WATER QUALITY STATUS REPORT

LOWER PORTNEUF RIVER

REPORT NO. WQ-28

September, 1977

Idaho Department of Health and Welfare
Division of Environment
Pocatello, Idaho 83201

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ABSTRACT

This paper describes the results of a twelve month, bi-weekly water quality sampling program on the Lower Portneuf River. Samples were collected at seven river stations, five effluents, and a major spring.

The results indicate that Marsh Creek, a major tributary draining agricultural land, is degrading the Portneuf River. Significant quantities of fecal coliform bacteria and total solids are exported from the Marsh Creek Basin to the Lower Portneuf River.

Based on water quality results at the river and effluent stations, it appears that two effluents have highly concentrated ionic loads but do not have demonstrable effects on the Portneuf River. These two effluents are the Union Pacific Railroad Oil Separation Plant and the Pocatello Sewage Treatment Plant.

Two other sources are contributing nutrients to the river in quantities that may accelerate eutrophication of American Falls Reservoir. These two are the J. R. Simplot Company (total phosphorus) and Batiste Springs (Total Kjeldahl Nitrogen).

Recommendations for better land use practices in the Marsh Creek Basin and more strict effluent limitations for point source discharges are included.

INTRODUCTION

The Portneuf River is a tributary of the Upper Snake River system in Southeastern Idaho. The Portneuf drains a 3,574 km^2 (1380 m^2) watershed. It arises in mountainous terrain at an elevation of 2,830 m (9,280 feet) and is approximately 156 km (97 miles) long. The river mouth is at approximately 1,326 m (4,350 feet) elevation; the resultant slope of the entire river is 26.6 m/km (50.8 feet/mile). Discharge of the river varies seasonably from 1.4 m^3/sec. (50 cfs) to 81.2 m^3/sec. (2,900 cfs), measured at Pocatello.

This portion of Southeastern Idaho is part of the cold desert ecological province. Precipitation is light and evenly distributed throughout the year. Mean annual precipitation at Pocatello is approximately 33 cm (13 in.). Annual temperature extremes range from -35° C (-31° F) in the winter to 41° C (105° F) in the summer. The mountains comprising the Portneuf River Basin are sedimentary rocks. The valleys are filled with the weathering products of these rocks, and with several very recent lava flows. The top soil is primarily loess (Minshall and Andrews, 1973). Land use practices in the Portneuf River Basin are as follows (from Merrell and Onstott, 1965):

Range	61%
Cropland	33%
Timber	2.5%
Meadow Hayland	1%

About 80% of the cropland is dryland wheat farms. Most of the remaining land is irrigated cropland (sugar beets, potatoes, and alfalfa hay).

Previous studies on the Portneuf River have examined sedimentation and land use practices (Merrell and Onstott, 1965), and the fishes of the basin (Mohr, 1968). Flood plain descriptions have been compiled for the Portneuf River near Pocatello (U.S. Army Corps of Engineers, 1970). Macro-benthos and water quality were examined at ten stations in 1968-69 (Minshall and Andrews, 1973).

There are eight point source discharges to the lower Portneuf River. These range in volume from 0.003 m^3/sec. (0.1 cfs) to 1.316 m^3/sec. (47 cfs) annual mean. There are also two major sources of non-point-source pollutants. Marsh Creek is the major tributary to the lower Portneuf (based on volume). Marsh Creek is heavily laden with sediment and dissolved solids. Storm drains from the City of Pocatello wash oil, grease, solids, and dissolved minerals into the Portneuf River. There have been no previous studies which were designed to evaluate the impact of these waste sources. This paper addresses some of those impacts.

Station 9 was the effluent of FMC, an elemental phosphorus plant.

Station 10 was the effluent of the J. R. Simplot fertilizer plant.

Station 11 represented the effluent of the Pocatello Sewage Treatment Plant. This facility had only primary treatment during this study. The secondary phase of the treatment facility went on line November 30, 1975.

Station 12 was at the head of Batiste Spring. This station was designed to represent the spring water before it entered the Batiste Spring Fish Hatchery.

Station 13 was at the discharge of the Batiste Spring Fish Hatchery.

Samples were taken with a steel shotshell sampler (Standard Methods, 1971). Samples for heavy metal analyses were taken directly into glass containers. Samples were collected from the mid-point of cross-sectional flow. They were stored at 4^{o} C until delivery to the laboratory. Temperature, pH, and dissolved oxygen were measured in the field. Metals samples were preserved with 2 ml HNO_3 per liter. Nutrient samples were preserved with 2 ml H_2SO_4 per liter.

Results

The following 27 parameters were monitored at the Portneuf River stations:

Temperature	Calcium
Dissolved Oxygen	Flouride
pH	Specific Conductance
Turbidity	Total Alkalinity
BOD_5	Iron
Total Solids	Manganese
Nitrate	Sodium
Total Kjeldahl Nitrogen	Potassium
Ortho-phosphate	Chloride
Total Inorganic Phosphate	Suspended Solids
Total Phosphorus	Oil and Grease
COD	Total Coliform Bacteria
Total Hardness	Fecal Coliform Bacteria
Sulphate	

Nitrogen in the Lower Portneuf River is most affected by the effluents that are farthest downstream (Figures 2, 3). The phosphate plants effect minor increases in dissolved nitrogen, and in organic nitrogen. Batiste Spring adds high levels of dissolved nitrogen and the Pocatello Sewage Treatment Plant discharges high concentrations of ammonia and organic nitrogen. The toxicity of ammonia near the J.R. Simplot and City of Pocatello discharges was not evaluated in this survey.

The phosphate industries cause a more marked rise in phosphorus concentrations (Figure 4). Mean concentrations from the two plants (9.96 mg/1 for FMC and 65.43 mg/1 P for Simplot) are very high in relation to river concentrations. Effluent concentrations from the Pocatello Sewage Treatment Plant are also high (8.2 mg/1), but do not increase concentrations in the river.

Total Residue (Figure 5) is increased by Marsh Creek, which carries high concentrations of sediment. High Total Residue in the effluents is primarily a reflection of dissolved rather than suspended matter.

Fecal coliform concentrations (Figure 6) depict the influence of pollutant sources. Influences near Inkom (Marsh Creek, City of Inkom STP, Portland Cement, etc.) raise river coliform concentrations to over 100 colonies per 100 ml. The UPRR Oil Separation Plant and the phosphate industries also discharge high concentrations of fecal coliform bacteria. It is interesting to note that Marsh Creek at the mouth has the same annual geometric mean fecal coliform density as does the effluent from the Pocatello Sewage Treatment Plant.

The discharge measurements on the river stations are not available, but annual mean discharges for the effluents have been estimated from NPDES Compliance Assurance data. Those estimates are tabulated below.

Table 1. Estimated 1975 mean discharge from effluents entering the Lower Portneuf River.

Effluent	1975 Mean Discharge		
	Cubic Meters/Sec.	cfs	mgd
Union Pacific Railroad	0.015	0.5	0.35
FMC	0.074	4.0	1.70
J.R. Simplot Co.	0.034	1.2	0.78
Pocatello STP	0.293	11.8	6.70
Batiste Spring	1.330	47.0	30.36

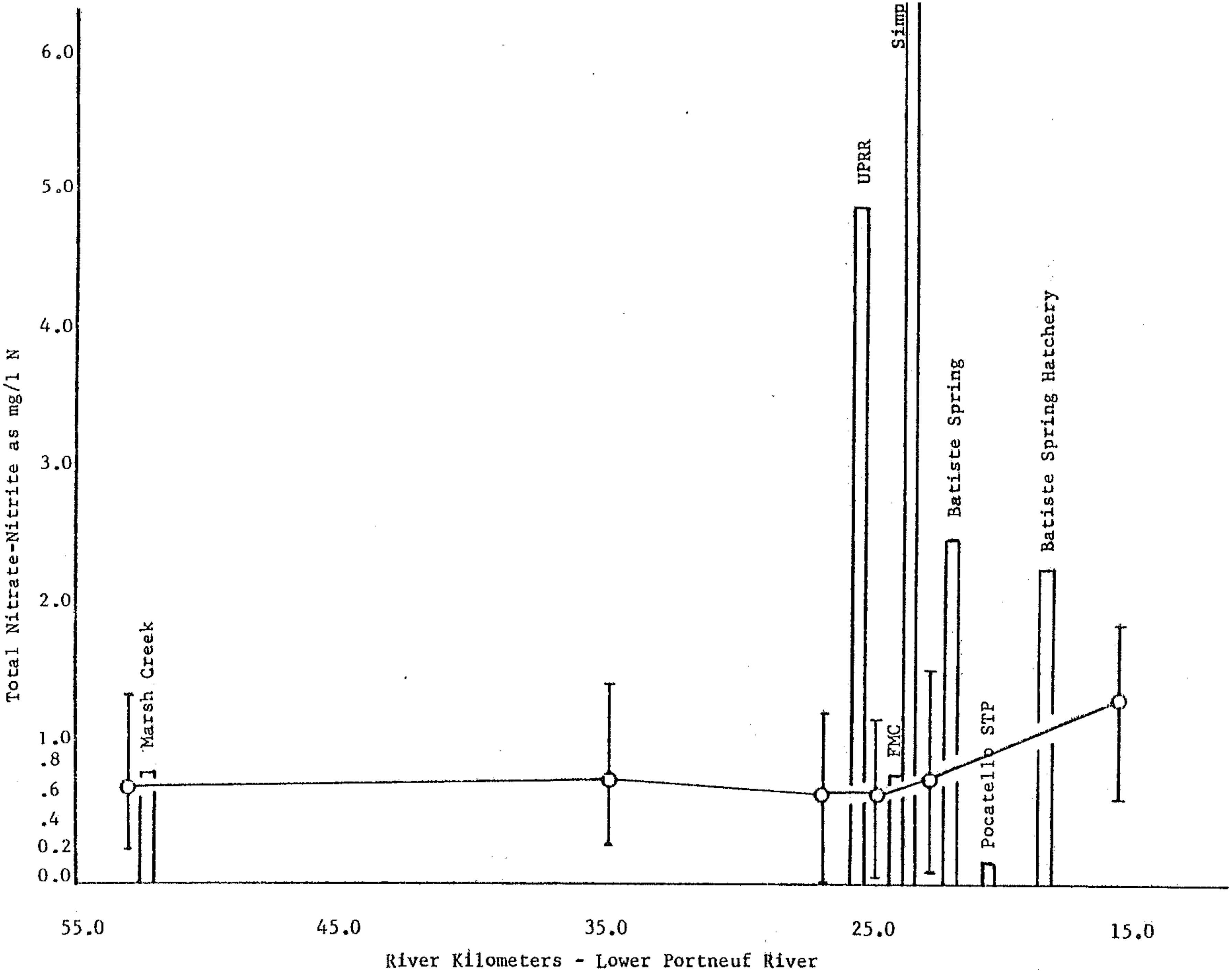

Figure 2. Annual Nitrate-Nitrite concentrations in the lower Portneuf River. Vertical lines are ranges. Bars represent mean annual effluent concentrations.

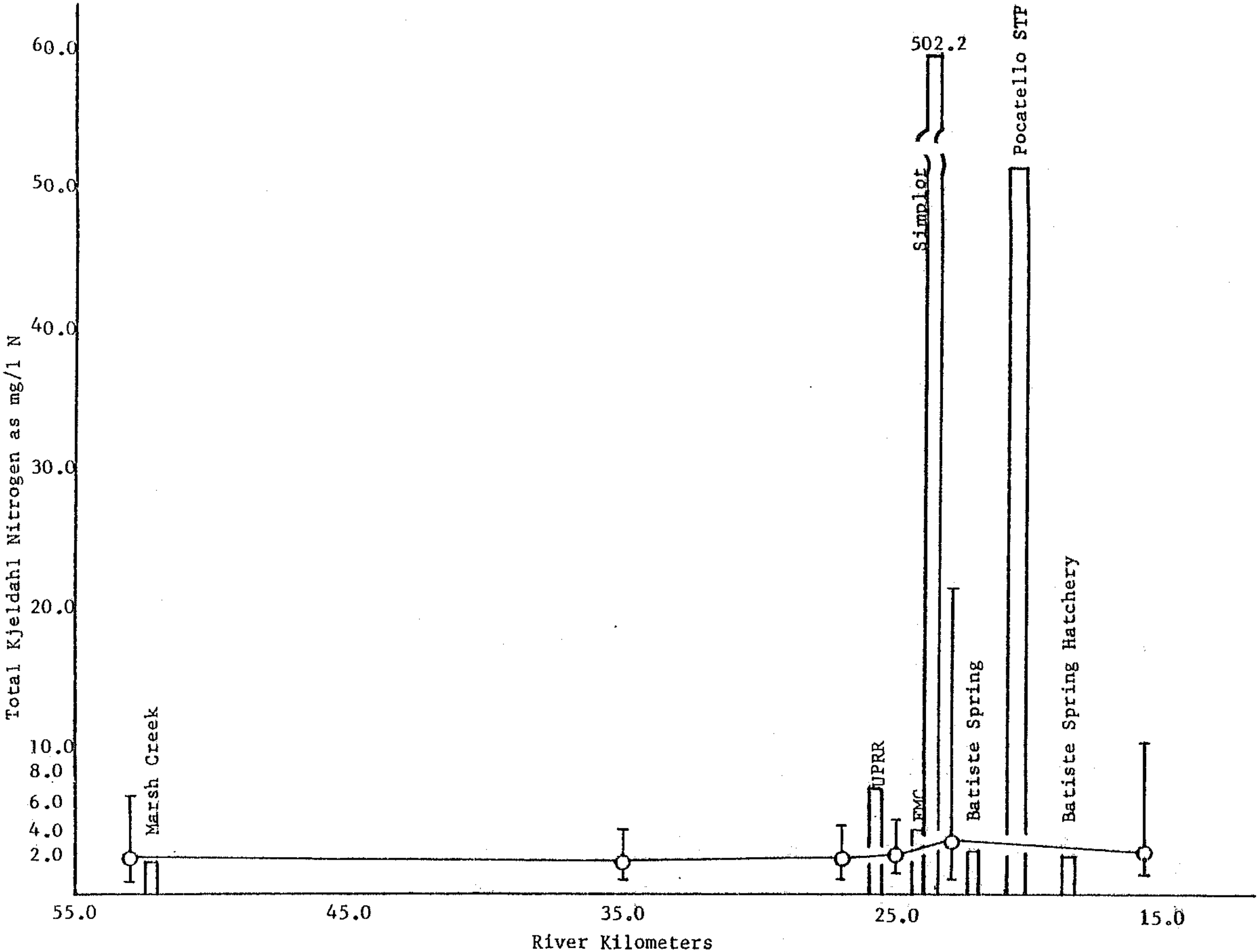

Figure 3. Total Kjeldahl Nitrogen in the Lower Portneuf River. Vertical lines represent range at river stations. Histogram depicts mean annual effluent concentrations.

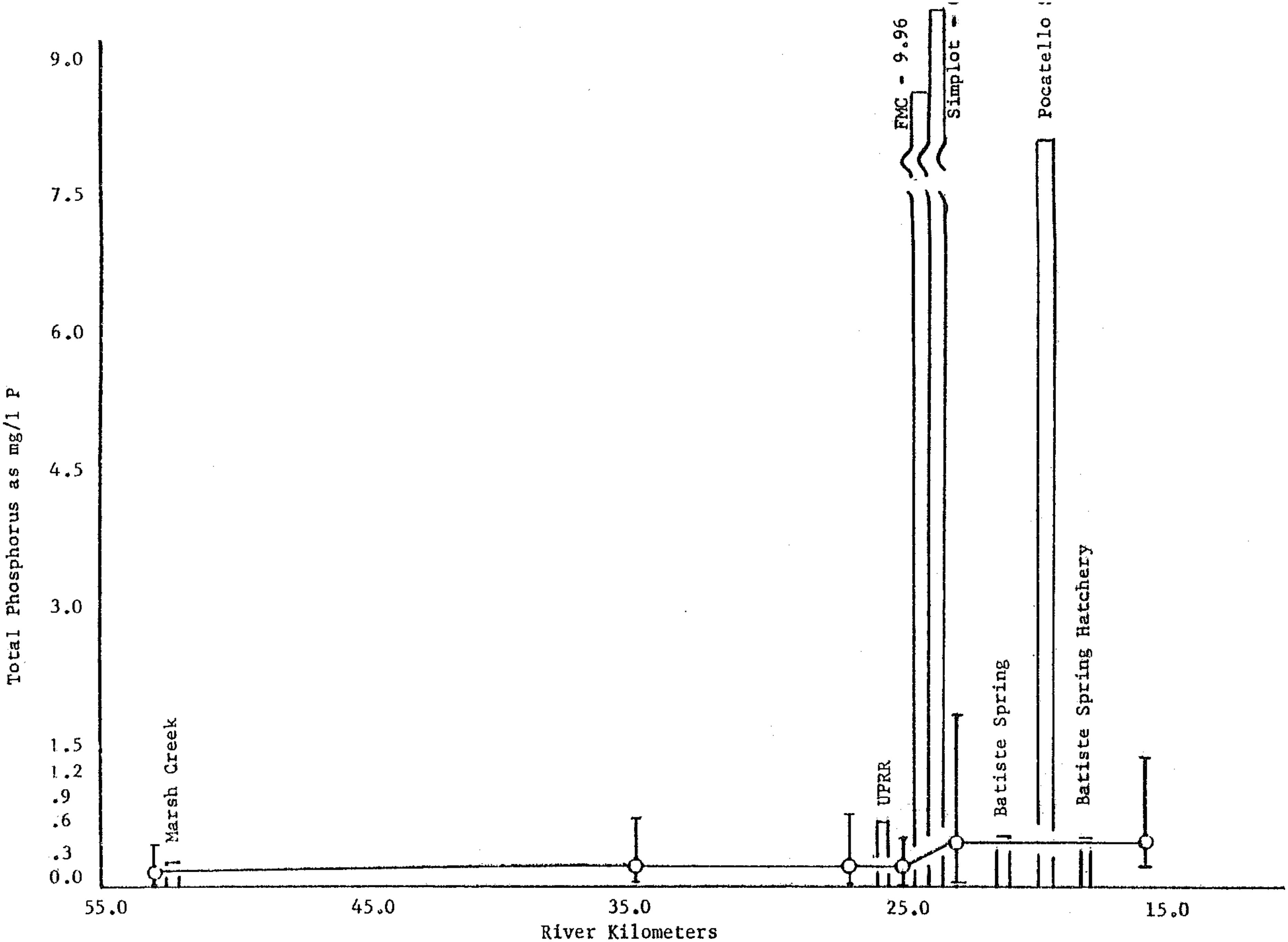

Figure 4. Total Phosphorus concentrations in the Lower Portneuf River. Vertical lines represent range surrounding annual mean. Historgram depicts mean annual effluent concentrations.

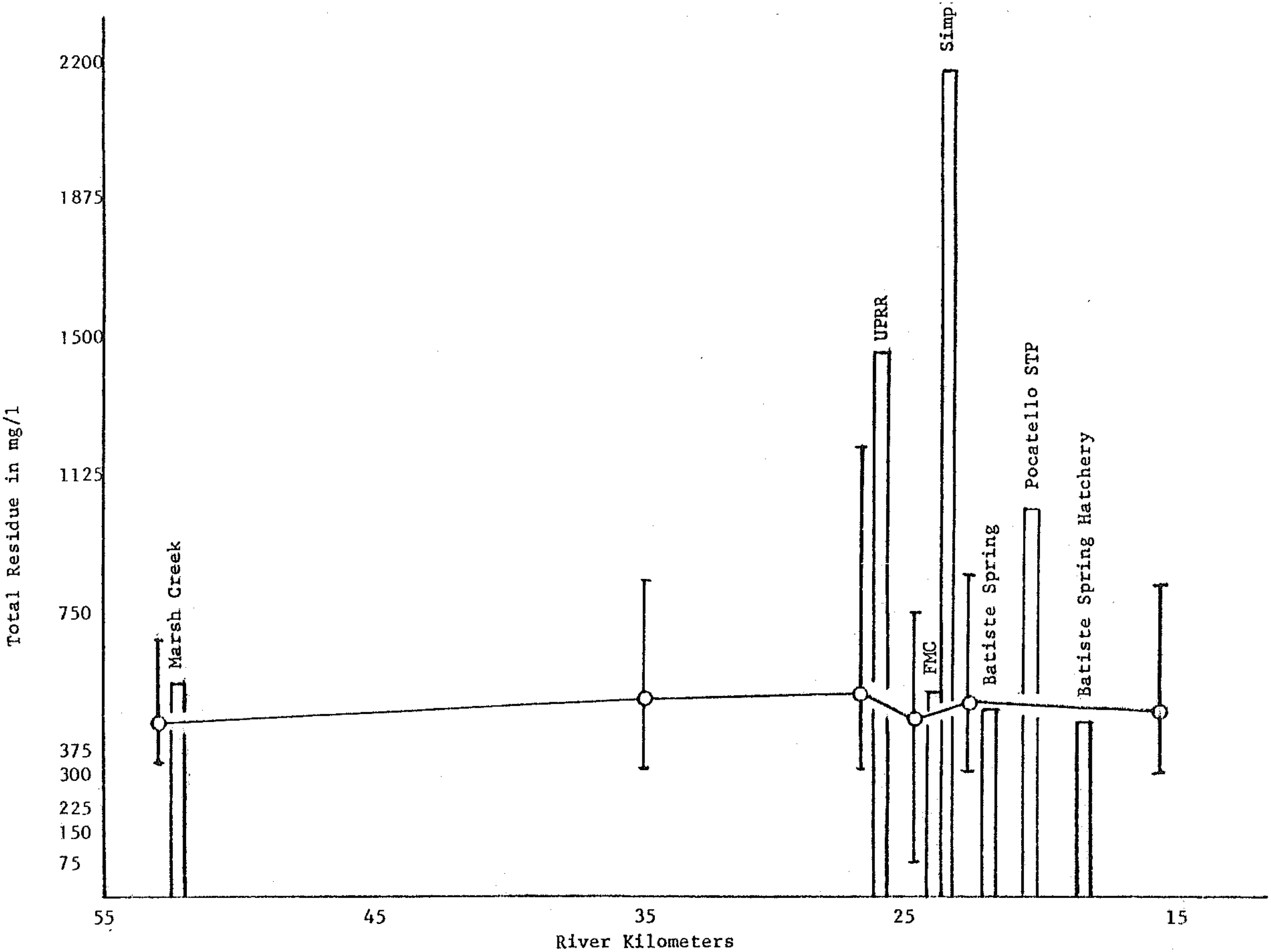

Figure 5. Total Residue concentrations in the lower Portneuf River. Vertical lines represent range about the mean. Histogram depicts mean annual effluent concentrations.

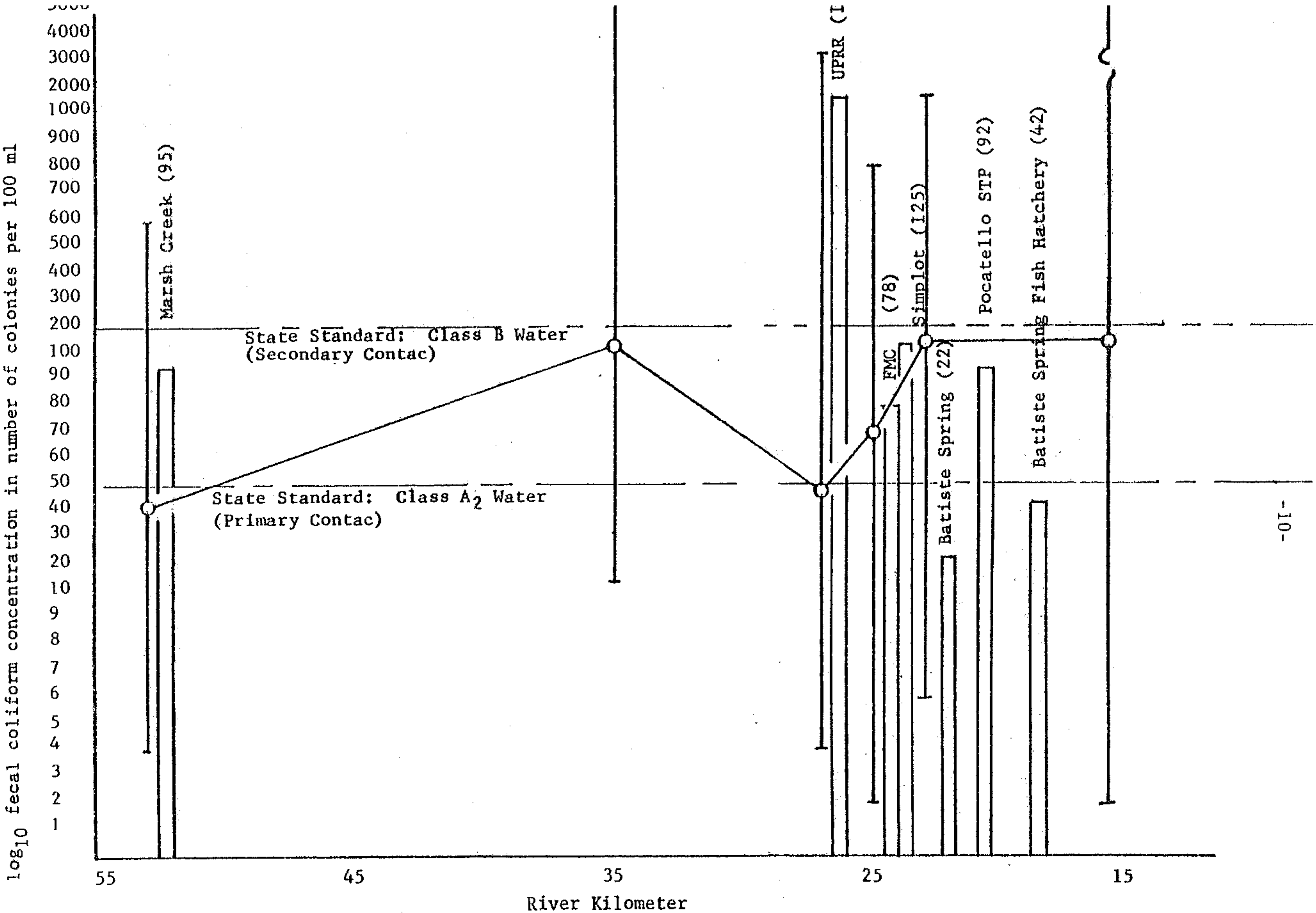

Figure 6. Semi-log plot of fecal coliform concentrations in the lower Portneuf River. Vertical bars represent range around annual geometric mean. Histogram depicts effluent annual geometric mean.

DISCUSSION

Marsh Creek is degrading the Portneuf River. Solids from the Marsh Creek drainage are increasing the river turbidity and are depositing out as silt. Fecal coliform bacteria from the Marsh Creek result in an increase in river coliform concentrations. The fecal coliform annual geometric mean above Marsh Creek was 42 colonies per 100 ml and was 110 below Marsh Creek. The solids are generated by erosion along the Marsh Creek channel. Coliform bacteria are associated with the sediments and are also added by the numerous cattle that graze along Marsh Creek.

The UPRR effluent is highly concentrated, but has no demonstrable effect on the Portneuf River. Annual mean concentrations of Nitrate Nitrogen, Total Residue, and Fecal Coliform bacteria are dramatically higher than river concentrations (Figures 2, 5, 6). However, effluent volume is small (1296 m^3/day) and there were no discernible increases in river concentrations below the discharge.

The Pocatello phosphate industries contribute concentrated effluents to the Portneuf River. They also cause notable increases in annual mean concentrations in the Portneuf River. The FMC discharge is more than twice the flow of the Simplot discharge, but the Simplot discharge is several times as concentrated in most parameters. The most striking increases in river concentrations below the phosphate plants are Total Phosphorus and Fecal Coliform Bacteria. The bacterial counts often exceed the allowable level for a Class B water. Also, the annual mean Total Phosphorus level is substantially above the recommended maximum for a stream (California Water Quality Control Board, 1963).

The impacts of the Pocatello Sewage Treatment plant and the Batiste Spring and hatchery are difficult to separate. Although the Pocatello STP has a very concentrated effluent, especially with regard to Total Kjeldahl Nitrogen and Total Phosphorus, no increases in river concentrations are attributable to this source. On the other hand, Nitrate Nitrogen is increased by the Batiste Spring waters. River Nitrate concentrations are nearly doubled by the spring waters and the result is that river water is nearly four times the recommended maximum (California Water Quality Control Board, 1963).

The increases in nutrients that have been described along the Lower Portneuf River are quite important because those nutrients are being exported to American Falls Reservoir where they will accelerate eutrophication.

Sodium absorption ratios (SAR) were calculated for all river stations. The SAR values range from 0.72 to 1.29. Values less than 4.00 are not considered detrimental. Therefore, calcium, mangnesium, and sodium are not significantly disproportionate in the Portneuf River.

CONCLUSIONS

Marsh Creek is degrading the Portneuf River with respect to Total Solids and Fecal Coliform Bacteria. These inputs stem from land use practices and grazing in the Marsh Creek Valley. As a result of these influences, Marsh Creek is a water quality limiting stream, at least in its lower reaches.

The Union Pacific Railroad and the Pocatello Sewage Treatment Plant discharge concentrated effluents, but the effluents do not have demonstrable effects on the Portneuf River.

The Pocatello phosphate plants (primarily J. R. Simplot) increase total phosphorus concentrations above the recommended levels. Batiste Spring waters increase Total Kjeldahl Nitrogen levels above the recommended levels. These nutrients are being exported to American Falls Reservoir and are probably leading to accelerated eutrophication.

The Lower Portneuf River is a water quality limiting stream. This status is primarily due to the influences of Marsh Creek and the phosphate industries.

RECOMMENDATIONS

No water quality standard changes are recommended for Marsh Creek or the Lower Portneuf River. Both stream segments frequently exceed the allowable levels of fecal coliform bacteria. These problems are considered correctable and therefore a change in classification should not be considered.

Better land use and soil erosion control practices should be initiated in the Marsh Creek basin. In addition, all attempts to remove effluents from the Lower Portneuf River should be encouraged. This study has shown that certain effluents are degrading the river. If these effluents were recycled to land rather than into the river, an improvement in the river water quality would be realized.

More strict effluent limitations for total phosphorus and fecal coliform bacteria should be imposed on the phosphate industries. The explanation for the high fecal coliform densities is not apparent. However, in most instances spills rather than routine discharges cause the problems. More effective monitoring and enforcement of present and future NPDES permits would alleviate many of the problems.

The high Nitrate Nitrogen content of Batiste Spring water should be investigated. The spring water is much higher than adjacent river water and the spring water causes an increase in river Nitrate concentrations. These Nitrates will encourage nuisance plant growths and will accelerate eutrophication of American Falls Reservoir.

A recent effluent limitation evaluation on the Lower Portneuf River has indicated that ammonia toxicity in the area of the J.R. Simplot and City of Pocatello outfalls could be a problem. In any future study on the Lower Portneuf River, the effects of these two dischargers should be examined with respect to their discharge of ammonia and its toxicity to aquatic life.

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APPENDIX 1: GLOSSARY OF TERMS

Benthos: Organisms living on the bottom of a stream.

Bi-Weekly: Once every two weeks.

cfs: See "Cubic Feet Per Second."

Cubic Feet Per Second (cfs): An expression of discharge water passing a given point in one second. Also called "second-feet."

Cubic Meters Per Second (cms): A metric expression of discharge measurement. One cms equals 35.31 cubic feet per second (cfs).

Geometric Mean: The Nth root of the product of N numbers. Used as a way of calculating the mean of a series of numbers where the extremes vary widely from the mean. Also used for mean population levels of animals.

Hydrograph: A graph of the discharge of a river at several points over time.

Loadings: The weight of a concentration of a dissolved or suspended substance in water. Use of a loading calculation allows one to express the relative importance of water quality parameters in streams of various sizes.

m^3/sec. (cms): See "Cubic Meters Per Second."

mg/l: See "Milligrams Per Liter."

Milligrams Per Liter (mg/l): The number of milligrams (thousandths of a gram) of a substance in one liter of water equivalent to parts per million (ppm).

Macro-Benthos: See "Benthos."

Non-point Source: Pollutants entering a stream from a broad, poorly defined area. The contrast of a "Point Source" in which pollutants are discharged to a water body directly; e.g., through a pipe.

Point Source Discharge: A direct, discrete effluent to a water body. Also see "Non-point Source."

SAR: See "Sodium Absorption Ratio."

Sodium Absorption Ratio: The relation between sodium, calcium, and magnesium in a water body. Abnormally high sodium concentrations may be detrimental to plant growth. SAR's of less than 4.00 are not considered harmful.

<u>Water Quality Limiting</u>: A designation given a stream segment indicating that the segment will not meet water quality standards after implementation of "secondary treatment" for publicly-owned treatment works and "Best Available Treatment" for all other point source dischargers.

APPENDIX 2: FINAL STUDY PLAN OF PORTNEUF RIVER SURVEY

I. PURPOSE

Studies made by the EPA indicate that 75% of the phosphates found in the Snake River, as it enters the Milner Reservoir, come from the American Falls Reservoir and the Snake River drainage above this point. The American Falls Reservoir is highly nutritive and fish kills, resulting from the depletion of oxygen in the reservoir, have occurred.

From available information, it has been determined that the Portneuf River is one of the major contributors of nutrients to the reservoir. This river drains portions of the Western Phosphate Field which lies in southeastern Idaho. Other possible contributors of nutrients are:

Marsh Creek
The discharge from Inkom's sewage lagoon
Runoff and storm drainage from the City of Pocatello
The Union Pacific Railroad Company oil separation plant
The J. R. Simplot Company outfall (fertilizer plant)
FMC outfall (elemental phosphorus plant)
The discharge from Pocatello municipal waste treatment plant

II. OBJECTIVES

The objectives of the study are fourfold:

1. Determine the water quality of the Portneuf River.
2. Determine the nutrient load carried by the river.
3. Determine the contributions made by the sources mentioned.
4. Determine the effects of runoff into the Portneuf River from Pocatello.

Although these are the major objectives of the study, additional information can be gained concerning the oils entering the river by establishing one additional sampling point. This can be done by placing a sampling point above the Union Pacific Railroad oil separation plant. This sampling point will allow us to evaluate the significance of the oils contributed from surface and street runoff from that discharged by the Union Pacific Railroad Company oil separation plant. This would also help establish a baseline for future oil spills from any other sources.

III. SAMPLING STRATEGY

Samples will be collected bi-weekly for thirteen months. Sampling will begin in September 1975.

IV. STATIONS

The following is a list of stations, locations, and purpose of each.

Station	Location	Purpose
P1	Portneuf at Charolais Ranch, Marsh Creek	Determine background
P2	Marsh Creek - Mouth	Determine water quality
P3	Above Pocatello at Ross Park	Determine water quality prior to city plus the effect of Marsh Creek and Inkom
P4	Above UPRR oil separation plant	Determine oil prior to plant and effect of runoff
P5	Below UPRR plant and above industrial plant outfalls	Determine oil contributed to river and quality above industrial plants
P6	Below industrial outfalls and above Pocatello STP	Determine quality and combined effects of outfalls
P7	Below Pocatello STP and before entering American Falls	Determine effect of Pocatello STP and water quality of river
P8	Plant	Amount of oil
P9	FMC outfall	Determine nutrients and quality
P10	J.R. Simplot Company outfall	Determine nutrients and quality
P11	Pocatello STP outfall	Determine quality of effluent