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M E M O R A N D U M

September 11, 1986

To: Carl Nuechterlein

From: Joe Joy JJ

Subject: Waitsburg Wastewater Treatment Plant Receiving Water Survey

ABSTRACT

A survey was performed on the Touchet River and Coppei Creek in the vicinity of the Waitsburg wastewater treatment plant (WTP). The WTP contains an infiltration lagoon set close to the banks of the two water bodies. The survey showed greatly improved water quality in Coppei Creek, the former wastewater receiving water. Little impact from the wastewater upon the water quality of the Touchet River or Coppei Creek was observed during this survey. There were no apparent seeps, suggesting any contact would be subsurface.

Data were insufficient to evaluate ground-water direction, quality changes, or facility impacts on an adjacent landfill. High nitrogen, chloride, and conductivity levels in both upstream surface water and upgradient ground waters tended to mask any impacts of the wastewater. Sources of these elevated concentrations should be investigated. Possible sources include cannery wastewater, agricultural runoff, an abandoned fertilizer plant, animal confinement areas, and fertilizers applied to an adjacent field.

INTRODUCTION

A Class II and receiving water survey was performed by Ecology Water Quality Investigations Section (WQIS) staff at the Waitsburg WTP and adjacent surface- and ground waters. This report covers the receiving water portion of the September 24-25, 1985, survey performed by Joe Joy and Pat Crawford of the WQIS. Marc Heffner (WQIS) and Carl Nuechterlein and Larry Peterson of the Ecology Eastern Regional Office (ERO) performed the ground-water and Class II portion of the survey; their findings will be covered under a separate memorandum (Heffner, 1986).

Memo to Carl Nuechterlein
Waitsburg Wastewater Treatment Plant Receiving Water Survey

The Waitsburg treatment system has been under a five-year provisional discharge permit since 1981 when a set of lagoons was added to the existing trickling filter system. Yake and Cloud (1979) had performed a similar pre-expansion survey. The ERO requested another survey by the WQIS to evaluate the new system's performance and its impact on ground water, Coppei Creek, and the Touchet River. The ERO will use this survey information to update Waitsburg's NPDES permit.

Site Description and Background

Waitsburg (population 1,060) lies in the Touchet River Valley in southeast Washington (Figure 1). The town supports the needs of the farmers in the surrounding hills and valleys, and also includes a cannery.

The Touchet River flows for 70 miles, draining 721 mi^2 of agricultural and rangelands from the northern Blue Mountains southeast of Waitsburg to the Walla Walla River (Figure 1). The river drains 361 mi^{-2} at river mile (r.m.) 40.1 just below Waitsburg (USGS #14017000, Touchet River at Bolles).

The Waitsburg WTP system lies between Coppei Creek and the Touchet River at approximately r.m. 43.5 (Figure 2). The system prior to 1981 consisted of a trickling filter with a single unit doubling as a primary and secondary clarifier (Yake, 1979). Effluent was discharged into Coppei Creek at r.m. 0.47 (Figure 3). In the current system, wastewater passes through the clarifier, trickling filter, and then into a set of lagoons. The last lagoon is a marsh. Effluent either evaporates or seeps out of the lagoons/marsh into the ground water, or it evaporates. There is no direct surface discharge of effluent to Coppei Creek or the Touchet River (Figure 3). The seepage lagoons lie beside an area formerly used as the municipal landfill. An animal confinement area, a hog wallow, and large tracts of agricultural land lie adjacent to the system (Figure 3). The lagoons are more fully described in Heffner's (1986) memo.

Water quality in the Touchet River and its tributaries (segment 15-32-03) should meet Class A water quality standards (Table 1). However, water quality data from samples collected at r.m. 0.5 (Ecology station 32B072) suggest that many of these standards are not met (Ecology, 1986). The Water Quality Index (WQI) values calculated in 1984 for data collected between 1978 and 1983 (Moore, 1984) indicate conditions have not met standards (Table 2). The Waitsburg treatment plant has previously been identified as a contributor of elevated bacterial and nutrient (trophic) WQI values in the segment. Agricultural runoff, low flows, and the lack of riparian vegetation also are thought to contribute to poor water quality in the river. The overall WQI value suggests that the Touchet is among the ten worst in the state of the river segments monitored.

The ERO has recognized that there are water quality problems in the Touchet River. In 1979, the ERO requested WQIS to assess the efficiency of the Waitsburg treatment system and the effects of the effluent on Coppei Creek and the Touchet River. Yake's and Cloud's (1979) survey showed the Waitsburg effluent to severely impact Coppei Creek water quality. Their conclusions were:

"1. During low flow conditions, effluent from the Waitsburg wastewater treatment plant substantially degrades the water quality and beneficial uses of the final half mile of Coppei Creek. Both chemical and biological water quality measurements reflect this degradation. The effluent is responsible for violations of the Class A standards for dissolved oxygen and fecal coliform concentrations. These adverse effects are a function of both the marginal treatment efficiency of the plant (see Class II memorandum, Yake, 1979) and inadequate low flow dilution. Upstream irrigation withdrawals during low flow have the potential to aggravate this situation.

2. During this survey, the effluent appeared to be having little impact on water quality in the Touchet River. An exception to this was the finding that the effluent was responsible for increasing fecal coliform concentrations in the Touchet. There is also a significant potential for increased nutrient loading to the Touchet.

3. The impact of unidentified non-point sources in or near Waitsburg was also detected. Organic and nitrate-nitrogen, as well as fecal coliforms, increased between stations C-1 and C-2 on Coppei Creek. Increases in organic and nitrate-nitrogen also occurred in the Touchet River between stations T-1 and T-2. In the case of nitrogen, this increase represented a substantial increase in loading to the river.

4. Coppei Creek has limited assimilative capacity. Even if the Waitsburg treatment plant were upgraded to meet the typical secondary treatment requirements (30/30 limitations for BOD and suspended solids), violations of fishable and swimmable receiving water criteria would probably not be eliminated in lower Coppei Creek. The potential for excess un-ionized ammonia and residual chlorine concentrations, as well as low dissolved oxygen concentrations, would remain. Addressing these concerns would probably require that the plant be designed to provide nitrification and dechlorination if continued discharge to Coppei Creek is contemplated. Receiving water quality degradation could be substantially decreased by foregoing discharge to Coppei Creek. Possible alternatives include: routing the discharge to a non-overflow or seepage lagoon, land application (irrigation), discharge to a subsurface drainfield, or discharge directly to the Touchet River."

Waitsburg pursued a seepage lagoon alternative (Peterson, 1981). In 1981, consultants working for Waitsburg performed a ground-water study in the vicinity of the lagoons to provide background data to the ERO (Gray and Osborne, 1981). The study was required by the ERO before a five-year interim approval could be given for Waitsburg WTP to operate a seepage lagoon. The consultants monitored water levels and various water quality parameters in several shallow (10- to 12-foot) test wells in the vicinity of the treatment plant during both modes of operation; i.e., trickling filter with discharge to Coppei Creek, and then trickling filter with discharge to the lagoons. They concluded that the infiltration lagoon operation neither raised the ground water in the nearby solid waste landfill nor did it change the chemical characteristics of the ground water downgradient from the lagoon system. Further dye tests performed in 1982 indicated no concentrated volumes of effluent were reaching the Touchet River.

Methods

Nine stations were established to evaluate the impacts of the lagoon system on surface water quality (Figure 2). Six were located on the Touchet River and three were located on Coppei Creek (Table 3). The following stations were located for direct comparison to Yake's and Cloud's (1979) data: T-1, T-5, T-6, C-1, C-2, and C-3. Grab samples were collected from all stations once each day for field and laboratory analysis (Table 3). All water samples were iced and transported to the Ecology/USEPA environmental laboratory in Manchester within 24 hours. Samples were analyzed using approved procedures (USEPA, 1983; APHA-AWWA-WPCF, 1985).

Benthic invertebrate samples were collected at five stations: T-1, T-2, T-4, T-5, and C-3. At each station, a rock of 4-inch to 6-inch diameter was randomly selected from mid-channel, right channel, and left channel. Organisms from each rock were scraped and rinsed into a small-mesh net. The contents were transferred to jars filled with 70 percent alcohol solution. Organisms were keyed to at least family using standard texts: Merritt and Cummins (1980), Pennak (1953), and Usinger (1973).

Discharge measurements were taken at most stations (Table 3). A top-setting rod, magnetic flow meter, and tape measure were used to determine discharge at these stations.

Samples from the lagoon, trickling filter effluent, wells, and swamp were collected by Heffner (1986). Methods he used are included in his report.

RESULTS AND DISCUSSION

Discharge

The Touchet River and Coppei Creek were flowing at higher rates than during Yake's and Cloud's (1979) survey (Tables 4 and 5). The Touchet River discharges during both surveys were within the 26 to 80 cfs range of September monthly mean flows at r.m. 40.1 (USGS, 1985). Both the 1979 and 1985 discharges also were far above the calculated 7-day, 10-year low flow value of 13 cfs (USGS, 1985).

During the 1985 survey, flows were relatively consistent between stations and between the two days of measurement (Table 4). Our results at stations T-4 and T-5 closely matched the provisional daily flows recorded by USGS three miles below station T-5 (USGS, 1986). A net gain of 1 cfs was estimated for the Touchet River within the 1.7 r.m. between Stations T-1 and T-4 (Table 4). Coppei Creek also contributed approximately 2 cfs to the river. Gaging interference from large rock rip-rap probably caused the low discharge measurement at Station T-2.

Using the occupied channel volume method (Velz, 1970), the travel time of the Touchet River between Stations T-1 and T-6 was calculated to be approximately two hours. No time of travel was calculated for Coppei Creek. However, a series of beaver ponds in the 0.5-mile reach between Stations C-1 and C-3 may extend the travel time to several hours or a day during low-flow conditions.

Touchet River Water Quality

Water quality data obtained at Station T-1, the Touchet River above Waitsburg, met all Class A criteria. Nutrients, chlorides, and COD concentrations were all relatively low considering the intensive agricultural use of the watershed (Table 4). The benthic community showed a healthy assemblage of organisms, including many pollution-intolerant families (Table 6). This was encouraging since the habitat was heavily affected by a large aqueous ammonia spill at r.m. 53.2 in April 1984 (Kittle, 1985).

Conductivity, dissolved solids, nitrate, chloride, and alkalinity concentrations greatly increased between Stations T-1 and T-2 during both the 1979 and 1985 studies (Tables 4 and 5; Figure 4). These elevated concentrations and the high fecal coliform counts observed on September 25 appear to have come from a source entering within Waitsburg - see below.

Sources within Waitsburg were not investigated during the survey. The wastes capable of producing the water quality changes between Stations T-1 and T-2 are characteristic of the mobile constituents of land-applied wastewater (Loehr, Klausner, and Scott, 1976). A vegetable cannery in the northern section of Waitsburg is a possible source (Figure 2). Most of the cannery's process wastes are spray-irrigated onto 230 acres of land located 0.3 mile north of the river (Nuechterlein, 1986). A 93 percent salt solution brine waste is discharged into two unlined brine pits adjacent to the cannery, and approximately 0.2 MGD of retort cooling water is discharged directly into the Touchet River at r.m. 44.6. The retort water should not be contaminated, but the cannery has been told by the ERO to remove the outfall and reroute the cooling water to the spray fields (Peterson, 1986). Other possible sources include an abandoned fertilizer plant, and agricultural runoff from Wilson Creek or Whoopemup creek (Figure 2); however, further investigations are necessary.

Water quality data from Stations T-3 and T-4 were very similar to data at T-2 (Table 4; Figure 4). The slight increases in chloride, nitrate, hardness, and iron concentrations between T-2 and T-4 could be the influences of the landfill or Waitsburg lagoon system. However, they could also be variations induced by the source above Station T-2, because the longitudinal increases were not always consistent between the two days of sampling.

No seeps or direct surface discharges from the lagoon/marsh treatment facility to the Touchet River were observed during this survey. No discolorations or unusual periphytic growths along the submerged right bank of the river were observed adjacent to the lagoon/marsh. Any releases of wastewater from the treatment facility to the river would have been via ground water.

Heffner (1986) attempted to chemically characterize the ground water in the vicinity of the treatment facility by sampling the existing well field during the Class II survey. Analytical results from the well samples collected at sites indicated in Figure 3 are presented in Table 4. Well head heights also were measured to identify ground-water direction. Heffner (1986) found there was insufficient data to evaluate ground-water direction or influences of the lagoon/marsh upon the abandoned landfill.

The well field sample results suggest many sources of contamination may be affecting ground-water quality: agricultural leachates, animal wastes, landfill leachates, as well as lagoon wastewater. For example, samples from upgradient wells A and C contained nitrate concentrations above or near the 10 mg/L health limit (WAC 248-54-740[5a]). These could be from aqueous ammonia or ammonia gas injected into nearby wheat fields in late May to June, and/or late August to September (Columbia Conservation District, 1986). Soil organisms easily convert ammonia to nitrate, a very mobile constituent in ground water, so that elevated nitrate concentrations are common in ground water in agricultural areas.

Cluster analyses were performed using selected chemical results from wells, lagoons, and the marsh to discern any rough similarities between the samples (Figure 5). The cluster analysis uses coefficients of similarity (e.g., Jaccard coefficient, regression coefficient, euclidean distance) to compare sets of samples and detect the level of similarity or dissimilarity between sample data. A certain degree of similarity yielding a grouping of samples is considered a cluster. These clusters and the entire cluster analysis can be graphically portrayed in a dendrogram. Following techniques outlined in Romesburg (1984), two cluster analyses using regression coefficients on standardized data were performed:

- Comparison of lagoon, marsh, and six well samples for conductivity, COD, coliform, nitrate, ammonia, total phosphorus, hardness, and chlorides.

- Comparison of the six well samples, alone using the same parameters.

Both cluster analyses showed a high similarity ($r = 0.95$ and 0.88) between samples from wells N and J (Figure 6). Also, lagoon and marsh samples were very similar to each other (r = 0.92) and very dissimilar to all well samples. In the first dendrogram, some clusters among well samples formed. However, the second cluster analysis indicated little similarity (r <0.6) between the other four wells, A, C, F, and K, when the large variance caused by the lagoon and swamp sample data was removed.

One interpretation of these cluster analysis results could be:

- Chemically unaltered wastewater is not directly entering ground water in the well field.
- Ground water nearest the lagoon/marsh (Wells N and J) is different from ground water in the rest of the well field and is probably influenced by the lagoon/marsh.
- There is no clear identification of "background" ground-water quality in the well field samples. More frequent monitoring and a few more wells may provide the ERO with the information it needs to quantify ground-water effects of the lagoons.

The increased nitrate, chloride, and alkalinity concentrations observed at T-2 tended to mask possible effects from the landfill and lagoon/marsh area on Touchet River water quality. A mass balance calculation using T-2, Well J, and T-3 indicates a possibility that wastewater was reaching the river (Appendix I). These inputs are considered minor compared to inputs above T-2 (Figure 4).

No great changes in water quality were observed at Stations T-5 and T-6 (Table 4; Figure 4). Most parameters remained at levels established at Station T-2. Changes due to Coppei Creek were not evident. Class A criteria were met for all parameters except the September 25 fecal coliform data.

The slight depression of dissolved oxygen (D.O.) saturation levels was probably a function of sampling time (Table 4; Figure 6). The results from Station T-6 illustrate the natural daily variation in D.O saturation because of daytime photosynthesis/night-time respiration of the benthic flora.

Touchet River Biological Quality

The fecal coliform sample results from the Touchet River stations are presented in Figure 7. Class A criteria were met at all stations on September 24. All samples except from T-1 far exceeded Class A criterion on September 25. The lagoon/marsh facility and Coppei Creek were probably not the source of the elevated coliform levels. The pattern illustrated in Figure 7 could represent a decay curve from a source located between T-2 and T-1, or possibly a "slug" of contaminated water that originated above T-1. Samples collected at all stations showed concurrent minor increases in nitrates, chlorides, and conductivity from the 24th to the 25th that may have been associated with the same wastewater source (Table 4; Figure 4).

The benthic invertebrate samples collected at Stations T-1, T-2, T-4, and T-5 were similar in diversity and dominant organisms to Yake's and Cloud's (1979) samples (Table 6). The Shannon-Weaver and Brillouin diversity indices in all 1985 samples indicated "good" or "excellent" water quality, as defined by Yake and Cloud in 1979. Most organisms identified in the samples are considered by researchers as faculative or intolerant (Table 6); i.e., they are able to live in environments with only moderate or low levels of organic contamination (Weber, 1973; Roback, 1974).

A cluster analysis was performed on the benthic invertebrate sample results. Similarities between the benthic populations of samples were established by using Jaccard's coefficient (Romesburg, 1984). When comparing a pair of samples, the Jaccard's coefficient is simply the number of families present in both samples compared to the total number of families represented in the sample pair.

The cluster analysis shown in Figure 8a suggests T-1 is similar to T-5, and T-2 is similar to T-4. The similarity between the two groups is not significant (Jaccard coefficient <0.65). The dissimilarity may indicate that T-2 and T-4 habitats are influenced by the source of wastes within Waitsburg, while T-1 and T-5 are not. A similar cluster pattern emerged from the analysis of the 1979 Touchet River benthic samples (Figure 8b), where T-2 (r.m. 43.25) and T-3 (r.m. 42.91) were significantly similar. Although these few samples alone cannot prove the relative water quality influences of various sources in the Touchet River, they help to support the chemical data findings: the source of wastes within Waitsburg had a more significant impact on water quality during the survey than the lagoon/ marsh.

Coppei Creek Water Quality

No significant changes in water quality were evident from samples taken from Coppei Creek above the Waitsburg wastewater treatment facility (Tables 4 and 5; Figure 9). Yake and Cloud (1979) and this 1985 survey found the water quality meeting all Class A criteria except fecal coliform. Nitrogen concentrations were somewhat higher than in the Touchet River, but COD and BOD concentrations approximated those in the Touchet River.

The most dramatic changes in Coppei Creek water quality since 1979 have occurred adjacent and below the treatment facility. Nutrients, coliform, and oxygen demand are substantially lower than 1979 (Figure 9). D.O. concentrations now meet the Class A criterion. Although the coliform concentration does not meet criteria, C-2 and C-3 values are not significantly different from upstream values. The benthic invertebrate sample taken at Station C-3 reflected these water quality improvements. The 1985 sample's Shannon diversity index of 2.17 is far better than the 1979 index of 1.26. The 1985 sample also contained faculative organisms not found in 1979; e.g., Plecoptera, Trichoptera, and Lepidoptera (Table 6).

The lagoon/marsh system may be slightly influencing water quality in Coppei Creek, but other potential sources of wastes also are present; e.g., the animal confinement area, hog wallow, beavers, and agricultural fields (Figure 3). Results from Stations C-2 and C-3 showed minor increases in ammonia, chloride, and hardness concentrations, and coliform and conductivity values compared to C-1 results (Table 4).

If the Well K sample is representative of the ground-water character reaching Coppei Creek in the vicinity of the Waitsburg lagoon system, the increases could be from approximately 0.1 cfs of ground-water input (based on chloride and conductivity values). However, as discussed earlier, the source of wastes in Well K is uncertain (see Touchet River Water Quality).

Direct Discharge Scenario

The Waitsburg wastewater treatment system has not had a direct discharge incident during low-flow periods. The probability of such an incident occurring appears to be very low because of the construction of the lagoons and the flow characteristics of the plant. However, a leak scenario was evaluated to estimate water quality problems in the Touchet River and Coppei Creek. The scenario assumed the following:

- The leak volume would be at steady state with the present 1985 effluent flow of 0.1 cfs.
- The Touchet River and Coppei Creek are under low-flow conditions, 13 cfs and 1 cfs, respectively.
- The quality of the discharging effluent is similar to the quality of the lagoon sample collected by Heffner (1986).
- Touchet River and Coppei Creek water quality conditions are similar to those found during the 1985 survey.

If the leak were to the Touchet River, violation of the Class A fecal coliform standard would occur, and increased nutrient levels could cause nuisance periphytic growth. Ammonia toxicity and dissolved oxygen depletion would probably be limited to the leak area. In Coppei Creek, a leak would have a similar effect, except the dissolved oxygen depletion would probably affect a larger area. No far-field ammonia toxicity would be expected unless temperatures would rise to greater than 20°C. Then the un-ionized ammonia concentration would exceed the 0.025 mg/L USEPA criterion for 4-day average in salmonid habitat (Federal Register, 1985).

CONCLUSIONS AND RECOMMENDATIONS

The data collected during this survey indicate the Waitsburg wastewater facility currently has little effect on water quality in the Touchet River or Coppei Creek during low-flow periods. No surface drainage or subsurface seeps from the lagoon/marsh to the Touchet River were observed. Sources of water quality degradation both upstream (surface water) and upgradient (ground water) made quantification of any impacts from the facility on surface water quality highly speculative. However, by removing the wastewater outfall from Coppei Creek, the new facility design has allowed significant water quality improvements in the lower 0.5 mile of Coppei Creek. The 1985 Coppei Creek water quality and benthic invertebrate sample results showed marked improvements over 1979. Most Class A criteria are now met.

Data were insufficient to determine the impact of the lagoon/marsh system on the landfill. Current ground-water flow direction could not be determined. No obvious signs of landfill leachate were present from the Touchet River sample results.

The waste source entering the Touchet River at Waitsburg continued to substantially increase in-stream nitrate loads as it had in 1979. It may also have been responsible for the elevated fecal coliform levels observed on the second day of the survey. The vegetable cannery, an abandoned fertilizer plant, or agricultural runoff are possible sources of the wastes. Benthic invertebrate and water quality sample results in 1979 and 1985 suggest this waste source has a more significant impact on Touchet River water quality than the Waitsburg wastewater treatment facility.

The following recommendations can be made:

- Continue to periodically check for surface or or subsurface discharges from the lagoon/marsh into the Touchet River or Coppei Creek.

- Identify and alleviate the waste source entering the Touchet River within Waitsburg.

JJ:cp

Attachments

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APPENDIX I

Mass balance calculations for evaluating the possibility of Waitsburg wastewater reaching the Touchet River.

where: C_e = parameter concentrations in well J = typical wastewater
C_u = parameter concentrations at T-2 = typical Touchet River upstream
C_d = parameter concentrations at T-3 = typical Touchet River downstream
and Q_e, Q_u, and Q_d = flows of effluent, Touchet R. upstream, and downstream

so that,

$$[C_e \times Q_e] + [C_u \times Q_u] = C_d \times Q_d$$

and, therefore,

$$\frac{T_3(Q_d) - T_2(Q_u)}{\text{Well J}} = Qe$$

A consistent flow, Q_e, result would suggest a source of contamination. Between T-2 and T-3 this would most likely be the Waitsburg wastewater treatment system and/or the adjacent abandoned landfill.

Using selected data in Table 4, the following values were calculated for Q_e:

Parameter	Date	Q_e (cfs)
Fe	9/25	0.25
Hardness	9/24	0.30
	9/25	0.27
Chlorides	9/24	-0.59
	9/25	0.37
T. Inorg. N	9/24	-0.17
	9/25	0.79
	$\overline{X}$	0.34

The values suggest a possible source of 0.3 cfs. However, the high variability in the data greatly reduces the certainty of this.

Table 1. Class A (excellent) water quality standards (WAC 173-201-045) and characteristic uses..

Characteristic uses:	Water supply, wildlife habitat; livestock watering; general recreation and aesthetic enjoyment; commerce and navigation; fish reproduction, migration, rearing, and harvesting.
<u>Water Quality Criteria</u>	
Fecal coliform:	Geometric mean not to exceed 100 organisms/100 mLs with not more than 10 percent of samples exceeding 200 organisms/100 mLs.
Dissolved oxygen:	Shall exceed 8 mg/L.
Total dissolved gas:	Shall not exceed 110 percent saturation.
Temperature:	Shall not exceed 18°C due to human activity. Increases shall not, at any time, exceed $t = 28/(T+7)$; or where temperature exceeds 18°C naturally, no increase greater than 0.3°C. t = allowable temperature increase across dilution zone, and T = highest temperature outside the dilution zone. Increases from non-point sources shall not exceed 2.8°C.
pH:	Shall be within the range of 6.5 to 8.5, with man-caused variation within a range of less than 0.5 unit.
Toxic, radioactive, or deleterious materials:	Shall be below concentrations 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.
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.

Table 2. 1984 Water Quality Index values for the Touchet River at river mile 0.5. Values 0 - 20 indicate acceptable water quality; 20 - 60 indicate routine violation of water quality standards (Moore, 1984).

Segment Number	Name and Ambient Station Number	Stream Miles	Temp.	Oxy-gen	pH	Bac-ter-ia	Tro-phic	Aes-the-tic	Susp. Solids	Over-all
15-32-03	Touchet R. 32B070	50	37	17	9	28	21	57	53	46

Table 3. Station loctions and analysis taken.

Station Number	River Mile	Description	Field/Laboratory Analyses
T-1	44.78	Touchet River upstream of Waitsburg at Grange property on Highway 12	Discharge, dissolved oxygen, pH, temperature, conductivity/nutrients(5), fecal coliform, alkalinity, hardness, chloride, BOD-5, solids (4), COD, color, turbidity, pH, and conductivity
T-2	43.44	Touchet River below Waitsburg but above the old landfill and the WTP lagoon area at rock rip-rap area	Same as above. Additional analysis of iron
T-3	43.28	Touchet River at Waitsburg WTP lagoon site--at blocked drainage channel from swamp	Same as T-2, except no discharge measured
T-4	43.04	Touchet River, 150 yds above confluence with Coppei Creek	Same as T-2
T-5	42.89	Touchet River, 200 yds below confluence with Coppei Creek	Same as T-2
T-6	42.60	Touchet River, 700 yds below confluence with Coppei Creek across from train trestle	Same as T-3
C-1	0.5	Coppei Creek, 5 yds below the Highway 124 bridge	Same as T-2
C-2	0.33	Coppei Creek along Waitsburg's WTP access road opposite the middle of the first treatment lagoon	Same as T-3 except no iron measurement
C-3	0.1	Coppei Creek, 100 yds upstream from confluence with Touchet River	Same as T-2

Table 4. Water quality results from the Touchet River, Coppei Creek, the Waitsburg wastewater lagoon/marsh system and its surrounding well field, taken during a Class II and receiving water study on September 24 and 25, 1985. All values mg/L unless otherwise indicated.

Field and Laboratory Parameter	TOUCHET RIVER T-1 (Station River Mile 44.78)		T-2 (43.44)		T-3 (43.28)		T-4 (43.04)		T-5 (42.89)		T-6 (42.60)		COPPEI CREEK C-1 (0.5)		C-2 (0.33)		C-3 (0.1)		TREATED EFFLUENT† Lagoon	Marsh	WELL FIELD† A	C	F	J	K	New Well
Date	24	25	24	25	24	25	24	25	24	25	24	25	24	25	24	25	24	25	25	25						
Time	1300	1125	1200	1100	1140	1040	1000	0950	0850	0930	1345	0910	1240	1140	1220	1025	1100	1000	0940	1340						
Flow (cfs)	53	--	49	--	--	--	54	53.50	55	--	56**	53**	--	2.1	--	--	2.1	1.9	--	--						
Temp. (°C)	14.5	12.1	12.9	11.7	12.6	11.6	11.4	10.8	10.9	10.8	14.7	10.7	11.2	11.3	11.8	10.7	11.2	11.0	12.4	21.8	14.9	15.9	15.1	15.9	13.4	15.4
pH (S.U.)	8.7	8.4	8.4	8.2	8.4	8.4	7.9	8.0	--	8.1	8.3	8.2	7.7	7.6	7.6	7.8	7.4	7.8	6.9	7.2	6.8	6.6	6.8	6.7	6.7	6.7
Conductivity (umhos/cm)	102	105	120	142	120	150	142	145	134	153	110	145	145	147	167	177	168	185	375	370	615	850	750	630	620	660
Dissolved Oxygen	10.4	11.3	11.4	11.2	11.5	11.4	11.4	11.1	11.2	11.1	11.6	11.0	9.8	9.3	9.4	8.8	9.4	9.0	0	--	--	--	--	--	--	--
% D.O. Sat.	101	104	107	103	108	104	104	100	101	100	113	99	88	84	86	79	85	81	0	--	--	--	--	--	--	--
COD	4	4	4	4	4	<4	9	4	17	<4	4	4	<4	4	4	4	9	9	34	55	9	17	17	17	9	22
5-day BOD	--	--	<4	<4	<4	<4	<4	<4	--	<4	--	--	<4	<4	<4	<4	<4	<4	14	--	--	--	--	--	--	--
F.C. (org/100 mL)	13*	47	18	1120*	18	2010*	31	1070*	71	670*	15	390	320	480	670*	780*	570	590	70,000	6400	152	360	<4	<4	1680*	<4
NO_3-N	0.10	0.13	0.31	0.35	0.32	0.39	0.36	0.39	0.37	0.40	0.28	0.40	0.54	0.56	0.56	0.54	0.59	0.55	0.01	0.02	11.0	8.1	0.02	0.01	2.9	0.01
NO_2-N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.25	<0.01
NH_3-N	0.03	0.03	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.10	0.06	0.05	0.06	12	12	0.25	3.6	1.0	3.2	2.3	3.0
T. Inorganic Nitrogen-N	0.13	0.16	0.35	0.36	0.34	0.41	0.38	0.41	0.39	0.42	0.31	0.42	0.57	0.58	0.66	0.60	0.64	0.61	12.01	12.02	11.2	11.7	1.0	3.2	5.4	3.0
O-PO_4-P	0.07	0.06	0.06	0.06	0.06	0.11	0.09	0.06	0.10	0.06	0.06	0.06	0.06	0.06	0.08	0.08	0.09	0.08	4.8	5.2	0.25	0.01	0.01	0.01	0.01	<0.01
T. Phosphorus	0.08	0.15	0.09	0.08	0.08	0.08	0.09	0.08	0.09	0.09	0.08	0.08	0.11	0.09	0.10	0.10	0.10	--	7.0	7.4	0.45	0.95	1.0	1.7	0.90	2.4
Alkalinity as $CaCO_3$	49	50	55	55	54	56	56	57	56	56	55	58	67	69	72	72	78	83	120	--	--	--	--	--	--	--
Hardness as $CaCO_3$	43	43	49	50	50	51	51	52	51	52	50	52	59	60	63	62	67	71	55	57	220	270	270	180	210	200
Color	17	--	0	8	8	13	8	8	13	8	8	13	25	38	46	55	71	80	92	110	4	17	580	590	12	170
Turbid. (NTU)	1	1	1	1	1	1	1	1	1	1	1	1	2	2	3	6	6	8	4	--	--	--	--	--	--	--
Chloride	1.1	1.3	4.5	4.7	4.2	4.9	4.1	5.2	4.1	5.3	4.1	5.0	0.8	0.9	1.4	1.2	1.8	2.5	17	18	12	14	36	27	17	26
Spec. Cond. (umhos/cm)	105	107	127	131	128	133	130	136	134	138	128	139	149	150	159	157	166	176	--	--	--	--	--	--	--	--
Total Solids	110	--	120	130	120	110	120	110	--	130	120	110	130	120	140	130	160	150	220	--	--	--	--	--	--	--
Total non-volatile solids	78	--	54	71	110	73	60	60	--	77	61	63	87	91	100	110	110	92	160	--	--	--	--	--	--	--
Total suspended solids	1	--	5	4	8	14	5	4	--	7	5	1	7	4	11	12	22	20	7	20	4	11	18	26	2	36
Total non-volatile suspended solids	<1	--	5	3	4	11	5	4	--	7	5	<1	6	3	7	11	19	17	4	--	--	--	--	--	--	--
Total iron	--	--	0.177	--	0.230	--	0.210	--	0.256	--	--	--	0.726	--	--	--	--	1.940	0.161	0.77	0.119	3.940	12.700	11.400	0.044	7.010

*Estimates based on non-ideal plate counts.
**USGS provisional flow data from Sta. 14017000 at r.m. 40.1.

< = less than
† = Analytical results from Heffner (1986).

Table 5. Selected results from samples collected by Yake and Cloud from the Touchet River and Coppei Creek in 1979. All values mg/L unless otherwise indicated.

	TOUCHET RIVER				COPPEI CREEK		
Station :	T-1	T-2	T-3	T-4	C-2	C-3	C-4
River Mile:	44.78	43.25	42.91	42.62	0.55	0.42	0.35
<u>Parameter</u>							
Flow (cfs)	32.2	32.4	(34.1)	31.3	1.61	(1.80)	1.67
Conductivity (umhos/cm)	125 120	142 148	138 138	155 148	155 162	242 235	252 198
Temperature (°C)	13.5 13.7	14.1 14.0	14.6 14.3	14.0 14.8	14.4 13.3	15.5 14.8	13.6 13.0
Dissolved Oxygen	11.3 10.9	11.2 11.2	11.0 11.0	11.4 11.5	9.8 10.6	9.2 8.1	5.7 6.7
5-day BOD	2	2	2	<2	<2	6	9
Nitrate-N	0.17 0.14	0.34 0.33	0.35 0.35	0.38 0.33	0.33 0.33	0.42 0.46	0.73 0.77
Nitrite-N	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01	0.11 0.12	0.10 0.10
Ammonia-N	0.02 0.06	0.01 0.01	0.02 0.08	0.05 0.08	0.09 0.11	1.1 1.5	0.39 0.40
Total Phosphorus-P	0.10 0.09	0.07 0.09	0.10 0.10	0.08 0.09	0.07 0.10	0.70 0.85	0.54 0.47
Fecal Coli. (org/100 mL)	14* 4*	10* 1*	62 60*	76 50	510 570*	19,000* 1,600*	1,200 370*

*Estimated populations based on non-ideal plate counts.

Table 6. Benthic invertebrate sample results from the Touchet River and Coppei Creek, collected September 25, 1985. Included are index values from Yake and Cloud (1979).

Tolerance Category*		Touchet River Stations T-1	T-2	T-4	T-5	Coppei Creek C-3
	INSECTA					
	Ephemeroptera					
F,I	Heptageniidae	43	22	13	39	--
F,I	Leptophlebiidae	--	--	--	4	--
I	Siphlonuridae	10	--	--	4	--
F	Tricorythidae	--	--	--	2	--
	Plecoptera					
F,I	Perlodidae	--	32	42	13	5
	Trichoptera					
F,I	Hydropsychidae	78	114	153	175	10
I	Hydroptilidae	4	32	3	4	--
F,I	Helicopsychidae	81	5	238	1	--
F,I	Glossosomatidae	--	3	--	--	--
F,I	Leptoceridae	--	--	5	--	--
	Lepidoptera					
F	Pyralidae	66	29	27	91	9
	Coleoptera					
F,I	Elmidae (larval)	7	9	9	7	--
	Elmidae (adult)	--	--	--	1	--
	Diptera					
F,T	Chironomidae	67	9	45	62	25
F	Simuliidae	--	1	31	--	3
	ACARINA					
I	Hydracarina	13	--	1	1	
	MOLLUSCA					
F	Ancylidae	--	--	1	--	37
	ANNELIDA					
F,T	Oligochaeta	--	--	--	--	71
Total number of families		9	10	12	12	7
Total number of individuals		369	256	528	404	160
Shannon Index† 1985 (1979)		2.70 (2.51)	2.49 (2.19)	2.39 (2.23)	2.31 (2.55)	2.17 (1.26)
Brillouin Index† 1985 (1979)		2.62 (2.42)	2.38 (2.10)	2.33 (2.17)	2.23 (2.49)	2.06 (1.24)

*Tolerance category for organic contamination based on lists available in USEPA, 1973 and Roback, 1974.

T = Tolerant
F = Faculative
I = Intolerant
† = Calculated as per Hellawell, 1978

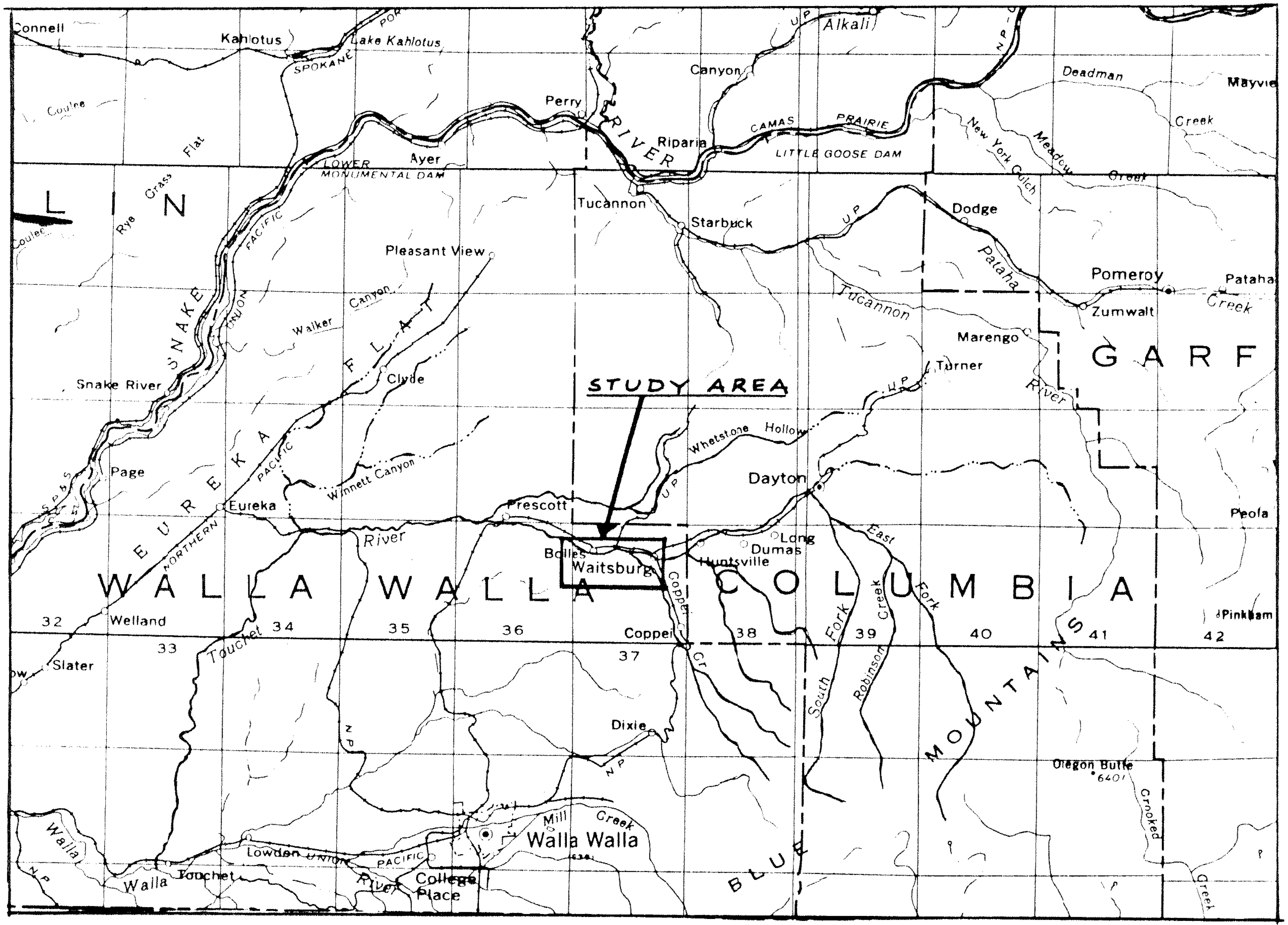


Figure 1. Touchet River drainage and receiving water study area at Waitsburg, 1985.

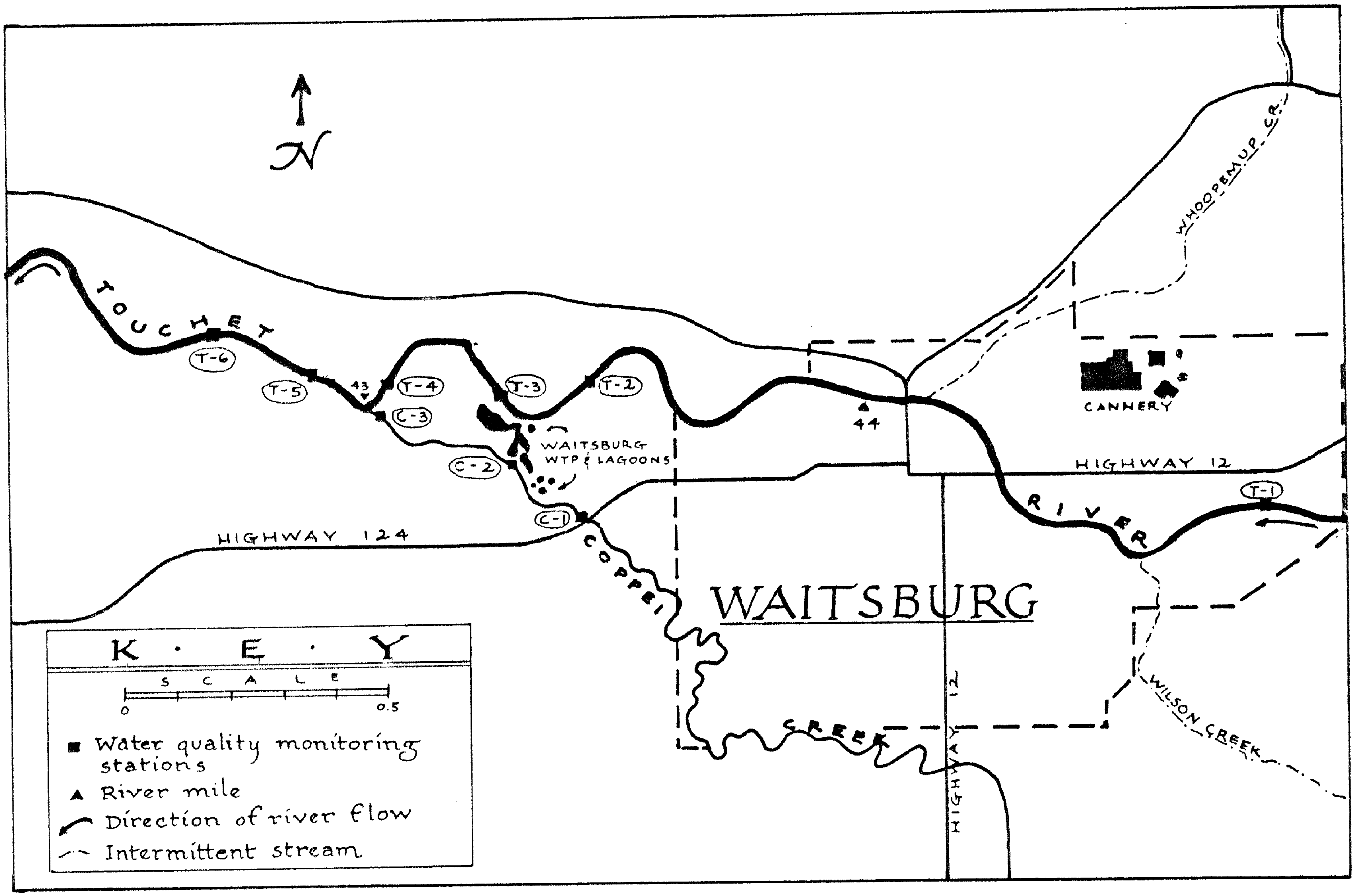


Figure 2. Station locations on Coppei Creek and the Touchet River in the vicinity of Waitsburg, September 24-25, 1985.

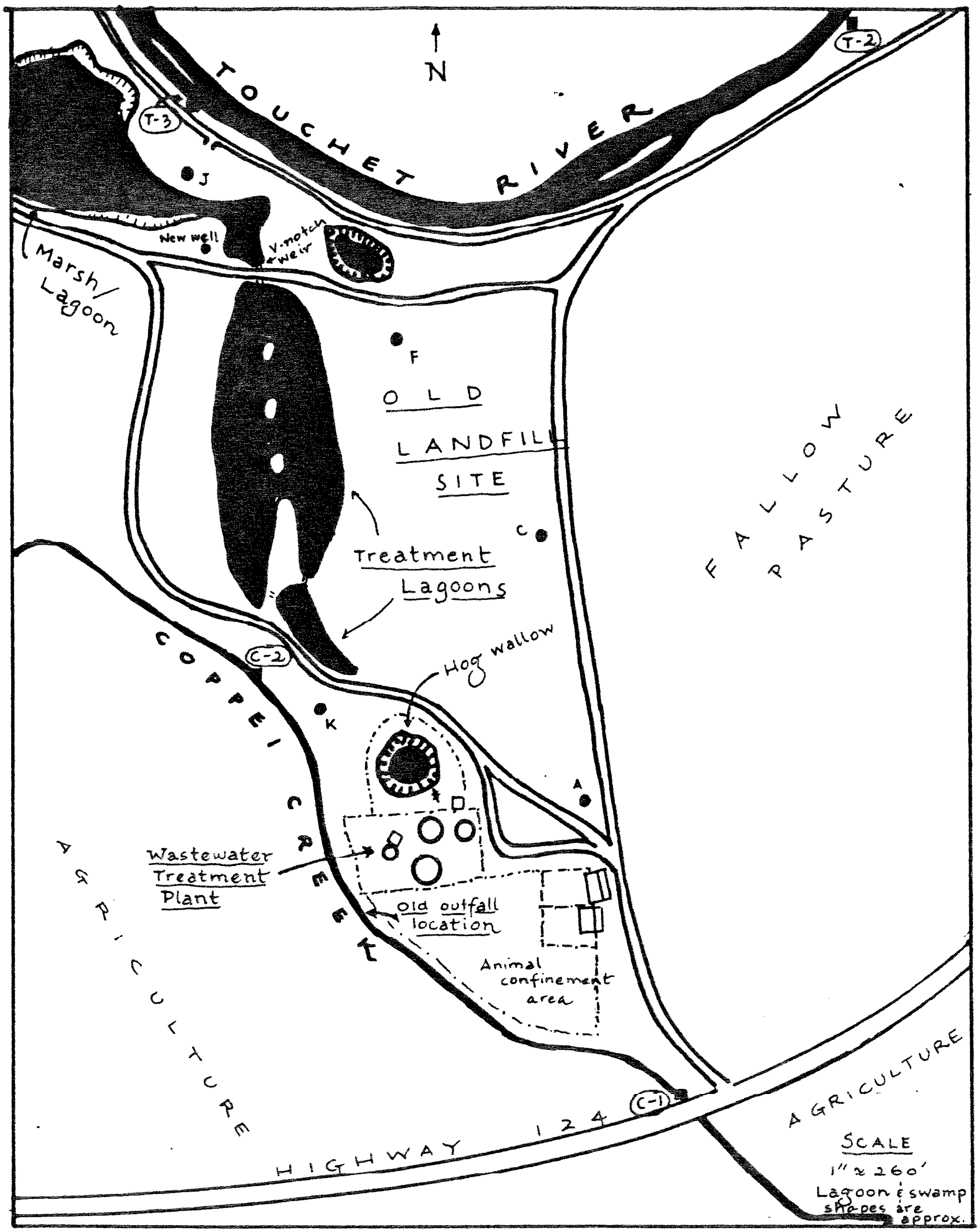
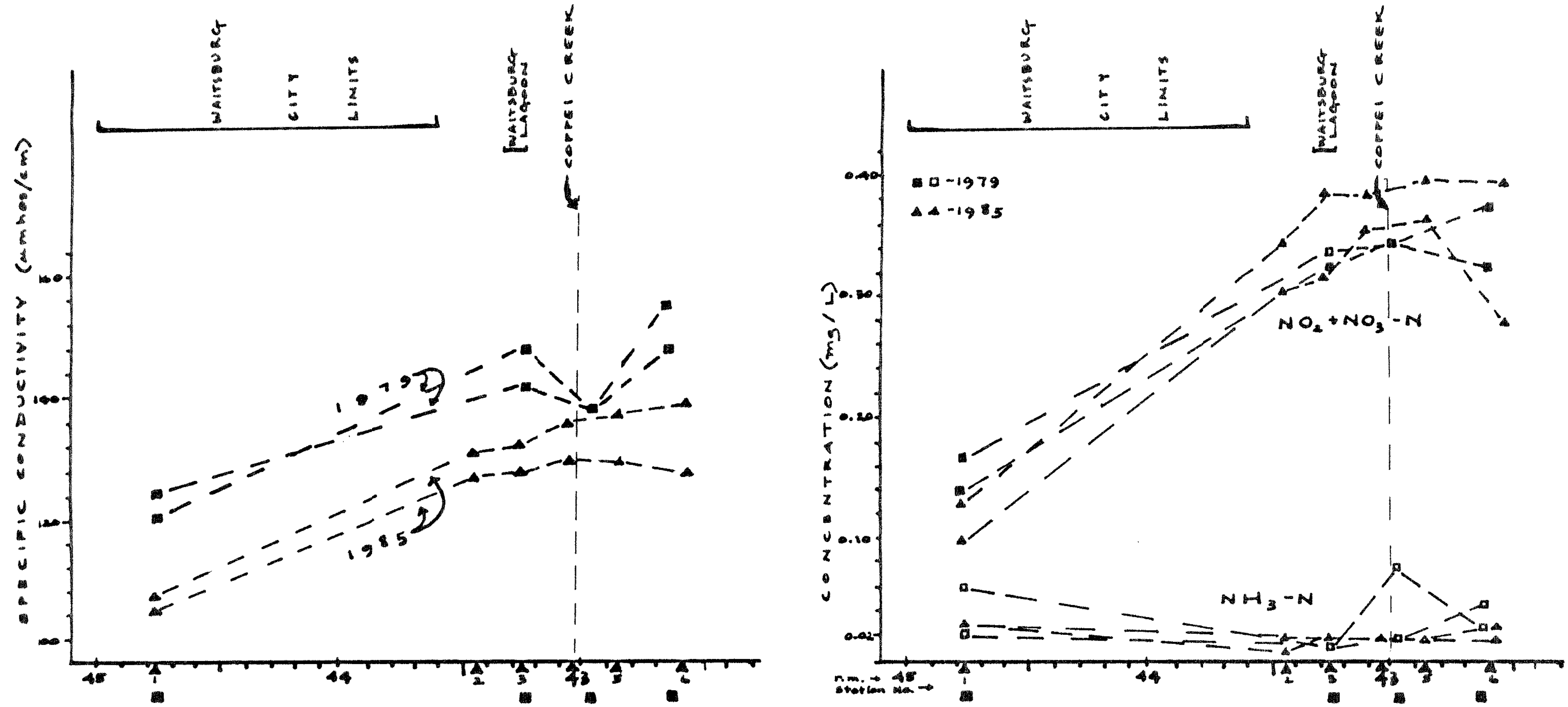


Figure 3. Waitsburg wastewater treatment plant and lagoons with monitoring wells (●) and surface water sampling sites (■) shown.



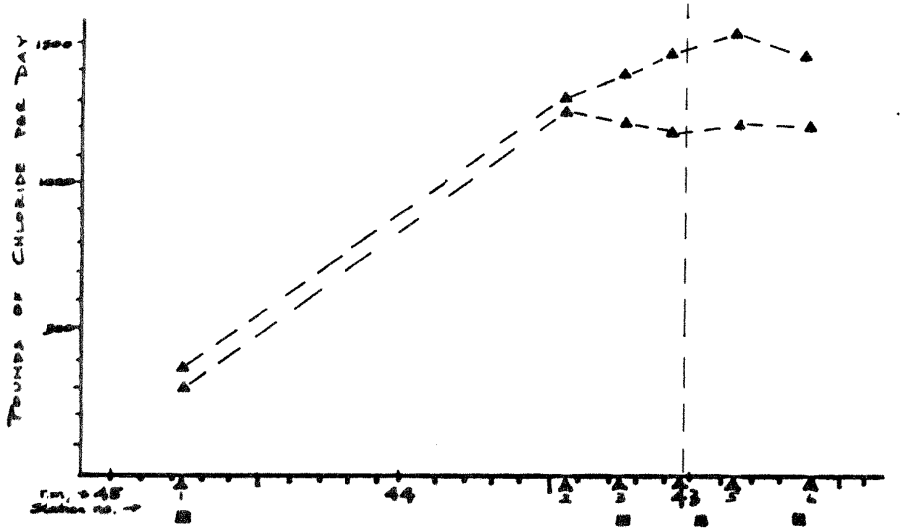
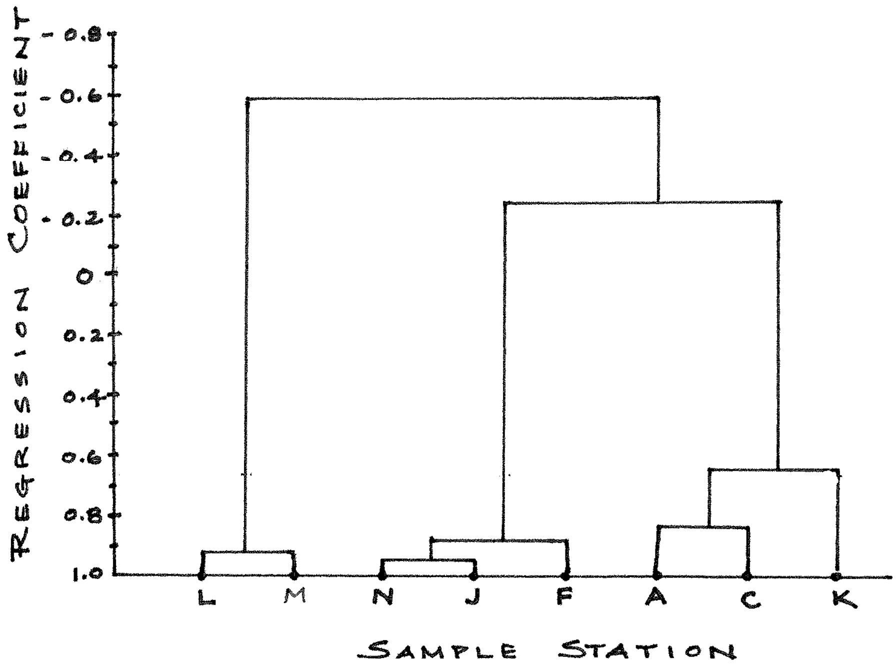


Figure 4. Conductivity and nutrient concentration profiles along the Touchet River during the 1985 (▲) and 1979 (■) receiving water studies. Chloride loading profile along the Touchet River during the 1985 survey.



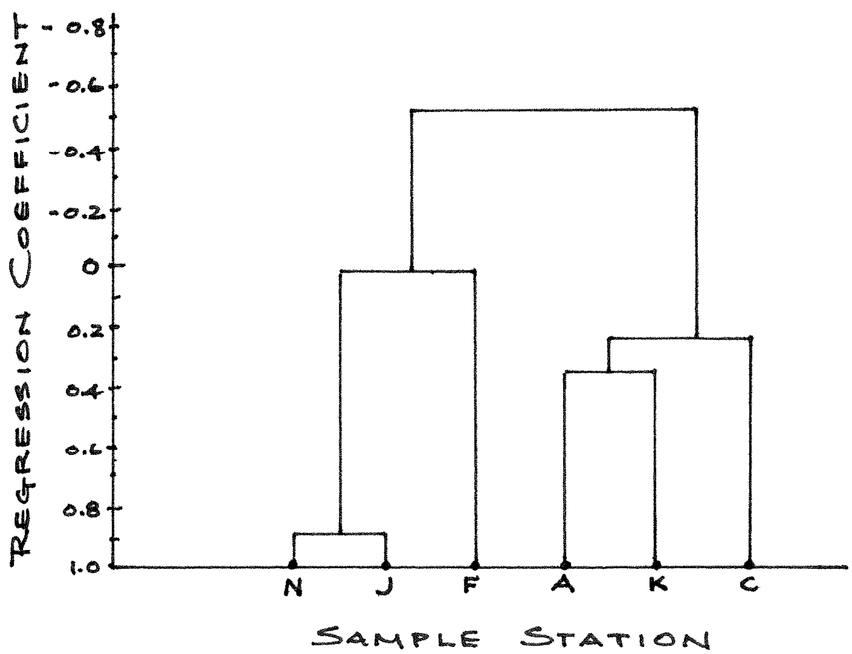


Figure 5. Cluster analysis dendograms for Waitsburg wastewater lagoon (L), marsh (M), and monitoring well samples (A, C, F, J, K, N) taken September 24-25, 1985.

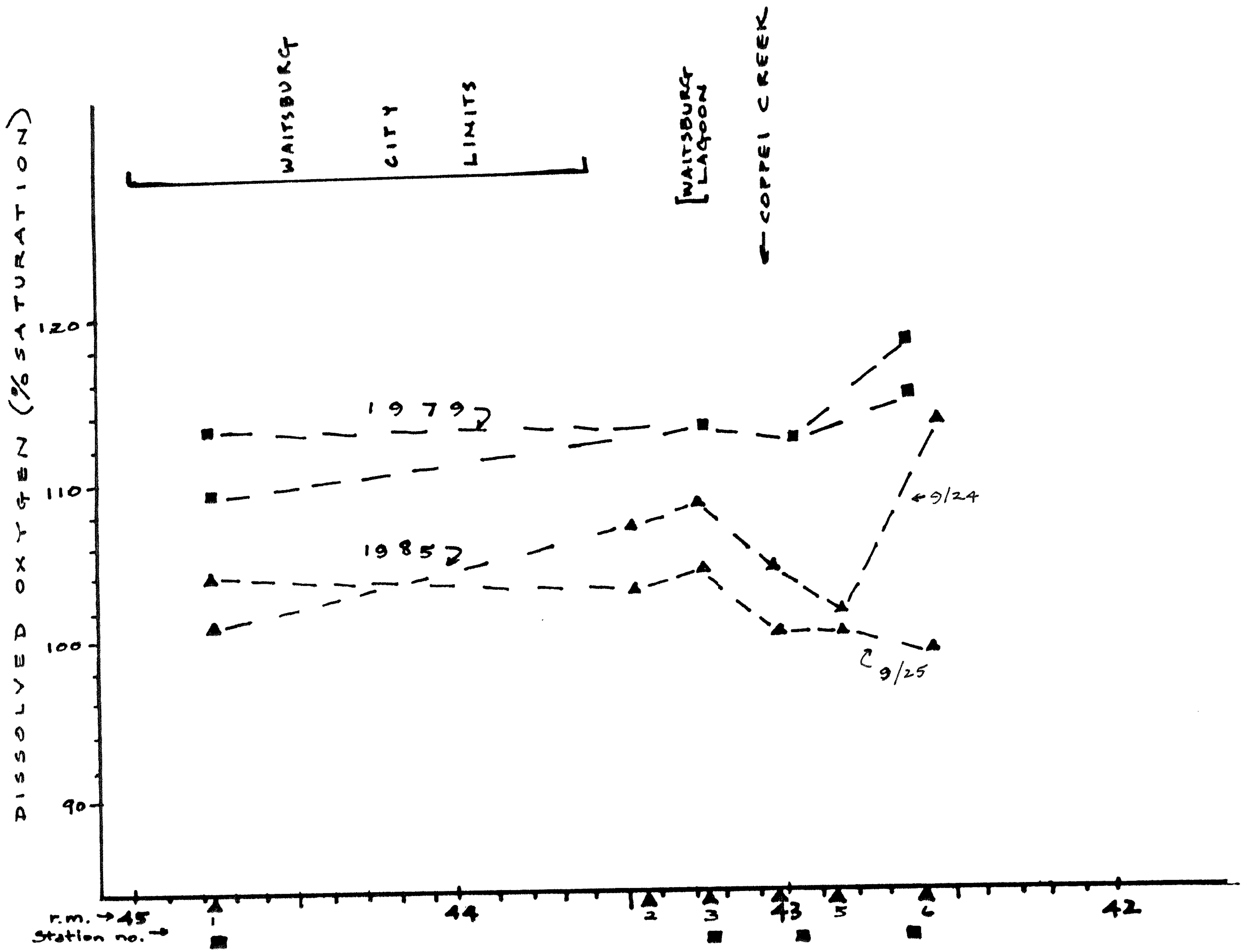


Figure 6. Dissolved oxygen profiles along the Touchet River during the 1985 and 1979 receiving water studies.

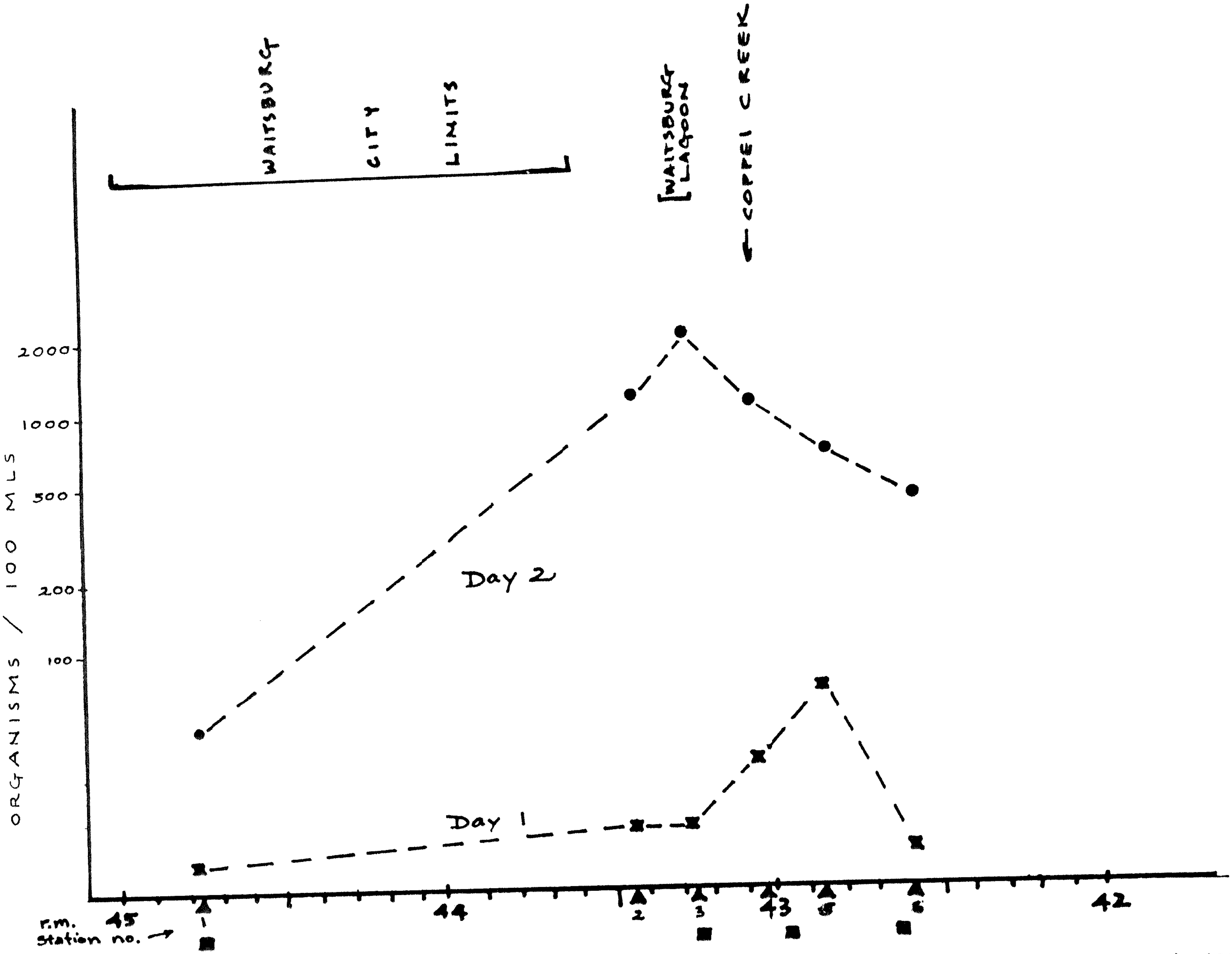
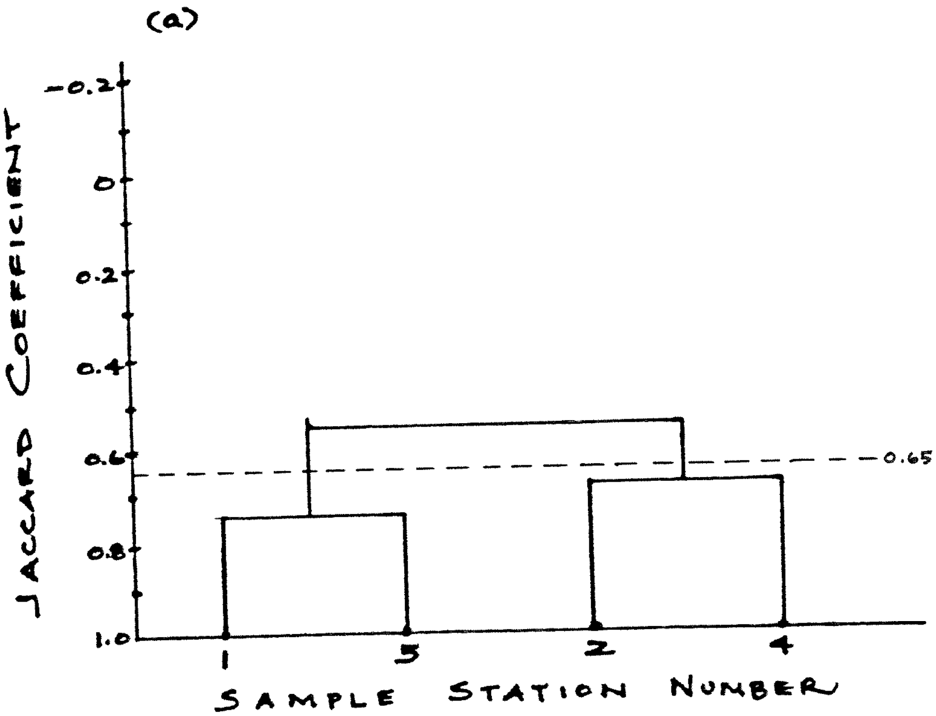


Figure 7. Fecal coliform results from samples taken along the Touchet River on September 24-25 (day 1 - day 2), 1985. Note logarithmic scale.



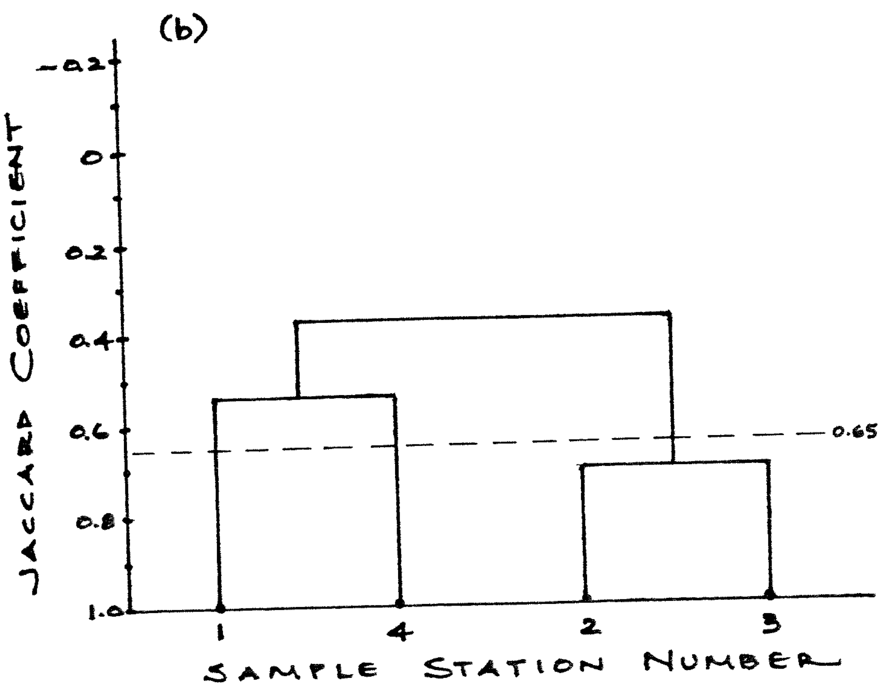


Figure 8. Cluster analysis dendograms comparing benthic invertebrate sample results taken along the Touchet River in 1985 (a) and 1979 (b).

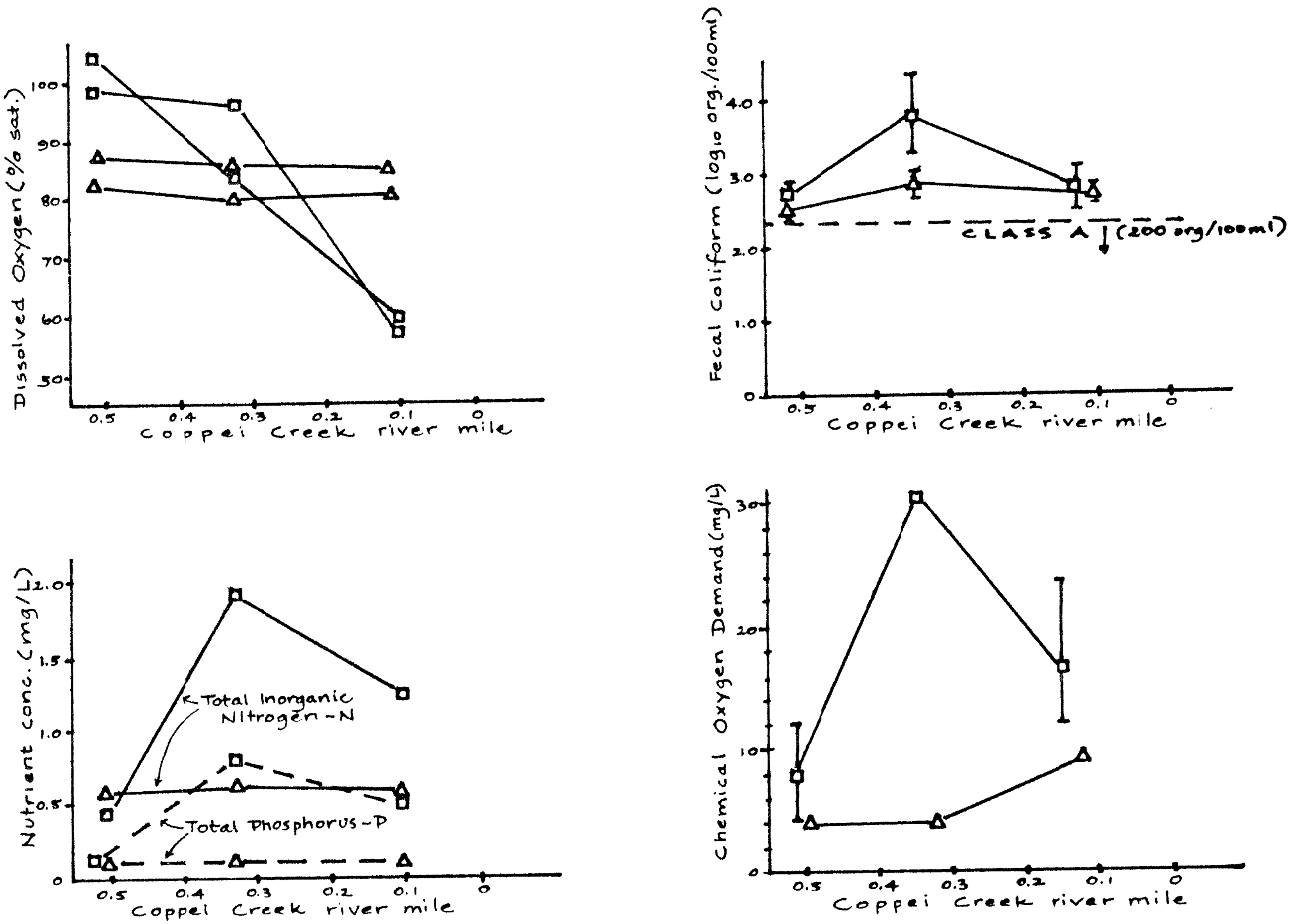


Figure 9. Concentration profiles of dissolved oxygen saturation, nutrients, fecal coliform, and chemical oxygen demand along Coppei Creek during the 1985 (Δ) and 1979 (□) receiving water surveys.