Environmental Engineering

DIAGNOSTIC TESTING OF EFFICIENCY
BY COMPUTERIZATION OF TREATMENT REPORTS

Master's Project

by

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Introduction

There are innumerable occupational situations where detailed accounts of routine proceedings must be completed and reported to the proper authorities. Current inventory status and process control information play a vital role in almost every functioning industry. Public utilities, including municipal wastewater treatment plants are no exception.

Each wastewater treatment plant operator in Massachusetts must complete a report containing pertinent operational data once a month. This report is then sent for review to the appropriate regional office of the Massachusetts Division of Water Pollution Control. This review process consists of checking the data for errors and obvious operational problems. In addition, all point discharges must be monitored according to the National Pollutant Discharge Elimination System (NPDES), as established by PL 92-500 (1972 Federal Water Pollution Control Act Amendments). The Division engineer could use the data to evaluate performance and determine the degree of percent plant utilization. The problem is that this type of individual attention is not feasible due to the number of reports which must be reviewed each month and the limited staff available.

The current data management system begins with tabular monthly operating reports prepared by the treatment plant operator. The Division of Water Pollution Control (DWPC) provides a monthly operating report form for this purpose, but many treatment plant operators prefer to use their own form. As a result, the Western Regional office of The DWPC recieves 80 operating reports with a variety of different formats each month. Report contents vary from 81 parameters to more elaborate forms with additional parameters and diagnostic evaluations.

After a required check of regulatory performance requirements, the most important task of the Division engineer is to "troubleshoot" treatment plants not in compliance with their permits. This includes a simple scan, and if time permits, a more detailed examination of the monthly data. Due to budget cutbacks, staff layoffs, and an ever increasing number of permit holders, Division Engineers find they do not have time to process all of the report forms. Each month approximately 400 report forms from both municipal and industrial dischargers must be reviewed, each taking about an hour to complete. Ther are approximately 110 municipal treatment plants in the State. Rapid feedback on plant performance to aid treatment plants performing poorly is impossible.

<u>Statement of Objectives</u>. The purpose of this project is to develop a readily usable, straightforward computer program

capable of aiding the Massachusetts Division of Water Pollution Control in its management of monthly reports from wastewater treatment plants in the state. The program must be suitable for checking whether the plants are in compliance with their discharge permits and be able to perform simple diagnostic evaluations for certain parameters. It is hoped that the implementation of this program will result in a more efficient management system at decreased costs to the state.

This project report provides a detailed description of the program along with information on usage of the computer program. This report can function as a users manual or simply provide information for future, suitable modification.

Benefits of Computerized Monthly Reports. The State would benefit in many ways from changing to an automated reporting system. In time saved processing municipal reports alone, 110 person-hours can be gained per month. The substitute computer processing costs are much lower. Since computerized compliance checking decreases processing time, efficiency of the overall review process is increased and the State will be able to respond more quickly to ailing treatment plants. Since the Regional Engineers have more time available for performance evaluation and meetings with operators, STP's will run more efficiently and unnecessary operating expentitures may be avoided.

The computer program can be expanded to include additional permit holders or expanded treatment diagnostics. Comparisons between similiar treatment plant schemes could be routinely performed by the program.

Computerized reporting will probably improve the accuracy of the monthly reports. The operator may be more conscientious in preparing reports knowing that each individual parameter is checked each month for compliance. Double checking data in the reports will be easier. The computer printout scheme is set up so that operator errors can be detected with just a quick glance. For example, an effluent BOD of 300 (mg/l) will appear unusual when compared to the months values ranging between 20 and 30 (mg/l). In fact the computer could be programmed to do routine statistical analysis of data in order to eliminate extraneous data points.

At the present time, there is no uniform monthly report form in Massachusetts. Furthermore, the current forms request up to 81 pieces of information each day (see AppendixI). Much more information is requested than is necessary for compliance checking. A computer printout containing only relevant information presented in tabular form would be much easier to read.

State of the Art in Monthly Performance Reporting

Wastewater treatment plant reports often contain careless errors. Regulatory agencies spend a vast amount of time checking for improper transcription of data, incorrect calculation of averages, and unsatisfactory computation of operational parameters. These errors may falsely present a plant in compliance or cause unnecessary paperwork to be sent to other regulatory agencies if the plant is spotted out of compliance incorrectly. Errors can be minimized by consistant updating and practice of dimensional analysis.

A national survey conducted by the U.S. Environmental Protection Agency (July 1979) cited improper technical guidance as the fifth most frequent cause of poor plant performance. This included misinformation from authoritive sources including design engineers, state and federal regulatory agency personnel, equipment suppliers, operator training staff, and other plant operators. Incorrect advice from officials could result from their limited field experience, inaccurate operator reporting, or simply from a lack of good supporting data.

A similiar survey conducted in 1981 by Roberts et al cited three potential sources of monitoring data by which the performance of a treatment plant might be evaluated. One source is the data contained in plant operating reports.

Another source is the sampling and analyses information maintained by state regulatory agencies. The third source is results of analysis performed on the samples collected during an on-site investigation. This survey also ranked factors contributing adversly to plant performance. Misinformation, once again, was listed as a primary concern.

Passage of the Federal Water Pollution Control Act Amendments of 1972 prompted Tinsley and Andrews to reevaluate South Carolina's method of processing monthly reports. They admit that state and federal authorities often request extraneous data and information on the operation of each wastewater treatment facility. Officials have failed to realize that extensive data collection requires both increased time and resource expenditures. Review of this data by regulatory personnel is not carried to its fullest extent simply because of the large quantities processed. Once the parameters have been reviewed for compliance and non-compliance, the data is placed in files, and generally is never accessed again. Multiple utilization of this data could result in the savings of many person-hours. They conclude that computer processing techniques utilizing only essential data would streamline the reporting system and render it more useful.

Previous Work Done at the University of Massachusetts. Research began in June 1974 by DiGiano et al on a computer program to analyze treatment plant data. The output, while presented more clearly than existing monthly reports, was not concise enough for general application. An optical scanning form was developed to aid data procesiing. A pilot scale study of implementation of the optical scanning form/DTECTR program system was conducted. Three wastewater treatment plants were involved in the study: Amherst, Massachusetts (at the time a primary treatment plant), Westfield, Massachusetts (an activated sludge treatment plant), and Greenfield, Massachusetts (a trickling filter treatment plant).

The old optical scanning form handled four days worth of data per sheet-two days of parameters were tightly fit onto each side. No decimal points were present to help the operator place significant figures. Instead of a circle response or bubble sheet, the form was equipped with bar *responses. This type of optical scanning form is now* obsolete and cannot be processed.

Plant operators from the treatment plants involved in the study completed the forms for processing and were then asked to comment on its format and the feasibility of the project. The Amherst primary treatment plant operator was not particularly impressed with the project. Data tabulation was not viewed as a more convienient system than presently used. The operator did comment that the optical scan data report sheet was a more convienient means of reporting data. However small facilities with no ability to manipulate process parameters were not highly served by the project.

The Westfield, Massachusetts treatment plant operator was more enthusiastic about the value of the project. He was convinced that the project would be a valuable tool in administration and operation of his facility.

The Greenfield, Massachusetts treatment plant operator did not feel that the data compilation method was more convienient than that currently used. She concluded that the computer report was not extensive enough to substitute completely for their Monthly Monitoring Report. In order for the monthly computer form to take the place of the monthly monitoring report, space must be provided for the operator to explain certain conditions, request assistance, etc.

Greenfield's operator felt that the computer form was not particularly valuable for administration/operation of a small plant such as theirs. The benefits gained were not outweighed by the time necessary to complete it. She did recognize the value of the program to controlling agencies. She concluded that she would not object to participating in the program since the long range benefits for the wastewater field in general would justify the inconvience to individual operators.

This work was not maintained and as of 1981 both the program and the optical scanning form were out of date, leading to the initiation of the work described in this report.

To date, very little has been published concerning automation of wastewater treatment plant data. All references do, however, agree on the usefulness and practicality of instituting such a computer program. It was decided that the actual development and implementation of the program might not be a published research topic but rather a task assigned to a consulting firm or research group.

Survey of State Practices. To determine what method of monthly monitoring was currently used, a telephone survey of State Water Pollution Control Agencies was conducted. Thirteen states were chosen as the most likely to have instituted some form of computerized monthly reporting because of their active concern and involvment in environmental controls. The following is a summary of the survey findings. The survey results are summarized in Table 1.

The state of New Hampshire has no computerized aid for checking monthly operating report forms. A state official scans each discharge report monthly. Colorado, Illinois,

STATE	COMPUTERIZED FORM GENERATION	COMPUTERIZED COMPLIANCE CHECKING	COMPUTERIZED PERFORMANCE EVALUATION	COMMENTS
New Hampshire	no	no	no	--
Colorado	no	no	no	--
Illinois	no	no	no	--
Minnesota	no	no	no	--
Oregon	no	no	no	--
Washington	no	no	no	--
Wisconsin	yes	no	no	--
Virginia	yes	no	no	--
Texas	yes	no	no	--
Maine	no	yes	no	--
New York	no	yes	no	pending
California	no	yes	no	pilot
North Carolina	no	yes	no	--
Massachusetts	no	yes	yes	w/DTECTR

TABLE 1
RESULTS OF TELEPHONE SURVEY
NOVEMBER 1982

Minnesota, Oregon, Washington and Massachusetts have divided their states into regions to ease the monthly reporting review process. They do not use computerized monthly reporting.

The Wisconsin Department of Natural Resources uses the computer to print out the required monthly forms rather than for data review. Permit information for each treatment facility has been keyed into the computer and is retrieved each month for compliance monitoring. Some information is available for design referral. Operating forms are filled out by the operator and checked for compliance by department personnel.

The Commonwealth of Virginia has adopted a computer system to print out monthly operating reports. As was the case in Wisconsin, the computer is keyed with parameters specific to each discharger. Virginia appears to do a more thorough monitoring for heavy metals and other priority pollutants. Forms completed by the operator are checked at the Virginia State Water Control Board Offices.

The Texas Department of Water Resources requires all dischargers to submit reports showing monthly averages and permit violations. If their NPDES permit requests sampling for a specific parameter, the Department also requires this data. All information is entered into the computer manually. Stored data is available for problem analysis but is not used for compliance checking.

The Department of Environmental Protection in the state of Maine has adopted a two form plan. The first sheet requires the operator to list all monthly operational parameters. Data on flow, sludge processing, secondary treatment and chlorination are required. Since the form checks for NPDES compliance, a section for analyzed parameters such as pH, temperature, BOD and suspended solids must be completed. Space is provided to give the minimum and maximum monthly values. The second form in Maine's Plan is a parameter "worksheet". The operator lists minimum, maximum and average values for a given parameter. Frequency of analysis and number of times permit levels were exceeded must also be included. This form provides valuable data on ailing treatment plants because it gives the Department of Environmental Protection a preliminary diagnosis to work from without traveling to the facility. The values for both forms are entered by hand into the computer and a monthly compliance report is printed out for all treatment plants in the state and used in the State office for reference.

New York State and California are both in the infant stages of computerized compliance monitoring. The New York State Department of Environmental Conservation is in the process of revising a previously abandoned monitoring system. Use of the program had been discontinued due to errors in the data base. Following implementation of the system, data will be entered by hand.

California's State Water Resources Control Board has recently launched a pilot program to monitor dischargers entitled "The Automated Compliance Checking System". The system is designed to test the percent removal and effluent concentration requirements of the waste discharging facilities' permit. California has about 10,000 such facilites in the state. This system is being implemented on a pilot basis with three of California's nine Regional Boards taking part. Up to this time each region had been responsible for it's own facilities' compliance.

The state of North Carolina has, by far, the most extensive computer data management and review system. A consulting engineer was hired to develop the program and an engineer, a chemist, and three programmers were hired specifically to implement the system. It is expected to take three years to complete the project. In additon to compliance monitoring, the system prints out non-compliance letters, checks on lab-technician and operator certification, and prints out latitudinal and longitudinal discharger locations. It is hoped that the program will eventually indentify river dischargers by their location relative to numbered dissolved oxygen monitoring stations.

The U.S. EPA has paid little attention to computerization of monthly operating reports. A memorandum dated August 5, 1977 was sent to all EPA Regional

Enforcement Directors detailing a form to be used in computerizing the monthly monitoring process. Most responses were agains; the implementation of such a system. Regional Enforcement Directors thought that a form of this type would be too complicated for a permitee to understand. The optical scanning form was seen as a valuable assest for some applications, but the monthly moniloring reports would not adapt easily to a computerized approach. Final evaluation of the system indicated overwhelmingly that the Agency was not ready for either the form or its related automated data entry process.

Development of the DTECTR Program

The acronym DTECTR stands for Diagnostic Testing of Efficiency by Computerization of Treatment Reports. It is the name first assigned to the 1975 version of the treatment plant compliance checking program. A flowchart of the current DTECTR program is presented in Figure 1.

The flowchart pictured in Figure 1 includes the implementation of an optical scanning form which is currently under development. (The old version of the optical scanning form is included in Figure 2.) With this form, the computer is capable of transferring treatment plant data from the optical scanning sheets (as entered by the operator) directly into specific signals the computer can interpret. Use of this form eliminates the need for

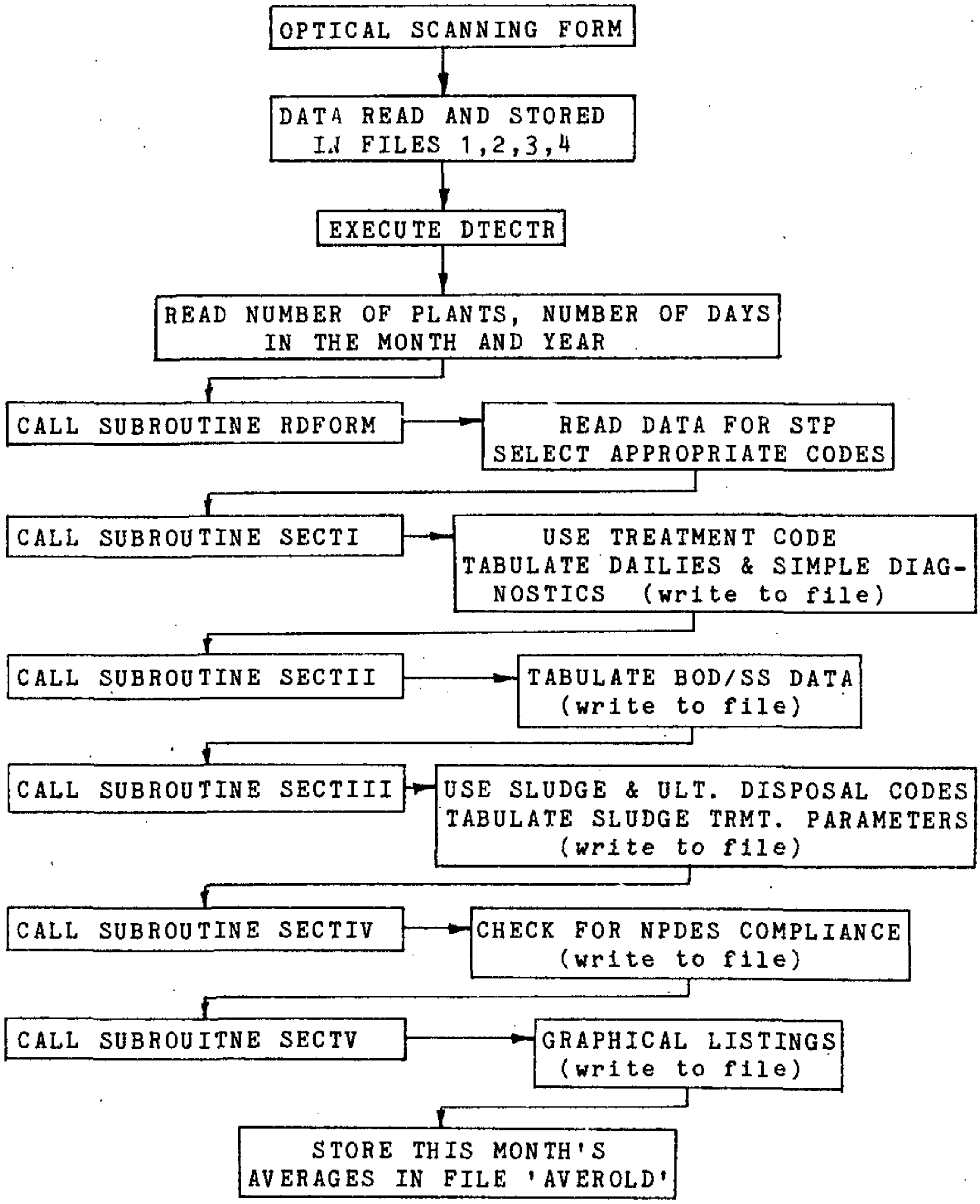


FIGURE 1
IDEALIZED DTECTR FLOW DIAGRAM

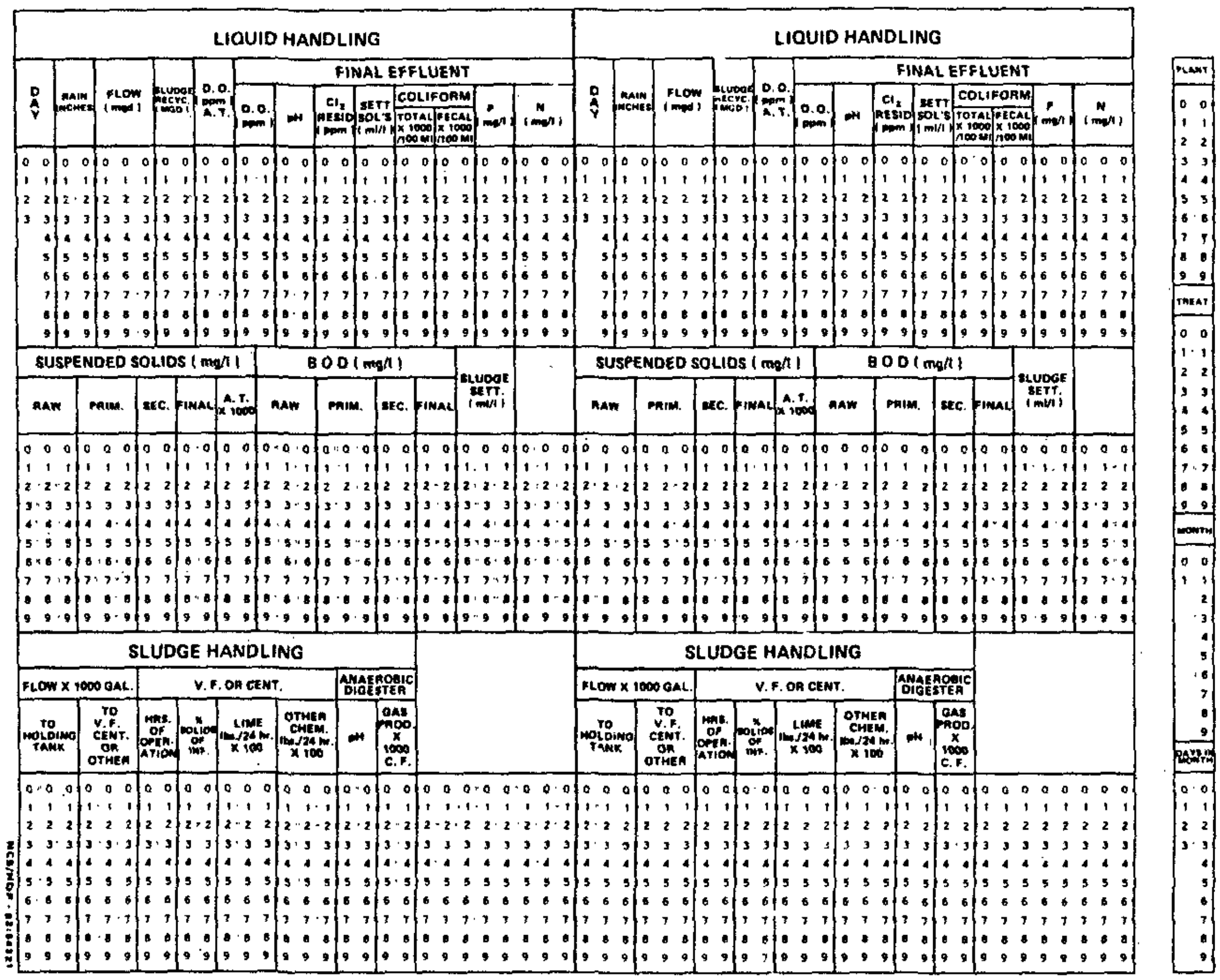


FIGURE 2
OLD OPTICAL SCANNING FORM

manual data processing.

Data entered on the optical scanning form is read and stored in four separate files. The computer also reads the number of days in the month and the total number of plants being processed.

Once data is stored in the prcper files, The DTECTR program can be executed. The first of six subroutines in the program reads data for a single plant being processed. The next subroutine reprints in tabular form, parameters which are sampled daily and performs some simple diagnostic calulations. The third subroutine prints BOD and suspended solids data for the specific days such analyses were run and the fourth prints sludge treatment parameters in tabular form. The fifth subroutine checks for NPDES permit compliance while the final subroutine graphs some design and permit parameters vs. time. The graphs are included to facilitate trend indentification and spot inspection.

<u>Program Description</u>. At the present time, the DTECTR program is stored on the VAX computer system located in the School of Engineering at the University of Massachusetts. The FORTRAN version of the program is structured as a main program with six separate subroutines for data manipulation. This program structure will facilitate understanding of the program and future modification. The program is designed to be easily adaptable to most other computer systems. (It is written in FORTRAN 77.)

Data from each treatment plant scheme is coded by three numbers: a treatment code, a sludge processing code and an treatment plant sludge ultimate disposal code. These numbers control what sections of each subroutine are applicable to each treatment facility. They are re-entered into the computer each month. There are five wastewater treatment, five sludge treament, and seven ultimate disposal options available in the program. See Table 3 for a summary of available treatment processes included in the program.

Description of Files. Four input files and three permanent files are called by the program for data manipulation. The first file, "date.dat", tells the computer how many plants are to be processed. This is an indication of how many iterations must be completed to process all plants. Numerical assignments are given to the month, year, and number of days in that month.

The second file, "dailies.dat", contains all values for data collected daily. The day of the month, daily rainfall, minimum, maximum, and average wastewater flows are included in this section. Other parameters for which file space is provided for daily monitoring results are: recycle flows, dissolved oxygen. ammonia, residual chlorine, mixed liquor suspended solids, total and fecal coliform, phosphorus, nitrogen, and settleable solids. Zeros must be entered for dates on which daily data are not available in order to retain file continuity.

WASTEWATER TREATMENT PROCESSES

- primary treatment
- activated sludge
- modified activated sludge
- trickling filter
- extended aeration

SLUDGE TREATMENT PROCESSES

- *thickening, digestion and mechanical* dewatering
- digestion and bed drying
- thickening and mechanical dewatering
- digestion and mechanical dewatering
- digestion

METHOD OF ULTIMATE DISPOSAL

- incineration
- landfill
- land application
- reclamation
- reuse
- ocean disposal

TABLE 2
SUMMARY OF AVAILABLE TREATMENT PROCESSES

The third file, "BODSS.dat", first states the number of days on which BOD and suspended solids (SS) were analyzed. This number keys the computer to read influent, intermediary, and effluent BOD and SS data for the specified number of days. BOD and SS are input according to the date of the month on which tests were done.

The "sludge.dat" file contains data taken on the sludge processing operations days. Parameters required include unit flows, solids concentration, gas production(in the case of anaerobic digestion),pH, and time of operation. As with the BOD and SS file, parameters are indentified by the day of the month data was taken. The file is also preceeded by an integer indicating the frequency of sludge processing data collection.

The first permanent file, "limits.dat", holds any existing NPDES permit requirements for the treatment facility with space provided additionally for plant specific requirements. This file is set up so that any number not equal to the integer zero is considered a current permit value.

The final permanent permit file "averold.dat" has been created for internal use in Section V of the computer program and output: the graphing section. Using this file, the subrouitne is designed to represent one past year's worth of BOD and SS data plus cumulative data for this year to date. A maximum of 24 months will be displayed. When the "averold.dat" file contains 24 months of BOD and SS monthly averages, the computer drops the earliest twelve values. This provides file space for the upcoming year's data.

Description of Subroutines. The DTECTR main program consists of a series of commands calling the various subroutines. It has been written so that each subroutine creates one section of output. The five subroutines can be described as follows.

Subroutine "rdform" reads files 1 through 4. For each plant, data is read and brought up for active use. Parameters are transferred consistently throughout the program via 'common' statements to maintain their original variable name assignment.

Subroutine "SectI" produces output Section I of the output: "Tabulation of Daily Operational Data". All parameters applicable to the chosen waste treatment code are printed out in tabular form for each day of the month. (See Figure 3) Numerical averages, or totals in the case of rainfall, are calculated and printed at the bottom of each column. The categories of treatment that can be handled by Section I include:

-primary treatment

-activated sludge

SECTION I :

TABULATION OF DAILY OPERATIONAL DATA

PLANT NUMBER 1 : MODIFIED ACTIVATED SLUDGE

DAY	RAINFALL (inches)	AVE. FLOW (mgd)	PEAK FLOW (mgd)	RECYC FLOW (mgd)	DO: AER TANK (mg/l)	MLSS (ml/l)	SVI (ml/g)	F/M RATIO (/days)	CHLORINE RESIDUAL (mg/l)	TOTAL COLIFORM (/100 ml)	FECAL COLIFORM (/100 ml)	PHOS (mg/l)	AMM NIT (mg/l)	NO3 NIT (mg/l)
1	0.00	3.06	4.10	0.00	0.0	2240.0	0.00	0.00	0.60	95.0	0.0	2.4	7.8	0.51
2	0.02	3.14	4.40	0.00	14.4	2235.0	0.00	0.00	1.40	0.0	0.0	0.0	0.0	0.00
3	0.06	3.10	4.40	0.00	0.0	0.0	0.00	0.00	1.30	0.0	0.0	0.0	0.0	0.00
4	0.01	3.03	4.20	0.00	0.0	0.0	0.00	0.00	0.30	0.0	0.0	0.0	0.0	0.00
5	1.14	3.54	6.80	0.00	0.0	0.0	0.00	0.00	0.40	0.0	0.0	0.0	0.0	0.00
6	0.35	3.16	4.70	0.00	0.0	2160.0	0.00	0.00	0.35	0.0	0.0	0.0	0.0	0.00
7	0.00	2.74	4.50	0.00	0.0	0.0	0.00	0.00	1.10	150.0	0.0	0.0	0.0	0.00
8	0.00	3.23	5.00	0.00	0.0	1710.0	0.00	0.00	0.87	0.0	0.0	1.8	12.6	0.00
9	0.00	3.16	4.40	0.00	31.8	1755.0	0.00	0.00	0.50	1000.0	0.0	0.0	0.0	0.00
10	0.00	3.36	4.50	0.00	0.0	1210.0	0.00	0.00	1.07	0.0	0.0	0.0	0.0	0.00
11	0.00	2.89	4.50	0.00	0.0	0.0	0.00	0.00	0.55	0.0	0.0	0.0	0.0	0.00
12	0.00	2.96	4.10	0.00	0.0	0.0	0.00	0.00	0.45	0.0	0.0	0.0	0.0	0.00
13	0.01	2.97	4.50	0.00	0.0	1620.0	0.00	0.00	0.50	0.0	0.0	0.0	0.0	0.00
14	0.00	2.13	4.40	0.00	0.0	1350.0	0.00	0.00	1.60	68.0	0.0	0.0	0.0	0.00
15	0.00	2.35	5.00	0.00	0.0	1615.0	0.00	0.00	1.80	0.0	0.0	2.4	9.5	0.29
16	0.00	2.85	4.70	0.00	0.0	1695.0	0.00	0.00	1.10	32.0	0.0	0.0	0.0	0.00
17	0.00	2.77	5.00	0.00	0.0	1410.0	0.00	0.00	1.50	0.0	0.0	0.0	0.0	0.00
18	0.00	2.46	5.00	0.00	0.0	0.0	0.00	0.00	1.10	0.0	0.0	0.0	0.0	0.00
19	0.03	2.45	4.50	0.00	0.0	0.0	0.00	0.00	1.20	0.0	0.0	0.0	0.0	0.00
20	0.28	3.30	5.00	0.00	0.0	1175.0	0.00	0.00	1.25	0.0	0.0	0.0	0.0	0.00
21	0.63	3.33	4.90	0.00	0.0	1415.0	0.00	0.00	1.45	28.0	0.0	0.0	0.0	0.00
22	0.02	2.91	4.50	0.00	0.0	1600.0	0.00	0.00	1.40	0.0	0.0	2.9	0.0	0.24
23	0.00	3.21	4.60	0.00	0.0	1635.0	0.00	0.00	0.85	170.0	0.0	0.0	0.0	0.00
24	0.00	3.07	4.50	0.00	0.0	1365.0	0.00	0.00	1.30	0.0	0.0	0.0	0.0	0.00
25	0.00	2.66	4.50	0.00	0.0	0.0	0.00	0.00	0.65	0.0	0.0	0.0	0.0	0.00
26	0.00	2.14	4.90	0.00	0.0	0.0	0.00	0.00	1.30	0.0	0.0	0.0	0.0	0.00
27	0.14	3.00	4.50	0.00	0.0	1475.0	0.00	0.00	0.60	0.0	0.0	0.0	0.0	0.00
28	0.00	2.86	5.80	0.00	0.0	1655.0	0.00	0.00	1.30	69.0	0.0	0.0	0.0	0.00
29	0.42	2.63	0.00	0.00	0.0	1735.0	0.00	0.00	1.15	0.0	0.0	4.0	15.4	0.19
30	0.00	2.96	0.00	0.00	0.0	2030.0	0.00	0.00	1.05	110.0	0.0	0.0	0.0	0.00
31	0.00	3.60	4.50	0.00	0.0	1620.0	0.00	0.00	1.10	0.0	0.0	0.0	0.0	0.00
AVE.	3.11	2.94	4.40	0.00	23.10	1652.62	0.00	0.00	1.00	191.2	0.0	2.7	11.3	0.31

FIGURE 3
SECTION I OUTPUT

-modified activated sludge

-trickling filter

-extended aeration

It is hoped that this listing can take the place of the current monthly operating report form. Section I also calculates two simple diagnostic indicators: the sludge volume index and F/M ratio for the case where secondary treatment is activated sludge.

Subroutine "SectII" produces Section II of the output: "Daily BOD, SS Loading and Percent Removals". This section lists influent, effluent, and percent removals for BOD and suspended solids in terms of milligrams/liter and pounds/day for the day on which these tests were run. Arithmetic averages are listed at the bottom of each column. (See Figure 4)

Section III: Tabulation of Sludge Treament Parameters is keyed from subroutine "SectIII". This section lists data for days when sludge processing units were operated. Arithmetic averages are listed below. (See Figure 5) Sludge treatment processes that can be handled are:

-thickening, digestion, and mechanical dewatering

-digestion and bed drying

-thickening and mechanical dewatering

-digestion and mechanical dewatering

-digestion

SECTION II:

DAILY BOD, SS LOADINGS, AND PERCENT REMOVALS

DAY	DAILY BOD (mg/l)		DAILY SS (mg/l)		BOD LOADING (PPD)		SS LOADING (PPD)		PERCENT REMOVALS	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	BOD	SS
1.	85.50	2.80	133.30	2.90	2181.99	71.46	3401.87	71.46	.97	.98
6	91.50	6.60	101.30	6.00	2411.43	173.94	2669.70	158.13	.93	.94
8	99.00	4.50	133.30	5.40	2666.88	121.22	3590.86	145.47	.95	.96
10	73.50	2.62	105.40	9.00	2059.65	73.42	2953.56	252.20	.96	.91
13	166.50	4.30	170.70	2.50	4124.17	106.51	4228.21	61.92	.97	.99
15	118.50	3.10	138.70	5.00	2322.48	60.76	2718.38	98.00	.97	.96
17	136.50	2.50	143.50	6.50	3153.40	57.75	3315.11	150.16	.98	.95
20	162.00	6.20	153.40	7.50	4458.56	170.64	4221.87	206.42	.96	.95
22	121.50	5.30	144.00	8.50	2948.73	128.63	3494.79	206.29	.96	.94
24	108.00	4.60	130.70	1.30	2765.21	117.78	3346.42	33.28	.96	.99
27	138.00	3.20	139.40	11.30	3452.76	80.06	3487.79	282.73	.98	.92
29	128.50	2.30	145.30	2.50	2599.20	50.45	3187.04	54.84	.98	.98
31	100.50	2.40	130.70	6.50	3017.41	72.06	3924.14	195.16	.98	.95
AVE.	116.88	3.88	136.13	5.75	2935.53	98.82	3426.13	147.39	.97	.96

FIGURE 4
SECTION II OUTPUT

SECTION III:

TABULATION OF SLUDGE TREATMENT PARAMETERS

METHOD: Digestion

DAY	FLOW TO DIGESTOR (100 gal)	INFL. PERCENT SOLIDS (mg/l)	GAS PRODUCED (ft-3)	DETENTION TIME (min)	PH	VOL. SLUDGE PRODUCED (yd-3)	% SOLIDS SLUDGE
1	15.300	0.0	0.0	60	5.2	20.0	27.0
6	15.800	0.0	0.0	70	4.9	30.0	25.0
8	16.500	0.0	0.0	75	5.0	25.0	30.0
13	14.850	0.0	0.0	90	4.7	27.0	29.0
15	11.750	0.0	0.0	95	4.8	30.0	32.0
17	13.850	0.0	0.0	90	5.1	15.0	33.0
20	16.500	0.0	0.0	93	4.7	17.0	28.0
22	14.550	0.0	0.0	95	4.9	19.0	33.5
24	15.350	0.0	0.0	86	5.1	25.0	35.1
27	15.000	0.0	0.0	87	5.2	19.0	29.7
29	13.150	0.0	0.0	90	4.9	28.0	29.1
AVE.	14.782	0.0	0.0	83.	5.0	23.2	30.1

METHOD OF DISPOSAL: Incineration

FIGURE 5
SECTION III OUTPUT

Generic treatment processes rather than specific treatment methods are used so that five choices might encompass as many sludge treatment schemes as possible. For a case where a treatment scheme cannot be matched to one of the five choices, zeros can be substituted for inappropriate parameters. Section III also prints out a treatment facility's method of ultimate sludge disposal. Options included in the program are:

- -incineration
- -landfill
- -land application
- -reclamation
- -reuse
- -ocean disposal

Subroutine "SectIV" checks for NPDES permit compliance. Each NPDES permit parameter is printed out in the first column, the plants' monthly maximum in the second, and the permit level in the third. (See Figure 6) A final column lists the number of times the permit was exceeded. Dates of the violations are not printed out since these are easily identified in the graphs presented in Section V and in the tabular listings of Sections I and II. Permit parameters not specified for a particular facility are shown as "0.0".

This section also compares overall plant flow to 80% of design capacity. Anything over 80% is flagged as a "violation". This is included as an indicator that whether

SECTION IV. :

COMPARISON OF OPERATING PERFORMANCES
WITH PERMIT AND DESIGN LIMITS

	MAXIMUM VALUE	PERMIT LEVEL	NO. TIMES PERMIT EXCEEDED
Daily BOD (mg/l)	2.40	0.00	0
Monthly BOD (mg/l)	3.88	30.00	0
Daily SS (mg/l)	6.50	0.00	0
Monthly SS (mg/l)	5.75	30.00	0
Daily Percent Removal: BOD	0.98	0.00	0
Monthly Percent Removal: BOD	0.97	0.00	0
Daily Percent Removal SS	0.98	0.00	0
Monthly Percent Removal: SS	0.96	0.00	0
Daily Effl. Phosphorus (mg/l)	4.00	0.00	0
Monthly Effl. Phosphorus (mg/l)	2.70	0.00	0
Daily Effl. Ammonia (mg/l)	15.40	0.00	0
Monthly Effl. Ammonia (mg/l)	11.33	0.00	0

FIGURE 6
SECTION IV OUTPUT

Daily Effl. Nitrate (mg/l)	0.19	0.00	0
Monthly Effl. Nitrate (mg/l)	0.31	0.00	0
Daily Flow (mgd)	3.60	0.00	0
Monthly Design Flow (mgd)	2.94	7.00	0
Daily Total Coliform (/100 ml)	110.0	0.0	0
Monthly Total Coliform (/100 ml)	191.2	1000.0	0
Daily Fecal Coliform (/100 ml)	0.0	0.0	0
Monthly Fecal Coliform (/100 ml)	0.0	200.0	0
Daily Settleable Solids (ml/l)	0.000	0.000	0
Monthly Settleable Solids (ml/l)	0.000	0.100	0
Other Parameter I (units)	0.000	0.000	0
Monthly Other Parameter I (units)	0.000	0.000	0
Other Parameter II (units)	0.000	0.000	0
Monthly Other Parameter I (units)	0.000	0.000	0

problems requiring remedial action such as increased capacity needs or excessive infiltration/inflow may be occurring.

Parameters included in this section are:

- -daily and monthly effluent BOD
- -daily and monthly effluent suspended solids
- -daily and monthly percent removal BOD
- -daily and monthly percent removal suspended solids
- -daily and monthly effluent phosphorus
- -daily and monthly effluent ammonia
- -daily and monthly effluent nitrate
- -daily and monthly total coliform
- -daily and monthly fecal coliform
- -daily and monthly settleable solids

Storage space has been provided for two additional permit parameters. They are listed on the output as Other Parameter I and Other Parameter II. These parameter categories may be used on a plant specific basis where the plant operator and the DWPC agree upon the parameters to include. The program heading must read Other Parameter I and Other Parameter II since they cannot be distinguished on a plant by plant basis.

The fifth and final subroutine produces Section V of the output: "Graphical Representation of Performance Data and NPDES and Design Parameters". It gives graphical representations of important parameters. (See Figure 7) There are 5 graphs in this section. The first two graphs show daily effluent BOD and SS concentrations for the current month. Data points are printed out only for days when samples were tested.

The third graph in Section V shows daily average plant flow and rainfall data as a function of time. Plant flow values can be read from the lefthand side of the graph and rainfall from the right side. Rainfall points on the graph are indicated with a rising vertical set of points in a 'pseudo-hyetograph' fashion for easier interpretation. This graph might give an inication of the effect of infiltration/inflow on a particular treatment plant.

The first three graphs are positioned one under the other so that a given day of the month can be read along the same vertical line. In all three cases, the maximum value for the graph has been arrived at by searching for that month's maximum value. Values on the y-axis are also printed for three-fourths, one half, and one fourth of this monthly maximum.

The same method was used to arrive at a maximum value for the fourth and fifth graphs in Section V; except that this maximum value is compared to the existing permit level. If the permit value is greater, it becomes the maximum value.

SECTION V :

GRAPHIC REPRESENTATION OF NPDES & DESIGN PARAMETERS

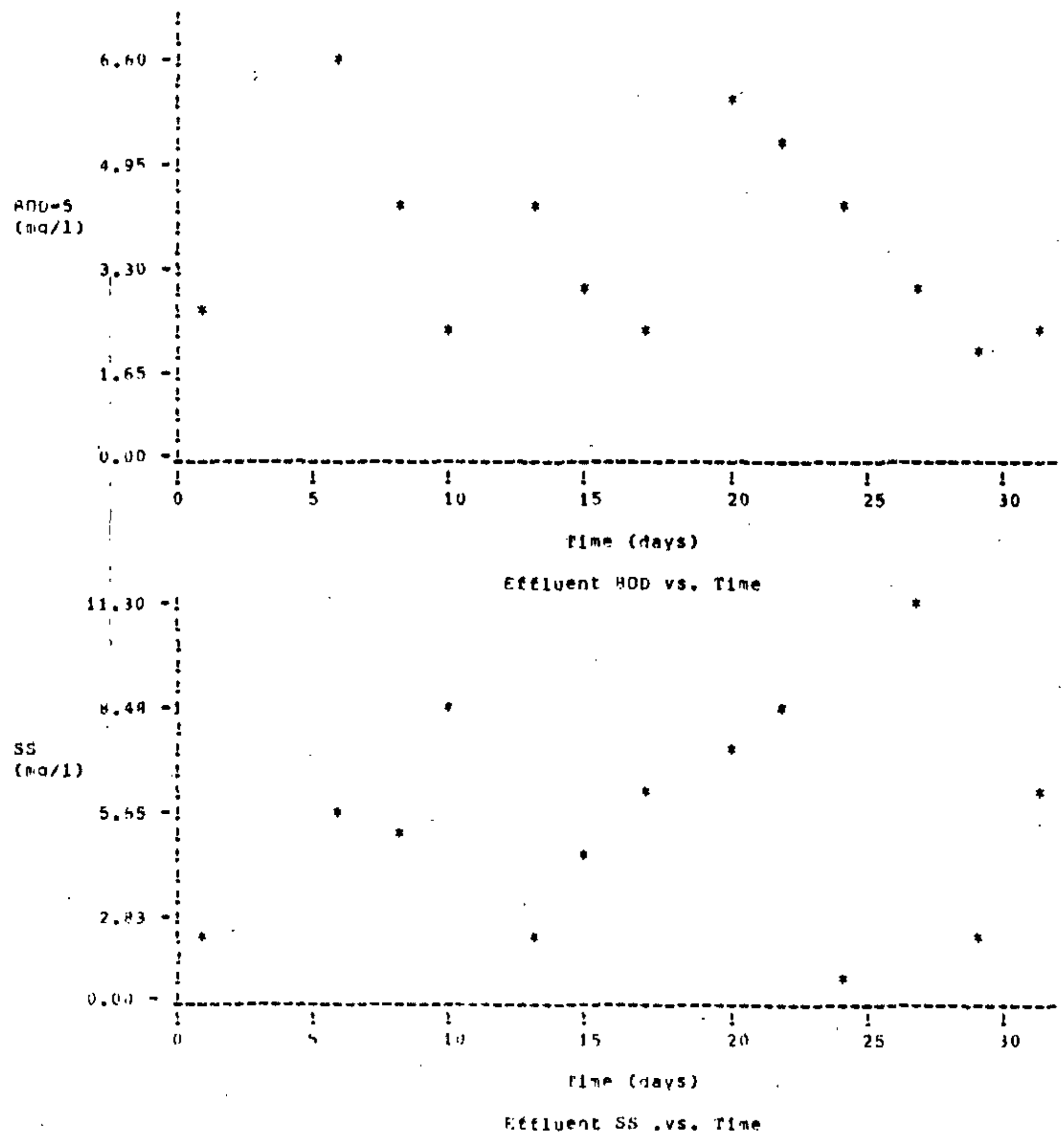
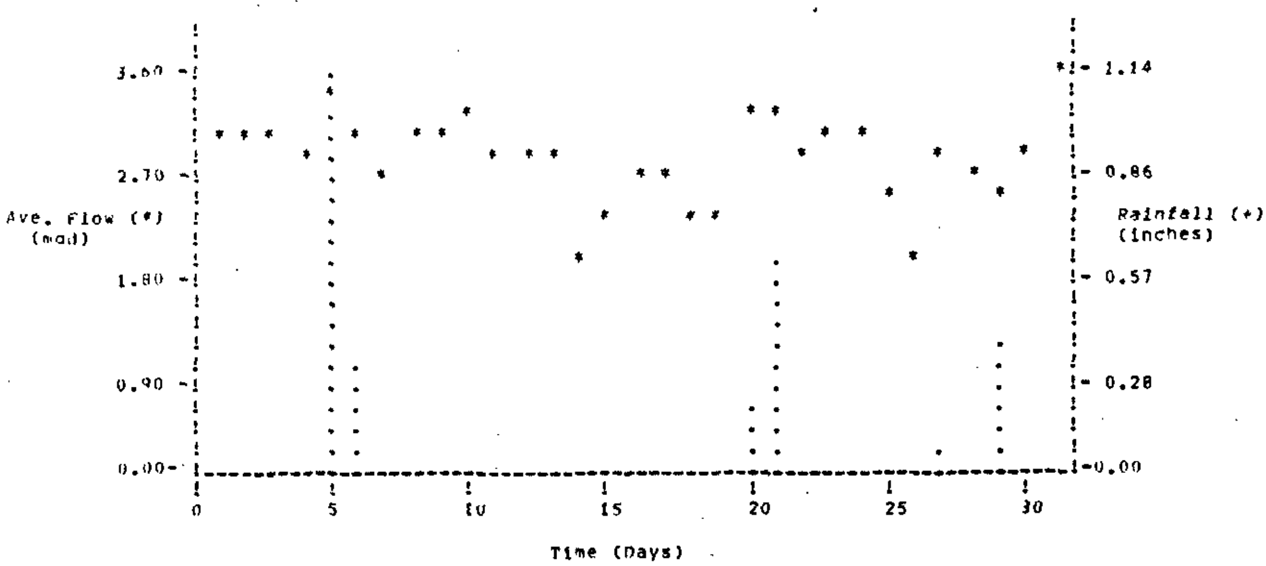
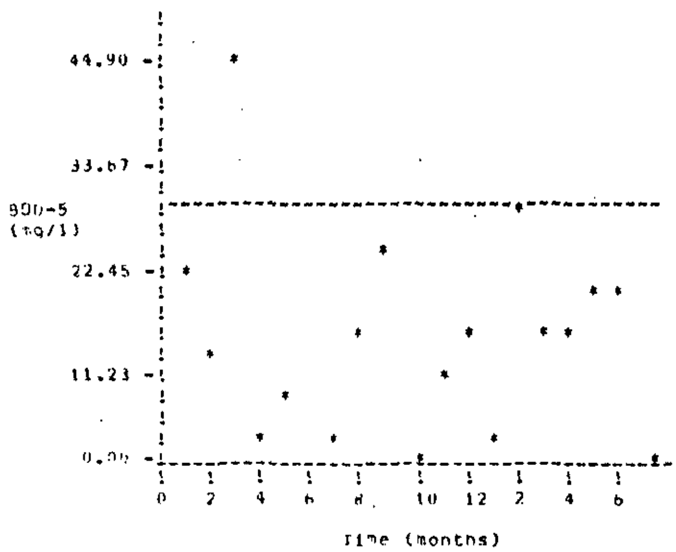


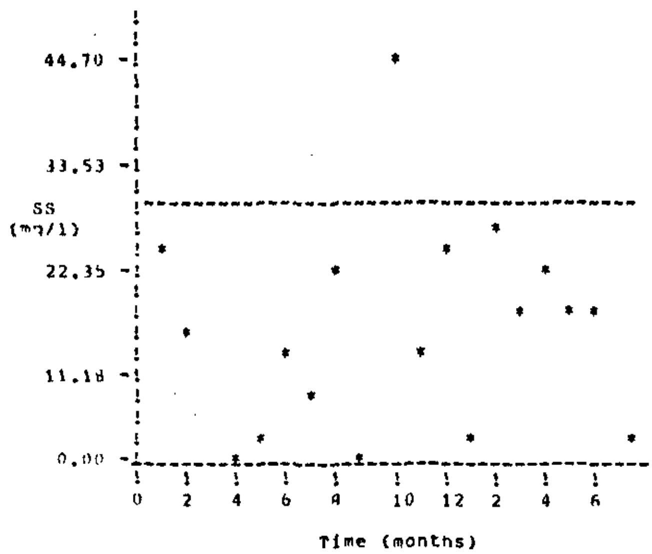
FIGURE 7
SECTION V OUTPUT



Average Flow & Rainfall vs. Time



Monthly BOD vs. Time



Monthly SS vs. Time

Graphs 4 and 5 use calculated average monthly BOD and SS values for the current year and the year past. At the end of every year, the previous year's data is dropped form storage to make room for the new year's data. Thus, between 13 and 24 monthly averages are shown on each graph.

<u>Specific Discussion of Output</u>. Figures 3 through 7 give examples of each section of printout. The format Sections II, IV, and V remain the same regardless of a change in treatment or sludge code; while different sections of I and III exist for each chosen code.

The following parameters are included in all treatment choices for Section I:

- -day of the month
- -rainfall
- -average flow
- -peak flow
- -chlorine residual
- -total coliform
- -fecal coliform
- -effluent phosphorus
- -effluent ammonia nitrogen
- -effluent nitrate nitrogen

The above parameters are printed out when primary treatment is coded in. Additional parameters included when a trickling filter scheme has been coded are:

-recycle flow

-effluent dissolved oxygen

For conventional activated sludge, extended aeration, and modifications of activated sludge (ie. step aeration) the following parameters are added:

-mixed liquor suspended solids

-sludge volume index

-food/microorganism ratio

-volatile suspended solids

The Sludge Volume Index and Food to Microorganism ratio are calculated within the the program. Both mixed liquor suspended soilds, volatile suspended solids and F/M ratio give an indication of the state of the activated sludge process (ie. microorganism age, need for detention time change). The sludge volume index indicates whether the microbial sludge is settling well enough to be properly dewatered farther down the line.

Additional simple diagnostics and process performance parameters could be added as a separate section. The primary purposes of DTECTR are to make monthly reporting and NPDES compliance checking more efficient so these diagnostics have not been included in this version.

The parameters included in Section I are similiar to those required by the 1974 DTECTR Program. The Western Massachusetts Office of the State Division of Water

Pollution Control and Department of Environmental Quality Engineering were consulted and recommended no major changes. All parameters required here are already included in most individual monthly operating reports. It should be noted that file space has not been created for inclusion of effluents from each unit process since this information is not intrinsic to the monthly compliance checking process.

Since coding of specific treatment types has not been included in Section II, the computer must determine what value represents the final effluent BOD and SS concentrations. If there is no value for the BOD from tertiary treatment, the BOD from secondary treatment is considered the final effluent BOD and so on through primary wastewater treatment. Chlorination is not considered tertiary treatment.

Use of the Program

As it exists now, the DTECTR program is workable for manual data input. With the use of cards or a CRT terminal for keypunching, plant parameters can be entered into their proper files and stored indefinately. The entire month's data from each plant must be entered together in chronological order. However, the order of plant arrangement need not be sequenced because the computer arranges them in a prespecified alphanumeric sequence. The plant number given at the beginning of Section I is another code number that can be referenced back to the name or the region or municipaliy where the treatment plant is located. This information is printed at the beginning of the program.

Logical abbreviations of standard names have been used for all variables, including those internal to the program, wherever possible. For example, the daily rainfall parameter is RAIN(M); with 'M' being a particular day of the month. A list of variables along with their usage in the program is included in the appendix of this report.

Implementation Costs. The most significant implementation action would involve entering treatment plant data and NPDES permit requirements into permanent files. In addition to programming costs during implementation, there are consulting and printing fees associated with the optical scanning form.

Minimal effort would be required to put DTECTR up on the Division's computer system. This discussion assumes that the Division would have the optical scanning forms read at the University of Massachusetts, Amherst rather than purchasing their own hardware.

Once implementated, considerable costs savings will be seen by the Massachusetts Division of Water Pollution Control. An actual cost comparison between conventional compliance report review and computerized systems is not available because a full scale computerized system with an optical scanning form has not as yet been implemented. A cost comparison, including required person-hours and computer costs was arrived at in 1975 by the Western Regional Office of the MDWPC. This branch processes approximately 100 treatment plant reports per month. The cost for computerized compliance checking in 1975 figures are as follows:

Computation Costs	
0.028 hr at $1000/hr	=$28
Printing and Storage Costs	=$30
Person-power Costs	
0.25 hr per review X	
100 reviews X $6/hr	=$150
Optical Scanner Rental Cost	
$400/month shared amongst	
three regional offices	=$133

Total Monthly Costs for DTECTR	$341

It should be noted that this cost estimation included the rental of an optical scanner and this is no longer necessary because reports are processed at the University of Massachusetts, Amherst.

Personnel at the Western Regional Office spend about one hour checking each treatment plant per month using the conventional method. At the salary rate given above, a simple calculation for 100 plants yields a monthly cost of 600 dollars. The figures indicate that costs of using the DTECTR system are almost half of the currently used method. In addition, person-hours are reduced and more time is available for the engineers to use these monthly report results to improve treatment plant efficiency.

A Look Forward

Several extensions of the current DTECTR program are possible. These include: (1) Optical scanning, (2) Distributed Data Processing, (3) An expanded evaluation system, (4) Non-municipal permit reporting and compliance checking, and (5) Cost Assessment Evaluation.

Optical Scanning. Optical scanning is the process of reading information from a document using an optical mark or character reader. Common examples are score sheets for computer graded tests. The process involves changing the information on the document into specific elctronic signals which can be stored on computer magnetic tapes.

Optical scanning has many advantages over the conventional means of data input. The marks entered on the scanning form are read directly by the scanner onto computer files. This eliminates a major factor of error in data transcription: keypunching oversight. Data files will therefore be more accurate and the processing time will be greatly reduced. Data collection costs are reduced because only paper and pencil are required to complete the process.

The primary purpose of an optical scanning form is to translate data into information a computer can understand. A number of steps are necessary before the scanning form system can be used. First, an optical scanning form must be designed to suit both the operator and the programmer. Secondly, a computer program must be written and tested to read the data from the optical scanning form. The documents read by the scanner and the information is processed by a computer program and organized into an input file suitable for use with the DTECTR program.

At the present time, optical scanning forms utilize a bubble or response circle format. Each circle on the forms corresponds to a point that can be read by a single photocell in the scanner. There are 2961 possible points on the optical scanning form. It is important that the form be designed so that space is utilized efficiently, but not to the point of clutter. The instructions must be clear and compatable with the scanner model being used.

Change of reporting methods to a computerized system will be a big change for treatment plant operator. The transition should be made as smoothly as possible. Planning an optical scanning form with the operators' convienience and comfort in mind is an important consideration in gaining acceptance and minimizing error. The UMASS Information Processing Center has written a number of manuals to provide guidance and the actual design of the optical scanning form.

An optical scanning form adaptable to the DTECTR Program should be arranged according to the program's input files. Wastewater treatment daily values, BOD and suspended solids data(filled in only on applicable days) and sludge treatment parameters should be placed in separate sections of the form. Separation of the daily and non-daily parameters should help minimize operator error. Also, both sides of the form should be used with 1 days' values on each side. A preliminary mock-up of an optical scanning form is presented in Figure 8.

Space should be provided for the operators' signature to certify that all entries have been entered correctly. A box for operator comments should also be included. Program indentifier codes, plant number, treatment scheme, and sludge handling, must be entered each month for the plant. A header form might be necessary to inform the computer of information contained in file 1; the total number of plants and the number of days in the month. Since the DTECTR program will be run from a CRT terminal, this information could be entered at the time of programming by a series of input interactive commands.

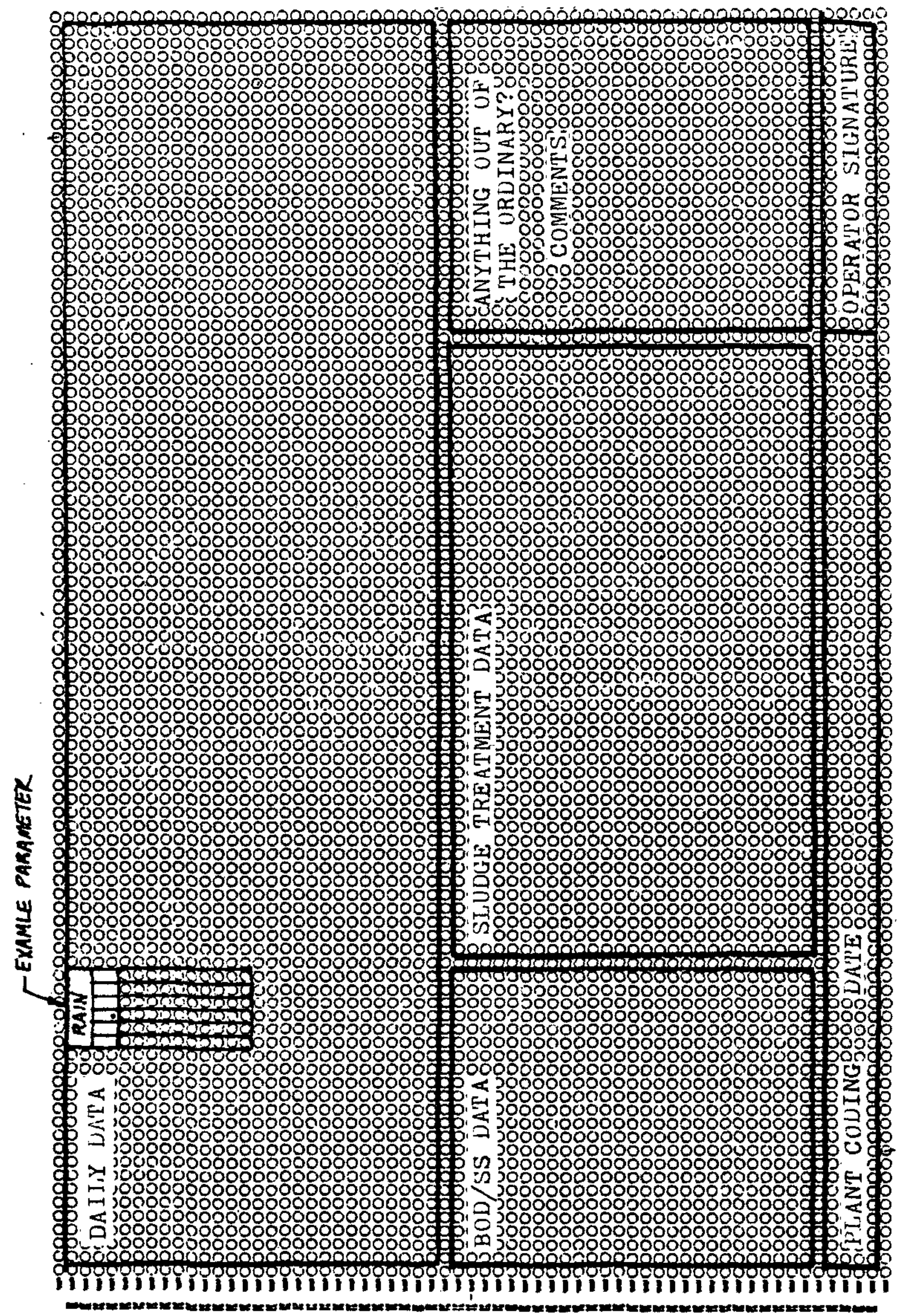


FIGURE 8
PRELIMINARY OPTICAL SCANNING FORM SKETCH

Optical scanning forms are usually 8-1/2 X 11 inches in area, however, the optical scanner at the University can process optical scanning forms up to 11 X 17 inches in size. The larger size might be preferable because the additional space can be used for directions, comments and boxes in which the data values can be written above the form's "bubble" marks.

It should be noted that the minimum number of optical scanning forms printed by the National Computer Systems, Inc. is 5,000 at a cost of approximately $87.00 per 1,000. Initial cost of the optical scanning form design is about $500.00. The designer must allow 7 weeks from the time the first draft of the form is sent in until the completed optical scanning forms are delivered.

<u>Distributed Data Processing</u>. We have assumed that monthly operating reports and permit compliance checking woul continue to be handled by the DWPC (ie. centralized). An alternate arrangement would be to have each treatment plant prepare the monthly reports on their own micro-computer with their own DTECTR program. They could then send the computer generated reports to the DWPC each month.

A centralized system is more economical than a distributed system. Perhaps most importantly, a centralized system allows the DWPC to maintain maximum control over the reporting/compliance process.

There are also a number of disadvantages. Mistakes can be made either in completing the optical scanning forms or in keypunching data files. There is a cost involved in processing the scanning forms in operator and computer time. If the keypunch option is chosen, data processing personnel must be hired to transcribe data to files. Both choices or data transcription to a central processing system can be inconvienient because all forms have to be present before the program is run.

Distributed monthly processing, while having a higher implementation cost, has many advantages. A small micro-computer could be equipped with a dynamic or interactive program written to ask the operator for daily data. The computer would then file this data onto a disk for storage. If required, the disk also could be sent to the State along with the program output for review each month.

The DTECTR Program could be modified to fit individual plant schemes. An "APPLE" micro-computer can have a memory capacity of up to 256,000 bytes. As it exists now, the FORTRAN DTECTR program could be run on a microcomputer. The DTECTR program without the interactive files is contained in 58,000 bytes. The executable version of the program requires approximately 39,500 bytes and the input/output files, about 3000 bytes. If the program is too large for a specific micro-computer, it could easily be broken down into several smaller programs and executed separately.

The operator would be able to enter more cost information into the computer for report purposes or for testing plant modificaton feasibility. The operator would be able to enter data into files every day instead of completing a compliance report form. The main disadvantage to a distributed system, however, is the high capitol cost involved in investing in micro-computers for each treatment plant. a significant investment in operation training may also be required to teach the operators to use and be comfortable with the micro-computers. On the other hand, once the operators are "computer literate", the micro-computer could be used to perform a host of other functions for the staff (automatic recording of process parameters, inventory, maintainence records, real time evaluation of plant performance, technical assistance and referencing, ect.) Substantial programming time and costs would be incurred if individual plant modification programs were implemented.

Expanded Evaluation System. An expanded evaluation system could be developed for plants not meeting their permit requirements. Additional subroutines would be called to describe and analyze the nature and probable cause of the non-compliance incident. The computer could determine whether the situation is unique or recurring and make recommendations to help alleviate the problem.

Non-Municipal Permit Reporting and Compliance Checking. The DTECTR program could be used to check industrial waste discharger permits. This would, of course, encompass a much larger range of permit values and diagnostics, but the basic programming ideas are the same.

Cost Assessment. The DTECTR program could be expanded to be used to complile and assess overall treatment plant operation and maintenance costs broken down for operating each unit if desired. This would enable the MDWPC to draw comparisons between similar plants and prepare practical operational recommendations for saving time and energy.

Recommendations For the Future

The first step in implementing the DTECTR system is the design of an optical scanning form. A preliminary version of this form should be sent to operators to complete for a number of months. Data from this form would be entered into the computer manually and results sent both to the State and back to the operator. After a few months of Division and operator feedback, a final version of the optical scanning form should be designed by the UMASS Environmental Engineering Program and the Information Processing Center. Design and printing of the form will take approximately two months.

The Division should consider expanding the DTECTR program to accomidate all permit holders: municipal, industrial and other non-municipal dischargers.

Conclusions

An optical scanning form for data reporting and computer program for report generation and compliance monitoring are a feasible alternative to the conventional method of monthly report checking. Benefits over the current checking method include time savings, cost reduction, increased accuracy, more complete and legible reporting, and easier interpretation of data and trends. In addition, the DTECTR computer program can be expanded to include more complicated diagnostics or cost information. This would make the time spent checking reports each month even shorter.

An optical scanning form designed with the operator in mind, once implemented, will be easy to complete each month. Operator feedback during the trial period will help minimize problems farther down the line.

As computerized technology takes on more and more filing and reporting tasks, it is inevitable that some type of computerized system be implemented to complete the monthly compliance checking of wastewater treatment plant report forms. The DTECTR/Optical Scanning form system is a practical, feasible method to meet current objectives and to provide a basis for future expansion.

APPENDIX I: CURRENT MONTHLY REPORT FORM

MONTHLY REPORT

WASTEWATER TREATMENT PLANT

2

City or Town ____________________

Month ____________________ 19 ____

Chief Operator ____________________

Date	pH				AIR SUPPLIED (CFM)	RECIRCULATION (MGD)		MIXED LIQUOR SETTLEABILITY (ml/L)	SAND FILTERS OR LAGOONS				Date
	Raw Sewage 37	Primary Effluent 38	Mixed Liquor 39	Final Effluent 40	41	To Trickling Filters 42	Return Activated Sludge 43	44	Total Acres Dosed 45	Unit Numbers 46	Total Dose (MGD) 47	48	
1													1
2													2
3													3
4													4
5													5
6													6
7													7
8													8
9													9
10													10
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25													25
26													26
27													27
28													28
29													29
30													30
31													31
TOTAL													
MEDIAN													

Date	5 DAY BOD (mg/L)									SUSPENDED SOLIDS (mg/L)									
										Raw		Effluent			Aeration Tank			Aerated Digester	
	Raw 49	Primary Effluent 50	% Removed 51	Secondary Effluent 52	% Removed 53	Final Effluent 54	% Removed 55	Downstream 56	Upstream 57	Total 58	Volatile 59	Primary Total 60	Secondary Total 61	Final Total 62	Total 63	Volatile 64	Return Sludge Total 65	Total 66	Volatile 67

Date	RAW SLUDGE		DIGESTER SLUDGE					SLUDGE BEDS				MPN or MF per 100 ml							
	Total Solids % 68	Volatile Solids % 69	pH 70	Alkalinity (mg/L) 71	Volatile Acids (mg/L) 72	Total Solids % 73	Volatile Solids % 74	Date Drawn 75	Volume (gal.) 76	Date Removed 77	Volume (cu. yds.) 78	Final Effluent 79	Downstream 80	Upstream 81	82	83	84	85	86

*Multiply Value By 1000

PLANT PERSONNEL

87

Name	Title	Class

89. COMPOSITE SAMPLE INFORMATION

1) Composite from ________ to ________

2) Number of samples in composite ________

3) Interval between samples ________

4) Composite made up from:

Samples of equal volume ☐ Proportion to flow ☐

90 GENERAL COMMENTS *(Operating Problems or Assistance Desired)*

'G' = Grab Samples *(Note All other samples will be composited)*

PLANT DESIGN DATA

88

Type	Present Average Flow MGD
Design Capacity MGD	Population Served

7200-2-78 Massachusetts Water Resources Commission / Division of Water Pollution Control

Date	DISSOLVED OXYGEN mg/L						SLUDGE														Date
										pH			Gas		Vacuum Filter or Centrifuge						
																	Chemicals		Filter Cake		
	Raw	Aeration Tank	Secondary Effluent	Final Effluent	Downstream	Upstream	Sludge to Digester (1000 gals)	Excess Activated Sludge (gals)	Digester Temp (°F)	Digester Sludge	Over flow to Primary Tank	Supernatant Wasted (1000 gals)	Produced (1000 cu ft)	Used (1000 cu ft)	1000 Gallons	% Solids	lbs. /24 hrs	lbs. /24 hrs	(lbs. /24 hrs	% Solids	
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
1																					1
2																					2
3																					3
4																					4
5																					5
6																					6
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28																					28
29																					29
30																					30
31																					31
TOTAL																					
MEDIAN																					

Please forward this report to the Regional Engineer at the address above by the 10th of each following month.

7200-2-78

1

MONTHLY REPORT
WASTEWATER TREATMENT PLANT

City or Town

Month 19

Chief Operator

Date	WEATHER		SEWAGE						CHLORINATION				SETTLEABLE SOLIDS ml/L				Date
				Flow (MGD)					Pre		Post						
	Rainfall (in.) 1	Temp °F 2	Temp. °F 3	Maximum 4	Minimum 5	Total 6	Bypass 7	Grit & Screening (cu. ft.) 8	Dosage lbs./24 hrs 9	Residual (mg/L) 10	Dosage lbs./24 hrs 11	Residual (mg/L) 12	Raw 13	Primary Effluent 14	Secondary Effluent 15	Final Effluent 16	
1																	1
2																	2
3																	3
4																	4
5																	5
6																	6
7																	7
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27																	27
28																	28
29																	29
30																	30
31																	31
TOTAL				Maximum	Minimum												
MEDIAN																	

APPENDIX II: LISTING OF VARIABLES IN DTECTR PROGRAM

VARIABLE	PARAMETER
a	counter
aa	counter
aaa	counter
amm	daily effluent NH3-N (mg/l)
ammave	monthly effluent NH3-N (mg/l)
ammavelim	monthly effluent permit value (mg/l)
ammlim	daily effluent ammonia value (mg/l)
ap	counter
app	counter
aza	counter
b	counter
bb	counter
bbb	counter
bodave	monthly BOD counter
bodavemax	maximum monthly BOD (mg/l)
bodavemx	3/4 maximum monthly BOD (mg/l)
bodavemxx	1/2 maximum monthly BOD (mg/l)
bodavemxxx	1/4 maximum monthly BOD (mg/l)
bodavelim	monthly effluent BOD permit value (mg/l)
bodawt	BOD tertiary (mg/l)
bodflb	effluent BOD (ppd)
bodflim	daily effluent BOD permit value (mg/l)
boddmax	daily BOD counter
bodfmax	maximum daily BOD (mg/l)
bodfmx	3/4 maximum daily BOD (mg/l)
bodfmxx	1/2 maximum daily BOD (mg/l)
bodfmxxx	1/4 maximum daily BOD (mg/l)
bodp	BOD primary (mg/l)
bodr	BOD influent (mg/l)
bodrlb	influent BOD (ppd)
bods	BOD secondary (mg/l)
byb	counter
c	counter
cc	counter
ccc	counter
clr	chlorine residual (mg/l)
colfec	fecal coliform count (/100 ml)
colfecave	monthly average fecal coliform (/100 ml)
colfecavelim	monthly fecal coliform permit value
colfeclim	daily fecal coliform permit value
coltot	total coliform count (/100 ml)
coltotave	monthly average total coiform (/ 100 ml)
coltotavelim	monthly total coliform permit value
coltotlim	daily total coliform permit value
cxc	counter
d	counter
dash	counter matrix
date	day of the month matrix
dates	day of the month matrix
day	day of the month
dd	counter
ddd	day BOD/SS sampled for

VARIABLE	PARAMETER
ddy	day sludge processed
desbodavelim	monthly design BOD (mg/l)
designbod	daily design BOD (mg/l)
designflow	daily design flow (mgd)
doat	dissolved oxygen aeration tank (mg/l)
dof	dissolved oxygen final (mg/l)
dwd	counter
e	counter
ee	counter
eee	counter
eve	counter
f	counter
ff	counter
fff	counter
flow	daily average flow (mgd)
flowave	monthly average flow (mgd)
flowavelim	monthly design flow value (mgd)
flowdewat	flow to dewatering (1000 gal)
flowdigest	flow to digestor (1000 gal)
flowmax	daily maximum flow (mgd)
flowmin	daily minimum flow (mgd)
flowpeak	maximum average flow
flowpk	3/4 maximum average flow (mgd)
flowpkk	1/2 maximum average flow (mgd)
flowpkkk	1/4 maximum average flow (mgd)
fm	F/M ratio
flowthick	flow to thickener (1000 gal)
fuf	counter
g	counter
gas	gas produced in digester (ft3)
gg	counter
ggg	counter
graph	graph matrix
h	counter
hh	counter
hhh	counter
i	treatment code number
iscdigest	influent % solids to digester
iscdewat	influent % solids to dewatering
iscthick	influent % solids to thickener
iloop	counter
incr	counter matrix
ixe	counter
j	counter
jcount	counter
jxe	counter
k	sludge treatment code number
m	counter for do-loop
mark	counter matrix
mlset	mixed liquor settleable solids
mm	number of days in month
mod	code #: method of ultimate disposal

VARIABLE	PARAMETER
mon	month being processed
month	numerical assignment or month's matrix
mxe	counter
nit	daily average nitrogen (mg/l)
nitave	monthly average nitrogen (mg/l)
nitavelim	monthly effluent nitrogen permit value
nitlim	daily effluent nitrogen permit value
nm	code: was sludge treated (Y)=0 (N)=1
nmm	counter: days sludge processed
nn	code: was BOD/SS sampled (Y)=0 (N)=1
nnn	counter: days BOD/SS sampled
nop	number of STP's processed
num	counter
numplnt	plant indentification number
o	counter
oo	counter
ooo	counter
otherI	daily other parameter I
otherIave	monthly other parameter I
otherIavelim	monthly other parameter I permit value
otherIlim	daily other parameter I permit value
otherII	daily other parameter II
otherIIave	monthly other parameter II
otherIIavelim	monthly other parameter II permit value
otherIIlim	daily other parameter II permit value
p	counter
ph	ph sludge in digestor
percentsol	% solids final sludge
phos	daily effluent average phosphorus (mg/l)
phosave	monthly average effluent phosphorus
phosavelim	monthly effluent phosphorus permit value
phoslim	daily effluent phosphorus permit value
plotI	graph matrix
plotII	graph matrix
pp	counter
prbodavelim	monthly % removal BOD permit value
prbodlim	daily % removal BOD permit value
prssavelim	monthly % removal SS permit value
prsslim	daily % removal SS permit value
s	counter
setsol	settleable solids (mg/l)
setsolave	monthly average settleable solids
setsolavelim	monthly settleable solids permit value
setsollim	daily settleable solids permit value
ss	counter
ssat	SS aeration tank (mg/l)
ssave	monthly suspended solids counter
ssavelim	monthly effluent SS permit value
ssavemax	maximum monthly SS (mg/l)
ssavemx	3/4 maximum monthly SS (mg/l)
ssavemxx	1/2 maximum monthly SS (mg/l)
ssavemxxx	1/4 maximum monthly sS (mg/l)

VARIABLE	PARAMETER
ssawt	tertiary SS (mg/l)
ssflb	SS effluent (ppd)
ssflim	daily effluent SS permit value
ssfmax	maximum daily SS (mg/l)
ssfmx	3/4 maximum daily SS (mg/l)
ssfmxx	1/2 maximum daily SS (mg/l)
ssfmxxx	1/4 maximum daily SS (mg/l)
ssp	SS primary (mg/l)
ssr	SS influent (mg/l)
ssrlb	SS influent (ppd)
sss	SS secondary (mg/l)
sssmax	SS daily counter
svi	sludge volume index
q	counter
qq	counter
r	counter
rain	daily rainfall (inches)
rainmax	maximum daily rainfall (inches)
rainmx	3/4 maximum daily rainfall (inches)
rainmxx	1/2 maximum daily rainfall (inches)
rainmxxx	1/4 maximum daily rainfall (inches)
recyc	recyle flow (mgd)
rr	counter
t	counter
table	graph matrix
time	time sludge processing operated (min)
tt	counter
ttble	graph matrix
u	counter
uu	counter
v	counter
volat	volatile solids-aeration tank
volsludge	volume sludge for ultimate disposal
vv	counter
w	counter
ww	counter
x	counter
xx	counter
y	counter
year	year being processed
yy	counter
z	counter
zz	counter

APPENDIX III: DTECTR PROGRAM LISTING

```
      program dtectr

      include 'common.for'

**    **    **    **    **    **    **    **    **    **    **    **
*
*     This program is designed to read in daily operating data from a
* sewage treatment plant, print the data in tabular form for the month,
* and compute various treatment performance parameters. These
* calculations include percent removals, solids loadings, F/M
* ratios, solids removal loadings and number of days certain design
* limits were exceeded.  The results are printed in 5 sections.
*
*     Section I: Tabulation of monthly operational data
*
*     Section II: Daily BOD, Suspended Solids Loading, and Percent Removal
*
*     Section III: Tabulation of Sludge Treatment Parameters
*
*     Section IV: Exceedance of Design or NPDES values
*
*     Section V: Graphical representations of important parameters
*
*     In addition, treatment plants are coded so that the program
* only performs those calculations that apply to each plant.
*
*     I: Liquids load number
*
*     K: Solids load number
*
*     MOD: Method of Ultimate Disposal
*
**    **    **    **    **    **    **    **    **    **    **    **


      open (unit=1,file='date.dat',status='old')
      open (unit=2,file='dailies.dat',status='old')
      open (unit=3,file='BODSS.dat',status='old')
      open (unit=4,file='sludge.dat',status='old')
      open (unit=5,file='limits.dat',status='old')
      open (unit=6,file='averold.dat',status='old',access='append')
      open (unit=11,file='plantname.dat',status='old')
      open (unit=14,file='results.dat',status='new')

**    **    **    **    **    **    **    **    **    **    **    **
*
*     The number of treatment plants being processed, the month,
* the year, and the number of days in the month are now read.
*
**    **    **    **    **    **    **    **    **    **    **    **

      read(1,*) nop,mon,year,mn

**    **    **    **    **    **    **    **    **
*
*     The following series of write and format statements prints
* out an introductory output page.
```

```
*
**        **        **        **        **        **        **        **        **
          write(44,500)
          write(44,505)
          write(44,510)
          write(44,515)
          write(44,520)
          write(44,525)
          write(44,526)
          write(44,527)
          write(44,528)
          write(44,530)
          write(44,535)
          write(44,540)
          write(44,545)
          write(44,550)
          write(44,555)
          write(44,560)
          write(44,565)
          write(44,570)
          write(44,575)
          write(44,580)
          write(44,585)
          write(44,590)
          write(44,595)
          write(44,600)
          write(44,605)
          write(44,610)
          write(44,615)
          write(44,620)
 500      format(//t44,'DIAGNOSTIC TESTING OF EFFICIENCY')
 505      format(t40,'BY COMPUTERIZATION OF TREATMENT REPORTS'/)
 510      format(t55,'VERSION 2.0')
 515      format(/t49,'Revised and Rewritten')
 520      format(t54,'January 1983')
 525      format(t36,'LORETTA M. RUH, Graduate Research Assistant')
 526      format(t32,'RICHARD R. NOSS, Assistant Professor of Civil
     . Engineering'/)
 527      format(t44,'ENVIRONMENTAL ENGINEERING PROGRAM')
 528      format(t45,'Department of Civil Engineering')
 530      format(t46,'University of Massachusetts')
 535      format(t45,'Amherst, Massachusetts  01003'/)
 540      format(t34,'This program was developed with financial
     . assistance')
 545      format(t31,'from the Massachusetts Division of Water Pollution
     . Control'//T1,119('='))
 550      format(/t35,'The DITCTR program has been developed to aid the')
 555      format(t38,'Massachusetts Division of Water Pollution')
 560      format(t33,'Control in monthly compliance checking of
     . municipal')
 565      format(t45,'wastewater treatment plants.'//)
 570      format(t30,'The output for each treatment plant consists of
     . 5 sections:'/)
 575      format(t40,'  I. Tabulation of Daily Operational Data')
 580      format(t37,' II. Daily BOD, SS Loadings and Percent Removals')
 585      format(t37,'III. Tabulation of Sludge Treatement Parameters')
 590      format(t25,' IV. Comparison of Operating Performances with
     . Permit and Design Limits')
 595      format(t31,'  V. Graphic Representation of Permit and Design
```

```
     . Parameters'//)
600   format(t35,'Plants are coded in alphanumeric order.  The')
605   format(t38,'following list gives a code number with its')
610   format(t45,'corresponding treatment plant')
615   format(//t43,'PLANT NUMBER',t65,'PLANT LOCATION')
620   format(t43,12('-'),t65,14('-'))

      do l=1,nop
      read(11,625) codeplnt(l), nameplnt(l)
625   format(i8,a20)
      enddo

      print*,'l=',l,'nameplnt=',nameplnt(l)

      do ll=1,nop
      write(44,630) codeplnt(ll), nameplnt(ll)
630   format(t42,i8,t57,a20)
      enddo

**    **    **    **    **    **    **    **    **    **    **    **
*
*     The following loop now executes the program once for each STP
* being processed.
*
**    **    **    **    **    **    **    **    **    **    **    **

      do  num=1,nop

**    **    **    **    **    **    **    **    **    **    **    **
*
*     Subroutine rdform is now called to
* read this months values.
*
**    **    **    **    **    **    **    **    **    **    **    **

      call rdform

**      **      **      **      **      **      **      **      **
*
*     Subroutine SectI is now called to list daily paremeters
* and calculate averages.  In most cases, a zero will indicate
* when data was not collected.
*
**      **      **      **      **      **      **      **      **

      call SectI

**    **    **    **    **    **    **    **    **    **    **    **
*
*     Subroutine SectII is now called to compute BOD, Suspended
* Solids values and their Percent Removals. They will be
* printed out in tabular form.
*
**    **    **    **    **    **    **    **    **    **    **    **

      call SectII

**      **      **      **      **      **      **      **      **
*
*     Subroutine SectIII lists the Sludge Treatment Data for
* for the particular process used.  Combinations of processes
```

```
* that can be handled by this subroutine are:
*
*       . Thickening,Digestion & Mechanical Dewatering
*       . Digestion & Drying Beds
*       . Thickening & Mechanical Dewatering
*       . Digestion & Mechanical Dewatering
*       . Digestion
*
**        **        **        **        **        **        **        **        **

          Call SectIII

**        **        **        **        **        **        **        **        **
*
*     Subroutine SectIV is now called.  It will list the days
* each NPDES Permit requirement was not met.  Design values
* will be compared to actual values to indicate capacity
* approach (90% design capacity).
*
**        **        **        **        **        **        **        **        **

          call SectIV

**        **        **        **        **        **        **        **        **
*
*     Subroutine SectV is now called to print out graphs of
* important parameters.  This section provides a generalized
* view. Numeric values can be found in Sections I, II, and III.
*
**        **        **        **        **        **        **        **        **

          call SectV

          enddo

          close (unit=1,status='save')
          close (unit=2,status='save')
          close (unit=3,status='save')
          close (unit=4,status='save')
          close (unit=5,status='save')
          close (unit=6,status='save')
          close (unit=11,status='save')
          close (unit=44,status='save')

          end

          subroutine rdform

          include 'common.for'

          rewind 2
          rewind 3
          rewind 4
          rewind 5

          numpint=0

   500    if(numpint .ne. num) then
          go to 505
          else
          go to 510
```

```
      endif
505   read(2,*) numplnt,i,k,mod,nn,nm
      do j=1,mr
      read(2,*) day(j),rain(j),flowmin(j),flow(j),flowmax(j),
    . recyc(j),doat(j),dof(j),amm(j),clr(j),mlset(j),coltot(j),
    . colfec(j),phos(j),nit(j),setsol(j),volat(j)
      enddo
      if (nn .ne. 1) then
      read(3,*) numplnt,nnn
      do l=1,nnn
      read(3,*) odd(l),ssr(l),ssp(l),sss(l),ssat(l),
    . ssewt(l),bodr(l),bodp(l),bods(l),bodawt(l)
      enddo
      endif
      if (nm .ne. 1) then
      read(4,*) numplnt,nmm
      do m=1,nmm
      read(4,*) ddy(m),flowthick(m),iscthick(m),flowdigest(m),
    . iscdigest(m),gas(m),time(m),ph(m),flowdewat(m),iscdewat(m),
    . volsludge(m),percentsol(m)
      enddo
      endif
      read(5,*) numplnt,bodflim,bodavelim,ssflim,ssavelim,
    . prbodlim,prbodavelim,prsslim,prssavelim,phoslim,phosavelim,
    . ammlim,ammavelim,nitlim,nitavelim,designflow,flowavelim,
    . designbod,desbodavelim,coltotlim,coltotavelim,colfeclim,
    . colfecavelim,setsollim,setsolavelim
      go to 500
510   continue
      end
      subroutine Sect1
      include 'common.for'
      real a,b,c,d,e,f,g,h,aa,bb,cc,dd,ee,ff,gg,hh,aaa,bbb,
    . ccc,ddd,eee,fff,ggg,hhh,aza,byb,cxc,dwd,eve,
    . svi(31),fm(31),o,p,fuf,oo,qq,ap,app
      integer z,y,x,w,v,u,t,s,zz,yy,xx,ww,vv
```

```
**      **      **      **      **      **      **      **      **      **
*
*       Subroutine sect1 lists all daily operational data in
*  tabular form.  Averages are calculated and printed at the bottom
*  of each column.
*
**      **      **      **      **      **      **      **      **      **

        write(44,1500)
        write(44,1505)

 1500   format('1'/t1,124('=')//t2,'SECTION I :'//)
 1505   format(t42,'TABULATION OF DAILY OPERATIONAL DATA'/)

        if (i .eq. 1) then
        go to 1510
        elseif (i .eq. 2) then
        go to 1610
        elseif (i .eq. 3) then
        go to 1710
        elseif (i .eq. 4) then
        go to 1810
        else
        go to 1910
        endif

 1510   write(44,1515) numplnt
        write(44,1520)
        write(44,1525)
        write(44,1530)
        write(44,1535)
        write(44,1540)
        write(44,1545)
        write(44,1550)
        write(44,1555)

 1515   format(t43,'PLANT NUMBER',i4,' : PRIMARY TREATMENT'/)
 1520   format(t5,112('-')/t22,'AVE',t30,'PEAK',t50,'CHLORINE',t63,
     . 'TOTAL')
 1525   format('+',t76,'FECAL',t100,'AMMONIA',t110,'NITRATE')
 1530   format(t15,'DAY',t22,'FLOW',t30,'FLOW',t38,'RAINFALL',t50,
     . 'RESIDUAL')
 1535   format('+',t62,'COLIFORM',t75,'COLIFORM',t87,'PHOSPHORUS')
 1540   format('+',t99,'NITROGEN',t110,'NITROGEN'/)
 1545   format(t22,'(mgd)',t30,'(mgd)',t38,'(inches)',t51,'(mg/l)',
     . t62,'(/100 ml)')
 1550   format('+',t75,'(/100 ml)',t89,'(mg/l)',t100,'(mg/l)')
 1555   format('+',t111,'(mg/l)'/t5,112('-'))

        do m=1,mm

        a=a+flow(m)

        ap=ap+flowmax(m)

        b=b+rain(m)

        if(clr(m) .ne. 0) then
        c=c+clr(m)
        y=y+1
        endif
```

```
p=p+flow(m)

ap=ap+flowmax(m)

if(recyc(m) .ne. 0) then
c=c+recyc(m)
z=z+1
endif

if(doat(m) .ne. 0) then
d=d+doat(m)
y=y+1
endif

if(mlset(m) .ne. 0) then
e=e+mlset(m)
x=x+1
endif

if(mlset(m) .ne. 0 .and. ssat(m) .ne. 0) then
svi(m)=mlset(m)/ssat(m)
f=f+svi(m)
w=w+1
else
svi(m)=0.0
endif

if(ssat(m) .ne. 0) then
volat(m)=100.0
fm(m)=(flow(m)*podp(m))/(ssat(m)*volat(m)*1000.0)
g=g+fm(m)
v=v+1
else
fm(m)=0.0
endif

if(clr(m) .ne. 0) then
n=n+clr(m)
u=u+1
endif

if(coltot(m) .ne. 0) then
aa=aa+coltot(m)
zz=zz+1
endif

if(colfec(m) .ne. 0) then
bb=bb+colfec(m)
yy=yy+1
endif

if(phos(m) .ne. 0) then
cc=cc+phos(m)
xx=xx+1
endif

if(amm(m) .ne. 0) then
dd=dd+amm(m)
ww=ww+1
endif
```

```
        if(coltot(m) .ne. 0) then
        a=a+coltot(m)
        x=x+1
        endif

        if(colfec(m) .ne. 0) then
        e=e+colfec(m)
        w=w+1
        endif

        if(phos(m) .ne. 0) then
        f=f+phos(m)
        v=v+1
        endif

        if(amm(m) .ne. 0) then
        g=g+amm(m)
        u=u+1
        endif

        if(nit(m) .ne. 0) then
        n=n+nit(m)
        t=t+1
        endif

        o=o+setsol(m)

        write(44,1560) day(m),flow(m),flowmax(m),rain(m),clr(m)
        write(44,1565) coltot(m),colfec(m),phos(m),amm(m),nit(m)

1560    format(t16,i2,t23,f4.2,t31,f4.2,t40,f4.2,t52,f4.2)
1565    format('+',t62,f7.1,t75,f7.1,t91,f3.1,t100,f5.1,t111,f5.2)

        enddo

        if (v .eq. 0) then
        y=1
        endif

        if (x .eq. 0) then
        x=1
        endif

        if (w .eq. 0) then
        w=1
        endif

        if (v .eq. 0) then
        v=1
        endif

        if (u .eq. 0) then
        u=1
        endif

        if (t .eq. 0) then
        t=1
        endif

        aa=a/mm
```

```
      aop=ap/mm
      bb=b/mm
      cc=c/y
      dd=d/x
      ee=e/w
      ff=f/v
      gg=g/u
      hh=h/t
      oo=o/mm

      flowave=aa
      coltotave=dd
      colfecave=ee
      phosave=ff
      ammave=gg
      nitave=hh
      setsolave=oo

      write(44,1570)
      write(44,1575) aa,aop,b,cc,dd
      write(44,1580) ee,ff,gg,hh

1570  format(t5,112('-'))
1575  format(t16,'AVE.',t23,f4.2,t31,f4.2,t40,f4.2,t52,f4.2,t62,f7.1)
1580  format('+',t75,f7.1,t91,f3.1,t100,f5.1,t111,f5.2)

      go to 2010

1610  write(44,1615) numplnt

1615  format(t43,'PLANT NUMBER',i4,' : ACTIVATED SLUDGE'/)

1617  write(44,1620)
      write(44,1625)
      write(44,1630)
      write(44,1635)
      write(44,1640)
      write(44,1645)
      write(44,1650)
      write(44,1655)
      write(44,1660)
      write(44,1665)
      write(44,1670)

1620  format(t2,124('-')/t16,'AVE.',t24,'PEAK')
1625  format('+',t31,'RECYC',t40,'DO:',t64,'F/M',t71,'CHLORINE')
1630  format('+',t82,'TOTAL',t93,'FECAL',t110,'AMM',t118,'NO3')
1635  format(t2,'DAY',t6,'RAINFALL',t16,'FLOW',t24,'FLOW',t32,'FLOW')
1640  format('+',t37,'AER TANK',t48,'MLSS',t56,'SVI',t63,'RATIO')
1645  format('+',t71,'RESIDUAL',t81,'COLIFORM',t91,'COLIFORM')
1650  format('+',t102,'PHOS',t110,'NIT',t118,'NIT'/)
1655  format(t6,'(inches)',t16,'(mgd)',t23,'(mgd)',t31,'(mgd)',t38,
     .'(mg/l)')
1660  format('+',t47,'(ml/l)',t56,'(ml/g)',t62,'(/days)',t72,
     .'(mg/l)')
1665  format('+',t81,'(/100 ml)',t91,'(/100 ml)',t101,'(mg/l)')
1670  format('+',t109,'(mg/l)',t117,'(mg/l)'/t1,124('-'))

      do m=1,mm

      a=a+rain(m)
```

```
      if(nit(m) .ne. 0) then
      ee=ee+nit(m)
      vv=vv+1
      endif

      ff=ff+setsol(m)

      write(44,1675) day(m),rain(m),flow(m),flowmax(m),recyc(m),
     . doat(m)
      write(44,1680) mlset(m),svi(m),fm(m),clr(m)
      write(44,1685) coltot(m),colfec(m),phos(m),amm(m),nit(m)

1675  format(t2,i2,t8,f4.2,t16,f4.2,t24,f4.2,t32,f4.2,t38,f6.1)
1680  format('+',t46,f8.1,t55,f5.2,t64,f4.2,t73,f4.2)
1685  format('+',t81,f7.1,t91,f7.1,t103,f3.1,t108,f5.1,t117,f5.2)

      enddo

      if(z .eq. 0) then
      z=1
      endif

      if(y .eq. 0) then
      y=1
      endif

      if(x .eq. 0) then
      x=1
      endif

      if(w .eq. 0) then
      w=1
      endif

      if(v .eq. 0) then
      v=1
      endif

      if(u .eq. 0) then
      u=1
      endif

      if(zz .eq. 0) then
      zz=1
      endif

      if(yy .eq. 0) then
      yy=1
      endif

      if(xx .eq. 0) then
      xx=1
      endif

      if(ww .eq. 0) then
      ww=1
      endif

      if(vv .eq. 0) then
      vv=1
```

```
      endif

      aaa=a/mm
      bbb=b/mm
      app=ap/mm
      ccc=c/z
      ooo=d/y
      eee=e/x
      fff=f/w
      ggg=g/v
      hhh=h/u
      aza=aa/zz
      byb=bb/yy
      cxc=cc/xx
      dwd=dd/ww
      eve=ee/vv
      fuf=ff/mm

      flowave=ooo
      coltotave=aza
      colfecave=byb
      phosave=cxc
      ammave=dwd
      nitave=eve
      setsolave=fuf

      write(44,1690)
      write(44,1695) a,bbb,app,ccc,ooo
      write(44,1700) eee,fff,ggg,hhh
      write(44,1705) aza,byb,cxc,dwd,eve

1690  format(t2,124('-'))
1695  format(t2,'AVE.',t8,f4.2,t16,f4.2,t24,f4.2,t32,f4.2,t38,f6.2)
1700  format('+',t46,f8.2,t55,f5.2,t64,f4.2,t73,f4.2)
1705  format('+',t81,f7.1,t91,f7.1,t103,f3.1,t108,f5.1,t117,f5.2)

      go to 2010

1710  write(44,1715) numplnt

1715  format(t43,'PLANT NUMBER',i4,' : MODIFIED ACTIVATED SLUDGE '/)

      go to 1617

1810  write(44,1815) numplnt
      write(44,1820)
      write(44,1825)
      write(44,1830)
      write(44,1835)
      write(44,1840)
      write(44,1845)
      write(44,1850)
      write(44,1855)
      write(44,1860)
      write(44,1863)

1815  format(t43,'PLANT NUMBER',i4,' : TRICKLING FILTER'/)
1820  format(t2,124('-')/t27,'AVE',t35,'PEAK',t42,'RECYC',t59,
     .'CHLORINE',t72,'TOTAL')
1825  format('+',t84,'FECAL',t109,'AMMONIA',t120,'NITRATE')
1830  format(t10,'DAY',t16,'RAINFALL',t27,'FLOW',t35,'FLOW',
```

```
     . t42,'FLOW')
1835   format('+',t52,'DO:',t59,'RESIDUAL',t71,'COLIFORM')
1840   format('+',t83,'COLIFORM',t95,'PHOSPHORUS')
1845   format('+',t109,'NITROGEN',t120,'NITROGEN'/)
1850   format(t16,'(inches)',t27,'(mgd)',t35,'(mgd)',t41,'(mgd)',
     . t50,'(mg/l)')
1855   format('+',t60,'(mg/l)',t71,'(/100 ml)',t83,'(/100 ml)')
1860   format('+',t97,'(mg/l)',t110,'(mg/l)',t121,'(mg/l)')
1863   format(t2,124('-'))

       do m=1,mm

       a=a+rain(m)

       b=b+flow(m)

       ap=ap+flowmax(m)

       if(recyc(m) .ne. 0) then
       c=c+recyc(m)
       z=z+1
       endif

       if(dof(m) .ne. 0) then
       d=d+dof(m)
       y=y+1
       endif

       if(clr(m) .ne. 0) then
       e=e+clr(m)
       x=x+1
       endif

       if(coltot(m) .ne. 0) then
       f=f+coltot(m)
       w=w+1
       endif

       if(colfec(m) .ne. 0) then
       g=g+colfec(m)
       v=v+1
       endif

       if(phos(m) .ne. 0) then
       h=h+phos(m)
       u=u+1
       endif

       if(amm(m) .ne. 0) then
       o=o+amm(m)
       t=t+1
       endif

       if(nit(m) .ne. 0) then
       p=p+nit(m)
       s=s+1
       endif

       q=q+setsol(m)

       write(44,1865) day(m),rain(m),flow(m),flowmax(m),recyc(m)
```

```
      write(44,1870) cof(m),clr(m),coltot(m),coltec(m)
      write(44,1875) pnos(m),amm(m),nit(m)

1865  format(t10,i2,t18,f4.2,t27,f4.2,t35,f4.2,t42,f4.2)
1870  format('+',t50,f5.1,t61,f4.2,t71,f7.1,t83,f7.1)
1875  format('+',t99,f3.1,t110,f5.1,t121,f5.2)

      enddo

      if(z .eq. 0) then
      z=1
      endif

      if(y .eq. 0) then
      y=1
      endif

      if(x .eq. 0) then
      x=1
      endif

      if(w .eq. 0) then
      w=1
      endif

      if(v .eq. 0) then
      v=1
      endif

      if(u .eq. 0) then
      u=1
      endif

      if(t .eq. 0) then
      t=1
      endif

      if(s .eq. 0) then
      s=1
      endif

      aa=a/mm
      bb=b/mm
      arr=ar/mm
      cc=c/z
      dd=d/y
      ee=e/x
      ff=f/w
      gg=g/v
      hh=h/u
      oo=o/t
      pp=p/s
      qq=q/mm

      flowave=bb
      coltotave=ff
      colfecave=gg
      pnosave=hh
      ammave=oo
      nitave=pp
      setsolave=qq
```

```
      write(44,1880) a,bb,abp,cc
      write(44,1885) dd,ee,ff,gg
      write(44,1890) hh,oo,pp

1880  format(t2,124('-')/t18,f4.2,t27,f4.2,t35,f4.2,t42,f4.2)
1885  format('+',t50,f6.2,t61,f4.2,t71,f7.1,t83,f7.1)
1890  format('+',t99,f3.1,t110,f5.1,t121,f5.2)

      go to 2010

1910  write(44,1915) numplnt
      write(44,1920)
      write(44,1925)
      write(44,1930)
      write(44,1935)
      write(44,1940)
      write(44,1945)
      write(44,1950)
      write(44,1955)
      write(44,1960)
      write(44,1965)
      write(44,1970)

1915  format(t43,'PLANT NUMBER',i4,' : EXTENDED AERATION'/)
1920  format(t2,124('-')/t19,'AVE.',t26,'PEAK')
1925  format('+',t34,'DO:',t60,'F/M',t67,'CHLORINE',t78,'TOTAL')
1930  format('+',t89,'FECAL',t108,'AMM',t115,'NO3')
1935  format(t5,'DAY',t10,'RAINFALL',t19,'FLOW',t26,'FLOW',t32,
     . 'AER TANK')
1940  format('+',t42,'MLSS',t51,'SVI',t59,'RATIO',t67,'RESIDUAL')
1945  format('+',t76,'COLIFORM',t88,'COLIFORM',t100,'PHOS')
1950  format('+',t106,'NIT',t115,'NIT'/)
1955  format(t10,'(inches)',t19,'(mgd)',t25,'(mgd)',t33,'(mg/l)',
     . t42,'(ml/l)')
1960  format('+',t50,'(ml/g)',t58,'(/days)',t68,'(mg/l)')
1965  format('+',t77,'(/100 ml)',t88,'(/100 ml)',t99,'(mg/l)')
1970  format('+',t107,'(mg/l)',t114,'(mg/l)'/t2,124('-'))

      do m=1,mm

      a=a+rain(m)

      b=b+flow(m)

      ap=ap+flowmax(m)

      if(doat(m) .ne. 0) then
      c=c+doat(m)
      z=z+1
      endif

      if(mlset(m) .ne. 0) then
      d=d+mlset(m)
      y=y+1
      endif

      if(mlset(m) .ne. 0 .and. ssat(m) .ne. 0) then
      svi(m)=mlset(m)/ssat(m)
      e=e+svi(m)
      x=x+1
```

```
      else
      svi(m)=0.0
      endif

      if(ssat(m) .ne. 0) then
      volat(numpint)=100.0
      fm(m)=(flow(m)*bodo(m))/(ssat(m)*volat(numpint)*1000.0)
      f=f+fm(m)
      w=w+1
      else
      fm(m)=0.0
      endif

      if(clr(m) .ne. 0) then
      g=g+clr(m)
      v=v+1
      endif

      if(coltot(m) .ne. 0) then
      h=h+coltot(m)
      u=u+1
      endif

      if(colfec(m) .ne. 0) then
      aa=aa+colfec(m)
      zz=zz+1
      endif

      if(phos(m) .ne. 0) then
      bb=bb+phos(m)
      yy=yy+1
      endif

      if(amm(m) .ne. 0) then
      cc=cc+amm(m)
      xx=xx+1
      endif

      if(nit(m) .ne. 0) then
      dd=dd+nit(m)
      ww=ww+1
      endif

      ee=ee+setsol(m)

      write(44,1975) day(m),rain(m),flow(m),flowmax(m),boat(m),
     . miset(m)
      write(44,1980) svi(m),fm(m),clr(m),coltot(m)
      write(44,1985) colfec(m),phos(m),amm(m),nit(m)

1975  format(t5,i2,t12,f4.2,t19,f4.2,t26,f4.2,t31,f6.1,t41,f8.1)
1980  format('+',t50,f5.2,t60,f4.2,t69,f4.2,t77,f7.1)
1985  format('+',t88,f7.1,t100,f3.1,t106,f5.1,t114,f5.2)

      enddo

      if(z .eq. 0) then
      z=1
      endif

      if(y .eq. 0) then
```

```
v=1
endif

if(x .eq. 0) then
x=1
endif

if(w .eq. 0) then
w=1
endif

if(v .eq. 0) then
v=1
endif

if(u .eq. 0) then
u=1
endif

if(zz .eq. 0) then
zz=1
endif

if(yy .eq. 0) then
yy=1
endif

if(xx .eq. 0) then
xx=1
endif

if(ww .eq. 0) then
ww=1
endif

aaa=a/mm
bbb=b/mm
afp=ap/mm
ccc=c/z
ddd=d/y
eee=e/x
fff=f/w
ggg=g/v
hhh=h/u
aza=aa/zz
byb=bb/yy
cxc=cc/xx
dwd=dd/ww
eve=ee/mm

flowave=bbb
coltotave=hhh
colfecave=aza
phosave=byb
ammave=cxc
nitave=dwd
setsolave=eve

write(44,1990)
write(44,1995) a,bbb,afp,ccc,ddd
write(44,2000) eee,fff,ggg,hhh
```

```
      write(44,2005) aza,bvb,cxc,dwd

1990  format(t2,124('-'))
1995  format(t5,'AVE',t12,f4.2,t19,f4.2,t26,f4.2,t31,f6.2,t41,f8.2)
2000  format('+',t50,f5.2,t60,f4.2,t69,t4.2,t77,f7.1)
2005  format('+',t88,f7.1,t100,f3.1,t106,f5.1,t114,f5.2)

2010  end

      subroutine SectII

      include 'common.for'

      real bodrlb(31),bodflb(31),ssrlb(31),ssflb(31),
     . a,b,c,d,e,f,r,s,t,u,aa,bb,cc,dd,
     . ee,ff,rr,ss,tt,uu

      integer q

**    **    **    **    **    **    **    **    **    **    **    **
*
*     Subroutine SectII lists the BOD, Suspended Solids and Percent
* Removals for each day samples were taken.  Results are printed out
* in tabular form.
*
**    **    **    **    **    **    **    **    **    **    **    **


      write(44,3500)
      write(44,3505)
      write(44,3510)
      write(44,3515)
      write(44,3520)
      write(44,3525)
      write(44,3530)
      write(44,3535)
      write(44,3540)
      write(44,3545)
      write(44,3550)

3500  format ('1'/t1,116('=')//t2,'SECTION II:'//)
3505  format (t39,'DAILY BOD, SS LOADINGS, AND PERCENT REMOVALS'/)
3510  format (t5,110('-')/t16,'DAILY BOD',t38,'DAILY SS')
3515  format ('+',t59,'BOD LOADING',t82,'SS LOADING')
3520  format (t6,'DAY',t96,'PERCENT REMOVALS')
3525  format (t18,'(mg/l)',t40,'(mg/l)',t62,'(PPD)',t84,'(PPD)')
3530  format (t5,110('-'))
3535  format (t11,'Influent',t22,'Effluent',t33,'Influent')
3540  format ('+',t44,'Effluent',t55,'Influent',t66,'Effluent')
3545  format ('+',t77,'Influent',t86,'Effluent',t100,'BOD',t109,'SS')
3550  format (t5,110('-'))

      do m=1,nnn

      if (bods(m) .eq. 0) then
      bodf(m)=bodp(m)
      ssf(m)=ssp(m)
      else if (bodawt(m) .eq. 0) then
      bodf(m)=bods(m)
      ssf(m)= sss(m)
      else
```

```
      bodf(m)=bodawt(m)
      ssf(m)=ssawt(m)
      end if

      g=god(m)

      bodrlb(m)=(flow(g)*bodr(m))*8.34
      bodflb(m)=(flow(g)*bodf(m))*8.34
      ssrlb(m)=(flow(g)*ssr(m))*8.34
      ssflb(m)=(flow(g)*ssf(m))*8.34

      if(bodr(m) .eq. 0) then
      prbod(m)=0
      prss(m)=0
      else
      prbod(m)=(bodr(m)-bodf(m))/bodr(m)
      prss(m)=(ssr(m)-ssf(m))/ssr(m)
      endif

      a=a+bodrlb(m)
      b=b+bodflb(m)
      c=c+ssrlb(m)
      d=d+ssflb(m)
      e=e+prbod(m)
      f=f+prss(m)
      r=r+bodr(m)
      s=s+bodf(m)
      t=t+ssr(m)
      u=u+ssf(m)

      write(44,3555) g,bodr(m),bodf(m),ssr(m),ssf(m),bodrlb(m),bodflb(m),
     . ssrlb(m),ssflb(m),prbod(m),prss(m)
3555  format (t7,i2,t12,f7.2,t23,f7.2,t34,f7.2,t45,f7.2,t55,f8.2,
     . t66,f8.2,t77,f8.2,t88,f8.2,t100,f3.2,t108,f3.2)

      enddo

      aa=a/nnn
      bb=b/nnn
      cc=c/nnn
      dd=d/nnn
      ee=e/nnn
      ff=f/nnn
      rr=r/nnn
      ss=s/nnn
      tt=t/nnn
      uu=u/nnn

      prbodave=ee
      prssave=ff

      bodave(mon)=ss
      ssave(mon)=uu

      write(6,3559) bodave(mon),ssave(mon)
3559  format(2f8.2)

      write(44,3560)
3560  format(t5,110('-'))

      write(44,3565) rr,ss,tt,uu,aa,bb,cc,dd,ee,ff
```

```
3555   format (t4,'AVE.',t12,f7.2,t23,f7.2,t34,f7.2,t45,f7.2,
     . t55,f8.2,t66,f8.2,t77,f8.2,t88,f8.2,t100,f3.2,t108,f3.2)

       end

       Subroutine SectIII

       include 'common.for'

**       **       **       **       **       **       **       **       **
*
*      Subroutine SectIII lists sludge data for the plant on
*  days sludge was processed.
*
**       **       **       **       **       **       **       **       **

       write(44,8000)
       write(44,8005)

 8000  format('1',t2,118('=')//t2,'SECTION III: '//)
 8005  format(t35,'TABULATION OF SLUDGE TREATMENT PARAMETERS'/)

       if(K .eq. 0) then
       go to 8100
       elseif(K .eq. 1) then
       go to 8200
       elseif(K .eq. 2) then
       go to 8305
       elseif(K .eq. 3) then
       go to 8400
       elseif(K .eq. 4) then
       go to 8500
       else
       go to 8600
       endif

 8100  go to 8800

 8200  write(44,8205)
       write(44,8210)
       write(44,8215)
       write(44,8220)
       write(44,8225)
       write(44,8230)
       write(44,8235)
       write(44,8240)
       write(44,8245)
       write(44,8250)
       write(44,8255)
       write(44,8260)


 8205  format(t33,'METHOD: Thickening, Digestion, & Mechanical
     . Dewatering'/)
 8210  format(t2,118('-')/t9,'FLOW TO',t18,'INFL PERCENT')
 8215  format('+',t32,'FLOW TO',t41,'INFL PERCENT',t56,'GAS')
 8220  format('+',t62,'DET',t73,'FLOW TO',t83,'INFL PERCENT')
 8225  format('+',t97,'VOL SLUDGE',t111,'% SOLIDS')
 8230  format(t2,'DAY',t8,'THICKENER',t21,'SOLIDS',t32,'DIGESTER')
 8235  format('+',t44,'SOLIDS',t55,'PROD.',t62,'TIME',t68,'PH')
 8240  format('+',t72,'DEWATERING',t86,'SOLIDS',t98,'PRODUCED')
```

```
8245   format('+',t109,'FINAL SLUDGE'/)
8250   format(t7,'(1000 gal)',t21,'(mg/l)',t31,'(1000 gal)')
8255   format('+',t44,'(mg/l)',t54,'(ft-3)',t61,'(min)')
8260   format('+',t72,'(1000 gal)',t86,'(mg/l)',t99,'(yd-3)'/
     . t2,118('-'))

       do m=1,nmm

       a=a+flowthick(m)
       b=b+iscthick(m)
       c=c+flowdigest(m)
       d=d+iscdigest(m)
       e=e+gas(m)
       f=f+time(m)
       g=g+ph(m)
       h=h+flowdewat(m)
       o=o+iscdewat(m)
       p=p+volsludge(m)
       q=q+percentsol(m)

       write(44,8265) day(m),flowthick(m),iscthick(m)
       write(44,8270) flowdigest(m),iscdigest(m),gas(m)
       write(44,8275) time(m),ph(m),flowdewat(m)
       write(44,8280) iscdewat(m),volsludge(m),percentsol(m)

8265   format(t3,i2,t10,f6.3,t21,f6.1)
8270   format('+',t33,f6.3,t44,f6.1,t52,f7.1)
8275   format('+',t62,i3,t68,f3.1,t76,f6.3)
8280   format('+',t86,f6.1,t97,f7.1,t113,f4.1)

       enddo

       aa=a/nmm
       bb=b/nmm
       cc=c/nmm
       dd=d/nmm
       ee=e/nmm
       ff=f/nmm
       gg=g/nmm
       hh=h/nmm
       oo=o/nmm
       pp=p/nmm
       qq=q/nmm

       write(44,8285)
       write(44,8290) aa,bb,cc
       write(44,8295) dd,ee,ff,gg
       write(44,8300) hh,oo,pp,qq

8285   format(t2,118('-'))
8290   format(t2,'AVE.',t10,f6.3,t21,f6.1,t33,f6.3)
8295   format('+',t44,f6.1,t52,f7.1,t62,f3.0,t68,f3.1)
8300   format('+',t76,f6.3,t86,f6.1,t97,f7.1,t113,f4.1/)

       go to 8700

8305   write(44,8310)
       write(44,8315)
       write(44,8320)
       write(44,8325)
       write(44,8330)
```

```
      write(44,8335)
      write(44,8340)
      write(44,8345)
      write(44,8350)
      write(44,8355)

8310  format(t45,'METHOD: Digestion & Bed Drying'/)
8315  format(t2,118('-')/t21,'FLOW TO',t32,'INFL. PERCENT')
8320  format('+',t51,'GAS',t61,'DETENTION',t76,'FLOW TO')
8325  format('+',t87,'VOL. SLUDGE',t102,'% SOLIDS')
8330  format(t13,'DAY',t20,'DIGESTER',t36,'SOLIDS')
8335  format('+',t49,'PRODUCED',t63,'TIME',t78,'BED')
8340  format('+',t88,'PRODUCED',t103,'SLUDGE'/)
8345  format(t19,'(1000 gal)',t35,'(mg/l)',t51,'(ft-3)')
8350  format('+',t63,'(min)',t75,'(1000 gal)',t89,'(yd-3)')
8355  format(t2,118('-'))

      do m=1,nmm

      a=a+ddy(m)
      b=b+flowdigest(m)
      c=c+iscdigest(m)
      d=d+gas(m)
      e=e+time(m)
      f=f+flowdewat(m)
      g=g+volsludge(m)
      h=h+percentsol(m)

      write(44,8360) ddy(m),flowdigest(m),iscdigest(m)
      write(44,8365) gas(m),time(m),flowdewat(m)
      write(44,8370) volsludge(m),percentsol(m)

8360  format(t14,i2,t21,f6.3,t35,f6.1)
8365  format('+',t50,f6.1,t64,i3,t77,f6.3)
8370  format('+',t88,f7.1,t104,f4.1)

      enddo

      aa=a/nmm
      bb=b/nmm
      cc=c/nmm
      dd=d/nmm
      ee=e/nmm
      ff=f/nmm
      gg=g/nmm
      hh=h/nmm

      write(44,8375)
      write(44,8380) bb,cc
      write(44,8385) dd,ee,ff
      write(44,8390) gg,hh

8375  format(t2,118('-'))
8380  format(t13,'AVE.',t21,f6.3,t35,f6.1)
8385  format('+',t50,f6.1,t64,f3.0,t77,f6.3)
8390  format('+',t88,f7.1,t104,f4.1)

      go to 8700

8400  write(44,8405)
      write(44,8410)
```

```
      write(44,8415)
      write(44,8420)
      write(44,8425)
      write(44,8430)
      write(44,8435)
      write(44,8440)
      write(44,8445)
      write(44,8450)

8405  format(t39,'METHOD: Thickening & Mechanical Dewatering'/)
8410  format(t2,118('-')/t20,'FLOW TO',t33,'INFL. PERCENT')
8415  format('+',t56,'FLOW TO',t70,'INFL. PERCENT')
8420  format('+',t87,'VOL. SLUDGE',t102,'% SOLIDS')
8425  format(t11,'DAY',t19,'THICKENER',t37,'SOLIDS')
8430  format('+',t50,'PH',t57,'DEWATERING',t74,'SOLIDS')
8435  format('+',t88,'PRODUCED',t103,'SLUDGE'/)
8440  format(t16,'(1000 gal)',t36,'(mg/l)',t57,'(1000 gal)')
8445  format('+',t72,'(mg/l)',t89,'(yd-3)')
8450  format(t2,118('-'))

      do m=1,nmm

      a=a+flowthick(m)
      b=b+iscthick(m)
      c=c+ph(m)
      d=d+flowdewat(m)
      e=e+iscdewat(m)
      f=f+volsludge(m)
      g=g+percentsol(m)

      write(44,8455) day(m),flowthick(m),iscthick(m)
      write(44,8460) ph(m),flowdewat(m),iscdewat(m)
      write(44,8465) volsludge(m),percentsol(m)

8455  format(t12,i2,t21,f6.3,t36,f6.1)
8460  format('+',t50,f3.1,t59,f6.3,t72,f6.1)
8465  format('+',t88,f7.1,t104,f4.1)

      enddo

      aa=a/nmm
      bb=b/nmm
      cc=c/nmm
      dd=d/nmm
      ee=e/nmm
      ff=f/nmm
      gg=g/nmm

      write(44,8470)
      write(44,8475) aa,bb
      write(44,8480) cc,dd,ee
      write(44,8485) ff,gg

8470  format(t2,118('-'))
8475  format(t11,'AVE.',t21,f6.3,t36,f6.1)
8480  format('+',t50,f3.1,t59,f6.3,t72,f6.1)
8485  format('+',t88,f7.1,t104,f4.1)

      go to 8700

8500  write(44,8505)
```

```
      write(44,8510)
      write(44,8515)
      write(44,8520)
      write(44,8525)
      write(44,8530)
      write(44,8535)
      write(44,8540)
      write(44,8540)
      write(44,8545)
      write(44,8550)
      write(44,8555)

8505  format(t40,'METHOD: Digestion & Mechanical Dewatering'/)
8510  format(t2,118('-')/t9,'FLOW TO',t20,'INFL. PERCENT')
8515  format('+',t39,'GAS',t47,'DETENTION',t67,'FLOW TO')
8520  format('+',t80,'INFL. PERCENT',t94,'VOL. SLUDGE',t107,
     . '% SOLIDS')
8525  format(t2,'DAY',t8,'DIGESTION',t24,'SOLIDS')
8530  format('+',t36,'PRODUCED',t49,'TIME',t59,'PH')
8535  format('+',t65,'DEWATERING',t82,'SOLIDS')
8540  format('+',t95,'PRODUCED',t108,'SLUDGE'/)
8545  format(t7,'(1000 gal)',t23,'(mg/l)',t38,'(ft-3)')
8550  format('+',t49,'(min)',t66,'(1000 gal)')
8555  format('+',t80,'(mg/l)',t96,'(yd-3)'/t2,118('-'))

      do m=1,nmm

      a=a+ddy(m)
      b=b+flowdigest(m)
      c=c+iscdigest(m)
      d=d+gas(m)
      e=e+time(m)
      f=f+ph(m)
      g=g+flowdewat(m)
      h=h+iscdewat(m)
      o=o+volsludge(m)
      p=p+percentsol(m)

      write(44,8560) ddy(m),flowdigest(m),iscdigest(m)
      write(44,8565) gas(m),time(m),ph(m)
      write(44,8570) flowdewat(m),iscdewat(m)
      write(44,8575) volsludge(m),percentsol(m)

8560  format(t3,i2,t8,f6.3,t23,f6.1)
8565  format('+',t37,f7.1,t50,i3,t59,f3.1)
8570  format('+',t68,f6.3,t80,f6.1)
8575  format('+',t95,f7.1,t109,f4.1)

      enddo

      aa=a/nmm
      bb=b/nmm
      cc=c/nmm
      dd=d/nmm
      ee=e/nmm
      ff=f/nmm
      gg=g/nmm
      hh=h/nmm
      oo=o/nmm
      pp=p/nmm
```

```
      write(44,8580) bb,cc
      write(44,8585) dd,ee,ff
      write(44,8590) gg,hh
      write(44,8595) gg,hh

8580  format(t2,118('-')/t2,'AVE.',t9,f6.3,t23,f5.1)
8585  format('+',t37,f7.1,t50,f3.0,t59,f3.1)
8590  format('+',t68,f6.3,t80,f6.1)
8595  format('+',t95,f7.1,t109,f4.1)

      go to 8700

8600  write(44,8605)
      write(44,8610)
      write(44,8615)
      write(44,8620)
      write(44,8625)
      write(44,8630)
      write(44,8635)
      write(44,8640)

8605  format(t52,'METHOD: Digestion'//t2,118('-'))
8610  format(t22,'FLOW TO',t31,'INFL. PERCENT',t51,'GAS')
8615  format('+',t61,'DETENTION',t80,'VOL. SLUDGE',t95,'% SOLIDS')
8620  format(t14,'DAY',t21,'DIGESTOR',t36,'SOLIDS')
8625  format('+',t49,'PRODUCED',t63,'TIME',t74,'PH')
8630  format('+',t81,'PRODUCED',t96,'SLUDGE'/)
8635  format(t21,'(100 gal)',t34,'(mg/l)',t50,'(ft-3)')
8640  format('+',t63,'(min)',t82,'(yd-3)'/t2,118('-'))

      do m=1,nmm

      a=a+ddy(m)
      b=b+flowdigest(m)
      c=c+iscdigest(m)
      d=d+gas(m)
      e=e+time(m)
      f=f+ph(m)
      g=g+volsludge(m)
      h=h+percentsol(m)

      write(44,8645) ddy(m),flowdigest(m),iscdigest(m)
      write(44,8650) gas(m),time(m),ph(m)
      write(44,8655) volsludge(m),percentsol(m)

8645  format(t15,i2,t23,f6.3,t34,f6.1)
8650  format('+',t49,f7.1,t64,i3,t74,f3.1)
8655  format('+',t81,f7.1,t97,f4.1)

      enddo

      aa=a/nmm
      bb=b/nmm
      cc=c/nmm
      dd=d/nmm
      ee=e/nmm
      ff=f/nmm
      gg=g/nmm
      hh=h/nmm

      write(44,8660) bb,cc
```

```
      write(44,8665) dd,ee,ff
      write(44,8670) gg,hh

8660  format(t2,118('-')/t14,'AVE.',t23,f6.3,t34,f6.1)
8665  format('+',t49,f7.1,t64,f3.0,t74,f3.1)
8670  format('+',t81,f7.1,t97,f4.1)

      go to 8700

8700  if(mod .eq. 1) then
      write(44,8705)
8705  format(//t15,'METHOD OF DISPOSAL: Incineration')
      elseif(mod .eq. 2) then
      write(44,8710)
8710  format(//t15,'METHOD OF DISPOSAL: Landfill')
      elseif(mod .eq. 3) then
      write(44,8715)
8715  format(//t15,'METHOD OF DISPOSAL: Land Application')
      elseif(mod .eq. 4) then
      write(44,8720)
8720  format(//t15,'METHOD OF DISPOSAL: Reclamation')
      elseif(mod .eq. 5) then
      write(44,8725)
8725  format(//t15,'METHOD OF DISPOSAL: Reuse')
      elseif(mod .eq. 6) then
      write(44,8730)
8730  format(//t15,'METHOD OF DISPOSAL: Ocean Disposal')
      else
      write(44,8735)
8735  format(//t15,'METHOD OF DISPOSAL: Barged to Sea')
      endif

      go to 8800

8800  end

4000  Subroutine SectIV

      include 'common.for'

      integer x

      real bodmax,sssmax,a

**    **    **    **    **    **    **    **    **
*
*     Subroutine SectIV lists the days each NPDES Permit require-
* ment is not met.  Design values will be compared to actual
* values to indicate capacity approach (90% design capacity).
*
**    **    **    **    **    **    **    **    **

      write (44,4004)
      write (44,4005)
      write (44,4010)
      write (44,4015)
      write (44,4020)
      write (44,4025)
      write (44,4030)
      write (44,4035)
```

```
      write (44,4040)
      write (44,4045)
      write (44,4050)
      write (44,4055)

4004  format ('1'/t1,116('=')//t2,'SECTION IV  : '//)
4005  format (t42,'COMPARISON OF OPERATING PERFORMANCES')
4010  format (t45,'WITH PERMIT AND DESIGN LIMITS'/)
4015  format (t1,116('-'))
4020  format (///,t20,74('-'))
4025  format (t20,':',t47,':',t61,':',t72,':',t93,':')
4030  format (t20,':',t47,':',t51,'MAXIMUM',t61,':')
4035  format ('+',t64,'PERMIT',t72,':',t75,'NO. TIMES PERMIT',
     . t93,':')
4040  format (t20,':',t47,':',t52,'VALUE',t61,':')
4045  format ('+',t65,'LEVEL',t72,':',t78,'EXCEEDED',t93,':')
4050  format (t20,':',t47,':',t61,':',t72,':',t93,':')
4055  format (t20,74('-'))

**      **      **      **      **      **      **      **      **
*
*     Daily BOD (mg/1)
*
**      **      **      **      **      **      **      **      **

      write (44,4050)

      boddmax=bodf(1)
      j=0

      do m=1,mm
      if(bodf(m) .gt. bodf(m-1)) then
      boddmax=bodf(m)
      endif
      if(bodf(m) .gt. bodflim) then
      j=j+1
      endif
      enddo

      if(bodflim .eq. 0) then
      j=0
      endif

      write(44,4060) boddmax,bodflim,j
      write(44,4065)
      write(44,4050)
      write(44,4055)

4060  format(t20,':',t28,'Daily BOD',t47,':',t51,f5.2,t61,':',t64,
     . f5.2,t72,':',t81,i2,t93,':')
4065  format(t20,':',t30,'(mg/1)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **      **
*
*     Monthly BOD (mg/1)
*
**      **      **      **      **      **      **      **      **      **

      write (44,4050)
```

```
        j=0

        if(bodave(mon) .gt. bodavelim) then
        j=1
        endif

        if(bodavelim .eq. 0) then
        j=0
        endif

        write(44,4070) bodave(mon),bodavelim,j
        write(44,4075)
        write(44,4050)
        write(44,4055)

 4070   format(t20,':',t27,'Monthly BOD',t47,':',t51,f5.2,t61,':',t64,
     .f5.2,t72,':',t81,i2,t93,':')
 4075   format(t20,':',t30,'(mg/l)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Daily Suspended Solids (mg/l)
*
**      **      **      **      **      **      **      **      **

        write (44,4050)

        sssmax=ssf(1)
        j=0

        do m=1,mm
        if(ssf(m) .gt. ssf(m-1)) then
        sssmax=ssf(m)
        endif
        if(ssf(m) .gt. ssflim) then
        j=j+1
        endif
        enddo

        if(ssflim .eq. 0) then
        j=0
        endif

        write(44,4080) sssmax,ssflim,j
        write(44,4085)
        write(44,4050)
        write(44,4055)

 4080   format(t20,':',t29,'Daily SS',t47,':',t51,f5.2,t61,':',t64,
     .f5.2,t72,':',t81,i2,t93,':')
 4085   format(t20,':',t30,'(mg/l)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Monthly Suspended Solids (mg/l)
*
**      **      **      **      **      **      **      **      **

        write (44,4050)

        j=0
```

```
      if(ssave(mon) .gt. ssavelim) then
      j=1
      endif

      if(ssavelim .eq. 0) then
      j=0
      endif

      write(44,4090) ssave(mon),ssavelim,j
      write(44,4095)
      write(44,4050)
      write(44,4055)

4090  format(t20,':',t28,'Monthly SS',t47,':',t51,f5.2,t61,':',t64,
     .f5.2,t72,':',t81,i2,t93,':')
4095  format(t20,':',t30,'(mg/1)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Daily Percent Removal : BOD
*
**      **      **      **      **      **      **      **      **

      write (44,4050)

      a=prbod(1)
      j=0

      do m=1,mm
      if(prbod(m) .gt. prbod(m-1)) then
      a=prbod(m)
      endif
      if(prbod(m) .gt. prbodlim) then
      j=j+1
      endif
      enddo

      if(prbodlim .eq. 0) then
      j=0
      endif

      write(44,4100) a,prbodlim,j
      write(44,4105)
      write(44,4050)
      write(44,4055)

4100  format(t20,':',t23,'Daily Percent Removal:',t47,':',t51,
     .f4.2,t61,':',t64,f4.2,t72,':',t81,i2,t93,':')
4105  format(t20,':',t32,'BOD',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Monthly Percent Removal : BOD
*
**      **      **      **      **      **      **      **      **

      write (44,4050)

      j=0
```

```
      if(prbodave .gt. prbodavelim) then
      j=1
      endif

      if(prbodavelim .eq. 0) then
      j=0
      endif

      write(44,4110) prbodave,prbodavelim,j
      write(44,4115)
      write(44,4050)
      write(44,4055)

 4110 format(t20,':',t22,'Monthly Percent Removal:',t47,':',t51,
     . f4.2,t61,':',t64,f4.2,t72,':',t81,i2,t93,':')
 4115 format(t20,':',t32,'BOD',t47,':',t61,':',t72,':',t93,':')

**       **       **       **       **       **       **       **       **
*
*    Daily Percent Removal : Suspended Solids
*
**       **       **       **       **       **       **       **       **

      write (44,4050)

      a=prss(1)
      j=0

      do m=1,mm
      if(prss(m) .gt. prss(m-1)) then
      a=prss(m)
      endif
      if(prss(m) .gt. prsslim) then
      j=j+1
      endif
      enddo

      if(prsslim .eq. 0) then
      j=0
      endif

      write(44,4120) a,prsslim,j
      write(44,4125)
      write(44,4050)
      write(44,4055)

 4120 format(t20,':',t23,'Daily Percent Removal',t47,':',t51,f4.2,
     . t61,':',t64,f4.2,t72,':',t81,i2,t93,':')
 4125 format(t20,':',t32,'SS',t47,':',t61,':',t72,':',t93,':')

**       **       **       **       **       **       **       **       **
*
*    Monthly Percent Removal : Suspended Solids
*
**       **       **       **       **       **       **       **       **

      write (44,4050)

      j=0
```

```
      if(prssave .gt. prssavelim) then
      j=1
      endif

      if(prssavelim .eq. 0) then
      j=0
      endif

      write(44,4130) prssave,prssavelim,j
      write(44,4135)
      write(44,4050)
      write(44,4055)

 4130 format(t20,':',t22,'Monthly Percent Removal:',t47,':',t51,
     . f4.2,t61,':',t64,f4.2,t72,':',t81,i2,t93,':')
 4135 format(t20,':',t32,'SS',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Daily Phosphorus Removal (mg/l)
*
**      **      **      **      **      **      **      **      **

      write (44,4050)

      a=phos(1)
      j=0

      do m=1,mm
      if(phos(m) .gt. phos(m-1)) then
      a=phos(m)
      endif
      if(phos(m) .gt. phoslim) then
      j=j+1
      endif
      enddo

      if(phoslim .eq. 0) then
      j=0
      endif

      write(44,4140) a,phoslim,j
      write(44,4145)
      write(44,4050)
      write(44,4055)

 4140 format(t20,':',t22,'Daily Effl. Phosphorus',t47,':',t51,f5.2,
     . t61,':',t64,f5.2,t72,':',t81,i2,t93,':')
 4145 format(t20,':',t30,'(mg/l)',t47,':',t61,':',t72,':',t93,':')


**      **      **      **      **      **      **      **      **
*
*     Monthly Phosphorus Removal (mg/l)
*
**      **      **      **      **      **      **      **      **

      write (44,4050)

      j=0
```

```
      if(phosave .gt. phosavelim) then
      j=1
      endif

      if(phosavelim .eq. 0) then
      j=0
      endif

      write(44,4150) phosave,phosavelim,j
      write(44,4155)
      write(44,4050)
      write(44,4055)

 4150 format(t20,':',t22,'Monthly Effl. Phosphorus',t47,':',t51,
     . f5.2,t61,':',t64,f5.2,t72,':',t81,i2,t93,':')
 4155 format(t20,':',t30,'(mg/l)',t47,':',t61,':',t72,':',t93,':')

**     **     **     **     **     **     **     **     **
*
*     Daily Ammonia Removal (mg/l)
*
**     **     **     **     **     **     **     **     **

      write (44,4050)

      a=amm(1)
      j=0

      do m=1,mm
      if(amm(m) .gt. amm(m-1)) then
      a=amm(m)
      endif
      if(amm(m) .gt. ammlim) then
      j=j+1
      endif
      enddo

      if(ammlim .eq. 0) then
      j=0
      endif

      write(44,4160) a,ammlim,j
      write(44,4165)
      write(44,4050)
      write(44,4055)

 4160 format(t20,':',t24,'Daily Effl. Ammonia',t47,':',t51,f5.2,
     . t61,':',t64,f5.2,t72,':',t81,i2,t93,':')
 4165 format(t20,':',t30,'(mg/l)',t47,':',t61,':',t72,':',t93,':')

**     **     **     **     **     **     **     **     **
*
*     Monthly Ammonia Removal (mg/l)
*
**     **     **     **     **     **     **     **     **

      write (44,4050)

      j=0

      if(ammave .gt. ammavelim) then
```

```
      j=1
      endif

      if(ammavelim .eq. 0) then
      j=0
      endif

      write(44,4170) ammave,ammavelim,j
      write(44,4175)
      write(44,4050)
      write(44,4055)

 4170 format(t20,':',t24,'Monthly Effl. Ammonia',t47,':',t51,
     . f5.2,t61,':',t64,f5.2,t72,':',t81,i2,t93,':')
 4175 format(t20,':',t30,'(mg/l)',t47,':',t61,':',t72,':',t93,':')

**       **       **       **       **       **       **       **       **
*
*     Daily Nitrate Removal (mg/l)
*
**       **       **       **       **       **       **       **       **

      write (44,4050)

      a=nit(1)
      j=0

      do m=1,mm
      if(nit(m) .gt. nit(m-1)) then
      a=nit(m)
      endif
      if(nit(m) .gt. nitlim) then
      j=j+1
      endif
      enddo

      if(nitlim .eq. 0) then
      j=0
      endif

      write(44,4180) a,nitlim,j
      write(44,4185)
      write(44,4050)
      write(44,4055)

 4180 format(t20,':',t23,'Daily Effl. Nitrate',t47,':',t51,f5.2,
     . t61,':',t64,f5.2,t72,':',t81,i2,t93,':')
 4185 format(t20,':',t30,'(mg/l)',t47,':',t61,':',t72,':',t93,':')

**       **       **       **       **       **       **       **       **
*
*     Monthly Nitrate Removal (mg/l)
*
**       **       **       **       **       **       **       **       **

      write (44,4050)

      j=0

      if(nitave .gt. nitavelim) then
      j=1
```

```
        endif

        if(nitavelim .eq. 0) then
        j=0
        endif

        write(44,4190) nitave,nitavelim,j
        write(44,4195)
        write(44,4050)
        write(44,4055)

 4190   format(t20,':',t25,'Monthly Effl. Nitrate',t47,':',t51,
     . f5.2,t61,':',t64,f5.2,t72,':',t81,i2,t93,':')
 4195   format(t20,':',t30,'(mg/l)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*    Daily Average Flow
*
**      **      **      **      **      **      **      **      **

        write (44,4050)

        a=flow(1)
        j=0

        do m=1,mm
        if(flow(m) .gt. flow(m-1)) then
        a=flow(m)
        endif
        if(flow(m) .gt. .80*designflow) then
        j=j+1
        endif
        enddo

        if(designflow .eq. 0) then
        j=0
        endif

        write(44,4200) a,designflow,j
        write(44,4205)
        write(44,4050)
        write(44,4055)

 4200   format(t20,':',t27,'Daily Flow',t47,':',t51,f5.2,t61,':',t64,
     .f5.2,t72,':',t81,i2,t93,':')
 4205   format(t20,':',t30,'(mgd)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*    Monthly average flow (mgd)
*
**      **      **      **      **      **      **      **      **

        write (44,4050)

        j=0

        if(flowave .gt. .80*flowavelim) then
        j=1
        endif
```

```
      if(flowavelim .eq. 0) then
      j=0
      endif

      write(44,4210) flowave,flowavelim,j
      write(44,4215)
      write(44,4050)
      write(44,4055)

 4210 format(t20,':',t25,'Monthly Design Flow',t47,':',t51,
     . f5.2,t61,':',t64,f5.2,t72,':',t81,i2,t93,':')
 4215 format(t20,':',t30,'(mgd)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*    Daily Total Coliforms ( /100 ml)
*
**      **      **      **      **      **      **      **      **

      write (44,4050)

      a=coltot(1)
      j=0

      do m=1,mm
      if(coltot(m) .gt. coltot(m-1)) then
      a=coltot(m)
      endif
      if(coltot(m) .gt. coltotlim) then
      j=j+1
      endif
      enddo

      if(coltotlim .eq. 0) then
      j=0
      endif

      write(44,4220) a,coltotlim,j
      write(44,4225)
      write(44,4050)
      write(44,4055)

 4220 format(t20,':',t23,'Daily Total Coliform',t47,':',t50,f7.1,
     . t61,':',t63,f7.1,t72,':',t81,i2,t93,':')
 4225 format(t20,':',t29,'(/100 ml)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*    Monthly Total Coliforms ( /100ml)
*
**      **      **      **      **      **      **      **      **

      write (44,4050)

      j=0

      if(coltotave .gt. coltotavelim) then
      j=1
      endif
```

```
        if(coltotavelim .eq. 0) then
        j=0
        endif

        write(44,4230) coltotave,coltotavelim,j
        write(44,4235)
        write(44,4050)
        write(44,4055)

 4230   format(t20,':',t22,'Monthly Total Coliform',t47,':',t50,
     . f7.1,t61,':',t63,f7.1,t72,':',t81,i2,t93,':')
 4235   format(t20,':',t29,'(/100 ml)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Daily Fecal Coliforms ( /100 ml)
*
**      **      **      **      **      **      **      **      **

        write (44,4050)

        a=colfec(1)
        j=0

        do m=1,mm
        if(colfec(m) .gt. colfec(m-1)) then
        a=colfec(m)
        endif
        if(colfec(m) .gt. colfeclim) then
        j=j+1
        endif
        enddo

        if(colfeclim .eq. 0) then
        j=0
        endif

        write(44,4240) a,colfeclim,j
        write(44,4245)
        write(44,4050)
        write(44,4055)

 4240   format(t20,':',t23,'Daily Fecal Coliform',t47,':',t50,f7.1,
     . t61,':',t63,f7.1,t72,':',t81,i2,t93,':')
 4245   format(t20,':',t30,'(/100 ml)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Monthly Fecal Coliforms ( /100 ml)
*
**      **      **      **      **      **      **      **      **

        write (44,4050)

        j=0

        if(colfecave .gt. colfecavelim) then
        j=1
        endif

        if(colfecavelim .eq. 0) then
```

```
        j=0
        endif

        write(44,4250) colfecave,colfecavelim,j
        write(44,4255)
        write(44,4050)
        write(44,4055)

 4250   format(t20,':',t22,'Monthly Fecal Coliform',t47,':',t50,
     . f7.1,t61,':',t63,f7.1,t72,':',t81,i2,t93,':')
 4255   format(t20,':',t29,'(/100 ml)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Daily Settleable Solids (ml/l)
*
**      **      **      **      **      **      **      **      **

        write (44,4050)

        a= setsol(1)
        j=0

        do m=1,mm
        if(setsol(m) .gt. setsol(m-1)) then
        a=setsol(m)
        endif
        if(setsol(m) .gt. setsollim) then
        j=j+1
        endif
        enddo

        if(setsollim .eq. 0) then
        j=0
        endif

        write(44,4260) a,setsollim,j
        write(44,4265)
        write(44,4050)
        write(44,4055)

 4260   format(t20,':',t22,'Daily Settleable Solids',t47,':',t51,
     . f5.3,t61,':',t64,f5.3,t72,':',t81,i2,t93,':')
 4265   format(t20,':',t30,'(ml/l)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Monthly Setteaole Solids (ml/l)
*
**      **      **      **      **      **      **      **      **

        write (44,4050)

        j=0

        if(setsolave .gt. setsolavelim) then
        j=1
        endif

        if(setsolavelim .eq. 0) then
        j=0
```

```
        endif

        write(44,4270) setsolave,setsolavelim,j
        write(44,4275)
        write(44,4050)
        write(44,4055)

 4270   format(t20,':',t22,'Monthly Settleable Solids',t47,':',t51,
     .  f5.3,t61,':',t64,f5.3,t72,':',t81,i2,t93,':')
 4275   format(t20,':',t30,'(ml/l)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Daily Other Parameter I (units)
*
**      **      **      **      **      **      **      **      **

        write (44,4050)

        a= otherI(1)
        j=0

        do m=1,mm
        if(otherI(m) .gt. otherI(m-1)) then
        a=otherI(m)
        endif
        if(otherI(m) .gt. otherIlim) then
        j=j+1
        endif
        enddo

        if(otherIlim .eq. 0) then
        j=0
        endif

        write(44,4280) a,otherIlim,j
        write(44,4285)
        write(44,4050)
        write(44,4055)

 4280   format(t20,':',t23,'Other Parameter I',t47,':',t51,
     .  f5.3,t61,':',t64,f5.3,t72,':',t81,i2,t93,':')
 4285   format(t20,':',t30,'(units)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Monthly Other Parameter II (units)
*
**      **      **      **      **      **      **      **      **

        write (44,4050)

        j=0

        if(otherIave .gt. otherIavelim) then
        j=1
        endif

        if(otherIlim .eq. 0) then
        j=0
        endif
```

```
      write(44,4290) otherIave,otherIavelim,j
      write(44,4295)
      write(44,4050)
      write(44,4055)

 4290 format(t20,':',t22,'Monthly Other Parameter I',t47,':',t51,
     . f5.3,t61,':',t64,f5.3,t72,':',t81,i2,t93,':')
 4295 format(t20,':',t30,'(units)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Daily Other Parameter II (units)
*
**      **      **      **      **      **      **      **      **

      write (44,4050)

      a= otherII(1)
      j=0

      do m=1,mm
      if(otherII(m) .gt. otherII(m-1)) then
      a=otherII(m)
      endif
      if(otherII(m) .gt. otherIIlim) then
      j=j+1
      endif
      enddo

      if(otherIIlim .eq. 0) then
      j=0
      endif

      write(44,4300) a,otherIIlim,j
      write(44,4305)
      write(44,4050)
      write(44,4055)

 4300 format(t20,':',t23,'Other Parameter II',t47,':',t51,
     . f5.3,t61,':',t64,f5.3,t72,':',t81,i2,t93,':')
 4305 format(t20,':',t30,'(units)',t47,':',t61,':',t72,':',t93,':')

**      **      **      **      **      **      **      **      **
*
*     Monthly Other Parameter II (units)
*
**      **      **      **      **      **      **      **      **

      write (44,4050)

      j=0

      if(otherIIave .gt. otherIIavelim) then
      j=1
      endif

      if(otherIIlim .eq. 0) then
      j=0
      endif
```

```
      write(44,4310) otherllave,otherllavelim,j
      write(44,4315)
      write(44,4050)
      write(44,4055)

4310  format(t20,':',t22,'Monthly Other Parameter II',t47,':',t51,
     . f5.3,t61,':',t64,f5.3,t72,':',t81,i2,t93,':')
4315  format(t20,':',t30,'(units)',t47,':',t61,':',t72,':',t93,':')

      end

      Subroutine SectV

      include 'common.for'

      real bodfmax,ssfmax,bodavemax,ssavemax

      integer q,jcount,ixe,jxe,mxe,iloop

      character*1 table(20,70),incr(71),date(71),ttble(20,70),
     . graph(20,70),dash(71),dates(71),plotI(20,40),plotII(20,40),
     . mark(41),month(41)

**       **       **       **       **       **       **       **       **
*
*     Subroutine SectV prints out graphs of important parameters
* vs. days of the month.  This section simply provides a means
* of monthly comparison or trend search aid.  Actual values
* can be found in Sections I, II, III, and IV.
*
**       **       **       **       **       **       **       **       **

      write(44,5000)
      write(44,5005)
      write(44,5010)

5000  format('1'/t1,116('=')//t2,'SECTION V :'//)
5005  format(t34,'GRAPHIC REPRESENTATION OF NPDES & DESIGN
     . PARAMETERS'/)
5010  format(t1,114('-')///)

      bodfmax=bodf(1)
      ssfmax=ssf(1)

      do m=1,nnn-1

      if(bodf(m+1) .gt. bodfmax) then
      bodfmax=bodf(m+1)
      endif

      if(ssf(m+1) .gt. ssfmax) then
      ssfmax=ssf(m+1)
      endif

      enddo

      if(bodfmax .lt. bodflim) then
      bodfmax=bodflim
      endif

      if(ssfmax .lt. ssflim) then
```

```
        ssfmax=ssflim
        endif

        podfmx=podfmax*15/20
        podfmxx=podfmax*10/20
        podfmxxx=podfmax*5/20

        ssfmx=ssfmax*15/20
        ssfmxx=ssfmax*10/20
        ssfmxxx=ssfmax*5/20

        do 5020 i=1,20
        do 5015 j=1,70

        table(i,j) = ' '

5015    continue
5020    continue

        do 5023 k=1,20
        do 5021 l=1,70

        ttble(k,l) = ' '

5021    continue
5023    continue

        do l=1,70
        incr(l) = ' '
        date(l) = ' '

        enddo

        if(podflim .ne. 0) then
        il=20*podflim/podfmax
        do ik=1,70
        table(il,ik) = '~'
        enddo
        endif

        if(ssflim .ne. 0) then
        ij=20*ssflim/ssfmax
        do im=1,70
        ttble(ij,im) = '~'
        enddo
        endif

        do m=1,2
        write(44,5024)
5024    format(t30,'!')
        enddo

        do 5028 m=1,nnn

        g=dod(m)

        i=20*podf(m)/podfmax

        j=70*g/mm

        k=20*ssf(m)/ssfmax
```

```
        l=70*q/mm

        if (i .eq. 0) then
        go to 5026
        endif

        table(i,j) = '*'

 5026   continue

        if(k .eq. 0) then
        go to 5028
        endif

        ttble(k,l) = '*'

 5028   continue

        do l=1,70

        if(date(l) .ne. ' ') then
        go to 5029
        endif

        ll=l-1

        if(date(ll) .ne. ' ') then
        go to 5029
        endif

        q=l*mm/70

        if(q .eq. 5) then
        incr(l)='!'
        date(l)='5'
        endif

        if(q .eq. 10) then
        incr(l)='!'
        date(l)='1'
        date(l+1)='0'
        endif

        if(q .eq. 15) then
        incr(l)='!'
        date(l)='1'
        date(l+1)='5'
        endif

        if(q .eq. 20) then
        incr(l)='!'
        date(l)='2'
        date(l+1)='0'
        endif

        if(q .eq. 25) then
        incr(l)='!'
        date(l)='2'
        date(l+1)='5'
        endif
```

```
        if(m .eq. 30) then
        incr(l)='!'
        date(l)='3'
        date(l+1)='0'
        endif

5029    continue

        enddo

        write(44,5030) bodfmax,(table(20,j),j=1,70)

        do i=19,16,-1
        write(44,5035) (table(i,j),j=1,70)
        enddo

        write(44,5040) bodfmx,(table(15,j),j=1,70)

        write(44,5045) (table(14,j),j=1,70)
        write(44,5046) (table(13,j),j=1,70)
        write(44,5047) (table(12,j),j=1,70)
        write(44,5048) (table(11,j),j=1,70)

        write(44,5050) bodfmxx,(table(10,j),j=1,70)

        do i=9,6,-1
        write(44,5055) (table(i,j),j=1,70)
        enddo

        write(44,5060) bodfmxxx,(table(5,j),j=1,70)

        do i=4,1,-1
        write(44,5065) (table(i,j),j=1,70)
        enddo

        write(44,5070)
        write(44,5075) (incr(l),l=2,71)
        write(44,5080) (date(l),l=2,71)
        write(44,5085)
        write(44,5090)

5030    format(t23,f5.2,t29,'-',t30,'!',70a)
5035    format(t30,'!',70a)
5040    format(t23,f5.2,t29,'-',t30,'!',70a)
5045    format(t30,'!',70a)
5046    format(t17,'BOD-5',t30,'!',70a)
5047    format(t17,'(mg/l)',t30,'!',70a)
5048    format(t30,'!',70a)
5050    format(t23,f5.2,t29,'-',t30,'!',70a)
5055    format(t30,'!',70a)
5060    format(t23,f5.2,t29,'-',t30,'!',70a)
5065    format(t30,'!',70a)
5070    format('+',t24,'0.00 -',t30,72('_'))
5075    format(t30,'!'70a)
5080    format(t30,'0',70a)
5085    format(/t62,'Time (days)')
5090    format(/t57,'Effluent BOD vs. Time')

        write(44,6030) ssfmax,(ttble(20,l),l=1,70)
```

```
      do i=19,16,-1
      write(44,6035) (ttble(i,l),l=1,70)
      enddo

      write(44,6040) ssfmx,(ttble(15,l),l=1,70)
      write(44,6045) (ttble(14,l),l=1,70)
      write(44,6046) (ttble(13,l),l=1,70)
      write(44,6047) (ttble(12,l),l=1,70)
      write(44,6048) (ttble(11,l),l=1,70)
      write(44,6050) ssfmxx,(ttble(10,l),l=1,70)

      do i=9,6,-1
      write(44,6055) (ttble(i,l),l=1,70)
      enddo

      write(44,6060) ssfmxxx,(ttble(5,l),l=1,70)

      do i=4,1,-1
      write(44,6065) (ttble(i,l),l=1,70)
      enddo

      write(44,6070)
      write(44,6075) (incr(m),m=2,71)
      write(44,6080) (date(m),m=2,71)
      write(44,6085)
      write(44,6090)

6030  format(t23,f5.2,t29,'-',t30,'!',70a)
6035  format(t30,'!',70a)
6040  format(t23,f5.2,t29,'-',t30,'1',70a)
6045  format(t30,'!',70a)
6046  format(t17,'SS',t30,'!',70a)
6047  format(t17,'(mg/l)',t30,'!',70a)
6048  format(t30,'!',70a)
6050  format(t23,f5.2,t29,'-',t30,'!',70a)
6055  format(t30,'!',70a)
6060  format(t23,f5.2,t29,'-',t30,'!',70a)
6065  format(t30,'!',70a)
6070  format('+',t23,'0.00 -',t30,72('_'))
6075  format(t30,'!',70a)
6080  format(t30,'0',70a)
6085  format(/t62,'Time (days)')
6090  format(/t57,'Effluent SS .vs. Time')

      flowpeak=flow(1)
      rainmax=rain(1)

      do m=1,mm-1

      if(flow(m+1) .gt. flowpeak) then
      flowpeak=flow(m+1)
      endif

      if(rain(m+1) .gt. rainmax) then
      rainmax=rain(m+1)
      endif

      enddo

      if(flowpeak .lt. designflow) then
      flowpeak=designflow
```

```
        endif

        flowpk=flowpeak*15/20
        flowpkk=flowpeak*10/20
        flowpkkk=flowpeak*5/20

        rainmx=rainmax*15/20
        rainmxx=rainmax*10/20
        rainmxxx=rainmax*5/20

        do 5105 i=1,20
        do 5100 j=1,70

        graph(i,j) = ' '

5100    continue
5105    continue

        do l=1,70

        dash(l) = ' '
        dates(l) = ' '

        enddo

        if(designflow .ne. 0) then
        ki=20*designflow/flowpeak
        do li=1,70
        graph(ki,li) = '~'
        enddo
        endif

        write(44,5110)
5110    format(//t30,'!',t101,'!'/t30,'!',t101,'!')

        do m=1,mm

        i=20*rain(m)/rainmax

        j=70*m/mm

        if(i .eq. 0) then
        go to 5115
        endif

        graph(i,j) = '+'

5115    continue

        enddo

        do ixe=1,20
        do jxe=1,70
        if(graph(ixe,jxe) .eq. '+') then
        iloop=ixe
        do mxe=iloop,1,-1
        graph(mxe,jxe)='.'
        enddo
        endif
        enddo
        enddo
```

```
      do m=1,mm

      k=20*flow(m)/flowpeak

      l=70*m/mm

      if(k .eq. 0) then
      go to 5120
      endif

      graph(k,l) = '*'

5120  continue

      enddo

      do n=1,70

      if(dates(n) .ne. ' ') then
      go to 5123
      endif

      nn=n-1

      if(dates(nn) .ne. ' ') then
      go to 5123
      endif

      r=n*mm/70

      if(r .eq. 5) then
      dash(n) = '!'
      dates(n) = '5'
      endif

      if(r .eq. 10) then
      dash(n) = '!'
      dates(n) = '1'
      dates(n+1) = '0'
      endif

      if(r .eq. 15) then
      dash(n) = '!'
      dates(n) = '1'
      dates(n+1) = '5'
      endif

      if(r .eq. 20) then
      dash(n) = '!'
      dates(n) = '2'
      dates(n+1) = '0'
      endif

      if(r .eq. 25) then
      dash(n) = '!'
      dates(n) = '2'
      dates(n+1) = '5'
      endif

      if(r .eq. 30) then
```

```
      dash(n) = '!'
      dates(n) = '3'
      dates(n+1) = '0'
      endif

5123  continue

      enddo

      write(44,5130) flowpeak,(graph(20,j),j=1,70),rainmax

      do i=19,16,-1
      write(44,5135) (graph(i,j),j=1,70)
      enddo

      write(44,5140) flowpk,(graph(15,j),j=1,70),rainmx
      write(44,5145) (graph(14,j),j=1,70)
      write(44,5150) (graph(13,j),j=1,70)
      write(44,5155) (graph(12,j),j=1,70)
      write(44,5160) (graph(11,j),j=1,70)
      write(44,5165) flowpkk,(graph(10,j),j=1,70),rainmxx

      do i=9,6,-1
      write(44,5170) (graph(i,j),j=1,70)
      enddo

      write(44,5175) flowpkkk,(graph(5,j),j=1,70),rainmxxx

      do i=4,1,-1
      write(44,5180) (graph(i,j),j=1,70)
      enddo

      write(44,5185)
      write(44,5190) (dash(l),l=2,71)
      write(44,5195) (dates(l),l=2,71)
      write(44,5200)
      write(44,5205)

5130  format(t23,f5.2,t29,'-!',70a,t101,'!-',f5.2)
5135  format(t30,'!',70a,t101,'!')
5140  format(t23,f5.2,t29,'-!',70a,t101,'!-',f5.2)
5145  format(t30,'!',70a,t101,'!')
5150  format(t15,'Ave. Flow (*)',t30,'!',70a,t101,'!',t105,
     . 'Rainfall (+)')
5155  format(t17,'(mgd)',t30,'!',70a,t101,'!',t105,'(inches)')
5160  format(t30,'!',70a,t101,'!')
5165  format(t23,f5.2,t29,'-!',70a,t101,'!-',f5.2)
5170  format(t30,'!',70a,t101,'!')
5175  format(t23,f5.2,t29,'-!',70a,t101,'!-',f5.2)
5180  format(t30,'!',70a,t101,'!')
5185  format('+',t24,'0.00-',t30,'!',70('_'),t101,'!-0.00')
5190  format(t30,'!',70a)
5195  format(t30,'0',70a)
5200  format(/t59,'Time (Days)')
5205  format(//t48,'Average Flow & Rainfall vs. Time')

      jcount=12+mon
      rewind 6
      numplnt=0

5208  if(numplnt .ne. num) then
```

```
        go to 5209
        else
        go to 5230
        endif

 5209   read(6,5210) numplnt
 5210   format(i4)
        do i=1,jcount
        read(6,5215) bodave(i),ssave(i)
 5215   format(2f6.2)
        enddo

        go to 5208

 5230   bodavemax=bodave(1)
        ssavemax=ssave(1)

        do j=1,jcount-1

        if(bodave(j+1) .gt. bodavemax) then
        bodavemax=bodave(j+1)
        endif

        if(ssave(j+1) .gt. ssavemax) then
        ssavemax=ssave(j+1)
        endif

        enddo

        if(bodavemax .lt. bodavelim) then
        bodavemax=bodavelim
        endif

        if(ssavemax .lt. ssavelim) then
        ssavemax=ssavelim
        endif

        bodavemx=bodavemax*15/20
        bodavemxx=bodavemax*10/20
        bodavemxxx=bodavemax*5/20

        ssavemx=ssavemax*15/20
        ssavemxx=ssavemax*10/20
        ssavemxxx=ssavemax*5/20

        do 5240 i=1,20
        do 5235 j=1,40

        plotI(i,j) = ' '

 5235   continue
 5240   continue

        do 5250 k=1,20
        do 5245 l=1,40

        plotII(k,l) = ' '

 5245   continue
 5250   continue
```

```
      do n=1,40
      mark(n) = ' '
      month(n) = ' '
      enddo

      write(44,5255)
5255  format(//t20,'!',t75,'!')
      write(44,5256)
5256  format(t20,'!',t75,'!')

      if(podavelim .ne. 0) then
      ii=20*podavelim/podavemax
      do jj=1,40
      plotI(ii,jj) = '~'
      enddo
      endif

      if(ssavelim .ne. 0) then
      kk=20*ssavelim/ssavemax
      do ll=1,40
      plotII(kk,ll) = '~'
      enddo
      endif

      do 5265 m=1,jcount

      i=20*podave(m)/podavemax

      j=40*m/jcount

      k=20*ssave(m)/ssavemax

      l=40*m/jcount

      if(i .eq. 0) then
      go to 5260
      endif

      plotI(i,j) = '*'

5260  continue

      if(k .eq. 0) then
      go to 5265
      endif

      plotII(k,j) = '*'

5265  continue

      do n=1,40

      if(month(n) .ne. ' ') then
      go to 5267
      endif

      if(month(n-1) .ne. ' ') then
      go to 5267
      endif

      s=n*jcount/40
```

```
if(s .eq. 2) then
mark(n) = '!'
month(n) = '2'
endif

if(s .eq. 4) then
mark(n) = '!'
month(n) = '4'
endif

if(s .eq. 6) then
mark(n) = '!'
month(n) = '6'
endif

if(s .eq. 8) then
mark(n) = '!'
month(n) = '8'
endif

if(s .eq. 10) then
mark(n) = '!'
month(n) = '1'
month(n+1) = '0'
endif

if(s .eq. 12) then
mark(n) = '!'
month(n) = '1'
month(n+1) = '2'
endif

if(s .eq. 14) then
mark(n) = '!'
month(n) = '2'
endif

if(s .eq. 16) then
mark(n) = '!'
month(n) = '4'
endif

if(s .eq. 18) then
mark(n) = '!'
month(n) = '6'
endif

if(s .eq. 20) then
mark(n) = '!'
month(n) = '8'
endif

if(s .eq. 22) then
mark(n) = '!'
month(n) = '1'
month(n+1) = '0'
endif

if(s .eq. 24) then
mark(n) = '!'
```

```
      month(n) = '1'
      month(n+1) = '2'
      endif

5267  continue

      enddo

      write(44,5270) bodavemax,(plotI(20,j),j=1,40),ssavemax,
     . (plotII(20,l),l=1,40)

      do i=19,16,-1
      write(44,5275) (plotI(i,j),j=1,40),(plotII(i,l),l=1,40)
      enddo

      write(44,5280) bodavemx,(plotI(15,j),j=1,40),ssavemx,
     . (plotII(15,l),l=1,40)

      write(44,5285) (plotI(14,j),j=1,40),(plotII(14,l),l=1,40)
      write(44,5290) (plotI(13,j),j=1,40),(plotII(13,l),l=1,40)
      write(44,5295) (plotI(12,j),j=1,40),(plotII(12,l),l=1,40)
      write(44,5300) (plotI(11,j),j=1,40),(plotII(11,l),l=1,40)

      write(44,5305) bodavemxx,(plotI(10,j),j=1,40),ssavemxx,
     . (plotII(10,l),l=1,40)

      do i=9,6,-1
      write(44,5310) (plotI(i,j),j=1,40),(plotII(i,l),l=1,40)
      enddo

      write(44,5315) bodavemxxx,(plotI(5,j),j=1,40),ssavemxxx,
     . (plotII(5,l),l=1,40)

      do i=4,1,-1
      write(44,5320) (plotI(i,j),j=1,40),(plotII(i,l),l=1,40)
      enddo

      write(44,5325)
      write(44,5330) (mark(l),l=2,40),(mark(m),m=1,40)
      write(44,5335) (month(l),l=2,40),(month(m),m=1,40)
      write(44,5340)
      write(44,5345)

5270  format(t13,f5.2,t19,'-',t20,'!',40a,t68,f5.2,t74,'-',
     . t75,'!',40a)
5275  format(t20,'!',40a,t75,'!',40a)
5280  format(t13,f5.2,t19,'-',t20,'!',40a,t68,f5.2,t74,'-',
     . t75,'!',40a)
5285  format(t20,'!',40a,t75,'!',40a)
5290  format(t8,'BOD-5',t20,'!',40a,t67,'SS',t75,'!',40a)
5295  format(t8,'(mg/l)',t20,'!',40a,t65,'(mg/l)',t75,'!',40a)
5300  format(t20,'!',40a,t75,'!',40a)
5305  format(t13,f5.2,t19,'-',t20,'!',40a,t68,f5.2,t74,'-',
     . t75,'!',40a)
5310  format(t20,'!',40a,t75,'!',40a)
5315  format(t13,f5.2,t19,'-',t20,'!',40a,t68,f5.2,t74,'-',
     . t75,'!',40a)
5320  format(t20,'!',40a,t75,'!',40a)
5325  format('+',t14,'0.00 -',t20,42('_'),t69,'0.00 -',t75,42('_'))
5330  format(t20,'!',40a,t75,'!',40a)
5335  format(t20,'0',40a,t75,'0',40a)
```

```
5340   format(/t35,'Time (months)',t90,'Time (months)')
5345   format(//t32,'Monthly BOD vs. Time',t87,'Monthly SS vs. Time')

       if(jcount .eq. 24) then

       do n=1,12
       bodsave(12+n)=bodsave(n)
       ssave(12+n)=ssave(n)
       enddo

       endif

       end
```

APPENDIX IV: SAMPLE DTECTR OUTPUT

DIAGNOSTIC TESTING OF EFFICIENCY BY COMPUTERIZATION OF TREATMENT REPORTS

VERSION 2.0

Revised and Rewritten
January 1983
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ENVIRONMENTAL ENGINEERING PROGRAM
Department of Civil Engineering
University of Massachusetts
Amherst, Massachusetts 01003

This program was developed with financial assistance from the Massachusetts Division of Water Pollution Control

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The DITECTR program has been developed to aid the Massachusetts Division of Water Pollution Control in monthly compliance checking of municipal wastewater treatment plants.

The output for each treatment plant consists of 5 sections:

I. Tabulation of Daily Operational Data
II. Daily BOD, SS Loadings and Percent Removals
III. Tabulation of Sludge Treatement Parameters
IV. Comparison of Operating Performances with Permit and Design Limits
V. Graphic Representation of Permit and Design Parameters

Plants are coded in alphanumeric order. The following list gives a code number with its corresponding treatment plant

PLANT NUMBER	PLANT LOCATION
1	Amherst

SECTION I :

TABULATION OF DAILY OPERATIONAL DATA

PLANT NUMBER 1 : MODIFIED ACTIVATED SLUDGE

DAY	RAINFALL (inches)	AVE. FLOW (mgd)	PEAK FLOW (mgd)	RECYC FLOW (mgd)	DO: AER TANK (mg/l)	MLSS (ml/l)	SVI (ml/g)	F/M RATIO (/days)	CHLORINE RESIDUAL (mg/l)	TOTAL COLIFORM (/100 ml)	FECAL COLIFORM (/100 ml)	PHOS (mg/l)	AMM NIT (mg/l)	NO3 NIT (mg/l)
1	0.00	3.06	4.10	0.00	0.0	2240.0	0.00	0.00	0.60	95.0	0.0	2.4	7.8	0.51
2	0.02	3.14	4.40	0.00	14.4	2235.0	0.00	0.00	1.40	0.0	0.0	0.0	0.0	0.00
3	0.06	3.10	4.40	0.00	0.0	0.0	0.00	0.00	1.30	0.0	0.0	0.0	0.0	0.00
4	0.01	3.03	4.20	0.00	0.0	0.0	0.00	0.00	0.30	0.0	0.0	0.0	0.0	0.00
5	1.14	3.54	6.80	0.00	0.0	0.0	0.00	0.00	0.40	0.0	0.0	0.0	0.0	0.00
6	0.35	3.16	4.70	0.00	0.0	2160.0	0.00	0.00	0.35	0.0	0.0	0.0	0.0	0.00
7	0.00	2.74	4.50	0.00	0.0	0.0	0.00	0.00	1.10	150.0	0.0	0.0	0.0	0.00
8	0.00	3.23	5.00	0.00	0.0	1710.0	0.00	0.00	0.87	0.0	0.0	1.8	12.6	0.00
9	0.00	3.16	4.40	0.00	31.8	1755.0	0.00	0.00	0.50	1000.0	0.0	0.0	0.0	0.00
10	0.00	3.36	4.50	0.00	0.0	1210.0	0.00	0.00	1.07	0.0	0.0	0.0	0.0	0.00
11	0.00	2.89	4.50	0.00	0.0	0.0	0.00	0.00	0.55	0.0	0.0	0.0	0.0	0.00
12	0.00	2.96	4.10	0.00	0.0	0.0	0.00	0.00	0.45	0.0	0.0	0.0	0.0	0.00
13	0.01	2.97	4.50	0.00	0.0	1620.0	0.00	0.00	0.50	0.0	0.0	0.0	0.0	0.00
14	0.00	2.13	4.40	0.00	0.0	1350.0	0.00	0.00	1.60	68.0	0.0	0.0	0.0	0.00
15	0.00	2.35	5.00	0.00	0.0	1615.0	0.00	0.00	1.80	0.0	0.0	2.4	9.5	0.29
16	0.00	2.85	4.70	0.00	0.0	1695.0	0.00	0.00	1.10	32.0	0.0	0.0	0.0	0.00
17	0.00	2.77	5.00	0.00	0.0	1410.0	0.00	0.00	1.50	0.0	0.0	0.0	0.0	0.00
18	0.00	2.46	5.00	0.00	0.0	0.0	0.00	0.00	1.10	0.0	0.0	0.0	0.0	0.00
19	0.03	2.45	4.50	0.00	0.0	0.0	0.00	0.00	1.20	0.0	0.0	0.0	0.0	0.00
20	0.28	3.30	5.00	0.00	0.0	1175.0	0.00	0.00	1.25	0.0	0.0	0.0	0.0	0.00
21	0.63	3.33	4.90	0.00	0.0	1415.0	0.00	0.00	1.45	28.0	0.0	0.0	0.0	0.00
22	0.02	2.91	4.50	0.00	0.0	1600.0	0.00	0.00	1.40	0.0	0.0	2.9	0.0	0.24
23	0.00	3.21	4.60	0.00	0.0	1635.0	0.00	0.00	0.85	170.0	0.0	0.0	0.0	0.00
24	0.00	3.07	4.50	0.00	0.0	1365.0	0.00	0.00	1.30	0.0	0.0	0.0	0.0	0.00
25	0.00	2.66	4.50	0.00	0.0	0.0	0.00	0.00	0.65	0.0	0.0	0.0	0.0	0.00
26	0.00	2.14	4.90	0.00	0.0	0.0	0.00	0.00	1.30	0.0	0.0	0.0	0.0	0.00
27	0.14	3.00	4.50	0.00	0.0	1475.0	0.00	0.00	0.60	0.0	0.0	0.0	0.0	0.00
28	0.00	2.66	5.80	0.00	0.0	1655.0	0.00	0.00	1.30	69.0	0.0	0.0	0.0	0.00
29	0.42	2.63	0.00	0.00	0.0	1735.0	0.00	0.00	1.15	0.0	0.0	4.0	15.4	0.19
30	0.00	2.96	0.00	0.00	0.0	2030.0	0.00	0.00	1.05	110.0	0.0	0.0	0.0	0.00
31	0.00	3.60	4.50	0.00	0.0	1620.0	0.00	0.00	1.10	0.0	0.0	0.0	0.0	0.00
AVE.	3.11	2.94	4.40	0.00	23.10	1652.62	0.00	0.00	1.00	191.2	0.0	2.7	11.3	0.31

SECTION II:

DAILY BOD, SS LOADINGS, AND PERCENT REMOVALS

DAY	DAILY BOD (mg/l)		DAILY SS (mg/l)		BOD LOADING (PPD)		SS LOADING (PPD)		PERCENT REMOVALS	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	BOD	SS
1	85.50	2.80	133.30	2.30	2181.99	71.46	3401.87	71.46	.97	.98
6	91.50	6.60	101.30	6.00	2411.43	173.94	2669.70	158.13	.93	.94
8	99.00	4.50	133.30	5.40	2666.88	121.22	3590.86	145.47	.95	.96
10	73.50	2.62	105.40	9.00	2059.65	73.42	2953.56	252.20	.96	.91
13	166.50	4.30	170.70	2.50	4124.17	106.51	4228.21	61.92	.97	.99
15	118.50	3.10	138.70	5.00	2322.48	60.76	2718.38	98.00	.97	.96
17	136.50	2.50	143.50	6.50	3153.40	57.75	3315.11	150.16	.98	.95
20	162.00	6.20	153.40	7.50	4458.56	170.64	4221.87	206.42	.96	.95
22	121.50	5.30	144.00	8.50	2948.73	128.63	3494.79	206.29	.96	.94
24	108.00	4.60	130.70	1.30	2765.21	117.78	3346.42	33.28	.96	.99
27	138.00	3.20	139.40	11.30	3452.76	80.06	3487.79	282.73	.98	.92
29	118.50	2.30	145.30	2.50	2599.20	50.45	3187.04	54.84	.98	.98
31	100.50	2.40	130.70	6.50	3017.41	72.06	3924.14	195.16	.98	.95
AVE.	116.88	3.88	136.13	5.75	2935.53	98.82	3426.13	147.39	.97	.96

SECTION III:

TABULATION OF SLUDGE TREATMENT PARAMETERS

METHOD: Digestion

DAY	FLOW TO DIGESTOR (100 gal)	INFL. PERCENT SOLIDS (mg/l)	GAS PRODUCED (ft-3)	DETENTION TIME (min)	PH	VOL. SLUDGE PRODUCED (yd-3)	% SOLIDS SLUDGE
1	15.300	0.0	0.0	60	5.2	20.0	27.0
6	15.800	0.0	0.0	70	4.9	30.0	25.0
8	16.500	0.0	0.0	75	5.0	25.0	30.0
13	14.950	0.0	0.0	80	4.7	27.0	29.0
15	11.750	0.0	0.0	95	4.8	30.0	32.0
17	13.850	0.0	0.0	90	5.1	15.0	33.0
20	16.500	0.0	0.0	93	4.7	17.0	28.0
22	14.550	0.0	0.0	95	4.9	19.0	33.5
24	15.350	0.0	0.0	86	5.1	25.0	35.1
27	15.000	0.0	0.0	87	5.2	19.0	29.7
29	13.150	0.0	0.0	90	4.9	28.0	29.1
AVE.	14.782	0.0	0.0	83.	5.0	23.2	30.1

METHOD OF DISPOSAL: Incineration

SECTION IV :

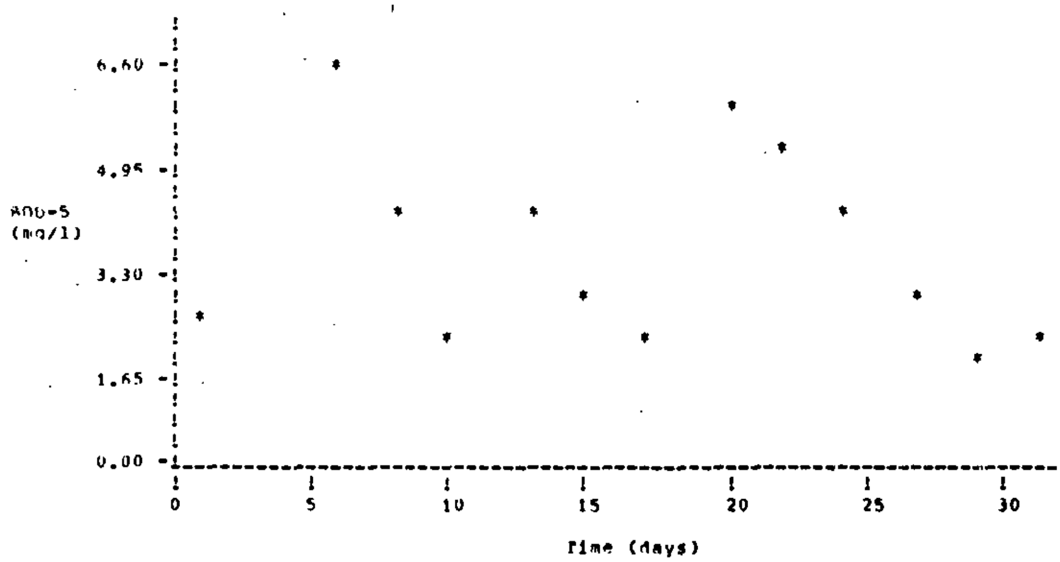
COMPARISON OF OPERATING PERFORMANCES WITH PERMIT AND DESIGN LIMITS

	MAXIMUM VALUE	PERMIT LEVEL	NO. TIMES PERMIT EXCEEDED
Daily BOD (mg/l)	2.40	0.00	0
Monthly BOD (mg/l)	3.88	30.00	0
Daily SS (mg/l)	6.50	0.00	0
Monthly SS (mg/l)	5.75	30.00	0
Daily Percent Removal: BOD	0.98	0.00	0
Monthly Percent Removal: BOD	0.97	0.00	0
Daily Percent Removal SS	0.98	0.00	0
Monthly Percent Removal: SS	0.96	0.00	0
Daily Effl. Phosphorus (mg/l)	4.00	0.00	0
Monthly Effl. Phosphorus (mg/l)	2.70	0.00	0
Daily Effl. Ammonia (mg/l)	15.40	0.00	0
Monthly Effl. Ammonia (mg/l)	11.33	0.00	0

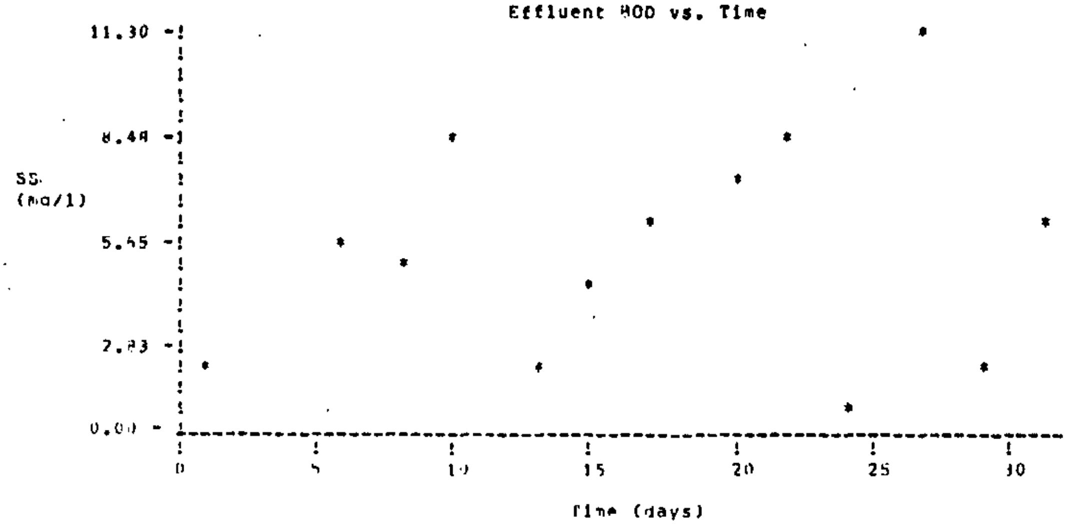
Daily Effl. Nitrate (mg/l)	0.19	0.00	0
Monthly Effl. Nitrate (mg/l)	0.31	0.00	0
Daily Flow (mgd)	3.60	0.00	0
Monthly Design Flow (mgd)	2.94	7.00	0
Daily Total Coliform (/100 ml)	110.0	0.0	0
Monthly Total Coliform (/100 ml)	191.2	1000.0	0
Daily Fecal Coliform (/100 ml)	0.0	0.0	0
Monthly Fecal Coliform (/100 ml)	0.0	200.0	0
Daily Settleable Solids (ml/l)	0.000	0.000	0
Monthly Settleable Solids (ml/l)	0.000	0.100	0
Other Parameter I (units)	0.000	0.000	0
Monthly Other Parameter I (units)	0.000	0.000	0
Other Parameter II (units)	0.000	0.000	0
Monthly Other Parameter I (units)	0.000	0.000	0

SECTION V :

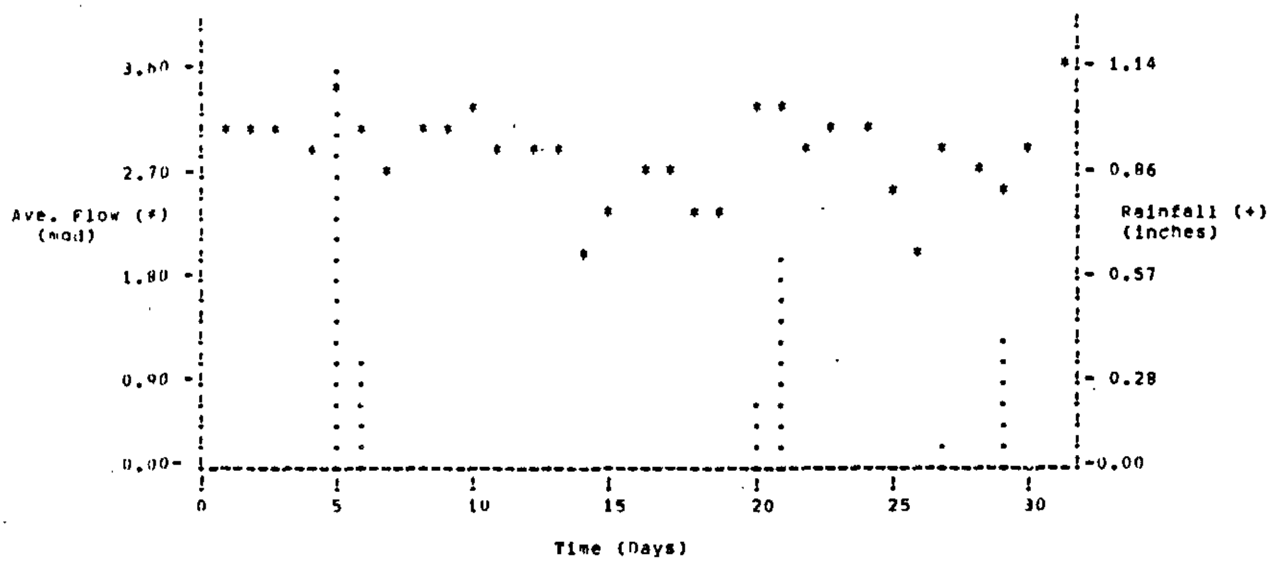
GRAPHIC REPRESENTATION OF NPDES & DESIGN PARAMETERS



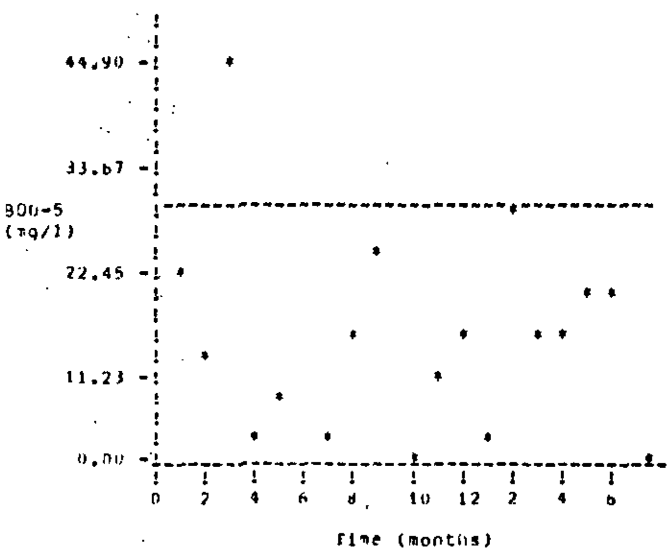
Effluent BOD vs. Time



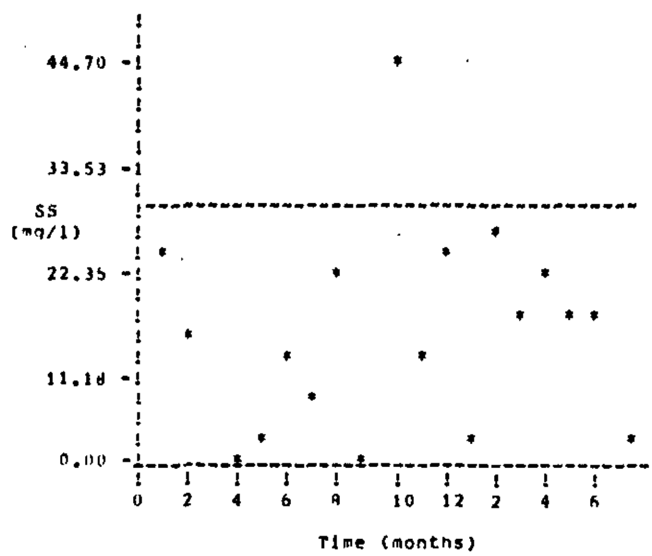
Effluent SS .vs. Time



Average Flow & Rainfall vs. Time



Monthly BOD vs. Time



Monthly SS vs. Time

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