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JORDAN RIVER STUDY
UTAH
JUNE - AUGUST, 1972

TECHNICAL SUPPORT BRANCH
SURVEILLANCE AND ANALYSIS DIVISION
U. S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII

FEBRUARY, 1973

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Norm Chamberlain
Russ Henshaw

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INTRODUCTION

This report on the quality of the waters of the Jordan River Basin is based on information obtained during the June and August 1972 field investigations conducted by personnel of Region VIII, Environmental Protection Agency.

The Utah Lake-Jordan River Basin has been one of the areas designated by the Environmental Protection Agency as a Priority Basin; i.e., EPA Region VIII is devoting the highest priority to a concentration of resources in these basins to obtain water quality goals at the earliest possible date. Thus, the priority basins receive first attention in the allocation of regional resources. In addition, Utah Lake is listed as a target area in EPA's National Eutrophication Control Program.

In implementing the Priority Basin Concept, Region VIII in cooperation with the State of Utah has conducted several studies in the Jordan River Basin in an effort to assist the State in the gathering of pertinent water quality information. Through meetings and discussions with the State and other concerned individuals and organizations, it was determined that there existed certain areas that would benefit from field work conducted by EPA.

The first of the studies in the Basin consisted of a short-term, intensive water quality study of Emigration Canyon conducted during the week of June 19-25, 1972. Also included in this study was a limited nutrient investigation of the Jordan River in the vicinity of a proposed impoundment on the river.

A second intensive effort during the period August 13-26, 1972, involved the entire length of the Jordan River from Utah Lake to the Great Salt Lake, and was focused on water quality and biological activity in the river. The study was conducted to supplement previous data obtained by the Utah Water Pollution Committee and the Utah Department of Fish and Game in their program of pollution abatement and control, and river use classification.

All sampling locations used in these investigations were developed in conjunction with State needs and consisted of (1) stations presently being sampled by the State, (2) newly established stations developed to provide more detailed information in certain areas, and (3) sampling sites where historic data was available within the study areas but not included in the present State sampling program.

AREA

The Utah Lake-Jordan River Basin is a semi-arid interior drainage basin located entirely within the State of Utah. Utah Lake, which averages about 8 feet in depth, is located in the center of the Utah Valley which is bounded on the east by the Wasatch Mountains and on the west by the Lake Mountains.

The Jordan River originates at Utah Lake and leaves the lake in a northerly direction at an elevation of approximately 4,488 feet, and flows approximately 55 miles northward to enter the Great Salt Lake at an elevation of 4,203 feet. As the gradient of 5.2 feet per mile indicates, a river of this type would tend to be slow and meandering with few riffles. It would be subject to silting and quite vulnerable to organic pollution due to its low capacity for natural reaeration.

At a point approximately 10 miles downstream from Utah Lake (at the Jordan Narrows), flow in the Jordon River is affected by the first of several diversion dams constructed for irrigation purposes. The average flow at this location is approximately 350 cfs, ranging from about 1,400 cfs during the spring run-off to 0 cfs when the irrigation gates are opened. Downstream from the Diversion Dam at the Narrows, the river's flow is augmented by numerous springs, irrigation return flows, waste water treatment plant effluents and about a dozen tributary streams (Figure 1). The most significant of these treatment plants and tributaries to the Jordan River are listed in Tables 1 and 2.

RESULTS OF STUDY

EMIGRATION CANYON

Based on meetings held between representatives of the State of Utah, the firm of Templeton, Linke, and Alsup, the City and County of Salt Lake, and the Environmental Protection Agency, EPA Region VIII personnel conducted a short-term water quality investigation of certain elements of the Utah Lake-Jordan River Basin during the period June 19-25, 1972.

The study, intended to provide baseline information, covered the elements of: (1) bacteriological quality of Emigration Canyon (Creek), and (2) nutrient concentrations in the area of the proposed impoundment of the Jordan River. The results of all physical, chemical, and microbiological determinations are tabulated in Appendix Table A-2.

Though some members of the coliform group are distributed widely in nature, coliform bacteria are always present in excretions from the intestinal tract of man and other warm-blooded animals. The absence of coliform bacteria, therefore, is evidence of a bacteriologically safe water. The presence of fecal coliform bacteria in the water environment is proof of fecal contamination and an indication of hazardous pollution.

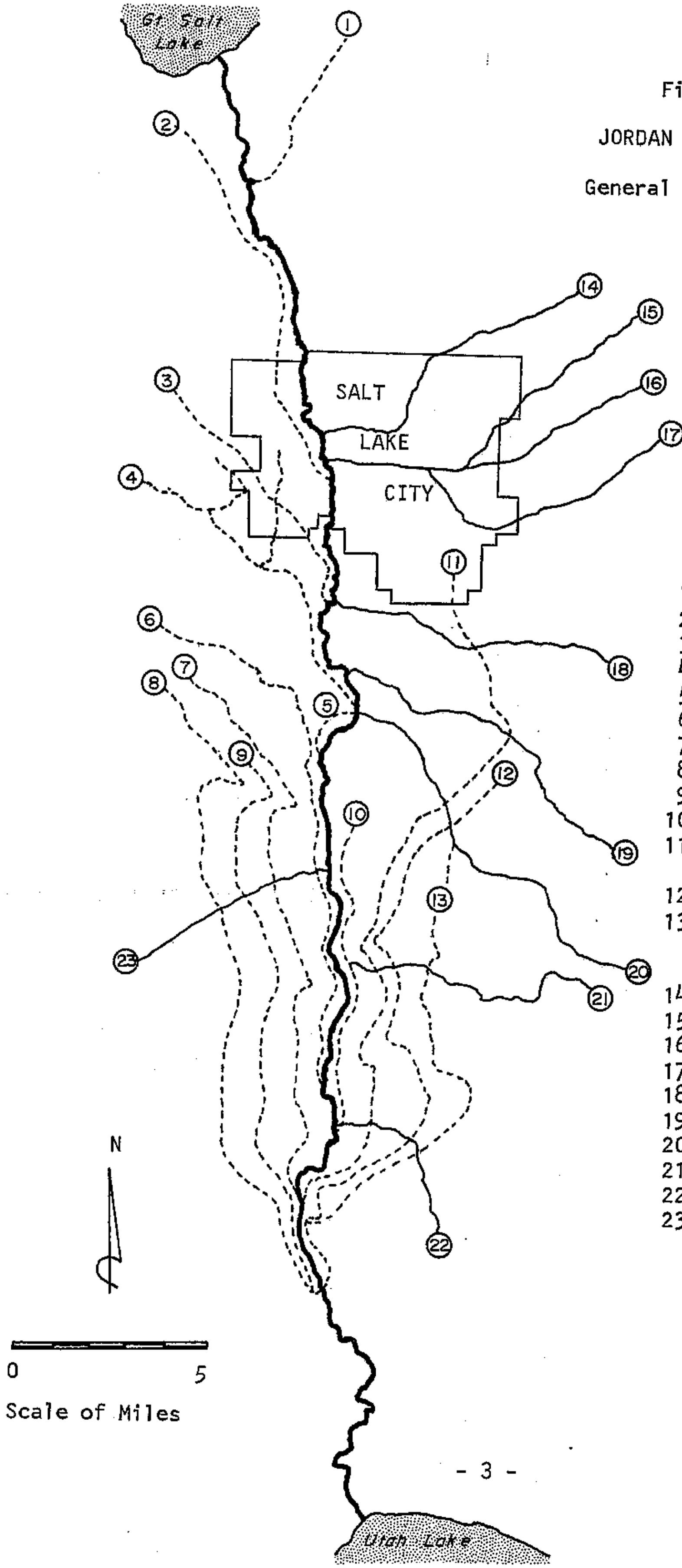
The microbiological investigation of Emigration Canyon was considered necssary due to the lack of a common wastewater collection and treatment system along the cnayon. Individual wastewater systems (cesspools, septic tanks, etc.) discharge in the vicinity of or directly into the creek that winds its way through the canyon.

Ten sampling locations were established along the creek from the vicinity of the headwaters to its confluence with the Jordan River near 13th South Street in Salt Lake City (Figure 2 and Table A-1). Daily grab samples were obtained at all established stations with twenty-four-hour (round-the-clock) samples obtained at two stations, EC-9 and EC-10.

Figure 1

JORDAN RIVER BASIN

General Location Map



Canals

1. State Canal
2. City Drain
3. Surplus Canal
4. Brighton Canal
5. Mill Race Ditch
6. North Jordan Canal
7. South Jordan Canal
8. Utah Lake Irrigation Canal
9. Utah & Salt Lake Canal
10. Galena Canal
11. Jordan & Salt Lake City Canal
12. East Jordan Canal
13. Draper Irrigation Canal

Tributaries

14. City Creek
15. Red Butte Creek
16. Emigration Creek
17. Parley's Creek
18. Mill Creek
19. Big Cottonwood Creek
20. Little Cottonwood Creek
21. Dry Creek
22. Corner Canyon Creek
23. Bingham Creek

TABLE 1

JORDAN RIVER

WASTEWATER TREATMENT FACILITIES

Domestic Wastewater Facilities Discharging their Effluents into the Jordan River or One of its Tributaries in the Area of EPA Study and Information about Each Plant's Capabilities

Sanitary District	River Mile Location	Estimated Population Served	Average Flow (MDG)	Designed for		Estimated BOD		EPA Biology Stations	
				Flow (MGD)	BOD (P.E.)	Untreated (P.E.)	Treated Discharge	UPS	DNS
Utah State Prison	39.9	770	0.16	0.07	700	770	540	14600 South	12600 South
Sandy	31.49	12,000	1.63	1.5	12,325	12,000	2,370	9000 South	7800 South
Tri-Community	28.03	23,781	3.80	3.6	24,000	28,588	4,847	7800 South	6400 South
Murray	24.65	20,846	2.69	4.0	15,000	30,588	3,300	4800 South	4500 South
Salt Lake County Cottonwood	24.0	34,370	4.1	4.0	40,000	34,370	—	4500 South	3300 South
Granger-Hunter	20.84	52,071	5.0	7.3	60,000	55,593	8,350	3100 South	2100 South
Salt Lake City Suburban #1	20.3	103,531	11.05	16.0	80,000	103,531	13,769	3100 South	2100 South
South Salt Lake	18.19	8,810	2.64	4.55	30,000	29,856	3,355	2100 South	300 South
South Davis South	5.81	13,133	1.25	2.27	25,000	13,505	1,508	1800 North	Cudahy Lane
South Davis North	2.8	32,079	3.97	5.35	35,000	32,079	4,165	Cudahy Lane	- -

P.E. = Population Equivalents

TABLE 2

JORDAN RIVER

TRIBUTARY STREAMS

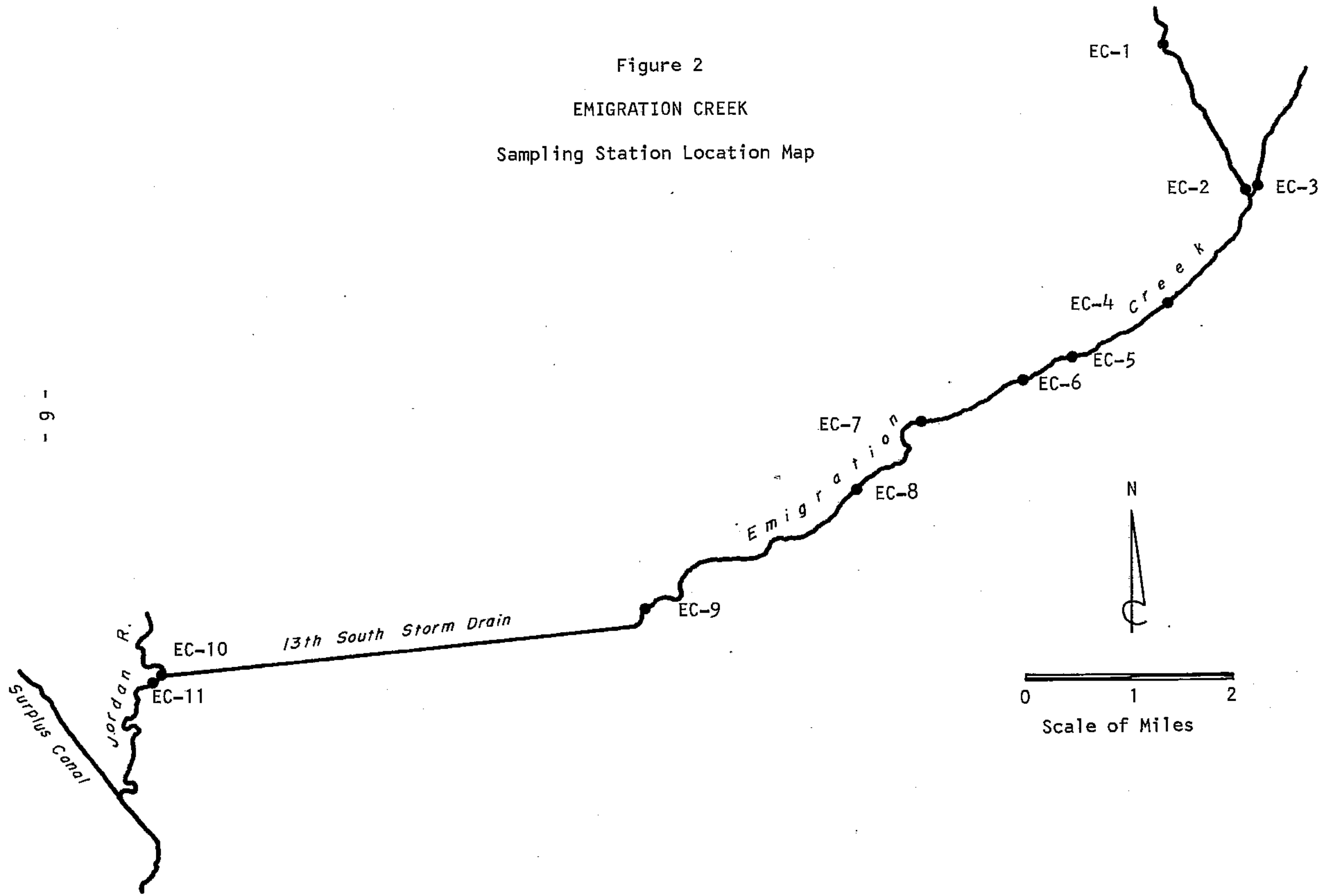
(Listed from South to North or Upstream to Downstream)

1. Corner Canyon Creek
2. Willow Creek
3. Dry Creek
4. Bingham Creek
5. Little Cottonwood Creek
6. Big Cottonwood Creek
7. Mill Creek
8. Parley's Creek
9. Emigration Creek
10. Red Butte Creek
11. City Creek

Figure 2

EMIGRATION CREEK

Sampling Station Location Map



Results of the grab samples indicated that low total and fecal coliform densities existed in the headwaters of the creek. At station EC-1, the mean total and fecal densities were 20/100 ml and 6/100 ml, respectively (Figure 3). Moving downstream, both the total and fecal mean densities steadily increased, reaching maximums at station EC-9 (TC 2413/100 ml and FC 623/100 ml over the 5 routine sampling days), the point where the creek enters the 13th South Storm drain. This increase is indicative of the effects of discharges along the stream's course.

The construction of the storm drain outfall is such that is is not possible to sample the outlet of the storm drain (creek) before it becomes partially mixed with Jordan River water. Station EC-10, the outlet of the storm drain, therefore, indicates the density of coliform in the creek mixed with the Jordan River. At this location, mean densities (over the 5 routine sampling days) of 1052/100 ml total coliform and 177/100 ml fecal coliform occurred.

At the station located in the Jordan River approximately 50 yards upstream from the confluence with the 13th South storm drain, mean total and fecal coliform densities of 64,000/100 ml and 3200/100 ml respectively, occurred. These values in the Jordan River indicate that the impact on the river from waters entering from the Emigration Canyon area was slight at the time of this investigation.

Water quality classifications applicable to all waters in the Utah Lake-Jordan River Basin call for total coliform densities not to exceed 5000/100 ml. Although the daily grab samples did not indicate values in excess of this criteria (Figure 3), the round-the-clock samples did indicate that at times during the day total coliform densities increased to levels which exceeded this criteria at stations EC-9 and EC-10 (Figures 4 and 5). This is of particular significance in that the sport of "tubing" - riding an innertube down the creek - was observed in the area of stations EC-8 and EC-9. In this reach between these two stations the creek is enclosed for some distance in a large concrete pipe. The "sport" calls for the navigation by innertube through this pipe. The high coliform densities at these locations, therefore, indicate a probable health hazard to those indulging in this "sport."

Organic matter contained in municipal and many industrial wastes, when biochemically degraded, exerts an oxygen demand on the waters receiving such wastes, resulting in a reduction of the dissolved oxygen resources of the waters. High concentrations of such oxygen-demanding wastes can cause excessive dissolved oxygen depletion, resulting in a reduction of desirable aquatic life, including fish, and create unpleasant odors.

Dissolved oxygen requirements applicable to all waters in the Utah Lake-Jordan River Basin call for a dissolved oxygen concentration of 5.5 mg/l to be maintained for a warm water fishery and that a concentration of 6.0 mg/l be maintained for a cold water fishery. All waters of the basin are classified by the State as a cold water fishery with the exception of Utah Lake and the Jordan River from Utah Lake downstream to the Utah County Line.

Figure 3

EMIGRATION CREEK

Mean Total & Fecal Coliform

vs

Stream Miles

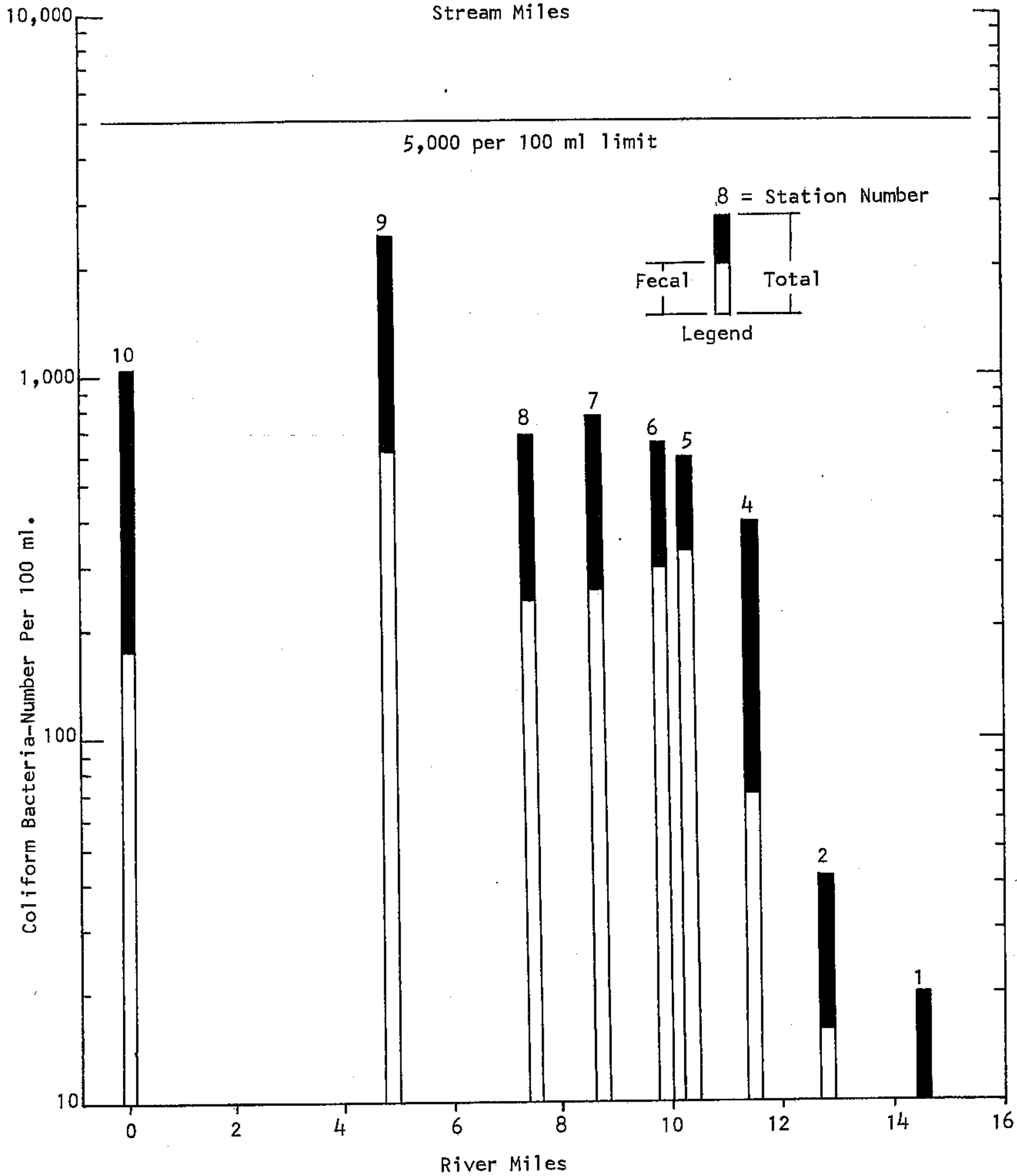


Figure 4

EMIGRATION CREEK

Total & Fecal Coliform vs Time

Station EC - 9

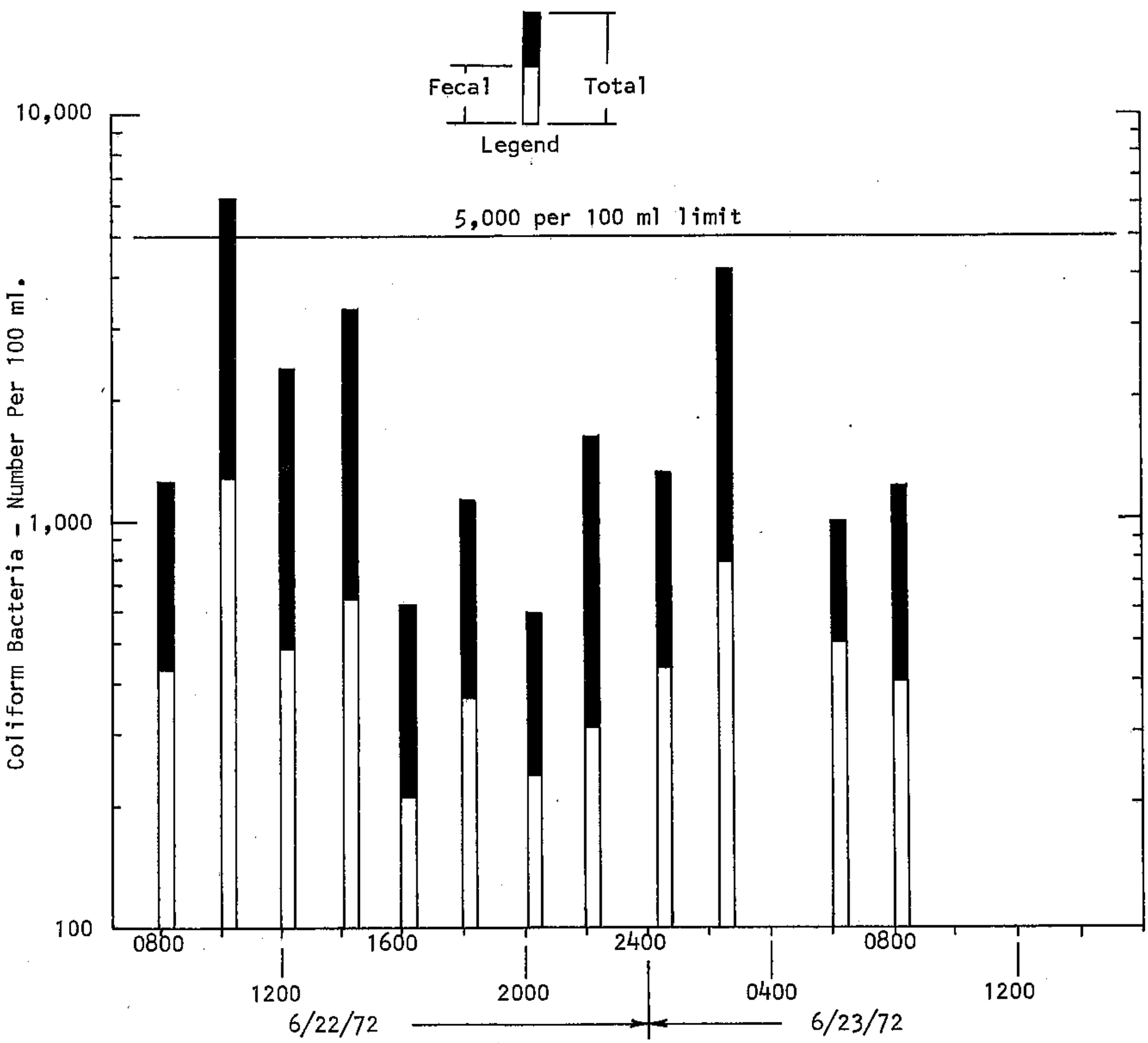
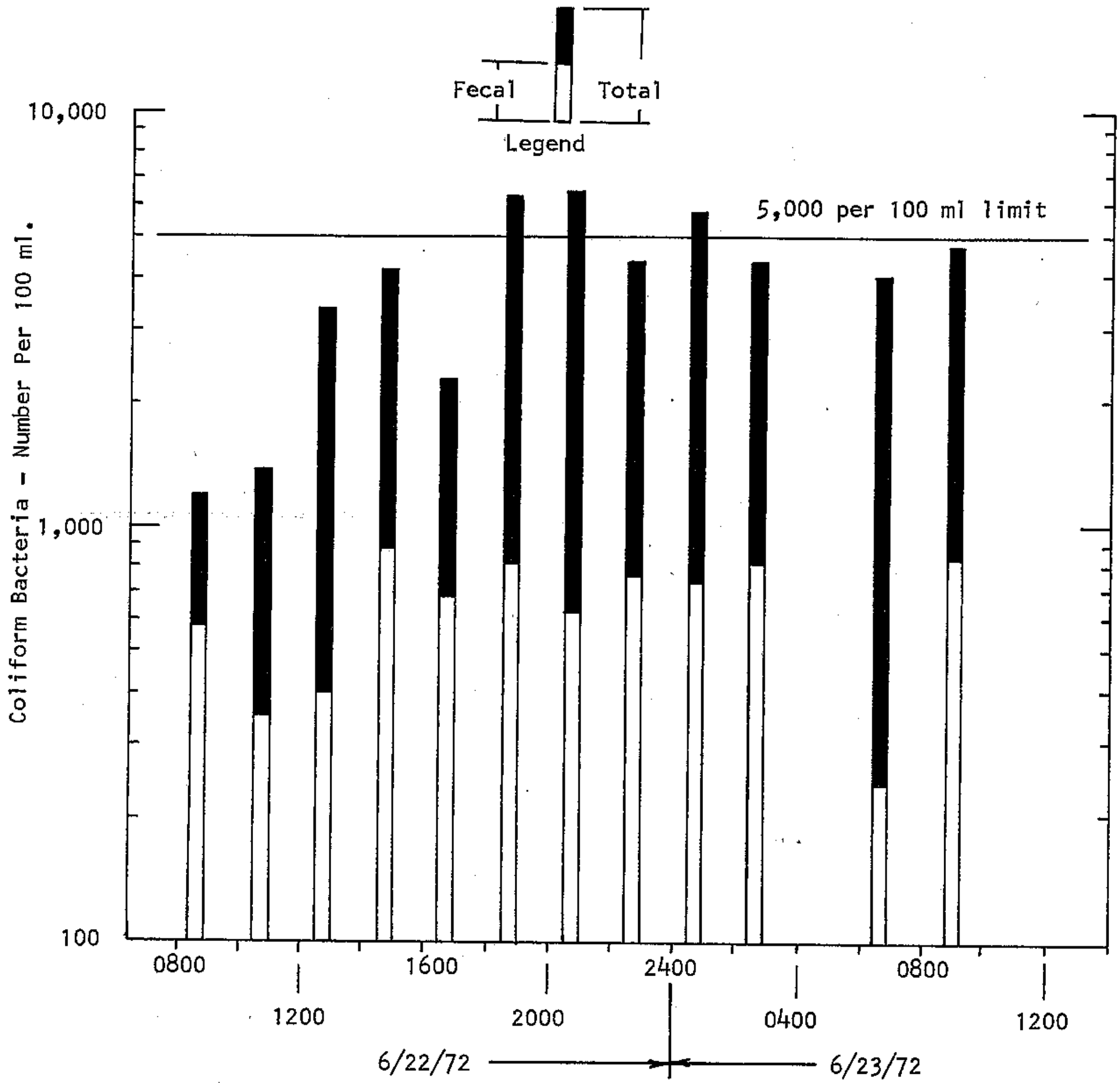


Figure 5

EMIGRATION CREEK

Total & Fecal Coliform vs Time

Station EC - 10



Dissolved oxygen determinations made during this study indicated that the DO was fairly uniform over the reach from the headwaters (EC-1) to station EC-9 (8.9 mg/l to 8.3 mg/l). The DO then decreased from 8.3 mg/l to 7.5 mg/l through the storm drain to the outlet to the Jordan River (Figure 6).

The results of the nutrient investigation in the vicinity of the proposed impoundment of the Jordan River are discussed later in this report.

JORDAN RIVER

As a result of additional meetings held between representatives of the State of Utah, the consulting firm of Templeton, Linke, and Alsup, and the Environmental Protection Agency, and based on the findings of the field study conducted by the EPA in June, EPA Region VIII personnel conducted an intensive short-term water quality investigation of certain elements of the Jordan River Basin during August 1972. This study covered the elements of: (1) bacteriological quality of the Jordan River, (2) dissolved oxygen concentrations in the Jordan River, (3) nutrient impact of irrigation return flow on selected tributaries and the Jordan River, and (4) aquatic biology of the Jordan River. The results of all physical, chemical, and microbiological determinations are tabulated in Appendix Table A-3.

Water Quality

Microbiology

The microbiological examination of the Jordan River was initiated to obtain information on short-term coliform concentrations, through a short-term intensive survey, for correlation with the long-term measurements of the State of Utah.

Eighteen sampling stations were established on the Jordan River (Figure 7) for this study. Another five sampling stations were established on major tributaries to the Jordan. Sampling at these stations was on a daily grab sample basis for a period of nine days.

These stations were also used for all other water quality measurements.

An additional round-the-clock study was undertaken during which samples were collected throughout a 24-hour period to document any changes that might occur during this time period. Two routine Jordan River stations were included as part of this study. These were JR-2 and JR-17, the Jordan River at Fairfield Road and at Cudahy Lane, respectively. Three additional stations in the vicinity of the Utah State Prison were also included.

Figure 6

EMIGRATION CREEK

Dissolved Oxygen vs Stream Miles

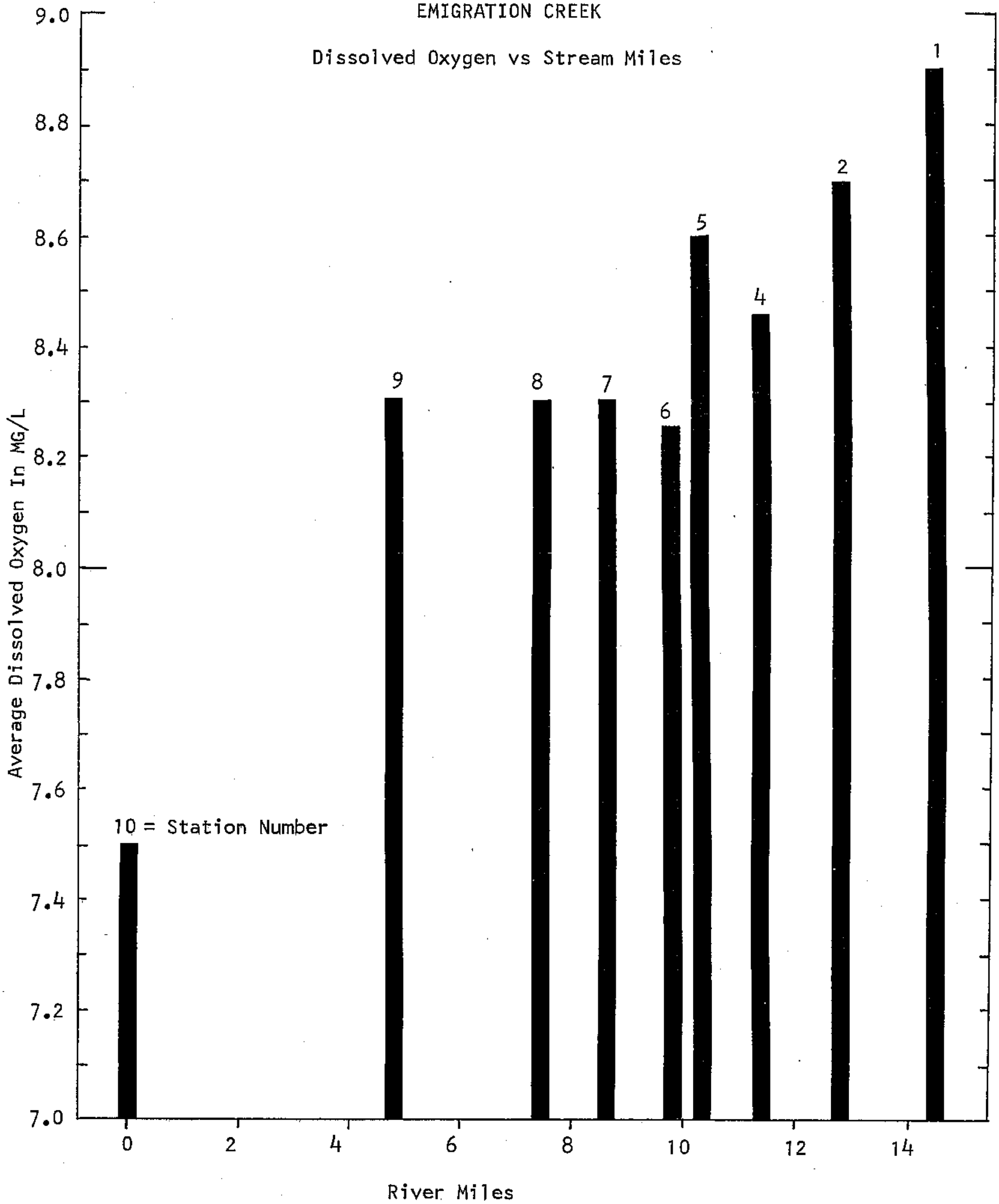
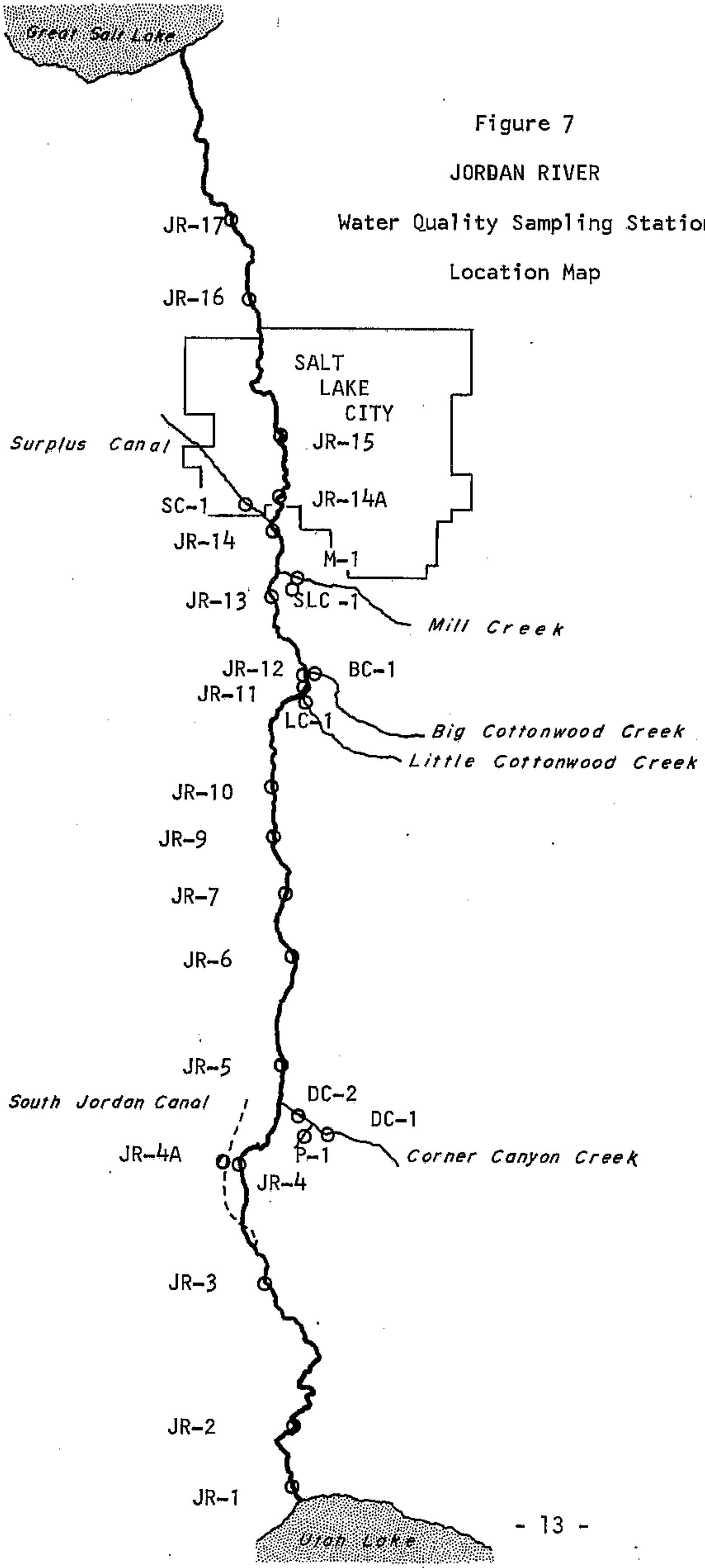


Figure 7

JORDAN RIVER

Water Quality Sampling Station

Location Map



Examination of the results of the daily grab samples indicated that the waters leaving Utah Lake (JR-1, Saratoga Springs Rd.) and forming the Jordan River, had a mean total and fecal coliform density of 1180 and 70/100 ml, respectively (Figure 8). Over the 13-mile reach of the river from JR-1 to JR-4 (Bluffdale Rd.), the total coliform concentration decreased and remained at a low level with a range of mean densities between 350-575/100 ml. From Bluffdale Rd. (JR-4) on downstream, the total coliform densities start to increase from various sources, including irrigation return flows, waste water treatment plant discharges, storm drains, and unknown sources, to reach a peak mean concentration of 52,470/100 ml at the station at 3rd South St. (JR-15).

From 3300 South St. (JR-13) downstream to the mouth of the Jordan River, the mean densities at all stations in this reach exceeded the 500/100 ml criteria for all waters of the Basin. From 7800 South St. (JR-9) downstream to the mouth, individual grab samples indicated values in excess of this criteria.

The results of the round-the-clock sampling at Fairfield Rd. (JR-2) and Cudahy Lane (JR-17) are shown graphically in Figures 9 and 10.

Chemistry

The average dissolved oxygen values in the Jordan River equalled or exceeded the DO requirements from the station near Utah Lake downstream to and including the station at 3300 South St. (JR-13). From the station at 2100 South St. (JR-14) downstream to the mouth of the river, the average dissolved oxygen values decreased steadily and did not meet the cold water fishery DO requirement. At the Cudahy Lane station (JR-17), the average DO was 3.7 mg/l (Figure 11).

During the June 1972 study, grab samples taken at selected stations on the Jordan River (Table A-1) indicated that there might be photosynthetic activity taking place since dissolved oxygen concentrations as high as 19 mg/l were measured (12600 South St., JR-5). To document any diurnal differences in DO concentrations in the Jordan River, two stations (Fairfield Rd., JR-2 and Cudahy Lane, JR-17) were sampled on a round-the-clock basis.

The results of the round-the-clock sampling program indicated that at Fairfield Rd. (JR-2), a significant dissolved oxygen change occurred over a day's time interval (Figure 12). DO concentrations at this station varied over a range of 7 to 12 mg/l throughout a 24-hour period, reaching a peak concentration around 10:00 p.m., and a minimum concentration around 8:00 a.m. No significant diurnal differences in the DO concentrations at the station at Cudahy Lane (JR-17) were indicated (Figure 13).

The two most significant nutrients influencing biotic production and nuisance aquatic plant growths are phosphorus and nitrogen. As nutrient concentrations in streams increase, and if physical

Figure 8

JORDAN RIVER

Mean Total & Fecal Coliform vs River Miles

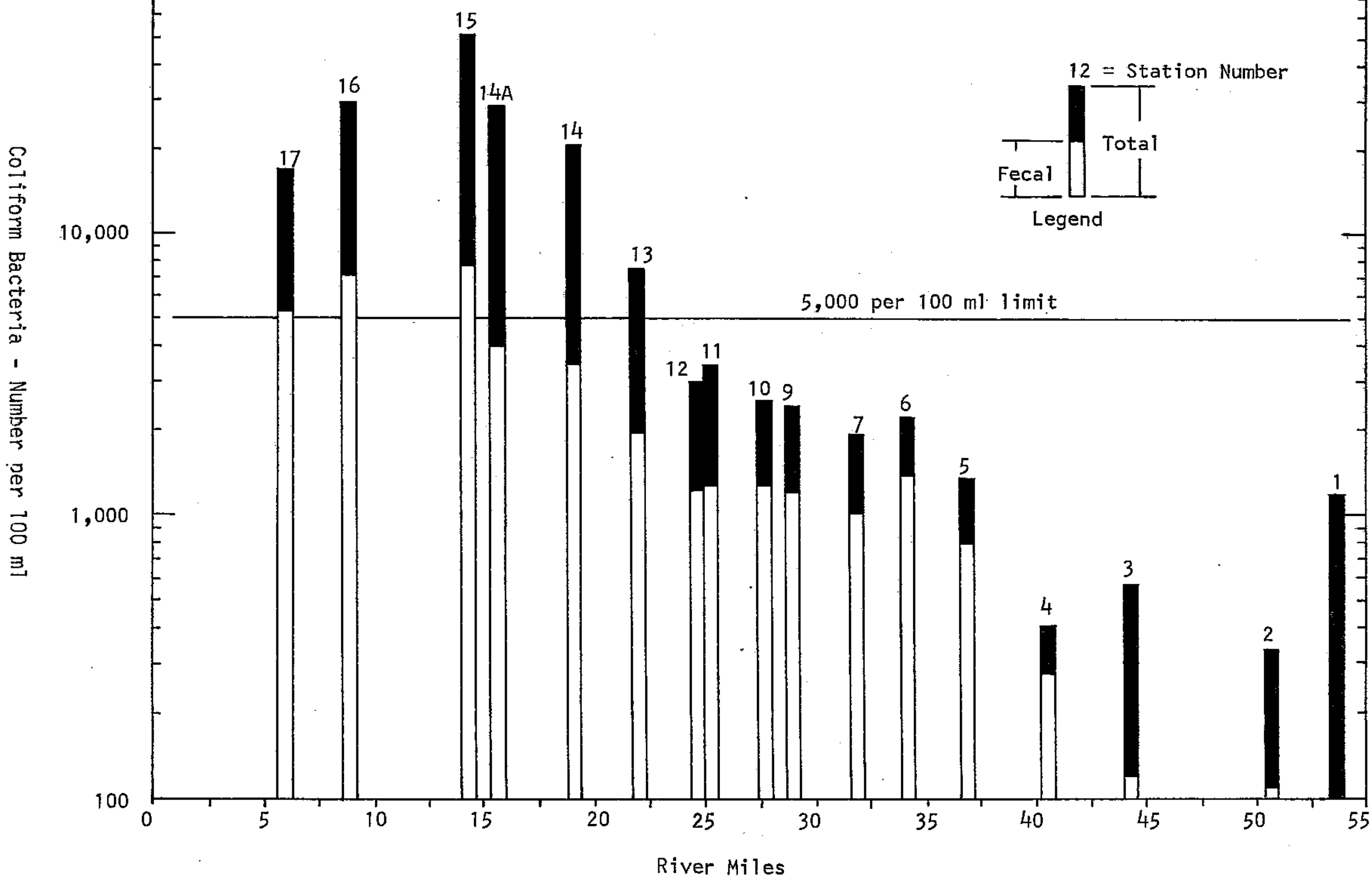


Figure 9

JORDAN RIVER

Total & Fecal Coliform vs Time

Station JR - 2

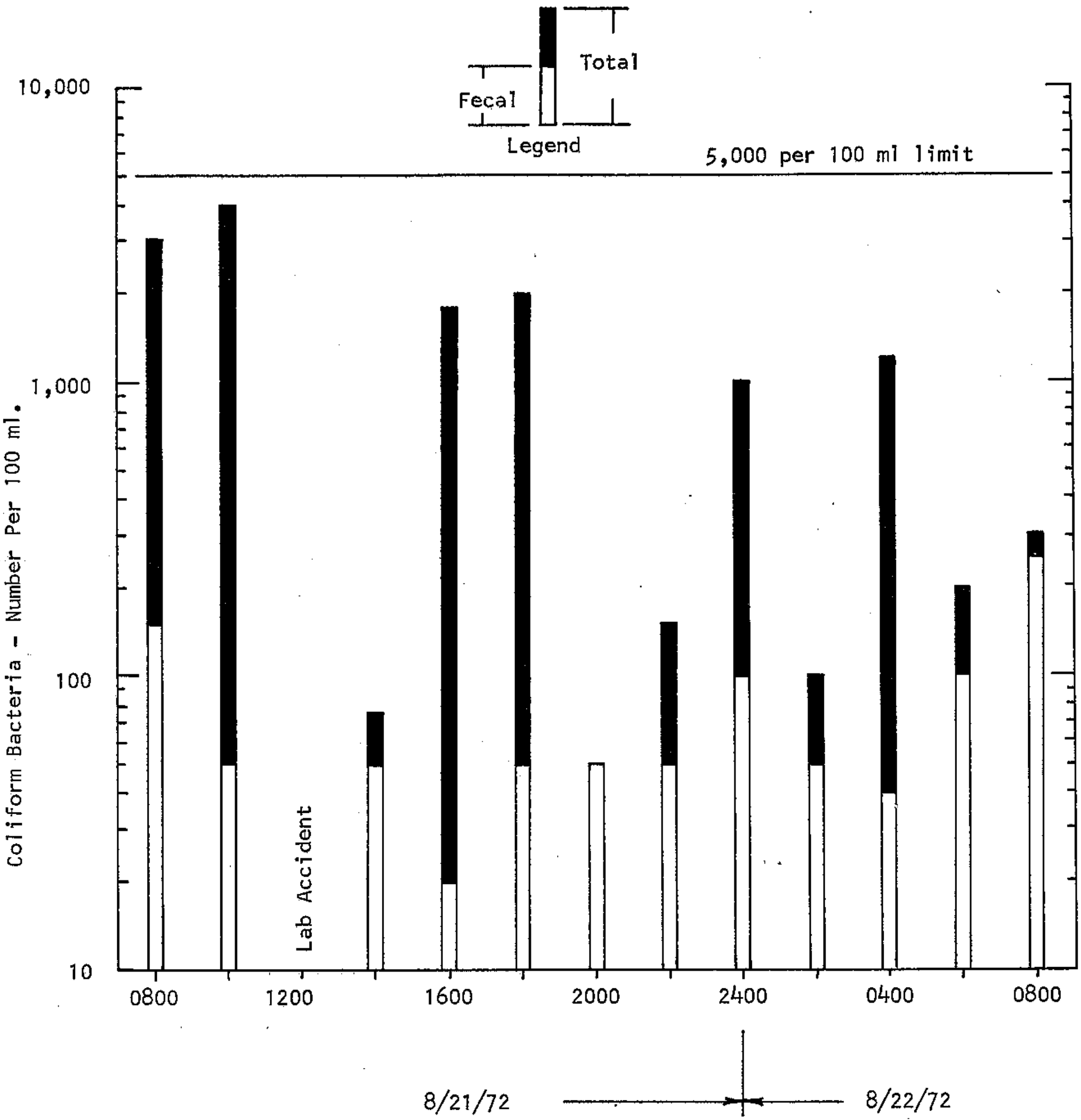


Figure 10

JORDAN RIVER

Total & Fecal Coliform vs Time

Station JR - 17

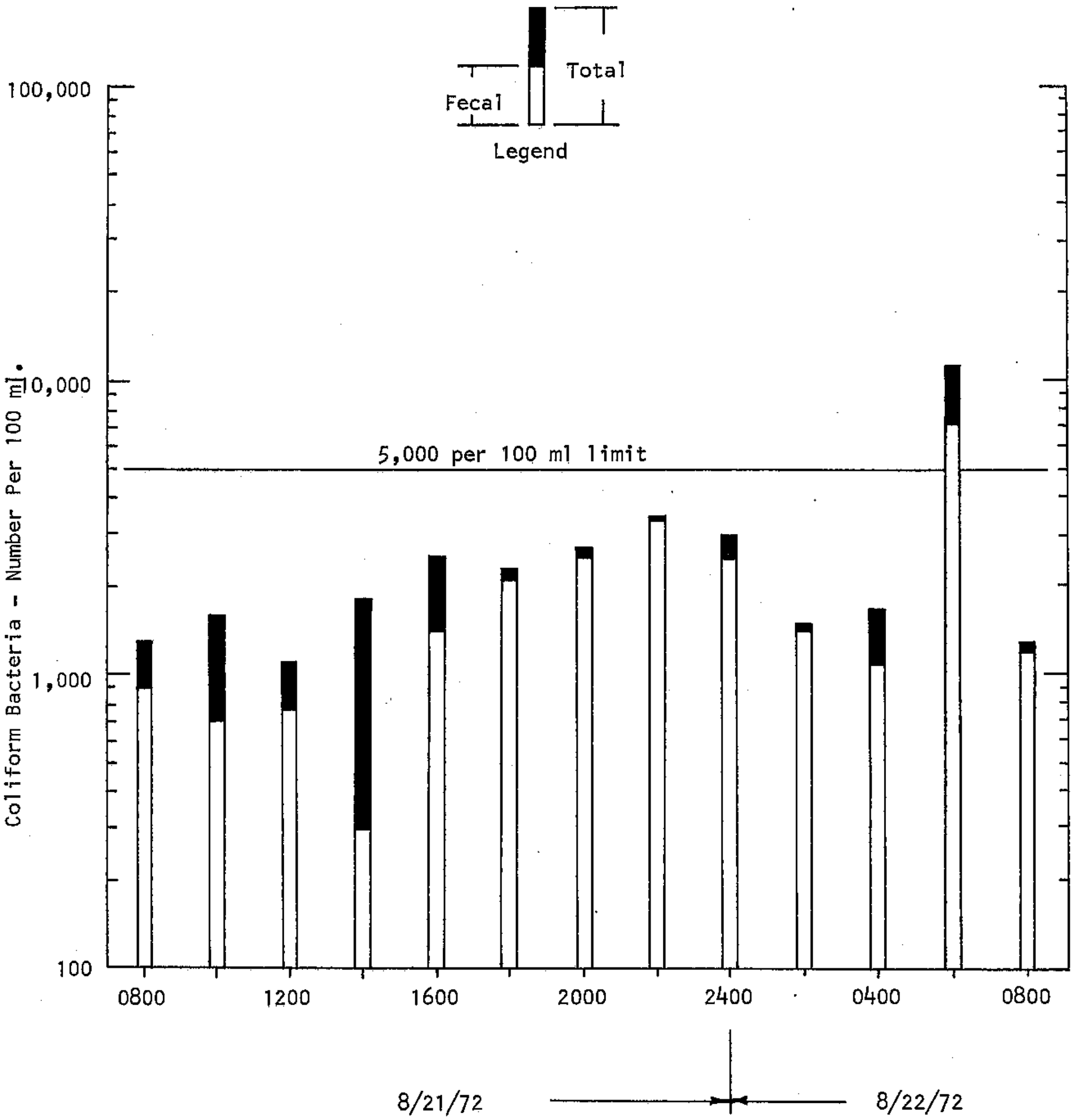


Figure 11

JORDAN RIVER

Average Dissolved Oxygen vs River Miles

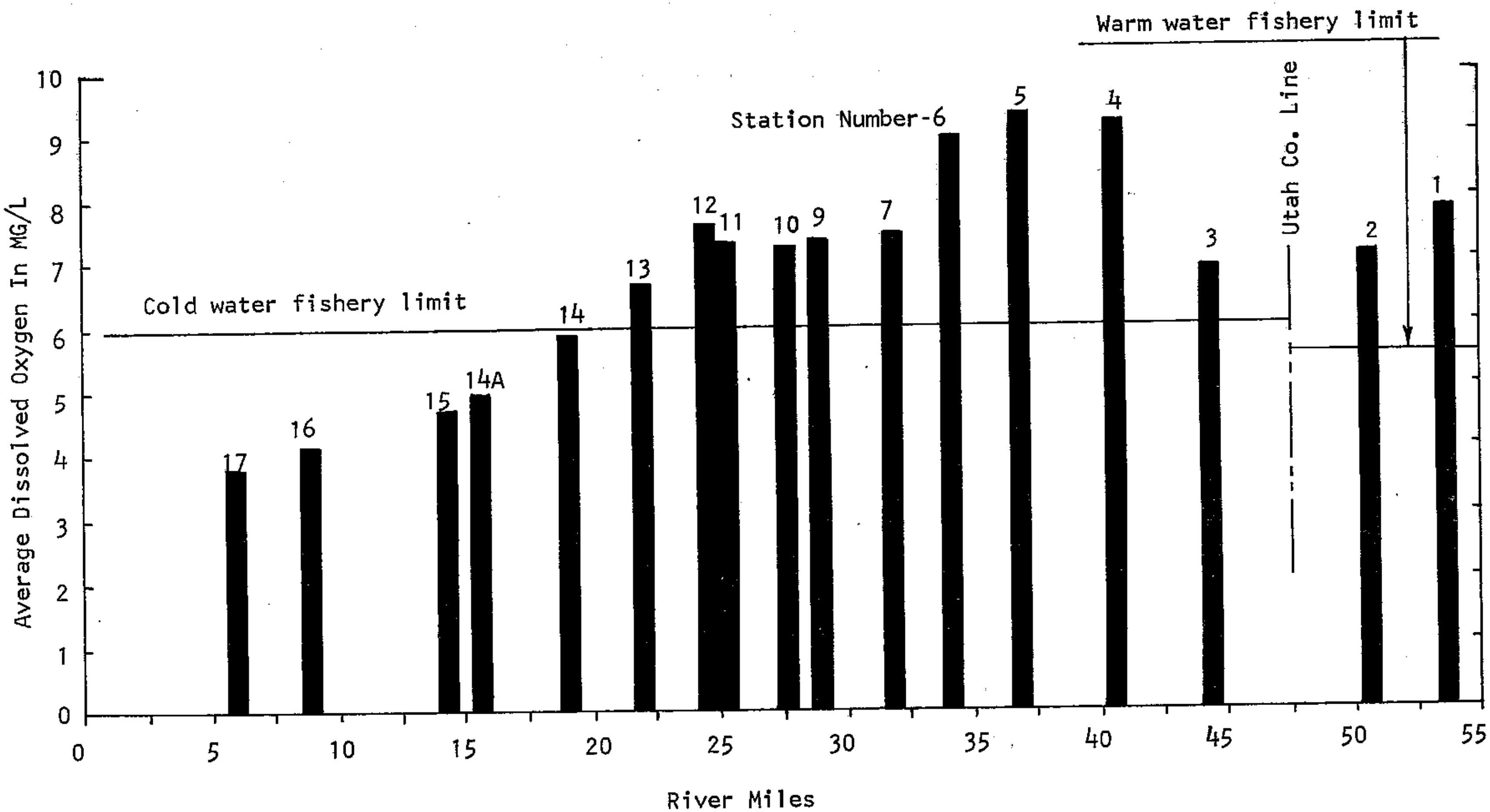


Figure 12

JORDAN RIVER

Dissolved Oxygen vs Time

Station JR - 2

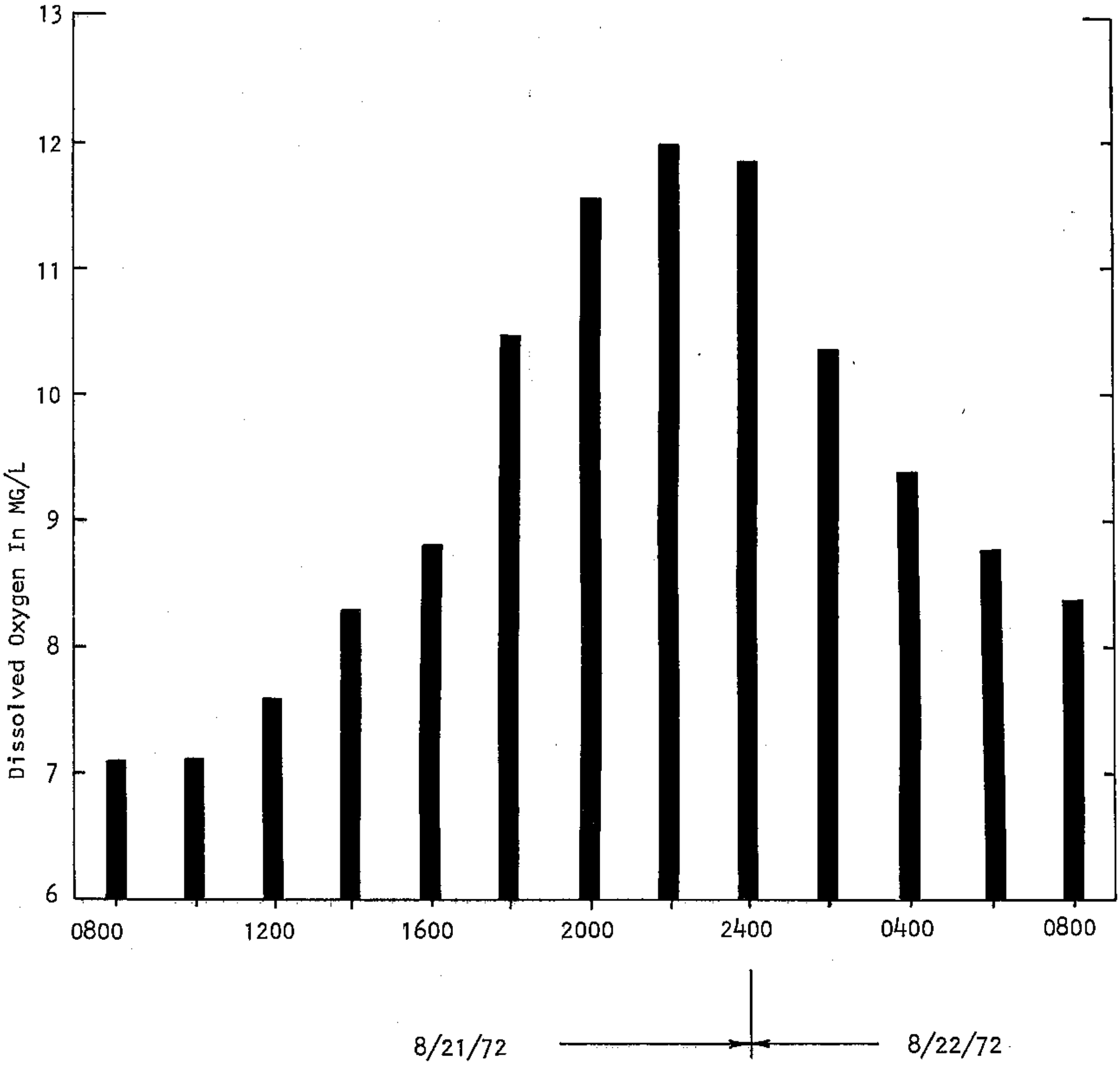
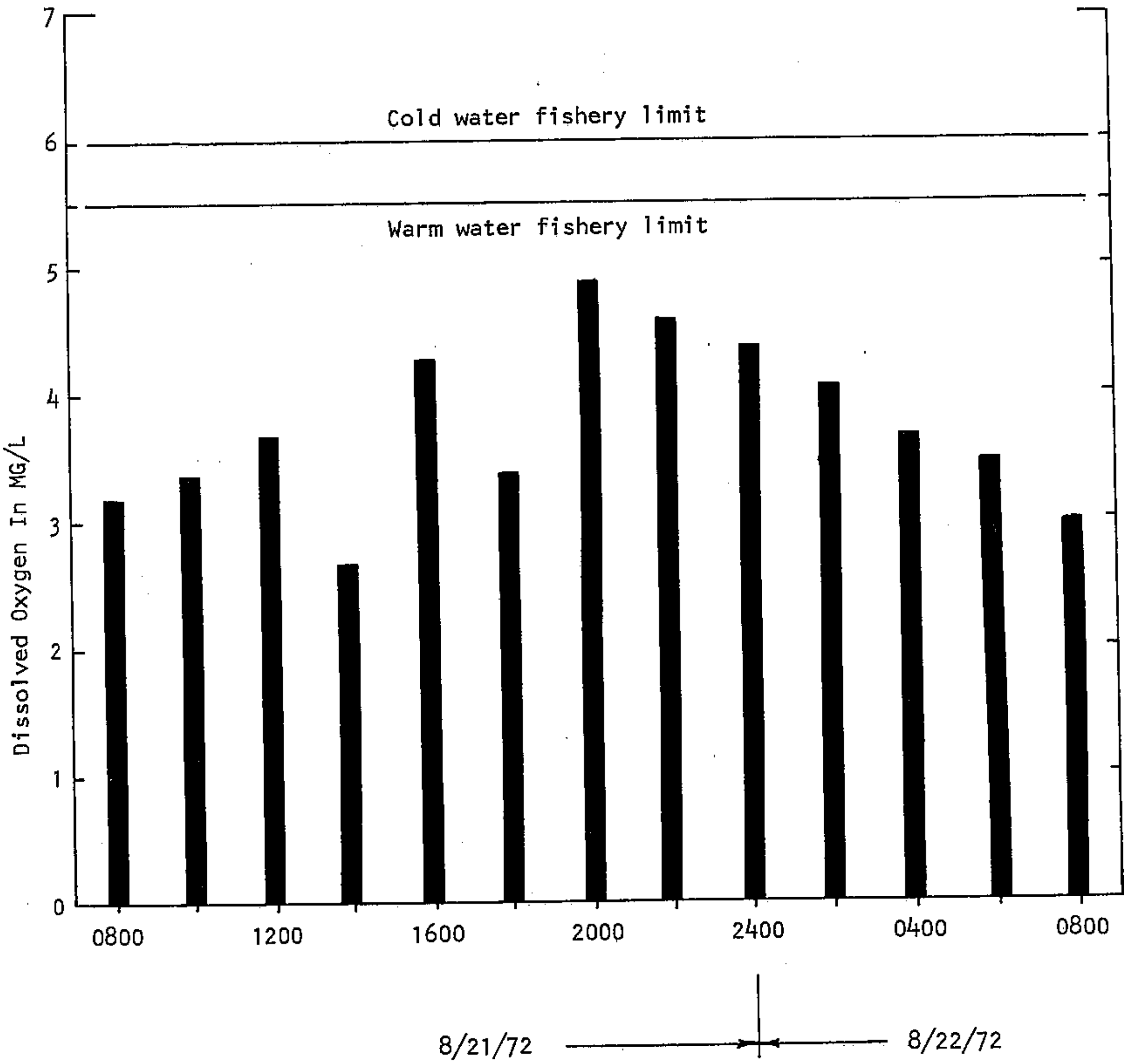


Figure 13

JORDAN RIVER

Dissolved Oxygen vs Time

Station JR - 17



factors such as velocity, turbidity, etc., are not limiting, the number of algal cells increase, leading to such nuisance conditions as surface scums and odors. Several significant sources of phosphorus and nitrogen in the environment are domestic and industrial waste effluents, agricultural run-off, detergents, and animal and plant processing wastes. Nutrients can also be released to the stream from bottom sediments and from decomposing plant and animal matter.

A proposal has been made to impound the Jordan River in the vicinity of the Jordan Narrows, producing a shallow reservoir with a maximum depth of about 60 feet. Inspecting the phosphorus and nitrogen concentrations from the June and August 1972 studies gives an indication that a major problem may occur (Tables A-2 and A-3). At the stations at Saratoga Springs Rd. (JR-1) and the Narrows Pumping Station (JR-3), the total phosphorus levels were 0.14 mg/l and 0.22 mg/l, respectively (Figure 14). The total nitrogen levels were 1.87 mg/l and 2.19 mg/l (Figure 15). Water Quality Criteria published by the National Technical Advisory Committee suggests that the amount of phosphorus entering lakes or reservoirs not exceed 0.05 mg/l. The Jordan River in the area of the proposed impoundment contained three to four times this suggested limit during the study period. Water Quality Criteria published by the State Water Quality Board of California reports that a total nitrogen level of less than 0.6 mg/l would not support large growths of aquatic plants. The Jordan River contained three times this level in the impoundment area. The phosphorus and nitrogen levels in the river appear to increase even more moving downstream to the mouth (Figures 14 and 15).

By impounding the Jordan River, with its high concentrations of nutrients (phosphorus and nitrogen), it is probable that large algal blooms, extensive growths of aquatic plants and fish mortalities would occur. As indicated in the discussion on dissolved oxygen, there already appears to be a significant amount of algal photosynthetic activity.

Nineteen sampling stations were established at several selected locations on tributaries and canals for examination of the irrigation return flow contribution to the nutrient levels at these locations. Included in the study were stations on Mill Creek, Jordan and Salt Lake City Canal, Upper Canal, Big Cottonwood Creek, Little Cottonwood Creek, East Jordan Canal, and the Sandy-Draper Canal. The location of each station and the results of the examination appear in Table 3. Results of this study indicate that with the exception of the extreme upstream stations on Mill Creek, Big Cottonwood Creek, and Little Cottonwood Creek, the phosphorus concentrations at all remaining stations exceeded the 0.05 mg/l suggested limit. The nitrogen concentrations were equally high.

Figure 14

JORDAN RIVER

Total Phosphorus vs River Mile

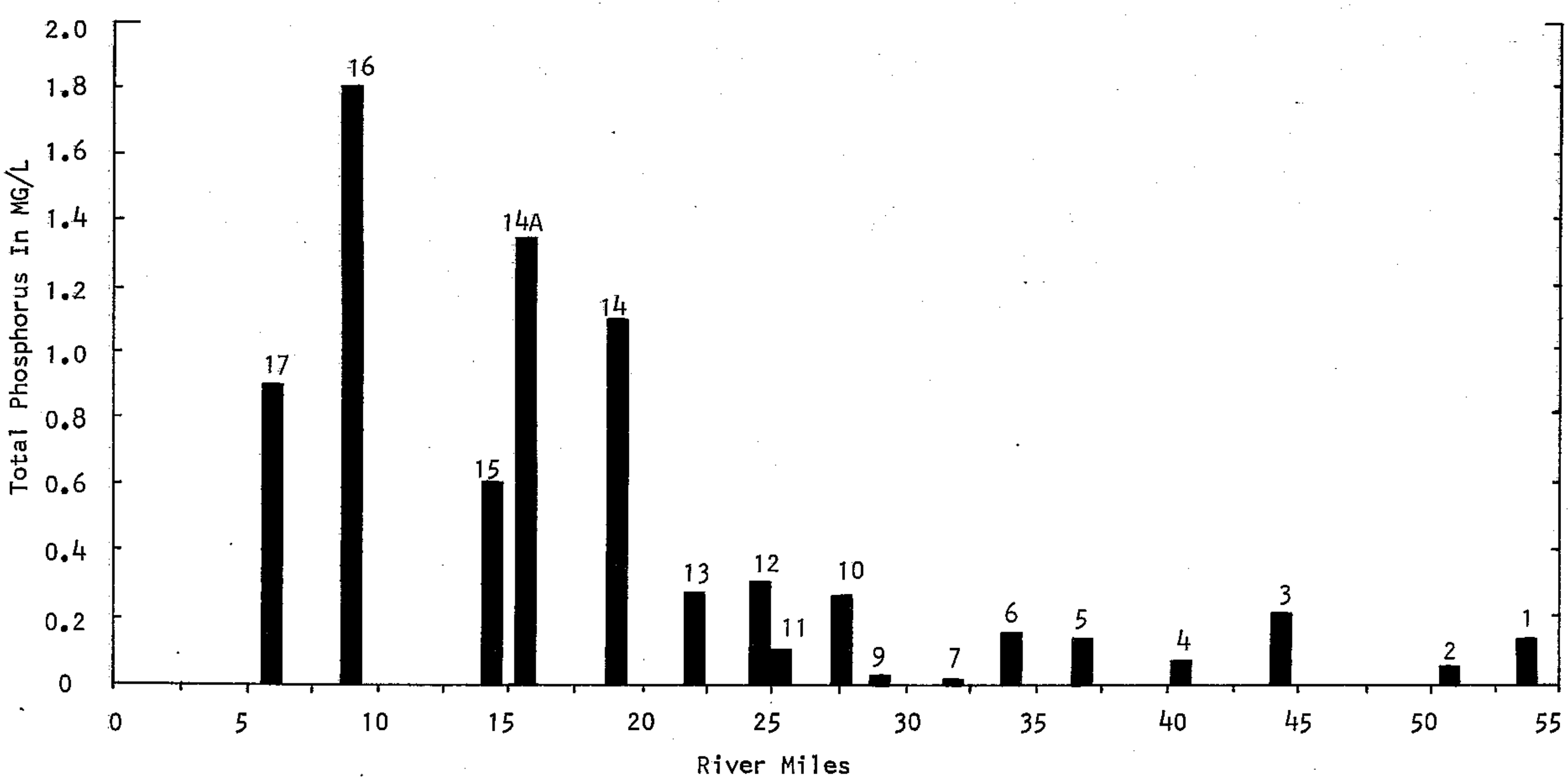


Figure 15

JORDAN RIVER

Nitrogen Concentrations vs River Miles

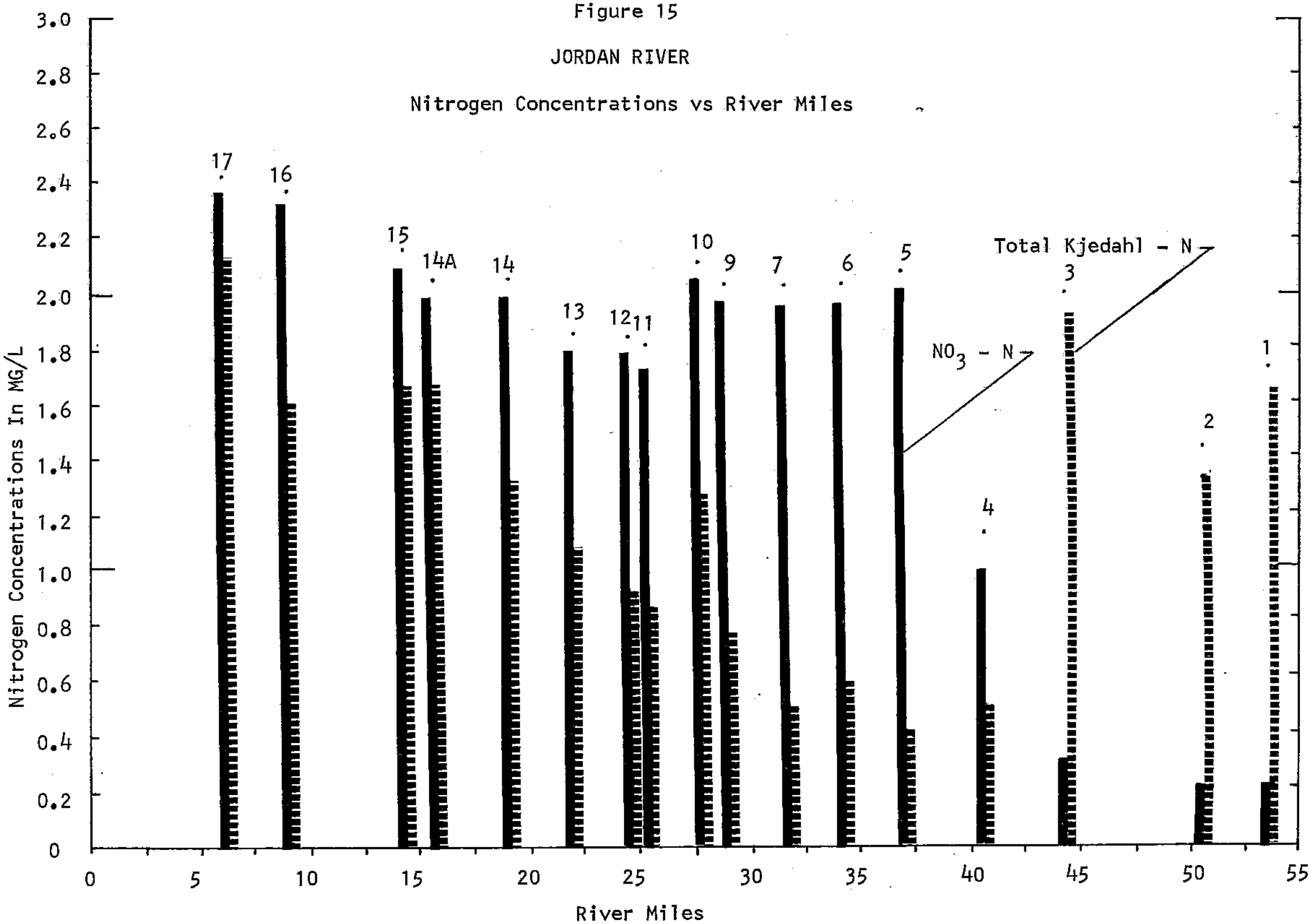


TABLE 3

JORDAN RIVER

Tributary Stream Nutrient Results

Station No.	Station Description	Date/Time of Sample	Total P as P (mg/l)	Total Kjeldahl N as N (mg/l)	NO_3 - N (mg/l)	Total Coliform (#/100ML)	Fecal Coliform (#/100ML)
N-1	Mill Creek below Hatchery	7/15/72 1800	0.03	0.94	1.28	--	--
N-2	Mill Creek above Hatchery	7/15/72 1810	0.05	1.37	0.26	--	--
N-3 / B-1	Mill Creek below J & SLCC	7/15/72 1500 / 7/17/72 0900	0.09	0.96	0.27	5700	1700
N-4 / B-2	J & SLCC Canal at Mill Creek	7/15/72 1500 / 7/17/72 0900	0.06	1.41	0.31	2300	1700
B-3	Mill Creek above J & SLCC	7/17/72 0910	--	--	--	4700	1800
N-5 / B-4	Mill Creek below Upper Canal	7/15/72 1540 / 7/17/72 0920	0.06	1.19	0.27	6300	5200
N-6 / B-5	Upper Canal at Mill Creek	7/15/72 1540 / 7/17/72 0920	0.06	1.22	0.28	5200	4300
B-6	Mill Creek above Upper Canal	7/17/72 0930	--	--	--	1400	750

TABLE 3 (Cont.)

Station No.	Station Description	Date/Time of Sample	Total P as P (mg/1)	Total Kjeldahl N as N (mg/1)	NO_3 - N (mg/1)	Total Coliform (#/100ML)	Fecal Coliform (#/100ML)
N-7	Mill Creek above Valley	7/15/72 1730	<0.01	0.40	0.13	--	--
N-8 / B-7	Big Cotton Cr. below Murray Spring	7/17/72 1010	0.09	0.59	1.07	2300	1200
N-9 / B-9	Murray Spring above Big Cotton Cr.	7/17/72 1020	--	--	--	2100	1600
B-9	Big Cotton Cr. above Murray Spring	7/17/72 1020	0.15	1.20	0.35	3500	2000
N-10 / B-10	Big Cotton Cr. below J & SLCC	7/15/72 1415 / 7/17/72 1030	0.05	1.41	0.26	1700	600
N-11 / B-11	J & SLCC at Big Cotton Cr.	7/15/72 1415 / 7/17/72 1035	.07	1.19	0.30	1900	500
B-12	Big Cotton Cr. above J & SLCC	7/17/72 1040	--	--	--	5500	4600

TABLE 3 (Cont.)

Station No.	Station Description	Date/Time of Sample	Total P as P (mg/1)	Total Kjeldahl N as N (mg/1)	NO_3 - N (mg/1)	Total Coliform (#/100ML)	Fecal Coliform (#/100ML)
N-12	Big Cotton Cr. above Valley	7/15/72 1350	0.01	0.56	0.15	--	--
N-13 / B-13	Little Cotton Cr. below J & SLCC	7/15/72 1155 / 7/17/72 1055	0.07	1.20	0.30	1600	870
N-14 / B-14	J & SLCC at Little Cotton Cr.	7/15/72 1200 / 7/17/72 1100	0.15	2.05	0.30	1800	1300
B-15	Little Cotton Cr. above J & SLCC	7/17/72 1105	--	--	--	5300	2000
N-15 / B-16	Little Cotton Cr. below East Jordan Canal	7/15/72 1130 / 7/17/72 1115	0.10	1.10	0.23	1200	840
N-16 / B-17	East Jordan Canal at Little Cotton Cr.	7/15/72 1125 / 7/17/72 1115	0.05	1.18	0.23	2300	1000
N-17 / B-18	Little Cotton Cr. above (valley) East Jordan Canal	7/15/72 1110 / 7/17/72 1120	$<$0.01	0.71	0.15	2200	1700

TABLE 3 (Cont.)

Station No.	Station Description	Date/Time of Sample	Total P as P (mg/l)	Total Kjeldahl N as N (mg/l)	NO_3 - N (mg/l)	Total Coliform (#/100ML)	Fecal Coliform (#/100ML)
N-18	Draper Canal at Dry Creek	7/14/72 1800	0.09	1.51	0.18	--	--
N-19	East Jordan Canal at Dry Creek	7/14/72 1815	0.10	1.35	0.22	--	--

As part of the August Jordan River Study, special round-the-clock samples were taken at stations established in the vicinity of the Utah State Prison. Samples were analyzed for total and fecal coliform and dissolved oxygen concentrations. Sampling stations were established in the effluent ditch from the waste water treatment facility of the Utah State Prison (P-1), in Corner Canyon Creek upstream from the confluence with the prison effluent ditch (DC-1), and in Corner Canyon Creek downstream from the effluent ditch and prior to the confluence with the Jordan River (DC-2).

Results of this study indicate that the total and fecal coliform concentrations in the prison effluent ditch reached mean densities of 306,250 and 262,300/100 ml, respectively (Figure 16). The effect of the wastes entering Corner Canyon Creek from the prison effluent ditch caused the total coliform concentration to increase from a mean of 5950/100 ml upstream of the ditch to a mean of 97,420/100 ml downstream from the ditch. The fecal coliform values likewise increased from a mean of 3545/100 ml upstream to a mean of 82,385/100 ml downstream (Figures 17 and 18).

Dissolved oxygen measurements at these stations indicated that the average DO in Corner Canyon Creek decreased from 7.3 to 5.8 mg/l after the influence of the waste ditch from the prison (Figure 19). The dissolved oxygen in the prison effluent ditch had an average concentration of 2.5 mg/l.

Biology

Methods

The biological study of the Jordan River (August 14-23, 1972) was conducted to supplement data obtained by the Utah Department of Fish and Game in its initial investigation in 1965-66.

Since the biological community is a good indicator of the severity of pollution, an investigation was made of the benthic organisms, algae, and existing fish populations in the river. Access to past data made it possible to compare trends in water quality.

A total of twenty-six sampling locations was selected on the Jordan River and several of its tributaries. (Biological sampling location descriptions are listed in Tables 4, 5, and 6.) Sampling stations were chosen on the basis of their relevance to existing data and also how pertinent they might be in reflecting changes in that data. All types of populations were not sampled at each location if it was felt that they could not show further change in water quality or were repetitious. The types of samples taken at each of the biological sampling stations are listed in Table 7.

Benthic sampling was conducted by examining the substrate and attached debris that might provide a suitable habitat for various organisms. Quantitative samples were taken with a square-foot

Figure 16

JORDAN RIVER

Total & Fecal Coliform vs Time

Utah State Prison P - 1

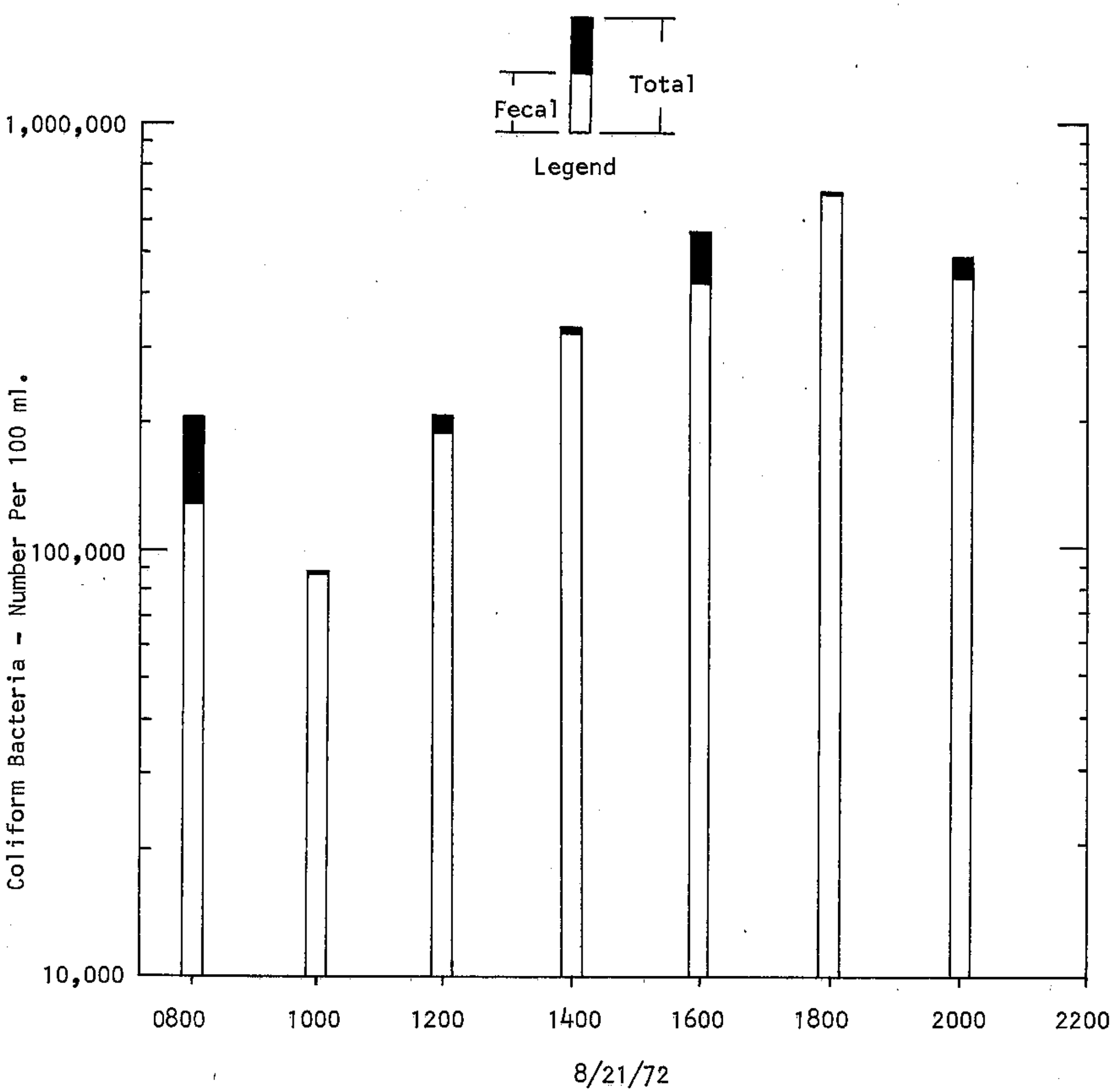


Figure 17

JORDAN RIVER

Total & Fecal Coliform vs Time

Corner Canyon Creek DC-1

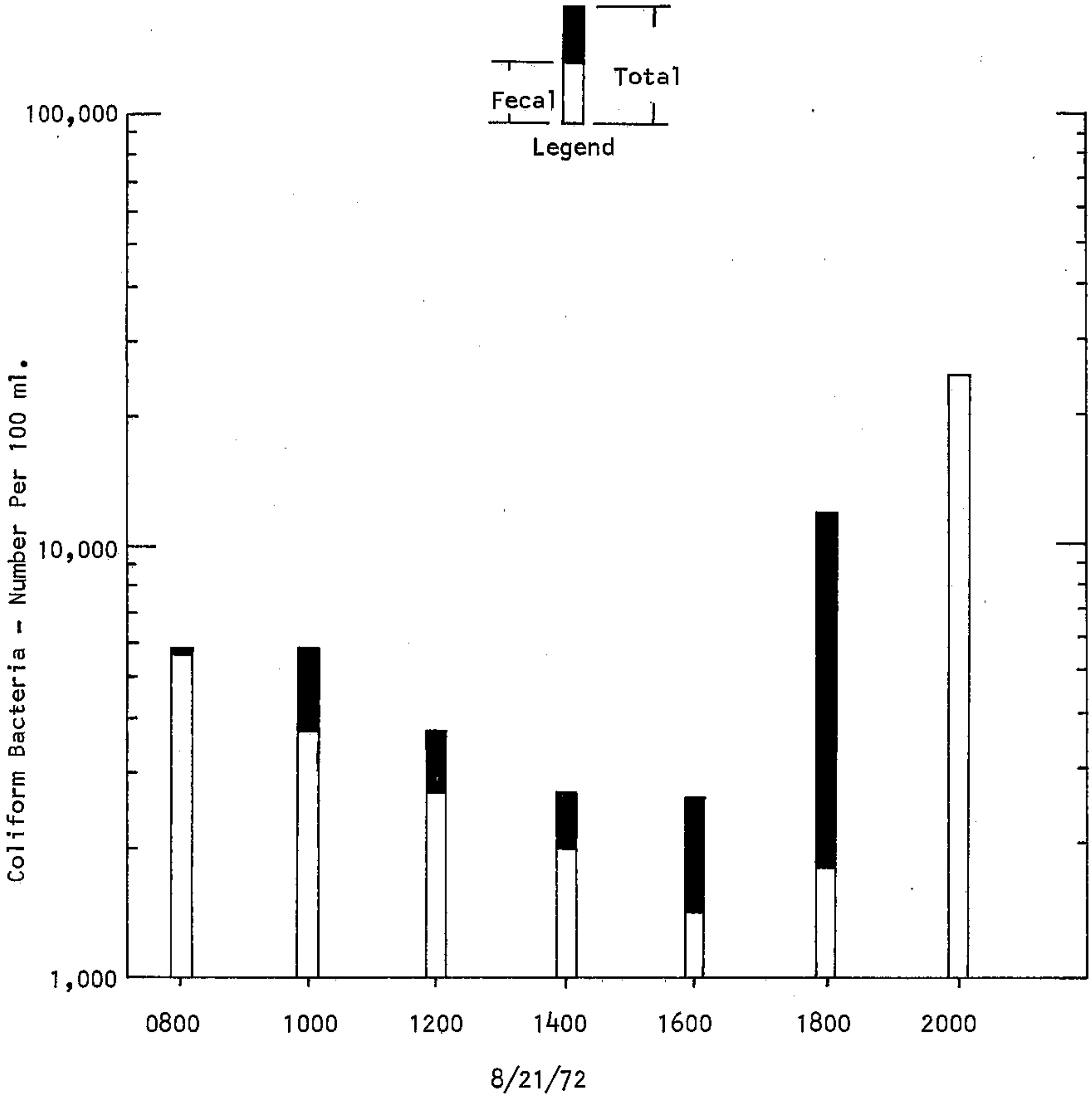


Figure 18

JORDAN RIVER

Total & Fecal Coliform vs Time

Corner Canyon Creek DC-2

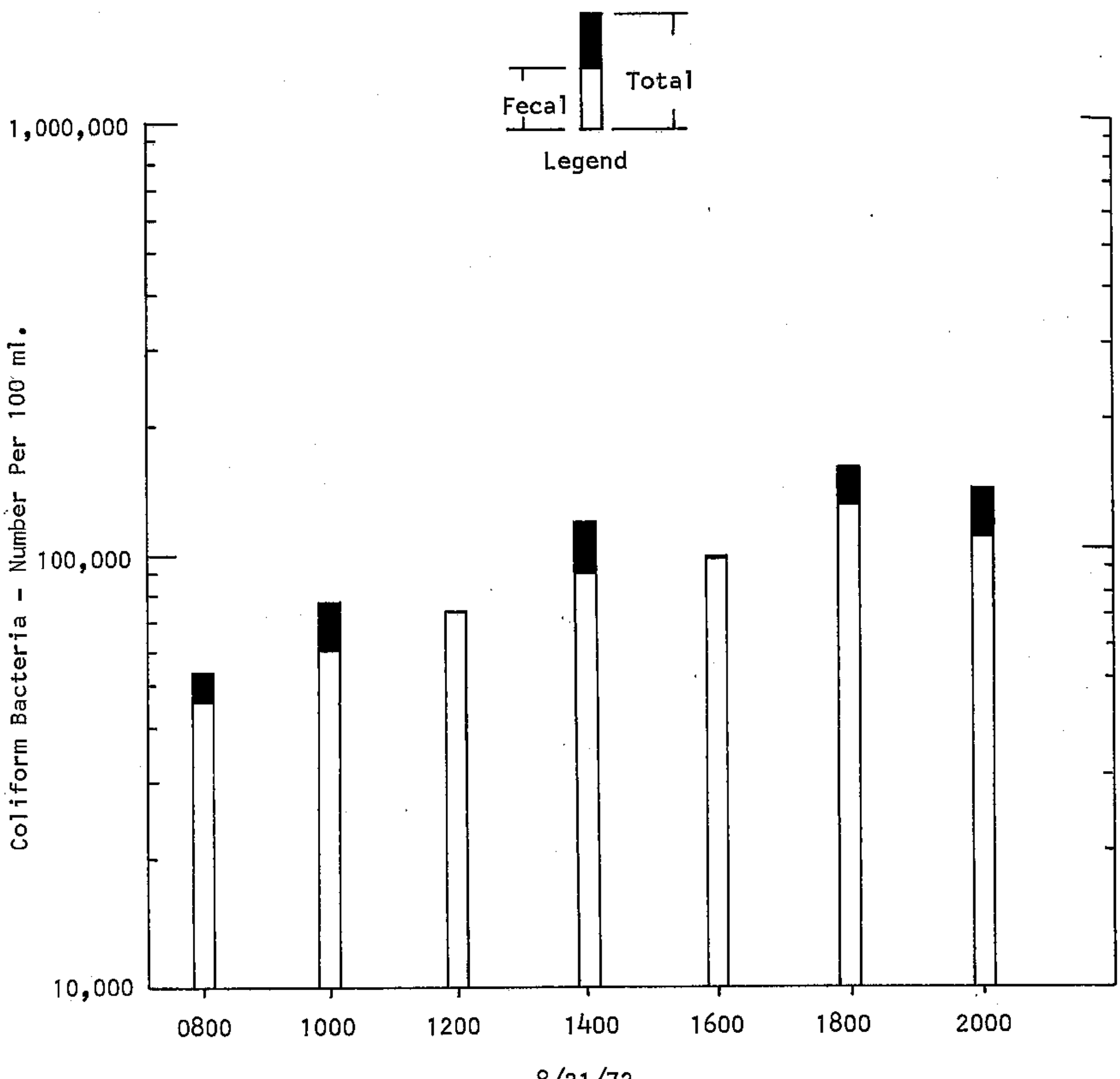


Figure 19

JORDAN RIVER

Corner Canyon Creek & Utah State Prison Outfall

Dissolved Oxygen vs Time

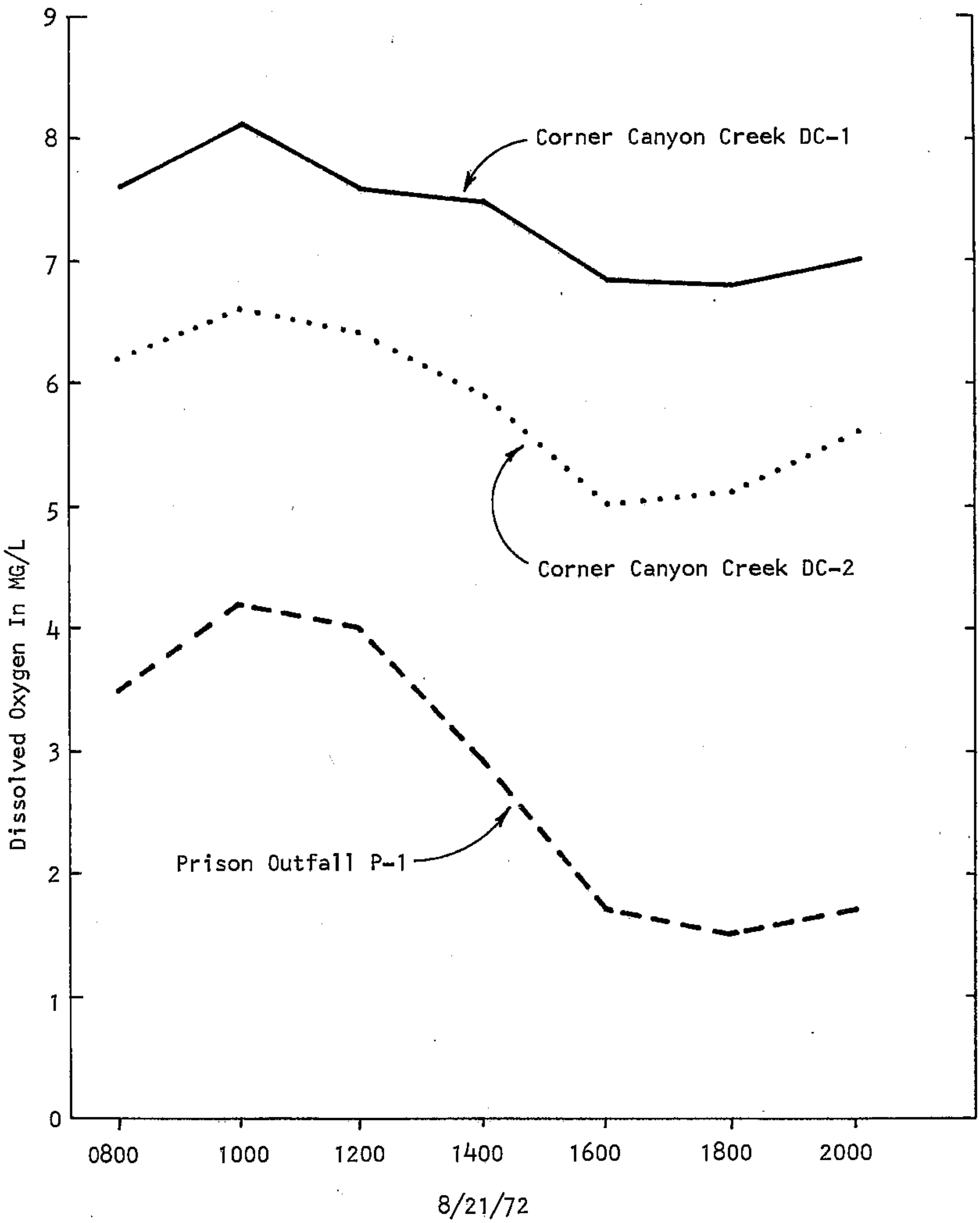


TABLE 4

JORDAN RIVER

Benthic Sampling Station Locations

Station No.	Location
1	Saratoga Springs Rd., approx. 1/4-mile below the bridge.
2	Lehi-Fairfield Rd. (Hwy.73), approx. 100 yds. upstream from bridge.
3	Upstream at Jordan Narrows Diversion Dam about 20 ft. above dam.
4	Downstream at Jordan Narrows Diversion Dam about 20 ft. below dam.
5	14600 South (Bluffdale Rd.) about 50 yds. upstream from bridge.
6	12600 South (Hwy.111) approx. 1/4-mile downstream from the diversion.
7	10600 South, approx. 50 yds. downstream from bridge.
8	9000 South about 30 ft. upstream from bridge.
9	7800 South (Hwy.48) about 30 ft. upstream from bridge.
10	6400 South, approx. 75 yds. downstream from bridge.
13	4800 South (Hwy.174) about 30 ft. upstream from mouth of Little Cottonwood Creek.
11	Little Cottonwood Creek at the 2000 East bridge about 50 ft.upstream.
12	Little Cottonwood Creek about 50 ft. upstream from its confluence with the Jordan.
14	4500 South (Hwy.266) about 30 ft. upstream from bridge.
15	Big Cottonwood Creek at junction of Hwy.152 and Wasatch Blvd., approx. 150 yds. upstream.
16	Big Cottonwood Creek at the 500 West bridge about 20 ft. upstream.
17	3300 South (Hwy.171) approx. 100 yds. downstream from bridge.
18	3100 South, then east, on dirt road past the Granger-Hunter S.T.P. to the river and approx. 50 yds. upstream.
19	2100 South (Hwy.Alt.50) about 50 ft. downstream from bridge.
20	300 South, approx. 30 yds. downstream from bridge.
21	1800 North and Redwood Rd., approx. 50 yds. upstream from bridge.
22	Cudahy Lane, approx. 1/4-mile downstream of South Davis South S.T.P.
23	State Canal at its confluence with the Jordan River.

TABLE 5

JORDAN RIVER

Plankton Sampling Station Locations

Station No.	Location
1	Saratoga Springs Rd. bridge taken halfway across on downstream side.
2	Lehi-Fairfield Rd. bridge taken halfway across on downstream side.
3	Jordan Narrows Diversion Dam on downstream side.
4	Bluffdale Rd. next to bridge on downstream side.
5	12600 South bridge, taken halfway across on downstream side.
6	10600 South bridge, taken halfway across on downstream side.
7	9000 South bridge, taken halfway across on downstream side.
8	7800 South bridge, taken halfway across on downstream side.
9	6400 South bridge, taken halfway across on downstream side.
10	4800 South bridge, taken halfway across on downstream side.
11	4500 South bridge, taken halfway across on downstream side.
12	3300 South bridge, taken halfway across on downstream side.
13	2100 South bridge, taken halfway across on downstream side.
14	300 South bridge, taken halfway across on downstream side.
15	1800 North bridge, taken halfway across on downstream side.
16	Cudahy Lane bridge, taken halfway across on downstream side.
17	State Canal at its confluence with Jordan River about 30 ft. downstream in canal.

TABLE 6

JORDAN RIVER

Fish Shocking Stations

Station No.	Location
1	Saratoga Springs for approx. 0.2 miles downstream.
2	Lehi-Fairfield for approx. 0.1 miles upstream.
3	Bluffdale Road for approx. 0.1 miles upstream.
4	North Prison Road for about 300 ft. downstream.
5	12400 South for approx. 800 ft. downstream.
6	9000 South for about 300 ft. upstream.
7	5770 South (Bullion Rd.) for about 400 ft. upstream.
8	4800 South for about 300 ft. upstream.
9	3300 South for approx. 0.2 miles downstream.
10	2100 South for approx. 0.1 miles up and downstream from bridge.
11	300 South for approx. 0.1 miles up and downstream from bridge.
12	1800 North for approx. 0.1 miles up and downstream from bridge.
13	State Canal at its confluence with the Jordan River for approx. 0.1 miles upstream on the river.

TABLE 7

JORDAN RIVER

Types of Biological Samples

Location	Sample Type				
	Quali-tative	Petersen Dredge	Surber (Sq.Ft.)	Plankton	Electro-Fishing (Hours)
Saratoga Springs	1	1	--	3	0.5
Lehi-Fairfield	1	--	--	3	0.6
Upstream Jordan Narrows	1	--	--	--	--
Downstream Jordan Narrows	1	--	--	3	--
14600 South	1	1	1	3	0.5
North Prison Road	--	--	--	--	0.3
12600 South	1	--	2	3	--
12400 South	--	--	--	--	0.6
10600 South	1	2	--	3	--
9000 South	1	2	--	3	0.3
7800 South	1	1	2	3	--
6400 South	1	2	--	3	--
5770 South	--	--	--	--	0.4
4800 South	1	2	--	3	0.2
Lt.Cottonwood Control	1	--	2	--	--
Lt.Cottonwood Downstream	1	1	--	--	--
4500 South	1	2	--	3	--
Big Cottonwood Control	1	--	1	--	--
Big Cottonwood Downstream	1	2	--	--	--
3300 South	1	--	--	3	0.5
3100 South	1	2	--	--	--
2100 South	1	--	--	3	0.4
300 South	1	2	--	3	0.4
1800 South	1	2	--	3	0.4
Cudahy Lane	1	2	--	3	--
State Canal	1	2	--	3	0.4
TOTALS	23	26	8	51	5.5

Surber sampler when shallow riffle areas were present and with a Peterson dredge when riffles were absent or substrate made the use of the Surber impractical. Qualitative samples were collected with U.S. No. 30 sieves and small mesh dip nets. All samples were washed through No. 30 sieves in the field, placed in pint jars, and preserved with 10% formalin. They were then packaged and transported to EPA's Regional Laboratory in Denver for analysis. In the laboratory, the samples were picked, sorted, and then classified to the lowest possible taxonomic groups, hereafter referred to as "kinds." When the number of organisms was too large to count in a reasonable amount of time, or the sample was loaded with debris, an aliquot of the sample was counted. This number was then equated to the entire sample, averaged with other quantitative samples of that station, and then calculated to numbers per square foot. The percentage of each kind of organism was also listed. A total of twenty-three stations was examined for presence of benthic fauna (Table 4).

Seventeen stations on the Jordan River were sampled for algae (Table 5). Qualitative grab samples of periphyton were collected from attached debris. They were placed in pint jars and preserved with 5% formalin. All samples were then put in dark storage and transported to the laboratory for processing. Identification was done with a phase contrast microscope and all specimens were taken to the lowest taxonomic group.

A fish population study was also conducted at thirteen stations selected along the length of the river (Table 6). The main objective was to determine the composition of populations in different sections of the river. The program was one of shock, count, and release. Game fish were weighed and measured before being released. Some specimens were preserved in 10% formalin for later identification. Equipment included a transformer capable of producing A.C. and pulsating D.C.; a seven horsepower, sixty-cycle generator; a probe with 200-foot leads; dip nets; and a 16-foot john boat equipped with a 25 H.P. motor that was used when wading was impossible. Shocking was most effective using alternating current at 160-170 volts and 6-8 amps.

Benthic Organisms

In an unpolluted situation many kinds of organisms can exist, but because of predation and the high competition for space and food each kind is low in numbers. Invertebrates usually associated with this type of habitat are pollution-sensitive kinds, such as stoneflies, mayflies, hellgrammites, caddis flies, and riffle beetles. All these are valuable fish-food organisms.

If nutrients are added to a river, they may be beneficial as long as the rate of enrichment does not exceed the assimilative capabilities of the aquatic life present. If it does not, one finds many kinds of organisms in large numbers. However, if enrichment exceeds assimilation, the physio-chemical properties of the water are affected, resulting in varying degrees of pollution. As organic pollution increases, there is a decrease in kinds and numbers of sensitive organisms and an increase of more tolerant forms such as midges, leeches, and sludge worms. If organic pollution becomes severe enough, there will also be a reduction in the kinds and numbers of tolerant organisms.

In the 55-mile course of the Jordan River, it receives effluents from ten domestic wastewater treatment facilities. Depending upon the degree of organic load added to the river, the benthic community reflected an enriched, moderately polluted, or severely polluted environment. Aside from the sources of organic pollution mentioned above, the headwaters of the Jordan River in Utah Lake, and several of its tributaries, also receive waters that have adverse effects on its quality. Other sources of pollution to the Jordan come from industry and irrigation return flows.

The reach of the Jordan River from Utah Lake downstream to the Jordan Narrows Diversion Dam had a moderately swift current flowing through a 3- to 12-foot deep channel. The bottom substrate was composed of shifting silt and sand. Quantitative sampling of the bottom revealed only low numbers of pollution-tolerant sludge worms (18 per sq. ft.). Other organisms were unable to exist due to the imcompatible habitat the substrate afforded. Even though the combination of a shifting silt and sand substrate and the high turbidity of the river is not conducive to the progagation and maintenance of the more sensitive organisms, qualitative samples taken from attached debris did indicate the quality of the water was sufficient to support some of the less tolerant forms (Table 8). The kinds of organisms increased from seven to eleven in the stream reach from Utah Lake downstream (stations 1 through 3, respectively) to the Jordan Narrows Diversion Dam, indicating the water quality was improving as some of the silt precipitated out in the river's slower stretches.

A marked decrease in kinds of organisms was found at station 4 immediately downstream of the diversion dam. There was a drop from eleven at station 3 to five at station 4. However, the decrease was not necessarily caused by a degradation in water quality. Most of the organisms found were of the clean water varieties. Physical characteristics of the river at this point made it nearly impossible to sample with available equipment. The river, although only one-third its original volume due to irrigation diversions, was deep and very swift. The bottom was composed of large rocks and boulders which were covered with attached algae or periphyton. The swift flow of turbulent water prevented the settling out of suspended materials and thus allowed sensitive organisms to inhabit the bottom.

Downstream approximately four miles, the benthic community at Bluffdale Road (station 5) increased to 13 kinds of organisms, numbering 1399 per sq. ft. (Table 8 and Figure 20). Although the majority were pollution sensitive, the large numbers per sq. ft. indicate an enriched situation. This part of the river was characterized by alternating riffle and pool areas, and was also the first station where clear water was encountered. A substrate of rocks, gravel, and sand provided an excellent habitat for benthic organisms and supported a healthy growth of aquatic plants. Water at the previous stations had a green tinge due to the abundance of free floating algae. At station 5, water clarity and a 7-8^{o}F drop in water temperature from the upstream stations were primarily due to cold water springs in the area. This area was also selected as the upstream control for the Utah State Prison sewage treatment plant (S.T.P.) effluent which discharges into Corner Canyon Creek and then to the Jordan River.

TABLE 8

JORDAN RIVER

Number and Kinds of Benthic Organisms

Notes: Q - Organism present in qual sample, counted as "1" in computing No. of Kinds.
20/2.3 - number/percent

Organism	Saratoga Springs	Lehi-Fairfield	Narrows Upstream	Narrows Downstream	14600 South	12600 South	10600 South	9000 South	7800 South	6400 South	Little Cottonwood Control	Little Cottonwood Downstream	4800 South	4500 South	Big Cottonwood 152/216	Big Cottonwood Upstream-STP	3300 South	3100 South	2100 South	300 South	1800 North	Cudahy Lane	State Canal
PLECOPTERA (stoneflies)																							
Isogenus sp.											2/1.3												
Brachyptera sp.											1/0.7				1/2.4								
Acroneuria sp.															1/2.4								
EPHEMEROPTERA (mayflies)																							
Callibaetis sp.		Q							Q			Q	Q				Q						
Baetis sp.	Q				Q						72/49.6			Q		2/0.3						Q	Q
Tricorythodes sp.			Q	Q	9/0.6	22/2.6	9/0.4	21/4.5	10/3.3	57/8.9		3/8.8		2/0.2		Q							
Stenonema sp.				Q																			
Heptagenia sp.									10/3.3	12/2/8	4/2.8				Q								
Ironopsis sp.															1/2.4								
Ephemerella sp.																							
TRICHOPTERA (caddis flies)																							
Hydropsyche sp.	Q	Q	Q	Q	1152/ 82.3	36/4.1	27/1.1	33/7.1	46/15.1	16/2.5	18/12.5		1/0.4	3/0.2		232/ 39.9							
Helicopsyche sp.					8/0.6																		
Hydroptila sp.							9/0.4	3/0.6															
Agapetus sp.											Q												
Rhyacophila sp.											7/4.8				Q								
Artopsyche sp.															Q								
Glossoma sp.															2/4.6								
Psychomyia sp.															Q								
COELENTERATA (hyroids)																							
Hydra sp.		Q	Q																				

(continued next page)

TABLE 8 (Cont.)

Organism	Saratoga Springs	Lehi-Fairfield	Narrows Upstream	Narrows Downstream	14600 South	12600 South	10600 South	9000 South	7800 South	6400 South	Little Cottonwood Control	Little Cottonwood Downstream	4800 South	4500 South	Big Cottonwood 152/216	Big Cottonwood Upstream-STP	3300 South	3100 South	2100 South	300 South	1800 North	Cudahy Lane	State Canal
PORIFERA (sponges)									1/0.3														
MOLLUSCA																							
Ancylidae (limpets)									62/20.3														
COLEOPTERA (beetles)																							
Gyrinidae		Q	Q												6/13.9								
Elmidae					21/1.5	10/1.1		1			5/3.4		1/0.4										
Dytiscidae																							
Haliplidae												Q											
Hydrophilidae																					Q		Q
HEMIPTERA																							
Corixidae (water boatmen)		Q	Q			4/0.5	Q	Q	Q				Q				Q		Q			Q	
Ambrysus (creeping water bugs)					Q																		
ODONATA																							
Zygoptera (damsel flies)																							
Coenagrionidae	Q	Q	Q				Q		Q			Q	Q								Q	Q	
Agrionidae				Q	Q			Q		Q													
Anisoptera (dragon files)																							
Gomphidae			Q							Q				Q									
AMPHIPODA (scuds)																							
Hyalella azteca	Q	Q	Q		Q	332/ 38.1	275/ 11.1	27/5.9	88/28.9	196/ 30.6			21/7.6	3/0.2				1/25.0	Q				Q
Gammarus sp.			Q			20/2.3		Q	2/0.7					Q									

(continued next page)

TABLE 8 (Cont.)

Organism	Saratoga Springs	Lehi-Fairfield	Narrows Upstream	Narrows Downstream	14600 South	12600 South	10600 South	9000 South	7800 South	6400 South	Little Cottonwood Control	Little Cottonwood Downstream	4800 South	4500 South	Big Cottonwood 152/216	Big Cottonwood Upstream-STP	3300 South	3100 South	2100 South	300 South	1800 North	Cudahy Lane	State Canal
DIPTERA																							
Chironomidae (midges)	Q	Q		Q	190/ 13.6	290/ 33.4	725/ 29.3	188/ 40.3	8/2.6	285/ 44.5	29/ 20.0	25/ 73.5	148/ 53.4	513/ 48.0	30/ 69.7	185/ 31.7	Q	1/25.0	Q	2/ 11.1	Q		Q
Simuliidae (black flies)			Q		11/ 0.8	26/ 3.1	60/ 2.4	Q	14/4.6	36/5.6	6/4.2	Q	9/3.2	Q			Q						
Tabanidae (horse flies)									1/0.3														
Empididae (snipe flies)										1/0.2	1/0.7												
Tipulidae															2/4.6								
MOLLUSCA (snails)																							
Ctenobranchiata					Q	Q	Q					Q											
Physa sp.	Q	Q	Q				Q	Q	Q										Q			3/3.1	Q
Lymnaea sp.														Q									
ANNELIDA																							
Oligochaeta (sludge worms)	18/ 100					32/ 3.6	1271/ 51.3	161/ 34.5	7/2.3	18/2.8		6/ 17.7	97/ 35.0	546/ 51.2		20/ 3.4	Q	1/25.0	Q	14/ 77.8	35/ 97.2	90/ 93.8	27/ 50.0
Hirudinea (leeches)					8/0.6	98/ 11.2	98/ 4.0	33/ 7.1	56/ 18.3	20/3.1		Q		Q		1/0.2	Q		Q	2/ 11.1	1/2.8	3/3.1	
MISCELLANEOUS																							
Elophila (aquatic moths)					Q																		
Asellus sp. (aquatic sowbugs)												Q		3/0.2		143/ 24.5		1/25.0	Q				27/ 50.0
Planaria																						Q	
Total No./sq.ft.	18	-	-	-	1399	870	2474	467	305	641	145	34	277	1070	43	583	-	4	-	18	36	96	54
Total No. of Kinds	7	9	11	5	13	11	12	13	16	11	11	10	9	12	11	7	6	4	7	3	5	7	7

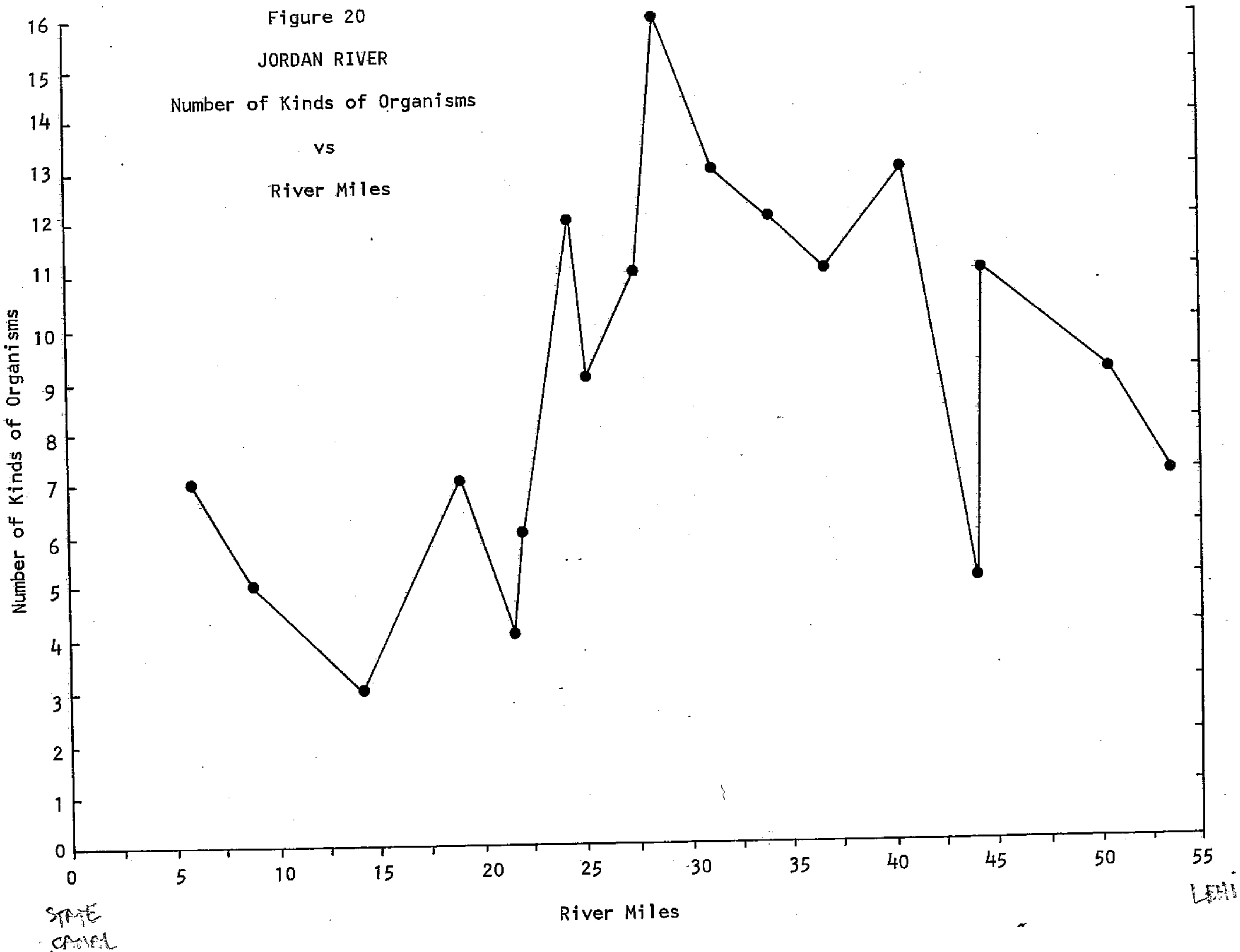


Figure 20

JORDAN RIVER

Number of Kinds of Organisms

vs

River Miles

At 12600 South (station 6), or the first station downstream from the prison S.T.P., there was a decrease in benthic organisms from 13 kinds at station 5 to eleven kinds. The reduction of two kinds of organisms is not as important as the 40% decrease in the numbers of benthic fauna per sq. ft. from the previous station to this one. Although some of the reduction might have been caused by dredging operations in past years, the main cause was attributed to organic pollution. This is further evidenced by the fact that the percentage of sensitive organisms per sq. ft. decreased from more than 85% of the total number to about 7% at this station.

Although there was approximately a 300% increase in the numbers of organisms at 10600 South, there was again a decline in the percentage of clean-water organisms and over 85% of the invertebrates collected were pollution-tolerant types, indicating organic enrichment had progressed to the point that the more sensitive organisms were unable to properly compete for available habitat.

At station 8, 9000 South, the river was both losing the cooling effects of the springs and becoming turbid due to irrigation return flow from Dry Creek. But water quality had improved sufficiently enough to allow percentages of less tolerant organisms an opportunity to increase slightly from about 2% to nearly 12%. This station was the upstream control for the Sandy S.T.P.

The largest number of kinds of organisms (16 total kinds) was found at 7800 South. The reason for this was entirely due to the influence of Bingham Creek. In years past the Utah-Idaho Sugar Company disposed of their wastes in the creek. Beet wastes discharged to Bingham Creek, flowed into the Jordan, and degraded water quality to the point that only pollution-tolerant organisms were able to exist (Hinshaw 19-). The plant has since ceased operations and the quality of the Jordan River in the immediate area downstream has been improved greatly by the waters of this tributary. Therefore, a cursory glance at the data presented in the tables for this station could be quite deceiving. Even though 16 kinds of organisms were found in the river directly downstream from the mouth of Bingham Creek, only four types were found in a quantitative sample taken immediately upstream of its mouth. This would indicate that the Sandy S.T.P. is definitely advesely affecting the river. A black coating on the bottom of the rocks caused by anaerobic decomposition of organic matter also indicated organic pollution.

The downstream station used to check the effects of the Tri-Community S.T.P. was located at 6400 South. There was a drop from 16 to 11 kinds of organisms at this location, but the change cannot be entirely attributed to detrimental effects caused by the S.T.P. upstream. As previously mentioned, the waters added by Bingham Creek slightly improved water quality in the Jordan River, but the effect was evident only in the immediate vicinity of the confluence. If the one quantitative sample taken directly in the influence of the creek at 7800 South was excluded, the benthic community at the peripheral margin of the creek's inflow would compare quite closely with those samples taken at 6400 South -- the only difference being in the increase of pollution-tolerant organisms at 6400 South from 176 per sq. ft. to 556 per sq. ft., respectively.

There was a decrease intotal kinds and numbers of organisms at 4800 South (refer to Table 8). Over 95% of the organisms found in the quantitative samples were pollution-tolerant organisms, indicating a high degree of pollution. This station was the upstream control for the Murray S.T.P.

Between the sampling station at 4800 South and station 14 at 4500 South, Little Cottonwood Creek enters the river. Samples taken on this creek showed that it supported a balanced and competitive clean water environment in its headwaters. In just a few miles of its East-to-West course across Salt Lake City, the creek picked up nutrients and silt from several irrigation canals, and the rock and cobble substrate of upstream was replaced by silt and organic debris. This absence of good substrate made it difficult to determine what aquatic life the water could support. The quality of water from this tributary was sufficient to dilute the Jordan enough to improve the numbers and kinds of organisms found at 4500 South. Populations per sq. ft. increased from 277 at 4800 South to 1065 at this station, and from 9 to 12 kinds. Any effects that the Murray S.T.P. discharge, which is located between these two stations, had on the river were limited to a short reach of river and were not evident at this station.

Big Cottonwood Creek enters the river between 4500 South and 3300 South. Samples taken on the creek upstream from the Salt Lake County Cottonwood S.T.P. revealed about the same situation that was found on Little Cottonwood Creek; i.e., an environment that proceeds from clean to enriched in a relatively short distance across the city. The 4500 South Station did support a fair diversity of kinds (12), but most of them were pollution-tolerant or moderately sensitive organisms. At 3300 South, or the downstream station for the Cottonwood S.T.P., the number of kinds of benthic organisms decreased by approximately 50% and the sludge and silt substrate supported only the most pollution-tolerant organisms. The plant discharge definitely contributes to the degradation of the river. (Table 8).

Although some sensitive organisms were found in all the previous stations, the river in the vicinity of 3100 South, 2100 South, 300 South, and 1800 North supported only those kinds of organisms that were pollution tolerant. The number of kinds varied slightly, from three to seven, as influenced by entering tributary streams, but on the whole this section of river was highly degraded by organic pollution.

The last two stations at Cudahy Lane and the State Canal showed some slight improvement. The total number of kinds, as well as the number of organisms per sq. ft., increased. Also, examples of sensitive organisms were found on attached debris, but quantitative samples of the substrate still showed only pollution-tolerant benthic organisms to be present.

Electro-fishing (Qualitative Fish Sampling)

The State of Utah has classified the waters involved in this investigation as class "C" waters. Utah Lake and the Jordan River from Utah Lake downstream to the Utah County Line has been further classified as class "CW" waters with the remainder of the Jordan River from the Utah County Line downstream to the Great Salt Lake classified as class "CC" waters. Appendix Table B defines these classifications.

The Jordan River supported a fish population that was predominatly rough fish (Tables 9 and 10). Warm water game fish species were found mainly in the stretch of stream from Utah Lake to the Jordan Narrows Diversion Dam. A few white bass were collected as far downstream as 5770 South, but the small numbers of fish collected indicated marginal populations probably caused by the colder temperatures at 12400 South St. and polluted conditions at 5770 South St.

Only one reach of water in the vicinity of North Prison Road produced a representative of a cold water fisheries (Tables 9 and 10). This single specimen was a brown trout weighing about 3½ lbs. In the northern most section of the river from 4800 South to the river's mouth at the Great Salt Lake, only pollution-tolerant rough fish were found. The most numerous kinds and numbers of fish were found in the southern end of the river. Here, the habitat had not been too severely disturbed by dredging operations and organic pollution had not destroyed the majority of fish food organisms.

Several problems were encountered during fish-shocking. In most areas of the river the water was extremely turbid and many fish that were shocked were not observed. Some fish, when shocked, tend to sink and roll along the bottom until out of the electric field. As a result, the data presented represents a minimum number of species collected.

TABLE 9

JORDAN RIVER

Summary of Fishes Collected by Electro-Fishing vs Sampling Stations

Station No. & Location	Carp (*Cyprinus carpio*)	Utah Sucker (*Catostomus ardens*)	Brown Trout (*Salmo trutta*)	Dace (*Rhinichthys sp.*)*	Redside Shiner (*Richardsonius balteatus hydrophlox*)	Utah Chub (*Gila atraria*)	Green Sunfish (*Lepomis cyanellus*)	Goldfish (*Carassius auratus*)	Yellow Perch (*Perca flavescens* (*Mitchell*))	White Bass (*Morone chrysops* (*Rafinesque*))	Black Bullhead (*Ictalurus melas*)	Mountain Sucker (*Catostomus platyrhynchus*)	TOTAL Species/Station
1 - Saratoga Springs	3						1		1	2			4
2 - Lehi-Fairfield	2						1			2	2		4
3 - Bluffdale Road	2	2		2								3	4
4 - North Prison Road		2	1	3	2							3	5
5 - 12400 South	3	2		2	2					1		3	6
6 - 9000 South	2	2					1					3	4
7 - 5770 South	3	3								1		2	4
8 - 4800 South	3	3										1	3
9 - 3300 South	3	3										2	3
10 - 2100 South	3	1											2
11 - 300 South	3	1				1		2					4
12 - 1800 North	3				2	2							3
13 - State Canal	2					1							2

Designation of Occurrence: 1 = Uncommon
2 = Common
3 = Very Common

*All dace examined in EPA laboratory were keyed out to Long Nose Dace.

TABLE 10

JORDAN RIVER

Number and Kinds of Fish

Station No.	Distance Fished	Hours Fished	Species: Carp (*Cyprinus carpio*)	Utah Sucker (*Catostomus ardens*)	Brown Trout (*Salmo trutta*)	Dace (*Rhinichthys sp.*)	Redside Shiner (*Richardsonius balteatus hydrophlox*)	Utah Chub (*Gila atraria*)	Green Sunfish (*Lepomis cyanellus*)	Yellow Perch (*Perca flavescens*)	Goldfish (*Carassius auratus*)	White Bass (*Morone chrysops*)	Black Bullhead (*Ictalurus melas*)	Mountain Sucker (*Catostomus platyrhynchus*)	Total No.	No. of Kinds
1	0.2 mi.	0.5	185						2	1		15			203	4
2	0.1 "	0.6	10						1			3	4		18	4
3	0.1 "	0.5	10	37		26								82	155	4
4	300 ft.	0.3		3	1	35	11							10	60	5
5	800 "	0.6	56	16		11	9					1		66	159	6
6	300 "	0.3	16	13					1					27	57	4
7	400 "	0.4	56	75								1		15	147	4
8	300 "	0.2	40	50										5	95	3
9	0.2 mi.	0.5	150	75										10	235	3
10	0.1 "	0.4	60	1											61	2
11	0.1 "	0.4	50	3				6			24				83	4
12	0.1 "	0.4	64				20	20							104	3
13	0.1 "	0.4	25					1							26	2

Algae

All periphyton samples collected were classified to genus level. The diatoms were cleared according to the acid digestion method suggested by Patrick and Reimer, 1967. Following the digestion procedure the samples were mounted permanently with Permount media.

The following results are strictly qualitative, and Table 11 will serve as a check list of algae present in the Jordan River on August 18, 1972:

> Four divisions of algae composed of 36 genera were collected from the Jordan River periphyton samples. The Bacillariophyceae (diatoms) were the most numerous genera, with a total of 22 different kinds being identified. Two other members of the Chrysophyta (yellow-green algae) were also collected, *Vaucheria* sp. and *Tribonema* sp. The Chlorophyta (green algae) were the next most predominant in diversity, being represented by nine genera. The Cyanophyta (blue-green algae) collected were limited to the genera *Oscillatoria* sp. and *Anabaena* sp. Pyrrhophyta (brown algae) were the least represented of the four algal divisions, with only *Ceratium* sp. being collected.

As indicated earlier in the discussion of phosphorus and nitrogen levels in the Jordan River, the river contains a high concentration of these nutrients.

In enriched situations, such as exists in the Jordan River, algal populations tend to shift from predominantly green algal communities to blue-green algal communities. Such blue-green communities usually produce taste and odor problems and unsightly scums along the shoreline.

TABLE 11
JORDAN RIVER
Algae Check List

(Station No. & Location)

Algae	1. Saratoga Spgs.	2. Lehi-Fairfield	3. Jordan Narrows	4. 14600 S.	5. 12600 S.	6. 10600 S.	7. 9000 S.	8. 7800 S.	9. 6400 S.	10. 4800 S.	11. 4500 S.	12. 3300 S.	13. 2100 S.	14. 300 S.	15. 1800 N.	16 Cudahy Lane	17. State Canal
CYANOPHYTA (blue-green)																	
Oscillatoria sp.				X	X		X	X	X		X	X	X	X	X	X	X
Anabaena sp.	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X
CHRYSOPHYTA (yellow-green)																	
Bacillariophyceae (diatoms)																	
Cocconeis sp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Melosira sp.	X			X			X				X				X		X
Synedra sp.	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Attheya sp.	X	X		X											X		X
Acanthes sp.	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Navicula sp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nitzschia sp.	X		X				X	X								X	
Bacillaria sp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Gyrosigma sp.	X	X	X	X			X	X	X	X	X	X				X	
Pleurosigma sp.	X	X	X	X									X	X	X	X	
Cymbella sp.	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X
Surirella sp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cyclotella sp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Diatoma sp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fragillaria sp.		X	X	X						X							
Gomphonema sp.		X		X										X			
Biddulphia sp.			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Epithemia sp.			X	X			X	X	X	X	X		X			X	X
Rhoicosphenia sp.			X	X			X	X	X		X	X	X	X	X	X	X
Stephanodiscus sp.			X	X											X		
Anomoeonis sp.				X						X		X				X	
Caloneis sp.							X	X	X	X	X	X	X	X	X	X	X
Vaucheriaceae																	
Vaucheria sp.					X						X						
Tribonemataceae																	
Tribonema sp.		X					X	X					X				
PYRRHOPHYTA (brown)																	
Ceratium sp.	X	X			X		X	X		X		X					
CHLOROPHYTA (green)																	
Cladophora sp.	X							X			X				X	X	
Rhizoclonium sp.	X	X			X	X		X	X						X		
Enteromorpha sp.			X	X													
Pediastrum sp.	X			X													
Oedogonium sp.						X							X	X		X	
Spirogyra sp.										X	X				X	X	
Zygnema sp.										X			X		X		
Closterium sp.								X	X			X			X	X	
Pandorina sp.																	X

SUMMARY AND CONCLUSIONS

The Utah Lake-Jordan River Basin, a semi-arid interior drainage basin located entirely within the State of Utah, is one of the areas designated by the Environmental Protection Agency as a Priority Basin. Additionally, Utah Lake is listed as a target area in EPA's National Eutrophication Control Program. In Support of the Environmental Protection Agency's Priority Basin Concept, EPA Region VIII personnel conducted field investigations in the Utah Lake-Jordan River Basin in June and August 1972. These studies were focused in the areas of Emigration Canyon and the main stem of the Jordan River.

Bacteriological examination of the Emigration Canyon area indicated the mean coliform densities in the headwaters of the creek that runs through the canyon to be generally low (20/100 ml total coliform and 6/100 ml fecal coliform). Furthermore, discharges from individual waste water disposal facilities in the vicinity of or directly into the creek have increased the coliform densities in the creek to values in excess of the 5,000/100 ml criteria for waters in the Basin. Waters in the creek, particularly in the reach where the excessive coliform densities occurred, are used by the local residents for the sport of "tubing"--riding an innertube downstream.

The results of the microbiological study of the Jordan River indicated that the mean total coliform densities in the headwaters of the river to be less than the 5,000/100 ml criteria for waters in the Basin (1118/100 ml TC mean at JR-1), a condition that existed for only 13 river miles downstream. Wastes from various sources entering the Jordan River along the reach from 7800 South St. (JR-9) downstream through the remainder of the river caused the total coliform densities in the river to exceed the 5,000/100 ml criteria on the basis of the daily grab samples. From 3300 South St. (JR-13) downstream to the mouth of the Jordan River, the mean densities at each station in this reach exceeded the coliform limit.

Average dissolved oxygen values in the Jordan River were greater than the cold water fishery criteria (6.0 mg/l) from Utah Lake downstream to and including the station at 3300 South St. (JR-13). From 2100 South St. (JR-14) downstream to the mouth of the river the average D.O. values decreased and were less than the 6.0 mg/l criteria. At Cudahy Lane (JR-17), the average D.O. was 3.7 mg/l.

Significant photosynthetic activity is taking place in the Jordan River in about the upstream third of the river. Single D.O. values as high as 19 mg/l have been measured. The results of a round-the-clock study at a station in this reach (Fairfield Rd., JR-2) indicated that the dissolved oxygen concentrations varied from 7 to 12 mg/l over a 24-hour period.

Total phosphorus and nitrogen concentrations in the Jordan River were excessive. This is particularly significant in the area of the proposed impoundment of the river where both the phosphorus and nitrogen levels exceeded those considered as limits for waters entering impounded areas. It is probable that by impounding these waters large algal blooms, extensive growths of aquatic plant, and fish mortalities would occur. With the exception of the extreme upstream stations on Mill Creek, Big Cottonwood Creek, and Little Cottonwood Creek, the nutrient concentrations at all remaining stations on these tributaries to the Jordan River were excessive.

Wastes from the Utah State Prison are contributing to a significant increase in the total and fecal coliform concentrations in Corner Canyon Creek, tributary to the Jordan River. Likewise, wastes entering the creek from the prison effluent ditch have caused a reduction in the dissolved oxygen resources of the creek.

A biological study conducted on the main stem of the Jordan River (August 14-23) showed that approximately 70% of the water in the river was adversely affected either by the headwaters from Utah Lake or by organic pollutants from numerous waste water treatment plants and irrigation return flows.

For approximately the first nine to ten miles of the river's course, from Utah Lake to the Jordan Narrows, a shifting, unstable substrate and highly turbid water limited the benthic invertebrate community to from seven to eleven kinds of organisms. The fish population in this reach of river was composed of five kinds, predominatly warm water game fish.

Downstream from the Jordan Narrows to about 7800 South (15 stream miles), the river supported a diversity of benthic organisms numbering from 11 to 16 kinds. In the upstream portion of this area, the substrate was composed of course sand and cobbles. Water quality was both augmented and enhanced by numerous springs which decreased the temperature and turbidity, thus permitting the river to support pollution-sensitive benthic organisms. Proceeding downstream from Bluffdale Rd. (14600 South), water quality was progressively degraded. Downstream from 7800 South, organic pollution had increased to the point that the only areas of recovery in water quality were found in the confluences of tributaries. One brown trout was collected from the upstream section of the above reach (North Prison Rd.), indicating that a portion of the river supported a cold water fishery.

Approximately 30 miles of river, from 7800 South to the Great Salt Lake, received increased organic pollution from waste water treatment plant effluents and irrigation return flows. The river had been dredged and the bottom consisted mainly of silt, sand, and organic sludge. The available habitat supported organisms more tolerant to pollution. Fish populations in this reach of river consisted of rough fish that were able to exist in water degraded by organic pollution.

If additional biological studies are to be conducted on this river system, efforts should be concentrated on Utah Lake and its tributaries and the section of the Jordan River from 9000 South, downstream to the Great Salt Lake.

APPENDIX A

Survey Data

TABLE A-1

UTAH LAKE - JORDAN RIVER

Water Quality Sampling Station Locations

Station No.	Approx. Miles from Mouth	Description
Emigration Canyon Stations		
EC-1	14.5	Upstream control station - near large tree at end of road.
EC-2	12.8	Opposite bus turn-around area.
EC-3	--	Killyon Canyon Creek about 100 yds. upstream from confluence with Emigration Cr.
EC-4	11.4	At USGS marker, opposite roadside historical marker.
EC-5	10.3	Footbridge over creek at "Shaw" residence.
EC-6	9.8	At culvert under roadway at "Story" residence.
EC-7	8.6	In field area at large tree.
EC-8	7.4	At "148 E. Sunnyvale."
EC-9	4.8	At 2100 East Street outfall.
EC-10	0	At 13th South St. storm drain outfall to Jordan River.
EC-11	--	Jordan River about 50 ft. upstream from the 13th South St. outfall.
Jordan River Stations		
JR-1	53.6	Jordan River at Utah Lake outlet - Saratoga Springs Rd.
JR-2	50.6	Jordan River, Bridge on Utah 73 - Fairfield Rd.
JR-3	44.2	Jordan River at Pumping Station.
JR-4	40.5	Jordan River, Bridge on 14600 South St. - Bluffdale Rd.
JR-4A	--	South Jordan River Canal on 14600 South St.
JR-5	36.8	Jordan River, Bridge on 12600 South St. - Utah Hwy. 111/71.
JR-6	34.2	Jordan River, Bridge on 10600 South St.
JR-7	31.9	Jordan River, Bridge on 9000 South St.
JR-9	28.9	Jordan River, Bridge on 7800 South St.
JR-10	27.6	Jordan River, Bridge on 6400 South St.
JR-11	25.1	Jordan River, Bridge on 4800 South St.
JR-12	24.6	Jordan River, off 4500 South St.
JR-13	21.9	Jordan River, Bridge on 3300 South St. - Hwy. 171
JR-14	19.0	Jordan River, Bridge on 2100 South St.

TABLE A-1 (Cont.)

Station No.	Approx. Miles from Mouth	Description
Jordan River Stations (Cont.)		
JR-14A	15.5	Jordan River, Bridge on 8th South St.
JR-15	14.1	Jordan River, Bridge on 3rd South St.
JR-16	8.8	Jordan River, off Redwood Rd. - North of Golf Course.
JR-17	6.0	Jordan River, Bridge on Cudahy Lane.
Miscellaneous Stations		
LC-1		Little Cottonwood Creek at 360 West St. off 4800 South St.
BC-1		Big Cottonwood Creek at 500 West St. off 3900 South St.
SLC-1		Salt Lake City, Suburban STP, effluent ditch off 8th West St.
M-1		Mill Creek at 8th West St.
P-1		Effluent from Utah State Prison, ditch about 50 yds. upstream from confluence with Corner Canyon Creek.
DC-2		Corner Canyon Creek (Draper Creek) about 100 ft. downstream from State Prison effluent ditch.
DC-1		Corner Canyon Creek about 50 ft. upstream from State Prison effluent ditch.
SC-1		Surplus Canal at footbridge about 100 yds. downstream of Hwy. 40 near airport road.

TABLE A-2

RESULTS OF ANALYSIS

JUNE 1972 STUDY

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	Phos-T mg/l	Ortho-P mg/l	T.Coli T/100ml	F.Coli T/100ml
EC-1	72/06/19	1148	9	-	-	-	-	-	-	29	<2
	72/06/20	1105	8.5	-	-	-	-	-	-	30	4
	72/06/21	0942	8	7.6	8.9	550	-	-	-	18	12
	72/06/24	0828	8.5	-	-	-	-	-	-	18	12
	72/06/24	1130	9	7.6	8.9	545	-	-	-	-	-
	72/06/25	0915	8.5	-	-	-	-	-	-	12	8
EC-2	72/06/19	1157	9	-	-	-	-	-	-	35	6
	72/06/20	1115	9.5	-	-	-	-	-	-	42	18
	72/06/21	1005	10	7.7	8.8	550	-	-	-	54	35
	72/06/24	0835	9.5	-	-	-	-	-	-	40	28
	72/06/24	1210	10.5	7.7	8.6	560	-	-	-	-	-
	72/06/25	0924	9.5	-	-	-	-	-	-	35	10
EC-3	72/06/19	1203	10	-	-	-	-	-	-	84	2
	72/06/20	1119	9.5	-	-	-	-	-	-	20	2
	72/06/21	1015	10	7.6	8.8	455	-	-	-	52	15
	72/06/24	0842	10	-	-	-	-	-	-	55	20
	72/06/24	1225	11.5	7.8	8.5	460	-	-	-	-	-
	72/06/25	0928	9.5	-	-	-	-	-	-	58	25
EC-4	72/06/19	1211	10	-	-	-	-	-	-	290	130
	72/06/20	1128	9	-	-	-	-	-	-	2800	210
	72/06/21	1030	10	7.7	8.8	550	-	-	-	210	36
	72/06/24	0850	10	-	-	-	-	-	-	180	38
	72/06/24	1433	13	7.9	8.1	515	-	-	-	-	-
	72/06/25	0938	10	-	-	-	-	-	-	300	49

TABLE A-2 (Cont.)

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	Phos-T mg/l	Ortho-P mg/l	T.Coli T/100ml	F.Coli T/100ml
EC-5	72/06/19	1218	10	-	-	-	-	-	-	320	130
	72/06/20	1136	9	-	-	-	-	-	-	2700	2500
	72/06/21	1042	11	7.9	8.8	615	-	-	-	450	200
	72/06/24	0856	11	-	-	-	-	-	-	320	200
	72/06/24	1522	13.5	8.0	8.4	610	-	-	-	-	-
	72/06/25	0942	10	-	-	-	-	-	-	600	290
EC-6	72/06/19	1224	10	-	-	-	-	-	-	400	150
	72/06/20	1141	9	-	-	-	-	-	-	450	210
	72/06/20	1625	13	8.2	8.4	610	-	-	-	-	-
	72/06/21	1054	11	-	-	-	-	-	-	480	260
	72/06/24	0901	12	-	-	-	-	-	-	570	230
	72/06/24	1532	13.5	8.0	8.1	635	-	-	-	-	-
	72/06/25	0947	11	-	-	-	-	-	-	2300	1200
EC-7	72/06/19	1230	11.5	-	-	-	-	-	-	380	150
	72/06/20	1147	11	-	-	-	-	-	-	740	190
	72/06/20	1610	14	8.1	8.5	640	-	-	-	-	-
	72/06/21	1100	11.5	-	-	-	-	-	-	490	300
	72/06/24	0907	11.5	-	-	-	-	-	-	1000	260
	72/06/24	1544	14	7.9	8.1	660	-	-	-	-	-
	72/06/25	0953	11	-	-	-	-	-	-	2000	520
EC-8	72/06/19	1242	12	-	-	-	-	-	-	480	160
	72/06/20	1156	11.5	-	-	-	-	-	-	520	290
	72/06/20	1555	15	8.2	8.4	615	-	-	-	-	-
	72/06/21	1105	12.5	-	-	-	-	-	-	630	270
	72/06/24	0912	12	-	-	-	-	-	-	670	250
	72/06/24	1558	15.5	7.8	8.2	640	-	-	-	-	-
	72/06/25	0959	11.5	-	-	-	-	-	-	1400	260

TABLE A-2 (Cont.)

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	Phos-T mg/l	Ortho-P mg/l	T.Coli T/100ml	F.Coli T/100ml
EC-9	72/06/19	1254	13	-	-	-	-	-	-	690	270
	72/06/20	1204	13.5	-	-	-	-	-	-	1400	650
	72/06/20	1515	16	8.0	8.6	615	0.04	0.025	0.020	-	-
	72/06/21	1110	14	-	-	-	-	-	-	5700	800
	72/06/22	0822	-	-	-	-	-	-	-	1300	440
	72/06/22	1022	-	-	-	-	-	-	-	6200	1300
	72/06/22	1222	-	-	-	-	-	-	-	2400	490
	72/06/22	1426	-	-	-	-	-	-	-	3300	650
	72/06/22	1620	-	-	-	-	-	-	-	620	210
	72/06/22	2024	-	-	-	-	-	-	-	600	240
	72/06/22	2222	-	-	-	-	-	-	-	1600	310
	72/06/23	0030	-	-	-	-	-	-	-	1300	420
	72/06/23	0221	-	-	-	-	-	-	-	4100	780
	72/06/23	0622	-	-	-	-	-	-	-	990	510
	72/06/23	0815	-	-	-	-	-	-	-	1200	400
	72/06/24	0919	13	-	-	-	-	-	-	3300	610
	72/06/24	1622	16	7.9	8.0	640	0.28	0.020	0.010	-	-
	72/06/25	1024	13.5	-	-	-	-	-	-	4500	1100
EC-10	72/06/19	1313	16	-	-	-	-	-	-	220	20
	72/06/20	1221	16	-	-	-	-	-	-	360	95
	72/06/20	1825	18	8.1	7.7	840	1.00	0.090	0.050	-	-
	72/06/21	1127	17	-	-	-	-	-	-	3700	570
	72/06/22	0838	-	-	-	-	-	-	-	1200	580
	72/06/22	1038	-	-	-	-	-	-	-	1400	350
	72/06/22	1237	-	-	-	-	-	-	-	3400	400
	72/06/22	1439	-	-	-	-	-	-	-	4200	890
	72/06/22	1634	-	-	-	-	-	-	-	2300	680
	72/06/22	1839	-	-	-	-	-	-	-	6300	820
	72/06/22	2040	-	-	-	-	-	-	-	6600	620
	72/06/22	2240	-	-	-	-	-	-	-	4500	760

TABLE A-2 (Cont.)

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	Phos-T mg/l	Ortho-P mg/l	T.Coli T/100ml	F.Coli T/100ml
EC-10 (cont.)	72/06/23	0042	-	-	-	-	-	-	-	5800	730
	72/06/23	0237	-	-	-	-	-	-	-	4400	820
	72/06/23	0636	-	-	-	-	-	-	-	4000	240
	72/06/23	0830	-	-	-	-	-	-	-	4700	840
	72/06/24	0935	-	-	-	-	-	-	-	2000	300
	72/06/24	1649	19	7.9	7.3	895	0.92	-	0.050	-	-
	72/06/25	1039	17	-	-	-	-	-	-	2200	530
EC-11 (JR)	72/06/24	0939	-	-	-	-	-	-	-	64000	3200
	72/06/24	1655	-	-	6.0	-	-	-	-	-	-
JR-5	72/06/21	1341	21.5	6.9	12.5	2120	1.99	0.140	0.110	-	-
	72/06/23	1540	22	8.0	19.1	2120	1.98	0.110	0.085	-	-
JR-4	72/06/21	1303	21	6.5	10.8	1590	1.97	0.025	0.025	-	-
	72/06/23	1616	22.5	7.9	9.6	1590	1.52	0.030	0.030	-	-
JR-4A	72/06/21	1326	24	-	-	-	0.30	0.150	0.015	-	-
	72/06/23	1602	22.5	8.1	7.3	1510	0.32	0.200	0.020	-	-
JR-3	72/06/21	1415	23.5	7.0	7.5	1460	0.22	0.105	0.010	-	-
	72/06/23	1640	22.5	8.1	6.6	1480	0.25	0.220	0.020	-	-
JR-1	72/06/21	1440	24.5	7.6	10.9	1410	0.12	0.065	0.010	-	-
	72/06/23	1715	22.5	8.1	7.6	1475	0.27	0.260	0.025	-	-

TABLE A-3

RESULTS OF ANALYSIS

AUGUST 1972 STUDY

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	NO_2-N mg/l	TKN mg/l	Phos-T mg/l	T. Coli T/100ml	F. Coli T/100ml
JR-1	72/08/14	1206	24	7	6.3	1270	-	-	-	-	20000	50
	72/08/15	1423	24	6	7.7	1590	-	-	-	-	33000	600
	72/08/15	0823	22	6	-	1590	-	-	-	-	13000	100
	72/08/17	1320	25	6	9.5	1670	-	-	-	-	200	< 20
	72/08/18	0846	22.5	6	8.5	1590	-	-	-	-	3000	< 20
	72/08/19	1401	22	6	7.3	1590	-	-	-	-	140	110
	72/08/20	0825	19.5	6	6.5	1670	-	-	-	-	200	100
	72/08/23	0828	20	6	8.0	1700	-	-	-	-	150	50
	72/08/24	1441	21.5	6	8.8	1640	0.22	0.002	1.65	0.14	200	< 50
JR-2	72/08/14	1222	24	6	6.2	1510	-	-	-	-	4000	100
	72/08/15	1406	23.5	-	7.2	1590	-	-	-	-	300	250
	72/08/16	0835	22	6	5.8	1590	-	-	-	-	400	400
	72/08/17	1310	25	6	8.9	1590	-	-	-	-	460	100
	72/08/18	0902	22.5	6	8.4	1590	-	-	-	-	200	60
	72/08/19	1350	22	6	6.6	1620	-	-	-	-	310	280
	72/08/20	0840	20	6	6.3	1670	-	-	-	-	140	< 50
	72/08/23	0843	20	6	7.9	1700	-	-	-	-	250	50
	72/08/24	1424	21.5	6	6.9	1640	0.20	0.002	1.35	0.06	150	< 50
JR-3	72/08/14	1238	24.5	6	5.9	1430	-	-	-	-	8000	100
	72/08/15	1350	23	6	6.9	1590	-	-	-	-	200	< 20
	72/08/15	0850	22	6	5.8	1590	-	-	-	-	5000	1100
	72/08/17	1253	25	6	8.9	1430	-	-	-	-	200	100
	72/08/18	0920	21.5	6	7.8	1670	-	-	-	-	220	60
	72/08/19	1333	24	6	6.5	1590	-	-	-	-	220	100
	72/08/20	0854	20	6	5.9	1640	-	-	-	-	1600	750
	72/08/23	0859	21	6	7.6	1640	-	-	-	-	140	< 50
	72/08/24	1408	21	6	6.5	1700	0.29	0.002	1.90	0.22	380	100

TABLE A-3 (Cont.)

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	NO_2-N mg/l	TKN mg/l	Phos-T mg/l	T. Coli T/100ml	F. Coli T/100ml
JR-4	72/08/14	1252	21.5	7	9.7	1460	-	-	-	-	1100	400
	72/08/15	1333	22.5	6	11.7	1480	-	-	-	-	4200	2300
	72/08/16	0905	18.5	6	6.7	1700	-	-	-	-	230	220
	72/08/17	1241	20.5	6	11.1	1720	-	-	-	-	90	80
	72/08/18	0935	18	6	7.2	1700	-	-	-	-	120	100
	72/08/19	1318	21	6	11.7	1700	-	-	-	-	590	390
	72/08/20	0908	16.5	6	7.4	1750	-	-	-	-	390	260
	72/08/23	0925	18	6	7.4	1590	-	-	-	-	330	230
	72/08/24	1343	21	6	10.3	1700	0.98	0.008	0.50	0.07	350	270
JR-5	72/08/14	1308	20.5	6	10.2	1680	-	-	-	-	1000	580
	72/08/15	1303	20.5	6	11.4	2330	-	-	-	-	390	340
	72/08/16	0917	17	6	6.6	1800	-	-	-	-	1000	680
	72/08/17	1225	18	6	11.0	2330	-	-	-	-	4900	4300
	72/08/18	0950	16.5	6	7.1	2220	-	-	-	-	2200	1100
	72/08/19	1305	18.5	6	11.3	2280	-	-	-	-	2700	1400
	72/08/20	0921	15.5	6	7.0	2280	-	-	-	-	1600	1200
	72/08/23	0937	16	6	7.2	2230	-	-	-	-	680	360
	72/08/24	1325	19	6	12.3	2280	2.01	0.027	0.38	0.14	1100	340
JR-6	72/08/14	1325	20.5	6	9.5	2225	-	-	-	-	3300	1200
	72/08/15	1246	21	6	9.9	2230	-	-	-	-	2100	1500
	72/08/16	0935	17.5	6	7.3	2550	-	-	-	-	1300	840
	72/08/17	1210	18.5	6	10.3	2760	-	-	-	-	1300	1200
	72/08/18	1008	15.5	6	7.1	2550	-	-	-	-	2600	2400
	72/08/19	1252	20	6	10.7	2550	-	-	-	-	2700	2500
	72/08/20	0936	16	6	7.4	2540	-	-	-	-	3600	3000
	72/08/23	0953	16	6	8.1	2540	-	-	-	-	1200	880
	72/08/24	1306	18.5	6	10.2	2540	1.95	0.023	0.58	0.16	1600	720

TABLE A-3 (Cont.)

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	NO_2-N mg/l	TKN mg/l	Phos-T mg/l	T. Coli T/100ml	F. Coli T/100ml
JR-7	72/08/14	1340	21	6	7.6	2120	-	-	-	-	3200	1000
	72/08/15	1226	20.5	6	7.6	2230	-	-	-	-	2400	1300
	72/08/16	0945	18	6	6.9	2280	-	-	-	-	2400	750
	72/08/17	1157	18	6	7.6	2540	-	-	-	-	2700	1000
	72/08/18	1025	16	6	6.9	2490	-	-	-	-	1900	1100
	72/08/19	1235	19	6	7.8	2540	-	-	-	-	1800	1300
	72/08/20	0948	16	6	7.2	2490	-	-	-	-	1200	1000
	72/08/23	1007	17	6	7.0	2440	-	-	-	-	1800	900
	72/08/24	1250	18	6	8.2	2440	1.95	0.022	0.49	0.02	1200	1000
JR-9	72/08/14	1355	21	6	6.9	2150	-	-	-	-	4500	4500
	72/08/15	1158	20	6	7.4	2230	-	-	-	-	1400	1400
	72/08/16	1110	20	6	7.3	2120	-	-	-	-	2200	710
	72/08/17	1140	20	6	7.9	2280	-	-	-	-	3200	930
	72/08/18	1038	17	6	6.9	2330	-	-	-	-	2100	860
	72/08/19	1221	18	6	7.1	2380	-	-	-	-	2200	2100
	72/08/20	0958	16	6	7.1	2330	-	-	-	-	1600	580
	72/08/23	1017	16.5	6	7.4	2440	-	-	-	-	6500	1400
	72/08/24	1233	17	6	8.1	2390	1.96	0.038	0.81	0.03	1500	940
JR-10	72/08/14	1409	20	6	6.7	-	-	-	-	-	4000	2300
	72/08/15	1145	19	6	7.3	2020	-	-	-	-	1900	580
	72/08/16	1128	19	6	7.1	2330	-	-	-	-	1400	720
	72/08/17	1111	19	6	7.2	2330	-	-	-	-	2900	1400
	72/08/18	1054	16.5	6	7.1	2330	-	-	-	-	1000	860
	72/08/19	1211	17.5	6	7.5	2440	-	-	-	-	2100	1100
	72/08/20	1008	16	6	7.1	2330	-	-	-	-	4000	1000
	72/08/23	1028	17	6	7.2	2330	-	-	-	-	2600	1800
	72/08/24	1215	17	6	7.6	2330	2.03	0.053	1.24	0.26	6100	4000

TABLE A-3 (Cont.)

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	NO_2-N mg/l	TKN mg/l	Phos-T mg/l	T. Coli T/100ml	F. Coli T/100ml
JR-11	72/08/14	1422	20.5	6	7.2	2010	-	-	-	-	46000	6600
	72/08/15	1117	19.5	6	7.4	2120	-	-	-	-	4300	1200
	72/08/16	1144	19.5	6	7.3	2230	-	-	-	-	1900	1000
	72/08/17	0957	18.5	6	6.7	2120	-	-	-	-	2800	2000
	72/08/18	1245	18	6	7.9	2330	-	-	-	-	2600	820
	72/08/19	1037	17	6	7.0	2330	-	-	-	-	1300	1200
	72/08/20	1029	16.5	6	7.3	2280	-	-	-	-	1300	960
	72/08/23	1049	17	6	7.3	2330	-	-	-	-	4900	700
	72/08/24	1008	16	6	7.2	2170	1.72	0.045	0.84	0.11	2200	800
JR-12	72/08/14	1610	22	6	7.4	1780	-	-	-	-	5800	1400
	72/08/15	0853	18	6	6.8	2120	-	-	-	-	2800	1500
	72/08/16	1204	21	6	7.7	2120	-	-	-	-	2000	950
	72/08/17	0932	17.5	6	7.0	2170	-	-	-	-	2900	1400
	72/08/18	1258	19	6	8.1	2230	-	-	-	-	3300	1200
	72/08/19	1028	17	6	7.6	2280	-	-	-	-	5100	1400
	72/08/20	1038	17	6	7.8	2230	-	-	-	-	1600	950
	72/08/23	1101	17	6	7.7	2230	-	-	-	-	3400	1100
	72/08/24	0956	16	6	7.6	2120	1.77	0.048	0.89	0.30	2000	1200
JR-13	72/08/14	1654	22	6	6.1	1800	-	-	-	-	70000	10000
	72/08/15	0830	18.5	6	5.7	1910	-	-	-	-	13000	1300
	72/08/16	1306	21	6	6.7	3070	-	-	-	-	59000	28000
	72/08/17	0835	17.5	6	5.9	2020	-	-	-	-	3000	2300
	72/08/18	1325	19	6	6.9	2010	-	-	-	-	3600	700
	72/08/19	0922	17	6	6.6	2040	-	-	-	-	4700	900
	72/08/20	1155	18	6	6.9	2020	-	-	-	-	1800	600
	72/08/23	1300	18.5	6	7.8	2120	-	-	-	-	3600	950
	72/08/24	0928	15.5	6	6.6	2070	1.77	0.070	1.07	0.27	3900	1400

TABLE A-3 (Cont.)

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	NO_2-N mg/l	TKN mg/l	Phos-T mg/l	T. Coli T/100ml	F. Coli T/100ml
JR-14	72/08/14	1718	22	6	5.6	1590	-	-	-	-	140000	44000
	72/08/15	0758	18	6	5.0	1800	-	-	-	-	94000	12000
	72/08/16	1325	21	6	6.1	2020	-	-	-	-	220000	72000
	72/08/17	0801	19	6	5.1	1960	-	-	-	-	95000	26000
	72/08/18	1338	19.5	6	6.8	1800	-	-	-	-	2700	280
	72/08/19	0853	17	6	5.7	2010	-	-	-	-	4900	1600
	72/08/20	1221	18.5	6	6.5	2010	-	-	-	-	1800	350
	72/08/23	1325	19.5	6	5.6	1960	-	-	-	-	2900	<50
	72/08/24	0852	16	6	5.9	2010	1.98	0.121	1.29	1.10	36000	8100
JR-15	72/08/14	1810	22.5	6	3.9	1480	-	-	-	-	650000	77000
	72/08/15	0733	18.5	6	3.9	1590	-	-	-	-	230000	100000
	72/08/16	1444	23.5	6	5.2	1800	-	-	-	-	120000	12000
	72/08/17	0737	19.5	6	3.8	1780	-	-	-	-	75000	16000
	72/08/18	1450	21	6	5.3	1700	-	-	-	-	43000	7200
	72/08/19	0828	18.5	6	4.2	1850	-	-	-	-	13000	2000
	72/08/20	1245	19	6	5.3	1850	-	-	-	-	3100	500
	72/08/23	1350	20	6	5.4	1800	-	-	-	-	38000	1200
	72/08/24	0825	17	6	4.3	1800	2.08	0.071	1.66	0.60	34000	8400
JR-16	72/08/14	1733	22	6	4.1	1620	-	-	-	-	550000	66000
	72/08/15	0723	19	6	3.7	1590	-	-	-	-	130000	93000
	72/08/16	1502	23.5	6	4.6	1800	-	-	-	-	32000	5100
	72/08/17	0720	19	6	3.0	1850	-	-	-	-	44000	13000
	72/08/18	1505	21	6	4.6	1910	-	-	-	-	39000	5900
	72/08/19	0732	18.5	6	3.7	1990	-	-	-	-	3600	2200
	72/08/20	1313	19.5	6	4.7	1880	-	-	-	-	2000	600
	72/08/23	1435	21	6	4.8	1850	-	-	-	-	20000	1700
	72/08/24	0747	17	6	3.7	1850	2.32	0.098	1.59	1.80	32000	8000

TABLE A-3 (Cont.)

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	NO_2-N mg/l	TKN mg/l	Phos-T mg/l	T. Coli T/100ml	F. Coli T/100ml
JR-17	72/08/14	1746	22	6	3.8	1590	-	-	-	-	120000	100000
	72/08/15	0710	20	6	3.1	1670	-	-	-	-	200000	72000
	72/08/16	1513	23.5	6	4.2	1670	-	-	-	-	90000	6800
	72/08/17	0707	18.5	6	2.8	1800	-	-	-	-	39000	11000
	72/08/18	1520	22	6	4.0	1910	-	-	-	-	7000	6700
	72/08/19	0720	19	6	3.4	1800	-	-	-	-	4900	1400
	72/08/20	1322	20	6	4.5	1860	-	-	-	-	550	340
	72/08/23	1422	21	6	4.0	1860	-	-	-	-	16000	3000
	72/08/24	0732	17	6	3.5	1910	2.37	0.112	2.15	0.90	4300	800
LC-1	72/08/14	1430	23	6	6.6	1480	-	-	-	-	27000	2000
	72/08/15	1128	20.5	6	7.6	1480	-	-	-	-	2900	1200
	72/08/16	1152	22	6	7.9	1540	-	-	-	-	16000	1100
	72/08/17	1003	21	6	7.2	1480	-	-	-	-	2900	1700
	72/08/18	1236	21	6	7.7	1590	-	-	-	-	2600	700
	72/08/19	1047	18.5	6	7.7	1480	-	-	-	-	2300	1100
	72/08/20	1022	19	6	7.6	1540	-	-	-	-	3400	1200
	72/08/23	1040	19	6	7.9	1540	-	-	-	-	2300	1300
	72/08/24	1016	17	6	7.7	1590	0.53	0.014	1.43	0.10	22000	1000
BC-1	72/08/14	1639	22	6	7.8	1000	-	-	-	-	73000	22000
	72/08/15	0843	19	6	6.5	1590	-	-	-	-	9000	1300
	72/08/16	1254	21.5	6	8.5	2020	-	-	-	-	2000	1200
	72/08/17	0944	19	6	7.1	1320	-	-	-	-	5300	2300
	72/08/18	1310	19.5	6	8.8	1320	-	-	-	-	3200	1600
	72/08/19	1020	18	6	7.2	1430	-	-	-	-	4400	2500
	72/08/20	1049	17.5	6	7.9	1380	-	-	-	-	1300	1300
	72/08/23	1115	18	6	8.2	1410	-	-	-	-	1900	520
	72/08/24	0943	16	6	7.8	1380	0.86	0.010	1.02	0.07	16000	2000

TABLE A-3 (Cont.)

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	pH SU	DO mg/l	Cond. umho	NO_3-N mg/l	NO_2-N mg/l	TKN mg/l	Phos-T mg/l	T. Coli T/100ml	F. Coli T/100ml
SLC-1	72/08/14	1702	21.5	6	4.5	1380	-	-	-	-	< 100	< 100
	72/08/15	1054	19	-	5.0	-	-	-	-	-	40	10
	72/08/16	1354	22	6	5.7	1640	-	-	-	-	140	8
	72/08/17	0824	20	6	5.1	1320	-	-	-	-	46	10
	72/08/18	1402	21.5	6	4.9	1640	-	-	-	-	1700	130
	72/08/19	0914	18	-	5.5	1540	-	-	-	-	100	< 10
	72/08/20	1206	20	6	6.3	1800	-	-	-	-	40	40
	72/08/23	1310	20	6	5.9	1700	-	-	-	-	97	20
	72/08/24	0913	18.5	6	5.4	1510	5.06	0.111	5.00	6.00	40	< 5
MC-1	72/08/14	1707	22	6	9.1	1170	-	-	-	-	46000	3800
	72/08/15	0812	17.5	6	5.6	1170	-	-	-	-	10000	3100
	72/08/16	1345	22	6	10.0	1250	-	-	-	-	3200	600
	72/08/17	0814	19	6	5.9	1270	-	-	-	-	1800	1200
	72/08/18	1353	21	6	10.7	1300	-	-	-	-	800	250
	72/08/19	0903	17	6	7.0	1270	-	-	-	-	1700	650
	72/08/20	1212	19	6	11.0	1270	-	-	-	-	570	270
	72/08/23	1317	19.5	6	12.7	1270	-	-	-	-	1100	50
	72/08/24	0903	15	6	7.6	1270	2.41	0.024	0.01	0.17	1700	1200
SC-1	72/08/18	1640	22	6	5.8	2070	-	-	-	-	48000	8900
	72/08/19	0750	18.5	6	5.5	2060	-	-	-	-	5300	3100
	72/08/20	1256	19	6	5.3	2070	-	-	-	-	3400	1900
	72/08/23	1404	20.5	6	5.4	2020	-	-	-	-	10000	1000
	72/08/24	0809	17.5	6	5.2	2060	2.06	0.093	2.07	1.20	1300	250
JR-14A	72/08/16	1409	22.5	6	4.9	1830	-	-	-	-	110000	14000
	72/08/17	0748	20	6	3.9	1780	-	-	-	-	130000	19000
	72/08/18	1420	21	6	4.9	1640	-	-	-	-	32000	5800
	72/08/19	0838	18.5	6	4.6	1880	-	-	-	-	11000	4300
	72/08/20	1234	19	6	5.5	1910	-	-	-	-	3300	1200
	72/08/23	1338	19.5	6	5.5	1800	-	-	-	-	29000	< 100
	72/08/24	0837	16.5	6	4.9	1800	1.96	0.142	1.67	1.35	36000	25000

TABLE A-4

RESULTS OF ANALYSIS

ROUND-THE-CLOCK SAMPLING

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	T. Coli T/100ml	F. Coli T/100ml	DO mg/1
JR-2	72/08/21	0800	20.5	3100	150	7.1
		1000	21	4000	< 50	7.1
		1200	21.5	LA	LA	7.6
		1400	21.5	75	50	8.3
		1600	22	1800	20	8.8
		1800	22.5	2000	50	10.5
		2000	22.5	50	50	11.6
		2200	22.5	150	50	12.0
		2400	22.5	1000	100	11.9
	72/08/22	0200	22	100	< 50	10.4
		0400	21.5	1200	400	9.4
		0600	20.5	200	100	8.8
		0800	21	300	250	8.4
JR-17	72/08/21	0800	20	1300	900	3.2
		1000	20	1600	700	3.4
		1200	22	1100	760	3.7
		1400	23.5	1800	300	2.7
		1600	24	2500	1400	4.3
		1800	24	2300	2100	3.4
		2000	22	3400	3300	4.6
		2400	20	3000	2500	4.4
	72/08/22	0200	20	1500	1400	4.1
		0400	19	1700	1100	3.7
		0600	18	11000	6900	3.5
		0800	19	1300	1200	3.0

Station No.	Date Yr/Mo/Day	Time Mlty	Temp. Cent.	T. Coli T/100ml	F. Coli T/100ml	DO mg/1
P-1	72/08/21	0801	16	210000	130000	3.5
		1007	17	89000	88000	4.2
		1159	19.5	210000	190000	4.0
		1400	21	340000	320000	2.9
		1601	20	560000	420000	1.7
		1802	19	690000	680000	1.5
		2003	18.5	490000	430000	1.7
DC-1	72/08/21	0808	14	5800	5600	7.6
		1010	16	5800	3700	8.1
		1204	19	3700	2700	7.6
		1406	21.5	2700	2000	7.4
		1606	22	2600	1400	6.8
		1806	20.5	12000	1800	6.8
		2007	19.5	25000	25000	7.0
DC-2	72/08/21	0755	15	53000	46000	6.2
		0959	16.5	79000	60000	6.6
		1154	19	74000	74000	6.4
		1355	21.5	120000	90000	5.9
		1556	21	100000	98000	5.0
		1755	20	160000	130000	5.1
		1955	20	140000	110000	5.6

LA = Lab Accident.

APPENDIX B

Stream Classifications

STREAM CLASSIFICATIONS

The following stream classifications adopted by the Utah Water Pollution Committee apply to the waters involved in this investigation:

Jordan River - From Utah Lake to Utah County Line.		CW
Utah Lake	Utah County	CW
Jordan River and Tributaries - From Utah County line to Great Salt Lake.		CC

Class "C" Waters shall be so protected against controllable pollution, including heat, as to be suitable at all times for domestic water supplies which are treated before use by coagulation, sedimentation, filtration, and disinfection. Class "C" waters shall be suitable without treatment for aesthetics, irrigation, stock watering, propagation and perpetuation of fish, other aquatic life, and wildlife, recreation (except swimming) 1/, as a source for industrial supplies, and for other uses as may be determined by the Committee and Board.

It shall be unlawful to discharge or place any wastes or other substances in such a way as to result in:

(a) Materials that will settle to form objectionable deposits;

(b) Floating debris, oil, scum and other matters;

(c) Substances producing objectionable color, odor, taste or turbidity;

(d) Materials, including radionuclides, in concentrations or combinations which are toxic or which produce undesirable physiological responses in humans, fish and other animal life and plants;

(e) Substances and conditions or combinations thereof which produce undesirable aquatic life; or

(f) Other constituents which will interfere with the stated Class "C" water uses; or

(g) The following specific standards being violated in any Class "C" waters:

1/ In bodies of water where natural purification action can be shown to result in water quality consistent with the "CR" quality standard, swimming may be permitted subject to specific approval by the State Board of Health, notwithstanding any different initial classification.

1. Chemical and radiological standards shall be as prescribed for drinking water by "Public Health Service Drinking Water Standards, 1962."

2. Radioactive substances shall not exceed 1/30th of the MPC_w values given for continuous occupational exposure in National Bureau of Standards Handbook 69 or result in accumulations of radioactivity in edible plants and animals that present a hazard to consumers.

3. Hydrogen-ion concentration shall not exceed the range described by a pH of 6.5 to 8.5, nor shall it change more than 0.5 pH unit, from other than natural causes.

4. Monthly arithmetical mean coliform density shall not exceed 5000 per 100 milliliters, as determined by standard multiple-tube fermentation or membrane filter techniques; except that 20% of all samples collected in any month may exceed this standard if no more than 5% of all samples collected in the same month exceed a coliform density of 20,000 per 100 milliliters; AND, monthly arithmetical mean fecal coliform density shall not exceed 2000 per 100 milliliters.

5. Monthly arithmetical mean biochemical oxygen demand (BOD) shall not exceed 5 milligrams per liter; except that 20% of all samples collected in any month may exceed this value if no more than 5% of all samples collected in the same month exceed a BOD of 10 milligrams per liter.

6. Dissolved oxygen shall be not less than 5.5 milligrams per liter.

<u>Class "CC" Waters</u> shall be protected as Class "C" waters, and also against any wastes or activities which alone or in combination will cause an incremental increase in temperature of said waters of more than 2°F., or an elevation in such temperature above 68°F., or will cause the dissolved oxygen level of such waters to fall below 6.0 milligrams per liter.

<u>Class "CW" Waters</u> shall be protected as Class "C" waters, and also against any wastes or activities which alone or in combination will cause an incremental increase in temperature of said waters of more than 4°F., or an elevation in such temperature above 80°F.

<u>Class "CR" Waters</u> shall be suitable for swimming as well as for other uses specified and shall be protected as Class "C" waters except for specific standard No. 4 which is modified as follows for application to Class "CR" waters:

> Monthly arithmetical mean coliform density shall not exceed 1000 per milliliters, as determined by standard multiple-tube fermentation or membrane filter techniques; no more than 20% of all samples collected in any month may exceed a coliform density of 1000 per 100 milliliters and no more than 5% of all samples collected in the same month may exceed a coliform density of 4000 per 100 milliliters; AND, monthly arithmetical mean fecal coliform density shall not exceed 200 per 100 milliliters, provided that no more than 10% of all samples collected in any month shall exceed a fecal coliform density of 400 per 100 milliliters.

APPENDIX C

References

REFERENCES

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