ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENFORCEMENT

EPA-330/2-77-009

# *Evaluation and Wastewater Characterization Philadelphia Southeast and Southwest Water Pollution Control Plants*

## *Philadelphia, Pennsylvania*

(OCTOBER 29 – NOVEMBER 5, 1976)

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
DENVER, COLORADO
AND
REGION III, PHILADELPHIA, PENNSYLVANIA

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Environmental Protection Agency
Office of Enforcement
*EPA-330/2-77-009*

# EVALUATION AND WASTEWATER CHARACTERIZATION

## PHILADELPHIA SOUTHEAST AND SOUTHWEST WATER POLLUTION CONTROL PLANTS

Philadelphia, Pennsylvania

(October 29-November 5, 1976)

March 1977

National Enforcement Investigations Center - Denver, Colorado
and
Region III - Philadelphia, Pennsylvania

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# I. INTRODUCTION

In June 1976, the Environmental Protection Agency (EPA), Region III Enforcement Division requested technical assistance from the National Enforcement Investigations Center (NEIC) in determining the nature and impact of discharges by the City of Philadelphia, Pennsylvania to the Delaware River. NEIC determined that the study should be conducted in two phases. During September 1976, Phase I was conducted, including waste characterization at the Northeast Water Pollution Control Plant (WPCP) and an assessment of the impact of those discharges at the Torresdale Water Treatment Plant (WTP).

On September 15 and 16, NEIC personnel conducted reconnaissance inspections for the Phase II study of the Southeast and Southwest Water Pollution Control Plants (NPDES* permits PA0026662 and PA0026671, respectively). During these inspections, past self-monitoring data were assembled, sampling and flow monitoring sites were selected, and treatment processes were evaluated.

Both plants provide primary treatment of wastewaters, including removal and grinding of screenings, grit removal, and sedimentation before discharge to the Delaware River [Figures 1 and 2]. Wastewater flows entering the Southeast and Southwest WPC Plants averaged 443,000 and 617,000 $m^3$ (117 and 163 mg)/day, respectively, from January to June 1976. BOD and TSS removals averaged 42 and 49%, respectively, at the Southeast WPCP and 33 and 58%, respectively, at the Southwest WPCP. Sludge from the Southeast WPCP is pumped approximately 7.6 km (4.7 mi)

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* *National Pollutant Discharge Elimination System (Public Law 92-500).*

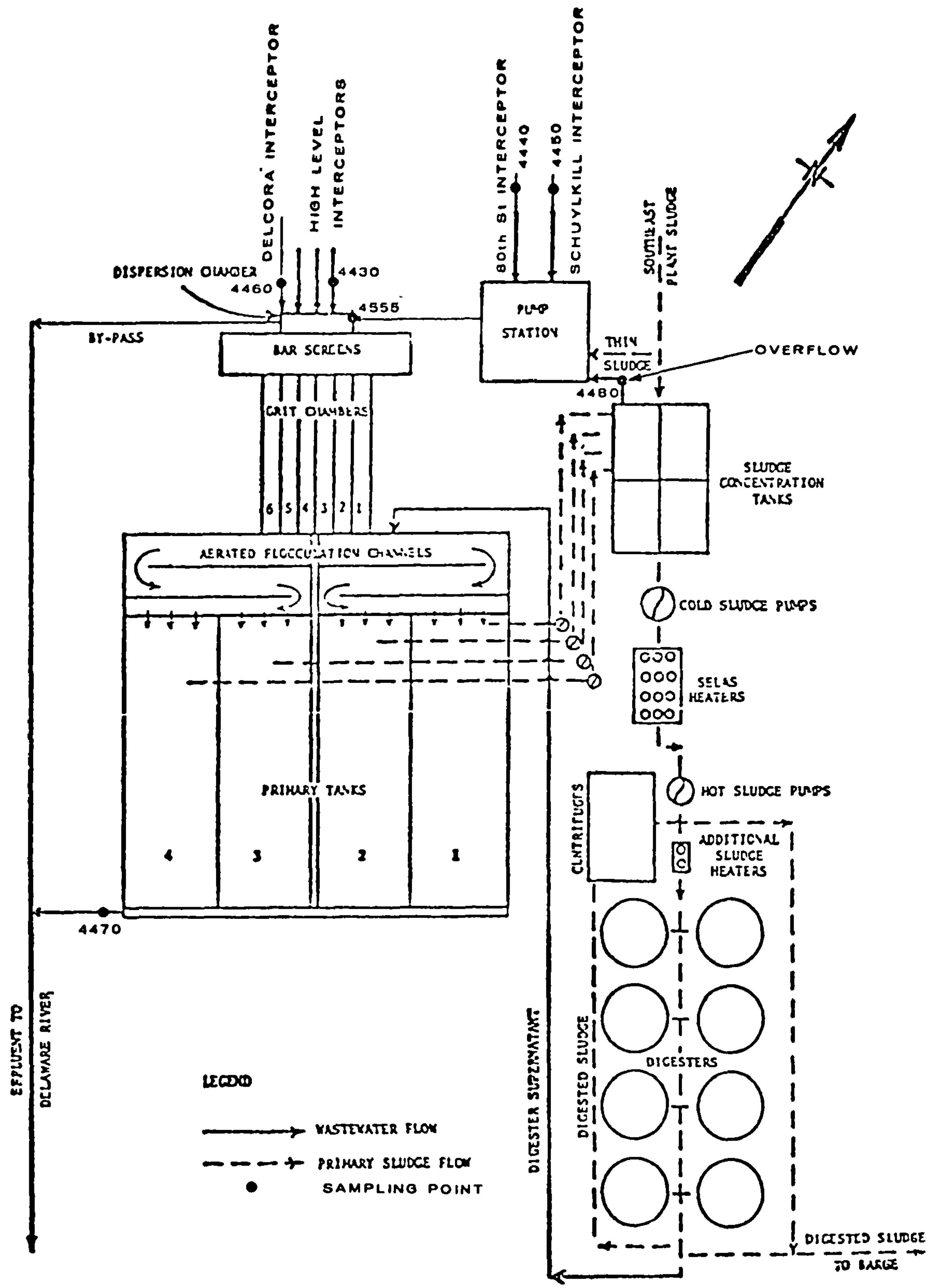


*Figure 1. Schematic Flow Diagram for Philadelphia Southwest Plant*

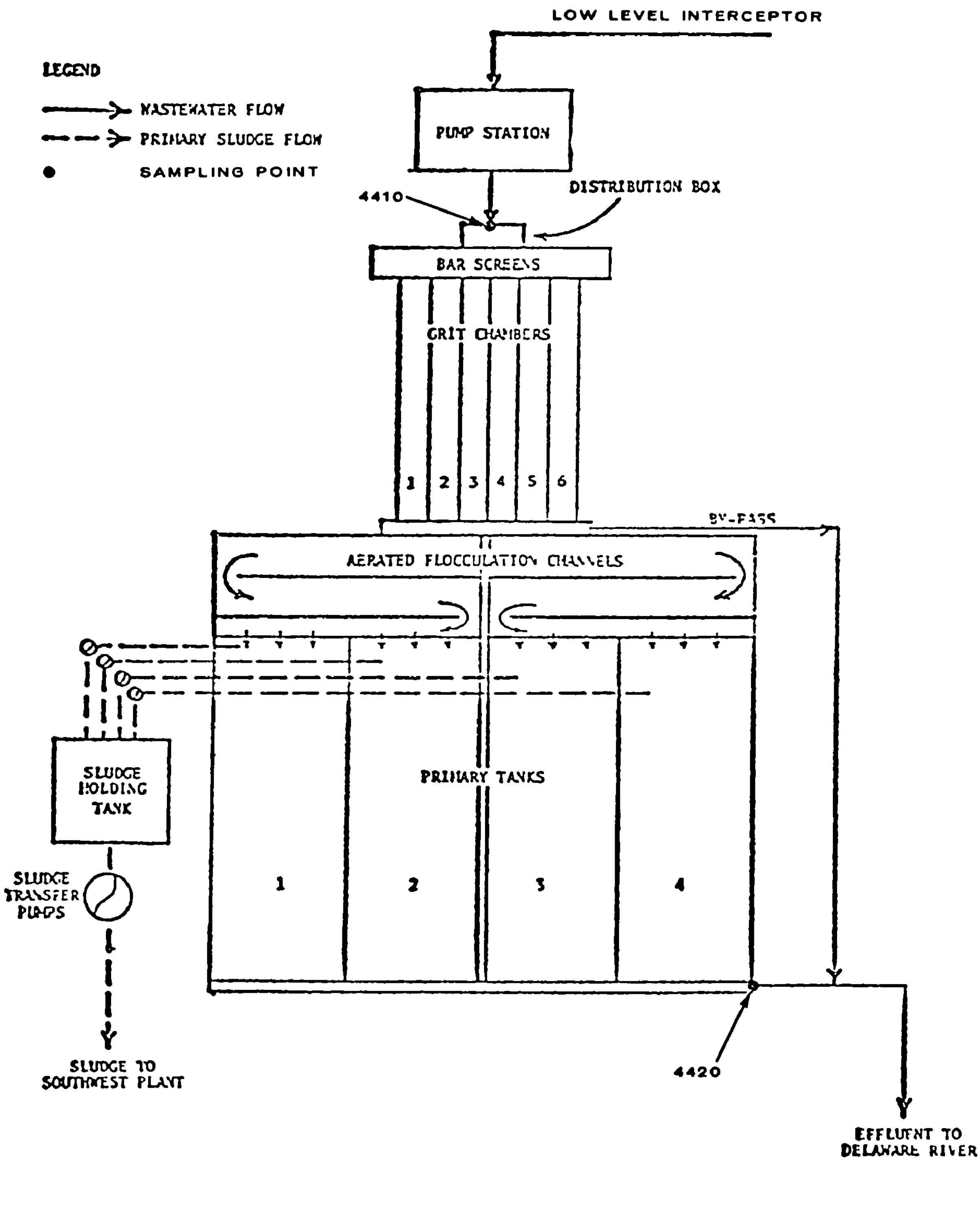


*Figure 2. Schematic Flow Diagram for Philadelphia Southeast Plant*

to the Southwest WPCP for single-stage digestion with the Southwest sludge. Digested sludge is pumped to a barge, transported to the Atlantic Ocean, and discharged.

During October 29 to November 5, NEIC conducted the Phase II study to characterize wastewaters and determine NPDES compliance at the Southeast and Southwest WPCP's. NPDES limitations for these plants became effective February 13, 1975, and include:

| Parameter | 30-day | 7-day |
|---|---|---|
| | Southeast WPCP (140 mgd) | |
| BOD† | 140 mg/l<br>74,000 kg (163,000 lb)/day | 200 mg/l |
| TSS†† | 110 mg/l<br>57,800 kg (128,000 lb)/day | 165 mg/l |
| pH | 6.0-9.0 | |
| | Southwest WPCP (167 mgd) | |
| BOD† | 90 mg/l<br>56,300 kg (125,000 lb)/day | 135 mg/l |
| TSS†† | 165 mg/l<br>103,000 kg (230,000 lb)/day | 210 mg/l |
| pH | 6.0-9.0 | |

† *≥25% removal during any 30-consecutive-day period.*
†† *≥35% removal during any 30-consecutive-day period.*

Interim limitations for both plants, which were to have been effective February 13, 1976, called for continuance of initial limits except that in no case were 30-day BOD and TSS removals to be less than 60% and effluent fecal coliform counts were not to exceed 400/100 ml for any period of 30 consecutive days or 200/100 ml for any 7 consecutive days. The City of Philadelphia requested an adjudicatory hearing and sought to eliminate these interim limitations regarding increased removals and disinfection.

## II. SUMMARY AND CONCLUSIONS

### NPDES COMPLIANCE

During October 29 to November 5, 1976, the National Enforcement Investigations Center conducted a waste characterizations study at the City of Philadelphia Southeast and Southwest Water Pollution Control Plants. These plants provide primary treatment of wastewater prior to discharge to the Delaware River. Data collected during this study and reported below indicate both plants were in compliance with their initial NPDES limitations for BOD and TSS.

| Parameter | NPDES Limits 30-day | NPDES Limits 7-day | Oct. 29 to Nov. 5, 1976 |
|---|---|---|---|
| | | Southeast WPCP | |
| BOD | 140 mg/l<br>74,000 kg (163,000 lb)/day | 200 mg/l | 120 mg/l<br>59,000 kg (130,000 lb)/day |
| TSS | 110 mg/l<br>57,800 kg (128,000 lb)/day | 165 mg/l | 68 mg/l<br>34,000 kg (75,000 lb)/day |
| | | Southwest WPCP | |
| BOD | 90 mg/l<br>56,300 kg (125,000 lb)/day | 135 mg/l | 120 mg/l<br>77,000 kg (170,000 lb)/day |
| TSS | 165 mg/l<br>103,000 kg (230,000 lb)/day | 210 mg/l | 85 mg/l<br>53,000 kg (120,000 lb)/day |

The only apparent NPDES violations included the following pH values at the Southeast WPCP:

| Date (Nov.) | Time (hours) | pH |
|---|---|---|
| 30 | 1415 | 5.9 |
| 30 | 1815 | 5.7 |
| 31 | 0815 | 5.9 |

The NPDES limitations include an allowable range of 6.0 to 9.0 standard units.

Seven-day average percentage removals of BOD and TSS were 28% and 62%, respectively, at the Southeast WPCP and 11% and 56% at Southwest WPCP. Although the NPDES permits contain no 7-day removal requirements, the 30-day average limitations for BOD and TSS at both plants are ≥25% and ≥35%, respectively.

## METALS

Metals data collected at the influents to both treatment plants indicated mercury (Hg) and lead (Pb) concentrations in excess of the Philadephia industrial waste regulations submitted May 25, 1976 to EPA Region III. These regulations became effective January 1, 1977. Data collected at the Southeast WPCP included one 24-hour composite sample in excess of the three mg/l Pb limit and all seven exceeding the 0.005 mg/l Hg limit. Data from the Southwest WPCP included two Pb composites in excess of three mg/l limit and eight Hg samples in excess of 0.005 mg/l. Considering that these regulations are to be applied at the point of discharge to the sewer rather than after dilution at the plants where NEIC sampled, it is likely that there are discharges to the sewers considerably in excess of these regulations.

## OIL AND GREASE

Oil and grease data collected at the Southeast and Southwest WPC Plants included at least 4 potential violations of Philadelphia's industrial waste regulations. As with the metals, there are probably numerous violations at the actual points of discharge to the sewers.

## ORGANICS

Influents and effluents at the Southeast and Southwest Water Pollution Control Plants were monitored for organics for three days, commencing October 31, 1976. A total of 67 different organic compounds were identified, followed by an investigation of their toxicity and the development of a toxicity index for 50 of them to estimate relative toxicity. In an exhaustive computerized literature search of 19 data bases, 606 references to the hazards of these 67 compounds were located. Consideration of absolute toxicity factors, such as the development of cancer or lethal dose, was used to indicate the compounds which were potentially more harmful than others. A total of 47 individual toxic doses were located for 17 of the chemicals identified, including one suspected carcinogen, biphenyl.

The effects of long-term exposure to individual compounds or exposure to the whole spectrum of the 67 compounds identified are unknown. Most of the organic compound concentrations found during the study were one or more orders of magnitude less than toxic doses, lethal doses and the U. S. Occupational Standards. However, important considerations remain unknown. Most of the toxic dosage and lethal dosage studies were of short duration using relatively high concentrations of the substances investigated, and, importantly, the toxic and lethal effects of each substance were evaluated on an individual basis. Virtually no reports are available concerning long-term effects of exposure to most of the substances identified and data are not available on the combined effects of exposure to this wide spectrum of toxic substances.

The influent to the Southeast WPCP contained 47 organic compounds, of which a toxicity index was established for 37. During the 3-day sampling period a total of 3,900 kg (8,500 lb) of these 47 compounds entered the Southeast WPCP, which represented a daily average influent concentration of 2,600 μg/l.

The effluent from the Southeast WPCP contained 36 organic compounds, of which 34 were also found in the influent. A toxicity index was established for 28 of the 36 compounds, including one suspected carcinogen, biphenyl. During the 3-day sampling period, a total of 1,600 kg (3,600 lb), or 42% of the influent organic loading, was discharged to the Delaware River. This represented a daily average discharge concentration of 1,000 μg/l.

The influents to the Southwest WPCP contained 54 organic compounds, of which a toxicity index was developed for 46. A suspected carcinogen, biphenyl, was identified in the DELCORA (Delaware County Regional Authority) Interceptor. During the 3-day sampling period, a total of 1,970 kg (4,220 lb) of the 54 compounds entered the plant, which represented a flow-weighted daily average concentration of 1,060 μg/l.

The effluent from the Southwest WPCP contained 40 organic compounds, of which 39 were also identified in the influents. A toxicity index was developed for 34 of them, including one suspected carcinogen, biphenyl. During the 3-day period, a total of 1,100 kg (2,500 lb), or

59% of the influent organic loading, was discharged to the Delaware River, which represented a daily average concentration of 600 μg/l.

In addition to these direct discharges of organic compounds to the Delaware River, an unknown quantity is contained in digested sludge which is barged to the Atlantic Ocean and discharged. Should this sludge be landfilled in the future, these compounds would then be present in the soil and leachate.

## SELF-MONITORING EVALUATION

The NEIC study also revealed that the City of Philadelphia does not conduct its self-monitoring in accordance with the NPDES requirements. Time-proportional composite samples are collected at both plants, not flow-proportional as required by the NPDES permits. In addition, the city does not sample all of the influent to the Southwest WPCP for NPDES reporting. Only the largest of the three influents (approximately 90% of flow) is sampled, and then flows for all influent sources are combined and used to calculate influent loadings.

# III. STUDY PROCEDURES

## SAMPLING TECHNIQUES

During the October 29 to November 5, 1976 study, samples were collected for a broad range of parameters [Table 1]. Hourly aliquots for the 24-hour influent and effluent composite samples were collected by hand, flow-proportioned, and stored at 4°C. Oil and grease samples were grab sampled three times per day. Field measurements of pH and temperature were performed hourly. At the end of each 24-hour sampling period, the composite samples for BOD and TSS were delivered for analysis to an NEIC mobile lab at the Southwest WPCP. All other composites were air-freighted to Denver for analysis at the NEIC laboratory. NEIC chain-of-custody [Appendix A] and analytical quality control [Appendix B] procedures were followed.

## SAMPLING LOCATIONS

Sampling locations included major interceptors entering the plants and the effluents [Figures 1, 2, and Table 1]. At the Southeast WPCP, a single influent point was used since all wastewaters enter through one 3.4 m (11 ft) diameter sewer. However, at the Southwest WPCP, three influent sites were sampled: the High Level Gravity, the Combined 80th Street and Schuylkill, and the DELCORA interceptor sewers. During the October 29 to November 5 study, these represented approximately 90%, 8%, and 2%, respectively, of the Southwest WPCP influent flows.

*Table 1*

*PHILADELPHIA PHASE II (SE AND SW PLANTS)*
*STATION DESCRIPTIONS AND SAMPLING PARAMETERS*

| Station No. | Station Description | PARAMETERS[4] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Organics[1] | BOD | COD | TSS | O/G[2] | $NH_3$-N | TKN | $NO_2$ + $NO_3$ | Total P | $PO_4$ | Heavy Metals[3] | Mutagenicity[1] | CN[1] |
| 4410 | SE Plant influent at distribution box following pump station | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4420 | SE Plant effluent at downstream end of effluent channel | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4430 | SW Plant--High Level Interceptor at dispersion chamber | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4440 | SW Plant--80th St. Low Level Interceptor at manhole approximately 50 m upstream of pump station | X[5] | | | | | | | | | | | | |
| 4450 | SW Plant--Schuylkill Low Level Interceptor at manhole approximately 50 m upstream of pump station | X[5] | | | | | | | | | | | | |
| 4555 | SW Plant--Combined 80th St. & Schuylkill Interceptors at dispersion chamber following pump station | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4460 | SW Plant--DELCORA Interceptor at Venturi section approximately 20 m upstream of dispersion chamber | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4470 | SW Plant-- Effluent at downstream end of effluent channel | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4480 | SW Plant--Sludge concentration tank overflow[6] | X | X | X | X | X | X | X | X | X | X | X | X | X |

1 *Collected three days· Oct. 31, Nov. 1 and Nov. 2.*
2 *Three grab samples per 24 hours.*
3 *Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn, Hg, Sn, Ag, Al, As, Ba, and Se.*
4 *All samples were 24-hour, flow-weighted composites, except as noted.*
5 *No composite samples. Grab sampled on Nov. 2, 1976.*
6 *Equal-volume composite collected each hour there was discharge.*

Originally, the 80th Street and Schuylkill interceptors were to be sampled separately at the Southwest WPCP. However, an inspection of the proposed sampling sites indicated that the pump station wet well caused a backwater condition which slowed the two sewers to near quiescent conditions. It was concluded that any data collected from these approximately 6.1 m (20 ft) deep manholes would be questionable since solids could have already settled in the sewer lines. An examination of the sewer plans indicated that moving further upstream would necessitate an excessive number of sampling and flow monitoring sites since various trunk sewers enter the interceptors. It was concluded that the only sampling point which could be used was at the dispersion chamber, downstream from the confluence of the two interceptors in the pump station. This site was also downstream from the sludge concentration tank overflow. Equal-volume composites were collected from this intermittent overflow to quantify the effect on the dispersion chamber sampling location.

## FLOW MONITORING

Flow monitoring for all Southeast and Southwest WPCP influents was performed with existing Venturi meters. On the day preceding the start-up of the study, the Southwest WPCP instrument crew calibrated all Venturis and metering equipment at the Southwest WPCP. On the next day the same crew calibrated the influent Venturis at the Southeast WPCP. Effluent flows were assumed to be equal to the sum of the influent flows. The sludge concentration tank overflow split into two portions: the first was confined in a rectangular channel and measured with a Marsh-McBirney magnetic flow meter; the second, smaller portion, cascaded down as a sheet flow and was measured by estimate.

# IV. COMPLIANCE MONITORING

Data collected during the October 29 to November 5 NEIC study [Tables 2, 3] indicated both the Southeast and Southwest WPC Plants were in compliance with NPDES initial 7-day limitations for BOD and TSS:

| Parameter | NPDES Limits 30-day | NPDES Limits 7-day | Oct. 29 to Nov. 5, 1976 |
|---|---|---|---|
| | | Southeast WPCP | |
| BOD | 140 mg/l<br>74,000 kg (163,000 lb)/day | 200 mg/l | 120 mg/l<br>59,000 kg (130,000 lb)/day |
| TSS | 110 mg/l<br>57,800 kg (128,000 lb)/day | 165 mg/l | 68 mg/l<br>34,000 kg (75,000 lb)/day |
| | | Southwest WPCP | |
| BOD | 90 mg/l<br>56,300 kg (125,000 lb)/day | 135 mg/l | 120 mg/l<br>77,000 kg (170,000 lb)/day |
| TSS | 165 mg/l<br>103,000 kg (230,000 lb)/day | 210 mg/l | 85 mg/l<br>53,000 kg (120,000 lb)/day |

The only apparent NPDES violations included the following pH values at the Southeast WPCP:

| Date (Nov.) | Time (hours) | pH |
|---|---|---|
| 30 | 1415 | 5.9 |
| 30 | 1815 | 5.7 |
| 31 | 0815 | 5.9 |

The NPDES limitations for pH include an allowable range of 6.0 to 9.0 standard units.

*Table 2*

*FIELD MEASUREMENTS AND ANALYTICAL DATA*
*SOUTHWEST PHILADELPHIA WATER POLLUTION CONTROL PLANT*
*October 29 - November 5, 1976*

| Station Description (Station No.) | 1976 Date | Flow[a] m³/day (x10³) | Flow[a] mgd | pH Range | BOD mg/l | BOD kg/day | BOD lb/day | TSS mg/l | TSS kg/day | TSS lb/day | COD mg/l | COD kg/day | COD lb/day | Total Cyanide mg/l | Total Cyanide kg/day | Total Cyanide lb/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High Level Interceptor | | | | | | | | | | | | | | | | |
| (4430) | 10/30 | 541 | 143 | 6.1-7.1 | 94[d] | 51,000 | 110,000 | 120 | 65,000 | 140,000 | 280 | 150,000 | 330,000 | - | - | - |
| | 10/31 | 575 | 152[b] | 5.8-7.1 | 97 | 56,000 | 120,000 | 140 | 31,000 | 180,000 | 190 | 110,000 | 240,000 | - | - | - |
| | 11/1 | 613 | 162 | 5.8-7.4 | 140 | 86,000 | 190,000 | 330 | 200,000 | 450,000 | 330 | 200,000 | 450,000 | 0.02 | 12 | 27 |
| | 11/2 | 541 | 143 | 6.0-6.9 | 90 | 49,000 | 110,000 | 120 | 65,000 | 140,000 | 140 | 76,000 | 170,000 | 0.05[e] | 27 | 60 |
| | 11/3 | 560 | 148 | 5.6-7.6 | 110 | 62,000 | 140,000 | 130 | 73,000 | 160,000 | 220 | 120,000 | 270,000 | 0 04 | 22 | 49 |
| | 11/4 | 564 | 149 | 6.2-7.5 | 200 | 110,000 | 250,000 | 190 | 110,000 | 240,000 | 320 | 180,000 | 400,000 | - | - | - |
| | 11/5 | 556 | 147 | 5.8-7.5 | 170 | 95,000 | 210,000 | 82 | 46,000 | 100,000 | 260 | 140,000 | 320,000 | - | - | - |
| 7-day Average | | 564 | 149 | | 130 | 73,000 | 160,000 | 160 | 91,000 | 200,000 | 250 | 140,000 | 310,000 | 0.04 | 20 | 45 |
| Combined 80th and Schuylkill Interceptors | | | | | | | | | | | | | | | | |
| (4555) | 10/30 | 47,3 | 12.5 | 6 0-7.6 | 180[d] | 8,500 | 19,000 | 270 | 13,000 | 28,000 | 410 | 19,000 | 43,000 | - | - | - |
| | 10/31 | 55.3 | 14.6[b] | 5.8-6.9 | 180 | 9,900 | 22,000 | 660 | 36,000 | 80,000 | 560 | 31,000 | 68,000 | - | - | - |
| | 11/1 | 59.0 | 15.6[c] | 5.9-7.1 | 230 | 14,000 | 30,000 | 770 | 45,000 | 100,000 | 510 | 30,000 | 66,000 | 0.03 | 1.8 | 3.9 |
| | 11/2 | 45.8 | 12.1[b] | 6.2-6.8 | 150 | 6,900 | 15,000 | 450 | 21,000 | 45,000 | 380 | 17,000 | 38,000 | 0.17[e] | 7.8 | 17 |
| | 11/3 | 46.9 | 12.4[b] | 5.7-7.1 | 270 | 13,000 | 28,000 | 660 | 31,000 | 68,000 | 830 | 39,000 | 86,000 | 0.20 | 9.4 | 21 |
| | 11/4 | 47.3 | 12 5 | 6.1-7.2 | 250 | 12,000 | 26,000 | 620 | 29,000 | 65,000 | 690 | 33,000 | 72,000 | - | - | - |
| | 11/5 | 43.9 | 11.6 | 5.9-8.1 | 180 | 7,900 | 17,000 | 320 | 14,000 | 31,000 | 560 | 25,000 | 54,000 | - | - | - |
| 7-day Average | | 49.3 | 13.0 | | 210 | 10,000 | 22,000 | 540 | 27,000 | 60,000 | 560 | 28,000 | 61,000 | 0.13 | 6.3 | 1.4 |
| DELCORA Interceptor | | | | | | | | | | | | | | | | |
| (4460) | 10/30 | 16 | 4.1 | 6.4-6.8 | 140[d] | 2,200 | 4,800 | 210 | 3,300 | 7,200 | 380 | 5,900 | 13,000 | - | - | - |
| | 10/31 | 12 | 3.1[b] | 6 1-7.2 | 190 | 2,200 | 4,900 | 430 | 5,000 | 11,000 | 420 | 4,900 | 11,000 | - | - | - |
| | 11/1 | 16 | 4.1 | 5 9-7 0 | 160 | 2,500 | 5,500 | 380 | 5,900 | 13,000 | 380 | 5,900 | 13,000 | <0.02 | <0.31 | <0.68 |
| | 11/2 | 13 | 3.4 | 6.7-7.1 | 120 | 1,500 | 3,400 | 190 | 2,400 | 5,400 | 280 | 3,600 | 7,900 | <0.02 | <0.26 | <0.57 |
| | 11/3 | 12 | 3.2 | 6 1-7.3 | 140 | 1,700 | 3,700 | 120 | 1,500 | 3,200 | 250 | 3,000 | 6,700 | <0.02 | <0.24 | <0.53 |
| | 11/4 | 12 | 3.3 | 5 8-7.2 | 320 | 4,000 | 8,800 | 220 | 2,700 | 6,100 | 390 | 4,900 | 11,000 | - | - | - |
| | 11/5 | 12 | 3.1 | 6.3-8.3 | 160 | 1,900 | 4,100 | 300 | 3,500 | 7,800 | 410 | 4,800 | 11,000 | - | - | - |
| 7-day Average | | 13 | 3.5 | | 180 | 2,300 | 5,000 | 260 | 3,500 | 7,700 | 360 | 4,700 | 11,000 | <0.02 | <0.27 | <0.59 |
| Plant Effluent (4470) | 10/30 | 606 | 160 | 6.0-7.1 | 87[d] | 53,000 | 120,000 | 110 | 67,000 | 150,000 | 210 | 130,000 | 280,000 | - | - | - |
| | 10/31 | 643 | 170[b] | 6.1-7.1 | 210 | 140,000 | 300,000 | 100 | 64,000 | 140,000 | 120 | 77,000 | 170,000 | - | - | - |
| | 11/1 | 689 | 182 | 6.1-7 2 | 72 | 50,000 | 110,000 | 92 | 63,000 | 140,000 | 54 | 37,000 | 82,000 | <0.02 | <14 | <30 |
| | 11/2 | 598 | 158 | 6.5-7.0 | 150 | 90,000 | 200,000 | 56 | 33,000 | 74,000 | 160 | 96,000 | 210,000 | 0.04[e] | 24 | 53 |
| | 11/3 | 621 | 164 | 6.0-7.4 | 97 | 60,000 | 130,000 | 74 | 46,000 | 100,000 | 210 | 130,000 | 290,000 | 0.04 | 25 | 55 |
| | 11/4 | 625 | 165 | 6.0-7.3 | 140 | 87,000 | 190,000 | 100 | 62,000 | 140,000 | 260 | 160,000 | 360,000 | - | - | - |
| | 11/5 | 613 | 162 | 6.1-7.2 | 100 | 61,000 | 140,000 | 63 | 39,000 | 85,000 | 220 | 135,000 | 300,000 | - | - | - |
| 7-day Average | | 628 | 166 | | 120 | 77,000 | 170,000 | 85 | 53,000 | 120,000 | 180 | 110,000 | 240,000 | <0.03 | <21 | <46 |
| Sludge Thickener Overflow | | | | | | | | | | | | | | | | |
| (4480) | 10/30 | Not Monitored | | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 10/31 | 0 83 | 0.22 | - | >3,300[f] | >2,700 | >6,100 | 7,300 | 6,100 | 13,000 | 1,700 | 1,400 | 3,100 | - | - | - |
| | 11/1 | 1.4 | 0.36 | - | 1,900 | 2,600 | 5,700 | 5,000 | 6,800 | 15,000 | 9,000 | 12,000 | 27,000 | 0.15 | 0.20 | 0.45 |
| | 11/2 | 0.79 | 0.21 | - | 1,100 | 870 | 1,900 | 2,300 | 1,800 | 4,000 | 450 | 360 | 790 | 0.08[e] | 0.06 | 0.14 |
| | 11/3 | 0.98 | 0.26 | - | 2,400 | 2,400 | 5,200 | 8,300 | 8,200 | 18,000 | 18,000 | 18,000 | 39,000 | 0.18 | 0.18 | 0.39 |
| | 11/4 | 0.30 | 0.08 | - | 2,300 | 700 | 1,500 | 5,000 | 1,500 | 3,300 | 8,600 | 2,600 | 5,700 | - | - | - |
| | 11/5 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 0 | 0.0 | 0.0 | 0.0 |
| Sum of Influents (Stations 4430, 4555 and 4460) | | | | | | 85,000 | 190,000 | | 120,000 | 270,000 | | 170,000 | 380,000 | | 27 | 60 |
| Percent Removal | | | | | | | 11 | | | 56 | | | 37 | | | 23 |

Table 2 (Cont.)
FIELD MEASUREMENTS AND ANALYTICAL DATA
SOUTHWEST PHILADELPHIA WATER POLLUTION CONTROL PLANT
October 26 - November 5, 1976

| Station Description (Station No.) | 1976 Date | Flow[a] m³/day (x10³) | mgd | pH Range | Total Phosphorus mg/l | kg/day | lb/day | Ortho Phosphate mg/l | kg/day | lb/day | Organic Nitrogen mg/l | kg/day | lb/day | Ammonia Nitrogen mg/l | kg/day | lb/day | Nitrite and Nitrate Nitrogen mg/l | kg/day | lb/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High Level Interceptor (4430) | 10/30 | 541 | 143 | 6.1-7.1 | 2.6[d] | 1,400 | 3,100 | 2.6[d] | 1,400 | 3,100 | 0.0[d] | 0 0 | 0 0 | 9 0[d] | 4,900 | 11,000 | 0 02[d] | 11 | 24 |
| | 10/31 | 575 | 152[b] | 5.8-7.1 | 3 0[d] | 1,700 | 3,800 | 3.0[d] | 1,700 | 3,800 | 0.0[d] | 0.0 | 0 0 | 10[d] | 5,800 | 13,000 | 0 02[d] | 12 | 25 |
| | 11/1 | 613 | 162 | 5.8-7.4 | 3.5[d] | 2,100 | 4,700 | 2.4[d] | 1,500 | 3,200 | 1.7[d] | 1,000 | 2,300 | 8.3 | 5,100 | 11,000 | 0.05[d] | 31 | 68 |
| | 11/2 | 541 | 143 | 6.0-6.9 | 3.4 | 1,800 | 4,100 | 3.4 | 1,800 | 4,100 | 0.0 | 0.0 | 0 0 | 9.0 | 4,900 | 11,000 | 0 04 | 22 | 48 |
| | 11/3 | 560 | 148 | 5.6-7.6 | 3.3 | 1,800 | 4,100 | 3.0 | 1,700 | 3,700 | 0.0 | 0 0 | 0 0 | 10 | 5,600 | 12,000 | 0.02 | 11 | 25 |
| | 11/4 | 564 | 149 | 6 2-7.5 | 4 0 | 2,300 | 5,000 | 2 9 | 1,600 | 3,600 | 1.0 | 560 | 1,200 | 11 | 6,200 | 14,000 | 0 02 | 11 | 25 |
| | 11/5 | 556 | 147 | 5.8-7.5 | 3.7 | 2,100 | 4,500 | 2.3 | 1,300 | 2,800 | 0.0 | 0 0 | 0 0 | 9 4 | 5,200 | 12,000 | 0 02 | 11 | 25 |
| 7-day Average | | 564 | 149 | | 3.4 | 1,900 | 4,200 | 2.8 | 1,600 | 3,500 | 0.4 | 220 | 500 | 9 5 | 5,400 | 12,000 | 0.03 | 16 | 34 |
| Combined 80th St and Schuylkill Interceptors (4555) | 10/30 | 47 3 | 12.5 | 6 0-7 6 | 3 4[d] | 160 | 350 | 3.2[d] | 150 | 330 | 0 0[d] | 0.0 | 0 0 | 11 | 520 | 1,100 | 0 04[d] | 1.9 | 4.2 |
| | 10/31 | 55 3 | 14 6[b] | 5.8-6.9 | 9 0[d] | 500 | 1,100 | 4.3[d] | 240 | 520 | 1.0[d] | 55 | 120 | 17 | 940 | 2,100 | 0 08[d] | 4.4 | 9.7 |
| | 11/1 | 59 0 | 15 6[c] | 5 9-7 1 | 9 0[d] | 530 | 1,200 | 4 0[d] | 240 | 520 | 7.0[d] | 410 | 910 | 12 | 710 | 1,600 | 0.07[d] | 4.1 | 9.1 |
| | 11/2 | 45 8 | 12 1[b] | 6 2-6 8 | 5 4 | 250 | 550 | 5 4 | 250 | 550 | 0 0 | 0 0 | 0 0 | 12 | 550 | 1,200 | 0 05 | 2 3 | 5.0 |
| | 11/3 | 46.9 | 12.4[b] | 5 7-7.1 | 12 | 560 | 1,200 | 5.1 | 240 | 530 | 8.0 | 380 | 830 | 14 | 660 | 1,400 | 0.02 | 0.94 | 2.1 |
| | 11/4 | 47.3 | 12.5 | 6.1-7.2 | 8.0 | 380 | 830 | 4.4 | 210 | 460 | 5 0 | 240 | 520 | 12 | 570 | 1,300 | 0 02 | 0.95 | 2 1 |
| | 11/5 | 43 9 | 11.6 | 5.9-8.1 | 6.4 | 280 | 620 | 2.2 | 97 | 210 | 2.1 | 92 | 200 | 9.9 | 430 | 960 | 0.02 | 0 88 | 1 9 |
| 7-day Average | | 49 3 | 13.0 | | 7 6 | 380 | 840 | 4.1 | 200 | 450 | 3.3 | 170 | 370 | 13 | 630 | 1,400 | 0.04 | 2 2 | 4.9 |
| DELCORA Interceptor (4460) | 10/30 | 16 | 4 1 | 6 4-6 8 | 5 8[d] | 90 | 200 | 5 7[d] | 88 | 200 | 0 0[d] | 0 0 | 0 0 | 16[d] | 250 | 550 | 0 02[d] | 0 31 | 0 68 |
| | 10/31 | 12 | 3.1[b] | 6.1-7 2 | 6.4[d] | 75 | 170 | 6.4[d] | 75 | 170 | 0.0[d] | 0 0 | 0 0 | 17[d] | 200 | 440 | 0 08[d] | 0.94 | 2 1 |
| | 11/1 | 16 | 4 1 | 5 9-7 0 | 5 2[d] | 81 | 180 | 5 2[d] | 81 | 180 | 0 0[d] | 0.0 | 0.0 | 14 | 220 | 490 | 0 08[d] | 1.2 | 2 7 |
| | 11/2 | 13 | 3 4 | 6 7-7.1 | 5.9 | 76 | 170 | 5 9 | 76 | 170 | 0 0 | 0.0 | 0 0 | 16 | 210 | 450 | 0 08 | 1 0 | 2 3 |
| | 11/3 | 12 | 3 2 | 6 1-7 3 | 6.9 | 84 | 180 | 5.6 | 68 | 150 | 0 0 | 0 0 | 0 0 | 18 | 220 | 480 | 0.02 | 0 24 | 0 53 |
| | 11/4 | 12 | 3.3 | 5 8-7.2 | 6.4 | 80 | 180 | 5 1 | 64 | 140 | 0 0 | 0 0 | 0 0 | 17 | 210 | 470 | 0 02 | 0 25 | 0 55 |
| | 11/5 | 12 | 3 1 | 6.3-8.3 | 7.2 | 84 | 190 | 6.3 | 74 | 160 | 0.0 | 0.0 | 0 0 | 24 | 280 | 620 | 0 02 | 0.23 | 0.52 |
| 7-day Average | | 13 | 3.5 | | 6.3 | 81 | 180 | 5.7 | 75 | 170 | 0.0 | 0 0 | 0.0 | 17 | 230 | 500 | 0 05 | 0.60 | 1.3 |
| Plant Effluent (4470) | 10/30 | 606 | 160 | 6.0-7.1 | 3 3[d] | 2,000 | 4,000 | 2.9[d] | 1,800 | 3,900 | 0 0[d] | 0 0 | 0 0 | 11[d] | 6,700 | 15,000 | 0 02[d] | 12 | 27 |
| | 10/31 | 643 | 170[b] | 6.1-7.1 | 2.7[d] | 1,700 | 3,800 | 2 7[d] | 1,700 | 3,800 | 0 0[d] | 0 0 | 0 0 | 9 0[d] | 5,800 | 13,000 | 0 02[d] | 13 | 28 |
| | 11/1 | 689 | 182 | 6 1-7.2 | 2.8[d] | 1,900 | 4,300 | 2.2[d] | 1,500 | 3,300 | 0.20[d] | 140 | 300 | 9.0 | 6,200 | 14,000 | 0 02[d] | 14 | 30 |
| | 11/2 | 598 | 158 | 6.5-7.0 | 4.6 | 2,800 | 6,100 | 3 6 | 2,200 | 4,700 | 0 0 | 0 0 | 0 0 | 13 | 7,800 | 17,000 | 0 02 | 12 | 26 |
| | 11/3 | 621 | 164 | 6.0-7.4 | 3 7 | 2,300 | 5,100 | 2.9 | 1,800 | 4,000 | 0 0 | 0 0 | 0 0 | 10 | 6,200 | 14,000 | 0 02 | 12 | 27 |
| | 11/4 | 625 | 165 | 6.0-7.3 | 3.2 | 2,000 | 4,400 | 3.1 | 1,900 | 4,300 | 0 0 | 0 0 | 0 0 | 10 | 6,200 | 14,000 | 0 02 | 12 | 28 |
| | 11/5 | 613 | 162 | 6.1-7.2 | 3.0 | 1,800 | 4,100 | 2.5 | 1,500 | 3,400 | 0 0 | 0 0 | 0 0 | 10 | 6,100 | 14,000 | 0 02 | 12 | 27 |
| 7-day Average | | 628 | 166 | | 3.3 | 2,100 | 4,600 | 2.8 | 1,800 | 3,900 | 0.03 | 20 | 43 | 10 | 6,400 | 14,000 | 0.02 | 12 | 28 |
| Sludge Thickener Overflow (4480) | 10/30 | Not Monitored | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 10/31 | 0.83 | 0 22 | - | 78[d] | 65 | 140 | 29[d] | 24 | 53 | 100[d] | 83 | 180 | 60[d] | 50 | 110 | 0 44[d] | 0.37 | 0.81 |
| | 11/1 | 1 4 | 0 36 | - | 80[d] | 110 | 240 | 26[d] | 35 | 78 | 130[d] | 180 | 390 | 50 | 68 | 150 | 0 56[d] | 0.76 | 1.7 |
| | 11/2 | 0.79 | 0.21 | - | 35 | 28 | 61 | 15 | 12 | 26 | 34 | 27 | 60 | 28 | 22 | 49 | 0 29 | 0.23 | 0.51 |
| | 11/3 | 0 98 | 0.26 | - | 130 | 130 | 280 | 30 | 30 | 65 | 393 | 390 | 850 | 57 | 56 | 120 | 0 94 | 0.92 | 2.0 |
| | 11/4 | 0 30 | 0 08 | - | 72 | 22 | 48 | 21 | 6 | 14 | 136 | 41 | 90 | 44 | 13 | 29 | 0 50 | 0.15 | 0.33 |
| | 11/5 | 0 0 | 0.0 | - | 0 0 | 0 0 | 0.0 | 0 0 | 0 0 | 0 0 | 0.0 | 0 0 | 0 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sum of Influents (Stations 4430, 4555, & 4460) | | | | | | 2,400 | 5,200 | | 1,900 | 4,100 | | 390 | 870 | | 6,300 | 14,000 | | 19 | 40 |
| Percent Removal | | | | | | | 12 | | | 4.9 | | | 95 | | | 0 0 | | | 30 |

a All flows are based on the difference in totalizer readings from 0600-0600, except as noted. Flows for 4470 are the sum of 4430, 4555, and 4460. Flows for 4480 are based on Marsh McBirney magnetic flow meter measurements and estimates.
b Flow based on average of hourly flow values.
c Flow based on totalizer for meter 5 and hourly averages from meter 1.
d Samples analyzed past recommended holding time due to equipment malfunction.
e Samples analyzed past recommended holding time due.
f All dilutions of this sample depleted on the first day; value was >3300.

*Table 3*

*FIELD MEASUREMENTS AND ANALYTICAL DATA*
*SOUTHEAST PHILADELPHIA WATER POLLUTION CONTROL PLANT*
*October 29 - November 5, 1976*

| Station Description (Station No.) | 1976 Date | Flow† m³/day (x10³) | Flow† mgd | pH Range | BOD mg/l | BOD kg/day | BOD lb/day | TSS mg/l | TSS kg/day | TSS lb/day | COD mg/l | COD kg/day | COD lb/day | Total Cyanide mg/l | Total Cyanide kg/day | Total Cyanide lb/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plant Influent (4410) | 10/30 | 473 | 125 | 5.8 - 7.5 | 140†† | 66,000 | 150,000 | 140 | 66,000 | 150,000 | 510 | 240,000 | 530,000 | - | - | - |
| | 10/31 | 526 | 139 | 5.9 - 9.5 | 160 | 84,000 | 190,000 | 280 | 150,000 | 320,000 | 380 | 200,000 | 440,000 | - | - | - |
| | 11/1 | 564 | 149 | 5.9 - 8.1 | 110 | 62,000 | 140,000 | 190 | 110,000 | 240,000 | 170 | 96,000 | 210,000 | <0.02 | <11 | <25 |
| | 11/2 | 473 | 125 | 6.8 - 7.8 | 140 | 66,000 | 150,000 | 210 | 99,000 | 220,000 | 330 | 160,000 | 340,000 | 0.08††† | 38 | 83 |
| | 11/3 | 484 | 128 | 6.9 - 7.5 | 180 | 87,000 | 190,000 | 160 | 78,000 | 170,000 | 280 | 140,000 | 300,000 | 0.11 | 53 | 120 |
| | 11/4 | 477 | 126 | 7.1 - 9.2 | 170 | 81,000 | 180,000 | 130 | 62,000 | 140,000 | 300 | 140,000 | 320,000 | - | - | - |
| | 11/5 | 484 | 128 | 6 75-8.2 | 250 | 120,000 | 270,000 | 120 | 58,000 | 130,000 | 340 | 160,000 | 360,000 | - | - | - |
| 7-day Average | | 497 | 131 | | 160 | 81,000 | 180,000 | 180 | 89,000 | 200,000 | 330 | 160,000 | 360,000 | <0.07 | <34 | <76 |
| Plant Effluent (4420) | 10/30 | 473 | 125 | 6.0 - 7.5 | 170†† | 80,000 | 180,000 | 60 | 28,000 | 63,000 | 320 | 150,000 | 330,000 | - | - | - |
| | 10/31 | 526 | 139 | 5.7 - 8.1 | 100 | 53,000 | 120,000 | 82 | 43,000 | 95,000 | 150 | 79,000 | 170,000 | - | - | - |
| | 11/1 | 564 | 149 | 5.9 - 8.1 | 68 | 38,000 | 85,000 | 73 | 41,000 | 91,000 | 51 | 29,000 | 63,000 | <0 02 | <11 | <25 |
| | 11/2 | 473 | 125 | 6.8 - 7.9 | 100 | 47,000 | 100,000 | 82 | 39,000 | 86,000 | 160 | 76,000 | 170,000 | 0.09††† | 43 | 94 |
| | 11/3 | 484 | 128 | 7.1 - 7.5 | 120 | 58,000 | 130,000 | 70 | 34,000 | 75,000 | 150 | 73,000 | 160,000 | 0.08 | 39 | 85 |
| | 11/4 | 477 | 126 | 7 1 - 8.3 | 140 | 67,000 | 150,000 | 46 | 22,000 | 48,000 | 240 | 110,000 | 250,000 | - | - | - |
| | 11/5 | 484 | 128 | 6 35 - 8.1 | 150 | 73,000 | 160,000 | 62 | 30,000 | 66,000 | 250 | 120,000 | 270,000 | - | - | - |
| 7-day average | | 497 | 131 | | 120 | 59,000 | 130,000 | 68 | 34,000 | 75,000 | 190 | 91,000 | 200,000 | <0.09 | <31 | <68 |
| Percent Removal | | | | | | | 28 | | | 62 | | | 44 | | | 11 |

| Station Description (Station No.) | 1976 Date | Flow† m³/day (x10³) | Flow† mgd | pH Range | Total Phosphorus mg/l | Total Phosphorus kg/day | Total Phosphorus lb/day | Ortho Phosphate mg/l | Ortho Phosphate kg/day | Ortho Phosphate lb/day | Organic Nitrogen mg/l | Organic Nitrogen kg/day | Organic Nitrogen lb/day | Ammonia Nitrogen mg/l | Ammonia Nitrogen kg/day | Ammonia Nitrogen lb/day | Nitrite and Nitrate Nitrogen mg/l | Nitrite and Nitrate Nitrogen kg/day | Nitrite and Nitrate Nitrogen lb/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plant Influent (1440) | 10/30 | 473 | 125 | 5.8-7.5 | 2.8†† | 1,300 | 2,900 | 2.1†† | 990 | 2,200 | 1.8†† | 850 | 1,900 | 7.0†† | 3,300 | 7,300 | 0.02†† | 9.5 | 21 |
| | 10/31 | 526 | 139 | 5.9-9.5 | 2.6†† | 1,400 | 3,000 | 1.6†† | 840 | 1,900 | 1 8†† | 950 | 2,100 | 5 6†† | 2,900 | 6,500 | 1 6†† | 840 | 1,900 |
| | 11/1 | 564 | 149 | 5.9-8.1 | 1.4†† | 790 | 1,700 | 1.3†† | 730 | 1,600 | 0.9†† | 510 | 1,100 | 4.5†† | 2,500 | 5,600 | 0 02†† | 11 | 25 |
| | 11/2 | 473 | 125 | 6 8-7.8 | 3.6 | 1,700 | 3,800 | 3.0 | 1,400 | 3,100 | 2.1 | 990 | 2,200 | 6.2 | 2,900 | 6,500 | 0.02 | 9.5 | 21 |
| | 11/3 | 484 | 128 | 6.9-7.5 | 5.0 | 2,400 | 5,300 | 2.5 | 1,200 | 2,700 | 5.2 | 2,500 | 5,600 | 5.8 | 2,800 | 6,200 | 0 02 | 9.7 | 21 |
| | 11/4 | 477 | 126 | 7.1-9.2 | 4.8 | 2,300 | 5,000 | 2.4 | 1,100 | 2,500 | 3.3 | 1,600 | 3,500 | 6.0 | 2,900 | 6,300 | 0 02 | 9.5 | 21 |
| | 11/5 | 484 | 128 | 6.75-8.2 | 4.8 | 2,300 | 5,100 | 2.2 | 1,100 | 2,300 | 2.2 | 1,100 | 2,300 | 6.6 | 3,200 | 7,000 | 0 02 | 9.7 | 21 |
| 7-day Average | | 497 | 131 | | 3.6 | 1,700 | 3,800 | 2.2 | 1,100 | 2,300 | 2.5 | 1,200 | 2,700 | 6.0 | 2,900 | 6,500 | 0.25 | 130 | 290 |
| Plant Effluent (4420) | 10/30 | 473 | 125 | 6.0-7.5 | 2.5†† | 1,200 | 2,600 | 2 4†† | 1,100 | 2,500 | 1.8†† | 850 | 1,900 | 7.0†† | 3,300 | 7,300 | 0 02†† | 9.5 | 21 |
| | 10/31 | 526 | 139 | 5.7-8.1 | 2.1†† | 1,100 | 2,400 | 1.6†† | 840 | 1,900 | 1.2†† | 630 | 1,400 | 5.6†† | 2,900 | 6,500 | 1 7†† | 890 | 2,000 |
| | 11/1 | 564 | 149 | 5.9-8.1 | 1.1†† | 620 | 1,400 | 1.0†† | 560 | 1,200 | 1.2†† | 680 | 1,500 | 4.2†† | 2,400 | 5,200 | 0.02†† | 11 | 25 |
| | 11/2 | 473 | 125 | 6.8-7.9 | 3.3 | 1,600 | 3,400 | 2.1 | 990 | 2,200 | 5.0 | 2,400 | 5,200 | 5.0 | 2,400 | 5,200 | 2.0 | 950 | 2,100 |
| | 11/3 | 484 | 128 | 7.1-7 5 | 2 8 | 1,400 | 3,000 | 1.8 | 870 | 1,900 | 2.4 | 1,200 | 2,600 | 5.4 | 2,600 | 5,800 | 0.02 | 9.7 | 21 |
| | 11/4 | 477 | 126 | 7.1-8.3 | 3.3 | 1,600 | 3,500 | 1.7 | 810 | 1,800 | 3 8 | 1,800 | 4,000 | 5.1 | 2,400 | 5,400 | 0.02 | 9.5 | 21 |
| | 11/5 | 484 | 128 | 6 35-8.1 | 3.4 | 1,600 | 3,600 | 1.6 | 780 | 1,700 | 3.2 | 1,600 | 3,400 | 5 0 | 2,400 | 5,300 | 2.2 | 1,100 | 2,300 |
| 7-day Average | | 497 | 131 | | 2.6 | 1,300 | 2,800 | 1.7 | 850 | 1,900 | 2.7 | 1,300 | 2,900 | 5 3 | 2,600 | 5,800 | 0.85 | 430 | 930 |
| Percent Removal | | | | | | | 26 | | | 17 | | | -7.4 | | | 11 | | | -220 |

† *All flows are based on the difference in totalizer readings from 0600 - 0600.*
†† *Samples analyzed past recommended holding time due to equipment malfunction.*
††† *Samples analyzed past recommended holding time due to delayed shipment.*

Seven-day average percentage removals of BOD and TSS were 28% and 62%, respectively, at the Southeast WPCP and 11% and 56% at Southwest. Although the NPDES permits for these plants contain no 7-day removal requirements, the 30-day average removal requirements for BOD and TSS at both plants are $\geq$25% and $\geq$35%, respectively. Including loadings from the Southwest WPCP, sludge concentration tank overflow results in higher than actual percentage removals. Analyses of the data, however, indicate that subtracting the overflow during October 31 to November 4 would reduce the average BOD and TSS removal efficiencies by an average of 1%. Using a safety factor of 2 to reflect the difficulty in monitoring the overflow would reduce the BOD and TSS removal efficiencies by an average of only 3%.

# V. DATA INTERPRETATION

As noted previously, samples were collected for a broad range of parameters [Tables 2 through 7]. The previous section dealt with how the data relate to NPDES requirements. An analysis of other significant findings follows.

## METALS

Pursuant to NPDES requirements for the Southeast and Southwest WPCP's, the City of Philadelphia submitted draft industrial waste regulations to EPA Region III on May 25, 1976. These regulations became effective January 1, 1977 and include limitations for various metals concentrations entering the city sewers. Lead (Pb) and mercury (Hg) concentrations from a composite sample over the process day are not to exceed 3 and 0.005 mg/l, respectively. Data collected during the NEIC study [Tables 4, 5] indicated concentrations in excess of these limitations at both the Southwest and Southeast WPCP's:

| Station | Date | Concentration (mg/l) Pb | Hg |
|---|---|---|---|
| Southeast WPCP | | | |
| Influent | 10/30 | - | 0.0094 |
| | 10/31 | - | 0.0052 |
| | 11/1 | - | 0.014 |
| | 11/2 | 3.3 | 0.0076 |
| | 11/3 | - | 0.015 |
| | 11/4 | - | 0.033 |
| | 11/5 | - | 0.028 |
| Southwest WPCP | | | |
| High Level Interceptor | 10/30 | - | 0.011 |
| | 11/3 | - | 0.0086 |
| | 11/4 | - | 0.011 |
| Combined 80th and Schuylkill | 10/31 | 3.3 | - |
| | 11/2 | - | 0.015 |
| | 11/3 | 4.1 | 0.0086 |
| | 11/4 | - | 0.015 |
| | 11/5 | - | 0.022 |
| DELCORA | 11/3 | - | 0.014 |

*Table 4*

*FIELD MEASUREMENTS AND ANALYTICAL DATA[1]*
*SOUTHWEST PHILADELPHIA WATER POLLUTION CONTROL PLANT*
*October 29-November 5, 1976*

| Station Description (Station Number) | Date | Flow[2] $m^3$/day x $10^3$ | Flow[2] mgd | pH Range | Aluminum mg/l | Aluminum kg/day | Aluminum lb/day | Arsenic µg/l | Arsenic kg/day | Arsenic lb/day | Barium[5] mg/l | Barium[5] kg/day | Barium[5] lb/day | Cadmium[5] mg/l | Cadmium[5] kg/day | Cadmium[5] lb/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High Level Interceptor (4430) | 10/30 | 541 | 143 | 6.1-7 1 | 0.7 | 380 | 840 | 16 | 8.7 | 19 | | | | | | |
| | 10/31 | 575 | 152[3] | 5.8-7.1 | 0 7 | 400 | 890 | 14 | 8 0 | 18 | | | | | | |
| | 11/1 | 613 | 162 | 5 8-7.4 | 1 6 | 980 | 2,200 | 8 | 4 9 | 11 | | | | | | |
| | 11/2 | 541 | 143 | 6 0-6.9 | 0.5 | 270 | 600 | 36 | 19 | 43 | | | | | | |
| | 11/3 | 560 | 148 | 5 6-7.6 | 0.6 | 340 | 740 | 20 | 11 | 25 | | | | | | |
| | 11/4 | 564 | 149 | 6.2-7.5 | 0.7 | 390 | 870 | 19 | 11 | 24 | | | | | | |
| | 11/5 | 556 | 147 | 5.8-7 5 | 0 7 | 390 | 860 | 17 | 9.5 | 21 | | | | | | |
| | 7-Day Average | 564 | 149 | | 0 8 | 450 | 1,000 | 19 | 10.3 | 23 | | | | | | |
| Combined 80th and Schuylkill Interceptors (4555) | 10/30 | 47 3 | 12 5 | 6.0-7.6 | 1.3 | 61 | 140 | 4 | 0 19 | 0.42 | | | | | | |
| | 10/31 | 55.3 | 14.6[3] | 5 8-6.9 | 4.7 | 260 | 570 | 21 | 1 2 | 2 6 | | | | | | |
| | 11/1 | 59.0 | 15 6[4] | 5.9-7.1 | 4.4 | 260 | 570 | 10 | 0.59 | 1 3 | | | | | | |
| | 11/2 | 45.8 | 12 1[3] | 6.2-6.8 | 2.8 | 130 | 280 | 34 | 1.6 | 3.4 | | | | | | |
| | 11/3 | 46 9 | 12.4[3] | 5.7-7 1 | 3.3 | 150 | 340 | 25 | 1 2 | 2.6 | | | | | | |
| | 11/4 | 47.3 | 12 5 | 6.1-7.2 | 2.3 | 110 | 240 | 46 | 2 2 | 4.8 | | | | | | |
| | 11/5 | 43 9 | 11 6 | 5.9-8.1 | 1.4 | 61 | 140 | 16 | 0 70 | 1.5 | | | | | | |
| | 7-Day Average | 49 3 | 13 0 | | 2.9 | 150 | 330 | 22 | 1.1 | 2 4 | | | | | | |
| DELCORA Interceptor (4460) | 10/30 | 16 | 4 1 | 6.4-6 8 | 0.4 | 6.2 | 14 | 10 | 0.16 | 0.34 | | | | | | |
| | 10/31 | 12 | 3 1[3] | 6 1-7.2 | 0.4 | 4.7 | 10 | 8 | 0.09 | 0.21 | | | | | | |
| | 11/1 | 16 | 4.1 | 5 9-7.0 | 1.5 | 23 | 51 | 34 | 0.53 | 1 2 | | | | | | |
| | 11/2 | 13 | 3 4 | 6.7-7.1 | 0.1 | 1 3 | 2 8 | 8 | 0 10 | 0 23 | | | | | | |
| | 11/3 | 12 | 3.2 | 6.1-7.3 | 0.3 | 3.6 | 8 0 | 12 | 0 14 | 0 32 | | | | | | |
| | 11/4 | 12 | 3.3 | 5.8-7 2 | 0.3 | 3.7 | 8 3 | 16 | 0 20 | 0.44 | | | | | | |
| | 11/5 | 12 | 3.1 | 6.3-8.3 | 0.4 | 4 7 | 10 | 17 | 0.20 | 0 44 | | | | | | |
| | 7-Day Average | 13 | 3.5 | | 0 5 | 6.7 | 15 | 15 | 0.20 | 0.45 | | | | | | |
| Plant Effluent (4470) | 10/30 | 606 | 160 | 6.0-7.1 | 0 3 | 180 | 400 | 16 | 9 7 | 21 | | | | | | |
| | 10/31 | 643 | 170[3] | 6.1-7.1 | 0.4 | 260 | 570 | 11 | 7 1 | 16 | | | | | | |
| | 11/1 | 689 | 182 | 6.1-7.2 | 0.7 | 480 | 1,100 | 12 | 8.3 | 18 | | | | | | |
| | 11/2 | 598 | 158 | 6.5-7.0 | 0.7 | 420 | 920 | 9 | 5 4 | 12 | | | | | | |
| | 11/3 | 621 | 164 | 6.0-7.4 | 0 3 | 190 | 410 | 14 | 8.7 | 19 | | | | | | |
| | 11/4 | 625 | 165 | 6.0-7.3 | 0.6 | 370 | 830 | 21 | 13 | 29 | | | | | | |
| | 11/5 | 613 | 162 | 6.1-7.2 | 0.3 | 180 | 410 | 12 | 7.4 | 16 | | | | | | |
| | 7-Day Average | 628 | 166 | | 0.5 | 300 | 660 | 14 | 8.5 | 19 | | | | | | |
| Sludge Thickener Overflow (4480) | 10/30 | Not monitored | | | | | | | | | | | | | | |
| | 10/31 | 0.83 | 0.22 | | 6.3 | 5 2 | 12 | 99 | 0.08 | 0.18 | 2.5 | 2.1 | 4.6 | 0.14 | 0.12 | 0.26 |
| | 11/1 | 1 4 | 0.36 | | 6.0 | 8.2 | 18 | 95 | 0 13 | 0 28 | 2.6 | 3.5 | 7.8 | 0.11 | 0.15 | 0.33 |
| | 11/2 | 0 79 | 0.21 | | 2.1 | 1.7 | 3.7 | 26 | 0.02 | 0 04 | 0.7 | 0.56 | 1 2 | 0 02 | 0 02 | 0 04 |
| | 11/3 | 0.98 | 0.26 | | 6.8 | 6.7 | 15 | 82 | 0 08 | 0 18 | 2.6 | 2.6 | 5.6 | 0.11 | 0 11 | 0.24 |
| | 11/4 | 0.30 | 0.08 | | 4.1 | 1.2 | 2 7 | 57 | 0 02 | 0 04 | 2.1 | 0.64 | 1 4 | <0.02 | <0.006 | <0.01 |
| | 11/5 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sum of Influents (Sum of 4430, 4555, and 4460) | | | | | | 610 | 1,400 | | 12 | 26 | | | | | | |
| % Removal | | | | | | | 51 | | | 27 | | | | | | |

*Table 4 (Continued)*

*FIELD MEASUREMENTS AND ANALYTICAL DATA[1]*
*SOUTHWEST PHILADELPHIA WATER POLLUTION CONTROL PLANT*
*October 20-November 5, 1976*

| Station Description (Station Number) | Date 1976 | Flow[2] $m^3$/day x $10^3$ | Flow[2] mgd | pH Range | Nickel mg/l | Nickel kg/day | Nickel lb/day | Lead mg/l | Lead kg/day | Lead lb/day | Zinc mg/l | Zinc kg/day | Zinc lb/day | Chromium mg/l | Chromium kg/day | Chromium lb/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High Level Interceptor (4430) | 10/30 | 541 | 143 | 6.1-7.1 | 0 04 | 22 | 48 | 0.18 | 97 | 210 | 0.27 | 150 | 320 | 0.32 | 170 | 380 |
| | 10/31 | 575 | 152[3] | 5.8-7 1 | <0 02 | <12 | <25 | 0.31 | 180 | 390 | 0 30 | 170 | 380 | 0 21 | 120 | 270 |
| | 11/1 | 613 | 162 | 5 8-7 4 | 0 03 | 18 | 41 | 0 58 | 360 | 780 | 0 50 | 310 | 680 | 0 13 | 80 | 180 |
| | 11/2 | 541 | 143 | 6 0-6.9 | 0 07 | 38 | 84 | 0 21 | 110 | 250 | 0 20 | 110 | 240 | 0 07 | 38 | 80 |
| | 11/3 | 560 | 148 | 5 6-7.6 | 0.15 | 84 | 190 | 0.33 | 180 | 410 | 0 27 | 150 | 330 | 0 15 | 84 | 190 |
| | 11/4 | 564 | 149 | 6.2-7.5 | 0.13 | 73 | 160 | 0.31 | 170 | 390 | 0.32 | 180 | 400 | 0.13 | 73 | 160 |
| | 11/5 | 556 | 147 | 5.8-7.5 | 0 06 | 33 | 74 | 0 23 | 130 | 280 | 0 27 | 150 | 330 | 0 11 | 61 | 130 |
| 7-Day Average | | 564 | 149 | | <0.07 | 40 | <89 | 0.31 | 180 | 390 | 0 30 | 170 | 380 | 0.16 | 89 | 200 |
| Combined 80th and Schuylkill Interceptors (4555) | 10/30 | 47 3 | 12.5 | 6 0-7.6 | 0.10 | 4 7 | 10 | 1 3 | 61 | 140 | 0 70 | 33 | 73 | 0 54 | 26 | 56 |
| | 10/31 | 55.3 | 14.6[3] | 5 8-6 9 | 0 14 | 7.7 | 17 | 3 3 | 180 | 400 | 1 8 | 99 | 220 | 0 77 | 43 | 94 |
| | 11/1 | 59.0 | 15.6[4] | 5 9-7.1 | 0 11 | 6.5 | 14 | 2.6 | 150 | 340 | 1.5 | 89 | 200 | 0 52 | 31 | 68 |
| | 11/2 | 45 8 | 12.1[3] | 6.2-6.8 | 0 19 | 8 7 | 19 | 2 4 | 110 | 240 | 1.3 | 60 | 130 | 0 56 | 26 | 57 |
| | 11/3 | 46.9 | 12.4[3] | 5.7-7.1 | 0.21 | 9.9 | 22 | 4.1 | 190 | 420 | 1.5 | 70 | 160 | 0 64 | 30 | 66 |
| | 11/4 | 47 3 | 12.5 | 6.1-7.2 | 0.28 | 13 | 29 | 1 4 | 66 | 150 | 0 97 | 46 | 100 | 0 40 | 19 | 42 |
| | 11/5 | 43.9 | 11.6 | 5 9-8.1 | 0.14 | 6.1 | 14 | 1.6 | 70 | 150 | 0.73 | 32 | 71 | 0 45 | 20 | 44 |
| 7-Day Average | | 49.3 | 13.0 | | 0 17 | 8.1 | 18 | 2.4 | 120 | 260 | 1 2 | 61 | 140 | 0 55 | 29 | 61 |
| DELCORA Interceptor (4460) | 10/30 | 16 | 4.1 | 6.4-6 8 | 0 10 | 1.5 | 3.4 | 0 27 | 4.2 | 9 2 | 0 37 | 5 7 | 13 | 0.17 | 2 6 | 5.8 |
| | 10/31 | 12 | 3 1[3] | 6 1-7 2 | 0 05 | 0.59 | 1.3 | 0 17 | 2 0 | 4.4 | 0 24 | 2 8 | 6 2 | 0 10 | 1.2 | 2.6 |
| | 11/1 | 16 | 4.1 | 5.9-7.0 | 0 02 | 0.31 | 0.68 | 0 44 | 6 8 | 15 | 0 46 | 7.1 | 16 | 0 12 | 1 9 | 4 1 |
| | 11/2 | 13 | 3 4 | 6 7-7.1 | 0 06 | 0.77 | 1.7 | <0.15 | <1.9 | <4.3 | 0 13 | 1 7 | 3 7 | 0 04 | 0.51 | 1 1 |
| | 11/3 | 12 | 3 2 | 6.1-7.3 | 0 07 | 0.85 | 1.9 | 0.16 | 1 9 | 4 3 | 0 25 | 3 0 | 6.7 | 0 13 | 1 6 | 3.5 |
| | 11/4 | 12 | 3 3 | 5 8-7.2 | 0.11 | 1.4 | 3 0 | 0.23 | 2.9 | 6 3 | 0 35 | 4.4 | 9 6 | 0 11 | 1 4 | 3.1 |
| | 11/5 | 12 | 3 1 | 6.3-8.3 | 0 09 | 1.1 | 2.3 | 0 32 | 3.8 | 8 3 | 0.31 | 3 6 | 8 0 | 0 12 | 1 4 | 3 1 |
| 7-Day Average | | 13 | 3.5 | | 0 07 | 0.93 | 2.0 | <0 25 | <3 2 | <7.4 | 0.30 | 4.0 | 9.0 | 0.11 | 1 5 | 3.3 |
| Plant Effluent (4470) | 10/30 | 606 | 160 | 6.0-7.1 | 0.04 | 24 | 53 | 0 20 | 120 | 270 | 0 20 | 120 | 270 | 0 25 | 150 | 330 |
| | 10/31 | 643 | 170[3] | 6 1-7.1 | 0 03 | 19 | 43 | 0.26 | 170 | 370 | 0.19 | 120 | 270 | 0.17 | 110 | 240 |
| | 11/1 | 689 | 182 | 6.1-7.2 | 0 02 | 14 | 30 | <0 15 | <100 | <230 | 0 16 | 110 | 240 | 0 05 | 34 | 76 |
| | 11/2 | 598 | 158 | 6.5-7.0 | 0 06 | 36 | 79 | 0.18 | 110 | 240 | 0 23 | 140 | 300 | 0 09 | 54 | 120 |
| | 11/3 | 621 | 164 | 6.0-7.4 | 0.11 | 68 | 150 | <0 15 | <93 | <210 | 0 27 | 170 | 370 | 0 10 | 62 | 140 |
| | 11/4 | 625 | 165 | 6.0-7.3 | 0.12 | 75 | 170 | 0.16 | 100 | 220 | 0 31 | 190 | 430 | 0 11 | 69 | 150 |
| | 11/5 | 613 | 162 | 6.1-7.2 | 0 06 | 37 | 81 | <0 15 | <92 | <200 | 0 17 | 100 | 230 | 0.08 | 49 | 110 |
| 7-Day Average | | 628 | 166 | | 0.06 | 39 | 87 | <0.18 | <110 | <250 | 0 22 | 140 | 300 | 0.12 | 75 | 170 |
| Sludge Thickener Overflow (4480) | 10/30 | Not monitored | | | | | | | | | | | | | | |
| | 10/31 | 0 83 | 0 22 | | 0 46 | 0 38 | 0 84 | 60 | 50 | 110 | 23 | 19 | 42 | 12 | 10 | 22 |
| | 11/1 | 1 4 | 0 36 | | 0.59 | 0.80 | 1 8 | 25 | 34 | 75 | 17 | 23 | 51 | 5 4 | 7 4 | 16 |
| | 11/2 | 0 79 | 0.21 | | 0.22 | 0.17 | 0.38 | 10 | 7 9 | 18 | 5.3 | 4.2 | 9 3 | 2.2 | 1 7 | 3.9 |
| | 11/3 | 0.98 | 0.26 | | 1.0 | 0.98 | 2.2 | 48 | 47 | 100 | 18 | 18 | 39 | 5.0 | 4.9 | 11 |
| | 11/4 | 0.30 | 0 08 | | 1.4 | 0 42 | 0.93 | 14 | 4.2 | 9.3 | 11 | 3.3 | 7.3 | 2 5 | 0.76 | 1.7 |
| | 11/5 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 0 | 0.0 | 0 0 | 0.0 | 0.0 |
| Sum of Influents (Sum of 4430, 4555, and 4460) | | | | | | 49 | 110 | | 300 | 660 | | 240 | 530 | | 120 | 260 |
| % Removal | | | | | | | 21 | | | 62 | | | 43 | | | 35 |

*Table 4 (Continued)*

*FIELD MEASUREMENTS AND ANALYTICAL DATA*[1]
*SOUTHWEST PHILADELPHIA WATER POLLUTION CONTROL PLANT*
*October 20-November 5, 1976*

| Station Description (Station Number) | Date 1976 | Flow[2] $m^3$/day x $10^3$ | Flow[2] mgd | pH Range | Copper mg/l | Copper kg/day | Copper lb/day | Iron mg/l | Iron kg/day | Iron lb/day | Mercury µg/l | Mercury kg/day | Mercury lb/day | Manganese mg/l | Manganese kg/day | Manganese lb/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High Level Interceptor (4430) | 10/30 | 541 | 143 | 6.1-7.1 | 0.20 | 110 | 240 | 2.3 | 1,200 | 2,700 | 11 | 6.0 | 13 | 0.41 | 220 | 490 |
| | 10/31 | 575 | 152[3] | 5.8-7.1 | 0.18 | 100 | 230 | 2.1 | 1,200 | 2,700 | 1.7 | 0.98 | 2.2 | 0.28 | 160 | 360 |
| | 11/1 | 613 | 162 | 5 8-7.4 | 0.22 | 130 | 300 | 3.1 | 1,900 | 4,200 | 4.9 | 3.0 | 6.6 | 0.27 | 170 | 370 |
| | 11/2 | 541 | 143 | 6.0-6.9 | 0.18 | 97 | 210 | 3.1 | 1,700 | 3,700 | 2.9 | 1 6 | 3.5 | 0.64 | 350 | 760 |
| | 11/3 | 560 | 148 | 5.6-7.6 | 0.20 | 110 | 250 | 2.1 | 1,200 | 2,600 | 8.6 | 4 8 | 11 | 0 30 | 170 | 370 |
| | 11/4 | 564 | 149 | 6.2-7.5 | 0 21 | 120 | 260 | 2.2 | 1,200 | 2,700 | 11 | 6 2 | 14 | 0 30 | 170 | 370 |
| | 11/5 | 556 | 147 | 5.8-7.5 | 0.18 | 100 | 220 | 1 1 | 610 | 1,300 | 2.9 | 1.6 | 3.6 | 0 16 | 89 | 200 |
| | 7-Day Average | 564 | 149 | | 0 20 | 110 | 240 | 2.3 | 1,300 | 2,800 | 6.1 | 3.5 | 7.7 | 0 34 | 190 | 420 |
| Combined 80th and Schuylkill Interceptors (4555) | 10/30 | 47.3 | 12.5 | 6.0-7.6 | 0 42 | 20 | 44 | 8.2 | 390 | 860 | - | - | - | 1.4 | 66 | 150 |
| | 10/31 | 55.3 | 14 6[3] | 5.8-6 9 | 0 70 | 39 | 85 | 12 | 660 | 1,500 | 4.4 | 0.24 | 0.54 | 1.4 | 77 | 170 |
| | 11/1 | 59 0 | 15 6[4] | 5.9-7.1 | 0.48 | 28 | 62 | 11 | 650 | 1,400 | 2.9 | 0.17 | 0 38 | 1.0 | 59 | 130 |
| | 11/2 | 45 8 | 12 1[3] | 6 2-6.8 | 0 58 | 27 | 59 | 10 | 460 | 1,000 | 15 | 0 69 | 1.5 | 1.4 | 64 | 140 |
| | 11/3 | 46 9 | 12 4[3] | 5.7-7.1 | 0 60 | 28 | 62 | 11 | 520 | 1,100 | 8.6 | 0.40 | 0.89 | 1 4 | 66 | 140 |
| | 11/4 | 47.3 | 12 5 | 6 1-7.2 | 0 50 | 24 | 52 | 8 2 | 390 | 860 | 15 | 0 71 | 1 6 | 1.1 | 52 | 110 |
| | 11/5 | 43 9 | 11.6 | 5.9-8.1 | 0 50 | 22 | 48 | 8.2 | 360 | 790 | 22 | 0 97 | 2.1 | 1.4 | 61 | 140 |
| | 7-Day Average | 49.3 | 13.0 | | 0.54 | 27 | 59 | 9.8 | 490 | 1,100 | 11 | 0 53 | 1 2 | 1.3 | 64 | 140 |
| DELCORA Interceptor (4460) | 10/30 | 16 | 4 1 | 6.4-6 8 | 0 24 | 3 7 | 8 2 | 2.0 | 31 | 68 | 1.1 | 0 02 | 0 04 | 0.17 | 2.6 | 5 8 |
| | 10/31 | 12 | 3.1[3] | 6 1-7.2 | 0.25 | 2.9 | 6 5 | 1.8 | 21 | 47 | 1.5 | 0.02 | 0.04 | 0 16 | 1.9 | 4.1 |
| | 11/1 | 16 | 4.1 | 5 9-7.0 | 0 28 | 4 3 | 9 6 | 3.8 | 59 | 130 | 1.8 | 0.03 | 0.06 | 0.28 | 4.3 | 9.6 |
| | 11/2 | 13 | 3.4 | 6.7-7.1 | 0 17 | 2 2 | 4 8 | 1.4 | 18 | 40 | 0.5 | 0.006 | 0 01 | 0 24 | 3.1 | 6.8 |
| | 11/3 | 12 | 3.2 | 6 1-7.3 | 0 22 | 2 7 | 5 9 | 1.6 | 19 | 43 | 14 | 0.17 | 0.37 | 0 15 | 1.8 | 4.0 |
| | 11/4 | 12 | 3 3 | 5.8-7.2 | 0.25 | 3.1 | 6 9 | 2 4 | 30 | 66 | 2.3 | 0 03 | 0 06 | 0 27 | 3.4 | 7.4 |
| | 11/5 | 12 | 3.1 | 6.3-8.3 | 0 25 | 2 9 | 6 5 | 1.8 | 21 | 47 | 1 0 | 0 01 | 0 02 | 0.16 | 1 9 | 4.1 |
| | 7-Day Average | 13 | 3 5 | | 0.24 | 3.1 | 6 9 | 2.1 | 28 | 63 | 3.2 | 0 04 | 0 09 | 0 20 | 2 7 | 6 0 |
| Plant Effluent (4470) | 10/30 | 606 | 160 | 6 0-7.1 | 0 17 | 100 | 230 | 1 2 | 730 | 1,600 | 1.2 | 0 73 | 1.6 | 0 22 | 130 | 290 |
| | 10/31 | 643 | 170[3] | 6 1-7.1 | 0.14 | 90 | 200 | 1.6 | 1,000 | 2,300 | 4.0 | 2 6 | 5.7 | 0 27 | 170 | 380 |
| | 11/1 | 689 | 182 | 6.1-7.2 | 0.12 | 83 | 180 | 1.4 | 960 | 2,100 | 2 2 | 1.5 | 3 3 | 0.18 | 120 | 270 |
| | 11/2 | 598 | 158 | 6 5-7.0 | 0 18 | 110 | 240 | 1.9 | 1,100 | 2,500 | 1.1 | 0.66 | 1.5 | 0 33 | 200 | 440 |
| | 11/3 | 621 | 164 | 6.0-7.0 | 0 15 | 93 | 210 | 1.3 | 810 | 1,800 | 0 8 | 0 50 | 1 1 | 0 22 | 140 | 300 |
| | 11/4 | 625 | 165 | 6.0-7.3 | 0.17 | 110 | 230 | 2.2 | 1,400 | 3,000 | 1.2 | 0.75 | 1 7 | 0 32 | 200 | 440 |
| | 11/5 | 613 | 162 | 6.1-7.2 | 0.16 | 98 | 220 | 1.2 | 740 | 1,600 | 8.8 | 5 4 | 12 | 0 24 | 150 | 320 |
| | 7-Day Average | 628 | 166 | | 0.16 | 98 | 220 | 1.5 | 960 | 2,100 | 2.8 | 1.7 | 3 8 | 0 25 | 160 | 350 |
| Sludge Thickener Overflow (4480) | 10/30 | Not monitored | | | | | | | | | | | | | | |
| | 10/31 | 0.83 | 0.22 | | 4.0 | 3 3 | 7.3 | 92 | 77 | 170 | 6.3 | 0.005 | 0.01 | 4 2 | 3 5 | 7.7 |
| | 11/1 | 1 4 | 0 36 | | 4.6, | 6 3 | 14 | 88 | 120 | 260 | 16 | 0 02 | 0 05 | 3 0 | 4 1 | 9.0 |
| | 11/2 | 0.79 | 0 21 | | 1.3 | 1.0 | 2 3 | 32 | 25 | 56 | 17 | 0 01 | 0.03 | 1.8 | 1.4 | 3 2 |
| | 11/3 | 0.98 | 0 26 | | 4 8 | 4.7 | 10 | 100 | 98 | 220 | 12 | 0 01 | 0.03 | 3 9 | 3.8 | 8.5 |
| | 11/4 | 0 30 | 0 08 | | 3.6 | 1.1 | 2 4 | 70 | 21 | 47 | 8 1 | 0.002 | 0.005 | 2.6 | 0.79 | 1.7 |
| | 11/5 | 0.0 | 0 0 | | 0.0 | 0 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 0 | 0.0 | 0.0 | 0 0 | 0 0 | 0 0 |
| Sum of Influents (Sum of 4430, 4555, and 4460) | | | | | | 140 | 310 | | 1,800 | 4,000 | | 4 1 | 9 0 | | 260 | 570 |
| % Removal | | | | | | | 29 | | | 48 | | | 58 | | | 39 |

[1] *The following metals were below detectable limits: selenium (<5 µg/l), silver (<0.01 mg/l), tin (<1 mg/l)*
[2] *All flows are based on the difference in totalizer readings from 0600-0600, except as noted. Flows for 4470 are the sum of 4430, 4555 and 4460.*
[3] *Flow based on average of hourly values*
[4] *Flow based on totalizer for meter 5 and hourly averages from meter 1.*
[5] *The following metals were below detectable limits except at Station 4480: Barium (0.2 mg/l), Cadmium (0.02 mg/l).*

*Table 5*[††]

*FIELD MEASUREMENTS AND ANALYTICAL DATA*
*SOUTHEAST PHILADELPHIA WATER POLLUTION CONTROL PLANT*
*October 29 - November 5, 1976*

| Station Description (Station No.) | 1976 Date | Flow[†] m³/day (x10³) | Flow[†] mgd | pH Range | Aluminum mg/l | Aluminum kg/day | Aluminum lb/day | Arsenic µg/l | Arsenic kg/day | Arsenic lb/day | Chromium mg/l | Chromium kg/day | Chromium lb/day | Lead mg/l | Lead kg/day | Lead lb/day | Zinc mg/l | Zinc kg/day | Zinc lb/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plant Influent | | | | | | | | | | | | | | | | | | | |
| (4410) | 10/30 | 473 | 125 | 5 8-7.5 | 1.0 | 470 | 1,000 | 8 | 3.8 | 8.3 | 0.32 | 150 | 330 | 2.0 | 950 | 2,100 | 1.4 | 660 | 1,500 |
| | 10/31 | 526 | 139 | 5.9-9.5 | 2.0 | 1,100 | 2,300 | 19 | 10 | 22 | 0.36 | 190 | 420 | 2 0 | 1,100 | 2,300 | 0.95 | 500 | 1,100 |
| | 11/1 | 564 | 149 | 5.9-8.1 | 1.3 | 730 | 1,600 | 24 | 14 | 30 | 0.09 | 51 | 110 | 0.92 | 520 | 1,100 | 0.55 | 310 | 680 |
| | 11/2 | 473 | 125 | 6 8-7.8 | 1.6 | 760 | 1,700 | 7 | 3.3 | 7.3 | 0.19 | 90 | 200 | 3 3 | 1,600 | 3,400 | 0.75 | 350 | 780 |
| | 11/3 | 484 | 128 | 6.9-7.5 | 1.3 | 630 | 1,400 | 9 | 4.4 | 9.6 | 0.31 | 150 | 330 | 2.3 | 1,100 | 2,500 | 0.81 | 390 | 870 |
| | 11/4 | 477 | 126 | 7.1-9.2 | 1.0 | 480 | 1,100 | 27 | 13 | 28 | 0.15 | 72 | 160 | 1.5 | 720 | 1,600 | 0.64 | 310 | 670 |
| | 11/5 | 484 | 128 | 6.75-8.2 | 0.8 | 390 | 850 | 8 | 3 9 | 8.5 | 0.19 | 92 | 200 | 1.4 | 680 | 1,500 | 0.64 | 310 | 680 |
| 7-day Average | | 497 | 131 | | 1.3 | 650 | 1,400 | 15 | 7.5 | 16 | 0.23 | 110 | 250 | 1.9 | 950 | 2,100 | 0.82 | 400 | 900 |
| Plant Effluent | | | | | | | | | | | | | | | | | | | |
| (4420) | 10/30 | 473 | 125 | 6.0-7.5 | 0.4 | 190 | 420 | 5 | 2.4 | 5.2 | 0.19 | 90 | 200 | 1.1 | 520 | 1,100 | 1.2 | 570 | 1,300 |
| | 10/31 | 526 | 139 | 5 7-8 1 | 0.2 | 110 | 230 | 10 | 5.3 | 12 | 0.11 | 58 | 130 | 0.45 | 240 | 520 | 0 33 | 170 | 380 |
| | 11/1 | 564 | 149 | 5.9-8.1 | 0.5 | 280 | 620 | 14 | 7.9 | 17 | 0.05 | 28 | 62 | 0.31 | 170 | 390 | 0.23 | 130 | 290 |
| | 11/2 | 473 | 125 | 6.8-7.9 | 0.6 | 280 | 630 | 12 | 5.7 | 13 | 0.15 | 71 | 160 | 1 5 | 710 | 1,600 | 0.38 | 180 | 400 |
| | 11/3 | 484 | 128 | 7.1-7.5 | 0.3 | 150 | 320 | 13 | 6.3 | 14 | 0.11 | 53 | 120 | 1.1 | 530 | 1,200 | 0.43 | 210 | 460 |
| | 11/4 | 477 | 126 | 7.1-8.3 | 0.4 | 190 | 420 | 8 | 3.8 | 8.4 | 0.16 | 76 | 170 | 0.86 | 410 | 900 | 0.38 | 180 | 400 |
| | 11/5 | 484 | 128 | 6.35-8 1 | 0.4 | 190 | 430 | 27 | 13 | 29 | 0.23 | 110 | 250 | 0.85 | 410 | 900 | 0.49 | 240 | 520 |
| 7-day Average | | 497 | 130 | | 0.4 | 200 | 440 | 13 | 6.3 | 14 | 0.14 | 69 | 160 | 0.88 | 430 | 940 | 0.49 | 240 | 540 |
| Percent Removal | | | | | | | 69 | | | 12 | | | 36 | | | 55 | | | 40 |

| Station Description (Station No.) | 1976 Date | Flow[†] m³/day (x10³) | Flow[†] mgd | pH Range | Copper mg/l | Copper kg/day | Copper lb/day | Iron mg/l | Iron kg/day | Iron lb/day | Mercury µg/l | Mercury kg/day | Mercury lb/day | Manganese mg/l | Manganese kg/day | Manganese lb/day | Nickel mg/l | Nickel kg/day | Nickel lb/day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plant Influent | | | | | | | | | | | | | | | | | | | |
| (4410) | 10/30 | 473 | 125 | 5.8-7.5 | 0.23 | 110 | 240 | 3.6 | 1,700 | 3,800 | 9 4 | 4.4 | 10 | 0 24 | 110 | 250 | 0.09 | 43 | 94 |
| | 10/31 | 526 | 139 | 5.9-9.5 | 0.27 | 140 | 310 | 4.0 | 2,100 | 4,600 | 5.2 | 2.7 | 6.0 | 0.30 | 160 | 350 | <0.02 | <11 | <23 |
| | 11/1 | 564 | 149 | 5 9-8.1 | 0.18 | 100 | 220 | 2.8 | 1,600 | 3,500 | 14 | 7.9 | 17 | 0.19 | 110 | 240 | <0 02 | <11 | <25 |
| | 11/2 | 473 | 125 | 6 8-7.8 | 0.25 | 120 | 260 | 2.8 | 1,300 | 2,900 | 7.6 | 3.6 | 7.9 | 0 30 | 140 | 310 | 0.11 | 52 | 110 |
| | 11/3 | 484 | 128 | 6.9-7.5 | 0.22 | 110 | 230 | 2.4 | 1,200 | 2,600 | 15 | 7.3 | 16 | 0.30 | 150 | 320 | 0.02 | 9.7 | 21 |
| | 11/4 | 477 | 126 | 7.1-9.2 | 0.18 | 86 | 190 | 2.0 | 950 | 2,100 | 33 | 16 | 35 | 0.29 | 140 | 300 | 0 04 | 19 | 42 |
| | 11/5 | 484 | 128 | 6.75-8.2 | 0.17 | 82 | 180 | 1.8 | 870 | 1,900 | 28 | 14 | 30 | 0.25 | 120 | 270 | 0.05 | 24 | 53 |
| 7-day Average | | 497 | 131 | | 0.21 | 110 | 230 | 2.8 | 1,400 | 3,100 | 16 | 8.0 | 17 | 0 27 | 130 | 290 | <0.04 | <24 | <53 |
| Plant Effluent | | | | | | | | | | | | | | | | | | | |
| (4420) | 10/30 | 473 | 125 | 6.0-7 5 | 0.15 | 71 | 160 | 2.4 | 1,100 | 2,500 | 3.0 | 1.4 | 3.1 | 0 18 | 85 | 190 | | | |
| | 10/31 | 526 | 139 | 5.7-8.1 | 0.12 | 63 | 140 | 1.5 | 790 | 1,700 | 19 | 10 | 22 | 0 18 | 95 | 210 | 0 05 | 24 | 52 |
| | 11/1 | 564 | 149 | 5.9-8.1 | 0.11 | 62 | 140 | 1.4 | 790 | 1,700 | 16 | 9.0 | 20 | 0 14 | 79 | 170 | <0.02 | <11 | <23 |
| | 11/2 | 473 | 125 | 6.8-7.9 | 0.15 | 71 | 160 | 1.4 | 660 | 1,500 | 18 | 8.5 | 19 | 0.18 | 85 | 190 | <0.02 | <11 | <25 |
| | 11/3 | 484 | 128 | 7.1-7.5 | 0.15 | 73 | 160 | 1.0 | 480 | 1,100 | 11 | 5.3 | 12 | 0.19 | 92 | 200 | 0.11 | 52 | 110 |
| | 11/4 | 477 | 126 | 7.1-8.3 | 0.17 | 81 | 180 | 1.8 | 860 | 1,900 | 21 | 10 | 22 | 0.17 | 81 | 180 | 0.03 | 15 | 32 |
| | 11/5 | 484 | 128 | 6.35-8.1 | 0.15 | 73 | 160 | 1.6 | 780 | 1,700 | 65 | 31 | 69 | 0 19 | 92 | 200 | 0 04 | 19 | 42 |
| 7-day Average | | 497 | 131 | | 0.14 | 71 | 160 | 1 6 | 780 | 1,700 | 22 | 11 | 24 | 0.18 | 87 | 190 | 0 05<br><0.05 | 24<br><22 | 53<br><48 |
| Percent Removal | | | | | | | 30 | | | 45 | | | -41 | | | 34 | | | 9.4 |

† *All flows are based on the difference in totalizer from 0600-0600.*

†† *The following metals were below detectable units, Barium (<0.2 mg/l), Cadmium (<0.2 mg/l), Selenium (<5<g/l), Silver (<0.01 mg/l); Tin (<1rg.l).*

*Table 6*

*OIL AND GREASE DATA*
*SOUTHEAST PHILADELPHIA WATER POLLUTION CONTROL PLANT*
*October 29-November 5, 1976*

| Date | Plant Influent (4410) Time | mg/l | Plant Effluent (4420) Time | mg/l |
|---|---|---|---|---|
| 10/29 | 0805 | 17 | 0815 | 15 |
| | 1605 | 51 | 1615 | 26 |
| | 2330 | 31 | 2345 | 23 |
| Daily Average | | 33 | | 21 |
| 10/30 | 0805 | 23 | 0815 | 20 |
| | 1605 | 220 | 1615 | 7 |
| | 2330 | 22 | 2345 | 20 |
| Daily Average | | 88 | | 16 |
| 10/31 | 0805 | 15 | 0815 | 9 |
| | 1615 | 85 | 1615 | 19 |
| | 2305 | 110 | 2320 | 19 |
| Daily Average | | 70 | | 16 |
| 11/1 | 0805 | 22 | 0815 | 7 |
| | 1605 | 96 | 1615 | 28 |
| | 2305 | 33 | 2315 | 26 |
| Daily Average | | 50 | | 20 |
| 11/2 | 0805 | 17 | 0815 | 12 |
| | 1605 | 90 | 1615 | 25 |
| | 2305 | 30 | 2315 | 21 |
| Daily Average | | 46 | | 19 |
| 11/3 | 0805 | 10 | 0815 | 9 |
| | 1608 | 43 | 1620 | 22 |
| | 2305 | 46 | 2315 | 21 |
| Daily Average | | 33 | | 17 |
| 11/4 | 0815 | 22 | 0823 | 9 |
| | 1620 | 49 | 1625 | 24 |
| | 2305 | 33 | 2315 | 21 |
| Daily Average | | 35 | | 18 |

*Table 7*

*OIL AND GREASE DATA*
*SOUTHWEST PHILADELPHIA WATER POLLUTION CONTROL PLANT*
*October 29 - November 5, 1976*

| Date | High Level Interceptor (4430) | | Combined 80th and Schulykill Interceptors (4555) | | DELCORA Interceptor (4460) | | Final Effluent (4470) | |
|---|---|---|---|---|---|---|---|---|
| | Time | mg/l | Time | mg/l | Time | mg/l | Time | mg/l |
| 10/29 | 0915 | 23 | 0910 | 120 | 1130 | 18 | 1030 | 27 |
| | 1610 | 42 | 1605 | 34 | 1750 | 51 | 1730 | 28 |
| Daily Average | | 33 | | 77 | | 35 | | 28 |
| 10/30 | 0012 | 42 | 0010 | 33 | 0835 | 110 | 0018 | 30 |
| | 0920 | 11 | | | 1525 | 72 | 0935 | 14 |
| | 1630 | 34 | 1625 | 66 | 1900 | 52 | 1735 | 25 |
| Daily Average | | 29 | | 50 | | 78 | | 23 |
| 10/31 | 0012 | 29 | 0010 | 28 | 0825 | 320 | 0015 | 39 |
| | 0920 | 38 | 0910 | 42 | 1520 | 32 | 0835 | 15 |
| | 1615 | 18 | 1610 | 41 | | | 1730 | 20 |
| Daily Average | | 28 | | 37 | | 180 | | 25 |
| 11/1 | 0012 | 25 | 0010 | 26 | 0825 | 81 | 0022 | 27 |
| | 0830 | 13 | 0925 | 20 | 1520 | 40 | 0945 | 12 |
| | 1620 | 33 | 1615 | 88 | 1915 | 42 | 1730 | 21 |
| Daily Average | | 24 | | 45 | | 54 | | 20 |
| 11/2 | 0010 | 46 | 0005 | 34 | 0720 | 29 | 0015 | 49 |
| | 0620 | 21 | 0615 | 9 | 1115 | 36 | 0930 | 13 |
| | 1320 | 27 | 1210 | 99 | 1815 | 45 | 1230 | 29 |
| Daily Average | | 31 | | 47 | | 37 | | 30 |
| 11/3 | 0012 | 39 | 0005 | 73 | 0820 | 520 | 0020 | 51 |
| | 0920 | 12 | 0810 | 206 | 1620 | 45 | 1330 | 15 |
| | 1720 | 31 | 1610 | 29 | 2130 | 46 | 1730 | 22 |
| Daily Average | | 27 | | 103 | | 200 | | 29 |
| 11/4 | 0010 | 44 | 0005 | 75 | 0820 | 60 | 0015 | 51 |
| | 1005 | 16 | 0810 | 110 | 1715 | 61 | 0730 | 23 |
| | 1520 | 37 | 1615 | 28 | 1930 | 40 | 1530 | 22 |
| Daily Average | | 32 | | 71 | | 54 | | 32 |
| 11/5 | 0005 | 25 | 0009 | 30 | | | 0012 | 19 |

These data were collected at the WPCP plants after considerable dilution in the sewers. Considering that these regulations are to be applied at the point of discharge to the sewers, it is likely that there are discharges to the sewers considerably in excess of the regulations.

OIL AND GREASE

The industrial waste regulations referenced above contain limitations for "Fats, Oils and Greases" which stipulate that: *Wastewaters not contain in excess of 100 mg/l of fats, oils and greases of mineral or petroleum or unknown origin for a composite sample representing one process day and twice this amount at any time as shown by grab sample. Wastewaters shall not contain in excess of 300 mg/l as a composite sample for one process day for fats, oils and greases of animal or vegetable origin, and not in excess of 400 mg/l at any time as shown by grab sample...* The standard oil and grease analysis does not identify the origin of material. However, potential violations (i.e., >200 mg/l) of this regulation [Tables 6, 7] are summarized below:

| Station | Date | Time (Hours) | Oil and Grease Concentrations (mg/l) |
|---|---|---|---|
| Southeast WPCP | | | |
| Influent | 10/30 | 1605 | 220 |
| Southwest WPCP | | | |
| Combined 80th and Schuylkill | 11/3 | 0810 | 206 |
| DELCORA | 10/31 | 0825 | 320 |
| | 11/3 | 0825 | 520 |

As with the metals analyses, these are diluted concentrations. Individual discharges to the sewers would be considerably higher.

# VI. SELF-MONITORING DEFICIENCIES

During the NEIC study, self-monitoring practices of the City of Philadelphia were observed at both the Southeast and Southwest WPCP Plants, which revealed the following discrepancies:

1. The City collects composite samples with QCE automatic samplers. The composites collected by the City are time-proportional, not flow-proportional as required by the NPDES permits. It is impossible to speculate on what effects this would have on past self-monitoring data submitted by the City.

2. The influent sampling point at the Southeast WPCP is downstream from the grit removal channels. Hence, removal efficiencies reported by the City are probably conservative since some solids are removed in the grit chambers.

3. The City of Philadelphia's NPDES influent sampling at the Southwest WPCP is not necessarily representative of all wastewaters entering the plant. Plant officials reported that sampling the High Level Gravity Interceptor (NEIC sampling point 4430) is considered representative of the DELCORA, 80th Street, and Schuylkill interceptors as well. Flows for loadings calculations are the sum of all the influent flows.

# VII. ORGANICS INTERPRETATION

Twenty-four-hour flow-weighted composite samples for organic compounds were collected for three days, commencing October 31, 1976 [Table 1]. Influents and effluents at the Southeast and Southwest WPC Plants were sampled, and a total of 67 compounds were identified [Table 8]. Each compound was assigned a unique compound reference number which is listed in the left column of Table 8 (ascending order), followed by the compound name and Chemical Abstracts Service (CAS) Registry number, if available.

This section interprets the significance of the organic compounds found in the survey, with particular emphasis on adverse environmental and health effects.

## DETERMINING THE TOXICITY INDEX

It has been commonly accepted that organic compounds occur in wastewater, rivers and, more recently, drinking water. In the past, most data relating to these occurrences were from gross measurements, such as carbon-chloroform extracts and non-volatile total organic carbon. Today the use of ultra-sensitive instrumentation, such as the computer-assisted gas chromatography-mass spectrometer (GC/MS) scan, has led to the detection of a myriad of organic molecules at very low concentrations. [For NEIC analytical methodology, see Appendix C.]

Although 67 compounds were identified during the study, recent EPA estimates indicate that these compounds constitute about 10% by weight

*Table 8*

*ORGANIC CHEMICAL COMPOUNDS*
*PHILADELPHIA SOUTHEAST AND SOUTHWEST WPC PLANTS*†

| Reference Number†† | Compound Name | Chemical Abstracts Service Registry Number | Sampling Date (Nov.) | Southeast Plant: Influent (4410) | Southeast Plant: Final Effluent (4420) | Southwest Plant: High Level Interceptor (4430) | Southwest Plant: Combined 80th/Schuykill Interceptors (4555) | Southwest Plant: DELCORA Interceptor (4460) | Southwest Plant: Final Effluent (4470) | Southwest Plant: Sludge Thickener Overflow (4480) | Toxic Substances List | Suspected Carcinogens List | OSHA Standards††† | Aquatic Toxicity | Toxline | Toxicity Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | μg/l | | | | | | | | | | | | |
| 201 | Toluene | 000108883 | 1 | 30 | | | 12 | | 16 | | 6/TC4 | 0/0 | 4 | 5/5 | 101 | 125 |
| | | | 2 | | 30 | | | 28 | 20 | 25 | | | | | | |
| | | | 3 | 23 | 16 | 36 | 15 | 15 | 32 | 77 | | | | | | |
| 202 | Ethylbenzene | 000100414 | 1 | 37 | 75 | 4 | 16 | 5[1] | 5 | 86 | 3/LD4 | 0/0 | 4 | 4/5 | 10 | 30 |
| | | | 2 | 55 | 30 | 11[1] | 31 | 7 | 10 | 61 | | | | | | |
| | | | 3 | 27 | 17 | 23 | 28 | 6[1] | 16 | 69 | | | | | | |
| 203 | *m*-Xylene | 000106423 | 1 | 100 | 190 | 17 | 62 | 21 | 18 | 270 | 0/0 | 0/0 | - | 6/5 | 9 | 20 |
| | *p*-Xylene | 000108383 | 2 | 160 | 88 | 35 | 95 | 21 | 36 | 170 | | | | | | |
| | | | 3 | 74 | 46 | 70 | 84 | 23 | 47 | 210 | | | | | | |
| 204 | *o*-Xylene | 000095476 | 1 | 31 | 39 | 6 | 18 | 8 | 6 | 47 | 1/LD3 | 0/0 | - | 6/5 | 10 | 25 |
| | | | 2 | 31 | 20 | 9 | 24 | 8 | 12 | 26 | | | | | | |
| | | | 3 | 19 | 12 | 24 | 19 | 9 | 17 | 43 | | | | | | |
| 205 | Cumene | 000098828 | 1 | 3[1] | 3 | | | | | 14[1] | 2/LD3 | 0/0 | 4 | - | 6 | 15 |
| | | | 2 | | | 20 | | | 26 | | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 206 | *m*-Ethyltoluene | 000620144 | 1 | 16 | 30 | 8 | 16 | 16 | 6 | 120[1] | 0/0 | 0/0 | - | - | 2 | 2 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | 22 | 16 | 38 | 14 | 12 | 26 | 180 | | | | | | |
| 207 | 1,3,5-Trimethyl-benzene | 000108678 | 1 | | | 6 | 11 | | | 120[1] | 2/LD3 | 0/0 | - | - | 10 | 15 |
| | | 000108952 | 2 | | | | 13[1] | 6 | 4 | | | | | | | |
| | | | 3 | 13 | | 23 | | | 15[1] | 210 | | | | | | |
| 208 | *o*-Ethyltoluene | 000611143 | 1 | 8 | 11 | 6 | 9 | 15[1] | 1 | 110[1] | 0/0 | 0/0 | - | - | 1 | 1 |
| | | | 2 | 10 | 5 | 6 | | 7 | 15 | 42 | | | | | | |
| | | | 3 | 11[1] | 7 | 18 | 11 | 7 | 11 | | | | | | | |
| 209 | 1,2,4-Trimethyl-benzene | 000095636 | 1 | 16 | 25 | 10 | 16 | 27 | 8 | 120[1] | 2/LD3 | 0/0 | - | - | 5 | 10 |
| | | | 2 | 21 | 12 | 22 | 15 | 14 | 22 | 54 | | | | | | |
| | | | 3 | 25 | 16 | 59 | 14 | 17 | 30 | 190 | | | | | | |
| 210 | *m*-Dichlorobenzene | 000541731 | 1 | | 10 | | | | 8 | | 0/0 | 0/0 | - | - | 6 | 6 |
| | | | 2 | MS[2] | | | | | | | | | | | | |
| | | | 3 | MS | | | MS | MS | | | | | | | | |

*Table 8 (Continued)*

*ORGANIC CHEMICAL COMPOUNDS*
*PHILADELPHIA SOUTHEAST AND SOUTHWEST WPC PLANTS*†

| Reference Number†† | Compound Name | Chemical Abstracts Service Registry Number | Sampling Date (Nov.) | Southeast Plant: Influent (4410) | Southeast Plant: Final Effluent (4420) | Southwest Plant: High Level Interceptor (4430) | Southwest Plant: Combined 80th/Schuylkill Interceptors (4555) | Southwest Plant: DELCORA Interceptor (4460) | Southwest Plant: Final Effluent (4470) | Southwest Plant: Sludge Thickener Overflow (4480) | Toxic Substances List | Suspected Carcinogens List | OSHA Standards††† | Aquatic Toxicity | Toxline | Toxicity Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | μg/l | | | | | | | | | | | | |
| 211 | 1,2,3-Trimethyl-benzene | 000526738 | 1 | 7[1] | 7[1] | | | | | | 0/0 | 0/0 | - | - | 3 | 3 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 212 | Isopropyltoluene | 000527844 | 1 | | | | 12[1] | 47[1] | | | 0/0 | 0/0 | - | - | 3 | 3 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 213 | Borneol | 000507700 | 1 | 59 | 39 | 33 | 39 | 85 | 29 | | 1/LD3 | 0/0 | - | - | 3 | 7 |
| | | | 2 | 77 | 46 | 38 | | 66 | 39 | | | | | | | |
| | | | 3 | 70 | 30 | 54 | 85 | 63 | 20 | | | | | | | |
| 214 | α-Terpineol | 000098555 | 1 | 110 | 63 | 71 | 65 | 115 | 87 | | 0/0 | 0/0 | - | - | 40 | 40 |
| | | | 2 | 56 | 110 | 110 | 100 | 180 | 120 | | | | | | | |
| | | | 3 | 130 | 99 | 140 | 86 | 165 | 130 | | | | | | | |
| 215 | 2-Metylnaphthalene | 000091576 | 1 | 22 | 29 | | 19 | 45 | 16 | | 0/0 | 0/0 | - | - | 4 | 4 |
| | | | 2 | 35 | 19 | | 14[1] | 13 | 9 | 180 | | | | | | |
| | | | 3 | | 8 | 16 | | 15 | 17 | | | | | | | |
| 216 | 5-Metyl-1,2,3,4-tetrahydro-naphthalene | 002809645 | 1 | | | | | 5[1] | | | 0/0 | 0/0 | - | - | - | 0 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | MS | | 7[1] | | | | | | | | | | |
| 217 | Dimethyl-1,2,3,4-tetrahydro-naphthalene | | 1 | 5[1] | 15[1] | 39[1] | 8[1] | 5[1] | | | 0/0 | 0/0 | - | - | - | 0 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 218 | Biphenyl | 000092524 | 1 | | 29 | | | MS | | | 3/LD3 | 3101/5 | 6 | - | 17 | 34 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | 17 | | | | MS | | | | | | | |
| 219 | sec-Butylbenzene | 000135988 | 1 | 8[1] | | | | | | | 1/LD3 | 0/0 | - | - | 2 | 6 |
| | | | 2 | | | 7[1] | | | | | | | | | | |
| | | | 3 | | | | | | 15[1] | | | | | | | |
| 220 | 2-Ethylnaphthalene | 000939275 | 1 | | | 39[1] | | MS | | | 1/LD3 | 0/0 | - | - | 1 | 5 |
| | | | 2 | MS | | 26[1] | | | | | | | | | | |
| | | | 3 | | | 14[1] | | | | | | | | | | |

*Table 8 (Continued)*

*ORGANIC CHEMICAL COMPOUNDS*
*PHILADELPHIA SOUTHEAST AND SOUTHWEST WPC PLANTS*†

| Reference Number†† | Compound Name | Chemical Abstracts Service Registry Number | Sampling Date (Nov.) | Southeast Plant: Influent (4410) | Southeast Plant: Final Effluent (4420) | Southwest Plant: High Level Interceptor (4430) | Southwest Plant: Combined 80th/Schuylkill Interceptors (4555) | Southwest Plant: DELCORA Interceptor (4460) | Southwest Plant: Final Effluent (4470) | Southwest Plant: Sludge Thickener Overflow (4480) | Toxic Substances List | Suspected Carcinogens List | OSHA Standards††† | Aquatic Toxicity | Toxline | Toxicity Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | µg/l | | | | | | | | | | | | |
| 221 | 1,2-Dimethyl-naphthalene | 000573988 | 1 | 100 | 100 | | 68[1] | 190 | 38 | | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | 170 | 53 | | 330 | 39 | 38 | 850 | | | | | | |
| | | | 3 | 140 | 36 | 49 | 250 | 37 | | 1,300 | | | | | | |
| 222 | Trimethyl-naphthalene | | 1 | 20[1] | 17[1] | 10[1] | 10[1] | 36[1] | 5[1] | 20 | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | 33[1] | 7[1] | 5[1] | 57[1] | 17[1] | | 220[1] | | | | | | |
| | | | 3 | 180[1] | 5[1] | 8[1] | 75[1] | 10[1] | 7 | 350 | | | | | | |
| 223 | 2,3,6-Trimethyl-naphthalene | 000829265 | 1 | 6[1] | 6[1] | 2 | 2[1] | 10 | | 5 | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | 12 | 2 | | 21 | | | 60 | | | | | | |
| | | | 3 | 27 | | 2 | 18 | 2 | MS | 60 | | | | | | |
| 224 | Diethylphthalate | 000084662 | 1 | | 43 | 11 | | MS | 13 | | 2/TD3 | 0/0 | 6[3] | - | 8 | 19 |
| | | | 2 | MS | 20 | 14 | | MS | 2 | | | | | | | |
| | | | 3 | | MS | | MS | 17 | 8 | | | | | | | |
| 225 | Di-n-Butylphthalate | 000084742 | 1 | | 19 | 14 | | 29 | 5 | | 2/TD4 | 0/0 | 6[4] | - | 20 | 32 |
| | | | 2 | 10 | 5 | | | 19 | 6 | | | | | | | |
| | | | 3 | | | 12 | | | | | | | | | | |
| 226 | 1,2,4,5-Tetramethyl-benzene | 000095932 | 1 | | | | | | 8 | | 0/0 | 0/0 | - | - | 1 | 1 |
| | | | 2 | 12[1] | | | | 15 | 13 | | | | | | | |
| | | | 3 | | | 19 | | | | | | | | | | |
| 227 | n-Octane | 000111659 | 1 | | | | | | | | 0/0 | 0/0 | 4 | - | 46 | 50 |
| | | | 2 | | | | | 7[1] | | | | | | | | |
| | | | 3 | 2 | | | 4 | | | | | | | | | |
| 228 | n-Nonane | 000111842 | 1 | | | 2 | | 6 | | | 0/0 | 0/0 | - | - | 19 | 19 |
| | | | 2 | | | | | 46 | 2 | 26 | | | | | | |
| | | | 3 | 3 | | 3 | 4 | | MS | | | | | | | |
| 229 | n-Decane | 000124185 | 1 | 14 | 7 | 10 | 14 | 34 | 3 | 340 | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | 11 | 4 | 6 | 39 | 9 | 6 | 170 | | | | | | |
| | | | 3 | 20 | 4 | 18 | 34 | 9 | 3 | 670 | | | | | | |
| 230 | n-Undecane | 001120214 | 1 | 77 | 37 | 21 | 39 | 81 | 8 | 940 | 0/0 | 0/0 | - | - | 8 | 8 |
| | | | 2 | 55 | 36 | 13 | 140 | 15 | 10 | 650 | | | | | | |
| | | | 3 | 130 | 30 | 28 | 120 | 17 | 7 | 1,200 | | | | | | |

*Table 8 (Continued)*

*ORGANIC CHEMICAL COMPOUNDS*
*PHILADELPHIA SOUTHEAST AND SOUTHWEST WPC PLANTS†*

| Reference Number†† | Compound Name | Chemical Abstracts Service Registry Number | Sampling Date (Nov.) | Southeast Plant: Influent (4410) µg/l | Southeast Plant: Final Effluent (4420) µg/l | Southwest Plant: High Level Interceptor (4430) µg/l | Southwest Plant: Combined 80th/Schuykill Interceptors (4555) µg/l | Southwest Plant: DELCORA Interceptor (4460) µg/l | Southwest Plant: Final Effluent (4470) µg/l | Southwest Plant: Sludge Thickener Overflow (4480) µg/l | Toxic Substances List | Suspected Carcinogens List | OSHA Standards††† | Aquatic Toxicity | Toxline | Toxicity Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 231 | n-Dodecane | 000112403 | 1 | 53 | 32 | 25 | 32 | 88 | 12 | 800 | 0/0 | 0/0 | - | - | 8 | 8 |
| | | | 2 | 61 | 15 | 11 | 170 | 19 | 11 | 660 | | | | | | |
| | | | 3 | 97 | 16 | 22 | 140 | 18 | 4 | 1,200 | | | | | | |
| 232 | n-Tridecane | 000629505 | 1 | 77 | 58 | 37 | 47 | 160 | 22 | 960 | 0/0 | 0/0 | - | - | 9 | 9 |
| | | | 2 | 110 | 24 | 22 | 300 | 21 | 21 | 750 | | | | | | |
| | | | 3 | 170 | 22 | 35 | 210 | 20 | 12 | 1,700 | | | | | | |
| 233 | n-Tetradecane | 000629954 | 1 | 100 | 68 | 38 | 48 | 150 | 20 | 1,080 | 0/0 | 0/0 | - | - | 20 | 20 |
| | | | 2 | 180 | 27 | 20 | 360 | 21 | 19 | 1,500 | | | | | | |
| | | | 3 | 180 | 22 | 30 | 300 | 17 | 10 | 2,000 | | | | | | |
| 234 | n-Pentadecane | 000629629 | 1 | 110 | 67 | 33 | 44 | 140 | 17 | 1,000 | 0/0 | 0/0 | - | - | 9 | 9 |
| | | | 2 | 200 | 26 | 17 | 400 | 22 | 19 | 1,700 | | | | | | |
| | | | 3 | 180 | 20 | 28 | 300 | 17 | 8 | 1,900 | | | | | | |
| 235 | n-Hexadecane | 000544763 | 1 | 150 | 69 | 36 | 42 | 110 | 19 | 940 | 0/0 | 0/0 | - | - | 8 | 8 |
| | | | 2 | 210 | 43 | 19 | 360 | 22 | 19 | 1,700 | | | | | | |
| | | | 3 | 190 | 49 | 32 | 140 | 20 | 7 | 1,900 | | | | | | |
| 236 | n-Heptadecane | 000629787 | 1 | 140 | 69 | 33 | 43 | 160 | 17 | 950 | 0/0 | 0/0 | - | - | 11 | 11 |
| | | | 2 | 200 | 26 | 19 | 360 | 32 | 19 | 1,500 | | | | | | |
| | | | 3 | 160 | 19 | 36 | 290 | 24 | 7 | 1,700 | | | | | | |
| 237 | Pristane | 001921706 | 1 | 48[1] | 40[1] | 25[1] | 29[1] | 95[1] | 13[1] | 640[1] | 0/0 | 0/0 | - | - | 15 | 15 |
| | | | 2 | 88[1] | 15[1] | 13[1] | 190[1] | 25[1] | 13[1] | 640[1] | | | | | | |
| | | | 3 | 77[1] | 13[1] | 21[1] | 160[1] | 19[1] | 5[1] | 1,100[1] | | | | | | |
| 238 | n-Octadecane | 000593453 | 1 | 100 | 57 | 32 | 34 | 110 | 12 | 1,400 | 0/0 | 0/0 | - | - | 20 | 20 |
| | | | 2 | 75 | 24 | 16 | 260 | 31 | 19 | 890 | | | | | | |
| | | | 3 | 140 | 18 | 25 | 190 | 30 | 9 | 1,700 | | | | | | |
| 239 | Phytane | 000638368 | 1 | 67[1] | 34[1] | 19[1] | 19[1] | 43[1] | 6[1] | 860[1] | 0/0 | 0/0 | - | - | 1 | 1 |
| | | | 2 | 46[1] | 50[1] | 8[1] | 86[1] | 15[1] | 10[1] | 330[1] | | | | | | |
| | | | 3 | 150[1] | 25[1] | 12[1] | 77[1] | 15[1] | 6[1] | 1,600[1] | | | | | | |
| 240 | n-Nonadecane | 000629925 | 1 | 67 | 39 | 19 | 22 | 71 | 4 | 500 | 0/0 | 0/0 | - | - | 3 | 3 |
| | | | 2 | 81 | 12 | 8[1] | 130 | 14 | 8 | 630 | | | | | | |
| | | | 3 | 70 | 9 | 17 | 110 | 31 | 6 | 1,400 | | | | | | |

*Table 8 (Continued)*

ORGANIC CHEMICAL COMPOUNDS
PHILADELPHIA SOUTHEAST AND SOUTHWEST WPC PLANTS[†]

| Reference Number[††] | Compound Name | Chemical Abstracts Service Registry Number | Sampling Date (Nov.) | Southeast Plant: Influent (4410) | Southeast Plant: Final Effluent (4420) | Southwest Plant: High Level Interceptor (4430) | Southwest Plant: Combined 80th/Schuykill Interceptors (4555) | Southwest Plant: DELCORA Interceptor (4460) | Southwest Plant: Final Effluent (4470) | Southwest Plant: Sludge Thickener Overflow (4480) | Toxic Substances List | Suspected Carcinogens List | OSHA Standards[†††] | Aquatic Toxicity | Toxline | Toxicity Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | μg/l | | | | | | | | | | | | |
| 241 | ρ-Eicosane | 000112958 | 1 | 12 | 13 | 7 | 13 | 31 | | 640 | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | 32 | | | 25 | | | 230 | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 242 | Heneicosane | 000629947 | 1 | | | | | 68 | | 500 | 0/0 | 0/0 | - | - | 1 | 1 |
| | | | 2 | 22 | | | | | | | | | | | | |
| | | | 3 | | | | | 190 | | | | | | | | |
| 243 | Other substituted Alkanes from $C_8$-$C_{22}$ (No of compounds) | | 1 | 0-38 (18) | 0-24 (20) | 0-16 (19) | 0-19 (19) | 0-100 (20) | 0-33 (10) | 0-370 (31) | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | 0-54 (26) | 0-15 (18) | 0-13 (16) | 0-110 (30) | 0-10 (18) | 0-8 (17) | 0-450 (25) | | | | | | |
| | | | 3 | 0-52 (23) | 0-8 (17) | 0-11 (17) | 0-90 (24) | 0-10 (24) | 0-3 (7) | 0-750 (30) | | | | | | |
| 244 | Chlorofluorocarbons from $C_3$-$C_6$ (No. of compounds) | | 1 | | | | | | | | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | | 2-15 (6) | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 245 | Bromobenzene | 000108861 | 1 | | | | | | | | 0/0 | 0/0 | - | - | 40 | 40 |
| | | | 2 | | | 20 | | | 26 | | | | | | | |
| | | | 3 | | | 54 | | | 40 | | | | | | | |
| 246 | m-, ρ-Ethyltoluene | | 1 | | | | | | | | 1/LD3 | 0/0 | - | - | 2 | 6 |
| | | | 2 | 25 | 13 | 24 | 16 | 8 | 13 | 53 | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 247 | Trimethylbenzene | | 1 | | | | | | | | 0/0 | 0/0 | - | - | 4 | 4 |
| | | | 2 | | | 6[1] | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 248 | Diethylbenzene | 000141935 | 1 | | | | | | | | 1/LD3 | 0/0 | - | - | 4 | 8 |
| | | | 2 | | | | | | 11 | | | | | | | |
| | | | 3 | | | 36 | | | | | | | | | | |

Table 8 (Continued)

ORGANIC CHEMICAL COMPOUNDS
PHILADELPHIA SOUTHEAST AND SOUTHWEST WPC PLANTS[†]

| | | | | Southeast Plant | | Southwest Plant (µg/l) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference Number[††] | Compound Name | Chemical Abstracts Service Registry Number | Sampling Date (Nov.) | Influent (4410) | Final Effluent (4420) | High Level Interceptor (4430) | Combined 80th/Schuylkill Interceptors (4555) | DELCORA Interceptor (4460) | Final Effluent (4470) | Sludge Thickener Overflow (4480) | Toxic Substances List | Suspected Carcinogens List | OSHA Standards[†††] | Aquatic Toxicity | Toxline | Toxicity Index |
| 249 | Dimethylethyl-benzene | | 1 | | | | | | | | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | | | 9[1] | | | 16[1] | | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 250 | 6-Methyl-1,2,3,4-tetrahydro-naphthalene | 001680519 | 1 | | | | | | | | 0/0 | 0/0 | - | | 0 | 0 |
| | | | 2 | | | | | | | 190[1] | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 251 | 2,6,Dimethyl-1,2,3,4-tetra-hydronaphthalene | 007524632 | 1 | | | | | | | | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | 39[1] | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 252 | 5,6-Dimethyl-1,2,3,4-tetra-hydronaphthalene | 020027774 | 1 | MS[2] | | | | | | | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | | |
| 253 | 2-n-Butoxyethanol | 000111762 | 1 | | | | | | | | 11/TD4 | 0/0 | 4 | - | 3 | 22 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | 79[1] | | | | | | | | |
| 254 | 2-Ethyl-1-hexanol | 000104767 | 1 | | | | | | | | 6/LD3 | 0/0 | - | - | 7 | 15 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | 38 | | | | | | | | | | | | |
| 255 | Methylisopropyl-benzene | | 1 | | | | | | | | 0/0 | 0/0 | - | - | 3 | 3 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | | 15[1] | | | | | | | |
| 256 | Tetramethylbenzene | | 1 | | | | | | | | 0/0 | 0/0 | - | - | 1 | 1 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | 21[1] | | | | | | | | | | | | |
| 257 | 2-Ethylhexyliodide | | 1 | | | | | | | | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | 25[1] | | | 510[1] | | | | | | |

*Table 8 (Continued)*

*ORGANIC CHEMICAL COMPOUNDS*
*PHILADELPHIA SOUTHEAST AND SOUTHWEST WPC PLANTS*†

| Reference Number†† | Compound Name | Chemical Abstracts Service Registry Number | Sampling Date (Nov.) | Southeast Plant: Influent (4410) | Southeast Plant: Final Effluent (4420) | Southwest Plant: High Level Interceptor (4430) | Southwest Plant: Combined 80th/Schuylkill Interceptors (4555) | Southwest Plant: DELCORA Interceptor (4460) | Southwest Plant: Final Effluent (4470) | Southwest Plant: Sludge Thickener Overflow (4480) | Toxic Substances List | Suspected Carcinogens List | OSHA Standards††† | Aquatic Toxicity | Toxline | Toxicity Index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | µg/l | | | | | | | | | | | | |
| 258 | Dimethyltetra-hydronaphthalene | | 1 | | | | | | | | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | 14[1] | | | | | | | | | | |
| 259 | n-Hexadecanol | 000124298 | 1 | | | | | | | | 1/LD3 | 0/0 | - | - | 4 | 8 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | 47 | | | | | | | | | |
| 260 | n-Tetradecanol | 000112721 | 1 | | | | | | | | 0/0 | 0/0 | - | - | 1 | 1 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | 24[1] | | | | | | | | |
| 261 | n-Eicosane | 000112958 | 1 | | | | | | | | 0/0 | 0/0 | - | - | 4 | 4 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | 38 | | | 54 | 47 | | 700 | | | | | | |
| 262 | n-Docosane | 000629970 | 1 | | | | | | | | 0/0 | 0/0 | - | - | 6 | 6 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | 260 | | | | | | | | |
| 263 | n-Tricosane | 000638675 | 1 | | | | | | | | 0/0 | 0/0 | - | - | 1 | 1 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | 520 | | | | | | | | |
| 264 | n-Tetracosane | 000646311 | 1 | | | | | | | | 0/0 | 0/0 | - | - | 3 | 3 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | 520 | | | | | | | | |
| 265 | n-Pentacosane | 000629992 | 1 | | | | | | | | 0/0 | 0/0 | - | - | 1 | 1 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | 470 | | | | | | | | |
| 266 | n-Hexacosane | 000630013 | 1 | | | | | | | | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | ~450 | | | | | | | | |
| 267 | n-Heptacosane | 000593497 | 1 | | | | | | | | 0/0 | 0/0 | - | - | 0 | 0 |
| | | | 2 | | | | | | | | | | | | | |
| | | | 3 | | | | | ~450 | | | | | | | | |

Table 8 (Continued)

ORGANIC CHEMICAL COMPOUNDS
PHILADELPHIA SOUTHEAST AND SOUTHWEST WPC PLANTS†

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† Column headings are explained in report text.

†† The chemical compounds have been assigned unique numbers which appear in ascending order.

††† The OSHA Standard toxicity rating is explained in Appendix D.

1 Compound has been identified but due to interferences or lack of an in-house standard the concentration value is only estimated from the response of a similar compound or the contribution to a multiple component peak estimated.

2 MS indicates mass spectrum identification only, not confirmed.

3 The toxicity rating for compound 224 is based on the Threshold Limit Value rather than the OSHA Standard which is not established.

4 The toxicity rating for compound 225 is based on the OSHA Standard which is reported as being 5 $mg/m^3$ using a conversion assuming that this is equivalent to 5 ppb.

of the total organic compounds present in such waters. A much fuller discussion is found in the recently published book *Identification and Analysis of Organic Pollutants in Water.*[5]

The compounds listed in Table 8 are not unique to the waters sampled. Concurrent exposure to these compounds by various segments of the United States population exists via some foods, ambient air, occupational environment, and household products including over-the-counter medications, cleaning solutions, and cosmetics. Exposure to such chemicals can cause adverse reactions in people, modified by individual susceptibility in terms of specific adaptation. Adverse reactions, which are manifested in a wide variety of physical and mental symptoms, are often chronic in nature and cyclic in occurrence, producing conditions which are frequently undiagnosed or poorly identified. Interpretation of the clinical ecological effects of the compounds identified in Table 8 is difficult and beyond the scope of this report, but may be found in *Clinical Ecology.*[6] However, the compounds identified during the survey were evaluated, and a toxicity index was developed [Appendix D] which is a number estimating each compound's toxicity relative to the other compounds identified. Consideration of absolute toxicity factors, such as the development of cancer or lethal dose, was used to indicate the compounds which are potentially more harmful than others. The toxicity index is more a safety hazard evaluation than a clinical ecological interpretation.

One of the most important conclusions reached in this study is that the effects of long-term exposure to individual compounds or exposure to the whole spectrum of the 67 compounds identified are unknown. A toxicity index was determined for 50 of these compounds including one suspected carcinogen, biphenyl.

## TOXICITY DATA

Table 9 summarizes, for the chemicals identified, the number of reported toxic doses to various organisms. Sixty-seven chemicals were identified and toxic dose data are reported for 17 of those in the 1974 NIOSH* Toxic Substances List,[7] the 1975 NIOSH Suspected Carcinogens - a Subfile of the NIOSH Toxic Substances List,[8] or in the Registry of Toxic Effects of Chemical Substances, 1975 edition.[9] For several of these chemicals there are multiple reports as to toxicity by each of several modes of exposure. For example, for toluene there are two reports concerning human toxicity through inhalation exposure; for other chemicals there may be several reported toxicities for "Oral dog," "Oral rat," "Inhalation human," etc. A total of 47 individual bits of toxicity data are reported for the 17 chemicals identified.

A more detailed presentation was made of the data relating to oral and inhalation exposure as these are the more likely modes of human contact [Table 10]. Table 10 also lists the U. S. Occupational Standards of chemicals for which data are reported in references 7, 8, and 9.

Most of the organic compound concentrations found during the study were one or more orders of magnitude less than toxic doses, lethal doses and the U. S. Occupational Standards. However, important considerations remain unknown. Most of the toxic dosage and lethal dosage studies were of short duration using relatively high concentrations of the substances investigated, and importantly, the toxic and lethal effects of each substance were evaluated on an individual basis. Virtually no reports are available concerning long-term effects of exposure to most of the

* *National Institute for Occupational Safety and Health.*

*Table 9*

*SUMMARY OF REPORTED TOXIC DOSES BY ORGANISM AND TYPE OF EXPOSURE*
*SOUTHEAST AND SOUTHWEST WATER POLLUTION CONTROL PLANTS*
*November 1-3, 1976*

| Toxicity Scale[†] | | Number of Reported Toxic Doses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Oral | Inhalation | Subcutaneous | Intraperitoneal | Skin | Intravenous | Parenteral | Ocular | Total |
| 7 | Human | 1 | 3 | - | - | - | - | - | 1 | 5 |
| 6 | Monkeys | - | - | - | - | - | - | - | - | 0 |
| 5 | Cat, Dog, Pig, Cattle, or Domestic Animal | - | - | - | - | - | - | - | - | 0 |
| 4 | Rat | 10 | 2 | 2 | 8 | 0 | 1 | - | - | 23 |
| 3 | Mouse | 1 | 2 | - | 1 | - | 1 | - | - | 5 |
| 2 | Guinea Pig, Gerbil, Hamster, Rabbit, etc. | 6 | - | - | 2 | 5 | 1 | - | - | 14 |
| 1 | Wild Bird, Bird, Chicken, Duck, Quail, Turkey | - | - | - | - | - | - | - | - | 0 |
| 0 | Frog | - | - | - | - | - | - | - | - | 0 |
| | Total | 18 | 7 | 2 | 11 | 5 | 3 | 0 | 1 | 47 |

† *Refer to text Section VII for explanation.*

*Table 10*

*SUMMARY OF ORAL AND INHALATION EXPOSURES TO TOXIC ORGANIC CHEMICALS*[†]
*SOUTHEAST AND SOUTHWEST WATER POLLUTION CONTROL PLANTS*

| Ref. No. | Compound Name (mode of dose) | Lowest Published Toxic Dose mg/kg | Lowest Published Lethal Dose mg/kg | Lethal Dose or Concentration 50% Kill mg/kg | U S. Occupational Std. time-weighted avg. concentration in air ppm |
|---|---|---|---|---|---|
| 201 | Toluene | | | | 200 |
| | Inhalation Human | 200 | | | |
| | Inhalation Man | 100 | | | |
| | Oral Rat | | | 3,000 | |
| | Inhalation Rat | | 4,000[††]/4 hr | | |
| 202 | Ethylbenzene | | | | 100 |
| | Oral Rat | | | 3,500 | |
| | Inhalation Rat | | 4,000[††]/4 hr | | |
| 205 | Cumene | | | | 50 |
| | Oral Rat | | | 1,400 | |
| | Inhalation Mouse | | 2,000[††] | | |
| 213 | Borneol | | | | |
| | Oral Rabbit | | 2,000 | | |
| 218 | Biphenyl | | | | 0.2 |
| | Oral Rat | | | 2,180 | |
| | Oral Rabbit | | | 2,400 | |
| 219 | sec-Butylbenzene | | | | |
| | Oral Rat | | | 2,240 | |
| 220 | 2-Ethylnaphthalene | | | | |
| | Oral Rat | | 5,000 | | |
| 227 | n-Octane | | | | 500 |
| 248 | Diethylbenzene | | | | |
| | Oral Rat | | | 1,200 | |
| 253 | 2-n-Butoxyethanol | | | | 50 |
| | Inhalation Human | 195[††]/8 hr | | | |
| | Oral Rat | | | 1,480 | |
| | Oral Mouse | | | 1,230 | |
| | Inhalation Mouse | | | 700[††]/7 hr | |
| | Oral Rabbit | | | 320 | |
| | Oral Guinea Pig | | | 1,200 | |
| 254 | 2-Ethyl-1-Hexanol | | | | |
| | Oral Rat | | | 4,125 | |
| | Oral Rabbit | | | 3,580 | |
| | Oral Guinea Pig | | | 1,300 | |
| 259 | n-Hexadecanol | | | | |
| | Skin Rabbit | | | 2,600 | |

† *From References 7, 8, and 9.*
†† *Concentration in parts per million*

substances identified, and data are not available on the combined effects of exposure to this wide spectrum of toxic substances.

## EVALUATION OF ORGANIC COMPOUNDS FOUND IN WASTEWATER

Although previous projects of a similar nature have been performed,[5] fewer compounds were identified. More compounds were identified in this study due to the large number of industries discharging to the Philadelphia Southeast and Southwest WPC plants and improved analytical techniques which have made it possible to identify a greater number of compounds at lower concentrations than in previous studies. As noted previously, a total of sixty-seven separate compounds were identified in this study. Forty-seven compounds were identified in the influent to the Southeast WPCP and thirty-six compounds were identified in the effluent. Thirty-four compounds were identified in both the influent and effluent. Fifty-four compounds were identified in one or more influents to the Southwest WPCP and forty compounds were identified in the effluent. Thirty-nine compounds were identified in both one or more influents, including the sludge thickener overflow, and in the effluent. Specific findings follow.

### Southeast WPCP

#### *Southeast Influent*

The forty-seven compounds identified in the influents to the Southeast WPCP are listed below. Thirty-seven compounds which have a toxicity index are identified by a dagger (†).

| Compound Number | Compound Name |
|---|---|
| 201† | toluene |
| 202† | ethylbenzene |
| 203† | *m*-, ρ-xylene |
| 204† | *o*-xylene |
| 205† | cumene |
| 206† | *m*-ethyltoluene |
| 207† | 1,3,5-trimethylbenzene |
| 208† | *o*-ethyltoluene |
| 209† | 1,2,4-trimethylbenzene |
| 210† | *m*-dichlorobenzene |
| 211† | 1,2,3-trimethylbenzene |
| 213† | borneol |
| 214† | *α*-terpineol |
| 215† | 2-methylnaphthalene |
| 216 | 5-methyl-1,2,3,4-tetrahydronaphthalene |
| 217 | dimethyl-1,2,3,4-tetrahydronaphthalene |
| 219† | sec-butylbenzene |
| 220† | ethylnaphthalene |
| 221 | 1,2-dimethylnaphthalene |
| 222 | tri-methylnaphthalene |
| 223 | 2,3,6-trimethylnaphthalene |
| 224† | diethylphthalate |
| 225† | di-n-butylphthalate |
| 226† | 1,2,4,5-tetramethylbenzene |
| 227† | n-octane |
| 228† | n-nonane |
| 229 | n-decane |
| 230† | n-undecane |
| 231† | n-dodecane |
| 232† | n-tridecane |
| 233† | n-tetradecane |
| 234† | n-pentadecane |
| 235† | n-hexadecane |
| 236† | n-heptadecane |
| 237† | pristane |
| 238† | n-octadecane |
| 239† | phytane |
| 240† | n-nonadecane |
| 241 | ρ-eicosane |
| 242† | heneicosane |
| 243 | other substituted alkanes |
| 246† | *m*-, ρ-ethyltoluene |
| 251 | 2,6-dimethyl-1,2,3,4-tetrahydronaphthalene |
| 252 | 5,6-dimethyl-1,2,3,4-tetrahydronaphthalene |
| 254† | 2-ethyl-1-hexanol |
| 256† | tetramethylbenzene |
| 261† | n-eicosane |

The total influent organic loads for November 1, 2, and 3, 1976, were 1,100 kg (2,400 lb), 1,300 kg (2,900 lb), and 1,500 kg (3,200 lb), respectively, as given in Table 11. Thus, the daily average load was 1,300 kg (2,833 lb) or 3,900 kg (8,500 lb) for the three-day sampling period. In terms of organic concentrations, the daily average was 2,600 μg/l.

The most general observation is that none of these compounds represent normal human metabolites [Table 8, and Appendix D]. They are all of industrial origin and it is likely that many of these compounds are foreign and inhibitory to the metabolism of organisms normally found in biological treatment systems. This could have significance in terms of reduced removal efficiencies when planned biological treatment facilities are completed.

A second observation is the wide range in concentration (100-fold), from 2 ppb for n-octane (227) to 210 ppb for n-hexadecane (235) [Table 8].

Trimethylnaphthalene (222) demonstrates another noticeable trend, namely that daily waste concentrations for individual compounds varied by a factor of more than 9 during sampling. Such rapid fluxes in concentration of these foreign chemicals could make it more difficult for microorganisms in the planned biological treatment facilities to adjust their metabolic processes to biodegrade the organics. For example, the load of trimethylnaphthalene (222) was 12 kg (26 lb) on November 1, 1976; 19 kg (42 lb) on November 2, and 102 kg (264 lb) on November 3. Since this compound is of industrial origin, it most likely represents discharges from manufacturing operations in which cleaning processes result in intermittent higher concentrations. Similar inferences can be found throughout Table 8 where a periodic or one-time significant discharge occurred along with chronic low-level discharges.

*Table 11*

*ORGANICS LOAD*
*SOUTHEAST WATER POLLUTION CONTROL PLANT*
*November 1976*

| Day (Nov. 1976) | Influent (4410) | | | | | Effluent (4420) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | μg/l | $m^3$/day x $10^3$ | mgd | kg/day | lb/day | μg/l | $m^3$/day x $10^3$ | mgd | kg/day | lb/day |
| 1 | 1,900 | 564 | 149 | 1,100 | 2,400 | 1,600 | 564 | 149 | 890 | 2,000 |
| 2 | 2,800 | 473 | 125 | 1,300 | 2,900 | 830 | 473 | 125 | 390 | 860 |
| 3 | 3,000 | 484 | 128 | 1,500 | 3,200 | 690 | 484 | 128 | 330 | 730 |
| Total | 7,700 | 1,521 | 402 | 3,900 | 8,500 | 3,100 | 1,521 | 402 | 1,600 | 3,600 |
| Avg. | 2,600 | 507 | 134 | 1,300 | 2,833 | 1,000 | 507 | 134 | 540 | 1,200 |

Due to the substantial quantities of organics, the distribution of manufacturing industries potentially discharging to the Philadelphia Southeast WPCP was evaluated. The drainage area was translated into zip code districts which were machine-searched in a computerized file of manufacturers in the area. There are 655 industrial plants employing 20 or more people within 20 broad SIC* or product codes in the area served by the collection system:

| SIC Code | Number of Plants | Industry |
|---|---|---|
| 20 | 71 | Food and kindred products |
| 21 | 1 | Tobacco products |
| 22 | 50 | Textile mill products |
| 23 | 140 | Apparel and related products |
| 24 | 8 | Wood and wood products |
| 25 | 26 | Furniture |
| 26 | 27 | Paper and allied products |
| 27 | 77 | Printing and publishing |
| 28 | 28 | Chemicals and allied products |
| 29 | 3 | Petroleum and energy products |
| 30 | 7 | Rubber and allied products |
| 31 | 17 | Leather and products |
| 32 | 10 | Stone, clay and glass products |
| 33 | 5 | Metals |
| 34 | 72 | Fabricated metal products |
| 35 | 31 | Machinery, electric |
| 36 | 18 | Electric and electronic equipment |
| 37 | 4 | Transport equipment |
| 38 | 20 | Instruments and related products |
| 39 | 40 | Manufacturing, miscellaneous |

An alphabetized list of all manufacturing industries, including employment, share of market, and sales statistics is on record at NEIC.[10]

* *Standard Industrial Classification*

*Southeast Effluent*

There were thirty-six compounds identified in the effluent from the Southeast WPCP. Thirty-four compounds in the effluent were also identified in the influent and are marked with an asterisk (*) in the following list. Twenty-eight compounds which have a toxicity index are identified by a dagger (†).

| Compound Number | Compound Name |
|---|---|
| 201*† | toluene |
| 202*† | ethylbenzene |
| 203*† | *m*-, ρ-xylene |
| 204*† | *o*-xylene |
| 205*† | cumene |
| 206*† | *m*-ethyltoluene |
| 208*† | *o*-ethyltoluene |
| 209*† | 1,2,4-trimethylbenzene |
| 210*† | *m*-dichlorobenzene |
| 211*† | 1,2,3-trimethylbenzene |
| 213*† | borneol |
| 214*† | *α*-terpineol |
| 215*† | 2-methylnaphthalene |
| 217* | dimethyl-1,2,3,4-tetrahydronaphthalene |
| 218† | biphenyl |
| 221* | 1,2-dimethylnaphthalene |
| 222* | trimethylnaphthalene |
| 223* | 2,3,6-trimethylnaphthalene |
| 224*† | diethylphthalate |
| 225*† | di-n-butylphthalate |
| 229* | n-decane |
| 230*† | n-undecane |
| 231*† | n-dodecane |
| 232*† | n-tridecane |
| 233*† | n-tetradecane |
| 234*† | n-pentadecane |
| 235*† | n-hexadecane |
| 236*† | n-heptadecane |
| 237*† | pristane |
| 238*† | n-octadecane |
| 239*† | phytane |
| 240*† | n-nonadecane |
| 241* | ρ-eicosane |
| 243* | other substituted alkanes |
| 244 | chlorofluorocarbons |
| 246*† | *m*-, ρ-ethyltoluene |

A suspected carcinogen, biphenyl (218), was detected in the discharge from the Southeast WPCP. On the first day of organics sampling, 16.4 kg (36.0 lb) of this hazardous substance was discharged to the Delaware River while somewhat less, 8.2 kg (18.1 lb), was discharged on the third day of sampling.

Of the approximately 3,900 kg (8,500 lb) of industrial-origin organics received by the Southeast WPCP collection system during the 3 days of sampling, 1,600 kg (3,600 lb), or 42%, was discharged at a daily concentration of 1,000 μg/l through the Southeast outfall to the Delaware River [Table 11]. These industrial chemicals are then available to potentially cause harm to organisms living in the river, or to organisms feeding on aquatic life or consuming the water. In addition, an unknown quantity of the organic compounds reach the ocean through the barging of anaerobically digested sludge.

## Southwest WPCP

### *Southwest Influent*

Fifty-four organic compounds were identified in one or more influents to the Southwest WPCP, including the sludge thickener overflow which is also discharged back to the headworks of the plant. The forty-six compounds which have a toxicity index are identified with a dagger (†).

| Compound Number | Compound Name |
|---|---|
| 201† | toluene |
| 202† | ethylbenzene |
| 203† | *m*-, *p*-xylene |
| 204† | *o*-xylene |
| 205† | cumene |
| 206† | *m*-ethyltoluene |
| 207† | 1,3,5-trimethylbenzene |
| 208† | *o*-ethyltoluene |
| 209† | 1,2,4-trimethylbenzene |
| 210† | *m*-dichlorobenzene |
| 212† | isopropyltoluene |
| 213† | borneol |
| 214† | α-terpineol |
| 215† | 2-methylnaphthalene |
| 216 | 5-methyl-1,2,3,4-tetrahydronaphthalene |
| 217 | dimethyl-1,2,3,4-tetrahydronaphthalene |
| 218† | biphenyl |
| 219† | sec-butylbenzene |
| 220† | ethylnaphthalene |
| 221 | 1,2-dimethylnaphthalene |
| 222 | trimethylnaphthalene |
| 223 | 2,3,6-trimethylnaphthalene |
| 224† | diethylphthalate |
| 225† | di-n-butylphthalate |
| 226† | 1,2,4,5-tetramethylbenzene |
| 227† | n-octane |
| 228† | n-nonane |
| 229 | n-decane |
| 230† | n-undecane |
| 231† | n-dodecane |
| 232† | n-tridecane |
| 233† | n-tetradecane |
| 234† | n-pentadecane |
| 235† | n-hexadecane |
| 236† | n-heptadecane |
| 237† | pristane |
| 238‡ | n-octadecane |
| 239† | phytane |
| 240† | n-nonadecane |
| 241 | p-eicosane |
| 242† | heneicosane |
| 243 | other substituted alkanes |
| 245† | bromobenzene |
| 246† | *m*-, *p*-ethyltoluene |
| 247† | trimethylbenzene |
| 248† | diethylbenzene |
| 249 | dimethylethylbenzene |
| 250 | 6-methyl-1,2,3,4-tetrahydronaphthalene |
| 253† | 2-n-butoxyethanol |
| 257 | 2-ethylhexyliodide |
| 258 | dimethyltetrahydronaphthalene |
| 259† | n-hexadecanol |
| 260† | n-tetradecanol |
| 261† | n-eicosane |
| 262† | n-docosane |
| 263† | n-tricosane |
| 264† | n-tetracosane |
| 265† | n-pentacosane |
| 266 | n-hexacosane |
| 267 | n-heptacosane |

The total influent organic loads for November 1, 2, and 3, 1976, were 575 kg (1,230 lb), 581 kg (1,274 lb), and 836 kg (1,810 lb), respectively, as given in Table 12. Thus the daily average load was 665 kg (1,415 lb) or 1,970 kg (4,220 lb) for the three-day sampling period. In terms of organic loadings, this represents a weighted-daily-average concentration of 1,060 μg/l.

As noted previously regarding the Southeast WPCP, none of these compounds entering the Southwest WPCP represent normal human metabolites. They are all of industrial origin and it is likely that many of these compounds are foreign and inhibitory to the metabolism of organisms normally found in biological treatment systems. This could have significance in terms of reduced removal efficiencies when planned biological treatment facilities are completed.

A second observation is the wide range in concentration (200-fold), from 2 ppb for 2,3,6-trimethylnaphthalene (223) to 400 ppb for n-pentadecane (234)[Table 8]. Trimethylnaphthalene (222) again demonstrates a noticeable trend, namely that daily waste concentrations for individual compounds varied by a factor of more than 10 during sampling. Such rapid fluxes in concentration of these foreign chemicals could make it that much more difficult for microorganisms in the planned treatment facilities to adjust their metabolic process to biodegrade the organics. For example, the load of trimethylnaphthalene (222) was 0.16 kg (0.35 lb) on November 1, 1976; 0 on November 2; and 0.02 kg (0.04 lb) on November 3 for the DELCORA Interceptor. For the combined 80th and Schuykill Interceptor, the loads for days 1, 2 and 3 were 0.12 kg (0.26 lb), 0.96 kg (2.1 lb), and 0.84 kg (1.9 lb), respectively. For the High Level Interceptor, the loads for days 1, 2, and 3 were 1.2 kg (2.7 lb), 0 and 1.1 kg (2.4 lb). Since this compound is of industrial origin, it most likely represents discharges from manufacturing operations in which cleaning processes result in intermittent higher concentrations. Similar inferences can be found throughout Table 8 where a periodic or one-time significant discharge occurs along with chronic low-level discharges.

The sludge thickener overflow returning to the head of the Southeast WPCP shows that this effect is carried over into the sludge. The overflow of trimethylnaphthalene (222) from the sludge was 0.007 kg (0.015 lb) for day 1, 0.047 kg (0.10 lb) for day 2, and 0.059 kg (0.13 lb) for day 3, respectively.

Not only does this slug loading effect carryover to the sludge, but the presence of the organics in the sludge overflow indicates that the treatment process is trapping and concentrating them in the sludge. A review of Table 8 shows that many compounds are increased in concentration several hundred times in the sludge thickener overflow compared to the three interceptors. Since concentrates of these industrial-origin organic contaminants are already leaching from the sludge while it is within the plant, there is good reason to believe that the contaminants will continue to leach from the sludge in concentrated form whenever it is exposed to water, such as in standard landfill or ocean disposal. Hence, careful consideration must be given to the method of sludge disposal.

A suspected carcinogen, biphenyl (218), was detected in the DELCORA Interceptor.

Due to the substantial quantities of organics, the distribution of manufacturing industries potentially discharging to the Philadelphia Southwest WPCP was evaluated. The drainage area was translated into zip code districts which were machine-searched in a computerized file of manufacturers in the area. There are 396 industrial plants employing 20 or more people within 20 broad SIC or product codes in the area served by the collection system:

| SIC Code | Number of Plants | Industry |
|---|---|---|
| 20 | 25 | Food and kindred products |
| 21 | 0 | Tobacco products |
| 22 | 19 | Textile mill products |
| 23 | 75 | Apparel and related products |
| 24 | 4 | Wood and wood products |
| 25 | 13 | Furniture |
| 26 | 18 | Paper and allied products |
| 27 | 61 | Printing and publishing |
| 28 | 26 | Chemicals and allied products |
| 29 | 8 | Petroleum and energy products |
| 30 | 6 | Rubber and allied products |
| 31 | 5 | Leather and products |
| 32 | 14 | Stone, clay and glass products |
| 33 | 4 | Metals |
| 34 | 30 | Fabricated metal products |
| 35 | 29 | Machinery, electric |
| 36 | 22 | Electric and electronic equipment |
| 37 | 5 | Transport equipment |
| 38 | 19 | Instruments and related products |
| 39 | 13 | Manufacturing, miscellaneous |

An alphabetized list of all 396 manufacturing industries, including employment, share of market, and sales statistics is on record at NEIC.[9]

*Southwest Effluent*

There were forty compounds identified in the effluent from the Southwest WPCP. Thirty-nine compounds in the effluent were also identified in one or more interceptors or the sludge thickener overflow and are marked with an asterisk (*) in the following list. Thirty-four compounds which have a toxicity index are identified with a dagger (†).

| Compound Number | Compound Name |
|---|---|
| 201*† | toluene |
| 202*† | ethylbenzene |
| 203*† | *m*-, ρ-xylene |
| 204*† | *o*-xylene |
| 205*† | cumene |
| 206*† | *m*-ethyltoluene |
| 207*† | 1,3,5-trimethylbenzene |
| 208*† | *o*-ethyltoluene |
| 209*† | 1,2,4-trimethylbenzene |
| 210*† | *m*-dichlorobenzene |
| 213*† | borneol |
| 214*† | α-terpineol |
| 215*† | 2-methylnaphthalene |
| 218*† | biphenyl |
| 219*† | sec-butylbenzene |
| 221* | 1,2-dimethylnaphthalene |
| 222* | trimethylnaphthalene |
| 223* | 2,3,6-trimethylnaphthalene |
| 224*† | diethylphthalate |
| 225*† | di-n-butylphthalate |
| 226*† | 1,2,4,5-tetramethylbenzene |
| 228*† | n-nonane |
| 229* | n-decane |
| 230*† | n-undecane |
| 231*† | n-dodecane |
| 232*† | n-tridecane |
| 233*† | n-tetradecane |
| 234*† | n-pentadecane |
| 235*† | n-hexadecane |
| 236*† | n-heptadecane |
| 237*† | pristane |
| 238*† | n-octadecane |
| 239*† | phytane |
| 240*† | n-nonadecane |
| 243* | other substituted alkanes |
| 245*† | bromobenzene |
| 246*† | *m*-, ρ-ethyltoluene |
| 248*† | diethylbenzene |
| 249* | dimethylethylbenzene |
| 255† | methylisopropylbenzene |

A suspected carcinogen, biphenyl (218), was detected in the discharge from the Southwest WPCP.

Of the approximately 1,970 kg (4,220 lb) of industrial origin organics received by the Southwest WPCP collection system during the 3 days of sampling, 1,100 kg (2,500 lb), or 59%, was discharged at a daily concentration of 600 μg/l through the Southwest outfall to the Delaware River [Table 12]. These industrial chemicals are then available to potentially cause harm to organisms living in the river, or to organisms feeding on aquatic life or consuming the water. In addition, an unknown quantity of the organic compounds reach the ocean through the barging of anaerobically digested sludge.

*Table 12*

*ORGANICS LOAD*
*SOUTHWEST WATER POLLUTION CONTROL PLANT*
*November 1976*

| Day (Nov.1976) | High Level Interceptor 4430 | | | | | Combined 80th and Schuylkill Interceptor 4555 | | | | | DELCORA Interceptor 4460 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | μg/l | $m^3$/day x $10^3$ | mgd | kg/day | lb/day | μg/l | $m^3$/day x $10^3$ | mgd | kg/day | lb/day | μg/l | $m^3$/day x $10^3$ | mgd | kg/day | lb/day |
| 1 | 760 | 613 | 162 | 470 | 1,000 | 990 | 59 | 15.6 | 58 | 130 | 3,000 | 16 | 4.1 | 47 | 100 |
| 2 | 640 | 541 | 143 | 350 | 760 | 4,900 | 45.8 | 12.1 | 220 | 490 | 840 | 13 | 3.4 | 11 | 24 |
| 3 | 1,100 | 560 | 148 | 600 | 1,300 | 4,000 | 46.9 | 12.4 | 190 | 410 | 3,800 | 12 | 3.2 | 46 | 100 |
| Total | 2,500 | 1,714 | 453 | 1,400 | 3,000 | 9,900 | 151.7 | 40.1 | 470 | 1,000 | 7,600 | 41 | 10.7 | 100 | 220 |
| Avg. | 830 | 571 | 151 | 470 | 1,000 | 3,300 | 50.6 | 13.4 | 160 | 340 | 2,500 | 14 | 3.6 | 35 | 75 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Final Effluent 4470 | | | | | Sludge Thickener Overflow 4480 | | | | |
| 1 | 590 | 689 | 182 | 400 | 890 | 18,000 | 1.4 | 0.36 | 25 | 55 |
| 2 | 680 | 598 | 158 | 410 | 900 | 19,000 | 0.79 | 0.21 | 15 | 33 |
| 3 | 540 | 621 | 164 | 340 | 740 | 33,000 | 0.98 | 0.26 | 33 | 72 |
| Total | 1,800 | 1,908 | 504 | 1,100 | 2,500 | 70,000 | 3.17 | 0.83 | 73 | 160 |
| Avg. | 600 | 636 | 168 | 380 | 840 | 23,000 | 1.06 | 0.28 | 24 | 53 |

# REFERENCES

1. Manual of Methods for Chemical Analysis of Water and Wastes, 1974, U. S. Environmental Protection Agency, Office of Technology Transfer, Washington, D.C.

2. Influent and Effluent Metal Loadings at Philadelphia's Wastewater Pollution Control Plants, November, 1974. Industrial Waste Unit, Philadelphia Water Department.

3. Letter from EPA Regional Administrator to Mayor Frank L. Rizzo, dated April 21, 1972.

4. National Interim Primary Drinking Water Regulations, Federal Register, Vol. 40, No. 248 - Wednesday, December 24, 1975.

5. Lawrence H. Keith, 1976. Identification and Analysis of Organic Pollutants in Water, Ann Arbor Science, Box 1425, Ann Arbor, Mich. 48106, 553 p.

6. Clinical Ecology, 1976. Lawrence C. Dickey. Ed.; Charles C. Thomas, Pub., Springfield, Ill., 807 p.

7. Herbert E. Christensen and T. T. Luginbyhl, Eds., 1974. Toxic Substances List 1974. U. S. Dept. HEW, Rockville, Md.

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9. Herbert E. Christensen and T. T. Luginbyhl, Eds. 1975. Registry of Toxic Effects of Chemical Substances. U.S. Dept. HEW, Rockville, Md.

10. Douglas B. Seba, Toxic Substances Coordinator, EPA National Enforcement Investigations Center, Bldg. 53, DFC, Denver, Colorado, 303/234-5306.

# APPENDICES

# APPENDIX A

# CHAIN OF CUSTODY PROCEDURES

ENVIRONMENTAL PROTECTION AGENCY
NATIONAL ENFORCEMENT INVESTIGATIONS CENTER

# CHAIN OF CUSTODY PROCEDURES

June 1, 1975

## GENERAL

The evidence gathering portion of a survey should be characterized by the minimum number of samples required to give a fair representation of the effluent or water body from which taken. To the extent possible, the quantity of samples and sample locations will be determined prior to the survey.

Chain of Custody procedures must be followed to maintain the documentation necessary to trace sample possession from the time taken until the evidence is introduced into court. A sample is in your "custody" if:

1. It is in your actual physical possession, or

2. It is in your view, after being in your physical possession, or

3. It was in your physical possession and then you locked it up in a manner so that no one could tamper with it.

All survey participants will receive a copy of the survey study plan and will be knowledgeable of its contents prior to the survey. A pre-survey briefing will be held to re-appraise all participants of the survey objectives, sample locations and Chain of Custody procedures. After all Chain of Custody samples are collected, a de-briefing will be held in the field to determine adherence to Chain of Custody procedures and whether additional evidence type samples are required.

## SAMPLE COLLECTION

1. To the maximum extent achievable, as few people as possible should handle the sample.

2. Stream and effluent samples shall be obtained, using standard field sampling techniques.

3. Sample tags (Exhibit I) shall be securely attached to the sample container at the time the complete sample is collected and shall contain, at a minimum, the following information: station number, station location, data taken, time taken, type of sample, sequence number (first sample of the day - sequence No. 1, second sample - sequence No. 2, etc.), analyses required and samplers. The tags must be legibly filled out in ballpoint (waterproof ink).

4. Blank samples shall also be taken with preservatives which will be analyzed by the laboratory to exclude the possibility of container or preservative contamination.

5. A pre-printed, bound Field Data Record logbook shall be maintained to record field measurements and other pertinent information necessary to refresh the sampler's memory in the event he later takes the stand to testify regarding his actions during the evidence gathering activity. A separate set of field notebooks shall be maintained for each survey and stored in a safe place where they could be protected and accounted for at all times. Standard formats (Exhibits II and III) have been established to minimize field entries and include the date, time, survey, type of samples taken, volume of each sample, type of analysis, sample numbers, preservatives, sample location and field measurements such as temperature, conductivity,

DO, pH, flow and any other pertinent information or observations. The entries shall be signed by the field sampler. The preparation and conservation of the field logbooks during the survey will be the responsibility of the survey coordinator. Once the survey is complete, field logs will be retained by the survey coordinator, or his designated representative, as a part of the permanent record.

6. The field sampler is responsible for the care and custody of the samples collected until properly dispatched to the receiving laboratory or turned over to an assigned custodian. He must assure that each container is in his physical possession or in his view at all times, or locked in such a place and manner that no one can tamper with it.

7. Colored slides or photographs should be taken which would visually show the outfall sample location and any water pollution to substantiate any conclusions of the investigation. Written documentation on the back of the photo should include the signature of the photographer, time, date and site location. Photographs of this nature, which may be used as evidence, shall be handled recognizing Chain of Custody procedures to prevent alteration.

## TRANSFER OF CUSTODY AND SHIPMENT

1. Samples will be accompanied by a Chain of Custody Record which includes the name of the survey, samplers' signatures, station number, station location, date, time, type of sample, sequence number, number of containers and analyses required (Fig. IV). When turning over the possession of samples, the transferor and transferee will sign, date and time the sheet. This record sheet allows transfer of custody of a group of samples in the field, to the mobile laboratory or when samples are dispatched to the NEIC - Denver laboratory. When transferring a portion of the samples identified on the sheet to the field mobile laboratory, the individual samples must be noted in the column with the signature of the person relinquishing the samples. The field laboratory person receiving the samples will acknowledge receipt by signing in the appropriate column.

2. The field custodian or field sampler, if a custodian has not been assigned, will have the responsibility of properly packaging and dispatching samples to the proper laboratory for analysis. The "Dispatch" portion of the "Chain of Custody Record shall be properly filled out, dated, and signed.

3. Samples will be properly packed in shipment containers such as ice chests, to avoid breakage. The shipping containers will be padlocked for shipment to the receiving laboratory.

4. All packages will be accompanied by the Chain of Custody Record showing identification of the contents. The original will accompany the shipment, and a copy will be retained by the survey coordinator.

5. If sent by mail, register the package with return receipt requested. If sent by common carrier, a Government Bill of Lading should be obtained. Receipts from post offices, and bills of lading will be retained as part of the permanent Chain of Custody documentation.

6. If samples are delivered to the laboratory when appropriate personnel are not there to receive them, the samples must be locked in a designated area within the laboratory in a manner so that no one can tamper with them. The same person must then return to the laboratory and unlock the samples and deliver custody to the appropriate custodian.

LABORATORY CUSTODY PROCEDURES

1. The laboratory shall designate a "sample custodian." An alternate will be designated in his absence. In addition, the laboratory shall set aside a "sample storage security area." This should be a clean, dry, isolated room which can be securely locked from the outside.

2. All samples should be handled by the minimum possible number of persons.

3. All incoming samples shall be received only by the custodian, who will indicate receipt by signing the Chain of Custody Sheet accompanying the samples and retaining the sheet as permanent records. Couriers picking up samples at the airport, post office, etc. shall sign jointly with the laboratory custodian.

4. Immediately upon receipt, the custodian will place the sample in the sample room, which will be locked at all times except when samples are removed or replaced by the custodian. To the maximum extent possible, only the custodian should be permitted in the sample room.

5. The custodian shall ensure that heat-sensitive or light-sensitive samples, or other sample materials having unusual physical characteristics, or requiring special handling, are properly stored and maintained.

6. Only the custodian will distribute samples to personnel who are to perform tests.

7. The analyst will record in his laboratory notebook or analytical worksheet, identifying information describing the sample, the procedures performed and the results of the testing. The notes shall be dated and indicate who performed the tests. The notes shall be retained as a permanent record in the laboratory and should note any abnormalties which occurred during the testing procedure. In the event that the person who performed the tests is not available as a witness at time of trial, the government may be able to introduce the notes in evidence under the Federal Business Records Act.

8. Standard methods of laboratory analyses shall be used as described in the "Guidelines Establishing Test Procedures for Analysis of Pollutants," 38 F.R. 28758, October 16, 1973. If laboratory personnel deviate from standard procedures, they should be prepared to justify their decision during cross-examination.

9. Laboratory personnel are responsible for the care and custody of the sample once it is handed over to them and should be prepared to testify that the sample was in their possession and view or secured in the laboratory at all times from the moment it was received from the custodian until the tests were run.

10. Once the sample testing is completed, the unused portion of the sample together with all identifying tags and laboratory records, should be returned to the custodian. The returned tagged sample will be retained in the sample room until it is required for trial. Strip charts and other documentation of work will also be turned over to the custodian.

11. Samples, tags and laboratory records of tests may be destroyed only upon the order of the laboratory director, who will first confer with the Chief, Enforcement Specialist Office, to make certain that the information is no longer required or the samples have deteriorated.

# EXHIBIT I

EPA, NATIONAL ENFORCEMENT INVESTIGATIONS CENTER

★ GPO IMPRINT

| Station No. | Date | Time | Sequence No. |
|---|---|---|---|
| | | | |

Station Location

_______ Grab
_______ Comp.

_______ BOD
_______ Solids
_______ COD
_______ Nutrients

_______ Metals
_______ Oil and Grease
_______ D.O.
_______ Bact.
_______ Other

Remarks/Preservative:

Samplers:

Front

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENFORCEMENT
NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
BUILDING 53, BOX 25227, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Back

EXHIBIT II

FOR ______________________________ SURVEY, PHASE ______, DATE ______________

TYPE OF SAMPLE ______________________

| | | | | | ANALYSES REQUIRED | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION NUMBER | STATION DESCRIPTION | TOTAL VOLUME | TYPE CONTAINER | PRESERVATIVE | NUTRIENTS | BOD | COD | TOC | TOTAL SOLIDS | SUSPENDED SOLIDS | ALKALINITY | DO | pH* | CONDUCTIVITY* | TEMPERATURE* | TOTAL COLIFORM | FECAL COLIFORM | TURBIDITY | OIL AND GREASE | METALS | BACTI | PESTICIDES | HERB | TRACE ORGANICS | PHENOL |
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REMARKS

EX T

Samplers: ______________________

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# FIELD DATA RECORD

| STATION | NUMBER | DATE | TIME | TEMPERATURE °C | CONDUCTIVITY µmhos/cm | pH S.U. | D O. mg/l | Gage Ht. or Flow Ft. or CFS |
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EXHIBIT IV

ENVIRONMENTAL PROTECTION AGENCY
Office Of Enforcement
NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
Building 53, Box 25227, Denver Federal Center
Denver, Colorado 80225

# CHAIN OF CUSTODY RECORD

| SURVEY | SAMPLERS: *(Signature)* |
|---|---|
| | |

| STATION NUMBER | STATION LOCATION | DATE | TIME | SAMPLE TYPE | | | SEQ NO | NO OF CONTAINERS | ANALYSIS REQUIRED |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water | | Air | | | |
| | | | | Comp | Grab | | | | |
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| Relinquished by: *(Signature)* | Received by: *(Signature)* | Date/Time |
| Relinquished by: *(Signature)* | Received by: *(Signature)* | Date/Time |
| Relinquished by: *(Signature)* | Received by: *(Signature)* | Date/Time |
| Relinquished by: *(Signature)* | Received by Mobile Laboratory for field analysis. *(Signature)* | Date/Time |

| | | | |
|---|---|---|---|
| Dispatched by: *(Signature)* | Date/Time | Received for Laboratory by: | Date/Time |
| Method of Shipment: | | | |

Distribution: Orig.— Accompany Shipment
1 Copy— Survey Coordinator Field Files

# APPENDIX B

# ANALYTICAL PROCEDURES AND QUALITY CONTROL

## ANALYTICAL PROCEDURES AND QUALITY CONTROL

Samples collected during this survey were analyzed, where appropriate, according to procedures approved by EPA for the monitoring of industrial effluents.* The procedures are listed in the following table.

| Parameter | Method | Reference |
|---|---|---|
| Cd, Mn, Ni, Al, Cr, Fe, Hg, Ag, As, Pb, Sn, Zn, Cu, Ba, Se | Atomic absorption | EPA Methods for Chemical Analyses of Water and Wastes 1974, p 78. |
| TSS | Gravimetric | ibid., p 268 |
| Ammonia | Automated Colorimetric phenate | ibid., page 168 |
| Oil and grease (Freon-extractable materials) | Separatory funnel extraction | ibid., p 229 |
| BOD | Serial dilution (Winkler-Azide) | ibid., page 11 |
| COD | Dichromate reduction | ibid., page 20 |
| TKN | Automated phenate | ibid., page 182 |
| $NO_3 + NO_2$ | Automate Codminum reduction | ibid., page 207 |
| Total P | Automated ascorbic acid reduction | ibid., page 256 |
| $PO_4$ | Automated ascorbic acid reduction | ibid., page 256 |

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* *Federal Register, Vol. 44, No. 232, December 1, 1976.*

Reliability of the analytical results was documented through an active Analytical Quality Control Program. As part of this program, replicate analyses were normally performed with every tenth sample to ascertain the reproducibility of the results. In addition, where appropriate, every tenth sample was spiked with a known amount of the constituents to be measured and reanalyzed to determine the percent recovery. These results were evaluated in regard to past AQC data on the precision, accuracy and detection limits of each test. On the basis of these findings, all analytical results reported for the survey were found to be acceptable with respect to the precision and accuracy control of this laboratory.

# APPENDIX C

# ORGANICS ANALYTICAL METHODOLOGY

## PHILADELPHIA SURVEY
## ORGANICS ANALYTICAL METHODOLOGY

Samples collected for general organics analyses were divided into three categories to facilitate characterization of the constituents. The first category, 3 and 6 liter extracts, were composite samples collected at sewage treatment plant (STP) influent and effluent stations. These samples were expected to contain the highest concentrations of organic constituents. The second category, 60 l extracts, were field extracted and composited on site so that very large sample volumes could be utilized where organics concentrations were expected to be lower, such as in open waters and finished water from the water treatment plant (WTP). The final category, volatile organics, were collected at all sites using the same technique since this method can tolerate a large range of concentrations of constituents.

### *EXTRACTION TECHNIQUES*

### 3 and 6 Liter Samples

Composited 3 or 6 liter (l) samples were received at the laboratory packed in ice. Each sample was warmed to room temperature and 3 l from each gallon container of composited sample was extracted with 300 milliliters (ml) of methylene chloride ($MeCl_2$). The $MeCl_2$ extract was passed through prewashed (100 ml acetone) anhydrous sodium sulfate ($Na_2SO_4$) to to remove any residual water. The $Na_2SO_4$ was then washed with 100 ml of acetone and the $MeCl_2$ extract and acetone wash combined in a 500 ml Kadurna-Danish (KD) equipped with a 3 ball Snyder column. After the volume was reduced to 10 ml, the extracts were transferred to graduated centrifuge tubes and concentrated to 5 ml under a stream of organic free air.

60 l Samples

Samples were received at the mobile laboratory as 4 five gallon glass containers of water for each 24 hour composite. 15 liter of each container were transferred to a 5 gallon pyrex bottle. 1 liter of $MeCl_2$ was added and the mixture stirred for 10 minutes using a hand-held industrial mixer. After allowing time for the $MeCl_2$ to separate, the water layer was siphoned off and the remaining mixture transferred to a 2 liter separatory tunnel. The $MeCl_2$ was drained and transferred to a 500 ml KD and the volume reduced to approximately 25 ml. On average, 600 ml of $MeCl_2$ were recovered. The extracts were transported to the NEIC laboratory where they were dried, composited and reduced in volume in the same manner as the 3 liter extracts.

Volatile Organics

The technique for volatile organics is attached as a separate section.

Gas Chromatography

The extracts from 3, 6 and 60 liter samples were analyzed using a gas chromatograph (GC) equipped with a 10 foot 2 mm ID glass column packed with 6% OV 101 on Gas-Chrom Q support and a flame ionization detector (FID). 1 microliter (μl) of the extracts (or dilutions as necessary to maintain peaks on scale) were injected onto the column. Analytical conditions were: injector temperature 220°C, detector temperature 250°C, He flow rate 20 ml/minute, initial oven temperature 80°C, final oven temperature 220°C, oven temperature program rate 6°C/min.

Mass Spectrometry

The constituents of each extract were identified using a gas chromatograph-mass spectrometer (GC-MS). The GC conditions were identical to those described earlier. Samples were injected onto the column and the oven program started. Mass spectrometer data acquisition was initiated after the solvent eluted from the GC column. A complete mass spectrum was collected in less than 4 seconds from 20-350 amμ. Mass spectra were selected on each peak of the chromatogram and identified by comparison to reference spectra obtained at the NEIC laboratory; Eight Peak Index of Mass Spectra, Second Edition, 1974; EPA mass spectral search system on the Cyphernetics Computer System or the Registry of Mass Spectral Data, Wiley & Sons, 1974. Constituents identified are considered only tentative unless verified by reference spectra obtained from the standard compound at NEIC.

Quantitation

After identification of the constituents by GC-MS, available standards were analyzed on FID GC. Retention times and peak heights of the standards were measured and used to calculate the concentrations of the identified constituents in the samples. Comparisons were also made of retention times to provide an additional verification of the identification.

Numerous other compounds were identified by GC-MS that could not be verified due to the lack of an appropriate standard at NEIC. In cases where the identification was considered very good when compared to external reference spectra, the concentrations were estimated using response factors of similar compounds with similar retention times.

# NEIC METHOD FOR DETERMINATION OF VOLATILE ORGANICS
September 1976

1. Scope and Application
   1.1 This method is applicable to open, waste, and drinking waters where volatile components are present at and above 20 ug/l.
   1.2 Since purging of the sample may not remove 100% of some components and the detector responses vary for classes of compounds, the sensitivity of the method may vary significantly for different compounds.

2. Summary of the Method
   2.1 Volatile components of the sample are purged with helium and trapped on a polymer adsorbant. The components are then desorbed and readsorbed at the head of a porous polymer analytical GC column. The GC oven is temperature programmed and the components analyzed by mass spectrometer (MS) or flame ionization detector (FID) detectors. The working range is 20 to 250 ug/l for most compounds using FID. The upper limit may be increased by using smaller sample volumes.

3. Comments
   3.1 This method requires a well conditioned GC column to avoid excessive baseline drift due to column bleed during temperature programming.
   3.2 The purging and desorbing procedure is applicable to either FID or MS detectors and is presented here independent of detector.
   3.3 The initial GC oven temperature (now 170°C) may be lowered to accommodate lower boiling components; however, some loss in information will occur due to peak broadening and decreased sensitivity.

4. Precision and Accuracy
   4.1 Replicate analyses of chloroform were performed at 500 ug/l at NEIC. Standard deviations were 0.50 and 0.006 for peak height and retention time (in cm) respectively.
   4.2 No accuracy data are available.

5. Sample Handling and Preservation
   5.1 Samples are collected in small (2 to 8 oz) glass bottles with Teflon lined screw caps and stored in ice or refrigerated at 4°C.
   5.2 Sample bottles should be filled completely to leave no air spaces. During analysis, the samples should be opened for as short a time as practicable to remove sufficient sample for analysis.

6. Apparatus
   6.1 Gas Chromatograph: Varian 1400 series or other unit capable of accepting FID or MS detectors. Unit should be temperature programmable and operable from ambient to 210°C.

6.2 GC column: 6 ft. by 2 mm ID glass column packed with 60/80 mesh Chromosorb 101. The column should be conditioned 16 hours at 230°C with 20 ml/min He flow before use.
6.3 Liquid Sample Concentrator: Tekmar LSC-1 or equivalent unit capable of purging 5 ml or more sample with He onto a Tenex adsorber column, then desorbing at 140°C from the Tenex into the injector of the GC. Bake the trap for 16 hours at 140°C with 20 ml/min He flow before use.
6.4 Mass spectrometer: Finnigan 1015 or similar.
6.5 Syringe: 5 ml gas tight syringe.

7. Reagents
7.1 Volatile organics free water: Tap or distilled water purged with He to remove volatile organics.
7.2 Helium: Zero grade He for use to purge the water samples.
7.3 Standards: Pure compounds diluted to working concentrations with water, tightly capped and stored at 4°C.

8. Procedure
8.1 Set up liquid sample concentrator (LSC) as described in the owner's manual. Adjust the purge flow rate to 20 ml/min with 65 psig He pressure at the tank. Adjust the desorb flow rate to 20 ml/min.
8.2 Set up the gas chromatograph as follows:

| | |
|---|---|
| Injector temperature: | 190-200°C |
| FID temperature: | 250°C |
| GC column flow rate: | 20 ml/min He @ 60 psig |
| Program rate: | 4°C/min |
| Initial temperature: | 170°C |
| Limit temperature: | 200°C |

8.3 Attach the LSC to the GC by pushing the hypodermic needle from the LSC trap effluent through the injector septum. Remove the LSC tubing and push a fine wire from the back of the needle through the point to remove any septum material that may have clogged the needle. Reattach the LSC to the needle.
8.4 Place 5 ml of sample into the LSC purging chamber and purge the sample for 5 minutes at 20 ml/min.
8.5 Desorb the sample components from the Tenex column for 5 minutes at 140°C onto the GC column at ambient temperature.
8.6 Immediately after 8.5, switch back to purge mode on the LSC, close the GC oven door and raise the oven temperature to 170°C by switching to "hold" with the initial temperature set to 170°C. Wait 2 minutes as the temperature rises.
8.7 Start the GC oven program at 4°C/min and the chart recorder or mass spectrometer. Note that the oven may not have stabilized at 170°C but should have just reached 170°C by this time. Collect data as necessary then repeat procedure for subsequent samples. 200°C is a sufficient upper limit for most analyses.

9. Results

9.1 Table I gives approximate retention times for a number of compounds. Figure 1 is a chromatogram showing the response using this method.

## TABLE I

Retention Times of Selected Volatile Organic Compounds

| Name | Minutes |
|---|---|
| Acetone | 1.4 |
| Methlene Chloride | 1.7 |
| Chloroform | 2.9 |
| Benzene | 3.9 |
| Toluene | 6.2 |
| Ethyl Benzene | 9.2 |
| Cumene | 13.9 |

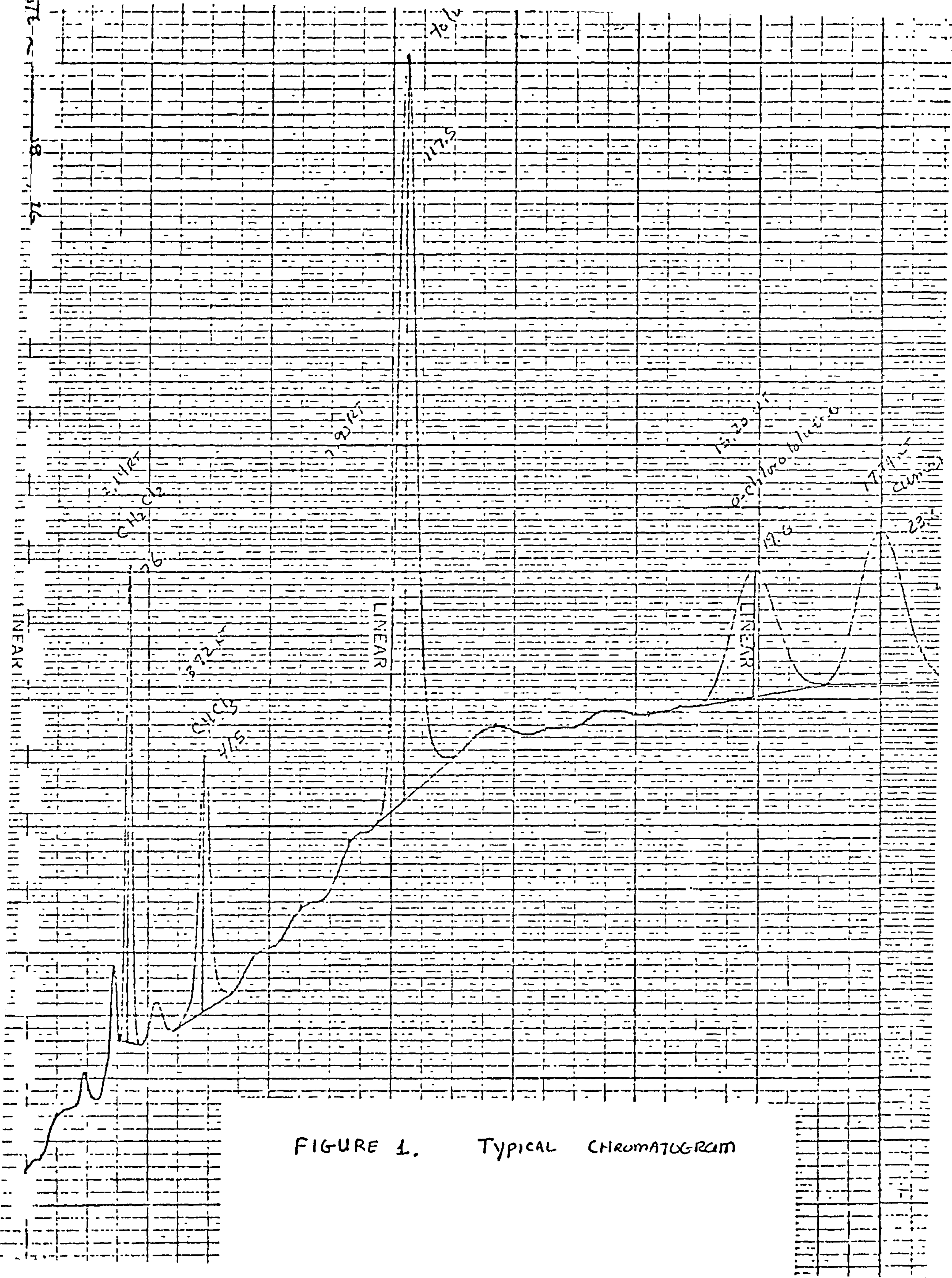


FIGURE 1. TYPICAL CHROMATOGRAM

# APPENDIX D

# DETERMINATION OF TOXICITY INDEX

## APPENDIX D
## DETERMINATION OF TOXICITY INDEX

The toxicity index developed herein is a number estimating the relative toxicity of all the organic compounds found. Consideration of absolute toxicity factors, such as the development of cancer or lethal dose, was used to indicate the compounds which are potentially more harmful than others. The toxicity index is more a safety hazard evaluation than a clinical ecological interpretation.

### Aquatic Toxicity

Data on acute doses required for intoxication serve first as a yardstick against which to compare one compound with another, and second, as a starting point in the design of repeated exposure and metabolism studies. The compounds listed in text Table 8 underwent an extensive literature search. The column heading "Aquatic Toxicity" was taken from the five-volume set *Water Quality Criteria Data Book*, published by EPA in the Water Pollution Control Research series over a period of several years. The numerator indicates the number of times a separate reference was found on the effects of that chemical on aquatic life. The denominator indicates the most toxic doses reported, according to the rating system of Gleason, et al,[1] as follows:

CLASSIFICATION SYSTEM FOR ACUTE TOXICITY OF CHEMICALS

| Toxicity Rating or Class | Lowest published toxic dose (TD) or $LD_{50}$ for animals (LD) |
|---|---|
| 6 - Super toxic | Less than 5 mg/kg (5 ppm) |
| 5 - Extremely toxic | 5 to 50 mg/kg (5 to 50 ppm) |
| 4 - Very toxic | 50 to 500 mg/kg (50 to 500 ppm) |
| 3 - Moderately toxic | 500 to 5,000 mg/kg (0.5 to 5 ppt) |
| 2 - Slightly toxic | 5 to 15 gm/kg (5 to 15 ppt) |
| 1 - Practically non-toxic | Greater than 15 gm/kg (>15 ppt) |

The specific toxicity doses (oral and inhalation) for which data are provided in references 2 or 3, are given in text Table 8. The number of citations addressing toxicity of one or another compound may reflect either the duration of the period of concern over the compound or the extraordinary recent recognition of its toxicity. Either of these motives could cause an abundance of literature citations with respect to the toxicity of a given compound. Conversely, many of the compounds which were identified have not been assigned a CAS (Chemical Abstract Registry Number) and no data concerning their toxicity and/or carcinogenicity are reported in the literature. Hence, although the number of references found is not a strict measure of the toxicity of a given substance, it is indicative of the concern and attention provided in literature. Presumably, the higher the sum of the numerator and denominator, the more toxic the chemical, the more widespread its effects, and the more cause for concern. Such a measurement does not necessarily take into account the difference between species nor does it necessarily bear any relationship to chronic toxicity which is more relevant to the low levels reported in text Table 8. This "measure" used in conjunction with other data provided in text Tables 8, 9 and 10 should be used collectively in evaluating the health effects of exposure to the compounds identified.

In addition, the Occupational Safety and Health Act (OSHA) standards have been developed for some chemicals and are given in the column "OSHA Standard." Standards were also taken from the Toxic Substances List, 1974 Edition[2] and the Registry of Toxic Effects of Chemical Substances, 1975 Edition.[3] The OSHA standards were rated in the same manner as was aquatic toxicity. For example, the OSHA standard for compound number 201 (Toluene) in Table 8 is 200 ppm which would give it a toxicity rating of 4 (very toxic). This rating system, based on a scale of 1 (practically non-toxic) to 6 (super toxic) is used to aid in weighting the overall toxicity index.

## Suspected Carcinogen List

The column "Suspected Carcinogen List" contains a numerator from which the four digits are summed to yield the denominator. The information came from the *Suspected Carcinogens: A Subfile of the NIOSH Toxic Substances List.*[4] However, in an attempt to solve the same problems encountered in interpreting the data presented in this report, the Suspected Carcinogens List was computer permuted by EPA[5] to produce a ranking of hazard, according to the following schedule:

The first digit, A, represents the species in which a carcinogenic (CAR) or neoplastic (NEO) response was reported, and assignments were made thus:

- 7: human
- 6: monkey
- 5: cat, dog, pig, cattle, or domestic animal
- 4: rat
- 3: mouse
- 2: guinea pig, gerbil, hamster, rabbit, squirrel, unspecified mammal
- 1: wild bird, bird, chicken, duck, pigeon, quail or turkey
- 0: frog

For compounds where CAR or NEO responses were reported in more than one species, the highest number was assigned.

The second digit, B, designates the number of different species for which a CAR or NEO response was reported, up to a maximum number of 9.

The third digit, C, was assigned on the basis of the route of administration for which a CAR or NEO response was reported:

- 2: inhalation, ocular or skin application
- 1: oral administration
- 0: all other routes of administration

Only the highest number was retained where CAR or NEO responses were reported for more than one route of administration.

The final digit, D, is the total number of CAR and/or NEO responses reported for this substance, up to a maximum of 9. Because the NIOSH Registry included only one entry for any route/species combination (specifically, the study in which the lowest effective dose was reported for that combination), this digit is a count of the number of different species/route combinations reported to result in a carcinogenic or neoplastic response.

## Toxline

The column "Toxline" lists the relative frequency of occurrence of toxic substance literature. The computerized data bases of the National Libraries of Medicine TOXLINE were exhaustively searched, both on-line for current files and off-line for historical files. This base contains data on toxicity and adverse effects of environmental pollutants and chemicals on the human food chain, laboratory animals, and biological systems; it also contains analytical techniques.

Accessible through Toxline are citations, and abstracts where available, from the following indexes for a total of 878,000 records, spanning the last 3-1/2 decades of medical literature.

CANCERLINE 1963-76 - Cancer Abstracts
PROJ 1975-76 - Cancer Projects
CBAC - 1965-76 - Chemical Abstracts, biochemistry sections
CHEMLINE 1973-76 - Chemical Information on Structure and Nomenclature
EMIC - 1971-74 - Environmental Mutagen Information Center
EPILEPSY - 1945-76 - Epilepsy Abstracts
HEEP - 1972-76 - Health Effects of Environmental Pollutants
PESTAB - 1966-76 - Pesticide Abstracts, EPA
HAYES - 1930-76 - EPA Pesticide File
IPA - 1970-76 - International Pharmaceutical Abstracts
TOXBIB - 1968-76 - Index Medicus toxicity subset

The search logic used was broadly constructed to retrieve any references to the adverse effects of any of the 156 chemicals listed.

Science Citation Index[R] determines the apparent scientific merit of an author's work by determining the number of times his work has been cited by other authors. Similarly, it was assumed that the more references there were in the literature to the adverse effects of a chemical, the more toxic it was in fact. Thus, the "Toxline" column lists the number of citations to the literature on the adverse effects of each chemical found in the TOXLINE.

Toxicity Index

All of these columns are mechanically summed, including both the numerators and denominators, if they occur, to create the "Toxicity Index" column. The exception is the "Suspected Carcinogen List" column, in which only the denominator was included. The "Toxicity Index" serves only as a guide to the potential hazard of those compounds found. The larger the index, the greater the potential hazard.

The total number of separate literature references gathered in the development of this report is substantial.* It should be recognized that 156 chemicals were evaluated against 19 data bases, resulting in some 3,000 possible intersections. The actual number of references located was 606 and some intersections contained more than one reference.

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* *Obviously, to explore this much information in depth on the adverse effects of these 67 chemicals would have required a report of inordinate length. However, the adverse aspects of a particular chemical can be further investigated by consulting the references on file at NEIC, Denver.*[6]

# REFERENCES

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CLEAN WATER