Middle Snake River Water Quality
for
Snake River at Star Falls

Submitted to

B and C Energy

by

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INTRODUCTION

This report covers Snake River water quality data collected by the University of Idaho at Star Falls and Murtaugh Bridge located in the Middle Snake River reach. The Middle Snake River flows through an incised canyon from Milner Dam to King Hill. The present location and configuration of the river is the result of ancient canyon filling processes and erosion and sedimentation during the Pleistocene Bonneville flood (Malde, 1968). Star Falls and Murtaugh Bridge water quality stations are located in the upper portion of the middle Snake River reach near Murtaugh, Idaho. The purpose of the water quality study was to develop base line water quality data on the Middle Snake River at Star Falls to assist in evaluating the impact of a proposed hydropower facility by B and C Energy. Sampling was conducted from July 1991 to December 1991 on a biweeky basis for the Star Falls station. The Murtaugh Bridge station was sampled concurrently with the Star Falls station approximately four times to provide data for establishing a relationship between the two sites. In an earlier water quality study by the University of Idaho, the Murtaugh Bridge station was sampled on a biweekly basis for an entire year.

Water Quality Sampling Stations

The river was sampled at two locations: above Star Falls and Murtaugh Bridge. The Star Falls site is approximately two miles upstream of the Murtaugh Bridge site which was a water quality monitoring station for the Middle Snake River Water Quality Study conducted by the University of Idaho for the Department of Health and Welfare - Division of Environmental Quality (Brockway and Robison, 1992). The Star Falls station is located imediately upstream of Star Falls on the north bank at river mile 631.9 (USGS topographic maps). The elevation of the station was estimated to be 3925 ft. The latitude and longitude of the site was estimated to 42° 29' 44" north and 114° 07' 43" west from USGS topographic maps. The river was sampled at the narrow outlet of a natural pool upstream of the falls by throwing a bucket out into the main stream. The Murtaugh Bridge sampling location was imediately upstream of the confluence of Dry Creek with the Snake River at the end of a riffle section near Murtaugh Bridge (river mile 630.5). The site elevation was estimated from USGS topographic map for the area to be 3840 ft, and the latitude and longitude are 42° 29' 58" north and 114° 09' 06" west. Further information regarding the Murtaugh Bridge site is documented by Brockway and Robison, 1992.

PROCEDURES

Water Quality Parameters

The water quality parameter package for each station was the same as that for the DEQ study and consisted of seventeen parameters. The field parameters collected were:

Air Temperature	°C
Water Temperature	°C
Dissolved Oxygen	mg/l

Electrical Conductivity	µmho
pH	
Transparency, Secchi Disk	(feet)

The chemical, biological, and bacterial parameters were:

Total Suspended Solids	mg/l
Turbidity	NTU
Nitrogen as Ammonia	NH_3-N mg/l
Nitrogen as Nitrate and Nitrite	NO_2+NO_3-N mg/l
Total Kjeldahl Nitrogen	N mg/l
Total Phosphorus	P mg/l
Ortho Phosphate	PO_4-P mg/l
Fecal Coliform Bacteria	colonies/100 ml
Fecal Strep Bacteria	colonies/100 ml
Five day Biochemical Oxygen Demand	mg/l
Chlorophyll-A	µg/l

Sampling Equipment

The water quality data were collected using standard methods and procedures. Field parameters were measured with portable electronic instruments. These instruments were calibrated each morning of sampling according to the manufactors specfications. If a field observation appeared to be in error, the instrument was re-calibrated in the field using standard solutions and procedures. The electrical conductivity was measured with a Hanna Model 0661-30 DiST 3 ATC. This instrument has a range of 10 - 1990 µmhos with and accuracy of 30 µmhos. The field pH was measured using a Hanna Model 0624-00 pHep - pH dip stick. The instrument has a pH range of 0.0 to 14.0 with a resolution of 0.1 and an accuracy of 0.2. The dissolved oxygen was measured with a Hanna Model HI8543 Dissolved Oxygen wand. The wand has a range of 0.0 to 19.9 mg/l O_2 with a resolution of 0.1 mg/l. The temperatures were measured with electronic thermometers which were within 0.2 °C of a glass standard thermometer in laboratory tests. Samples for laboratory analysis were collected in 1 quart plastic cubicontainers, 15 ml tissue culture tubes (plastic), and 47 mm membrane filters.

Sampling Methods

The following procedures were used in collecting the water quality samples from each station. Upon arrival at each station, all sampling tools (buckets, dipper, churn, ...) were triple rinsed with water from the station downstream of the sampling point. After rinsing the equipment, water was collected by tossing a bucket attached to a rope into the middle of the river and retrieving the bucket through the water. The sample was placed in a 6 gallon churn splitter. A minimum of 3 to a maximum of 5 gallons of sample was obtained by throwing the bucket out repeatedly. The following procedures were performed by the sampling personnel:

Event	Description:
1.	Arrive at station, collect forms, sample containers, and tools.

2. Observe local weather conditions and environment.
3. Triple rinse all collection tools in typical water from stream downstream of sampling site.
4. Collect sample volume and place in churn.
5. Quickly churn sample and extract 1 liter for field parameters.
6. Churn sample and extract 250 ml bacteria sample.
7. Churn sample and extract 1 liter TSS and turbidity sample.
8. Churn sample and extract 1 liter Nitrogen series sample.
9. Churn sample, extract, and filter ortho phosphate sample.
10. Churn sample and extract biological oxygen demand sample.
11. Churn sample and extract chlorophyll-A sample for filtration at center.
12. Record field instrument readings.
13. Record all sample container numbers.
14. Place sample containers on ice in cooler.
15. Collect and store sampling equipment, make log book entries.

Sample Handling and Laboratory Analysis

After collection, the samples were placed on ice in coolers. Upon arrival at the research center, the samples were removed from the coolers, checked in, and transferred to shipping coolers packed with fresh ice. The Chlorophyll-A samples were filtered and the filter paper with volume filtered where placed in a 60 mm petri dish, which was wrapped with aluminum foil. The samples were shipped via courier to the Idaho Department of Health and Welfare Bureau of Laboratories for analysis. The laboratory analysis codes and minimum detection levels are shown in Table 1. The minimum detection level of Chlorophyll-A is dependent on the filtered sample volume.

Table 1. Laboratory Water Quality Analyses

Analysis	STORET Analysis Code	Minimum Detection Level
Total Suspended Solids	00530	2.0 mg/l
Turbidity	00076	0.1 NTU
Ammonia Nitrogen	00610	0.005 mg-N/l
Nitrate+Nitrite Nitrogen	00630	0.005 mg-N/l
Total Kjeldahl Nitrogen	00625	0.05 mg-N/l
Total Phosphorus	00665	0.05 mg-P/l
Ortho Phosphate	70507	0.005 mg-P/l
BOD_5	00310	
Chlorophyll-A	32211	0.4 µg/(filtered volume)
Fecal Coliform Bacteria	31616	
Fecal Strep Bacteria	31679	

Data Analysis Procedures

Field data, sample container numbers, and comments recorded on the field data sheets (and log books) were entered into a relational data base the day following sampling. After

receipt of the laboratory analysis data, the data was also entered into the relational data base. In addition to several scans by project personnel for keyboard errors during data entry, the data were examined for outliers using Chauvenet's outlier procedure (Kennedy, 1976). The data points identified were again reviewed with the field sheets and laboratory analysis reports and rejected or retained.

Quality Control and Assurance

For this survey no water quality sampling quality control and assurance procedures were implemented. The Middle Snake Water Quality Project - Phase 1 project was still in progress at the time. Identical sampling procedures and methods were used for this project; therefore, it was assumed that those quality control and assurance program results would be transferable to this survey. In the Mid Snake River Water Qaulity Project four sampling stations served as control stations. Blank, duplicate, spiked samples were taken and analyized. The quality control and assurance program results are summaried in the following table 2.

Table 2. Mid Snake Water Quality Survey Quality Control and Assurance Sampling Results (Brockway and Robison, 1992)

Parameter	Duplicate Samples Relative Range	Spiked Samples Percent Recovery
Total Suspended Solids	17.7	97.1
Turbidity	12.5	-NA-
Ammonia Nitrogen	25.9	97.1
Nitrate+Nitrite Nitrogen	4.7	94.0
Total Kjedahl Nitrogen	18.0	92.2
Ortho Phosphate	10.6	98.3
Total Phosphorus	15.4	95.0
Biochemical Oxygen Demand	21.9	-NA-
Chlorophyll - A	39.4	-NA-

RESULTS

Snake River above Star Falls

The water quality data for Snake River above Star Falls is shown in Table 4 for the 11 observations from July to December 1991. Water temperature ranged from 2.5°C to 23.0°C for the six month period. Dissolved oxygen during midmorning to late afternoon ranged from 6.5 to 10.7 mg/l for the six month period. Average nitrogen levels were 0.06, 0.38, and 0.74 mg/l-N for Ammonia, Total Kjeldhal, and Nitrate+Nitrite forms, respectively. Ortho-phosphate and total phosphorus levels averaged 0.13 and 0.17 mg/l-P respectively. Chlorophyll-A measured at the station range from 1.5 to 31.6 µg/l.

Snake River near Murtaugh Bridge

The water quality data for Murtaugh Bridge is shown in Table 5 for the period from June 1991 to December 1991. Similar ranges for the various parameters were seen at this site as for the Star Falls site. Daytime dissolved oxygen was 0.6 mg/l higher to 1.2 mg/l lower than those measured at Star Falls. Water temperatures at Murtaugh Bridge were always lower than Star Falls by an average of 0.3°C. With the exception of Total Kjeldhal Nitrogen, nutrient and chlorophyll-A levels between the stations are highly correlated. The R-squared value between stations for the nutrient and Chlorophyll-A observations were are shown in Table 3.

Table 3. Star Falls vs Murtaugh Bridge R2 values

Ammonia N	0.99
Total Kjeldahl N	0.28
Nitrate+Nitrite N	1.00
Ortho Phosphate P	1.00
Total Phosphate P	0.95

Figures 1 through 11 show the graphical relationship between nutrients and other parameters at the two stations.

Snake River Discharge

During the sampling period, 9/13/91, the discharge of the Snake River between the two station was measured using current meter methods and determined to be 213 cfs. This compared with a measured discharge of 213 cfs at Milner gage (river mile 638.7) approximately 7 miles upstream of Star Falls.

Table 4. Measured Water Quality for Star Falls Monitoring Station (IS00S).

Date	Temperature Air °C	Temperature Water °C	Secchi Disk Transparancy ft	pH	Electrical Conductivity umho/cm	Dissolved Oxygen ppm	BOD 5 - Day mg/l	Non-Filterable Residue mg/l	Turbidity NTU	Total Ammonia mg/l-N	Nitrogen Total Kjeldhal mg/l-N	Total NO2+NO3 mg/l-N	Ortho Phosphate mg/l-P	Total Phosphorus mg/l-P	Fecal Bacteria Coliform #/100ml	Fecal Bacteria Strep #/100ml	Chlorophyll A ug/l
7/17/91	22.1	22.0	3.0	8.3	380	7.4	2.2	10	5.0	0.096	0.31	0.19	0.054	0.10	5	21	9.3
7/31/91	24.5	22.2	3.9	8.3	380	6.7	1.2	9	4.0	0.058	0.34	0.17	0.064	0.11	5	3	6.1
8/14/91	29.6	23.0	3.0	8.5	420	6.5	2.0	13	6.5	0.063	0.70	0.21	0.104	0.12	2	32	18.8
8/28/91	24.9	21.4	4.0	8.4	440	7.2	2.0	10	3.0	0.086	0.38	0.45	0.108	0.12	18	18	10.3
9/11/91	15.3	18.7	4.0	8.7	450	8.5	2.0	1	3.0	0.060	0.29	0.51	0.109	0.12	18	18	6.1
9/25/91	30.0	17.1	4.0	8.6	460	9.5	2.0	10	4.0	0.034	0.40	0.64	0.110	0.14	<1	2	15.8
10/9/91	16.7	12.8	2.7	8.4	550	10.7	4.0	8	5.0	0.060	1.10	0.44	0.020	0.15	<1	4E	31.6
10/23/91	8.0	10.0	2.9	8.6	480	10.2	2.0	9	6.0	0.063	0.41	0.83	0.107	0.13	1	13	10.8
11/6/91	13.0	3.5	3.7	8.5	550	10.5	3.0	6	4.0	0.040	0.13	1.45	0.256	0.22	<1	5	10.1
11/20/91	7.0	5.4	3.5	8.3	560	10.5	2.0	4	4.0	0.046	0.10	1.43	0.208	0.24	15E	7E	4.8
12/4/91	3.9	2.5	4.2	8.3	560	10.5	2.5	5	5.0	<0.005	0.38	1.82	0.260	0.29	1E	30	1.5
Average	17.7	14.4	3.5	8.4	475	8.9	2.3	8	4.5	0.055	0.41	0.74	0.127	0.16	8	16	11.4
Minimum	3.9	2.5	2.7	8.3	380	6.5	1.2	1	3.0	<0.005	0.10	0.17	0.020	0.10	<1	2	1.5
Maximum	30.0	23.0	4.2	8.7	560	10.7	4.0	13	6.5	0.096	1.10	1.82	0.260	0.29	18	32	31.6

Table 5. Measured Water Quality for Murtaugh Bridge Monitoring Station (IS01S).

Date	Temperature Air °C	Temperature Water °C	Secchi Disk Transparancy ft	pH	Electrical Conductivity umho/cm	Dissolved Oxygen ppm	BOD 5 - Day mg/l	Non-Filterable Residue mg/l	Turbidity NTU	Total Ammonia mg/l-N	Nitrogen Total Kjeldhal mg/l-N	Total NO2+NO3 mg/l-N	Ortho Phosphate mg/l-P	Total Phosphorus mg/l-P	Fecal Bacteria Coliform #/100ml	Fecal Bacteria Strep #/100ml	Chlorophyll A ug/l
7/17/91	22.2	21.8	3.0	8.3	380	7.7	2.0	13	5.0	0.113	0.36	0.21	0.051	0.09	7	29	6.4
8/28/91	23.4	21.0	2.0	8.5	450	7.8	2.0	10	4.0	0.090	0.36	0.51	0.112	0.13	8	37	5.9
9/11/91	15.1	18.2	2.0	8.7	450	8.3	2.0	5	4.0	0.066	0.44	0.60	0.107	0.16	11	65	4.5
12/4/91	2.6	2.3	3.0	7.8	570	10.6	3.0	5	3.0	0.003	0.39	1.77	0.250	0.26	1	30	1.1
Average	15.8	15.8	2.5	8.3	463	8.6	2.3	8	4.0	0.068	0.39	0.77	0.130	0.16	7	40	4.5
Minimum	2.6	2.3	2.0	7.8	380	7.7	2.0	5	3.0	0.003	0.36	0.21	0.051	0.09	1	29	1.1
Maximum	23.4	21.8	3.0	8.7	570	10.6	3.0	13	5.0	0.113	0.44	1.77	0.250	0.26	11	65	6.4

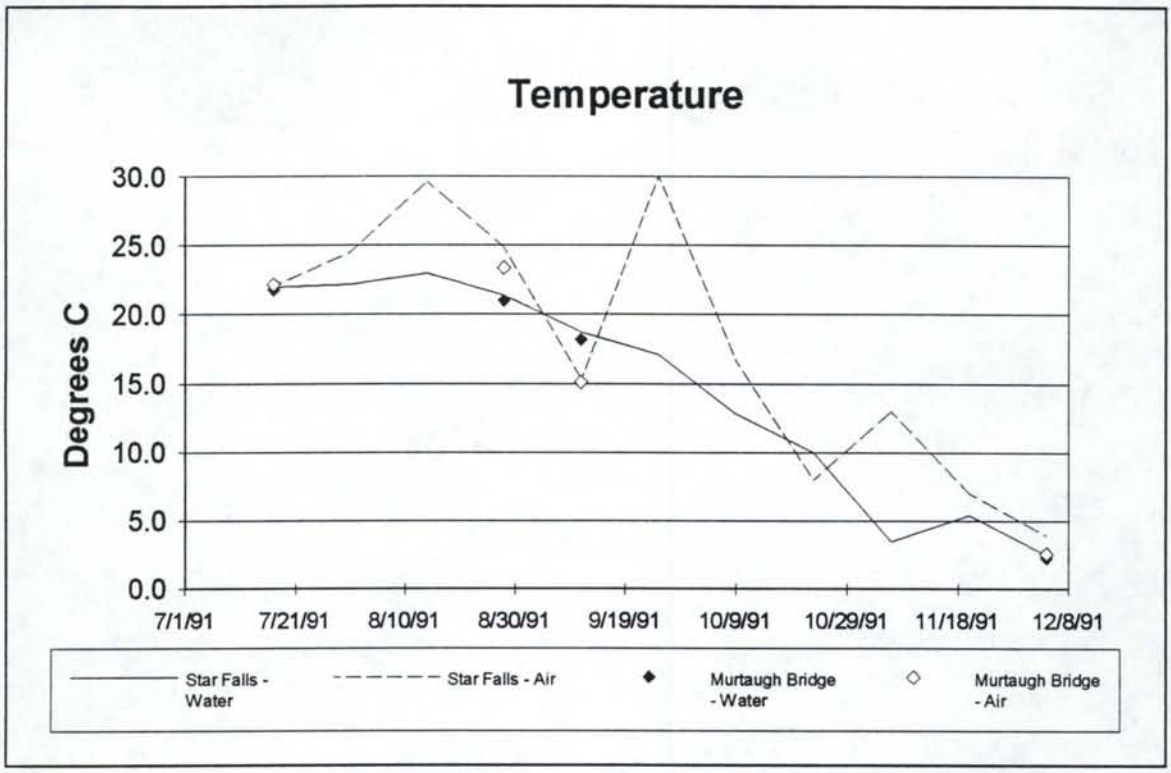

Figure 1. Air and Water Temperatures at Star Falls and Murtaugh Bridge

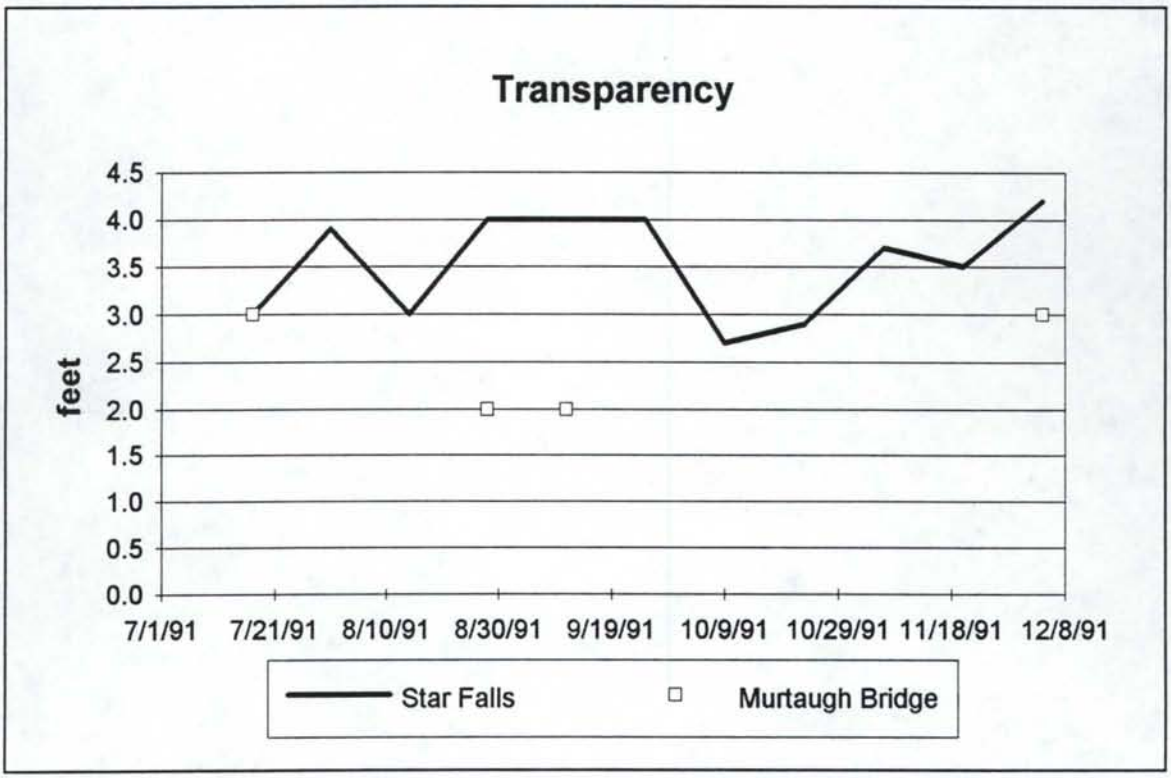

Figure 2. Water Transparency at Star Falls and Murtaugh Bridge.

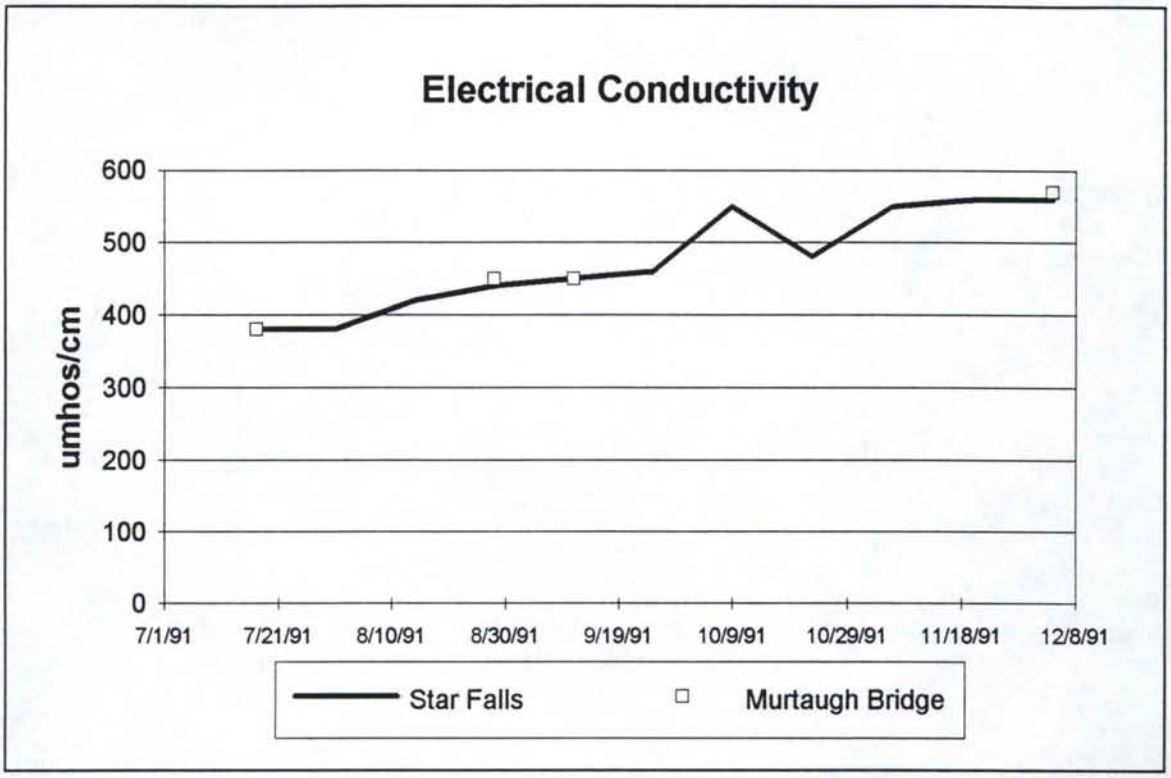

Figure 3. Electrical Conductivity at Star Falls and Murtaugh Bridge.

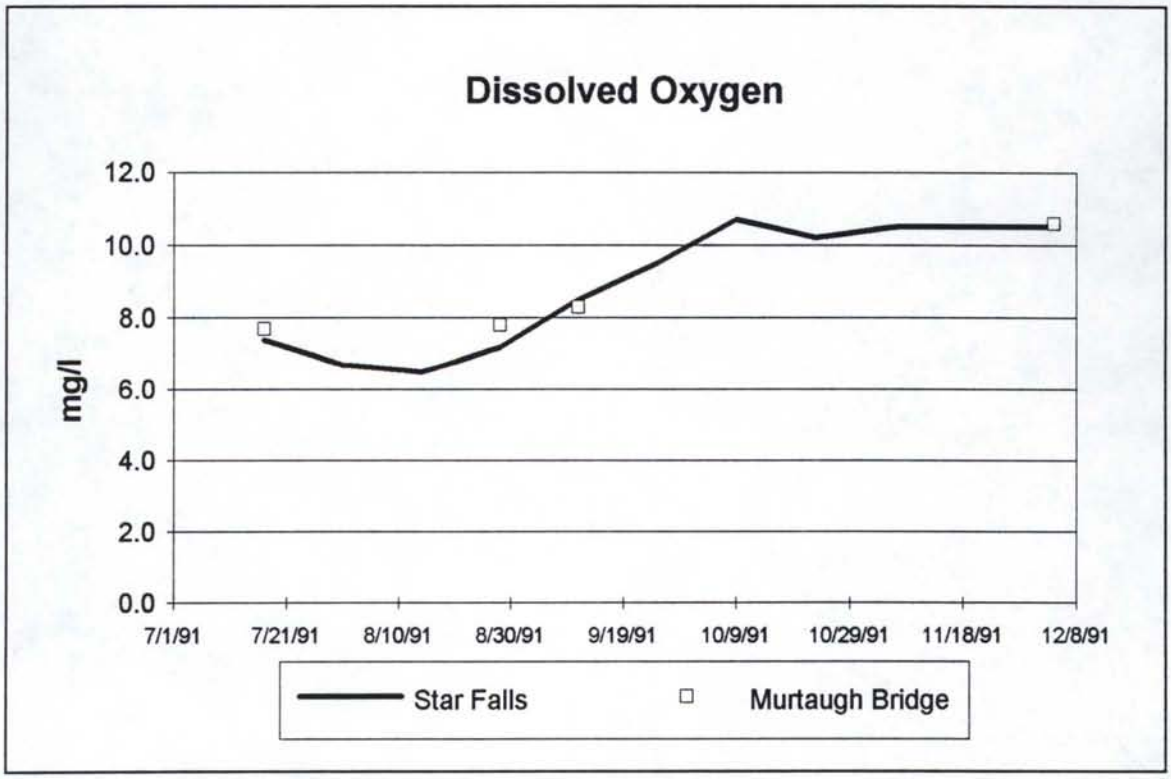

Figure 4. Dissolved Qxygen at Star Falls and Murtaugh Bridge.

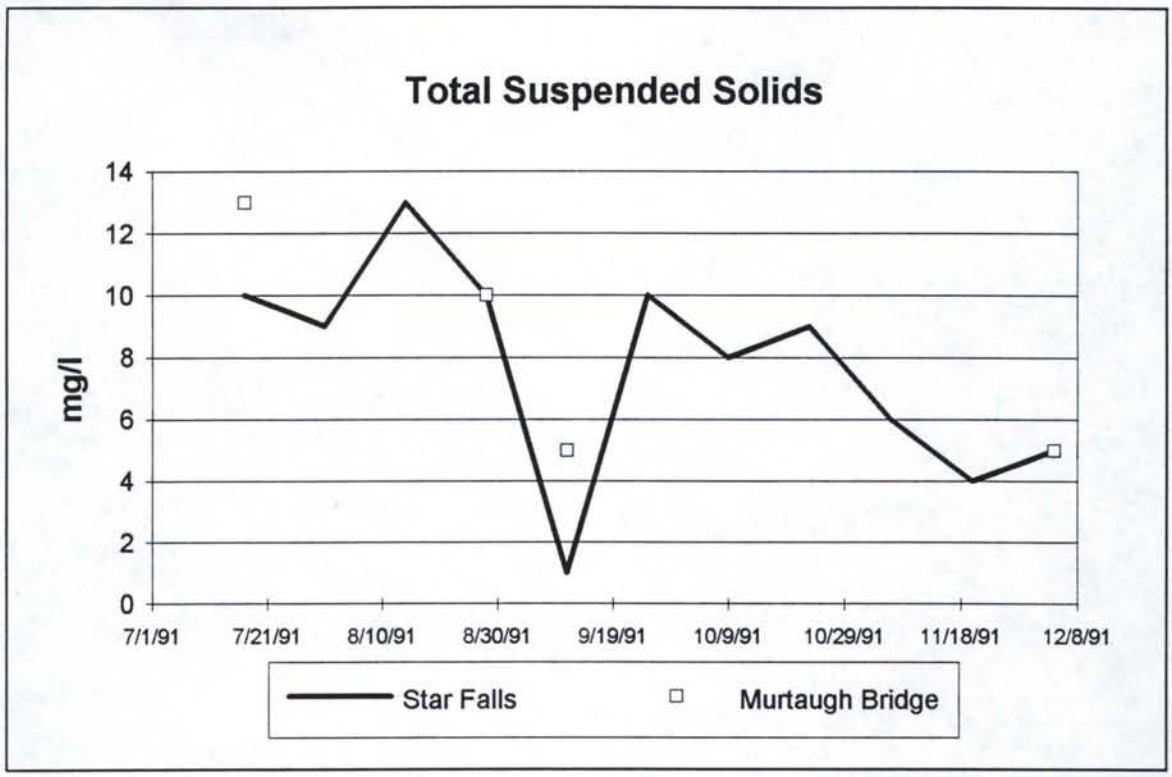

Figure 5. Total Suspended Solids at Star Falls and Murtaugh Bridge

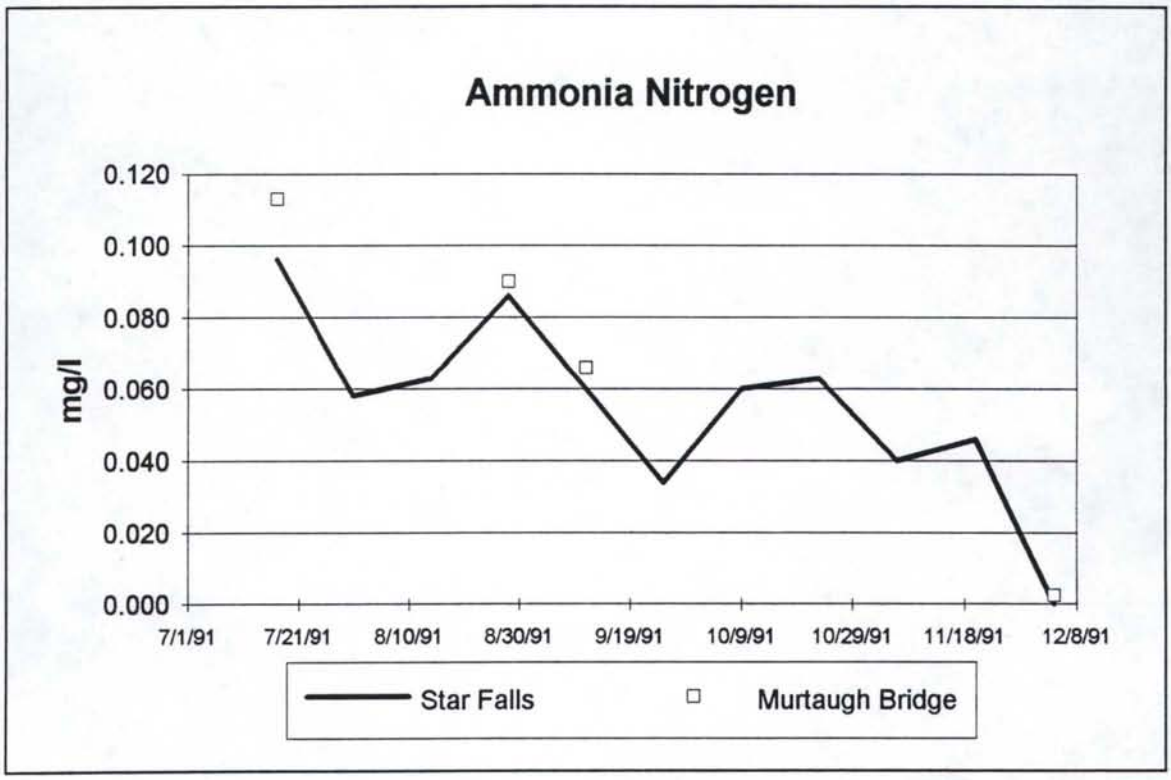

Figure 6. Ammonia Nitrogen at Star Falls and Murtaugh Bridge.

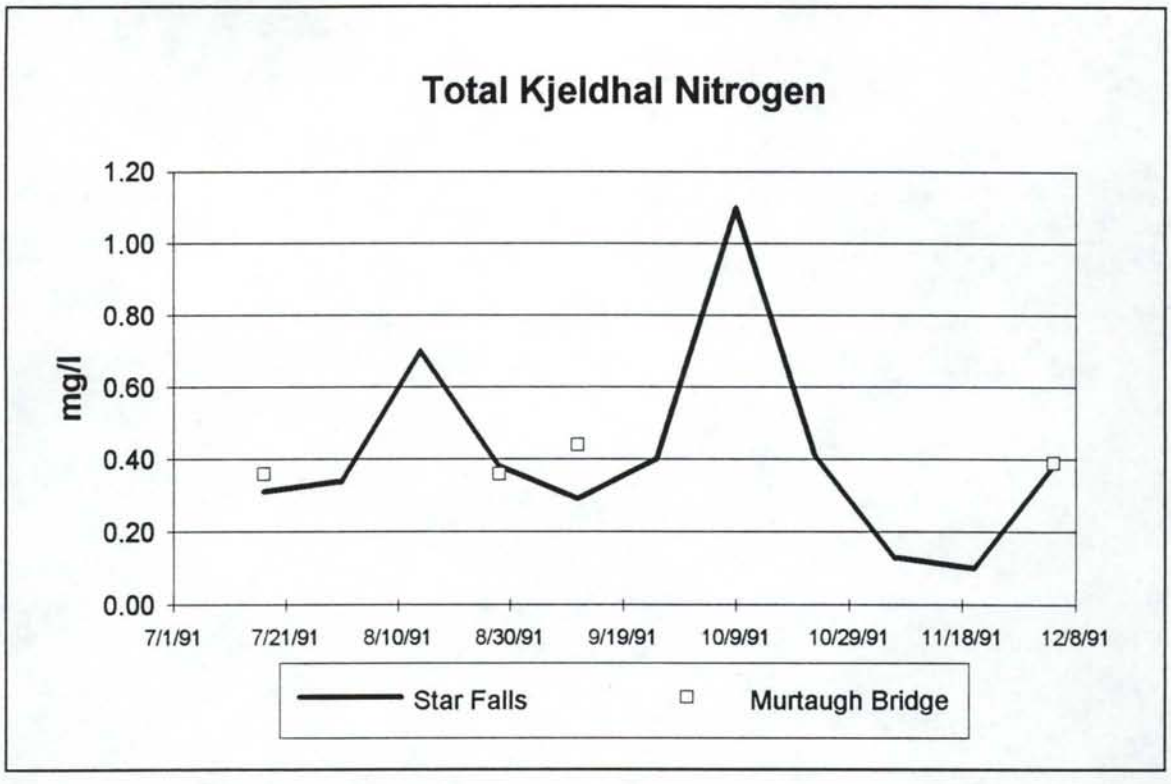

Figure 7. Total Kjeldhal Nitrogen at Star Falls and Murtaugh Bridge.

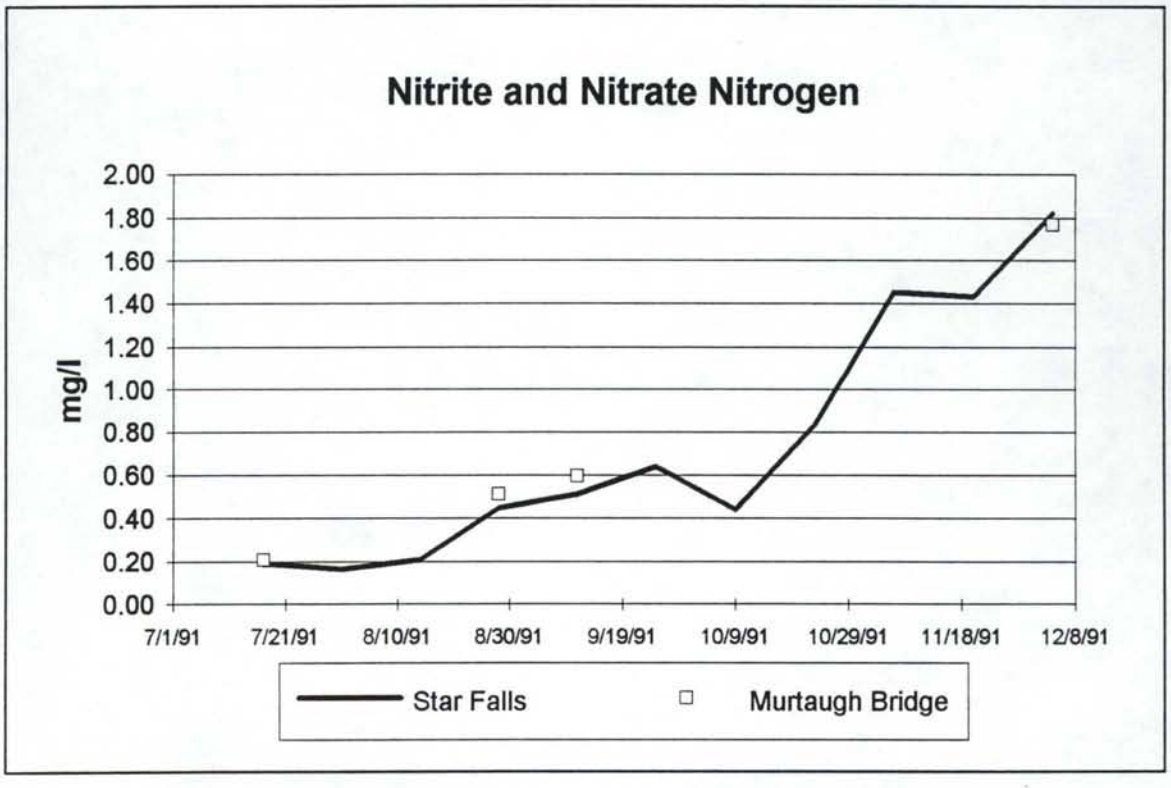

Figure 8. Nitrate+Nitrite Nitrogen at Star Falls and Murtaugh Bridge.

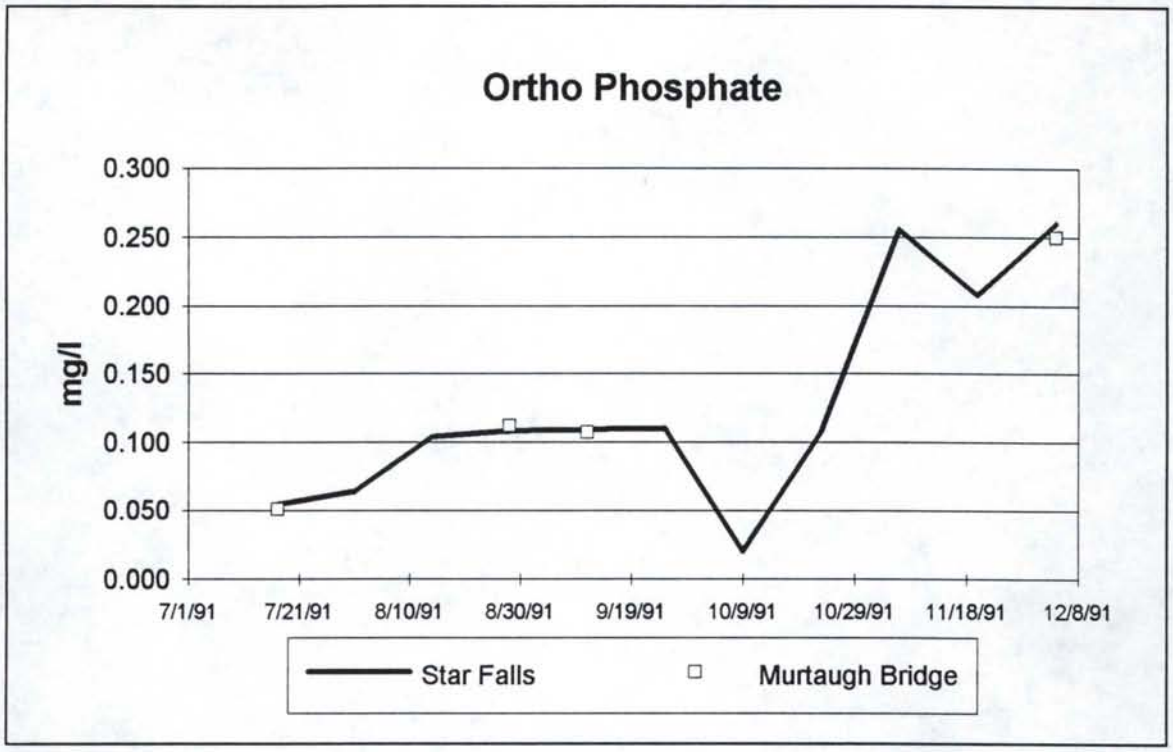

Figure 9. Ortho Phosphate at Star Falls and Murtaugh Bridge.

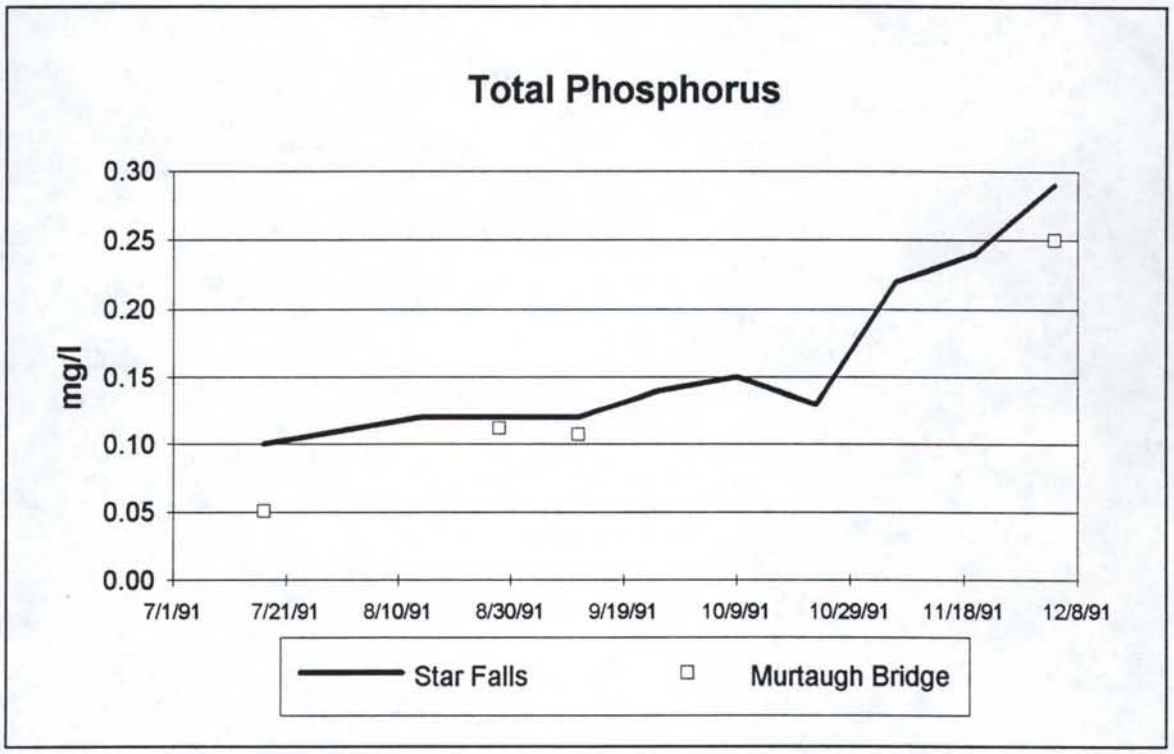

Figure 10. Total Phosphorus at Star Falls and Murtaugh Bridge.

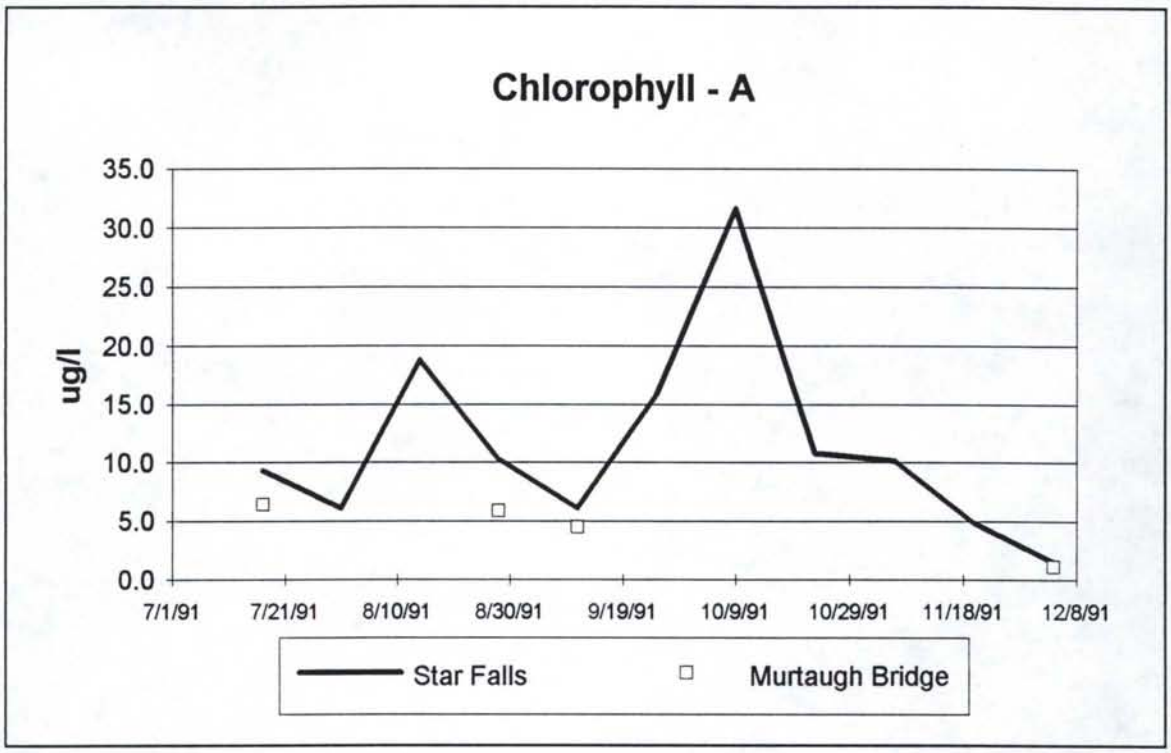

Figure 11. Chlorophyll-A at Star Falls and Murtaugh Bridge.

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