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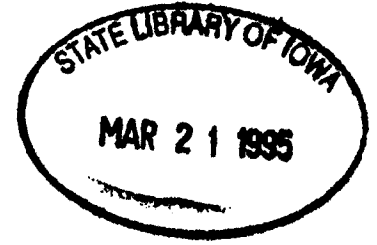
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WINTER WATER QUALITY
SURVEY OF THE ROCK RIVER

#77-28

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

The publication of this report was financially acted through a
contract between the Iowa Department of Environmental Quality
and University of Iowa, State Hygienic Laboratory utilizing funds
made available to the Iowa Department of Environmental Quality by the
United States Environmental Protection Agency.

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ABSTRACT

A water quality survey of the Rock River was conducted during winter low flow conditions. Results of the survey indicate the discharges from several wastewater treatment plants had a deteriorating effect on the Rock River's water quality. Downstream of the waste discharges, fecal coliform, ammonia nitrogen, filtrable phosphate, BOD and chlorides increased significantly. Assimilation of the organic waste by the Rock River was much better than expected under winter conditions.

INTRODUCTION

The Rock River originates in Pipestone County, Minnesota and enters Iowa in Lyon County just north of Rock Rapids. The Iowa reach (approximately 40 miles) of the Rock extends from the Iowa-Minnesota line to its juncture with the Big Sioux River. Total drainage area for the Rock is 1688 square miles of which over 925 square miles are in Iowa.

The Rock River flows through a rather narrow flat valley and according to a report by the Iowa Conservation Commission, offers the best habitat for fish of any stream tributary to the Missouri River in Iowa.

Major tributaries to the Rock are the Little Rock River and Otter Creek. Several small towns (Rock Valley, Sibley, Little Rock and Rock Rapids) discharge their municipal wastes into the Rock or its tributaries. The Rock River is classified as a class B fresh warmwater stream from its mouth to the Iowa Minnesota state line.

Except for the quarterly monitoring station located just above the mouth of the Rock River and a recent low flow survey (State Hygienic Laboratory Report #77-17), water quality data on the Rock River is limited. The purpose of this survey was to assess the effects of various point source waste discharges on water quality during winter ice cover low flow conditions. Water quality samples were collected 3 January 1977. Figure 1 is a map representing the sampling area and a list of the sampling stations will be found in Table 1.

Two U.S. Geological Survey gage stations are located on the Rock River. One gage is located in the city park at Rock Rapids, and the other just north of Rock Valley. Because of the difficulty in measuring flow in the winter under ice, accurate provisional flow data were not available at the writing of this report. A figure of 4.63 cfs

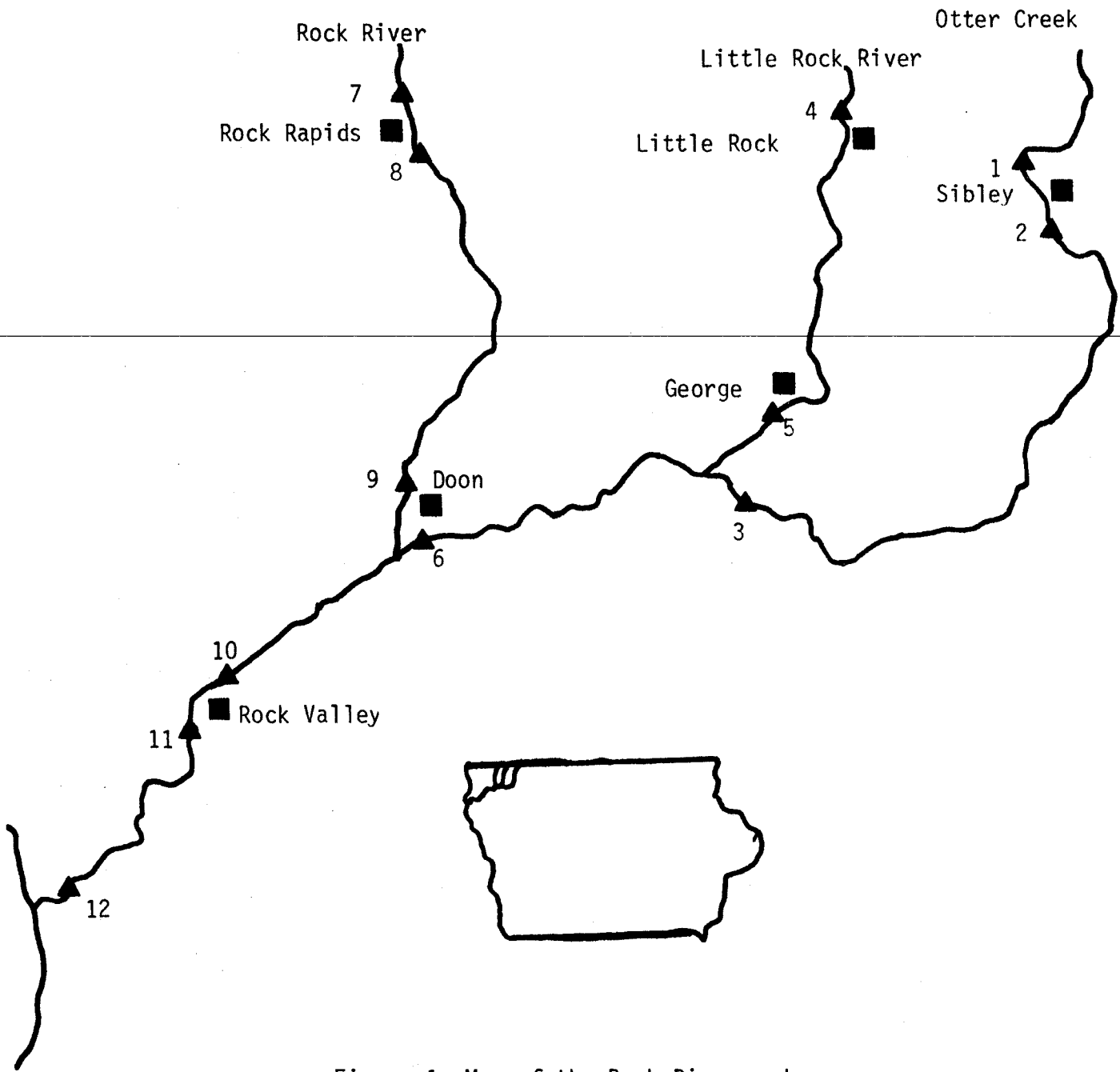


Figure 1 Map of the Rock River and Tributaries showing Sampling Locations

TABLE 1
 Rock River Sampling Locations
 3 January 1977

<u>STATION</u>	<u>LOCATION</u>
1. Otter Creek	Osceola Co.Rd. A22 Bridge T99N R42W Sec. 1
2. Otter Creek	Osceola Co.Rd. Bridge T99N R41W Sec. 19
3. Otter Creek	Lyon Co.Rd. Bridge T98N R44W Sec. 21
4. Little Rock River	Lyon Co. Hwy 9 Bridge T99N R43W Sec. 34
5. Little Rock River	Lyon Co.Rd. Bridge T98N R44W Sec. 10
6. Little Rock River	Lyon Co.Rd. K42 Bridge T98N R46W Sec. 36
7. Rock River	Lyon Co. Dam in City Park at Rock Rapids
8. Rock River	Lyon Co.Rd. A22 Bridge T99N R45W Sec. 10
9. Rock River	Lyon Co.Rd. K42 Bridge T98N R46W Sec. 24
10. Rock River	Sioux Co.Rd. K30 Bridge T97N R46W Sec. 16
11. Rock River	Sioux Co. Hwy 18 Bridge T97N R47W Sec. 24
12. Rock River	Sioux Co.Rd. B40 Bridge T96N R47W Sec. 31

was obtained for the Rock Valley gage in December. The 7 day Q_{10} for that gage is 0.20 cfs. The Geological Survey reported the stream frozen to the bottom at Rock Valley when they attempted flow measurements in mid-January. Flow in the city park at Rock Rapids was very close to zero flow and for this report will be considered zero.

RESULTS AND DISCUSSION

~~Selected data from this survey will be tabulated in the text by~~
tributaries and major rivers. All data collected will be found in the Appendix.

Otter Creek

Three sampling stations were located on Otter Creek (Fig. 1). Station 1 located above Sibley was frozen to the bottom, therefore no sample was collected. Values for selected parameters from stations 2 and 3 are listed below:

Otter Creek
(all values in mg/L unless designated otherwise)

Station	Fecal Coliform per 100 ml	Specific Conductance*	Ammonia Nitrogen	Filtrable Phosphate	Dissolved Oxygen	BOD	Chloride
1	no sample						
2	330,000	4200	14	4.2	0.0	65	415
3	10	1700	0.56	0.06	2.8	1	16

*micromhos

Station 2 downstream of Sibley had very poor water quality as indicated by the high fecal coliform, ammonia nitrogen, BOD and dissolved oxygen values. Because there was no flow above Sibley, the sample collected at Station 2 reflects the discharge from the Sibley wastewater treatment plant. Station 3, several miles downstream, showed remarkable recovery

for winter conditions. Except for dissolved oxygen and specific conductance, water quality had improved at station 3 to expected wintertime values. A water quality survey (SHL #77-17) performed during September 1976 indicated a similar recovery between stations 2 and 3.

Little Rock River

Three sampling stations were located on the Little Rock River.

Station 4, located upstream of the town of Little Rock was frozen to the bottom and no sample was collected. Selected data for station 5 and 6 are shown below:

Little Rock River

(all values in mg/L unless designated otherwise)

Station	Fecal Coliform per 100 ml	Specific Conductance*	Ammonia Nitrogen	Filtrable Phosphate	Dissolved Oxygen	BOD	Chloride
4	no sample						
5	<10	1300	1.4	0.07	2.2	3	26
6	10	810	0.72	0.72	6.8	1	15

*micromhos

At station 5, located downstream from George, Iowa, values for specific conductance, ammonia nitrogen and BOD were elevated slightly with a reduction in dissolved oxygen concentration, suggesting an organic waste discharge upstream. Water quality at station 6 had improved compared to station 5 and is closer to values expected for winter conditions.

Rock River

Six sampling stations were located on the mainstream of the Rock River.

Rock River

(all values in mg/L unless designated otherwise)

Station	Fecal Coliform per 100 ml	Specific Conductance*	Ammonia Nitrogen	Filtrable Phosphate	Dissolved Oxygen	BOD	Chloride
7 (Rock Rapids)	<10	1100	1.9	0.06	10.5	4	64
8	21,000	1500	7.8	1.9	4.3	10	150
9	<10	860	0.48	0.12	6.8	2	39
10 (Rock Valley)	50	970	0.29	0.07	11.7	1	31
11	6,000	1100	3.5	0.76	6.0	3	56
12	10	960	0.55	0.13	9.7	2	24

*micromhos

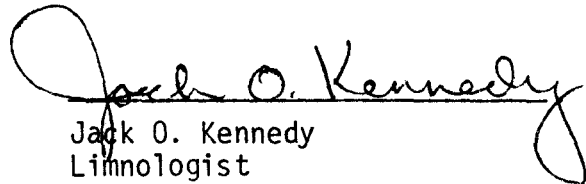
Station 7 located upstream of Rock Rapids had background values (ammonia-N, BOD and chlorides) somewhat higher than expected, and are probably related to the low flows. The effect of Rock Rapids on the Rock River water quality is demonstrated at station 8. All parameters indicative of an organic waste discharge (ammonia-N, organic-N, fecal coliform and BOD) increased significantly. Although the ammonia-N (7.8 mg/L) and dissolved oxygen (4.3 mg/L) values violate the Iowa Water Quality Standards, the standards may not apply due to the extreme low flows.

Stations 9 and 10 show an improvement in water quality over station 8. Ammonia-N, filtrable phosphate and BOD declined to background levels while dissolved oxygen increased to 11.7 mg/L. Rock Valley's waste discharge impact on water quality may be seen at station 11. Ammonia-N and BOD increased significantly over upstream values while dissolved oxygen decreased. By the time the water reached station 12, most values again approached expected background levels.

A general comparison may be made between the survey conducted in September 1976 and this winter survey. Values for the winter survey, especially ammonia-N and filtrable phosphate were higher than the fall study. Dissolved oxygen and BOD were significantly lower in the winter than in the fall. The most notable point of both surveys is the Rock River's ability for relatively rapid recovery from the several organic point source discharges. Recovery is more delayed during the winter survey, but that is to be expected at colder temperatures.

SUMMARY AND CONCLUSION

Water quality samples were collected from the Rock River on 3 January 1977. Stream flow was probably at or below the 7 day Q_{10} with extremely heavy ice cover. Results of the survey indicate that Sibley's, Rock Rapids', and Rock Valley's municipal wastewater treatment plant discharges had a deteriorating effect on the Rock River water quality. If the Iowa Water Quality standards were applicable (low flow conditions may pre-empt standards) violations of the 2 mg/L ammonia standard occurred below Rock Rapids (7.8 mg/L) and Rock Valley (3.5 mg/L). Waste assimilation and stream recovery were much better than expected and should be beneficial in determining future waste load allocations for the Rock River.


Jack O. Kennedy
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 Source Specific Location	Station 2 Otter Creek Osceola Co. Rd. T99N R41W Sec. 19	Station 3 Otter Creek Co. Rd. T98N R44W Sec. 21	Station 5 Little Rock River Co. Rd. T98N R44W Sec. 10
Date Collected	4 Jan 1977	3 Jan 1977	3 Jan 1977
Date Received	5 Jan 1977	5 Jan 1977	5 Jan 1977
Lab Number	2604	2605	2606
Collection Time	9:15	4:30	5:15
pH		FIELD DATA	
Temperature	0°C	0°C	0°
Dissolved Oxygen			
Fecal Coliform/100 ml	330,000 >24 hrs.	10 >24 hrs	<10 >24 hrs
BACTERIOLOGICAL EXAMINATION			
Conductance (micromhos)	4200	1700	1300
CHEMICAL ANALYSIS (as mg/l unless designated otherwise)			
MBAS (as LAS)			
pH (units)	7.85	7.45	7.55
Alkalinity: P	none	none	none
T	449	345	508
NITROGEN: Organic N	10	0.94	1.6
Ammonia N	14	0.56	1.4
Nitrite N			
Nitrate N	<0.1	4.0	0.1
Nitrate as NO ₃			
RESIDUE: Total	3160	1570	1020
Fixed	2730	1300	800
Volatile	430	270	220
Filtrable Residue T	3000	1460	916
F	2730	1300	776
V	270	160	140
Nonfiltrable Residue T	30	16	30
F	24	16	30
V	6	0	0
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	4.2	0.06	0.07
Total P	5.3	0.20	0.30
Dissolved Oxygen	0.0	2.8	2.2
BOD	65	1	3
COD	288	4	30
Grease or Oil			
Turbidity (JTU)	50	4.6	6.7
Total Hardness (as CaCO ₃)			
Calcium (Ca ⁺⁺)			
Magnesium (Mg ⁺⁺)			
Chloride (Cl ⁻)	415	16	26
Sulfate (SO ₄ ⁻)			
total organic carbon	82.6	4.2	15.2
Chlorophyll a	5 µg/L	10 µg/L	63 µg/L

REMARKS: complete ice cover complete ice cover complete ice cover

COLLECTOR
REPORT TO

Miller, Kennedy
Limnology Division
State Hygienic Lab
Des Moines Branch

R. L. Morris, Ph.D.
Associate Director & Principal Chemist

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WATER QUALITY REPORT

STATE HYGIENIC LABORATORY, Des Moines Branch
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Town Source Specific Location	Station 6 Little Rock River Co.Rd. K42 T98N R46W Sec. 36	Station 7 Rock River Dam in city park at Rock Rapids	Station 8 Rock River Co.Rd. A22 T99N R45W Sec. 10
Date Collected	3 Jan 1977	4 Jan 1977	3 Jan 1977
Date Received	5 Jan 1977	5 Jan 1977	5 Jan 1977
Lab Number	2607	2608	2609
Collection Time	3:30	8:15	5:45
pH			
Temperature	0°C	0°C	0°C
Dissolved Oxygen			
BACTERIOLOGICAL EXAMINATION			
Fecal Coliform/100 ml	10 >24 hrs	<10 >24 hrs	21,000 >24 hrs
CHEMICAL ANALYSIS (as mg/l unless designated otherwise)			
Conductance (micromhos)	810	1100	1500
MBAS (as LAS)			
pH (units)	7.6	7.75	7.75
Alkalinity: P	none	none	none
T	266	398	424
NITROGEN: Organic N	0.18	3.2	3.2
Ammonia N	0.72	1.9	7.8
Nitrite N			
Nitrate N	0.1	1.7	1.9
Nitrate as NO ₃			
RESIDUE: Total	578	816	992
Fixed	456	642	776
Volatile	122	174	216
Filtrable Residue T	526	728	920
F	458	602	776
V	68	126	144
Nonfiltrable Residue T	20	8	36
F	14	8	36
V	6	0	0
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.12	0.06	1.9
Total P	0.18	0.38	2.4
Dissolved Oxygen	6.8	10.5	4.3
BOD	1	4	10
COD	<3	16	42
Grease or Oil			
Turbidity (JTU)	4.4	4.7	16
Total Hardness (as CaCO ₃)			
Calcium (Ca ⁺⁺)			
Magnesium (Mg ⁺⁺)			
Chloride (Cl ⁻)	15	64	150
Sulfate (SO ₄ ⁻)			
Total organic Carbon	3.8	6.8	17.0
Chlorophyll a	10 µg/L	21 µg/L	72 µg/L

REMARKS: 98% ice cover complete ice cover complete ice cover

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WATER QUALITY REPORT

STATE HYGIENIC LABORATORY, Des Moines Branch
The University of Iowa
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Town Source Specific Location	Station 9 Rock River Co.Rd. K42 T98N R46W Sec. 24	Station 10 Rock River Co.Rd. K30 T97N R46W Sec. 16	Station 11 Rock River Hwy 18 Br. T97N R47W Sec. 24
Date Collected	3 Jan 1977	3 Jan 1977	3 Jan 1977
Date Received	5 Jan 1977	5 Jan 1977	5 Jan 1977
Lab Number	2610	2611	2612
Collection Time	4:00	FIELD DATA	2:50
pH		3:15	
Temperature	0°C	0°C	0°C
Dissolved Oxygen			
BACTERIOLOGICAL EXAMINATION			
Fecal Coliform/100 ml	<10	>24 hrs 50	>24 hrs 6,000
CHEMICAL ANALYSIS (as mg/l unless designated otherwise)			
Conductance (micromhos)	860	970	1100
MBAS (as LAS)			
pH (units)	7.6	7.55	7.6
Alkalinity: P	none	none	none
T	300	320	322
NITROGEN: Organic N	0.72	0.93	0.40
Ammonia N	0.48	0.29	3.5
Nitrite N			
Nitrate N	0.5	2.7	1.7
Nitrate as NO ₃			
RESIDUE: Total	560	680	770
Fixed	418	504	590
Volatile	142	176	180
Filtrable Residue T	532	652	738
F	426	528	606
V	106	124	132
Nonfiltrable Residue T	0	12	6
F	0	12	6
V	0	0	0
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.12	0.07	0.76
Total P	0.22	0.15	0.88
Dissolved Oxygen	6.8	11.7	6.0
BOD	2	1	3
COD	4	7	13
Grease or Oil			
Turbidity (JTU)	5.3	3.5	4.2
Total Hardness (as CaCO ₃)			
Calcium (Ca ⁺⁺)			
Magnesium (Mg ⁺⁺)			
Chloride (Cl)	39	31	56
Sulfate (SO ₄ ⁻)			
Total organic Carbon	6.9	5.6	18.2
Chlorophyll a	5 µg/L	8 µg/L	9 µg/L

REMARKS: complete ice cover complete ice cover complete ice cover

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WATER QUALITY REPORT

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

Town	Station 12		
Source	Rock River		
Specific Location	Co.Rd. B40 T96N R48W Sec. 31		
Date Collected	3 Jan 1977		
Date Received	5 Jan 1977		
Lab Number	2613		
Collection Time	2:15	FIELD DATA	
pH			
Temperature	0°C		
Dissolved Oxygen			
Fecal Coliform/100 ml	10	>24 hr	BACTERIOLOGICAL EXAMINATION
Conductance (micromhos)	960		CHEMICAL ANALYSIS (as mg/l unless designated otherwise)
MBAS (as LAS)			
pH (units)	7.5		
Alkalinity: P	none		
T	324		
NITROGEN: Organic N	0.65		
Ammonia N	0.55		
Nitrite N			
Nitrate N	2.1		
Nitrate as NO ₃			
RESIDUE: Total	708		
Fixed	544		
Volatile	164		
Filtrable Residue T	674		
F	552		
V	122		
Nonfiltrable Residue T	22		
F	22		
V	0		
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.13		
Total P	0.24		
Dissolved Oxygen	9.7		
BOD	2		
COD	15		
Grease or Oil			
Turbidity (JTU)	5.2		
Total Hardness (as CaCO ₃)			
Calcium (Ca ⁺⁺)			
Magnesium (Mg ⁺⁺)			
Chloride (Cl ⁻)	24		
Sulfate (SO ₄ ⁻)			
Total Organic Carbon	7.4		
Chlorophyll a	18 µg/L		

REMARKS: complete ice cover

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

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