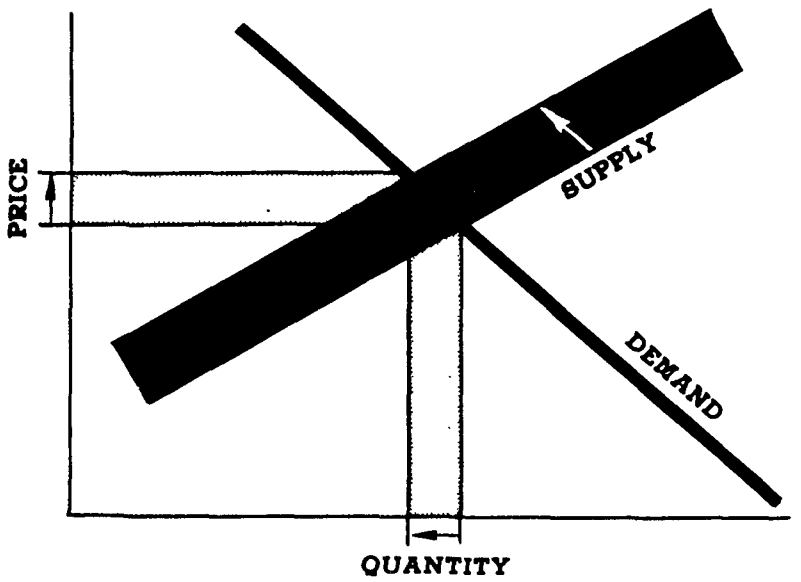
EPA-230/1-73-028
MARCH 1974

ECONOMIC ANALYSIS OF PROPOSED EFFLUENT GUIDELINES

TEXTILES INDUSTRY



U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Planning and Evaluation
Washington, D.C. 20460

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PREFACE

The attached document is a contractors' study prepared for the Office of Planning and Evaluation of the Environmental Protection Agency ("EPA"). The purpose of the study is to analyze the economic impact which could result from the application of alternative effluent limitation guidelines and standards of performance to be established under sections 304(b) and 306 of the Federal Water Pollution Control Act, as amended.

The study supplements the technical study ("EPA Development Document") supporting the issuance of proposed regulations under sections 304(b) and 306. The Development Document surveys existing and potential waste treatment control methods and technology within particular industrial source categories and supports promulgation of certain effluent limitation guidelines and standards of performance based upon an analysis of the feasibility of these guidelines and standards in accordance with the requirements of sections 304(b) and 306 of the Act. Presented in the Development Document are the investment and operating costs associated with various alternative control and treatment technologies. The attached document supplements this analysis by estimating the broader economic effects which might result from the required application of various control methods and technologies. This study investigates the effect of alternative approaches in terms of produce price increases, effects upon employment and the continued viability of affected plants, effects upon foreign trade and other competitive effects.

The study has been prepared with the supervision and review of the Office of Planning and Evaluation of EPA. This report was submitted in fulfillment of Task Order No. 10 of Contract 68-01-1541 by Arthur D. Little, Inc. Work was completed as of March 1974.

This report is being released and circulated at approximately the same time as publication in the Federal Register of a notice of proposed rule making under sections 304(b) and 306 of the Act for the subject point source category. The study has not been reviewed by EPA and is not an official EPA publication. The study will be considered along with the information contained in the Development Document and any comments received by EPA on either document before or during proposed rule making proceedings necessary to establish final regulations. Prior to final promulgation of regulations, the accompany study shall have standing in any EPA proceeding or court proceeding only to the extent that it represents the views of the contractor who studied the subject industry. It cannot be cited, referenced, or represented in any respect in any such proceeding as a statement of EPA's views regarding the subject industry.

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1. EXECUTIVE SUMMARY

a. Introduction. This study examines the economic impact on the textile industry of the proposed effluent guidelines for:

- the proposed best practicable technology,
- the proposed best available technology, and
- new source performance standards (NSPS).

The textile industry has been divided into seven categories for the purpose of establishing effluent guidelines. They are:

- Wool scouring,
- Wool dyeing and finishing,
- Greige goods mills,
- Woven fabrics dyeing and finishing (cotton and synthetics),
- Knit fabric dyeing and finishing (cotton and synthetics),
- Carpet mills, and
- Stock and yarn dyeing and finishing.

The economic impact of the proposed guidelines has been examined for five of the above categories. They are:

- Wool scouring,
- Wool dyeing and finishing,
- Woven fabric dyeing and finishing (cotton and synthetics),
- Knit fabric dyeing and finishing (cotton and synthetics), and
- Stock and yarn dyeing and finishing.

Two other categories – greige goods mills and carpet mills – have been precluded from this initial study of the economic impact on the assumption that they would not be significantly impacted by the proposed effluent guidelines.

In addition to setting aside two of the seven textile categories from this initial study, we have also set aside large integrated textile mills which will not be significantly impacted, generally because of their higher profit levels, larger size and integrated production, as well as their ability to apply a strong price on levels within the industry. The ability to raise (control) prices will allow them to pass on the cost of pollution control.

This assumption was made at the outset of this study and has largely been borne out by the results of the analysis, since there is minimal impact from the proposed best practicable technology, and it is similarly minimal if municipal treatment is used instead of activated carbon following secondary biological treatment technology for the proposed best available technology and new source performance standards.

b. Methodology. This study is divided into two parts. The first part produces a profile of the five categories studied based upon published information, in-house information, and other readily available sources. The contractor has profiled the category in terms of the number of mills, size distribution, type of product, financial status, type of plant, geographic distribution, and sector segments to be affected by the guidelines.

The second half of the study discusses the economic impact that the proposed effluent guidelines may have upon the five categories and is presented in the form of a scenario. For each of the categories studied, personal interviews with operating mills were made and used in conjunction with telephone interviews with operating mills and other industry sources. The contractor also relied on his textile industry specialists to provide direct input into the scenarios.

Each scenario describes the categories in some detail and presents a composite of a mill believed to be representative of mills within each category. Composites of a small mill with under 20 employees, and both small and medium size mills are presented for each category, with the exception of wool scouring in which there are only two size classifications. A wide range of sizes (3) was not found in the wool scouring sector, as found within the other categories. The dimensions of each composite mill are presented in terms of annual sales, profit, depreciation expense, cash flow, production, waste loads, water usage, and similarly related dimensions.

The composite mill is then used as the basis for calculating annual operating costs and investments necessary for pollution control within each category and mill size. For example, the waste load and water usage estimated for each composite mill is applied to the methodology of Appendix A to determine the operating costs and investment for each level of treatment.

To measure the impact in terms of mill closings, we have assumed a mill will close only if the annual cost of treatment exceeds the annual cash flow of the mill.

The estimated range of cash flows has been compared to the annual operating cost, and we assumed no mill would close if the minimum annual cash flow exceeded the estimated incremental annual operating costs of effluent treatment. In those cases where the annual operating costs of treatment exceeded the minimum estimated cash flow but did not exceed the maximum cash flow, we estimated the number of plant closings as a percentage proportional to the linear relationship between the operating cost and the cash flow. For example, if the cash flow ranged between $0 and $1000 and the annual operating costs were $250, then 25% of the mills operating in this category and size classification would be expected to close.

Other impacts on employment and production are derived directly from the estimated number of mill closings. Tangential impacts, such as those relating to community pricing, financial and foreign trade, are treated for the most part independently.

The impact on a specific mill and/or on a group of mills that form a slightly different composite can be estimated with material presented in the appendix of this study. This material permits estimates of the initial investment and annual operating costs for pollution control. The cash flow criterion for a mill closing or other criteria, such as profitability or rate of return on invested assets, can then be applied.

c. Costs. The costs of alternate waste treatment methods to meet the guidelines have been calculated on the basis of initial capital investment and annual operating costs for each of the composite mills. The basis for these calculations are described in detail in Appendix A, and the results of this analysis are presented in Table 1-1.

Costs for best practicable technology waste treatment have been calculated on the assumption that extended biological treatment will enable a mill to meet the guidelines for BOD, COD, and color.

Best practicable technology (BPT) for the textile industry, as specified by the EPA, includes pretreatment of wastes (screening and 8-hour holdup) and subsequent municipal treatment, or alternatively, self-treatment by preliminary screening, primary settling (wool scouring only), coagulation (carpet mills only), secondary biological treatment by extended aeration and stabilization ponds, and chlorination.

Best available technology (BAT) for the textile industry, as specified by the EPA, includes the preliminary screening, primary settling (wool scouring only), coagulation (carpet mills only), secondary biological treatment by extended aeration and stabilization ponds, and chlorination listed under Best Practicable Control Technology. In addition, it includes advanced treatment techniques, such as multimedia filtration and/or activated carbon adsorption following biological treatment. Small plants with less than 20 employees have not had COD limits set so only a multimedia filter is required for them to meet BAT requirements.

d. Financial Profiles. Financial profiles for each category were derived from field interviews, contractors' in-house knowledge, and other industry sources. The profiles represent commission houses, with the exception of the very small raw wool scouring and wool dyeing and finishing. A summary of pertinent financial data drawn from each composite mill representation of its category and size classification is presented in Table 1-2.

e. Impacts. The impact of the guidelines on prices, plant closings, unemployment, communities, international trade, and other areas has been estimated for each of the five categories. A summary of these findings is given below.

(1) Prices. In general, industry sources state that any added costs cannot be readily passed on to the mills' customers since the mills affected are the smaller, independent companies which work in the aftermarket of small lots for fill-in needs of the

TABLE 1-1

ESTIMATED WASTE TREATMENT INVESTMENTS AND ANNUAL OPERATING COSTS TO MEET PROPOSED TEXTILE GUIDELINES

Category	1 Raw Wool Scouring		2 Wool Dyeing and Finishing			4 Broad Woven Goods Dyeing and Finishing			5 Knit Goods Dyeing and Finishing			7 Stock and Yarn Dyeing		
Mill Size	Small Exempt	Medium	Small Exempt	Small	Medium	Small Exempt	Small	Medium	Small Exempt	Small	Medium	Small Exempt	Small	Medium
Water Use (gal/lb product)	1 5	1 5	13.8	13 8	13 8	18	18	18	20	20	20	22	22	22
Treatment Plant Size (MM gal/day)	0 022	0 034	0 027	0 131	0 462	0.040	0 162	1.305	0.152	0.30	0 80	0.50	0.235	0.528
WASTE TREATMENT INVESTMENTS AND ANNUAL OPERATING COSTS														
Proposed Best Practicable Technology														
• Pretreatment Followed by Discharge to a Municipal Treatment Plant (Includes Annual Municipal Charges)														
Capital Investment	17,400	21,300	19,000	41,100	76,200	23,000	45,600	127,000	44,100	61,600	99,800	43,900	54,600	81,300
Annual Expenses	9,200	11,600	10,100	28,100	75,700	12,700	33,000	188,100	31,400	53,100	121,700	31,200	43,800	84,800
• Self-Treatment (Mill Owned)														
Capital Investment	54,400	57,300	55,800	125,300	228,500	68,700	111,600	353,700	105,800	148,300	240,100	108,800	136,100	205,000
Annual Expenses	20,300	21,600	19,800	37,600	67,100	22,200	34,000	100,600	32,500	44,400	69,600	33,100	40,900	60,200
PROPOSED BEST AVAILABLE TECHNOLOGY AND NEW SOURCE PERFORMANCE STANDARDS														
Capital Investment	71,300	320,000	75,200	541,700	1,165,100	93,700	511,100	1,895,100	167,900	699,700	1,293,100	170,300	655,000	1,082,700
Annual Expenses	25,300	189,500	25,200	238,100	443,900	28,700	216,800	609,400	46,200	260,000	412,400	51,700	257,300	378,200

* These costs are additive to secondary treatment costs above

TABLE 1-2

FINANCIAL PROFILE SUMMARY – TEXTILE INDUSTRY
(categories included in this study)

Category	1. Raw Wool Scouring		2. Wool Dyeing and Finishing		
Mill Size	Very Small	Small/Medium	Very Small	Small	Medium
Sales/Year	$650,000	$6,500,000-$13,000,000	$675,000	$1,075,000-$5,375,000	$5,375,000-$17,500,000
Profit after Taxes	$0-$5,000	$0-$74,000	$0-$27,600	$0-$174,000	$0-$554,000
Depreciation Expenses	Negligible	Negligible	$6,700	$10,800-$54,000	$53,800-$175,300
Principal Repayment	Not Known	Not Known	Not Known	Not Known	Not Known
Annual Cash Flow	$0-$5,000	$0-$74,000	$6,700-$34,000	$10,800-$223,000	$53,800-$729,300

	4. Broad Woven, Dyeing, and Finishing			5. Knit Fabric Dyeing and Finishing		
	Very Small	Small	Medium	Very Small	Small	Medium
Sales/Year	$204,700	$1,060,000-$2,120,000	$8,480,000-$15,900,000	$1,015,000	$1,605,000-$3,210,000	$5,082,500-$8,560,000
Profit after Taxes	$0-$9,600	$0-$72,600	$0-$502,600	$0-$32,900	$0-$90,000	$112,200-$540,600
Depreciation Expenses	$14,300	$74,200-$148,400	$593,600-$1,113,000	$101,500	$160,500-$321,000	$503,250-$856,000
Principal Repayment	Not Known	Not Known	Not Known	$40,600	$64,200-$128,400	$203,300-$342,400
Annual Cash Flow	$14,300-$23,900	$74,200-$221,000	$593,600-$1,615,600	$60,900-$93,800	$96,300-$282,600	$417,200-$1,054,200

	7. Stock and Yarn Dyeing Mill		
	Very Small	Small	Medium
Sales/Year	$916,400	$916,400-$2,687,500	$2,687,500-$5,375,000
Profit after Taxes	$0-$30,300	$0-$76,400	$62,400-$174,200
Depreciation Expenses	$64,200	$64,000-$188,100	$188,100-$376,250
Principal Repayment	Not Known	Not Known	Not Known
Annual Cash Flow	$64,200-$94,500	$64,000-$264,500	$250,500-$550,500

customers. Their price structure is determined by the larger corporations which do the volume production. The smaller firms may charge a small premium of 5% or so on the going rate, but if much more than that is charged, the larger mills will undertake the work. The larger companies have already accomplished much of the expenditures necessary to meet the best practicable treatment guidelines and, presumably, their present prices reflect this and other factors such as overseas competitive effects. Specific category comments follow.

Wool scouring is a special case. The wool market has been depressed for some time and mills have been closing with fair regularity, resulting in a highly competitive situation that precludes higher pricing.

Broad wovens may be able to pass on a good share of the costs in the case of the best practicable treatment since the market there is strong. Knits cannot do so now, but within six months or so the knit market is expected to firm up at which time it may be able to pass on most treatment costs. Stock and yarn dyeing mills also share a reasonably strong market at present and may be able to pass on at least a portion of the treatment costs.

Table 1-3 provides a summary of the base price currently charged for processing, and the incremental price increase that would result for the various treatment costs, if these costs could be passed on, assuming no mark-up by the mill.

(2) Plant Closings and Unemployment. Table 1-4 summarizes the impact on mill closings and unemployment projected for the five categories considered in this study. In each case, the impact is considered as if all mills in that category had to treat their wastes in the manner described, such as in the municipal treatment, where we have assumed that all mills must connect to municipal treatment plants, and we have calculated the percentage that can or cannot afford to do so by the cash flow criterion. The table shows that the greatest relative effects will be in the wool categories, which is already a distressed industry. The greatest effect on groupings appears to be on small mills having to meet best available self treatment.

(3) Community Impacts. A large percentage of the small and medium sized independent mills are located in small communities where the mills hold a significant position. They often account for up to 5% of the town's direct employment, and sometimes as much as 30%. Hence, although the impact may be small in light of the total industry, local impacts will be significant.

(4) International Trade. In terms of international trade, the impact of the guidelines on the industry appears to be of little consequence. If, in fact, the guidelines produced a much greater effect than predicted in this study, imports would be further encouraged since the smaller, independent mills provide the fast turnaround on small lots that neither the large domestic mills nor the overseas mills can provide.

TABLE 1-3

PRICE IMPACT SUMMARY

	1 Wool Scouring		2 Wool Dyeing and Finishing		
	Very Small	Small/Medium	Very Small	Small	Medium
Base Price ($/pound of product)	.13	1.73		$1.43	
Incremental Price for:					
Municipal Treatment	.0018	.0020	.0202	.0113	.0093
BPT, Self-Treatment	.0041	.0038	.0396	.0151	.0083
BAT, Self-Treatment	.0051	.0337	.0504	.0958	.0548

	4 Woven Goods Dyeing and Finishing			5 Knit Goods Dyeing and Finishing		
	Very Small	Small	Medium	Very Small	Small	Medium
Base Price ($/pound of product)		0.37-0.70			0.53	
Incremental Price for:						
Municipal Treatment	.0231	.0147	.0102	.0165	.0118	.0095
BPT, Self-Treatment	.0404	.0151	.00545	.0171	.0099	.0054
BAT, Self-Treatment	.0522	.0964	.0330	.0243	.0578	.0323

	7 Stock and Yarn Dyeing		
	Very Small	Small	Medium
Base Price ($/pound of product)		0.54	
Incremental Price for:			
Municipal Treatment	.0183	.0131	.0113
BPT, Self-Treatment	.0194	.0122	.0080
BAT, Self-Treatment	.0303	.0767	.0504

TABLE 1-4

SUMMARY OF IMPACT ON MILL CLOSINGS AND UNEMPLOYMENT

Category	1 Raw Wool Scouring		2 Wool Dyeing and Finishing			4 Broad Woven Dyeing and Finishing			5 Knit Fabric Dyeing and Finishing			7 Stock and Yarn Dyeing Mills		
Mill Size	Very Small	Small/Medium	Very Small	Small	Medium	Very Small	Small	Medium	Very Small	Small	Medium	Very Small	Small	Medium
Mills Exposed	3	9	23	33	20	146	167	102	50	25	15	42	32	15
Employees Exposed	57	270	437	2,970	6,000	2,774	12,525	45,900	950	938	1,500	798	960	900
Mill closings, caused by implementation of														
Municipal Treatment	3 (100%)	1 (16%)	3 (12%)	3 (8%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0(0%)
BPT, Self Treatment	3 (100%)	3 (29%)	11 (14%)	4 (13%)	1 (2%)	120 (82%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
BAT, Self Treatment	3 (100%)	9 (100%)	15 (67%)	33 (100%)	12 (58%)	146 (100%)	162 (97%)	2 (2%)	0 (0%)	22 (88%)	0 (0%)	0 (0%)	31 (96%)	7 (43%)
Unemployment, caused by implementation of														
Municipal Treatment	57	26	52	49	155	0	0	0	0	0	0	0	0	0
BPT, Self Treatment	57	87	61	80	152	2,275	0	0	0	0	0	0	0	0
BAT, Self Treatment	57	270	293	2,970	1,612	2,774	11 788	318	0	69	0	0	886	199

f. Study Limitations. This study was undertaken to permit an initial estimate of the economic impact that the proposed effluent guidelines would have upon certain sub-categories of the textile industry. The contractor was placed under severe calendar time and budgetary constraints which have tended to limit the accuracy of the analysis. The contract required the contractor to prepare a scenario or word picture of the impact that the proposed effluent guidelines would have upon the textile industry. This means that the analysis was more judgmental than analytical, when compared with the economic analyses of other industries. It is not that the EPA has not made available the same resources for the study of the textile industry as it has for other industries, but rather that the major economic impact that will occur within the textile industry will occur to companies which are generally small, privately held, and are very reticent and, in many cases, actually refused to reveal details of their financial profitability and expected impact of the effluent guidelines on their businesses. Responsible and knowledgeable people have been contacted and the contractor discussed the composite mill for each sub-category and size classification and these persons believe that the composites are representative of their category and size classification. On that basis the study is presented as an initial view of the impact that the proposed effluent guidelines will have upon this industry.

Follow-on studies, should they be required, can build upon the methodology used in this study to improve the understanding of the impact that the guidelines will have upon this industry. For example, the number of interviews conducted could be increased to a point that forms a statistically valid sample of the industry in each category. It is anticipated that the statistical sample will be developed on the basis of personal interviews and the balance of the industry could be conducted by means of mail questionnaires sent to companies listed in Davidson's Blue Book or similar directories.

2. INDUSTRY PROFILES

This chapter presents a profile of the five sectors of the textile industry considered in this study. Based in part on the Annual Survey of Manufacturers, a Department of Commerce publication, each profile presents a table illustrating the size distribution of mills according to number of employees, as defined by the Annual Survey, followed by a similar table listing the number of mills and size distributions expected to be impacted, and the rationale employed to identify them.

The discussion on size distribution is followed in each case by the types of plants considered, their geographic distribution, the type of product segments of the sector which will be affected by the requirements to meet the guidelines, and a brief financial profile.

a. Wool Finishing.

(1) U.S. Wool Industry – General

(a) U.S. Fiber Consumption. The consumption of wool declined drastically between 1960 and 1972. Table 2-1 illustrates a fiber consumption of 411 million pounds in 1960 declining to 219 million pounds in 1972.

TABLE 2-1

TOTAL FIBER CONSUMPTION
(millions of pounds)

Year	Cotton	Man-made Fiber	Wool
1960	4,191.0	1,874.7	411.1
1965	4,477.4	3,614.1	387.0
1970	3,815.6	5,501.3	240.3
1972	3,841.3	7,588.0	219.2

Source: Dept. of Agriculture Textile Organon

(b) Looms in Place. To ascertain woolen and worsted productive capacity, we analyzed the number of looms producing fabric that were in place between 1965 and 1972. Table 2-2 illustrates that in 1965 approximately 7000 looms were engaged in the manufacture of woolen and worsted fabrics, declining to an estimated 3000 looms in 1972.

TABLE 2-2

WOOLEN AND WORSTED LOOMS IN PLACE

Year	No. of Looms
1965	6,967
1970	3,735
1972	2,881

Source: Dept. of Commerce, Bureau of the Census, 1967

(c) Index of Industrial Production. Table 2-3 illustrates the index of industrial production between 1960 and 1972, where total textile mill products rose from 100 in 1967 to 114 in 1972. Wool fabrics, on the other hand, declined from a total of 100 in 1967 to 44 in 1972.

TABLE 2-3

INDEX OF INDUSTRIAL PRODUCTION

	Annual Averages			
	1967	1970	1971	1972
Total index	100.0	106.6	106.8	114.4
All manufacturing	100.0	105.2	105.2	113.1
Textile mill products	100.0	106.3	108.6	114.5
Cotton fabrics	100.0	87.4	90.7	86.5
Man-made fabrics	100.0	125.6	118.9	133.4
Wool fabrics	100.0	72.5	47.5	44.3
Knit goods	100.0	130.5	134.3	147.7
Fabric finishing	100.0	90.1	89.1	92.1
Carpeting	100.0	129.3	148.0	164.1
Yarn & misc. textiles	100.0	96.6	103.3	107.3

Source: U.S. Federal Reserve System

(2) Wool Scouring.

(a) General. According to the 1967 Census of Manufactures, 68 establishments were engaged in wool scouring and/or worsted combing. Table 2-4 illustrates the relative position of wool scouring and combing plants between 1958 and 1970 during which period employment dropped sharply from 6,000 to 3,900.

TABLE 2-4

WOOL SCOURING AND COMBING PLANTS
INDUSTRY GROWTH 1958-1970

	No. Employees		Value	Cost of	Value of	Capital
	No. (000)	Payroll ($MM)	Added ($MM)	Materials ($MM)	Shipments ($MM)	Expenditures ($MM)
1970	3.9	23.9	27.4	30.2	62.5	2.4
1958	6.1	22.7	36.1	48.5	87.6	1.3

Source: Annual Survey of Manufacturers

Value of shipments declined from a high of $87 million in 1958 to $62 million in 1970. Capital expenditures on the other hand, increased from 1.3 million in 1958 to $2.4 million in 1970. This relates directly to the fact that worsted-type fabrics have been declining in the United States between 1958 and 1970, and the increased capital investment is a reflection of modernization of those plants that have not gone out of business.

(b) Size Distribution. Table 2-5 illustrates that of a total of 68 wool scouring plants, only one employed 1000 people or more. Eleven plants employed 100 to 500 people, and the remaining 56 employed less than 100 people. We estimate, however, that between 1967 and 1972 the number of establishments declined drastically. Of 68 establishments in operation in 1967, we estimate that in 1973 the following 16 establishments were in business:

Amos Abbott Corp., Dexter, Maine
Hart Wool Combing Inc., Holyoke, Mass.
Barre Wool Combing Co., N. Barre, Mass. – Large
Hudson Combing Co., Inc., Hudson, Mass.
Gilet Wool Scouring Corp., North Chelmsford, Mass.
Southwell Combing Co., North Chelmsford, Mass.
Caron International, Rochelle, Ill.
Santee River Wool Combing Co., Inc., Jamestown, S.C. – Large
Roddie Wool Scouring Co., Brady, Texas
Bollman Industries, San Marcos, Texas
San Angelo Wool Processing Co., San Angelo, Texas
Associated Wool Processors of Texas, Inc., Del Rio, Texas
Burlington Industries, Clarksville, Va. – Large
Burlington Industries, Lees Carpets Div.; Glasgow, Va. – Large
J.P. Stevens Inc., Allendale, S.C. – Large
Columbia Wool Scouring Mills, Portland, Oregon

Wellman Industries of Johnsonville, S.C., has recently decided to withdraw from this industry.

We estimate that three of the above mills fall into the "less than 20 employees" category, and that nine are in the "medium" classification. Refer to Table 2-6 for a comparison of the Census figures with the distribution chosen for use in this study.

TABLE 2-5

WOOL SCOURING AND COMBING – SIZE DISTRIBUTION

	No. of Establishments	No. of Employees (000's)
Total establishments	68	5.0
Establishments with an average of:		
1 to 4 employees	14	–
5 to 9 employees	5	–
10 to 19 employees	10	.1
20 to 49 employees	21	.7
50 to 99 employees	6	.4
100 to 249 employees	7	1.0
250 to 499 employees	4	2.7
1,000 to 2,499 employees	1	–

Source: Census of Manufactures, 1967

TABLE 2-6

CATEGORY 1 – RAW WOOL SCOURING MILLS

Study Size Division	(No. Mills)	Census Size Division (No. Employees)	Unadjusted Census (No. Mills)	Adjusted* Census (No. Mills)
Extra Small	3	0- 19	29	3
		20- 49	21	5
Small	9	50- 99	6	1
		100-249	7	2
Medium	–	250-499	4	1
	12		67	12

*Mills remaining in business, excluding large plants.

(c) Types of Plants. The 16 plants still active in wool scouring have equipment and technology that is adequate when compared with competing enterprises in Europe and Japan.

(d) Geographic Distribution. Table 2-7 gives the 1967 geographic distribution of wool scouring and combing plants and shows that of a total of 68 the majority – 52 plants – was located in the northeastern region, 12 were located in the southern regions, and 4 (not listed) were located elsewhere. Many scouring plants in the northeastern region have shut down since the 1967 Census, shifting the distribution to about equal for the northeastern, south Atlantic, and west south central regions.

TABLE 2-7

WOOL SCOURING AND COMBING PLANTS – GEOGRAPHIC DISTRIBUTION*

	No. of Establishments	No. of Employees (000's)
United States	68	5.0
Northeastern Region	52	–
New England Division	35	2.6
Massachusetts	20	1.8
Rhode Island	10	.7
Middle Atlantic Division	17	–
New York	5	–
Pennsylvania	10	.4
Southern Region	12	1.5
South Atlantic Division	6	1.3
South Carolina	4	–
West South Central Division	6	.2
Texas	6	.2

Source: Census of Manufactures, 1967

*The subtotals do not add up to totals in all cases, since all geographic areas have not necessarily been included.

(e) Types of Products. The plants listed in this section are engaged in the purchase of raw wool from various parts of the world which, in turn, is scoured, carbonized, combed, and converted into top. The tops are then sold to customers who are engaged in spinning and weaving operations. They, in turn, convert them into yarn.

(f) Segments to be Affected. We believe that the majority of the 16 plants currently in operation has already taken steps to abide by governmental regulations. The large mills will probably stay in business since they are top mills which operate an integrated facility, buying the wool, scouring it, and converting it into top. Their margins are adequate to warrant taking significant steps for pollution control.

The very small and small/medium mill groups often do commission scouring and, consequently, are vulnerable to impact from the guidelines.

(g) Financial Profile. Financial data are not available from independent manufacturers. All larger manufacturers are, in turn, a part of larger integrated textile mills, such as Burlington and J.P. Stevens. Financial data available from these firms do not permit separation of the wool scouring operations from the balance of companies' operations.

(3) Weaving and Finishing of Wool Fabrics.

(a) General. No official breakdown exists to segregate wool fabric finishers from weaving mills engaged in the manufacture of woolen fabrics. Therefore, all data pertaining to this segment take into account:

(1) integrated establishments having wool weaving, dyeing, and finishing;

(2) wool commission finishers; and

(3) wool weavers.

According to the Census of Manufactures, some 310 mills were engaged in the manufacture of woolen and worsted woven fabrics, including dyeing and finishing, in 1967. Table 2-8 illustrates the relative position of woolen and worsted weaving and finishing plants between 1958 and 1970, during which period employment dropped sharply from 56,000 to 32,000. The value of shipments declined from $929 million in 1958 to $770 million in 1970. This relates directly to the fact that woolen fabrics have been declining in the United States between 1958 and 1970.

TABLE 2-8

WEAVING AND FINISHING WOOL FABRICS INDUSTRY GROWTH 1958-1970

	No. Employees		Value Added	Cost of Materials	Value of Shipments	Capital Expenditures
	No. (000)	Payroll ($MM)	($MM)	($MM)	($MM)	($MM)
1970	32.4	187.6	310.6	443.9	770.4	24.7
1958	56.0	206.1	336.6	576.6	929.0	9.7

Source: Annual Survey of Manufacturers, Dept. of Commerce, 1967

Capital expenditures, on the other hand, increased from $9.7 million in 1958 to $24 million in 1970, and increased capital investment is reflected in modernization of establishments that have not gone out of business.

(b) Size Distribution. Table 2-9 illustrates that in 1967 only three or four of a total of 310 mills employed 1000 or more people, and that small plants accounted for the major portion of the inudstry, with 157 plants employing less than 50 people, and 95 plants employing from 100 to 500 people. Refer to Table 2-10 for a comparison of the Census figures with those chosen for this study.

TABLE 2-9

WEAVING AND FINISHING WOOL FABRICS – SIZE DISTRIBUTION

	No. of Establishments	No. of Employees (000's)
Total establishments	310	41.8
Establishments with an average of:		
1 to 4 employees	54	.1
5 to 9 employees	17	.1
10 to 19 employees	22	.3
20 to 49 employees	64	2.0
50 to 99 employees	41	2.9
100 to 249 employees	60	10.3
250 to 499 employees	35	12.2
500 to 999 employees	14	13.9
1,000 to 2,499 employees	3	–

Source: *1967 Census of Manufactures*

TABLE 2-10

CATEGORY 2 – WOOL FINISHING MILLS

Study Size Division	(No. Mills)	Census Size Division (No. Employees)	Unadjusted Census (No. Mills)	Adjusted* Census (No. Mills)
Extra Small	23	0- 19	(93)	23
		20- 49	(64)	17
Small	33	50- 99	(41)	11
		100-249	(60)	16
Medium	20	250-499	(35)	9
	76			76

*Mills remaining in business and having wet processing operations.

(c) Types of Plants. With the exception of four to six of the largest manufacturers, equipment for both weaving and finishing proved to be outmoded, and the level of technology was below average compared to competing European and Japanese mills.

(d) Geographic Distribution. Table 2-11 gives the geographic distribution of wool weaving and finishing mills in 1967 and shows that, of the total 310 mills, the northeast region accounted for two-thirds of the industry. In the north central region there were 22 establishments, 52 in the southern region, and 20 in the western region.

(e) Types of Products. The wool fabric industry basically produces two types of products:

(1) Worsted fabrics, the raw material of which is wool top. This is woven into medium- and light-weight fabrics; and is mostly used in men's tailored clothing, including slacks. Fabrics are 100% wool or of a blend of wool and polyester.

(2) Woolen-type fabrics that are composed of medium-weight and heavy fabrics and are utilized in both men's and women's sportswear. These fabrics are made of 100% wool or blends of various fibers with wool.

Because the raw materials of wool have doubled in price and the supply has been curtailed over the past 18 months, very few mills in the United States classified under this segment are engaged in the manufacture of 100% wool content fabric. In most cases, both in worsted- and woolen-type fabrics, blends of wool with other fibers are being manufactured.

(f) Segments to be Affected. Of the 310 establishments accounted for in the 1967 Census of Manufactures, we estimate about 150 of these went out of business between 1967 and 1972. Of the remaining mills, eight of the largest establishments, which have integrated weaving, dyeing, and finishing facilities. and account for 70% of the total fabric output, and of the remaining 152 mills, we estimate that 50%, or 76 of the mills, have their own dyeing and finishing facilities, and hence will be exposed to impact by the guidelines. Because of the small size, we believe this segment will be significantly impacted due to:

(1) relatively weak financial structure in a declining market, and

(2) inability to engage in major capital investment.

(g) Financial Profile. No pertinent information is available on mills exclusively engaged in woolen weaving, dyeing, and finishing, since the major factors in this business are divisions of large diversified textile companies, where the wool portion is only a small percentage of the total volume.

TABLE 2-11

WOOL WEAVING AND FINISHING MILLS – GEOGRAPHIC DISTRIBUTION*

	No. of Establishments	No. of Employees (000's)
United States	310	41.8
Northeastern Region	216	22.2
New England Division	127	16.3
Maine	18	4.0
New Hampshire	16	3.6
Vermont	7	.4
Massachusetts	41	4.8
Rhode Island	36	2.2
Connecticut	9	1.1
Middle Atlantic Division	89	5.9
New York	39	3.2
New Jersey	10	.6
Pennsylvania	40	2.1
North Central Region	22	1.3
East North Central Division	12	.9
Ohio	5	2.5-5.0
Illinois	3	–
Wisconsin	2	–
West North Central Division	10	.5
Minnesota	6	–
Missouri	3	.2
South Region	52	17.2
South Atlantic Division	43	15.0
Maryland	3	1.0
Virginia	10	2.5
West Virginia	1	.5
North Carolina	6	4.0
South Carolina	11	2.5
Georgia	11	2.5
East South Central Division	7	1.0–2.5
Tennessee	2	1.0
Alabama	2	1.0
West South Central Division	2	–
Texas	2	–
West Region	20	1.1
Pacific Division	18	1.0–2.5
Washington	1	.5
Oregon	8	.5
California	9	.2

Source: Census of Manufactures, 1967

*The subtotals do not add up to totals, in all cases, since all geographic areas are not necessarily included.

b. Woven Fabrics – Dyeing and Finishing.

(1) General. According to the Census of Manufactures, during 1967 a total of 449 establishments were engaged in the dyeing and finishing of synthetic and cotton woven goods. Table 2-12 illustrates the relative position of cotton finishing plants and synthetic finishing plants between 1958 and 1970. During that period there was a drastic reduction of employment. In cotton finishing plants, an employment level of 49,000 in 1958 declined to 29,000 in 1970. Employment in synthetic finishing plants rose from 16,000 in 1958 to 34,000 in 1970. This trend directly reflects a shift in U.S. mill fiber consumption between 1958 and 1970. Other indicators, such as value added and value of shipments, also reflect this trend.

(2) Size Distribution. Table 2-13 illustrates size breakdown of various plants by number of employees and illustrates the following:

Cotton Finishing: Cotton finishing is a highly fragmented industry where small plants (50 employees and under) accounted for more than half the establishments, or 122.

Synthetic Finishing: In synthetic finishing, there is a similar pattern, where plants with up to 50 employees accounted for 50% of all establishments, or 115.

Refer to Table 2-14 for a comparison of the Census figures with those chosen as a basis for this study.

TABLE 2-12

WOVEN FABRICS
DYEING AND FINISHING

	No. Employees (000's)	Payroll ($MM)	Value Added ($MM)	Cost of Materials ($MM)	Value of Shipments ($MM)	Capital Expenditures ($MM)	Total Plants
Cotton finishing plants: ratio of concentration, 1967: 4 large, 42%; 8 large, 59%							
1958	49.2	189.9	289.1	399.1	686.2	15.7	
1970	28.9	180.1	252.7	304.2	603.0	22.9	216
Synthetics finishing plants: ratio of concentration, 1967: 4 large, 37%; 8 large, 49%							
1958	16.2	74.3	114.8	95.3	210.7	3.6	
1970	33.8	220.4	429.0	608.9	1,011.6	29.3	233

Source: Annual Survey of Manufacturers, 1970

TABLE 2-13

WOVEN FABRICS

(Dyeing and Finishing Establishments)

1967

	Number of Establishments	Number of Employees (000's)
Finishing plants – cotton:		
Total establishments	216	35.7
Establishments with an average of employees:		
1 to 4	42	0.1
5 to 9	13	0.1
10 to 19	25	0.4
20 to 49	42	1.4
50 to 99	29	2.0
100 to 249	26	4.6
250 to 499	15	5.6
500 to 999	21	21.6
1,000 to 2,499	1	–
2,500 or more	2	–
Finishing plants – synthetics:		
Total establishments	233	25.7
Establishments with an average of employees:		
1 to 4	21	–
5 to 9	14	0.1
10 to 19	31	0.5
20 to 49	49	1.7
50 to 99	47	3.5
100 to 249	44	7.1
250 to 499	17	5.8
500 to 999	9	7.0
1,000 to 2,499	1	–
2,500 or more	–	–

Source: Census of Manufactures, 1967

TABLE 2-14

CATEGORY 4 – WOVEN FABRICS, DYEING, AND FINISHING

Study Size Division	(No. Mills)	Census Size Division (No. Employees)	Unadjusted Census (No. Mills)	Adjusted Census (No. Mills)
Extra Small	146	0- 19	(146)	146
		20- 49	(91)	91
Small	167	50- 99	(76)	76
		100-249	(70)	70
Medium	102	250-499	(32)	32
	415			415

(3) Type of Plants. Types of plants vary greatly, depending on the size, and the types of products they process, since the industry is engaged in bleaching, printing, dyeing, and finishing. The smaller plants with no more than 50 employees, in most cases, have old equipment that has not been modernized due to lack of capital resources. The larger plants, both independent and those that are part of weaving complexes, are modern and efficient.

(4) Geographic Distribution. Tables 2-15 and 2-16 illustrate the geographic distribution of the industry. In cotton finishing plants the northeastern region accounted for the majority of establishments, mostly composed of the 125 out of 216 establishments. In the southern region, where most of the large integrated establishments are located, there are 67 establishments. The synthetic finishing plants show a similar pattern, where the northeastern region represents over 50%, or 177 plants, and the southern region 46 plants of a total 233.

(5) Level of Integration. Figure 2-1 is a schematic layout illustrating the level of integration of cotton and synthetics finishing establishments. There are basically two types of establishments:

(a) Those owned by large weaving mills: These are separate dyeing and finishing companies owned by large textile corporations, such as Burlington, Stevens, and Deering Milliken, which might within a single corporate complex own up to four finishing plants. We estimate that out of a total of 450 establishments between 100 and 130 are integrated. However, value of shipments of these establishments accounted for an estimated 50 to 60% of the total dyeing and finishing industry.

TABLE 2-15

WOVEN FABRICS – COTTON DYEING AND FINISHING
(Geographic Distribution)

	No. of Establishments	With 20 or More Employees
Finishing Plants – Cotton:		
United States	216	136
Northeastern Regin	125	70
New England Division	37	27
New Hampshire	2	2
Massachusetts	15	11
Rhode Island	15	9
Connecticut	5	5
Middle Atlantic Division	88	43
New York	44	19
New Jersey	25	16
Pennsylvania	19	8
North Central Region	18	6
East North Central Division	14	4
Illinois	9	3
Southern Region	67	59
South Atlantic Division	54	49
Delaware	1	1
Maryland	3	3
Virginia	2	2
North Carolina	18	18
South Carolina	17	17
Georgia	10	6
East South Central Division	8	7
Tennessee	3	2
Alabama	3	3
West South Central Division	5	3
Arkansas	1	1
Oklahoma	1	1

Sources: Census of Manufactures, 1967, ADL estimates and industry listings.

(b) Commission dyers and finishers: We estimate that 320 to 350 of a total of 449 are independent commission dyers and finishers without corporate relationship to weaving mills. Their sole function is to commission-finish woven goods, supplying such services as bleaching, dyeing, printing, and finishing.

TABLE 2-16

WOVEN FABRICS – SYNTHETIC DYEING AND FINISHING*
(Geographic Distribution)

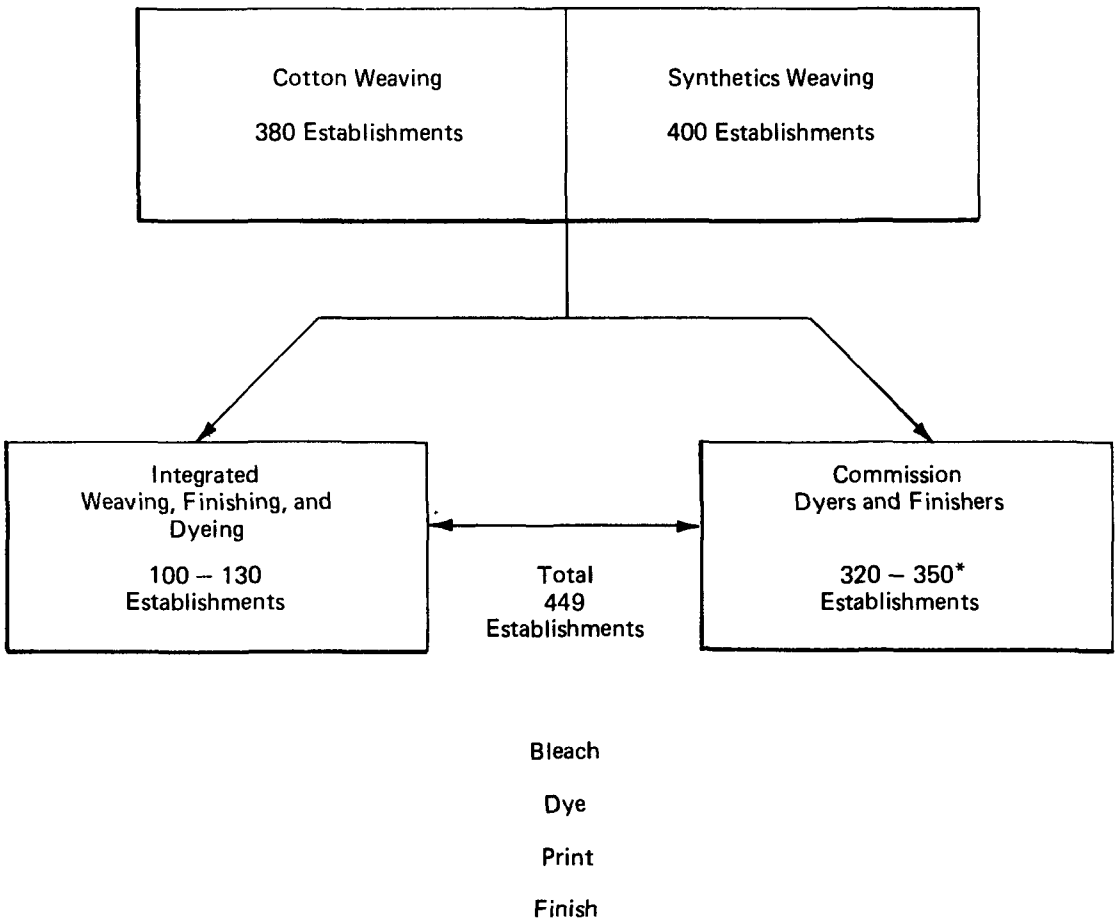
	No. of Establishments	With 20 or More Employees
Finishing Plants – Synthetics:		
United States	233	167
Northeastern Region	177	124
New England Division	43	35
New Hampshire	1	1
Massachusetts	20	16
Rhode Island	9	8
Connecticut	13	10
Middle Atlantic Division	134	89
New York	58	28
New Jersey	67	54
Pennsylvania	9	7
Southern Region	46	39
South Atlantic Division	45	38
Virginia	5	5
North Carolina	24	21
South Carolina	10	9
Georgia	2	1
East South Central Division	1	1
Tennessee	1	1
West Region	6	2
Pacific Division	5	2
California	5	2

Sources: Census of Manufactures, 1967, ADL estimates and industry listings.

*The subtotals do not add up to totals, in all cases, since all geographical areas are not necessarily included.

(6) Types of Products. Both the synthetic and cotton fabric finishing industries are engaged in processing the following products:

- Bleaching operation – the major volume is household domestics, including sheets and pillowcases;
- Dyeing, plain colors – a conversion of greige woven goods into dyed fabric for both apparel and household products;
- Printing – a conversion of woven greige goods into printed fabrics; and
- Special finishing – includes all processes after dyeing to impart special effects to fabrics, such as heat setting, water repellency, or other finishes.



*Vulnerability – 320-350 Establishments

Source: ADL Estimates

FIGURE 2–1 DYEING AND FINISHING – WOVEN COTTON AND SYNTHETICS

(7) Segments to be Affected.

(a) Integrated Weaving-Finishing. We feel that these plants, which are integrated with weaving and finishing operations, will not be affected due to their substantial size and their ability to make the necessary capital investment to abide by government rules, and their ability to pass on the increased cost to the apparel manufacturer and the consumer.

(b) Independent Commission Dyers and Finishers. We believe that this segment will be significantly impacted because over 50% of the establishments are small and fragmented, with weak financial structure, and thus would be unable to make a major capital investment. The larger units in this segment, however, would be able to do so.

In all cases, we anticipate that the independent commission dyers and finishers will be able to pass the cost on to their customers, if they can raise the capital required.

(8) Financial Structure. No published financial structure for independent dyeing and finishing establishments is available. We have therefore included financial data relating to large textile companies which own facilities for dyeing and finishing their own fabrics, or provide commission dyeing and finishing services (Table 2-17).

c. Knitted Fabric – Dyeing and Finishing.

(1) General. Census figures are available for mills that perform dyeing and finishing only (commission dyers) and for total knit mills which include both "knitting only," as well as commission finishers, and integrated establishments that have both knitting and dyeing and finishing. We have therefore estimated the breakdown between integrated finishing mills and those mills that do knitting only.

According to the Census of Manufactures 1967, some 541 mills were engaged in the manufacture of knitted fabrics, including dyeing and finishing.

Table 2-18 illustrates the relative position of the industry between 1958 and 1970. Employment rose sharply from 18,000 in 1958 to 48,000 in 1970. A similar relationship is reflected in the value of shipments and capital expenditures. This relates directly to the fact that knitted fabrics have been the fastest growing segment of the textile industry in the United States between 1958 and 1970.

(2) Size Distribution. Table 2-19 illustrates the size distribution of knit fabric mills and also illustrates the nature of the industry, which is highly fragmented with small plants being the dominant factor. Plants with under 50 employees per establishment accounted for a total of 371 establishments out of 541.

Refer to Table 2-20 for a comparison of these Census figures with those chosen for this analysis.

TABLE 2-17

FINANCIAL PROFILE

(Integrated Textile Mills with Dyeing and Finishing Facilities)

	Burlington Industries	J.P. Stevens	Merchants	Lowenstein	West Point Pepperell	Springs	Cannon Mills	Cone	Dan River	Fieldcrest
Net Sales ($MM)										
1970	1,822	893	708	387	374	308	306	298	293	212
1971	1,727	861	738	444	355	326	323	319	312	227
Net Profit ($MM)										
1970	71.4	6.3	17.4	8.3	8.7	6.2	15.6	4.8	(1.0)	7.8
1971	40.1	(0.6)	16.4	8.9	6.2	8.4	16.8	7.0	(2.6)	7.9
Profit Margin										
1970	3.9%	0.7%	2.5%	2.1%	2.3%	2.0%	5.1%	1.6%	–%	3.7%
1971	2.3%	–%	2.2%	2.0%	1.8%	2.6%	5.2%	2.2%	–%	3.5%
Return on Equity										
1970	10%	2%	7%	6%	5%	3%	7%	4%	–	10%
1971	5%	–%	6%	6%	3%	3%	7%	5%	–	10%
Return on Investment										
1970	6%	1%	4%	5%	5%	2%	7%	3%	–	6%
1971	4%	–%	4%	4%	3%	3%	7%	4%	–	6%
Capital Expenditures ($MM)										
1970	123	28	22	19	12	15	15	11	8	7
1971	104	30	16	25	10	17	12	12	10	7

Source: Based on Annual Reports

TABLE 2-18

DYEING AND FINISHING – KNITTED FABRICS INDUSTRY GROWTH 1958-1970

	No. Employees		Value Added	Cost of Materials	Value of Shipments	Capital Expenditures
	No. (000)	Payroll ($MM)	($MM)	($MM)	($MM)	($MM)
1970	48.2	296.2	648.5	1,235.9	1,881.8	85.3
1958	18.4	73.9	147.4	336.1	487.2	7.1

Source: Annual Survey of Manufacturers, Dept. of Commerce

TABLE 2-19

KNITTED FABRICS MANUFACTURERS – DYEING AND FINISHING
(Size Distribution)

	No. of Establishments	No. of Employees (000's)
Total establishments	541	36.3
Establishments with an average of		
1 to 4 employees	95	.2
5 to 9 employees	59	.4
10 to 19 employees	93	1.3
20 to 49 employees	124	4.0
50 to 99 employees	63	4.6
100 to 249 employees	75	11.7
250 to 499 employees	23	7.7
500 to 999 employees	8	6.4
1,000 to 2,499 employees	1	–

Source: 1967 Census of Manufactures

TABLE 2-20

CATEGORY 5 – KNIT FABRIC, DYEING, AND FINISHING

Study Size Division	(No. Mills)	Census Size Division (No. Employees)	Censust (No. Mills)	Adjusted Census* (No. Mills)
Extra Small	50	0-19	(247)	50
Small	25	20-49	(124)	25
Medium	15	50-99	(63)	15
	90			90

†Total mills, including knit only and dry finish.

*Mills dyeing and finishing only.

(3) Types of Plants. The knitted fabric industry emerged in the United States in 1960. Therefore, most equipment on hand is relatively new. The age of plants in most cases varies from 15 to 5 years.

The level of technology is good and efficiency is excellent in the larger mills, and below average in the small and fragmented ones.

(4) Geographic Distribution. Table 2-21 shows the geographic distribution of the knitting industry with the northeastern region accounting for 398, or 74% of the mills, mostly in the Middle Atlantic section, with employment of 21,000. In the South there are 124 plants, mostly the large integrated mills, employing 14,000.

Table 2-22 gives the geographic distribution of mills engaged in dyeing and finishing in 1967. Of the total there were only 80 establishments, 63% of which were located in the Northeast, mostly the Middle Atlantic section, where there were 44 plants. The southern region accounts for 22 establishments, or 28% of the total. The current estimate of the number of mills is 90, and the geographic distribution has not changed significantly.

(5) Level of Integration. Figure 2-2 illustrates the level of integration in the knitted fabric industry, which can be divided into the following segments:

(a) Knitting mills engaged primarily in knitting and dry finishing (only 320-330 establishments). They purchase dyed yarn from outside sources and it is knitted on premises and dry-finished, or they purchase greige yarn that they knit on their own premises and have it commission dyed and finished by outside sources.

TABLE 2-21

GEOGRAPHIC DISTRIBUTION OF KNITTED FABRIC MANUFACTURERS INCLUDING DYEING AND FINISHING*

	No. of Establishments	No. of Employees (000's)
United States	541	36.3
Northeastern Region	398	21.2
New England Division	43	6.0
Massachusetts	17	3.7
Rhode Island	12	1.0--2.5 est.
Connecticut	11	.4
Middle Atlantic Division	355	15.1
New York	233	6.8
New Jersey	60	2.8
Pennsylvania	72	5.6
North Central Region	12	.6
East North Central Division	7	.5—1.0 est.
Wisconsin	7	.5—1.0 est.
Southern Region	124	14.3
South Atlantic Division	113	12.3
Virginia	6	1.0
North Carolina	86	9.0
South Carolina	14	1.7
Georgia	5	.5--1.0 est.
East South Central Division	11	2.0
Tennessee	5	1.0—2.5 est.
Alabama	4	.4
Western Region	7	.2
Pacific Division	7	.2
California	7	.2

Sources: 1967 Census of Manufactures, ADL estimates and industry listings.

*The subtotals do not add up to totals, in all cases, since all geographic areas are not necessarily included.

(b) Integrated knitting mills (120 establishments). These are the large knitwear producers of both warp and circular knit fabrics which, in addition to knitting, have yarn-dyeing facilities and piece-dyeing facilities. In most cases these mills dye and finish their total fabric requirements. In some cases, they also act as commission dyers and finishers for other parties.

(c) Knit goods fabric commission dyers and finishers (60-90 establishments). These are firms which predominantly work on a commission basis, performing a service for knitting mills that do not have their own dyeing and finishing facilities.

TABLE 2-22

GEOGRAPHIC DISTRIBUTION OF KNITTED FABRIC DYERS AND FINISHERS ONLY*

	No. of Establishments
United States	80
Northeastern Region	50
New England Division	6
Massachusetts	3
Rhode Island	1
Connecticut	1
Vermont	1
Middle Atlantic Division	44
New York	24
New Jersey	12
Pennsylvania	8
Southern Region	22
South Atlantic Division	14
Virginia	2
North Carolina	10
South Carolina	2
East South Central Division	2
Tennessee	1
Florida	1
Unaccounted for	8

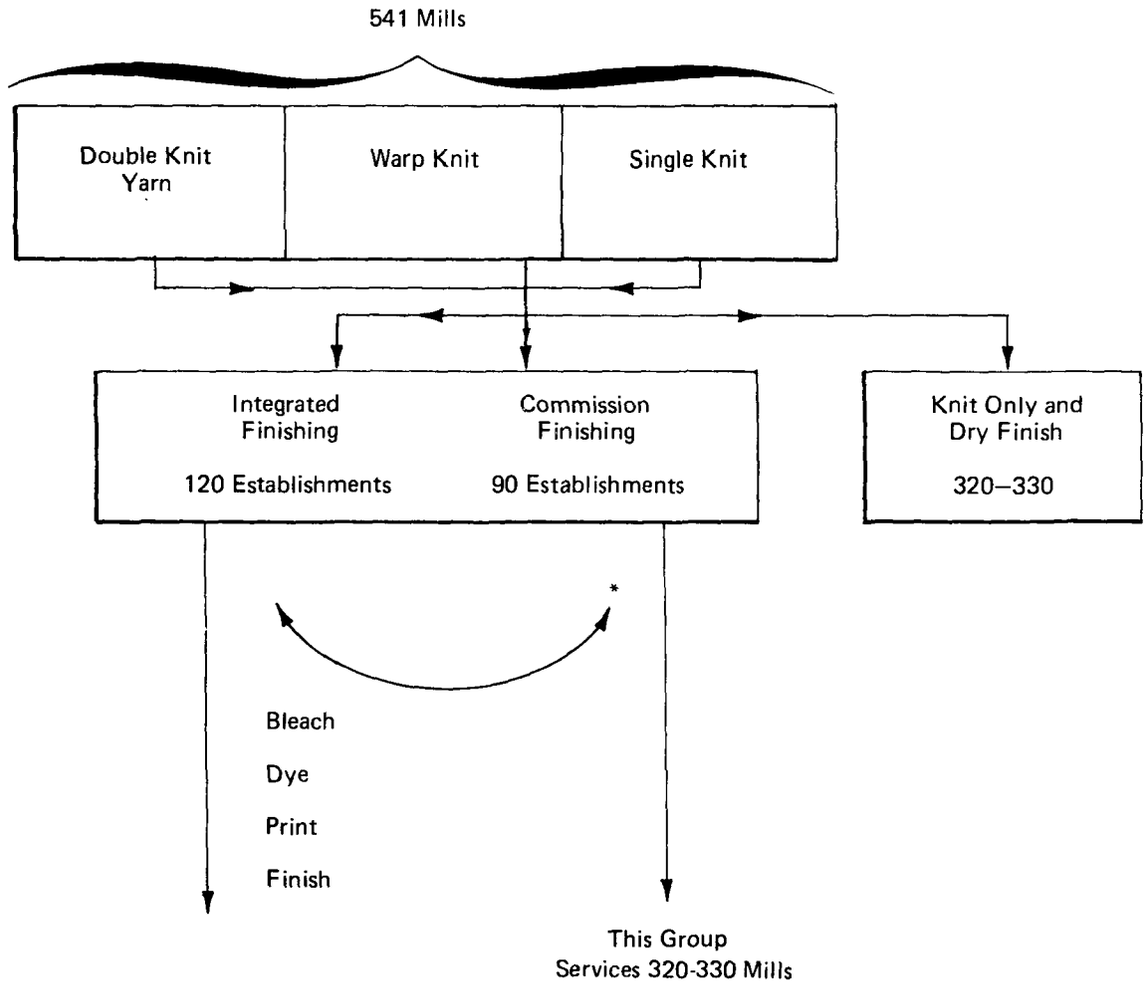
Sources: Census of Manufactures 1967, ADL estimates and industry listings.

*The subtotals do not add up to totals, in all cases, since all geographic areas are not necessarily included.

(6) Type of Products. The knitted fabric industry basically produces three types of products:

(a) Warp knit fabrics, both yarn and piece-dyed, composed of tricot and raschel types that predominantly utilize three raw materials – filament acetate, and filament polyester. Sixteen of the largest mills accounted for 60% of the total productive capacity.

(b) Double-knit fabrics, both yarn and piece dyed, which utilize predominantly polyester filament yarns and, to a lesser degree, nylon, acrylics, and cotton, and predominantly produce fabrics for the apparel trade. Twenty-eight of the largest mills accounted for 50% of total productive capacity.



Vulnerability – 90 Establishments

*Integrated finishing sometime service outside customers.

Source: ADL Estimates

FIGURE 2–2 KNIT FABRIC FINISHING

(c) Single-knit fabrics, utilizing cotton, acrylics, polyester filament yarn and piece dyed, for the apparel trades. Thirteen of the largest mills accounted for 40% of total productive capacity.

(7) Segments to be Affected

(a) Knitting mills primarily engaged in knitting only are segments which would not be affected, since all wet finishing is done on the outside (320 mills).

(b) Integrated knitting mills have their own dye and finishing facilities, all of which are of substantial size, and they have the necessary assets to make the required capital investment to abide by government rules; they are also able to control the total manufacturing process and pass increased cost on to the apparel manufacturer (estimated 120 mills).

(c) Knitted fabric commission dyers and finishers. We believe that this segment will be significantly impacted due to its relatively weak financial structure, and because all of these mills perform a service on a commission basis and cannot control total price structure of the product.

We expect that, in the next six months, barring industry-wide recession, the knit segment will turn profitable once again, as demand takes up the capacity slack.

We feel the major problem will arise, not in passing additional costs on, but in ability to make capital investment.

(8) Financial Profile. Table 2-23 represents the financial structure of the largest integrated knitting mills having their own dyeing and finishing facilities. Table 2-24 represents financial profiles of the largest independent commission finishers for knitted fabrics.

d. Yarn and Stock – Dyeing and Finishing.

(1) General. According to the Census of Manufactures, during 1967 a total of 192 establishments were engaged in the dyeing and finishing of yarn, stock, and narrow fabrics. Yarn dyeing facilities accounted for the bulk of these establishments, estimated at 80% of the total.

Table 2-25 illustrates the relative position of yarn dyeing facilities between 1958 and 1970. During that period, employment increased from 7,800 to 12,300, and value of shipments doubled, and capital expenditures rose from $2.1 million to $13.3 million.

TABLE 2-23

FINANCIAL PROFILE – PROFIT MARGIN OF INTEGRATED KNITTING MILLS

1970-1971

	Texfi Industries	Guilford Mills, Inc.	Stevecoknit	Edmos Corp	Scottex Corp
Net Sales ($MM)					
1970	97	43	27	25	15
1971	164	53	33	32	24
Net Profit ($MM)					
1970	5.3	0.7	1.6	1.8	0.8
1971	11.3	2.7	2.4	2.5	1.1
Profit Margin					
1970	5.5%	1.6%	5.9%	7.2%	5.3%
1971	6.9%	5.1%	7.3%	7.8%	4.6%
Return on Equity-Return on Investment					
1970	18% 12%	10% 6%	44% 25%	22% 17%	29% 13%
1971	25% 16%	37% 25%	27% 21%	14% 12%	11% 7%

Source: Based on Company Annual Reports

TABLE 2-24

FINANCIAL PROFILE – PROFIT MARGIN OF THE LARGEST COMMISSION DYERS OF KNITTED FABRIC (1969-1971)

	1969	1970	1971
United Piece Dye Works, Inc.:			
Net Sales ($MM)	28	28	30
Net Profit ($MM)	2.1	2.6	3.9
Profit Margin	7.5%	9.1%	13.2%
Return on Equity-Return on Investment	21% 15%	21% 17%	26% 23%
Capital Expenditures ($MM)	2	2	2

Source: Based on Company Annual Reports.

TABLE 2-25

YARN AND STOCK DYEING AND FINISHING INDUSTRY GROWTH 1958-1970

	No. Employees (000's)	Payroll ($MM)	Value Added ($MM)	Cost of Materials ($MM)	Value of Shipments ($MM)	Capital Expenditures ($MM)
Finishing Plants – Yarn: Ratio of concentration, 1967: 4 large, 29%; 8 large, 44%						
1958	7.8	28.8	52.0	105.7	158.0	2.1
1970	12.3	72.9	141.9	206.5	346.3	13.3

Total Plants: 192

Source: Annual Survey of Manufacturers 1970.

(2) Size Distribution. Table 2-26 illustrates the size breakdown of various plants by number of employees and differentiates between companies that finish their own yarn, which in most cases are integrated with spinning or texturizing operations, and commission finishing plants that only provide a service of dyeing yarns. Refer to Table 2-27 for a comparison of Census figures with those chosen as a basis for this analysis.

In the case of companies finishing their own yarn, establishments with less than 50 employees represented over two-thirds of total establishments, or 85 out of 129. A similar pattern occurs in the case of commission finishing and dyeing, where 42 establishments out of a total of 63 had fewer than 50 employees.

(3) Types of Plants. As we have illustrated in Table 2-25, major capital investment has occurred in the last 10 years, which is reflected in the relatively modern equipment in the establishments that are of large size. Small establishments are fragmented and equipment is not up to date.

(4) Geographic Distribution. Table 2-28 gives the geographic distribution of yarn finishing plants. Of a total of 192 plants in the United States the majority is in the northeastern region, where there are 121 plants or two-thirds of the total, and 57 plants or one-third are located in the southern region.

(5) Level of Integration. Figure 2-3 is a schematic layout illustrating the level of integration between integrated yarn dyers and independent commission yarn dyers.

TABLE 2-26

YARN AND STOCK DYEING AND FINISHING

Establishments

	No. of Establishments	No. of Employees (000's)
Finishing Own Yarns:		
Total Establishments	129	8.2
Establishments with an average of:		
1 to 4 employees	29	0.1
5 to 9 employees	13	0.1
10 to 19 employees	21	0.3
20 to 49 employees	22	0.7
50 to 99 employees	23	1.7
100 to 249 employees	14	2.1
250 to 449 employees	4	1.3
500 to 999 employees	3	1.9
Commission Finishing – yarn:		
Total Establishments	63	4.2
Establishments with an average of:		
1 to 4 employees	9	—
5 to 9 employees	11	.1
10 to 19 employees	4	.1
20 to 49 employees	18	.6
50 to 99 employees	9	.6
100 to 249 employees	6	1.0
250 to 449 employees	6	1.9

Source: Census of Manufactures, 1967

TABLE 2-27

CATEGORY 7 – YARN AND STOCK – DYEING AND FINISHING

Study Size Division	(No. Mills)	Census Size Division (No. Employees)	Unadjusted Census (No. Mills)	Adjusted Census (No. Mills)
Extra Small	53	0-19	(87)	53
Small	16	20-49	(40)	16
Medium	21	50-99	(32)	21
	90			90

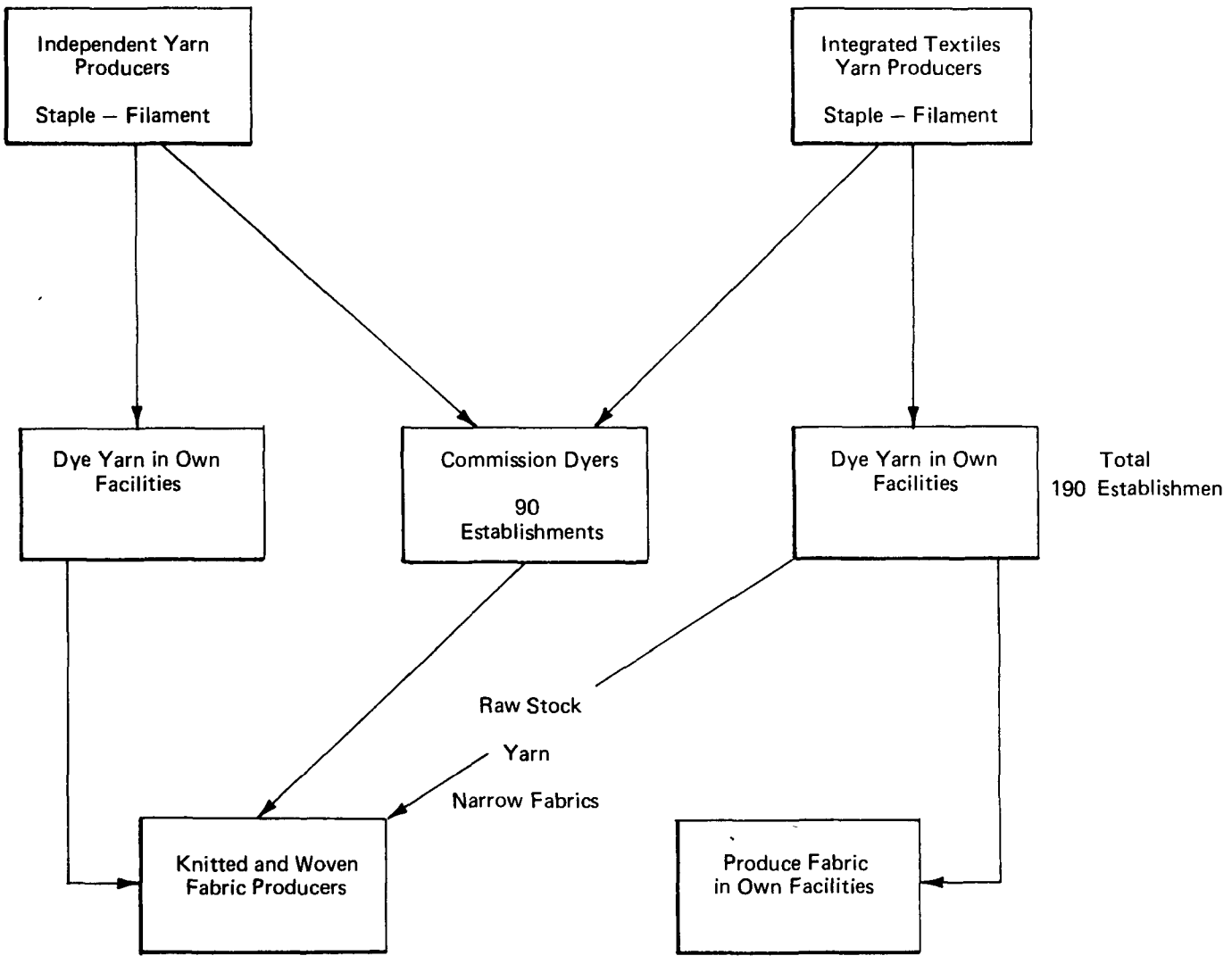
TABLE 2-28

YARN AND STOCK DYEING AND FINISHING*
(Geographic Distribution)

	No. of Establishments	With 20 or More Employees
Finishing Plants – Yarn:		
United States	192	105
Northeastern Region	121	53
New England Division	18	13
Massachusetts	10	8
Rhode Island	7	5
Middle Atlantic Division	103	40
New York	42	14
New Jersey	39	15
Pennsylvania	22	11
North Central Region	7	4
East North Central Division	6	4
Ohio	1	1
Illinois	2	1
Michigan	1	1
Wisconsin	2	1
Southern Region	57	45
South Atlantic Division	46	39
Virginia	2	2
North Carolina	35	29
South Carolina	4	3
Georgia	4	4
East South Central Division	10	6
Tennessee	7	4
Alabama	3	3 2
Western Region	7	3
Pacific Division	7	3
California	7	

Sources: Census of Manufactures 1967, ADL estimates and industry listings.

*The subtotals do not add up to the totals, in all cases, since all geographic areas are not necessarily included.



Vulnerability-- 90 Establishments

Source: ADL Estimates

FIGURE 2–3 YARN AND STOCK DYEING AND FINISHING
Level of Integration

(a) Integrated Yarn Dyers. Integrated yarn dyers are composed of two distinct types:

(1) Divisions of the large integrated weaving mills that own their own spinning and texturizing facilities and utilize their own yarn-dyeing facilities to finish the output of their spinning and texturizing mills. Dyed yarn is then sold to outside customers or used internally.

(2) Independent yarn spinners and texturizers that have their own dyeing facilities and produce yarn only, which in turn is dyed in their own facilities and sold outside.

In both cases, the dyeing facility could be used to do commission dyeing for outside customers in addition to its own requirements.

We estimate that out of a total of 190 establishments, between 100 and 110 are parts of independent yarn producers or integrated textile companies.

(b) Commission Yarn Dyers. Commission yarn dyers are independent plants that perform a service function only. The larger ones purchase yarn and sell dyed yarns to their customers; the smaller ones simply perform the function of commission dyeing.

It is estimated that out of a total of 190 establishments, 80 to 90 are independent yarn dyers and this would also account for the discrepancy in ratios illustrated according to the Census of Manufactures in Table 2-29.

TABLE 2-29

FINISHING PLANTS, YARN AND STOCK

(Size Distribution by Number of Employees)

	No. of Establishments	No. of Employees (000's)
Finishing Own Yarns:	129	8.2
Commission Finishing:	63	4.2

Source: Census of Manufactures 1967

(6) Types of Products. The dyeing of stock and yarn is a limited, specialized operation, solely limited to imparting color to both filament and staple yarns, predominantly in cotton and synthetic fibers.

(7) Segments to be Affected.

(a) Yarn Dyeing Facilities Owned by Independent Yarn Producers and Integrated Textile Producers. We feel that these plants, estimated at 100 to 110, with the exception of the smaller ones, may not be affected due to their size and ability to make the necessary capital investment to meet government requirements.

(b) Independent Commission Yarn Dyers. These represent a total of 90 plants. We believe this segment will be significantly impacted because over two-thirds of these establishments are small and fragmented with weak financial structure, and might be unable to make the necessary capital investment to abide by government regulations. Furthermore, current technological advances in multifabric weaving and dyeing are tending to make this whole industry sector obsolete. Stock and yarn dyeing necessitate less flexibility to meet changing market demands of style and color, and create a much larger cost because of the larger inventories required compared to dyeing the knit or woven fabric.

(8) Financial Profile. No financial structure for independent commission yarn dyers is available. We therefore feel that representative financial structures are expressed in the category of integrated yarn manufacturing and dyeing as illustrated in Table 2-30.

TABLE 2-30

FINANCIAL PROFILE

(Yarn Spinning and Dyeing)

	Dixie Yarns	National Spinning Company	Standard Coosa-Thatcher	Burkyarns Inc.
Net Sales ($MM)				
1970	87	75	50	17
1971	99	76	53	22
Net Profit ($MM)				
1970	1.7	2.1	1.9	0.9
1971	2.3	1.9	1.7	1.3
Profit Margin				
1970	2.0%	2.8%	3.8%	5.3%
1971	2.3%	2.5%	3.2%	5.9%
Return on Equity				
1970	6%	9%	7%	25%
1971	7%	8%	6%	24%
Return on Investment				
1970	5%	9%	6%	15%
1971	7%	8%	5%	15%
Capital Expenditures ($MM)				
1970	3	4	3	3
1971	–	2	6	2

Source: Based on Company Annual Reports

3. IMPACT ANALYSIS IN SPECIFIC TEXTILE CATEGORIES

a. Introduction.

The textile industry has been divided into seven categories by the proposed effluent guidelines for this industry. They are:

Category 1 – Wool Scouring,
Category 2 – Wool Dyeing and Finishing,
Category 3 – Greige Goods Mills,
Category 4 – Woven Fabric Dyeing and Finishing (Cotton and Synthetics),
Category 5 – Knit Fabric Dyeing and Finishing (Cotton and Synthetics),
Category 6 – Carpet Mills, and
Category 7 – Stock and Yarn Dyeing.

The economic impact of the proposed effluent guidelines has been examined for five of the above categories. They are:

Category 1 – Wool Scouring,
Category 2 – Wool Dyeing and Finishing,
Category 4 – Woven Fabric Dyeing and Finishing (Cotton and Synthetics),
Category 5 – Knit Fabric Dyeing and Finishing (Cotton and Synthetics), and
Category 7 – Stock and Yarn Dyeing and Finishing.

Two categories – greige goods mills and carpet mills – have been precluded from this initial study of the economic impact, on the assumption that these two categories would not be significantly impacted by the proposed effluent guidelines.

Greige goods mills, by definition, are mills employing only dry processes, such as knitting and weaving. Weaving mills would likely have a slashing operation, but in a well managed mill the pollution load generated by this process would be negligible. Therefore, we find greige goods mills have no appreciable pollution load beyond the sanitary load and, in our judgment, they will be unaffected by the proposed effluent guidelines.

Carpet mills have been set aside from this initial study on the basis that they, unlike any other category of the textile industry, can pass on treatment costs in the form of investment or operating costs to their customers. While the situation might change between now and 1983, we believe that the largely inelastic demand for this product and prevailing pricing practices will allow absorption of treatment costs in the pricing structure for large, medium, and small carpet mills. In addition, because of this situation, these mills offer attractive investments, so that capital should be available to enable them to continue operation while complying with the guidelines.

A final circumstance that will reduce the impact on the carpet industry is that well over 50% of the industry is located in Dalton, Georgia, and are connected to the municipal waste system where the personnel are experienced in handling carpet mill wastes.

In addition to setting aside two of the seven textile categories from this initial study, we have also set aside large integrated textile mills which will not be significantly impacted, generally because of their higher profit levels, larger size, and integrated production, as well as their ability to influence price levels strongly within the industry and hence pass on the cost of pollution control. It is generally felt that the small and medium sized mills do not have the same freedom to increase prices as do the larger, integrated mills. It is then the small and medium sized mills that must absorb these costs from profits rather than by passing on the cost to their customers.

Many of the larger, integrated mills have already established treatment facilities and/or are connected to municipal treatment systems and have already met or exceeded the requirements of the proposed best practicable technology. They have, in turn, already absorbed the cost and, if necessary, passed on this cost to their customers. Small and medium sized mills, in general, service the aftermarket and thus lag behind the larger mills, and as the market and the pricing structure have already absorbed the costs for larger mills to control pollution, the small and medium sized mills cannot increase their prices.

Since the impact of pollution control is partially absorbed already by the larger mills, and since they should not, for the most part, have difficulty in absorbing additional increments, either from higher profits and/or price increases, we may set them aside and concentrate on the impact that will be felt by the small and medium sized mills within each of the five categories studied. In addition, the smaller mills have been divided into two categories: (1) very small, with under 20 employees, and (2) small, with 20 and over employees. The very small grouping was developed by EPA as a special group with special financial restrictions.

(1) Sources. In undertaking the study, the contractor interviewed at least one representative mill within each size classification and category. In many cases, multiple interviews were conducted to permit presentation of a more representative example. In addition to personal interviews, telephone interviews were extensively conducted not only with operating mills but with other industry sources as well which were able to supply pertinent information. The contractor also relied on his in-house textile industry specialists to provide direct input to the study as well as to judge on the relative accuracy of information gained through confidential interviews.

Because of both budgetary and calendar constraints, the number of interviews conducted during this study was too small to provide statistically valid conclusions, but it was adequate to provide a generally qualitative basis. It is anticipated that in subsequent studies the number of textile companies interviewed – and hence the data base from which the analysis will be made – will be significantly increased.

(2) Methodology of Impact Analysis. Earlier studies of the textile industry have concluded that the industry would not be severely impacted by the proposed effluent guidelines, and that conclusion is largely supported by the findings of this study. Imports have recently played – and are expected to continue to play – a dominant role in determining price levels within the industry. In view of this, price levels which permit profit levels adequate to absorb the cost of pollution controls are sensitive to tariff levels, and we

have assumed that the industry as a whole will continue to be protected from low-cost, foreign imports – at least at the level of protection now afforded by existing duties, quotas, and the like. Pricing effects are discussed for each category within the individual scenario for that category.

For each of the five categories studied, the contractor prepared a scenario to show how the small mill with less than 20 employees and a medium and small sized mill would be impacted by the proposed effluent guidelines.

On the basis of the interviews, other industry sources, and in-house information, a composite mill was composed for each size classification within each category. This composite mill is considered representative of a mill of the size classification and category. The composite, with the exception of wool scouring and wool dyeing and finishing, is in each case essentially a commission dye house. This kind of model was selected because it would best represent the impact of water pollution controls or the impact of the proposed effluent guidelines. Textile mills with both wet and dry processes tend to be more profitable than those with only wet processes, such as commission dye houses, and thus they will be impacted to a lesser degree, since they have broader profit bases which they can use to absorb the costs of pollution control.

Although the limitations caused by the small data base are recognized, a range of sales revenues, profits, depreciation expenses, annual cash flows, production, employment, and other parameters have been presented for the composite mills in each size classification and category.

(3) Meeting the Guidelines. A mill may meet the proposed best practicable technology for 1977 in several ways. It may begin or continue to discharge its effluent for treatment to a municipal facility. If this choice is made, the mill will be obligated to pretreat its effluent in accordance with the proposed guidelines for pretreatment. This would include, but not be limited to, extraction of fiber and particulate matter from the stream as well as the removal of substances which pass through the municipal treatment plant, i.e., refractory COD material, or else the effluent might have a deleterious effect upon the municipal treatment plant such as the discharge of heavy metals (i.e., chrome-based dyes).

However, the mill may choose to treat its own effluent. It is assumed that the treatment would consist of good, secondary biological treatment with extended aeration and lagooning. The EPA believes that secondary biological treatment would be adequate to achieve the proposed guidelines for BOD, COD, and color. In some cases, good secondary biological treatment may be inadequate to achieve the guideline levels of COD and color removal. If that eventuality were to come to pass and the guidelines were to be met, then the contractor suggests that massive lime treatment and activated carbon treatment would be one method of achieving the guidelines while evaporation of 20% of the discharge stream and incineration of the solids residue would be another method of achieving the guideline levels on COD and color. While the latter two treatment systems added to good secondary biological treatment would undoubtedly produce an effluent within the guidelines, it is not known whether or not either would be required, and therefore the impact analysis will be based upon only secondary biological treatment where the mill has adequate space for lagooning.

In some unusual cases a mill will be situated in a location which prohibits the use of secondary biological treatment and lagooning, and further is prevented from discharging to a municipal treatment plant either because the municipal treatment plant does not exist, or is not large enough to handle the additional discharge of the textile mill, or refuses to accept the mill's industrial wastes. If such conditions were to exist, and this would be an unusual condition, the mill would have to decide whether to change its product mix, move its operation, or install a high-rate, activated sludge, two-stage treatment plant.

We have not addressed this space-limited mill condition, since on investigation we feel that such situations do not really exist or, if they do, they are so few and have such special conditions that they warrant individual mill-by-mill treatment.

For each of the options discussed above, the mills would have to decide how to make the new investments in pretreatment or treatment equipment. In some cases, the mill might choose to fund the investment from its operations. The majority of the small and medium sized mills would probably finance the investment in new treatment facilities. Conventional financing might be available through banks handling a company's general banking needs, but in other cases, probably the majority, the financing would be made available only with Federal or State guarantees. Another form of financing would be through industrial bonds issued by the local municipality. In each case, the mill would be able to continue operations and the problem would merely be one of how to finance or fund the new investments required.

Some industry sources believe that marginal operations exist and that these operations are so marginal that they cannot acquire any kind of financing. The contractor found one case in which the State limits the amount of corporate indebtedness of firms under its jurisdiction, which provides an artificial limit to financing pollution abatement. In the case of the marginal mill, it would be faced with either closure or discontinuance of the wet process operation, thus changing the product mix. Obviously, this latter option would not be available to those who are simply commission dye houses, except in that instance where a process change or product mix change might produce an effluent more readily treatable. If none of the above options is open to the mill, the mill would have to close.

(4) Waste Treatment Costs. For each of the five categories studied, the contractor developed the investment and operating costs necessary to meet the proposed best practicable technology. The investment and operating costs were developed for municipal treatment and self-treatment with space available for lagooning. For each category the investments and operating costs were based upon a very small mill with 19 employees, and small and medium sized mills operating with the range of estimates presented for the composite mill of its size and category. The waste and hydraulic loads conform to the proposed guidelines for water usage and waste. The one exception to this general approach is wool scouring, where we made estimates for only two size mills – very small, with 19 employees, and small, since there appears to be no medium mill classification.

The basis for the waste treatment cost estimates is the original work presented in the proposed effluent guidelines for the textile industry. It was under that

contract that the methodology for making the estimates was developed, and this study has applied that methodology to the proposed effluent guidelines and the models of mills chosen for this study. Appendix A presents the methodology in an abbreviated form and can be used to approximate the results of our analysis.

The original work presented in the proposed effluent guidelines study did not consider chlorination, or color removal. The additional material necessary to make those calculations has been included as part of Appendix A.

When calculating the annual operating cost for effluent treatment, we included labor, materials, and utilities. In addition, we included a charge equivalent to 8% of the capital investment to represent the cost of capital or interest expense applicable should the investment be financed. Further, we included a depreciation expense of 10% of the initial capital investment being representative of the total depreciation expense. The latter, the depreciation expense, is also assumed to be the source of cash for principal repayment of a 10-year loan repayment schedule.

(5) Best Available Control Technology. In a similar manner, we calculated the investments and operating costs for mills conforming to the Best Available Technology (BAT) level, as specified by the EPA for the textile industry. BAT, so defined, includes the preliminary screening, primary settling (for wool scouring only), coagulation (for carpet mills only), secondary biological treatment and chlorination. In addition, it includes advanced treatment techniques such as multi-media filtration and/or activated carbon adsorption following biological treatment. The very small mills with under 20 employees have no COD requirements in BAT and, therefore, employ only a multimedia filter.

(6) COD and Color Considerations. In estimating the economic impact that the proposed best practicable technology portion of the effluent guidelines will have upon the textile industry, we have assumed that good, secondary biological treatment will be adequate for the reduction of BOD, COD, and color to the required levels as stated in these guidelines. There exists the possibility that good, secondary biological treatment will not be adequate for the reduction of COD and color in certain circumstances, however. Discharges of some but not all exemplary plants in that report meet the guidelines with secondary biological treatment. Since detailed information is not available about the raw waste loads of these exemplary plants, we are uncertain as to whether or not all mills can meet the guidelines, discharging the raw waste loads and hydraulic loads as proposed in the effluent guidelines.

While raising the issue, we have not been able to resolve it in a manner that would be acceptable by all parties. The resolution of this issue will be left to a subsequent study, or simply by passage of time, with more and more mills demonstrating their ability to treat the effluent with secondary biological treatment. Therefore, as indicated above, we have measured the economic impact of the proposed effluent guidelines on the textile industry by considering the costs and investments of a good secondary biological treatment plant.

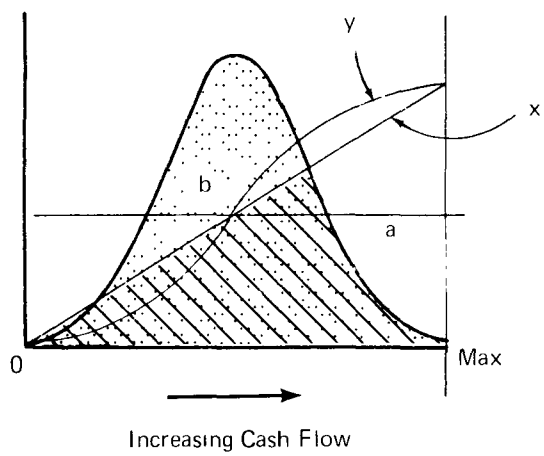
If in fact the COD and color levels, as described by the proposed guidelines, could not be met, we suggest that there are two methods which may be employed to achieve the proper level. Before discussing the methods we must point out that these may not be the only technologies available for achieving these ends, but rather two technologies which are practical and recognized.

The first method would be to employ a massive lime treatment to the effluent, followed by an activated carbon treatment. The second method would be to isolate the dye stuffs from the rinse waters and wash waters of the effluent. These spent dye stuffs not only contain most of the colors, but as well include much of the highly refractory COD components of the effluent. In this method 20% of the total wastewater stream, isolated in the manner described above, would be evaporated and the resulting residue incinerated, thus creating only a burned waste for disposal.

(7) Mill Closings Criterion. Having estimated the range of cash flows and other financial characteristics of a mill in each category and size classification studied, and further having established what the investment and operation costs would be for a mill operating within this range of financial characteristics, we subtracted the estimated annual operating cost from the range of annual positive cash flows. When the annual operating cost did not exceed the minimum cash flow thought to exist for that category, then we assumed the no plant closings would ensue as the result of meeting the proposed effluent guidelines. Following this technique, if the annual operating cost should exceed cash flow for any particular mill example, then we would assume that all mills operating within this category and size classification would close. Continuing to use the zero cash flow criterion for a plant closing, we found that some plants within a certain category and size classification might close, since the operating cost of the treatment system would place them in a zero or negative cash position. To make an estimate of the percentage of mills within a category and size classification and in turn an estimate of the number of mills that will close, we assumed that the cash flow would be distributed linearly throughout the range described. If this assumption is made, then zero or negative cash flow would be proportional to the percentage of mills falling below the point where the annual operating cost would penetrate the cash flow range.

Had the data base been larger it might have been useful to assume a normal distribution of cash flows for each size mill rather than the linear distribution. Certainly in a statistical sense this would be a more elegant approach to determining the percentage of mills closing. For example, if we had reliable and accurate information about at least 30 mills in each size category, we could demonstrate whether or not the cash flows actually form a normal distribution. Since, for the most part, there are not that many mills in a size classification for a category, the demonstration of normalcy is not possible.

Using the simpler linear distribution and the influence that it has upon the results can be envisioned by examining the figure. The area defined by "a" in the figure defines the linear distribution where it is equally probable that we will find a cash flow. The area defined by "b" is that of a normal distribution and would express the probability of finding a cash flow within a population obeying this distribution. The difference between these two assumptions can best be seen by comparing "line x" and "line y" which represent the cumulative probability for the linear and normal distributions. In our model it would make no difference whether a normal distribution and/or linear distribution were used at the halfway point. That is to say, both techniques would estimate the same percentage of mill closings.



For cash flows below the mean we would find that the linear distribution tends to show a larger number of mill closings than does the normal distribution and, conversely, above the mean the normal distribution tends to increase the percentage of mill closings until finally at the end point where both distributions once again are equal. The contractor does not believe that the slight overstatement of the linear distribution is particularly punitive, since it is his expectation that the firms with lower positive cash flows would be more inclined to close than those with higher cash flows, even if the distribution were normal. That is to say, even though the linear distribution tends to bias the percentage of mill closings below the 50% point, the contractor believes that this may be a more realistic expectation.

The use of a zero or negative cash flow as the criterion to determine plant closings tends to understate the number of mill closings if higher level criteria were to be used. Those higher level criteria would include profitability on sales, minimum rate on return on invested assets, internal rate of return, discounted cash flow method, or present

value analysis. Each of these forms of analysis would likely carry with it a higher level of cash flow demand to satisfy the criterion, and hence would tend to increase the potential number of mill closings. We believe that since a large majority of the mills of small and medium size within the five categories studied are privately held companies or corporations, the zero or negative cash flow criterion most closely approximates the criteria actually (but perhaps never formally) applied to the decision of a mill closing.

There are an unknown number of mills which face imminent closing decisions and the necessity of meeting the proposed effluent guidelines, and the attendant investments and operating costs will merely hasten the final decision to close the mill rather than actually cause its closing, i.e., being the sole factor. There will undoubtedly be closings that will be ostensibly associated with the mills' inability to meet the investment and operating costs required by the proposed effluent guidelines. Based upon industry sources and interviews undertaken in support of this study, we estimate that as many as one-half of the mill closings which occur as a result of the proposed effluent guidelines will simply be accelerated closings, i.e., the mill would have closed spontaneously without the necessity of meeting the effluent guidelines.

Within each scenario, we have presented the investments and annual operating costs against a background of how a mill would finance its new investments in waste treatment equipment. While an important criterion, which may in and of itself lead to mill closings, we have not used this as the closing criterion, but rather have selected the zero or negative cash flow as the criterion. We reason that far fewer mills will have great difficulty financing the investment than those which simply cannot afford the annual operating costs.

b. Category 1 – Scenario of Wool Scouring.

(1) General Description. This segment of the textile industry has been severely set back by the conversion to synthetic fibers. There are now only about 16 active raw wool scouring mills in the United States compared with about 21 listed in Davidson's Blue Book of 1972. (Davidson's listings tend to list mills even after their closing; hence this large reduction did not necessarily take place entirely since 1971.) The 1967 Census, lists a total of 68 scouring and combing mills but combing mills are dry operations and hence can be treated the same as griege mills. Two large mills in Massachusetts and several in Texas are the only remaining commission scouring mills. The remainder also produce top wool and are components of vertically integrated organizations.

Wool scouring is conveniently separated from other segments of the textile industry because of its uniqueness. Raw wool (grease wool) must be wet-cleaned (wet-processed) before the fiber can be dry-processed to produce top yarn, then fabric.

The grease wool contains 25 to 75% non-wool materials, consisting of wool grease (a recoverable material of some economic value) and other materials of animal origin

such as urine, feces, sweat, and blood, as well as dirt consisting of both oil and vegetable matter. Additional materials that may be present include insecticides (sheep dip) and fugitive dyes used for identification. This variability in both yield and the composition of impurities and grease causes a correspondingly large variability in raw waste loads.

(2) Process Description. Scouring consists of sorting the fleece and feeding it to a hopper. The fleece is wet with fresh water in the first bowls. The wool is then carried through a series of scouring bowls where scour liquor flows countercurrent to it. Detergent is added in the third or fourth bowls to emulsify the greases and oils. The scoured wool is then dried. In mills where the cleaned wool is converted into top wool, the wool is combed and drawn – and sometimes air-washed – to remove the short fibers (used for wool yarn) from the long fibers (used for worsted yarn).

The wool grease constitutes a special problem in treatment since it does not appear to be readily biodegradable, unless it is well-emulsified so that bacteria can reach it. Therefore, the grease-recovery step is important to reduce pollution. The scour liquor from the separation tank is processed to break the emulsion and recover the wool grease. Two methods are commonly used in this procedure: centrifuging and acid-cracking.

In the centrifugal method, about 60 percent of the grease is recovered, and the remaining 40 percent is attached to the dirt and grit. Centrifuging recovers over 90 percent of the grease from the scour liquor. In the acid-cracking method, pilot plant performance indicates a 98 percent recovery of grease from the degritted liquor. No data are available to indicate the initial split of grease between the grit and the raw liquor from the grit settling tank. Grease yield, in total, is 8 to 15 percent by weight of the greasy wool, and this constitutes 50 to 65 percent of the wool grease intially present. Note that 1 to 3 percent of the wool grease present in the grease wool is allowed to remain on the wool as a conditioner. The market for recovered, unrefined wool grease is very unpredictable. The demand varies between zero and a level permitting a price of $0.25 per pound. When prices are depressed, the mill stores the grease for up to 6 months or more, making it an unattractive business for many operators.

Some "raw" wools, mostly the Australian and New Zealand wools, are prescoured at the source. However, this fact does not appear to affect this analysis of U.S. raw wool scouring mills significantly. Scoured wool is often converted into "tops" at the same mill. In this operation, the short fibers are separated mechanically from the long ones; the long fiber "tops" are used for worsted yarn and the short fibers are used to blend into woolen yarns. No added pollution occurs, but the water load is increased slightly by water washing of the air from an air washing step. The guidelines developed for Category 1 are based on the total product fiber and include both short fibers and tops.

Several small mills are connected to municipal treating systems. Most small mills are not treating their wastes at all. The larger mills are treating their own wastes, with the exception of Wellman in South Carolina which is connected to a municipal system. Two

large Burlington mills treat wastes combined from carpet and woolen broad-woven fabric finishing plants, respectively. We are not considering as exposed those mills which are integrated into a large corporate organization. This criterion reduces the mills exposed from 16 to 12.

(3) Composite Mill. The wool scouring mills of interest to this study are the commission scouring mills (4 or 5 mills) and the top-making companies. As stated above we are not considering those integrated with spinning, knitting, weaving and finishing operations which are a part of a larger corporate organization. The generalized models are shown in Tables 3-1 and 3-2. Only a very small mill with 19 employees, and the small mill with 20 to 40 employees are considered. The few "large" mills are now processing about 50,000 pounds per day; the smallest about 5,000 pounds per day. In general, the wool scouring equipment is old and has been written off long ago.

TABLE 3-1

REPRESENTATIVE VERY SMALL RAW WOOL SCOURING MILL

Sales	$650,000
Profit (before taxes)	0-1%
	0-$6,500
Profit (after taxes)	0.8%
	0-$5,000
Depreciation	Negligible
Debt Repayment	Not known
Cash Flow	0-$5,000
Salvage Value	Negligible
Cost Structure:	
Fixed	20%
	$129,000
Variable	80%
	$515,000
Production	5,000,000 lb/year
	14,300 lb/day
Employment	19
Work Week	5 days, 1 shift
Water Use	7.5 Million gallons per year
	21,500 gallons per day
	1.5 gallons per pound of clean wool

One scouring line will handle about 15,000 pounds per day. This typical mill performs commission scouring: many of the scouring mills also make top, a dry operation. Table 3-2 presents typical ranges of the various business aspects of a small mill involved in raw wool scouring.

Mills doing commission scouring only will realize about $0.065 per pound of raw wool, or $0.13/pound of clean wool, resulting in a sales volume of $650,650 per year for

the production rate shown in Table 3-2. Those mills selected for the small/medium class perform commission scouring and some top making, resulting in a sales level of about $1.73 per pound of clean wool, based on the mills sampled in this study. Not considered are top mills which buy all their wool and process it into top, where the sales price could be as high as $2-3/pound.

TABLE 3-2

REPRESENTATIVE SMALL/MEDIUM RAW WOOL SCOURING MILL*

Sales	$6,500;000 – $13,000,000
Profit (before taxes)	0 – $130,000
	0 – 1%
Profit (after taxes)	0 – $74,000
	0 – 0.6%
Depreciation	Negligible
Debt Repayment	Not Known
Cash Flow	0 – $74,000
Salvage Value	Negligible
Cost Structure	
Fixed	19%
	$1,200,000 – $2,400,000
Variable	81%
	$5,280,000 – $10,450,000
Production	3,750,000 – 7,500,000 lb/yr
	15,000 – 30,000 lb/day
Employment	20 – 40
Work Week	5 days, 1 shift
Water Use	9.5 – 19 millions of gallons per year
	0.03 – 0.05 millions of gallons per day
	1.8 gallons per pound of clean wool

* Assumption: Commission scouring and some top making.

(4) Discussion of Representative Mills. The production and sales levels of the wool scouring mills, after eliminating the large mills and those that are part of a larger corporation, do not vary sufficiently to warrant the two categories of small and medium sized mills. Therefore, we have shown only one composite mill model for those two categories.

We estimate that the representative mills have sales of $500,000 for the very small mills, and ranging from $6.5 to 13 million per year for the small mill. The lower limit of the small mill is based on a single scouring line that is up to capacity. Profits from these mills range from 0 to 1% before taxes. This very low profit level is the result of the depressed wool market of the last few years, combined with international wool-buying practices that have left the United States short in supply. The wool business is currently

looking up but the short supply is causing prices to rise to the point where it may be priced out of the market. In any event, the low profit levels we found during interviews appear reasonable to use for this projection.

The wool scouring mills are intensely competitive and, as one fails, the others see reason to continue existence on the business they can glean from the failed firm. Hence, the resultant profits after taxes range from $0-$5,000 for the very small mills, and $0 to $74,000 per year for the small mills.

The equipment found in the wool scouring mills is almost wholly over 15 to 20 years old and has been written off long ago. As a result, depreciation is negligible as is salvage value of the equipment. We could not determine debt repayment values so we will use profit after taxes for cash flow. The cash flow of the composite mills therefore will be between $0 to $5,000 for the very small mill, and between $0 to about $74,000 per year for the small mill.

(5) Waste Treatment Systems Costs. Operating costs for waste treatment for the composite wool scouring mill are given in Table 3-3. The very small mill uses 22,000 gpd while the small mill uses 34,000 gpd of water, using guideline water-use figures applied to the production rate of clean wool. Based on the methodology presented in Appendix A, used with the applicable figures, we estimated the investment and operating costs necessary to achieve the guidelines.

TABLE 3-3

ECONOMIC IMPACT OF EFFLUENT GUIDELINES ON WOOL SCOURING MILLS CATEGORY 1

	Very Small Size Mills	Small and Medium Size Mills
Estimated Number of Mills Exposed	3	9
Estimated Number of Employees Exposed	57	270
Cash Flow (from composite mill)	$0 – $5,000	$0 to 74,000
Impact resulting from proposed best practicable technology		
If all were to use		
• Municipal treatment		
Annual cost	$9,200	$ 11,600
Mill closings, number (%)	3 (100%)	1 (16%)
• Self-treatment		
Annual cost	$20,300	$ 21,600
Mill closings, number (%)	3 (100%)	3 (29%)
Impact resulting from proposed best available technology		
If all were to use		
• Self-treatment	25,300	189,500
Add on annual cost	$25,300	$189,500
Mill closings, number (%)	3 (100%)	9 (100%)

The guidelines may be met by discharging the mill effluent to a municipal treatment plant or by self-treatment. The wool scouring mill effluent has a special problem of high grease content that creates problems in both treatment and sludge disposal. As a result most municipal systems have refused to accept wool scour wastes, even after recovery of wool grease (which only removes about 60% of the grease and oils). Work is actively being performed by at least one wool scourer to make these wastes acceptable to the municipality. Further, we understand Caron International is on a municipal system. Also, mixed dye house and scouring wastes are being treated successfully in several private treatment plants. For purposes of this analysis, we will assume that this grease problem will be overcome without significant capital or operating costs involved; if it develops that such costs are significant, they will have to be considered in the impact analysis.

The cost for pretreatment for the very small mill amounts to a capital investment of $17,400 and an operating cost (including amortization of the capital investment) of $9,200 per year. Similar figures for the small/medium sized mill are a capital investment of $21,300 and an operating cost of $10,000, respectively. These calculations are based on an intermediate sized municipal treatment plant which would charge $0.40 per 1000 gallons treated. If a smaller municipal plant is involved, a higher treatment cost of $0.68 per 1000 gallons treated should be used.

The annual operating costs for self-treatment for BPT are $20,300 with a capital investment of $54,400 for the very small mill, and $21,600 operating costs and $57,300 capital investment for the small/medium sized mill. These cost figures are based on primary settling followed by a treatment in a well-operated 30-day oxidation pond, since the guidelines state that good secondary treatment should be able to achieve the limits stated. To evaluate the impact of the guidelines we have assumed that the low water use and the COD and color can be reduced to acceptable limits by good secondary treatment. If further tertiary treatment and extensive process changes are needed, these costs must be considered.

The costs to the mills to meet BAT in the manner defined in the guidelines amount to $71,300 for capital investment and $25,300 for operating expenses per year for the very small mill, and $320,000 for capital investment and $189,500 for operating costs per year for the small/medium sized wool scouring mill.

(6) Impact. Table 3-3 presents the economic impact of effluent guidelines on wool scouring mills. As previously mentioned, we have measured the impact of the guidelines on wool scouring mills by assuming the mill would close when the annual treatment costs exceeded the cash flow. Furthermore, we assumed the distribution of cash flows to be linear through the ranges of cash flow. Implementation of BPT or BAT by the very small wool scouring mills would, in all cases, cause the three mills so classified to shut down, affecting up to 57 employees.

Implementation of the best practicable technology by small/medium wool scouring mills by municipal treatment would cause 16% closings, or 1-2 of the 9 mills exposed by our standard criteria. This would affect about 26 people. If all mills had to meet this same goal by self-treatment, 29% closings would occur, or 2-3 mills, affecting 87 people.

Implementation of BAT would require operating costs of $189,500 (and a capital investment of $320,000) and, as a result, would cause all mills which did not have the alternative of connecting to municipal systems to close, affecting 270 employees. Assuming that wool scouring mills could make their effluent acceptable to municipalities, we feel that the only mills affected by BAT requirements then would be those which do not have access to municipal systems. We estimate this number to be 2 or 3. Even this conclusion must be modified by the fact that in those communities with which we are familiar where wool scouring mills have been trying to connect to municipal sewage systems, only 1 or 2 appear to be making headway, and there, with almost full-sized self-treatment systems as pretreatment. Therefore, without more investigation, we must assume the full impact.

It should be noted, in general, that this industry is very borderline at present; it has been noted that it expects at least one mill to close a year. Hence, any expenditures for clean-up may hasten the demise of mills that would have closed soon in any event. Further, we seriously doubt if good secondary treatment would meet the guidelines for best practicable treatment, and that most municipalities would continue to resist acceptance of scouring mill wastes. Hence, the chances are good that more like 7 or 8 mills would close, even at this first step. However, a study in greater depth would be needed to make a definitive judgment possible.

(7) Price Effects. The extensive competitiveness of this industry precludes passing on any costs as prices increase. Mills interviewed had tried to pass on increased labor costs recently, but could not. If the wool market continues to look up, however, the surviving mills may be in a position to pass on costs. The situation is too fluid to make accurate predictions at this stage.

If prices could be passed on, the price increase necessary to meet the guidelines might be as follows (in dollars per pound of wool scoured):

	Very Small	Small/Medium
Municipal	0.0018	0.0020
BPT, Self-Treatment	0.0041	0.0038
BAT, Self-Treatment	0.0051	0.0337

These figures would be added to a processing price of $0.065 per pound of raw wool (roughly $0.13 per pound of clean wool) for mills doing scouring but which do not own their own wool and which do not make top. If they own their own wool, the selling price would be $2.00 or more per pound of clean wool, and in the small/medium mill example doing mixed work, the average price of their product would be $1.60/pound of clean wool.

(8) Secondary Effects. If the costs of implementing the guidelines can be passed on, they will be marked up at least 15%. Wool is already in danger of being priced out of the market, so this increase, plus the increase from wool-finishing operations, may seriously affect wool's position in competition with other fibers as well as encouraging wool imports.

(9) Financial Effects. The profitability of wool scouring mills would fall off as follows:

	Present Profit	Municipal Treatment	BPT, Self-Treatment	BAT, Self-Treatment
Very Small Mill	0-1%	1.8% of Sales	4.1%	5.1%
Small/Medium Mill	0-1%	0.12% of Sales	0.22%	1.9%

Capital availability will affect the marginal mills even on municipal pretreatment; all of the very small and 29% of the small/medium mills may not be able to obtain internally generated cash for the capital required. Banks are reluctant to invest in wool-scouring operations, because of their low profit and uncertain future.

(10) Production Effects. Achievement of best practicable technology would reduce production as follows (assuming as before, that all mills are subject to each given type of treatment):

	Very Small Mills	Small/Medium Mills	
Municipal	10.6	4.9	MMlbs/yr
BPT, Self-Treatment	10.6	16.3	MMlbs/yr
BAT, Self-Treatment	10.6	50.6	MMlbs/yr

(11) Employment Effects. The same rationale used in estimating the production effects above yields layoffs as follows:

	Very Small Mills	Small/Medium Mills
Municipal	57	26
BPT, Self-Treatment	57	87
BAT, Self-Treatment	57	270

Note, however, that the mills that pick up the business from the plants that close might add a number roughly equivalent to the impacted number to their employment rolls.

(12) Community Effects. Effects on the communities would be specific to the towns where the mills affected were shut down. These mills tends to be in small communities where the local impact would be significant.

c. Category 2 – Scenario of Wool* Dyeing and Finishing.

(1) General Description. The 1967 Census figures for SIC 2231, wool manufacturing and finishing, indicate 310 mills operating in this category. Of these, perhaps 160 are still in business, mostly being located in the northeast region. As discussed in Chapter 2, this figure of 160 mills reduces to a total of 76 that are potentially exposed to impact by the guidelines. We estimate that these 76 mills are composed of 23 very small, 33 small, and 20 medium sized mills.

Most small mills do commission dyeing, and even the larger mills that are part of the larger corporations commonly perform commission dyeing in addition to their own dyeing. Commission dyeing operations imply a wide range of fabrics and finishes as well as fiber types.

Probably not more than 5 or 10 mills still process more than 50% wool and wool blends; the rest process synthetic fabrics principally.

Wool finishing has been differentiated from other finishing categories because (1) the fiber is dirtier than other fibers, (2) different chemicals are used, and (3) it involves high water usage per pound of product. Most northern mills are discharging directly to streams, while a few discharge to municipal systems or to their own treatment plants.

Category 2 involves a high water usage rate caused by washing after the "fulling" operation (peculiar to wool systems), because the higher quality fabric produced necessitates more washing and, finally many of the mills in this category are old mills with inefficient equipment and piping layouts.

Variations occur in processing, similar to other finishing categories, in that some fabrics are woven or knit from yarns that are already dyed, either in the fiber or yarn form. A given mill may dye and finish part of its production while only finishing the remainder. This variation is unpredictable and causes a spread in data on pollution generation.

*Wool includes not only that from sheep, but also that from other animals, such as alpaca, vicuna, and the Kashmir goat. Subsequent discussion here will address sheep's wool only: processing the other wool involves somewhat special finishing techniques.

(2) Process Description. There are three distinct finishing processes: stock, yarn, and fabric finishing. The pollution generated by the fabric finishing operation is similar to that generated by the other two, and thus it is included in this category. If the greige goods are 100 percent wool, they are first cleaned of vegetable matter (and cotton fibers) by carbonizing (soaking in strong sulfuric acid, dried, and crushed with the char separated from the cloth). The fabric is then cleaned of spinning oils and any weaving sizes by a light scour (detergent wash). The 100 percent woolens, with the exception of worsteds, are then dimensionally stabilized in the presence of detergents to produce a controlled shrinkage or "felting." Worsteds are hard, tightly-woven and dimensionally stable as received at the finishing plant; woolens are loosely-woven, soft and often are firmed up by fulling.

The fabric is then batch-dyed in vessels called becks, washed in the same vessels, and taken to dry finishing operations. The only dry finishing operation of concern to water pollution is mothproofing.

(3) Composite Mills. The mills of this category could be northern mills, located in small towns, where the mill is a significant part of the town's economy. Most of the small and medium sized woolen finishing mills are so located. All woolen mills contacted by the contractor are integrated, spinning through weaving and finishing. Tables 3-4 and 3-5, present typical ranges of the various business facets of the very small, small and medium size mills involved in Category 2 operations.

TABLE 3-4

REPRESENTATIVE VERY SMALL WOOL DYEING AND FINISHING MILL

Sales	$675,000
Profit (before taxes)	0 – 6%
	0 – $40,500
Profit (after taxes)	0 – 4.1%
	0 – $27,600
Depreciation	$6,700
Debt Repayments	Not Known
Cash Flow	$6,700 – 34,000
Salvage Value	$34,000
Cost Structure:	
Fixed	11-24%
	$70,000 – $152,000
Variable	76-89%
	$482,000 – $565,000
Production	495,000 lb/yr
	1,980 lb/day
Employment	19
Work Week	5 days, 1 shift
Water Use	6.8 Million gallons per year
	0.027 Million gallons per day
	1.38 gallons per pound of clean wool

TABLE 3-5

REPRESENTATIVE WOOL DYEING AND FINISHING MILLS

	Small	Medium
Sales	$1,075,000 – 5,375,000	$5,375,000 – $17,500,000
Profit (before taxes)	0 – 6%	0 – 6%
	$0 – $322,500	$0 – 1,653,000
Profit (after taxes)	0 – 3¼%	0 – 3.2%
	0 – $174,000	0 – $554,000
Depreciation	$10,800 – $54,000	$53,800 – $175,300
Debt	Not Known	Not Known
Cash Flow	$10,800 – $223,000	$53,800 – $729,300
Salvage	$270,000	877,000
Cost Structure		
Sales exp.	10%	10%
Fixed	$212,000 – $1,060,000	$1,058,000 – $3,525,000
	21%	21%
Variable	$700,000 – $3,500,000	$3,490,000 – $11,600,000
	69%	69%
Production	750,000 – 4,200,000 lb/yr	4,200,000 – 12,000,000 lb/year
	3,000 – 16,000 lb/day	17,000 – 50,000 lb/day
Employment	30 – 150	150 – 450
Work Week	5 day/wk, 1 shift	5 day/wk, 1 shift
Water Use	14.5 – 77.3 MGPY	82 – 242 MGPY
	0.04 – 0.22 MGPD	0.23 – 0.69 MGPD
	13.8 gal/lb	13.8 gal/lb

We estimate that the very small mill, with 19 employees, will have $675,000 sales per year. Profits will be 0-6% before taxes, and profits after taxes will range from 0 to $28,000.

We estimate that the representative small mill will have sales ranging from $1.1 to 5.4 million per year. Profits from these small mills range from 0 to 6% before taxes. They operate in a very competitive environment; a few mills have established speciality lines and enjoy the higher profit level. The resultant profits after taxes range from $0 to $174,200 per year.

Most of the equipment found in woolen finishing mills is old, having been written off already. The more progressive woolen finishing mills have modest programs of reinvestment. The low profit levels cause the depreciation figure to be a significant part of the cash flow for the poor performers, but quite a small part of the cash flow of those showing a more normal profit.

The composite mills are integrated mills. The dry operations, such as spinning and weaving, are more profitable than finishing and help to carry that part of the operations. The mill owners prefer to carry wet operations in spite of their poor financial performance, since it gives them the ability to provide fast response to an aftermarket when cutters need small lots of the more popular styles and shades, which the larger corporations cannot handle economically.

The representative medium sized woolen fabric finishing mill (also integrated) has sales from $5.4 to 17.5 million per year. Percentage profit before taxes does not appear to differ much from the small mills and yields an after-tax profit ranging from $0 to about $554,000. As in the small mills, the medium sized mills' depreciation represents a significant part of the cash flow only for the poor financial performers.

Operating costs for waste treatment for the very small, the small and the medium sized woolen finishing mills are found in Table 3-6. The very small mill uses 0.027 MGD while the small sized mill uses .131 MGD, and the medium size mill uses 0.46 MGD. Based on the methodology presented in Appendix A, used with the applicable figures, we have estimated the investment and operating costs necessary to achieve the proposed levels of treatment.

The guidelines may be met by discharging the mill effluent to a municipal treatment plant or by self-treatment. The costs for pretreatment, plus the annual municipal charge (which includes amortization of the capital investment), amount to $10,100 and a capital investment of $19,000 for the very small mill, $28,000 and a capital investment of $41,100 for the small mill and $75,700 operating and $76,200 capital costs for the medium-sized mill, based on an intermediate-sized municipal treatment plant which would charge $0.40 per 1000 gallons treated. If a smaller municipal plant is involved, a higher treatment cost of $0.63 per 1000 gallons treated should be used.

The costs for self-treatment are based on the use of extended aeration lagoons. The annual costs for extended aeration lagoons would be $19,800 and the capital costs would be $55,800 for the very small mill, $37,600 annual costs and $125,300 capital costs for the small mill, and the annual costs would be $67,100 and the capital costs $228,500 for the medium sized mill.

In a similar fashion, the costs for BAT self-treatment are $25,200 operating and $75,200 capital costs for the very small mill, $238,100 and $541,700 for the small, and $443,900 annual operating costs and $1,165,100 capital investment for the medium-size mill.

(4) Impact. We have measured the impact of the guidelines on woolen finishing mills by assuming that the mill would close when the annual treatment costs exceed the positive cash flow from operations. Further, we assumed that the distribution of cash flows is linear through the range of cash flows shown. Table 3-6 shows the economic impact of the effluent guidelines on the wool dyeing and finishing mills.

TABLE 3-6

ECONOMIC IMPACT OF EFFLUENT GUIDELINES
ON WOOL DYEING AND FINISHING MILLS
CATEGORY 2

	Very Small Mills	Small Mills	Medium Size Mills
Estimated Number of Mills Exposed	23	33	20
Estimated Number of Employees Exposed	437	2,970	6,000
Cash Flow (from composite mill)	$6,800 – $34,300	$10,700 – $228,000	$53,800 – $729,000
Impact resulting from proposed best practicable technology			
If all were to use			
• Municipal treatment			
Annual cost	$10,100	$ 28,100	$ 75,700
Mill closings, number (%)	3 (12%)	3 (8%)	1 (3%)
• Self-treatment			
Annual cost	$19,800	$ 37,600	$ 67,100
Mill closings, number (%)	11 (14%)	4 (13%)	1 (2%)
Impact resulting from proposed best available technology			
If all were to use			
• Self-treatment			
Annual cost	$25,200	$238,100	$443,900
Mill closings, number (%)	15 (67%)	33 (100%)	12 (50%)

Based on this assumption, implementation of the best practicable technology by woolen finishing mills might cause 12% of the very small, 8% of the small and 3% of the medium-sized mills to close, if all were to go to municipal treatment. This would cause 3, 3 and 1 mill closings, respectively. If self-treatment is required, 47% of the very small, 13% of the small, and 2% of the medium sized mills would close, or 11, 4 and 1 mills, respectively. Our estimate of actual mill closings and employment affected is shown below:

	Very Small		Small		Medium	
	Mills	Employment	Mills	Employment	Mills	Employment
Municipal	3	52	3	49	1	155
BPT, Self-Treatment	11	61	4	80	1	152
BAT, Self-Treatment	15	293	33	2970	12	1612

We find the impact of the proposed best available technology to be significant to all three size categories of mills. The annual cost of treatment exceeds the minimum cash flows and exceeds the maximum cash flow in the case of the small size mills. We estimate that 67% of the very small mills, 100% of the small mills, and 50% of the medium size mills will be closed, resulting in 15, 33, and 12 mill closings, respectively.

(5) Price Effects. The current market for woolen fabrics is strong, having turned around during the past several years. However, the market is considered too competitive to be able to pass on any appreciable operating expenses incurred by meeting effluent guidelines. The prime reasons given are that:

a) The large, integrated companies can spread the cost of design and operation of treatment systems among their many mills;

b) The large integrated companies can and will establish price leadership, even in view of the need for internally generated funds for items such as the present guidelines implementation, because they are more diversified and have greater "staying" power than the smaller mills; and

c) Imports, particularly from the Far East, are still dictating the market price for woolens and wool blends.

We believe that the real price detriment today is the stiff competition from synthetic fibers (this is described in the industry profile in Chapter 2).

The price of clean wool has risen so sharply recently that the wool finishing mills, even with very nominal profit, are being priced out of the market. Therefore, even though demand is strong, the price the converter can charge for spinning, weaving, and finishing is very rigid. Therefore, for this analysis, we will assume that the price increases, due to implementing the guidelines, cannot be readily passed on.

For the composite mills, the price increases necessary to cover the costs of meeting the guidelines (if these prices could, in fact, be passed on) in dollars per pound are as follows:

	Very Small Mill	Small Mill	Medium Mill
Municipal	0.0202	0.0113	0.0093
BPT, Self-Treatment	0.0396	0.0151	0.0083
BAT, Self-Treatment	0.0504	0.0958	0.0543

These costs would be added to a current price for finished wool of approximately $3.50 to 4.00 per pound (clean wool is selling for $2.00 to 3.00 per pound and spinning, weaving, and finishing adds about $1.00 to the price) for the larger mills, but for the mills described here, the costs would be added to current prices of $1.43 on the average for the mixed commission and integrated processing they do.

(6) Secondary Effects. If the costs for implementation of the guidelines could be passed on, a 15% markup to the cutters would be added.

(7) Financial Effects. The profitability for the wool finishing mills would fall of as follows:

	Present Profit	Municipal Treatment	BPT, Self-Treatment	BAT, Self-Treatment
Very Small Mill	0-6%	1.5%	2.9%	3.7% of Sales
Small Mill	0-6%	0.9%	1.2%	7.4% of Sales
Medium Mill	0-6%	0.7%	0.6%	3.9% of Sales

(8) Capital Availability. The better performing small specialty mills may be able to raise $100,000 through bank loans, but we feel anything much higher would require government guarantees. The marginal small mills could not raise the $100,000 without such guarantees. Therefore, it appears that the projected capital requirements for BAT for small and medium size mills could be handled only by the better performing woolen mills, and government guarantees would be needed for most of the mills to do so.

(9) Production Effects. There will be little effect from application of the best practical technology to the better performers; however, the average mills and the marginal ones will be affected. Most mills in this category do not have alternative production capability without appreciable capital expenditures for new becks, etc. Also, since the guidelines are written on a pounds of pollutant per 1000 pounds of production basis, curtailing production would be of no help. Furthermore, to this same point, many wool finishing plants are already processing synthetics and blends, both woven and knits, from a small percentage to complete conversion. This step has been forced by the distressed wool

market in the past 5 or 6 years. The waste production from synthetic alternates is lower, but the cost to meet current guidelines does not differ significantly.

Mills that will have trouble meeting guidelines that have combined dry and wet processing plants, such as spinning and weaving along with dyeing and finishing, have the choice of closing down wet operations and continuing or expanding their spinning and weaving operations. This approach means that the marginal small mills will lay off most of their male help and retain the female help: some of the average mills may also do the same or divert money into other investment opportunities.

It further means that those mills that do close wet processing will lose the flexibility for fast-style turnaround that justifies their existence, and perhaps make them non-competitive. (This aspect should be investigated in greater depth.) This will further open the door to imports. However, the number of mills so affected by best practicable treatment will be quite small so these considerations will only gain importance at higher treatment levels.

Best practicable technology guidelines implementation and zero discharge requirements will probably reduce production as follows (in millions of pounds per year), assuming all mills have to meet guidelines for each category:

	Very Small Mill	Small Mill	Medium Size Mill
Municipal	1.4	1.3	4.2
BPT, Self-Treatment	1.6	2.2	4.1
BAT, Self-Treatment	7.9	80.2	43.5

A good share of the lowered production described above would be picked up by the surviving mills, many of which would probably belong to the larger corporations in the South.

(10) Employment Effects.

(a) Production Curtailment. The wet processing would likely be dropped. This would cause the male employees to be discharged, while maintaining the female help in the spinning/weaving/knitting plant. This percentage of total employment working in the dyehouse varies from 8% to 100%. A summary of likely layoffs under the different conditions is shown below:

	Very Small Mill	Small Mill	Medium Size Mill
Municipal	52	49	155
BPT, Self-Treatment	61	80	152
BAT, Self-Treatment	293	2970	1612

(b) Plant Closings. For the reasons given above, it would appear that the marginal small independent mills would have to close. Further, as mentioned under "production" above, prospects for growth in employment appear unlikely for those mills remaining in business. The mill closings and the effect on unemployment are given in Table 3-5 presented earlier in this section.

(c) Community Effects. Most of the woolen finishing mills are located in small towns, mostly in Massachusetts, Rhode Island, New York State and Pennsylvania. Being in small towns, they constitute from less than 5% to 10% of the town's direct industrial employment.

(11) Balance of Trade. Effects on the balance of trade are considered negligible.

d. Category 4 – Scenario of Woven Fabric Dyeing and Finishing (Cotton and Synthetics).

(1) General Description. Of the 449 establishments (in 1967) engaged in dyeing and finishing synthetic and cotton woven goods, about 146 are very small mills employing less than 20 people, while 167 are small mills, employing between 20 and 99, and 102 are medium size mills employing between 100 and 500 workers.

The types of plants vary greatly, depending on the size and the type of products they process, since the industry is engaged in bleaching, printing, dyeing, and finishing. The smaller plants, with 19 employees or less, in most cases have old equipment that has not been modernized due to lack of capital resources. The larger plants, both independent and those that are part of weaving complexes, are modern and efficient.

(2) Process Description. This category is one of the most important, because such plants are responsible for much of the wastewater effluent load of the textile industry. Integrated woven fabric finishing mills are also included in this category rather than in category 3 because the greige goods section of these mills contributes only a small amount to the overall effluent load.

When starch sizing is used in preparing woven fabrics, it becomes the major contributor to the BOD load of the plant. Another commonly employed sizing is polyvinyl alcohol (PVA), which tends to be less biodegradable than starch and therefore presents a lower BOD level, while contributing significantly to the COD load.

Mill wastes generally have a high total of dissolved solids and color (dye stuffs), and contain a variety of dye-dispersing agents. The use of caustic soda to mercerize cottons produces an effluent of high pH dyes, and their associated additives represent the most complicated treatment problem, since the BOD and COD load, as well as color, can vary considerably with the type of dyed fabric being processed and the color effects to be achieved.

Wet process steps include greige goods scouring, bleaching, mercerizing (cotton), dyeing, washing, and rinsing, followed by application of finishes such as soil repellants, antistatics, and the like.

(3) Composite Mill. The following examples are for mills that do commission dyeing and finishing only. Those that do spinning and weaving as well will show a higher profit from the contribution of the dry processing, and the sales volume per pound of goods produced will increase by a factor of about 3.5. Therefore, they will be in better shape to handle waste treatment costs. Tables 3-7 and 3-8 present typical ranges of the various business facets of the small and medium size mills involved in category 4 operations.

TABLE 3-7

REPRESENTATIVE VERY SMALL BROAD WOVEN DYEING AND FINISHING MILL

Sales	$204,700
Profit (before taxes)	6-6%
	$0 – $12,300
Profit (after taxes)	0 – 4.7%
	$0 – $9,600
Depreciation	$14,300
Debt Repayment	Not Known
Cash Flow	$14,300 – $23,900
Salvage Value	$50,000
Cost Structure	
Fixed	38%-43%
	$72,600 – $82,600
Variable	52%-62%
	$109,800 – $119,800
Production	550,000 lb/yr
	2,200 lb/day
Employment	19
Work Week	5 days 1-2 shifts
Water Use	9.9 million gallons per year
	0.04 million gallons per day
	18.0 gallons per pound of product

We estimate that the representative very small mill will have sales of $204,700 per year. Profits will be from 0-6% before taxes, resulting in an after-tax profit of 0-$9,600.

The representative small mill will have sales ranging from $1.6 to $2.1 million per year. Profits from these small mills range from 0 to 6% before taxes. They operate in a well established and very competitive environment. This would result in profits

after taxes of $0 to $72,600/year. These sales include printing operations and other specialty work that reflects a higher price per pound than that found in the very small mills, and reflects our findings from field interviews.

TABLE 3-8

REPRESENTATIVE BROAD WOVEN DYEING AND FINISHING MILLS

	Small	Medium
Sales	$1,060,000 – $2,120,000	$8,480,000 – $15,900,000
Profit (before taxes)	$0 – $127,200	$0 – $954,000
	0 – 6%	0 – 6%
Profit (after taxes)	$0 – $72,600	$0 – $502,600
	0 – 3.4%	0 – 3.2%
Depreciation	$74,200 – $148,400	$593,600 – $1,113,000
Debt Repayment	Not Known	Not Known
Cash Flow	$74,200 – $221,000	$593,600 – $1,615,600
Salvage Value	$265,000 – $530,000	$2,120,000 – $3,975,000
Cost Structure		
Fixed	$400,000 – $752,000	$3,222,000 – $5,640,000
	38%	38%
Variable	$660,000 – $1,240,800	$5,258,000 – $9,306,000
	62%	62%
Production	1,500,000 – 3,000,000 lb/yr	12,500,000 – 23,800,000 lb/yr
	6,000 – 12,000 lb/day	50,000 – 95,000 lb/day
Employment	50 – 100	300 – 600
Work Week	5-6 days, 2-3 shifts	5-6 days, 2-3 shifts
Water Use	37.8 – 75.6 MGY	315 – 598 MGY
	6.1 – 6.2 MGD	0.9 – 1.71 MGD
	18.0 gal/lb	18.0 gal/lb

Most of the equipment found in woven goods finishing mills is old, much of it having been written off already. It will not be quite as old as that found in woolen finishing plants, however. The more progressive woven goods finishing mills will have had a small capital improvement program that may have resulted in at leas a few jet becks as well as pressure becks and perhaps, in the larger mills, a continuous washer. The low profit levels, however, cause this depreciation expense to represent a significant part of the cash flow.

The composite mills depicted here are commission dye houses, and will be more severely impacted than the integrated mills. The latter are able to carry low-profit dye house performance by offsetting it with more profitable spinning and weaving operations. They prefer to do so (carry the wet operations) in spite of their poor performance, however, because the reason they exist is most often their ability to provide fast response to the aftermarket when cutters need small lots of the more popular styles and shades, and the larger corporations are not set up to handle these small lots economically.

The representative medium-sized woven fabric finishing mill (also a commission dye house with printing and/or other specialties) has sales ranging from $8.5 to $15.9 million per year. Profit before taxes does not appear to differ much from the small mills and yields an after-tax profit from $0 to $954,000. As in the small mills, the medium sized mills' depreciation is a significant part of the cash flow.

The water use for the mills interviewed during this study was found to be about twice that proposed in the effluent guidelines. The water use for the example composite mill was reduced to the levels proposed in the guidelines. Therefore, we assumed that these mills could accomplish such a reduction in the use of water primarily by better operating practice (in process changes) rather than by any significant capital expenditures. If such investments or operating costs associated with the reduced water usage are necessary and significant, then such costs must be included in calculating the impact of the guidelines on the mill. As with other facets of the impact, this must be considered on a mill-to-mill basis and cannot be generalized upon. The raw waste loads of the mills interviewed were found to be similar to those described in the guidelines, and the composite mill is assumed to conform.

(4) Impact. Operating costs for waste treatment for both the small- and the medium-sized woven goods finishing mills are given in Table 3-9 and the economic impact of the effluent guidelines on broad woven dyeing and finishing mills (Category 4) is presented in Table 3-8. Based on the methodology presented in Appendix A, used with the applicable figures, we have estimated the investment and operating costs necessary to achieve the proposed levels of treatment.

The guidelines may be met by discharging the mill effluent to a municipal treatment plant or by self-treatment. If discharging to a municipal plant, the annual operating costs for pretreatment and the annual municipal charge are estimated to be $12,700 for the very small mill, $33,000 for the small mill and $188,100 for the medium-sized mill, with an initial investment of $23,000, $45,600 and $127,000, respectively. The municipal charge is based on an intermediate-sized municipal treatment plant charging $0.40 per 1000 gallons of wastes treated. If a smaller municipal plant is involved, a higher treatment cost of $0.63 per 1000 gallons treated should be used.

The costs for BPT self-treatment are based on the use of extended aeration lagoons. The annual operating costs for extended aeration lagoons would be $22,200 for the very small mill, $34,000 for the small mill, and $100,600 for the medium-sized mill with initial investments of $68,700, $111,600 and $353,700, respectively.

The cost to apply best available technology, as defined in the guidelines, amounts to $93,700 capital expenditure and $28,700 annual operating cost for the very small mill, $511,100 capital expenditure and $216,800 annual operating expenses for the small mill and $1,895,100 capital expenditure and $609,400 annual operating expenses for the medium sized mill.

TABLE 3-9

ECONOMIC IMPACT OF EFFLUENT GUIDELINES
ON BROAD WOVEN DYEING AND FINISHING MILLS
CATEGORY 4

	Very Small Mill	Small Mill	Medium Size Mill
Estimated Number of Mills Exposed	146	167	102
Estimated Number of Employees Exposed	2,774	12,525	45,900
Cash Flow (from composite mill)	$14,300 – 23,900	$74,200 – 221,000	$593,600 – 1,615,000
Impact resulting from proposed best practicable technology			
If all were to use			
• Municipal treatment			
Annual cost	$12,700	$ 33,000	$188,100
Mill closings, number (%)	0 (0)	0 (0)	0 (0)
• Self-treatment			
Annual cost	$22,200	$ 34,000	$100,600
Mill closings, number (%)	120 (82)	0 (0)	0 (0)
Impact resulting from proposed best available technology			
If all were to use			
• Self-treatment			
Annual cost	$28,700	$216,800	$609,400
Mill closings, number (%)	146 (100)	162 (97)	2 (2)

We have measured the impact of the guidelines on woven goods finishing mills by assuming, as before, that the mill would close when the annual treatment costs exceeded the annual cash flow, and that the distribution of cash flows would be linear through the ranges given for the three mill groupings.

Implementation of the best practicable technology by woven goods finishing mills, both small- and medium-sized, would not cause mill closings since the annual costs of either municipal or self-treatment would not exceed the respective cash flows. However, very small mills would experience significant impact from both best practical and best available technology guidelines implementation if they must accomplish those goals through self-treatment.

In addition, implementation of best available technology by self-treatment would cause almost all of the small mills to shut down.

(5) Price Effects. The current market for broad-woven finished fabrics is reasonably strong. However, the finishing mills servicing this market are well established and the competition is also strong. Industry sources stated that imports set the price and have caused shutdowns already in this category. In addition, we stated that the larger, integrated companies would be less impacted by the guidelines and this would penalize the small independents. We feel, however, that probably all would be able to pass a good share of the cost of implementing the guidelines on to the customers.

For the composite mills, the price increases necessary to cover the costs of meeting the guidelines, in dollars per pound, would be as follows:

	Very Small	Small	Medium
Municipal	0.0231	.0147	.0102
BPT, Self-Treatment	0.0404	.0151	.00545
BAT, Self-Treatment	0.0522	.0964	.0330

These costs would be added to a current charge of roughly $0.37 per pound for dyeing and finishing broad woven fabrics, or about $0.70 per pound for those mills doing printing and other specialties.

(6) Secondary Effects. The costs (for implementation of the guidelines), if passed on to the cutters, would be done so with an additional 15% markup.

(7) Financial Effects. The profitability for woven fabrics finishing would fall off as follows:

	Present Profit	Municipal Treatment	BPT, Self-Treatment	BAT, Self-Treatment
Very Small Mills	0-6%	6.2%	2.1%	1.5 % of Sales
Small Mills	0-6%	10.8%	2.1%	0.8 % of Sales
Medium Mills	0-6%	14.0%	13.6%	5.0 % of Sales

Capital availability might not be a problem for some mills since they could divert capital expenditures from normal mill improvements to treatment operations. Other mills would have to look to some form of debt financing.

(8) Production Effects. Compliance with the guidelines could reduce production as follows:

	Municipal Treatment	BPT, Self-Treatment	BAT, Self-Treatment
Very Small Mills	0	68.3	83.2 MMlbs/yr
Small Mills	0	0	354 MMlbs/yr
Medium Size Mills	0	0	12.7 MMlbs/yr

(9) Employment Effects. Compliance with the guidelines could cause the following layoffs in number of employees:

	Municipal Treatment	BPT, Self-Treatment	BAT, Self-Treatment
Very Small Mills	0	2,275	2,774
Small Mills	0	0	11,788
Medium Size Mills	0	0	318

Implementation of the guidelines at all levels would cause a temporary halt to providing increased jobs from mill expansions for an increasing population.

(10) Community Effects. Effects on the communities would be highly specific to those mills that would be shut down. As in other categories, the small mills are often a major part of the town's employment.

(11) Balance of Payments Effects. The balance of payments effects would be negligible.

e. Category 5 – Scenario of Knit Fabric Dyeing and Finishing (Cotton and Synthetics).

(1) General Description. The knitting industry is characterized by a large number of plants and a structure organized along specialized product segments. The major segments are knit-fabric piece goods, hosiery, outerwear, and underwear. The geographical distribution of knit mills (SIC Code 225), according to 1967 census data, is as follows:

	No. Plants
Northeast Region	1616
North Central Region	76
South Region	910
West Region	96
Total	2698

While the industry has shown substantial growth in value of shipments, we estimate that – through consolidation and other factors – the current number of plants in this industry is about 2,500. Of this number, we estimate that 1,100 plants have only dry operations. These are plants, such as sweater mills in the outerwear segment, which knit goods from purchased or commission dyed yarns, or mills which have finished goods dyed on a commission basis and therefore have no process water requirements. Most of these mills are located in the Northeast.

Of the 1,400 plants estimated to have wet process operations, we estimate that 85 percent discharge to municipal treatment systems. The great bulk of these are hosiery plants (700-800) located primarily in North Carolina, Tennessee, and Pennsylvania. Census data (1968) on process water use and discharge indicates that virtually all (more than 90%) of the hosiery plants discharge to municipal systems.

The knit fabric mills within this segment amount to about 541 mills. Of these, the commission finishers, about 90 mills, will be those most likely impacted. These plants are the source of finished knit piece or yard goods for the apparel, industrial, and household good trades, and also supply fabric to underwear and outerwear manufacturers. The large knit fabric plants are located mainly in North and South Carolina and Georgia, but substantial numbers are also located in New York and Pennsylvania.

The production of knit fabrics for women's and men's wear has been the fastest growing sector of the textile industry over the past decade. Synthetic fibers are the predominant types used in knit goods, except for cotton goods produced for apparel, underwear, and sleepwear. In the latter case, however, polyester has been replacing increasing proportions of cotton fiber. Plants which previously processed only cotton are using greater amounts of polyester, and the trend is expected to continue.

(2) Process Description. The wet processing operations performed in knit fabric dyeing and finishing are described below, with specific operations employed varying from plant to plant.

Yarns are purchased in the undyed state, with a knitting oil finish to provide lubrication for the knitting operation. The amount of finish on the yarn ranges from 5-15 percent, depending on the type of yarn and fiber. There is a significant difference between knitting and weaving yarns, since the latter are sized with starch or other polymeric materials to add strength during the weaving operation.

After the yarn has been knit into fabric, the fabric may be processed by one or more alternative routes. Typically, it is processed in piece goods form. The fabric is washed in continuous countercurrent washers (warm water and detergent) prior to being loaded in dye machines. This washing step removes knitting oils and other contaminants. In some processes, washing is the first step in the dye machine cycle. The types of dyeing equipment used include: pressure becks, pressure jet becks, and sometimes atmospheric becks. The types of dyestuffs, auxiliaries, and conditions employed for dyeing knit goods are essentially the same as for woven goods of comparable fiber composition.

Most knit fabrics are treated with softeners, antistats, and resin finishes, and, in some cases, water and oil repellents. These finishes are applied from a pad bath just prior to the final drying and dry finishing operations. These baths are discharged periodically, as required, for fabric lot or formulation changes, but the total daily volume of discharge is very small.

(3) Composite Model. The composite small and medium mills are commission dyers and finishers. Because the average age of the equipment is much lower than in the other finishing categories, knit finishing operations have higher salvage and depreciation levels.

An increasing number of knit finishers are involved in knitting, along with dyeing and finishing. Their sales dollar per pound of product will be about twice as high as that of commission dyers. The profit for the dry operations is 1 or 2% (after taxes) higher than for dyeing and finishing.

Some mills in this category buy their own yarn, knit it, and then dye and finish the knitted fabric. In these mills, the sales dollar per pound of product will be about five times what the commission dyers charge. As in the case of the knitter/finisher described above, the profit level will be higher since the dry operations are more profitable than dyeing and finishing.

Note that employees are hourly employees and salvage value is for equipment only.

Tables 3-10 and 3-11 present typical ranges of the various business facets of the very small, small, and medium size mills involved in Category 5 operations.

TABLE 3-10

REPRESENTATIVE VERY SMALL KNIT FABRIC DYEING AND FINISHING MILL

Sales	$1,015,000
Profit (before taxes)	0-5%
	0 – $50,800
Profit (after taxes)	0-3¼%
	0 – $32,900
Depreciation	$101,500
Debt Repayment	$40,600
Cash Flow	$60,900 – $93,800
Salvage Value	$335,000
Cost Structure:	
Fixed	28%
	$284,200 – $270,400
Variable	72%
	$730,800 – $694,000
Production	1,897,500 lb/yr
	7,590 lb/day
Employment	19
Work Week	5 day, 3 shift
Water Use	37,950,000

Note: This size classification has experienced a business downturn and some small mills will close, primarily because of increasing vertical integration, but the remainder will increase sales and profits. The above representative mill will be valid for about 6 months. It is expected that vertical integration will be complete within 5 years.

TABLE 3-11

REPRESENTATIVE KNIT FABRIC DYEING AND FINISHING MILLS

	Small	Medium
Sales	1,605,000 – $3,210,000	$5,082,500 – $8,560,000
Profit (before taxes)	$0 – $160,500	$203,300 – $1,027,200
	0 – 5%	0 – 12%
Profit (after taxes)	$0 – $90,000	$112,200 – $540,600
	0 – 2.8%	2.2 – 6.3%
Depreciation	$160,500 – $321,000	$508,250 – $856,000
Debt Repayment	$64,200 – $128,400	$203,300 – $342,400
Cash Flow	$96,300 – 282,600	$417,200 – $1,054,200
Salvage Value	$529,650 – $1,059,300	$1,677,200 – $2,824,800
Cost Structure		
Fixed	$450,000 – $855,000	$1,368,000 – $2,112,000
	28%	27 – 28%
Variable	$1,155,000 – $2,194,500	$3,511,200 – $5,420,800
	72%	73 – 72%
Production	3,000,000 – 6,000,000 lb/yr	9,500,000 – 16,000,000 lb/yr
	10,000 – 20,000 lb/day	30,000 – 50,000 lb/day
Employees	25 – 50	75 – 125
Work Week	5-6 day, 3 shifts	5-6 day, 3 shifts
Water Use	70 – 140 MGY	210 – 350 MGY
	0.2 – 0.4 MGD	0.6 – 1.0 MGD
	20 gal./lb	20 gal./lb

The very small mill will have sales of about $1,000,000, with profits of 0-5% before taxes, yielding after tax profits of $0-33,000.

We estimate that the representative small mill will have sales ranging from $1.6 to $3.2 million per year. Profits for these small mills range between 0 and 5% before taxes, because of current distressed market conditions for polyester double-knits. This results in after-tax profits of $0 to $90,000.

A large percentage of the equipment found in knitting and knit finishing mills is relatively new. The higher temperatures needed for dyeing polyester with disperse dyes and the need to handle knits much more gently than woven piece goods have required new equipment designs: principally, the pressure jet beck. As a result, combined with the low profit level, depreciation is a major contributor to cash flow.

The composite mill is presented as a commission dye house, which should be more severely impacted than an integrated mill, since it cannot carry dye house losses or overhead by the more profitable dry operations.

The representative medium-sized knit finishing mill (also a commission dye house) has sales ranging from $5.08 to $8.56 million per year. Profits before taxes for the medium sized mills not expected to be as low as some of the small mills, and will range from 4 to 12%.

After-tax profits, therefore, result in values of $112,216 to $540,644. Similar to the small mill example, the new equipment generates high depreciation expenses which, even with substantial principal repayments deducted, provide an adequate cash flow of $0.42 to $1.05 million.

The rate of water use in the mills interviewed during this study was found to be substantially the same as that proposed in the guidelines. As a consequence, we assume that all knit finishers can achieve the proposed water use rate without significant added costs for either new equipment or modifications to existing equipment. If it is necessary to make substantial investments to meet such water conservation goals, the cost will have to be included in calculating the guidelines' impact on the mill. As with other facets of the impact, this must be considered on a mill-to-mill basis and cannot be generalized.

The raw waste loads were found to be similar to those described in the guidelines.

(4) Waste Treatment System Costs. Investments and operating costs for waste treatment for the very small, small- and the medium-sized knit finishing mills are presented in Appendix A where we have estimated those costs necessary to achieve the proposed levels of treatment.

The guidelines may be met by discharging the effluent to a municipal treatment plant or by self-treatment. The costs for pretreatment, plus the annual municipal charge, amount to $44,100 capital cost and $31,400 operating cost for the very small mill, $61,600 capital cost and $53,100 operating cost per year for the small mill and $121,700 capital cost and $96,000 operating cost per year for the medium-sized mill, based on an intermediate sized municipal plant which would access a charge of $0.40 per 1,000 gallons treated. If a smaller municipal plant is involved, in the order of 1 MGD capacity, a higher treatment charge of $0.63 per 1,000 gallons treated should be used.

The costs for self-treatment are based on extended aeration lagoons. The extended aeration lagoons will have a capital cost of $105,800 and an annual operating cost of $32,500 for the very small mill, $148,300 capital cost and $44,400 annual operating costs for the small mill, and $240,100 capital cost and $69,600 operating cost for the medium-sized mill.

The costs to apply best available technology, as defined in the guidelines, amounts to $167,900 capital costs and $46,200 annual operating costs for the very small mills, $699,700 capital expenditure and $260,000 annual operating expenses for the small mill, and $1,293,100 capital expenditure and $412,400 annual operating expenses for the medium sized mill.

(5) Impact. As described in the introduction to this chapter, we have measured the impact of the guidelines on knit finishing mills by assuming that a mill would close when its annual treatment costs exceeded its positive cash flow. Furthermore, we assumed that the distribution of cash flows is linear through the ranges for the three mill groups shown. Table 3-12 presents the economic impact of effluent guidelines on the knit fabric dyeing and finishing mills.

Implementation of the best practicable technology by knit finishing mills will not cause mill closings in any of the three size categories, based on the observation that the annual operating costs of either municipal or self-treatment will not exceed their respective cash flows. The same observation is true for best available technology implementation, except in the case of the small mills having to undertake self-treatment in order to meet guidelines. In that case, 88%, or 22 mills, will be shut down.

(6) Price Effects. The current market for finished knit fabrics is depressed. Because of the intense competition, particularly in doubleknits, the mills interviewed feel they will be unable to pass on the increased costs (from implementation of the guidelines) to their customers. This is probably true since knits, according to industry experts, are selling at cost right now and probably will continue to do so for the next 6 months or so.

TABLE 3-12

ECONOMIC IMPACT OF EFFLUENT GUIDELINES
ON KNIT FABRIC DYEING AND FINISHING
CATEGORY 5

	Very Small Mills	Small Mills	Medium Size Mills
Estimated Number of Mills Exposed	50	25	15
Estimated Number of Employees Exposed	950	938	1,500
Cash Flow (from composite mill)	$60,900 – 93,800	$96,300 – 282,600	$417,200 – $1,054,200
Impact resulting from proposed best practicable technology			
If all were to use			
• Municipal treatment			
Annual cost	$31,400	$ 53,100	$121,700
Mill closings, number (%)	0 (0%)	0 (0%)	0 (0%)
• Self-treatment			
Annual cost	$32,500	$ 44,400	$69,600
Mill closings, number (%)	0 (0%)	0 (0%)	0 (0%)
Impact resulting from proposed best available technology			
If all were to use			
• Self-treatment			
Annual cost	$46,200	$260,000	$412,400
Mill closings, number, (%)	0 (0%)	22 (88%)	0 (0%)

For the composite mills, the price increases necessary to cover the costs of meeting the guidelines, in dollars per pound, are

	Very Small	Small	Medium
Municipal	0.0165	0.0118	0.0095
BPT, Self-Treatment	0.0171	0.0099	0.0054
BAT, Self-Treatment	0.0243	0.0578	0.0323

These costs would be added to a current charge of roughly $0.535 per pound for dyeing and finishing.

(7) Secondary Effects. Price increases in knit finishing may occur in the next 6 months or so. Presumably, demand will catch up with supply and the pricing structure for knits and knit finishing will become more elastic. When that occurs, the added costs will be passed on to the cutters with about a 15% markup.

(8) Financial Effects. The profitability for knit dyeing and finishing will probably fall off as a percent of sales, before taxes, as shown below, due to compliance with the guidelines:

	Present Profit	Municipal Treatment	BPT, Self-Treatment	BAT, Self-Treatment
Very Small Mills	0-5%	3.1%	2.2%	1.8%
Small Mills	0-5%	3.2%	1.8%	1.0%
Medium Size Mills	4-12%	4.6%	10.8%	6.0%

Capital availability should not be a major problem for most mills. The small, marginal mills and the space-limited mills will have problems, however, and will have to seek debt financing.

(9) Production Effects. Compliance with the guidelines could reduce production as follows:

	Municipal Treatment	BPT, Self-Treatment	BAT, Self-Treatment
Very Small Mills	0	0	0
Small Mills	0	0	8.3 MMlbs/yr
Medium Size Mills	0	0	0

(10) Employment Effects. Potential number of employees that would be laid off as a result of the mill closings due to compliance with the guidelines is as follows:

	Municipal Treatment	BPT, Self-Treatment	BAT, Self-Treatment
Very Small Mills	0	0	0
Small Mills	0	0	69
Medium Size Mills	0	0	0

(11) Community Effects. Effects on the communities will be highly specific to those mills that will be shut down. The few examples of space-limited mills which do not have the option of connecting to municipal systems indicate they are located in small towns where the impact on the local community will be significant.

(12) Balance of Trade. Effects on the balance of trade would be negligible.

(13) Consideration of Future Trends in Knit Finishing Business Outlook. If the knit finishing industry does experience a return to good profitability in the next 6 months or so, as is considered probable, then the composite mills might look like those described in Table 3-13. These improved cash flows would reduce the impact on the small mill having to meet best available technology treatment to zero mill closings, thereby establishing essentially no mill closings in any of the three size categories, even under the need to treat wastes according to best available technology.

f. Category 7 – Scenario of Stock and Yarn Dyeing

(1) General Description. Category 7 includes plants which clean, dye, and finish fiber stock or yarn. The plants may or may not have yarn-spinning facilities. Sewing thread and textile and carpet yarn are typical products. According to the 1967 Census of Manufactures, 192 establishments were engaged in the dyeing and finishing of yarn, stock, and narrow fabrics. We estimate that 90 plants in the country perform dyeing and finishing only, on a commission basis, and hence will potentially be impacted significantly by the guidelines.

A strong trend is occurring in which mills in this group are changing from commission dyeing to buying their own yarn, dyeing and finishing it, and then selling it. These integrated operations will make them much less susceptible to impact by compliance with the guidelines.

About 60 percent of yarn dyeing activity is divided between Virginia, North Carolina, South Carolina, Georgia and Alabama, with the remainder distributed across other eastern and western states.

Most of the small and medium sized independent mills are commission houses located in the Northeast Region. Such commission establishments are disappearing in favor of integrated mill operations.

TABLE 3-13

REPRESENTATIVE KNIT FABRIC DYEING AND FINISHING MILLS*

	Very Small Mill	Small Mill	Medium Mill
Sales	$ 1,015,162	1,783,000 3,576,470	5,082,500 – 8,560,000
Profit (before taxes)	0 – 5%	10 – 15%	10 – 15%
	$0 – 50,758	178,300 – 536,471	508,250 – 1,284,000
Profit (after taxes)	0 – 3.2%	5.6 – 8%	5.3 – 7.9%
	$0 – 32,894	99,216 – 285,465	270,790 – 674,180
Depreciation	$101,516	178,300 – 357,647	508,250 – 856,000
Debt Repayment	$ 40,606	71,320 – 118,024	203,300 – 342,400
Cash Flow	$60,910 – 93,804	285,280 – 525,088	575,740 – 1,187,780
Salvage Value	$335,003	588,390 – 1,180,235	1,677,225 – 2,824,800
Cost Structure			
Fixed	28%	28%	28%
	$270,394	$450,000 – 840,000	1,368,000 – 2,112,000
Variable	72%	72%	72%
	$694,010	$1,155,000 – 2,200,000	3,511,200 – 5,420,800
Production	1,897,500 lb/yr	3,000,000 – 6,000,000 lb/yr	9,500,000 – 16,000,000 lb/yr
	7,590 lb/day	10,000 – 20,000 lb/day	30,000 – 50,000 lb/day
Employment	19	25 – 50	75 – 125
Work Week	5 day 3 shift	5 day, 3 shift	5 day, 3 shift
Water Use	38 MGY	70 – 140 MGY	210 – 350 MGY
	0.15 MGD	0.2 – 0.4 MGD	6.6 – 1.0 MGD
	20 gal/lb	20 gal/lb	20gal/lb

*If greater profit appears as expected, within the next 6 months or so.

Assumption: A return to a 15% profit, before taxes, for the larger, well-run plants.

Most dyed yarns are used in woven fancy piece goods, Jacquard knits, and carpets, which constitute a strong segment of the current textile market.

Stock-dyed fiber is losing importance. Stock dyeing was used to obtain yarns containing fibers of different shades; i.e., blended from different stock fibers. Use of newly developed specific cationic dyes provides a similar effect in single-bath piece dyeing (after weaving or knitting) at a lower production cost and provides a rapid turnaround of inventories and quickened delivery to the customer.

(2) Process Description. The raw material for the plants of Category 7 is staple or filament yarn. The yarn may consist of either natural or synthetic fibers or a blend of both. Wet processes used by yarn mills include scouring, bleaching, mercerizing, and dyeing. Yarn dyeing is different from woven fabric dyeing inasmuch as there is no desizing operation. It is different from knit fabric dyeing because its water use is significantly smaller.

Several techniques for processing raw yarn into the finished product are available. The most common process is probably package dyeing, but other processes, such

as space dyeing, are widely used as well. In the former process, yarn wound on perforated tubes is placed in a large vessel, which is then sealed. The dye solution is circulated through the yarn at an appropriate temperature. The dyed yarn is then washed, rinsed, and dried. In space dyeing, yarn is knit and the fabric is piece-dyed, washed, rinsed, and dried. The fabric is then unravelled and the yarn is wound onto cones.

(3) Composite Model. A representative small or very small mill dealing in this category might be a small northern yarn mill with some of its buildings dating from the late 1800's with newer sections built in the 1920's, and then modified in the 1950's. Some production equipment might be 30 years old with some pressure dye kettles being less than 5 years old. The average age of the equipment might range from 8 to 10 years.

A representative medium sized mill might be an urban-type mill located in one of the mid-Atlantic states. This mill would likely be a commission dye house which buys its own yarn, dyes it, and then sells it to its customers (formerly the customer owned the yarn). Thus the mill would have appreciable capital tied up in yarn inventory. The age of its equipment would vary considerably, as with the small mills, with some of its machines being 30 or more years old and some relatively new, since the medium sized mills generally have a regular capital improvement program.

The medium sized mill would likely process both synthetic and natural fibers, including wool, but it would not likely have space for treatment facilities. Any treatment required would have to be performed in some of its present production or warehouse space, as they may be space-limited. Tables 3-14 and 3-15 present typical ranges of the various business facets of the very small, small and medium size mills involved in Category 7 operations.

We estimate that a representative very small size mill would have sales of $916,400, per year. Industry sources report profits, before taxes, ranging from 0 to 5%. On this basis, we estimate an after-tax profit ranging from 0 to $30,300. Because newer equipment has been installed in these mills in recent years, the depreciation expense may be in the order of $64,200 and become a major contributor to the cash flow. To isolate the impact upon a mill performing dyeing and finishing only, we assumed that the representative mill would be a commission dye house.

The representative small size stock and yarn dyeing mill (also assumed to be a commission dye house) would have sales ranging from a low of $916,400 to a high of $2,687,500. The representative medium size mill would have sales ranging from $2,687,500 to $5,375,000. For purposes of this study, however, mills within this category having sales greater than $5,000,000 were assumed to be large plants that would be substantially unaffected (minimal impact) by pollution control as promulgated in the proposed effluent guidelines. As a composite of mills of medium size operating within this category, we estimate that profits, before taxes, would range from 4 to 6%. On that basis, after-tax profits would range from $62,400 to $174,200. As in the case of the small mill, recent

TABLE 3-14

REPRESENTATIVE VERY SMALL STOCK AND YARN DYEING MILL

Sales	$916,400
Profit (before taxes)	0-5%
	0 – $45,800
Profit (after taxes)	0-3.3%
	0 – $30,300
Depreciation	$64,200
Debt Repayment	Not Known
Cash Flow	$64,200 – $94,500
Salvage Value	$229,000
Cost Structure	
Fixed	24%
	219,900 – 202,500
Variable	76%
	696,500 – 668,100
Production	1,705,000 lb/yr
	6,820 lb/day
Employment	19
Work Week	5 day, 3 shift
Water Use	52,514,000 GPY
	150,040 GPD
	22 gallon/lb

Note: This industry subcategory probably won't be affected by the vertical integration picture, as in Category 5, but it is becoming technologically obsolete with significant impact expected in 3-5 years. (Texturized filament yarns of differential dye affinity permit wearing pattern in the greige and developing colors in a single dye bath.)

TABLE 3-15

REPRESENTATIVE SMALL SIZE AND MEDIUM STOCK AND YARN DYEING MILLS

	Small	Medium
Sales	$916,400 – $2,687,500	$2,687,500 – $5,375,000
Profit (before taxes)	$0 – $134,400	$107,500 – $322,500
	0 – 5%	4 – 6%
Profit (after taxes)	$0 – $76,400	$62,400 – $174,200
	0 – 2.8%	2.3 – 3.2%
Depreciation	$64,000 – $138,100	$188,100 – $376,250
Debt Repayment	Not Known	Not Known
Cash Flow	$64,000 – $264,500	$250,500 – $550,500
Salvage	$229,100 – $671,900	$671,900 – $1,343,750
Cost Structure		
Fixed	$202,500 – $593,750	$593,400 – $1,175,000
	23%	23%
Variable	$668,100 – $1,959,400	$1,986,600 – $3,877,500
	77%	77%
Production	1,705,000 – 5,000,000 lb/yr	5,000,000 – 10,000,000 lb/yr
	6,820 – 16,000 lb/day	16,000 – 32,000 lb/day
Employment	20 – 40	40 – 80
Work Week	5 day, 3 shift	5-6 day, 3 shifts
Water Use	52.5 – 123 MGY	52.5 – 246 MGY
	0.15 – 0.35 MGD	0.15 – 0.70 MGD
	22 gal/lb	22 gal/lb

investments in new equipment would produce higher depreciation expenses, which would, in turn, contribute significantly to the cash flow. On the basis of these assumptions the cash flow would range from $250,500 to $550,500.

While these composite mills – being representative of small and medium size stock and yarn dyeing mills – do not embrace all possible financial and production combinations, they are merely meant to be representative of their size within each category.

The water use for the mills interviewed during this study was found to be higher than that used in the representative plants described here, although not substantially so. This latter water use, in fact, conforms with the proposed guidelines which assume "in-process changes" which will substantially reduce the use of water in many cases. For purposes of this study, we have assumed that the reduction in water use will be achieved through process change which will not involve significant cost either for new equipment or modification of existing equipment. If, in fact, it becomes necessary to make a substantial investment in equipment or in the modification of existing equipment, the associated cost would have to be included in the impact upon the mill. As with many other facets of the impact, this would have to be considered on a mill-by-mill basis and cannot be treated as a generality.

(4) Waste Treatment System Costs. Investments and operating costs for waste treatment for the three size groupings of mills in this category are calculated for the various proposed levels of treatment and presented in Appendix A.

The guidelines may be met by discharging the effluent to a municipal treatment plant or by self-treatment. In the case of municipal treatment, we assumed that the effluent would be pretreated, requiring an investment in equipment and an associated annual operating cost. The operating expense includes municipal charges of $31,200, $43,800 and $84,800 for the very small, small and medium sized mills, respectively, and is based on a 40¢ per 1,000 gallon municipal charge. This, in turn, is based upon the treatment cost for an intermediate size 5,000,000-gallon per day treatment plant. In cases in which the municipal plant might have a 1,000,000-gallon-per-day capacity, a higher treatment charge should be applied. This charge is estimated to be $0.63 per 1,000 gallons. The capital expenditures for pretreatment amount to $43,900 for the very small mill, $54,600 for the small mill, and $81,300 for the medium-size mill.

If treatment were undertaken by the mill itself, it would most likely employ secondary biological treatment if adequate space for lagooning were available. Our impact analysis has been based upon this low-cost treatment.

The costs to meet the guidelines limits using best practicable technology by self-treatment amount to $108,800 capital expenditures and $33,100 annual operating expenses for the very small mill, $136,100 capital expenditures and $40,900 annual operating expenses for the small mill, and $205,000 capital costs and $60,200 annual operating expenses for the medium-size mill.

(5) Impact. It has not been demonstrated that all mills will be able to achieve the guideline levels through secondary biological treatment alone. If such treatment is found to be inadequate for COD reduction, a lime and activated carbon treatment (hereafter referred to as activated carbon treatment) would have to be employed. Should the secondary biological treatment prove inadequate for the removal of color sufficient to meet the guideline, then evaporation and incineration of 20% of the effluent would have to be considered. In each case, significant investment and operating costs are involved. Table 3-16 presents the economic impact of effluent guidelines on stock and yarn dyeing mills. We estimate that of the 90 commission finishing mills exposed, 42 are very small with under 20 employees, 32 are small mills with 20 to 50 employees, and 15 are medium size mills employing 50 to 100.

The need to meet zero discharge technology for stock and yarn mills will result in capital expenditures of $1,132,000 and $2,521,000 with associated annual operating expenses of $638,000 and $1,721,000 for the small and medium sized mills, respectively.

TABLE 3-16

ECONOMIC IMPACT OF EFFLUENT GUIDELINES
ON STOCK AND YARN DYEING MILLS
CATEGORY 7

	Very Small Mills	Small Size Mills	Medium Size Mills
Estimated Number of Mills Exposed	42	32	15
Estimated Number of Employees Exposed	798	960	900
Cash Flow (from composite mill)	$64,200 – 94,500	$64,000 – $264,500	$250,500 – $550,500
Impact resulting from proposed best practicable technology			
If all were to use			
• Municipal treatment			
Annual cost	$31,200	$ 43,800	$ 84,800
Mill closings, number (%)	0 (0%)	0 (0%)	0 (0%)
• Self-treatment			
Annual cost	$33,100	$ 40,900	$ 60,200
Mill closings, number (%)	0 (0%)	0 (0%)	0 (0%)
Impact resulting from proposed best available technology			
If all were to use			
• Zero discharge treatment			
Add on annual cost	$51,700	$257,300	$378,200
Mill closings, number (%)	0 (0%)	31 (96%)	7 (43%)

The cash flows as presented in this table are drawn from Tables 3-14 and 3-15 for the composite mill of each size. As described in the introduction of this chapter, we have measured the impact on this category by assuming that, if the annual treatment costs produce a negative cash flow, then the plant (mill) will close. Further, we assumed the distribution of cash flows to be linear through the ranges shown for each of the three size groupings.

The impact of the proposed best practicable technology upon stock and yarn dyeing mills, assuming either municipal treatment or self-treatment, is considered to be negligible since the annual cost of treatment for municipal treatment and self-treatment is in each case lower than the minimum cash flow for the size mill considered.

While the impact from the proposed best practicable technology is minimal, we find the impact resulting from the proposed best available technology and new source performance standards to be considerable in an economic sense for the small and medium size mills. The add-on annual cost of treatment exceeds the annual cash flows of a portion of our composite mills; therefore, following our assumption, some mills within these groups would close if all were required to meet the guideline requirement of BAT. (Probably most of these mills, however, will be connected to municipal systems and will have their own pretreatment systems, for which costs are not much greater than the annual cost for municipal treatment under the proposed best practicable technology.)

There are undoubtedly a few mills which are so borderline in their economic posture as to declare a mill closing if faced with any of the additional costs due to meeting the proposed guidelines. Implementation of these guidelines will, therefore, only hasten the closing of such marginal activities rather than being the cause of such closings.

In summary, plants in this category discharging to municipal treatment plants would probably not close, while many mills having to conform to a BAT guideline would close.

(6) Price Effects. The price of finished yarns is flexible since they are used principally in woven fabrics of the fancy type, Jacquard knits and carpets and all three end-use markets are currently strong. Therefore, assuming no federal restrictions on the procedure, the short-term view indicates that the price increases in this category may be passed on to the ultimate consumer.

For the representative mills, the price increases necessary to cover the costs of meeting the guidelines in dollars per pound (assuming a direct pass-on) are:

	Very Small	Small	Medium
Municipal	$0.0183	$0.0131	$0.0113
Self-Treatment	0.0194	0.0122	0.0080
Zero Discharge	0.0303	0.0767	0.0504

These costs would be added to a current charge of roughly $0.54 per pound.

(7) Secondary Effects. If price increases in this segment of the industry can occur, they may be passed on through the weaving, knitting, and carpet mills where this price will be marked up by 15% on the price charged for woven and knit fabrics and carpeting, on the average. This last figure will be a direct increase in cost to the carpet purchaser; the cost increase on fabrics will receive another markup by the converters before purchase by the ultimate consumer.

The larger companies (not considered in the study) may increase their own interplant costs (if allowed under federal pricing guidelines) where they have not already done so. Even if they do not, the small commission dyer may still have some flexibility of charging up to a 10% premium for his services in fulfilling his normal role of supplying the aftermarket for small-lot re-orders.

(8) Financial Effects. The "before tax" profitability of the representative mills would decrease, as a percentage of sales, due to the annual cost of meeting guidelines, according to the following schedule:

	Percent Profit	Municipal Treatments	BPT, Self-Treatment	BAT, Self-Treatment
Very Small Mills	0-5%	3.4%	2.4%	2.1%
Small Mills	0-5%	4.8%	2.3%	1.5%
Medium Size Mills	4.6%	5.6%	14.3%	9.4%

Capital availability should not provide a major problem to most mills since they can divert capital from normal reinvestment programs or acquire debt financing.

(9) Production Effects. There will be little effect on production since mill closings are expected only when small- and medium-size mills must treat their own wastes and meet best available technology guidelines. In this case, the production would be expected to decrease by 111 million pounds of finished yarn per year from the small mills, and 24.9 million pounds per year from the medium size mills. Growth, however, may slow down somewhat since the capital normally assigned for new equipment, modernization (including instrumentation), and expansions will be tied up for several years by the need to meet the guidelines.

(10) Employment Effects. As in the "Production Effects" discussion above, there will be little impact on employment levels primarily in the cases where the small- and medium-size mills must meet best available technology treatment, by self-treatment. An estimate of employees affected is 886 for the small mills and 199 for the medium sized ones. Even employment displacement from the Northeast and Mid-Atlantic Regions probably will not occur, since expansion of even the more profitable high-volume work in the Southern Region is being held up due to a labor shortage and rapidly rising labor costs.

The slowdown in industrial growth will cause a temporary halt in providing increased jobs for a growing population, from mill expansions in the medium sized mills.

(11) Community Effects. Effects on the communities will likely be negligible on the basis of the foregoing analysis, for achievement of best practicable treatment. In attaining best available treatment, however, as in other categories, the mill shutdowns will probably often be in relatively small communities where the mill constitutes a significant part of the local employment.

(12) Balance of Trade. There will be negligible impact in the balance of trade picture as well.

APPENDIX

WASTE TREATMENT MODEL FOR TEXTILE EFFLUENT GUIDELINES

1. BEST PRACTICABLE TREATMENT TECHNOLOGY (LEVEL I)

The proposed Level I guidelines are based primarily on secondary biological treatment. The BOD levels proposed by EPA are assumed to be met by extended biological treatment which also reduces COD. But, by definition, COD consists essentially of refractory organic compounds which are not degraded readily by biological treatment. The available data on COD reduction in a biological system and the ultimate effluent levels which can be achieved are quite limited.

Costs for Level I guidelines have been calculated on the assumption that extended biological treatment would enable the plant to meet the guidelines for BOD and COD. For some plants this level of treatment alone may not be adequate to meet Level I guidelines and tertiary treatment may be required.

To reflect the very different treatment economics between small and medium plants, costs have been developed for three plant sizes in each industry category (except Category 1). Treatment plant size is based on actual production and the assumed water use (gal/lb product) from the EPA guidelines for that category. No allowance has been made for increased in-plant costs to reduce water use, where plants have a higher water use rate than the standard set for that category.

Information on actual treatment cost experience in the textile industry was available in varying degrees of completeness from the exemplary plants visited. To verify the quality of the data received and to provide a broader basis for estimation, a costing model was developed based on standard wastewater treatment practice. This model covers both capital and operating costs for the equivalent of what appears to be the best technology currently practiced by the industry: essentially primary and secondary treatment as extended aeration with stabilization ponds. Over a plant size range of 400-12,000 cubic meters per day (0.1 to 3.0 mgd) the cost experience data from the plants visited came within ± 30 percent of that predicted by the cost model. The costs calculated from the model, therefore, are believed to be realistic bases for estimating the (replacement) value of existing facilities and the economic impact of further secondary-type treatment requirements.

The cost data used were derived from varied industrial and municipal applications. They are adjusted where possible to reflect specific changes necessary for the textile industry. Costs have been adjusted to the national average cost level of 1973, using the ENR Construction Cost Index. The estimated cost curves have been adjusted to exclude unusual construction or site-specific requirements. The curves include all elements of construction cost which a contract bidder would normally encounter in completing the wastewater treatment. Included are building materials, labor, equipment, electrical, heating

and ventilation, normal excavation and other similar items. Also included are the engineering costs. The annual operating costs include operation and maintenance labor, chemicals, power, material and supplies, and depreciation.

a. Land Available. The best practicable treatment technology in this industry, when land is available, is considered to be the end-of-pipe treatment steps shown in Figure A-1.*

- Primary Treatment: For removal of suspended solids, including screening and chemical coagulation or precipitation (to remove heavy metals where required); and

- Secondary Treatment: Primarily for removal of BOD_5, including aerated stabilization basins, sludge recycle and disposal, and final clarification with a long-duration polishing lagoon and chlorination. (Land and landfill requirements are very small.)

A description of the major cost elements is given below.

(1) Primary Treatment. This consists of grit removal and flow measurement as a means of protecting subsequent facilities from excessive wear and deposition of grit, including pH control, screening, and coagulation. Costs include flow channels and superstructures, grit handling equipment, electrical, heating, ventilating, and auxiliary equipment as required.

(2) Aerated Stabilization Basin System. The lagoons are sized for a given retention time (determined on the basis of available treatability data) with a depth of 7 feet. These data were extended to the higher inlet and lower effluent BOD levels by assuming constant ratios of biological characteristics to be applicable over the entire range. Costs include lagoon construction, access road, outfall sewer, fencing, seeding, and other construction work (excluding costs for aeration equipment). The costs of aeration equipment are based upon mechanical surface aeration equipment sized on the basis of 50 lb BOD_5 per horsepower-day. Good design practice dictates that total requirements be divided between two or more aerator units. In addition, a complete spare unit is provided. Costs include the aerator motor, gearbox, impeller, draft tube, supporting structure, and applicable electrical work.

The sludge lagoons are sized for 5-months' retention with an 8-inch depth. Sludge production is small (0.2 lb sludge/lb BOD_5 removal and 1 lb sludge/lb suspended solids removal). Cost includes normal excavation, dike construction, and sludge distribution piping. Sludge pumps are designed for periodic operation only. Nutrient addition is based upon: nitrogen at 0.008 lb/lb BOD_5. Costs are included for periodic hauling of the accumulated sludge to landfill.

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*Points on all curves are calculated rather than data points.

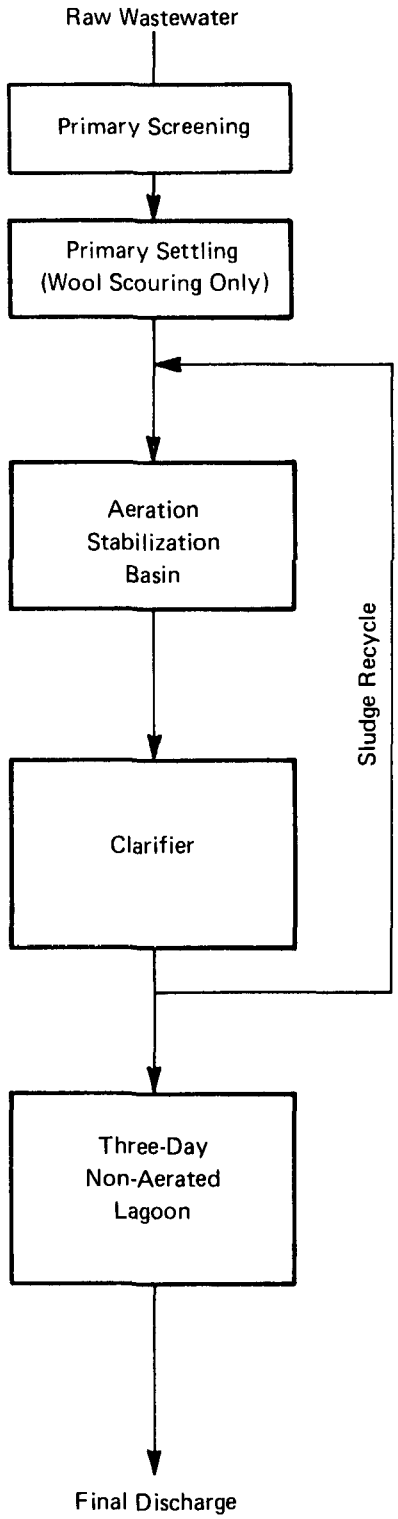


FIGURE A–1 SCHEMATIC FLOW DIAGRAM OF PROCESS STEPS AND COST CENTERS FOR LEVEL I TREATMENT

(3) Clarification. Basin construction costs are related to surface area, since the range of normal liquid depths is relatively small. These costs generally decrease as the basin size is increased. It is considered good practice to provide at least two independently operated basins. The size is based upon an overflow rate of 600 gpd/ft^2 and a depth of 12 feet. Costs include all necessary excavation, backfill, concrete, mechanical and electrical equipment, piping, and other work related to the basin construction.

(4) Non-Aerated Lagoon. The lagoon is sized for a 3-day retention time with a depth of 7 feet. Costs include lagoon construction, access road, outfall sewer, fencing, seeding, and other construction work.

(5) Chlorination. Chlorine is added to wastewater during the treatment process as an aid to treatment and for disinfection prior to discharge of effluent to a receiving stream. The cost of chlorine varies with the quantity used and the distance between the point of manufacture and the point of use. Our cost estimates are based upon the purchase of chlorine in 150 or 2,000 pound cylinders. About $0.15 per pound might be a maximum at a small plant distant from the manufacture point and $0.03 per pound a minimum. The construction costs include the chlorination equipment, chlorine feed building, chlorine storage building and handling equipment and scales. The contact basin is sized for 30-minute detention.

(6) Other Contributions to Capital Cost.

(a) Yardwork. The cost of a treatment plant also includes costs of general site clearing and grading, intercomponent piping, lighting, control structures, road paving, and other items outside the structural confines of an individual plant component. These items are commonly called yardwork and are included in the construction cost as an additional 15% of the total construction cost of the individual steps.

(b) Engineering Costs. Engineering costs are based upon the total construction cost, including yardwork.

(c) Land Requirements. Land requirements have not been included in the initial capital investment. Typically mills do not include this cost in their total cost of waste treatment. However, land is a legitimate cost factor to the extent that textile mills have to buy new land, especially in urban areas, for wastewater treatment. The costs developed here are therefore biased on the low side.

(7) Description of Operating Costs.

(a) Material and Supply Costs. Material and supply costs (all of the operation and maintenance items, excluding chemicals and power) are related, where appropriate, to the same sizing parameters used for construction costs.

(b) Chemical Costs.

(1) pH Control:

Lime	$24/ton
Sulfuric acid	$34/ton

(2) Sedimentation Aids. It is assumed that only polyelectrolytes (at 0.5 ppm) will be used in the clarifiers to aid the sedimentation step. Several combinations of polyelectrolytes, alum, and ferric chloride are commonly used. Their costs are:

Polyelectrolytes	$1.25/pound
Ferric chloride	$0.04/pound

(3) Nutrients. Nutrients will be added to the activated sludge treatment as follows: nitrogen at 0.8 lb/20 lb BOD, and phosphorus at 0.5 lb/100 lb BOD. Considerably less nutrients will be added to the aerated stabilization basins: nitrogen at 0.16 lb/20 lb BOD, and phosphorus at 0.1 lb/100 lb BOD.

Ammonia (25%)	$32.50/ton
Phosphoric Acid (72%)	$82.80/ton

(8) Operation and Maintenance Labor. The annual labor requirements are related, where appropriate, to the same sizing parameters used for construction cost estimates. Requirements were based upon a man-year consisting of 52 weeks at 40 hours per week, or a total of 2,080 hours per year.

Operation man-hours x $5/hr = direct operation labor cost
Maintenance man-hours x $5/hr = direct maintenance labor cost

(a) Energy and Power Cost. Power costs are related, where appropriate, to the same sizing parameters used for construction costs. Costs were based upon: $0.015/kwh and 70% motor efficiency. Fuel costs were based on fuel oil at $1.00 million Btu and steam at $1.50 million Btu.

(b) Landfill Costs. Two costs were considered for landfill operations: handling and burial. Handling charges were costed at $0.25/cu ft of solids generated from incineration; burial costs were based on $15 per dry ton of solids.

Cost curves developed from the cost model are presented in Figures A-2 through A-14. (For very small plants, about 110 cu m/day or 30,000 gpd and an overall cost figure of $1.00 for 1 gpd was assumed.) Figures A-6 through A-14 present the operating and maintenance costs over the ranges of production found. The initial capital cost of biological treatment systems depends mainly upon (and here is related to) the hydraulic load, the other factors making only minor variations in the total cost. Operating costs, on the other hand, have been viewed as dependent on pollutant as well as hydraulic loads.

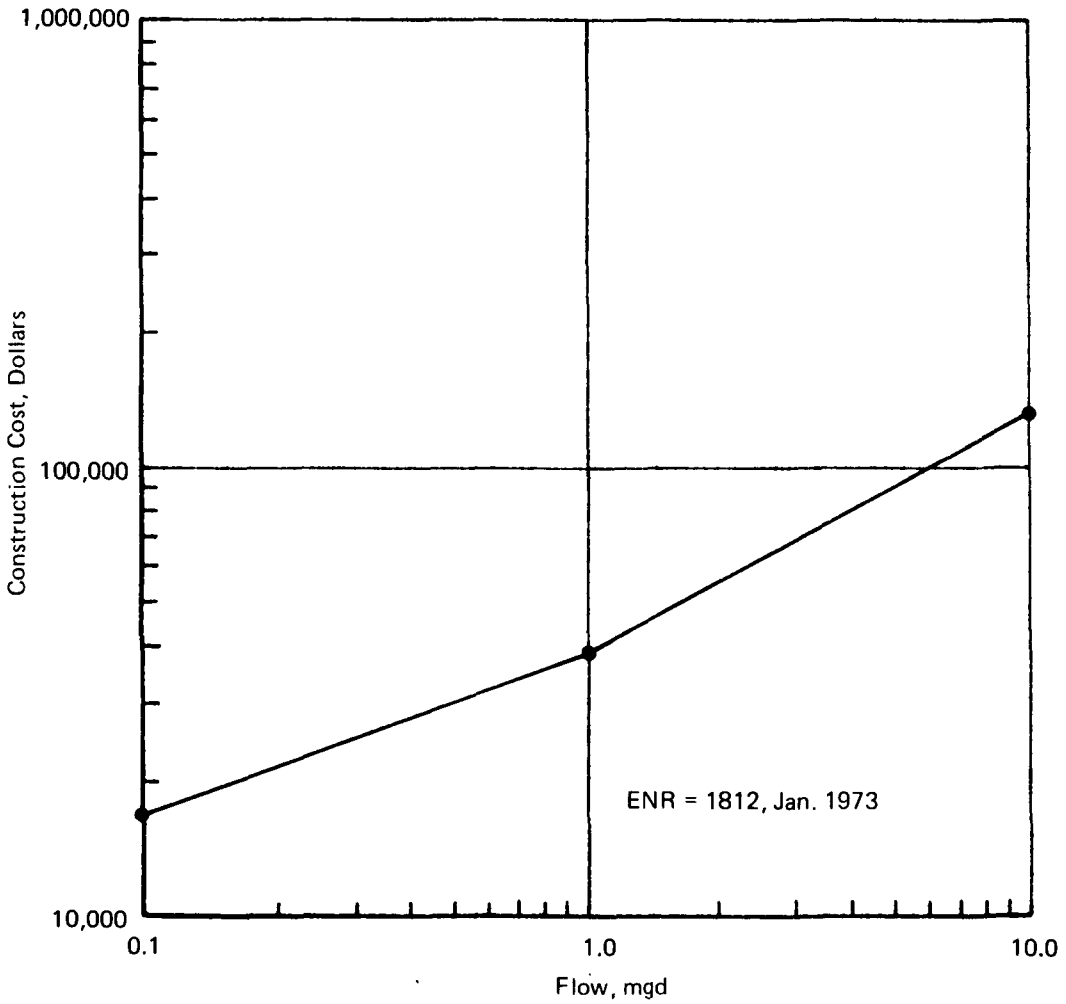


FIGURE A–2 AERATED STABILIZATION BASIN CONSTRUCTION COST

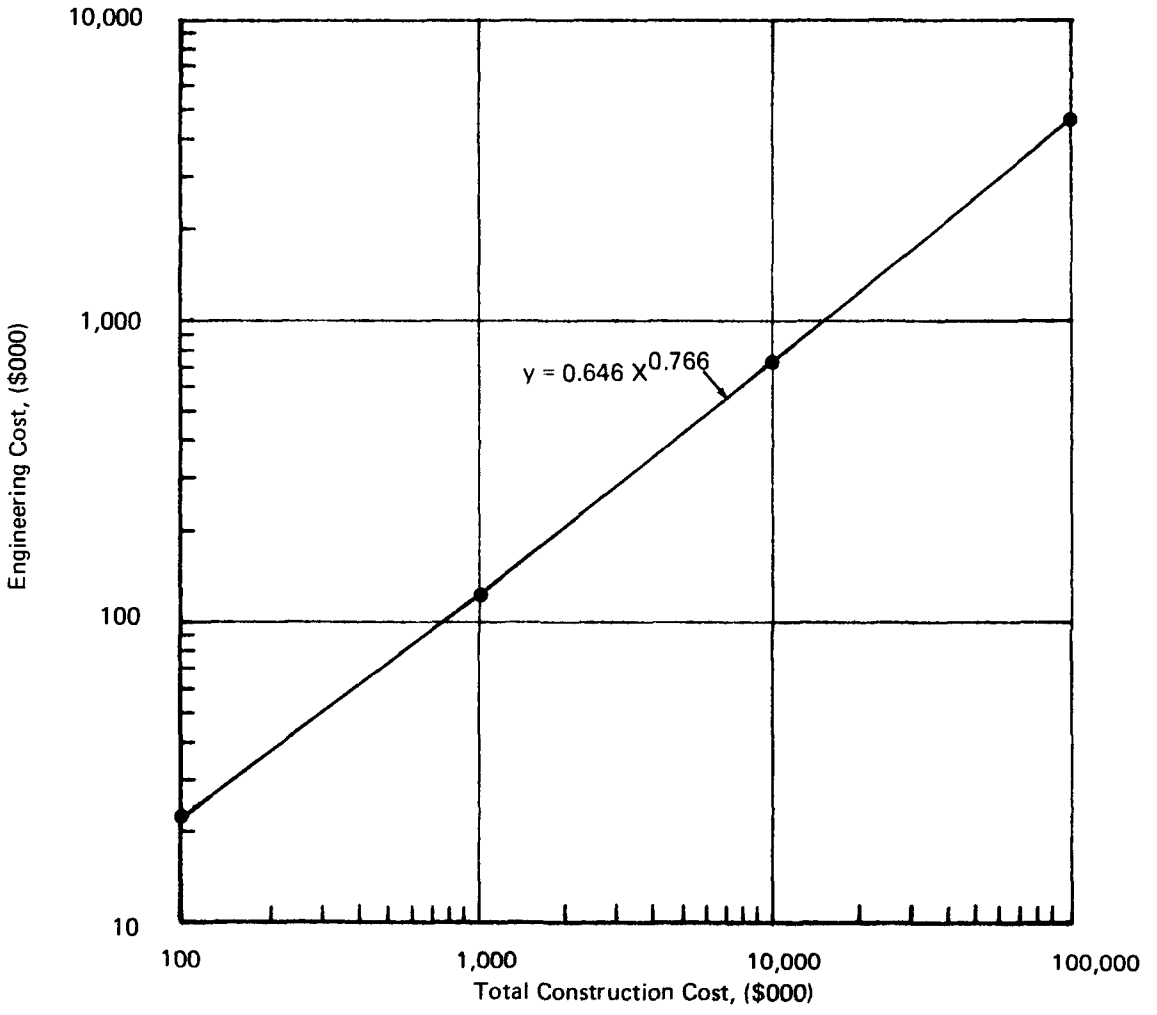


FIGURE A–3 ENGINEERING COSTS

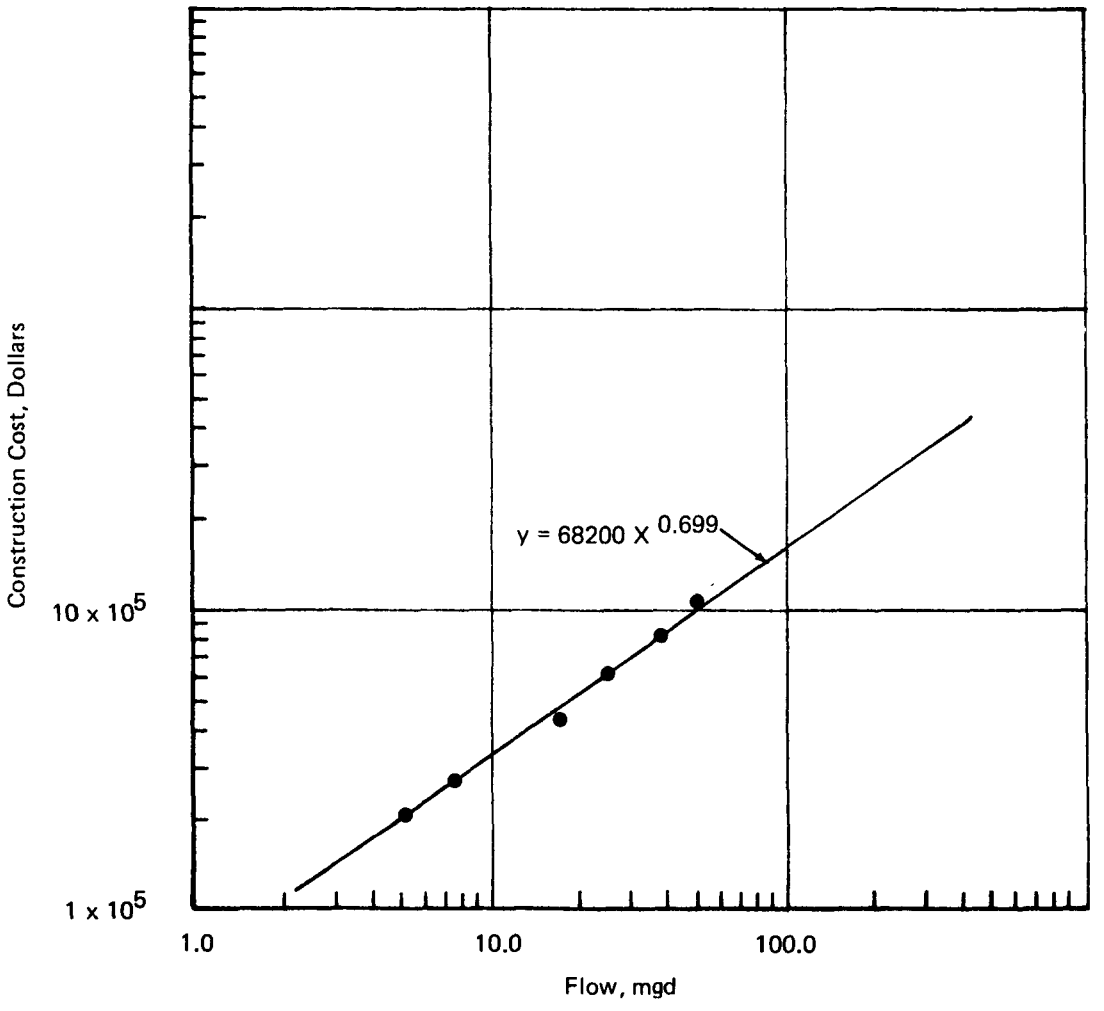


FIGURE A–4 CLARIFIER CAPITAL COST

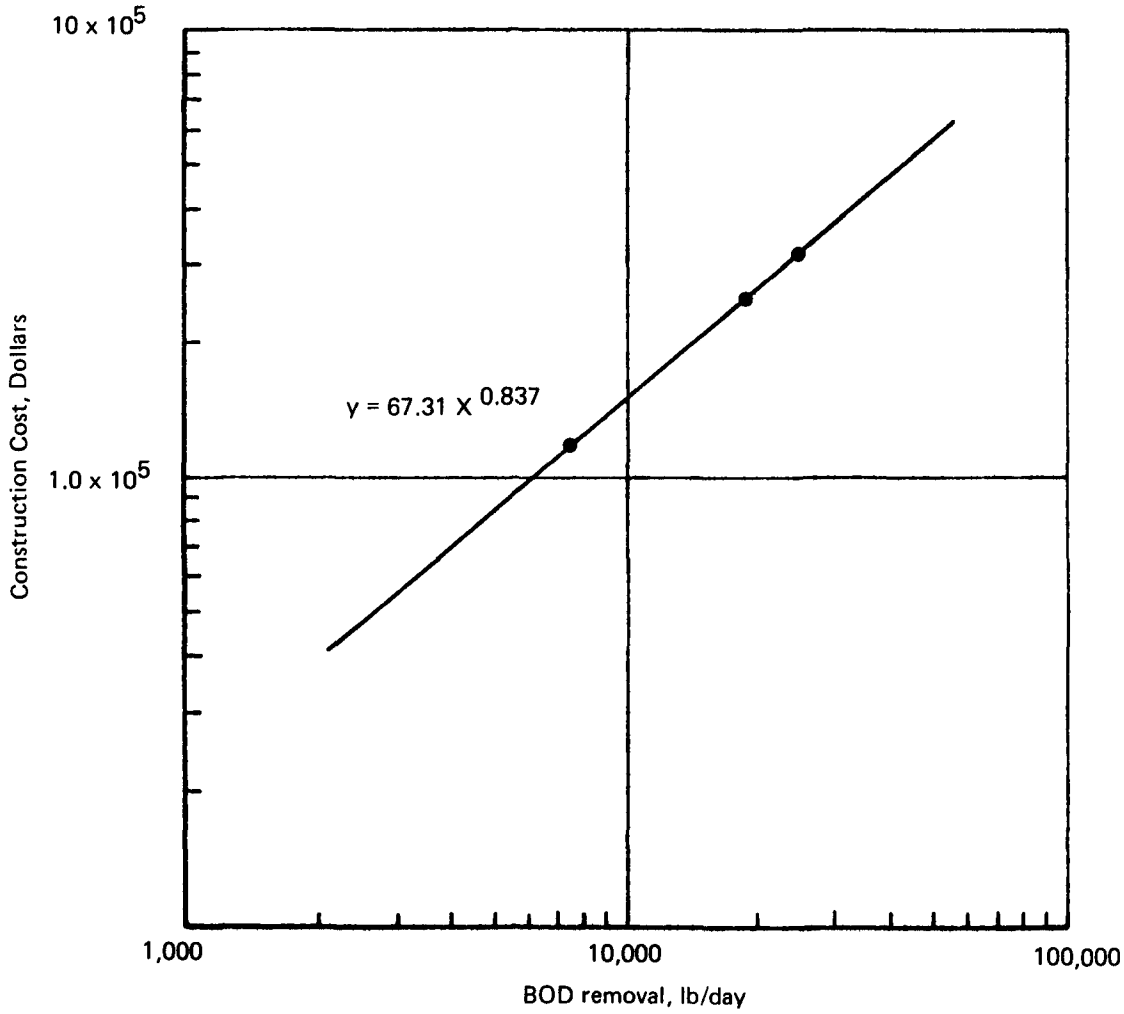


FIGURE A–5 AERATED STABILIZATION BASIN (Aeration Equipment Only)

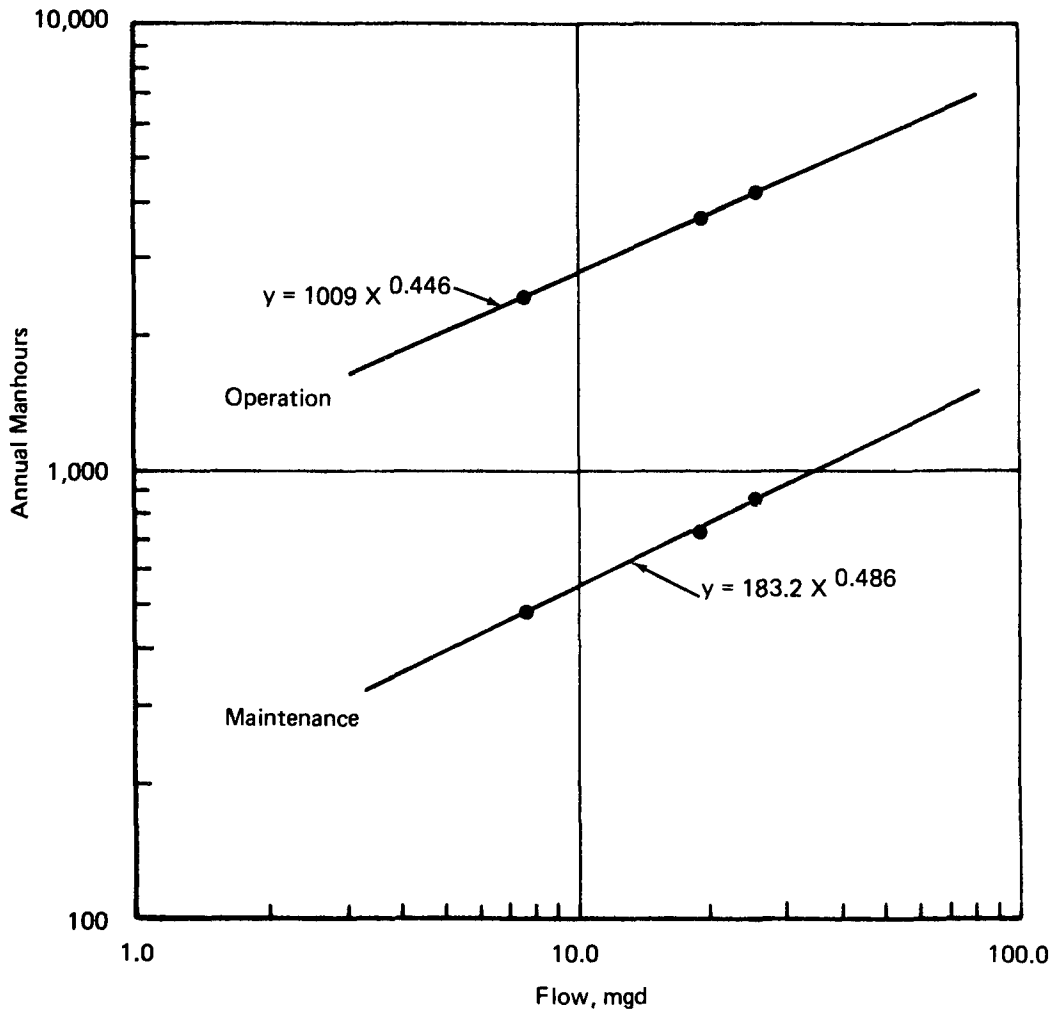


FIGURE A–6 AERATED STABILIZATION BASIN ANNUAL OPERATION AND MAINTENANCE LABOR

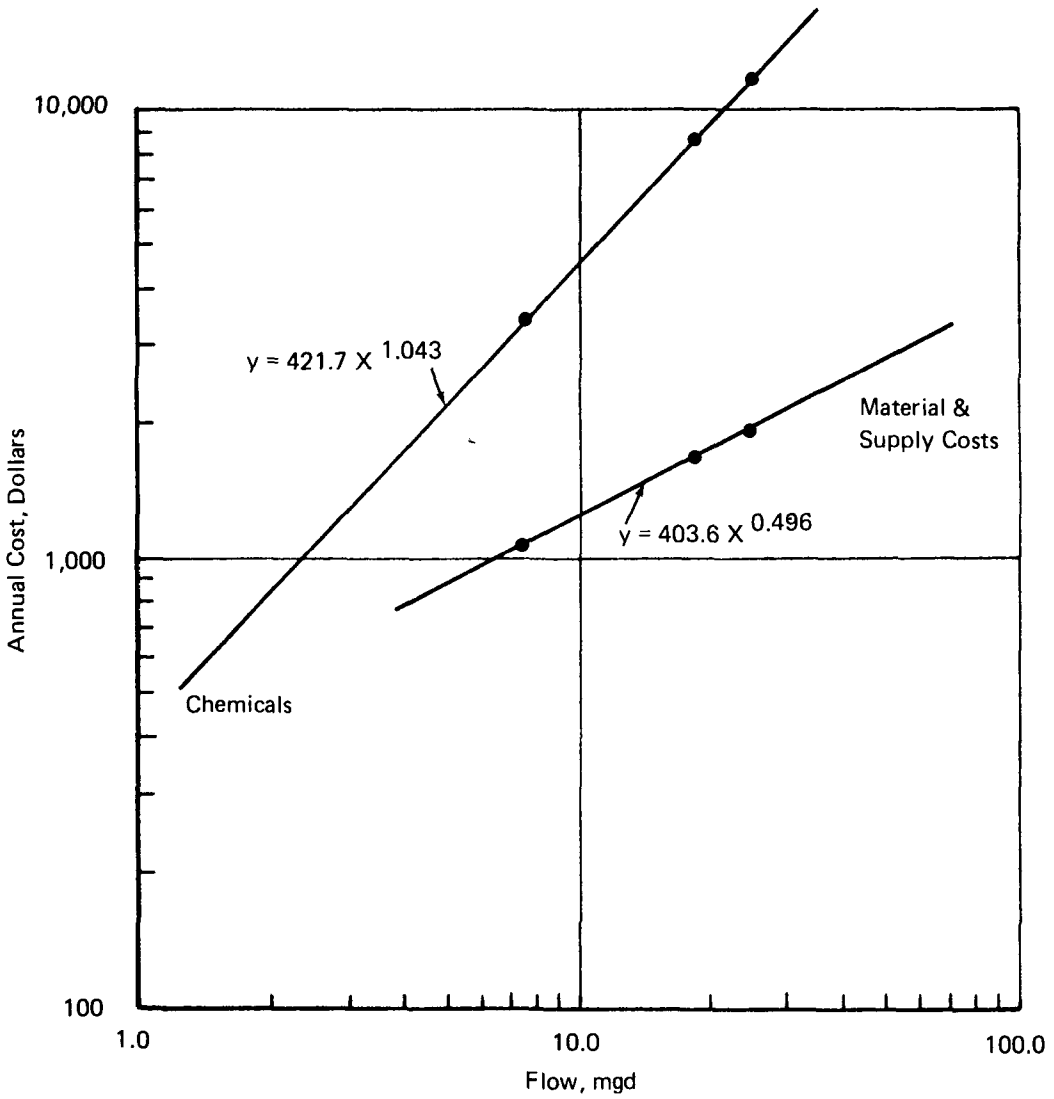


FIGURE A–7 AERATED STABILIZATION BASIN
1. Material and Supply Costs
2. Chemical Costs

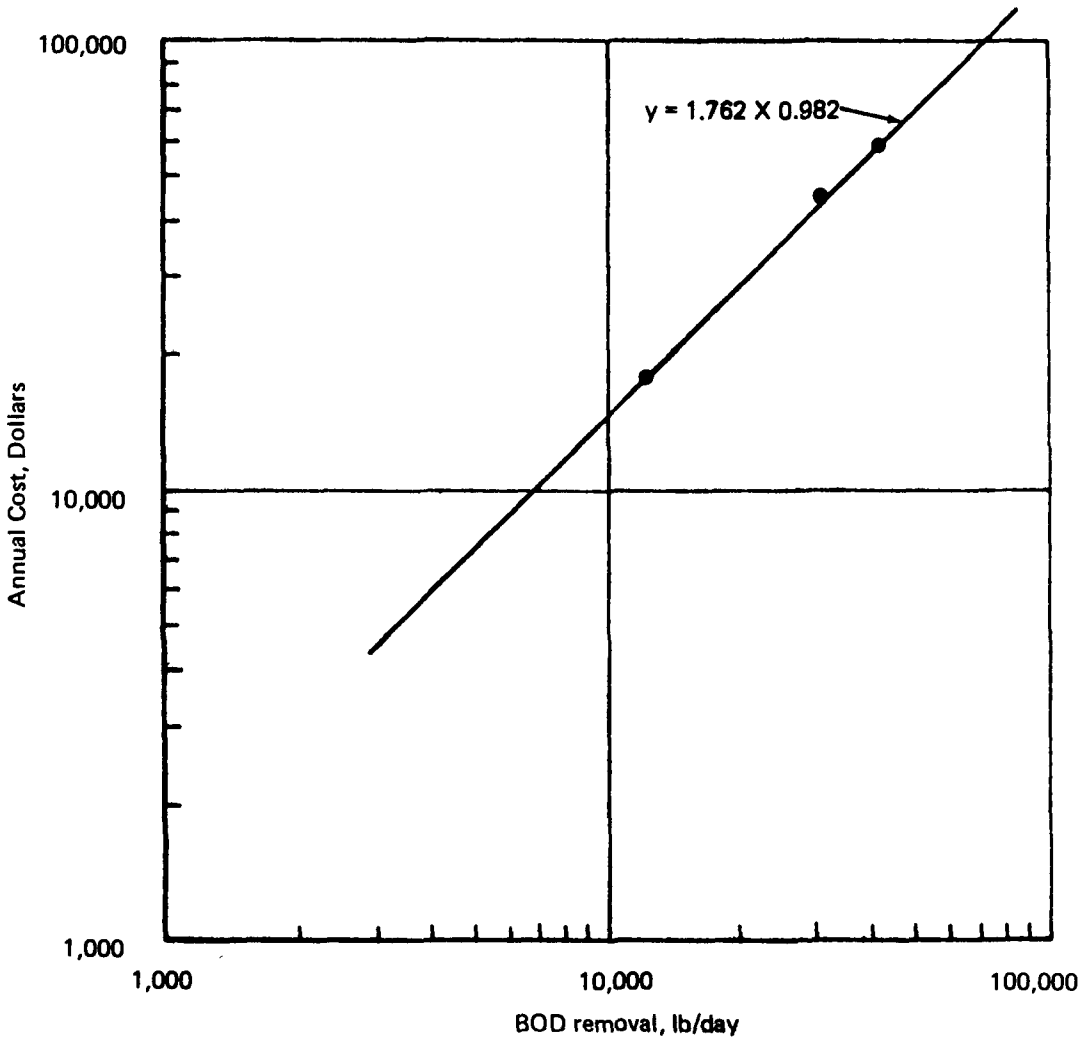


FIGURE A–8 AERATION EQUIPMENT ANNUAL POWER COSTS
Aerated Stabilization Basin

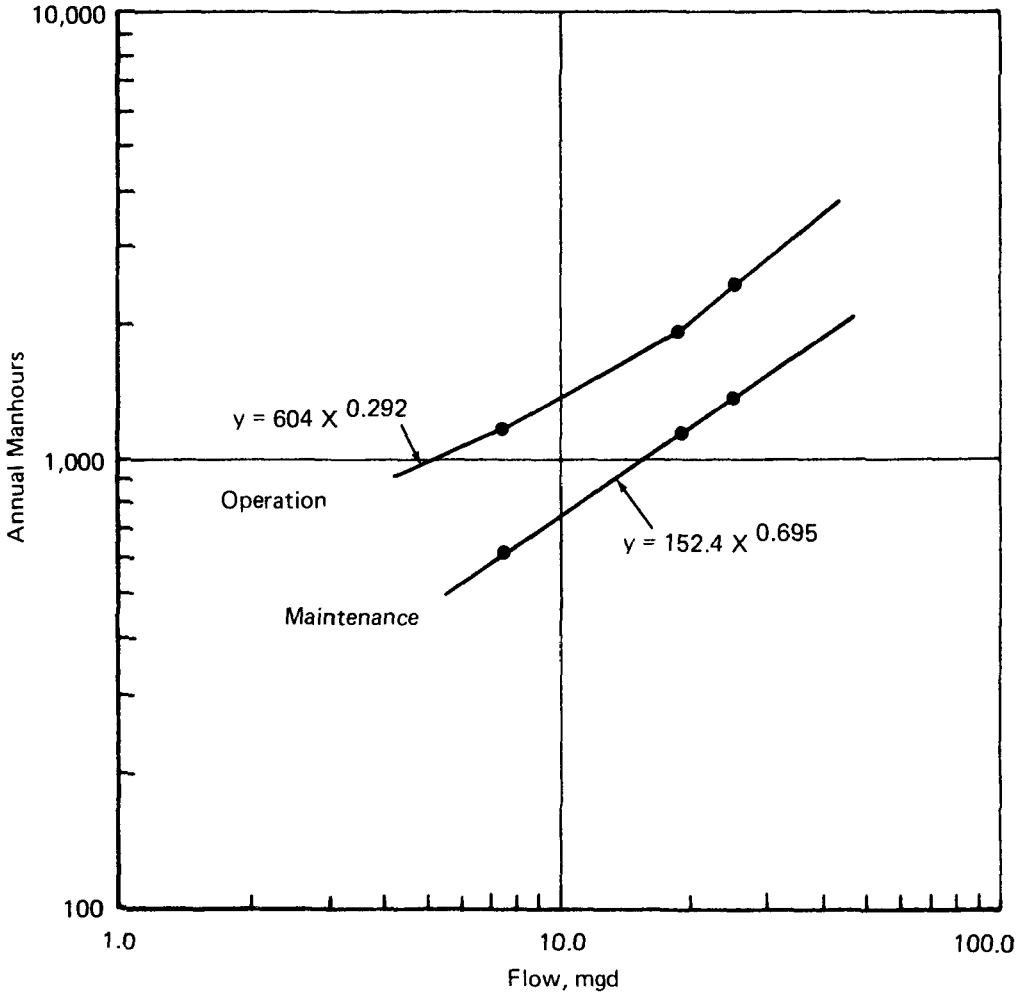


FIGURE A–9 CLARIFIER, ANNUAL OPERATION AND MAINTENANCE LABOR

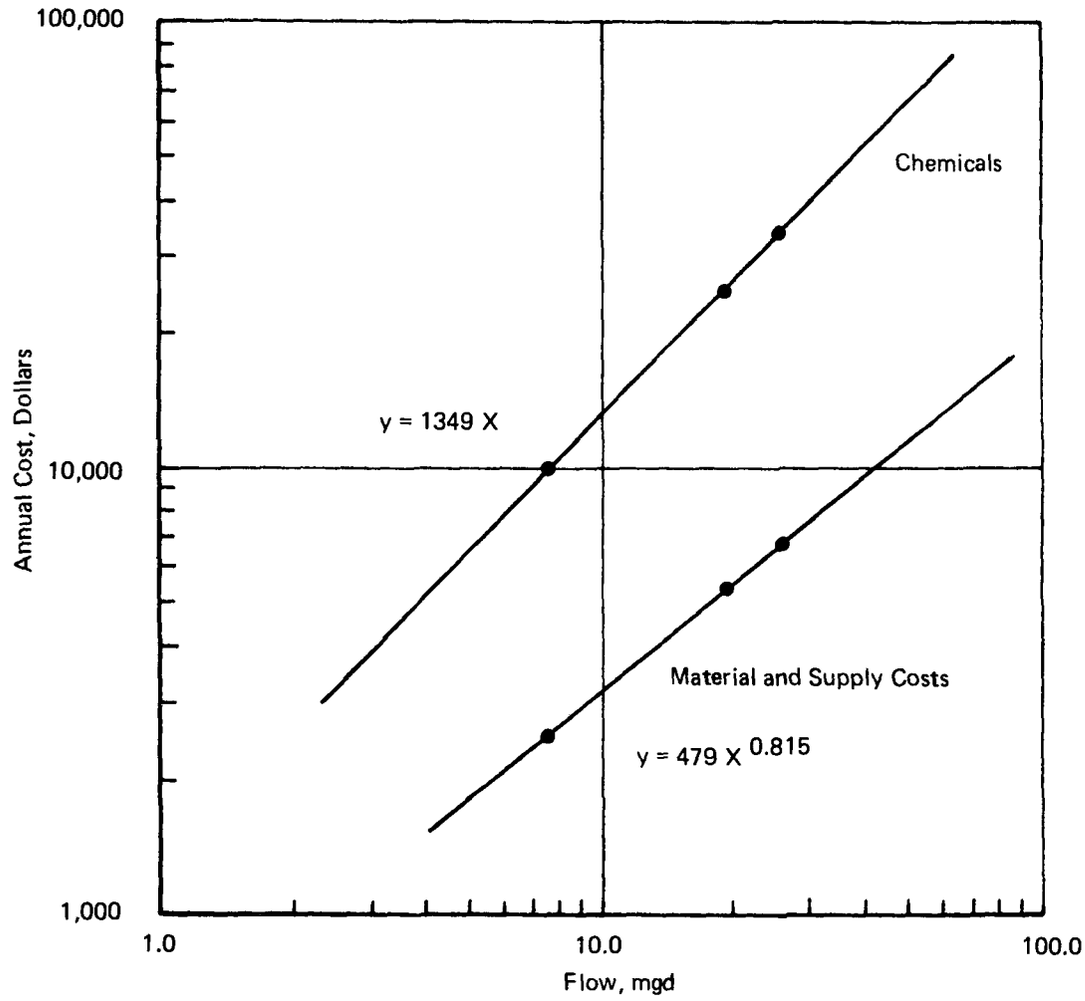


FIGURE A–10 CLARIFIER

1. **Material and Supply Costs**
2. **Major Chemical Costs**

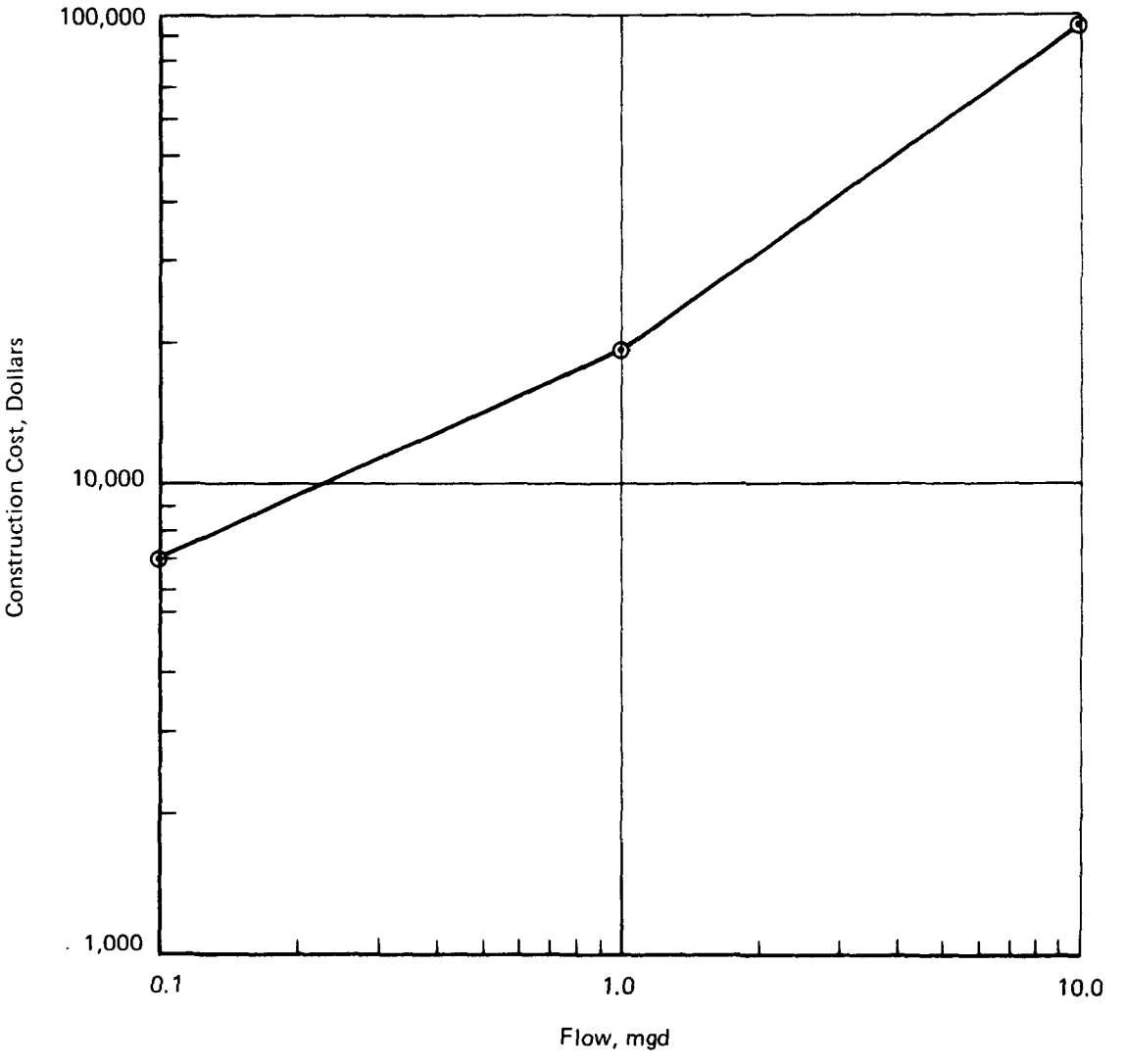


FIGURE A–11 CONSTRUCTION COST – THREE-DAY NON-AERATED LAGOON

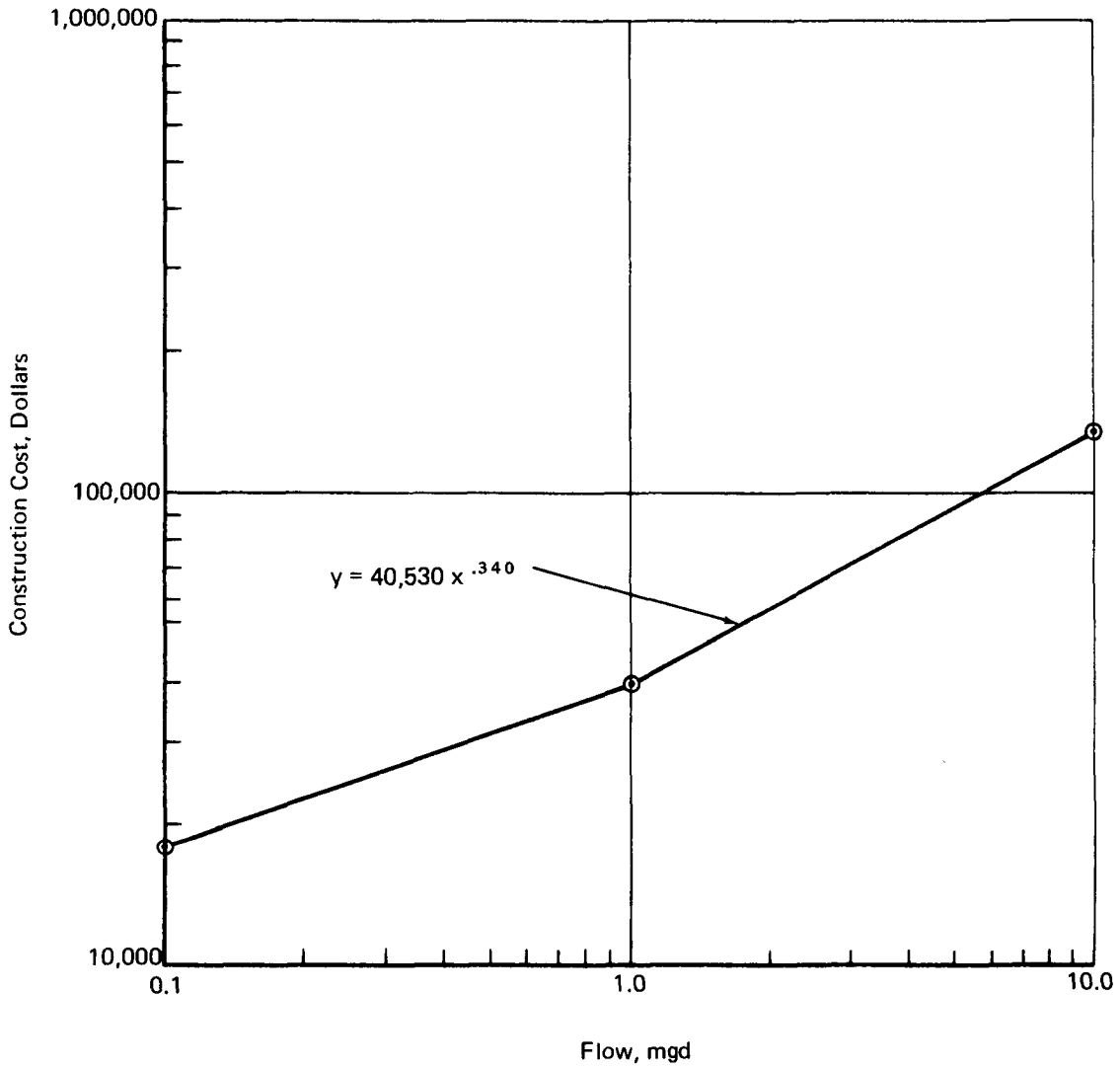


FIGURE A–12 CHLORINATION – CONSTRUCTION COSTS
(Aerated Stabilization Basin System)

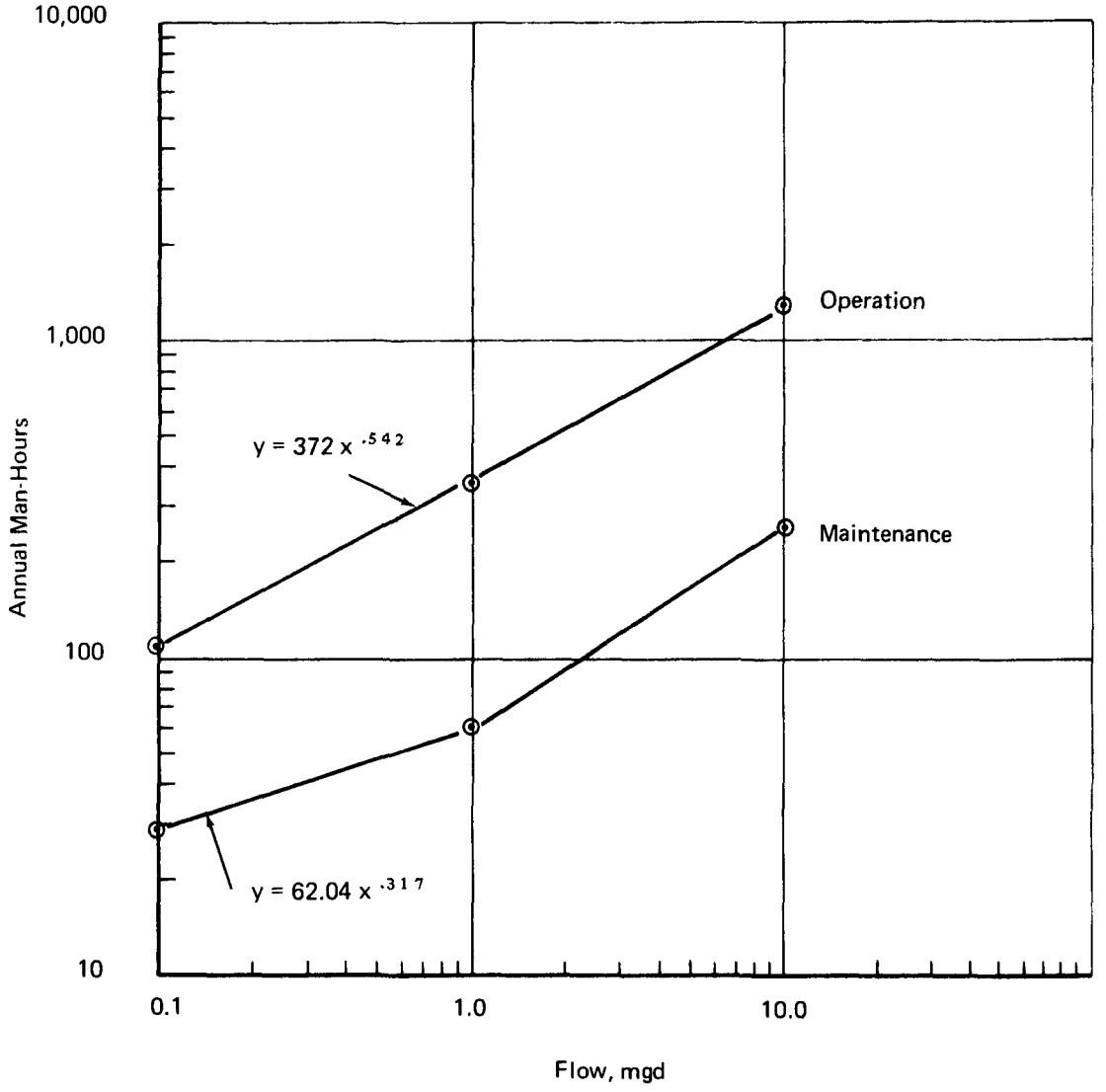


FIGURE A–13 CHLORINATION – ANNUAL OPERATION AND MAINTENANCE LABOR

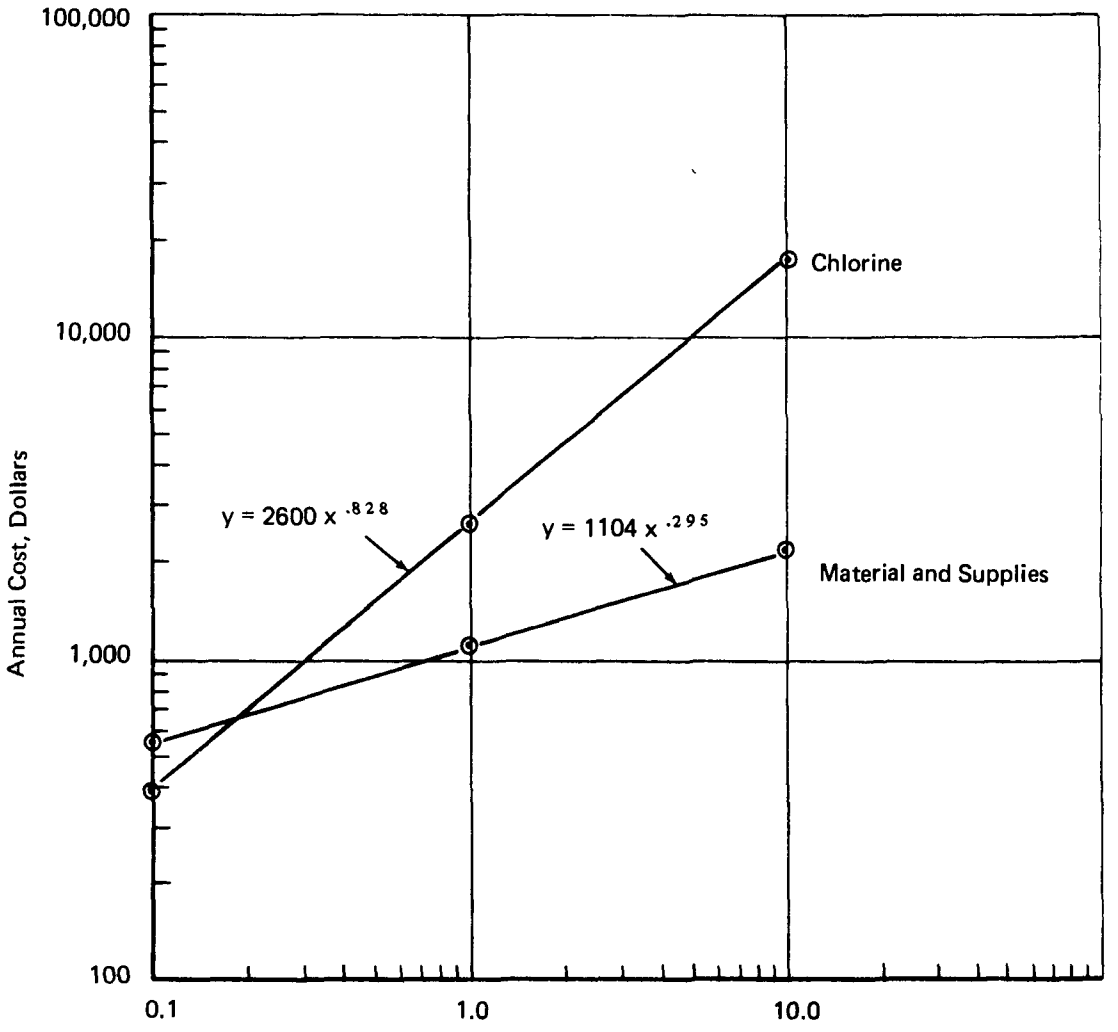


FIGURE A–14 CHLORINATION – CHEMICALS AND MATERIAL AND SUPPLIES

Costs for representative plants in industry categories were developed using these curves and assuming an aerated stabilization basin, which is widely used by the industry when land is readily available. The following items were determined for the individual treatment steps:

(1) Construction cost as a function of hydraulic load at a given pollutant level;

(2) Operating and maintenance labor as a function of hydraulic load;

(3) Chemical requirements as a function of hydraulic and pollutant load;

(4) Power requirements as a function of hydraulic and pollutant load; and

(5) Additional material and supply cost as a function of hydraulic load.

b. Land-Limited Waste Treatment. For those plants with only limited space available, extended aeration and lagoon systems are inapplicable, and a model based on high-rate activated sludge has thus been developed. No textile plants currently are using this system, so the model necessarily had to be developed using data from other industries. Unit operation includes equalization, primary and secondary sludge handling, and an activated sludge unit. Effective BOD_5 removal is achieved through increased nutrient addition and residence time in the activated sludge unit. Sludge production is greater than in regular secondary treatment, and thus sludge handling becomes a major contributor to capital investment. A schematic flow diagram of the process steps is presented as Figure A-15. Cost curves developed for the cost model are presented in Figures A-16 through A-26. A description of the design elements in the model is provided below.

(1) Equalization. The cost is based on one-half day retention to protect the following system components from upsets. This includes the cost of a stirring mechanism and pumps where necessary.

(2) Primary Sludge Handling from Primary Clarifier.

(a) Primary Sludge Pumping. A common design includes a sludge pumping station for each pair of sedimentation basins. Each station is equipped with three pumps: one sludge pump for each basin and a single scum pump. They are identical and their piped installed capacity is 150 percent of firm capacity. Total construction costs include normal earth work, station structures, piping and pumping equipment, electrical, ventilating and heating.

(b) Solids Holding Tank. One-day capacity for primary sludge.

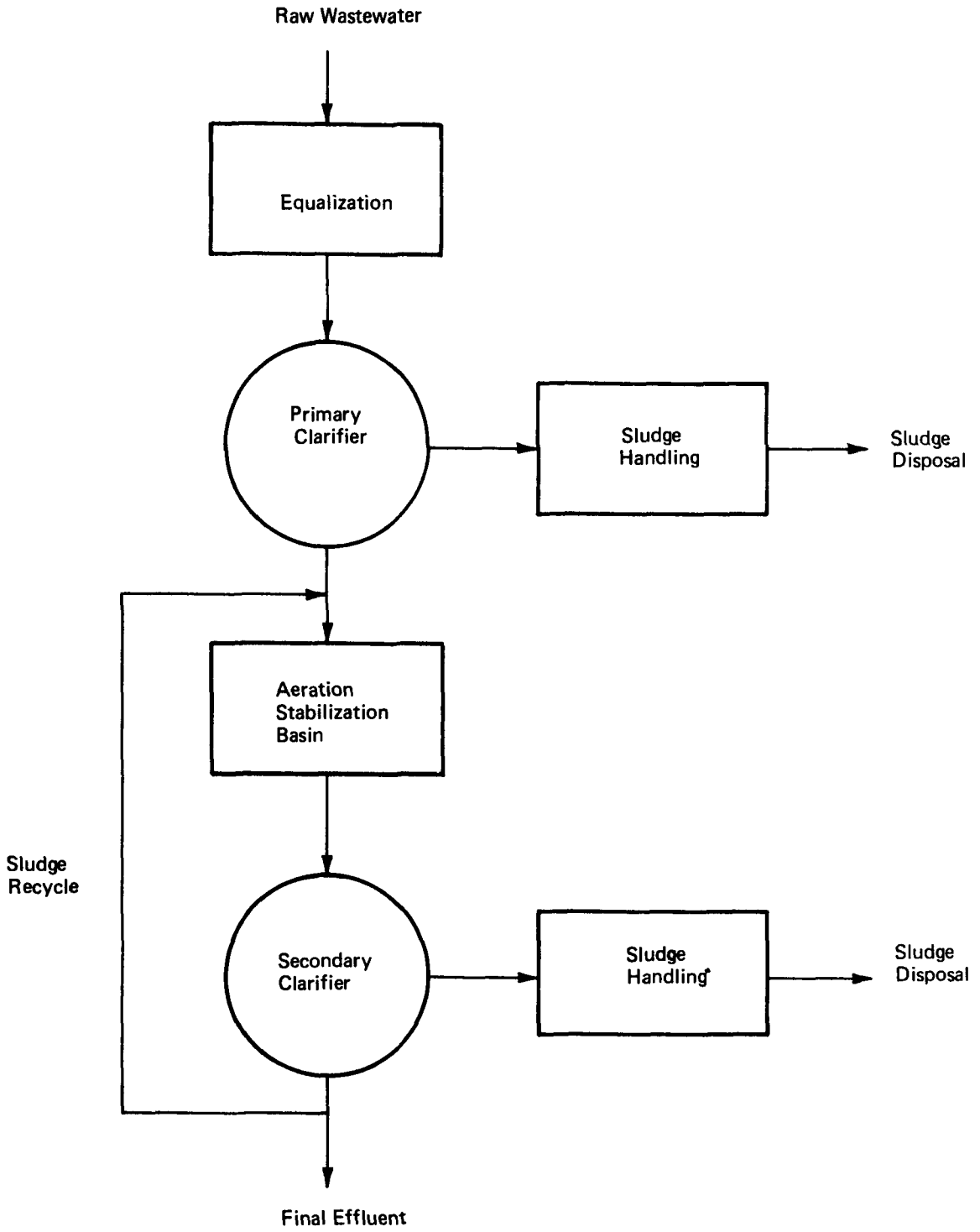


FIGURE A-15 SCHEMATIC FLOW DIAGRAM OF PROCESS STEPS AND COST CENTERS FOR HIGH-RATE ACTIVATED SLUDGE

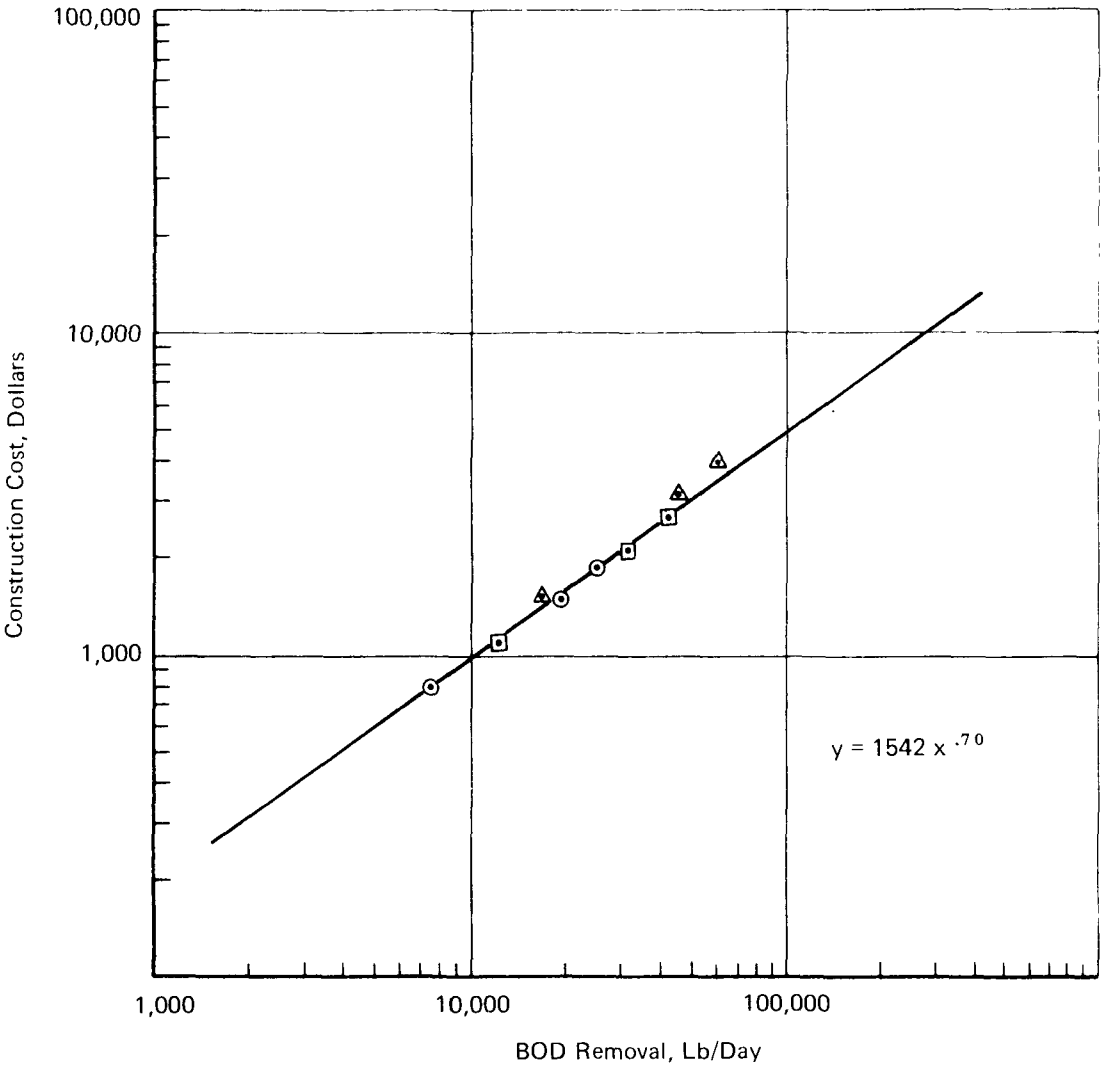


FIGURE A–16 CONSTRUCTION – ACTIVATED SLUDGE UNIT PROCESS

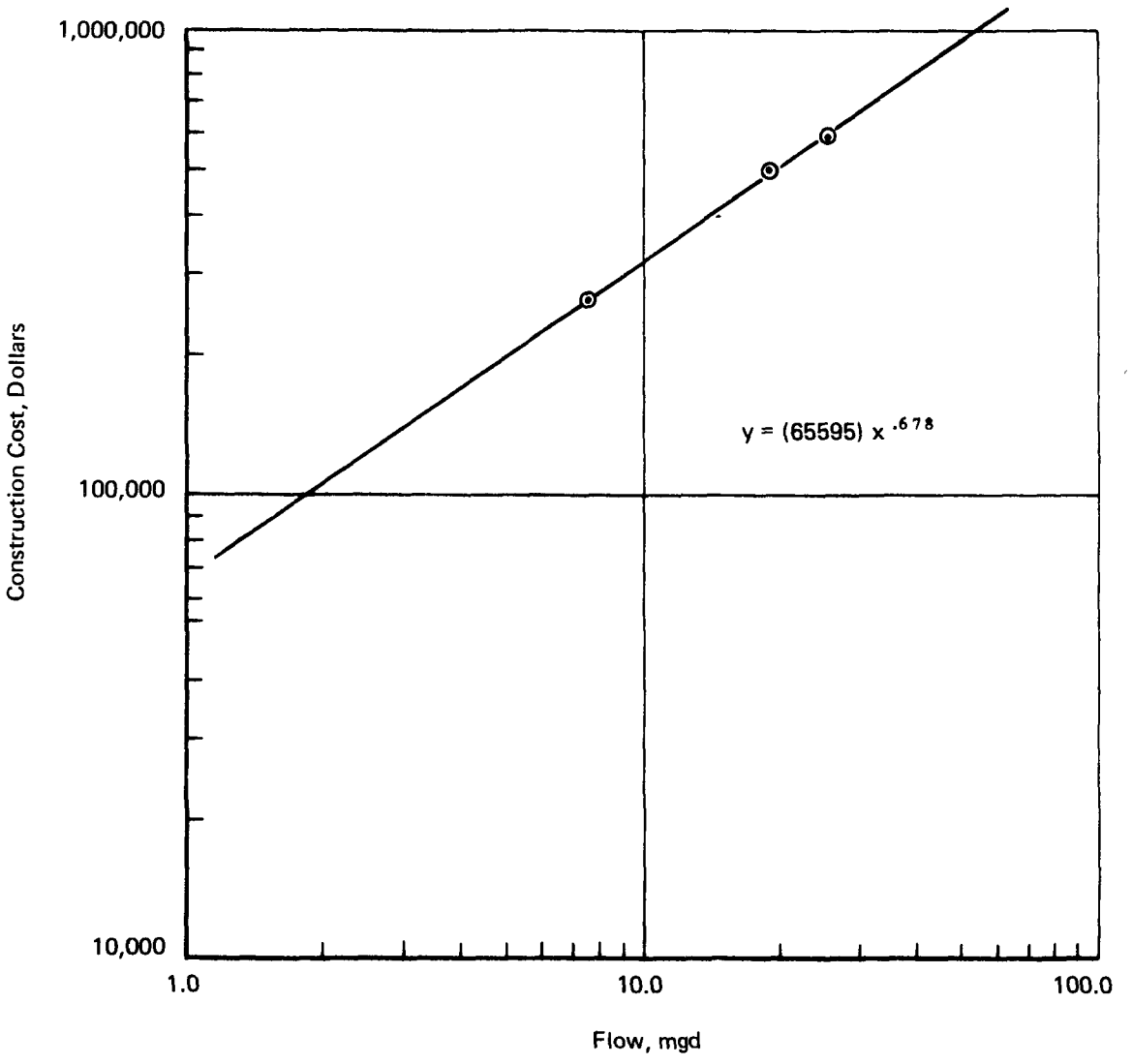


FIGURE A–17 CONSTRUCTION – EQUALIZATION

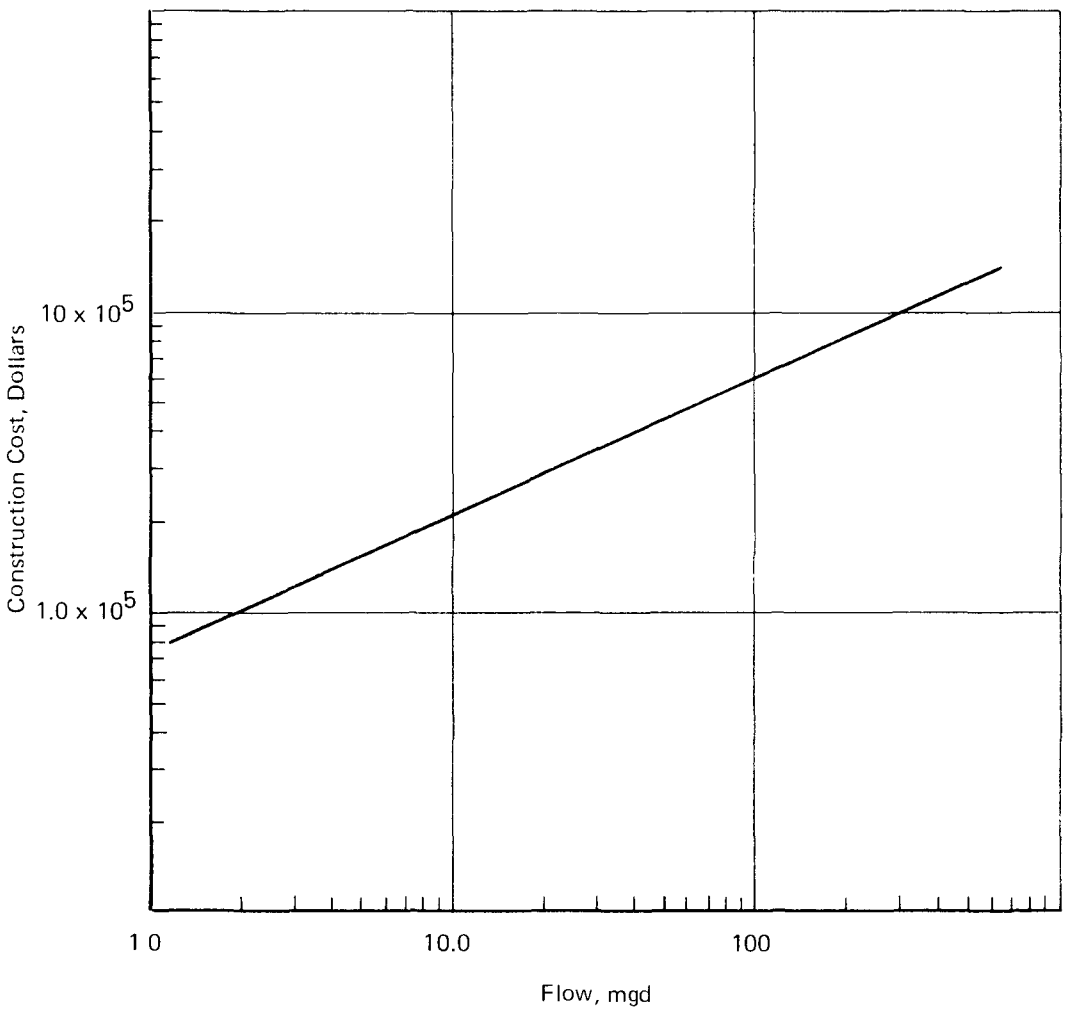


FIGURE A–18 SLUDGE HANDLING – CONSTRUCTION COST

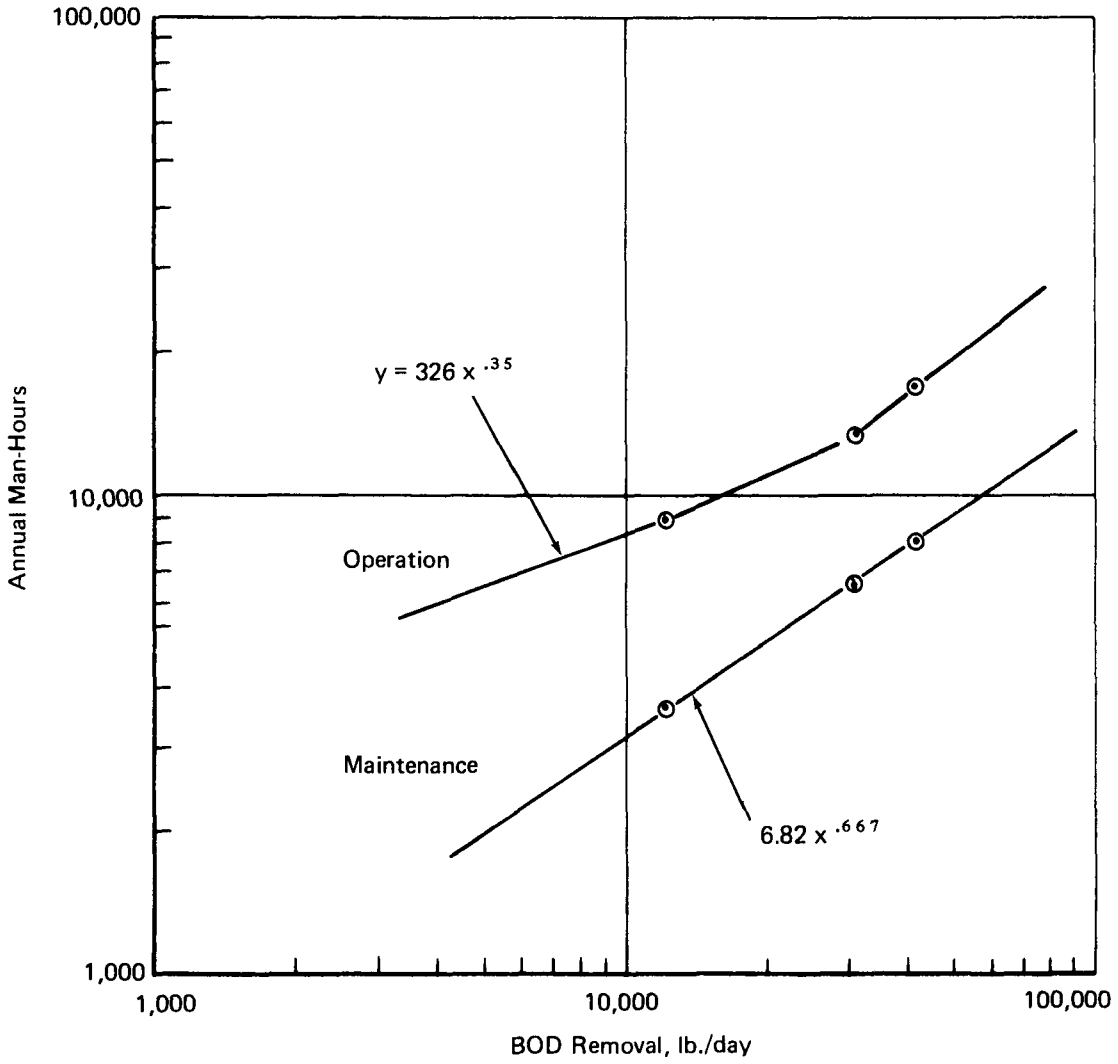


FIGURE A–19 ANNUAL OPERATION AND MAINTENANCE LABOR – ACTIVATED SLUDGE UNIT PROCESS

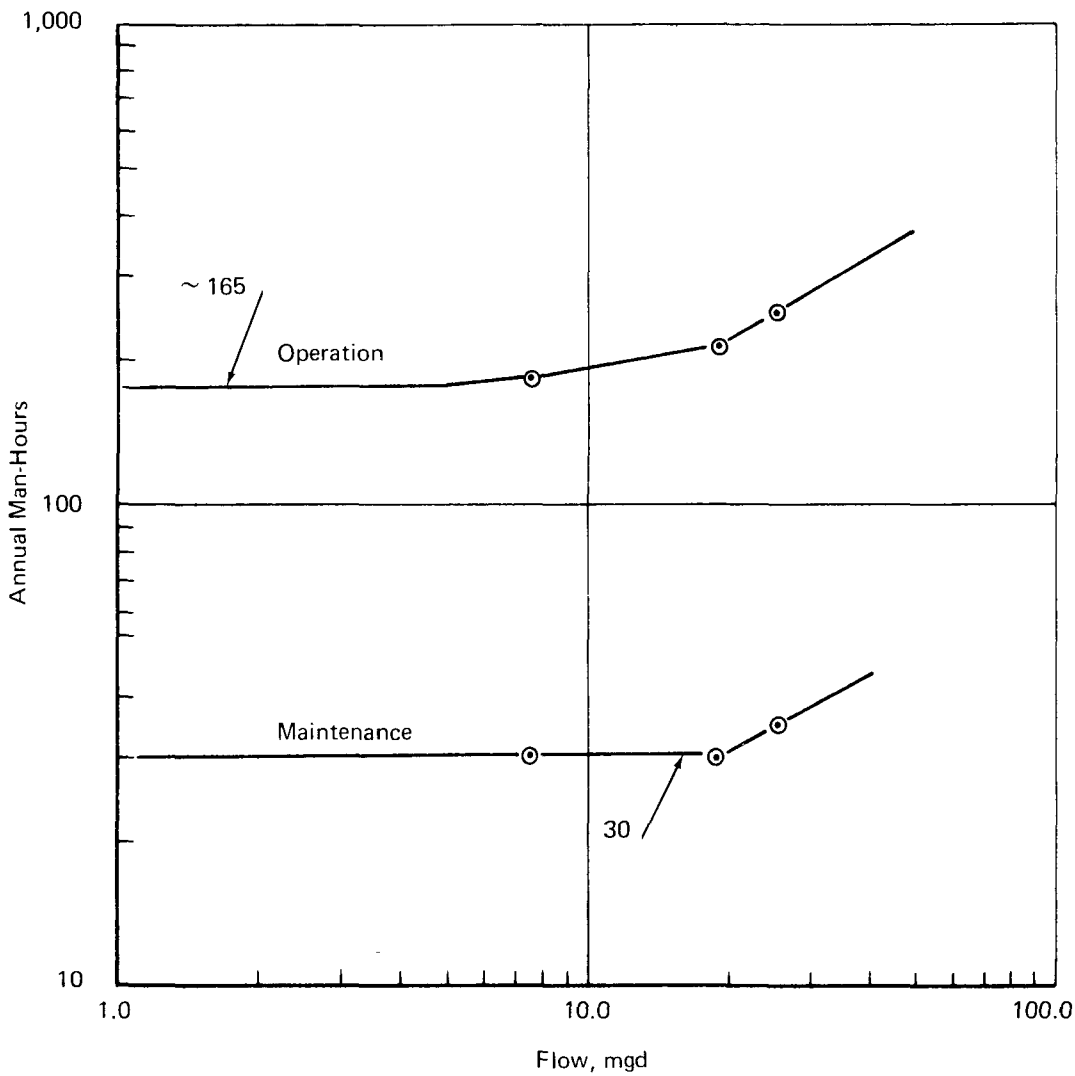


FIGURE A–20 ANNUAL OPERATION AND MAINTENANCE LABOR – EQUALIZATION

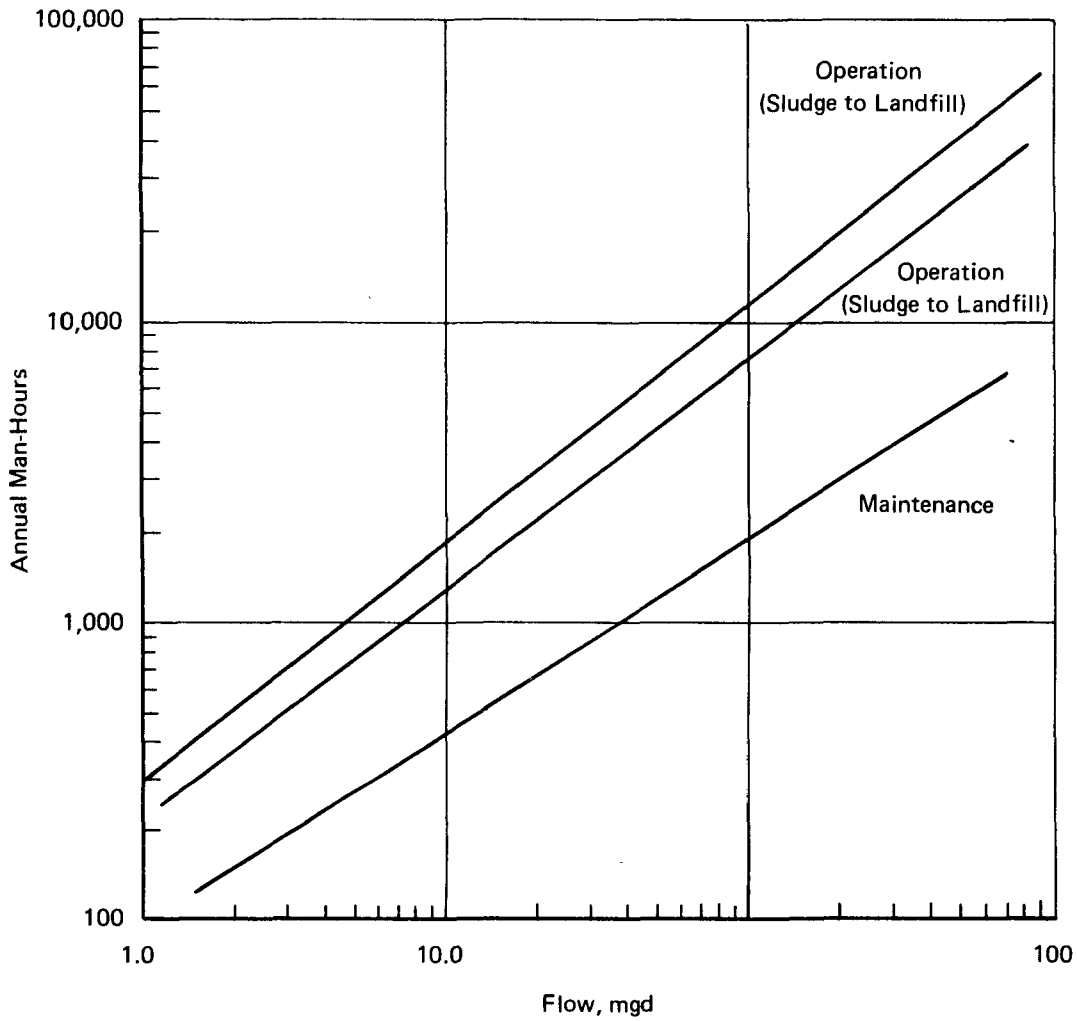


FIGURE A–21 SLUDGE HANDLING – OPERATION AND MAINTENANCE

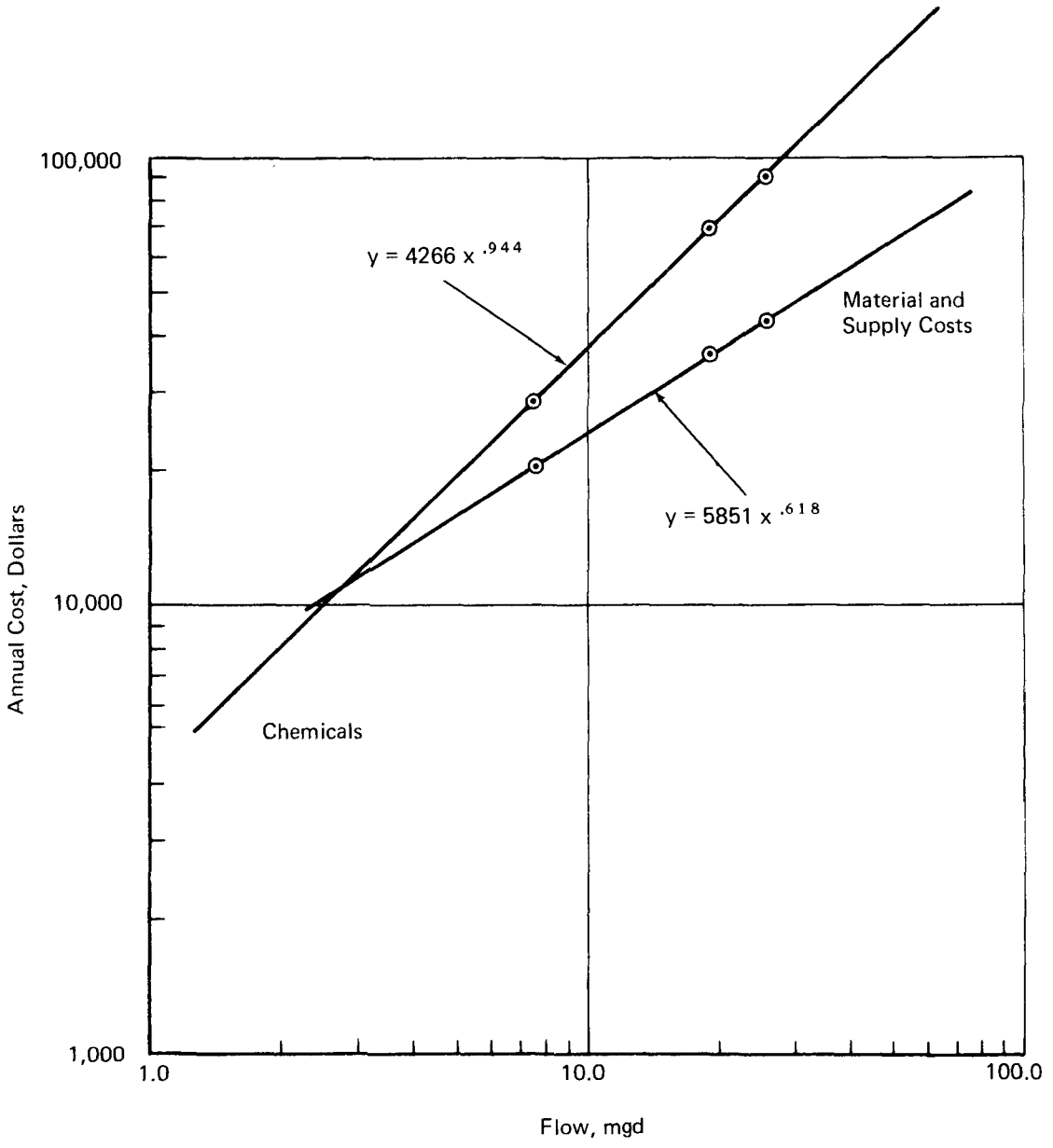


FIGURE A–22 ACTIVATED SLUDGE UNIT PROCESS COSTS
1. Material and Supply Costs
2. Chemical Costs

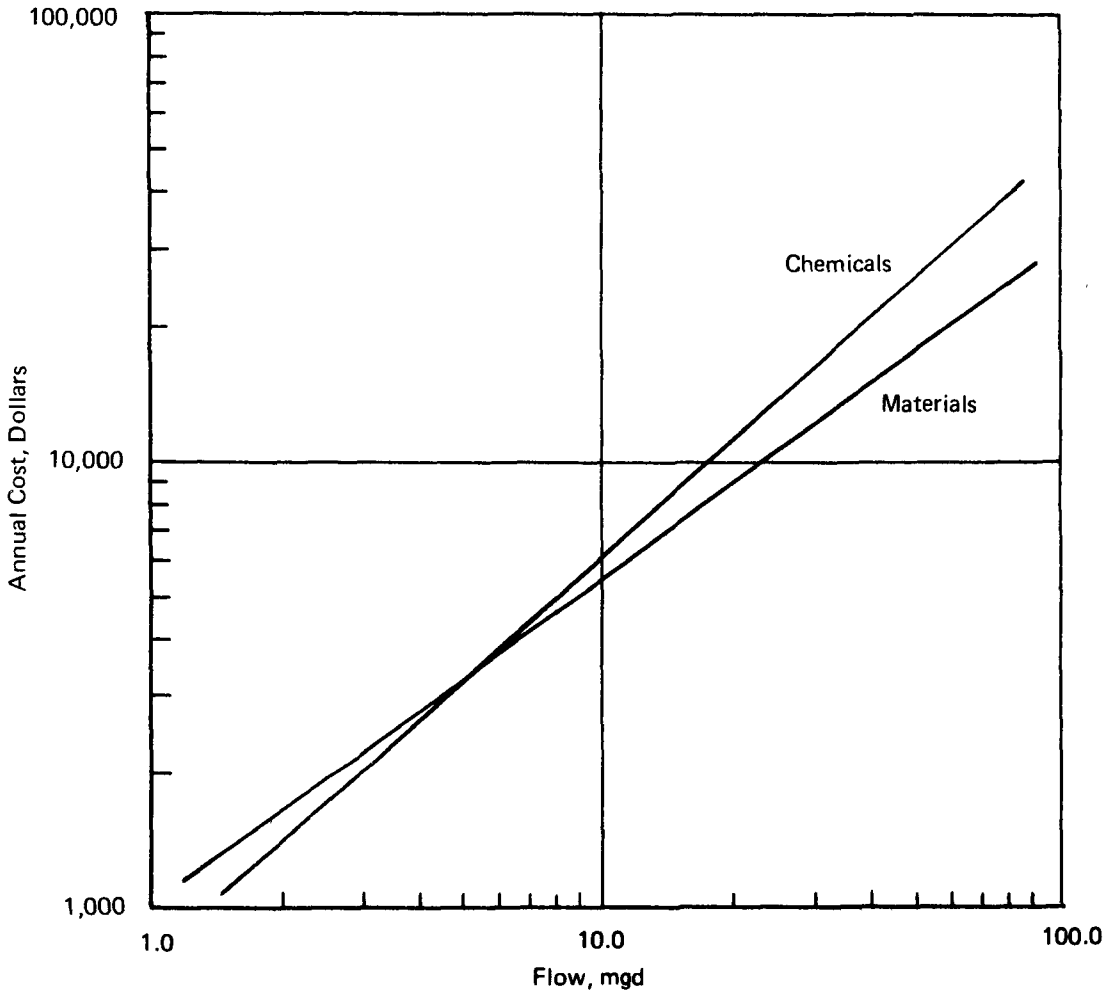


FIGURE A–23 SLUDGE HANDLING – MATERIAL AND SUPPLY COSTS – MAJOR CHEMICAL COSTS

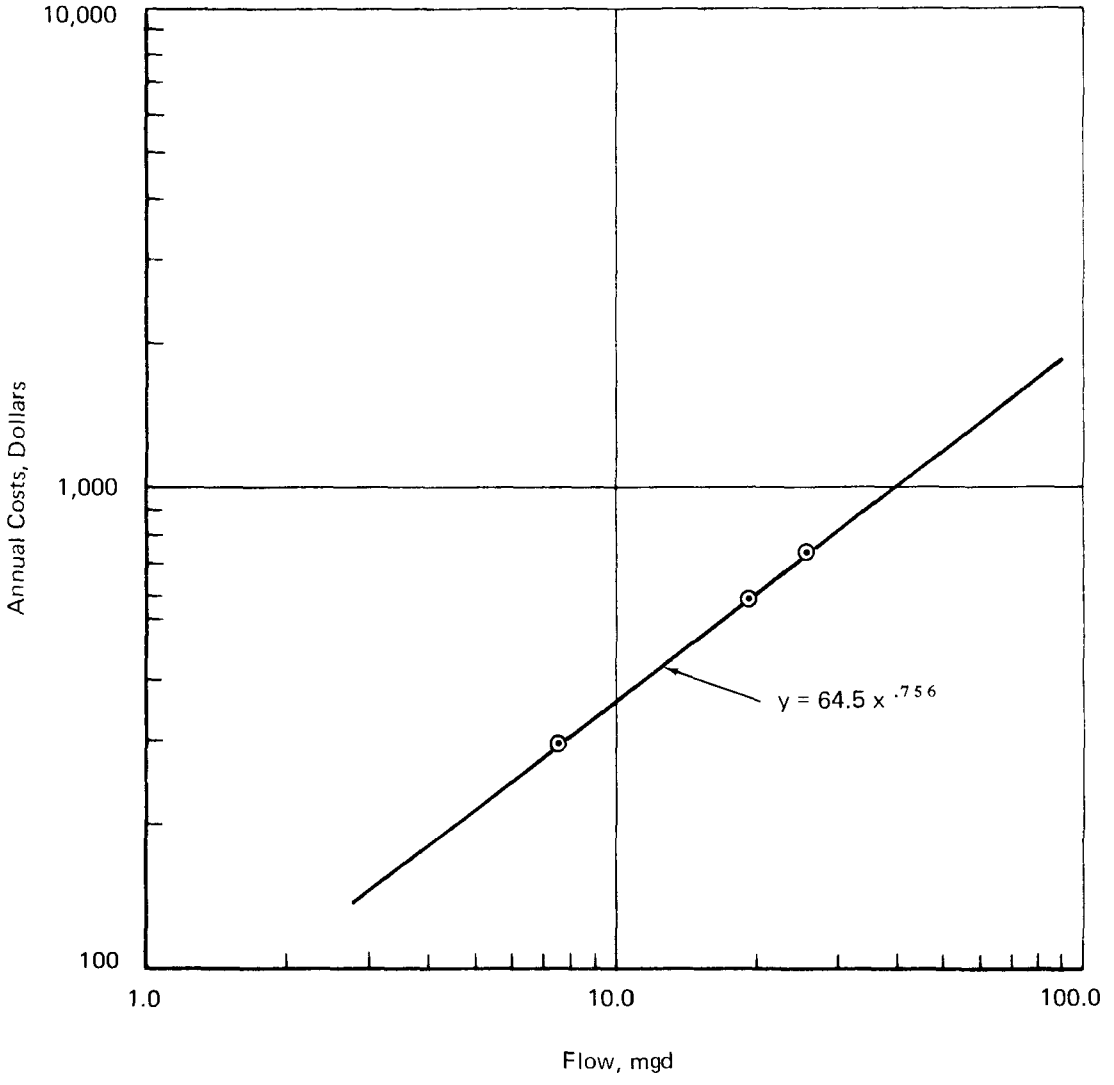


FIGURE A–24 ANNUAL MATERIAL AND SUPPLY COSTS – EQUALIZATION

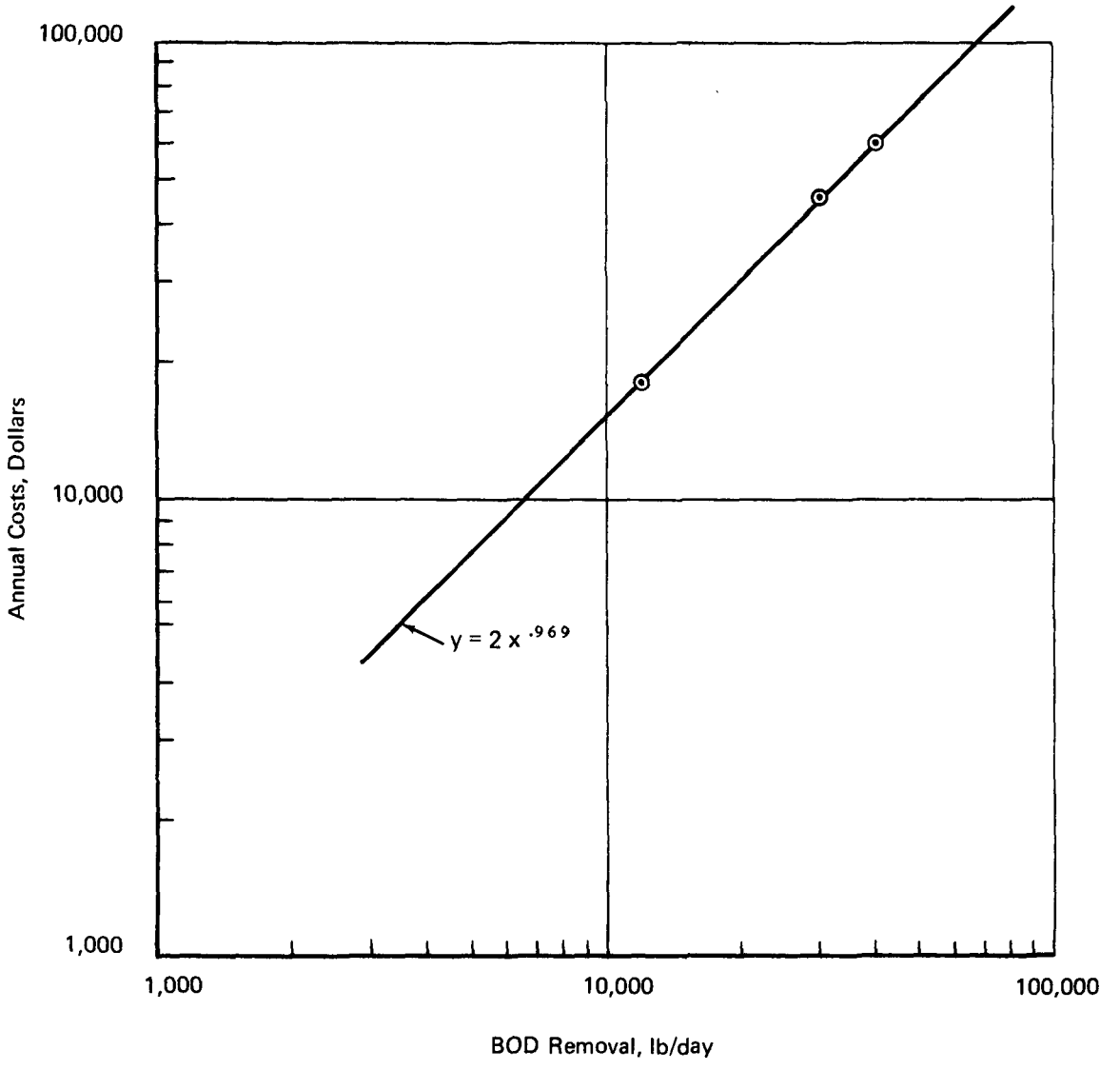


FIGURE A–25 ANNUAL POWER COSTS – AERATION EQUIPMENT – ACTIVATED SLUDGE

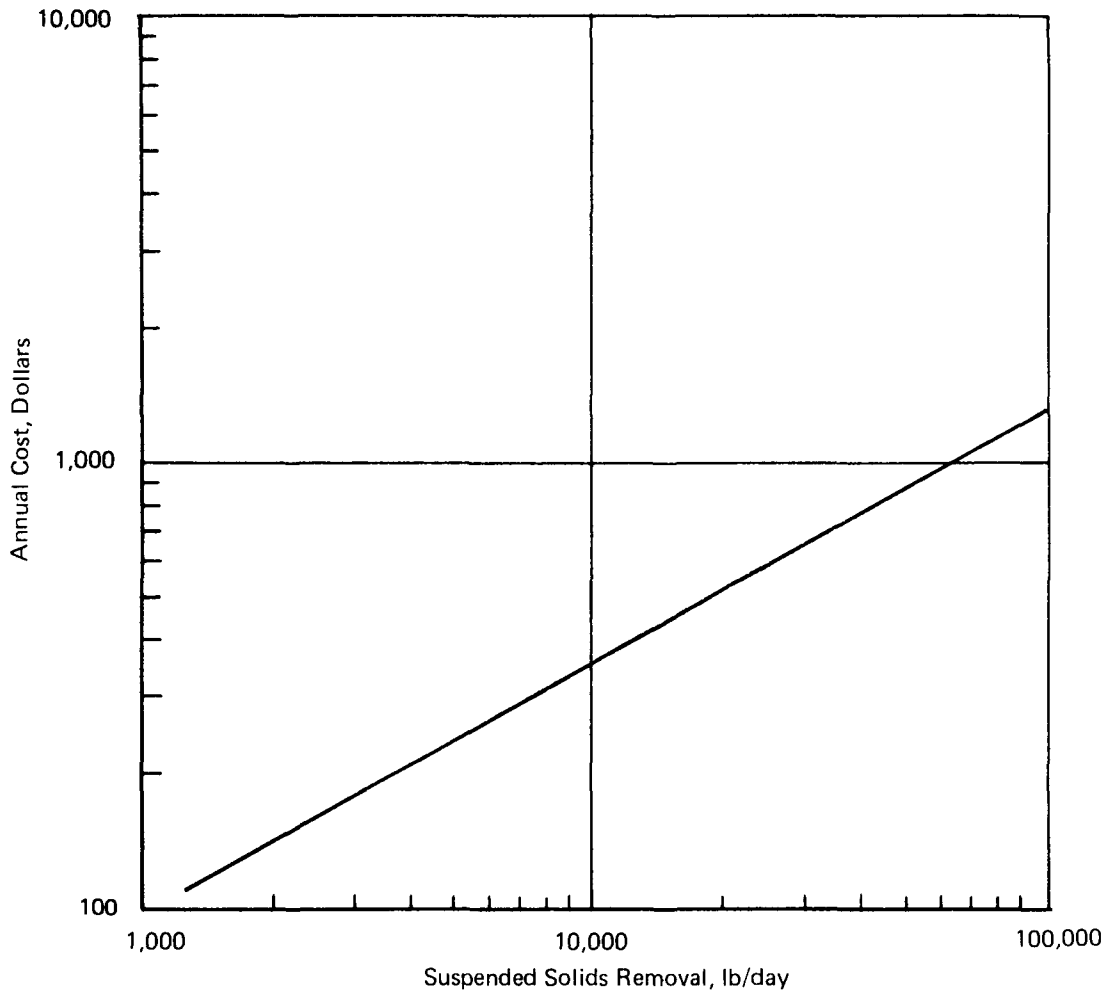


FIGURE A-26 SLUDGE HANDLING – ANNUAL POWER COSTS

(c) Centrifugation for Dewatering Sludge. The costs include centrifugation equipment, sludge pumps and piping, sludge cake conveyors, equipment hoists, electrical facilities, and an enclosing structure. Capacity used here is the total installed capacity with one centrifuge inoperative.

(3) Activated Sludge. The costs of the aeration basin (50 lb BOD/1000 ft^3 aeration basin/day) include normal structure related costs and exclude costs of aeration equipment.

The costs are for mechanical aeration equipment (2-lb O_2/horsepower). Good design practice dictates that the total be divided between two or more aerator units. In addition, a complete spare unit is provided. Costs include the aerator motor, gearbox, impeller, draft tube, supporting structure, and applicable electrical work.

Costs for a nutrient feed system – continuous operations (nitrogen at 0.8 lb/20 lb BOD, and phosphorus at 0.5 lb/100 lb BOD) include feed and handling equipment, feed building, storage building. The secondary clarifier has an overflow rate of 400 gpd/ft^2, and the secondary sludge handling includes pumping, holding, and centrifugation.

c. Municipal Treatment. To comply with the proposed Level I guidelines, textile mills may also send their wastewater to a municipal treatment facility. In doing so, certain pretreatment steps would be necessary, including screening and an eight-hour retention basin. The cost of treating the wastewater municipally can be added to the pretreatment costs. A cost schedule has been developed for treatment of wastewater in a municipal system within two size ranges. On a cents/1000 gal basis, this additional cost would be $0.39 for a 10- to 20-mgd plant and $0.63 for a 1- to 3-mgd plant. Figures A-27 through A-30 are the cost curves developed for pretreatment.

2. BEST AVAILABLE TREATMENT TECHNOLOGY (LEVEL II)

The costs for meeting Level II guidelines have been calculated on the assumption that multimedia filtration and/or activated carbon adsorption would enable the plant to meet the guidelines. Those plants specified in the guidlines as having no additional COD requirements in Level II would only be required to install multimedia filtration units to meet the guidelines. The larger plants would be expected to install activated carbon units. Also, because they may find it necessary to put the multimedia filter in the system prior to the carbon unit to avoid blockage problems, this cost has been included in our estimates also.

In determining the costs for the activated carbon adsorption it has been assumed that 60% removal of the COD would be achieved and that the carbon loading would be 0.07 lb COD/lb of carbon at a bed volume per hour flow rate of 0.5, i.e., 120 minutes contact time in the adsorbers. Capital and operating costs have been prepared using the input parameters of millions of gallons per day and pounds of COD per day applied to the activated carbon system. Capital investment and operating costs were based on data from references 3, 4, 5. Figure A-31 shows the process steps involved. Cost curves developed for the cost model are shown in Figures A-32 through A-39.

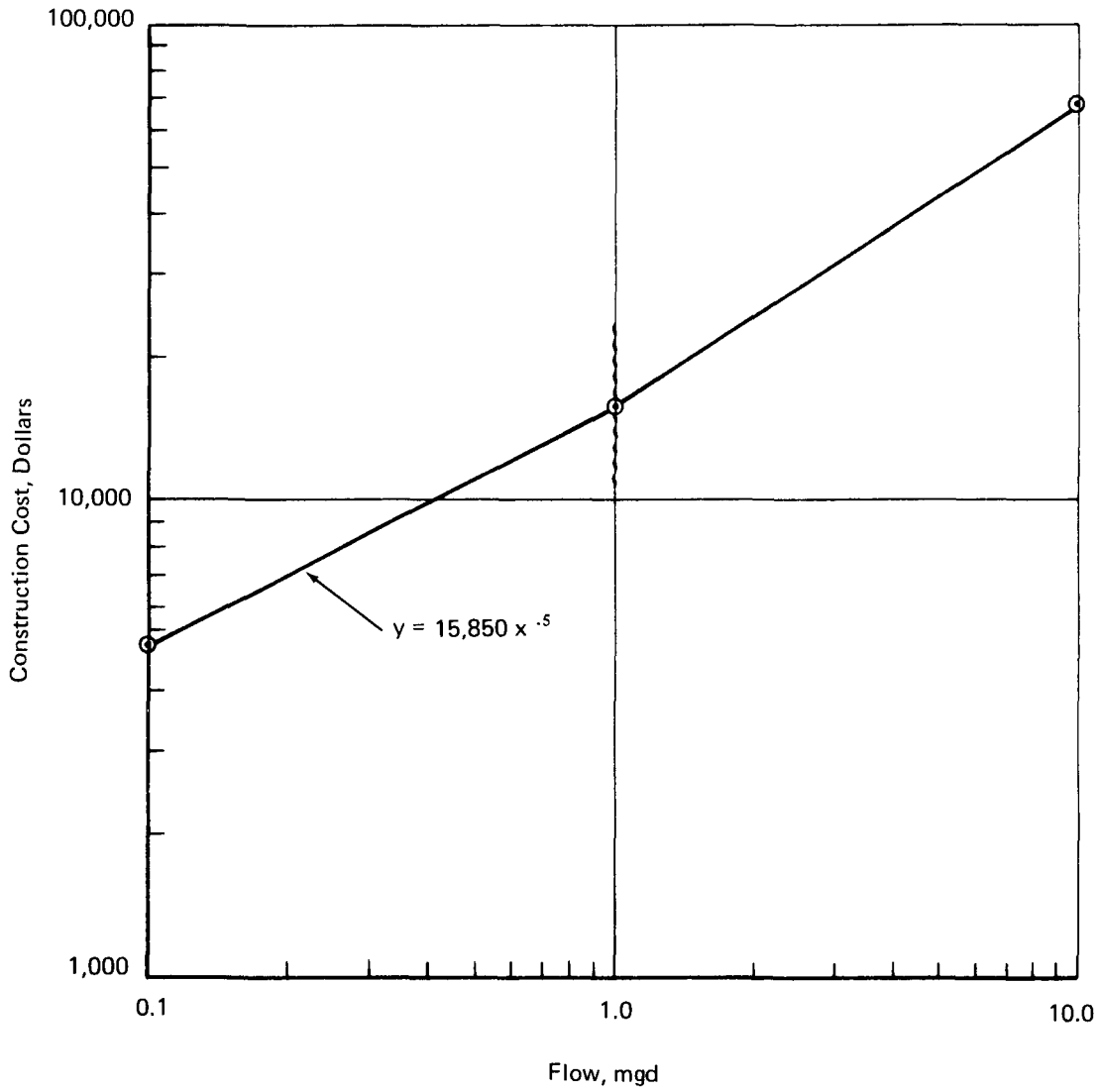


FIGURE A–27 SCREENING PRIOR TO MUNICIPAL TREATMENT (CONSTRUCTION COST)

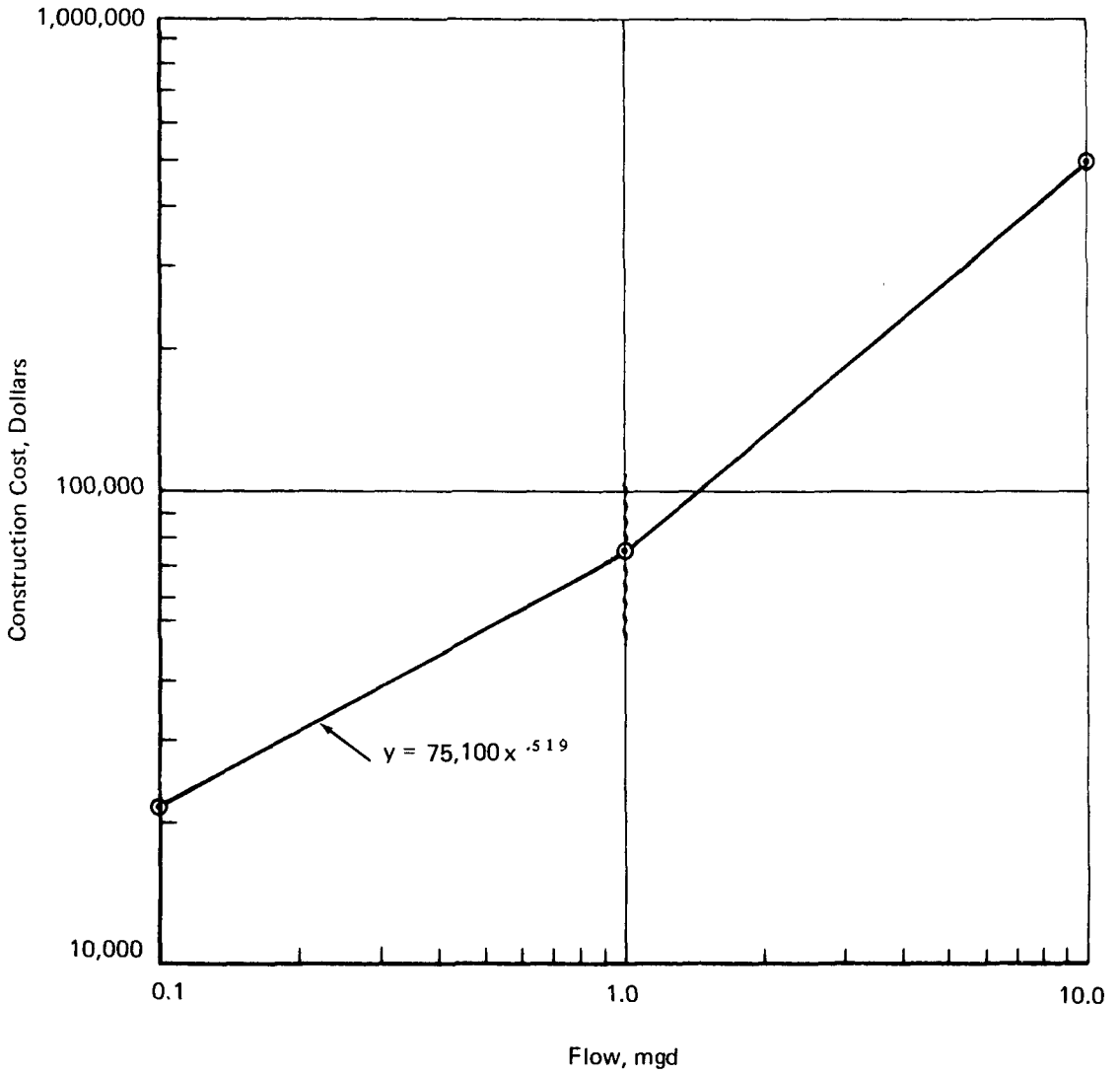


FIGURE A–28 HOLD-UP PRIOR TO MUNICIPAL TREATMENT (8 HOURS) – CONSTRUCTION COST

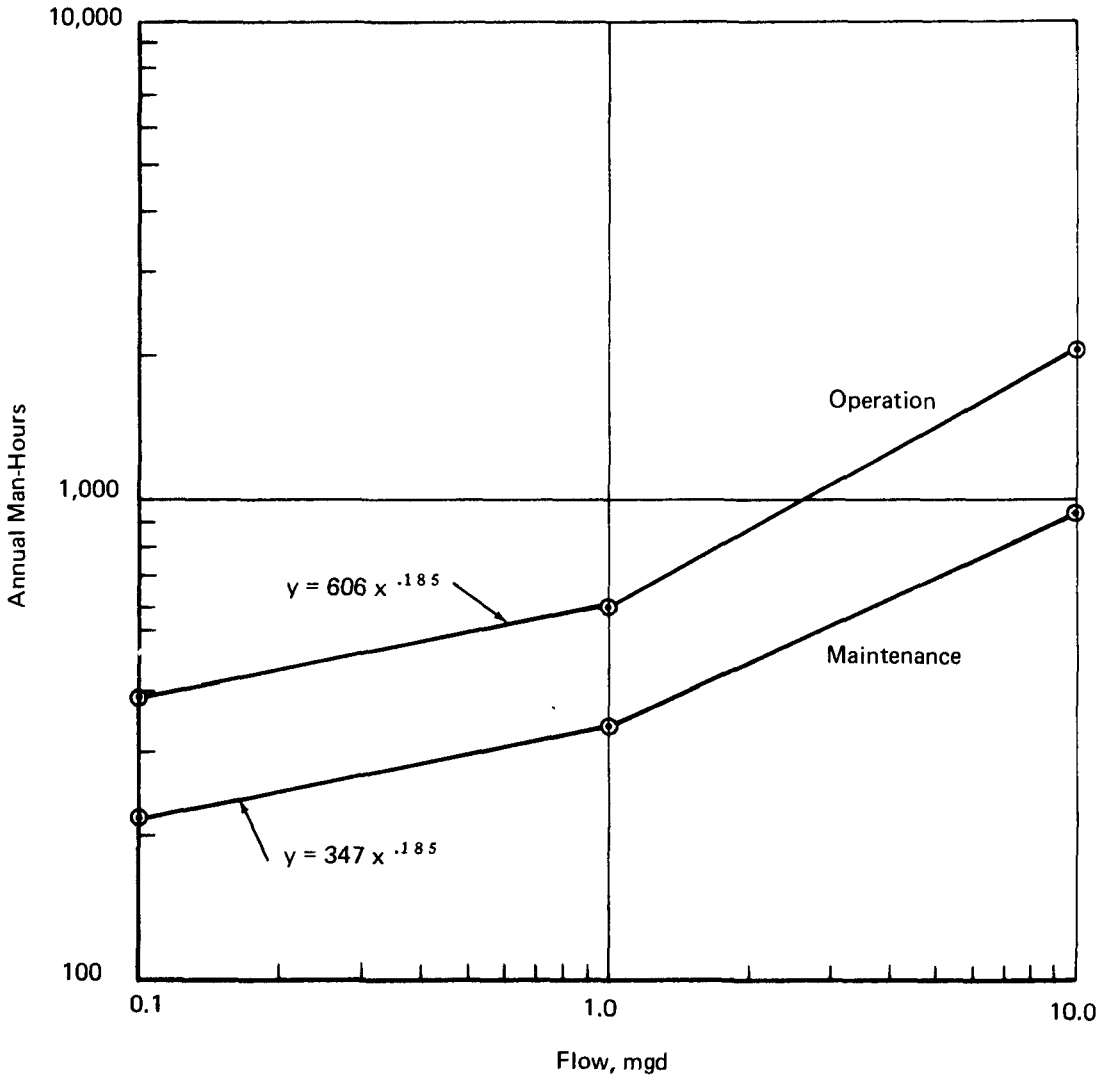


FIGURE A–29 TREATMENT PRIOR TO MUNICIPAL – ANNUAL LABOR MAN-HOURS

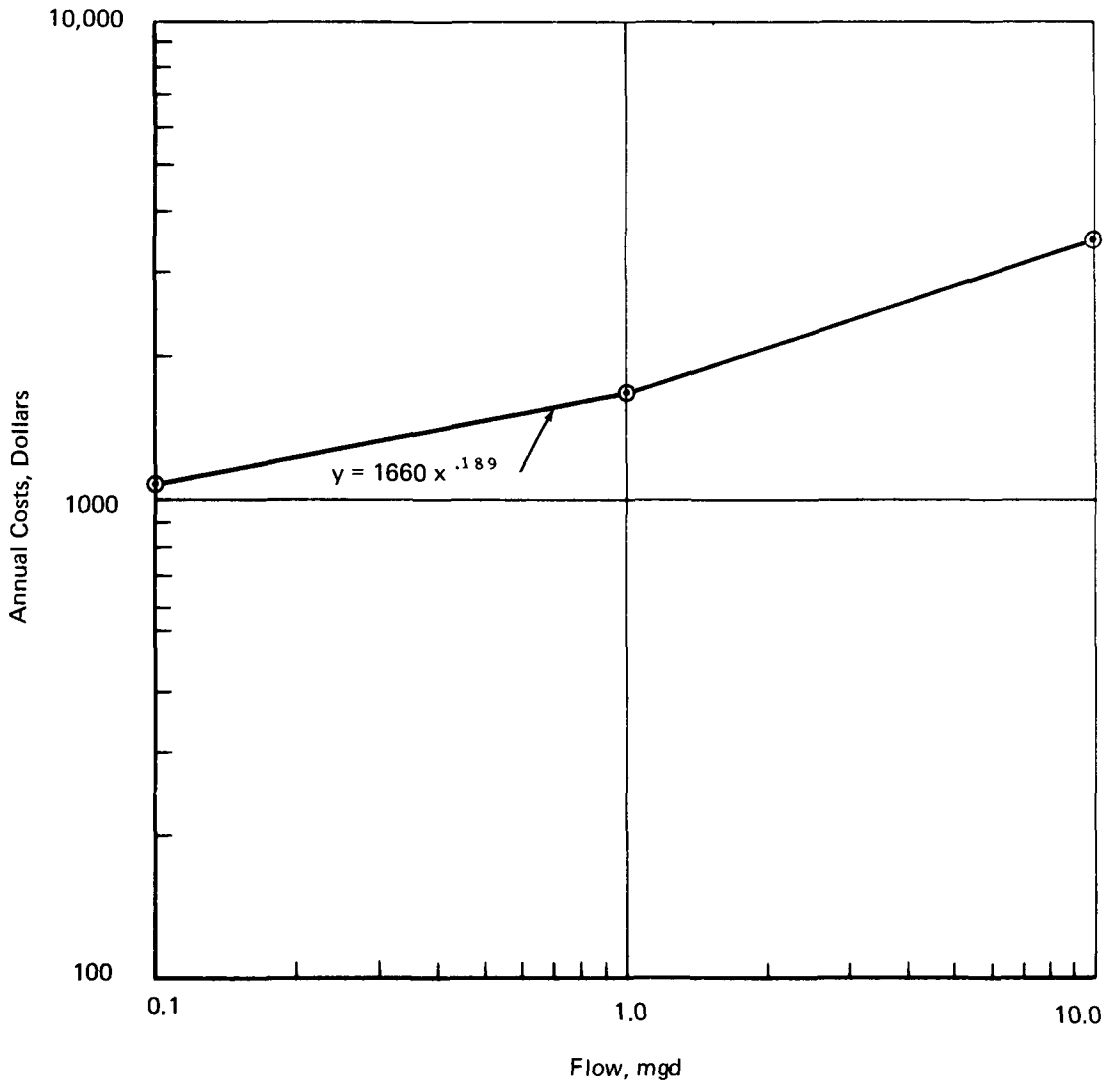


FIGURE A–30 TREATMENT PRIOR TO MUNICIPAL – ANNUAL MATERIAL AND SUPPLY COSTS

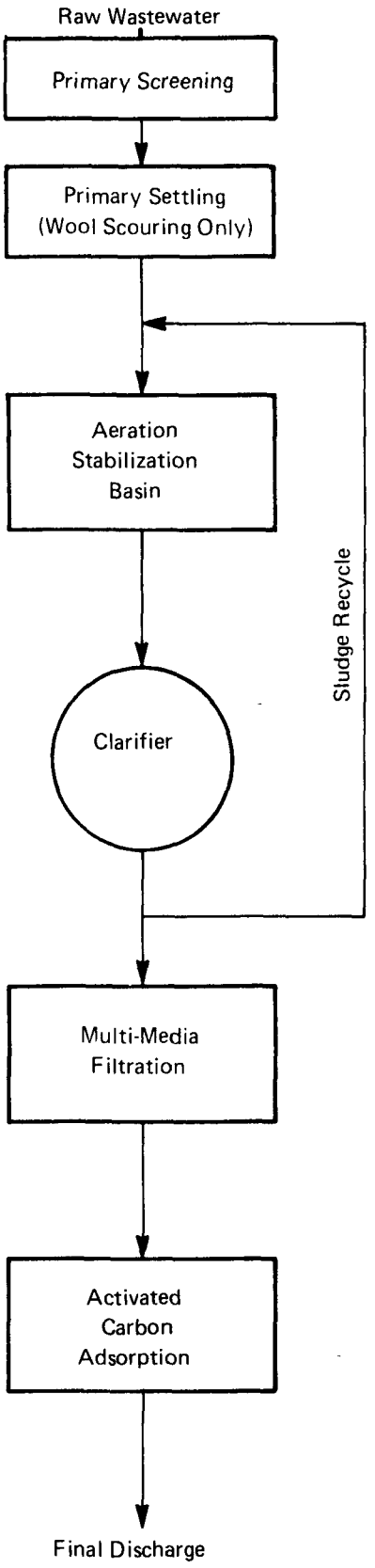


FIGURE A–31 SCHEMATIC FLOW DIAGRAM OF PROCESS STEPS AND COST CENTERS FOR LEVEL II TREATMENT

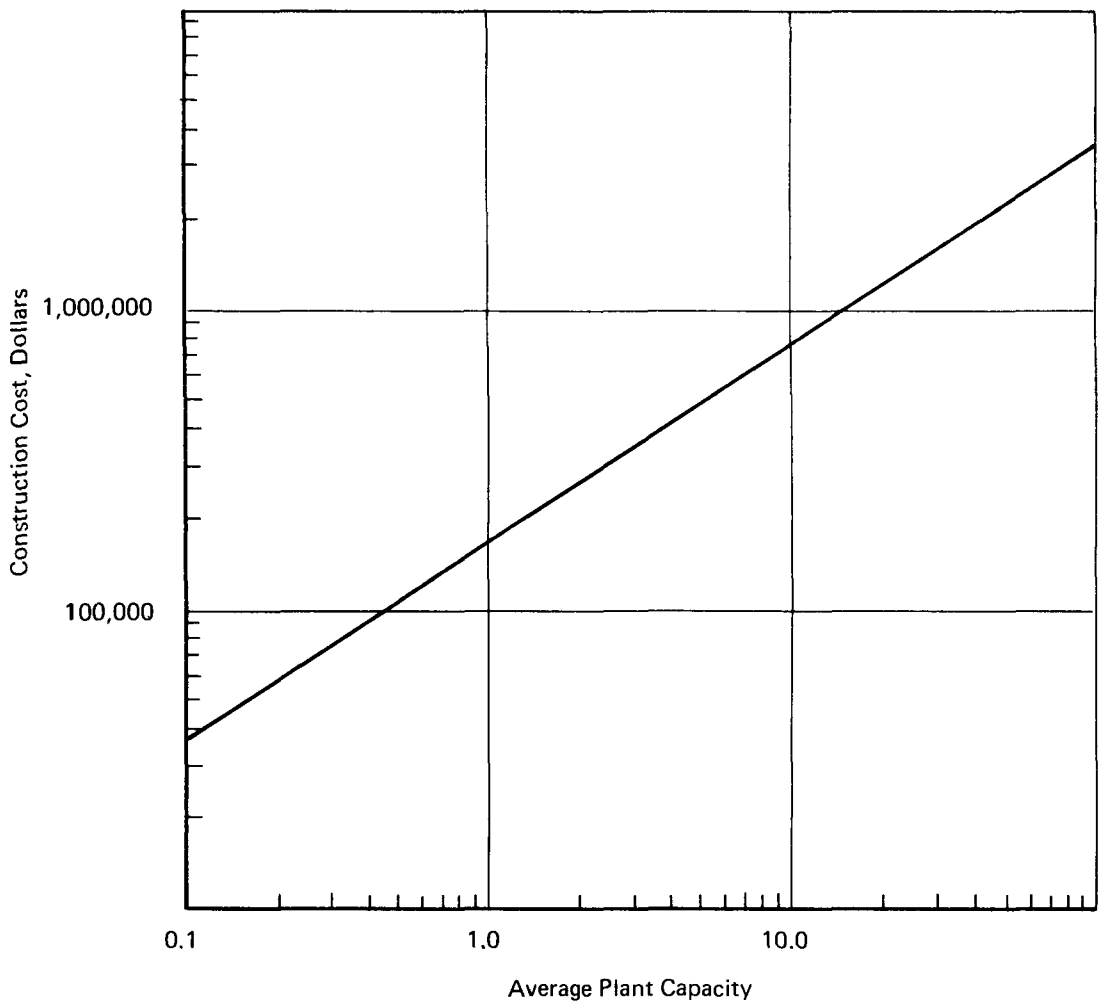


FIGURE A–32 MULTI-MEDIA FILTRATION – CONSTRUCTION COSTS

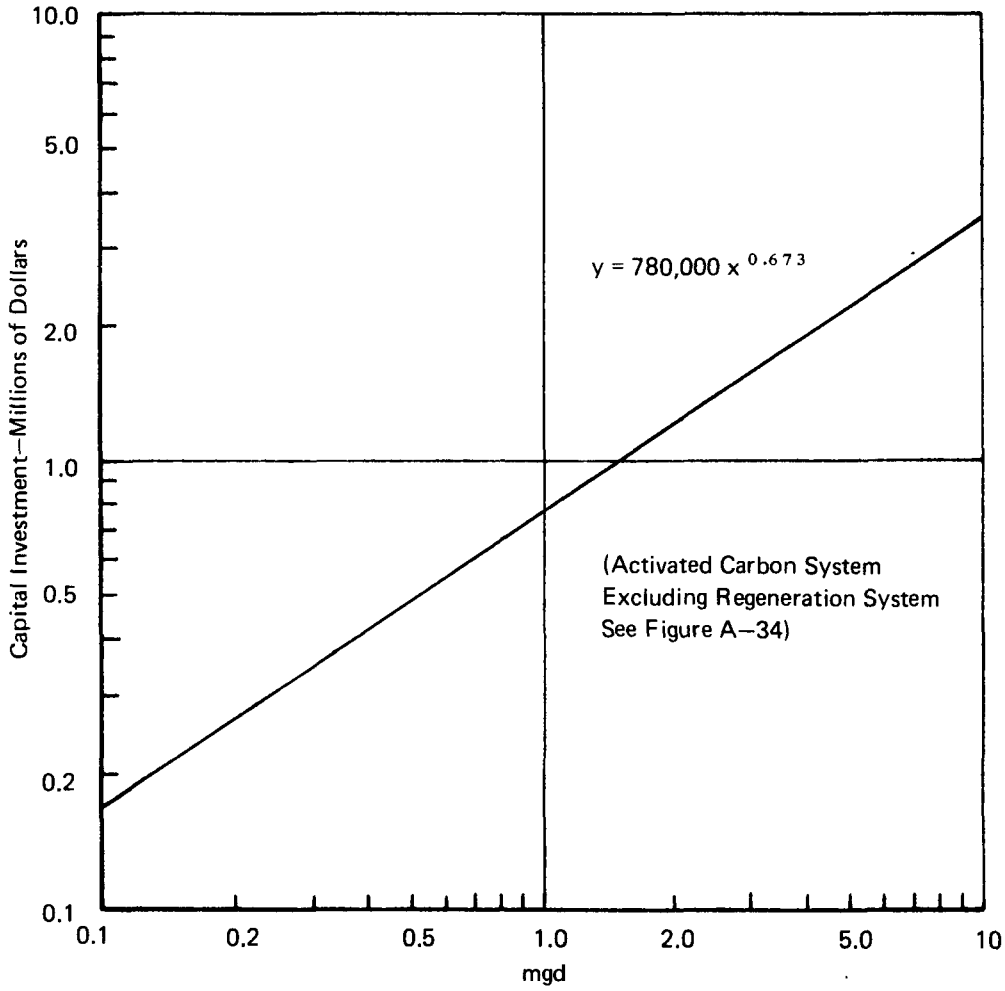
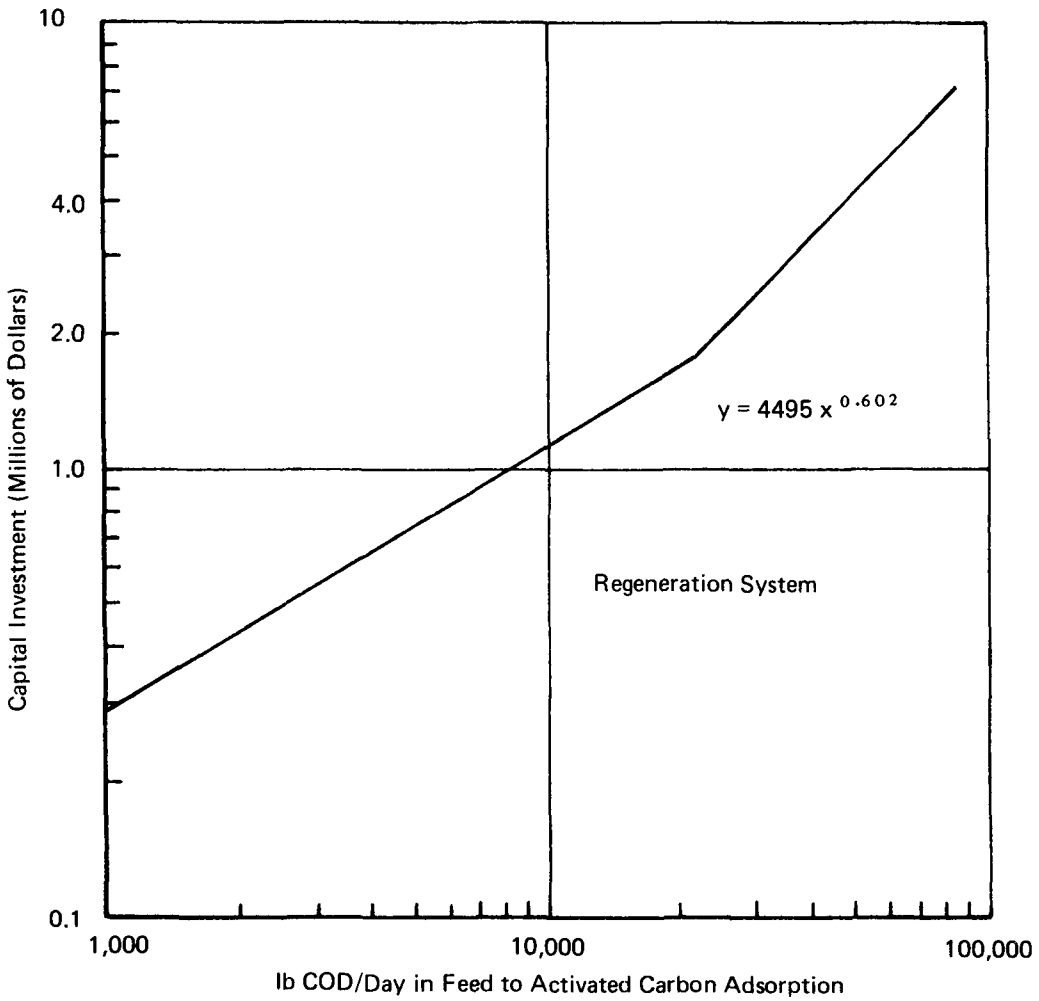


FIGURE A-33 CAPITAL INVESTMENT—ACTIVATED CARBON SYSTEM



Note: Below 700 lb COD/Day Investment = $225,000

FIGURE A–34 CAPITAL INVESTMENT–REGENERATION SYSTEM

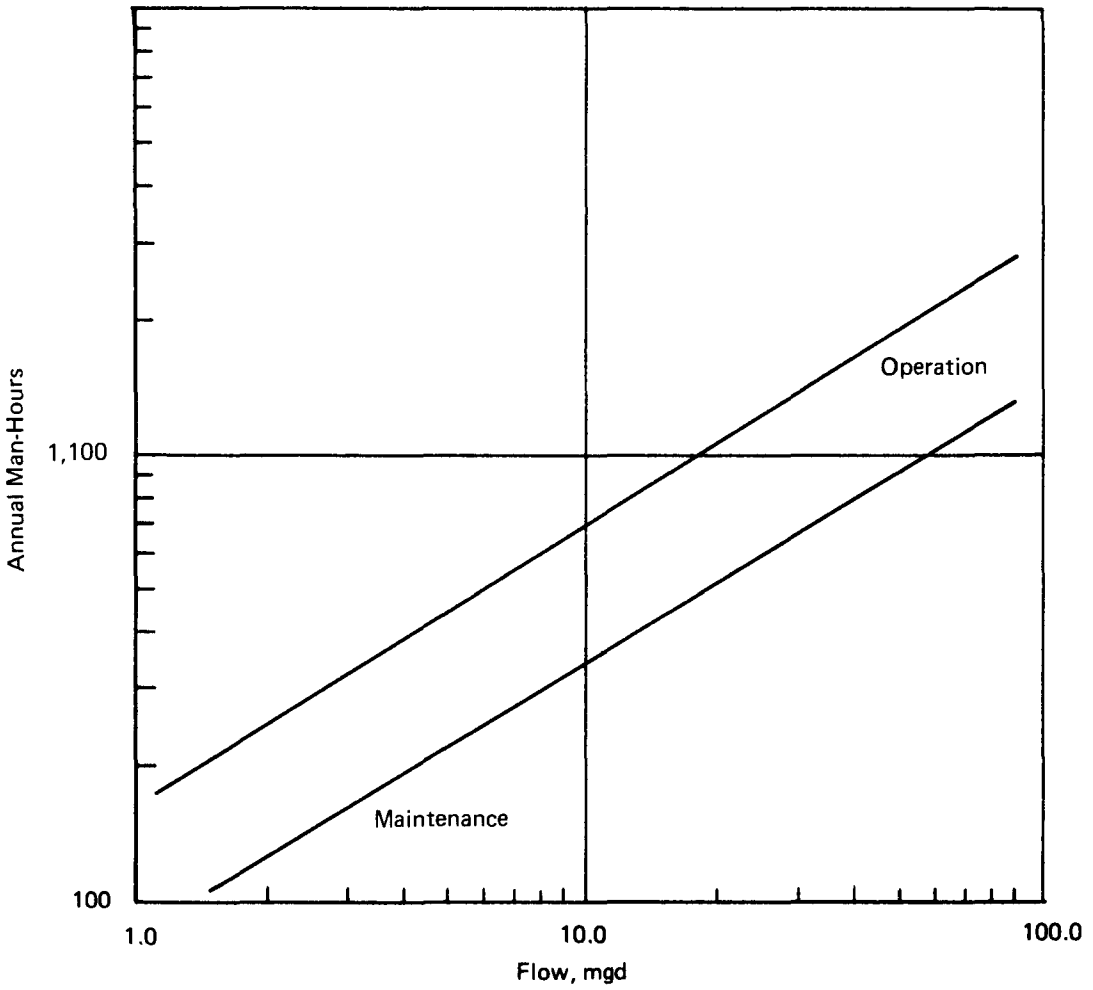


FIGURE A-35 MULTI-MEDIA FILTRATION – ANNUAL OPERATION AND MAINTENANCE LABOR

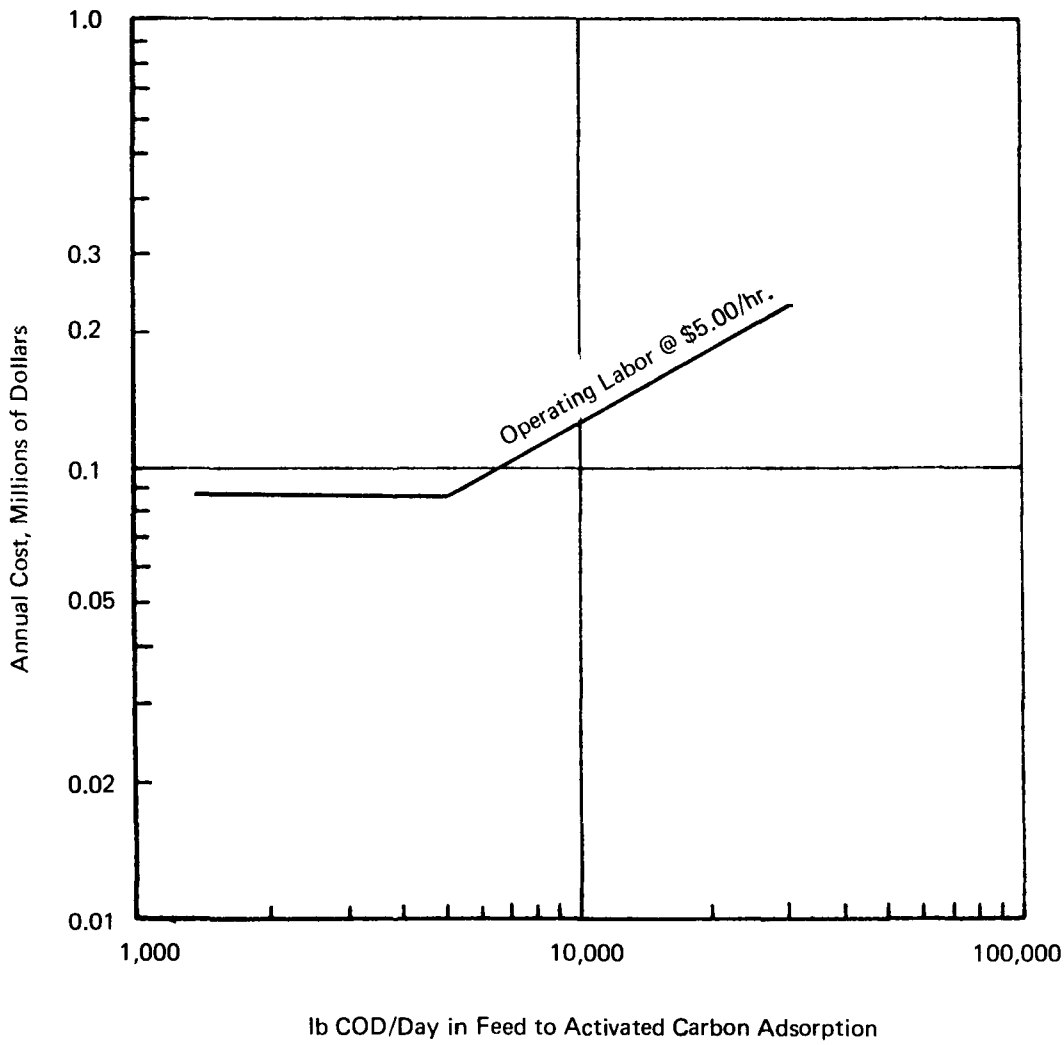


FIGURE A–36 LABOR COSTS – ACTIVATED CARBON ADSORPTION

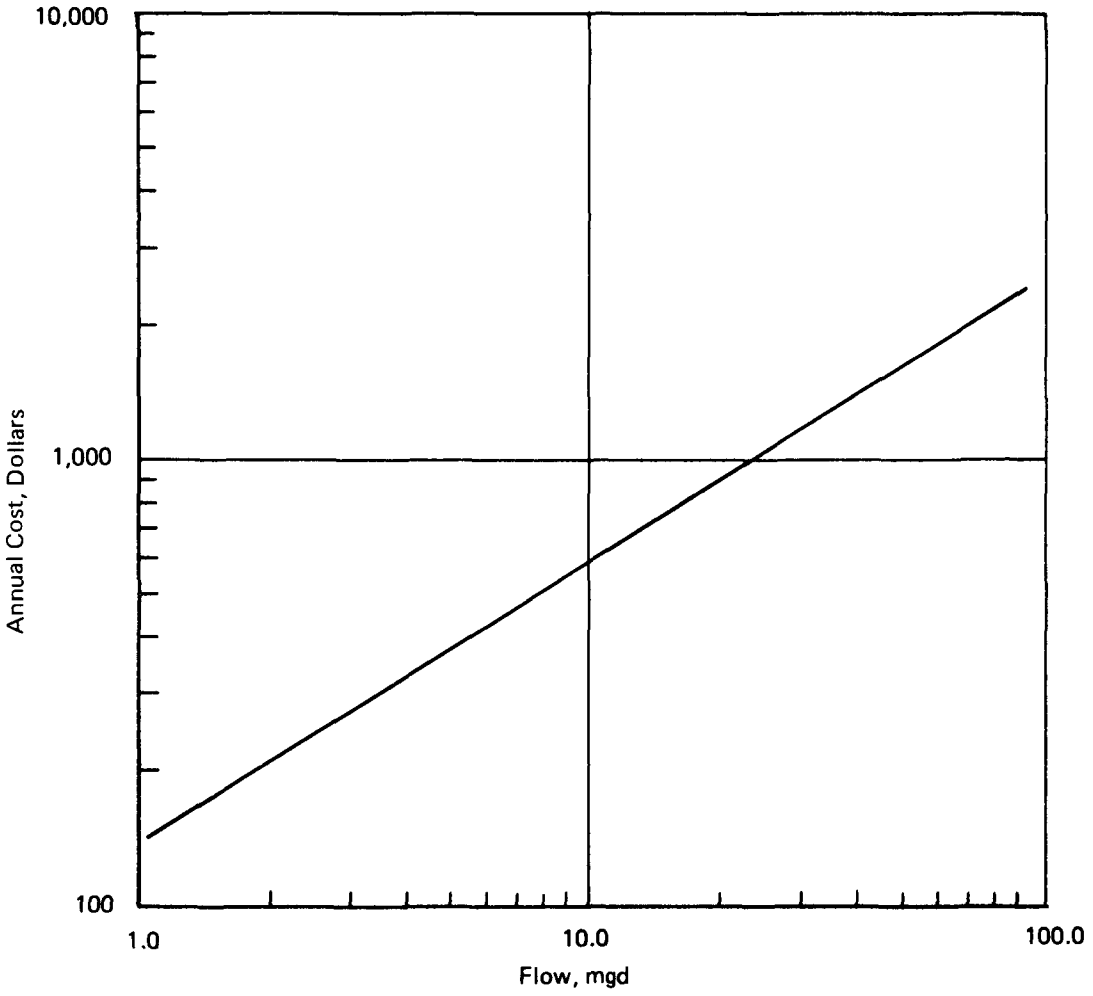


FIGURE A-37 MULTI-MEDIA FILTRATION – ANNUAL MATERIAL AND SUPPLY COSTS

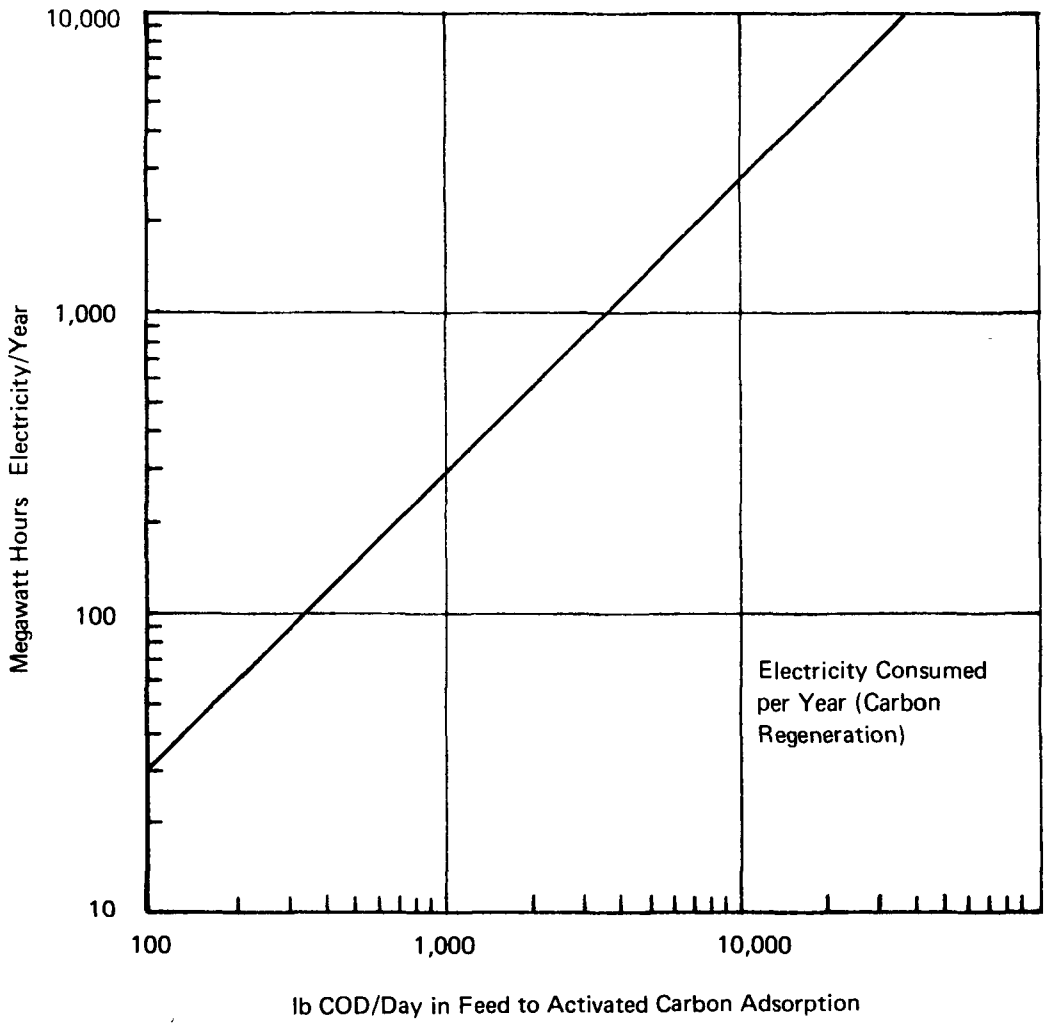


FIGURE A–38 ENERGY COSTS – ACTIVATED CARBON ADSORPTION

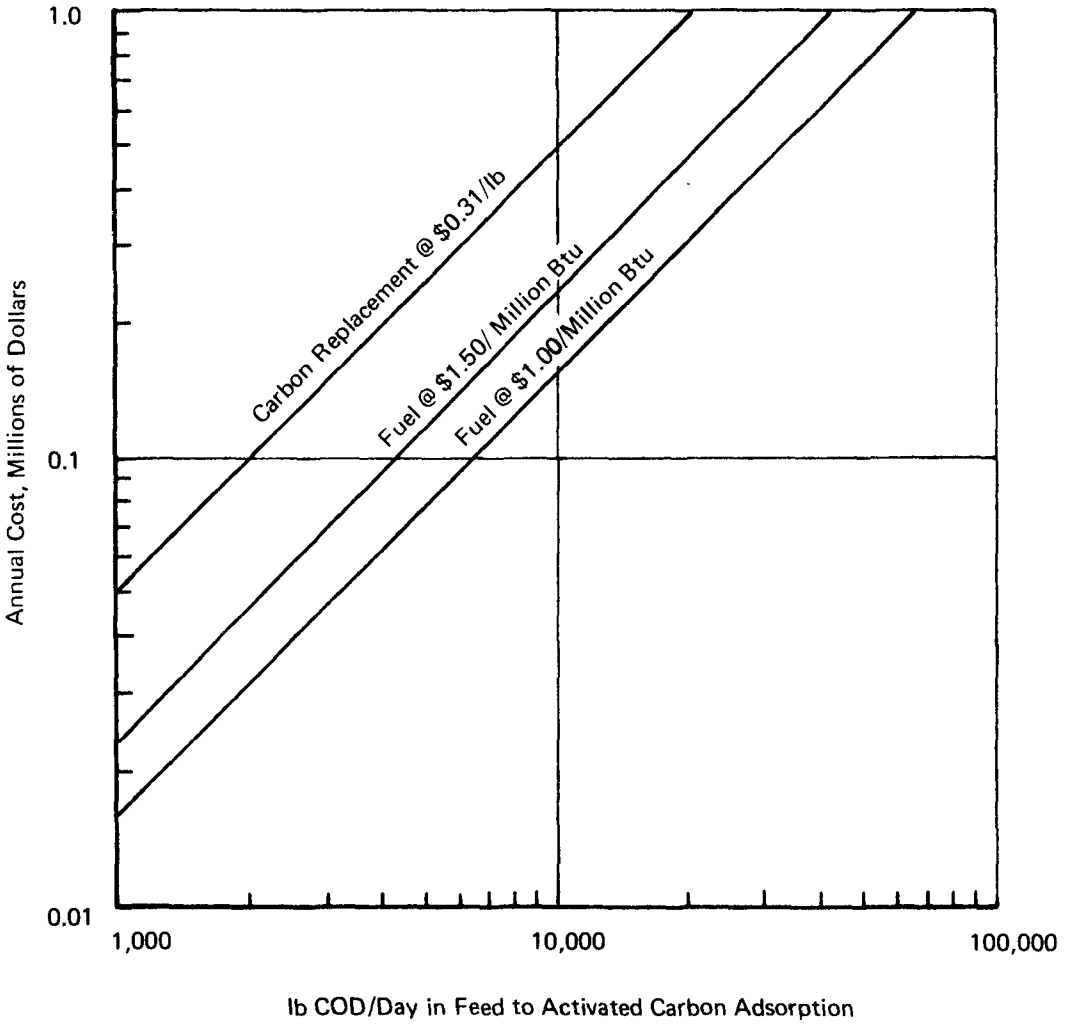


FIGURE A–39 CARBON REPLACEMENT AND FUEL COSTS – ACTIVATED CARBON ADSORPTION

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15. Supplementary Notes

16. Abstracts

An initial analysis of the economic impact of proposed water effluent guidelines upon the Textile industry (SIC 221 to 224) was performed based on abatement cost data supplied by EPA. The impact was evaluated for implementation of best practicable control technology for mills with physical space and those that are space-limited, as well as for implementation of best available control technology. Connection to municipal systems creates minimum impact. Self-treatment under best practicable treatment also produces minimal impact. However, best available treatment will force most mills to close unless they take the option of connecting to municipal systems. An addendum is included to cover an estimate of the impact of a major revision to the guidelines accomplished after issuance of a draft of this report.

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Effluent Guidelines

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

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