07	0745											
74/05/22	0840											
74/06/04	0840		24	0	22.0	2	5.8	1.8	1.60	0.70	1.3	9.0
74/06/25	0730											
74/07/10	1135											
74/07/26	0930											
74/08/07	0900											

74/08/22 0945										
74/09/10 1000	102	0	90.0	7	20.0	9.8	4.30	1.70	3.4	11.0
74/09/25 1100										
74/10/08 0820										
74/10/21 1015										
74/11/11 0915										
74/11/25 0930										
74/12/09 0930	62	0	54.0	3	14.0	4.7	2.90	1.20	1.8	9.5
74/12/23 0930										
75/01/06 0930										
75/01/23 0945										
75/02/12 0945										
75/02/20 0850										
75/03/27 1015	40	0	42.0	10	12.0	3.0	2.80	1.00	1.8	11.0
75/04/07 1000										
75/05/05 0900										
75/05/20 1125										
75/06/09 1100	22	0	22.0	4	6.3	1.6	1.80	0.70	0.6	6.0
75/06/23 1100										
75/07/10 1040										
75/07/22 1000										
75/08/07 0915										
75/08/25 1000										
75/09/08 0945	75	0	65.0	3	16.0	6.0	3.70	1.30	3.0	9.7
75/09/25 1000										
75/10/08 1000										
75/11/13 0815										
75/12/10 0930										
76/01/05 0930	37	0	43.0	13	12.0	3.2	3.30	1.20	3.9	17.0
76/02/05 1430										
76/03/11 1330	40	0	45.0	12	11.0	4.2	4.20	1.90	5.2	14.0
76/04/13 0845										
76/05/11 1300										
76/06/22 1310	42	0	35.0	0	8.9	3.0	2.00	0.90	1.4	8.0
76/07/06 1415										
76/08/02 1145										
76/09/02 1430	86	0	77.0	6	19.0	7.1	4.10	1.50	3.5	11.0
76/10/05 1000										
76/10/12 1100										
76/11/04 0945										
76/11/15 1110										
76/11/30 1330										
76/12/13 1330										
77/01/07 1215	75	0	63.0	1	16.0	5.5	3.80	1.30	3.0	13.0
77/01/24 1045										
77/01/25 1130										
77/02/14 1140										
77/02/22 1300										
77/03/21 1005										
77/03/22 0930	58	0	55.0	7	14.0	4.8	3.20	1.10	2.4	12.0
77/04/18 1100										
77/04/19 1000										
77/05/16 1145										
77/05/17 1430										
77/06/15 1030	44	0	48.0	12	13.0	3.7	2.60	1.00	3.7	15.0
77/06/20 1145										
77/07/14 1000										
77/07/25 1150										
77/08/12 1500										
77/08/22 1010										

77/09/26 0950										
77/09/27 1115	61	0	59.0	9	15.0	5.3	3.70	1.10	2.7	11.0
77/10/19 1200	66	0	63.0	9	16.0	5.7	4.20	1.30	3.7	12.0
77/11/30 1300	49	0	48.0	8	12.0	4.4	3.00	1.20	2.4	13.0
78/01/02 1300	39	0	48.0	16	13.0	3.7	2.20	1.00	1.2	16.0
78/02/07 1415	40	0	46.0	13	12.0	3.9	4.00	3.50	4.3	12.0
78/03/10 1245	35	0	41.0	12	11.0	3.2	2.50	1.00	1.5	12.0
78/04/06 1500	26	0	29.0	7	7.7	2.3	1.50	0.90	0.9	10.0
78/05/02 1530	29	0	34.0	10	7.9	3.4	1.60	0.80	1.2	7.8
78/05/11 1430									1.2	
78/05/23 1115	28	0	30.0	7	8.7	2.0	1.90	0.70	0.8	8.1
78/06/22 0900	46	0	44.0	6	11.0	3.9	2.40	0.90	2.7	9.8
78/08/01 1030	78	0	78.0	14	19.0	7.5	4.30	1.60	3.8	13.0
78/08/24 1415	61	0	56.0	6	14.0	5.2	3.70	1.20	2.9	11.0
78/09/12 1145	60	0	57.0	8	14.0	5.4	3.70	1.30	3.2	11.0
78/10/18 1200	64	0	60.0	8	15.0	5.5	3.70	1.30	3.2	13.0
78/11/21 1130	72	0	64.0	5	16.0	5.8	3.70	1.40	3.8	13.0
78/12/18 1045	59	0	61.0	13	15.0	5.8	3.60	1.50	2.5	11.0
79/01/17 1300	62	0	61.0	10	15.0	5.7	4.10	1.10	4.2	12.0
79/02/21 1320	47	0	56.0	17	15.0	4.4	3.00	1.50	2.4	12.0
79/03/22 1200	30	0	30.0	6	8.2	2.4	2.30	0.80	1.2	7.8
79/04/25 1050		0	32.0		8.4	2.6	2.10	0.90	0.9	12.0
79/05/16 1110	26	0	24.0	3	6.8	1.8	2.00	0.70	0.8	6.0
79/06/12 1155	73	0	73.0	13	18.0	6.7	3.10	1.40	3.0	11.0
79/07/26 1345	98	0	88.0	7	21.0	8.6	5.20	1.70	6.1	17.0
79/08/20 1130	100	0	87.0	5	21.0	8.5	4.50	1.90	4.1	18.0
79/09/18 1245			170.0	120	59.0	5.6	4.50	6.90	4.0	17.0
79/10/11 0900			68.0	13	17.0	6.2	3.90	1.40	2.5	23.0
79/11/13 1215			56.0	4	14.0	5.0	4.00	1.30	3.1	12.0
79/12/19 1305			56.0	8	14.0	5.0	4.00	1.30	2.8	13.0
80/01/23 1100			41.0	7	11.0	3.2	2.80	1.10	2.4	14.0
80/02/20 1115			49.0	15	12.0	4.7	5.60	1.80	6.7	13.0
80/03/13 1155			35.0	7	9.2	3.0	3.40	1.00	1.3	12.0
80/04/09 0930			46.0	14	12.0	3.8	3.20	1.20	2.8	13.0
80/05/19 1150			31.0		8.4	2.5	2.00	0.80	0.3	7.7
80/05/20 1030			48.0		12.0	4.3	2.60	1.00	0.7	18.0
80/05/21 1030			37.0	3	9.7	3.2	1.70	0.70	1.0	7.4
80/05/22 1030										
80/05/27 1135			28.0	13	7.4	2.2	2.80	1.00	3.1	12.0
80/05/28 1200										
80/06/06 0815										
80/06/12 1040			29.0	2	8.0	2.1	2.70	0.90	2.0	2.2
80/06/19 1110			26.0	5	7.1	2.0	1.90		1.5	8.8
80/06/25 0930			40.0	9	10.0	3.6	2.40		15.0	10.0
80/07/08 0900			47.0	4	12.0	4.2	2.60	1.00	1.8	8.9
80/07/30 1030			78.0	13	20.0	6.7	3.90	1.50	1.9	18.0
80/08/21 0845			63.0	6	16.0	5.7	3.50	1.80	3.2	12.0
80/09/22 0745			60.0	12	15.0	5.5	3.30	1.30	3.9	10.0
80/10/21 1230			59.0	4	15.0	5.3	4.30	1.40	3.5	13.0
80/11/19 1300			55.0	5	14.0	4.8	3.70	1.30	3.2	13.0
80/12/17 1245									2.2	13.0
81/01/21 1300			44.0	0	12.0	3.5	3.20	0.90	1.6	14.0
81/02/23 1200			29.0	11	7.8	2.4	2.30	0.90	2.0	14.0
81/03/17 1030			42.0		11.0	3.5	3.00	1.10	1.6	14.0
81/04/23 1100			36.0		10.0	2.6	2.50	0.90	1.5	13.0
81/05/20 1330			35.0		9.1	3.0	2.80	0.90	1.6	10.0
81/11/10 0915			5.8							
81/12/09 0930			60.0							
82/01/27 0855			38.0							
82/02/16 1405			48.0							

82/03/16	1230	28.0
82/04/20	1215	28.0
82/05/11	1200	33.0
82/06/07	1430	28.0
82/07/11	1450	64.0
82/08/17	1645	92.0
82/09/14	1435	73.0
82/10/19	1350	60.0
82/11/16	1405	65.0
82/12/28	1355	46.0
83/01/25	1410	54.0
83/02/22	1450	42.0
83/03/23	0835	58.0
83/04/19	1525	46.0
83/05/24	1525	36.0
83/06/28	1520	48.0
83/07/19	1510	42.0
83/08/23	1540	120.0
83/09/27	1540	64.0
83/10/25	1500	65.0
83/11/29	1505	63.0
83/12/20	1505	52.0
84/01/17	1350	56.0
84/02/07	1320	40.0
84/03/06	1335	44.0
84/04/10	1335	36.0
84/05/08	1335	40.0
84/06/12	1345	
84/07/10	1530	68.0
84/08/14	1410	92.0
84/09/11	1545	68.0
84/10/09	1350	84.0
84/11/13	1410	120.0
84/12/11	1435	44.0
85/01/15	1415	68.0
85/02/05	1430	76.0
85/03/12	1450	80.0
85/04/02	1400	36.0

DATE FROM TO	TIME	DEPTH METERS	71900 MERCURY TOTAL Hg ug/l	01030 CHROMIUM DIS Cr ug/l	01040 COPPER DIS Cu ug/l	01049 LEAD DIS Pb ug/l	01090 ZINC DIS Zn ug/l	01045 IRON TOT Fe ug/l	01105 ALUMINUM TOT Al ug/l	01130 LITHIUM DIS Li ug/l	01145 SELENIUM DIS Se ug/l	01080 STRONTIUM DIS Sr ug/l
72/02/22	1310											
72/10/10	1815											
72/10/31	1350											
72/11/19	1415											
72/11/29	1255											
72/12/12	1350											
72/12/27	1205											
73/01/18	1310											
73/02/06	1415											
73/02/22	1310											
73/02/27	1345											
73/03/13	1105											
73/03/20	1215											
73/03/27	1520											
73/04/10	1200											

	TOTAL Hg	
73/04/24 1510		
73/06/12 1430		
73/06/26 1000		
73/07/11 1145		
73/07/24 1130		
73/08/07 1245		
73/08/21 1200		
73/09/12 1240		
73/09/25 1135		
73/12/07 0910	0.00	830
73/12/20 0935	0.10	400
74/01/08 1050	0.10	80
74/01/21 1330	0.00	920
74/02/05 0840	0.00	2400
74/02/22 1350	0.10	590
74/03/06 0930	0.00	1900
74/03/26 0845	0.00	910
74/04/11 0825	0.20	1600
74/04/22 1030	0.10	810
74/05/07 0745	0.00	430
74/05/22 0840	0.00	390
74/06/04 0840	0.00	250
74/06/25 0730	0.00	320
74/07/10 1135	0.00	100
74/07/26 0930	0.00	22000
74/08/07 0900	0.00	20
74/08/22 0945	0.00	80
74/09/10 1000	0.80	140
74/09/25 1100	0.20	80
74/10/08 0820	0.00	130
74/10/21 1015	0.00	50
74/11/11 0915	0.00	50
74/11/25 0930	0.20	60
74/12/09 0930	0.10K	270
74/12/23 0930	0.10K	110
75/01/06 0930	0.00	90
75/01/23 0945	0.00	590
75/02/12 0945	0.00	730
75/02/20 0850	0.00	800
75/03/27 1015	0.00	390
75/04/07 1000	0.30	860
75/05/05 0900	0.00	0
75/05/20 1125	0.00	560
75/06/09 1100	0.00	270
75/06/23 1100	0.00	150
75/07/10 1040		
75/07/22 1000		
75/08/07 0915		
75/08/25 1000		
75/09/08 0945	0.00	160
75/09/25 1000		
75/10/08 1000		
75/11/13 0815		
75/12/10 0930		
76/01/05 0930	0.10	230
76/02/05 1430		
76/03/11 1330	0.00	16000
76/04/13 0845		
76/05/11 1300		
76/06/22 1310	0.50K	180

	TOTAL Hg	Diss. Cr	Diss. Cu	Diss. Pb	Diss. Zn		
76/07/06 1415							
76/08/02 1145							
76/09/02 1430	0.00					100	
76/10/05 1000							
76/10/12 1100							
76/11/04 0945							
76/11/15 1110							
76/11/30 1330							
76/12/13 1330							
77/01/07 1215	0.00					80	
77/01/24 1045							
77/01/25 1130							
77/02/14 1140							
77/02/22 1300							
77/03/21 1005							
77/03/22 0930	0.20					240	
77/04/18 1100							
77/04/19 1000							
77/05/16 1145							
77/05/17 1430							
77/06/15 1030	0.00					180	
77/06/20 1145							
77/07/14 1000							
77/07/25 1150							
77/08/12 1500							
77/08/22 1010							
77/09/26 0950							
77/09/29 1115	0.00					30	
77/10/19 1200	0.00	0.0	2.0	1.0	100		0
77/11/30 1300	0.00	0.0	1.0	1.0	100		0
78/01/02 1300		0.0	2.0	2.0	170		0
78/02/07 1415	0.00	0.0	10.0	0.0	50		0
78/03/10 1245	0.00					1700	
78/04/06 1500	0.00	0.0	2.0	0.0	210		0
78/05/02 1530	0.50	0.0	3.0	0.0	150		0
78/05/11 1430							
78/05/23 1115	0.10					300	
78/06/22 0900	0.30					240	
78/08/01 1030	0.10	10.0	4.0	5.0	50		0
78/08/24 1415	0.20	0.0	5.0	3.0	40		0
78/09/12 1145	0.10					160	
78/10/18 1200	0.00	0.0	8.0	5.0	80		0
78/11/21 1130	0.00	0.0	4.0	5.0	90		0
78/12/18 1045	0.00					30	
79/01/17 1300	0.00	0.0	4.0	2.0	100		0
79/02/21 1320	0.10	10.0	3.0	1.0	80		0
79/03/22 1200	0.00					460	
79/04/25 1050	0.20	0.0	2.0	0.0	180		0
79/05/16 1110	0.10	0.0	0.0	2.0	10		0
79/06/12 1155	0.00					60	
79/07/26 1345	0.80	0.0	4.0	1.0	30		0
79/08/20 1130	0.40	0.0	2.0	4.0	9		0
79/09/18 1245							
79/10/11 0900	1.20	10.0	3.0	7.0	50		
79/11/13 1215	1.10	8.0	0.0	10.0	80		
79/12/19 1305	0.10					50	
80/01/23 1100	0.00	0.0	0.0	2.0	110		
80/02/20 1115	0.10	0.0	1.0	0.0	10		0
80/03/13 1155	0.10					1500	
80/04/09 0930	0.80	0.0	2.0	0.0	140		0

	Total Hg	Diss Cr	Diss Cu	Diss Pb	Diss Zn					
80/05/19 1150	0.00	0.0	4.0	0.0	90	730	950	4K	0	
80/05/20 1030	0.00	0.0	2.0	3.0	80	380	280	4K	0	
80/05/21 1030	0.10	0.0	10.0K	10.0K	28	40	20	5	0	32
80/05/22 1030										
80/05/27 1135										
80/05/28 1200										
80/06/06 0815										
80/06/12 1040	0.10					110				
80/06/19 1110										
80/06/25 0930										
80/07/08 0900	0.00	0.0	2.0	0.0	70				0	
80/07/30 1030										
80/08/21 0845	0.10	10.0	1.0	4.0	50				0	
80/09/22 0745	0.10					90				
80/10/21 1230	0.00	0.0	2.0	0.0	90				0	
80/11/19 1300	0.00	10.0	3.0	2.0	100				0	
80/12/17 1245	0.00									
81/01/21 1300	0.10	10.0	4.0	3.0	170				0	
81/02/23 1200	0.10	0.0	3.0	2.0	160				0	
81/03/17 1030	0.20					160				
81/04/23 1100	0.30	10.0	2.0	0.0	180				0	
81/05/20 1330	0.10	10.0	3.0	5.0	90				0	
81/11/10 0915	0.30	3.0	4.0		80					
81/12/09 0930	0.10	2.0		4.0	70					
82/01/27 0855	0.05K	1.0	2.0	4.0	50					
82/02/16 1405	0.07K	3.0	11.0	8.0	110					
82/03/16 1230	0.06K	1.0K	4.0	8.0	100					
82/04/20 1215	0.06	2.0	3.0	4.0	150					
82/05/11 1200	0.10		4.0	4.0	140					
82/06/07 1430										
82/07/11 1450	0.13	8.0	2.0	2.0						
82/08/17 1645	0.07K	10.0	2.0							
82/09/14 1435	0.15		1.0	4.0	34					
82/10/19 1350	0.38		1.0K	2.0	30					
82/11/16 1405	0.12	1.0K	2.0	3.0	54					
82/12/28 1355	0.06K	0.0K		1.0K	101					
83/01/25 1410	0.12	0.0K		0.0K	116					
83/02/22 1450	0.12	1.0K		2.0	111					
83/03/23 0835	0.06K		1.0		127					
83/04/19 1525	0.06	1.0K		1.0K	89					
83/05/24 1525	0.11	1.0K	2.0	1.0	71					
83/06/28 1520	0.06K	1.0K	1.0K	1.0K	48					
83/07/19 1510	0.06K	1.0	1.0K	1.0K	36					
83/08/23 1540	0.15	1.0K	1.0	1.0	12					
83/09/27 1540	0.06K	1.0K	2.0	1.0K	21					
83/10/25 1500	0.06K	1.0K	1.0K	1.0K	37					
83/11/29 1505	0.05	1.0K	2.0	1.0K	68					
83/12/20 1505	0.05	1.0K	1.0	1.0K	84					
84/01/17 1350	0.06K	1.0K	1.0	1.0K	87					
84/02/07 1320		1.0K	1.0K	2.0	101					
84/03/06 1355		1.0K	1.0K	1.0	76					
84/04/10 1335		1.0K	2.0	1.0K	69					
84/05/08 1335		10.0	1.0K	1.0K	73					
84/06/12 1345		1.0K	1.0K	7.0	57					
84/07/10 1530										
84/08/14 1410										
84/09/11 1545										
84/10/09 1350										
84/11/13 1410										
84/12/11 1435										

85/01/15 1415
85/02/05 1430
85/03/12 1450
85/04/02 1400

DATE FROM TO	TIME	DEPTH METERS	01075 SILVER DIS Ag ug/l	01025 CADMIUM DIS Cd ug/l	01005 BARIUM DIS Ba ug/l	01000 ARSENIC DIS As ug/l	00340 COD HI LEVEL mg/l	00310 BOD 5 DAY mg/l	00025 BAROM PRESSURE mm OF Hg	00008 LAB LOG NUMBER	00500 SOLIDS TOTAL mg/l	00535 SOLIDS SUSP VOL mg/l
72/02/22	1310											
72/10/10	1815							3.7				
72/10/31	1350							3.5				
72/11/19	1415							2.7				
72/11/29	1255							2.6				
72/12/12	1350							2.2				
72/12/27	1205							0.6				
73/01/18	1310							2.4				
73/02/06	1415							2.2				
73/02/22	1310							2.4				
73/02/27	1345							3.4				
73/03/13	1105							2.0				
73/03/20	1215							2.2				
73/03/27	1520							2.5				
73/04/10	1200							3.4				
73/04/24	1510											
73/06/12	1430							2.3				
73/06/26	1000							0.8				
73/07/11	1145							2.8				
73/07/24	1130							3.5				
73/08/07	1245							8.3				
73/08/21	1200							4.3				
73/09/12	1240							4.1				
73/09/25	1135							2.1				
73/12/07	0910											
73/12/20	0935											
74/01/08	1050											
74/01/21	1330											
74/02/05	0840											
74/02/22	1350											
74/03/06	0930											
74/03/26	0845											
74/04/11	0825											
74/04/22	1030											
74/05/07	0745											
74/05/22	0840											
74/06/04	0840											
74/06/25	0730											
74/07/10	1135											
74/07/26	0930											
74/08/07	0900											
74/08/22	0945											
74/09/10	1000											
74/09/25	1100											
74/10/08	0820											
74/10/21	1015											
74/11/11	0915											
74/11/25	0930											
74/12/09	0930											

74/12/23 0930				
75/01/06 0930				
75/01/23 0945				
75/02/12 0945				
75/02/20 0850				
75/03/27 1015				
75/04/07 1000				
75/05/05 0900				
75/05/20 1125				
75/06/09 1100				
75/06/23 1100				
75/07/10 1040				
75/07/22 1000				
75/08/07 0915				
75/08/25 1000				
75/09/08 0945				
75/09/25 1000				
75/10/08 1000				
75/11/13 0815				
75/12/10 0930				
76/01/05 0930				
76/02/05 1430				
76/03/11 1330				
76/04/13 0845				
76/05/11 1300				
76/06/22 1310				
76/07/06 1415				
76/08/02 1145				
76/09/02 1430				
76/10/05 1000				
76/10/12 1100				
76/11/04 0945				
76/11/15 1110				
76/11/30 1330				
76/12/13 1330				
77/01/07 1215				
77/01/24 1045				
77/01/25 1130				
77/02/14 1140				
77/02/22 1300				
77/03/21 1005				
77/03/22 0930				
77/04/18 1100				
77/04/19 1000				
77/05/16 1145				
77/05/17 1430				
77/06/15 1030				
77/06/20 1145				
77/07/14 1000				
77/07/25 1150				
77/08/12 1500				
77/08/22 1010		Diss Cd		
77/09/26 0950				
77/09/29 1115				
77/10/19 1200	0.0	0.00	0	1.0
77/11/30 1300	0.0	1.00	400	1.0
78/01/02 1300	0.0	1.00	0	1.0
78/02/07 1415	0.0	1.00	0	2.0
78/03/10 1245				
78/04/06 1500	0.0	2.00	0	1.0

☐ = violation of water quality criterion

		Diss cd						
78/05/02 1530	0.0	0.00	0	1.0				
78/05/11 1430								
78/05/23 1115								
78/06/22 0900								
78/08/01 1030	0.0	6.00	20	2.0				
78/08/24 1415	0.0	1.00K	20	2.0				
78/09/12 1145								
78/10/18 1200	0.0	3.00	20	1.0				
78/11/21 1130	0.0	1.00K	20	1.0				
78/12/18 1045								
79/01/17 1300	0.0	2.00	20	2.0				
79/02/21 1320	0.0	1.00	0	1.0				
79/03/22 1200								
79/04/25 1050	0.0	2.00	20	1.0				
79/05/16 1110	0.0	2.00	0	1.0				
79/06/12 1155								
79/07/26 1345	0.0	1.00K	30	2.0				
79/08/20 1130	0.0	1.00	20	2.0				
79/09/18 1245								
79/10/11 0900	0.0	1.00K	30	1.0	0			
79/11/13 1215	1.0	1.00	20	1.0	15			
79/12/19 1305					13			
80/01/23 1100	0.0	1.00K	20	2.0	24			
80/02/20 1115	0.0	0.00	100	4.0	76			
80/03/13 1155					18			
80/04/09 0930	0.0	1.00	20	1.0	6			
80/05/19 1150	0.0	0.00	30	2.0	33			
80/05/20 1030	0.0	0.00	30	1.0	11			
80/05/21 1030	0.0	1.00K	10	1.0				
80/05/22 1030								
80/05/27 1135								
80/05/28 1200								
80/06/06 0815								
80/06/12 1040					11			
80/06/19 1110								
80/06/25 0930								
80/07/08 0900	0.0	1.00K	20	2.0	5			
80/07/30 1030								
80/08/21 0845	0.0	1.00K	20	5.0	6			
80/09/22 0745					3			
80/10/21 1230	0.0	1.00K	30	1.0	7			
80/11/19 1300	0.0	1.00K	20	1.0	5			
80/12/17 1245					18			75
81/01/21 1300	0.0	3.00	30	5.0	18			
81/02/23 1200	0.0	3.00	30	1.0	0			
81/03/17 1030					13			
81/04/23 1100	0.0	2.00	10	1.0	56			
81/05/20 1330	0.0	1.00K	20	1.0	3			
81/11/10 0915		0.50			9	717.6	4794	
81/12/09 0930		0.50			12	704.3	5015	
82/01/27 0855		0.20			20	726.2	315	
82/02/16 1405					58	675.1	663	
82/03/16 1230		1.60			9	721.4	1105	
82/04/20 1215		1.00			12	737.6	1934	
82/05/11 1200		0.90			4	724.4	2398	
82/06/07 1430					8	725.9	2810	
82/07/11 1450		0.40			13	725.9	3357	
82/08/17 1645		0.30			4	708.7	4105	
82/09/14 1435		0.20			5	717.8	4769	
82/10/19 1350		0.30			4	732.0	5491	

82/11/16	1405						4		690.9	5960	
82/12/28	1355			0.10K					727.5	6445	
83/01/25	1410			0.50			5		724.4	215	
83/02/22	1450			1.00K			8		712.7	595	
83/03/23	0835			1.10			4		705.6	1051	
83/04/19	1525			1.00		0.1	19		698.0	1557	
83/05/24	1525			0.70			4		712.0	2417	
83/06/28	1520			0.40			6		723.6	3163	
83/07/19	1510			0.40			14		720.9	3419	
83/08/23	1540			0.30			4		710.2	4293	
83/09/27	1540			0.20			4		708.2	5100	
83/10/25	1500			0.20			7		717.0	5718	
83/11/29	1505			0.50			4		713.7	6500	
83/12/20	1505			0.40			8		717.8	6871	
84/01/17	1350			0.50			4		723.4	179	
84/02/07	1320			0.50			4		718.6	442	
84/03/06	1355			0.50			7		714.5	868	
84/04/10	1335						8		700.0	1402	
84/05/08	1335			0.50			4		710.9	2078	
84/06/12	1345			0.40			4		708.2	2582	
84/07/10	1530						11		709.2	2994	
84/08/14	1410						4		708.4	3623	
84/09/11	1545						8		699.8	4031	
84/10/09	1350						12		707.1	4160	
84/11/13	1410						4K		796.8	4660	
84/12/11	1435						15		706.9	5060	
85/01/15	1415						4K		722.9	360	
85/02/05	1430						4		712.2	660	
85/03/12	1450						7		716.8	1160	
85/04/02	1400						4		716.0	1460	

DATE FROM TO	TIME	DEPTH METERS	00680 TOC C mg/l	00660 PHOSPHATE ORTHO P04 mg/l	31625 FECAL COLIFORM /100ml MA	70300 SOLIDS DIS 180C mg/l	00405 CARBON DIOXIDE mg/l CO2	00605 NITROGEN ORGANIC T mg/l N	01065 NICKEL DIS Ni ug/l	01034 CHROMIUM TOT REC ug/l Cr	01042 COPPER TOT REC ug/l Cu	01051 LEAD TOT REC ug/l Pb
72/02/22	1310											
72/10/10	1815		2.5					0.21				
72/10/31	1350		2.0					0.22				
72/11/19	1415		3.0					0.23				
72/11/29	1255		3.0					0.25				
72/12/12	1350		2.5	0.14				0.12				
72/12/27	1205		3.5	0.08				0.14				
73/01/18	1310		11.0	0.11				0.61				
73/02/06	1415											
73/02/22	1310		8.5	0.10				0.35				
73/02/27	1345			0.21				0.93				
73/03/13	1105		4.5	0.00				0.33				
73/03/20	1215		5.0	0.05				0.24				
73/03/27	1520		4.5	0.03				0.03				
73/04/10	1200		7.0	0.00				0.11				
73/04/24	1510		6.0	0.08				0.17				
73/06/12	1430		5.5	0.26				0.01				
73/06/26	1000		5.0	0.20				0.20				
73/07/11	1145		10.0	0.43				1.40				
73/07/24	1130		11.0	0.58				0.64				
73/08/07	1245		18.0	0.55				0.70				
73/08/21	1200		6.0	0.46				1.00				
73/09/12	1240		7.5	0.06				0.75				

73/09/25 1135	6.0	0.16				0.39
73/12/07 0910	5.5	0.21		69	2.4	0.41
73/12/20 0935	53.0	0.03		50		0.14
74/01/08 1050	1.9	0.12		60		0.20
74/01/21 1330	3.0	0.12		57		0.28
74/02/05 0840	6.0			83		
74/02/22 1350	4.6	0.28		82		0.10
74/03/06 0930	4.9			71	1.5	2.40
74/03/26 0845	3.0	0.12		68		0.65
74/04/11 0825	3.4	0.12		58		0.17
74/04/22 1030	3.8	0.09		60		0.10
74/05/07 0745	2.9	0.06		48		2.40
74/05/22 0840	1.7	0.03		45		0.17
74/06/04 0840	2.0	0.00		52	1.0	0.79
74/06/25 0730	1.8	0.03		38		0.12
74/07/10 1135	2.5	0.18		109		2.50
74/07/26 0930	1.5	0.12		82		0.34
74/08/07 0900	1.5	0.18		77		
74/08/22 0945	2.6	0.25		113		0.12
74/09/10 1000	3.7	0.28		120	2.6	0.25
74/09/25 1100	4.2	0.25		78		0.15
74/10/08 0820	4.0	0.21		85		0.13
74/10/21 1015	4.5	0.31		87		0.15
74/11/11 0915	2.1	0.25		81		0.48
74/11/25 0930	3.4	0.28		72		0.19
74/12/09 0930	2.7	0.25		76	3.9	0.37
74/12/23 0930	2.2	0.15		83		0.12
75/01/06 0930	2.6	0.21		100		0.19
75/01/23 0945	4.3	0.21		69		0.27
75/02/12 0945	3.2	0.15		78		0.33
75/02/20 0850	7.0	0.21		71		0.40
75/03/27 1015	4.4	0.03		68	0.8	0.49
75/04/07 1000		0.12		79		0.23
75/05/05 0900	3.9	0.06		51		0.21
75/05/20 1125	6.1	0.03		53		0.16
75/06/09 1100	2.3	0.09		33	2.8	0.14
75/06/23 1100	2.2	0.03		39		0.06
75/07/10 1040	3.6	0.06		56		0.13
75/07/22 1000	5.1	0.12		72		0.10
75/08/07 0915	8.7	0.25		100		0.20
75/08/25 1000	3.6	0.12		67		0.21
75/09/08 0945	3.0	0.25		93	4.8	0.19
75/09/25 1000	3.0	0.21		72		0.20
75/10/08 1000	2.7	0.18		81		0.12
75/11/13 0815	2.0	0.12		69		0.20
75/12/10 0930	3.8	0.06		52		0.12
76/01/05 0930	2.4	0.03		60	4.7	0.16
76/02/05 1430	1.8	0.09		65		0.19
76/03/11 1330	12.0	0.09		79	10.0	2.90
76/04/13 0845	2.3	0.03		52		0.16
76/05/11 1300	2.7	0.03		40		0.13
76/06/22 1310		0.09		50	1.7	0.19
76/07/06 1415	2.1	0.18		82		0.19
76/08/02 1145	1.9	0.25		102		0.29
76/09/02 1430	2.2	0.37		97	0.5	0.34
76/10/05 1000	1.0	0.18	3000	72		0.37
76/10/12 1100		0.18				0.61
76/11/04 0945	1.6	0.25	24	91		0.27
76/11/15 1110		0.18				0.27
76/11/30 1330	1.7	0.34	11	98		0.34

76/12/13 1330		0.31				0.41	
77/01/07 1215	2.6	0.31	320	92	3.8	0.11	
77/01/24 1045		0.25				1.30	
77/01/25 1130	3.8	0.34		89		0.31	
77/02/14 1140		0.28				0.30	
77/02/22 1300	2.3	0.34	28	91		0.35	
77/03/21 1005		0.06				0.24	
77/03/22 0930	2.6	0.21	230	78	7.4	0.10	
77/04/18 1100		0.12				0.24	
77/04/19 1000	2.4	0.15	120	66		0.31	
77/05/16 1145		0.06				0.19	
77/05/17 1430	2.5	0.12	120	55		0.19	
77/06/15 1030	2.9	0.12	240	57	0.4	0.17	
77/06/20 1145		0.09				0.39	
77/07/14 1000	2.5	0.28	530	91		0.36	
77/07/25 1150		0.28				0.52	
77/08/12 1500	3.0	0.55	4500	114		0.36	
77/08/22 1010		0.40				0.31	
77/09/26 0950		0.37				0.14	
77/09/29 1115	1.8	0.09	170	75	1.9	0.19	
77/10/19 1200	1.3	0.40	3	75	3.3		
77/11/30 1300	4.6	0.31	880	70	1.2		
78/01/02 1300	1.0	0.09	58	55	1.0		
78/02/07 1415	13.0	0.25	100	90	2.5		
78/03/10 1245	3.7	0.06	21	51	1.4		
78/04/06 1500	3.0	0.00	23	45	0.7		
78/05/02 1530	3.2	0.00	110	46	1.5		
78/05/11 1430		0.00					
78/05/23 1115	2.4	0.00	48	43	0.7		
78/06/22 0900	1.5	0.00	44	62	1.8		
78/08/01 1030	1.8	0.03	2	105	1.2		
78/08/24 1415	1.7	0.03	17	75	0.4		
78/09/12 1145	1.6	0.06	29	77	1.2		
78/10/18 1200	1.6	0.03	2	88	0.6	0.23	
78/11/21 1130	2.4	0.03	25	94	1.2	0.14	
78/12/18 1045	1.3	0.03	6	81	1.2	0.17	
79/01/17 1300	1.3	0.03	9	80	1.6	0.00	
79/02/21 1320	3.2	0.12	55	82	1.2	0.45	
79/03/22 1200	2.4	0.03	120	51	0.8	0.19	
79/04/25 1050	3.8	0.03	7	49		0.21	
79/05/16 1110	2.3	0.00	48	40	0.7	0.25	
79/06/12 1155	2.6	0.00	20	88	0.7	0.29	
79/07/26 1345	1.0	0.12	1K	120	1.6	0.94	
79/08/20 1130	2.4	0.09	1500	395	0.8	0.65	
79/09/18 1245	1.1	0.15					
79/10/11 0900	1.8	0.15	19	82		0.52	
79/11/13 1215	2.4	0.03	100	87		0.34	
79/12/19 1305	2.7	0.03	45	62		0.33	
80/01/23 1100	3.2	0.09	20	63		0.55	
80/02/20 1115			250	89		2.30	
80/03/13 1155	2.9	0.03	19	58		0.42	
80/04/09 0930	2.2	0.00	3900	71		0.54	
80/05/19 1150				44		0.20	3
80/05/20 1030				63		0.65	2
80/05/21 1030				54	1.1	0.49	5
80/05/22 1030							
80/05/27 1135			800L	40		3.50	
80/05/28 1200							
80/06/06 0815							
80/06/12 1040	2.1	0.03	300	51		0.48	

80/06/19 1110			56	42	0.53			
80/06/25 0930			76	54	0.34			
80/07/08 0900	2.1	0.06	960	68	0.43			
80/07/30 1030			7	91	0.68			
80/08/21 0845	3.9	0.03	210	89	2.70			
80/09/22 0745	2.7	0.03	480	85	0.37			
80/10/21 1230	4.3	0.06	31	87	0.85			
80/11/19 1300		0.06	61	84	0.33			
80/12/17 1245	3.0	0.03	20	64	0.61			
81/01/21 1300	2.0	0.03		64	0.54			
81/02/23 1200	2.1	0.03		51	0.55			
81/03/17 1030	2.0	0.03		58	0.30			
81/04/23 1100	2.3	0.03		61	0.49			
81/05/20 1330	2.8	0.12		57	0.32			
81/11/10 0915							4.0	6.0	3.0
81/12/09 0930							5.0	2.0	4.0
82/01/27 0855							2.0	7.0	4.0
82/02/16 1405							7.0	21.0	9.0
82/03/16 1230							1.0	7.0	35.0
82/04/20 1215							3.0	3.0	22.0
82/05/11 1200							8.0	27.0	10.0
82/06/07 1430									
82/07/11 1450							19.0	2.0	2.0
82/08/17 1645							27.0	2.0	1.0K
82/09/14 1435							1.0K	3.0	10.0
82/10/19 1350							5.0	1.0K	2.0
82/11/16 1405							1.0K	5.0	
82/12/28 1355							0.0K	0.0K	1.0K
83/01/25 1410							1.0K	0.0K	4.0
83/02/22 1450							1.0K	1.0	4.0
83/03/23 0835							1.0K	3.0	1.0
83/04/19 1525							1.0K	5.0	1.0
83/05/24 1525							1.0K	2.0	4.0
83/06/28 1520							1.0K	3.0	2.0
83/07/19 1510							1.0	5.0	5.0
83/08/23 1540							1.0K	1.0	1.0
83/09/27 1540							1.0K	2.0	1.0K
83/10/25 1500							1.0K	1.0K	2.0
83/11/29 1505							1.0K	2.0	1.0K
83/12/20 1505							1.0K	20.0	11.0
84/01/17 1350							1.0K	37.0	6.0
84/02/07 1320							1.0K	1.0	3.0
84/03/06 1355							1.0K	29.0	16.0
84/04/10 1335							9.0	24.0	13.0
84/05/08 1335							20.0	16.0	10.0
84/06/12 1345							1.0K	1.0K	15.0
84/07/10 1530									
84/08/14 1410									
84/09/11 1545									
84/10/09 1350									
84/11/13 1410									
84/12/11 1435									
85/01/15 1415									
85/02/05 1430									
85/03/12 1450									
85/04/02 1400									

DATE	01092 ZINC	01027 CADMIUM	01002 ARSENIC	00930 SODIUM

Total Rec Cr | Total Rec Cu | Total Rec Pb

FROM TO	TIME	DEPTH METERS	TOT REC ug/l Zn	TOT REC ug/l Cd	TOT As ug/l	DIS Na mg/l
72/02/22	1310					
72/10/10	1815					
72/10/31	1350					
72/11/19	1415					
72/11/29	1255					
72/12/12	1350					
72/12/27	1205					
73/01/18	1310					
73/02/06	1415					
73/02/22	1310					
73/02/27	1345					
73/03/13	1105					
73/03/20	1215					
73/03/27	1520					
73/04/10	1200					
73/04/24	1510					
73/06/12	1430					
73/06/26	1000					
73/07/11	1145					
73/07/24	1130					
73/08/07	1245					
73/08/21	1200					
73/09/12	1240					
73/09/25	1135					
73/12/07	0910					3.80
73/12/20	0935					
74/01/08	1050					
74/01/21	1330					
74/02/05	0840					
74/02/22	1350					
74/03/06	0930					3.30
74/03/26	0845					
74/04/11	0825					
74/04/22	1030					
74/05/07	0745					
74/05/22	0840					
74/06/04	0840					1.60
74/06/25	0730					
74/07/10	1135					
74/07/26	0930					
74/08/07	0900					
74/08/22	0945					
74/09/10	1000					4.30
74/09/25	1100					
74/10/08	0820					
74/10/21	1015					
74/11/11	0915					
74/11/25	0930					
74/12/09	0930					2.90
74/12/23	0930					
75/01/06	0930					
75/01/23	0945					
75/02/12	0945					
75/02/20	0850					
75/03/27	1015					2.80
75/04/07	1000					
75/05/05	0900					

75/05/20	1125	
75/06/09	1100	1.80
75/06/23	1100	
75/07/10	1040	
75/07/22	1000	
75/08/07	0915	
75/08/25	1000	
75/09/08	0945	3.70
75/09/25	1000	
75/10/08	1000	
75/11/13	0815	
75/12/10	0930	
76/01/05	0930	3.30
76/02/05	1430	
76/03/11	1330	4.20
76/04/13	0845	
76/05/11	1300	
76/06/22	1310	2.00
76/07/06	1415	
76/08/02	1145	
76/09/02	1430	4.10
76/10/05	1000	
76/10/12	1100	
76/11/04	0945	
76/11/15	1110	
76/11/30	1330	
76/12/13	1330	
77/01/07	1215	3.80
77/01/24	1045	
77/01/25	1130	
77/02/14	1140	
77/02/22	1300	
77/03/21	1005	
77/03/22	0930	3.20
77/04/18	1100	
77/04/19	1000	
77/05/16	1145	
77/05/17	1430	
77/06/15	1030	2.60
77/06/20	1145	
77/07/14	1000	
77/07/25	1150	
77/08/12	1500	
77/08/22	1010	
77/09/26	0950	
77/09/29	1115	3.70
77/10/19	1200	4.20
77/11/30	1300	3.00
78/01/02	1300	2.20
78/02/07	1415	4.00
78/03/10	1245	2.50
78/04/06	1500	1.50
78/05/02	1530	1.60
78/05/11	1430	
78/05/23	1115	1.90
78/06/22	0900	2.40
78/08/01	1030	4.30
78/08/24	1415	3.70
78/09/12	1145	3.70
78/10/18	1200	3.70

78/11/21 1130				3.70
78/12/18 1045				3.60
79/01/17 1300				4.10
79/02/21 1320				3.00
79/03/22 1200				2.30
79/04/25 1050				2.10
79/05/16 1110				2.00
79/06/12 1135				3.10
79/07/26 1345				5.20
79/08/20 1130				4.50
79/09/18 1245				4.50
79/10/11 0900				3.90
79/11/13 1215				4.00
79/12/19 1305				4.00
80/01/23 1100				2.80
80/02/20 1115				5.60
80/03/13 1155				3.40
80/04/09 0930				3.20
80/05/19 1150				2.00
80/05/20 1030				2.60
80/05/21 1030				1.70
80/05/22 1030				
80/05/27 1135				2.80
80/05/28 1200				
80/06/06 0815				
80/06/12 1040				2.70
80/06/19 1110				1.90
80/06/25 0930				2.40
80/07/08 0900				2.60
80/07/30 1030				3.90
80/08/21 0845				3.50
80/09/22 0745				3.30
80/10/21 1230				4.30
80/11/19 1300				3.70
80/12/17 1245				
81/01/21 1300				3.20
81/02/23 1200	Total Rec	Total Rec		2.30
81/03/17 1030				3.00
81/04/23 1100	Zn	Cd		2.50
81/05/20 1330				2.80
81/11/10 0915	110	0.60		
81/12/09 0930	120	0.50		
82/01/27 0855	60	0.50		
82/02/16 1405	130	1.30		
82/03/16 1230	150	1.80		
82/04/20 1215	170	1.20		
82/05/11 1200	170	1.10		
82/06/07 1430				
82/07/11 1450	48	0.40		
82/08/17 1645	35	0.30		
82/09/14 1435	38	0.30		
82/10/19 1350	89	0.60		
82/11/16 1405	69	0.20		
82/12/28 1355	111	0.20		
83/01/25 1410	126	0.60		
83/02/22 1450	120	1.00		
83/03/23 0835	156	1.20		
83/04/19 1525	114	1.30	2.5	
83/05/24 1525	100	0.80		
83/06/28 1520	65	0.40		

		Total Rec. Zn	Total Rec. Cd.
83/07/19	1510	55	0.90
83/08/23	1540	17	0.30
83/09/27	1540	31	0.20
83/10/25	1500	45	0.50
83/11/29	1505	92	0.60
83/12/20	1505	100	0.50
84/01/17	1350	113	0.50
84/02/07	1320	118	1.00
84/03/06	1355	117	0.50
84/04/10	1335	100	0.40
84/05/08	1335	93	0.60
84/06/12	1345	87	0.60
84/07/10	1530		
84/08/14	1410		
84/09/11	1545		
84/10/09	1350		
84/11/13	1410		
84/12/11	1435		
85/01/15	1415		
85/02/05	1430		
85/03/12	1450		
85/04/02	1400		