ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF ENFORCEMENT

REPORT ON

WATER QUALITY INVESTIGATIONS NORTH PLATTE RIVER BASIN TORRINGTON, WYOMING-TO-BAYARD, NEBRASKA

NATIONAL FIELD INVESTIGATIONS CENTER-DENVER

DENVER, COLORADO

AND

REGION VII KANSAS CITY, MO.

APRIL 1972

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WATER QUALITY INVESTIGATIONS
NORTH PLATTE RIVER BASIN
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National Field Investigations Center-Denver
Denver, Colorado
and
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Kansas City, Missouri

April 1972

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GLOSSARY OF TERMS

BOD - Biochemical Oxygen Demand, 5-Day

COD - Chemical Oxygen Demand

DO - Dissolved Oxygen

NH_3N - Ammonia Nitrogen

NO_3-NO_2-N - Nitrate Nitrite Nitrogen

P - Phosphorous

TOC - Total Organic Carbon

TSS - Total Suspended Solids

VSS - Volatile Suspended Solids

cfs - flow rate given in cubic feet per second

gpm - flow rate given in gallons per minute

mgd - flow rate given in million gallons per day

mg/l - concentration given in milligrams per liter

RM - river mileage

I. INTRODUCTION

A. BACKGROUND

In November 1960 a water quality survey[1] conducted on the North Platte River between Torrington, Wyoming, and Morrill, Nebraska, indicated that substantial interstate pollution of the river was occurring. A Conference on Pollution of the Interstate Waters of the North Platte River, Wyoming-Nebraska, was held in Scottsbluff, Nebraska, September 12, 1961, to consider pollution resulting from the wastes discharged from the Holly Sugar Corporation plant at Torrington, Wyoming, and from the four plants of the Great Western Sugar Company at Mitchell, Scottsbluff, Gering, and Bayard, Nebraska.

The Conference recommended that various water quality and waste source surveys be conducted during the 1961-62 and 1962-63 sugar beet processing seasons.[2,3] The Conference was reconvened on March 21, 1962, and again on November 20, 1963, in order to evaluate the results of the surveys.

During the period between the first and third sessions various waste treatment and control improvements were accomplished by municipalities and industries. In particular, Holly Sugar Corporation eliminated all waste discharges, except flume and condenser water, and provided fine screening for the flume water discharge. The Great Western Sugar Company at Scottsbluff ponded its entire waste discharge during the 1962-63 season. Levels of BOD and suspended solids were substantially reduced. Depressions of DO were minor, but bacterial counts remained high. By 1965, waste treatment and control facilities were installed at the other mills in compliance with the Conference recommendations. All municipal sources, with the exception of that of Bayard, Nebraska, were in compliance by the end of 1968.

In December 1970 a water quality and waste source survey of the ten-mile reach of the North Platte River between Torrington, Wyoming, and Henry, Nebraska, produced evidence that inadequate waste treatment by the Holly Sugar Corporation was still creating interstate pollution of the river. Consequently, a 180-day notice was issued on June 15, 1971, giving Holly Sugar Corporation until December 23, 1971 to abate the pollution.

A public hearing concerning the 180-day notice was held in Scottsbluff, Nebraska, on July 21, 1971, in order to consider the standards violations and means of achieving pollution abatement.[4] The Environmental Protection Agency (EPA), Region VII, made recommendations [Appendix A] to the Holly Sugar Company concerning their waste discharge. Holly Sugar has complied with most of these recommendations.

B. 1972 WATER QUALITY INVESTIGATIONS

EPA, Region VII, requested the EPA National Field Investigations Center-Denver to conduct water quality investigations in the North Platte River. A study was made during the 1971-72 sugar beet campaign, specifically January 5-15, 1972, with the following four objectives:

1) determine compliance with water quality standards established for the North Platte River;
2) determine the effects of waste sources from sugar beet mills on water quality of the North Platte River;
3) determine if proposed water pollution control measures are adequate to protect the specified water uses of the North Platte River; and
4) determine if any enforcement actions are necessary.

The North Platte River was surveyed from upstream of Torrington, Wyoming (RM 209.3) to downstream from Bayard, Nebraska (RM 152.1). Bacteriological analyses were performed on water samples from selected stations to determine whether or not standards were being violated. Investigations were conducted at both the Great Western Sugar Company and Holly Sugar Corporation mills in order to evaluate water pollution control practices and determine the waste loads discharged. Bacteriological analyses were performed on both the sugar mill discharges and the effluents from the municipal wastewater treatment plants at Terrytown, Gering, and Scottsbluff to identify sources of bacterial contamination.

The cooperation of personnel from the following State, county, city, and Federal agencies and industries in supplying information and assistance for the water quality investigations is gratefully acknowledged.

Nebraska Department of Water Resources

Nebraska Game Commission

Nebraska Department of Environmental Control

Wyoming State Engineer's Office

Wyoming Department of Health and Social Services

City of Scottsbluff

City of Gering

City of Terrytown

Scottsbluff County Engineer's Office

U.S. Geological Survey, Cheyenne, Wyoming

U.S. Bureau of Reclamation, Torrington, Wyoming

Great Western Sugar Company

Holly Sugar Corporation

II. SUMMARY AND CONCLUSIONS

Water quality investigations in the North Platte River Basin (Torrington, Wyoming, to Bayard, Nebraska) were conducted during January 1972. These included an evaluation of the waste sources that could affect water quality. Industrial wastes discharged from the Holly Sugar Corporation mill at Torrington, and the Great Western Sugar Company mills at Scottsbluff, Mitchell, Gering, and Bayard, Nebraska, were characterized. Bacteriological analyses were made on the effluents from mills and the municipal wastewater treatment facilities at Terrytown, Scottsbluff, and Gering, Nebraska, in order to identify sources of bacterial contamination.

Bacterial densities in that reach of the North Platte River downstream from RM 209.3 (Torrington) to upstream of RM 172.9 (Terrytown) were below established limits for coliforms; the maximum geometric averages* for total and fecal coliform densities observed in this section were 790/100 ml and <74/100 ml, respectively. At every river station downstream from the Terrytown waste treatment plant, the total and fecal coliform densities were above the Nebraska Water Quality Standards limit (10,000/100 ml and 2,000/100 ml, respectively). The maximum total coliform densities were 750,000/100 ml and 75,000/100 ml, respectively. These densities were found at Station 7 (RM 172.3) downstream from the Gering Great Western sugar beet mill.

The greatest sources of bacterial contamination were the effluents from the Gering and Scottsbluff Great Western sugar plants. The Terry-

* All bacterial densities will be geometric averages unless otherwise specified.

town municipal waste treatment plant discharged a small volume of poorly disinfected effluent.

The only discharge from the Holly Sugar Corporation was condenser water; all other wastes were re-cycled or impounded. This effluent had a five-day BOD of less than 0.5 lb per ton of beets processed. Contamination by other waste waters caused the TSS load to exceed 0.5 lb per ton of beets processed. An effluent containing 0.5 lb each of BOD and TSS per ton of beets processed is achievable with installation of the best practicable control technology currently available for the sugar beet industry.

The discharge from the Bayard mill caused violations of the DO criterion in Stuckenholz Drain. No violations of water quality criteria for the North Platte River were documented as a result of the discharge from the Mitchell mill. The present treatment system relies on seepage to the near surface ground water formation as a substitute for secondary treatment as required by the State of Nebraska's water quality standards.

The DO, pH, and temperature of the North Platte River, within the reach studied, were within acceptable levels. The DO concentration in Stuckenholz Drain, downstream from the Great Western Sugar Company mill at Bayard, was 3.2 mg/l, in violation of the criterion (5.0 mg/l). The DO value upstream of the discharge was 11 mg/l. The Great Western mill was discharging about 6,900 lb BOD per day to Stuckenholz Drain during the survey.

The four Great Western Sugar Company plants failed to meet the Nebraska Water Quality Standards which require that industrial wastes shall receive a degree of treatment equivalent to secondary or shall

receive control consistent with waste characteristics, uses and quality of receiving waters. For the sugar beet processing mills, the treatment or control must result in effluent containing no greater than 0.5 lb each of BOD and TSS per ton of beets processed.

The amounts of BOD and TSS discharged, per ton of sugar beets per day, were as follows:

Sugar Mill	lb/ton sugar beets sliced BOD	TSS
Holly Sugar	0.27	0.84
Great Western		
Mitchell	0.48	0.71
Scottsbluff	2.69	0.30
Gering	7.01	0.80
Bayard	2.94	0.48

An examination of historical low-flow conditions (1951-1970) during the sugar beet processing season (Oct. 1-Feb. 1) indicated that minimum stream flows are sufficient to maintain acceptable water quality when adequate treatment, as defined herein, is provided for all waste sources.

III. RECOMMENDATIONS

1. It is recommended that abatement measures to be undertaken at Great Western Sugar Company plants at Mitchell, Gering, Scottsbluff, and Bayard, Nebraska, include the following requirements:

(a) The Company may elect to provide completely closed transport water systems with discharge of condenser water only or may elect to treat transport waters prior to discharge. In either case, separated condenser waters discharged to the North Platte River shall not exceed the following:

	24-Hour Composite (mg/l)	Any Grab Sample (mg/l)
BOD	30	50
TSS	30	50
COD	54	90

(b) If treated transport waters are to be discharged, the total BOD, TSS, and COD loads contained in all discharges shall not exceed 0.5 lbs, 0.5 lbs, and 0.9 lbs, respectively, per ton of beets processed. In no case shall the discharges from specific plants exceed the following:

	BOD & TSS (lbs/day)	COD (lbs/day)
Scottsbluff	1,635	2,950
Gering	1,100	2,000
Mitchell	1,075	1,940
Bayard	1,085	1,950

(c) No toxic or hazardous material, as designated under the provisions of Section 12 of the Federal Water Pollution Control Act, or known to be hazardous or toxic, except with the approval of the Regional Administrator (EPA) or his designee, shall be discharged.

(d) Organisms isolated in the fecal coliform test, contained in the wastewaters reaching the North Platte River shall not exceed 2,000 organisms per 100 ml.

(e) There shall not be a discharge of ammonia that may cause toxic or hazardous conditions or accelerate eutrophication in the receiving water, except with the approval of the Regional Administrator (EPA) or his designee.

(f) Waste water shall be equalized prior to discharge in order to minimize slug loads to the receiving waters.

(g) Discharges of all wastewaters subsequent to the actual beet processing campaign shall meet the effluent limitations and requirements described in Item 1, paragraphs (a), (c), (d), (e), and (f).

2. The necessary abatement measures required to meet the criteria specified in Item 1 shall be in operation at the Great Western Sugar Company mills in Scottsbluff, Gering, Mitchell, and Bayard, Nebraska, prior to startup of the 1972-73 beet processing season.

3. It is recommended that appropriate abatement proceedings be initiated in order to require adequate disinfection of municipal wastewater

discharges and to prohibit the disposal of sludge along the periphery of the North Platte River by the City of Terrytown, Nebraska.

IV. STUDY AREA

A. DESCRIPTION

The North Platte River, originating in Colorado, flows northward into Central Wyoming and then follows a southeastward course to join the South Platte River at North Platte, Nebraska, forming the Platte River. During the summer months the North Platte River is regulated by a large number of reservoirs, in Colorado and Wyoming, that keep the river flow at high levels during the irrigation season.

The section of the North Platte River investigated lies in three counties, Goshen County, Wyoming, and Scottsbluff and Morrill Counties, Nebraska [Figure 1, inside back cover], the major portion being in Scottsbluff County. The North Platte River Valley is predominantly farmland irrigated by the Bureau of Reclamation North Platte Project and private irrigation systems. The valley is approximately 20 miles wide with ranges of hills -- parallel to the river, averaging 600-700 feet in height to the south and 300-400 feet on the north.

The main source of groundwater is the annual rainfall of approximately 14 inches. Most of the precipitation occurs from evening thundershowers during April through July. The daily mean temperature from April through September is 63.9°F; and from October through March is 34.9°F. Predominant winds are from the northwest.

The elevation at the Wyoming-Nebraska state line is 4,025 ft and at Bayard, Nebraska, 3,760 ft; the river gradient is seven ft/mile. The approximate drainage area between Torrington and Bayard is 8,500 square miles. The annual mean flow of the North Platte River at the Wyoming-Nebraska state line is about 350,000 acre-ft.

Scottsbluff, Nebraska, is the largest community in the valley, having a population of approximately 15,000. Gering, Nebraska, a twin city to Scottsbluff, and Torrington, Wyoming, each have populations of about 5,000. All other communities have populations of 2,000 or less.

The population within the survey area remained essentially constant from 1940 through 1960. The past decade has shown an increase of about 7.8 percent in the population of all communities except Torrington and Bayard, which have continued to remained constant.

Agriculture is the predominant economic base in the valley. Sugar beets, corn, wheat, sorghum, alfalfa, oats, and potatoes are the leading crops. Cattle, sheep, hogs, and chickens make up the livestock population. The agricultural related industries consist of feedlots, sugar beet processing, and meat packing.

B. SOURCES OF POLLUTION

Within the study area, the North Platte River receives discharges from municipal and industrial wastes, irrigation return flows, feedlots, and rural runoff. The magnitude of industrial and municipal wastes is known, while that of the other wastes is not known.

In 1961 there were 14 known sources of industrial wastes discharging to the North Platte River study area. The major contributors were the five sugar beet plants. They discharged a total waste load with a BOD population equivalent (P.E.) of about 1.5 million. [The P.E. of an industrial effluent is computed by dividing its total daily weight of BOD in pounds by 0.17 lb, the daily per capita BOD of domestic wastewaters.]

The remaining nine industries discharged a total waste load with a P.E. of 43,000.

The 1967 Nebraska implementation plan required five industries, excluding the Great Western mills, either to provide a private treatment facility or connect to a municipal treatment system by January 1, 1972.

All communities in the study area have waste treatment systems. In Nebraska, Terrytown operates an extended aeration plant. The city of Melbeta uses a clarifier followed by sand filtration, and McGrew uses septic tanks. The remaining communities employ lagoons for treatment. Discharges from the lagoons are controlled in order to allow maximum dilution with the receiving streams during maximum river flows. Industrial wastes at Gering are collected separately from domestic wastes and are discharged to three anaerobic lagoons, operated in parallel, for oil and grease separation. The oils and grease are burned in these lagoons. The lagoon effluents flow to three mechanically aerated lagoons, operated in parallel, and then finally into a polishing lagoon. Domestic wastes are discharged to a waste lagoon and then discharged to the same polishing lagoon. The effluent from the polishing lagoon is discharged to the North Platte River.

Inasmuch as the North Platte Valley supports an important agricultural economy, much of the valley is irrigated. The return flows from the irrigated areas can contain substantial loads of salt, nutrients, pesticides, and oxygen demanding materials. The effects of irrigation return flows on water conditions were not determined by this survey.

A number of feedlots containing cattle and/or other animals for meat production were scattered throughout the valley. The runoff and drainage from these feedlots also were not determined in this study.

V. WATER QUALITY REQUIREMENTS

A. NEBRASKA WATER QUALITY STANDARDS

The North Platte River has been designated by Nebraska as Class C, suitable for agricultural uses including irrigation and livestock watering, partial body contact sports, growth and propagation of aquatic life, semi-aquatic life, wildlife, and industrial use. Water quality standards have been established to protect the above uses. [These standards are shown in Appendix B.]

The specific standards applicable to this survey include:

1. Bacteria - Coliform group and fecal coliform organisms shall not exceed a geometric mean of 10,000/100 ml total or 2,000/100 ml fecal coliform bacteria. No more than 20 percent of samples shall exceed 20,000/100 ml total or 4,000/100 ml fecal coliform bacteria.
2. Suspended, Colloidal or Settleable Solids - None from wastewater sources which will permit objectionable deposition or be deleterious for the designated uses. In no case shall turbidity caused by wastewater impart more than a 10 percent increase in turbidity to the receiving water.
3. Temperature -

   Trout Streams - Allowable change 5°F, maximum limit 65°F.

   Warm Water Streams - Allowable change 5°F May through October; 10°F November through April. Maximum limit 90°F; maximum rate of change limited to 2°F per hour.

4. Dissolved Oxygen - Oxygen consuming wastes shall not lower the dissolved oxygen in receiving stream lower than 5 mg/l in warm water stream and 6 mg/l in a trout stream.
5. pH - The hydrogen ion concentrations expressed as pH shall be maintained between 6.5 and 9.0 with a maximum total change of 1.0 pH unit from the value in the receiving stream.

Municipal wastes are required by Nebraska to receive secondary treatment with a minimum of 85 percent removal of the five-day BOD and TSS. Industrial wastes are required to receive an equivalent degree of treatment or control consistent with waste characteristics, uses and quality of the receiving waters.

For the sugar beet processing industries, adequate treatment or control is that which will result in an effluent containing not more than 0.5 lb each of BOD and TSS per ton of beets processed. These effluent levels can be obtained through the installation of best practicable treatment technology currently available for the sugar beet processing industry.

B. WYOMING WATER QUALITY STANDARDS

[Water Quality Standards applicable to the North Platte River are enclosed in Appendix C.]

VI. STREAM SURVEY

A stream survey was conducted from January 9 to 15, 1972. Fourteen stream sampling stations were established in the North Platte River between Torrington, Wyoming (RM-209.3), and Bayard, Nebraska (RM-152.1). [Figure 1 and Table 1]. Flow data were obtained at USGS gaging stations. Supplemental flow data were obtained for the major creeks and drains discharging to the North Platte River. There were eight effluent outfalls sampled [Table 2].

Daily grab samples of water were taken from the 14 stream stations for bacteriological, DO, and turbidity analyses [Appendix D - Methods of Analysis]. Field measurements for pH, temperature, and conductivity were also made at all locations [Table 3]. [The supplemental flow data for groundwater accretion and the major creeks and drains discharging into the North Platte River between Torrington and Bayard are shown in Figure 2.]

A 1970 survey of the North Platte River downstream from Torrington, Wyoming (RM-209.3), indicated that the Nebraska Water Quality Standards for bacteria were violated at Henry, Nebraska (RM-199.0). An 180-day notice under the Federal Water Pollution Control Act was issued to the Holly Sugar Company for violation of the Nebraska Water Quality Standards. Results of the 1972 stream survey indicated that the bacterial densities [Table 4] were well within the Nebraska criteria from Henry (RM 199) to upstream of the Terrytown municipal treatment plant discharge (RM 173). From RM-172.9 (Station 6) to downstream from Bayard (RM-152.1 - Station 14) the bacterial criteria were violated. The Terrytown waste treatment

TABLE 1

STREAM SURVEY LOCATIONS

Station Designation	Description/Location	River Mileage
1	North Platte River, Torrington, Wyoming, upstream of Holly discharge.	209.3
2	North Platte River, Henry, Nebraska.	199.0
3	North Platte River, Mitchell, Nebraska, upstream of Great Western discharge.	184.0
4	North Platte River downstream from Great Western (Mitchell) discharge.	183.5
5	North Platte River upstream of Scottsbluff, Nebraska. (Highway 29 and 92 Bridge)	177.3
6	North Platte River downstream from Terrytown Nebraska, STP discharge.	172.9
7	North Platte River downstream from Great Western at Gering discharge.	171.4
8	Winter Creek discharge into North Platte River.	170.4
9	North Platte River downstream from Winter Creek and Great Western at Scottsbluff.	170.1
10	North Platte River downstream from all discharges in the Scottsbluff and Gering areas.	168.2
11	Nine Mile Drain discharge into North Platte River.	160.6
12	North Platte River at Bayard, Nebraska	154.6
13	Stuckenholz Drain downstream from Bayard Great Western Sugar mill discharge.	155.1/0.2
14	North Platte River downstream from Bayard, Nebraska.	152.1

TABLE 2

WASTEWATER DISCHARGES

Station Designation	Description/Location	River Mileage
A	Holly Sugar Corporation discharge pipe.	208.8
B	Great Western discharge at Mitchell, Nebraska.	183.8
C	Terrytown, Nebraska, waste treatment facility effluent.	173
D	Great Western discharge at Gering, Nebraska.	171.9
E	Gering, Nebraska, waste treatment facility effluent.	171.3
F	Great Western discharge at Scottsbluff, Nebraska.	170.5
G	Scottsbluff, Nebraska, waste treatment facility effluent.	169.8
H	Great Western discharge at Bayard, Nebraska.	155.1/0.8

TABLE 3

SUMMARY OF STREAM CONDITIONS
January 5-15, 1972

Sample Station	(River Mile)	Flow CFS	pH S.U.	Temperature °C	Conductivity µmhos/cm	Dissolved Oxygen mg/l	Turbidity JTU
1	(209.3)		7.9	2	846	10.6	3.2
2	(199.0)	281.4	8.0	1	832	10.8	5.7
3	(184.0)	544.4	7.9	1	882	10.9	15
4	(183.5)		8.0	2	918	10.7	14
5	(177.3)		8.1	2	818	11.0	15
6	(172.9)		8.1	1	911	11.2	15
7	(171.4)		7.8	2	1,085	11.2	18
8	(170.4)	38.7	7.9	4	911	10.3	12
9	(170.1)		7.8	3	986	9.7	18
10	(168.2)		7.8	2	976	9.5	18
11	(160.6)	90.4	7.9	4	945	10.6	16
12	(154.6)		7.9	1	993	10.4	21
13	(155.1)	21.1	7.5	2	1,210	3.2	76
14	(152.1)		7.9	1	1,020	9.5	19

TABLE 4

STREAM SURVEY BACTERIOLOGICAL CHARACTERISTICS
January 5-15, 1972

Sample Station	River Mileage	Total Coliform*			Fecal Coliform*			Fecal Streptococcus*	
		geom avg.	Range	% in excess of 20,000**	geom avg.	range	% in excess of 4,000**	geom avg.	Range
1	209.3	110	36-610	0	<22	<4-320	0	810	240-7,000
2	199.0	190	110-500	0	<13	<4-60	0	3,700	2,200-4,400
3	184.0	510	140-2,100	0	<62	4-190	0	3,200	1,800-6,000
4	183.5	790	180-3,500	0	<74	16-160	0	>70,000	5,000->1,000,000
5	177.3	500	120-3,300	0	<61	<10-180	0	17,000	3,800-72,000
6	172.9	18,000	300-49,000	71	950	50-4,200	14	13,000	4,900-67,000
7	171.4	750,000	290,000-3,000,000	100	75,000	17,000-180,000	100	>610,000	81,000-6,400,000
8	170.4	160	20-2,000	0	<31	<4-210	0	5,000	1,800-37,000
9	170.1	26,000	7,200-38,000	86	3,100	900-6,200	57	>310,000	58,000-1,700,000
10	168.2	150,000	32,000-370,000	100	15,000	5,800-50,000	100	310,000	58,000-930,000
11	160.6	320	90-2,100	0	140	20-900	0	13,000	3,300-37,000
12	154.6	46,000	14,000-170,000	100	2,600	500-16,000	43	>39,000	13,000->1,000,000
13	155.1	11,000	2,700-36,000	57	340	90-700	0	>6,800,000	>1,000,000->15,000,000
14	152.1	24,000	6,900-55,000	71	3,800	1,500-6,900	43	>66,000	11,000->1,000,000

* Per 100 ml
** Allowable excess-20%

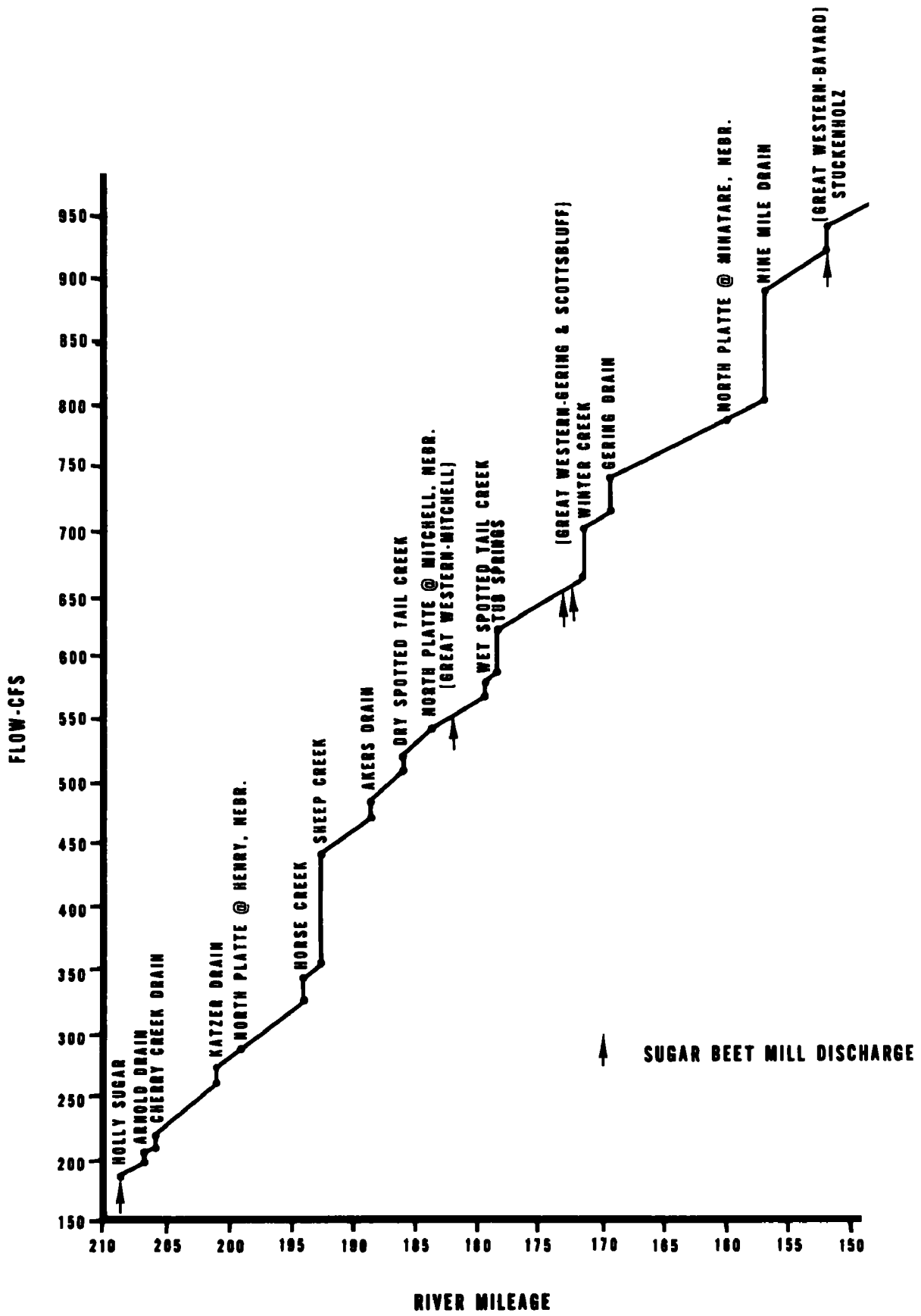

Figure 2 Flow Balance, North Platte River
January 5-15, 1972

plant was not providing adequate disinfection (fecal coliform densities, 520,000/100 ml) at the time of the survey and was responsible for the violation occurring at Station 6.

Effects of the discharge from the Great Western mill at Gering (RM-171.9) were measured at Station 7 (RM-171.4), in the south channel of the North Platte River. (The river channel, upstream of the Gering Great Western mill discharge, splits into two channels -- a north channel and one to the south, and is then re-formed downstream from the Gering municipal treatment lagoon discharge. Both the Great Western mill at Gering and the Gering municipal treatment plant discharge into the south channel.) The total and fecal coliform densities in this reach of the river were at least 75 and more than 37 times the criteria, respectively.

Downstream (RM-170.1 - Station 9) from the discharge of the Great Western mill, Scottsbluff (RM 170.5), and from the mouth of Winter Creek (RM-170.4), the total and fecal coliform densities were 26,000/100 ml and 3,100/100 ml, respectively. Violations of the Nebraska Standards were occurring. The Winter Creek flow was of good bacterial quality (160/100 ml, total coliforms, and < 31/100 ml, fecal coliforms) and would tend to have a diluting effect on the North Platte River. The waste effluent from the Scottsbluff Great Western mill had a fecal coliform density of 86,000/100 ml, and, thus, was responsible for the violations observed.

At RM-168.2 (Station 10) the total and fecal coliform densities increased about five times the values reported at Station 9. Station 10 shows the effects of all waste discharges in the Gering-Scottsbluff area.

The bacterial contamination at this point was caused primarily by discharges from the Great Western mills at Gering and Scottsbluff. The municipal waste discharges from these two cities were considered minor contributors.

The North Platte River at Bayard (RM-154.6 - Station 12) had total and fecal coliform densities of 46,000/100 ml and 2,600/100 ml, respectively. The high counts at Bayard were attributed to residual contamination carried downstream from the Scottsbluff-Gering area and possible runoff from feedlots located near the area, at Minatare (RM-164.5).

In the Stuckenholz Drain, downstream from the Great Western discharge (RM-155.1/0.8), the total coliform density was 11,000/100 ml, but the fecal coliform one was only 340/100 ml. The inflow from Stuckenholz Drain did not contribute to the bacterial contamination of the North Platte River, but tended, instead, to have a dilution effect. At Station 14, although the bacterial densities had decreased, they still exceeded the criteria.

The DO levels were within the criteria of 5 mg/l for warm water streams at all locations on the North Platte River [Table 3]. Data supplied by the Great Western mill at Bayard indicate that the DO level at the Great Western water supply intake, from the Stuckenholz Drain, ranged from 10.6-11 mg/l for the months of December 1971, and January 1972. The DO level at Station 13 (RM-155.1/0.2), approximately 0.6 miles downstream from the waste discharge, was 3.2 mg/l. At the time of the survey the mill was discharging 6,900 lb BOD per day which depressed the DO to levels below the Standards.

VII. WASTE SOURCE EVALUATION

A. INDUSTRIAL SOURCES

Five sugar beet processing mills were evaluated in order to determine both the effectiveness of waste treatment practices and the quality of the waste effluents. Data were collected in the following ways: in-plant surveys; contacts with state water pollution control authorities; and company representatives. Grab samples of condenser water were taken from the seal tanks inside the Great Western mills. Five 24-hour composite samples of the treatment lagoon influent and effluent were collected using automatic sampling devices (SERCO). Samples were composited on an equal volume basis and analyzed for BOD, COD, TOC, TSS, VSS, turbidity, metals, and nutrients. The condenser wastewater from the Holly Sugar plant was sampled similarly.

The Great Western Sugar Company plants at Scottsbluff and Gering, Nebraska, and the Holly Sugar Corporation plant at Torrington, Wyoming, are Steffen houses, whereas the Great Western Sugar Company mills at Mitchell and Bayard are straight houses [Appendix E]. [The operational characteristics of these plants are listed in Table 5.]

Great Western Sugar Company Mill at Scottsbluff

Wastewater influent to the lagoons averaged 7.4 mgd. Lime mud was discharged into a 10-acre pond with no surface discharge; all other wastes were discharged into three lagoons operated in series, situated over sand and gravel beds. The surface areas of the three lagoons were 30, 20, and 40 acres, respectively [Figure 3]. Average liquid depth in the lagoons ranged from 12-18 in. A channel was provided for bypassing the lagoons. [The characteristics of the condenser and process wastes are shown in Table 6.]

TABLE 5

OPERATIONAL CHARACTERISTICS
SUGAR BEET MILLS

Plant	No. of Employees	Tons Sugar Beets/day Rated Capacity	Tons Sugar Beets/day Actual Production	Source & Quantity of Water Supply	Type of Treatment
Holly Sugar					
Torrington,* Wyoming	250	3,000	3,000	North Platte River 5 mgd	Clarification and recycling of both transport water and general plant wastes; excess conveyed to lagoons, no discharge. Condenser water discharged without treatment. Lime slurry separately impounded.
Great Western					
Scottsbluff,* Nebraska	440	3,275	3,700	Winter Creek 8.1 mgd	Condenser and general plant wastes transport water conveyed to lagoons prior to discharge. Lime sludge separately impounded.
Gering,* Nebraska	330	2,210	2,210	Winter Creek 7.9 mgd	Same as Scottsbluff
Mitchell,* Nebraska	320	2,150	2,320	Dry Spotted Tail Creek 7.1 mgd	Same as Scottsbluff, except lime slurry discharged to lagoons
Bayard,** Nebraska	330	2,175	2,340	Stuckenholz Drain 7.2 mgd	Same as Mitchell

* Wastes discharged to North Platte River
** Wastes discharged to Stuckenholz Drain

TABLE 6

SUMMARY OF WASTE CHARACTERISTICS
GREAT WESTERN SUGAR COMPANY
SCOTTSBLUFF, NEBRASKA

Parameter	Condenser Water	Lagoon System	
		Influent	Effluent
Flow (mgd)	-	7.4*	2.4
pH range (S.U.)	8.2-8.7	8.3-8.7	6.9-7.5
Temperature range (°C)	32-42	31-33	0.0-1.5
Conductivity range (µmhos/cm)	850-900	900-1,100	1,250-1,300
Turbidity (JTU)	13	180	130
Dissolved Oxygen (mg/1)	2.8	-	-
Ortho P, (mg/1)	0.10	0.21	0.17
NH_3 as N, (mg/1)	3.74	6.02	6.83
NO_3-NO_2 as N (mg/1)	3.23	2.58	0.07
COD (mg/1)	59	1,010	670
BOD (mg/1)	19	720	500
BOD (lb/day)	-	-	9,984
BOD (lb/ton beets)	-	-	2.69
TOC (mg/1)	9	340	125
TSS (mg/1)	30	781	56
TSS (lb/day)	-	-	1,111
TSS (lb/ton beets)	-	-	0.30
VSS (mg/1)	5	167	22
Fecal Coliform			
geom. avg/100 ml	-	-	86,000
range/100 ml	-	-	14,000-340,000
Fecal Streptococcus			
geom. avg x 10^6/100 ml	-	-	> 18
range x 10^6/100 ml	-	-	4.6-> 100

* This flow is an approximation based on information provided in the Refuse Act permit application.

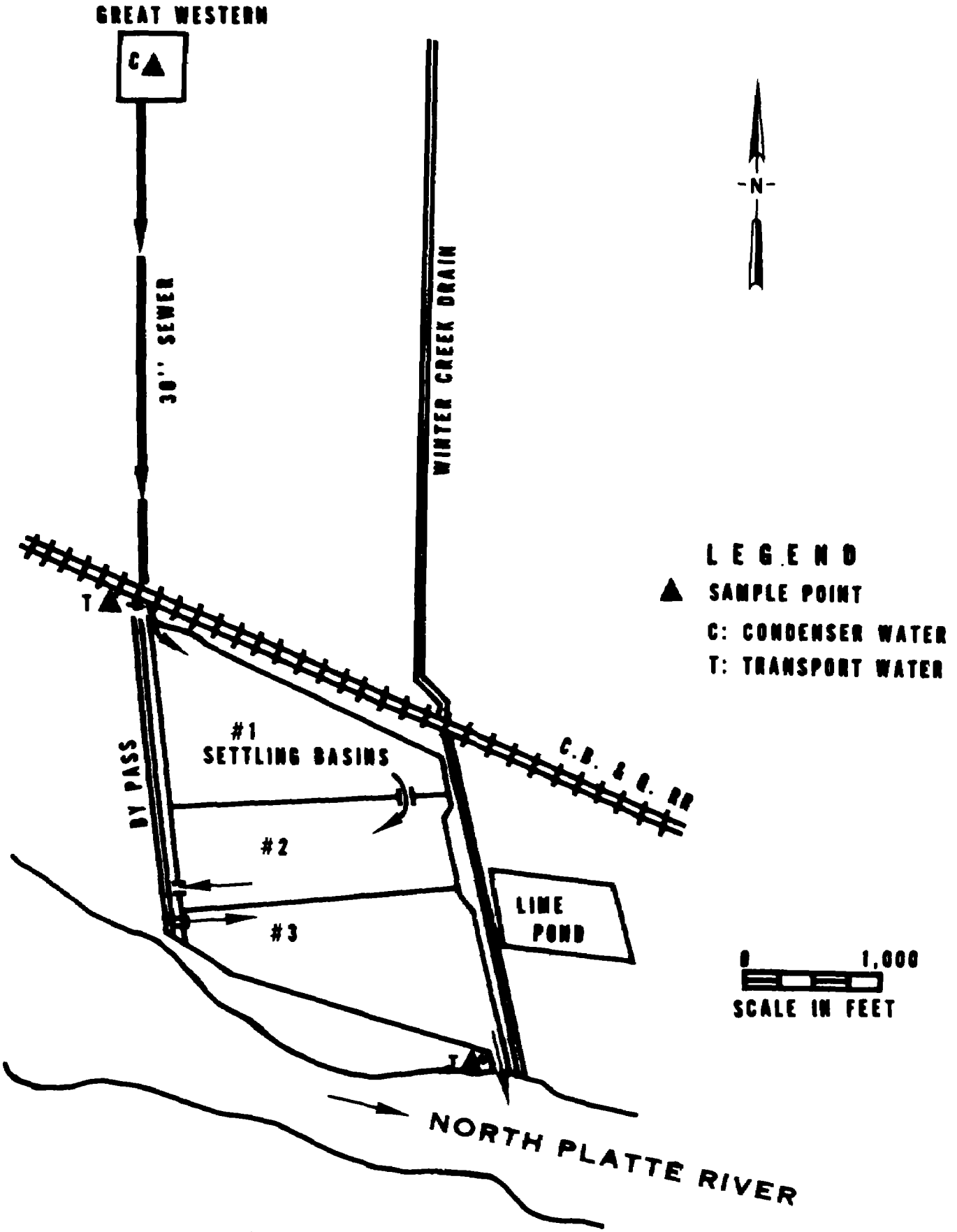

Figure 3. Great Western Sugar Co.
Waste Treatment Lagoons & Sampling Locations.
Scottsbluff, Nebraska

Flow data provided by the Great Western Sugar Company in the Refuse Act Permit application for this mill indicates 7.4 mgd wastewater leave the plant (i.e. enter the lagoon system). Flow measurements of the discharge from the lagoons showed 2.4 mgd during the survey. The difference of 5.0 mgd is attributed to seepage from the lagoons. The effluent contained an average of 2.69 lb BOD and 0.28 lb TSS per ton of beets processed. Approximately 10,000 lb of BOD were discharged daily during the survey. The waste loads discharged would increase if the excessive seepage was eliminated, e.g. the ponds were sealed to limit the loss to one-fourth inch per day.

Great Western Sugar Company Mill at Gering

General plant wastes, condenser water, and flume waters, are routed to a screening station and then to lagoons located about 1,400 feet northeast of the plant [Figure 4]. These lagoons, constructed in 1969, consist of four legs, each about 800 ft long by 50 ft wide by 4 ft deep. The estimated detention time was eight hours. [Characteristics of the process wastes and condenser water are shown in Table 7.]

The Gering mill discharged 15,500 lb (7.0 lb/ton) BOD and 1,759 lb TSS (0.8 lb/ton) daily. Based on current production capacity, the waste loads should be reduced to 1,100 lb/day each of BOD and TSS. Information provided in the Refuse Act Permit application shows that 7.4 mgd of wastewater leave the mill. Flow measurements during January showed that an average of 6.3 mgd was discharged to the river.

TABLE 7

SUMMARY OF WASTE CHARACTERISTICS
GREAT WESTERN SUGAR COMPANY
GERING, NEBRASKA

Parameter	Condenser Water	Lagoon System Influent	Lagoon System Effluent
Flow (mgd)	-	7.4*	6.3
pH range (S.U.)	7.5-8.7	8.2-8.7	5.9-6.7
Temperature range (°C)	40-48	31-34	20-29
Conductivity range (μmhos/cm)	850-900	900-950	1,100-1,300
Turbidity (JTU)	10	194	84
Dissolved Oxygen (mg/l)	2.5	-	-
Ortho P, (mg/l)	0.13	0.21	0.28
NH_3 as N, (mg/l)	11.22	8.97	5.62
NO_3-NO_2 as N (mg/l)	2.76	0.05	0.05
COD (mg/l)	61	1,130	1,175
BOD (mg/l)	27	806	978
BOD (lb/day)	-	-	15,496
BOD (lb/ton beets)	-	-	7.01
TOC (mg/l)	9.8	496	246
TSS (mg/l)	24	1,018	111
TSS (lb/day)	-	-	1,759
TSS (lb/ton beets)	-	-	0.80
VSS (mg/l)	6	265	64
Fecal Coliform			
geom. avg/100 ml	-	-	2,200,000
range/100 ml	-	-	230,000-14,000,000
Fecal Streptococcus			
geom. avg x 10^6/100 ml	-	-	> 9
range x 10^6/100 ml	-	-	0.65-> 100

* This flow is an approximation based on information provided in the Refuse Act permit application.

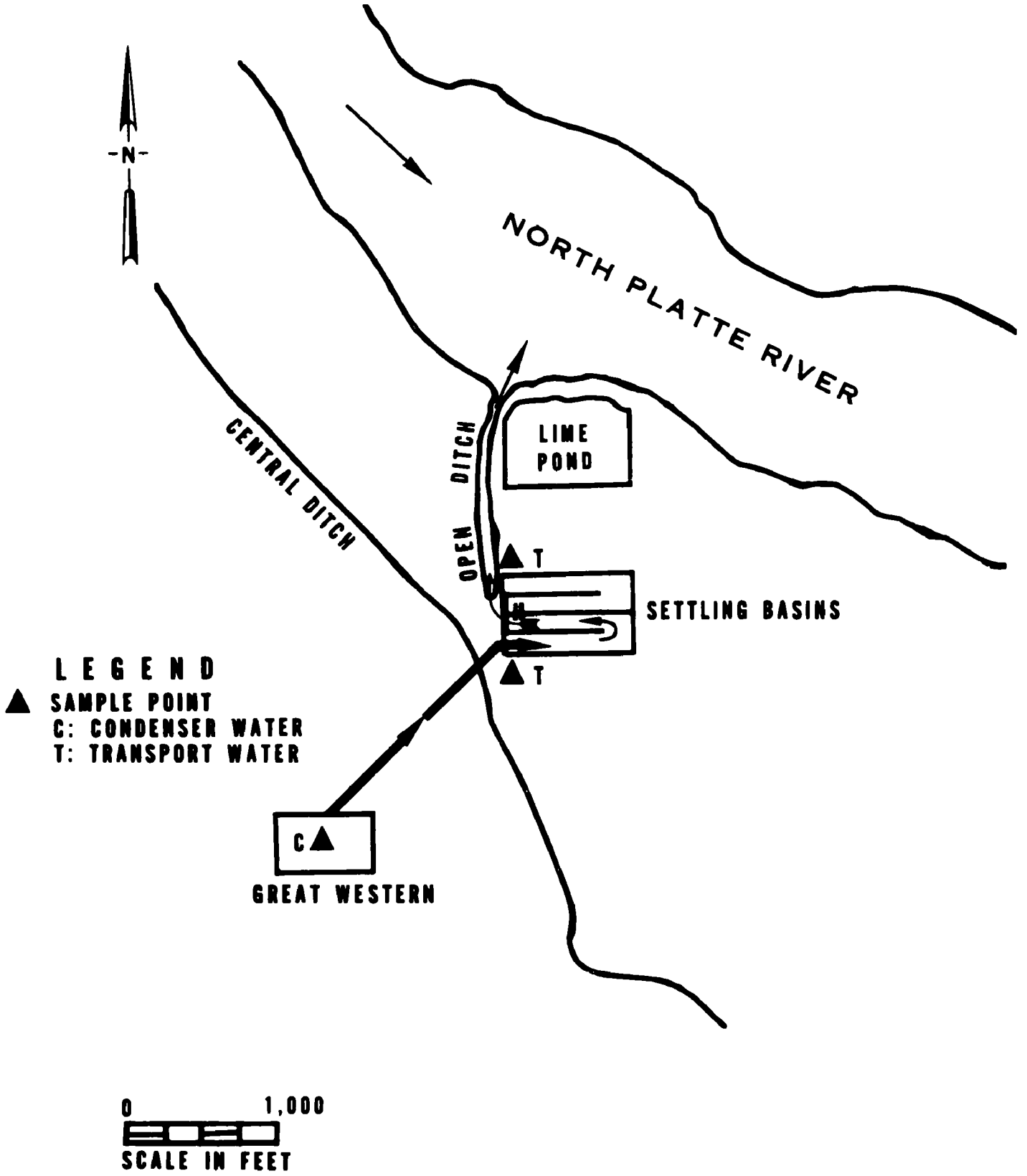

Figure 4 Great Western Sugar Co.

Waste Treatment Lagoons & Sampling Locations.

Gering, Nebraska

Great Western Sugar Company Mill at Mitchell

A 27-in. sewer conveys the entire plant wastes 4,500 feet to a lift station and to a series of lagoons with a surface area of about 85 acres [Figure 5]. The discharge from the lagoon flows in an open drain approximately 2,700 feet before reaching the North Platte River at RM 183.8. [The characteristics of the condenser and process wastes are shown in Table 8.]

The influent flow to the lagoon system was measured at 8.6 mgd; the effluent flow measured 0.65 mgd. Direct discharge from the system does not normally begin until late in the campaign. During the survey the Mitchell effluent contained 0.48 lb BOD and 0.71 lb TSS per ton of beets processed but it should be understood that these waste loads would be significantly greater if the high seepage was eliminated. The effects of this percolation on the groundwater was not ascertained but is considered to have a detrimental effect. Complaints regarding damage to well water supplies were made by a local resident.

Great Western Sugar Company Mill at Bayard

Corrugated metal plates and intermediate dikes separate the 160-acre treatment lagoon into four cells, operated in series [Figure 6]. The upper cell, which collects the majority of settleable solids, contains a series of parallel channels formed by dredging. Average liquid depth in the lagoons ranged from 8 to 12 in., with a maximum depth of 2 to 3 ft.

Odor problems have been associated with the lagoons, and to mask the odors about 3-5 lb per day of Nalco 671 are added. The effluent from the lagoon is discharged to the Stuckenholz Drain and travels about 0.8 mile

TABLE 8

SUMMARY OF WASTE CHARACTERISTICS
GREAT WESTERN SUGAR COMPANY
Mitchell, Nebraska

Parameter	Condenser Water	Lagoon System	
		Influent	Effluent
Flow (mgd)	-	8.6	0.65
pH range (S.U.)	8.1-8.8	8.7-9.4	6.6-7.5
Temperature range (°C)	34-48	21-30	0.0-6.0
Conductivity range (umhos/cm)	750-850	800-900	1,050-1,400
Turbidity (JTU)	7.2	240	70
Dissolved Oxygen (mg/l)	1.8	-	-
Ortho P, (mg/l)	0.21	1.31	0.11
NH_3 as N (mg/l)	8.12	4.09	1.82
NO_3-NO_2 as N (mg/l)	2.56	2.27	0.45
COD (mg/l)	79	1,270	381
BOD (mg/l)	38	840	206
BOD (lb/day)	-	-	1,110
BOD (lb/ton beets)	-	-	0.48
TOC (mg/l)	9	400	63
TSS (mg/l)	22	3,762	306
TSS (lb/day)	-	-	1,649
TSS (lb/ton beets)	-	-	0.71
VSS (mg/l)	9	344	64
Fecal Coliform			
geom. avg/100 ml	-	-	390
range/100 ml	-	-	130-900
Fecal Streptococcus			
geom. avg x 10^6	-	-	7.3
range x 10^6/100 ml	-	-	0.6-76

TABLE 9

SUMMARY OF WASTE CHARACTERISTICS
GREAT WESTERN SUGAR COMPANY
BAYARD, NEBRASKA

Parameter	Condenser Water	Lagoon System	
		Influent	Effluent
Flow (mgd)	-	6.7	1.3
pH range (S.U.)	8.4-8.6	8.2-9.4	6.8-7.3
Temperature range (°C)	37.5-47	21.5-30.5	0.0-2.5
Conductivity range (µmhos/cm)	950-1,600	850-1,600	600-2,700
Turbidity (JTU)	7.0	260	120
Dissolved Oxygen (mg/l)	1.8	-	-
Ortho P, (mg/l)	0.20	1.43	0.98
NH_3 as N (mg/l)	10.0	3.55	1.85
NO_3-NO_2 as N (mg/l)	1.67	1.12	0.80
COD (mg/l)	66	1,290	767
BOD (mg/l)	16	964	620
BOD (lb/day)	-	-	6,877
BOD (lb/ton beets)	-	-	2.94
TOC (mg/l)	11	425	170
TSS (mg/l)	20	2,460	102
TSS (lb/day)	-	-	1,132
TSS (lb/ton beets)	-	-	0.48
VSS (mg/l)	6	433	73
Fecal Coliform			
geom avg/100 ml	-	-	1,200
range/100 ml	-	-	660-3,900
Fecal Streptococcus			
geom. avg x 10^6/100 ml	-	-	> 50
range x 10^6/100 ml	-	-	2.1-330

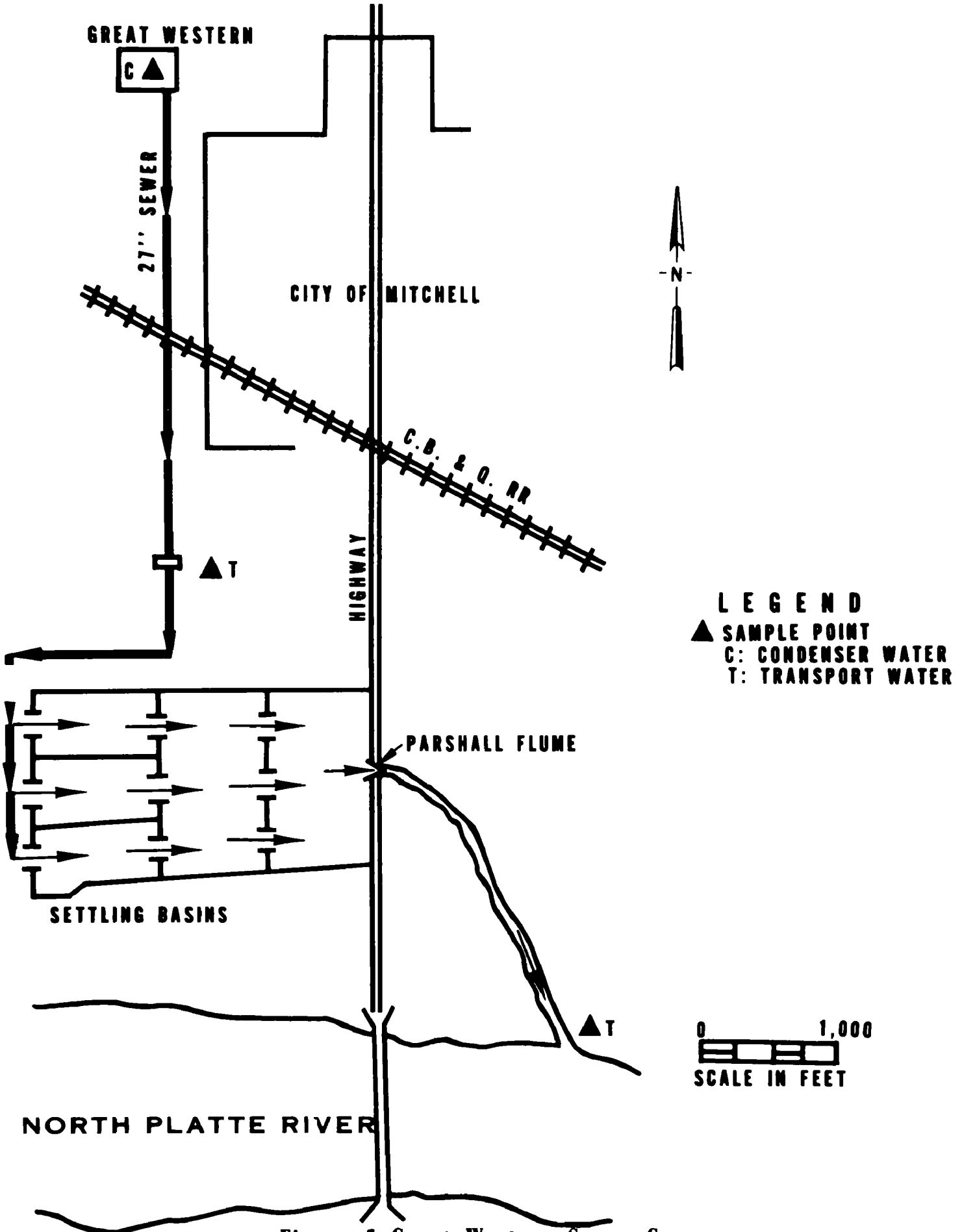

Figure 5 Great Western Sugar Co.
Waste Treatment Lagoons & Sampling Locations.

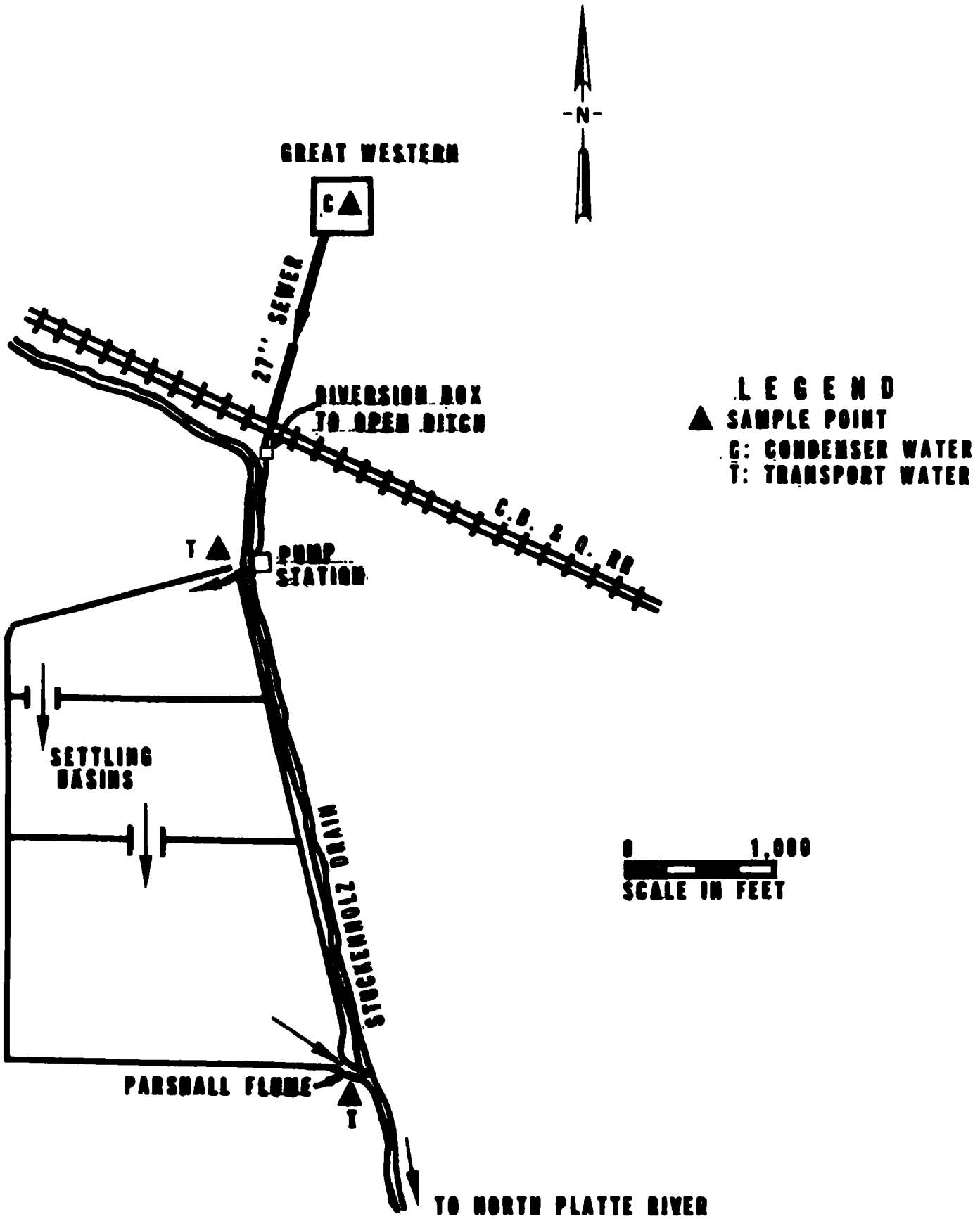

Figure 6 Great Western Sugar Co.
Waste Treatment Lagoons & Sampling Locations.
Bayard, Nebraska

to the North Platte River. [The characteristics of the condenser water and process wastes are listed in Table 9.]

Seepage from the Bayard lagoon system was also excessive (approximately 5.4 mgd or 1 1/4 inch/day). The BOD load discharged was 6,800 lb (2.94 lb per day per ton of beets processed); the TSS load amounted to 0.48 lb per ton of beets processed and meets current criteria. Based on current production capacity, the BOD waste load should be reduced to 1,100 lb/day.

Holly Sugar Corporation Mill at Torrington

During the survey, the only waste discharged from the plant was untreated condenser water. [Waste characteristics are listed in Table 10.] Process waters were re-cycled and reused. Excess process water was discharged to the lagoons for holding and treatment, with no discharge to the North Platte River [Figure 7].

As a result of the 1970 study, the EPA demonstrated that the Holly Sugar Corporation was polluting the North Platte River. Among the recommendations made at the 180-day hearing held at Scottsbluff, Nebraska,[4] was that, for the 1971-72 sugar beet campaign, all condenser water was to be discharged to the North Platte River without limits. By the start of the 1972-73 campaign, however, the condenser effluent discharged to the North Platte River will be restricted to a maximum daily average of 30 mg/l BOD and TSS, with no grab sample to exceed 50 mg/l. All wastewater discharged, except cooling waters, will be effectively disinfected.

The Torrington mill had a BOD of 0.27 lb per ton beets in the effluent and a TSS concentration of 0.84 lb per ton beets.

TABLE 10

SUMMARY OF CONDENSER WATER CHARACTERISTICS
HOLLY SUGAR CORPORATION

Flow (mgd)	3.3
pH range (S.U.)	7.7-8.5
Temperature range (°C)	16.5-34
Conductivity range (μmhos/cm)	750-900
Turbidity (JTU)	20
DO (mg/l)	5.2
Ortho P, (mg/l)	0.15
NH_3 as N (mg/l)	1.75
NO_3-NO_2 as N (mg/l)	1.10
COD (mg/l)	83
BOD (mg/l)	29
BOD (lb/day)	800
BOD (lb/ton beets)	0.27
TOC (mg/l)	16
TSS (mg/l)	91
TSS (lb/day)	2,512
TSS (lb/ton beets)	0.84
VSS (mg/l)	48
Fecal Coliform	
geom avg/100 ml	< 160
range/100 ml	< 4-1,300
Fecal Streptococcus	
geom avg/100 ml	2,200
range/100 ml	140-67,000

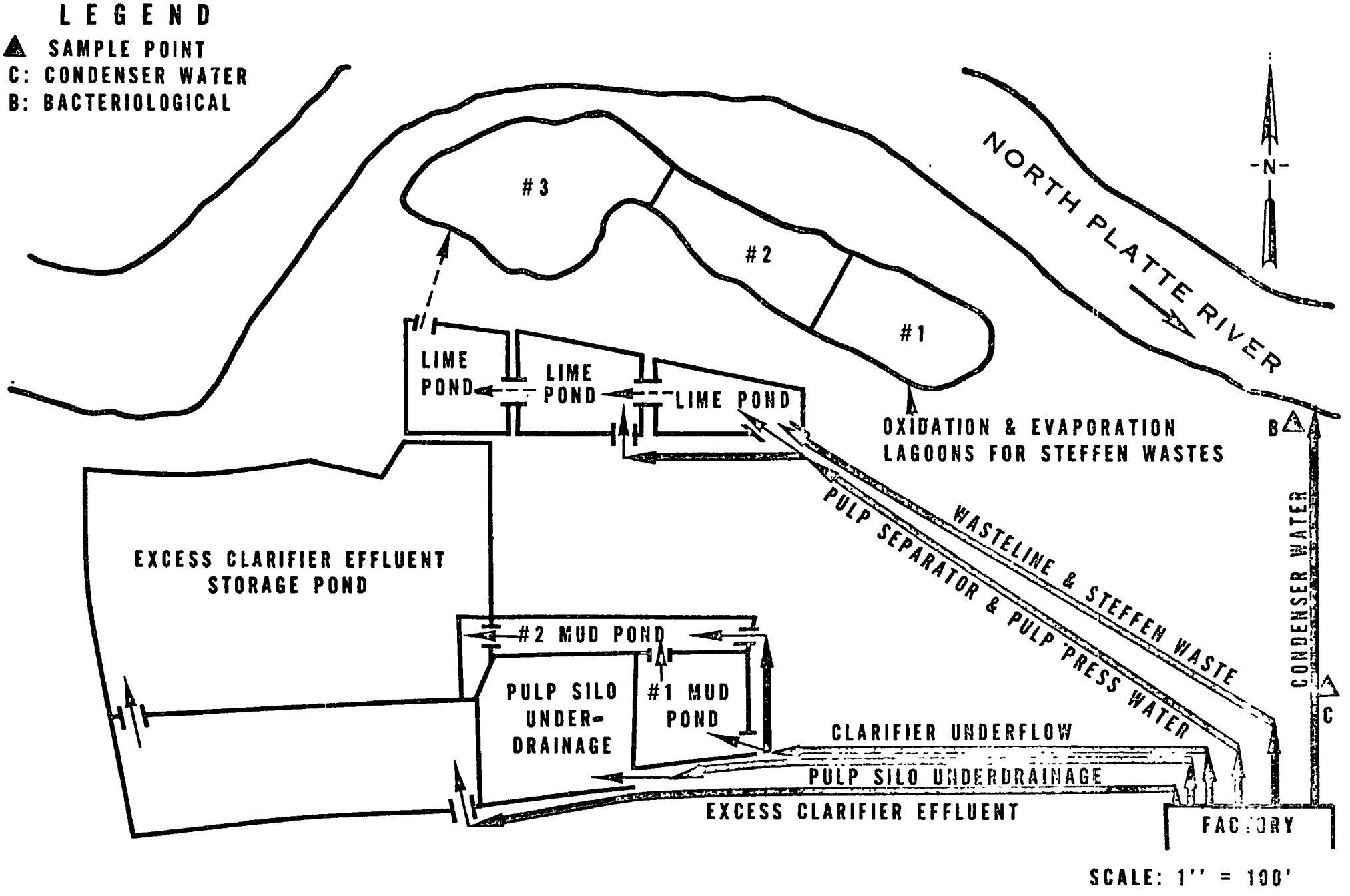

Figure 7 Holly Sugar Corporation, Waste Treatment Lagoons & Sampling Locations, Torrington, Wyoming

B. MUNICIPAL SOURCES

In conjunction with the stream survey on the North Platte River, effluents from the Scottsbluff, Gering, and Terrytown (Nebraska) municipal waste treatment facilities were sampled in order to define sources of bacterial contamination. These were the only municipal facilities discharging to the river during the survey period. Because bacteriological parameters were being evaluated in the analysis of the river, these parameters were made relative to the municipal facilities. [The effluent characteristics are listed in Table 11.]

Visual examination of the river area at Terrytown revealed that the sludge from the extended aeration plant was being discharged along the banks of the North Platte River. This sludge discharge violates the Nebraska Standard, both the category of suspended, colloidal, or settleable solids and the aesthetic considerations category.

TABLE 11

SUMMARY OF EFFLUENT CHARACTERISTICS
MUNICIPAL WASTE LAGOONS

Parameter	Terrytown	Scottsbluff	Gering
Flow (mgd)	0.2	*	0.6
pH (S.U.)	7.4	7.5	8.1
Temperature (°C)	11.5	0.0	1.0
Conductivity (µmhos/cm)	2,065	2,500	2,685
Fecal Coliform			
geom avg/100 ml	520,000	47,000	3,800
range/100 ml	10,000-1,900,000	8,000-140,000	800-9,500
Fecal Streptoccoccus			
geom avg/100 ml	310,000	92,000	9,200
range/100 ml	39,000-780,000	33,000-410,000	4,800-23,000

* Flow was estimated to be 5-6 gpm. Waste was being stored in lagoons for discharge into the North Platte River during maximum flow conditions.

VIII. WATER QUALITY IMPROVEMENT NEEDS

A. LOW FLOW CONDITIONS

The annual processing of sugar beets is usually conducted from October 1 through February 1. Because low flows normally prevail during part of this period, an examination of the records was made for the period of 1951-1970.

The USGS maintains three gaging stations on the North Platte River in the reach studied. These are located at Henry, Mitchell, and Minatare, Nebraska. The 10-year, 7-day low flows for these stations are tabulated below.

10-Year, 7-Day Low Flows (cfs)

	Henry	Mitchell	Minatare
Entire Water Year	90	70	35
October 1-February 1	125	280	490

Examination of the records indicates that, the low flows during the sugar beet campaign do not approach conditions, if adequate waste treatment is achieved, that require special consideration.

B. CONTROL OF INDUSTRIAL DISCHARGES

The attainment of an effluent containing 0.5 lb each of BOD and TSS is possible through the installation of the best practicable treatment technology currently available to the sugar beet industry. Suggested methods for attaining these effluent concentrations are as follows:

1) Separate impoundment of all lime mud and flume mud waste;

2) Installation of a closed flume water transport system with continuous solids removal;

3) Complete removal and disposal of the settleable solids from the closed flume water transport circuit;

4) Complete reuse of pulp press and transport wastes;

5) Recovery or reuse of all Steffen filtrates;

6) Separate impoundment or reuse of strong general plant wastes (e.g. acid and caustic boilouts, line cleaning solutions, etc.);

7) Retention and disposal of flumed residual ash waste;

8) Water conservation and maximum reuse in all plant operations.

In addition, all lagoons; mud ponds, etc. need to be constructed in accordance with best engineering practices, e.g. sealing of ponds to avoid excessive seepage; proper sloping of dikes; compaction of dikes during construction, etc. Regular maintenance of these systems is necessary.

REFERENCES

1. Joe K. Neel, U. S. Public Health Service, Region VI; "Biological Effects of Wastes Discharged to the North Platte River in the Torrington, Wyoming to Bridgeport, Nebraska Reach, November 1960-November 1961", Water Supply and Pollution Control Program, Kansas City, Missouri.

2. Public Health Service (Regions VI and VIII), Wyoming Department of Public Health, Nebraska Department of Health; "Report of Survey, North Platte River, Torrington, Wyoming-Bridgeport, Nebraska, November 30-December 6, 1962".

3. A. D. Sidio, and F. W. Kittrell. "Report on North Platte River Survey, Wyoming-Nebraska, September and November 1961", U. S. Department of Health, Education, and Welfare, Public Health Service, Robert A. Taft Sanitary Engineering Center. Cincinnati, Ohio. February 1962.

4. Transcript of Proceedings, Public Hearing regarding 180-day notice to the Holly Sugar Company of violation of State and Federal Water Quality Standards for the Interstate Waters of the North Platte River, Scottsbluff, Nebraska. July 21, 1971.

5. State-of-Art, Sugarbeet Processing Waste Treatment, Beet Sugar Development Foundation, Fort Collins, Colorado, for the Water Quality Office, EPA, April, 1971.

Appendix A

Pollution Abatement Measures Recommended by EPA, Region VII, for the Holly Sugar Corporation Mill, Torrington, Wyoming

APPENDIX A

POLLUTION ABATEMENT MEASURES RECOMMENDED BY EPA, REGION VII, FOR THE HOLLY SUGAR CORPORATION MILL, TORRINGTON, WYOMING

EPA, Region VII, recommended the following pollution abatement steps be taken by Holly Sugar Corporation:

1. Interim system prior to startup of the 1971-72 sugar beet campaign.
   A. Separate condenser and transport systems.
   B. Install a closed loop system for recycle of transport waters. Any waters discharged from this system to the North Platte River should not exceed daily average effluent concentrations of 30 mg/1 BOD_5 and suspended solids, with no grab sample to exceed 50 mg/1.
   C. Interim provisions will allow separated condenser waters to be discharged directly to the North Platte River.
2. Complete system by start of 1972-73 sugar beet campaign.
   A. Transport waters recycled via clarifier system. Solids recovered from clarifier should be dewatered and disposed of in a manner which will not create odor problems. Any supernatant from sludge dewatering should be returned to recycle system or treated to effluent concentrations not to exceed a daily average of 30 mg/1 BOD_5 and suspended solids, with no grab sample to exceed 50 mg/1 if discharged.

      Any buildup (i.e. excess water) water generated in the transport water recycle system, as well as contents of the

system at the end of the campaign, should receive whatever treatment is necessary to produce an effluent concentration not to exceed a daily average of 30 mg/l BOD_5 and suspended solids with no grab sample to exceed 50 mg/l prior to discharge to the North Platte River.

B. Condenser water recycle via cooling device. Any discharge from this system to the North Platte should not exceed a daily average effluent concentration of 10 mg/l BOD_5 and suspended solids with no grab sample to exceed 20 mg/l.

C. Any wastewater discharge from the system, with the exception of uncontaminated cooling waters, should be effectively disinfected to assure compliance with applicable water quality standards.

Appendix B

Nebraska Water Quality Standards

APPENDIX B

NEBRASKA WATER QUALITY CRITERIA APPLICABLE TO THE NORTH PLATTE RIVER

General Criteria

All surface waters shall meet general aesthetic standards and shall be capable of supporting desirable diversified aquatic life. These waters shall be free of substances attributable to discharges or wastes having materials that will form objectionable deposits, floating debris, oil scum and other matter producing objectionable color, odor, taste or turbidity - materials including radionuclides, in concentration or combinations which are toxic or which produce undesirable physiological responses in human, fish or other animal life or plants and substances and conditions or combinations thereof in concentrations which produce undesirable aquatic life.

Specific Criteria

1. Coliform Group Organisms. Coliform group and fecal coliform organisms shall not exceed a geometric mean of 10,000 total coliform organisms or 2,000 fecal coliform organisms per 100 milliliters. No more than 20 percent of samples shall exceed 20,000 total or 4,000 fecal coliform bacteria.

2. Dissolved Oxygen. Shall not be lower than 5 mg/l in warm waters and 6 mg/l in trout waters.

3. Hydrogen Ion. Hydrogen ion concentrations as expressed as pH shall be maintained between 6.5 and 9.0 with a maximum total change of 1.0 pH unit from the value in the receiving stream.

4. Temperature.

   Trout Waters - allowable change 5°
   - maximum limit 65° F.

   Warm Water Waters - allowable change 5° F May thru October
   - allowable change 10° F November thru April
   - maximum limit 90° F
   - maximum rate of change limited to 2° per hr.

5. Total Dissolved Solids. A point source discharge shall not increase the total dissolved solids concentration of a receiving water by more than 20%, this value shall not exceed 100 mg/l, and in no case shall the total dissolved solids of a stream exceed 1500 mg/l

Data regarding specific conductivity will be considered in lieu of TDS data. A point source discharge shall not increase the conductivity of the recovery water by more than 20%, this value shall not exceed 150 micromhos/centimeter, and in no case shall the conductivity of the receiving waters exceed 2250 micromhos/centimeter at 25° C.

For irrigation use the SAR value and conductivity shall not be greater than a C3-S2 class irrigation water as shown in Figure 25 of Agricultural Handbook 60.

6. Residue, Oil and Floating Substances. No residue attributable to waste water or visible film of oil or globules of grease shall be present.

   Emulsified oil and grease shall be less than 15 mg/l.

7. Aesthetic Considerations. No evidence of matter that creates nuisance conditions or is offensive to the senses of sight, touch, smell, or taste, including color.

8. Taste and Odor Producing Substances. Concentration of substances shall be less than that amount which would degrade the water quality for the designated use. Phenols concentration shall not exceed 0.001 mg/l. Shall not contain concentrations of substances which will render any undesirable taste to fish, flesh, or in any other way make such fish flesh inedible.

9. Suspended, Colloidal, or Settleable Solids. None from waste water sources which will permit objectionable deposition or be deleterious for the designated uses. In no case shall turbidity caused by waste water impart more than a 10% increase in turbidity to the receiving water.

10. Toxic and Deleterious Substances. None alone or in combination with other substances or wastes in concentration of such nature so as to render the receiving water unsafe or unsuitable for the designated use. Raw water shall be of such quality that after treatment by coagulation, filtration, sedimentation, the water will meet Public Health Drinking Water Standards. Radiological limits shall be in accordance with the Radiological Health Regulations, State of Nebraska, 1st edition 1966, and as amended in its latest edition.

    Plus ammonia nitrogen concentrations shall not exceed 1.4 mg/l in trout streams nor exceed 3.5 mg/l in warm water streams where the pH in these streams does not exceed a pH value of 8.3. If the pH of a stream exceeds 8.3, the undissociated ammonium hydroxide as nitrogen shall not exceed one-tenth mg/l in trout streams not exceed 0.25 mg/l in warm water streams.

For irrigation use, the boron concentration shall not exceed 0.75 mg/l.

For toxic materials not specified, bioassay methods acceptable to Nebraska Water Pollution Control Council.

Date of Compliance for Pollution Abatement

All municipal wastes shall receive at least secondary treatment plus such additional treatment as is required to maintain Water Quality Criteria, as set forth in these Standards. All other wastes shall receive an equivalent degree of treatment or control consistent with waste characteristics, uses and quality of receiving waters.

The date for compliance with the requirements of these Standards for all domestic and industrial wastes which discharge into intrastate and interstate waters of the State, except for those waste sources discharging directly into the Missouri River, shall be January 1, 1972, with earlier compliance where necessary. The date for compliance with these Standards for all domestic and industrial wastes discharging directly into the Missouri River shall be December 31, 1975, with earlier compliance where necessary. All proposed construction of waste treatment facilities in the interim periods prior to the dates of compliance shall provide treatment consistent with the policies and objectives of these Standards.

Appendix C

Wyoming Water Quality Standards

APPENDIX C

WYOMING WATER QUALITY CRITERIA APPLICABLE TO THE NORTH PLATTE RIVER

1. Settleable Solids. Essentially free from substances of other than natural origin that will settle to form sludge, bank or bottom deposits.

2. Floating Solids. Essentially free from floating debris, oil, grease, scum, and other floating materials of other than natural origin in amounts sufficient to be unsightly.

3. Taste, Odor, Color. Essentially free from substances of other than natural origin which produce taste, odor, or color that would:

    a. of themselves or in combination, impart an unpalatable or off-flavor in fish flesh

    b. visibly alter the natural color of the water, or impart color to skin, clothing, vessels or structures

    c. produce detectable odor at the site of use

    d. directly or through interaction among themselves, or with chemicals used in the existing water treatment process, result in concentrations that will impart undesirable taste or odor to the finished water.

4. Toxic. Free from toxic, corrosive, or other deleterious substances of other than natural origin in concentrations or combinations which are toxic to human, animal, plant or aquatic life. This standard is not intended to interfere with the use of approved fish toxicants under the supervision of the Wyoming Game and Fish Commission for fish management purposes.

5. Radioactive. Radioactive materials of other than natural origin shall not be present in any amount which reflects failure in any case to apply all controls which are physically and economically feasible. In no case shall such materials exceed the limits established in the 1962 Public Health Service Drinking Water Standards or 1/30 (168 hour value) of the values for radioactive substances specified in the National Bureau of Standards Handbook 69.

6. Turbidity. Turbidity of other than natural origin shall not impart more than a 15 turbidity unit increase to the water when the turbidity of the receiving water is 150 units or less, or more than a 10% increase when the water turbidity is over 150 turbidity units.

7. Dissolved Oxygen. Wastes of other than natural origin shall not be discharged in amounts which will result in dissolved oxygen content of less than 6 ppm at any time.

8. Temperature. For streams where natural temperatures do not exceed 70° F, wastes of other than natural origin shall not be discharged in amounts which will result in an increase of more than 2° F over existing temperatures.

   For streams where natural temperatures exceed 70° F, wastes of other than natural origin shall not be discharged in amounts which will result in an increase of more than 4° F over existing temperatures.

   Maximum allowable temperatures will be established for individual streams as data becomes available. As an interim policy, the maximum allowable stream temperatures will be the maximum daily stream temperatures plus the allowable rise; provided that this temperature is not lethal to existing fish life, which is considered to be 78° F in the case of cold water fish.

9. pH. Wastes of other than natural origin shall not affect the pH of the receiving water beyond the following limits:

   a. North Platte River & Interstate Canals: Range between 7.5 and 8.5.

   b. Horse Creek: Range for pH shall be 6.5 to 8.5.

10. Coliform Bacteria. During the recreation season (May 1 through September 30), wastes or substances of other than natural origin shall not be discharged into waters designated as having limited body contact use which will cause organisms of the fecal coliform group to exceed the following limits.

    While sample data is accumulated no individual samples shall exceed the 95% confidence limit of the historical average; provided that in no case will the geometric mean of the last five consecutive samples exceed 2000 per 100 ml. (Most Probable Number), which ever is the least.

Appendix D

Methods of Analysis

APPENDIX D

METHODS OF ANALYSIS

Bacteriological analyses for total and fecal coliform, and for streptococcus were performed, according to the method prescribed in the 13th Edition, *Standard Methods for the Examination of Water and Wastewater, 1971.*[*] using the membrane filter technique. To prevent contamination, all samples were collected in sterlized bottles.

The BOD and DO tests were determined, according to the method prescribed in the 13th Edition, *Standard Methods for the Examination of Water and Wastewater, 1971,*[*] using the azide modification of the Winkler method.

All other laboratory analyses and field measurements used were conducted in accordance with *Methods for Chemical Analyses of Water and Wastes, July 1971.*[**]

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* M.J. Taras, A. E. Greenberg, R. D. Hoak, and M. C. Rand, *Standard Methods for the Examination of Water and Wastewater,* 13th Ed., Amer. Public Health Assn. New York, N. Y. 1971.

** *Methods for Chemical Analysis of Water and Wastes,* Environmental Protection Agency, National Environmental Research Center, Analytical Quality Control Laboratory, Cincinnati, Ohio, 1971.

Appendix E

Sugar Beet Refining Process

APPENDIX E

SUGAR BEET REFINING PROCESS

PROCESS DESCRIPTION

Raw sugar beets, with 15-16 percent sugar content, are delivered to factories by either railroad car or truck. The beets are removed from storage piles or directly from incoming vehicles, placed into the wet hoppers of the beet flumes, and conveyed via a continuous stream of water into the factory. Beet chips and tailings, stones, and miscellaneous debris are removed in the flume line.

The beets are a) separated from the flume water, b) enter a beet wheel and are elevated to the beet washing tank, c) pass over a roller-spray table; and are d) then ready for slicing. The washed beets are sliced into thin strips or cossettes, and conveyed to the diffuser where the sugar is removed from them under a counter-current flow of hot water. After the diffusion process using osmosis, or the passage of sugar through the porous membrane of the cossettes to the water, the sugar impregnated liquor, called *raw juice*, is sent to the purification operation. Exhausted cossettes are transferred to the pulp dryer or wet pulp silo to be used as livestock feed.

In the purification process *raw juice* is limed and carbonated and then clarified. Non-sugars and undesirable sugars are absorbed into the precipitated calcium carbonate. A second carbonation removes the last traces of lime, producing a purified liquor, called *thin juice*. Sludges from the thickener-clarifier and second carbonation are filtered and sent to waste. This waste is known as lime mud or lime mud slurry.

The *thin juice* is concentrated from 15-20 percent sugar solids to 55-70 percent solids by passing through multi-effect evaporators under

high pressure steam. This *thick juice* is mixed with melted sugar, heated and fettered, and becomes *standard liquor*. It moves on to the white pan to be boiled and crystallized to a high concentration of sugar, called "white massecuite". The massecuite is mixed, centrifuged, granulated for drying, and then packaged or stored. The remaining crystallization and separation operations involve treatment and recovery of additional sugar from the middle and low-grade syrups and massecuite to make molasses.

The molasses is then further refined in a Steffen process. This process, found only in a Steffen house factory, employs a two-stage lime precipitation of sugar from the molasses, giving hot and cold saccharate cakes off the filters. A mixture of the cold and hot saccharate sludges is returned as the liming agent in the first carbonation stage of raw juice purification.

The concentrated Steffen filtrate process (CSF) is a procedure for concentrating the filtrate essentially from the hot saccharate filter cake. The Steffen filtrate is concentrated by removing water, and then shipped to the Johnstown (Colorado) MSG plant, for the extraction of monosodium glutamate, an edible flavor enhancer.

GREAT WESTERN SUGAR COMPANIES

The Scottsbluff and Gering mills are Steffen houses, while the Mitchell and Bayard installations are straight houses. Molasses from the Mitchell plant is shipped to the Scottsbluff mill and the molasses from Bayard is transported to the Gering plant. The majority of the CSF is prepared at the Gering mill, with the Scottsbluff plant preparing smaller quantities.

There is little process water reuse at the four plants except for the return of pulp press and pulp transport wasters to the diffusers. Because of their antiquated nature and the old equipment in use, the plants generate more steam and condensates than may ever be used profitably. Consequently, relatively large volumes of excess condensates are continuously discharged.

All four plants have pulp driers. Dried pulp is sold as cattle feed. Excess molasses, originating from the straight-house operations, is added to the driers to give a final feed product having 25-35 percent molasses by dry weight.

Sanitary sewage at all four plants is directed to lagoon systems. Sanitary wastes from the Scottsbluff mill will be diverted to the city treatment plant during 1972. Similar provisions are planned for the other three factories. Inorganic ash and unburned carbon, resulting from coal and coke burning, are conveyed by flume to separate ash ponds. Some water is lost by percolation, but in each case there is overflow to the general pond system, with some ashes in the overflow. Ashes are reclaimed by State and local highway departments.

The Steffen houses at Scottsbluff and Gering require considerably more lime than do the straight-house operations at Mitchell and Bayard. The limestone, used for various sugar recovery operations, is released as waste lime mud. The lime mud is diverted to separate holding ponds at Scottsbluff and Gering and is discharged to the general treatment lagoon systems at Mitchell and Bayard.

The Scottsbluff plant commenced its campaign October 7, 1971, and the other three plants started October 8. All plants ceased operations

the latter part of January. The plants operated continuously with no off days during the campaign. During an interim campaign period each plant retains 25-30 persons for maintenance and construction.

HOLLY SUGAR CORPORATION

The Holly Sugar mill at Torrington, Wyoming, is a Steffen house. It produces 175 tons of Steffen molasses per day. The campaign period lasts 120 days and requires 3 shifts, 7 days a week. The interim campaign work force is 70 people.

Eighty percent of the process water is reused. The remaining 20 percent is sent to the lagoons for treatment, but is not discharged to the North Platte River. All of the condensate water is reused, while all of the condenser water is discharged to the river without reuse or recovery. All sanitary waste is discharged to the lime ponds, but will soon be sent to the Torrington municipal waste treatment plant.

At the present time, there is no pulp drier, but one will be built within the next two years. The underflow from the pulp silo goes to the mud ponds.

The Torrington plant is unique in that the beet unloading system is done on a dry basis. Therefore, screens remove some of the soil before the beets enter the process system. Some of the beet tops are broken off in the screening process, and are sold for feed and filling.

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