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EPA-440/1-77/031E
GROUP 1, PHASE II
PROPOSED

SUPPLEMENT TO DEVELOPMENT DOCUMENT FOR EFFLUENT GUIDELINES LIMITATIONS AND NEW SOURCE PERFORMANCE STANDARDS FOR THE

RENDERER

SEGMENT OF THE
MEAT PRODUCTS AND RENDERING
POINT SOURCE CATEGORY

APRIL 1977

U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

SUPPLEMENT TO DEVELOPMENT DOCUMENT

for

EFFLUENT LIMITATIONS GUIDELINES

and

NEW SOURCE PERFORMANCE STANDARDS
(Remand)
for the

RENDERER
SEGMENT OF THE
MEAT PRODUCTS AND RENDERING
POINT SOURCE CATEGORY

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ABSTRACT

The study presented herein was conducted in response to a directive from the U.S. Court of Appeals for the Eighth Circuit to review and revise if necessary, the promulgated New Source Performance Standards and to restudy and update the cost of achieving these standards for the Renderer Segment of the Meat Products and Rendering Processing Point Source Category. In the course of making the study, the 1983 limitations were also reviewed. This document is a supplement to the original, "Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Renderer Segment of the Meat Products and Rendering Processing Point Source Category." (January, 1975).

The rendering plants considered in this study are those that process animal by-products at an independent plant site. In this study five models of rendering plants were considered for the purposes of costing the required waste water control technology and for assessing the economic impact of the controls on new plants. These models are based on plant size (i.e., amount of raw material processed per day) and on type of cooker (batch versus continuous).

This study sets forth various waste water control technologies available to meet the 1983 limitations and the New Source Performance Standards and the cost of these technologies based upon the most recent and representative cost information available. An economic analysis was conducted to determine the effect implementation of the proposed new source performance standards would have on the viability of the industry.

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SECTION I

CONCLUSIONS

An extensive survey of a substantial portion of the Renderer Segment of the Meat Products and Rendering Processing Point Source Category (i.e., the independent rendering industry) was conducted pursuant to the remand from the U.S Court of Appeals for the Eighth Circuit. The data from this survey, along with other available information were then reviewed and analyzed in detail. The results were used to re-define the waste water pollution control technologies available to meet New Source Performance Standards for the Independent Rendering Industry.

The data collected substantiate that rendering plant waste waters are indeed very biodegradable and can be successfully treated with biological treatment. In particular, a form of activated sludge--extended aeration was found capable of producing a very high quality effluent. Lagoon systems, which are used extensively in this industry are also capable of effective performance in treating rendering plant waste waters.

Mixed-media filtration can be used to upgrade effluents from the biological treatment systems. The performance of mixed-media filtration following biological treatment has been amply demonstrated at an independent rendering plant.

The industry is very active in implementing water reuse and conservation practices. Such practices as recycling and/or reuse of treated waste waters are currently being used at several plants as an effective means of reducing or eliminating the discharge of pollutants. Practically all newer plants and most plants undergoing in-plant modifications have chosen to use air-cooled or shell and tube condensers. This has resulted in large reductions in the volume of waste waters that have to be treated and discharged. Water conservation at several plants has permitted them to reduce dramatically the quantities of wastes discharged without making substantial changes to their treatment systems.

On the basis of this study it is concluded that new source performance standards can be more stringent than those previously promulgated. Similar control levels are recommended for 1983 limitations for existing sources using Best Available Technology Economically Achievable (BATEA). The standards and limitations can be achieved using adequate biological treatment in conjunction with widely practiced water conserving in-plant controls.

The estimated construction and operating costs set forth in this report are indicative of the most current and representative cost data for pollution control technology within this industry. Costs are tabulated for conventional biological treatment systems with and without filtration using June 1976 dollars. The economic analysis indicates effluent control requirements on new source plants will not impede industry growth.

SECTION II

RECOMMENDATIONS

Based upon an extensive review of available data it is recommended that the New Source Performance Standards (NSPS) and the 1983 limitations for existing sources listed below be implemented for the independent rendering industry.

Pounds Discharged in Effluent Per 1000 Pounds of Raw Material Processed (lb/1000 lbs = kg/kkg)				Within the Range	MPN 100/ml
BOD5	Suspended Solids	Oil & Grease	Ammonia Nitrogen	pH	Fecal Coliform
0.09	0.11	0.05	0.07	6.0-9.0	400

SECTION III

INTRODUCTION

On January 3, 1975, the Environmental Protection Agency (EPA) promulgated final regulations for the renderer subcategory of the meat products and rendering processing point source category These regulations set forth the limitations that existing plants in the industry are to meet by 1977 and by 1983, and the new source performance standards to be met by any new plants constructed after the effective date of the proposed regulations. The promulgated regulations were as follows:

Table III-1 Promulgated Effluent Limitations

	Pounds Per 1000 Pounds (lb/1000 lbs = kg/kkg) of Raw Material (RM) Processed				Range	MPN/100 ml
	BOD$_5$	TSS	Oil & Grease	Ammonia Nitrogen	pH	Fecal Coliform
1977	0.17	0.21	0.10	-	6.0-9.0	400
1983	0.07	0.10	0.05	0.02	6.0-9.0	400
NSPS	0.17	0.21	0.10	0.17	6.0-9.0	400

In addition these regulations exempted all small plants processing less than 75,000 pounds of raw material (RM) per day.

The industry's trade association, the National Renderers Association, challenged the New Source Performance Standards in the U.S Court of Appeals for the Eighth Circuit. On August 30, 1976, the Court issued its decision, which remanded the NSPS for additional technical and economic analyses.

Court Findings

In reviewing the New Source Performance Standards for the independent renderers, the Court determined that EPA should reconsider its exclusion of capital cost for equalization tanks, air flotation systems and pumps and piping to recirculate condenser water. Furthermore, the Court advised EPA to reconsider the size and design of lagoon systems in light of the apparent need for additional in-plant controls to meet NSPS. The role and significance of lining lagoons was also questioned.

Although the Court supported the EPA's analysis of the economic impact on controls for existing plants, it found that EPA's failure to project after-tax net income and cash flow for small, medium, and large new plants was inappropriate to the analysis on the economic impact of New Source Performance Standards. The Court therefore, instructed EPA to reevaluate the economic impact of New Source Performance Standards using the most current control technology costs.

Finally, the Court pointed out that the New Source Performance Standards should be clearly based upon the best available demonstrated technology. In this regard, the Court suggested a complete review of the fact that the new source standards allowed less stringent levels of effluent control than did the 1983 existing source guidelines.

Objectives and Scope of the Report

The objective of this report is to provide responses to the remand from the Court. It is designed to review, reconsider, and fully justify:

1. New Source Performance Standards for the renderer subcategory.
2. Technology required to meet the standards adopted.
3. Cost of the required control technology based on recent representative data and the impact of new source performance standards on the economic viability of new plants.

To obtain information required to respond to the remand a survey was made of the industry. A questionnaire sent to industry plants requested information on in-plant operations, the technology used to control process wastes, the cost and performance of these systems, and the costs of in-plant equipment and raw materials used in processing. Much of the information from the survey was used in this report. Survey data was also used by the Agency to develop an economic analysis of the proposed new source performance standards as they affect new, direct-discharging, independent rendering plants.

Section IV that follows summarizes the data and information that were used to respond to the Court remand. Section V answers the questions raised in the Court remand, establishes New Source Performance Standards and 1983 limitations (BAT), defines the recommended pollution control technology and details the costs of this control technology.

SECTION IV

SUPPLEMENTAL DATA SUMMARY

The information presented here is intended to supplement, not replace, information provided in the original Development Document. The information was largely obtained from a survey of independent renderers, the open literature, equipment manufacturers, consulting engineering firms, Environmental Protection Agency regional offices, and State and local pollution control agencies.

The bulk of the information was obtained through a questionnaire survey. About 350 plants were contacted in the survey and about 240 responded. Of these, 148 provided sufficient information to be used in this study and only 44 provided waste water effluent information. The list of contacts was provided by the National Renderers Association, Inc. (NRA).

Long-term performance data on the treatment of waste waters were obtained primarily through regional EPA offices and State pollution control agencies. A summary of long-term operating data for four rendering plants is included in this section.

A field sampling survey was conducted on January 26 and 27, 1977, at one plant, for which there was long-term data to verify the performance of an extended aeration treatment system. During this visit, the EPA project officer and contractor and a representative from the NRA met with the president and owner of the plant to discuss waste water treatment, trends in processing operations, and various economic issues.

Equipment manufacturers and representatives, including several prominent suppliers to the industry, provided considerable cost data on equipment and waste water treatment components. This information was used to supplement or verify the survey information used in estimating the cost of the required treatment technology. A partial list of those contributing is:

F. M. C. Environmental Systems Division
Itasca, Illinois

Perry Grubb Associates
Minneapolis, Minnesota

Dorr-Oliver Co.
Chicago, Illinois

Infilco Degremont Inc.
Richmond, Virginia

Clow Waste Treatment Division
Florence, Kentucky

Richards of Rockford
Rockford, Illinois

Industry Subcategorization

The original study found that rendering operations differ materially from meat processing, packinghouses and poultry processors. The study presented in the original Development Document also found there was no justification for subdiving the industry into different segments for the purpose of setting limitations and standards. The following factors were considered: waste water characteristics and treatability, raw materials, final products, manufacturing processes (operations), processing equipment and size, age and location of production facilities.

The data and analyses of the current study confirmed the following information and findings presented in the original Development Document:

1. Waste waters from all rendering plants contain the same general constituents and are amenable to treatment by a variety of biological treatment concepts.

2. A clear independent relationship was disclosed that all types of raw materials may be expected to result in similar organic (BOD5) discharges.

3. The final products are generally the same for all plants.

4. Close similarities were present in waste loads regardless of processes or equipment employed.

5. Basic manufacturing processes were found to be consistent throughout the industry. Hide curing, where practiced, contributes waste loads over and above those from the basic manufacturing processes. An adjustment factor to the basic effluent limitations is provided to account for this added load.

6. No consistent relationship was found between BOD5 waste load and size. Age was also not found to be a factor. Newer plants use both batch and continuous systems and also use shell-and tube and air condensers more frequently than barometric legs. However, in recent years some older plants have replaced batch systems with continuous systems and barometric leg condensers with air or shell and tube condensers. Examination of raw waste water characteristics relative to plant location revealed no apparent relationship or pattern. The above indicated subcategorization of the industry was not required.

In contrast to the above, the economic analysis required that many of the above factors be taken into consideration as they are relevant to economic viability. For example, the raw materials used in a rendering plant may not be germaine to the amount of waste load generated but, they are a significant factor in determining profitability. Raw material costs and product yields differ according to the composition of the raw material input. Whether a rendering plant uses the continuous system or the batch system is important because investment costs for continuous plants are higher than batch plants.

To be able to take the above and other pertinent factors into consideration, model plants were developed for the economic analysis. There plants reflected size, type of rendering and type of raw materials processed. This approach allowed for a detailed economic analysis of the industry.

It is obvious that this analysis had no connection with setting pollution control effluent limitations and standards. Rather its objective was to determine what impact the limitations and standards would have on the viability of the model rendering plants. The models considered important to the analysis by the economic contractor are shown below.

For the purposes of grouping survey data and information and for estimating the cost of the treatment technology required to achieve the new source performance standards, the independent rendering industry was classified by size and by type of processing equipment. Basically the processing equipment differs in the type of cookers used which are of two types: (1) batch and (2) continuous. Plant size varies somewhat with the amount of raw materials processed. To recognize these variations batch plants were sized small, medium and large and continuous, large and extra large. The following is a tabular summary of the plant types with typical characteristics for each.

Plant Types	Range of Raw Materials Processed Per Day kkg RM/day (1000 lb RM/day)	Typical kkg RM/day (1000 lb RM/day)
Small Batch (SB)	0-34 (0-75)	16.8 (37)
Medium Batch (MB)	34-113.5 (75-250)	53.6 (118)
Large Batch (LB)	over 113.5 (over 250)	133.5 (294)
Medium Continuous (MC)	up to 113.5 (up to 250)	76.3 (168)
Large Continuous (LC)	113.5 to 204.3 (250-450)	162 (357)

Industry Profile

The industry estimated in 1973 that the number of independent renderers was 350. This number still appears to be an accurate estimate based upon a 1976 listing of independent renderers provided by NRA.

A projected distribution of plants based on survey data is given below. This assumes there are 350 plants in the industry and that they are distributed in a way similar to that determined for the 148 renderers included in this study.

Type of Plant	Number of Plants	
	From Survey	Projected
Batch		
Small	67	158
Medium	35	83
Large	7	17
Continuous		
Medium	11	26
Large	11	26
Extra Large	8	19
Batch and Continuous	9	21
	148	350

Table IV - I was developed from survey data and shows typical operating characteristics for various types of rendering plants. These characteristics include the number of cookers typically being used in a plant, the average amount of raw material processed per day, the average number of hides handled daily by the indicated number of plants, and plant working hours. Note the large fraction of plants handling hides are small and medium batch plants and medium and large continuous plants. Also note that the raw materials processed per day are in the expected size range but are not always in agreement with the typical values choosen for the purposes of costing the required treatment technology. This is especially true for the large batch model because two of the seven large batch plants have very large production levels (1,700,000 and 3,072,000 pounds per day). Without these two plants, the average production would be 484,000 pounds per day.

The survey data in Table IV-2 lists the percent by weight of the various raw materials processed in each model. The number of plants that reported processing each type of raw material is also indicated. This table shows that:

(a) Small batch plants process mainly packinghouse materials, shop fat and bone, and dead animals.

(b) Medium batch and continuous plants process all varieties of materials.

(c) Large batch plants largely process packinghouse materials, shop fat and bone, and poultry materials.

(d) Large continuous plants process mainly packinghouse, and shop fat and bone materials.

The waste water disposal methods reported by 137 independent renderers are given in Table IV - 3. The table shows that over 50 percent of the plants discharge to municipalities; 30 percent practice no discharge, 20 percent via impoundment (evaporation/percolation), and 10 percent via irrigation and underground infiltration systems. Approximately 17 percent of the 137 plants are currently direct dischargers. Compared with the value of 26 percent reported in the original Development Document, there appears to be a trend away from direct discharging of waste waters by the independent rendering industry. Table IV - 3 also shows that a large number of small and medium batch plants treat their waste waters to achieve no discharge. This would imply that small and medium batch plants can afford to treat process waste water and that the most favorable approach is to use no-discharge systems. Several plants are now achieving no discharge by treating and recycling all waste waters. This is the first time EPA studies have identified total recycle as a feasible method of handling waste water in the independent rendering industry.

Waste water Characterization

Raw Waste water

Water is used in the rendering industry for condensing cooking vapors, plant cleanup, truck and barrel washing, odor control and for boiler makeup water.

The waste water generated by the rendering process consists primarily of condensed cooking vapors (condensate), cooling water used for condensing cooking vapors, and cleanup water. Waste water is considered "raw" following in-plant primary treatment such as catch basins or mechanical skimmer/settlers.

The quantity of waste water generated in a rendering plant is a very important parameter because it largely determines the size of the treatment system needed by the plant. Table

TABLE IV-1

OPERATING CHARACTERISTICS

	Batch Plants			Continuous Plants			Batch and Continuous
	Small	Medium	Large	Medium	Large	Extra-Large	
Number of cookers (typical)	2-3	4-7	11	1	1-2	1-2	3-5 B, 1 C
Raw Materials (1000 lb/day)	28.4	139.4	1027	111	346	608	230
Hides (number per day)	30	118	50	285	294	631	421
(number of plants reporting)	39	19	1	8	6	3	2
Operating Periods (hours/day)	10.4	18.8	18.4	11.3	15.8	17.1	15.3
(days/week)	5.3	5.4	5.4	5.3	5.3	5.3	5.1
Number of Plants	67	35	7	11	11	8	9

SURVEY DATA

TABLE IV-2

RAW MATERIAL DISTRIBUTION, AVERAGE PERCENT BY WEIGHT
(Number of Plants Processing the Raw Material Source)

Raw Material Source	Batch Plants						Continuous Plants			
	Small		Medium		Large		Medium		Large	
	%	(No.)	%	(No.)	%	(No.)	%	(No.)	%	(No.)
Packinghouse	31.8	(46)	40.0	(27)	7.9	(2)	27.0	(8)	30.9	(10)
Shop fat & bone	29.4	(53)	16.0	(22)	16.4	(3)	31.7	(10)	41.2	(10)
Restaurant Grease	9.7	(41)	5.5	(18)	1.0	(2)	12.2	(9)	4.8	(7)
Blood	1.2	(8)	4.0	(11)	0.0	(0)	2.9	(3)	1.0	(3)
Dead Animals	22.0	(34)	10.2	(20)	5.0	(1)	12.8	(7)	8.2	(6)
Poultry Offal	3.8	(6)	15.2	(14)	41.4	(1)	8.2	(4)	12.4	(4)
Poultry Feathers	2.1	(3)	9.1	(11)	28.3	(5)	5.2	(2)	1.5	(2)

SURVEY DATA

TABLE IV-3

TYPE OF DISCHARGE BY MODEL

no discharge

Plant Type and Size	Direct	City	Impoundment	Irrigation and Underground	Total Plant	Percent Total	Plants Treating Wastewater*	
							Number	Percent
BATCH								
Small	6	27	18	11	62	45.3	35	56.5
Medium	6	21	7	0	34	24.8	13	38.2
Large	1	0	0	0	1	.7	1	100.
CONTINUOUS								
Medium	0	3	2	1	6	4.4	3	50.
Large	1	8	1	1	11	8.0	3	27.3
Extra-Large	3	7	1	2	13	9.5	6	46.2
BATCH AND CONTINUOUS								
Medium	5	2	0	0	7	5.1	5	71.4
Large	1	2	0	0	3	2.2	1	33.3
TOTAL	23	70	29	15	137	100	67	
PERCENT OF TOTAL	16.8	51.1	21.2	10.9	100			

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*Sum of Direct, and No Discharge

SURVEY DATA

TABLE IV-4

WASTE WATER FLOW SUMMARY

Reporting Number of Plants	Average Flow l/kkg RM	Average Flow gal/1000 lb RM	Comment
144	8351	1001	All reporting plants
128	3346	401	Reporting plants with flow less than 20,000 l/kkg RM

SURVEY DATA

IV-4 shows the average waste water flow value for the 144 plants for which both a flow and production rate were reported in the survey. It is 1001 gal/1000 lb RM. Also shown is the value when 16 of the plants that reported excessive flow rates of greater than 20,000 l/kkg (2400 gal/1000 lb RM) or more are excluded. This average flow rate of 401 gal agrees very well with the average flow rate of 403 gal per 1000 lb RM reported in Table 6 of the original Development Document. Reported flows greater than 20,000 l/kkg RM are considered high and indicative of very poor inplant practices. Therefore, the data summaries are frequently presented both for flows greater and less than 20,000 l/kkg RM.

Table IV-5 summarizes raw waste water characteristics for the 22 plants that provided flow, production and waste water analytical information in the survey. The table lists data for plants with flow rates greater than and less than 20,000 l/kkg RM (2400 gal/1000 lb RM). The average raw waste water values for the plants with flows less than 20,000 lb/kkg RM agree well with those shown in Table 6 of the original Development Document. The table shows that the average BOD5, TSS and O&G values increase considerably when the average includes the plants having flows greater than 20,000 lb/kkg RM.

The survey showed that raw waste water flow rate is directly related to the type of condenser used for condensing the cooker vapor. The data of Table IV-6 dramatically illustrate this. Plants employing air-cooled condensers are shown to produce the least flow (i.e., one sixth the value for barometric leg condensers). The waste water flow rate for plants using shell-and-tube condensers is also much less than that for barometric leg condensers. The data of Table IV-6 illustrate why air-cooled condensers and shell-and-tube condensers are the recommended choices. These condensers do not require pumps and piping for recirculating water for condensing, as is necessary with barometric leg condensers.

Control and Treatment Technology

In the survey, 55 plants reported using secondary waste water treatment components. The systems used by the various types of rendering plants are shown in Table IV-7 by plant code number. The plants are also identified as to method of waste water disposal; direct refers to those discharging to receiving streams, other refers to indirect methods which include impoundment, irrigation, and total recycle. This table shows nine combinations of biological treatment

TABLE IV-5

RAW WASTE WATER CHARACTERIZATION

PLANT*	-------FLOW--------		----kg/kkg RM	(lb/1000 lb RM)---					
	l/kkgRM	gal/1000lbRM	BOD5	SS	O&G	NH3-N	COD5	pH	NOTE
1	7790	933.	6.70	5.75	2.40	.90		7.5	
5	785	94.1	1.65	.40	.01	.14	3.47		
7	16700	2000.	3.13	3.20	1.22			8.2	
14	13900	1667.	3.47	2.78				7.	
18	2130	255.	27.0	20.6	10.6			6.5	1
21	3910	468.	3.92	.82	.22			7.45	
29	2430	291.	.50	.50	.01			7.6	
38	4170	500.	1.46						
51	1850	222.	2.46	1.20	.92				
65	57600	6900.	32.8	18.6	9.25			7.34	2
69	34500	4130.	18.9	64.7	14.3			6.7	2
70	1870	224.	.42	.13	.16			7.7	
76	634	76.	2.92	1.49	.32				
83	1150	138.	1.22	.90	.35			7.	
90	935	112.	1.31	.54				7.4	
100	1890	227.	7.43		.56			6.9	
104	9370	1123.	2.4	1.09	.66				
105	668	80.	.23	.23	.17				
112	734	88.	.26	.20	.20			7.5	
122	10300	1230.	2.71	2.02	1.22			8.1	
144	1200	144.		.31	.20		2.02	8.5	
160	2290	274.	.26	.30	.34			8.	
AVERAGE	8314	966.	4.71	5.53	1.81	.52	2.75	7.53	3
STD DEV.	13900	1660.	7.83	14.93	3.77	.54	1.03	.51	3,6
AVERAGE	4346	521.	2.36	1.29	.56	.52	2.75	7.60	4
STD DEV.	4875	584.	2.08	1.46	.62	.54	1.03	.44	4,6

NOTES: 1- not used in averaging, processes fleshed hides only
2- flow over 20,000l/kkgRM
3- all reporting plants
4- flows less than 20,000l/kkg RM
5- Chemical Oxygen Demand
6- standard deviation

*These are the plants that reported all of the following: flow production and analytical data.

SURVEY DATA

TABLE IV-6

DAILY WASTEWATER FLOW STATISTICS BY CONDENSER TYPE AND DISCHARGE TYPE*

FORMAT OF EACH CELL IS AS FOLLOWS:

NUMBER OF DATA POINTS
MEAN FLOW(LITER/KG)
STANDARD DEVIATION
MINIMUM FLOW VALUE
MAXIMUM FLOW VALUE

	DIRECT	LAND	SUBSURFACE	NO DISCHAR	MUNICIPAL	OTHER	SUM'RY-ROW
SHELL AND TUBE	4 1.671 0.473 1.001 2.009	1 0.974 0.974 0.974		6 6.694 13.555 0.390 34.335	18 4.638 15.158 0.074 65.312		29 4.528 13.227 0.074 65.312
BAROMETRIC LEG	3 32.772 28.315 2.384 58.418	2 21.497 23.245 5.060 37.934	1 14.307 14.307 14.307	7 6.221 9.001 0.535 26.038	16 18.792 16.566 1.874 57.583	1 0.642 0.642 0.642	30 16.682 17.290 0.535 58.418
AIR CONDENSER	3 0.761 0.683 0.348 1.550	1 0.626 0.626 0.626		4 2.837 3.715 0.668 8.398	11 2.956 6.445 0.063 22.255		19 2.462 5.127 0.063 22.255
OTHER	1 20.029 20.029 20.029			3 5.853 4.930 0.174 9.041	6 12.956 17.767 0.908 48.529		10 11.533 14.174 0.174 48.529
2 OR MORE OF ABOVE	1 0.935 0.935 0.935			3 2.023 0.109 1.897 2.086	6 15.256 27.272 0.484 69.545	1 1.043 1.043 1.043	11 9.053 20.562 0.484 69.545
SUMMARY FOR COLUMN	12 10.687 18.761 0.348 58.418	4 11.149 17.970 0.626 37.934	1 14.307 14.307 14.307	23 5.161 8.446 0.174 34.335	57 10.279 17.034 0.063 69.545	2 0.843 0.284 0.642 1.043	99 9.025 15.412 0.063 69.545

* If a plant listed more than one type of discharge, they are not included in this chart.

TABLE IV-7

WASTE TREATMENT SYSTEMS

(DOES NOT INCLUDE PLANTS DISCHARGING TO MUNCIPAL SYSTEMS)

	ANAEROBIC		ANAEROBIC AEROBIC AERATED		ANAEROBIC AERATED		AERATED		ANAEROBIC AEROBIC		AEROBIC		AERATED AEROBIC		ACITVATED SLUDGE		ANAEROBIC ACT SLUDGE AEROBIC		TOTAL
	DIR	OTHER	DIR	OTHER	DIR	OTHER	DIR	OTHER	DIR	OTHER	DIR	OTHER	DIR	OTHER	DIR	OTHER	DIR	OTHER	
BATCH:																			
SMALL		2,80 97,123 182		3,181					185* 43 151	9,11 45,95		27,56 178,63 79,96						75	21
MEDIUM		109* 118		93*				100*			122 125		29* 103* 202*	64,157					11
LARGE		19					107*		25,90										4
CONTINUOUS:																			
MEDIUM								4,36				32							3
LARGE					106*	108*		58		108			59* 200*						6
BATCH & CONTINUOUS:																			
MEDIUM													33*						1
LARGE					153										180*				2
SIZE &/or TYPE UNKNOWN		89		47				116				87	114			117		115	7
TOTAL		9		4	2	1	1	5	5	5	2	8	7	2	1	1		2	55

*- EXEMPLARY PLANTS
(1) TO STREAM
(2) NO DISCHARGE

SURVEY DATA

systems being used. The majority of the no dischargers with lagoon systems are using anaerobic, anaerobic-aerobic, and aerobic lagoons. Eighteen of the 21 lagoon systems used by small batch plants are achieving a no-discharge status by impoundment. In addition, there are at least six small batch plants that are known to use septic tanks and drainfields to achieve no discharge; no other subcategory is known to use septic tanks and drainfields for handling process waste waters. Also note that direct discharging plants tend to use multiple components systems such as anaerobic-aerobic lagoons and aerated-aerobic lagoons.

Performance of Existing Treatment Systems

The characteristics of the waste waters discharged to receiving streams by 22 rendering plants that have secondary treatment systems are given in Tables IV-8 and IV-9. These data are based on information obtained from both the survey questionnaire (Table IV-8) and governmental agencies (Table IV-9). Data for plants numbers 29, 90, 103, 106, 107, and 122 were obtained from both sources. The data presented in the tables for these plants are not always in agreement. The government agency data includes more past information and may not be as current as that from the survey. To exemplify this, note the higher government flow rate data for plant number 29 compared with the survey data (1080 versus 291 gal/1000 lb RM). Investigation indicates that relatively recent changes and improvements in inplant controls and waste treatment methods are responsible. This is only reflected in the more current survey data shown in Table IV-8. Also the reduction in flow rate for plant 29 from 9040 to 2430 l/kkg RM was accompanied by a reduction in the BOD5 content of the treated waste from an average of 0.54 lb/1000 lb RM to 0.085 lb. If is for just such a reason that survey data were considered important.

Also shown in Tables IV-8 and IV-9 are the average and standard deviations of all listed values. In the summarized data for plants with flows less than 20,000 l/kkg correlates quite well with the data presented in Table 27 of the original Development Document, particularly when the suspended solids value for plant number 7 of Table 27 (SS of 4.4 kg/kkg RM, lb/1000 lb RM) is omitted.

For comparison purposes, data for rendering plants treating their waste waters but not discharging them to streams are shown in Table IV-10. This data compares favorably with that for the direct dischargers indicating that no unusual technology is being used by direct dischargers.

Many of the rendering plants discharge their wastes to municipal systems. Often the municipality requires the renderer to pretreat its waste (with catch basins or dissolved air flotation) so as to reduce the strength of the waste to levels amenable to treatment by the municipal plant.

Survey data for rendering plants using dissolved air flotation as a pretreatment device prior to discharging wastes to municipal systems is shown in Table IV-11. Again the listed data are summarized for all plants and for only those plants having waste water flows less than 20,000 l/kkg RM (2400 gal/1000 lb RM). In general, the data clearly indicates higher pollutant discharge levels occur when the waste flow is high (e.g., greater than 10,000 l/kkg RM or 1200 gal/1000 lb RM). This confirms the importance of controlling flow rate.

Some long-term treatment performance data was available for four exemplary plants. It is summarized in Table IV-12. Shown are the average of all values, the standard deviation (which is an indication of the degree of scatter of the individual data points about the average), the high and low values and the number of data points of each data set. The data cover periods of time from 9 to 15 months and indicate that treatment systems are able to maintain high performance levels on a consistant basis.

In addition to the long-term data available for plant 180, the most recent four months of the data illustrate the effectiveness of a mixed-media filter. These data show the filter influent BOD_5 of 0.0082 kg/kkg RM was reduced to 0.0062 and the influent TSS of 0.020 kg/kkg RM to 0.0071 kg/kkg RM.

Capital Costs

For the purposes of conducting assessments of cost and economic impact, it was necessary to derive updated capital costs of various waste water treatment components, both primary and secondary. These costs were established from information provided by the survey. In order to utilize survey information, it was considered necessary to have the following three items of information for each treatment component; size, installed cost, and year of installation. Unfortunately, in many cases where a treatment component was specified, one or more of the above items were not provided.

TABLE IV-8

DIRECT DISCHARGERS
SUMMARY OF SURVEY DATA

PLANT NO.	-------FLOW-------- l/kkgRM	gal/1000lbRM	kg/kkgRM (lb/1000lbRM) BOD5	SS	O&G	NH3-N	pH	NOTE
29	2430	291.	.085	.225	.024		7.8	
43	55400	7000.	4.08	2.92	2.79		6.9	1
59	1490	179.	.021	.0354			7.7	
69	34500	4130.	5.16	.52	.17		5.5	1
90	935	112.	.375	.004		.128	11.2	
103	1670	200.	.083	.083	.050		7.5	
106	348	41.7	.014	.018	.001		7.5	
107	1000	120.	.040	.040	.005		7.5	
122	10300	1230.	.318	.205	.451		7.5	
185	2220	266.	.033	.059	.010			
AVERAGE	11030	1357.	1.021	.411	.438	.128	7.678	2
STD DEVIATION	18760	2343.	1.918	.895	.963		1.5	2
AVERAGE	2550	305.	.121	.084	.090	.128	8.10	3
STD DEVIATION	3210	382.	.142	.085	.178		1.37	3

NOTES: 1- flow over 20,000l/kkgRM
2- all reporting plants l/kkgRM
3- flows less than 20,000L/KKGRM

TABLE IV-9

DIRECT DISCHARGERS EFFLUENT DATA
SUMMARY OF GOVERNMENT DATA

PLANT NO.	-------FLOW-------- l/kkgRM	GAL/1000#RM	kg/kkgRM (lb/1000lbRM) BOD5	SS	O&G	NH3-N
13	14300	1710.	.222	.200	.101	
19	7620	913.	.335	.335		.265
25	6400	767.	.543	.359		.283
29	9040	1080.	.539	.457	.294	
90	4170	500.	.103	.450		
103	1620	194.	.220	.202	.019	.303
106	278	33.3	.033	.216		
107	429	51.4	.042	.124	.096	.00024
122	6030	722.	.385	.269	.138	
200	445	53.3	.052	.073	.019	.022
201	5800	695.	.200	.250	.036	
202	254	30.5	.038	.036		.035
AVERAGE	4700	562.	.226	.248	.100	.151
STD DEVIATION	4380	524.	.188	.135	.097	.146

TABLE IV-10

EFFLUENT DATA FOR PLANTS NOT DISCHARGING

INDIRECT DISCHARGE

PLANT	--------FLOW--------		KG/KKGRM (#/1000#RM)		
NO.	L/KKGRM	GAL/1000#RM	BOD5	SS	O&G
108	976	117	.012	.019	.002

NO DISCHARGE (FINAL LAGOON SAMPLE)

PLANT	--------FLOW--------		KG/KKGRM (#/1000#RM)			
NO.	L/KKGRM	GAL/1000#RM	BOD5	SS	O&G	NH3-N
33	1040	125	.019	.067		.062
93	3670	440	.121	.084	.033	.066
100	1890	227	.091		.049	
109	390	46.7	.117	.078	.078	
AVERAGE	1750	210	.087	.076	.053	.064
STD DEVIATION	1420	170	.047	.009	.023	.003

TABLE IV-11

DAF* UNITS - EFFLUENT DATA

PLANT	-------FLOW--------		kg/kkgRM (lb/1000lbRM)					
NO.	l/kkgRM	gal/1000lbRM	BOD5	SS	O&G	NH3-N	pH	NOTE
31	16400	1961	16.3	8.17	3.27			
52	96.0	11.5	0.22	.082	.049		5.8	
57	44100	5288	46.6	27.6	15.9		6.98	1
60	13400	1600	9.33	6.67	2.67		8.	
67	19500	2333	48.6	38.9	5.83		7	2
82	25600	3069	19.2	9.0				1
138	707	84.7	1.23	0.28	0.07		8.5	
156	835	100	0.51	0.16	0.08		7.2	
163	251	30.1	0.17	0.07	.002			
AVERAGE	13400	1609	15.8	10.1	3.5		7.2	3
STD DEVIATION	15000	1801	19.4	13.9	5.4		.9	3
AVERAGE	5280	631	4.63	2.57	1.02		7.38	4
STD DEVIATION	7520	898	6.73	3.79	1.52		1.18	4

*Dissolved Air Flotation

NOTES: 1- flow over 20,000l/kkgRM
2- not strictly rendering
3- all reporting plants
4- plants with flows less than 20,000l/kkgRM that render only

SURVEY DATA

TABLE IV-12

LONG-TERM TREATED WASTEWATER DATA-SUMMARY

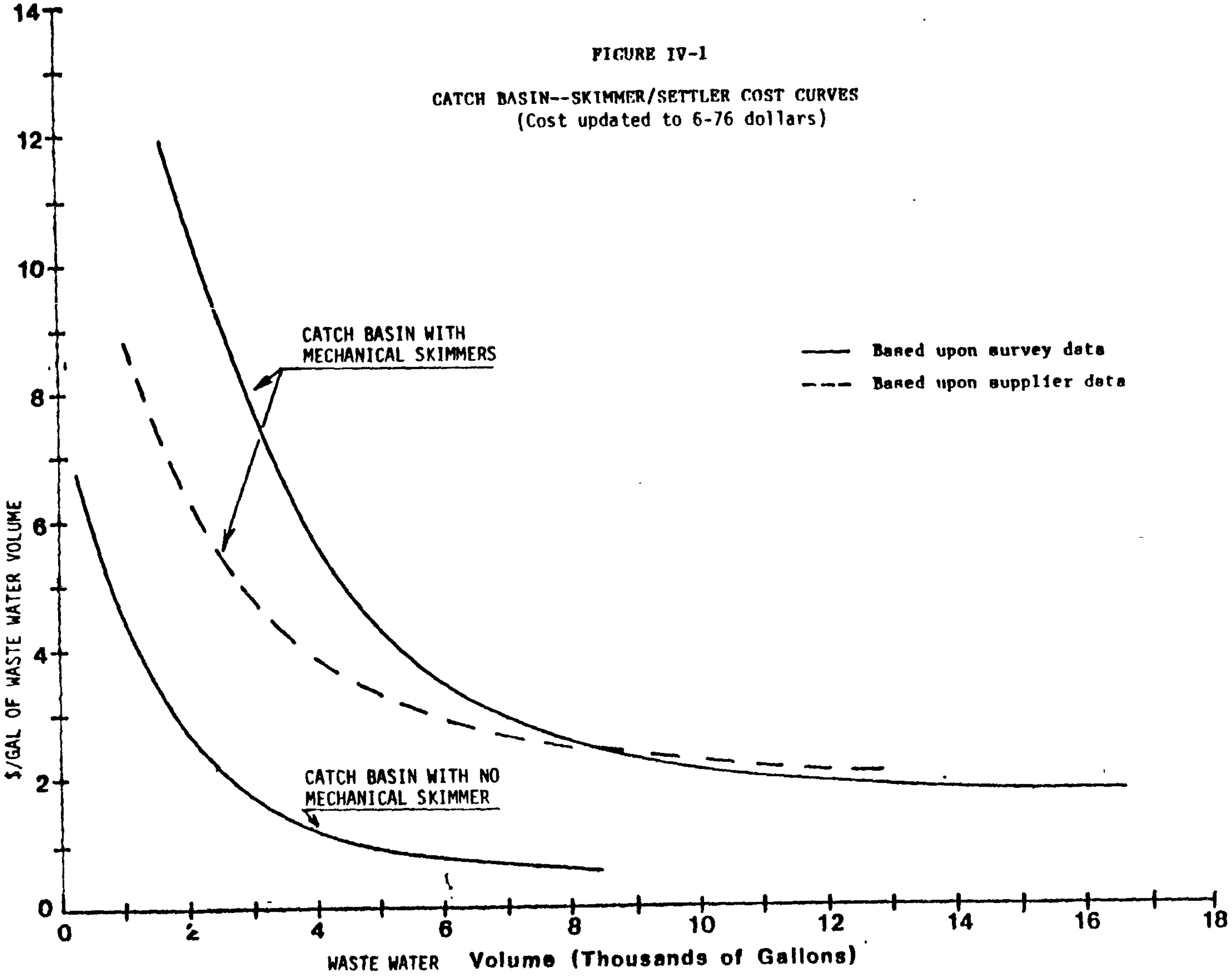
PARAMETER	FLOW l /kkg	gal/1000 lb	---kg/kkg RM (lb/1000#RM)----			
			BOD5	TSS	O&G	NH3-N
PLANT NO. 180 (SAMPLE DATES 11-75 to 1-77)						
AVERAGE	1600	192	.0082	.020		.052*
STD DEVIATION	638	76.5	.0042	.019		
LOW VALUE	78.7	9.43	.0028	.00067		
HIGH VALUE	5150	617	.0188	.20		
NO. OF SAMPLES	382		64	381	0	60
PLANT NO. 185 (SAMPLE DATES 7-75 to 3-76)						
AVERAGE	2230	267	.034	.059	.0098	
STD DEVIATION			.030	.030	.0076	
LOW VALUE			.0067	.0089	.0022	
HIGH VALUE			.098	.116	.022	
NO. OF SAMPLES	1		12	12	10	0
PLANT NO. 200 (SAMPLE DATES 11-75 to 12-76)						
AVERAGE	445	53.3	.052	.073	.019	.022
STD DEVIATION	354	42.9	.033	.061	.010	.013
LOW VALUE	134	16.1	.020	.027	.0089	.0055
HIGH VALUE	1050	126.2	.098	.189	.037	.037
NO. OF SAMPLES	6		6	6	6	5
PLANT NO. 202 (SAMPLE DATES 10-75 to 12-76)						
AVERAGE	323	38.7	.038	.036		.035
STD DEVIATION	226	27.1	.021	.018		.019
LOW VALUE	77	9.2	.010	.005		.005
HIGH VALUE	796	95.4	.091	.067		.059
NO. OF SAMPLES	10		15	15	0	10

*For period of 4-76 through 1-77 value was 0.003 lb/1000 lb. RM.

Cost curves were developed from complete data sets, organized by type of treatment components. The installed costs were derived for the various model plants using 150 gallons per 1000 lb RM and associated BOD5 loadings for treatment system design. These figures were inflated to June 1976 dollars using EPA's "Sewage Treatment Plant and Sewage Construction Cost Indexes." Costs per unit size (e.g., $/gal of waste water treated) were divided into a limited number of size groups for each treatment component. Each such subset of data was then analyzed as follows: 1) wherever sufficient data existed, both the high and low values were excluded to minimize bias in averages and 2) the remaining data were averaged and used. Cost curves were generated using these average values. The resulting cost curves are shown in Figures IV-1 through IV-6 for catch basins (grease traps with no mechanical skimmers), skimmer/settlers (catch basins with mechanical skimmers) dissolved air flotation, aerobic lagoons, septic tanks, aerated lagoons, and anaerobic lagoons. It should be noted that the cost curve for aerated lagoons had to be developed using data from other than survey sources, because the survey data were far too limited and scattered. Additional non-survey information, obtained from equipment manufacturers and distributors, were used to confirm the cost curves for skimmer/settlers and dissolved air flotation. When increased by 35 percent to account for estimated installation expenses, these data agreed well with the curves developed from the survey data. It was to demonstrate this agreement that the curves shown in Figures IV-1 and IV-2 for skimmer/settlers and dissolved air flotation were included in this report. A curve for septic tanks (a technology found common to many very small meat plants of all types) was also included for information and comparative purposes only. It is hoped that these curves will be of use to future studies. In addition note that no cost curves were developed for activated sludge or mixed-media filtration, since only one complete set of data were received for each. However costs were obtained from many manufacturers for package-type activated sludge and extended aeration units. The costs for these units were much lower than those developed in Section V of this report for extended aeration built to specification. The lower costs of package treatment systems were not used; although, in the future such systems may be in use. The approach taken in this report assures a conservative evaluation.

FIGURE IV-1

CATCH BASIN--SKIMMER/SETTLER COST CURVES
(Cost updated to 6-76 dollars)



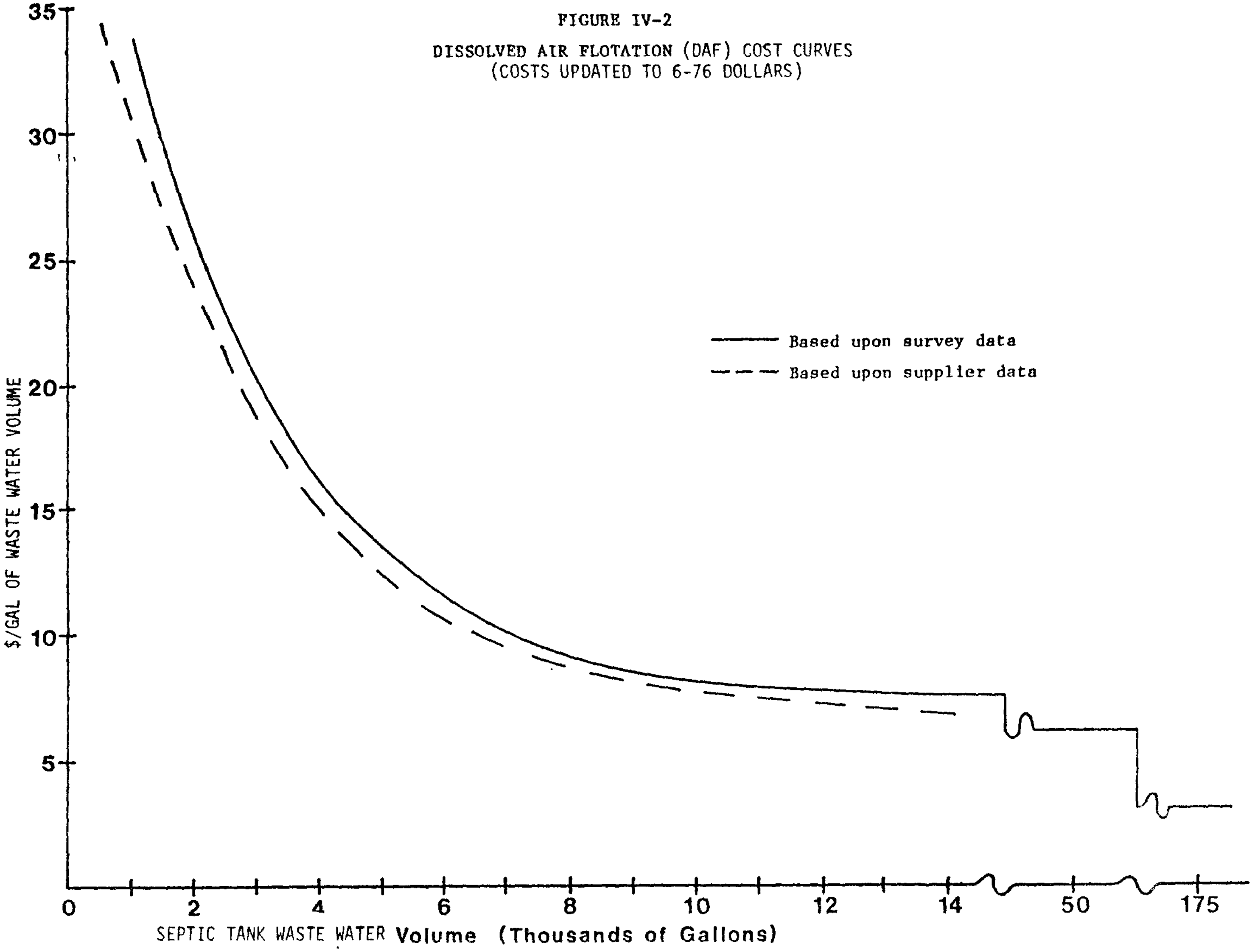


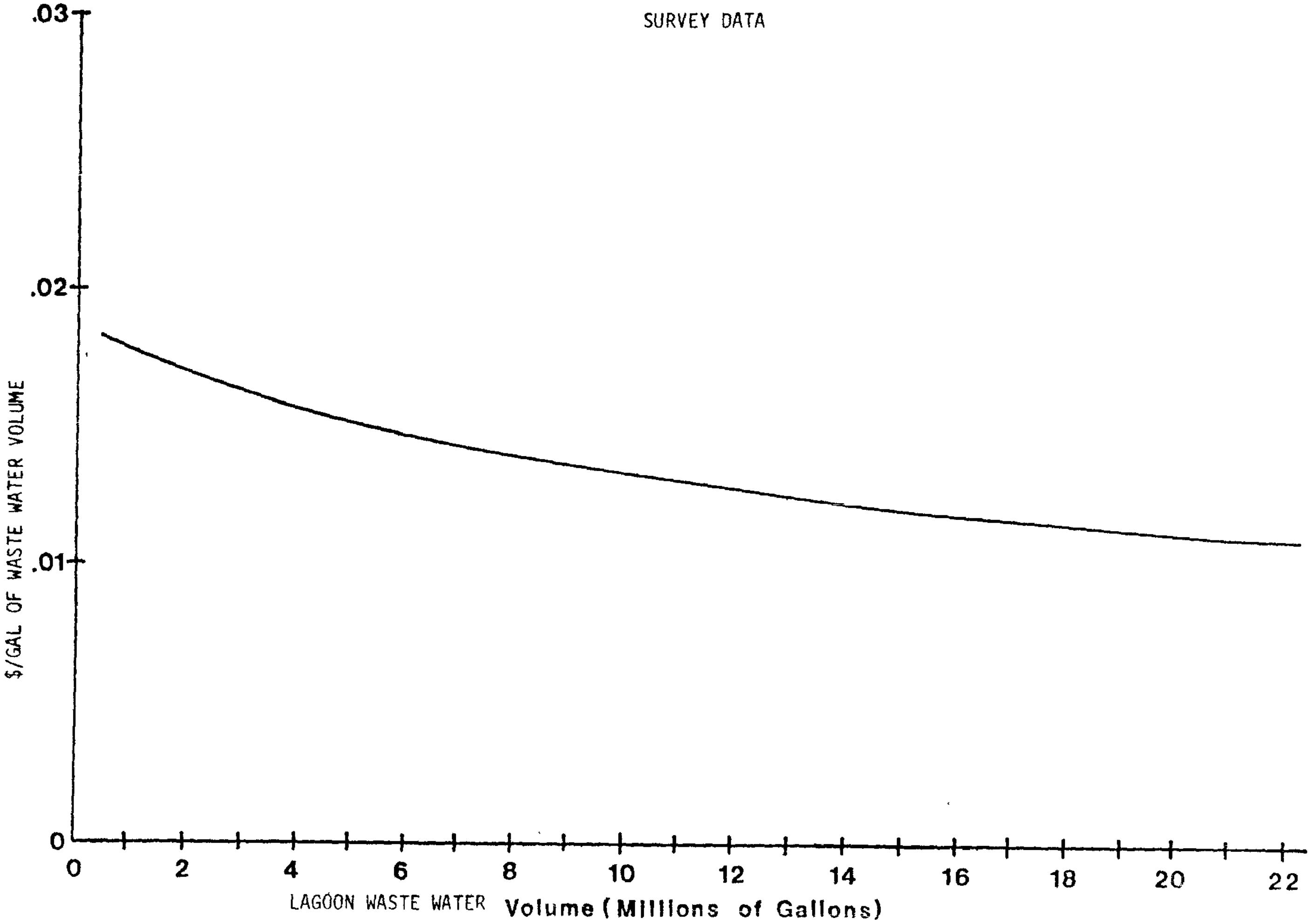
FIGURE IV-2

DISSOLVED AIR FLOTATION (DAF) COST CURVES
(COSTS UPDATED TO 6-76 DOLLARS)

FIGURE IV-3

AEROBIC LAGOON COST CURVE
(Costs updated to 6-76 dollars)

SURVEY DATA



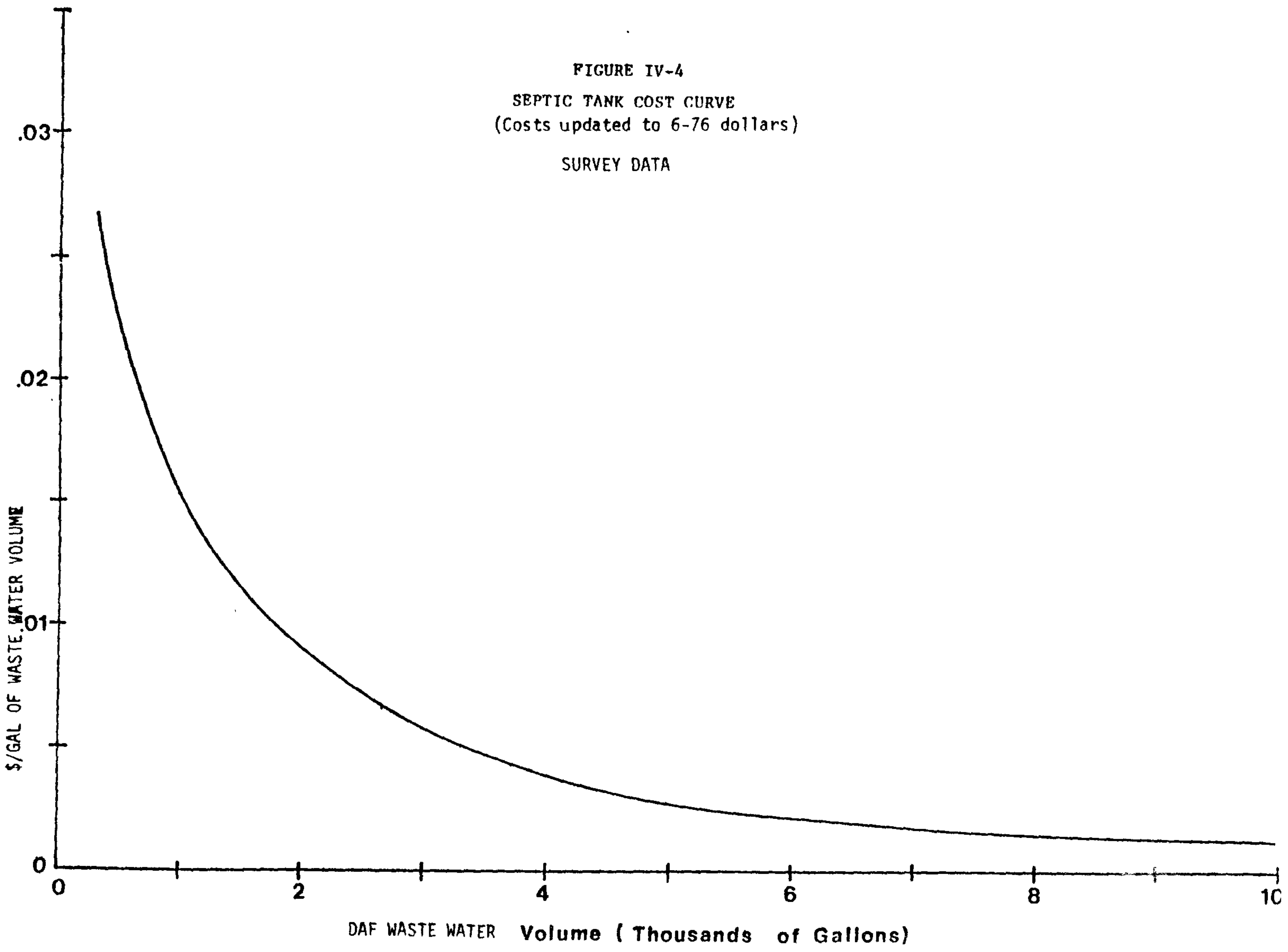


FIGURE IV-4

SEPTIC TANK COST CURVE
(Costs updated to 6-76 dollars)

SURVEY DATA

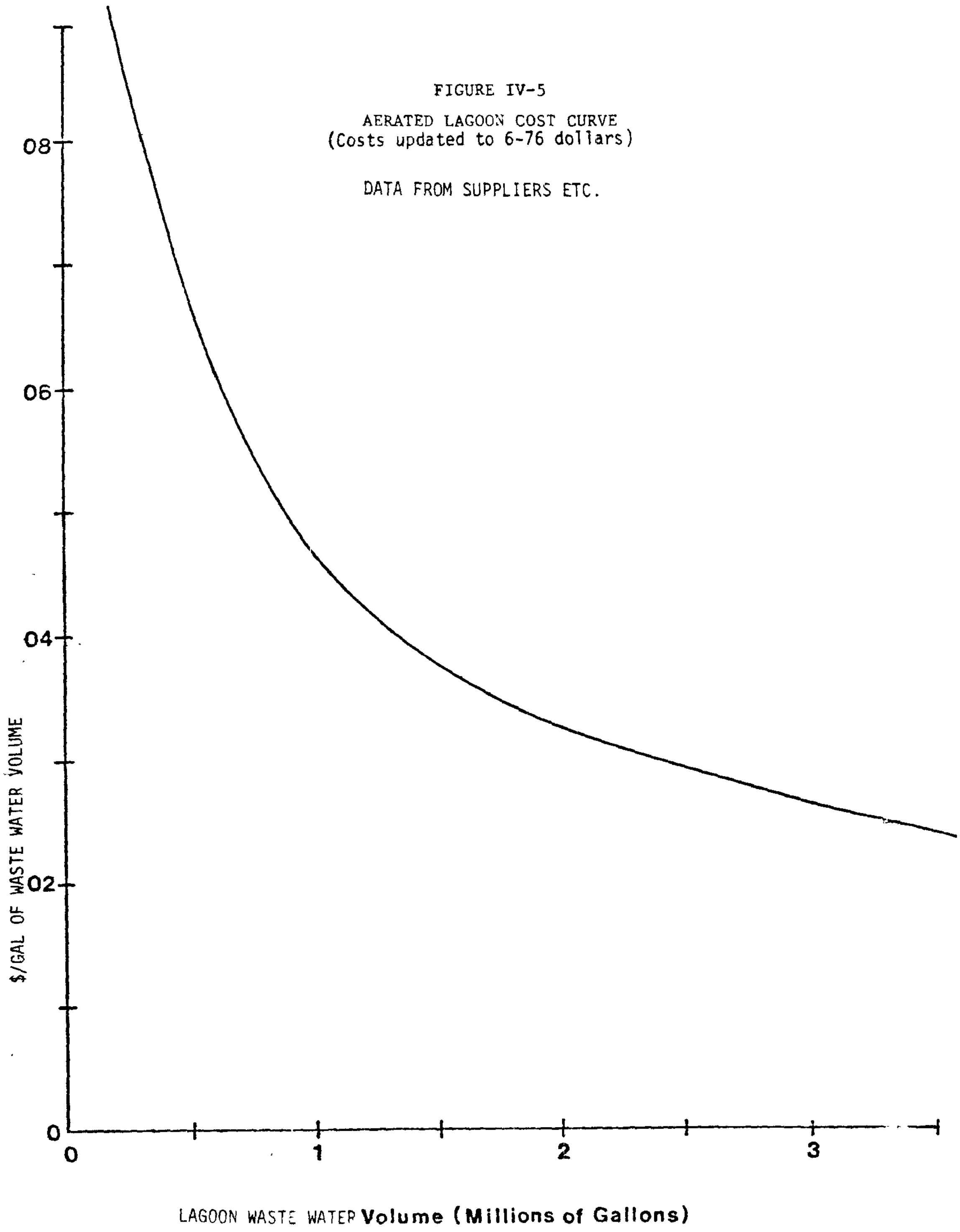


FIGURE IV-5

AERATED LAGOON COST CURVE
(Costs updated to 6-76 dollars)

DATA FROM SUPPLIERS ETC.

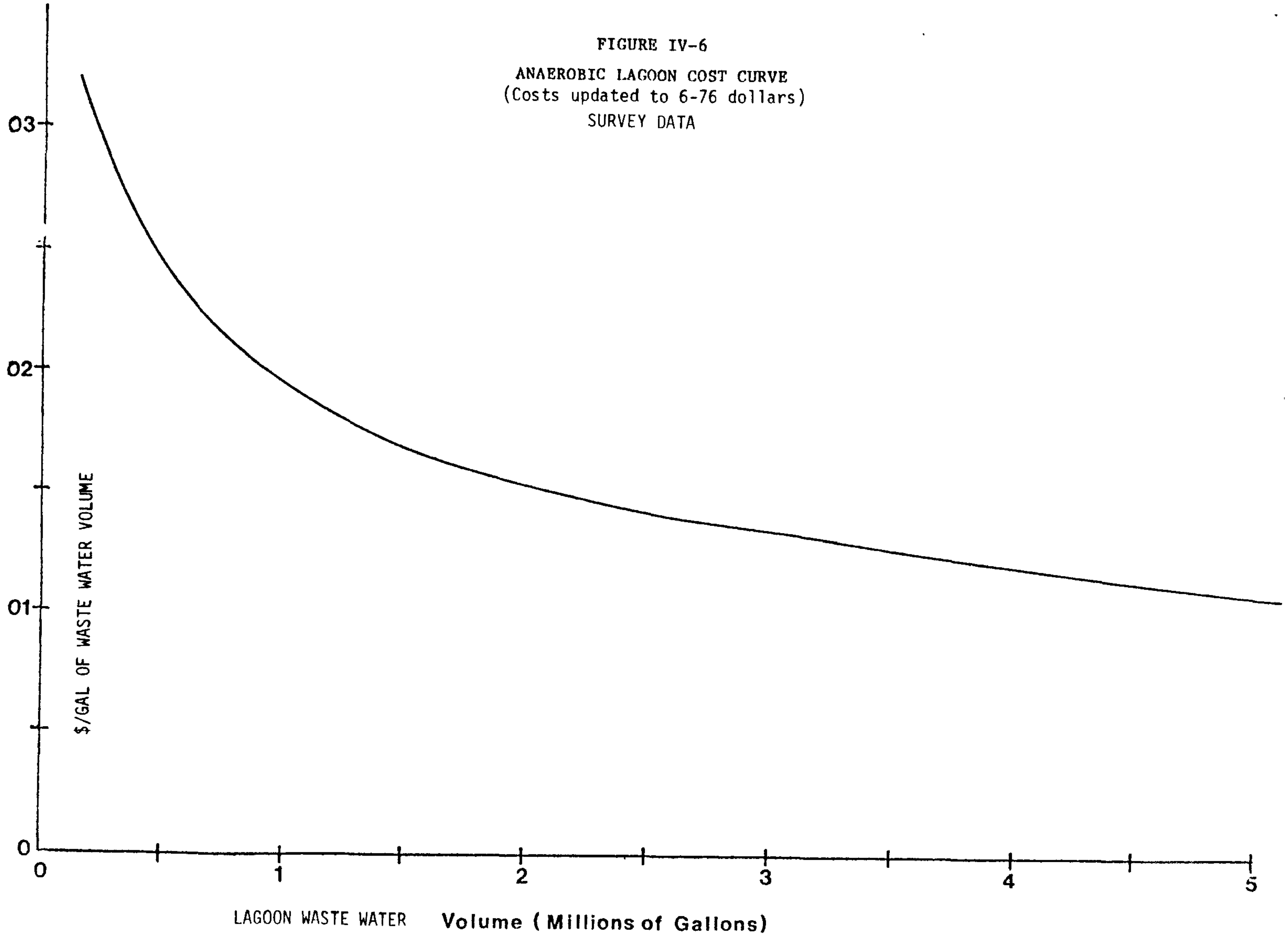


FIGURE IV-6

ANAEROBIC LAGOON COST CURVE
(Costs updated to 6-76 dollars)
SURVEY DATA

SECTION V

Responses to Court Remand

This section summarizes findings on the technical issues before the court. Economic impact is presented in the supplemental report titled "Economic Analysis of Effluent Guidelines (NSPS) on the Independent Rendering Industry Updated to 1976 Conditions."

The following are discussed in this section:

1. The recommended New Source Performance Standards, their supporting rationale and the 1983 effluent limitations.

2. The control technology applicable to meeting the New Source Performance Standards and 1983 limitations.

3. The costs of the required control technology.

New Source Performance Standards and 1983 Effluent Limitations

The effluent limitations that must be achieved by new sources are termed "New Source Performance Standards." The New Source Performance Standards apply to any source for which construction starts after the publication of the proposed regulations.

The recommended standards are listed below. They are based on performance information for plants demonstrating good in-plant and end-of-process control technology. In developing these standards consideration was given to process and operating options, type of cooker (batch versus continuous) employed, plant size, and to in-plant control technology variations.

The standards of performance considered attainable for new sources within the independent rendering industry are as follows:

Pounds Discharged in Effluent Per 1000 Pounds of Raw Material Processed (lb/1000 lbs = kg/kkg)				Within the Range	MPN 100/ml
BOD5	Suspended Solids	Oil & Grease	Ammonia	pH	Fecal Coliform
0.09	0.11	0.05	0.07	6.0-9.0	400

These limitations are also recommended for the best available technology economically achievable (1983 effluent limitations guidelines).

The recommended new source standards and 1983 limitations are considered achieveable and reasonable because a number of existing rendering plants are currently achieving them. Table V-I presents effluent discharge data for nine direct-discharging, exemplary operations that collectively are achieving the limitations. Six of the nine plants are meeting the limitations for those parameters for which data are available. Plant 180, which is utilizing the extended aeration form of activated sludge, has achieved the best treatment performance of the nine plants listed. The performance of this plant was also verified by field sampling results. This performance reflects management's interest in the daily operation of the treatment system. The final filtered effluent from this plant is known to be even better than that shown in Table V-1 (see Section IV). On an average the filters reduced the BOD5 and TSS by about 50 percent.

The average waste water flow for the nine exemplary direct discharging plants is 1267 liters/kkg RM (152 gal/1000 lb RM). The industry average for all survey plants is 8890 liters/kkg RM (1067 gal/1000 lb RM). The survey data shows that the type of condensers being used to condense the cooking vapors by all but one of the exemplary plants are shell-and-tube and air-cooled. Since the air-cooled condensers use air for cooling and since the cooling water for shell-and-tube condensers does not contact the contaminated condensate the waste water flow rate for these plants can be at a minimum. In our study it was found that in-plant equipment that allowed attainment of low waste water flows (approximately 150 gallons per 1000 lb RM or less) was the principal reason that the nine plants achieved low pollutants mass loading levels in their discharges.

Six other exemplary plants that treat waste waters but are not direct dischargers are shown in Table V-2. The average values listed for BOD_5, TSS and oil and grease (O&G) and ammonia meet or are close to the new source limitations.

Table IV-12 shows long range data for four of the exemplary plants. Three of these plants achieve the recommended limitations utilizing treatment components typically found in the industry today and without tertiary treatment. The exemplary rendering plants include all size subcategories, have high performance condensers and were found to process a variety of raw materials.

Required Controls and Treatment Technology

Based upon survey information and known existing in-plant operating conditions and end-of-process waste water treatment performance, the following three approaches appear to be the most feasible for achieving the recommended New Source Performance Standards and 1983 limitions.

1. Use of process equipment that allows the unit waste water flow to be at or below 1250 liters/kkg RM (150 gal/1000 lb RM). The waste waters are amenable to complete biological treatment system following in-plant primary treatment.

2. Where the unit waste water flow is high, a high degree of in-plant primary treatment followed by a high efficiency complete biological treatment system will be required. Possibly a mixed-media filter will be needed following the biological system.

3. Go to a no discharge system. Land application is typical.

The first approach is typical of the exemplary plants currently achieving or approaching NSPS. No known plants are currently meeting NSPS by following the second approach. None of these, however, is using mixed-media filters to further reduce pollutant load in the discharge. The third approach is feasible as at least 29 plants reported no discharge in the survey questionnaire.

The first approach mentioned above is the one that appears most feasible. It has been proven, and it is available. Use of the second approach to meet the standards is not common. With a high waste flow the treatment system would require the ultimate in efficiency and performance particularly if the flow is greater than about 3750 liters/kkg RM (450 gal/1000 lb RM).* This approach will

TABLE V-1

EFFLUENT DATA FOR DIRECT DISCHARGING PLANTS

Plant Number	Plant Type	Condenser Type	Wastewater Flow l/kkg RM (gal/1000 lb RM)	Effluent Parameters (kg/kkg RM)*				Principal RM Source
				BOD$_5$	Suspended Solids	Oil & Grease	Ammonia Nitrogen	
185	SB***	Barometric Leg	2223 (266)	0.033	0.059	0.01		Shop fat, Packinghouse
29	MB	Air	2430 (291)	0.085	0.225	0.024		Poultry Offal
103	MB	Shell & Tube	1667 (200)	0.083	0.083	0.050		Poultry Offal & Feathers
107	MB	Shell & Tube	1000 (120)	0.040	0.040	0.005		Packinghouse
202	MB***	Air	254 (30.5)	0.038	0.036		0.035	Packinghouse
59	LC	Shell & Tube	1491 (179)	0.021	0.035			Poultry Offal
106	LC	Air	348 (41.7)	0.014	0.018	0.001		Shop Fat
180	Large B&C***	Air	1542 (186)	0.0082	0.020		0.052**	Shop Fat, Packinghouse
200	X-L B&C***	Shell & Tube	444 (53.3)	0.052	0.073	0.019	0.022	Poultry
		AVERAGE	1267 (152)	0.042	0.065	0.018	0.036	
		STANDARD DEVIATION	804 (96)	0.028	0.064	0.018	0.015	

---

* kg/kkg RM = lb/1000 lb RM

** For period of April 1976 through January 1977, kg NH_3-N/kkg RM = 0.003

*** The values for the effluent parameters shown for plants 180, 185, 200, and 202 are averages for periods of time from just less than one year to slightly greater than one year.

SURVEY DATA

TABLE V-2

EFFLUENT DATA FOR NO DISCHARGE PLANTS

Plant Number	Plant Type	Condenser Type	Wastewater Flow l/kkg RM (gal/1000 lb RM)	Effluent Parameters (kg/kkg RM)* BOD5	Suspended Solids	Oil & Grease	Ammonia Nitrogen	Principal RM Source
93	MB	Barometric Leg	3704.9 (444.4)	0.12	0.084	0.033	0.066	Dead Animals
100	MB	Shell & Tube	1895. (227.3)	0.09		0.044		Shop Fat & Packing-house
109	MB	Shell & Tube	388.5 (46.6)	0.12	0.078	0.078		Packing-house
33	M B&C	Shell & Tube & Air	1041. (125)	0.019	0.067		0.062	Poultry & Shop Fat
108	LC	Shell & Tube	972.0 (116.6)	0.012	0.019	0.002		Packing-house
		AVERAGE	1600.3 (192.0)	0.064	0.053	0.041	0.064	
	STANDARD DEVIATION		1293.5 (155.1)	0.052	0.033	0.032	0.003	

---

* kg/kkg RM = lb/1000 lb RM

SURVEY DATA

require rigorous design and operation of treatment equipment and systems.

* At this flow the BOD5, TSS and ammonia levels would have to be reduced to 1/3 those acceptable at the exemplary flow of 150 gal/1000 lb RM.

In-Plant Controls

The major in-plant control applicable to meeting limitations was use of air-cooled or non-contact vapor condensers rather than barometric-leg condensers. With this type of in-plant equipment waste water flows of less than 1250 liters per kkg RM (150 gal/1000 lb RM) are readily attainable. As illustrated in Table IV-6, the average flow rate for the direct discharging plants using air-cooled condensers or shell-and-tube condensers is 760 l/kkg RM (91.2 gal/1000 lb RM) and 1668 l/kkg RM (200.2 gal/1000 lb RM), respectively. Table IV-6 shows the value for barometric-leg condensers is 32,772 l/kkg RM (3927 gal/1000 lb RM). A similar distinction based on condenser type was also found for the entire industry. Based on the survey over 15 plants now have air-cooled condensers and over 30 plants have shell-and-tube.

The prime advantages of reducing the process waste water flow were found to be:

(1) The size of waste water treatment control components can be reduced when process waste flows are reduced.

(2) With lowered flows, the survey shows the mass amounts of pollutants in the final discharge are reduced.

This approach permits achievement of the limitations without having to install tertiary or advanced treatment, e.g., mixed-media filtration, following secondary treatment.

In addition to achieving an exemplary waste water flow, good water conservation practices such as those outlined in the original Development Document must also be observed. As discussed below flow equalization will be required prior to activated sludge treatment systems.

The term primary treatment is used to designate the in-plant process used to separate the reclaimable grease from processing wastes. It is being done effectively with skimmer/settler type catch basins with a forty minute detention time. Dissolved air flotation is not required to meet NSPS or 1983 limitations. Discussion of this primary type of treatment is given below.

Flow Equalization

Fluctuations in flow in the independent rendering industry are usually not large. Continuous cookers, as the name imples, approximate a steady state operation. Hence waste waters resulting from the condensing of cooking vapors also approximate a steady state condition, i.e., a constant flow rate. With a series of batch cookers the situation is only slightly different. The normal operating procedure is to sequentially load and empty batch cookers. Thus the flow rate will vary somewhat but it will not experience extreme fluctuations. Any fluctuations that do occur can be adequately dampened by the large holding capacity of the typical lagoon treatment system. However, flow equalization is needed to prevent possible surges from upsetting activated sludge systems.

Very few rendering operations use flow equalization even though many plants indicated in the survey that they do. Follow-up inquiries to these facilities revealed certain respondents to the survey were assigning credit for flow equalization to wet wells, sumps, catch basins, and mechanical skimmer/settlers. Although these devices do provide a limited degree of retention time they are not its equivalent. Adequate flow equalization consists of a holding tank with sufficient capacity to reduce large fluctuations in flow and waste load. The tank should have a capacity which allows the flow to be equalized over 16 to 24 hours and should be equipped with some sort of agitation to prevent solids separation. The equipment is relatively inexpensive.

Because of the 1 to 3 days detention time in extended aeration systems, they are not as sensitive to surges as normal activated sludge plants where detention times are often 8 hours or less. However, good operating practice dictates use of flow equalization to assure upsets do not occur. In addition, it can be shown that flow equalization allows a smaller aeration basin to be used, requires less aeration and thus less energy, and by damping surges aids final clarification.

Limited flow equalization was used at only one of the fifteen identified exemplary plants. The detention time reported for this case was only 8 hours. This information reaffirmed that flow equalization is not required with lagoon systems.

Dissolved Air Flotation

Dissolved air flotation (DAF) units have only recently been put to use by the industry. The units are relatively expensive to install and operate. For optimum performance chemical addition and careful operation are often required. The recovered float not only contains chemicals but is very high in water content (typically 95 percent). Thus, it is not desirable in many cases to recycle this captured material. This is not to say that DAF units are not useful. In certain cases, such as with city dischargers, DAF units may be the best approach to pretreating the waste to meet the municipal standards.

Although these devices have the potential for being the most effective type of primary treatment available, data from the survey showed that, in general, these units are not performing in actual operation any better than are well-operated skimmer/settlers. This is evident from data for DAF units and for raw waste characteristics presented in Section IV. The raw waste data primarily represent the effluent from skimmer/settlers. Note in Table IV-II that there are four DAF units doing a very good job. However, all of these units are preceded by skimmer/settlers and discharge to municipal systems.

End-of-Process Technology

The end-of-process treatment technology found effective in achieving NSPS and 1983 limitations includes the extended aeration form of activated sludge and certain combinations of lagoons. The lagoon systems found capable of meeting the standards were:

1. Mechanically aerated - aerobic lagoons.
2. Anaerobic - aerobic lagoons.
3. Anaerobic - mechanically aerated - aerobic lagoons.

It has been assumed for costing purposes only that mixed media filters will be required after the lagoon systems. Since catch basins and skimmer/settlers are considered part of the in-plant processing, they are not included in end-of-process technology.

Other systems may of course be capable of adequately treating the waste waters. The above lagoon and activated sludge systems are recommended because specific rendering plants were found to be meeting the standards where these end-of-process systems were used. In addition, the above type lagoons are known to be effective in treating wastes from other segments of the meat industry. It is known, for example, that lagoon systems can be very effective in treating waste water effluent from meat packinghouses. On-going monitoring and testing show that at least 3 different lagoon systems in the meat processing industry can reduce pollutants to the low levels shown in Table V-I for plant 180. This plant uses the extended aeration form of activated sludge for treatment. That lagoon systems treating waste water effluents from rendering plants can be as effective is yet to be documented.

Table IV-7 lists all the independent rendering plants that reported using waste water treatment systems. The Table shows that the recommended treatment technology for meeting the standards and limits is being used by twenty-five of the fifty-five plants listed and by nine of the fourteen exemplary plants. The list also shows that of the eighteen direct-discharging plants answering the survey, thirteen used the recommended treatment technology. The other treatment systems listed in Table IV-7 such as anaerobic lagoons or aerobic lagoons are normally used to provide a low or intermediate degree of treatment such as might be required prior to introducing a rendering plants discharge into a municipal treatment system. The control and treatment section of the original Development Document gives additional information on the above treatment systems.

The Court also raised the question as to whether the lagoons treating rendering wastes require linings. A survey indicated lining of lagoons is not required by law in any of eleven states contacted. These eleven states include those having the greatest number of independent rendering operations (see Section IV). Six of the eleven states contacted had restrictions on lagoon seepage rate, and frequently require some soil testing prior to lagoon construction to insure compliance. The allowable seepage rates vary from about 940 to 64,000 l/ha/day (100-6800 gal/acre/day). Some states also suggest the use of compacted clay or bentonite whenever there is any question about excessive seepage.

<u>Cost of Treatment Technology</u>

The capital costs along with the operation and maintainance costs for each of the four recommended end-of-process treatment systems are presented in Tables V-3 through V-6 (extended aeration, aerated-aerobic, anaerobic-aerobic and anaerobic-aerated-aerobic lagoons). Costs are based on June, 1976 dollars and are given for the five models of plant studied in the economic analysis. The extra large continuous type plant was not analyzed. No impact would be anticipated because the next smaller plant of this type was not impacted.

The costs listed in Tables V-3 through V-6 were based upon the most conservative cost information obtained in the survey. When not available from survey information, cost data was obtained from consulting engineering firms, the literature and equipment suppliers. The waste treatment technology costs do not include in-plant primary equipment. For the purposes of this report primary equipment consists of catch basins and dissolved air flotation units or any other device used to collect and recycle grease. This equipment was included in the economic impact analysis as part of the production facilities costs. All renderers, regardless of the method used for disposing of waste water, utilize primary treatment. The primary equipment is feasible from an economic standpoint and is not unique to direct-discharge plants.

The mixed-media filters that were included in the cost analysis were designed to accommodate flow rates three times that of the exemplary (3750 l/kkg RM). A unit will thus be able to handle an average 24-hour waste flow in 8-hours if conditions dictate.

The total costs for equiping, constructing, operating and maintaining tertiary mixed-media filters in conjunction with the recommended lagoon systems are shown in Table V-7. As mentioned previously filters are not required to meet recommended limitations when the exemplary waste flow and recommended control and treatment technology are used. However, when the waste water flow is significantly greater than the exemplary rate of 1250 l/kkg RM, it has been assumed for costing purposes that filters (or a comparable cost option such as further expanded biological treatment) will be required.

Construction Cost Basis

Many factors were taken into consideration when the determinations were made for the model treatment plant construction costs listed in Tables V-3 through V-6.

The design and sizing of the model treatment plants were based on a waste water flow rate of 1250 l/kkg RM (150 gal/1000 lb RM). This flow is representative of rendering plants using air-cooled or shell and tube condensers for condensing cooking vapors. Design was also based on treating wastes with the following pollutant loads: 2.15 kg BOD5/kkg RM, 1.13 kg TSS/kkg RM, 0.72 kg oil and grease/kkg RM and 0.30 kg ammonia/kkg RM. These values compare favorably with the survey data for BOD5, TSS and O&G presented at the bottom of Table IV-5. The ammonia value is within the two ammonia values of 0.90 and 0.14 kg/kkg RM reported in the Table. In addition to waste treatment plant costs, total construction costs also include land values and engineering and contingency fees. Land was valued at $2,000/acre. Sufficient land is included in all estimated costs to provide an adequate buffer zone around all end-of-process treatment components and to allow space for additional treatment components (e.g. tertiary treatment). Engineering and contingency fees were based on increasing the cost of construction by 25 percent when construction costs are less than $25,000, an increase by 10 percent when costs are greater than $25,000. These percentages have been found acceptable in the construction industry for covering the costs associated with engineering and contingency fees and spillways, piping, etc. More specific information on construction costs for each of the four recommended treatment systems follows.

Extended Aeration

The estimated construction cost determined for the extended aeration system includes a 24-hour flow equalization tank, a concrete-lined aeration basin, floating aerators, a package-type air lift clarifier, a prefabricated fiberglass chlorine contact basin with the associated chlorine delivery system, and a sludge holding tank and drying beds.

The aeration basin was designed for a loading rate of 30.5 lb BOD5/1000 cu ft. This provides a detention of 3.6 days which compares very favorably with the 3-day detention time in the aeration basin at exemplary plant number 180. The basin is to be located below ground level, and to have a concrete lining. The excavation costs were determined to be $4/cu yd and lining with concrete costs to be $33.33 sq yd. The aeration basin is to have two feet of freeboard.

The aeration requirements were based on the equipment manufacturers design factors of 3.2 lb oxygen/hp-hr, 0.3 lb oxygen/day/lb MLVSS (Mixed Liquor Volatile Suspended Solids), and 0.2 lb BOD5/day/lb MLVSS. (These factors are equivalent to 1 hp-hr/2.13 lb BOD5). To accommodate possible production changes in the processing plant with attendent fluctuation in BOD5, sufficient aeration horsepower was provided to handle the model plant BOD5 load in 8 hours. The cost of aerators, including their support system, was obtained from a noted equipment supplier.

The final clarifiers operate on the air-lift principle and were designed for the accepted overflow rate of 1.63 1/sq ft/day (400 gal/sq ft/day). Costs for the prefabricated clarifiers were provided by a well known manufacturer of waste treatment systems. These systems are less expensive than the standard type of clarifier because they have air lifts rather than mechanical drive systems and have a life expectancy of 20 years rather than the 50 for the standard models. The performance of both types is satisfactory and comparable. The cost for a second, standby blower, is also included.

The sludge drying bed included as part of the total treatment package is to consist of a shallow excavated lagoon lined with reinforced plastic. The bed is to be provided with a plastic pipe under drain system covered with sand and gravel. The system cost was determined by using $6/cu yd for excavation, $1/sq ft for lining, $12/cu yd for sand and gravel and 10 percent of the construction cost for piping.

Aerated-Aerobic Lagoons Systems

The model aerated lagoons for this system are designed to reduce the BOD5 load from the typical 2.15kg/kkg RM to 0.25 kg/kkg at process waste flow of 1250 l/kkg RM (150 gal/1000 lb RM). The aerated lagoon volume for each model was determined by using the typical production rate, the maximum exemplary waste water flow rate of 1250 l/kkg RM and a detention time of 9.5 days. The detention time was calculated using the following equation:

$$\frac{(\text{Effluent BOD5})}{(\text{Influent BOD5})} = \frac{(1)}{(1+Kt)}$$

where K is an efficiency constant and was assumed to be 0.8/day and t is in days.

Lagoon design provided for the desired side wall slopes of 3 in the horizontal to one in vertical, a botton-of-the-lagoon length to width ratio of 2 to 1, and a three foot freeboard.

The aerated lagoon construction costs shown in Table V-4 were determined using $4/cu yd for excavation and $1/sq ft for lining.

The horsepower requirements for oxygen transfer were assessed using the following factors: 1.06 lb oxygen/lb BOD5, 1 hp-hr/3.2 lb oxygen, a BOD5 influent rate equal to the daily BOD5 load applied over an eight hour period. This latter parameter increases the hp requirement by a factor of three over the case where the BOD5 rate is set equal to the daily BOD5 load equalized over 24 hours.

The horsepower requirement is provided by anywhere from 2 to 6 floating aerators, depending upon the type of rendering plant and the mixing needs of lagoons. Aerator costs were determined using cost data provided by a well known supplier of aeration equipment.

The costs determined as outlined above were verified for each of the rendering plant models. This was done by comparing the costs with those ascertained from questionnaire cost curves data as presented in the cost curves of Section IV. The agreement is very good.

The aerobic lagoon, which follows the aerated lagoon in the system under discussion is designed to treat an influent BOD5 load of 0.25 kg/kkg RM at 1250 l/kkg RM. The size of the lagoon is based on applying the BOD5 load at a rate of 20 lb BOD5/day/acre. The lagoon is to have a nominal water depth of 5 feet with an allowable working range of 2 to 5 feet. At a water depth of 5 feet, the detention in the aerobic lagoon ranges from 137 days for the small batch to 160 days for the large continuous model. If the aerobic lagoon depth is lowered to 2 feet in the fall and allowed to accumulate waste water until the depth is again 5 feet, a no discharge status is achieved for periods ranging from 90 days for the small batch plant to 99 days for the large continuous plant. This is the usual practice in the industry when there is an ice cover on the lagoons. These detention and accumulation times do not account for the effect of precipitation, evaporation or percolation. The overall lagoon depth is 7 feet. The side walls slope at a horizontal to vertical ratio of 3 to 1. Costs of the aerobic lagoons as shown in Table V-4 were determined using the design volumes and the unit cost for aerobic lagoons presented in Section IV.

Anaerobic-aerobic Lagoons

TABLE V-3

ESTIMATED COSTS FOR EXTENDED AERATION

	MODEL				
	Batch			Continuous	
	Small	Medium	Large	Medium	Large
CONSTRUCTION COSTS					
Basin	$ 10,245	$ 18,740	$ 32,510	$ 23,469	$ 35,475
Aerators	3,000	6,000	10,000	7,000	13,200
Flow Equalization	1,350	4,150	9,350	5,900	11,800
Final Clarifier	5,700	8,600	15,750	10,100	17,250
Sludge Holding Tank	913	960	1,230	1,010	1,460
Sludge Drying Bed	4,419	13,131	31,363	18,341	55,819
Chlorination	1,530	1,710	1,960	1,800	2,050
Engineering, Contingency Fees	2,716	5,329	10,216	6,762	13,711
Piping, Spillway, Etc.	2,716	5,329	10,216	6,762	13,711
Land	1,500	2,000	4,000	3,300	4,500
TOTAL	$ 34,089	$ 65,949	$126,595	$ 84,444	$169,036
OPERATING & MAINTENANCE COSTS					
Labor	$ 9,360	$ 12,480	$ 15,600	$ 14,040	$ 18,720
Power	2,500	4,000	15,000	11,000	16,500
Wastewater Analysis	619	1,238	1,857.6	1,857.6	1,857.6
Maintenance & Supplies	1,629	3,197	6,130	4,057	8,227
TOTAL	$ 14,108	$ 20,915	$ 38,587.6	$ 30,954.6	$ 45,304.6

TABLE V-4

ESTIMATED COSTS FOR AERATED-AEROBIC TREATMENT

	MODEL				
	Batch Plants			Continuous Plants	
	Small	Medium	Large	Medium	Large
CONSTRUCTION COSTS					
Aerated Lagoon	$ 7,514	$ 15,403	$ 28,264	$ 19,156	$ 32,462
Aerators	3,000	6,000	15,000	9,000	18,000
Aerobic Lagoon	12,231	39,035	87,591	51,575	101,510
Engineering, Contingency Fees	5,686	6,043	13,085	7,967	15,197
Piping, Spillway, etc.	5,686	6,043	13,085	7,967	15,197
Land	3,000	7,000	14,000	8,000	16,000
TOTAL	$ 37,117	$ 79,524	$171,025	$103,605	$198,366
OPERATING & MAINTENANCE COSTS					
Labor	$ 1,560	$ 1,872	$ 2,496	$ 2,184	$ 2,808
Wastewater Analysis	619	1,238	1,857.6	1,857.6	1,857.6
Power	1,140	3,626	7,671	4,780	14,816
Maintenance & Supplies	1,706	2,851	7,128	4,277	8,554
TOTAL	$ 5,025	$ 9,587	$ 19,152.6	$13,098.6	$ 28,035.6

TABLE V-5

ESTIMATED COSTS FOR ANAEROBIC-AEROBIC TREATMENT

	MODEL				
	Batch Plants			Continuous Plants	
	Small	Medium	Large	Medium	Large
CONSTRUCTION COSTS					
Anaerobic Lagoon	$ 1,942	$ 5,398.5	$ 11,069	$ 7,308	$ 12,852
Aerobic Lagoon	18,135	54,535	121,850	75,743	137,872
Engineering, Contingency Fees	5,019	5,993	13,292	8,305	15,072
Piping, Spill-way, etc.	5,019	5,993	13,292	8,305	15,072
Land	3,160	10,000	18,000	11,000	20,000
TOTAL	$ 33,275	$ 81,919.5	$177,503	$110,661	$200,868
OPERATING & MAINTENANCE COSTS					
Labor	$ 1,248	$ 1,248	$ 1,872	$ 1,560	$ 2,184
Wastewater Analysis	619.2	1,238	1,857.6	1,857.6	1,857.
Maintenance & Supplies	1,506	3,596	7,975	4,983	9,043
TOTAL	$ 3,373.2	$ 6,082	$ 11,704.6	$ 8,400.6	$ 13,084.

The anaerobic lagoon portion of this system was designed to reduce the BOD5 load from the typical 2.15 kg/kkg RM to 0.37 at the exemplary flow rate of 1270 l/kkg RM (150 gal/1000 lb RM). The lagoons were sized using a BOD5 loading of less than 176 kg/100 cu liters (11 lb/1000 cu ft) or a detention time of 12.7 days. Costs presented in Table V-5 were obtained using the design volumes and the anaerobic lagoon cost curve presented in Section IV.

The aerobic lagoons were designed using the same criteria as were used in designing the aerobic lagoons for the aerated-aerobic treatment systems. However, since the influent BOD5 load is larger for the system under discussion the lagoon volumes are greater. The detention times are also greater. Detention times range from 213 days for the small batch rendering plant to 243 days for the large continuous rendering plant. The accumulation times, (i.e. the time it takes to raise the lagoon depth from 2 to 5 feet while there is no discharge) range from 138 days for the small batch model to 150 for the large continuous model.

The aerobic lagoons were costed using the design volumes and the unit cost curve for aerobic lagoons from Section IV.

Anaerobic-Aerated-Aerobic Lagoons

In this system the anaerobic lagoons are designed to reduce the BOD5 load from the typical 2.15 kg/kkg RM to 0.37 kg/kkg RM. This is the same waste reduction requirement used in designing and costing the anaerobic lagoons for the anaerobic-aerobic lagoon systems. Hence, the costs are as cited earlier for the same type rendering plant. The aerated lagoons were designed to further reduce the BOD5 load to 0.25 kg/kkg. This load is then applied to the aerobic lagoon. This is the same design load as used in designing and costing the aerobic lagoons for the aerated-aerobic lagoon systems. The construction costs for these aerobic lagoons will therefore be the same for corresponding types of rendering plants.

The aerated lagoons were designed using the same parameters and criteria as used for designing the aerated lagoons for the aerated-aerobic lagoon systems. This resulted in a design detention time of 15 hours. A one day detention was used.

The aerated lagoons were costed using $4/cu yd for excavation and $0.80/sq ft for lining. Cost curves could not be derived from the survey information because insufficient data on aerated-aerobic systems was provided.

TABLE V-6

ESTIMATED COSTS FOR ANAEROBIC-AERATED-AEROBIC TREATMENT

	MODEL				
	Batch Plants			Continuous Plants	
	Small	Medium	Large	Medium	Large
CONSTRUCTION COSTS					
Anaerobic Lagoon	$ 1,942	$ 5,400	$ 11,069	$ 7,308	$ 12,852
Aerated Lagoon	1,184	2,017	4,178	3,000	4,947
Aerobic Lagoon	12,231	39,035	87,591	51,515	101,510
Engineering, Contingency Fees	3,839	4,645	10,284	6,182	11,931
Piping, Spillway, etc.	3,839	4,645	10,284	6,182	11,931
Land	2,300	5,500	13,000	7,600	15,000
TOTAL	$ 25,335	$ 61,242	$136,406	$ 81,787	$158,171
OPERATING & MAINTENANCE COSTS					
Labor	$ 1,560	$ 1,872	$ 2,496	$ 2,184	$ 2,808
Wastewater Analysis	619	1,238	1,858	1,858	1,858
Power	143	143	300	300	300
Maintenance & Supplies	1,151	2,787	6,170	3,709	7,159
TOTAL	$ 3,473	$ 6,040	$ 10,824	$ 8,051	$ 12,125

TABLE V-7

CONSTRUCTION AND OPERATING AND MAINTENANCE COSTS WITH MIXED MEDIA FILTER

	Aerated-Aerobic		Anaerobic-Aerated-Aerobic		Anaerobic-Aerobic	
	Construction	Operating & Maintenance	Construction	Operating & Maintenance	Construction	Operating & Maintenance
SB (1)	$ 41,214	$ 5,230	$ 31,650	$ 3,789	$ 38,172	$ 3,618
MB (2)	$104,244	$11,598	$ 85,962	$ 7,276	$106,639	$ 7,318
LB (3)	$217,105	$22,180	$182,486	$13,128	$223,583	$14,010
MC (4)	$135,525	$15,198	$113,707	$ 9,650	$142,581	$10,000
LC (5)	$255,006	$31,432	$214,811	$14,960	$257,508	$15,900

(1) Small Batch

(2) Medium Batch

(3) Large Batch

(4) Medium Continuous

(5) Large Continuous

Operating and Maintance Cost Basis

Operating and maintance costs include labor, power, waste water analysis, and maintance and supplies. Labor is costed at \$6/hr. and power at \$0.035/kwh. The waste water pollutant parameters and costing data for analysis are as follows: BOD5/\$18.60; total suspended solids (TSS)/\$4.80; oil and grease (O&G)/\$22.00; coliform count/\$6.00 and pH/no charge. Total cost per set is \$51.60. The number of analyses per year included in the costs ranged from 12 sets for small batch plants to 36 sets for large continuous plants. Maintance and supplies were costed at the accepted level of five percent of construction costs less land costs.

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