A REPORT FROM

The State Hygienic Laboratory

MEDICAL LABORATORIES BUILDING

THE UNIVERSITY OF IOWA

IOWA CITY, IOWA 52242

Water Quality Survey
of the
Shellrock River

#78 - 15

Prepared for the Iowa Department of Environmental Quality by the University of Iowa, State Hygienic Laboratory.

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26 October 1977

ABSTRACT

A water quality survey of the Shellrock River was conducted during July, 1977. The purpose of the survey was to assess summer water quality of the Shellrock River as affected by point source discharges. Results of the survey demonstrate the poor quality of water entering Iowa and its affect on water quality in the Iowa section of the Shellrock River. The high organic loadings entering Iowa were characterized by elevated organic nitrogen (2.9 mg/L), filtrable phosphate (0.97 mg/L), BOD (10 mg/L) and chloride (78 mg/L). The organic loading created an oxygen sag near Northwood which resulted in violation of Iowa's dissolved oxygen water quality standard at three stations. The biological community was also affected as demonstrated by the high numbers of pollution tolerant leeches, snails and amphipods found at Station 1. A decline in water quality was observed at the last three stations on the Shellrock and may be due to an as yet undefined organic waste loadings. Water quality of the Shellrock River was poor and is expected to remain poor as long as it receives the point source waste loading, especially from Albert Lea, Minnesota.

INTRODUCTION

The Shellrock River originates at Albert Lea Lake in Minnesota, crosses the Iowa-Minnesota line near Northwood, Iowa and flows some 100 miles before joining the Cedar River near Cedar Falls, Iowa. The Shellrock River, a beautiful stream with limestone borders along much of its course, is probably the best producer of fresh-water mussels in the state. It is also one of Iowa's outstanding smallmouth bass streams and is excellent for channel catfish and walleyes (Iowa Conservation Commission). The Shellrock River has one major tributary, the Winnebago River, and several small tributaries; Elk Creek, Flood Creek, Cold Water Creek and Dry Run Creek.

Two previous water quality surveys (State Hygienic Laboratory report #70-35 and 73-19) have been conducted on the Shellrock River. Results of both those reports have indicated poor water quality entering Iowa from Minnesota and improving as it proceeds downstream. A quarterly monitoring station, located near Northwood on the Shellrock, has also indicated very poor water quality, especially in winter under ice cover conditions. The purpose of this survey was to determine if any changes in water quality have occurred since the last survey performed in the fall of 1972.

Provisional flow data for the Shellrock was obtained from the United States Geological Survey and are listed below for the two gage stations at Northwood and Shellrock.

	18 July 1977	7 Day Q_{10}	% of time 18 July flow equalled or exceeded
Shellrock at Northwood	10	8.2	97%
Shellrock at Shellrock	121	57	90%

Stream flow at Northwood was very close to the 7 day Q_{10}, while flow at Shellrock, Iowa was approximately twice as much as the 7 day Q_{10}.

A comprehensive study of the Shellrock River was initiated on 16 June 1977 with the placement of artificial substrates for collection of benthic macroinvertebrates. Substrates were removed on 26 July 1977, with the collection of water samples, and a 24 hour dissolved oxygen study was performed on 18 and 19 July 1977. All samples were returned to the State Hygienic Laboratory-Des Moines Branch Laboratory for subsequent analysis.

Figure 1 is a map of the Shellrock River and Table 1 lists the approximate locations of the sampling stations.

RESULTS AND DISCUSSION

Selected chemical and bacteriological data for the Shellrock River has been tabulated and will be found on Table 2. All data collected may be found in the Appendix. Except for Elk Creek, all the tributaries (Stations 10, 11, 13, 14 and 15), were dry due to the drought conditions.

With the exception of Station 4, located on Elk Creek, fecal coliform levels were low and in expected ranges (30 - 360 organisms/100 ml). The elevated value at Station 4 (6800 organisms/100 ml) may be a result of cattle wading in the stream.

The nitrogen series was fairly consistent throughout the entire river reach. Organic nitrogen declined slightly from Station 1 (2.9 mg/L) to Station 16 (1.7 mg/L). Ammonia nitrogen levels ranged from <0.01 mg/L at Stations 2, 3, 6 and 8 to 0.54 mg/L at Station 12, just downstream of Greene, Iowa. A slight rise in ammonia (0.29 mg/L) was observed downstream of Nora Springs and may be attributed to their waste water discharge. Nitrate nitrogen was quite low (range <0.1 to 0.6 mg/L). Water coming into Iowa was nitrate poor, probably as a result of utilization of the nitrates for a nutrient source by the algal community in Lake Albert Lea. Continued algal utilization kept nitrates low throughout the entire reach.

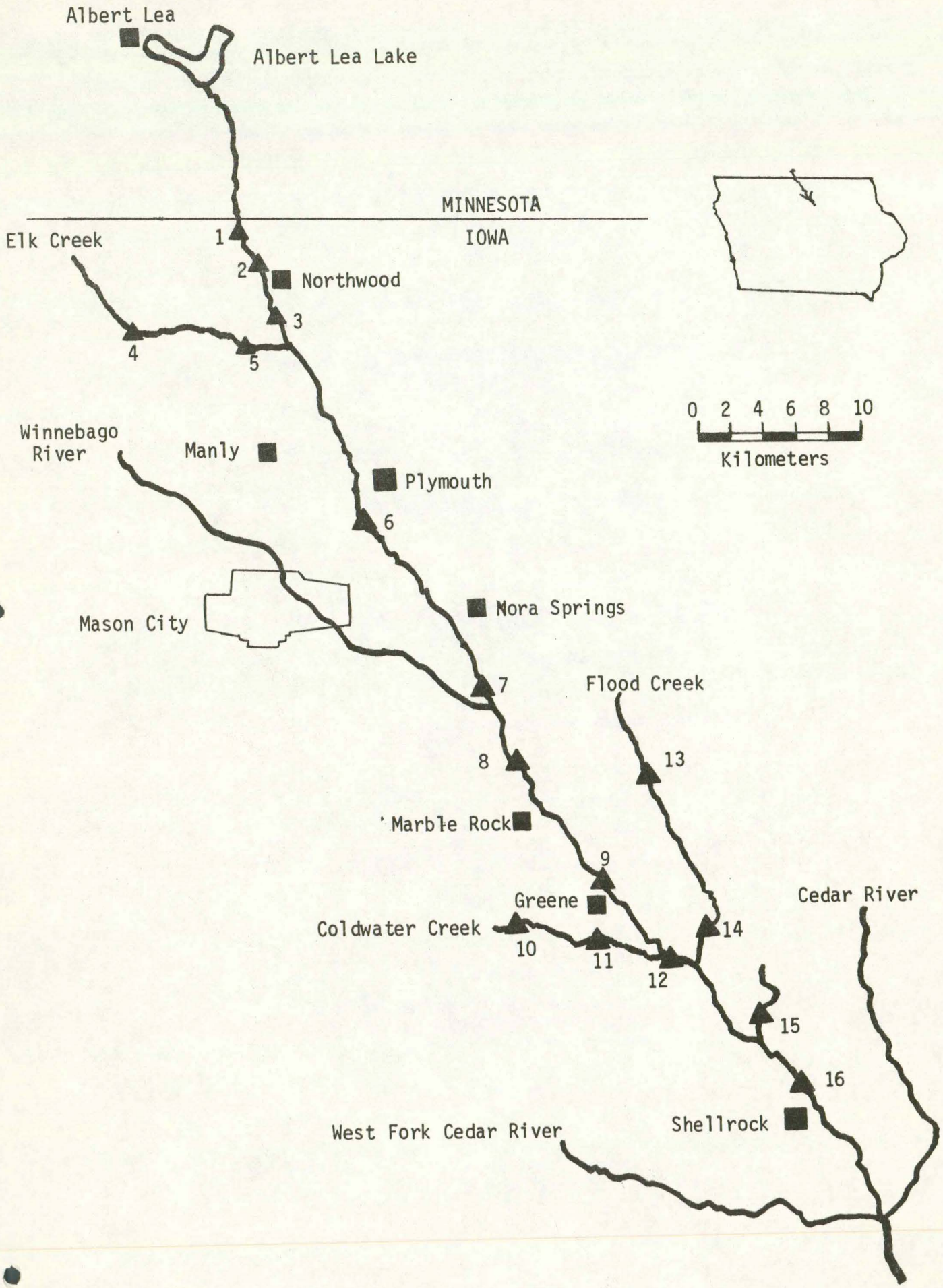
Albert Lea
Albert Lea Lake
MINNESOTA
IOWA
Elk Creek
1
2
Northwood
3
4
5
0 2 4 6 8 10
Kilometers
Winnebago River
Manly
Plymouth
6
Mason City
Mora Springs
7
Flood Creek
8
13
Marble Rock
9
Greene
Cedar River
Coldwater Creek
10
11
12
14
15
16
Shellrock
West Fork Cedar River

TABLE 1

SHELLROCK RIVER SAMPLING STATIONS

18 July 1977

Station		Location
1	Shellrock River	Worth Co. Rd. Bridge T100N, R20W Sec. 18
2	Shellrock River	Worth Co. Hwy 105 Bridge T100N, R20W Sec. 29/32
3	Shellrock River	Worth Co. Hwy 65 Bridge T99N, R20W Sec. 16
4	Elk Creek	Worth Co. Rd. S22 Bridge T99N, R22W, Sec. 11/12
5	Elk Creek	Worth Co. Hwy 65 Bridge T99N, R20W Sec. 21/28
6	Shellrock River	Cerro Gordo Co. Rd. B20 Bridge T97N, R19W Sec. 21/2
7	Shellrock River	Floyd Co. Hwy 147 Bridge, T95N, R18W, Sec. 14
8	Shellrock River	Floyd Co. Rd. T24 Bridge T94N, R18W Sec. 35/36
9	Shellrock River	Butler Co. Hwy 14 Bridge T93N, R17W Sec. 2
10	Coldwater Creek	Butler Co. Rd. Bridge T93N, R18W Sec. 1/2
11	Coldwater Creek	Butler Co. Rd. Bridge T93N, R16W, Sec. 19
12	Shellrock River	Butler Co. Rd. T47 Bridge T93N, R16W Sec. 27/28
13	Flood Creek	Floyd Co. Rd. B60 Bridge T94N, R16W, Sec. 7/18
14	Flood Creek	Butler Co. Rd. C23 Bridge, T93N, R16W, Sec 23/26
15	unnamed tributary to Shellrock River	Butler Co. Rd. C33 Bridge T92N, R15W, Sec. 16
16	Shellrock River	Butler Co. Hwy 3 Bridge T91N, R15W, Sec. 2

TABLE 2

SELECTED BACTERIOLOGICAL AND CHEMICAL DATA
FOR THE SHELLROCK RIVER
18 July 1977

(all values in mg/L unless designated otherwise)

ation	Fecal Coliforms (organisms/100 ml)	Nitrogen Organic	Nitrogen Ammonia	Nitrate	Phosphate Filtrable	Phosphate Total	Dissolved Oxygen	BOD	TOC	Chloride
1	30	2.9	0.01	<0.1	0.87	1.2	11.6	10 (6)	28.9	78
2	30	3.2	<0.01	<0.1	0.83	1.2	15.8	12 (5)	28.3	74
3	290	2.8	<0.01	<0.1	0.72	1.0	16.5	13 (7)	25.2	60
4 Elk Creek	6800	3.2	0.02	<0.1	0.99	1.2	9.1	13 (5)	28.4	16
5 Elk Creek	400	2.9	0.13	0.4	0.09	0.31	11.4	7 (5)	21.1	9
6	90	2.0	<0.01	<0.1	0.42	0.65	12.6	8 (4)	21.1	63
7	140	2.5	0.29	0.1	0.22	0.46	6.9	6 (4)	23.3	68
8	160	2.2	<0.01	0.6	0.58	0.86	11.3	7 (5)	20.4	50
9	10	1.8	0.46	<0.1	0.26	0.44	4.2	6 (6)	17.2	37
2	360	1.7	0.54	0.3	0.32	0.49	4.4	7 (6)	15.5	34
6	270	1.7	0.25	0.4	0.24	0.44	4.6	7 (6)	14.0	26

(Filtered BOD)

Specific conductance, chloride and total filtrable residues all declined in a downstream direction indicating the high levels entering Iowa. Conductance values of 740 micromhos and chloride values of 78 mg/L are not typical background levels for this area of the state.

Phosphate levels, both filtrable and total, were highest at the first three stations (0.87 mg/L and 1.2 mg/L respectively) and declined downstream, reaching 0.24 mg/L filtrable phosphate by Station 16. Elevated phosphate values were also observed on Elk Creek at Station 4 (0.99 mg/L and 1.2 mg/L) but had declined to 0.99 mg/L and 0.31 mg/L by Station 5.

Values for dissolved oxygen were quite variable and dependent on when during the day they were collected. Dissolved oxygen values ranged from 16.5 mg/L at Station 3 to 4.2 mg/L at Station 9. Stations 9, 12 and 16 had dissolved oxygen values of 4.2 mg/L, 4.4 mg/L and 4.6 mg/L around mid-day (12 noon) which gives cause for some concern. Generally, dissolved oxygen values during the summer are increasing around mid-day, reaching their peak values between 4 and 6 p.m. Low values at mid-day indicate night time dissolved oxygen may reach critical levels. A 24 hour dissolved oxygen study was performed on the first six Shellrock River stations and a summary of that data will be found on Figure 2. Unfortunately, due to time limitations, Stations 9, 12 and 16 were not collected and may have provided some very interesting information. Figure 2 shows graphically the diurnal fluctuation of dissolved oxygen at the first six stations. Station 2 reached the lowest value (1.2 mg/L) with Station 1 (2.7 mg/L) and Station 3 (2.4 mg/L) close behind. The dissolved oxygen sag in the vicinity of Station 2 is probably a result of the organic loadings coming from Lake Albert Lea. The figure also demonstrates the importance time of sample collection has on the reported value.

Figure 2. Shellrock River Diurnal Dissolved Oxygen
July 18 and 19, 1977

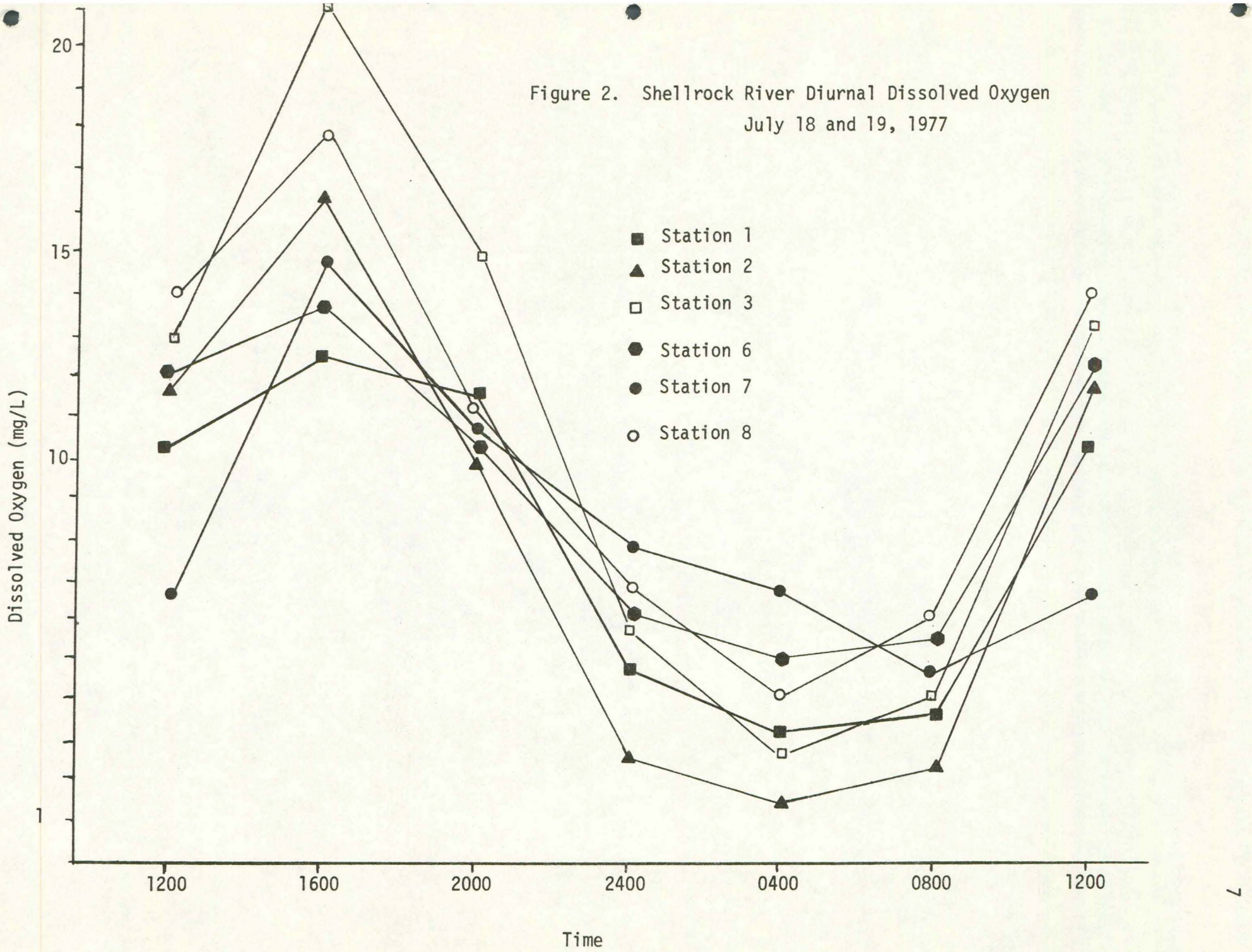

TABLE 2A

Shellrock River
Diurnal Dissolved Oxygen Study
July 18 and 19, 1977

(all values in mg/L)

Station	Time 1200	1600	2000	2400	0400	0800
1	10.2	12.1	11.1	4.3	2.7	3.2
2	11.5	16.1	9.7	2.2	1.2	2.0
3	13.0	21.2	14.8	5.4	2.4	3.6
6	11.7	13.3	10.0	5.9	4.9	5.2
7	6.4	14.5	10.1	7.5	6.4	3.9
8	13.9	17.5	11.0	6.1	3.8	5.3

Biochemical Oxygen Demand (BOD) followed the general trend of declining in a downstream direction (Station 1--10 mg/L; Station 16--7 mg/L). In an attempt to determine how much affect the algal cells and large particulate matter had on the BOD analysis, samples were filtered and then analyzed for BOD. In general, the filtered BOD ranged from 4 to 6 mg/L, while the non-filtered ranged from 6 to 13 mg/L. The differences between the BOD analyses were greatest at the first six stations indicating algal and particulate matter contributed significantly at those stations.

Total organic carbon (TOC) values ranged from 14.0 mg/L to 28.9 mg/L and correlated fairly consistently with the non-filtered BOD, with values being greatest at the first seven stations.

The chloride values at Station 1 (78 mg/L) declined to 26 mg/L by Station 16. Chloride is often used as an indication of organic waste contamination, with chloride values of 20 - 30 mg/L being average for north-central Iowa surface waters. In reviewing last year's quarterly monitoring data for the Shellrock River at Northwood, chloride has consistently been greater than 88 mg/L, indicating a chronic problem.

Samples for metals analysis were collected at four Shellrock River stations (Stations 1, 6, 9 and 16). Barium and zinc were found at all stations in background concentrations. A reportable lead value (0.01 mg/L) was found at Stations 1 and 4 and a reportable nickel value (0.03 mg/L) was found at Station 3. These values are very low and not considered significant at this time.

Collection of biological data was performed at ten stations on the Shellrock and one station located on the Winnebago River. Sample collection consisted of placing at each station three artificial substrates (Hester-Dendy type) suspended in the river for a period of 4 - 6 weeks. Organisms inhabiting the river in that area colonize the substrates, which gives an indication

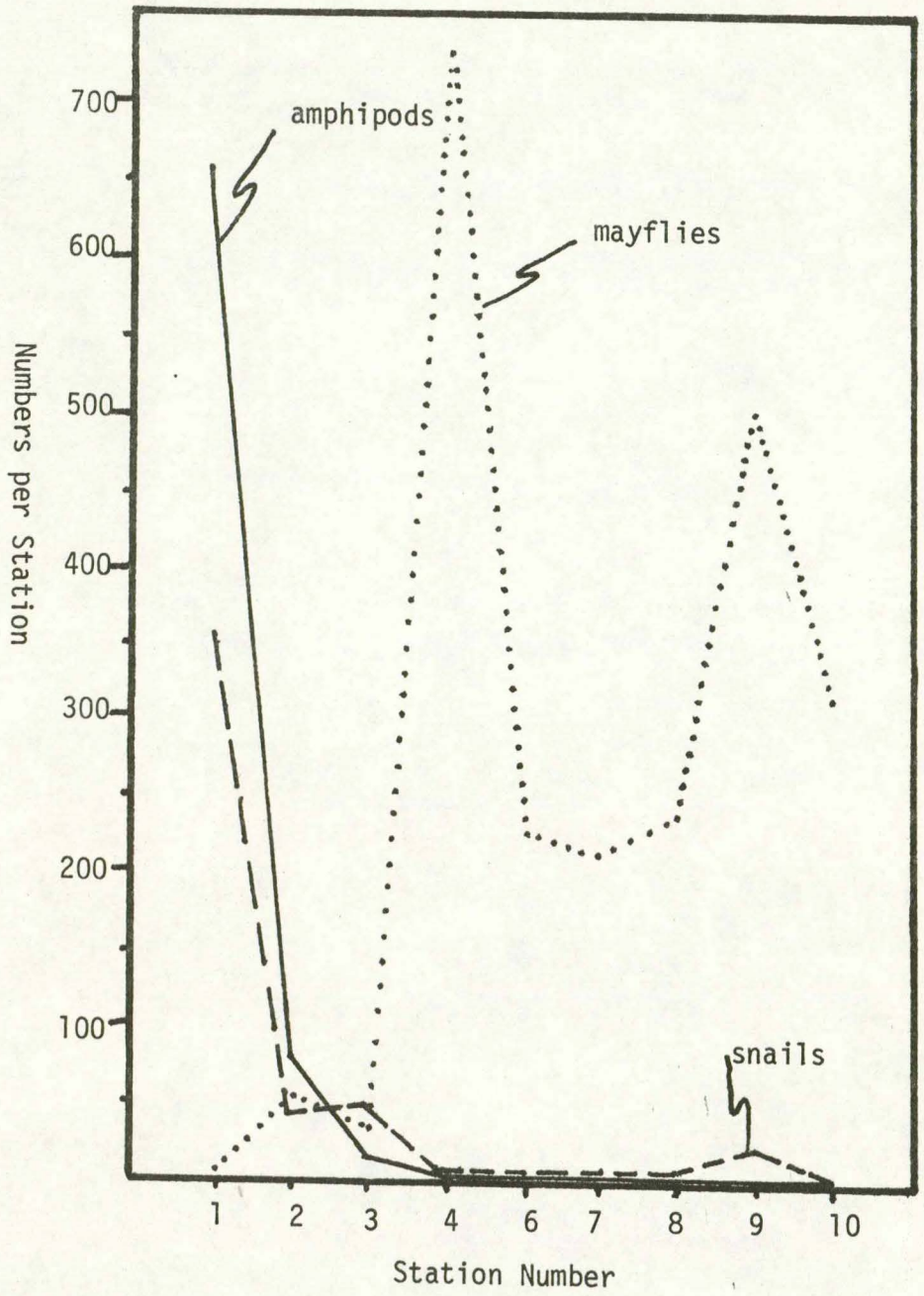

Figure . Selected benthic densities from the Shellrock River

Group 4 - The fourth group contains the animals from Station 5, which is on the lower Winnebago River. This station had four types of animals that were not found in the Shellrock River and also many more midge larvae than any other station in this survey. The difference in the types of organisms found at Station 5 is because the station was located on the Winnebago River and represents different water quality than found in the Shellrock River.

In general, the benthic macroinvertebrates of the Shellrock River exhibit a characteristic pattern in response to organic enrichment of their environment. The initial zone (Section 1) is composed of many numbers of a few types of pollution tolerant organisms. An intermediate zone of recovery occurs in which the pollution tolerant forms give way to the normal or background types. Finally, the benthos assumes its typical population ratios and densities (for the Shellrock River). A more detailed study, using more sites and substrate sampling techniques, would be required in order to firmly establish these conclusions.

SUMMARY AND CONCLUSIONS

Results of a water quality survey of the Shellrock River indicate the upper reaches are influenced by organic wastes from Albert Lea Lake, Minnesota. Shellrock River water flowing into Iowa was high in organic nitrogen, filtrable phosphate, BOD, total organic carbon and chloride. A twenty-four hour dissolved oxygen study indicated a dissolved oxygen sag occurring at Station 2, with violation of Iowa's dissolved oxygen standard at the first three stations. The dramatic decline in dissolved oxygen may be attributed to the organic waste loadings coming into Iowa. The high organic loading also affected the aquatic biological community, resulting in large numbers

of pollution tolerant organisms at Station 1. The last three stations on the Shellrock River had low daytime dissolved oxygen levels and elevated ammonia nitrogen levels indicating a possible source of organic contamination in the Marble Rock - Greene area. Under the summer sampling conditions experienced, water quality of the Shellrock River could best be classified as poor and is expected to remain poor as long as it receives the organic waste loadings from Albert Lea, Minnesota.

Jack O. Kennedy
Limnologist

Murray Meierhoff
Limnologist

APPENDIX

WATER QUALITY REPORT

STATE HYGIENIC LABORATORY, Des Moines Branch
The University of Iowa
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town	Shellrock River	Northwood	Shellrock River
Source	Worth Co. Rd. Br.	Shellrock River	Hwy 65 Br. in Worth Co.
Specific Location	T100N, R20W, Sec.18	Hwy 105 Br in Worth Co. T100N, R20W, Sec.29/32	T99N, R20W, Sec. 16
Date Collected	18 July 1977	18 July 1977	18 July 1977
Date Received	20 July 1977	20 July 1977	20 July 1977
Lab Number	304	305	306
	FIELD DATA		
Collection Time	4:25 pm	4:10 pm	4:00 pm
pH			
Temperature	31.5°C	32°C	32°C
Dissolved Oxygen			
	BACTERIOLOGICAL EXAMINATION		
Fecal Coliform/100 ml	30 >30 hrs	30 >30 hrs	290 >30 hrs
	CHEMICAL ANALYSIS (as mg/l unless designated otherwise)		
Conductance (micromhos)	740	720	720
MBAS (as LAS)			
pH (units)	8.45	8.65	8.55
Alkalinity: P	13.0	20.0	15.0
T	229	226	248
NITROGEN: Organic N	2.9	3.2	2.8
Ammonia N	0.01	<0.01	<0.01
Nitrite N			
Nitrate N	<0.1	<0.1	<0.1
Nitrate as NO_3			
RESIDUE: Total	552	506	522
Fixed	364	332	352
Volatile	188	174	170
Filtrable Residue T	444	438	434
F	374	354	360
V	70	84	74
Nonfiltrable Residue T	40	32	30
F	24	16	14
V	16	16	16
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.87	0.83	0.72
Total P	1.2	1.2	1.0
Dissolved Oxygen	11.6	15.8	16.5
BOD	10	12	13
Filtered BOD	6	5	7
COD	72	72	62
Grease or Oil			
Turbidity (JTU)	18	17	14
Total Hardness (as $CaCO_3$)			
Calcium (Ca^{++})			
Magnesium (Mg^{++})			
Chloride (Cl^-)	78	74	60
Sulfate (SO_4^{--})			
Total organic carbon	28.9	28.3	25.2
Chlorophyll a	101 µg/L	143 µg/L	157 µg/L

REMARKS: cows upstream

COLLECTOR: Miller, Granston

REPORT TO: Limnology Division
State Hygienic Lab
Des Moines Branch

WATER QUALITY REPORT

STATE HYGIENIC LABORATORY, Des Moines Branch
The University of Iowa
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town	Elk Creek	Kensett	Rock Falls
Source	Elk Creek	Elk Cr.	Shellrock River
Specific Location	Worth Co. Rd. S22 Br T99N R22W Sec. 11/12	Hwy 65 Br. in Worth Co. T99N, R20W Sec. 21/28	Cerro Gordo Co. Rd. B20 Br. T97N, R19W Sec.21 and 22
Date Collected	18 July 1977	18 July 1977	18 July 1977
Date Received	20 July 1977	20 July 1977	20 July 1977
Lab Number	307	308	309
	FIELD DATA		
Collection Time	4:55 pm	3:50 pm	3:15 pm
pH			
Temperature	30°C	33°C	29.5°C
Dissolved Oxygen			
	BACTERIOLOGICAL EXAMINATION		
Fecal Coliform/100 ml	6,800 >30 hrs	400 >30 hrs	90 >30 hrs
	CHEMICAL ANALYSIS (as mg/l unless designated otherwise)		
Conductance (micromhos)	800	520	680
MBAS (as LAS)			
pH (units)	7.7	7.9	8.45
Alkalinity: P	none	none	6.0
T	398	222	225
NITROGEN: Organic N	3.2	2.9	2.0
Ammonia N	0.02	0.13	<0.01
Nitrite N			
Nitrate N	<0.1	0.4	<0.1
Nitrate as NO_3			
RESIDUE: Total	586	404	470
Fixed	390	262	308
Volatile	196	142	162
Filtrable Residue T	484	308	398
F	408	240	328
V	76	68	70
Nonfiltrable Residue T	50	44	20
F	32	32	8
V	18	12	12
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.99	0.09	0.42
Total P	1.2	0.31	0.65
Dissolved Oxygen	9.1	11.4	12.6
BOD	13	7	8
Filtered BOD	5	5	4
COD	68	51	57
Grease or Oil			
Turbidity (JTU)	18	21	12
Total Hardness (as $CaCO_3$)			
Calcium (Ca^{++})			
Magnesium (Mg^{++})			
Chloride (Cl^-)	16	9.5	63
Sulfate (SO_4^{--})			
Total organic carbon	28.4	21.1	21.1
Chlorophyll a	102 µg/L	89 µg/L	93 µg/L

REMARKS: cows upstream

COLLECTOR Miller, GRanston
REPORT TO Limnology Division
State Hygienic Lab
Des Moines Branch

WATER QUALITY REPORT

STATE HYGIENIC LABORATORY, Des Moines Branch
The University of Iowa
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town	Rockford		Greene
Source	Shellrock River	Shellrock River	Shellrock River
Specific Location	Hwy 147 Br. in Rockford T95N, R18W, Sec 14	Floyd Co. Rd. T24 Br. T94N, R18W Sec. 35/36	Hwy 14 Br
Date Collected	18 July 1977	18 July 1977	18 July 1977
Date Received	20 July 1977	20 July 1977	20 July 1977
Lab Number	310	311	312
	FIELD DATA		
Collection Time	2:00 pm		1:10 pm
pH			
Temperature	27°C	27 °C	26°C
Dissolved Oxygen			
	BACTERIOLOGICAL EXAMINATION		
Fecal Coliform/100 ml	140 >30 hrs	160 >30 hrs	10 >30 hrs
	CHEMICAL ANALYSIS (as mg/l unless designated otherwise)		
Conductance (micromhos)	700	670	560
MBAS (as LAS)			
pH (units)	7.95	8.35	7.55
Alkalinity: P	none	2.0	none
T	214	206	171
NITROGEN: Organic N	2.5	2.2	1.8
Ammonia N	0.29	<0.01	0.46
Nitrite N			
Nitrate N	0.1	0.6	<0.1
Nitrate as NO_3			
RESIDUE: Total	498	492	400
Fixed	336	334	254
Volatile	162	158	146
Filtrable Residue T	396	380	298
F	326	314	244
V	70	66	54
Nonfiltrable Residue T	58	64	42
F	40	44	30
V	18	20	12
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.22	0.58	0.26
Total P	0.46	0.86	0.44
Dissolved Oxygen	6.9	11.3	4.2
BOD	6	7	6
Filtered BOD	4	5	6
COD	58	54	46
Grease or Oil			
Turbidity (JTU)	29	28	24
Total Hardness (as $CaCO_3$)			
Calcium (Ca^{++})			
Magnesium (Mg^{++})			
Chloride (Cl^-)	68	50	37
Sulfate (SO_4^{--})			
Total organic Carbon	23.3	20.4	17.2
Chlorophyll a	101 µg/L	201 µg/L	115 µg/L

REMARKS:

COLLECTOR REPORT TO

Miller, Granston
Limnology Division
State Hygienic Lab
Des Moines Branch

WATER QUALITY REPORT

STATE HYGIENIC LABORATORY, Des Moines Branch
The University of Iowa
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town	Packard	Shellrock	
Source	Shellrock River	Shellrock River	
Specific Location	Butler Co. Rd. T47 Bridge T93N, R16W, Sec. 28/27	Hwy 3 Br.	
Date Collected	18 July 1977	18 July 1977	
Date Received	20 July 1977	20 July 1977	
Lab Number	313	314	
	FIELD DATA		
Collection Time	12:25 pm	11:40 am	
pH			
Temperature	25°C	23°C	
Dissolved Oxygen			
	BACTERIOLOGICAL EXAMINATION		
Fecal Coliform/100 ml	360 >30 hrs	270 >30 hrs	
	CHEMICAL ANALYSIS (as mg/l unless designated otherwise)		
Conductance (micromhos)	510	480	
MBAS (as LAS)			
pH (units)	7.3	7.25	
Alkalinity: P	none	none	
T	150	150	
NITROGEN: Organic N	1.7	1.7	
Ammonia N	0.54	0.25	
Nitrite N			
Nitrate N	0.3	0.4	
Nitrate as NO_3			
RESIDUE: Total	354	336	
Fixed	220	218	
Volatile	134	118	
Filtrable Residue T	266	248	
F	214	200	
V	52	48	
Nonfiltrable Residue T	38	30	
F	26	22	
V	12	8	
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.32	0.24	
Total P	0.49	0.44	
Dissolved Oxygen	4.4	4.6	
BOD	7	7	
filtered BOD	6	6	
COD	38	38	
Grease or Oil			
Turbidity (JTU)	21	18	
Total Hardness (as $CaCO_3$)			
Calcium (Ca^{++})			
Magnesium (Mg^{++})			
Chloride (Cl^-)	34	26	
Sulfate (SO_4^{--})			
tal organic carbon	15.5	14.0	
Chlorophyll a	63 µg/L	75 µg/L	

REMARKS:

COLLECTOR: Miller, Granston

REPORT TO:
Limnology Division
State Hygienic Lab
Des Moines Branch

WATER QUALITY REPORT
METALS

STATE HYGIENIC LABORATORY, Des Moines Branch
The University of Iowa
515:281-5371

Town	Shellrock River	Rock Falls	Greene
Source	Worth Co. Rd.Br. T100N	Shellrock River	Shellrock River
Specific Location	R20 W, Sec. 18	Cerro Gordo Co. Rd. B20 Br. T97N, R19W Sec. 21/22	Hwy 14 Br
Date Collected	18 July 1977	18 July 1977	18 July 1977
Date Received	20 July 1977	20 July 1977	20 July 1977
Lab Number	304	309	312
METALS ANALYSIS (as mg/l unless designated otherwise)			
Arsenic	<0.01	<0.01	<0.01
Barium	0.3	0.4	0.3
Cadmium	<0.01	<0.01	<0.01
Chromium, Total	<0.01	<0.01	<0.01
Chromium, Hexavalent			
Copper	<0.01	<0.01	<0.01
Lead	0.01	<0.01	<0.01
Mercury	<0.001	<0.001	<0.001
Nickel	<0.1	0.03	<0.1
Selenium	<0.01	<0.01	<0.01
Silver	<0.01	<0.01	<0.01
Zinc	0.01	0.01	0.02

REMARKS:

COLLECTOR REPORT TO

Miller, Granston
Limnology Division
State Hygienic lab
Des Moines Branch

Date Reported SEP 0 9 1977

W.J. Hausler Jr., Ph.D.
Director

WATER QUALITY REPORT
METALS

STATE HYGIENIC LABORATORY, Des Moines Branch
The University of Iowa
515:281-5371

Town	Shellrock		
Source	Shellrock River		
Specific Location	Hwy 3 Bridge		
Date Collected	18 July 1977		
Date Received	20 July 1977		
Lab Number	314		

METALS ANALYSIS (as mg/l unless designated otherwise)

Arsenic	<0.01		
Barium	0.3		
Cadmium	<0.01		
Chromium, Total	<0.01		
Chromium, Hexavalent			
Copper	<0.01		
Lead	.0.01		
Mercury	<0.001		
Nickel	<0.1		
Selenium	<0.01		
Silver	<0.01		
Zinc	0.02		

REMARKS:

COLLECTOR
REPORT TO

Miller, Granston
Limnology Division
State Hygienic Lab
Des Moines Branch

Date Reported SEP 0 9 1977

W.J. Hausler Jr., Ph.D.
Director

Table 1

Benthos Listing from the Shellrock River

June 16, 1977 to July 20, 1977

Collected from Hester-Dendy Multiplate Samplers

Station 1: Worth Co. T-100N, R-20W, Sec. 18 (Shellrock River)

	Substrate A	Substrate B	Substrate C	Total
Ectoprocta				
Plumatella sp.	p*	p	Substrate not recovered	p
Annelida				
Hirudinea	-	2		2
Batrachobdella picta	4	-		4
Erpobdellidae	12	-		12
Helobdella stagnalis	1	-		1
Oligochaeta				
Naididae	-	6		6
Mollusca				
Gastropoda				
Lymnaea sp.	-	1		1
Physa sp.	7	353		360
Planorbula sp.	-	2		2
Arthropoda				
Crustacea				
Amphipoda	138	517		655
Insecta**				
Trichoptera				
Cheumatopsyche sp.	9	3		12
Ephemeroptera				
Caenis sp.	-	4		4
Stenonema sp.	1	-		1
Tricorythodes sp.	1	-		1
unknown (damaged)	1	-		1
Odonata				
Agrionidae	-	1		1
Enallagma sp.	-	1		1
Diptera				
Chironomidae	323	406		729
Coleoptera				
Dytiscidae				
Laccophilus sp.	1	-		1
Gyrinidae				
Dineutus sp.	3	1		4
# individuals/# taxa	501/13	1297/13		1798/20

Station 2: Worth Co. T-98N, R-20W, Sec. 1 (Shellrock River)

	Substrate A	Substrate B	Substrate C	Total
Ectoprocta				
Plumatella sp.	p	p	p	p
Aschelminthes				
Nematomorpha				
Paragordius varius	-	-	1	1
Annelida				
Hirudinea				
Erpobdellidae	1	2	-	3
Placobdella montifera	2	-	-	2
Mollusca				
Gastropoda				
Physa sp.	28	5	9	42
Arthropoda				
Crustacea				
Amphipoda	39	6	27	72
Insecta				
Trichoptera				
Cheumatopsyche sp.	3	86	489	578
Hydropsyche bifida (gr.)	-	1	92	93
Ephemeroptera				
Ameletus sp.	-	-	3	3
Caenis sp.	-	3	3	6
Siphlonuris sp.	-	1	-	1
Stenonema sp.	14	6	3	23
Tricorythodes sp.	-	1	17	18
Odonata				
Enallagma sp.	1	-	-	1
Diptera				
Ceratopogonidae				
Bezzia/Probezzia sp.	1	-	1	2
Chironomidae	105	92	176	373
Simuliidae				
Simulium sp.	-	-	4	4
Hemiptera				
Corixidae (immature)	-	1	1	2
Coleoptera				
Elmidae				
Dubiraphia (*vittata*?) (adult)	-	-	2	2
Neoelmis sp.	4	-	-	4
Stenelmis sp. (adult)	-	-	1	1
Gyrinidae				
Dineutus sp.	1	-	-	1
Hydrophilidae				
Anacaena sp.	-	1	-	1
Hydrochara sp.	-	-	1	1
# individuals/# taxa	199/12	205/13	830/17	1234/24

Station 3: Cerro Gordo Co. Rd. B-19. T-97N, R-19W, Sec. 5-8 (Shellrock River)

	Substrate A	Substrate B	Substrate C	Total
Ectoprocta				
Plumatella sp.	P	P	P	P
Mollusca				
Gastropoda				
Lymnaea sp.	-	1	2	3
Physa sp.	5	37	7	49
Arthropoda				
Crustacea				
Amphipoda	2	-	13	15
Insecta				
Trichoptera				
Cheumatopsyche sp.	1	10	9	20
Hydropsyche bifida (gp.)	-	-	1	1
Psychomyiid Genus A (Ross)	-	-	11	11
Ephemeroptera				
Caenis sp.	4	1	1	6
Siphlonuris alternatus	-	-	1	1
Stenonema sp.	9	9	5	23
Tricorythodes sp.	1	1	2	4
Odonata				
Enallagma sp.	1	1	1	3
Ischnura sp.	-	-	1	1
Diptera				
Chironomidae	549	332	543	1424
Ceratopogonidae				
Bezzia/Probezzia sp.	-	-	1	1
Simuliidae				
Simulium sp.	-	-	1	1
Hemiptera				
Corixidae (immatures)	-	2	1	3
Trichocorixa sp. (male)	-	1	-	1
Saldidae (adult)	-	-	1	1
# individuals/# taxa	572/9	395/11	601/18	1566/19

Station 4: Floyd Co. T-96N, R-18W, Sec. 20 (Shellrock River)

	Substrate A	Substrate B	Substrate C	Total
Ectoprocta				
Plumatella sp.	P	P	P	P
Mollusca				
Gastropoda				
Physa sp.	1	-	-	1
Pelecypoda				
Musculium sp.	-	1	-	1
Arthropoda				
Crustacea				
Amphipoda	2	-	-	2
Insecta				
Collembola				
Podura aquatica	-	-	1	1
Trichoptera				
Cheumatopsyche sp.	38	-	26	64
Ephemeroptera				
Ameletus sp.	1	-	-	1
Caenis sp.	7	-	3	10
Stenonema sp.	238	273	213	724
Diptera				
Chironomidae	107	41	64	212
Coleoptera				
Hydrophilidae				
Hydrobius sp. (adult)	-	1	-	1
# individuals/# taxa	394/8	316/5	307/6	1017/11

Station 5: Floyd Co. T-95N, R-18W, Sec. 5 (Winnebago River)

	Substrate A	Substrate B	Substrate C	Total
Ectoprocta				
Plumatella sp.	p	p	p	p
Platyhelminthes				
Tricladida				
Dugesia sp.	1	-	-	1
Mollusca				
Gastropoda				
Physa sp.	-	1	-	1
Arthropoda				
Crustacea				
Amphipoda	1	-	-	1
Insecta				
Trichoptera				
Cheumatopsyche sp.	14	25	7	46
Hydropsyche cuanis	1	-	-	1
Psychomyiid Genus A (Ross)	-	1	-	1
Pycnopsyche sp.	2	-	-	2
unknown	1	-	-	1
Ephemeroptera				
Caenis sp.	9	12	13	34
Potamanthus sp.	-	3	2	5
Stenonema sp.	4	14	-	18
Tricorythodes sp.	76	91	108	275
Odonata				
Enallagma sp.	1	2	-	3
Diptera				
Chironomidae	1919	2264	1096	5279
Coleoptera				
Elmidae				
Dubiraphia (vittata?) (adult)	-	1	1	2
Stenelmis sp. (adult)	18	18	5	41
Gyrinidae				
Dineutus sp.	1	-	2	3
Lepidoptera				
Pyralididae				
Elophila sp.	-	-	1	1
# individuals/# taxa	2058/14	2422/12	1235/10	5715/19

Station 6: Floyd Co. Rd. T-24. T-95N, R-18W, Sec. 35-36 (Shellrock River)

	Substrate A	Substrate B	Substrate C	Total
Ectoprocta				
Plumatella sp.	p	-	Substrate not recovered	p
Platyhelminthes				
Tricladida				
Dugesia sp.	20	27		47
Mollusca				
Gastropoda				
Lymnaea sp.	1	-		1
Physa sp.	3	1		4
Arthropoda				
Insecta				
Trichoptera				
Cheumatopsyche sp.	46	15		61
Hydropsyche bifida (gr.)	1	1		2
Mayatrichia ayama	1	-		1
Psychomyiid Genus A (Ross)	2	1		3
Ephemeroptera				
Ameletus sp.	7	5		12
Stenonema sp.	4	-		4
Tricorythodes sp.	127	79		206
Diptera				
Chironomidae	854	623		1477
Coleoptera				
Elmidae				
Dubiraphia (*vittata*?) (adult)	-	1		1
Stenelmis sp. (adult)	7	1		8
Zaitzevia sp. (?)	1	-		1
# individuals/# taxa	1074/14	754/10		1826/15

Station 8: Butler Co. Rd. T-47. T-93N, R-16W, Sec. 27-28 (Shellrock River)

	Substrate A	Substrate B	Substrate C	Total
Entoprocta				
Urnatella gracilis	-	-	p	p
Platyhelminthes				
Tricladida				
Dugesia sp.	2	-	1	3
Arthropoda				
Insecta				
Trichoptera				
Athripsodes sp.	1	-	-	1
Cheumatopsyche sp.	30	23	17	70
Hydropsyche bifida (gr.)	1	1	-	2
H. orris	1	2	6	9
Psychomyiid Genus A (Ross)	1	-	1	2
Ephemeroptera				
Ameletus sp.	1	-	-	1
Caenis sp.	9	5	2	16
Potamanthus sp.	-	1	1	2
Tricorythodes sp.	117	54	49	220
Odonata				
immature Agrionidae	-	1	-	1
Diptera				
Chironomidae	190	1662	1729	3581
Simuliidae				
Simulium sp.	1	-	-	1
Simulium sp. (pupa)	-	-	1	1
Hemiptera				
Gerridae				
Rheumatobates rileyi (adult)	-	-	1	1
Coleoptera				
Gyrinidae				
Dineutus sp.	-	1	-	1
# individuals/# taxa	354/11	1750/9	1808/11	3912/17

Station 9: Butler Co. Rd. C-33. T-92N, R-16W, Sec. 12-13 (Shellrock River)

	Substrate A	Substrate B	Substrate C	Total
Entoprocta				
Urnatella gracilis	p	-	-	p
Platyhelminthes				
Tricladida				
Dugesia sp.	18	1	-	19
Mollusca				
Gastropoda				
Physa sp.	23	-	1	24
Arthropoda				
Crustacea				
Amphipoda	1	-	-	1
Astacidae (female crayfish)	1	-	-	1
Insecta				
Collembola				
Podura aquatica	1	-	-	1
Trichoptera				
Cheumatopsyche sp.	2	98	57	157
Hydropsyche bifida (gr.)	-	3	-	3
H. orris	-	1	-	1
Mayatrichia ayama	1	-	-	1
Ochrotrichia tarsalis	-	2	-	2
Psychomyiid Genus A (Ross)	-	1	-	1
Ephemeroptera				
Ameletus sp.	2	1	1	4
Caenis sp.	2	3	3	8
Potamanthus sp.	5	-	-	5
Stenonema sp.	1	1	-	2
Tricorythodes sp.	28	203	247	478
Odonata				
Agrionidae				
Argia sp.	1	-	-	1
Diptera				
Chironomidae	178	283	108	569
Hemiptera				
Corixidae (female)	-	1	-	1
Corixidae (immature)	-	-	3	3
Coleoptera				
Gerridae				
Rheumatobates rileyi (adult)	-	-	1	1
# individuals/# taxa	264/15	598/12	421/8	1283/22

Station 10: Bremer Co. T-91N, R-14W, Sec. 18 (Shellrock River)

	Substrate A	Substrate B	Substrate C	Total
Platyhelminthes				
Tricladida				
Dugesia sp.	-	8	-	8
Mollusca				
Gastropoda				
Physa sp.	1	6	-	7
Arthropoda				
Crustacea				
Amphipoda	-	1	-	1
Insecta				
Trichoptera				
Cheumatopsyche sp.	189	3	199	391
Hydropsyche bifida (gr.)	2	-	3	5
H. orris	7	-	1	8
Mayatrichia ayama	8	1	1	10
Psychomyiid Genus A (Ross)	-	-	1	1
Ephemeroptera				
Ameletus sp.	12	-	5	17
Caenis sp.	19	-	62	81
Stenonema sp.	-	-	4	4
Tricorythodes sp.	116	12	78	206
Odonata				
Enallagma sp.	1	-	-	1
Diptera				
Chironomidae	16	112	31	159
Rhagionidae				
Atherix variegata	1	-	-	1
Hemiptera				
Corixidae (immature)	1	-	-	1
Coleoptera				
Gyrinidae				
Dineutus sp.	5	-	-	5
# individuals/# taxa	378/13	143/7	385/10	906/17

*Animal was present.

**Unless otherwise noted, insects were found in larval or immature form.