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BACTERIOLOGICAL SURVEY OF THE
CACHE LA POUDE RIVER
NEAR GREELEY, COLORADO

APRIL, 1972

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

November, 1972

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INTRODUCTION

Two brief microbiological studies of the Cache La Poudre River in the Greeley, Colorado, area were conducted during April, 1972, to:

- (1) Identify the source(s) of bacterial pollution in the reach bracketed by the foot-bridge crossing at Island Grove Park and the low head dam at 2nd Avenue. (This reach is upstream of the effluents from the Greeley wastewater treatment plant and the Great Western sugar beet factory)
- (2) Develop some insight to the relative impact of storm runoff on the bacteriological quality of the river in the Greeley area.

Although bacteriological degradation of the river in the Island Grove Park - 2nd Avenue reach was identified in EPA studies conducted during the last half of 1971, the source or sources were not identified since these studies were designed to assess the effect of Great Western's sugar factory effluent on water quality.

STUDY AREA DESCRIPTION

The Cache La Poudre River flows from west to east along the north edge of Greeley, Colorado, and is bordered by agricultural and marsh lands, gravel pits, cattle feed lots, junk yards, a meat packing plant, a sugar beet refinery, a livestock truck-washing facility, a municipal sewage treatment facility, a city park, and residential area. All this development is located in the river flood plain and provides the potential for significant bacteriological pollution during periods of storm runoff.

In contrast to the large number of potential sources during storm runoff, there are only a limited number of direct discharges to the Cache La Poudre River in the Greeley area. The effluent from the Greeley wastewater treatment plant enters the river downstream from the 2nd Avenue Dam. As previously reported (Ref.2) the treatment facility is severely overloaded by packing house wastes resulting in heavy bacteriological and organic loadings on the river. Effluent from the Eaton sewage treatment plant (oxidation ditch secondary treatment) flows down Eaton draw and enters the river at a point approximately 1.5 miles upstream from 2nd Avenue. The operation of the Great Western sugar factory is seasonal occurring during the winter months. The factory was not in operation during the April studies.

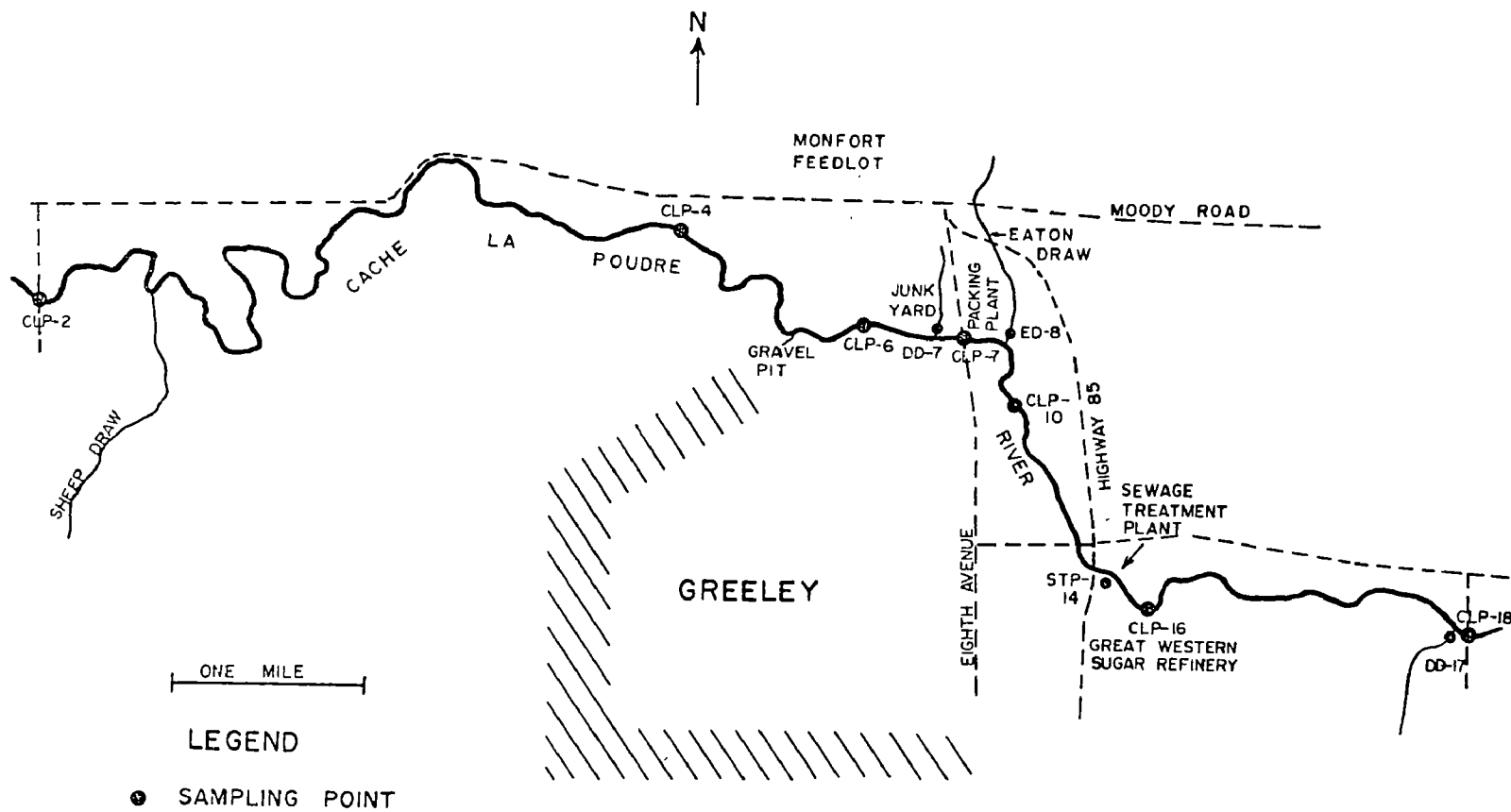


Figure 1 Map of Survey Area

With the exception of the wastewater treatment plant effluents the only other observed discharges were from a gravel pit (RM8.2), the Monfort meat packing plant (RM7.0), and several small drainage ditches containing spring water and irrigation return water. Figure 1 shows the locations of the various discharges.

APPLICABLE WATER QUALITY STANDARDS

During 1971, the State of Colorado adopted the following coliform standards for the Cache La Poudre River in the Greeley area: (Ref.3)

- (1) Upstream from the 2nd Avenue Bridge - the highest classification is a warm water fishery (Class B₂). Fecal coliforms must not exceed a log-mean of 1000 per 100 ml or 2000 per 100 ml in more than 10% of the samples collected in any 30-day period.
- (2) Downstream from the 2nd Avenue Bridge to the mouth - Classification as industrial and irrigational waters (Classes C and D₁) with no coliform limits.

SURVEY PROCEDURES

The selection of sampling periods was based on the desirability of making bacteriological measurements during periods of normal and storm runoff conditions. During normal flow conditions a bacteriological baseline can be established for use as a reference for evaluation of data collected during times of increased bacteriological loading; i.e., storm runoff.

The time period of April 18-21, 1972, was selected as a suitable interval for the collection of baseline data in anticipation of significant storm activity within a subsequent period of 2 to 3 weeks. Precipitation (about ½ inch rainfall) did occur on April 26 and sampling was undertaken on April 27 and 28. Although the rainfall was associated with a one foot rise in the Cache La Poudre River, there did not appear to be any significant overland runoff in the Greeley area. This being the case, the increase in flow was most likely due to additional rainfall over upstream areas.

Sampling was conducted at 7 stations on the Cache La Poudre River covering a 13 mile reach (river miles 2.9 to 15.7). In addition, samples were collected from Eaton draw, two drainage ditches, and the Greeley wastewater treatment plant. Sample station descriptions

ENVIRONMENTAL PROTECTION AGENCY

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File with Report

Date: January 24, 1973

Reply to
Attn of: AWWO

Subject: Review of S and A report entitled "Bacteriological Survey of the
Cache La Poudre River near Greeley, Colorado - April, 1972"

To: Charles W. Murray, Jr. *CMJ*
Thru: William H. Hornberg *WHH*

At Mr. Hornberg's request, I have briefly reviewed the subject report and have the following comments:

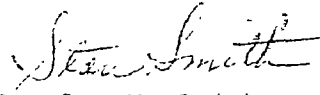
1. One of the objectives of the study was to identify pollution in the reach from the foot-bridge at Island Grove Park to the low head dam at Second Avenue. Since there was apparently no sampling station at Second Avenue, it might help the report if it were explained that there are no potential pollution sources of any significance in the reach from the 6th Avenue Bridge down to the low head dam at Second Avenue.

2. It would seem to me that the report should indicate that the 2nd objective of the study as listed on page 1 could not be accomplished due to the absence of adequate rainfall during the study period to produce any significant runoff in the Greeley area. While 1/2 inch of rainfall did occur, the report states on page 3 that "Although the rainfall was associated with a one foot rise in the Cache La Poudre River, there did not appear to be any significant overland runoff in the Greeley area."

I would like to make it clear that I am not criticizing the S and A Division due to the fact that their study did not cover a period of significant runoff. From my experience in Kansas, I know how difficult it is to get water pollution evidence on feed lot runoff. Such studies almost have to be conducted during and immediately following a runoff situation. It is not easy to get prompt notification of the runoff condition, get a crew together, and implement a sampling program within the time available.

I am concerned, however, that unless there is a disclaimer in the report regarding the capability of adequately developing an insight as a result of the study into the relative impact of storm runoff, that it might tend to white-wash the Monfort feed lots as a significant pollution source under runoff conditions if the feed lots are, in fact, a significant

pollution source. I obviously do not know for sure if they are or not; but I do not think that the study provides evidence that the feed lots might not severely pollute the river at times of storm runoff in the feed lot area.

A handwritten signature in cursive script, appearing to read "Stan Smith".

Stanley M. Smith
Municipal Waste Water Branch

TABLE 1

Sample Point Locations

Station #	River Mile	Location	Sampling Point
CLP-2	15.7	CLP River 4 miles west of Mumper Corner	Upstream side of County Road Bridge
CLP-4	9.4	CLP River Bridge at Spanish Colony	Upstream side of Bridge
CLP-6	7.8	CLP River Island Grove Park	Upstream side of Bridge
DD-7	7.4	Drainage Ditch Located Between 8th and 11th Ave. Bridges	North Bank of River
CLP-7	7.1	CLP River Eighth Avenue Bridge	Downstream Side of Bridge
ED-8	6.9	Culvert Near Mouth of Eaton Draw	Downstream End of Culvert
CLP-10	6.3	CLP River 6th Avenue Bridge	Upstream Side of Bridge
STP-14	5.3	Greeley Sewage Treatment Plant	Chlorination Basin Effluent Point
CLP-16	5.2	CLP River First Bridge Below Greeley Sewage Plant Outfall	Upstream Side of Bridge
CLP-18	2.9	CLP River Bridge South of Weld County Airport	About 200 yds upstream of Bridge on north bank
DD-17	2.9	Drainage Ditch South of Weld County Airport	Upstream end of culvert
ED-1	-	Eaton, Colorado Sewage Treatment Plant	Effluent Pipe
ED-2	-	Eaton Draw About 3 miles Below Eaton Outfall	Upstream End of Culvert Under County Road

are presented in Table 1 and depicted in Figure 1. At each station, surface grab samples were collected using sterile 250 ml wide-mouth bottles. Field measurements included temperature, stream depth, visual assessment of the water condition (clear, turbid, etc.) and, in the case of the wastewater treatment plant effluent, the chlorine residual. The residual chlorine values are shown in Table 5 in the Appendix.

All samples were analyzed for total and fecal coliforms by the millipore filter method. Selected samples were also analyzed for fecal streptococcus. Analyses were conducted in accordance with the 13th Edition of "Standard Methods for the Examination of Water and Wastewater." (Note: The Biology Department, University of Northern Colorado, graciously donated laboratory space to EPA for the conduct of bacteriological analyses)

RESULTS AND DISCUSSION

General

A total of 72 water samples were collected from the Cacha La Poudre River and its tributaries during the two studies. Analysis of each sample for total and fecal coliforms yielded results which are summarized in Table 2. Colorado water quality standards for the Cache La Poudre River upstream from the 2nd Avenue Bridge require that fecal coliform bacteria not exceed a log-mean value of 1000 per 100 mls. In this study, 30 samples were collected from 5 stations above the 2nd Avenue Bridge and only 3 (10%) of these samples exceeded 1000 fecal coliforms per 100 ml. The average log-mean value for the 5 river stations upstream from the 2nd Avenue Bridge was 212 fecal coliforms per 100 ml. The state standard was, therefore, not violated.

Rainfall Effects

On April 26, 1972, the Greeley area received about $\frac{1}{2}$ inch of rainfall with an undetermined amount of rainfall occurring further upstream. The following day the river was higher by about one foot, and, as shown in Tables 1 and 2 in the Appendix, there was an associated increase (by a factor of about 5) in total and fecal coliform concentrations at each station. Due to the dry soil conditions before the rain in the Greeley area, no significant surface runoff was observed. The increase in total and fecal coliforms was likely caused by bacteria washed from the river banks in adjacent pastureland and feedlot areas and by bacteria brought downriver from unknown sources by the increased river flow.

When the river returned to its original depth on April 28, the total and fecal coliform concentrations likewise returned to their original levels.

TABLE 2

Summary of Total and Fecal Coliform Counts

Sta. #	Location	Total Coliforms/100ml				Fecal Coliforms/100ml			
		Samples #	Maximum	Minimum	Log-Mean Value	Samples #	Maximum	Minimum	Log-Mean Value
CLP-2	CLP-River 4 mi. west of Mumper Corner at County Road Bridge	6	7100	500	2024	6	1300	150	317
CLP-4	CLP River Bridge at Spanish Col.	6	3300	260	934	6	610	20	145
CLP-6	CLP River Footbridge Is. Grove Pk.	6	3600	190	466	6	1200	50	188
DD-7	Drainage Ditch in No. 6 Bank between 8 & 11th Avenue Bridges	6	9200	720	2777	6	6400	100	1281
CLP-7	CLP River Eight Avenue Bridge	6	2900	210	613	6	1400	50	215
ED-1	Eaton, Colo. Sewage Treatment Plant Effl.	5	5000	1700	3283	5	1100	180	579
ED-2	Eaton Draw about 3mi. 1 below Eaton Sewage Outfall	1	1100	1100	1100	1	40	40	40
ED-8	Culvert near Mouth of Eaton Draw	6	35000	200	3724	6	1800	60	469
CLP-10	CLP River 6th Avenue Bridge	6	48000	180	1002	6	1000	110	195
STP-14	Greeley Sewage Treat. Plant Effluent	6	6700000	7600	888500	6	740000	100	8880
CLP-16	CLP River First Bridge below Greeley Sewage Outfall	6	990000	1100	30550	6	180000	40	3664
DD-17	Drainage Ditch South of Weld County Airport	6	5000	400	1341	6	520	80	171
CLP-18	CLP River Upstream of Bridge South of Weld County Airport	6	460000	500	15375	6	34000	340	3934

Drainage Ditches

The concentration of total coliforms in the river increased by more than 100% (as the log-mean measurement) between the Island Grove Park footbridge and the 6th Avenue Bridge. Fecal coliforms increased by only 3½% in this same stretch of river. The increase in total coliforms was due primarily to the two tributary streams entering the river on either side of the Monfort Packing Plant (DD-7 and ED-8). Eaton Draw (ED-8) contains the sewage effluent from Eaton, Colorado, plus additional irrigation return water. The drainage ditch (DD-7) flows through a marshy, junk-littered area and then into the river.

Sewage Treatment Plants

It can easily be seen from Table 2 that the Greeley sewage treatment plant generally produces a gross bacterial overload on the Cache La Poudre River. This contamination is due primarily to the extremely overloaded condition of the sewage treatment plant caused by meat packing wastes from the Monfort Packing Plant. Although heavy chlorine dosages were commonly employed at the sewage treatment plant, adequate disinfection was often not accomplished. For example, Table 2 in the Appendix shows that fecal coliform counts were above 450,000 per 100 ml on 3 out of 6 days during the study. On the remaining 3 days disinfection reduced the fecal coliform concentration to 200 per 100 mls or less. It is clear that the Cache La Poudre River would benefit greatly from more reliable disinfection at the Greeley sewage treatment plant.

This study also shows that the Eaton sewage treatment plant (oxidation ditch secondary treatment) has generally effective chlorination. Results show a residual log-mean fecal coliform value of only 579 per 100 mls, which is less than the warm water fishery standard adopted by the State of Colorado for the reach of the Cache La Poudre River affected by this discharge.

Comparison With Earlier Surveys

As a matter of interest the results of total and fecal coliform analyses from three previous surveys of the Cache La Poudre River are presented with similar data from this survey in Table 3. The surveys of September and December, 1971 (Ref. 1) were conducted jointly by the National Field Investigations Center - Denver and Region VIII-EPA, whereas this survey and the November, 1971, survey (Ref.2) were conducted by Region VIII only. Table 3 shows a significant variation for the September and November surveys while there is fairly close agreement between the April and December survey results. There is not enough data to determine the exact causes for similarity or disagreement in survey results except for the November survey. During that survey, the Great Western sugar beet refinery was in full operation and undoubtedly contributed to the coliform increase in the lower stream reach.

TABLE 3

Log Mean Total and Fecal Coliform Counts for Several Different
Surveys on the Cache La Poudre River

Sta. #	Location	Log-Mean Total Coliforms/100ml				Log-Mean Fecal Coliforms/100ml			
		*Sept. 13-15/71	**Nov. 16-18/71	*Dec.6,7 13-15/71	Apr.18-21 27-28/72	*Sept. 13-15/71	**Nov. 16-18/71	*Dec.6,7 13-15/71	Apr.18-21 27-28/72
CLP-4	CLP River Bridge at Spanish Colony	9600			934	640	300		145
CLP-6	CLP River Footbridge at Island Grove Park		960		466				188
CLP-7	CLP River 8th Ave. Bridge		2298		613		212		215
ED-8	Culvert Near Mouth of Eaton Draw				3724			500	469
CLP-10	CLP River 6th Ave. Bridge	20000	7266	1900	1002	3200	2569	220	195
STP-14	Greeley Sewage Treatment Plant Effluent		4879000		888500		22000		8880
CLP-16	CLP River First Bridge Below Greeley Sewage Outfall	38000	429400	47000	30550	2500	226500	3400	3664
CLP-18	CLP River Upstream of Bridge South of Weld County Airport		525600		15375		134300		3934

* Values from National Field Investigations Center Report ¹

** Region VIII EPA Report ² - Laboratory Analysis by Colorado State Health Dept.

SUMMARY

The findings which relate to the occurrence and distribution of total and fecal coliforms in the Cache La Poudre River are the following:

1. Fecal coliform standards for that portion of the river classified as a warm water fishery were not exceeded at any sample location.
2. The primary sources of bacteriological pollution between the Island Grove Park (CLP-6) and Second Avenue are:
 - a) A drainage ditch flowing through a junk yard near the north river bank at Station DD-7.
 - b) Eaton Draw which carries treated municipal sewage from Eaton, Colorado, and irrigation runoff from nearby agricultural lands.
3. Total and fecal coliform densities increased significantly (by a factor of about 5) after a rainfall of $\frac{1}{2}$ inch in the Greeley area and an associated river rise of about one foot. This increase was likely caused by bacteria washed from the stream banks in adjacent pastureland and feedlot areas and by bacteria brought downriver from unknown sources by the increased river flow. The same pattern of decreased water quality during runoff periods can be expected in the future.
4. The Greeley sewage treatment plant often does not provide adequate disinfection to the discharged effluent. Fecal coliforms varied from >100 to 740,000 per 100 ml. The quality of this effluent should improve significantly with the construction of an alternate sewage treatment facility for the Monfort Packing Plant wastes.
5. Total coliform densities increased by more than 100% primarily as a result of the two tributary streams on either side of the Monfort Packing Plant (RM 7.4 to 6.9). These two flows are the sources for the high coliform counts found during the November, 1971 survey in the stream reach upstream from the sewage plant and sugar beet refinery discharges.
6. Data from this survey agree closely with results from the December, 1971 survey but differ markedly from the September and November, 1971 survey results. The explanation for the high coliform concentrations in November is that the Great Western sugar beet refinery was in full operation and contributed significant wasteloads at that time.

REFERENCES

1. Report on Effects of Waste Discharges on Water Quality of the Cache La Poudre and South Platte Rivers - Greeley Area, National Field Investigations Center - Denver and Region VIII, Denver, Colorado, February, 1972.
2. Summary of a Water Quality Survey - Greeley, Colorado, November 16-19, 1971, Region VIII. EPA. Denver, Colorado, July, 1972.
3. Water Quality Standards and Stream Classification, Water Pollution Control Commission, Colorado Department of Health, 1971.

APPENDIX

Data Summaries

TABLE 1

Total Coliforms at all Stations
Counts/100ml

Station #	River Mile	4/18	4/19	4/20	4/21	4/27	4/28
CLP-2	15.7	500	600	3900	2300	7100	3600
CLP-4	9.4	420	350	3300	260	2500	2100
CLP-6	7.8	320	270	580	190	3600	300
DD-7	7.4	9200	4000	1600	2300	4700	720
CLP-7	7.1	260	430	340	210	2900	2300
ED-8	6.9	12000	3900	2200	200	35000	3700
CLP-10	6.3	580	550	400	180	48000	920
STP-14	5.3	6700000	480000	720000	7600	4300000	6500000
CLP-16	5.2	990000	1700	3800	1100	680000	170000
CLP-18	2.9	13000	500	8000	4600	460000	120000
DD-17	2.9	800	5000	400	450	4500	1800
ED-1	-	-	3400	5000	1700	4400	3000
ED-2	-	-	-	1100	-	-	-

TABLE 2
Fecal Coliforms at all Stations
Counts/100ml

Station #	River Mile	4/18	4/19	4/20	4/21	4/27	4/28
CLP-2	15.7	370	150	440	160	1300	200
CLP-4	9.4	150	220	330	70	610	20
CLP-6	7.8	50	75	220	60	1200	120
DD-7	7.4	6400	3200	1400	100	2200	700
CLP-7	7.1	140	240	140	50	1400	300
ED-8	6.9	1800	500	1100	60	300	600
CLP-10	6.3	140	230	130	110	1000	120
STP-14	5.3	740000	>100	100	200	460000	720000
CLP-16	5.2	180000	100	300	40	80000	140000
CLP-18	2.9	6500	340	830	2200	27000	34000
DD-17	2.9	120	250	90	80	520	220
ED-1	-	-	1000	330	1100	180	1000
ED-2	-	-	-	40	-	-	-

TABLE 3
Water Temperatures at all Stations
OF

Station #	River Mile	4/18	4/19	4/20	4/21	4/27	4/28
CLP-2	15.7	51	47	44	52	42	54
CLP-4	9.4	52	48	48	54	42	54
CLP-6	7.8	53	48	49	52	42	50
DD-7	7.4	53	48	50	57	42	54
CLP-7	7.1	53	47	49	51	42	49
ED-8	6.9	53	46	52	52	42	48
CLP-10	6.3	55	49	53	52	44	49
STP-14	5.3	62	58	64	63	62	64
CLP-16	5.2	55	50	56	52	46	48
CLP-18	2.9	56	50	54	50	46	47
DD-17	2.9	55	50	50	47	43	44
ED-1	-	-	54	56	55	50	53
ED-2	-	-	-	58	-	-	-

TABLE 4
Time of Sample Collection

Station #	River Mile	4/18	4/19	4/20	4/21	4/27	4/28
CLP-2	15.7	0915	1210	0845	1100	0930	1028
CLP-4	9.4	1000	1135	0910	1035	0945	1013
CLP-6	7.8	1015	1100	0940	1015	1000	1000
DD-7	7.4	1100	1025	0955	1000	1006	0950
CLP-7	7.1	1130	0950	1005	0950	1020	0938
ED-8	6.9	1145	0930	1045	0935	1050	0902
CLP-10	6.3	1215	0920	1100	0925	1055	0855
STP-14	5.3	1300	0900	1120	0910	1130	0840
CLP-16	5.2	1235	0840	1130	0855	1140	0830
CLP-18	2.9	1330	0750	1145	0835	1150	0815
DD-17	2.9	1345	0810	1200	0835	1155	0810
ED-1	-	-	1505	1400	1210	1030	0920
ED-2	-	-	-	1330	-	-	

TABLE 5

Chlorine Residual
PPM

Station #	River Mile	4/18	4/19	4/20	4/21	4/27	4/28
CLP-2	15.7	-	-	-	-	-	-
CLP-4	9.4	-	-	-	-	-	-
CLP-6	7.8	-	-	-	-	-	-
DD-7	7.4	-	-	-	-	-	-
CLP-7	7.1	-	-	-	-	-	-
ED-8	6.9	-	-	-	-	-	-
CLP-10	6.3	-	-	-	-	-	-
STP-14	5.3	0	0.5	0.5	0.5	0	0
CLP-16	5.2	0	0	0.1	0.1	-	0
CLP-18	2.9	-	-	-	-	-	-
DD-17	2.9	-	-	-	-	-	-
ED-1	-	-	0.1	0.1	0.25	0.5	0.5
ED-2	-	-	-	-	-	-	-