WATER QUALITY STATUS REPORT ● REPORT NO. 68

JIM FORD CREEK
Clearwater County, Idaho
1987

Prepared by
Ramon Latham

Lewiston Field Office
1118 F. Street
Lewiston, Idaho 83501

Department of Health & Welfare
Division of Environment
Boise, Idaho

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METHODS AND MATERIALS

The purpose of the water quality study was to: 1) assess the impact of the City of Weippe municipal effluent on the water quality of Jim Ford Creek during low flow; 2) determine if the recommended NPDES average monthly discharge limitations of 45 mg/l for BOD, and 70 mg/l for suspended solids would impair the beneficial uses of Jim Ford Creek.

Sample Collection

Methods of sample collection, preservation and analysis followed Standard Methods (APHA, 1985), or EPA guidelines (EPA, 1979). Grab samples were obtained from approximately 0.6 times the stream depth. Samples from the standing pool at St. #1 were collected from the upstream edge of the pool. Effluent samples were collected in a bucket at the lagoon outfall, and the in-situ parameters were monitored from the bucket at this site. Duplicate grab samples from St.#1 and St.#5 were submitted for quality control analysis. Data from these samples were averaged with the regular samples.

Sample Sites

The locations of sampling sites were the same as for the 1979 study, except for the deletion of a site at the mouth of Jim Ford Creek (Table 2).

Parameters

The monitored parameters reflect the water quality limitations necessary to protect the designated and existing beneficial uses of Jim Ford Creek, and assess the impact of the effluent on these uses (Table 3).

The parameters monitored in-situ were: 1) discharge using a Marsh-McBirney model 201 current meter for the stream, and a 2.5 gallon bucket with a stopwatch for the effluent; 2) electrical conductance and temperature using a YSI model 33 S-C-T meter; 3) dissolved oxygen using a YSI model 43A meter; 4) pH was determined with a Corning model 103 pH meter.

The bacteria and BOD_5 samples were submitted to the State of Idaho Bureau of Laboratories in Lewiston for analysis. The suspended solids, total phosphorus, total Kjeldahl nitrogen and total ammonia samples were preserved appropriately and shipped to the Bureau of Laboratories in Boise for analysis.

Quality Assurance

Duplicate grab samples were submitted for analysis of precision and accuracy of sampling and analytical techniques. Five duplicate sets were collected at St. #1 and

TABLE 2. Survey Station Sites on Jim Ford Creek

Station	Description	STORET
1	Jim Ford Cr. at Highway #7 (above outfall)	2020160
2	Weippe Municipal Lagoon Outfall	2020159
3	Jim Ford Creek (below outfall)	2020158
4	Grasshopper Creek above Lagoons (1/3 mile above mouth)	2020157
5	Jim Ford Creek 1/3 mile below Confluence with Grasshopper Creek	2020156

TABLE 3. Sample Parameters

Parameter	Units	STORET
Discharge	cfs	00061
Water Temperature	°C	00010
Dissolved Oxygen (DO)	mg/l	00300
Electrical Conductivity	µmhos/cm	00095
pH	S.U.	00400
Biochemical Oxygen Demand (BOD_5)	mg/l	00310
Suspended Solids (SS)	mg/l	00530
Total Phosphorus (TP)	mg/l	00665
Total Kjeldahl Nitrogen (TKN)	mg/l	00625
Total Ammonia (NH3)	mg/l	00610
Fecal Coliform	#/100 ml	31616

three sets were taken at St. #5. Two additional duplicate samples from St. #5 were spiked with known quantities of total phosphorus, suspended solids, TKN, and ammonia. The methods of data analysis for quality assurance followed the DOE guidelines (Bauer, 1986).

RESULTS AND DISCUSSION

Sampling began on June 10, 1986 to characterize the stream during the moderate to low flow periods, typical during the late spring, fall and winter months. Periodic sampling, at two-week intervals, commenced on July 15, and ended on September 9, 1986. A total of 6 sample sets were collected from the Jim Ford Creek stations and the City of Weippe treatment lagoon outfall (Appendix A1-5). Grasshopper Creek was sampled a total of four times, until August 12, 1986.

Discharge

A record of the stream flows above the lagoon outfall and the discharge volumes from the lagoon are recorded once a month, averaged, and submitted quarterly in Discharge Monitoring Reports (DMR's). The NPDES file for Weippe contains DMR's from 1979 to present. The records do not reflect the flow extremes which occur in Jim Ford Creek. The average quarterly reported discharges from the lagoon were greatest from the period of January through March and the least during the summer months from July to September (Table 4).

Jim Ford Creek is subject to large fluctuations in flow. The 1980 IDHW/DOE study on Jim Ford Creek recorded a discharge of 160 cfs near Weippe, on March 3, 1979 (IDHW/DOE, 1980). The peak discharge estimated for the proposed hydroelectric diversion point near St.#5 below Weippe, is 209 cfs with a 5% chance of exceedance (O'Neal, 1986). The mean monthly flow estimates of Jim Ford Creek, prepared for the hydroelectric facility, seem to be overly optimistic for a continuous summer flow, but the hydrograph is helpful in identifying periods of minimum and maximum flows (Figure 2). Periods of minimal flow, less than 1 cfs, typically occur from mid-July through September.

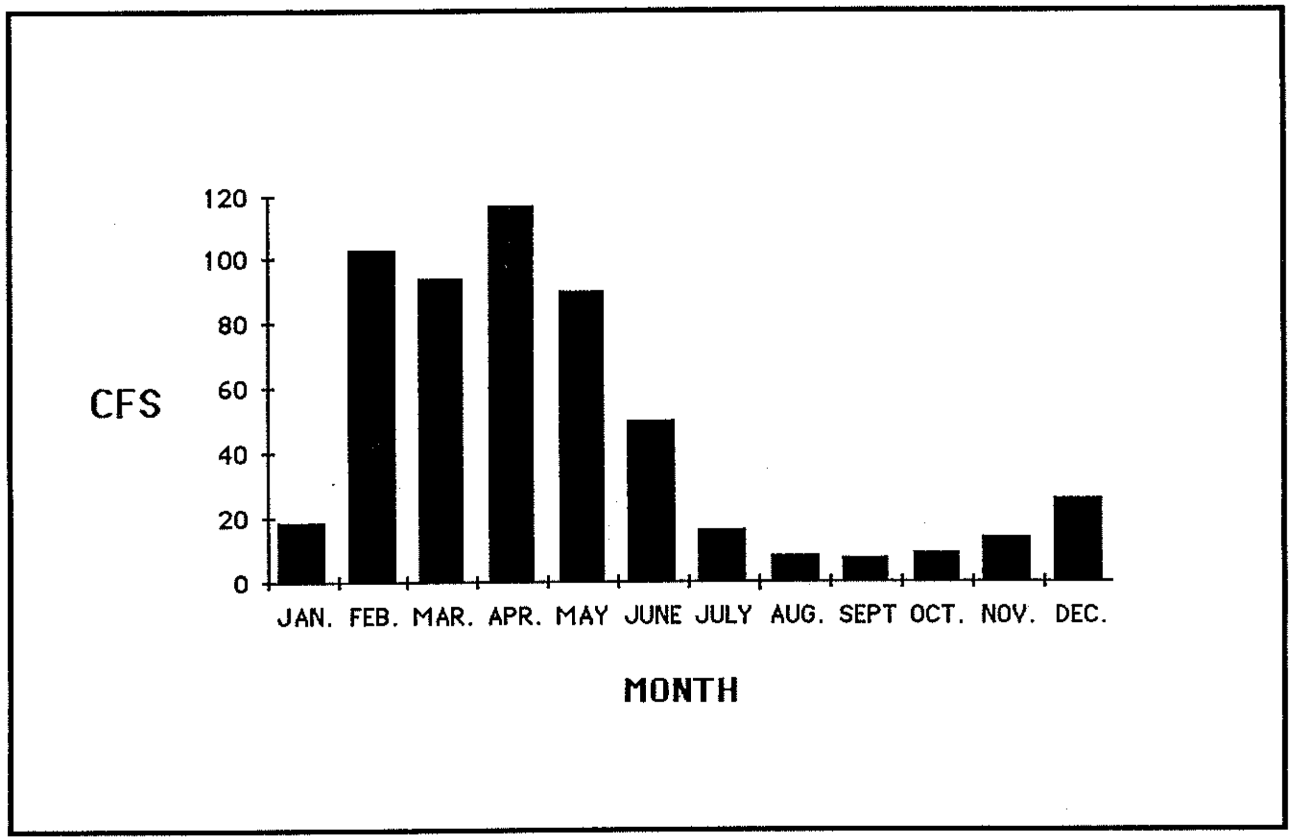
Stream discharges during the study exhibited the intermittent nature of the stream at Weippe (Appendix A1-5). On the first sampling date, June 10, 1986, the stream flow was 2.9 cubic feet per second (cfs) at St.#1 above Weippe. This was the only monitoring date during the study where the effluent dilution ration approached 50:1. By July 15th the stream flow was reduced to less than 0.1 cfs above Weippe and 0.2 cfs at St.#5, below Weippe. Two weeks later there was no surface flow above Weippe and there was less than 0.1 cfs below the lagoon discharge. Subsurface flows may continue through the period of no apparent surface flow, as evidenced by the constant size of the standing pools at St.#1 above Weippe, and at the lagoon discharge.

TABLE 4. Quarterly Mean Discharges of the Weippe Municipal Lagoon. (mgd)*

Year	Jan.-Mar.	April-June	July-Sept.	Oct.-Dec.
1979	-----	-----	0.02	0.07
1980	0.20	0.17	0.06	0.07
1981	0.4	0.102	0.069	0.132
1982	0.56	0.15	0.00	0.31
1983	0.45	0.06	0.09	0.25
1984	0.841	0.42	0.13	0.06
1985	0.686	0.20	0.086	0.065
1986	0.57	0.17	------	------
Mean	0.53	0.18	0.06	0.14

*NPDES # ID-002035-4

FIGURE 2. ESTIMATED MONTHLY FLOW REGIME OF JIM FORD CREEK *



* ADAPTED FROM O'NEAL, 1986

Flows in Grasshopper Creek, St. #4, during the study ranged from 1.5 cfs on June 10th to no flow by July 29th. There is no potential for dilution of the effluent by surface flows from Grasshopper Creek during the period of no flow.

The discharge from the lagoon is controlled by a weir structure utilizing drop boards to adjust flow. There had been no control of the discharges since July of 1986. The City of Weippe wastewater lagoon discharge (St.#2) fluctuated between 0.04 - 0.06 cfs (0.026 - 0.039 mgd) during the study. The wastewater discharge provided the majority of the flow exhibited below the discharge point during the periods of minimal stream flow.

A large standing pool is present in the stream bed at the lagoon discharge point. This pool provides some initial dilution of the effluent. A temporary road fill to provide access to a gravel pit was constructed across Jim Ford Creek at the head of the pool. No culvert was installed, but large fill material allowed water to filter through. No pooling was observed above the fill, and the pool by the lagoon discharge did not appear to decrease in size. The road was removed two weeks after construction and the channel was graded back to the original configuration.

Fluorescein™ dye was introduced into the stream at the lagoon outfall, St.#2, to assess the effluent mixing zone. Visual observation of the dye at St.#3, approximately 100 ft. downstream confirmed that complete mixing of the effluent with the stream water occurred by St.#3, when flows were less than 3.0 cfs. Therefore grab samples taken at St.#3 were considered to reflect the influence of the discharge.

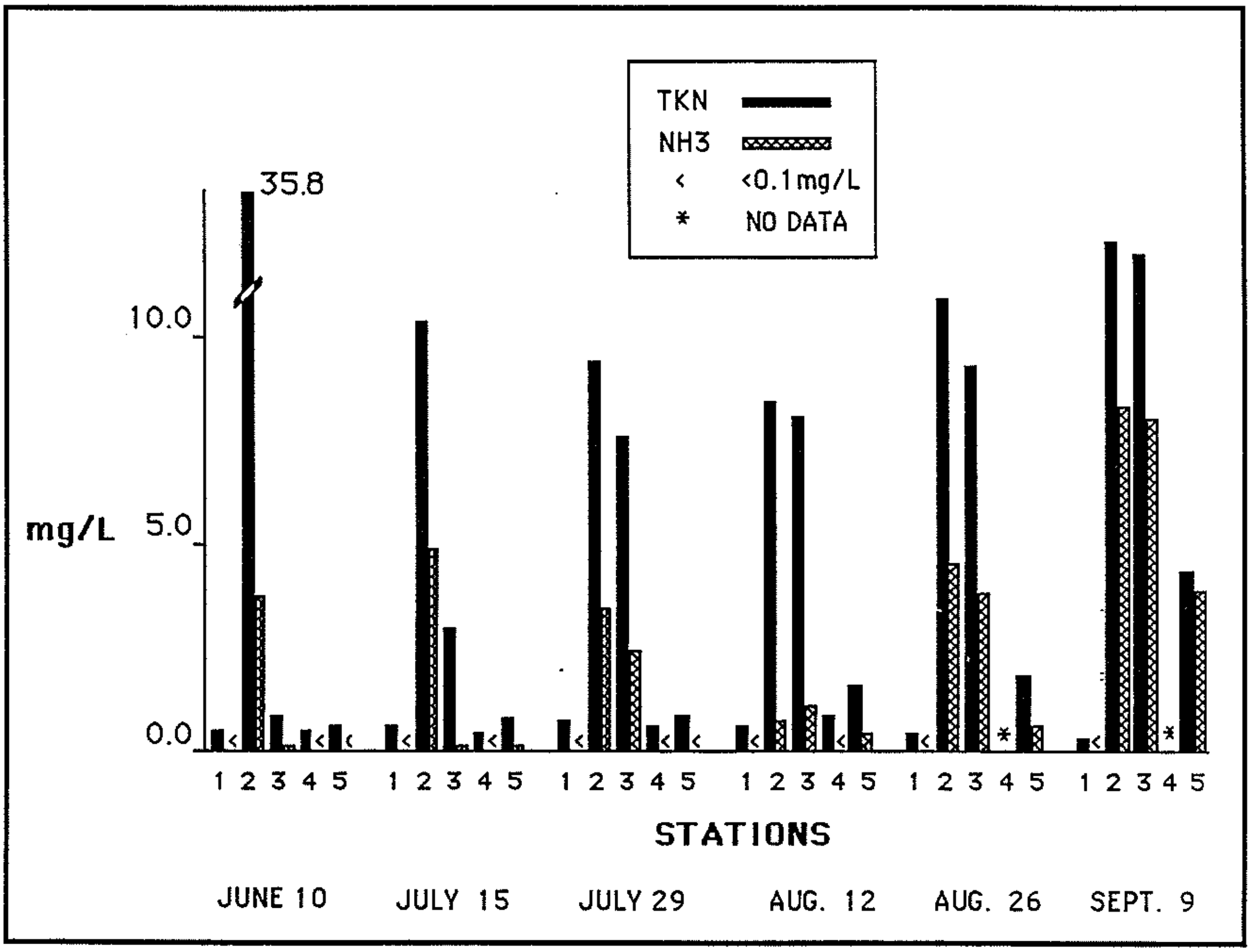
Nutrients

The Weippe wastewater lagoon effluent is the primary source of flow for Jim Ford Creek during the dry summer months. As such the effluent's characteristics impact the water quality of Jim Ford Creek at the point of discharge. The presence of a nuisance algal growth and an odor below the discharge are evidence of a condition of eutrophy in the stream brought about by the excessive nutrients provided by the lagoon.

The concentrations of nutrients from the effluent were reduced at each subsequent monitoring station downstream (Figures 3-5). The lack of a diluting source below St.#3 leads to the conclusion that this reduction is the result of biological activities which utilize the available nutrients.

The rate at which the stream is able to utilize the nutrients declined during the length of the study, as evidenced by the increasing nutrient concentrations at St.#5 (Figures 3 & 5). The BOD concentrations contributed by the effluent discharge increased the oxygen demand in the stream. The level of biological activity, coupled with a lack of oxygen in the stream could not utilize the increased nutrient loadings from the lagoons. This resulted in an increased BOD_5, increase of total Kjeldahl nitrogen, and total ammonia concentrations downstream.

FIGURE 3. Concentrations of Nitrogen in Jim Ford Creek, Summer of 1986.



STATION LOCATIONS

1. Jim Ford Creek, above the City of Weippe.
2. Wastewater treatment lagoon effluent.
3. Jim Ford Creek, 100 ft below effluent discharge.
4. Grasshopper Creek, 1/3 mile from mouth.
5. Jim Ford Creek, 1/3 mile downstream of effluent discharge.

FIGURE 4. Total Phosphorus Concentrations, Summer of 1986
Station locations same as Figure #3

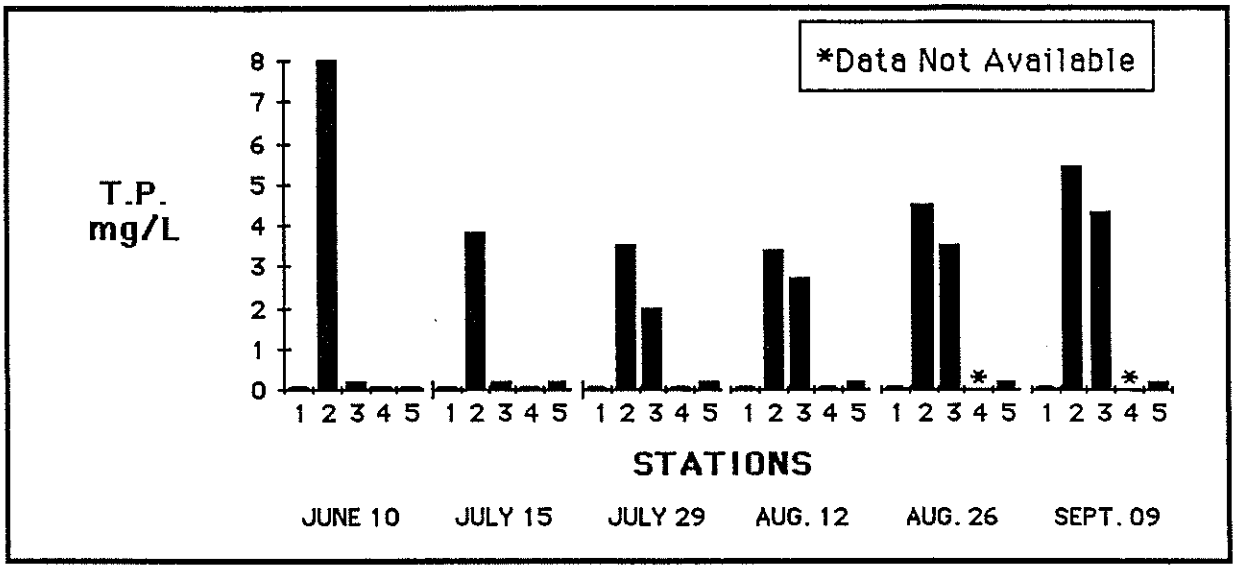
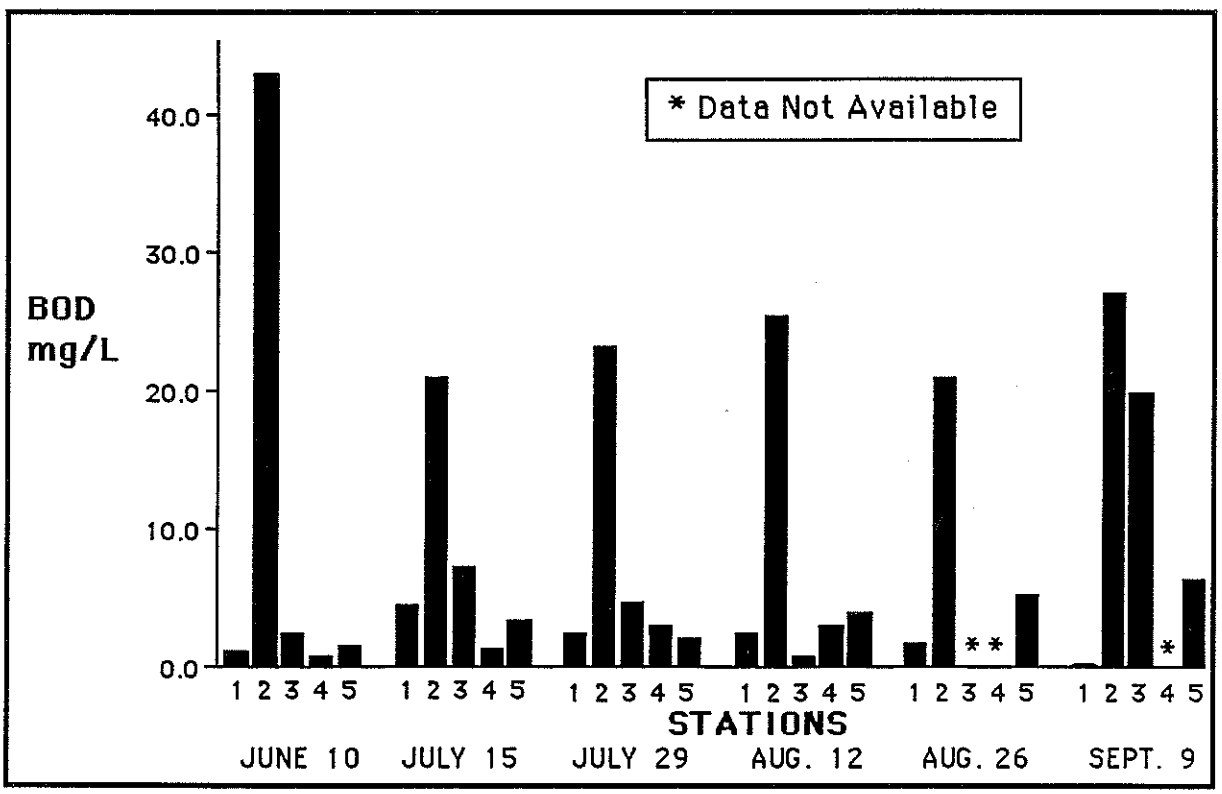


FIGURE 5. Biochemical Oxygen Demand, Summer of 1986
Station locations same as Figure #3



Total Kjeldahl Nitrogen (TKN)

Nitrogen is a basic element necessary for biological production and may occur in water in several oxidative states. Total Kjeldahl nitrogen (TKN) is the analytical method used to detect organic nitrogen and ammonia. Elevated concentrations of TKN are used to indicate contamination by sewage or organic waste in an aquatic system. Most forms of nitrogen are biologically interconvertible (APHA,1986).

TKN concentrations at St.#1, above Weippe, had a mean of 0.51 mg/l ± s.d.= 0.15 mg/l (Appendices A1-5). Grasshopper Creek,#4, had similar concentrations with a mean of 0.58 mg/l ± s.d.= 0.19 mg/l. The effluent from the treatment lagoons was rich in Kjeldahl nitrogen, with a mean of 14.6 mg/l ± s.d.=10.5 mg/l. The effluent increased the levels at St. #3, below the discharge, to 6.8 mg/l ± s.d. = 4.1 mg/l. The mean TKN concentration at the lowest station (#5) was over three times greater than the mean concentration sampled above the effluent point, 1.68 mg/l ± s.d.=1.40 mg/l.

The lagoon added between 2.3 - 4.4 lbs/day of total Kjeldahl nitrogen to the stream. Sixty two percent of it was organic nitrogen and 38% was as ammonia. The nitrogen loads in the stream below the outfall at St.#3 were 1.6 - 6.5 lb/day during minimal flows. The nitrogen loads at St.#3 were reduced an average of 24% by St.#5, 1/3 mile downstream. The stream at St.#5 showed a net gain of 7 times the TKN load exhibited above the outfall.

The total Kjeldahl nitrogen load at St.#3 below the discharge increased on each sample date in response to the increasing concentration contributed by the effluent (Figure 3). The length of the affected stream section observed can be expected to extend downstream as TKN loads increase.

Ammonia (NH_3)

The IDHW/DOE 1987 revised standard for the allowable concentration of total ammonia to protect salmonids and cold water biota is pH and temperature sensitive. A chart is provided in the standards to calculate the allowable concentration (IDHW/DOE, 1980). The EPA's ambient water quality criteria for ammonia, 1985, is to be used when the parameters fall outside the IDHW/DOE listed ranges. The EPA chart for one hour average concentrations was used to characterize the grab samples. A "worst case" scenario was assumed by over-estimating the temperature to the next greatest 5°C and pH to the next higher 0.5 su. Under these stipulations the total ammonia concentrations did not exceed the one-hour exposure criteria for salmonids and cold water biota.

Total ammonia concentrations above Weippe averaged 0.041 mg/l ± s.d. = 0.021 mg/l. Grasshopper Creek was similar averaging 0.025 mg/l ± s.d. = 0.008 mg/l. The effects of the lagoon discharges are seen in the data downstream. The lagoon released a mean total ammonia concentration of 4.31 mg/l ± s.d. = 2.49 mg/l The station below the outfall averaged 2.61 mg/l ± s.d. = 3.01 mg/l. Levels of ammonia had decreased at St. #5, to a mean of 0.86 mg/l ± s.d. = 1.48 mg/l.

Concentrations of total ammonia in the water samples taken from the stream generally increased during the length of the study (Figure 3). This is the result of the increase in concentration from the effluent and the process of ammonification that occurs under anoxic conditions present in the stream and the lagoon during the late summer months. An unexplained decrease in the ammonia concentrations from the effluent on August 12th suppressed the concentrations in the stream for that sampling date. Other sources of ammonia to the stream such as organic waste from livestock grazing, and other agricultural nonpoint sources are considered insignificant compared to the load contributed by the effluent during minimal flows.

Total Phosphorus (T.P.)

Concentrations of total phosphorus at St. #1, above Weippe, and in Grasshopper Creek, St. #4, were at or below the detection limit of 0.1 mg/l (Appendices A1-5). The effluent had a mean total phosphorus concentration of 5.8 mg/l ± s.d.= 4.1 mg/l. The concentration was reduced an average of 37% immediately below the outfall, St.#3, to a mean of 2.2 mg/l ± s.d.=1.6 mg/l. This downward trend continues to where at the last monitoring site, St. #5, the samples averaged 0.2 mg/l ± s.d.= 0.04 mg/l (Figure 4). This is still twice the concentration of 0.1 mg/l recommended to prevent the nuisance growth of algae (Mackenthun, 1973). The algal mat present below the discharge is due in part to the excess phosphorus. The concentration at St.#5 remained stable at 0.2 mg/l despite the increasing concentrations of phosphorus being added by the effluent.

The phosphorus loads in Jim Ford Creek above the lagoon discharge during low flows were less than 0.1 lb/day (Appendices B1-5). The lagoon added 1.0 lb/day of phosphorus to the stream, but by St#5, 1/3 mile downstream, the instream loads were reduced to approximately 0.1 lb/day.

Suspended Solids (S.S.)

The previous NPDES permit issued in 1976 limited the effluent to a daily average suspended solid concentration of 70 mg/l, and a daily maximum concentration not to exceed 105 mg/l (NPDES #ID-002035-4). The average daily load was not to exceed 146 lbs/day and the maximum allowable daily load limit was 219 lbs/day.

Table 5 is a summary of the suspended solids data from the Weippe NPDES file from 1982 to 1986. The daily average concentrations and loads are given first and the recorded daily maximum concentration and maximum loads follow in parenthesis. Exceedance of previous permit limits are noted with an asterisk.

TABLE 5. Summary of Suspended Solids Data of Weippe Municipal Lagoon (NPDES #002035-4).

		Jan - Mar Daily Ave	Max	Apr - June Daily Ave	Max	Jul - Sept Daily Ave	Max	Oct - Dec Daily Ave	Max
1986	Conc	54	(73)	35	(52)	77*	(93)	68	(96)
	Load	279*	(479)*	46	(116)	36	(90)	58	(86)
1985	Conc.	31	(31)	42	(84)	86*	(86)	40	(56)
	Load	177*	(177)	74	(206)	62	(62)	23	(24)
1984	Conc.	39	(39)	39	(58)	61	(63)	62	(78)
	Load	273*	(273)*	115	(160)	69	(173)	25	(38)
1983	Conc.	18	(32)	25	(42)	33	(47)	42	(52)
	Load	66	(112)	18	(50)	25	(32)	88	(164)
1982	Conc.	17	(40)	7	(8)	-	(-)	37	(42)
	Load	89	(220)*	9	(15)	-	(-)	105	(193)

* Violation of Permit Limitation
– No Discharge
( ) Daily maximum

The 1976 NPDES permit limitations for suspended solids were exceeded most often during the first quarter of the year. This may be a reflection of taking advantage of the increased stream flows to provide dilution of the effluent to draw down of thelagoons for additional capacity. The data from effluent samples collected during the 1986 study did not exceed the previous NPDES permit for suspended solid concentration or loads.

Wastewater treatment lagoons are customarily required to be at least 65% effective in removing suspended solids from the influent (EPA, 1980). Typical residential wastewater has between 200-290 mg/l of suspended solids. Assuming an influent concentration of 200 mg/l, and using the greatest effluent concentration sampled of 64 mg/l on August 26, 1986, it is reasonable to conclude that at least a 68% reduction of suspended solids concentration was being achieved during the study. An E.P.A. NPDES inspection on August 20, 1985 noted the lagoon to be 86% effective for removing suspended solids (NPDES #002035-4).

Suspended solids concentrations during minimal flows were relatively constant at stations #1, #4, and #5; ranging from 4 to 22 mg/l. The effluent discharge had a mean concentration of 43 mg/l ± s.d.=16 mg/l. Station #3, just below the discharge, reflected a slightly lower concentration than the effluent, mean 37 mg/l ± s.d.=13 mg/l.

Above the wastewater discharge the instream suspended solids loads were between 2-6 lb/day when the stream was flowing at or less than 0.1 cfs. The lagoon discharged an average of 11.5 lb/day of suspended solids. The load at #3, directly below the outfall, averaged 20.4 lb/day, and there was a mean load of 6.6 lb/day present at St.#5, for the same time period.

A dilution ratio of 2:1 or less was maintained for most of the 1986 study. At this ratio the effluent contributed up to 90% of the suspended solid loading of Jim Ford Creek. This additional loading may contribute to the overproduction of nuisance algae, the cultural eutrophication of the stream, and adversely impacted the beneficial uses of Jim Ford Creek.

A dilution ratio of close to 50:1 was achieved on June 10, 1986. On that day there was a 160 lb/day increase in the suspended solid load between the sampling station #1, above Weippe, and #3, below the discharge. Only 10 lb/day of the load was attributable to the effluent. The rest is presumably from nonpoint sources between the stations. One third of a mile downstream from the lagoon the load had been reduced to 270 lbs/day which was 10 lbs/day less than the load recorded above the discharge. Part of the decrease was from dilution by Grasshopper Creek and part may have been due to filtration and biological utilization by the aquatic biota. Under an extreme condition, where the effluent concentration would approach the discharge limitation of 70 mg/l, the load would be approximately 23 lbs/day. This is still only 8% of the total daily load of the stream. If the discharge is kept within the limitations of the proposed permit of a 50:1 dilution its effect on the beneficial uses of Jim Ford Creek will be minimal.

Biochemical Oxygen Demand (BOD)

The IDHW/DOE wastewater discharge regulations require treatment lagoons to be able to remove 65% of the influent biochemical oxygen demand, BOD_5 (IDHW/DOE, 1985). The 30 day average concentration of the effluent is not to exceed 45 mg/l.

The BOD_5 of typical domestic wastewater is between 200-290 mg/l, 35-50 gm/cap/day (EPA, 1980). The 800 people of Weippe would then be expected to produce between 60-90 lbs. of BOD_5 per day. If the lagoons are operating correctly a maximum of only 21-30 lbs/day of BOD_5 should be released daily. The discharge monitoring reports recorded an average BOD_5 of 22.8 mg/l ±s.d. 10.6 mg/l.

The effluent BOD_5 characteristics during the summer of 1986 were within IDHW/DOE regulations. The effluent averaged 27 mg/l ± s.d. = 8 mg/l. The load discharged from the lagoon averaged 7.5 lbs/day, with a peak load of 14 lbs/day on June 10, 1986. On that day the concentration went up to 43 mg/l, perhaps as the result of an unexplainably high TKN concentration of 35.8 mg/l on the same sampling date.

The BOD_5 of the water at St.#1, above the effluent discharge, averaged 2.1 mg/l ± s.d. = 1.5 mg/l. Grasshopper Creek was very similar and averaged 2.1 mg/l ± s.d. = 1.1 mg/l. The effluent's BOD_5 load accounts for 83% of the instream load at St. #3, below the discharge. At St. #3 the mean BOD_5 concentration was 7.1 mg/l ± s.d. = 7.6 mg/l. It was reduced 54% to 3.8 mg/l ± s.d. = 1.8 mg/l by the time the water reached St. #5, 1/3 mile downstream.

The BOD_5 test results indicate the ability of Jim Ford Creek to recover from receiving the effluent. Dilution and biological activity account for the initial decrease in the BOD_5 at St.#3 below the discharge point. Further reduction of the load is accomplished within the next 1/3 mile to St.#5. The reduction of BOD_5 between the treatment lagoon and the last station was 64% at the beginning of the study but declined to 31% by the end of the study. This indicates that the stream has reached its capacity to continuously oxidize the BOD_5 load from the effluent. This resulted in an increased BOD_5 at St.#5 through the summer. Overall there was an 86% reduction of the effluent BOD_5 to the background stream level in 1/3 mile.

Dissolved Oxygen (DO)

Several factors will influence the amount of dissolved oxygen in water. The percent saturation or carrying capacity of the water for oxygen is related to the water temperature and the atmospheric pressure. Biochemical and chemical oxidation will utilize the oxygen available. The morphology and hydrology of the stream, and the local climate are factors in determining the rate at which the oxygen is replaced.

Dissolved oxygen levels in Jim Ford Creek ranged between 1.2 - 10.4 mg/l. The mean DO concentrations at stations #1, #3, #4, and #5 were 7.0, 6.0, 7.2 and 7.1 mg/l respectively.

Seasonal declines in the DO concentrations were evident at all instream stations. The upstream station, St.#1, showed less of an oxygen sag, s.d.= 1.7 mg/l, over the summer than did the stations below the discharge point. The oxygen levels in the effluent were relatively constant with a mean concentration of 4.7 mg/l $\pm$ s.d. = 1.1mg/l. The greatest decrease occured at St. #3, where the concentrations varied from 9.0 mg/l to 1.2 mg/l during the study, s.d. = 3.0 mg/l. Some re-oxygenation of the stream had occured by St.#5, due to the influence of several riffles and the decrease in the BOD. The standard deviation at St.#5 was 2.2 mg/l.

The State of Idaho's D.O. criteria for cold water biota and salmonid spawning is 6 mg/l or 90% saturation, whichever is greater. Jim Ford Creek , above Weippe at St. #1, failed to meet the minimum criteria on August 12 and August 26. The oxygen demand from the effluent suppressed the oxygen levels in the stream below the outfall to less than the criteria level on the last 3 sample dates.

Specific Conductivity

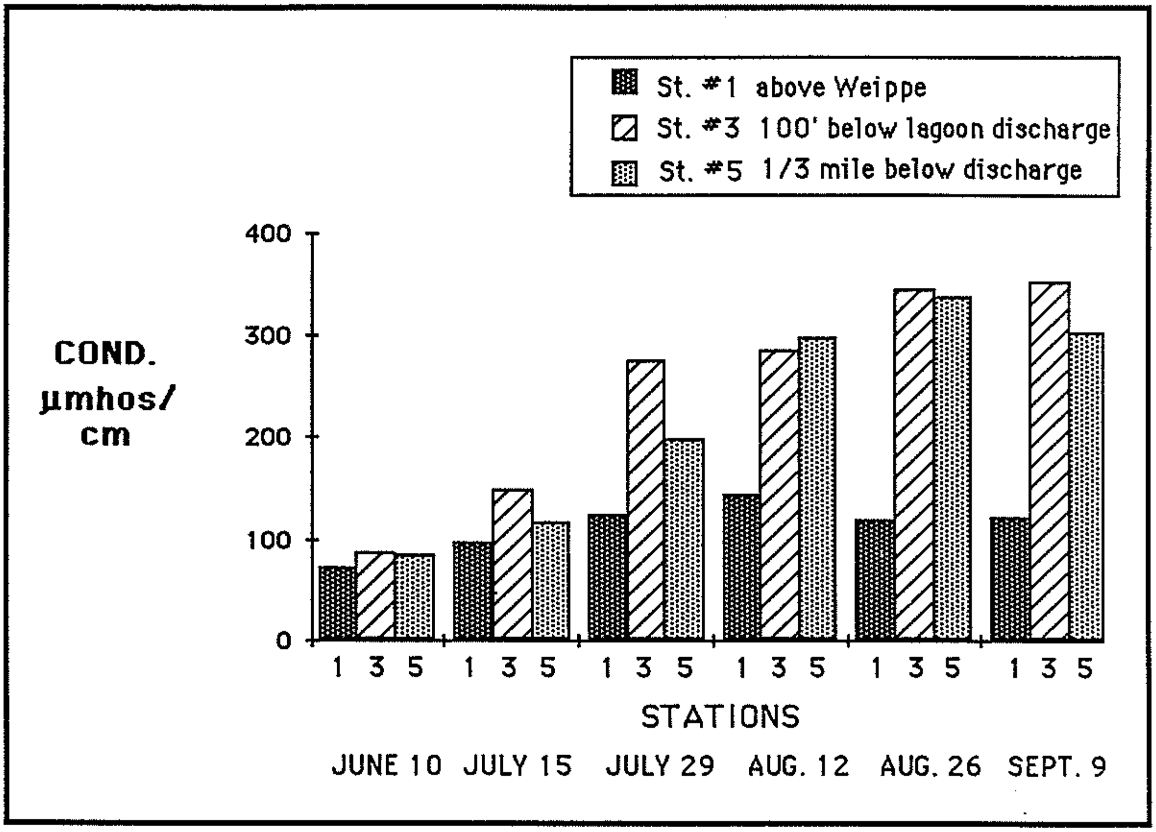
The conductivity in the flowing waters of Jim Ford Creek above Weippe was relatively low averaging 114 µmhos/cm ± s.d. = 25 µmhos/cm. This is typical of surface waters low in solutes. Some increase in the conductivity of a stream may be expected from nonpoint sources such as agriculture. Stagnation will also increase the ionic strength of water resulting in increased conductance.

During the summer the conductance in Jim Ford Creek above Weippe increased from 73 µmhos/cm to 144 µmhos/cm (Figure 6). Grasshopper Creek increased from 74 µmhos/cm when it was flowing to 414 µmhos/cm in the stagnant pool. The effluent had a mean conductance of 302 µmhos/cm ± s.d. = 44 µmhos/cm, with a 65% increase in conductivity of the discharge throughout the summer. The effluent had an immediate impact on the specific conductance of Jim Ford Creek at St. #3. The receiving stream at St. #3 had a mean conductance of 249 µmhos/cm ± s.d. = 108 µmhos/cm, with a four-fold increase in the conductivity during the summer. The last station downstream had a similar trend with a three-fold increase, and a mean of 223 µmhos/cm ± s.d. = 106 µmhos/cm. This increase is the result of decreasing flows that result in less effluent dilution, and the additional presence of by-products from organic decay in the stagnant pools. Conductivity values during minimum flows in the stream were within 2% of the values of the effluent. At St. #5, 1/3 mile downstream, the values were still within 11% of the effluent discharge conductivity.

Bacteria

Fecal coliform bacteria counts in Jim Ford Creek above Weippe had a geometric mean of 68 colonies per 100 ml. The wastewater discharge fecal coliform counts ranged between 600 and 4700 colonies/100 ml with a mean of 1700 colonies/100 ml.

FIGURE 6. Specific Conductance in Jim Ford Creek, Summer of 1986.



The station directly below the discharge, St.#3, reflected the discharge from the lagoons with a geometric mean count of 850/100 ml, and ranged from 310-2700/100 ml. At the last station, #5, the counts had declined to a mean of 39/100 ml, with a range from 30-1200/100 ml.

The primary contact recreation standard of 500 colonies of fecal coliform per 100 ml for any single sample was exceeded once during the study at St.#1, above Weippe, in 4 out of 6 samples at St.#3, below the discharge, and once at St.#5, downstream. On that sample date at Station #5 the less stringent limit for secondary contact use would also have been exceeded. Pastured livestock along the banks are a probable source of fecal contamination of the stream above Weippe.

The lagoon effluent bacterial counts exceeded the IDHW/DOE discharge limitations of 200 fecal coliform colonies/100 ml in all the samples taken. A decline from this source of contamination may help bring Jim Ford Creek below the discharge into compliance with the IDHW/DOE primary contact recreation standard.

Much of the bacterial contamination of the stream seen at St. #3 was reduced by St. #5, one-third mile downstream. The decline in bacterial counts downstream may be due to the effects of photo-oxidation and ultraviolet radiation in the stream (Nestor, et.al. 1978).

Quality Assurance

Duplicate samples from St.#5 were submitted with each sample set to assess precision. The Average Relative Ranges (ARR) were calculated (Table 6). The spiked samples submitted for accuracy were analyzed and the percent recovery was calculated (Table 7). One sample for TKN was an outlier that was rejected with the Dixon formula.

The samples analyzed for total Kjeldahl nitrogen had excellent precision and accuracy. The suspended solids samples had only fair precision with very good accuracy. The lack of precision in the suspended solids samples may have been due to the low concentrations, less than 20 mg/l, and grab samples that may have disturbed the bottom sediments during replicate collection. Ammonia also had a fair precision but overestimated the concentrations by 28%. Total phosphorus concentrations, on the basis of only four samples, exhibited good reproducibility between samples but overestimated the concentration by 11%.

Designated Uses

Jim Ford Creek has a value class of III placed upon it by the U. S. Fish and Wildlife Service and the Idaho Department of Fish and Game. This classification denotes a habitat that is "occasionally used by a highly-valued population..." namely the salmonid

Table 6. Precision Estimates of Jim Ford Creek Study

Parameter	N*	Average Relative Range (%)	Overall Mean
Suspended Sediment (SS)	8	11.17	11.25
Total Phosphorus as P	8	10.00	0.14
Total Kjeldahl Nitrogen (TKN)	8	5.49	1.18
Total Ammonia (NH_3)	8	16.26	0.573

*N = number of samples submitted

Table 7. Accuracy Estimates of Jim Ford Creek Study.

Parameter	N*	Mean Percent Recovery (%)
Suspended Sediment (SS)	1	96.7
Total Phosphorus (T.P.)	2	113.4
Total Kjeldahl Nitrogen (TKN)	1	101.9
Total Ammonia (NH_3)	2	128.3

*N = number of samples submitted

spawning in the lower reaches (USDI, 1978). Opportunities may exist for cold water biota and salmonid spawning to exist in the headwaters of the streams above Weippe and/or below a 65 foot falls approximately one mile northwest of Weippe.

The water quality necessary to support cold water biota and salmonid spawning in streams in the vicinity of Weippe are impaired by low flows and elevated water temperatures during the summer months. The lack of flows in the streams also reduces aeration resulting in a lower dissolved oxygen content. The limited historical data available through STORET indicates that Jim Ford Creek is perennial at the mouth, but the perennial flows are probably not present until below the falls.

Present uses of Jim Ford and Grasshopper Creeks around and above Weippe are for primary and secondary contact recreation, and as an agricultural water supply. There is evidence that a large shallow pool at St.#1 above Weippe is used for primary and secondary contact recreation. This pool remained a constant size throughout the length of the study, indicating some subsurface flow. Water quality and primary contact recreation opportunities deteriorate rapidly with flows less than 3.0 cfs in Jim Ford Creek and Grasshopper Creek.

The pH of Jim Ford Creek was below the criteria limit of 6.5 S.U. for cold water biota and salmonid spawning in two of the samples taken during extremely low flows at St.#1, and once at St.#5 on July 15th. The pH of the effluent minimally affected the pH of the stream.

Grasshopper Creek is not used as a domestic water supply, as verified by City of Weippe personnel. The intermittent flows and general water quality indicate that the stream will not support this designated use.

CONCLUSIONS

1. Jim Ford Creek and Grasshopper Creek in the vicinity of Weippe are intermittent streams. Effluent discharges during the summer at times constitute the majority of the stream flow. Grasshopper Creek, due to its intermittent nature, does not provide flows for diluting effluent discharges during the summer.

2. The Weippe municipal wastewater lagoon discharge is the primary source of flows, nutrient enrichment, BOD loading, and bacterial contamination downstream from the discharge. The effluent failed to meet the IDHW/DOE discharge criteria for fecal coliform densities. The standard for fecal coliform bacteria on waters for primary contact recreation was exceeded once in the stream above the lagoon discharge point, in four out of six samples immediately below the discharge, and once at the last sample site.

3. Spring and fall turnovers of the lagoon are responsible for the periodic anaerobic odors from the facility. The overwhelming growth of duckweed on the surface of the lagoon and lack of adequate aeration lead to anaerobic conditions in the lagoon.

4. Reduction of the nutrient, BOD, and bacterial loading from lagoon discharge occurs in the stream section between the point of effluent discharge and the last monitoring station, St.#5, which is 1/3 mile downstream. The stream shows a declining capacity throughout the summer to stabilize the nutrient and BOD loads introduced by the effluent, as evidenced by an increase in concentrations at the stream monitoring sites during the study.

5. The designated uses for Jim Ford Creek and Grasshopper Creek, in the vicinity of Weippe, are impaired by low and intermittent flows, nutrients, and bacterial loading from the wastewater lagoon. Sufficient water remained in pools of Jim Ford Creek throughout the study to provide for livestock watering and secondary contact recreation. Grasshopper Creek is not a domestic water supply.

RECOMMENDATIONS

1. A 50:1 dilution ratio in the past has been recommended for streams where the beneficial uses are impacted by wastewater discharges. A minimum of 50:1 ratio is recommended in order to protect the designated beneficial uses of Jim Ford Creek. No discharge from the facility should be allowed when the dilution ratio cannot be met. A staff gauge could be located in the stream channel to aid in the estimation of stream flows.

2. An examination of the discharge structure is recommended to determine if the present weir structure will adequately control the recommended discharges.

3. Bacterial disinfection of the wastewater effluent is necessary to meet the IDHW/DOE criteria for wastewater discharge.

4. Management techniques are needed to control odors from the lagoon.

5. An effluent limitation of 70 mg/l suspended solids, as a 30 day average, will not adversely affect the designated beneficial uses of Jim Ford Creek if the other NPDES limitations and IDHW/DOE wastewater discharge criteria are met.

6. Designation of Grasshopper Creek as a domestic water supply is inappropriate and should be removed.

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APPENDICES

APPENDIX A1. WATER QUALITY DATA FOR JIM FORD CREEK AT ST#1, ST. HIGHWAY 7.

STORET # 2020260

SITE	DATE	TEMP. °C	FLOW cfs	COND. @ 25° µmhos /cm	pH S.U.	S.S. mg/L	T.P. mg/L	TKN mg/L	NH3 mg/L	D.O. mg/L	BOD. mg/L	FECAL COLI. #/100ml
1	06/10/86	23	2.9	73	6.8	18	0.1	0.49	0.021	7.7	1.2	93
2	*07/15/86	20	<0.1	98	6.3	10	<0.1	0.64	0.018	8.6	4.5	10
3	*07/29/86	15	0.0	124	6.1	6	<0.1	0.66	0.070	6.6	2.5	55
4	*08/12/86	18	0.0	144	6.7	18	<0.1	0.61	0.039	5.5	2.5	646
5	*08/26/86	21	<0.1	120	7.2	4	0.1	0.40	0.060	4.5	1.7	30
6	*09/09/86	12	0.1	122	6.6	12	<0.1	0.29	0.040	8.8	0.2	100

SUMMARY OF DATA

	TEMP.	FLOW	COND.	pH	S.S.	T.P.	TKN	NH3	D.O.	BOD.	FECAL COLI.
MEAN	18	0.6	114	£6.6	11	<0.1	0.51	0.041	7.0	2.1	£ 68
MAXIMUM	23	2.9	144	7.2	18	0.1	0.66	0.070	8.8	4.5	646
MINIMUM	12	0.0	73	6.1	4	<0.1	0.29	0.018	4.5	0.2	10

* MEAN FOR ALL DATA COLLECTED THAT DAY
£ LOGARTHMIC MEAN

APPENDIX A2. WATER QUALITY DATA FOR JIM FORD CREEK AT ST#2, FROM THE WEIPPE LAGOON OUTFAL

STORET # 2020261

SITE	DATE	TEMP. °C	FLOW cfs	COND. @ 25° µmhos /cm	pH S.U.	S.S. mg/L	T.P. mg/L	TKN mg/L	NH3 mg/L	D.O. mg/L	BOD. mg/L	FECAL COLI. #/ 100ml
1	06/10/86	17	0.06	235	6.2	30	8.0	35.8	3.77	3.2	43.0	4600
2	07/15/86	16	0.05	299	6.2	38	3.8	10.4	4.85	5.5	21.1	4700
3	07/29/86	16	0.05	293	7.3	32	3.5	9.5	3.48	5.1	23.3	600
4	08/12/86	17	0.05	282	6.6	62	3.4	8.5	0.72	4.1	25.4	600
5	08/26/86	16	0.04	340	6.7	64	4.5	11.0	4.64	4.2	21.0	*1300
6	09/09/86	13	0.05	361	6.4	32	5.4	12.4	8.41	6.3	27.1	2800

SUMMARY OF DATA

	TEMP.	FLOW	COND.	pH	S.S.	T.P.	TKN	NH3	D.O.	BOD.	FECAL COLI.
MEAN	16	0.05	302	£6.6	43	5.8	14.6	4.31	4.7	27.0	£1700
MAXIMUM	17	0.06	361	7.3	64	14.0	35.8	8.41	6.3	43.0	4700
MINIMUM	13	0.04	235	6.2	30	3.4	8.5	0.72	3.2	21.0	600

* MEAN FOR ALL DATA COLLECTED THAT DAY
£ LOGARTHMIC MEAN

APPENDIX A3. WATER QUALITY DATA FOR JIM FORD CREEK AT ST#3, BELOW LAGOON OUTFALL

STORET # 2020262

SITE	DATE	TEMP. °C	FLOW cfs	COND. @ 25° µmhos /cm	pH S.U.	S.S. mg/L	T.P. mg/L	TKN mg/L	NH3 mg/L	D.O. mg/L	BOD. mg/L	FECAL COLI. #/100ml
1	06/10/86	23	2.7	87	6.7	30	0.2	0.90	0.159	9.0	2.5	2700
2	07/15/86	18	0.1	148	6.1	20	0.8	2.93	0.146	8.1	7.4	310
3	07/29/86	16	<0.1	276	6.7	32	2.0	7.60	2.42	8.3	4.7	440
4	08/12/86	18	<0.1	285	6.6	52	2.7	8.08	1.11	5.6	0.9	550
5	08/26/86	17	<0.1	345	6.7	54	3.5	9.30	3.80	4.0	--	1700
6	09/09/86	14	<0.1	352	6.5	32	4.3	12.05	8.04	1.2	19.9	1100

SUMMARY OF DATA

	TEMP.	FLOW	COND.	pH	S.S.	T.P.	TKN	NH3	D.O.	BOD.	FECAL COLI.
MEAN	18	0.5	249	£6.5	37	2.2	6.8	2.61	6.0	7.1	£ 850
MAXIMUM	23	2.7	352	6.7	54	4.3	12.05	8.04	9.0	19.9	2700
MINIMUM	14	0.1	87	6.1	20	0.2	0.90	0.146	1.2	0.9	310

* MEAN FOR ALL DATA COLLECTED THAT DAY
£ LOGARTHMIC MEAN
<0.1 = 0.1 FOR CALCULATING MEANS

APPENDIX A4. WATER QUALITY DATA FOR JIM FORD CREEK ST#4, GRASSHOPPER CREEK

STORET # 2020263

SITE	DATE	TEMP. °C	FLOW cfs	COND. @ 25° µmhos /cm	pH S.U.	S.S. mg/L	T.P. mg/L	TKN mg/L	NH3 mg/L	D.O. mg/L	BOD. mg/L	FECAL COLI. #/ 100ml
1	06/10/86	24	1.5	74	7.0	20	0.1	0.50	0.021	6.6	0.9	130
2	07/15/86	18	<0.1	95	6.2	10	<0.1	0.39	0.026	9.7	1.4	180
3	07/29/86	18	<0.1	148	7.2	6	<0.1	0.59	0.037	7.2	3.0	50
4	08/12/86	19	0.0	414	6.8	22	<0.1	0.84	0.018	5.5	3.1	1200

SUMMARY OF DATA

	TEMP.	FLOW	COND.	pH	S.S.	T.P.	TKN	NH3	D.O.	BOD.	FECAL COLI.
MEAN	20	0.4	183	£6.8	14	<0.1	0.58	0.025	7.2	2.1	£190
MAXIMUM	24	1.5	414	7.2	22	0.1	0.84	0.037	9.7	3.1	1200
MINIMUM	18	0.0	74	6.2	6	<0.1	0.39	0.018	5.5	0.9	50

* MEAN FOR ALL DATA COLLECTED THAT DAY
£ LOGARTHMIC MEAN
<0.1 = 0.1 FOR CALCULATING MEANS

APPENDIX A5. WATER QUALITY DATA FOR JIM FORD CREEK ST#5, 1/3 MILE BELOW LAGOON OUTFALL

STORET # 2020264

SITE	DATE	TEMP. °C	FLOW cfs	COND. @ 25° µmhos /cm	pH S.U.	S.S. mg/L	T.P. mg/L	TKN mg/L	NH3 mg/L	D.O. mg/L	BOD. mg/L	FECAL COLI. #/100ml
1	06/10/86	23	2.8	85	6.8	18	0.1	0.61	0.085	7.6	1.6	400
2	*07/15/86	22	0.2	117	6.0	13	0.2	0.77	0.124	10.4	3.5	100
3	07/29/86	17	<0.1	199	6.8	4	0.2	0.91	0.085	8.7	2.1	30
4	08/12/86	19	<0.1	298	6.8	20	0.2	1.66	0.380	5.4	4.0	50
5	08/26/86	19	<0.1	337	7.3	8	0.2	1.79	0.646	4.8	5.2	100
6	*09/09/86	14	0.1	304	6.9	17	0.2	4.38	3.86	5.9	6.3	1200

SUMMARY OF DATA

	TEMP.	FLOW	COND.	pH	S.S.	T.P.	TKN	NH3	D.O.	BOD.	FECAL COLI.
MEAN	19	0.6	223	£6.8	13	0.2	1.68	0.86	7.1	3.8	£ 139
MAXIMUM	23	2.8	337	7.3	20	0.2	4.38	3.86	10.4	6.3	1200
MINIMUM	14	<0.1	85	6.0	4	0.1	0.61	0.085	4.8	1.6	30

* MEAN FOR ALL DATA COLLECTED THAT DAY
£ LOGARTHMIC MEAN
<0.1 = 0.1 FOR CALCULATING MEANS

APPENDIX B1. NUTRIENT LOADS OF JIM FORD CREEK ST.#1, ST. HIGHWAY 7.

STORET # 2020260

DATE	FLOW cfs	S.S. LBS/ DAY	T.P. LBS/ DAY	TKN LBS/ DAY	NH3 LBS/ DAY	ORGANIC LBS/ DAY	BOD LBS/ DAY
06/10/86	2.9	280	1.6	7.6	0.3	7.3	19
*07/15/86	<0.1	5.4	<0.1	0.3	<0.1	0.3	2.4
*07/29/86	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*08/12/86	0.0	0.0	0.0	0.0	0.0	0.0	0.0
*08/26/86	<0.1	2.2	<0.1	0.2	<0.1	0.2	0.9
*09/09/86	0.1	6.5	<0.1	0.2	<0.1	0.2	0.1

SUMMARY OF DATA

TOTAL	--	300	1.9	8.3	0.6	8.0	22.4
MAXIMUM	2.9	280	1.6	7.6	0.33	7.3	19
MINIMUM	0.0	0.0	0.0	0.0	0.00	0.0	0.0

<0.1 = 0.1 FOR CALCULATING LOADS
* MEAN FOR ALL DATA COLLECTED THAT DAY

APPENDIX B2. NUTRIENT LOADS OF JIM FORD CREEK ST.#2, FROM THE WEIPPE LAGOON OUTFALL

STORET # 2020261

DATE	FLOW cfs	S.S. LBS/DAY	T.P. LBS/DAY	TKN LBS/DAY	NH3 LBS/DAY	ORGANIC LBS/DAY	BOD LBS/DAY
06/10/86	0.06	10	2.6	4.4	1.2	3.2	14
07/15/86	0.05	10	1.0	2.8	1.3	1.5	6
07/29/86	0.05	9	0.9	2.6	0.9	1.6	6
08/12/86	0.05	17	0.9	2.3	0.2	2.1	7
08/26/86	0.04	14	1.0	2.4	1.0	1.4	5
09/09/86	0.05	9	1.4	3.3	2.3	1.1	7

SUMMARY OF DATA

TOTAL	---	69	7.8	17.8	6.9	10.9	45
MAXIMUM	0.06	17	2.6	4.4	2.3	3.2	14
MINIMUM	0.04	9	0.9	2.3	0.2	1.1	5

<0.1 = 0.1 FOR CALCULATING LOADS
* MEAN FOR ALL DATA COLLECTED THAT DAY

APPENDIX B3. NUTRIENT LOADS OF JIM FORD CREEK ST.#3, BELOW LAGOON OUTFALL

STORET # 2020262

DATE	FLOW cfs	S.S. LBS/DAY	T.P. LBS/DAY	TKN LBS/DAY	NH3 LBS/DAY	ORGANIC LBS/DAY	BOD LBS/DAY
06/10/86	2.7	440	2.9	13.1	2.3	10.8	36.4
07/15/86	0.1	11	0.4	1.6	0.1	1.5	4.0
07/29/86	<0.1	17	1.1	4.1	1.3	2.8	2.5
08/12/86	<0.1	28	1.4	4.4	0.6	3.8	0.5
08/26/86	<0.1	29	1.9	5.0	2.0	3.0	--
09/09/86	<0.1	17	2.3	6.5	4.3	2.2	10.7

SUMMARY OF DATA

TOTAL	--	542	10.0	34.7	10.6	24.1	54.1
MAXIMUM	2.7	440	2.9	13.1	4.3	10.8	36.4
MINIMUM	0.1	11	0.4	1.6	0.1	1.5	0.5

<0.1 = 0.1 FOR CALCULATING LOADS
* MEAN FOR ALL DATA COLLECTED THAT DAY

APPENDIX B4. NUTRIENT LOADS OF JIM FORD CREEK ST.#4, GRASSHOPPER CREEK

STORET # 2020263

DATE	FLOW cfs	S.S. LBS/ DAY	T.P. LBS/ DAY	TKN LBS/ DAY	NH3 LBS/ DAY	ORGANIC LBS/ DAY	BOD LBS/ DAY
06/10/86	1.5	160	0.8	4.0	0.2	3.9	7.3
07/15/86	<0.1	5.4	<0.1	0.2	<0.1	0.2	0.8
07/29/86	<0.1	3.2	<0.1	0.3	<0.1	0.3	1.6
08/12/86	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SUMMARY OF DATA

TOTAL	--	169	1.0	4.5	0.4	4.4	9.7
MAXIMUM	1.5	160	0.8	4.0	0.2	3.9	7.3
MINIMUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0

<0.1 = 0.1 FOR CALCULATING LOADS
* MEAN FOR ALL DATA COLLECTED THAT DAY

APPENDIX B5. NUTRIENT LOADS OF JIM FORD CREEK ST.#5, 1/3 MILE BELOW LAGOON OUTFALL

STORET # 2020264

DATE	FLOW cfs	S.S. LBS/DAY	T.P. LBS/DAY	TKN LBS/DAY	NH3 LBS/DAY	ORGANIC LBS/DAY	BOD LBS/DAY
06/10/86	2.8	270	1.5	9.2	1.3	7.9	24.1
*07/15/86	0.2	14.0	0.2	0.8	0.1	0.7	3.8
07/29/86	<0.1	2.2	0.1	0.5	<0.1	0.4	1.1
08/12/86	<0.1	10.8	0.1	0.9	0.2	0.7	2.2
08/26/86	<0.1	4.3	0.1	1.0	0.3	0.7	2.8
*09/09/86	0.1	9.2	0.1	2.4	2.1	0.3	3.4

SUMMARY OF DATA

TOTAL	--	310	2.1	14.8	4.1	10.7	37.4
MAXIMUM	2.8	270	1.5	9.2	2.1	7.9	24.1
MINIMUM	<0.1	2.2	0.1	0.5	<0.1	0.3	1.1

<0.1 = 0.1 FOR CALCULATING LOADS
* MEAN FOR ALL DATA COLLECTED THAT DAY