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Economic Analysis of Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry

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EXECUTIVE SUMMARY

ES.1 BACKGROUND

The U.S. Environmental Protection Agency is proposing to revise subcategorization and effluent limitations guidelines and standards for the meat products industry point source category. The current meat products rule, 40 CFR Part 432, sets effluent guidelines and limitations for the beef, pork, and rendering sectors of the meat products industry. These standards were set and revised over a number of years, most recently in 1995. This proposed rule revises the existing subcategories in the industry as well as guidelines for those subcategories, and proposes new standards for facilities that perform poultry slaughter and processing operations. Prior to this proposed rule, EPA has set no national effluent limitations guidelines or standards for poultry slaughterers or processors.

With the exception of small processors (Subcategory E), EPA is proposing revisions to Best Practicable Control Technology Currently Available (BPT), Best Available Technology Economically Achievable (BAT), Best Conventional Pollutant Control Technology (BCT), and New Source Performance Standards (NSPS) in Subcategories A through D (red meat facilities that perform slaughter operations), Subcategories F through I (red meat facilities that process meat not slaughtered at the facility), and Subcategory J (rendering facilities). EPA is proposing to create two new subcategories (K and L) for facilities that slaughter and process poultry, and to set BPT, BAT, BCT, and NSPS for these poultry subcategories. EPA is not proposing any revisions to current guidelines and standards for indirect dischargers in the red meat subcategories, nor is it proposing to set new standards for indirect dischargers in the poultry subcategories.

ES.2 INDUSTRY OVERVIEW

The meat products industry includes establishments that primarily slaughter livestock and/or process meat into products for further processing or for final sale to consumers. The industry can be roughly divided into red meat facilities, primarily producing beef or pork products, and poultry facilities, which primarily produce chicken (excluding eggs) and turkey products. (Red meat facilities may also process lamb or veal. Poultry facilities may also process other birds, such as ducks and geese, and also small game, such as rabbits.) Facilities may perform slaughtering operations, processing operations from carcasses slaughtered at other facilities, or both. In addition, rendering operations may be performed either at stand alone facilities, or in combination with slaughter and/or further processing operations. Companies that own meat product facilities may also own facilities that perform “upstream” or “downstream” operations involved in getting meat products from the farm to the consumer (e.g., livestock raising, wholesale distribution), but these facilities are not considered part of the meat products industry.

The meat products industry is primarily composed of four North American Industrial Classification System (NAICS) codes: 311611 (animal – except poultry – slaughtering), 311612 (meat processed from carcasses), 311613 (rendering), and 311615 (poultry processing). Based on *1997 Economic Census* data (U.S. Census, 1999a - 1999d), the industry employs 464,000 workers in 3,400 establishments, and produced $30.9 billion of products (value added basis) in 1997. The industry component sectors, however, are quite distinct. For example, red meat slaughtering facilities (NAICS 311611) employ 142,000 workers in about 1,400 establishments, while red meat processors (NAICS 311612) employ 89,000 workers in 1,300 establishments. However, total value added by meat processors exceeds that of slaughterers (29 percent and 28 percent of total industry value added respectively). Poultry plants (NAICS 311615) account for only 14 percent of industry establishments (470), yet employ almost 50 percent of the industry work force (225,000 workers) and produce 39 percent of industry value added output. Rendering facilities (NAICS 311613) employ 2 percent of industry labor and produce 4 percent of output.

ES.3 DATA SOURCES

The economic analysis relies on a wide variety of sources. Both data availability and relevance determined the relative reliance EPA placed on different sources for various components of the economic profile, methodology, and analysis.

EPA surveyed the meat products industry under authority of the CWA Section 308 (U.S. EPA, 2002a). EPA administered 1,650 screener surveys and 350 detailed surveys. EPA used data from the screener survey to classify and subcategorize facilities by meat type, processes performed, and facility size to determine the relevant industry population potentially affected by the proposed rule and to provide a framework for the estimation of compliance costs and economic impacts. EPA will use facility and company specific financial data from the detailed survey to develop models for estimating impacts of the final rule; this data was not available in time for use in analyzing impacts for the proposed rule.

EPA relied heavily on the U.S. Census Bureau's *1997 Economic Census* to profile the meat products industry. Furthermore, data from the same source were used to develop economic model facilities for estimating impacts of the proposed rule. EPA also obtained special tabulations of Census data to statistically model the distribution of facilities represented by each model facility. EPA used U.S. Department of Agriculture (USDA) publications as data sources for the baseline economic models and the analysis of changes and trends in the industry over time. Publications by USDA's Economic Research Service were a rich source of information and analysis on important issues such as the demand for meat products, industry concentration, competitiveness, and technological change.

Academic journals were an important source of information on the nature of competition in the meat products industry, technological change, and industry trends. EPA also used academic research to provide econometric estimates of key industry parameters — such as the price elasticities of demand and supply — for its economic impact models. EPA used industry sources such as trade journals and trade associations to develop its industry profile, to formulate a better understanding of industry changes, trends, and concerns, and to highlight significant firms and their role in the industry.

ES.4 ECONOMIC METHODOLOGY

EPA developed capital and operating and maintenance (O&M) costs for incremental pollution control. The capital cost, a one-time cost, is the initial investment needed to purchase and install equipment involved in pollution control. The O&M cost is the annual cost of operating and maintaining that equipment; a site incurs its O&M cost each year. For this proposal, EPA estimated average compliance costs for a series of model facilities based on subcategory, size, and discharge type (for details, see the Development Document, U.S. EPA, 2002b).

EPA then annualized the estimated capital and O&M compliance costs. Annualized costs are calculated as the equal annual payments of an annuity that has the same present value as the stream of cash outflow over the project life and includes the opportunity cost of money or interest. An annualized cost is analogous to a mortgage payment that spreads the one-time investment of a home over a series of constant monthly payments. EPA annualizes capital and O&M costs because: (1) capital costs are incurred only once in the equipment's lifetime and the initial investment should be expended over the life of the equipment, and (2) money has a time-based value, so expenditures incurred at the end of the equipment's lifetime or O&M expenses in the future are not the same as expenses paid today.

EPA used its estimated annualized compliance costs in four different levels of analysis:

- Facility-level impacts model (see Section 3.1.2 for details),
- Financial ratio analysis (see Section 3.1.3 for details),
- Market model (see Section 3.1.4 for details), and
- National impacts (see Section 3.1.5 for details).

Each is discussed briefly, below.

EPA used *1997 Economic Census* data at the employment class level from the four meat product industry NAICS codes to develop model facilities representing red meat slaughter plants, red meat processing plants, rendering plants, and poultry combined slaughter and processing plants. EPA used Census revenue and cost data to estimate facility revenues, earnings before interest and taxes, net income, and cash flow. EPA also obtained from Census special tabulations of the variance of key revenue and cost measures that it used to estimate the variance of each model facility's income. Combining this with the assumption that facility income is normally distributed, EPA estimated a cumulative probability distribution function for each model facility. This allows EPA not only to estimate impacts to each model facility, but to the entire class of facilities the model represents as well. Thus, EPA presents two types of model facility impacts. First, EPA provides impact measures such as the ratio of annualized compliance costs to revenues and net income to the model facility itself. Second, EPA uses its estimated probability distributions to project impacts to the group of facilities represented by the model. These include impacts such as the percentage and number of facilities that incur costs exceeding 100 percent of cash flow, or 1 percent of revenues.

EPA used financial ratio analysis to examine whether a company can afford the aggregate costs of upgrading all of its sites. Many banks use financial ratio analysis to assess the credit worthiness of a potential borrower. If regulatory costs cause a company's financial ratios to move into an unfavorable range, the company will find it more difficult to borrow money. EPA considers a company in such a condition to be in financial distress. Financial ratio analysis is performed at the company level rather than the facility level. This is because: (1) many firms maintain complete financial statements (balance sheet and income statement) at the business entity or corporate level, but not the site level, (2) significant financial decisions, such as expansion of a site's capacity, are typically made or approved at the corporate level, and (3) the business entity (or corporate parent) is the legal entity responsible for repayment of a loan, and therefore the lending institution evaluates the credit worthiness of the business entity, not the site. EPA selected the Altman Z′ score, a weighted-average of several financial ratios, to characterize the baseline and post-regulation financial conditions of potentially affected firms. The Altman Z′ score simultaneously considers measures of liquidity, leverage, profitability, and asset management. It addresses the problem of how to interpret the data when some financial ratios look "good" while other ratios look "bad." Also, it provides well defined thresholds for classifying firms as in good, indeterminate, and poor financial health. For proposal, EPA could only perform the Altman Z′ score analysis for a select group of facilities due to a lack of data availability; all firms will be examined for the final rule.

EPA developed a market model to examine the impacts of the meat products industry effluent guidelines on the price and output of various meat products. The distinguishing feature of EPA's market model is that it explicitly incorporates cross-market impacts among meat types into the analysis. This is for two reasons. First, the demand for meat products such as beef, pork, broilers, and turkey is closely related; a change in the price of pork will also tend to cause a change in the demand for beef because it is a substitute for pork. Second, EPA's proposed effluent guidelines will simultaneously affect the price of beef, pork, chicken, and turkey, thus the market analysis for each product depends not only on the compliance costs for that product but also on the impact of compliance costs on the prices of the other three meat products. The market model also examines international trade effects of the proposed rule; the export of meat products is becoming an increasingly important source of growth for U.S. meat producers.

Finally, EPA uses the U.S. Department of Commerce's Bureau of Economic Analysis (BEA) "input-output" multipliers (RIMS II) to examine indirect and induced impacts of the proposed rule on the national economy. Impacts on the meat product industry are known as direct effects, impacts on industries that supply inputs to the meat products industry economy are known as indirect effects, and effects on consumer demand are known as induced effects.

ES.5 RESULTS

ES.5.1 Regulatory Options and Costs

Table ES-1 presents EPA's proposed subcategories for the meat products industry along with the facility process combinations (meat type and process classes) and EPA's count of potentially affected facilities (based on survey data) contained in each subcategory.

Table ES-2 summarizes the pollution control options considered for each subcategory. EPA is proposing option 3 for BAT and NSPS in all subcategories except Subcategory J, for which option 2 is proposed. EPA proposes to exclude small red meat processors (facilities producing less than 6,000 pounds of finished product per day; Subcategory E) from revisions to the current guidelines. EPA proposes to set less stringent requirements (option 1) for small processors in subcategories K and L. EPA does not propose revisions to PSES in red meat subcategories, nor does it propose to set PSES for subcategories K and L.

Table ES-3 provides estimated compliance costs by subcategory and option. Note that EPA estimated two sets of costs: "upper-bound" and "retrofit." Upper-bound costs represent the estimated cost of purchasing new capital equipment for each option. However, in options 3 and 4, it is possible to retrofit or upgrade already purchased wastewater treatment technologies to meet the more stringent standard rather than purchase new equipment. Thus EPA provides retrofit costs as a lower-bound compliance cost

Table ES-1
Proposal 40 CFR 432 Subcategories,
Meat Type and Process Class,
Discharge Type, and Size

Meat Type	Processes	Size	Number of Facilities: Direct Dischargers	Number of Facilities: Indirect Dischargers
Subcategory A through D				
Red Meat	(1) First Processing; (2) First Processing and Further Processing; (3) First Processing and Rendering; (4) First, Further Processing, and Rendering	Small	59	1,001
		Non Small	66	60
Subcategory E through I				
Red Meat	(1) Further Processing; (2) Further Processing and Rendering; (3) Mixed Meat Further Processing; (4) Mixed Meat Further Processing and Rendering[1]	Small	48	2,940
		Non Small	19	234
Subcategory J				
Red Meat or Poultry	(1) Rendering	Small	6	17
		Non Small	21	75
Subcategory K				
Poultry	(1) First Processing; (2) First Processing and Further Processing; (3) First Processing and Rendering; (4) First, Further Processing, and Rendering	Small	0	39
		Non Small	88	138
Subcategory L				
Poultry	(1) Further Processing; (2) Further Processing and Rendering; (3) Mixed Meat Further Processing; (4) Mixed Meat Further Processing and Rendering[1]	Small	4	568
		Non Small	15	208

[1] EPA allocated 61 percent of facilities from the mixed further processing and mixed further processing and rendering classes to Subcategory E through I, and the remaining 39 percent to Subcategory L. For small facilities, the allocation is 59 percent in Subcategory E through I and 41 percent in Subcategory L. EPA designated facilities as "small" based on production (See Chapters 4 and 6 for details).

Table ES-2
Meat Products Industry Treatment Technology Options

Option	Treatment Unit
Direct Dischargers	
BAT 1 (nonsmall facilities)	Preliminary Treatment, Dissolved Air Flotation, Lagoon, Ultra-Violet Disinfection
BAT 1 (small facilities)	Preliminary Treatment, Dissolved Air Flotation, Lagoon, Ultra-Violet Disinfection, *Drying Beds*
BAT 2	Preliminary Treatment, Dissolved Air Flotation, Lagoon, *Nitrification - Suspended Growth*, Ultra-Violet Disinfection, Drying Beds
BAT 3	Preliminary Treatment, Dissolved Air Flotation, Lagoon, *Biological Nitrogen Removal*, Ultra-Violet Disinfection, Drying Beds
BAT 4	Preliminary Treatment, Dissolved Air Flotation, Lagoon, *Biological Nutrient Removal - 3/5 Stage*, Ultra-Violet Disinfection, Drying Beds
BAT 5 (poultry only)	Preliminary Treatment, Dissolved Air Flotation, Lagoon, Biological Nutrient Removal - 3/5 Stage, *Filtration*, Ultra-Violet Disinfection, Drying Beds
Indirect Dischargers	
PSES 1	Preliminary Treatment, Dissolved Air Flotation, Equalization
PSES 2	Preliminary Treatment, Dissolved Air Flotation, Equalization, *Nitrification - Suspended Growth*, *Drying Beds*
PSES 3	Preliminary Treatment, Dissolved Air Flotation, Equalization, *Biological Nitrogen Removal*, Drying Beds
PSES 4	Preliminary Treatment, Dissolved Air Flotation, Equalization, *Biological Nutrient Removal - 3/5 Stage*, Drying Beds

Changes between technology options indicated by italics.

Table ES-3
Total Estimated Compliance Costs (Upper-Bound & Retrofit) by 40 CFR 432 Subcategories

Number of Facilities	Option	Total Upper-Bound Costs (x $1,000)				Total Retrofit Costs (x $1,000) [1]			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Subcategory A through D									
66	BAT1	$0	$0	$0	$0	NA	NA	NA	NA
	BAT2	$8,247	$8,341	$9,197	$5,495	NA	NA	NA	NA
	BAT3	$274,637	$26,093	$55,111	$36,315	$123,587	$26,093	$39,121	$24,705
	BAT4	$567,300	$49,288	$109,237	$72,334	$178,514	$49,288	$68,081	$42,449
60	PSES1	$32,126	$3,134	$6,528	$4,295	NA	NA	NA	NA
	PSES2	$624,537	$74,314	$140,269	$91,308	NA	NA	NA	NA
	PSES3	$460,188	$40,491	$89,120	$58,966	$374,211	$40,491	$80,019	$52,358
	PSES4	$602,773	$47,997	$111,703	$74,298	$473,484	$47,997	$98,017	$64,361
Subcategory E through I									
19	BAT1	$0	$0	$0	$0	NA	NA	NA	NA
	BAT2	$151	$359	$374	$221	NA	NA	NA	NA
	BAT3	$2,467	$381	$641	$415	$1,110	$381	$497	$310
	BAT4	$32,065	$3,104	$6,492	$4,283	$1,603	$3,104	$3,268	$1,938
234	PSES1	$61,732	$10,888	$17,400	$11,127	NA	NA	NA	NA
	PSES2	$388,979	$53,466	$94,529	$61,370	NA	NA	NA	NA
	PSES3	$360,165	$39,439	$77,482	$50,875	$356,436	$39,439	$77,087	$50,588
	PSES4	$529,275	$46,103	$102,034	$67,840	$526,022	$46,103	$101,689	$67,590
Subcategory J									
21	BAT1	$0	$0	$0	$0	NA	NA	NA	NA
	BAT2	$0	$512	$511	$304	NA	NA	NA	NA
	BAT3	$24,236	$2,814	$5,373	$3,547	$10,906	$2,814	$3,962	$2,514
	BAT4	$27,388	$2,949	$5,842	$3,872	$15,753	$2,949	$4,610	$2,970

Table ES-3 (continued)
Total Estimated Compliance Costs (Upper-Bound & Retrofit) by 40 CFR 432 Subcategories

Number of Facilities	Option	Total Upper-Bound Costs (x $1,000)				Total Retrofit Costs (x $1,000) [1]			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
75	PSES1	$3,497	$862	$1,230	$782	NA	NA	NA	NA
	PSES2	$82,709	$12,803	$21,532	$14,003	NA	NA	NA	NA
	PSES3	$121,047	$13,057	$25,844	$17,127	$78,858	$13,057	$21,378	$13,855
	PSES4	$130,925	$13,225	$27,056	$17,993	$92,107	$13,225	$22,947	$14,982
Subcategory K									
88	BAT1	$0	$0	$0	$0	NA	NA	NA	NA
	BAT2	$1,485	$4,319	$4,467	$2,633	NA	NA	NA	NA
	BAT3	$221,276	$21,410	$44,788	$29,501	$99,574	$21,410	$31,905	$20,143
	BAT4	$292,840	$25,768	$56,713	$37,546	$143,829	$25,768	$40,939	$26,088
	BAT5	$327,081	$26,630	$61,198	$40,681	NA	NA	NA	NA
138	PSES1	$42,408	$5,560	$10,038	$6,500	NA	NA	NA	NA
	PSES2	$771,398	$93,496	$174,956	$113,790	NA	NA	NA	NA
	PSES3	$637,073	$55,838	$123,160	$81,513	$575,708	$55,838	$116,664	$76,797
	PSES4	$670,721	$55,543	$126,427	$83,928	$625,628	$55,543	$121,653	$80,462
Subcategory L									
15	BAT1	$0	$0	$0	$0	NA	NA	NA	NA
	BAT2	$155	$263	$279	$167	NA	NA	NA	NA
	BAT3	$12,149	$1,446	$2,729	$1,794	$5,467	$1,446	$2,022	$1,277
	BAT4	$19,181	$1,978	$4,004	$2,653	$7,897	$1,978	$2,810	$1,779
13[2]	BAT5	$17,720	$1,696	$3,568	$2,372	NA	NA	NA	NA
208	PSES1	$50,931	$8,753	$14,126	$9,119	NA	NA	NA	NA
	PSES2	$375,177	$57,933	$97,526	$63,254	NA	NA	NA	NA
	PSES3	$319,734	$35,269	$69,041	$45,584	$316,967	$35,269	$68,748	$45,371
	PSES4	$444,047	$40,216	$87,137	$58,144	$442,132	$40,216	$86,934	$57,997

Table ES-3 (continued)
Total Estimated Compliance Costs (Upper-Bound & Retrofit) by 40 CFR 432 Subcategories

Number of Facilities	Option	Total Upper-Bound Costs (x $1,000) Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Total Retrofit Costs (x $1,000) [1] Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Total Costs Excluding 65 Certainty Facilities									
209	BAT1	$0	$0	$0	$0	NA	NA	NA	NA
	BAT2	$10,038	$13,795	$14,828	$8,821	NA	NA	NA	NA
	BAT3	$534,764	$52,144	$108,643	$71,572	$240,644	$52,144	$77,508	$48,949
	BAT4	$938,773	$83,088	$182,289	$120,687	$347,597	$83,088	$119,708	$75,225
101[2]	BAT5	$344,800	$28,326	$64,766	$43,053	NA	NA	NA	NA
715	PSES1	$190,694	$29,197	$49,322	$31,824	NA	NA	NA	NA
	PSES2	$2,242,800	$292,012	$528,812	$343,725	NA	NA	NA	NA
	PSES3	$1,898,206	$184,095	$384,646	$254,065	$1,702,180	$184,095	$363,895	$238,970
	PSES4	$2,377,742	$203,084	$454,357	$302,203	$2,159,373	$203,084	$431,241	$285,393
Total Costs Including 65 Certainty Facilities									
226	BAT1	$0	$0	$0	$0	NA	NA	NA	NA
	BAT2	$10,841	$14,899	$16,015	$9,526	NA	NA	NA	NA
	BAT3	$577,545	$56,315	$117,334	$77,298	$259,895	$56,315	$83,708	$52,865
	BAT4	$1,013,875	$89,735	$196,872	$130,342	$375,405	$89,735	$129,285	$81,244
	BAT5	$372,384	$30,592	$69,947	$46,497	NA	NA	NA	NA
772	PSES1	$205,950	$31,533	$53,268	$34,370	NA	NA	NA	NA
	PSES2	$2,422,224	$315,373	$571,117	$371,223	NA	NA	NA	NA
	PSES3	$2,050,063	$198,823	$415,418	$274,390	$1,838,355	$198,823	$393,007	$258,087
	PSES4	$2,567,961	$219,331	$490,706	$326,379	$2,332,122	$219,331	$465,740	$308,224

[1] Retrofit costs are not applicable to options 1, 2, and 5.
[2] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

estimate and expects that the true cost to industry will lie somewhere between the two figures.[1] EPA currently believes that the retrofit costs are the more realistic of the two sets of costs.

ES.5.2 Impacts

Table ES-4 presents facility level impacts under the proposed options. Total posttax annualized compliance costs are estimated to range from $50.4 million to $73.8 million. Posttax annualized costs per facility range from $14,500 in Subcategory J to $550,000 in Subcategory A through D. These costs compose from 0.29 percent (Subcategory E through I) to 4.23 percent of net income (Subcategory L). EPA estimates that annualized compliance costs per facility will average less than 0.5 percent of facility revenues.

Of the 20 major meat product companies for which EPA was able to perform the Altman Z′ analysis, none are projected to incur financial distress under the proposed options. Two firms, however, are projected to experience some worsening of their financial condition, moving from "financially healthy" to "indeterminate" status.

Table ES-5 provides projected market level and international trade impacts under the proposed options. The largest impacts are incurred in the market for chicken products. Estimated compliance costs decrease supply of chicken products by 0.4 percent, causing a 0.12 percent increase in price, a 0.5 decrease in domestic supply, and a 0.14 percent decrease in exports. Impacts in other markets are smaller.

ES.5.3 Small Business Impacts

Based on Small Business Administration size standards, EPA estimates that 91 percent (5,174 out of 5,670) of facilities in the meat products industry are small business owned (that is, they employ 500 workers or fewer). However, the vast majority of these facilities (4,991) are indirect dischargers, and thus

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[1] As explained in Chapter 5, EPA was unable, for the purpose of this proposal, to allocate 65 "certainty" facilities by subcategory, hence costs for these facilities are estimated by multiplying total industry costs by 1.08.

Table ES-4
Summary of Impacts Under Proposed Options

Cost	Proposed Option	Number of Facilities	Total Posttax Annualized Costs ($Millions)	Average Posttax Annualized Compliance Costs per Facility	Ratio of Posttax Compliance Costs to Net Income	Probability Cash Flow Less than Costs	Projected Facility Closures	Ratio of Pretax Compliance Costs to Revenues	Number of Facilities Incurring Costs Greater Than	
									1 percent revenues	3 percent revenues
Subcategory A through D										
Upper-Bound	BAT 3	66	$36.3	$550,000	1.90%	0.34%	0.2	0.12%	2.1	0.6
Retrofit	BAT 3	66	$24.7	$374,000	1.30%	0.23%	0.1	0.09%	1.4	0.3
Subcategory E through I										
Upper-Bound	BAT 3	19	$0.4	$22,000	0.40%	0.06%	0.0	0.05%	0.2	0.1
Retrofit	BAT 3	19	$0.3	$16,300	0.29%	0.05%	0.0	0.04%	0.2	0.1
Subcategory J										
Upper-Bound	BAT 2	21	$0.3	$14,500	0.68%	0.12%	0.0	0.17%	0.9	0.3
Subcategory K										
Upper-Bound	BAT 3	88	$29.5	$335,000	3.98%	0.72%	0.5	0.43%	12.2	2.8
Retrofit	BAT 3	88	$20.1	$229,000	2.73%	0.49%	0.2	0.30%	7.6	1.7
Subcategory L										
Upper-Bound	BAT 3	15	$1.8	$120,000	4.23%	0.77%	0.1	0.48%	2.5	0.4
Retrofit	BAT 3	15	$1.3	$85,500	3.01%	0.55%	0.1	0.36%	1.5	0.3

Table ES-4 (continued)
Summary of Impacts Under Proposed Options

Cost	Proposed Option	Number of Facilities	Total Posttax Annualized Costs ($Millions)	Average Posttax Annualized Compliance Costs per Facility	Ratio of Posttax Compliance Costs to Net Income	Probability Cash Flow Less than Costs	Projected Facility Closures	Ratio of Pretax Compliance Costs to Revenues	Number of Facilities Incurring Costs Greater Than	
									1 percent revenues	3 percent revenues
Total Upper-Bound		**209**	**$68.3**	**NA**	**NA**	**NA**	**0.8**	**NA**	**17.9**	**4.2**
Total Upper-Bound Including 65 Certainty Facilities		**226**	**$73.8**	**NA**	**NA**	**NA**	**0.9**	**NA**	**19.3**	**4.5**
Total Retrofit [1]		**209**	**$46.7**	**NA**	**NA**	**NA**	**0.4**	**NA**	**11.6**	**2.7**
Total Retrofit Including 65 Certainty Facilities		**226**	**$50.4**	**NA**	**NA**	**NA**	**0.4**	**NA**	**12.5**	**2.9**

[1] Used upper-bound costs and impacts for Subcategory J.
Numbers may not sum due to rounding.

Table ES-5
Projected Compliance Cost Impacts on Meat Product Markets
Proposed Option: BAT 2 for Subcategory J, BAT 3 All Other Subcategories
With Cross-Market Impacts, Armington Trade

Subcategory	Price ($/lb.)	Net Quantity (lbs. x 1 mil.)	Domestic Supply (lbs. x 1 mil.)	Quantity Imported (lbs. x 1 mil.)	Domestic Demand (lbs. x 1 mil.)	Quantity Exported (lbs. x 1 mil.)	Per Unit Compliance Costs	Percent Shift in Supply	Percent Shift in Demand
Beef									
Baseline	$1.1105	29,260	26,386	2,874	26,843	2,417	$0.00107	-0.10%	0.02%
Post-regulatory	$1.1112	29,251	26,376	2,874	26,836	2,415			
% Change	0.06%	-0.03%	-0.04%	0.01%	-0.03%	-0.09%			
Pork									
Baseline	$1.0038	20,105	19,278	827	18,827	1,278	$0.00158	-0.16%	0.02%
Post-regulatory	$1.0046	20,095	19,268	827	18,819	1,276			
% Change	0.08%	-0.05%	-0.05%	0.00%	-0.04%	-0.12%			
Chicken									
Baseline	$0.5807	29,746	29,741	5	24,826	4,920	$0.00218	-0.38%	0.02%
Post-regulatory	$0.5814	29,731	29,726	5	24,817	4,913			
% Change	0.12%	-0.05%	-0.05%	0.00%	-0.03%	-0.14%			
Turkey									
Baseline	$0.6898	5,298	5,297	1	4,919	379	$0.00101	-0.15%	0.01%
Post-regulatory	$0.6901	5,297	5,296	1	4,918	379			
% Change	0.05%	-0.02%	-0.02%	0.00%	-0.02%	-0.05%			

will not be affected by the proposed rule. EPA estimates that 183 small business owned facilities are direct dischargers, 112 of which are likely to be excluded due to low levels of production, leaving 71 small business owned facilities affected by the proposed rule.

Table ES-6 presents EPA's projected small business impacts. Four small processing facilities (based on production) in Subcategory L incur posttax annualized costs of $700 per facility: about 2.4 percent of facility net income, and 0.2 percent of facility revenues. The 67 nonsmall (by production level) affected facilities owned by small businesses incur, on average, posttax annualized costs of $119,000 per facility. Note, however, that in subcategories A through D, E through I, and J, the average cost per facility is $26,000 or less (less than 0.7 percent of net income and 0.2 percent of revenues). Conversely, average costs per facility for the 40 facilities in subcategories K and L range from $126,000 to $215,400, about 4.9 percent to 6.8 percent of net income.

ES.5.4 Environmental Benefits

The proposed meat products industry effluent limitations guideline will reduce emissions into the waters of the United States. The reduction in emissions will reduce the levels of fecal coliform and biological oxygen demand and improve other indicators of water quality. As water quality improves, waters may become suitable for increasingly demanding human uses. A primary benefit of the regulation is the restoration of waters to conditions conducive to fishing and swimming.

Each use category can be defined in terms of a set of water quality indicators. If the indicators meet or exceed all of the criteria for a given use, then the water body can be used for that use. Vaughan (1986) developed a water quality criteria ladder which describes the type of recreational use that a water body can support (none, boating, fishing, or swimming). Once the use of the water body is defined by the Vaughan ladder, the public willingness to pay for changes in use category can be estimated.

One criticism of the water quality ladder approach is that a rule is only credited with a benefit when it results in a change from one category to another. Thus, even if a regulation causes significant improvements in water quality, but does not result in a change in use, no benefits are attributed to it. When

Table ES-6
Summary of Impacts Under the Proposed Options
Small Business Owned Facilities

Size	Proposed Option	Number of Facilities	Posttax Annualized Costs ($1,000's)		Ratio of Cost to Net Income	Probability of Closure	Ratio of Cost to Revenues	Number of Facilities Incurring Costs Greater Than:	
			Total	Average				1 Percent of Revenues	3 Percent of Revenues
Subcategory A through D									
Nonsmall	BAT 3	5	$33.8	$6.8	0.25%	0.04%	0.02%	0.0	0.0
Subcategory E through I									
Nonsmall	BAT 3	10	$271.7	$26.0	0.55%	0.09%	0.07%	0.2	0.1
Subcategory J									
Nonsmall	BAT 2	12	$181.3	$15.1	0.69%	0.12%	0.17%	0.5	0.1
Subcategory K									
Small[1]	BAT 1	NA	NA	NA	NA	NA	NA	NA	NA
Nonsmall	BAT 3	28	$6,030.8	$215.4	6.82%	1.22%	0.58%	5.9	1.2
Subcategory L									
Small	BAT 1	4	$2.6	$0.7	2.44%	0.31%	0.20%	0.2	0.1
Nonsmall	BAT 3	12	$1,456.4	$126.0	4.87%	0.89%	0.55%	2.2	0.4
Total Small		**4**	**$2.6**	**$0.7**	**NA**	**NA**	**NA**	**0.2**	**0.1**
Total Nonsmall		**67**	**$7,974.0**	**$119.0**	**NA**	**NA**	**NA**	**8.8**	**1.8**

[1] EPA is proposing option BAT 1 for small producers in Subcategory K, but currently estimates zero facilities in that subcategory.
Numbers may not sum due to rounding.

a marginal change in water quality measures results in a change in use category, large benefits are ascribed to it. Therefore, EPA has also developed a continuous approach in order to value improvements in water quality that do not result in a change in use category (see Section 7.1.1 for details).

EPA presents the results of the benefits evaluation for both the discrete and continuous methods of determining the value of improvements in water quality. Under the proposed rule, EPA estimates that about 21 miles of river reaches nationwide experience improvements in water quality from nonswimmable to swimmable levels. EPA estimates that the public's willingness to pay for these improvements ranges from $1.1 million (discrete method of valuation) to $15.6 million (continuous method of valuation). These benefits estimates reflect only the 36 plants actually analyzed for water quality improvements. The corresponding annualized costs for these facilities are $33.7 million. If the ratio of costs to benefits for these facilities is the same as the ratio of costs to benefits for all facilities, the total (continuous) benefits of the rule would be $37.0 million.

ES.6 REFERENCES

U.S. Census Bureau. 1999a. *Animal (Except Poultry) Slaughtering. EC97M-3116A. 1997 Economic Census: Manufacturing Industry Series.* Washington, D.C.: U.S. Department of Commerce. November.

U.S. Census Bureau. 1999b. *Meat Processed From Carcasses. EC97M-3116B. 1997 Economic Census: Manufacturing Industry Series.* Washington, D.C.: U.S. Department of Commerce. November.

U.S. Census Bureau. 1999c. *Poultry Processing. EC97M-3116D. 1997 Economic Census: Manufacturing Industry Series.* Washington, D.C.: U.S. Department of Commerce. November.

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U.S. EPA. 2002b. *Development Document for the Proposed Revisions to the Effluent Limitations Guidelines for the Meat Products Industry.* EPA-821-B-01-007. Washington, D.C.: U.S. Environmental Protection Agency, Office of Water.

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CHAPTER 1

INTRODUCTION

1.1 SCOPE AND PURPOSE

The U.S. Environmental Protection Agency (EPA) proposes and promulgates water effluent discharge limits (effluent limitations guidelines and standards) for industrial sectors. This Economic Analysis (EA) summarizes the costs and economic impacts of technologies that form the bases for setting limits and standards for the meat products industry.[1]

The Federal Water Pollution Control Act (commonly known as the Clean Water Act [CWA, 33 U.S.C. §1251 et seq.]) establishes a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (section 101(a)). EPA is authorized under sections 301, 304, 306, and 307 of the CWA to establish effluent limitations guidelines and standards of performance for industrial dischargers. The standards EPA establishes include:

- Best Practicable Control Technology Currently Available (BPT). Required under section 304(b)(1), these rules apply to existing industrial direct dischargers. BPT limitations are generally based on the average of the best existing performances by plants of various sizes, ages, and unit processes within a point source category or subcategory.

- Best Available Technology Economically Achievable (BAT). Required under section 304(b)(2), these rules control the discharge of toxic and nonconventional pollutants and apply to existing industrial direct dischargers.

- Best Conventional Pollutant Control Technology (BCT). Required under section 304(b)(4), these rules control the discharge of conventional pollutants from existing industrial direct dischargers.[2] BCT limitations must be established in light of a two-part cost-reasonableness test. BCT replaces BAT for control of conventional pollutants.

- Pretreatment Standards for Existing Sources (PSES). Required under section 307. Analogous to BAT controls, these rules apply to existing indirect dischargers (whose discharges flow to publicly owned treatment works [POTWs]).

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[1] The industry, however, is free to use whatever technology it chooses in order to meet the limit.

[2] Conventional pollutants include biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, pH, and oil and grease.

- New Source Performance Standards (NSPS). Required under section 306(b), these rules control the discharge of toxic and nonconventional pollutants and apply to new source industrial direct dischargers.

- Pretreatment Standards for New Sources (PSNS). Required under section 307. Analogous to NSPS controls, these rules apply to new source indirect dischargers (whose discharges flow to POTWs).

The current meat products rule, 40 CFR Part 432, set effluent guidelines and limitations for the beef and pork sectors of the meat products industry. These standards were set and revised over a number of years, most recently in 1995. Table 1-1 presents a listing of the standards set for each of the 10 current subcategories in the meat products industry along with the relevant Federal Register citation. This proposed rule revises the existing subcategories in the industry, and proposes new standards for facilities that perform poultry slaughter and processing operations. Prior to this proposed rule, EPA has set no national effluent limitations guidelines or standards for poultry slaughterers or processors.

1.2 DATA SOURCES

The economic analysis relies on a wide variety of sources. Both data availability and relevance determined the relative reliance EPA placed on different sources for various components of the economic profile, methodology, and analysis. Data sources used in the economic analysis include:

- EPA survey of the Meat Products industry.
- Census data.
- USDA data.
- Academic literature.
- Industry journals.
- General economic and financial references (these are cited throughout the report).

The use of each of these major data sources is discussed in turn below. Citations for these data sources as utilized will be found in the relevant chapters of this EA.

Table 1-1
EPA Effluent Limitations Guidelines for Meat Products Industry

Subcategory	Standard	Federal Register Notice
Simple Slaughterhouses (Subpart A)	BPT	39 FR 7897, February 28, 1974; amended at 60 FR 33964, June 29, 1995
	BAT	Reserved
	PSES	40 FR 6446, February 11, 1975; amended at 60 FR 33964, June 29, 1995
	NSPS	39 FR 7897, February 28, 1974; 39 FR 26423, July 19, 1974
	PSNS	60 FR 33964, June 29, 1995
	BCT	51 FR 25001, July 9, 1986
Complex Slaughterhouses (Subpart B)	BPT	39 FR 7897, February 29, 1974; 39 FR 26423, July 19, 1974; amended at 45 FR 82254, December 15, 1980; 60 FR 33964, June 29, 1995
	BAT	Reserved
	PSES	40 FR 6446, February 11, 1975; amended at 60 FR 33965, June 29, 1995
	NSPS	39 FR 7897, February 28, 1974; 39 FR 26423, July 19, 1974
	PSNS	60 FR 33965, June 29, 1995
	BCT	51 FR 25001, July 9, 1986
Low-Processing Packinghouse (Subpart C)	BPT	39 FR 7897, February 28, 1974; amended at 60 FR 33965, June 29, 1995
	BAT	Reserved
	PSES	40 FR 6446, February 11, 1975; amended at 60 FR 33965, June 29, 1995
	NSPS	39 FR 7897, February 28, 1974; 39 FR 26423, July 19, 1974
	PSNS	60 FR 33965, June 29, 1995
	BCT	51 FR 25001, July 9, 1986

Table 1-1 (cont.)
EPA Effluent Limitations Guidelines for Meat Products Industry

Subcategory	Standard	Federal Register Notice
High-Processing Packinghouse (Subpart D)	BPT	39 FR 7897, February 28, 1974; amended at 60 FR 33965, June 29, 1995
	BAT	Reserved
	PSES	40 FR 6446, February 11, 1975; amended at 60 FR 33965, June 29, 1995
	NSPS	39 FR 7897, February 28, 1974; 39 FR 26423, July 19, 1974
	PSNS	60 FR 33965, June 29, 1995
	BCT	51 FR 25001, July 9, 1986
Small-Processor (Subpart E)	BPT	40 FR 905, January 3, 1975; amended at 60 FR 33965, June 29, 1995
	BAT	Reserved
	PSES	Reserved
	NSPS	40 FR 905, January 3, 1975
	PSNS	40 FR 905, January 3, 1975; amended at 60 FR 33965, June 29, 1995
	BCT	51 FR 25001, July 9, 1986
Meat Cutter (Subpart F)	BPT	40 FR 906, January 3, 1975; amended at 60 FR 33965, June 29, 1995
	BAT	44 FR 50748, August 29, 1979
	PSES	Reserved
	NSPS	40 FR 906, January 3, 1975
	PSNS	40 FR 906, January 3, 1975; amended at 60 FR 33965, June 29, 1995
	BCT	51 FR 25001, July 9, 1986
Sausage and Luncheon Meats Processor (Subpart G)	BPT	40 FR 907, January 3, 1975; amended at 60 FR 33966, June 29, 1995
	BAT	40 FR 50748, August 29, 1979

Table 1-1 (cont.)
EPA Effluent Limitations Guidelines for Meat Products Industry

Subcategory	Standard	Federal Register Notice
	PSES	Reserved
	NSPS	40 FR 907, January 3, 1975
	PSNS	40 FR 907, January 3, 1975; amended at 60 FR 33966, June 29, 1995
	BCT	51 FR 25001, July 9, 1986
Ham Processor (Subpart H)	BPT	40 FR 908, January 3, 1975; amended at 60 FR 33966, June 29, 1995
	BAT	44 FR 50748, August 29, 1979
	PSES	Reserved
	NSPS	40 FR 908, January 3, 1975
	PSNS	40 FR 908, January 3, 1975; amended at 60 FR 33966, June 29, 1995
	BCT	51 FR 25001, July 9, 1986
Canned Meats Processor (Subpart I)	BPT	40 FR 909, January 3, 1975; amended at 60 FR 33966, June 29, 1995
	BAT	44 FR 50748, August 29, 1979
	PSES	Reserved
	NSPS	40 FR 909, January 3, 1975
	PSNS	40 FR 909, January 3, 1975; amended at 60 FR 33966, June 29, 1995
	BCT	51 FR 25001, July 9, 1986
Renderer (Subpart J)	BPT	40 FR 910, January 3, 1975; 40 FR 11874, March 14, 1975; amended at 60 FR 33966, June 29, 1995
	BAT	44 FR 50748, August 29, 1979
	PSES	Reserved
	NSPS	42 FR 54419, October 6, 1977
	PSNS	40 FR 910, January 3, 1975; amended at 60 FR 33966, June 29, 1995
	BCT	51 FR 25001, July 9, 1986

EPA collected site- and company-specific data under authority of the CWA Section 308 (U.S. EPA, 2002). EPA administered 1,650 screener surveys and 350 detailed surveys. EPA used data from the screener survey to classify and subcategorize facilities by meat type, processes performed, and facility size to determine the relevant industry population potentially affected by the proposed rule and to provide a framework for the estimation of compliance costs and economic impacts. EPA also used production data from the screener survey to match engineering model facilities with economic model facilities. EPA will use facility and company specific financial data from the detailed survey to develop models for estimating impacts of the final rule.

EPA relied heavily on the U.S. Census Bureau's *1997 Economic Census* to profile the meat products industry. In addition, data from the same source were used to develop economic model facilities for estimating impacts of the proposed rule. EPA also obtained special tabulations of Census data to statistically model the distribution of facilities represented by each model facility.

EPA used U.S. Department of Agriculture publications for two major purposes. First, publications such as *Livestock, Dairy and Poultry Situation and Outlook*, and the *Packers and Stockyards Statistical Report* provided data for the baseline economic models and the analysis of changes and trends in the industry over time. Second, publications by USDA's Economic Research Service were a rich source of information and analysis on important issues such as the demand for meat products, industry concentration, competitiveness, and technological change. Finally, data to model international trade in meat products was obtained from the databases of USDA's Foreign Agricultural Trade of the U.S. (FATUS) and the Food and Agriculture Organization of the United Nations (UN FAO).

Academic journals were an important source of information on the nature of competition in the meat products industry, technological change, and industry trends. EPA also used academic research to provide econometric estimates of key industry parameters – such as the price elasticities of demand and supply – for its economic impact models.

EPA used industry sources such as trade journals and trade associations to develop its industry profile, to formulate a better understanding of industry changes, trends, and concerns, and to highlight significant firms and their role in the industry. EPA also accessed company specific websites to develop its profiles of major industry "players."

As necessary, EPA cites various economic and financial references used in its analysis throughout the EA. These references may be in the form of financial and economic texts, or other relevant sources of information germane to the impact analysis.

1.3 REPORT ORGANIZATION

This Economic Analysis (EA) is organized as follows:

- Chapter 2—Industry Profile

  Provides background information on the industry and companies affected by this regulation.

- Chapter 3—Economic Impact Analysis Methodology Overview

  Summarizes the economic methodology by which EPA examines incremental pollution control costs and their associated impacts on the industry. More detailed information on the economic methodology is located in Appendixes A through D.

- Chapter 4—Pollution Control Options

  Presents short descriptions of the regulatory options considered by EPA. More detail is given in the Development Document (U.S. EPA, 2002).

- Chapter 5—Economic Impacts

  Using the methodology presented in Chapter 3, EPA presents the annualized costs reflecting both the capital and annual operating and maintenance costs that are associated with more stringent pollution control. EPA then presents the economic impacts associated with the regulatory costs, including impacts on facilities, companies, industry output, prices, international trade, and employment. In other words, this chapter presents the findings on which EPA based its determination of economic achievability under the CWA.

- Chapter 6—Initial Regulatory Flexibility Analysis

  Pursuant to the Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act, EPA examines whether the regulatory options have a significant adverse impact on a substantial number of small entities.

- Chapter 7—Benefits Methodology

  Summarizes the methodology by which EPA identifies, qualifies, quantifies, and—where possible—monetizes the benefits associated with reduced pollution.

- Chapter 8—Cost and Benefits of the Proposed Rule

  Using the benefits described in Chapter 7, EPA presents an assessment of the nationwide costs and benefits of the regulation pursuant to Executive Order 12866 and the Unfunded Mandates Reform Act (UMRA).

1.4 REFERENCES

U.S. EPA. 2002. 2001 Meat Products Industry Survey. Washington, DC: OMB Control No. 2040-0225. Expiration Date February 29, 2004.

CHAPTER 2

INDUSTRY PROFILE

Chapter 2 presents a profile of the meat products industry. Section 2.1 provides a snapshot of the meat products industry based on *1997 Economic Census* data; Section 2.2 is a snapshot of the industry based on Section 308 survey data. This data formed the basis for EPA's subcategorization of the industry and the framework for projecting economic impacts. Section 2.3 discusses trends in industry output and prices. Section 2.4 describes the trends in beef, pork, and poultry production toward market concentration and summarizes analyses of whether the trend toward concentration has generated significant market power for the large firms apparently dominating the industry. Section 2.5 provides a brief guide to the important players in the industry.

2.1 INDUSTRY OVERVIEW BASED ON CENSUS DATA

The meat products industry includes establishments that primarily slaughter livestock and/or process meat into products for further processing or for final sale to consumers. The industry can be roughly divided into red meat facilities, primarily producing beef or pork products, and poultry facilities, which primarily produce chicken (excluding eggs) and turkey products. (Red meat facilities may also process lamb or veal. Poultry facilities may also process other birds, such as ducks and geese, and also small game, such as rabbits.) Facilities may perform slaughtering operations, processing operations from carcasses slaughtered at other facilities, or both. In addition, rendering operations may be performed either at stand alone facilities, or in combination with slaughter and/or further processing operations. Companies that own meat product facilities may also own facilities that perform "upstream" or "downstream" operations involved in getting meat products from the farm to the consumer (e.g., livestock raising, wholesale distribution), but these facilities are not considered part of the meat products industry.

The *1997 Economic Census* (U.S. Census Bureau, 1999a through 1999d) provides a snapshot of the meat products industry based on factors such as facility size, employment, value of shipments, and geographical distribution. The red meat industry segment is profiled in two separate North American Industry Classification System (NAICS) codes: Animal Slaughtering (NAICS 311611) and Meat

Processed From Carcasses (NAICS 311612).[1] Thus, the NAICS codes divide the red meat industry into meat packers (or slaughterers) and meat processors, but do not distinguish beef production from pork production at the facility level. Therefore, neither Sections 2.1.1.1 nor 2.1.1.2 of this profile distinguish beef production from pork production. Although these two industry segments are relatively well defined, they are not mutually exclusive.[2] The poultry processing industry (NAICS 311615) is well defined and distinct from the red meat industries; it is profiled in Section 2.1.1.3. Note that at the corporate level, a single company may own facilities in all three industry segments, while at the facility level, a single facility may manufacture some products classified in other segments. The rendering industry is briefly discussed in Section 2.1.1.4. Section 2.1.2 relates the NAICS sectors to each other and to the meat products industry as a whole, and also describes the industry's geographic distribution.

2.1.1 Industry Sectors

2.1.1.1 Animal (Except Poultry) Slaughtering: NAICS Code 311611

NAICS 311611 consists of establishments primarily engaged in the slaughter of cattle, hogs, sheep, lambs, calves, and horses for human consumption.[3] These establishments may also cook, can, cure, and freeze the meat after slaughtering. Some industry establishments manufacture prepared feeds and feed ingredients for animals (except dogs and cats). These establishments may perform slaughtering operations to manufacture the animal feed as well.

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[1] NAICS 311611 was previously covered under Standard Industrial Classification (SIC) code 2011 (Meat Packing Plants) and part of SIC 2048 (Prepared Feeds, not elsewhere classified). NAICS 311612 was covered under SIC 2103 (Sausages and Other Prepared Meats) and part of SIC 5147 (Wholesale Distribution of Meat and Meat Products).

[2] The coverage ratio for animal slaughtering is 99 percent, i.e., 99 percent of animal slaughter product shipments are accounted for by establishments classified in the industry. Furthermore, 96 percent of animal slaughtering product shipments are the primary product of establishments classified in the industry. (This number is called the specialization ratio). For the meat processing industry, the coverage ratio is 96 percent and the specialization ratio is 92 percent.

[3] For this industry, the *1997 Economic Census* did not fully implement the conversion from the SIC to the NAICS system. Therefore the Census data for NAICS 311611 does not include SIC 0751, which consists of establishments engaged in custom slaughtering. Nevertheless, the SIC and NAICS data for this industry are comparable (within 3 percent).

The animal slaughtering industry comprises 1,300 companies with approximately 1,400 establishments. The industry employs 142,000 people with payroll expenditures in excess of $3.2 billion. The total value of shipments for the industry is $54 billion, of which $8.5 billion is value added by manufacture.

Twelve states have industry shipments exceeding $1 billion. Table 2-1 presents statistics for these. As can be seen, Texas, California, Illinois, Iowa, and Wisconsin contain the largest number of animal slaughtering establishments, with at least 60 establishments each (the five states account for 28 percent of all animal slaughtering establishments). Nebraska ranks seventh in the number of slaughtering establishments, but with 18,500 workers, it employs the most workers in the slaughtering industry. Iowa, Kansas, and Texas also employ more than 14,000 workers each in the industry. Combined, these four states account for 44 percent of all employment in the animal slaughtering industry. Nebraska alone accounts for almost 17 percent of all value added and 16 percent of total shipments in the industry. Iowa, Minnesota, Nebraska, and Texas contribute almost 45 percent of value added in the industry, while Nebraska, Kansas, and Texas account for 40 percent of industry shipments. Thus industry activity is most heavily concentrated in Nebraska, Kansas, Iowa, and Texas.

Table 2-2 portrays the relative importance to the industry of different establishment size categories. More than a thousand establishments—72 percent of the total—have fewer than 20 employees each, employ less than 5 percent of the industry workforce, and contribute an even smaller percentage of value added and value of shipments to the industry. Conversely, while the 39 establishments employing between 1,000 and 2,500 workers make up only 3 percent of the total number of establishments, they provide 43 percent of industry employment and 55 percent of value added by manufacture. Forty-six percent of the value of shipments in this industry also comes from these facilities.

With the exception of the largest establishments (those with employment exceeding 2,500 workers), as employee size class increases, the relative contribution of the class to industry output increases—even though the number of establishments in the class decreases. Note that while the nine establishments with more than 2,500 employees employ 19 percent of the industry workers, and 21 percent of industry shipments, the value added by these establishments is relatively low: only 4 percent of industry value added by manufacture is attributed to these facilities. Thus, the largest establishments apparently perform a very

Table 2-1
1997 Animal Slaughter Industry: NAICS Code 311611
Statistics for Selected States

State	Number of Establishments		Number of Employees	Value Added by Manufacture ($1,000,000)	Value of Shipments ($1,000,000)
	All	20 or More Employees			
United States	**1,393**	**386**	**142,374**	**8,525**	**54,501**
California	77	27	4,300	306	1,571
Colorado	37	13	5,999	416	2,858
Illinois	85	35	8,663	492	2,795
Iowa	60	25	16,163	811	5,291
Kansas	39	10	14,116	658	7,044
Michigan	42	13	2,725	369	1,266
Minnesota	32	12	5,462	783	2,720
Nebraska	55	25	18,461	1,414	8,690
Pennsylvania	56	23	4,923	282	1,751
Texas	102	30	14,055	794	6,047
Washington	25	9	2,464	163	1,211
Wisconsin	60	19	4,728	411	2,043

Source: U.S. Census Bureau, 1999a.

Table 2-2
1997 Animal Slaughter Industry: NAICS Code 311611
Statistics by Employment Size

Employment Size Class	Number of Establishments	Number of Employees	Value Added by Manufacture ($1,000,000)	Value of Shipments ($1,000,000)
Total[a]	**1,393**	**142,374**	**8,525**	**54,501**
1 to 19	1,007	5,990	220	1,081
20 to 99	220	10,324	602	2,758
100 to 249	64	9,833	729	4,133
250 to 999	54	26,926	1,936	10,047
1,000 to 2,499	39	61,833	4,706	24,892
2,500 or More	9	27,468	331	1,159

Source: U.S. Census Bureau, 1999a.
[a] Numbers may not sum due to rounding.

high volume of low value-added operations—presumably just the initial slaughter and cutting operations (e.g., whole and half carcasses)—with higher-value operations occurring at other facilities.

Table 2-3 presents the value of shipments for selected animal slaughter industry primary products. Beef products make up approximately 55 percent of total shipments; over half of beef production is accounted for by boxed beef (30 percent of total shipments). Pork products make up 34 percent of shipments; of $17 billion in total pork product shipments, approximately 30 percent are accounted for by products requiring further processing such as curing and sausage making. The remainder of shipments consists primarily of veal and lamb products, with a small fraction accounted for by hides, skins, and pelts.

2.1.1.2 Meat Processed From Carcasses: NAICS Code 311612

Establishments in NAICS 311612 are engaged in processing or preserving meat and meat byproducts (but not poultry or small game) from purchased meats. Many of the processing and canning operations are essentially identical to those undertaken in the animal slaughter industry (NAICS 311611). It is not the final processed, canned, cooked, or cured meat product that differs between the two NAICS codes, but the fact that one industry produces that meat product from animals that it slaughters in its facility, while the second industry performs no slaughtering operations, purchasing its meat inputs from other facilities.

The meat processing industry comprises 1,164 companies. These companies own and operate approximately 1,300 meat processing establishments. The industry employs 88,000 people, with a payroll exceeding $2.3 billion. The value of all shipments from this industry is more than $25.0 billion, of which $9.1 billion is value added by manufacture. Thus, although there are almost as many establishments in the meat processing industry as the animal slaughter industry, employment in meat processing is approximately 60 percent of the employment in animal slaughter, and the value of shipments is 45 percent. However, value added in meat processing exceeds that of slaughtering by $600 million (i.e., it is 7 percent greater).

Table 2-4 shows the geographic distribution of major meat processing establishments and the relative geographic concentration of the industry. Four states, California, Illinois, New York, and Texas,

Table 2-3
1997 Animal Slaughter Industry: NAICS Code 311611
Output by Selected Product Codes

NAICS Product Code	Product Description	Value of Product Shipments ($1,000,000)[a]
311611	**Animal slaughtering products, except poultry**	**50,781**
3116111	**Fresh and frozen beef, not canned or made into sausage, made from animals slaughtered in this plant**	**28,209**
31161111	Fresh and frozen whole carcass and half carcass beef, not canned or made into sausage, made from animals slaughtered in this plant	6,734
31161113	Fresh and frozen subprimal and fabricated cuts packaged in plastics (boxed beef), not canned or made into sausage, made from animals slaughtered in this plant	15,465
31161115	Fresh and frozen boneless beef, including hamburger, not canned or made into sausage, made from animals slaughtered in this plant	3,272
311611A	**Fresh and frozen pork, not canned or made into sausage, made from animals slaughtered in this plant**	**11,812**
311611A121	Fresh and frozen primal and fabricated cuts (including trimmings), not canned or made into sausage, made from animals slaughtered in this plant	10,249
311611G	**Pork, processed or cured (not canned or made into sausage), made from animals slaughtered in this plant**	**3,305**
311611J	**Sausage and similar products (not canned), made from animals slaughtered in this plant**	**1,998**
311611P	**Hides, skins, and pelts**	**2,068**

Source: U.S. Census Bureau, 1999a.
[a] Value of shipments by product class is not the same as value of shipments by industry. Value of shipments by industry includes all products from establishments classified as animal slaughtering plants, whether those products are primary to the industry or not; value of shipments by product class includes all shipments of that product regardless of the industry classification of the establishment.

Table 2-4
1997 Meat Processing Industry: NAICS Code 311612
Statistics for Selected States

State	Number of Establishments		Number of Employees	Value Added by Manufacture ($1,000,000)	Value of Shipments ($1,000,000)
	All	20 or More Employees			
United States	**1,297**	**622**	**87,966**	**9,136**	**25,005**
California	123	60	4,779	467	1,147
Illinois	94	51	6,515	720	1,911
Iowa	40	24	4,764	875	2,438
Kansas	20	13	2,574	234	692
Nebraska	21	15	3,369	212	771
New York	96	34	2,419	938	1,210
North Carolina	40	22	3,290	125	481
Ohio	46	23	4,638	454	1,375
Pennsylvania	74	46	5,169	428	1,491
Texas	99	49	7,296	1,094	2,570
Wisconsin	53	27	10,000	1,220	2,951

Source: U.S. Census Bureau, 1999b.

contain more than 90 meat processing establishments each, and account for almost 32 percent of industry establishments. As with the animal slaughter industry, however, employment in this industry is concentrated in another set of states: Illinois, Pennsylvania, Texas, and Wisconsin. Together, these four states employ one-third of the United States's meat processing employees. Thus, these states tend to have larger establishments. In Wisconsin, for example, more than half the establishments employ more than 20 workers; Wisconsin also accounts for the largest share of both total shipments and value added in the industry. Four states, Illinois, Iowa, Texas, and Wisconsin, account for almost 40 percent of industry shipments. Of these four, two states, Iowa and Texas, are also among the largest four animal slaughtering states, while the other two largest slaughtering states, Nebraska and Kansas, rank ninth and tenth respectively in meat processing shipments.[4] Thus, the meat processing industry partially, but not entirely, overlaps the slaughter industry in terms of geographical distribution. It is not as regionally concentrated as the slaughter industry.

Table 2-5 presents meat processing establishments according to employment class. From the table it can be seen that more than half of the establishments have fewer than 20 employees, but this group contributes only a small fraction of value added and value of shipments of this industry. The bulk of employment (54 percent), value added (55 percent) and total shipments (57 percent) is accounted for by facilities employing between 100 and 500 workers.

A comparison between meat processing and animal slaughtering facilities by employment class is illuminating. The distribution of employment, value added, and value of shipments in the meat processing industry is relatively equally divided among facilities in the 100 to 249 and 250 to 999 employment classes, with smaller, but still considerable percentages accounted for by establishments in the 20 to 99 and the 500 to 999 employment classes. The largest (more than 1,000) and smallest (fewer than 20) employment classes account for relatively small percentages of employment and production. In the animal slaughtering

[4] Note that while New York is ranked seventh in value of shipments, it is third in value added by manufacture. This relatively high share of value added could be something of an anomaly: if New York processors purchase meat inputs (which account for the largest share, by far, of production costs) at approximately the same price as meat processors in other states, but need to pay New York wages to meet the high cost of living in the greater metropolitan New York area (and selling their product at a higher price as well), these establishments would show a greater percentage of value added per dollar of shipment relative to areas where the cost of living is lower. Some of the difference may also be attributable to differences in product mix (e.g., veal compared to bologna).

Table 2-5
1997 Meat Processing Industry: NAICS Code 311612
Statistics by Employment Size

Employment Size Class	Number of Establishments	Number of Employees	Value Added by Manufacture ($1,000,000)	Value of Shipments ($1,000,000)
Total[a]	**1,297**	**87,966**	**9,136**	**25,005**
1 to 19	675	4,661	366	930
20 to 99	386	17,566	1,506	4,332
100 to 249	143	23,298	2,755	7,697
250 to 499	68	23,983	2,264	6,618
500 to 999	22	18,458	2,245	5,427
1,000 or More[b]	3	4,946	714	1,538

Source: U.S. Census Bureau, 1999b.
[a] Numbers may not sum due to rounding.
[b] Two establishments employ between 1,000 and 2,449 workers, one establishment employs between 2,500 and 4,999 employees; the Census Bureau did not provide detail due to confidentiality issues.

industry, meanwhile, the distribution of employment and output is heavily skewed toward the largest establishments. Establishments employing more than 1,000 workers account for 63 percent of employment and 66 percent of shipments. There are 48 establishments employing more than 1,000 workers in animal slaughtering, but only 3 in meat processing. Thus the animal slaughter industry is dominated by a handful of very large facilities, while output from the meat processing industry is spread relatively evenly over a large number of moderately sized facilities.

Table 2-6 lists the value of shipments for selected product codes in the animal processing industry. The share of industry shipments by type of meat is reversed in the meat processing industry compared to the animal slaughtering industry. Pork makes up the biggest share of total shipments at 52 percent, while beef products account for roughly a third of shipments.[5]

2.1.1.3 Poultry Processing: NAICS Code 311615

Establishments in the poultry processing industry primarily slaughter poultry or small game, and may also process the meat and prepare meat byproducts.[6] Under the SIC system, the code for poultry processing (SIC 2015) includes facilities that dry, freeze, and break eggs. Therefore, data for the SIC and NAICS codes for this industry are not comparable. SIC sales or receipts cannot be estimated within 3 percent from NAICS data, and only 95 percent of SIC 2015 sales and receipts are classified under NAICS 311615.

Poultry processing operations are performed by 260 companies, which own 470 poultry processing establishments. Together, these companies employ a total of 224,000 employees, with a payroll exceeding $4.0 billion. The poultry processing industry's total value of shipments is $31.7 billion, of which $12.1 billion is value added by manufacture.

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[5] Note that although the pork product percentage of shipments exceeds 50 percent, the absolute value of pork shipments is lower in the meat processing industry than in the animal slaughter industry.

[6] The coverage ratio for poultry processing is 96 percent. The specialization ratio is 97 percent. Thus, the poultry processing industry is well defined by this NAICS code.

Table 2-6
1997 Meat Processing Industry: NAICS Code 311612
Output by Selected Product Codes

NAICS Product Code	Product Description	Value of Product Shipments ($1,000,000)[a]
311612	**Meat processed from carcasses**	**22,245**
3116121	**Pork, processed or cured, including frozen, (not canned or made into sausage), not made in meat packing plants**	**5,068**
31161212	Smoked pork hams and picnics (not otherwise cooked), except canned, not made into sausage	2,208
31161214	Smoked pork sliced bacon (not otherwise cooked), except canned, not made in meat packing plants	1,628
3116124	**Sausage and similar products, (not canned), not made in meat packing plants**	**6,527**
31161241	Fresh sausage (pork sausage, breakfast links, etc.), except canned, not made in meat packing plants	1,088
31161242	Dry or semidry sausage and similar products (salami, cervelat, beef jerky, pepperoni, summer sausage, pork roll, etc.), except canned, not made in meat packing plants	1,189
31161243	Frankfurters, including wieners, except canned, not made in meat packing plants	1,546
31161244	Other sausage, smoked or cooked, and jellied goods and similar preparations, not canned, not made in meat packing plants	2,701
311612A	**Other processed, frozen, or cooked meats, not made in meat packing plants**	**7,737**
311612A1	Boxed meat (beef, pork, lamb, etc.) not made in slaughtering plants	1,463
311612A2	Frozen ground meat patties (processed, frozen, or cooked), not made in meat processing plants	1,759
311612A3	Frozen portion control meats (processed, frozen, or cooked), not made in meat packing plants	1,061
311612A4	Other processed, frozen, or cooked meats, not made in meat packing plants	3,241

Source: U.S. Census Bureau, 1999b.
[a] Value of shipments by product class is not the same as value of shipments by industry. Value of shipments by industry includes all products from establishments classified as meat processing plants, whether those products are primary to the industry or not; value of shipments by product class includes all shipments of that product regardless of the industry classification of the establishment.

Table 2-7 presents data on poultry processing establishments for nine states in which the value of poultry product shipments exceeded $1 billion per state. Unlike the red meat industries described above, the poultry processing industry has a large percentage of establishments—82 percent—that employ more than 20 workers. Among these are almost all the establishments in Arkansas and Georgia.[7] Five states, Alabama, Arkansas, California, Georgia, and North Carolina, account for 36 percent of the nation's poultry processing establishments. Output and employment are dominated by four of these states: Alabama, Arkansas, Georgia, and North Carolina account for approximately 44 to 45 percent of industry workforce, value added, and total shipments of processed poultry in the United States.

The poultry processing industry has relatively few very small facilities. Like the red meat animal slaughtering industry, it is dominated by a few very large facilities. This is shown in Table 2-8. Almost 50 percent of industry employment and over 40 percent of industry shipments are accounted for by the 75 facilities that employ more than 1,000 workers each. Facilities with more than 500 workers account for 80 percent of employment and 74 percent of total shipments. Yet facilities employing more than 500 workers each make up only 36 percent of poultry processing establishments.

Output of the poultry processing industry can be divided into three key components: broilers and fryers, turkeys, and processed poultry. Shipments by the industry for selected product codes are presented in Table 2-9. Broilers and fryers are by far the most important product, making up over half of the industry's shipments. Processed poultry accounts for approximately 30 percent of shipments, and turkey products account for about 12 percent of shipments.

2.1.1.4 Rendering and Meat Byproduct Processing: NAICS Code 311613

NAICS 311613 consists of establishments engaged in rendering inedible stearin, grease, and tallow from animal fat, bones, and meat scraps. It also includes establishments manufacturing animal oils,

[7] Red meat processing establishments most likely include many relatively small butcher shops and specialty meat processors. Poultry production as a specialized industry, on the other hand, is a relatively recent development that started directly with industrialized production, resulting in relatively large facilities.

Table 2-7
1997 Poultry Processing Industry: NAICS Code 311615
Statistics for Selected States

State	Number of Establishments		Number of Employees	Value Added by Manufacture ($1,000,000)	Value of Shipments ($1,000,000)
	All	20 or More Employees			
United States	**474**	**387**	**224,511**	**12,062**	**31,656**
Alabama	30	28	19,944	1,088	2,340
Arkansas	43	42	33,409	1,869	4,908
California	29	19	7,671	577	1,327
Georgia	42	40	30,435	1,201	3,833
Mississippi	25	22	15,952	665	1,672
Missouri	24	19	12,215	994	1,988
North Carolina	29	26	18,166	1,111	2,852
Texas	18	15	10,792	586	1,620
Virginia	15	13	10,162	386	1,518

Source: U.S. Census Bureau, 1999c.

Table 2-8
1997 Poultry Processing Industry: NAICS Code 311615
Statistics by Employment Size

Employment Size Class	Number of Establishments	Number of Employees	Value Added by Manufacture ($1,000,000)	Value of Shipments ($1,000,000)
Total[a]	**474**	**224,511**	**12,062**	**31,656**
1 to 19	87	407	34	79
20 to 99	69	3,421	345	851
100 to 499	146	40,418	2,558	7,186
500 to 999	97	70,625	4,111	10,536
1,000 to 2,499	70	95,187	4,634	11,621
2,500 or More	5	14,453	379	1,383

Source: U.S. Census Bureau, 1999c.
[a] Numbers may not sum due to rounding.

Table 2-9
1997 Poultry Processing Industry: NAICS Code 311615
Output by Selected Product Codes

NAICS Product Code	Product Description	Value of Product Shipments ($1,000,000)[a]
311615	**Poultry processing**	**30,998**
3116151	**Young chickens (usually under 20 weeks of age), whole or parts**	**16,527**
31161511	Wet ice pack broilers and fryers (usually under 20 weeks of age), bulk	6,702
31161513	Tray pack (consumer packaged) broilers and fryers (usually under 20 weeks of age), chilled	4,030
31161514	Other broilers and fryers (usually under 20 weeks of age), including frozen	3,449
3116157	**Turkeys (including frozen), whole or parts**	**3,802**
31161572	Young turkeys (mature) (usually 4 to 7 months of age), whole, including frozen	1,705
31161573	Old turkeys, whole, and turkey parts	1,915
311615D	**Processed poultry and small game (except soups) containing 20 percent or more poultry or meat**	**9,200**
311615D 121	Cooked or smoked turkey, including frozen (except frankfurters, hams, and luncheon meats), containing 20 percent or more poultry	1,403
311615D 131	Cooked or smoked chicken, including frozen (except frankfurters, hams, and luncheon meats), containing 20 percent or more poultry	4,125
311615D 151	Cooked or smoked poultry hams and luncheon meats, including frozen, containing 20 percent or more poultry	1,838

Source: U.S. Census Bureau, 1999c.

[a] Value of shipments by product class is not the same as value of shipments by industry. Value of shipments by industry includes all products from establishments classified as meat processing plants, whether those products are primary to the industry or not; value of shipments by product class includes all shipments of that product regardless of the industry classification of the establishment.

including fish oil, and fish and animal meal.[8] Many establishments not classified as rendering plants perform rendering operations; only 62 percent of primary product shipments are accounted for by establishments classified in this industry (the coverage ratio).[9]

The rendering industry consists of 137 companies, which own and operate 240 establishments. The industry employs 8,800 employees, with $269 million in payroll expenditures. The total value of shipments in 1997 was $2.6 billion, with value added by manufacture of $1.3 billion.

Table 2-10 displays employment and output data for the six states with more than $100 million in rendering product shipments. Texas and California are the two states accounting for the largest share of the rendering industry. The six states listed in Table 2-10 contain establishments with 34 percent of total industry shipments.

Table 2-11 summarizes rendering industry establishments according to employment size class. In general, rendering plants are relatively small; only 11 plants employ more than 100 workers each, and only one employs more than 250 workers. The 132 establishments that employ between 20 and 99 workers account for the largest share of industry shipments (66 percent) and employment (72 percent).

Table 2-12 lists the value of shipments for selected rendering industry product codes. The industry has two primary product classes: (1) rendering and meat byproducts (primarily lard), accounting for 31 percent of shipments, and (2) animal and marine feed and fertilizer products, accounting for 63 percent of shipments. Miscellaneous rendering products, none of which are significant, account for the remainder.

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[8] Prior to 1997, this industry was classified as SIC 2077: Animal and Marine Fats and Oils. The *1997 Economic Census* did not fully implement the conversion from the SIC system to NAICS for this industry. NAICS 311613 does not include establishments engaged in manufacturing lard from purchased materials. Hence, the SIC and NAICS codes for this industry are not comparable.

[9] However, 97 percent of product shipments by establishments classified as rendering facilities are rendering products (the specialization ratio).

Table 2-10
1997 Rendering Industry: NAICS Code 311613
Statistics for Selected States

State	Number of Establishments		Number of Employees	Value Added by Manufacture ($1,000,000)	Value of Shipments ($1,000,000)
	All	20 or More Employees			
United States	**240**	**143**	**8,804**	**1,257**	**2,572**
California	21	14	770	77	178
Georgia	10	8	432	44	109
Minnesota	12	5	358	45	101
Nebraska	15	9	474	75	159
Pennsylvania	9	4	301	54	128
Texas	20	12	789	103	208

Source: U.S. Census Bureau, 1999d.

Table 2-11
1997 Rendering Industry: NAICS Code 311613
Statistics by Employment Size

Employment Size Class	Number of Establishments	Number of Employees	Value Added by Manufacture ($1,000,000)	Value of Shipments ($1,000,000)
Total[a]	**240**	**8,804**	**1,257**	**2,572**
1 to 19	97	839	136	380
20 to 49	81	2,803	435	879
50 to 99	51	3,550	417	811
100 or More[b]	11	1,612	269	502

Source: U.S. Census Bureau, 1999d.
[a] Numbers may not sum due to rounding.
[b] Ten establishments employ between 100 and 249 workers, one establishment employs between 250 and 499 employees; the Census Bureau did not provide detail due to confidentiality issues.

Table 2-12
1997 Rendering Industry: NAICS Code 311613
Output by Selected Product Codes

NAICS Product Code	Product Description	Value of Product Shipments ($1,000,000)[a]
311613	**Rendering or meat byproducts**	**3,839**
3116131	**Rendering and meat byproduct processing**	**1,209**
31161311	Lard, except canned, not made in meat packing plants	1,142
3116134	**Animal and marine feed and fertilizer byproduct**	**2,406**
31161341	Animal and marine feed and fertilizer byproducts	1,096
31161342	Other feed and fertilizer byproducts	1,060

Source: U.S. Census Bureau, 1999d.
[a] Value of shipments by product class is not the same as value of shipments by industry. Value of shipments by industry includes all products from establishments classified as meat processing plants, whether those products are primary to the industry or not; value of shipments by product class includes all shipments of that product regardless of the industry classification of the establishment.

2.1.2 Sector Overview

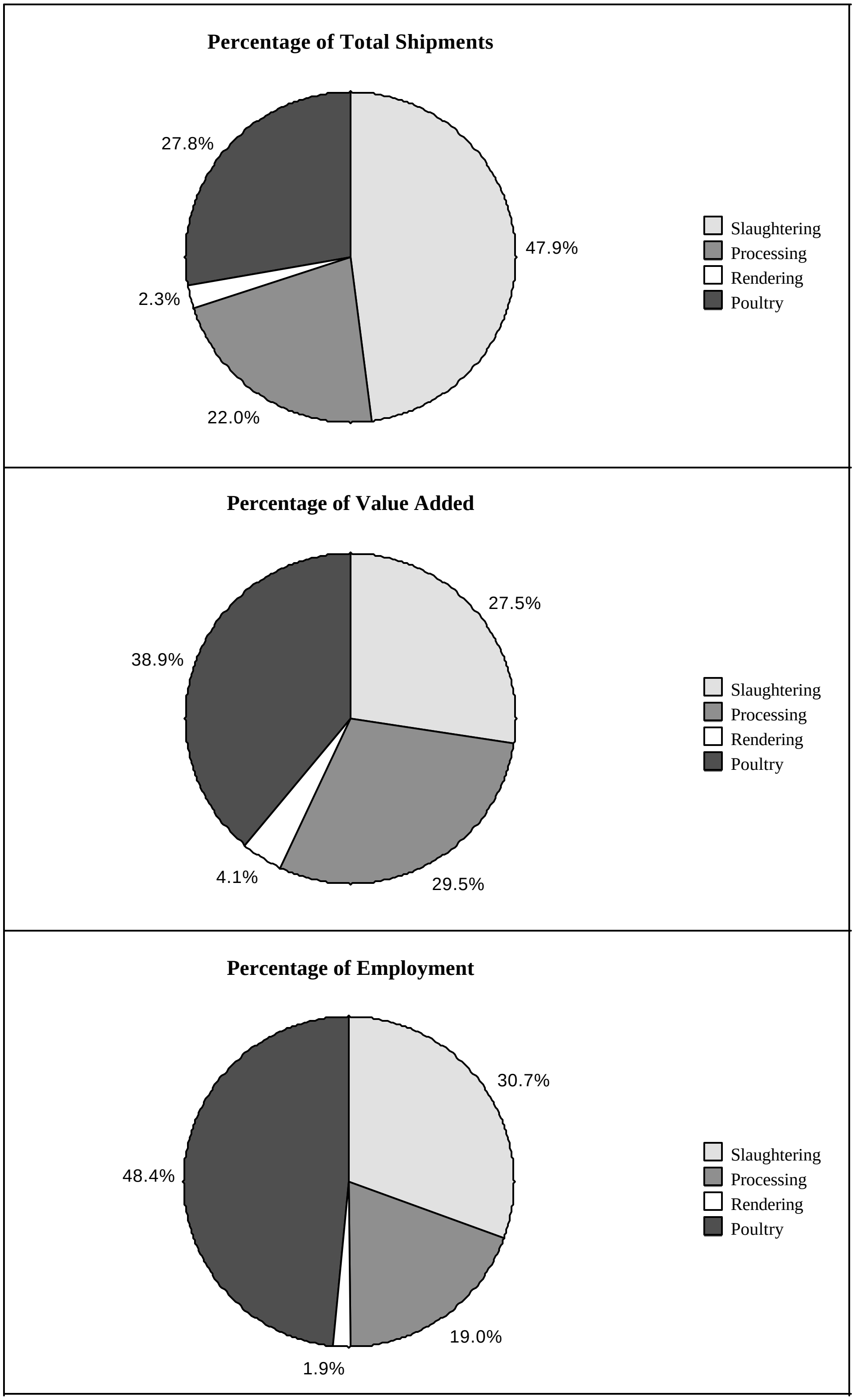
Sections 2.1.1.1 through 2.1.1.4 present a detailed overview of the principal sectors of the meat product industry. This section places those component sectors in context to each other: the importance of each of the four component NAICS code sectors relative to the overall size of the industry. Then it places the industry in geographical context: which states are the most important producers in the industry and, therefore, which states may be most affected by the proposed effluent guideline.

2.1.2.1 Relative Industry Shares

Figure 2-1 shows what percent of the industry each NAICS sector occupies. Industry output as measured by value of shipments for the meat products industry in 1997 totaled \$113.9 billion (the sum of the value of shipments for NAICS 311611, 311612, 311613, and 311615). Almost 50 percent of that output (47.9 percent) was produced in plants that perform (nonpoultry) animal slaughter operations (NAICS 311611). The poultry sector (NAICS 311615)—slaughterers, processors, and entities that slaughter and process—produced 27.8 percent of shipments. Plants that process but do not slaughter animals (NAICS 311612) produced 22 percent of shipments, and plants that primarily perform rendering operations (NAICS 311613) account for 2.3 percent of shipments.

In fact, value of shipments does not express the relative significance of industry segments as well as value added by sector. Value added subtracts the cost of material inputs from the value of shipments, so it includes an estimate of the additional value to materials already produced that can be attributed to an industry or sector. A prime example of the significance of measuring value added can be observed in the relationship between slaughter plants and further processing plants (NAICS 311611 and 311612). Further processing plants use the output of slaughter plants as raw materials in their production process. Including the value of meat purchased from slaughter plants in the value of processing plant output means double-counting goods produced by the slaughter sector. Comparing the relative shares of industry value added, the poultry sector is the largest, accounting for 38.9 percent of the meat product industry’s \$30.9 billion value added. Further processing accounts for a larger share of industry value added than slaughter plants: 29.5 percent to 27.5 percent. Rendering accounts for 4.1 percent of industry value added.

Figure 2-1
Meat Products Industry
Percentage of Employment, Total Shipments, and
Value Added by NAICS Sector



Source: U.S. Census Bureau, 1999a through 1999d

The poultry sector accounts for almost 50 percent of the 464,000 total jobs provided by the meat products industry. Plants that perform slaughter operations account for 30.7 percent of employments, while 19 percent and 1.9 percent of jobs can be attributed to further processing and rendering, respectively. Note that this suggests that the value added by an employee in the processing sector is much higher than the value added by an employee in either the slaughter or poultry sectors.

2.1.2.2 Geographic Distribution of Industry

EPA presents two comparisons to demonstrate the relative importance of geographical regions to the meat product industry, as well as the importance of the industry in state economies.

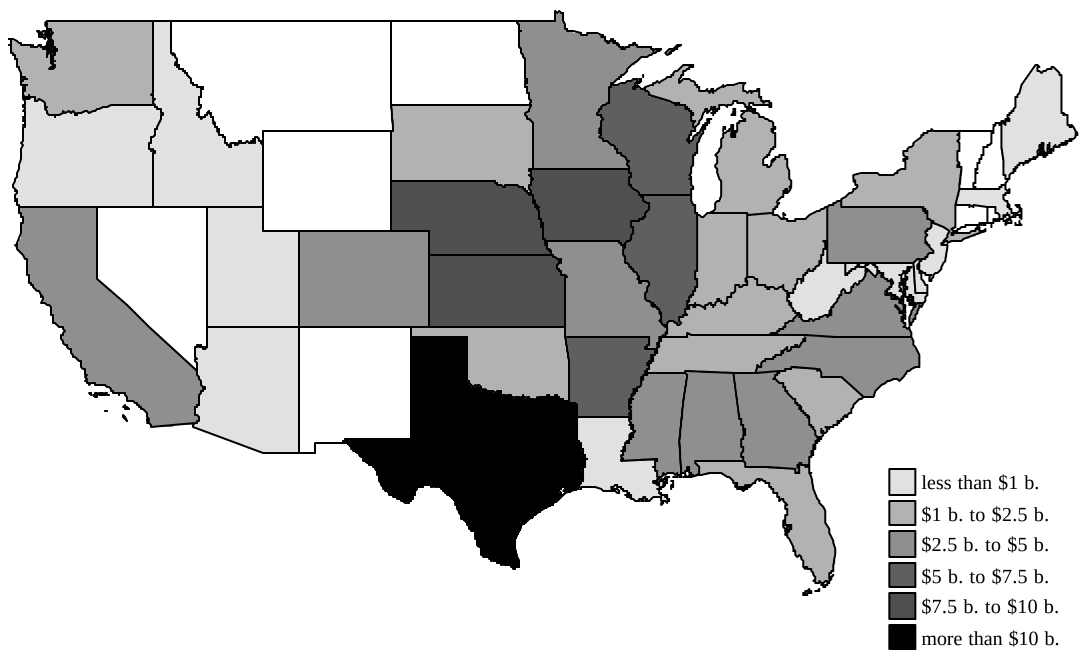
The top panel of Figure 2-2 presents the value of meat product shipments by state. Texas is the leader, producing more than $10 billion worth of meat product shipments in 1997. Nebraska, Iowa, and Kansas follow Texas, with shipments valued between $7.5 billion and $10 billion. In the third tier are states such as Arkansas, Wisconsin, and Illinois, with 1997 shipments between $5 billion and $7.5 billion in 1997. These seven states account for 46 percent of meat product shipments.

The lower panel of Figure 2-2, however, indicates that the significance of the meat products industry within these states varies widely. For Nebraska, Kansas, Iowa, and Arkansas, the meat products industry accounts for a minimum of 12 percent of manufacturing production within the state; in Kansas, for example, it accounts for almost 35 percent of state manufacturing output. While Texas is the largest producer of meat products by value, meat products only make up 3.5 percent of state manufacturing production (Texas is seventeenth in percentage of production devoted to meat products). Conversely, while Delaware is only ranked twenty-ninth in the value of meat production—its total value of production is 8 percent of Texas' production—meat products are relatively more important to its economy than to the Texas economy, accounting for more than 6 percent of manufacturing output.

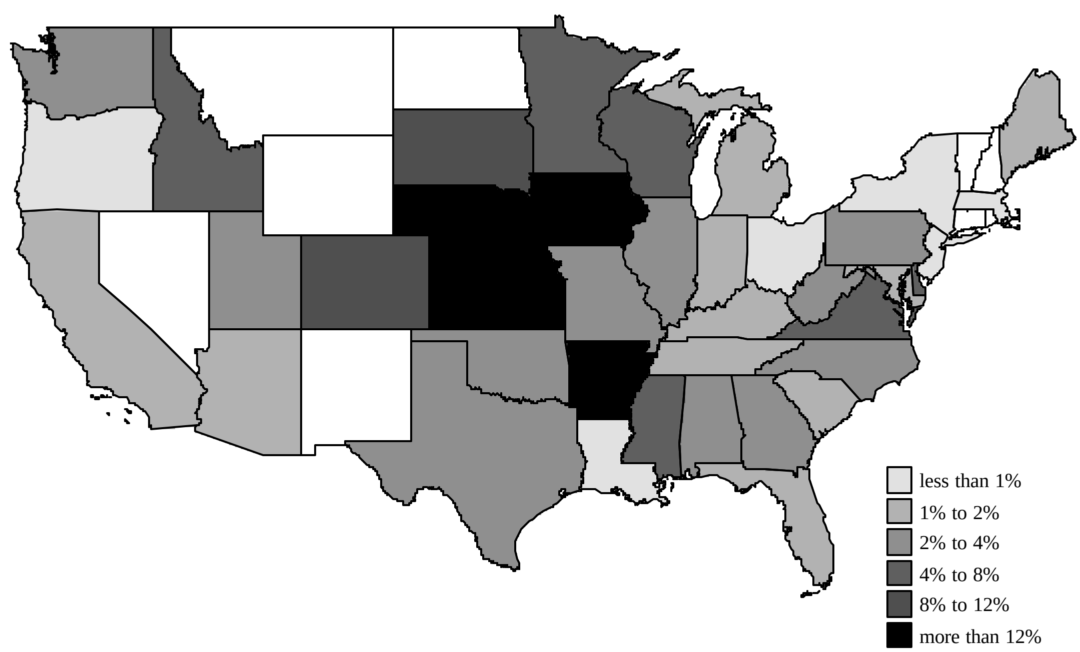
A similar pattern can be observed in industry employment (Figure 2-3). Arkansas, Georgia, and Texas each employ more than 30,000 meat product industry workers. North Carolina, Iowa, Nebraska, and Alabama each employ more than 20,000 workers. Nebraska is first, though, in percent of employment: the

Figure 2-2
Value of Meat Products Shipments by State and
Meat Products as a Percentage of Shipments by State

Value of Meat Product Shipments



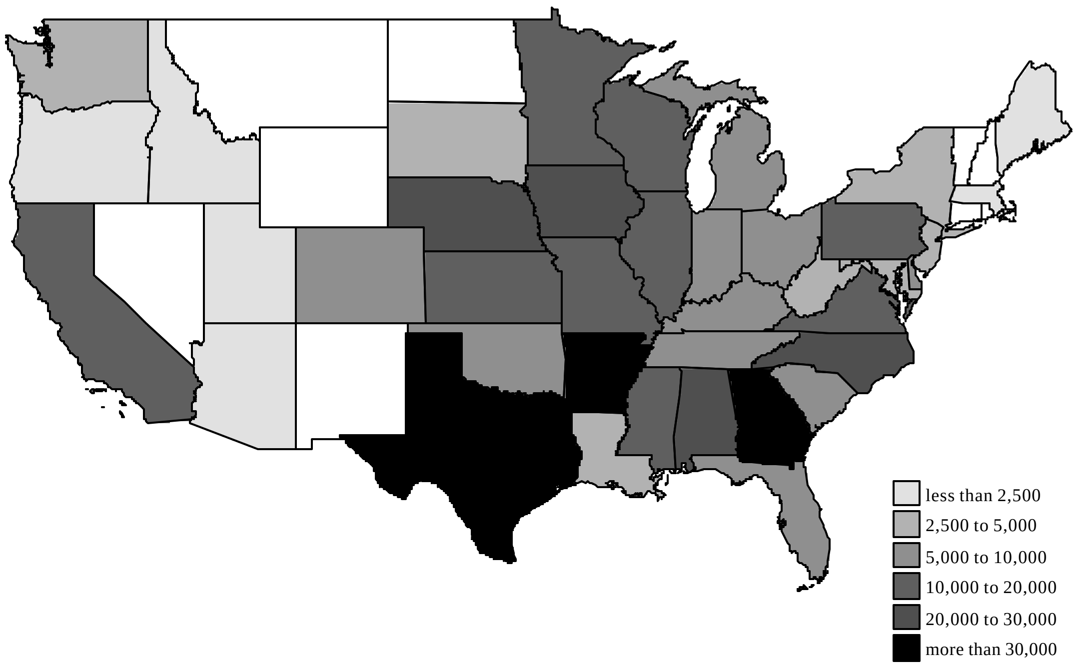
As Percent of State Total Shipments



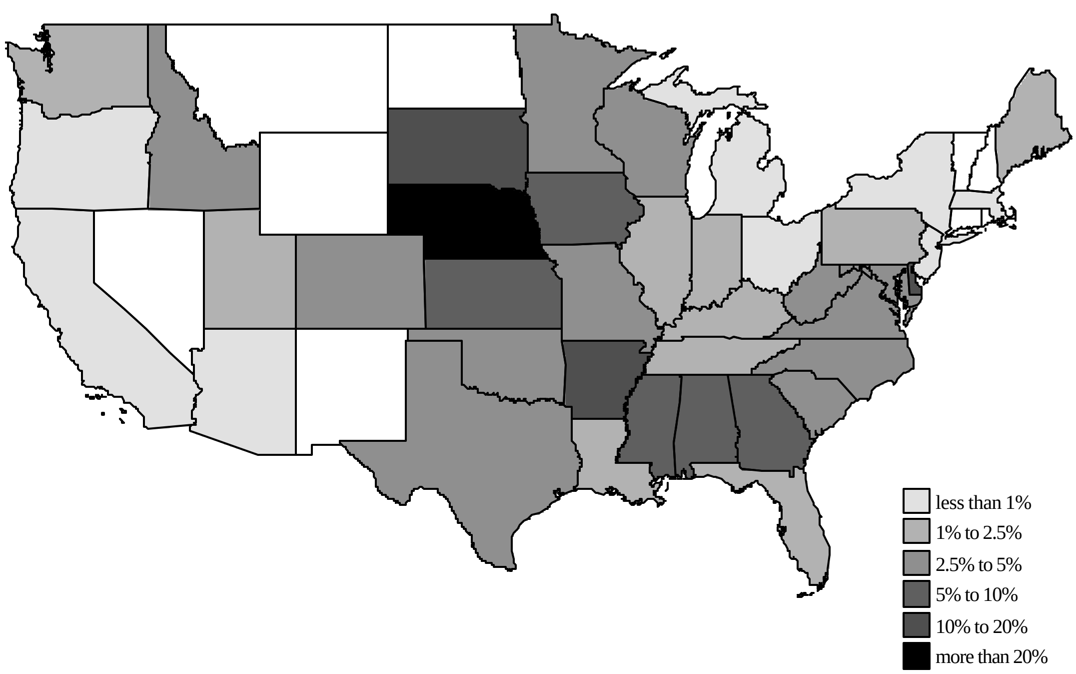
Source: U.S. Census Bureau, 2000.

Figure 2-3
Meat Products Employment by State and Employment as a Percentage of State Employment

Employment by State



As Percent of State Employment



Source: U.S. Census Bureau, 2000.

meat products industry accounts for 21 percent of Nebraska's manufacturing employment. Although Delaware only provides 6,400 meat product industry jobs, making it twenty-fourth among all states, the meat product industry accounts for 16 percent of manufacturing employment in Delaware. Meat product industry employment accounts for 3.4 percent of manufacturing employment in Texas, which is the third largest industry employer.

2.2 SCREENER SURVEY AND SUBCATEGORIZATION

For the proposal analysis, EPA used the 2001 Meat Products Industry Screener Survey (hereinafter referred to as the "Screener Survey") to obtain information on a sample of meat product facilities potentially affected by the rule. EPA used its authority under Section 308 of the Clean Water Act to collect information not available otherwise, such as site-specific employment, production, and wastewater data.

EPA used this detailed data to construct a framework for the proposed effluent guideline. Site level data on production and wastewater flow was used to determine classifications based on meat type, type of process, size, and discharge type. These meat type and process classes were then grouped into the 40 CFR 432 subcategories (hereafter, subcategories). Effluent limitations and guidelines are set on the basis of these subcategories.

2.2.1 Meat Type and Process Classes

2.2.1.1 Method of Classification

To generate the meat type and process classes, EPA first evaluated the screener survey population based on the type of meat produced at the facility:

- red meat (primarily beef and pork),
- poultry (primarily chicken and turkey),

- mixed (both red meat and poultry),
- rendering, or meat byproducts (either red meat or poultry),

and second, the type of processes performed at the facility:

- first processing (slaughter),
- further processing,
- rendering (the process resulting in meat byproducts).

This results in a classification of facilities consisting of combinations of the processes for each meat type. For example, a poultry facility may perform any of the following six combinations of processes, each one of which will place it in a different class: (1) first processing; (2) further processing; (3) first and further processing; (4) first processing and rendering; (5) further processing and rendering; or (6) first processing, further processing, and rendering. Facilities that only perform the process of rendering are classified as renderers; if rendering is performed in combination with the other two processes the facility is classified with the appropriate meat type (red meat or poultry).

EPA also classified facilities by discharge type and facility size. Discharge type distinguishes those facilities that discharge process wastewater directly into U.S. surface waters (direct dischargers) from those that discharge wastewater to treatment works (indirect dischargers). Under the Clean Water Act, EPA may apply different standards to direct and indirect dischargers (see Section 4.2). Size is determined by facility production and wastewater flow and was used to cost the appropriate treatment capacity for the facility. For the purposes of costing, EPA divided facilities in each class into small, medium, large, and very large. Detailed information on classification can be found in the Development Document (EPA, 2002).

2.2.1.2 Facility Count by Class, Discharge, and Size

As mentioned above, data from the Screener Survey sample was used to generate facility classes, based on meat type and process. Moreover, each class is further divided into direct and indirect dischargers, as well as four size groupings within the discharging group. Table 2-13 shows the number of facilities in each of the meat type and process class by discharge type and size. An analysis by meat type shows that of the total 5,606 facilities, 70 percent produce red meat, followed by facilities producing mixed meat at 15 percent of the total. Poultry producing facilities make up 13 percent of total facilities. By process, further processors comprise of 71 percent of all facilities, and first and further processing facilities are 14 percent of the total. By discharge type, 94 percent of facilities are indirect dischargers. Finally, a size distribution is as follows: 84 percent of facilities are small, 11 percent are medium, 3 percent large, and 2 percent very large.

2.2.2 Proposal 40 CFR 432 Subcategories

2.2.2.1 Method of Subcategorization

The subcategories developed for the proposed rule modify and extend the existing industry subcategories. Currently, EPA has subcategorized the industry as follows:

- Subcategory A — Simple Slaughterhouse
- Subcategory B — Complex Slaughterhouse
- Subcategory C — Low-Processing Packinghouse
- Subcategory D — High- Processing Packinghouse
- Subcategory E — Small Processor
- Subcategory F — Meat Cutter
- Subcategory G — Sausage and Luncheon Meats Processor
- Subcategory H — Ham Processor
- Subcategory I — Canned Meats Processor
- Subcategory J — Renderer

Using the meat type and process classes described in Section 2.2.1.1 above, EPA grouped the screener survey population into five subcategories. For the proposed rule, the first four subcategories are combined to form Subcategory A through D, the next four are combined to form Subcategory E through I, while

Table 2-13
Facility Count by Meat Type and Process Class, Discharge Type, and Size

Meat Type	Process	Size	Number of Facilities: Direct Dischargers	Number of Facilities: Indirect Dischargers
Red Meat	First Processing	Small	17	265
		Medium	6	0
		Large	0	0
		Very Large	0	0
Red Meat	Further Processing	Small	43	2,489
		Medium	10	160
		Large	1	4
		Very Large	1	4
Red Meat	First and Further Processing	Small	0	674
		Medium	0	28
		Large	0	0
		Very Large	0	0
Red Meat	First Processing and Rendering	Small	17	12
		Medium	17	7
		Large	7	3
		Very Large	12	5
Red Meat	Further Processing and Rendering	Small	0	32
		Medium	4	7
		Large	0	0
		Very Large	0	0
Red Meat	First Processing, Further Processing, and Rendering	Small	25	50
		Medium	17	12
		Large	7	5

Table 2-13 (cont.)
Facility Count by Meat Type and Process Class, Discharge Type, and Size

Meat Type	Process	Size	Number of Facilities	
			Direct Dischargers	Indirect Dischargers
		Very Large	0	0
Poultry	First Processing	Small	0	19
		Medium	17	32
		Large	25	48
		Very Large	7	12
Poultry	Further Processing	Small	0	272
		Medium	10	133
		Large	1	4
		Very Large	2	18
Poultry	First and Further Processing	Small	0	20
		Medium	6	11
		Large	2	4
		Very Large	8	14
Poultry	First Processing and Rendering	Small	0	0
		Medium	7	2
		Large	8	2
		Very Large	2	1
Poultry	Further Processing and Rendering	Small	0	4
		Medium	0	9
		Large	0	6
		Very Large	0	0
Poultry	First Processing, Further Processing, and Rendering	Small	0	0
		Medium	2	3

Table 2-13 (cont.)
Facility Count by Meat Type and Process Class, Discharge Type, and Size

Meat Type	Process	Size	Number of Facilities: Direct Dischargers	Number of Facilities: Indirect Dischargers
		Large	3	7
		Very Large	1	2
Mixed Meat	Further Processing	Small	9	707
		Medium	5	97
		Large	0	0
		Very Large	0	0
Mixed Meat	Further Processing and Rendering	Small	0	4
		Medium	0	0
		Large	0	0
		Very Large	0	0
Either	Rendering	Small	6	17
		Medium	7	26
		Large	6	21
		Very Large	8	28

Subcategory J is unchanged. The proposed rule creates new subcategories for the poultry industry which is not regulated under the current effluent guidelines.

Thus, the structure of the subcategorization for the proposed rule is as follows:

- red meat facilities that perform first processing alone or in combination with further processing and/or rendering are assigned to Subcategory A through D.

- red meat facilities that perform further processing alone or in combination with rendering, but no first processing, are assigned to Subcategory E through I.

- facilities that perform rendering but no other processes are assigned to Subcategory J.

- poultry facilities that perform first processing alone or in combination with further processing and/or rendering are assigned to Subcategory K.

- poultry facilities that perform further processing alone or in combination with rendering, but no first processing, are assigned to Subcategory L.

- mixed facilities — both red meat and poultry — performing further processing are split into the two subcategories consisting of further processors (Subcategory E through I and Subcategory L). The facilities are assigned based on average production of each meat type. The mixed facilities are divided as such:

    — for medium, large, and very large facilities, 61 percent are assigned to the red meat further processors (Subcategory E through I), while for small facilities, the ratio is 59 percent.

    — the remaining mixed facilities, i.e., 39 percent of medium, large, and very large facilities and 41 percent of small facilities are assigned to the poultry further processors (Subcategory L).

2.2.2.2 Facility Count by Subcategories

Table 2-14 presents the proposed subcategorization and the corresponding meat type and process classes that constitute each subcategory. Also shown on the table is the number of facilities in each subcategory by discharge type and size (smalls and non smalls only). Of the total facilities, 58 percent are in Subcategory E through I, followed by 21 percent in Subcategory A through D. Subcategory L consists

Table 2-14
Facility Count by Proposal 40 CFR 432 Subcategories, Discharge Type, and Size

Meat Type	Processes	Size	Number of Facilities	
			Direct Dischargers	**Indirect Dischargers**
Subcategory A through D				
Red Meat	First Processing; First Processing and Further Processing; First Processing and Rendering; and First, Further Processing, and Rendering	Small	59	1,001
		Non Small	66	60
Subcategory E through I				
Red Meat	Further Processing; Further Processing and Rendering; Mixed Meat Further Processing; and Mixed Meat Further Processing and Rendering	Small	48	2,940
		Non Small	19	234
Subcategory J				
Red Meat or Poultry	Rendering	Small	6	17
		Non Small	21	75
Subcategory K				
Poultry	First Processing; First Processing and Further Processing; First Processing and Rendering; and First, Further Processing, and Rendering	Small	0	39
		Non Small	88	138
Subcategory L				
Poultry	Further Processing; Further Processing and Rendering; Mixed Meat Further Processing; and Mixed Meat Further Processing and Rendering	Small	4	568
		Non Small	15	208

of 14 percent of facilities, 5 percent of facilities belong to Subcategory L, and the remaining 2 percent belong to Subcategory J.

2.3 TRENDS IN PRODUCTION, PRICES, AND INTERNATIONAL TRADE

2.3.1 Aggregate Industry Trends

2.3.1.1 Domestic Production and International Trade Trends

The *1997 Economic Census* provides a detailed snapshot of the meat products industry in 1997. The screener survey provides detailed data that allows EPA to analyze and subcategorize the industry. However, neither provide information on industry trends. Furthermore, due to the switch from the SIC code system to the NAICS system, it is difficult to reliably interpret Census time series data for the industry. EPA used data from a variety of sources, primarily the U.S. Department of Agriculture (USDA), to characterize industry trends.

Table 2-15 presents data on aggregate beef production and trade from 1980 to 2000. Overall domestic production grew at an average annual rate of little more than 1 percent from 1980 to 2000, although the industry grew at a faster rate of 1.7 percent per year from 1990 to 2000. The significant role of international trade in sustaining industry growth is readily apparent from Table 2-15. Beef exports grew by 12 percent per year from 1980 to 2000, and at a somewhat slower but still robust 9.5 percent since 1990. Exports now make up almost 10 percent of domestic production. The year to year volatility of beef exports is also apparent in the data. Note that despite this substantial growth in beef exports, the U.S. is a net importer of beef.

Table 2-16 presents data on aggregate pork production and trade from 1980 to 2000. Domestic output of pork grew more slowly than either beef or chicken in this time frame. Although pork exports grew more quickly than beef exports, pork exports as a percent of domestic production are less significant than beef exports. However, because pork exports have maintained a double-digit annual growth rate since

Table 2-15
Beef Production, Exports and Imports, 1980–2000

Year	Beef (million of pounds, carcass weight)						
	Domestic Production	Percent Change	Imports	Percent Change	Exports	Percent Change	As Percent of Domestic Production
1980	21,643		2,064		173		0.8%
1981	22,389	3.4%	1,743	-15.6%	216	24.9%	1.0%
1982	22,536	0.7%	1,939	11.2%	250	15.7%	1.1%
1983	23,243	3.1%	1,974	1.8%	268	7.2%	1.2%
1984	23,598	1.5%	1,823	-7.6%	323	20.5%	1.4%
1985	23,728	0.6%	2,071	13.6%	325	0.6%	1.4%
1986	24,371	2.7%	2,129	2.8%	516	58.8%	2.1%
1987	23,566	-3.3%	2,269	6.6%	600	16.3%	2.5%
1988	23,589	0.1%	2,379	4.8%	680	13.3%	2.9%
1989	23,087	-2.1%	2,178	-8.4%	1,023	50.4%	4.4%
1990	22,743	-1.5%	2,356	8.2%	1,006	-1.7%	4.4%
1991	22,917	0.8%	2,406	2.1%	1,188	18.1%	5.2%
1992	23,086	0.7%	2,440	1.4%	1,324	11.4%	5.7%
1993	23,049	-0.2%	2,401	-1.6%	1,275	-3.7%	5.5%
1994	24,386	5.8%	2,369	-1.3%	1,611	26.4%	6.6%
1995	25,222	3.4%	2,103	-11.2%	1,821	13.0%	7.2%
1996	25,525	1.2%	2,073	-1.4%	1,877	3.1%	7.4%
1997	25,490	-0.1%	2,343	13.0%	2,136	13.8%	8.4%
1998	25,653	0.6%	2,642	12.8%	2,171	1.6%	8.5%
1999	26,386	2.9%	2,874	8.8%	2,417	11.3%	9.2%
2000	26,777	1.5%	3,032	5.5%	2,516	4.1%	9.4%
Avg., 1980–2000		1.1%		2.8%		12.4%	
Avg., 1990–2000		1.7%		3.3%		9.5%	
Avg., 1995–2000		1.6%		5.3%		7.7%	

Source: 1980–1997 data: Putnam & Allshouse, 1999, extended through 2000 from Livestock, Dairy & Poultry: Situation & Outlook, 12/27/00 and 8/29/01.

Table 2-16
Pork Production, Exports and Imports, 1980–2000

Year	Pork (million of pounds, carcass weight)						
	Domestic Production	Percent Change	Imports	Percent Change	Exports	Percent Change	As Percent of Domestic Production
1980	16,617		550		252		1.5%
1981	15,873	-4.5%	542	-1.5%	307	21.8%	1.9%
1982	14,229	-10.4%	612	12.9%	214	-30.3%	1.5%
1983	15,199	6.8%	707	15.5%	219	2.3%	1.4%
1984	14,812	-2.5%	954	34.9%	164	-25.1%	1.1%
1985	14,807	-0.0%	1,128	18.2%	128	-22.0%	0.9%
1986	14,063	-5.0%	1,122	-0.5%	86	-32.8%	0.6%
1987	14,373	2.2%	1,195	6.5%	109	26.7%	0.8%
1988	15,684	9.1%	1,137	-4.9%	195	78.9%	1.2%
1989	15,813	0.8%	896	-21.2%	262	34.4%	1.7%
1990	15,354	-2.9%	898	0.2%	238	-9.2%	1.6%
1991	15,999	4.2%	775	-13.7%	283	18.9%	1.8%
1992	17,233	7.7%	645	-16.8%	420	48.4%	2.4%
1993	17,088	-0.8%	740	14.7%	446	6.2%	2.6%
1994	17,696	3.6%	743	0.4%	549	23.1%	3.1%
1995	17,849	0.9%	664	-10.6%	787	43.4%	4.4%
1996	17,117	-4.1%	618	-6.9%	970	23.3%	5.7%
1997	17,274	0.9%	633	2.4%	1,044	7.6%	6.0%
1998	18,981	9.9%	704	11.2%	1,229	17.7%	6.5%
1999	19,278	1.6%	827	17.5%	1,278	4.0%	6.6%
2000	18,928	-1.8%	967	16.9%	1,305	2.1%	6.9%
Avg., 1980–2000		1.0%		4.5%		14.8%	
Avg., 1990–2000		2.2%		2.6%		16.3%	
Avg., 1995–2000		1.3%		6.6%		14.3%	

Source: 1980–1997 data: Putnam & Allshouse, 1999, extended through 2000 from Livestock, Dairy & Poultry: Situation & Outlook, 12/27/00 and 8/29/01.

1995, this may change. Note that despite the substantial growth in pork exports, the U.S. is a net importer of pork.

Table 2-17 presents data on aggregate broiler production and exports from 1980 to 2000; broiler imports have generally been negligible and were not included in the table. Domestic broiler production maintained an average 5 percent annual growth rate over the 20-year period. Carcass weight of broiler production expanded from approximately 50 percent of beef production in 1980 to 114 percent of beef production in 2000. Broiler exports grew at 15 percent per year over the 20-year period, and now account for more than 18 percent of domestic production.[10]

Table 2-18 presents data on aggregate domestic turkey production from 1999 to 2000; turkey imports have generally been negligible and were not included in the table. While overall turkey production grew at 4 percent per year over the 1980 to 2000 time frame—much faster than beef or pork, and only slightly slower than broilers—growth has slowed considerably since 1995. The pattern for turkey exports is similar: a high growth rate over the entire 20-year period is offset by a significant slowdown in the last 5 years.

The above tables amply illustrate the importance of international trade for U.S. meat producers. Most of this growth in trade of meat and poultry has been attributed to a liberalized trading environment. Trade agreements like NAFTA, for example, have spurred the growth of U.S. beef exports to Canada and poultry exports to Mexico (USDA, 1997b; USITC, 1998). Yet there exist trade barriers, such as health and sanitary concerns, that have been preventing the U.S. from open access to certain markets. For instance, the European Union bans the importation of U.S. beef produced with growth-promoting agents (USDA, 1997b). Industry organizations like the National Pork Producers Council and the National Cattlemen's Beef Association believe that the growth of U.S. exports has been limited by unfair and unscientific non-tariff trade barriers on meat imports imposed by some countries (NPPC, 1999b; NCBA, 2000a).

[10] Focus on aggregate trade statistics can sometimes obscure significant differences in traded goods. For example, Russia is a significant importer of U.S. poultry products. Russian consumers prefer dark poultry meat while U.S. consumers prefer white meat. Thus, trade with Russia provides an important element of complementary production for U.S. poultry processors (Standard & Poor's, 1999).

Table 2-17
Broiler Production and Exports, 1980–2000

Year	Broilers (million of pounds, ready-to-cook carcass weight)				
	Domestic Production	Percent Change	Exports	Percent Change	As Percent of Domestic Production
1980	11,252		567		5.0%
1981	11,868	5.5%	719	26.8%	6.1%
1982	11,996	1.1%	501	-30.3%	4.2%
1983	12,326	2.8%	432	-13.8%	3.5%
1984	12,921	4.8%	407	-5.8%	3.1%
1985	13,520	4.6%	417	2.5%	3.1%
1986	14,180	4.9%	566	35.7%	4.0%
1987	15,413	8.7%	752	32.9%	4.9%
1988	16,007	3.9%	765	1.7%	4.8%
1989	17,227	7.6%	814	6.4%	4.7%
1990	18,430	7.0%	1,143	40.4%	6.2%
1991	19,591	6.3%	1,261	10.3%	6.4%
1992	20,904	6.7%	1,489	18.1%	7.1%
1993	22,015	5.3%	1,966	32.0%	8.9%
1994	23,666	7.5%	2,876	46.3%	12.2%
1995	24,827	4.9%	3,894	35.4%	15.7%
1996	26,124	5.2%	4,420	13.5%	16.9%
1997	27,041	3.5%	4,664	5.5%	17.2%
1998	27,863	3.0%	4,673	0.2%	16.8%
1999	29,741	6.7%	4,920	5.3%	16.5%
2000	30,485	2.5%	5,548	12.8%	18.2%
Avg., 1980–2000		5.1%		15.4%	
Avg., 1990–2000		5.0%		15.6%	
Avg., 1995–2000		4.3%		11.4%	

Source: 1980–1997 data: Putnam & Allshouse, 1999; extended through 2000 from Livestock, Dairy & Poultry: Situation & Outlook, 12/27/00 and 8/29/01.
Broiler imports are negligible.

Table 2-18
Turkey Production and Exports, 1980–2000

Year	Turkey (million of pounds, ready-to-cook carcass weight)				
	Domestic Production	Percent Change	Exports	Percent Change	As Percent of Domestic Production
1980	2,370		75		3.2%
1981	2,536	7.0%	63	-16.0%	2.5%
1982	2,472	-2.5%	51	-19.0%	2.1%
1983	2,590	4.8%	47	-7.8%	1.8%
1984	2,601	0.4%	27	-42.6%	1.0%
1985	2,817	8.3%	27	0.0%	1.0%
1986	3,155	12.0%	27	0.0%	0.9%
1987	3,701	17.3%	33	22.2%	0.9%
1988	3,879	4.8%	51	54.5%	1.3%
1989	4,136	6.6%	41	-19.6%	1.0%
1990	4,514	9.1%	54	31.7%	1.2%
1991	4,603	2.0%	122	125.9%	2.7%
1992	4,777	3.8%	202	65.6%	4.2%
1993	4,798	0.4%	244	20.8%	5.1%
1994	4,937	2.9%	280	14.8%	5.7%
1995	5,069	2.7%	348	24.3%	6.9%
1996	5,401	6.5%	438	25.9%	8.1%
1997	5,412	0.2%	598	36.5%	11.0%
1998	5,281	-2.4%	446	-25.4%	8.4%
1999	5,297	0.3%	379	-15.0%	7.2%
2000	5,402	2.0%	458	20.8%	8.5%
Avg., 1980–2000		4.0%		18.5%	
Avg., 1990–2000		1.8%		20.5%	
Avg., 1995–2000		1.6%		12.8%	

Source: 1980–1997 data: Putnam & Allshouse, 1999; extended through 2000 from Livestock, Dairy & Poultry: Situation & Outlook, 12/27/00 and 8/29/01.
Turkey imports are negligible.

2.3.1.2 Price Trends

Table 2-19 compares the overall trend in meat prices with all food prices and the Consumer Price Index (CPI). While food prices have increased more slowly than the overall CPI, meat prices have increased even more slowly than food prices. Thus, the price of meat products has decreased relative to the prices for other food products, and other products in general, over the last 20 years. Beef prices have consistently increased more slowly than pork or poultry, which again reflects a relative decline in the price of beef (see Table 2-20). The price of pork as a component of the aggregate meat measure has increased at approximately the same rate as overall food prices for the 20-year period—with some fluctuation in subperiods. As with beef, the price of poultry has risen more slowly than the overall price of food, indicating a relative price decrease for poultry. The decrease in the relative price of poultry combined with the high growth rate of output indicates that productivity gains in the poultry industry were probably substantial.

2.3.2 Industry Response to Changing Consumer Preferences

Meat consumption patterns in the U.S. have undergone important changes in the last three decades. While total meat consumption increased from 1970 to 1998, the relative consumption of red meats to poultry has not remained the same. Total annual per capita meat consumption (boneless, trimmed equivalent) increased by 10 percent between 1970 and 1998. In the same period, annual per capita red meat consumption declined by 12 percent and per capita poultry consumption increased by 92 percent. More specifically, annual per capita beef consumption decreased 18 percent (from 79.6 pounds in 1970 to 64.9 pounds in 1998). Annual per capita pork consumption levels remained relatively constant over the same period. Chicken and turkey consumption, however, increased dramatically: annual per capita chicken consumption increased from 27.4 pounds in 1970 to 50.8 pounds in 1998 (an 85 percent increase). Turkey consumption increased from 6.4 pounds per capita to 14.2 pounds over the same period (Putnam and Allshouse, 1999).

Changes in demand for meat and poultry are considered to be largely responsible for higher degrees of concentration in the meat and poultry industry. In the case of beef, declining per capita consumption

Table 2-19
Consumer Price Index for All Items, Food, and Meat, 1980–2000

Year	All Items		Food		Meats	
	Index	Percent Change	Index	Percent Change	Index	Percent Change
1980	82.4		86.8		92.7	
1981	90.9	10.3%	93.6	7.8%	96.0	3.6%
1982	96.5	6.2%	97.4	4.1%	100.7	4.9%
1983	99.6	3.2%	99.4	2.1%	99.5	-1.2%
1984	103.9	4.3%	103.2	3.8%	99.8	0.3%
1985	107.6	3.6%	105.6	2.3%	98.9	-0.9%
1986	109.6	1.9%	109.0	3.2%	102.0	3.1%
1987	113.6	3.6%	113.5	4.1%	109.6	7.5%
1988	118.3	4.1%	118.2	4.1%	112.2	2.4%
1989	124.0	4.8%	125.1	5.8%	116.7	4.0%
1990	130.7	5.4%	132.4	5.8%	128.5	10.1%
1991	136.2	4.2%	136.3	2.9%	132.5	3.1%
1992	140.3	3.0%	137.9	1.2%	130.7	-1.4%
1993	144.5	3.0%	140.9	2.2%	134.6	3.0%
1994	148.2	2.6%	144.3	2.4%	135.4	0.6%
1995	152.4	2.8%	148.4	2.8%	135.5	0.1%
1996	156.9	3.0%	153.3	3.3%	140.2	3.5%
1997	160.5	2.3%	157.3	2.6%	144.4	3.0%
1998	163.0	1.6%	160.7	2.2%	141.6	-1.9%
1999	166.6	2.2%	164.1	2.1%	142.3	0.5%
2000	172.2	3.4%	167.8	2.3%	150.7	5.9%
Avg., 1980–2000		3.8%		3.4%		2.5%
Avg., 1990–2000		2.8%		2.4%		1.6%
Avg., 1995–2000		2.5%		2.5%		2.2%

Source: Putnam and Allshouse, 1999.
U.S. Consumer Price Index; city average, base period: 1982 - 1984 = 100.

Table 2-20
Consumer Price Index for Meat Products, 1980–2000

Year	Beef and Veal		Pork		Poultry		Fresh Whole Chicken		Fresh and Frozen Chicken Parts		Fish and Seafood	
	Index	Percent Change	Index	Percent Change	Index	Percent Change	Index	Percent Change	Index	Percent Change	Annual Average	Percent Change
1980	98.4		81.9		93.7		94.4		91.7		87.5	
1981	99.2	0.8%	89.5	9.3%	97.5	4.1%	96.5	2.2%	96.7	5.5%	94.8	8.3%
1982	100.6	1.4%	101.0	12.8%	95.8	-1.7%	94.8	-1.8%	94.9	-1.9%	98.2	3.6%
1983	99.1	-1.5%	100.1	-0.9%	97.0	1.3%	96.3	1.6%	96.6	1.8%	99.3	1.1%
1984	100.3	1.2%	98.8	-1.3%	107.3	10.6%	109.0	13.2%	108.4	12.2%	102.5	3.2%
1985	98.2	-2.1%	99.1	0.3%	106.2	-1.0%	104.5	-4.1%	104.6	-3.5%	107.5	4.9%
1986	98.8	0.6%	107.2	8.2%	114.2	7.5%	115.4	10.4%	114.6	9.6%	117.4	9.2%
1987	106.3	7.6%	116.0	8.2%	112.6	-1.4%	113.3	-1.8%	114.4	-0.2%	129.9	10.6%
1988	112.1	5.5%	112.5	-3.0%	120.7	7.2%	125.1	10.4%	123.3	7.8%	137.4	5.8%
1989	119.3	6.4%	113.2	0.6%	132.7	9.9%	137.1	9.6%	135.7	10.1%	143.6	4.5%
1990	128.8	8.0%	129.8	14.7%	132.5	-0.2%	134.9	-1.6%	135.9	0.1%	146.7	2.2%
1991	132.4	2.8%	134.1	3.3%	131.5	-0.8%	131.7	-2.4%	134.7	-0.9%	148.3	1.1%
1992	132.3	-0.1%	127.8	-4.7%	131.4	-0.1%	131.9	0.2%	134.4	-0.2%	151.7	2.3%
1993	137.1	3.6%	131.7	3.1%	136.9	4.2%	138.0	4.6%	140.1	4.2%	156.6	3.2%
1994	136.0	-0.8%	133.9	1.7%	141.5	3.4%	140.1	1.5%	145.6	3.9%	163.7	4.5%
1995	134.9	-0.8%	134.8	0.7%	143.5	1.4%	142.2	1.5%	146.0	0.3%	171.6	4.8%
1996	134.5	-0.3%	148.2	9.9%	152.4	6.2%	152.6	7.3%	155.0	6.2%	173.1	0.9%
1997	136.8	1.7%	155.9	5.2%	156.6	2.8%	158.5	3.9%	157.4	1.5%	177.1	2.3%
1998	136.5	-0.2%	148.5	-4.7%	157.1	0.3%	159.6	0.7%	157.2	-0.1%	181.7	2.6%
1999	139.2	2.0%	145.9	-1.8%	157.9	0.5%	161.8	1.4%	156.8	-0.3%	185.3	2.0%
2000	148.1	6.4%	156.5	7.3%	159.8	1.2%	162.9	0.7%	157.7	0.6%	190.4	2.8%
Avg., 1980–2000		2.1%		3.4%		2.8%		2.9%		2.8%		4.0%
Avg., 1990–2000		1.4%		2.0%		1.9%		1.9%		1.5%		2.6%
Avg., 1995–2000		1.9%		3.2%		2.2%		2.8%		1.6%		2.1%

Source: Putnam and Allshouse, 1999.
U.S. Consumer Price Index; city average, base period: 1982 - 1984 = 100.

resulted in a corresponding decrease in the demand for cattle. Combined with increased fabrication by beef slaughterers, the decreasing demand for cattle led to increased concentration in the cattle slaughter industry. Per capita demand for pork has remained relatively constant through the years, so concentration in hog slaughter has increased only slightly. Increasing per capita consumption of chicken and turkey consumption, on the other hand, has tended to limit industry concentration in poultry production (see Section 2.4 for a more detailed discussion on concentration in the meat products industry).

There are several causes for these demand related changes in the volume and composition of meat consumption. First, meat has become increasingly affordable to consumers in recent years. Even though per capita consumption of meat has increased, the percentage of income spent on meat purchase has decreased from 4.3 to 2.2 percent in the last quarter century (AMI, 2000a). Second, health and safety concerns regarding red meat have been found to result in lower per capita beef consumption and increased per capita poultry consumption (Flake and Patterson, 1999; Moon and Ward, 1999). Third, as noted above, the relative price of chicken to beef has declined; combined with increased chicken production, these data are consistent with increased productivity in the industry, thus reinforcing the apparent increase in demand for poultry.

In addition to the abovementioned overall changes in the markets for meat products, a change in marketing strategy by poultry producers shifted retail packaging of chicken from whole birds to a product mix of traypacks, parts, and other further processed products (Hetrick, 1994). The poultry industry also started the branding of processed products (Ollinger, 2000). The introduction of such retail marketing strategies has apparently increased consumer demand for reasonably priced and convenient value-added branded chicken products.

Value-added products include case-ready and consumer-ready meats. Case-ready meats are trimmed, precut, processed, portion controlled, sealed directly by the processor, and sold to supermarkets ready for purchase. In addition to traditional cuts, case-ready meats include whole muscle portions and even ground beef (Krizner, 1998). Consumer-ready meat products, also known as home-meal-replacement items, include microwavable, oven-ready, and other ready-to-cook items.[11] The advantages of case-ready

[11] Meat producers have begun producing consumer-ready products in an attempt to regain some of the business that the increased popularity of eating out has cost them (Rice, 1998). These meals are catered to consumers seeking convenience and nutrition in meal preparation.

meats for retailers include extended shelf life, reduced labor costs, and fewer out-of-stocks. Consumers benefit from the consistency, improved quality and packaging, and safety of a product untouched by human hands (Nunes, 1999; AMI, 2000b). Branded meat products, unlike private and store labels, are those processed by meat producers themselves, using the highest-quality animals, and sold directly to consumers.

By further processing meat, integrated producers may be able to reduce the impact of price fluctuations in the related commodity markets (Standard & Poor's, 1999).[12] Value-added products can benefit meat producers by potentially giving them more control over the pricing of their products. Other benefits to packers include control over all aspects of the production process and, possibly, brand name recognition (Krizner, 1995). The branding of products allows a producer to differentiate its product from its competitors' and to certify the quality of its products.

As mentioned above, these product trends were pioneered by the chicken industry in the 1970s and emulated by the turkey industry in the 1980s. To emphasize the lower fat content in chicken, slaughterers produced further processed poultry such as traypacks, cut up and deboned chicken, nuggets, and luncheon meats (Ollinger, 2000). Pork production, on the other hand, has traditionally involved the further processing of the meat into hams, bacon, and sausages. Today, almost all poultry products and one-half to two-thirds of pork products are consumer-ready (AMI, 2000b). Product branding of chicken and turkey, introduced in the 1960s, was met with positive consumer response; brand loyalty was achieved as consumers perceived certain branded products to be of higher quality. Beef producers are also adopting such retail strategies by establishing case-ready plants and branding their products.[13]

[12] This was an important reason for the sale of Iowa Beef Processors, Inc., or IBP (WSJ, 2000). In the past IBP's stock price has been affected by price fluctuations in the commodity markets. IBP managers believed that stock market perceptions of the company did not account for IBP's shift away from commodity production toward more value-added production. IBP managers felt that privatizing the company would better insulate its corporate valuation from commodity price fluctuations.

[13] In a study conducted by the National Cattlemen's Beef Association, consumers were indifferent to consumer brand names. Nonetheless, beef processors are eager to differentiate their case-ready meats from others (Nunes, 1999). The introduction of case-ready meats in the beef industry was attempted in the 1980s, but was not successful until the late 1990s. Early problems included hesitation on the part of retailers and consumer concerns with the appearance and packaging of the product (Krizner, 1998).

This is one of several strategic responses of beef producers and packers to decreasing red meat consumption.[14]

2.4 INDUSTRY CONCENTRATION

Another trend in the meat products industry is the growing concentration of industry output in a handful of large companies. This trend is most dramatic in the beef slaughter industry, but is also evident in the pork and poultry industries. Industry trends in all three meat industries give rise to two important questions:

- What caused the increased concentration in each industry?
- Has this increased industry concentration led to market power on the part of the largest firms?

The answers to both of these questions could have implications for the economic impact analysis.

This report's discussion of trends in the beef and pork slaughter industries is based on statistics published by Packers and Stockyards Program (PSP) of the Grain Inspection, Packers, and Stockyards Administration (GIPSA). GIPSA was established in 1994 by USDA, but its roots lie in the U.S. Congress's Packers and Stockyards Act of 1921.

PSP maintains time series data on slaughtering plants that purchase at least $500,000 worth of livestock in a fiscal year. Thus, many small slaughtering facilities are exempt from PSP reporting requirements, and the number of facilities reporting in any one year will fluctuate. However, plants meeting the PSP reporting requirements accounted for 97 percent of federally inspected slaughter and 95 percent of

[14] Another important response to declining red meat consumption has been a reduction in the fat content of beef and pork. The fat content in beef has declined 27 percent since the 1970s, and nutrient information on beef packaging now reflects this (NCBA, 2000b). This reduction in the fat content was made possible by the breeding of leaner animals and the use of leaner cuts in beef production. The beef industry has also been promoting the nutritional value of lean beef with research and marketing campaigns (Carpenter, 2000). In addition, the trend toward leaner meat is also seen in the pork slaughter industry, where there has been a 50 percent reduction in hog fat since the 1950s (NPPC, 1999a).

commercial slaughter in the heifer and steer class and the hog class. For this profile, EPA mainly used the PSP data to examine industry trends. As is described below, the trends in cattle and hog classes are unmistakable, and small fluctuations in the number of plants reporting do not affect the conclusions drawn from this data.

Unfortunately, there is no publicly available source of data on trends in the poultry industry. Discussion of trends in the poultry industry is therefore based on other researchers' analysis of the Census Bureau's Longitudinal Research Database. Though it does not provide the same wealth of detail as PSP, this source more than adequately documents the trend towards concentration in the poultry industry.

Section 2.4.1 discusses, in turn, the trends toward concentration in the beef, pork, and broiler industries. Section 2.4.2 describes the changes in these industries that may be responsible for the trend toward concentration. Finally, Section 2.4.3 presents a summary of studies that have examined if the trend toward concentration has given market power to large firms in these industries.

2.4.1 Trends in Industry Concentration

Beef

Discussion of the beef industry will primarily focus on the heifer and steer industry segment. The generic term "cattle" applies to two distinct groups of animals: (1) heifers and steers and (2) cows and bulls. Heifers and steers are raised specifically for meat production and are corn fed prior to slaughter. Cows and bulls are generally culled from dairy and breeder herds and fed on grass and forage. Slaughter plants typically specialize in one of the two types due to differences in animal shapes and meat products from the two types (cows are generally used to make ground beef). Cow slaughter plants tend to be smaller and more geographically diversified than heifer and steer slaughter plants; sale lots of culled cows and bulls tend to be small, and the dairy industry is more geographically diversified than the beef industry (MacDonald et al., 2000; Mathews et al., 1999). In 1998, GIPSA plants reported slaughter of 27.4 million steers and heifers, and 6.4 million cows and bulls.

Table 2-21 presents total annual steer and heifer slaughter by head in slaughter plants reporting to PSP from 1972 to 1998. Total steer and heifer slaughter increased by approximately 5 percent over that period. More significant than the growth rate of steer and heifer slaughter is the distribution of that slaughter among plants of various size. Plants that slaughtered fewer than 50,000 head per year accounted for almost 21 percent of total slaughter in 1972 (5.4 million head); this had fallen to less than 3 percent of total slaughter by 1998 (0.7 million head). Similarly, plants that slaughtered between 50,000 and 250,000 head per year accounted for almost 50 percent of total slaughter in 1972 (12.9 million head), but less than 5 percent in 1998 (1.2 million head). Conversely, the largest plants—those slaughtering more than 250,000 head per year—increased their share of total slaughter from 30 percent in 1972 (7.8 million head) to almost 93 percent in 1998 (25.4 million head).

The increased percentage of annual slaughter accounted for by the largest plants is much less than proportionate to the increased number of large plants in the industry, although the trend is similar. As Table 2-22 shows, the number of plants with capacity in excess of 250,000 head increased from 20 in 1972 (2.5 percent of plants reporting to PSP) to about 28 in 1998 (17 percent of plants reporting to PSP). The number of plants with the smallest capacity (below 50,000 head) fell from over 660 in 1972 to 130 in 1998 (still 77.4 percent of PSP-reporting plants), while intermediate plants (capacity between 50,000 and 250,000 head) declined from 120 in 1972 to 10 in 1998.

Thus, Tables 2-21 and 2-22 illustrate not only a shift from slaughtering by many small facilities to a handful of large facilities, but also a significant increase in the size of the largest facilities. In 1972, the largest-capacity facilities slaughtered an average of 389,000 head per plant; by 1998, that had grown to an average of 909,000 head per plant.[15]

The trend in the number of plants by size, as well as in slaughter by plant size, is mirrored by industry measures of concentration at the firm level. The percentage of annual commercial heifer and steer slaughter accounted for by the four largest firms in the industry (i.e., the four-firm concentration ratio, or

[15] Cow and bull slaughter shows a roughly similar pattern over the same period, but a much less extreme one. Slaughter was almost unchanged at about 6.4 million head in both 1972 and 1998. The number of plants declined for all but the largest-capacity plants (those with slaughter in excess of 100,000 head per year), which increased from 6 to 26 plants from 1972 to 1998. The average slaughter per facility rose from 133,500 to 192,500 over the same period for the largest-capacity facilities.

Table 2-21
Annual Heifer and Steer
Slaughter by Plant Size, 1972–1998

Year	Steers and Heifer Slaughter by Plant Size (Annual Slaughter by Head)						Total Head (1,000s)
	Less than 49,999		50,000–249,999		More Than 249,999		
	Head (1,000s)	Percent	Head (1,000s)	Percent	Head (1,000s)	Percent	
1972	5,416	20.7%	12,939	49.5%	7,778	29.8%	26,133
1973	5,212	20.7%	11,340	45.0%	8,657	34.3%	25,209
1974	5,010	19.7%	11,934	47.0%	8,457	33.3%	25,401
1975	4,889	19.1%	12,147	47.5%	8,536	33.4%	25,572
1976	4,506	16.7%	13,044	48.4%	9,408	34.9%	26,958
1977	4,316	14.9%	12,949	44.6%	11,785	40.6%	29,050
1978	4,239	14.9%	12,208	43.0%	11,930	42.0%	28,377
1979	3,716	14.5%	10,537	41.1%	11,359	44.4%	25,612
1980	3,446	14.1%	8,876	36.3%	12,157	49.7%	24,479
1981	2,723	10.8%	7,330	29.1%	15,171	60.1%	25,224
1982	2,436	9.6%	6,790	26.7%	16,250	63.8%	25,476
1983	2,238	8.6%	5,929	22.8%	17,879	68.6%	26,046
1984	2,141	8.2%	6,201	23.6%	17,897	68.2%	26,239
1985	1,947	7.2%	5,642	20.9%	19,433	71.9%	27,022
1986	1,623	6.1%	4,532	17.0%	20,482	76.9%	26,637
1987	1,264	4.7%	5,439	20.0%	20,443	75.3%	27,146
1988	1,257	4.6%	3,926	14.4%	21,992	80.9%	27,175
1989	1,156	4.5%	3,032	11.7%	21,698	83.8%	25,886
1990	987	3.8%	2,535	9.8%	22,238	86.3%	25,760
1991	860	3.4%	3,024	11.9%	21,495	84.7%	25,379
1992	711	2.8%	2,287	9.0%	22,293	88.1%	25,291
1993	684	2.7%	2,142	8.4%	22,725	88.9%	25,551
1994	717	2.7%	1,418	5.4%	23,992	91.8%	26,127
1995	627	2.3%	1,902	7.0%	24,820	90.8%	27,349
1996	686	2.4%	1,587	5.6%	26,062	92.0%	28,335
1997	611	2.2%	1,712	6.2%	25,490	91.6%	27,813
1998	700	2.6%	1,257	4.6%	25,439	92.9%	27,396

Source: GIPSA, 1997; GIPSA, 2000.

Table 2-22
Heifer and Steer Slaughter Plants
by Plant Size, 1972–1998

Year	Steer and Heifer Annual Slaughter (Number of Head)						Total Plants
	Less than 50,000		50,000–249,999		More Than 249,999		
	Plants	Percent	Plants	Percent	Plants	Percent	
1972	666	82.5%	121	15.0%	20	2.5%	807
1973	660	83.0%	112	14.1%	23	2.9%	795
1974	615	81.8%	115	15.3%	22	2.9%	752
1975	597	81.2%	116	15.8%	22	3.0%	735
1976	591	80.3%	123	16.7%	22	3.0%	736
1977	542	78.3%	123	17.8%	27	3.9%	692
1978	552	80.8%	105	15.4%	26	3.8%	683
1979	529	82.1%	91	14.1%	24	3.7%	644
1980	520	83.1%	80	12.8%	26	4.2%	626
1981	442	82.0%	65	12.1%	32	5.9%	539
1982	422	82.3%	59	11.5%	32	6.2%	513
1983	423	82.9%	54	10.6%	33	6.5%	510
1984	397	82.9%	51	10.6%	31	6.5%	479
1985	359	82.3%	46	10.6%	31	7.1%	436
1986	315	82.0%	39	10.2%	30	7.8%	384
1987	314	81.3%	43	11.1%	29	7.5%	386
1988	309	82.6%	33	8.8%	32	8.6%	374
1989	262	82.1%	25	7.8%	32	10.0%	319
1990	257	82.9%	20	6.5%	33	10.6%	310
1991	237	82.3%	21	7.3%	30	10.4%	288
1992	222	82.8%	17	6.3%	29	10.8%	268
1993	218	83.5%	15	5.7%	28	10.7%	261
1994	191	83.0%	11	4.8%	28	12.2%	230
1995	173	80.1%	14	6.5%	29	13.4%	216
1996	165	78.2%	14	6.6%	32	15.2%	211
1997	156	78.4%	13	6.5%	30	15.1%	199
1998	130	77.4%	10	6.0%	28	16.7%	168

Source: GIPSA, 1997; GIPSA, 2000.

CR-4) increased from approximately 36 percent in 1980 to 80 percent in 1998 (Table 2-23).[16] The CR-4 grew more rapidly than either the CR-8 or the CR-20. When the four largest firms in an industry account for more than 50 percent of output, some economists argue, those firms may be starting to acquire significant market power (Rogers and Sexton, 1994). The Herfindahl-Hirshman index (HHI) also demonstrates increasing market concentration in the beef slaughtering industry, increasing from 561 in 1980 to 1,921 in 1998 (Table 2-23). The U.S. Department of Justice and the Federal Trade Commission regard a market with an HHI in excess of 1,000 to be moderately concentrated, and one with an HHI above 1,800 to be highly concentrated (Mathews et al., 1999).[17]

However, increased firm-level concentration cannot be entirely attributed to the increased number of large facilities and the growth in facility size. As Table 2-24 shows, the pattern of facility ownership among the largest firms differs from that among smaller firms. The four largest firms each own, on average, six slaughter facilities large enough to meet reporting requirements for PSP. The fifth through eighth largest firms own, on average, two slaughter facilities each (with a distinct downward trend, over time, in facilities owned); smaller firms typically own one slaughter facility.

Pork

The pork industry displays many of the same trends as the beef industry. However, these trends have not been as strong as in the beef industry, and the pork industry has not reached the same degree of concentration as the beef industry.

Table 2-25 presents total annual hog slaughter by head in slaughter plants reporting to PSP from 1972 to 1998. Growth in total hog slaughter was double that of beef: slaughter increased by approximately 10 percent between 1972 and 1998. The distribution of that slaughter among plants of various size was

[16] MacDonald et al. (2000) claim that no other industry has experienced as rapid an increase in concentration over any 15-year period as the cattle slaughter industry.

[17] One calculates HHI by taking the square of each firm’s market share, then summing over all firms. Thus, a market consisting of 100 firms, each with a 1 percent market share, has an HHI of 100; a market consisting of one firm with a 100 percent market share has an HHI of 10,000. The HHI is generally considered a more reliable indicator of market concentration than the CR-4 (Mathews et al., 1999).

Table 2-23
Concentration Ratios and
Herfindahl-Hirshman Index
for Steer and Heifer Slaughter, 1980–1998

Year	Concentration Ratio			Herfindahl-Hirshman Index
	4 Firm	8 Firm	20 Firm	
1980	35.7%	51.4%	64.1%	561
1981	39.6%	53.8%	69.6%	643
1982	41.4%	56.1%	70.6%	683
1983	46.6%	57.7%	71.7%	862
1984	49.5%	60.5%	75.1%	944
1985	50.2%	63.9%	78.4%	999
1986	55.1%	68.6%	80.6%	1,088
1987	67.1%	76.2%	85.7%	1,435
1988	69.7%	79.7%	88.6%	1,589
1989	70.4%	80.6%	89.4%	1,602
1990	71.6%	82.1%	91.5%	1,661
1991	73.5%	82.7%	91.3%	1,766
1992	77.8%	85.9%	92.7%	2,005
1993	79.8%	87.6%	93.8%	2,052
1994	80.9%	87.5%	92.5%	2,096
1995	79.3%	86.1%	92.9%	1,982
1996	80.4%	87.8%	96.1%	1,987
1997	78.4%	86.3%	93.4%	1,899
1998	80.0%	87.5%	93.0%	1,921

Source: GIPSA, 2000.

Table 2-24
Firms Performing Steer and Heifer Slaughter
Number of Plants Owned by Firm Size, 1980–1998

Year	Plants Owned by Steer and Heifer Slaughter Firms (Ranked by Size)							
	Rank 1–4		Rank 5–8		Rank 9–20		Rank 21–50	
	Total	Average	Total	Average	Total	Average	Total	Average
1980	23	5.8	24	6.0	19	1.6	37	1.2
1981	23	5.8	19	4.8	18	1.5	40	1.3
1982	20	5.0	18	4.5	17	1.4	37	1.2
1983	22	5.5	8	2.0	22	1.8	41	1.4
1984	23	5.8	9	2.3	20	1.7	37	1.2
1985	20	5.0	9	2.3	21	1.8	41	1.4
1986	21	5.3	9	2.3	19	1.6	41	1.4
1987	28	7.0	10	2.5	18	1.5	39	1.3
1988	27	6.8	12	3.0	18	1.5	40	1.3
1989	25	6.3	12	3.0	15	1.3	32	1.1
1990	26	6.5	10	2.5	16	1.3	32	1.1
1991	29	7.3	6	1.5	12	1.0	32	1.1
1992	26	6.5	10	2.5	12	1.0	37	1.2
1993	28	7.0	8	2.0	12	1.0	36	1.2
1994	25	6.3	7	1.8	12	1.0	35	1.2
1995	27	6.8	5	1.3	12	1.0	37	1.2
1996	28	7.0	6	1.5	12	1.0	38	1.3
1997	27	6.8	6	1.5	13	1.1	34	1.1
1998	25	6.3	7	1.8	13	1.1	32	1.1

Source: GIPSA, 2000.

Table 2-25
Annual Hog Slaughter
By Plant Size, 1972–1998

Year	Hog Slaughter by Plant Size (Animal Slaughter by Head)								Total Head (1,000s)
	Less Than 99,999		100,000–299,999		300,000–999,999		More Than 999,999		
	Head (1,000s)	Percent	Head (1,000s)	Percent	Head (1,000s)	Percent	Head (1,000s)	Percent	
1972	6,380	7.6%	9,410	11.2%	37,894	45.2%	30,120	35.9%	83,804
1973	5,630	7.4%	9,970	13.1%	35,933	47.2%	24,661	32.4%	76,194
1974	5,364	6.9%	8,153	10.5%	38,452	49.5%	25,646	33.0%	77,615
1975	4,651	6.8%	8,748	12.7%	38,961	56.6%	16,418	23.9%	68,778
1976	4,603	6.7%	9,216	13.4%	36,169	52.6%	18,828	27.4%	68,816
1977	4,779	6.4%	7,754	10.4%	34,132	45.6%	28,219	37.7%	74,884
1978	4,850	6.5%	8,073	10.8%	30,137	40.3%	31,787	42.5%	74,847
1979	4,568	5.6%	6,446	7.8%	22,970	27.9%	48,236	58.7%	82,220
1980	4,822	5.2%	5,601	6.0%	23,998	25.8%	58,504	63.0%	92,925
1981	5,134	6.0%	4,666	5.4%	24,950	29.0%	51,151	59.5%	85,901
1982	4,748	5.8%	5,359	6.5%	23,180	28.2%	48,788	59.4%	82,075
1983	4,536	5.8%	6,402	8.1%	20,279	25.8%	47,491	60.3%	78,708
1984	4,301	5.2%	5,859	7.1%	23,522	28.5%	48,937	59.2%	82,619
1985	3,977	4.9%	4,540	5.6%	17,920	22.3%	53,979	67.1%	80,416
1986	3,841	4.8%	3,930	4.9%	17,589	22.1%	54,398	68.2%	79,758
1987	3,714	4.8%	2,992	3.9%	14,946	19.3%	55,900	72.1%	77,552
1988	3,992	4.8%	2,720	3.3%	13,826	16.6%	62,952	75.4%	83,490
1989	3,963	4.8%	3,250	3.9%	12,287	14.8%	63,687	76.6%	83,187
1990	3,784	4.7%	2,861	3.6%	9,798	12.2%	63,651	79.5%	80,094
1991	3,825	4.6%	2,423	2.9%	5,249	6.3%	71,632	86.2%	83,129
1992	3,915	4.3%	2,715	3.0%	6,661	7.3%	78,258	85.5%	91,549
1993	3,755	4.2%	1,591	1.8%	7,744	8.7%	76,053	85.3%	89,143
1994	3,685	4.1%	1,796	2.0%	6,065	6.8%	77,663	87.1%	89,209
1995	3,508	3.8%	2,719	3.0%	6,162	6.7%	79,222	86.5%	91,611
1996	3,093	3.7%	2,605	3.1%	4,750	5.7%	73,081	87.5%	83,529
1997	3,125	3.6%	2,550	2.9%	4,444	5.1%	77,680	88.5%	87,799
1998	2,764	3.0%	2,277	2.5%	4,288	4.7%	82,469	89.8%	91,798

Source: GIPSA, 1997; GIPSA, 2000.

similar the distribution in the beef industry. Both the number of hogs slaughtered and the percentage of total hog slaughter declined among all but the largest plants over the time period. Plants that slaughtered fewer than 300,000 head per year accounted for almost 19 percent of total slaughter in 1972 (15.8 million head); this had fallen to less than 6 percent of total slaughter by 1998 (5.0 million head). Similarly, plants that slaughtered between 300,000 and 1 million head per year accounted for 45 percent of total slaughter in 1972 (37.9 million head), but less than 5 percent in 1998 (4.3 million head). Conversely, the largest plants, those slaughtering more than 1 million head per year, increased their share of total slaughter from 36 percent in 1972 (30.1 million head) to almost 90 percent in 1998 (82.5 million head).

As with beef slaughter, the increased percentage of annual slaughter accounted for by the largest plants is less than proportionate to the increase in the number of large plants. As Table 2-26 shows, the number of plants with capacity in excess of 1 million head increased from 23 in 1972 (3.9 percent of plants reporting to PSP) to about 30 in 1998 (16.5 percent of plants reporting to PSP). (Note that plants in this capacity range reached a high of 41 plants in 1980.) The absolute number of plants with less capacity fell significantly in all other ranges, but as a percentage of the number of plants in the industry, the number of plants with less capacity remained relatively stable.

Thus, the hog industry mirrors the beef industry, with a shift from slaughtering performed by many small facilities to slaughtering performed by a handful of large facilities, as well as a significant increase in the size of the largest facilities. In 1972, the largest-capacity facilities slaughtered an average of 1.3 million head per plant; by 1998, that had grown to an average of 2.8 million head per plant.

However, although the hog industry has become much more highly concentrated over the last quarter century, it has not, by standard economic measures, reached the degree of market concentration found in the beef industry. The CR-4 for the hog industry (CR-4) increased from approximately 34 percent in 1980 to 54 percent in 1998 (Table 2-27). This is much lower than the CR-4 for the beef industry in 1998. Also, the CR-8 for hog slaughter actually grew faster than the CR-4. Similarly, the hog slaughtering industry HHI increased from 436 in 1980 to 960 in 1998 (see Table 2-27). This is below the benchmark set by the U.S. Department of Justice and the Federal Trade Commission for moderate concentration (an HHI in excess of 1,000).

Table 2-26
Hog Slaughter Plants
By Plant Size, 1972–1998

Year	Hog Annual Slaughter (Number of Head)								Total Plants
	Less Than 99,999		100,000–299,999		300,000–999,999		More Than 999,999		
	Plants	Percent	Plants	Percent	Plants	Percent	Plants	Percent	
1972	463	77.6%	47	7.9%	64	10.7%	23	3.9%	597
1973	433	76.8%	51	9.0%	61	10.8%	19	3.4%	564
1974	417	76.8%	43	7.9%	64	11.8%	19	3.5%	543
1975	380	75.7%	45	9.0%	65	12.9%	12	2.4%	502
1976	382	76.9%	45	9.1%	56	11.3%	14	2.8%	497
1977	356	75.9%	39	8.3%	52	11.1%	22	4.7%	469
1978	354	75.8%	40	8.6%	48	10.3%	25	5.4%	467
1979	374	77.1%	34	7.0%	41	8.5%	36	7.4%	485
1980	394	77.4%	32	6.3%	42	8.3%	41	8.1%	509
1981	380	78.4%	25	5.2%	43	8.9%	37	7.6%	485
1982	363	77.9%	27	5.8%	41	8.8%	35	7.5%	466
1983	362	78.5%	31	6.7%	36	7.8%	32	6.9%	461
1984	341	77.7%	31	7.1%	37	8.4%	30	6.8%	439
1985	317	78.7%	23	5.7%	29	7.2%	34	8.4%	403
1986	278	77.2%	20	5.6%	31	8.6%	31	8.6%	360
1987	278	79.2%	16	4.6%	25	7.1%	32	9.1%	351
1988	277	79.4%	15	4.3%	24	6.9%	33	9.5%	349
1989	249	78.1%	19	6.0%	19	6.0%	32	10.0%	319
1990	272	81.2%	16	4.8%	16	4.8%	31	9.3%	335
1991	250	81.4%	14	4.6%	10	3.3%	33	10.7%	307
1992	240	80.0%	16	5.3%	10	3.3%	34	11.3%	300
1993	216	79.1%	10	3.7%	13	4.8%	34	12.5%	273
1994	200	78.7%	11	4.3%	10	3.9%	33	13.0%	254
1995	187	76.3%	17	6.9%	10	4.1%	31	12.7%	245
1996	175	75.4%	17	7.3%	8	3.4%	32	13.8%	232
1997	162	74.3%	16	7.3%	9	4.1%	31	14.2%	218
1998	132	72.5%	13	7.1%	7	3.8%	30	16.5%	182

Source: GIPSA, 1997; GIPSA, 2000.

Table 2-27
Concentration Ratios And
Herfindahl-Hirshman Index
For Hog Slaughter, 1980–1998

Year	Concentration Ratio			Herfindahl-Hirshman Index
	4 Firm	8 Firm	20 Firm	
1980	33.6%	50.9%	71.2%	436
1981	33.3%	48.9%	69.0%	411
1982	35.8%	53.2%	74.7%	479
1983	29.1%	46.0%	68.8%	363
1984	35.0%	53.1%	79.6%	487
1985	32.2%	50.8%	80.5%	456
1986	32.5%	53.6%	84.0%	481
1987	36.6%	55.3%	81.2%	516
1988	33.5%	52.2%	77.8%	456
1989	34.0%	52.4%	78.3%	470
1990	40.3%	58.1%	82.8%	593
1991	41.9%	60.7%	84.4%	649
1992	43.8%	62.6%	86.0%	689
1993	43.5%	65.0%	86.1%	704
1994	44.3%	67.4%	85.5%	734
1995	45.5%	69.4%	87.3%	754
1996	49.6%	69.2%	84.1%	797
1997	54.3%	75.7%	89.6%	969
1998	53.9%	75.4%	86.8%	960

Source: GIPSA, 2000.

Hog slaughter firms' pattern of ownership is similar to that of steer and heifer firms: the largest firms own several slaughter facilities, and the number of facilities owned declines with firm size. Table 2-28 presents hog slaughter facility ownership by firm size.

Poultry

Although sales of processed poultry products have grown much more rapidly than sales of beef and pork products over the past 25 years, poultry processing has displayed many of the same trends toward concentration as the red meat industry. Table 2-29 presents annual liveweight slaughter of young chickens and turkeys from 1972 to 1995; both chicken and turkey slaughter by weight have more than tripled since 1972.[18] This compares to the 5 percent growth in cattle slaughter and 10 percent growth in hog slaughter over the same period.

Ollinger et al. (1997) have published estimates of CR-4 for chicken and turkey slaughter based on the Census Bureau's Longitudinal Research Database; these estimates are summarized in Table 2-30. Between 1963 and 1992, the value share of shipments accounted for by the four largest chicken slaughter firms increased from 14 percent to 41 percent, and from 23 percent to 45 percent for the four largest turkey slaughter firms. Although not directly comparable with the beef and pork data presented above (because it is calculated on value shares, not slaughter shares), the data for the chicken and turkey markets show the same unmistakable trend toward concentration.

Even more marked than the growth in CR-4, the value share of shipments accounted for by large facilities increased from 29 percent to 88 percent in chicken slaughtering, and from 16 percent to 83 percent in turkey slaughtering over the 1963 to 1992 period. Although the growing importance of large facilities in the poultry industry is as striking as in the red meat industry, it should be noted that Ollinger et al. define larger facilities as those employing more than 24 workers. However, the *1997 Economic Census* of the poultry processing NAICS code (U.S. Census, 1999d) also demonstrates the importance of very

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[18] Because the average slaughter weight of both chickens and turkeys has increased over this period, the annual slaughter by head has increased at a somewhat slower rate.

Table 2-28
Firms Performing Hog Slaughter
Number of Plants Owned by Firm Size, 1980–1998

Year	Plants Owned by Hog Slaughter Firms (Ranked by Size)							
	Rank 1–4		Rank 5–8		Rank 9–20		Rank 21–50	
	Total	Average	Total	Average	Total	Average	Total	Average
1980	27	6.8	12	3.0	21	1.8	42	1.4
1981	28	7.0	11	2.8	22	1.8	43	1.4
1982	26	6.5	11	2.8	25	2.1	43	1.4
1983	25	6.3	14	3.5	23	1.9	44	1.5
1984	25	6.3	13	3.3	33	2.8	41	1.4
1985	23	5.8	9	2.3	32	2.7	41	1.4
1986	20	5.0	12	3.0	32	2.7	39	1.3
1987	19	4.8	10	2.5	29	2.4	41	1.4
1988	16	4.0	9	2.3	30	2.5	41	1.4
1989	15	3.8	8	2.0	25	2.1	41	1.4
1990	16	4.0	8	2.0	24	2.0	40	1.3
1991	15	3.8	8	2.0	19	1.6	41	1.4
1992	17	4.3	8	2.0	20	1.7	37	1.2
1993	16	4.0	14	3.5	15	1.3	35	1.2
1994	17	4.3	10	2.5	15	1.3	38	1.3
1995	17	4.3	10	2.5	15	1.3	39	1.3
1996	19	4.8	8	2.0	15	1.3	37	1.2
1997	19	4.8	9	2.3	15	1.3	37	1.2
1998	18	4.5	9	2.3	21	1.8	31	1.0

Source: GIPSA, 2000.

Table 2-29
Annual Poultry Production, 1972 - 1995

Year	Young Chicken Liveweight Slaughtered (1,000 lbs.)	Growth Rate	Ready-to-Cook Chicken (1,000 lbs.)	Growth Rate	Turkeys, Liveweight Slaughtered (1,000 lbs.)	Growth Rate	Ready-to-Cook Turkey (1,000 lbs.)	Growth Rate
1972	10,957,278		7,823,383		2,140,783		1,796,505	
1973	10,858,806	-0.9%	7,786,095	-0.5%	2,123,718	-0.8%	1,787,912	-0.5%
1974	10,999,837	1.3%	7,916,834	1.7%	2,173,898	2.4%	1,835,821	2.7%
1975	10,982,560	-0.2%	7,966,103	0.6%	2,031,627	-6.5%	1,716,053	-6.5%
1976	12,407,838	13.0%	8,987,270	12.8%	2,324,808	14.4%	1,950,111	13.6%
1977	12,740,714	2.7%	9,227,289	2.7%	2,285,685	-1.7%	1,892,479	-3.0%
1978	13,656,047	7.2%	9,883,206	7.1%	2,418,733	5.8%	1,983,476	4.8%
1979	15,111,418	10.7%	10,915,517	10.4%	2,643,203	9.3%	2,181,794	10.0%
1980	15,530,601	2.8%	11,272,385	3.3%	2,823,335	6.8%	2,332,381	6.9%
1981	16,349,889	5.3%	11,905,743	5.6%	2,060,006	-27.0%	2,509,107	7.6%
1982	16,456,531	0.7%	12,039,023	1.1%	3,003,980	45.8%	2,458,890	-2.0%
1983	16,893,860	2.7%	12,388,980	2.9%	3,156,641	5.1%	2,563,110	4.2%
1984	17,800,956	5.4%	12,998,613	4.9%	3,187,169	1.0%	2,574,095	0.4%
1985	18,622,787	4.6%	13,569,204	4.4%	3,444,031	8.1%	2,799,723	8.8%
1986	19,675,636	5.7%	14,265,627	5.1%	3,879,405	12.6%	3,133,078	11.9%
1987	21,339,550	8.5%	15,502,464	8.7%	4,609,521	18.8%	3,717,084	18.6%
1988	22,207,755	4.1%	16,124,400	4.0%	4,876,206	5.8%	3,923,452	5.6%
1989	23,881,618	7.5%	17,334,190	7.5%	5,191,490	6.5%	4,174,874	6.4%
1990	25,549,697	7.0%	18,554,511	7.0%	5,684,400	9.5%	4,560,901	9.2%
1991	27,170,780	6.3%	19,727,657	6.3%	5,798,849	2.0%	4,651,915	2.0%
1992	28,997,878	6.7%	21,052,418	6.7%	6,040,376	4.2%	4,828,939	3.8%
1993	30,474,243	5.1%	22,178,143	5.3%	6,075,032	0.6%	4,847,657	0.4%
1994	32,765,941	7.5%	23,846,169	7.5%	6,279,731	3.4%	4,992,225	3.0%
1995	34,352,980	4.8%	25,020,790	4.9%	6,456,579	2.8%	5,128,816	2.7%

Source: USDA, 1997a.

Table 2-30
Concentration Ratios For
Poultry Industry, 1963 - 1992

Year	Chicken Slaughter		Turkey Slaughter	
	Value Share of Shipments by 4 Largest Firms	Value Share of Shipments by Large Plants[1]	Value Share of Shipments by 4 Largest Firms	Value Share of Shipments by Large Plants[1]
1963	14.0%	ND	23.0%	ND
1967	23.0%	29.0%	28.0%	16.0%
1972	18.0%	34.0%	41.0%	15.0%
1977	22.0%	45.0%	41.0%	29.0%
1982	32.0%	65.0%	40.0%	35.0%
1987	42.0%	76.0%	38.0%	64.0%
1992	41.0%	88.0%	45.0%	83.0%

Source: Ollinger, et. al., 1997.

[1] Large is defined as plants with more than 24 employees.

large poultry processing facilities (see Section 2.2.1.3 above). Therefore, the concentration trends in poultry processing are quite similar to those in the beef and pork industries.

2.4.2 Facility Size and Economies of Scale

This section examines potential causes of increased concentration in the meat products industry; the section that follows examines the results of research into the question of market power in the industry.

Research into why industry concentration has increased focuses on economies of scale due not only to changes in technology, but to changes in industry institutional arrangements as well.

MacDonald et al. (2000) used the U.S. Census Bureau's Longitudinal Research Database to examine plant-specific slaughter costs, both over time and between plants. MacDonald et al. adjust the output of slaughter plants to account for the trend toward increased fabrication at both cattle and hog slaughter plants (e.g., increased production of boxed beef); not only has fabrication become increasingly prevalent as a share of output, but it is correlated with larger plants as well.[19] Increased fabrication increases production costs, so ignoring the change in product mix would obscure evidence of technological economies of scale in large plants. MacDonald et al. found evidence of relatively small but statistically significant economies of scale: the largest facilities have a 3 to 5 percent per unit cost advantage over facilities with one-fourth the capacity.

Although MacDonald et al. (2000) find similar trends in economies of scale in both cattle and hog slaughter, concentration in the beef slaughter industry is much more pronounced. The authors believe this is a result of the relative industry growth rates. Growth in demand for beef has been relatively flat, while the market for pork has grown faster. The higher growth rate has enabled older, smaller hog slaughter facilities to remain in business even as newer, larger, more efficient facilities have developed. In the beef industry,

[19] Using GIPSA statistics, about 43 percent of heifer and steer slaughter in 1979 was accounted for by boxed beef, and 47 percent of boxed beef was fabricated in plants that slaughtered more than 500,000 head per year. By 1998, almost 95 percent of heifer and steer slaughter in GIPSA-reporting plants was accounted for by boxed beef, and 88 percent of that boxed beef was fabricated in plants that slaughtered more than 500,000 head per year.

flat growth means that the larger, more efficient facilities have gained market share more rapidly, because the less efficient firms have exited the market. Hence the faster rate of concentration in the beef industry than in the pork industry.

Ollinger et al.'s (1997) examination of trends in the entry/exit of facilities in beef, pork, and poultry markets also tends to confirm the impact of demand growth in these markets. They found higher entry rates for facilities in the poultry markets than in the red meat markets, especially in recent years. Just as significantly, the exit rate of facilities was much lower in the poultry markets than in the red meat markets; the higher rate of growth allows marginal facilities to remain in production. This slows the rate of concentration. Also, the exit rate is, not surprisingly, higher for small facilities than for larger facilities.

Plant-level factors were more important than market-level factors in plant exit decisions in a probit analysis of plants that slaughtered cattle in 1991 but no longer did in 1993 (Anderson et al., 1998). The age of the plant, variety of animals slaughtered, and degree of downstream processing performed at the plant were more relevant to the exit decision than the regional HHI. However, a plant was more likely to close if it was already only a small player in its regional market. Regional supply and demand conditions, such as wages, population, and income, had little effect on closure, indicating the national market for beef products. The results could not discern whether plants were "forced out" or if normal competition was at work. Either way, the authors concluded, the welfare losses from industry consolidation are likely to be offset by efficiency gains (Anderson et al., 1998).

Azzam and Schroeter (1995) quantify the concentration/welfare trade-off. They showed that given the elasticities and other parameters of the beef industry, a 50 percent consolidation of packing plants would require only a 2.4 percent cost savings to be welfare neutral. They also estimate that the actual cost savings from a 50 percent increase in plant size would be about 4 percent. Paul (1999) concludes that "Increasing concentration in the U.S. meat packing industry seems justifiably to have emerged from cost economies, which appear in turn to be primarily transmitted to suppliers and demanders of cattle and meat products rather than generating excessive profits for the plants or firms. Thus, these cost economies and resulting evidence of concentration seem better interpreted in the context of social efficiency than inefficiency" (p. 629).

Findings of the GIPSA-sponsored detailed survey of pricing practices support Paul's argument that the benefits of cost economies are passed on to suppliers and demanders (Texas Agricultural Market Research Center, 1996). The survey found that the largest processors paid the *highest* prices for fed cattle when the data were corrected for quality and uniformity. The largest packers operated the largest plants and maintained the highest-capacity utilization ratios, presumably to take advantage of their economies of scale in processing (Texas Agricultural Market Research Center, 1996).

Hayenga (1997) has provided some anecdotal evidence of economies of scale. Double-shifting of production lines in beef and pork slaughter plants has become much more prevalent in recent years. According to one industry expert interviewed by Hayenga, double-shifting a hog processing plant adds approximately 20 percent to facility cost for additional cooler capacity and similar items, but expands the volume of output by approximately 95 percent. This implies that per unit fixed costs in a double-shifted plant are roughly 60 percent of those in a single-shift facility. Hayenga's interviewees also discussed the importance of maintaining a relatively constant high utilization rate, thus providing some confirmation of findings of both Paul (1999) and the Texas Agricultural Market Research Center (1996) discussed above.

2.4.3 Industry Concentration and Market Power

Industry concentration does necessarily lead to market power (firms selling at prices that differ from the competitive price in order to gain a profit). If market power existed in the meat products industries, it could have substantial implications for the economic impact analysis. This section reviews the existing literature on market power in these industries.

Beef

Beef packers' abuse of market power was one of the motivating forces for the Sherman Anti-Trust Act of 1890. New regulation and technological developments contributed to the breakup of the 19th century packers' trust, but once again in the 1990s a few packers have come to dominate the beef markets. A debate has developed over whether packers are extracting excess profits from their potential market power.

To detect the use of market power, economists look for indications that prices differ from those they expect to see if markets are competitive. Most of this research has focused on lower than competitive cattle prices, but some has considered the whole marketing chain.

One method for detecting price deviations is the Structure-Conduct-Performance (SCP) approach. SCP relates measures of market power to measures of market performance. If there are few firms and they are exerting their market power, market prices should be lower than the competitive market equilibrium. This empirical approach finds correlations between market-level variables. The SCP literature has produced a robust empirical regularity of statistically significant negative correlations between buyer concentration and prices of cattle and hogs; that is, when markets are more concentrated, prices are lower (Azzam and Anderson, 1996). However, the SCP method offers no means to distinguish between market power and other possible causes of a correlation, such as efficiencies of size. Without a theoretical framework, a conclusion of market power is not warranted (Azzam and Anderson, 1996).

The New Empirical Industrial Organization (NEIO) approach begins with microeconomic theory. Under perfect competition, profit maximization requires that input price equal net value of marginal product. Deviations from this equality are taken as evidence of market power. SCP involves only generalized relationships, but NEIO incorporates measures of the appropriate response to other firms' decisions into a firm's optimal input choices. The degree of market power can be assessed through the deviation of observed prices from the net value of marginal product as predicted by an economic model (Rogers and Sexton, 1994; Muth and Wohlgenant, 1999). Incidental results can be used to verify the models and support conclusions on market power. As with most applications of economic theory, assumptions about the appropriate economic model and the firms' optimal choices influence NEIO results.

Schroeter (1988) applied NEIO methods to beef packing in the years 1955 to 1983. He found both the cattle and beef markets significantly distorted, but with only small price effects: price distortions amounted to 1 percent in the cattle market and 3 percent in the beef market. Increasing concentration in the industry during the 1970s had no observed effect on the price distortion. Schroeter attributed the lack of larger distortions to a threshold effect—a CR-4 might need to exceed 68 percent before substantial distortions would be observed. That level was exceeded in 1988.

Many later authors applied less restrictive NEIO models to similar data and obtained similar results. NEIO studies often find a statistically significant but economically small deviation in prices from the competitive ideal. Stiegert et al. (1993) point out that 1 to 4 percent sounds modest, but may represent 10 to 40 percent of the packers' marketing margin. Schroeter and Azzam (1990) found the most significant exercise of market power in the beef and pork markets. They claimed that 55 percent of the farm-retail price margin for beef and 47 percent of the margin for pork were attributable to market power. This result appears to be an outlier, as other studies found market power distortions to be from 1 to 3 percent of prices (Stiegert et al., 1993; Weliwita and Azzam, 1996). Azzam and Anderson (1996) note that all of the studies they reviewed vary in methods, data sources, geographic coverage, and temporal coverage and therefore are not additive in their conclusions. They also conclude "there is not a definitive analysis in the lot" (Azzam and Anderson, 1996, p. 110).

NEIO studies have come under increasing criticism. Hunnicutt and Weninger (1999) cite three aspects of the NEIO approach that may lead to inaccurate assessments. First, most NEIO studies ignore the dynamic nature of oligopoly relationships. When there are few competitors, all of the firms involved are aware of each other's reputation, as are growers and regulators. Thus current behavior will reflect on future relationships. In this situation, the NEIO assumption of short-term profit maximization may not be reasonable. Second, NEIO approaches ignore other strategic variables that could be influencing a firm's price decision. As Hayenga (1997) and others observed, firms may be more interested in stable supplies than high current profits, and may accept prices accordingly. Finally, NEIO generally relies on empirical supply and demand elasticities. These are notoriously difficult to measure and so are unlikely to be an adequate reflection of market conditions.

To relax some of the traditional NEIO assumptions, Muth and Wohlgenant (1999) implemented a flexible model of imperfect competition that did not rely on empirically estimated demand and supply elasticities and allowed the market power terms to vary over time. They found that the conclusion of whether imperfect competition was present was highly sensitive to the constraint that the market power terms were constant. Whenever they were constrained, the data supported imperfect competition. Whenever they were allowed to vary through time, the results indicated perfectly competitive markets. As many prior studies constrained these parameters, the conclusions of the earlier studies may have been merely artifacts of the constraint, not accurate observations of market power.

Clark and Reed (2000) implemented an even more flexible model with very little structure imposed on the data before developing test statistics for competition and oligopsony. The changing structure of the agricultural industries over the period they considered, 1960–1997, was subsumed in the model. Clark and Reed (2000) could not refute the competitive model for beef, dairy, eggs, or poultry.

Just as SCP studies were methodologically challenged but lead to a robust observation, NEIO studies consistently find a gap between the price of cattle and its net marginal value product. Azzam and Anderson (1996) conclude that "the body of empirical evidence from both SCP and NEIO studies is not persuasive enough to conclude that the industry (red meat packing) is not competitive" (p. 122). They note that failure to show that the industry is not competitive is not evidence that it is competitive.

More recent studies have taken different directions in response to the perceived weaknesses of the SCP and NEIO approaches. Rogers and Sexton (1994) suggest that the nature of agricultural goods (specialized, difficult to transport, perishable) encourages the exercise of market power in regional markets, though it might not be detectable in aggregated national markets. Several studies have tried to define the regional markets and detect whether market power is important in them. Bailey et al. (1995) used spatial statistical techniques to identify eight market areas for feeder cattle. Though the market areas were large (all of them included several states), irregular, and largely overlapping, Bailey et al. found that where only one feeder market area dominated a county, prices for feeder cattle were lower than elsewhere by $8 to $9 for a 700- to 800-pound steer. Where feeding areas overlapped, sellers received a premium price.

Koontz et al. (1993) have developed a non-cooperative game theoretic model of short run beef packer behavior for four regions. They suggest that packers may switch between cooperative and non-cooperative pricing regimes based on observation of their own margin between boxed beef and fed cattle prices. In econometric estimations using daily price data, the researchers found that the difference between the cooperative and non-cooperative price was only 0.5 to 0.8 percent and that the difference varied over time and across regional markets.

Meat packers sell to a concentrated network of wholesalers and large retail food chains, which may also have market power. The observed deviations from competitive conditions could originate at either market level. Azzam (1992) used an approach in which the prices of inputs to the production process, along with the price spread from farm output to retail product, indicate the presence of monopsony or monopoly power on the part of packers in either the farm or wholesale markets. The study found that packers exercised monopsony power in the cattle market but did not have market power in the wholesale markets. Schroeter et al. (2000) tested an econometric model for bilateral oligopoly power between meat packers and retailers. The model encompassed the possibilities that packers were price takers, retail chains were price takers, or both were price takers. The model that fit the data best implied that packers were price takers in the face of retailers' market power. The authors point out that less complete models of the same data would have indicated that all levels were price takers and rejected any market power.

In summary, the literature on beef marketing indicates that beef packers exercise little market power at the national level. There has been a consistent finding that packer concentration has resulted in statistically significant but economically small reductions in the prices received by farmers. What evidence there is for deviation of national prices from the competitive level can also be explained by cost efficiencies and methodological errors. In a region dominated by a single packer, the evidence indicates, that packer may exercise some market power within a limited range.

Pork

Though it is often included under the rubric of "red meat" packing, pork processing has attracted less academic attention than beef processing when it comes to market power. Paarlberg and Haley (2000) state they are "unaware of any estimates of market power for the swine industry" (p. 6).

While hog processing has not increased in concentration as rapidly as beef production, the industry has integrated vertically to a much greater extent as it has expanded into new production regions. It has been argued that hog production may follow the path of broiler production to large, vertically integrated producer/processor firms that control the whole production chain (Martinez, 1999). This arrangement can benefit both the integrator and the contract grower. The integrator gets an assured supply of the desired quality of input, ensuring a high rate of return on investments in plant and research. The contract grower gains an assured price and access to the latest genetic technology. In a sense, the benefits to contract growers come at the expense of independent growers, who face thinner, more volatile auction markets, and cannot keep pace with current technology (Paarlberg et al., 1999).

The findings of Hayenga (1997) may help explain the combination of high levels of concentration found in the pork industry with the relatively insignificant degrees of market power. Hayenga found that pork plant capacities are typically determined by the peak seasonal demand for pork products. However, even during offpeak seasons, the plant runs most efficiently at high- rather than low-capacity utilization. Thus, the pork industry suffers from overcapacity during the offpeak season. Competition engendered by industry overcapacity may prevent the largest firms from gaining market power.

Poultry

Analysis of the beef and pork industry has focused on the issue of market concentration and the potential for market power with respect to both farmers and consumers. This is probably a result of both academic and government concern with the industry dating back over 100 years; the behavior of the meat packing industry probably played a key role in the passage of the Sherman Act—the foundation for antitrust law in the United States—in 1890 (Azzam and Anderson, 1996). In contrast, concern about competition and market power in the poultry industry is relatively recent. Analysis of the poultry industry has focused in particular on the nature of the production contracts between growers and processors. That focus is reflected in the studies summarized below.

Almost all broiler production is carried out under contract to large integrators (e.g., poultry slaughtering and processing firms or feed mills) that process chicken for retail sale. This arrangement evolved as farmers sought price stability and processors sought assured supplies of a standard quality. Technological and genetic improvements allowed both growers and processors to develop larger and more efficient facilities. Contract terms are not made public and there is no market-determined price for live broilers, so the methods used to discover market power in the beef sector are inappropriate. Several studies, however, make it clear that integrators wield market power over growers.

Most poultry producers are compensated through a two-part piece rate tournament contract that compares their production performance with that of the group of growers delivering birds to the processor at about the same time (Tsoulouhas and Vukina, 2000). Farmers opt for this type of contract knowing that they may receive a lower price but that their stream of income will be less volatile than if they faced a fluctuating retail market price. Whether the farmer is made better or worse off by this type of contractual arrangement depends on the farmer's risk preferences. Tsoulouhas and Vukina (1999) argue that the form of the contract is a result of the volatility of prices, growth of the industry, and bankruptcy risk of integrators. As integrators are large, risk-neutral corporations, unlikely to go bankrupt and national in scope, they can accept all of the risk-averse growers' price risk and the growers need not be concerned about integrator bankruptcy risk. The tournament contract protects the integrator from unproductive growers by basing payments on performance relative to others. Using their market power, the integrators are able to drive growers' payments down to the grower's average reservation utility (the point at which the grower is indifferent between raising chickens and leaving the industry) and extract all rents from the farm process.

In contrast, Lewin-Solomons (1999) assumes that growers may still earn rent, but that an integrator may require specific capital improvements adapted to its production system in order to commit growers to sell exclusively to them. Required assets screen out low-ability growers and leverage integrators' capital resources (Tsoulouhas and Vukina, 2000), but unreasonable asset specificity ties the grower to one integrator in a franchise relationship. With no alternative use for the specific assets, the grower must continue to satisfy this integrator in order to recover its sunk costs (Lewin-Solomons, 1999). Integrators are able to maintain the franchise relationship because there are relatively few competing outlets for poultry producers.

Bernard and Willett (1996) established that wholesale broiler prices "cause" farm and retail prices in all regions of the United States: "concentration and power of the integrators have allowed the wholesale price to become the center, causal price in the [broiler] market" (p. 288). Downward movements in wholesale prices are passed on more fully to broiler growers than upward movements, suggesting that integrators use price decreases to adjust the contract arrangement. Consumers do not suffer greatly from the asymmetry between upward and downward movements in retail prices. Only in the North Central United States can integrators pass on a larger portion of price increases than decreases.

Research has tended to focus on the evolving relationship between poultry processors and poultry growers and its implications for market power in the industry. These studies leave little doubt that large broiler integrators have, and use, market power in their relationships with growers and retailers. There is less evidence that large poultry processors have significant market power in their relationship with consumers.

2.5 PROFILE OF INDUSTRY LEADERS

Section 2.5 provides a profile of key industry leaders in the meat products industry. The information contained in these profiles is based on a large number of publicly available information sources such as industry trade journals, company internet sites, and company 10-K reports on file with the Securities Exchange Commission (SEC) EDGAR database.

The information provided by these various sources is not always consistent. The information may vary for a number of reasons. The most reliable source, the EDGAR database, often does not provide detail on many meat product entities because they are frequently divisions or subsidiaries of much larger companies. Privately-owned companies do not file 10-K reports with the SEC; much information on privately-held companies had to be estimated. In addition, sources may often make undisclosed assumptions concerning the processes, subsidiaries, divisions, and brands included in their estimates. For example, three different sources provide estimates of 11, 17, and 48 individual plants owned by Sara Lee. Sara Lee owns a large number of subsidiaries, some of which perform slaughtering operations, others of which perform processing operations; the differences in these estimates are most likely due to which subsidiaries and processes were included. EPA used its judgement to reconcile differences between various sources. However, the uncertainty concerning the reliability of sources means that the figures cited in the tables and profiles below should be used with care. They should be considered no more than order of magnitude estimates that provide useful information about the relative size of various companies operations.

Also, in the summary tables EPA included some entities that are subsidiaries, divisions, or even brands of a larger business entity. EPA presented the material in this manner for a number of reasons.

First, many of the subsidiary and division names (e.g., Oscar Mayer, Butterball, Bryan Foods, John Morrell) are widely used throughout the industry. EPA thought that knowledge of the industry would be improved by using the "familiar name" and linking it to the parent entity through the use of footnotes. Second, many of these subsidiaries and divisions are significant entities; presenting information at this level, when appropriate, provides additional detail of company operations (e.g., information is presented separately about ConAgra's red meat operations under the ConAgra name, and poultry operations under the Butterball name). Third, some subsidiaries apparently have considerable autonomy within the main corporate structure (e.g., in 1995 John Morrell was acquired by Smithfield Foods; in 1998, John Morrell is listed by GIPSA (2000) as the purchaser of Mohawk Packing).

Section 2.5 is organized as follows. Sections 2.5.1 and 2.5.2 present the largest beef and pork slaughtering operations in the U.S. ranked by 1999 slaughter. Section 2.5.3 profiles the largest poultry slaughtering operations ranked by 1999 liveweight slaughter. Finally, in order to place the different type of meat operations in perspective, Section 2.5.4 provides a listing of U.S. meat producers with 1999 revenues in excess of $250 million, regardless of type of meat produced or operations performed.

It is important to note that most of the company information presented below is specific to the year 1999. This year is the base year of the analysis because it is the latest year for which financial data will be available from the Section 308 survey. As appropriate, mergers and other significant events that occurred after 1999 have been added to the profiles for completeness.

2.5.1 Beef Slaughtering Operations

Table 2-31 lists beef firms ranked by 1999 slaughter performed. The revenues of the top four slaughterers demonstrates the high degree of concentration in the industry discussed in Section 2.4.1 above (although note that revenues reflect all operations, not just beef slaughter operations). Revenues of the fifth largest operation in 1999, Packerland Packing, are roughly one third those of the fourth largest company, and one tenth those of the largest company.

Table 2-31
Firms With Beef Slaughter Plants
Ranked by 1999 Slaughter

Company	Beef Slaughter Rank	Pork Slaughter Rank	1999 Fiscal Year Sales ($ millions)	1999 Employment	Plants
IBP [1]	1	1	$14,100	49,000	60
ConAgra [2]	2	2	$12,500	48,000	72
Cargill Red Meat Group (Excel) [3]	3	3	$9,000	20,000	18
Farmland Refrigerated Foods	4	5	$3,800	12,000	14
Packerland Packing	5		$1,300	4,000	4
GFI America	6		$600	1,200	4
Moyer Packing	7		$560	1,600	2
American Foods Group	8		$530	1,500	2
Emmpak Foods	9		$490	1,800	3
Taylor Packing	10		$380	1,000	1
Sam Kane Beef Processors	11		$320	600	1
Washington Beef	12		$280	620	3
PM Holdings	13		$250	800	4
Harris Ranch Beef	14		$180	530	1
Shamrock Beef Processors	15		$130	300	1
Agri-Processors	16		$100	300	1
Caviness Packing	17		$100	200	2
Simplot Meat Products	18		$100	250	1
Vienna Sausage Manufacturing	19		$100	500	1
Abbyland Foods	20	17	$90	350	2

Source: Meat Marketing & Technology, 2000; Meat Processing, 2000; Meat&Poultry, 2000a.
[1] In fiscal 2000 IBP acquired Corporate Brand Foods America, a processor of beef, pork, chicken, and turkey.
[2] ConAgra Poultry, a subsidiary of ConAgra Inc. is the 5th largest broiler processor. ConAgra also acquired Seaboard Corporation's poultry division which is the 10th largest broiler company. ConAgra's turkey operations are carried out under the name Butterball Turkey, the 2nd largest turkey producer in the U.S.
[3] Cargill is also the 3rd largest turkey processor.

Two things in particular are worth noting in Table 2-31. First, the rapid decline in relative size from the largest firm to the 20th largest firm as measured by revenues, employment, and the number of plants owned. Second, the four largest beef slaughter operations also rank among the top five hog slaughter operations. With a single exception, Abbyland Food, all other companies appear to specialize in beef slaughter. Only the very largest companies are involved in both types of livestock slaughter operations, and they are heavily involved in both.

Brief profiles of the ten largest beef slaughter companies are provided below. It is worth noting that four of the ten largest U.S. beef slaughter companies in 1999 were also among the top ten largest meat and poultry companies in the world (Meat&Poultry, 2000c).

Iowa Beef Processors, Inc. (IBP)

In 1999, IBP, Inc. was the largest meat and poultry company in the U.S. and the world, with revenues of $14.1 billion (Meat&Poultry, 2000a; Meat&Poultry, 2000c). IBP was also the largest beef packer and the largest pork packer in the U.S. (Hughes, 2000). IBP's operations are conducted by two segments. The Fresh Meats segment produces fresh and boxed beef and pork, while the Foodbrands segment produces value-added food products. The Foodbrands segment consists of three subsidiaries: Foodbrands America, The Bruss Company, and IBP Foods, Inc.

IBP owned a total of 45 meat plants in the U.S. in 1999, 13 of which were beef plants with a total slaughter capacity of 38,800 head per day (Meat&Poultry, 2000a; Hughes, 2000). IBP also owned ten beef carcass production facilities, eight of which produced boxed beef. In 1999, IBP's processing facilities operated at 84 percent of production capacity. The company also had one ground beef processing facility.

IBP was among the most aggressive meat product companies in acquiring smaller operations; IBP purchased at least 12 other meat product companies from 1995 to 1999 (GIPSA, 1997; GIPSA, 2000). Among IBP's acquisitions in 1999 are H&M Food Systems Company, Inc., Russer Foods, Wilton Foods, and Thorn Apple Valley, Inc. IBP also acquired Corporate Brand Foods America in fiscal 2000. Corporate Brand Foods was a processed meat company with 11 plants whose products included deli meats, ground beef, and roast beef (IBP, 2000). IBP's acquisitions reflect the company's active role in the expansion of its case-ready and value-added meats segments. With one producing case-ready facility, IBP was set to acquire two more in 2001 (Meat&Poultry, 2000b). The company was also planning to venture into the cooked-beef products market by 2002.

Since 1999, IBP has further expanded its case-ready and cooked meats sectors. The company entered into a partnership with Carneco Holdings in early 2001 to share the operations of its ground beef processing plant (Meat&Poultry, 2001a). IBP's fiscal 2000 sales were $17 billion, lower than ConAgra's, making IBP the second largest meat and poultry company in the U.S. and the world (Meat&Poultry, 2001g and 2001j).

In January 2001, IBP agreed to an acquisition by Tyson Foods, Inc. This merger, valued at $4.7 billion, was approved by IBP stockholders and completed in September 2001 (IBP, 2001). Tyson Foods is now believed to hold 28 percent of the U.S. beef market, 23 percent of the chicken market, and 18 percent of the pork market (IBP, 2001). The sale of IBP is apparently a result of the industry trend towards emphasis on higher value-added products such as case-ready meats. IBP management felt its company was undervalued by the stock market, which had failed to perceive its move away from commodity meat production (WSJ, 2000). This motivated the managerial decisions that eventually resulted in the sale of IBP to Tyson.

ConAgra, Inc.

ConAgra, Inc. was the second largest meat and poultry company in the U.S. and the world in 1999 (Meat&Poultry, 2000c). A largely diversified food company, ConAgra's operations fall into three segments: Packaged Foods, Refrigerated Foods, and Agricultural Products. ConAgra's beef operations are conducted by ConAgra Beef Companies under the Refrigerated Foods segment. ConAgra Beef Companies included Armour Fresh Meats, E.A.Miller, Monfort, Northern States Beef, and Signature Ground Beef. Together, these companies made ConAgra Beef the second largest beef packer in the U.S. in 1999 (Hughes, 2000). ConAgra's meat and poultry related sales for fiscal 1999 were $12.5 billion (Meat Processing, 2000).

ConAgra had a total of 83 meat and poultry plants in 1999 (Meat&Poultry, 2000a). Seven of them were beef slaughtering plants with a combined daily capacity of 23,000 head (Hughes, 2000). ConAgra's annual sales for beef were $6.7 billion in 1998 (Hughes, 2000). The company and its divisions own several brands of cooked and refrigerated convenience meals.

At the end of 1999 ConAgra announced a major restructuring process whereby the above mentioned beef companies were integrated under one unit, called the ConAgra Beef Company (ConAgra, 2000). The ConAgra Beef company had projected sales of $5.8 billion in 1999 from its eight plants (Meat&Poultry, 2000a). The company's restructuring plan also emphasized customer focus and value-added products (Meat&Poultry, 2000b). As of 1999, among ConAgra's subsidiaries in other segments identifiably involved in beef processing are Goodmark Foods, and Decker Food Company. ConAgra has been aggressive in acquiring subsidiaries since 1995.

ConAgra's post-1999 acquisitions includes Marburger Foods, a bacon producer (Meat&Poultry, 2000d). The company also entered into a joint venture with Sigma Alimentos to market frozen foods in the U.S., Canada, and Mexico (Meat&Poultry, 2001i). ConAgra's fiscal 2000 sales amounted to $20 billion making it the largest meat and poultry company in the U.S. and the world in 2001, a position enjoyed by IBP in 2000 (Meat&Poultry, 2001g and 2001j).

Cargill Red Meat Group (Excel Corporation)

Excel is a wholly owned subsidiary of Cargill, Inc., an international marketer, processor and distributor of agricultural, food, and industrial products. In 1999 Forbes ranked Cargill, Inc. as the largest privately-owned company in the U.S. (Hoover's, 2000). Cargill was the third largest meat and poultry company in the U.S. and the world in 1999, with annual sales of $9 billion for meat and poultry related operations (Meat&Poultry, 2000a; Meat&Poultry, 2000c). Cargill's beef operations are carried out under the umbrella of Excel Corporation.

Excel owned five beef plants and four beef and pork further processing plants in 1999 (Excel, 2000). At the time, Excel's beef plants had a total daily capacity of 22,500 cattle, earning the company

$6.4 billion in beef sales annually (Hughes, 2000). In addition, the company also had six branded value-added lines and three case ready plants in the U.S. (Meat&Poultry, 2000b).

Cargill's position as the third largest meat and poultry producer in the U.S. and the world in 1999 remains unchanged in 2001 (Meat&Poultry, 2001j). The company's 2000 sales equaled $10 billion (Meat&Poultry, 2001g). In an effort to expand its value-added lines, during the end of 2000 Excel formed a joint venture with Advance Food Company (Meat&Poultry, 2000d). In 2001, Excel also announced plans to acquire Emmpak Foods, Inc., a value-added meat producer with three processing plants and sales of $570 million in fiscal 2000 (Meat&Poultry, 2001f). This acquisition will give Excel the capability of producing 180 million pounds of cooked meat a year (Meat&Poultry, 2001l). Furthermore, Excel will acquire Taylor Packing in early 2002 (Meat&Poultry, 2001n).

Farmland National Beef

Farmland National Beef was the fourth largest beef processor in the U.S. in 1999 supplying 10 percent of the country's beef (Farmland, 2000b). Farmland National Beef Company, L.P. is owned jointly between Farmland Industries and U.S. Premium Beef, both agricultural cooperatives. As of August 1999, Farmland owned 71.2 percent of National Beef. Farmland Industries is an agricultural farm supply, processing, and marketing cooperative. In 1999, Farmland was owned by 1,400 local cooperatives; its membership was expected to grow even larger with its planned merger with Cenex Harvest States to create United Country Brands. Farmland National Beef earned total revenues of $3.8 billion in fiscal year 1999 (Meat&Poultry, 2000a).

Farmland National Beef had two beef processing facilities with daily capacities of 9,000 head in 1999 (Hughes, 2000). In 1999, these two facilities slaughtered an aggregate of 2.6 million cattle. Sales from beef processing and marketing increased $223 million in 1999 compared to 1998. Farmland National Beef's processing capacities increased 50 percent from 1992 to 1999 (Farmland, 2000b). In addition, Farmland was also involved in the production of branded case-ready beef and cooked beef meals (Meat&Poultry, 2000b). Farmland Industries' members provided 38 percent of the beef cattle processed in

1999 while U.S. Premium Beef members also supplied cattle. Farmland also had a feed business segment which provided cattle producer members with feed.

Since 1999, Farmland's position has fallen from the fourth largest to the sixth largest meat and poultry company in the U.S. with annual sales of $4.4 billion in fiscal 2000 (Meat&Poultry, 2001g). The company has been expanding its case-ready operations and plans to open a third case-ready plant in 2002 (Meat&Poultry, 2001i).

Packerland Packing Company, Inc.

Packerland was the fifth largest beef processing company in 1999. This privately held company had four beef plants and fiscal 1999 sales of $1.3 billion (Meat Processing, 2000). Packerland's daily slaughter was about 5,200 head of cattle (Hoover's, 2000). During the fall of 2001, Smithfield Foods acquired Packerland at a price of $250 million (Meat&Poultry, 2001j).

GFI America, Inc.

GFI America was the sixth largest beef slaughter company in the U.S. with annual sales of $600 million in 1999 (Meat Marketing & Technology, 2000). A private company, GFI is owned and operated by its founding family. GFI's products include ground beef, cooked beef, value-added beef, and custom cut fresh beef.

GFI owned four plants in 1999, two of which were slaughtering and rendering plants, while the other two were custom processing plants (GFI, 2000). GFI's vertically integrated beef operations also include a special procurement team to select and purchase cattle, and a strategically designed feeding program (GFI, 2000). Federal Beef Processors and GFI Premium Foods are among GFI's subsidiaries. GFI currently owns three facilities, including one which performs slaughtering, boning, and rendering operations, as well as two custom processing facilities (GFI, 2001).

Moyer Packing

Moyer Packing Company, a beef processing and rendering business, was the seventh largest beef slaughtering company in the U.S. in 1999 (Meat Marketing & Technology, 2000). Moyer's annual sales in 1999 were $560 million (Meat&Poultry, 2000a).

Moyer processed 1,850 cattle head per day in 1999 to produce 330 million pounds of boxed beef, ground beef, and variety meats (Moyer, 2000). The company owned, in addition to its beef processing plant, two rendering plants and one protein blending plant (Moyer, 2000). The company exported as much as 20 percent of its annual production in 1999.

Smithfield Foods acquired Moyer in 2001, thus entering the beef case-ready market (Meat&Poultry, 2001d). Moyer's fiscal 2000 sales were $6 billion and this ninth largest beef processor processed 360 million pounds of beef in fiscal 2000 (Meat&Poultry, 2001g and 2001i).

American Foods Group

American Foods Group is a processor of beef and pork, producing fresh and ground beef, among other products. American Foods had annual sales of $530 million in 1999 (Meat&Poultry, 2000a). The company owned two beef slaughtering and processing plants at the time, where it processed 1,800 cattle per day (American Foods Group, 2000). Subsidiaries known to be involved in meat processing include: Green Bay Dressed Beef, Huron Dressed Beef, and Dawson-Baker Packing Company. American Foods' fiscal 2000 sales amounted to $580 million (Meat&Poultry, 2001g). Smithfield Foods announced plans to purchase American Foods Group, but canceled the transaction in late 2001 (Meat&Poultry, 2001m).

Emmpak Foods

Emmpak Foods, Inc. is a meat processor with three subsidiaries, Emmber Foods, Peck Meat Packing, and Wis-Pak Foods (Meat&Poultry, 2000a). Emmpak's annual sales in 1999 were $490 million

(Meat&Poultry, 2000a). At the time, the company owned three beef plants with an estimated daily slaughter capacity of 1,800 head in. In 1999 Emmpak announced an alliance with Titan Corporation, whereby Emmpak's beef will be pasteurized in Titan's irradiation facility (Salvage, 1999). In 2001, Emmpak was acquired by Excel Corporation, a subsidiary of Cargill, Inc. (Meat&Poultry, 2001f).

Taylor Packing Company, Inc.

Taylor Packing Co., Inc., with annual sales of $380 million in 1999, produces fresh and value-added beef products (Meat&Poultry, 2000a). This company owned one processing plant at the time, capable of processing 1,900 cattle per day (Taylor, 2000). In addition, the company's subsidiary, Taylor By-Products, Inc., operates a rendering plant (Taylor, 2000). Taylor Packing was the tenth largest beef slaughter firm in the U.S. in 1999 (Meat Marketing & Technology, 2000). Since 1999, the company's sales have grown to fiscal 2000 sales of $455 million. Cargill announced plans to purchase Taylor Packing in late 2001 (Meat&Poultry, 2000n).

2.5.2 Hog Slaughtering Operations

Table 2-32 lists the 20 largest entities in 1999 performing hog slaughtering operations in the U.S. As observed in Section 2.4.1 above, the concentration ratios in the hog slaughtering industry are lower than the in the beef industry; in Table 2-32, it can also be observed that the relative size of companies owning hog slaughtering facilities does not decline as rapidly as in the beef industry; Hormel Foods, ranked seventh in pork packing in 1999, had similar 1999 revenues as the fourth ranked beef packer, Farmland. Also, note that the list of top twenty pork packers contains a number of firms much smaller than the list of top 20 beef packers. Finally, Table 2-32 again displays the tendency for firms to specialize in one meat type or the other; with one exception, only four out of the five largest pork packers are also significant beef packers.

Table 2-32
Firms With Pork Slaughter Plants
Ranked by 1999 Slaughter

Company	Pork Slaughter Rank	Beef Slaughter Rank	1999 Fiscal Year Sales ($ millions)	1999 Employment	Plants
IBP	1	1	$14,100	49,000	60
ConAgra [2]	2	2	$12,500	48,000	72
Cargill Red Meat Group (Excel) [3]	3	3	$9,000	20,000	18
Sara Lee [4]	4		$4,100	15,000 [5]	30 [5]
Farmland Refrigerated Foods	5	4	$3,800	12,000	14
Smithfield Foods [6]	6		$3,800	25,000	31
Hormel Foods [7]	7		$3,400	12,000	12
John Morrell [6]	8		$1,600	6,000	8
Seaboard Corporation [2,8]	9		$820	4,100	1
Bryan Foods [4]	10		$640	2,100	2
Indiana Packers	11		$360	1,200	1
Clougherty Packing	12		$320	1,300	2
Premium Standard Farms	13		$300	800	1
Bob Evans Farms	14		$260	350	6
Simeus Foods International	15		$150	700	2
J.H. Routh Packing	16		$120	340	1
Abbyland Foods	17	20	$90	350	2
Sioux-Preme Packing	18		$70	250	2
Cloverdale Foods	19		$50	300	2
Leidy's	20		$40	260	1

Source: Meat Marketing & Technology, 2000; Meat Processing, 2000; Meat&Poultry, 2000a.
[1] In fiscal 2000 IBP acquired Corporate Brand Foods America, a processor of beef, pork, chicken, and turkey.
[2] ConAgra Poultry, a subsidiary of ConAgra Inc. is the 5th largest broiler company. ConAgra also acquired Seaboard Corporation's poultry division which ranks as the 10th largest broiler producer. ConAgra's turkey operations are carried out under the name Butterball Turkey, the 2nd largest turkey processor.
[3] Cargill is also the 3rd largest turkey producer in the U.S.
[4] Sara Lee's turkey operations are carried out through its subsidiary Bil Mar Foods. Sara Lee's other subsidiary, Bryan Foods, also a pork processor, is ranked 10th on this list.
[5] Sara Lee employment and number of plants differed between sources by roughly 100 percent.
[6] Smithfield Foods is also a producer of turkey. It's subsidiary, Carolina Turkeys, is the 5th largest turkey processor. John Morrell, another subsidiary of Smithfield Foods, is the 8th largest pork slaughterer on this list.
[7] In addition to pork, Hormel also produces turkey. It's subsidiary Jennie-O Foods is the largest turkey slaughterer in the country.
[8] Seaboard Corporation's 1999 fiscal year sales and employment numbers do not include its poultry business (Seaboard Farms) which was recently acquired by ConAgra.

Brief profiles of the 10 largest pork packers in 1999 follow.

IBP, Inc.

IBP had six pork carcass production facilities in 1999, which together had a daily slaughter capacity of 69,500 hogs, and operated at 64 percent of their daily capacity (NPPC, 1999a). In addition, IBP also had seven processing facilities. At the time, IBP did not have facilities of its own to raise cattle or hogs in the U.S. IBP's main supply of live cattle and hogs was purchased by IBP buyers trained to select high quality animals that would be candidates for higher yields. In 1999, IBP completed its acquisitions of Thorn Apple Valley, Inc., a further processor of pork and poultry with five processing facilities. For further information on IBP see Section 2.5.1 above.

ConAgra, Inc.

ConAgra's Refrigerated Foods Division operates its fresh pork business through its subsidiary Swift & Company. In 1987, ConAgra purchased Monfort and Swift Independent Packing Company which were merged, and eventually renamed Swift & Company (Swift & Co., 2000). Swift owned three pork processing plants in 1999 with a total daily slaughter capacity of 39,400 hogs (NPPC, 1999a). Swift also operated three further processing plants. In 1998, Swift acquired Zoll Foods, a processor of custom pork ribs and other pork products. For further information on ConAgra, see Section 2.5.1 above.

Cargill Red Meat Group (Excel Corporation)

Cargill's pork operations are also carried out under the umbrella of Excel Corporation, one of the two wholly owned subsidiaries of Cargill, Inc. Excel produces fresh, frozen, and processed pork products. Its three pork slaughter plants had a total daily capacity of 38,700 hogs in 1999 (NPPC, 1999a). In addition, Excel operated four beef and pork further processing plants and two case ready plants in 1999

(Excel, 2000). Due to private ownership and Cargill's extensive operations, little information was readily available regarding its pork operations. For more information on Cargill, see Section 2.5.1 above.

Sara Lee

Sara Lee Corporation is engaged in pork and poultry slaughter, processing, and further processing (Meat Processing, 1999). Sara Lee's meat and poultry operations are conducted under the Sara Lee Packaged Meats segment, which had revenues of $4.1 billion in fiscal 1999 (Meat&Poultry, 2000a). Sara Lee Packaged Meats ranked as the fifth largest meat and poultry company in the U.S. and the seventh largest meat and poultry company in the world in 1999 (Meat&Poultry, 2000a and 2000c). Among Sara Lee's subsidiaries engaged in pork slaughter and processing are Bryan Foods, Inc., Hillshire Farm & Kahn's, and Jimmy Dean Foods. Bryan Foods ranked as the tenth largest pork slaughterer in the U.S. in 1999. Sara Lee is also involved in turkey processing through its Bil Mar Foods subsidiary.

In 1999, Sara Lee owned two slaughter facilities for pork. These facilities had a daily slaughter capacity of 9,000 hogs (NPPC, 1999a). The company completed the construction of another pork processing facility in 1999. Sara Lee's involvement in the value-added meat segment can be illustrated through the example of Hillshire Farm, one of the above mentioned subsidiaries. In 1997, Hillshire was actively involved in the production of gourmet sausage convenience meals, trying to gain a niche for sausage products in the home meal replacement market (Nunes, 1997).

Sara Lee's fiscal 2000 sales were no different from the 1999 sales and the company lost its rank as the fifth largest meat and poultry company. It is now the seventh largest meat and poultry company in the U.S., as well as the world (Meat&Poultry, 2001g and 2001j). Sara Lee and its brands are believed to have the largest share of the hot dog, smoked sausage, breakfast sausage, breakfast sandwich, cocktail sausage, and corn dog markets (Meat&Poultry, 2001i). Due to Sara Lee's extensive operations, further information through its 10-K, annual report, or website about its pork production and processing operations was not available.

Farmland Foods, Inc.

Farmland Foods, Inc. is a 99 percent owned subsidiary of Farmland Industries, Inc. Farmland is a processor of both beef and pork. Farmland's sales from pork processing and marketing decreased $130.4 million in 1999 compared with 1998. In 1999, Farmland Foods, Inc. operated 11 processing facilities across the country. The company is at least partially vertically integrated, producing swine through contract growers. In addition, the Livestock Production Group is another business segment of Farmland producing market hogs for processing. Farmland is also involved in the production of case-ready pork products.

Farmland Industries formed Triumph Pork Group, LLC in 1999. Triumph was a joint venture with The Hanor Company and Pork Technologies L.C. Triumph provided Farmland's pork producers with customized genetic lines, safety and environmental welfare programs, and brand alignment (Farmland, 2000a). More information on Farmland can be found in Section 2.5.1 above.

Smithfield Foods, Inc.

Smithfield Foods, Inc. was the nation's largest vertically integrated hog-grower and pork processor and the world's ninth largest meat and poultry company in 1999 (Meat&Poultry, 2000c). Smithfield conducts its business through the Hog Production Group and the Meat Processing Group, including various subsidiaries under each segment. The company produced 2.4 billion pounds of fresh pork and 16 billion pounds of processed meat products in the U.S. in fiscal 2000. Smithfield's revenues for fiscal 1999 were $3.8 billion (Meat Marketing & Technology, 2000).

In 1999, the Meat Processing Group consisted of six domestic pork producing subsidiaries including: John Morrell and Company, Smithfield Packing Company, Inc., Gwaltney of Smithfield, Ltd., Lykes Meat Group, Inc., Patrick Cudahy, Inc., and North Side Foods, Corp. Along with IBP and ConAgra, Smithfield has been the most aggressive U.S. meat packer at acquiring new firms since 1995. John Morrell was the largest of these subsidiaries in 1999, and ranked as the eighth largest pork slaughterer in the U.S. John Morrell owned eight meat plants, and had fiscal 1999 sales of $1.6 billion (Meat

Processing, 2000). Collectively, the above subsidiaries and four foreign subsidiaries operated 48 slaughtering and further processing plants in 1999. The five slaughter plants in the U.S. had an aggregate daily slaughter capacity of 78,300 hogs. Smithfield has been increasing volumes of case-ready pork products and opened four new case-ready facilities in 2000. Together with John Morrell, Smithfield Packing was expected to produce 75 million pounds of case ready products in fiscal 2001 (Meat&Poultry, 2000b). The Meat Processing Group purchased approximately 50 percent of its live hog requirements from the Hog Production Group in 1999.

Since 1999, Smithfield has continued its aggressive acquisitions of companies. In 2001, the company stepped into the beef processing sector acquiring two companies: Moyer Packing Company and Packerland Packing Company (Meat&Poultry, 2001d and 2001l). The company also expanded its case-ready sectors by acquiring a stake in Pinnacle Foods, Inc. (Meat&Poultry, 2000g).

Smithfield's pork related acquisitions include Gorges/Quik-to-Fix Foods (a producer of value-added beef, pork, and poultry products for $34 million), Stadlers Country Hams, Inc. (a processor of pre-cooked beef and pork entrees), The Smithfield Companies (a producer of ham, previously unrelated to the company), and RMH Foods (Meat&Poultry, 2001h and 2001k). Combined, all these acquisitions are likely to make Smithfield one of the largest meat and poultry companies in the future. It is currently the sixth largest meat and poultry company in the world (Meat&Poultry, 2001k). Its fiscal 2000 sales were $5.1 billion (Meat&Poultry, 2001g).

Hormel Foods Corporation

Hormel Foods Corporation and its subsidiary, Rochelle Foods, Inc., are involved in both the processing of fresh meat and the manufacture of branded consumer products. Hormel also produces turkey products under the Jennie-O name. With revenues of $3.4 billion in 1999 for all operations, Hormel ranked as the tenth largest meat and poultry company in the world (Meat&Poultry, 2000c).

The company owned three hog slaughter plants with a total daily slaughter capacity of 31,600 in 1999 (NPPC, 1999a). One of these plants was leased to Quality Pork Processors of Dallas, Texas. In addition, Hormel owned eleven processing plants for the production of manufactured food items. The company had already moved into the case-ready segment by 1999 and planned to diversify into the cooked meals and ethnic foods markets as well (Meat&Poultry, 2000b). Hormel's 2000 sales equaled $3.7 billion and it ranked as the eighth largest meat and poultry company in the U.S. (Meat&Poultry, 2001g). The company acquired The Turkey Store in 2001 (see Section 2.5.3 for more detail).

John Morrell, Inc.

John Morrell is a subsidiary of Smithfield foods and its pork slaughter operations are discussed under that name.

Seaboard Corporation

Seaboard Corporation is a diversified international agribusiness and transportation company. As part of its primary domestic operations, the company produces and processes pork and poultry. Early in 2000 Seaboard sold its poultry operations to ConAgra and started to expand its vertically integrated pork segment. Seaboard's pork revenues in fiscal 1999 were $820 million (Meat Marketing & Technology, 2000).

Seaboard owned a hog processing plant with double-shift capacity of approximately four million hogs in 1999. At the time, Seaboard was planning the construction of a second integrated pork operation with a capacity to process over four million hogs annually. Seaboard's fiscal 2000 sales were $725 million, down from $1 billion in 1999 (Meat&Poultry, 2001g).

Bryan Foods, Inc.

Bryan Foods, the tenth largest hog slaughter operation in the U.S. in 1999, is a subsidiary of Sara Lee and its operations are discussed under that name.

2.5.3 Poultry Slaughtering Operations

Tables 2-33 through 2-35 present summary information on the largest poultry slaughter companies in the U.S. in 1999. Table 2-33 lists the 25 largest broiler companies ranked by estimated annual liveweight slaughter. Table 2-34 summarizes the 20 largest turkey slaughter operations, again, ranked by annual liveweight slaughter.[20] Finally, Table 2-35 combines the information in Tables 2-33 and 2-34 to provide a ranking of the 30 largest poultry slaughter entities in 1999. The purpose of Table 2-35 is to provide a sense of the relative size of broiler operations to turkey operations.

Table 2-33 shows that Tyson Foods clearly dominated the industry in 1999, processing 2.6 times more broilers by weight than the second largest company; Tyson alone accounted for 24 percent of 1999 industry broiler slaughter by weight. Due to incomplete data, exact concentration ratios cannot be calculated from this data. However, the percentage of live animal slaughter accounted for by the largest companies is highly suggestive of the degree of concentration in this industry. The four largest broiler companies, Tyson, Gold Kist, Perdue, and Pilgrim's Pride, slaughtered an estimated 20.1 billion pounds of broilers in 1999, 47 percent of the 46.2 billion pound industry total. Adding the next four largest companies, ConAgra Poultry, Wayne Farms, Sanderson Farms, and Cagle's, to the total means that the eight largest broiler companies in the U.S. produced 63 percent (26.7 billion pounds liveweight slaughter) of the national production in 1999.

In the turkey sector, the industry is not as dominated by a single firm as the broiler sector (Table 2-34). The largest turkey producer in 1999, Jennie-O Foods (a wholly owned subsidiary of Hormel), accounted for 13 percent of the U.S. total (860 million pounds of turkeys out of 6.7 billion pounds, live slaughter weight). Production by the top four and eight turkey processors, however, is roughly as concentrated as the broiler industry. The four largest turkey producers in 1999, Jennie-O, Butterball Turkey (a subsidiary of ConAgra), Cargill, and Wampler Foods, produced 44 percent of U.S. turkey (2.9

[20] Sources for this memorandum cite the average number of birds slaughtered weekly, and average bird weight. Thus, EPA estimated annual slaughter by multiplying the average number of birds slaughtered weekly by the average weight, then multiplied by 52. Slaughter was converted to an estimated annual rate in order to facilitate a comparison between broiler operations and turkey operations. Turkey slaughter data was already expressed in pounds of annual liveweight slaughter.

Table 2-33
Firms with Broiler Slaughter Plants
Ranked by 1999 Slaughter

Company	Rank	Broiler Slaughter[1] (millions of pounds)	1999 FY Sales ($ millions)	1999 Employment	Processing Plants [2]		
					Primary	Further	Total
Tyson Foods	1	10,338	$7,400	65,000	42	14	56
Gold Kist	2	3,963	$1,800	18,000	12	2	14
Perdue Farms [3]	3	3,200	$2,500	19,000	14	19	33
Pilgrim's Pride	4	2,595	$1,400	15,000	9	6	15
ConAgra Poultry [4]	5	2,420		10,800	9	7	16
Wayne Farms [5]	6	1,582	$830	9,100	8	4	12
Sanderson Farms	7	1,372	$560	7,700	6	1	7
Cagle's	8	1,268	$310	7,000	5	3	8
Foster Farms [6]	9	1,099	$1,100	8,900	5	5	10
Seaboard Farms [4]	10	1,006	$460	5,000	4	2	6
Townsends	11	955	$520	4,400	4	1	5
Fieldale Farms	12	889	$450	4,800	3	1	4
Wampler Foods [7]	13	881	$890	7,100	7	1	8
O.K. Foods	14	836	$250 - $499	4,300	2	5	7
Allen Family Foods	15	713	$300	2,400	3		3
Mountaire Farms	16	701	$300	2,900	2		2
Choctaw Maid Farms	17	667	$250	3,200	2	1	3
Peco Foods	18	658	$300	3,900	4	2	6
Simmons Foods	19	622	$420	4,300	3	4	7
Case Foods	20	508	$200	2,000	3		3
George's	21	471			2	1	3
Marshall Durbin	22	464	$200	1,800	2		2
B.C. Rogers Poultry	23	456	$330	3,400	1	3	4
House of Raeford Farms [8]	24	451	$480	5,000	4	4	8
Koch Foods	25	401	$530	4,400	2	7	9

Source: Meat&Poultry, 2000a; Meat Processing, 2000; Thornton, 2000a; Thornton, 2000b; Thornton, 2000c.
[1] 1999 average weekly estimated slaughter x average slaughter weight x 52.
[2] For companies producing both broilers and turkeys, plants estimated to adjust for double-counting.
[3] Perdue Farms is also the 12th largest turkey producer.
[4] ConAgra Poultry is a subsidiary of ConAgra, Inc. The company also recently acquired Seaboard Farms, (Seaboard Corporation' poultry division) ranked 10th on this list. Seaboard Farms' 1999 fiscal year sales and employment numbers do not include Seaboard Corporation's pork business. ConAgra is also engaged in turkey slaughter through Butterball Turkey. This division of ConAgra is the 2nd largest turkey producer. ConAgra is also the 2nd largest pork processor and 2nd largest beef processor in the U.S.
[5] Wayne Farms is a division of ContiGroup Companies. ContiGroup also produces beef, but does not slaughter or process it; ContiGroup does process pork.
[6] Foster Farms is also the 13th largest turkey processor.
[7] Wampler Foods, a subsidiary of WLR Foods, Inc. is also the 4th largest turkey processor.
[8] House of Raeford is also the 10th largest turkey producer in the country.

Table 2-34
Firms With Turkey Slaughter Plants
Ranked by 1999 Slaughter

Company	Rank	Turkey Slaughter (millions of pounds)	1999 FY Sales ($ millions)	1999 Employment	Processing Plants [1] Primary	Further	Total
Jennie-O Foods [2]	1	859			4	4	8
Butterball Turkey [3]	2	790			4		4
Cargill [4]	3	715			4		4
Wampler Foods [5]	4	579	$890	7,100	7	1	8
Carolina Turkeys [6]	5	460	$350	2,300	1		1
Rocco Enterprises [7]	6	427	$550	3,600	3	1	4
The Turkey Store	7	375	$250 - $499	2,700	2		2
Louis Rich Brand [8]	8	350			1		1
Bil Mar [9]	9	260			1	1	2
House of Raeford Farms [10]	10	245	$480	5,000	4	4	8
Willowbrook Foods	11	227			2	1	3
Perdue Farms [11]	12	224	$2,500	19,000	14	19	33
Foster Farms [12]	13	173	$1,100	8,900	5	5	10
Norbest	14	150	$145	1,300	2	4	6
Farbest	15	146			1		1
Zacky Foods [13]	16	144	$330	3,000	2	1	3
Cooper Farms	17	143	$150	850	1	1	2
West Liberty Foods	18	138			1		1
Iowa Turkey Products	19	85			1		1
Empire Kosher Poultry [14]	20	50		1,100	1	1	2

Source: Heffernan, 2000; Meat&Poultry, 2000a; Meat Processing, 2000.
[1] For companies producing both broilers and turkeys, plants estimated to adjust for double-counting.
[2] Jennie-O is a subsidiary of Hormel Foods. Hormel Foods also produces pork and is the 7th largest pork slaughter company.
[3] Butterball Turkey is a division of ConAgra, Inc. The parent company is also engaged in broiler processing. Its subsidiary, ConAgra Poultry, is the 5th largest broiler producer. ConAgra also recently acquired Seaboard Farms' poultry division. Seaboard is the 10th largest broiler company. ConAgra is also the 2nd largest pork processor and 2nd largest beef processor in the U.S.

[4] Cargill also produces beef and pork through its subsidiary Excel Corporation. Cargill is the 3rd largest beef processor and 5th largest pork processor in the U.S.
[5] Wampler Foods, a subsidiary of WLR Foods, Inc. is also the 13th largest broiler processor.
[6] Smithfield Foods, the parent company of Carolina Turkeys also produces pork. Smithfield is the 6th largest pork producer and its subsidiary John Morrell, also engaged in pork slaughter, is the 8th largest pork producer.
[7] Rocco Enterprises' turkey production is carried out through its subsidiary, Shady Brook Farms. Rocco is also the 30th largest broiler producer in the U.S.
[8] Louis Rich Brand is a brand name of Kraft Foods, a subsidiary of Philip Morris Companies, Inc.
[9] Bil Mar Foods is a subsidiary of Sara Lee Corporation. Sara Lee is also the 4th largest pork producer, and its subsidiary, Bryan Foods, is the 10th largest pork producer.
[10] House of Raeford is also the 24th largest broiler company in the U.S.
[11] Perdue Farms is also the 3rd largest broiler company.
[12] In addition to turkey Foster Farms also producers broilers and is ranked as the 9th largest broiler producer in the country.
[13] Zacky Farms also processes broilers, beef, and pork.
[14] Empire Kosher Poultry is also engaged in broiler slaughter and processing.

billion pounds, live slaughter weight). The next four largest producers, Carolina Turkeys, Shady Brook Farms, The Turkey Store, and Louis Rich Brand (Kraft Foods), added 1.6 billion pounds to the total; thus the eight largest turkey producers accounted for 68 percent of U.S. production by liveweight slaughter in 1999. For both broiler and turkey processing, the concentration ratio estimated from this data are quite consistent with those cited in Section 2.4.1 above.

Also, note that turkey operations are much more likely to be subsidiaries or divisions of larger meat product firms than any of the other types of meat slaughtering operations examined in this profile. Of the 10 largest turkey slaughterers in 1999, only two, The Turkey Store (ranked seventh among turkey operations), and House of Raeford (ranked tenth) were independent companies at the time.[21]

Table 2-35 provides a comparison of the size of turkey operations relative to broiler operations as of 1999. No turkey slaughterer ranks among the 10 largest poultry operations; only the three largest turkey slaughterers rank among the 20 largest poultry slaughterers. Thus, turkey operations are, in general, much smaller than broiler operations. It should be remembered, however, that turkey demand is much more seasonal than broiler demand, thus the peak capacity of a turkey slaughter plant may be closer to that of a broiler plant than indicated by this comparison.

Finally, note that, as in the case of both beef and pork slaughter operations, business entities tend to specialize in either broiler or turkey production, but not both. Of the 30 largest poultry companies listed in Table 2-35, only six produced both broilers and turkeys in 1999. Perdue Farms, Wampler Foods, and Foster Farms are the only top ten broiler companies that also produced turkeys, and of those three, only for Wampler Foods was a large percentage of overall output attributable to turkey operations in 1999.

[21] Since then, The Turkey Store has been acquired by Hormel Foods (Meat&Poultry, 2001b).

Table 2-35
Firms with Poultry Slaughter Plants
Ranked by 1999 Slaughter

Company	Rank	Slaughter (millions of pounds)			1999 Fiscal Year Sales ($ millions)	1999 Employment	Processing Plants [2]		
		Broilers [1]	Turkeys	Total			Primary	Further	Total
Tyson Foods	1	10,338		10,338	$7,400	65,000	42	14	56
Gold Kist	2	3,963		3,963	$1,800	18,000	12	2	14
Perdue Farms [3]	3	3,200	224	3,424	$2,500	19,000	14	19	33
Pilgrim's Pride	4	2,595		2,595	$1,400	15,000	9	6	15
ConAgra Poultry [4]	5	2,420		2,420		10,800	9	7	16
Wayne Farms [5]	6	1,582		1,582	$830	9,100	8	4	12
Wampler Foods [6]	7	881	579	1,460	$890	7,100	7	1	8
Sanderson Farms	8	1,372		1,372	$560	7,700	6	1	7
Foster Farms [7]	9	1,099	173	1,272	$1,100	8,900	5	5	10
Cagle's	10	1,268		1,268	$310	7,000	5	3	8
Seaboard Farms [3]	11	1,006		1,006	$460	5,000	4	2	6
Townsends	12	955		955	$520	4,400	4	1	5
Fieldale Farms	13	889		889	$450	4,800	3	1	4
Jennie-O Foods [8]	14		859	859			4	4	8
O.K. Foods	15	836		836	$250 - $499	4,300	2	5	7
Butterball Turkey [3]	16		790	790			4		4
Rocco Enterprises [9]	17	300	427	727	$550	3,600	3	1	4
Cargill [10]	18		715	715			4		4
Allen Family Foods	19	713		713	$300	2,400	3		3
Mountaire Farms	20	701		701	$300	2,900	2		2
House of Raeford Farms	21	451	245	696	$480	5,000	4	4	8

Table 2-35 (cont.)
Firms with Poultry Slaughter Plants
Ranked by 1999 Slaughter

Company	Rank	Slaughter (millions of pounds)			1999 Fiscal Year Sales ($ millions)	1999 Employment	Processing Plants [2]		
		Broilers [1]	Turkeys	Total			Primary	Further	Total
Choctaw Maid Farms	22	667		667	$250	3,200	2	1	3
Peco Foods	23	658		658	$300	3,900	4	2	6
Simmons Foods	24	622		622	$420	4,300	3	4	7
Case Foods	25	508		508	$200	2,000	3		3
Zacky Foods	26	355	144	499	$330	3,000	2	1	3
George's	27	471		471			2	1	3
Marshall Durbin	28	464		464	$200	1,800	2		2
Carolina Turkeys [11]	29		460	460	$350	2,300	1		1
B.C. Rogers Poultry	30	456		456	$330	3,400	1	3	4

Source: Heffernan, 2000; Meat&Poultry, 2000a; Meat Processing, 2000; Thornton, 2000a; Thornton, 2000b; Thornton, 2000c.
[1] 1999 average weekly estimated slaughter x average slaughter weight x 52.
[2] For companies producing both broilers and turkeys, plants estimated to adjust for double-counting.
[3] Perdue Farms is the 3rd largest broiler producer and the 12th largest turkey producer in the country.
[4] Combining production from Seaboard Farms (ranked 11th), Butterball Turkey (ranked 16th), and ConAgra Poultry (ranked 5th) would make ConAgra the 2nd largest poultry producer in the U.S. (4.2 million pounds in 1999). Butterball Turkey is a division of ConAgra. Seaboard Farms was recently purchased by ConAgra from Seaboard Corporation. Seaboard Farms' 1999 fiscal year sales and employment numbers do not include Seaboard Corporation's pork business. ConAgra is also the 2nd largest beef processor and 2nd largest pork processor in the U.S.
[5] Wayne Farms is a division of ContiGroup Companies. ContiGroup also produces beef, but does not slaughter or process it; ContiGroup does process pork.
[6] Wampler Foods, a subsidiary of WLR Foods, Inc. ranks as the 13th largest broiler producer and the 4th largest turkey producer.
[7] Foster Farms is the 9th largest broiler producer and the 13th largest turkey producer.
[8] Jennie-O is a subsidiary of Hormel Foods. Hormel Foods is also the 7th largest pork processor in the U.S.
[9] Rocco Enterprises, a broiler and turkey processor, carries out its turkey production through its subsidiary Shady Brook Farms.
[10] Cargill is also the 3rd largest beef processor and the 3rd largest pork processor through its subsidiary, Excel Corporation.
[11] Smithfield Foods, the parent company of Carolina Turkeys, also produces pork. Smithfield is the 6th largest pork producer and its subsidiary, John Morrell, also engaged in pork processing, is the 8th largest producer.

Below are brief profiles of the 10 largest U.S. broiler producers, and the five largest U.S. turkey producers in 1999.

2.5.3.1 Broiler Companies

Tyson Foods, Inc.

Tyson Foods, Inc. was the nation's largest producer of broiler chickens in 1999. The company was also the nation's largest poultry-based food company and the world's fifth largest meat and poultry company (Meat&Poultry, 2000c). Tyson Foods is also involved in hog production and processing. A fully integrated company, Tyson breeds, rears, feeds, processes, further processes, markets, and distributes its value enhanced chicken products. Company revenues for the fiscal year 1999 ending in September were $7.4 billion (Thornton, 2000b).

The principal poultry operations of the company consisted of 56 processing plants in 1999, involved with various phases of slaughtering, dressing, cutting, packaging, deboning or further processing. Together, these plants had a capacity of 47.6 million head per week. The average weekly production of ready-to-cook chicken in 1999 was 154.3 million pounds (Thornton, 2000b). Tyson completed several plant expansions in 1999 and planned to expand operations at two processing plants in 2000 (Thornton, 2000b). Tyson also began focusing on its value-added line of products and market testing convenience chicken products (Meat&Poultry, 2000b).

Tyson's acquisition of the beef and pork giant IBP took place in 2001 making it the largest protein provider in the world (IBP, 2001). The company also expanded its international operations in China, Mexico, and Central America (Meat&Poultry, 2001e). Tyson is now the fourth largest meat and poultry company in the U.S. with sales of $7.2 billion in fiscal 2000 (Meat&Poultry, 2001g). It is still the fifth largest meat and poultry company in the world (Meat&Poultry, 2001k).

Gold Kist, Inc.

Gold Kist, Inc., the second largest poultry processor in 1999, is a diversified agricultural cooperative broken into two segments: Poultry and Agri-Services. The Poultry segment maintains broiler, pullet, and breeder flocks, and operates hatcheries, feed mills, and processing plants. Broiler production in 1999 was 14.8 million head per week (Thornton, 2000a). Gold Kist's sales in fiscal 1999 amounted to $1.8 billion (Meat Processing, 2000).

Gold Kist's integrated facilities included twelve processing plants, two further processing plants, and three rendering plants in 1999. Gold Kist also operated nineteen hatcheries, twelve feed mills, ten distribution plants, and six wastewater treatment plants (Thornton, 2000b). In 1997, Gold Kist acquired Golden Poultry with four integrated complexes, and Carolina Golden, with one complex (Meat&Poultry, 1999).

Perdue Farms, Inc.

The third largest broiler company in the U.S. in 1999, Perdue Farms, Inc. is a vertically integrated agribusiness producing chicken, turkey, and grain. This company produced 47.8 million pounds of ready-to-cook chicken weekly in 1999 (Thornton, 2000b). Perdue's revenues for the fiscal year 1999 were $2.5 billion (Thornton, 2000b).

Perdue's integrated operations included thirteen processing plants, nineteen further processing plants, and three rendering plants in 1999. In addition, the company also owned eighteen hatcheries, eleven feed mills, and four distribution centers. In 1998, Perdue acquired Gol-Pak Corporation, a producer of value-added chicken specialties, and Advantage Foods, a breast deboning operation (Perdue, 2000). Perdue's new products as of 1999 included precooked and cooked chicken meals.

The company's fiscal 2000 sales were slightly more than $2.5 billion and Perdue is currently the ninth largest meat and poultry company in the U.S. (Meat&Poultry, 2001g). As of 2001, the company had a total of 21 processing plants in the U.S. producing 50 million pounds of poultry on a weekly basis (Meat&Poultry, 2001i).

Pilgrim's Pride Corporation

Pilgrim's Pride Corporation is a vertically integrated company producing fresh and frozen chicken. The company's operations include hatcheries, grow-out farms, feed mills, processing and further processing plants, distribution centers, rendering plants, and wastewater treatment plants. Revenues for 1999 were $1.4 billion (Thornton, 2000b).

The company's six processing plants had the capacity to produce 8.2 million head of chicken per week as of 1999. Pilgrim's Pride also had three prepared foods plants, one of them purchased in 1998 from Plantation Foods, Inc. These prepared foods plants, located in Texas, operated two shifts in a six day week. In 1999 the company produced 38.2 million pounds of ready-to-cook chicken per week (Thornton, 2000b).

The company's fiscal 2000 sales were $1.5 billion (Meat&Poultry, 2001g). In early 2001, Pilgrims Pride acquired WLR Food, Inc., which owns Wampler Farms, a major turkey producer, for a total of $280 million (Meat&Poultry, 2001g; Pilgrims Pride, 2001).

ConAgra Poultry Companies

ConAgra Poultry Companies ranked as the fifth largest broiler processor in the country in 1999. ConAgra is a large diversified company, whose operations fall into three segments: Packaged Foods, Refrigerated Foods, and Agricultural Products. ConAgra Poultry Companies include ConAgra Broiler Company and ConAgra Frozen Foods which together produced approximately 34.9 pounds of chicken per week in 1999 (Thornton 2000b).

ConAgra Poultry Companies operated nine processing plants, seven further processing plants, and four rendering plants in 1999. Moreover, the company had ten hatcheries, nine feed mills, nineteen distribution centers, and five wastewater treatment plants (Thornton, 2000b). ConAgra Poultry's fiscal 1999 sales were $1.4 billion.

In January 2000 ConAgra, Inc. acquired Seaboard Farms, Seaboard Corporation's poultry division; this acquisition was expected to make ConAgra the third largest broiler processor in the U.S. in 2000. In addition, ConAgra operates Butterball Turkey as a division specializing in turkey production (second largest turkey producer in 1999), and was the second largest pork and beef processor in the U.S. in 1999. For more information on ConAgra see Section 2.5.1.

Wayne Farms LLC

Wayne Farms LLC is a division of ContiGroup Companies (CGC). CGC is a largely diversified entity and was one of the leading poultry and pork processors in the U.S. in 1999 (Hoover's, 2000). Wayne Farms was the sixth largest broiler company and produced 25.3 million pounds of ready-to-cook chicken in 1999 (Thornton, 2000b).

Wayne Farms' operations at the time included eight processing plants and four further processing plants. The company has one subsidiary, Southland Foods, which is a poultry processing facility (Meat&Poultry, 2000a). Wayne Farm's complexes also included eight hatcheries and seven feed mills. In 1999, the company slaughtered 4.74 million birds per week and had revenues amounting to $830 million (Thornton, 2000b).

Sanderson Farms, Inc.

Sanderson Farms, Inc. is a fully integrated poultry processing company. The company produces, processes, markets, and distributes fresh and frozen chicken products. Sanderson Farms, Inc. has three divisions: Production, Processing, and Foods. The Production Division produces broilers, while the Processing Division processes, sells, and distributes the product. In addition, the Foods Division processes, markets, and distributes prepared food items. The company's sales topped $560 million in 1999, producing almost 5.0 million head per week (Thornton, 2000b). The company owned six processing plants, a further processing plant, a rendering plant, and five wastewater treatment plants in 1999 (Thornton, 2000b).

Cagle's, Inc.

Cagle's, Inc. and its wholly owned subsidiary Cagle's Farms, Inc., raise broiler chickens to produce fresh and frozen poultry products. The company's vertically integrated operations include breeding, hatching, and growing chickens, as well as feed milling, processing, further processing, and marketing. In 1999 Cagle's weekly production was 19.7 million pounds of ready-to-cook chicken and its fiscal 1999 sales were $310 million (Thornton, 2000b).

Cagle's processed approximately 2.2 million birds per week in three processing plants in 1999, two of which operated in double shifts, and two further processing plants. Cagle's expected to begin operation of its new Perry, GA, processing facility in September 2000 with a capacity of 1.2 million head of broilers per week.

In 1999, Cagle's owned a 50 percent interest in a joint venture fully integrated poultry company located in Camilla, GA. As of 1999, this facility was growing and processing approximately 1.3 million birds per week. Cagle's also formed another joint venture partnership with Executive Holdings, L.P. called Cagle's-Keystone Foods LLC which was expected to construct an integrated poultry complex in Kentucky (Daily Edition, 1997; Hoover's, 2000).[22] Keystone Foods is a privately-owned meat processor of frozen meat products made from purchased beef. Meatnews.com estimated that Keystone was the eleventh largest meat processor in the U.S. in 1999 (Meat Processing, 2000).

Foster Poultry Farms

Foster Poultry Farms is a vertically integrated company producing quality chicken and turkey products. In 1999 Foster Farms slaughtered 4.1 million birds weekly, producing 15.4 million pounds of ready-to-cook chicken per week (Thornton, 2000b). The ninth largest broiler company in the U.S. as of 1999, Foster Farms was also the largest poultry farm in the Western U.S. (Foster Farms, 2000). Sales for Foster Farms in 1999 were $1.1 billion (Meat&Poultry, 2000a).

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[22] This is EPA's interpretation of the relationship between these three entities as of 1999, based on very limited information.

As of 1999, Foster Farms' broiler operations included four processing plants, four further processing plants, two rendering plants, and three wastewater treatment plants in addition to hatcheries, grow-out ranches, feed mills, and distribution centers (Thornton, 2000b). Foster Farms completed an expansion project in its Fresno chicken plant in fiscal 2000, adding 45,000 square feet to the 150,000 square feet facility (Meat&Poultry, 2000a).

Since then, Foster Farms also announced plans to acquire Zacky Farms' chicken operations (Meat&Poultry, 2001c). Zacky Farms' operations include a processing plant, feed mill, hatchery, and 35 ranches and its inclusion in the Foster family is expected to increase Foster's chicken production by 25 percent (Meat&Poultry, 2001c).

Seaboard Farms

Seaboard Corp. is a diversified international agribusiness and transportation company. Through 1999, poultry production took place through its wholly-owned subsidiary Seaboard Farms. As part of its domestic operations, the company also produces and processes pork.

As of January 2000, Seaboard Farms was acquired by ConAgra, Inc. for $375 million. The facilities sold included four processing plants and two further processing plants. In 1999 the company produced 14.5 million pounds of ready-to-cook chicken per week (Thornton, 2000b). Having completed several capital improvements to increase capacity prior to the acquisition, Seaboard had hoped to increase production by two million pounds per week in 2000 (Thornton, 2000b). Seaboard Farms earned $460 million in fiscal 1999 sales (Thornton, 2000b).

2.5.3.2 Turkey Companies

Jennie-O Foods, Inc.

Jennie-O Foods, Inc. was the nation's largest turkey processor in 1999, based on live pounds processed (Heffernan, 2000). The company produced approximately 859 million live pounds of turkey in that year (Heffernan, 2000). Jennie-O Foods is a wholly owned subsidiary of Hormel Foods Corporation, which was ranked as the seventh largest meat processor, and seventh largest pork slaughterer in the U.S. in 1999.

A vertically integrated turkey operation, Jennie-O apparently owned four processing and four further processing plants in 1999. Capital improvements, including the expansion of a plant and new processing equipment, were expected to increase Jennie-O's output by 40 million pounds in the year 2000 (Hormel, 2000). In 2001, Hormel Foods purchased The Turkey Store Company, the sixth largest turkey producer in the U.S. Combined with Jennie-O's turkey production, Hormel is expected to produce more than 1.2 billion pounds of turkey annually (Meat&Poultry, 2001b).

Butterball Turkey Co.

ConAgra Poultry's operations include the integrated production of turkeys under the Butterball Turkey Company label. Butterball Turkey Company, the second largest U.S. turkey processor in 1999, operates in the Refrigerated Foods Division (Heffernan, 2000).

Butterball Turkey operated four processing plants in 1999; a fifth processing plant in California was sold to Foster Farms in July 1999. Heffernan (2000) estimated that this decreased Butterball's slaughter by 40 million pounds in 1999.

As of 1999, ConAgra had not announced any restructuring plans associated with its acquisition of Seaboard Corporation's broiler operations. Assuming ConAgra closes none of Seaboard's plants, ConAgra could produce a total of 4.2 billion pounds of poultry between its ConAgra, Seaboard, and Butterball facilities, which could make it the second largest poultry producer in the U.S. (including turkey production). For more information on ConAgra, see Section 2.5.1.

Cargill North American Turkey Operations

Cargill, Inc. is an international marketer, processor and distributor of agricultural, food, and industrial products. One of its two subsidiaries, Cargill North American Turkey Operations is a turkey processor. Cargill's revenues for all meat and poultry related operations in 1999 were estimated at $9 billion (Meat&Poultry, 2000a). It ranked as the largest privately-owned company in the U.S. in 1999 (Hoover's, 2000).

According to *WATT PoultryUSA*, Cargill was the country's third largest turkey processor, slaughtering 715 million pounds of turkeys by live weight in 1999 (Heffernan, 2000). At the time, Cargill's four processing plants had the capacity to handle 23,000 birds a day (Cargill, 2000). Cargill acquired Plantation Foods in September 1998 (Heffernan, 2000).

Cargill acquired Rocco Enterprises' turkey operations in 2001 (Meat&Poultry, 2001h). This acquisition is expected to increase Cargill's turkey sales to $1 billion. For more information on Cargill, see Section 2.5.1.

Wampler Foods, Inc.

Wampler Foods, Inc., a subsidiary of WLR Foods, Inc., produces, processes, and markets fresh, frozen, and further processed chicken and turkey. Wampler was the thirteenth largest broiler processor and the fourth largest turkey processor in 1999 as measured by live slaughter weight. Its combined turkey and broiler operations made it the seventh largest overall poultry processor. WLR Foods had sales of $890 million in fiscal 1999 (Meat&Poultry, 2000a). A vertically integrated company, Wampler Foods' primary operations include the breeding, hatching, grow-out and processing of chickens and turkeys.

The company owned four chicken processing plants with a double-shift capacity of 3.7 million chickens per week in 1999 (Thornton, 2000c). Wampler had three turkey processing plants with a slaughter capacity of 450,000 turkeys per week on a single shift as of 1999 (Heffernan, 2000). In 2001, WLR Foods, Inc. was purchased by the Pilgrims Pride Corporation (Meat&Poultry, 2001g).

Carolina Turkeys

Carolina Turkeys is jointly owned by Carroll's Foods, Inc. and Goldsboro Milling Company (Carroll's Foods, 2000). In May 2000, Smithfield Foods, Inc. acquired Carroll's Foods and its 49 percent interest in Carolina Turkeys. Carolina Turkeys was the fifth largest turkey producer in the U.S. with an annual production of 460 million live pounds in 1999 (Heffernan, 2000). Carolina Turkey's 1999 fiscal sales amounted to $350 million (Meat&Poultry, 2000a).

Carolina Turkeys is an integrated producer and had the largest processing plant in the United States in 1999 (Carroll's Foods, 2000). The company processed 22 million turkeys in 1999 and production took place round the clock (Carolina Turkeys, 2000). Carolina Turkeys also had its own hatcheries, breeding farms, feed mills, growing farms, research farms, and diagnostic labs (Carolina Turkeys, 2000).

2.5.4 Overall Ranking of Meat Processing Companies

Table 2-36 presents summary information for all meat product industry companies with 1999 revenues in excess of $250 million. Although most of the companies perform slaughter operations, and have appeared already in Tables 2-31 through 2-35, a number of companies that primarily perform processing operations do appear in Table 2-36. The companies meeting the revenue cutoff for Table 2-36 are predominantly companies that perform at least some slaughter operations. Of the 71 companies listed, only 12 were confirmed as having minimal slaughter operations. Among the top 15 companies listed in Table 2-36, only three (Oscar Mayer, Keystone Foods, and OSI International Foods) apparently do not perform significant slaughtering operations. It is interesting to note that these three companies all employ significantly fewer workers than the slaughter companies with similar 1999 revenues. This is consistent with the census data in Sections 2.1 above, which showed that processing plants tended to be smaller than slaughter plants, but have a relatively greater value added.

Table 2-36
Meat Processing Firms with
1999 Revenues Exceeding $250 Million

Company	Rank	Type	Slaughter	1999 Fiscal Year Sales ($ millions)	1999 Employment	Plants
IBP [1]	1	M	Y	$14,100	49,000	60
ConAgra [2]	2	M	Y	$12,500	48,000	72
Cargill Red Meat Group (Excel)	3	M	Y	$9,000	20,000	18
Tyson Foods	4	P	Y	$7,400	65,000	56
Sara Lee [3]	5	M	Y	$4,100	15,000 [4]	30 [4]
Farmland Refrigerated Foods	6	M	Y	$3,800	12,000	14
Smithfield Foods [5]	6	M	Y	$3,800	25,000	31
Hormel Foods [6]	8	M	Y	$3,400	12,000	12
Oscar Mayer [7]	9	M	Y	$2,500	9,000	8
Perdue Farms	9	P	Y	$2,500	19,000	33
Keystone Foods	11	M	N	$2,200	2,500	15
OSI Int'l Foods	11	M	N	$2,200	2,000	14
Gold Kist	13	P	Y	$1,800	18,000	14
John Morrell [5]	14	M	Y	$1,600	6,000	8
Pilgrim's Pride	15	P	Y	$1,400	15,000	15
Packerland Packing	16	M	Y	$1,300	4,000	4
Foster Farms	17	P	Y	$1,100	8,900	10
Wampler Foods [8]	18	P	Y	$890	7,100	8
Wayne Farms [9]	19	P	Y	$830	9,100	12
Seaboard Corporation (pork) [10]	20	M	Y	$820	4,100	1
Corporate Food Brands America [1]	21	M	N	$800	3,600	11
Empire Beef	22	M	N	$720	230	3
Colorado Boxed Beef	23	M	N	$650	450	1
Bryan Foods [3]	24	M	Y	$640	2,100	2
Rosen's Diversified	25	M	Y	$620	1,000	3
GFI America	26	M	Y	$600	1,200	4
Moyer Packing	27	M	Y	$560	1,600	2
Sanderson Farms	27	P	Y	$560	7,700	7
Wolverine Packing	27	M		$560	250	3
Rocco Enterprises [11]	30	P	Y	$550	3,600	4
American Foods Group	31	M	Y	$530	1,500	2
Greater Omaha Packing	31	M	Y	$530	650	1
Koch Foods	31	P	Y	$530	4,400	9
Townsends	34	P	Y	$520	4,400	5

Table 2-36 (cont.)
Meat Processing Firms with
1999 Revenues Exceeding $250 Million

Company	Rank	Type	Slaughter	1999 Fiscal Year Sales ($ millions)	1999 Employment	Plants
Nebraska Beef	35	M	Y	$500 - $865	1,200	1
Sherwood Food Distributors	35	M		$500 - $865	550	3
Emmpak Foods	37	M	Y	$490	1,800	3
House of Raeford Farms	38	P	Y	$480	5,000	8
Seaboard Farms (poultry) [2]	39	P	Y	$460	5,000	6
Fieldale Farms	40	P	Y	$450	4,800	4
Simmons Foods	41	P	Y	$420	4,300	7
Taylor Packing	42	M	Y	$380	1,000	1
Indiana Packers	43	M	Y	$360	1,200	1
Carolina Turkeys [5]	44	P	Y	$350	2,300	1
Hatfield Quality Meats	45	M	Y	$340	1,600	4
Sysco Corp.	45	M	N	$340		3
B.C. Rogers Poultry	47	P	Y	$330	3,400	4
Zacky Foods	47	P	Y	$330	3,000	3
Clougherty Packing	49	M	Y	$320	1,300	2
Sam Kane Beef Processors	49	M	Y	$320	600	1
Cagle's	51	P	Y	$310	7,000	8
Bar-S Foods	51	M	N	$310	1,500	4
Allen Family Foods	53	P	Y	$300	2,400	3
Mountaire Farms	53	P	Y	$300	2,900	2
Peco Foods	53	P	Y	$300	3,900	6
Premium Standard Farms	53	M	Y	$300	800	1
Freshmark	57	M	N	$280	1,500	3
Washington Beef	57	M	Y	$280	620	3
Bob Evans Farms	59	M	Y	$260	350	6
Buckhead Beef	60	M		$250	430	1
Choctaw Maid Farms	60	P	Y	$250	3,200	3
International Trading	60	M		$250	1,000	3
Lundy Packing	60	M	Y	$250	900	3
Omaha Steaks Int'l	60	M	N	$250	1,500	3
PM Holdings	60	M	Y	$250	800	4
United Food Group	60	M	N	$250	380	1
Harker's/Lombardi Bros.	60	M	N	$250 - $499	650	3
JAO Long Island Beef	60	M	N	$250 - $499	350	4
O.K. Foods	60	P	Y	$250 - $499	4,300	7

Table 2-36 (cont.)
Meat Processing Firms with
1999 Revenues Exceeding $250 Million

Company	Rank	Type	Slaughter	1999 Fiscal Year Sales ($ millions)	1999 Employment	Plants
Randall Farms	60	P	Y	$250 - $499	600	3
The Turkey Store	60	P	Y	$250 - $499	2,700	2

Source: Heffernan, 2000; Meat Marketing & Technology, 2000; Meat&Poultry, 2000a; Meat Processing, 2000; Thornton, 2000a; Thornton, 2000b; Thornton, 2000c.
[1] IBP purchased Corporate Brand Foods America in fiscal 2000.
[2] ConAgra's significant divisions include Butterball Turkey and ConAgra Poultry. ConAgra also recently acquired Seaboard Corporation's poultry division, Seaboard Farms. The 1999 fiscal year sales and employment numbers for Seaboard Farms (poultry) do not include Seaboard Corporation's pork business.
[3] Sara Lee's significant subsidiaries include Bil Mar (turkey) and Bryan Foods (pork).
[4] Sara Lee employment and number of plants differed between sources by roughly 100 percent.
[5] Smithfield's significant subsidiaries include Carolina Turkeys and John Morrell (pork).
[6] Hormel's major subsidiary is Jennie-O Foods, the largest turkey processor in the U.S.
[7] Oscar Mayer is a brand name of Kraft Foods, a subsidiary of Philip Morris Companies, Inc.
[8] Wampler Farms is a subsidiary of WLR Foods, Inc.
[9] Wayne Farms is a division of ContiGroup Companies.
[10] Seaboard Corporation's 1999 fiscal year sales and employment numbers do not include Seaboard Farms (Seaboard's poultry division recently acquired by ConAgra).
[11] Rocco Enterprises carries out its turkey operations through its subsidiary Shady Brook Farms.

Oscar Mayer

Oscar Mayer is a brand of Kraft Foods North America, in itself, a wholly owned subsidiary of Philip Morris Companies, Inc. As of 1999, Oscar Mayer's meat production took place in its nine slaughtering and processing plants. Thus Oscar Mayer did perform slaughter operations, however, they were apparently not large enough to rank among the top 20 slaughter operations for either beef or pork. Presumably then, its high ranking in the meat product industry must have been due primarily to its processing operations. Oscar Mayer's business growth can be attributed to its focus on "quick-to-fix" products (Meat&Poultry, 2000b). The company had 1999 fiscal sales of $2.5 billion (Meat Processing, 2000). Kraft Foods North America's operating revenues in fiscal 1999 were $17.5 billion. In June 2001, Kraft Foods became a publicly traded company (Meat&Poultry, 2001i). Owing to the large, diversified business interests of both Philip Morris and Kraft, EPA could not find additional information on Oscar Mayer from the 10-K, annual report, or the company's website.

Keystone Foods

Keystone Foods is a privately held meat and poultry processor operating 15 processing plants as of 1999. Keystone apparently performed little or no livestock slaughter, and thus, its revenues were presumably from its processing operations. This company had fiscal 1999 sales amounting to $2.2. billion (Meat Processing, 2000). Keystone owns a joint venture partner with Cagle's, a producer of broilers (Hoover's, 2000). Little public information is available on Keystone.

OSI International Foods

OSI Group of Companies, previously known as Glenmark, is the parent company of OSI International Foods (OSI, 2000). OSI processed beef, pork, and poultry in its 14 meat plants in 1999; OSI apparently performed little or no livestock slaughter, and its revenues were apparently from its processing operations. A privately held company, OSI had estimated fiscal 1999 sales of $2.2 billion (Meat Processing, 2000).

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CHAPTER 3

ECONOMIC IMPACT METHODOLOGY

This section provides a brief overview of the methodology used in the economic impact, regulatory flexibility, and environmental justice analyses. EPA will use two methodologies to evaluate economic impacts of the effluent limitations and guidelines (ELGs) on the meat products industry. For the proposed rule, EPA evaluated impacts based on models developed from publicly available information obtained from the U.S. Census Bureau, the U.S. Department of Agriculture, and other sources. For the final rule, EPA will examine impacts based on data collected in the Section 308 Meat Products Industry Survey. (This survey is the reason why EPA chose to use two approaches: the detailed survey could not be completed in time for EPA to incorporate its data into the economic impact analysis.) Section 3.1 presents the methodology used to evaluate the impacts of the proposed rule. Section 3.2 presents the methodology that will be used to evaluate the impacts of the final rule.

The discussion in Section 3.1 works from the smallest scale (costs for specific configurations of option, subcategory, and site) up to the largest scale (market analysis). The section presents the economic impact methodology as follows:

- Cost annualization model, Section 3.1.1
- Facility-level impacts model, Section 3.1.2
- Financial ratio analysis, Section 3.1.3
- Market model, Section 3.1.4
- National impacts, Section 3.1.5

The results of these analyses are presented in Chapter 5.

In general, the methodologies that will be used for the final rule are the same as those used for the proposed rule. However, for the final rule the analysis will primarily be based on survey data. For the proposed rule, most analysis is based on publicly available data. Section 3.2 will discuss the differences between the two methodologies.

3.1 METHODOLOGY FOR THE PROPOSED RULE

3.1.1 Cost Annualization Model

The beginning point for any analysis is the cost annualization model (see Figure 3-1). Inputs to the cost annualization model come from EPA's engineering staff and secondary data.

EPA's engineering staff developed capital and operating and maintenance (O&M) costs for incremental pollution control. The capital cost, a one-time cost, is the initial investment needed to purchase and install equipment involved in pollution control. The O&M cost is the annual cost of operating and maintaining that equipment; a site incurs its O&M cost each year. For this proposal, EPA estimated average compliance costs for a series of model facilities based on subcategory, size, and discharge type (for details, see the Development Document, U.S. EPA, 2002).

Annualized costs are calculated as the equal annual payments of an annuity that has the same present value as the stream of cash outflow over the project life and includes the opportunity cost of money or interest. An annualized cost is analogous to a mortgage payment that spreads the one-time investment of a home over a series of constant monthly payments. There are two reasons to annualize capital and O&M costs. First, the capital cost is incurred only once in the equipment's lifetime; therefore, initial investment should be expended over the life of the equipment. Second, money has a time-based value, so expenditures incurred at the end of the equipment's lifetime or O&M expenses in the future are not the same as expenses paid today.

All other inputs into the cost annualization model are from secondary data sources. The depreciation method used in the cost annualization model is the Modified Accelerated Cost Recovery System (MACRS). MACRS can model businesses as depreciating a higher percentage of an investment in the early years and a lower percentage in the later years. A real discount rate of 7 percent, as recommended by OMB, was used to represent the opportunity cost of capital (OMB, 1996).

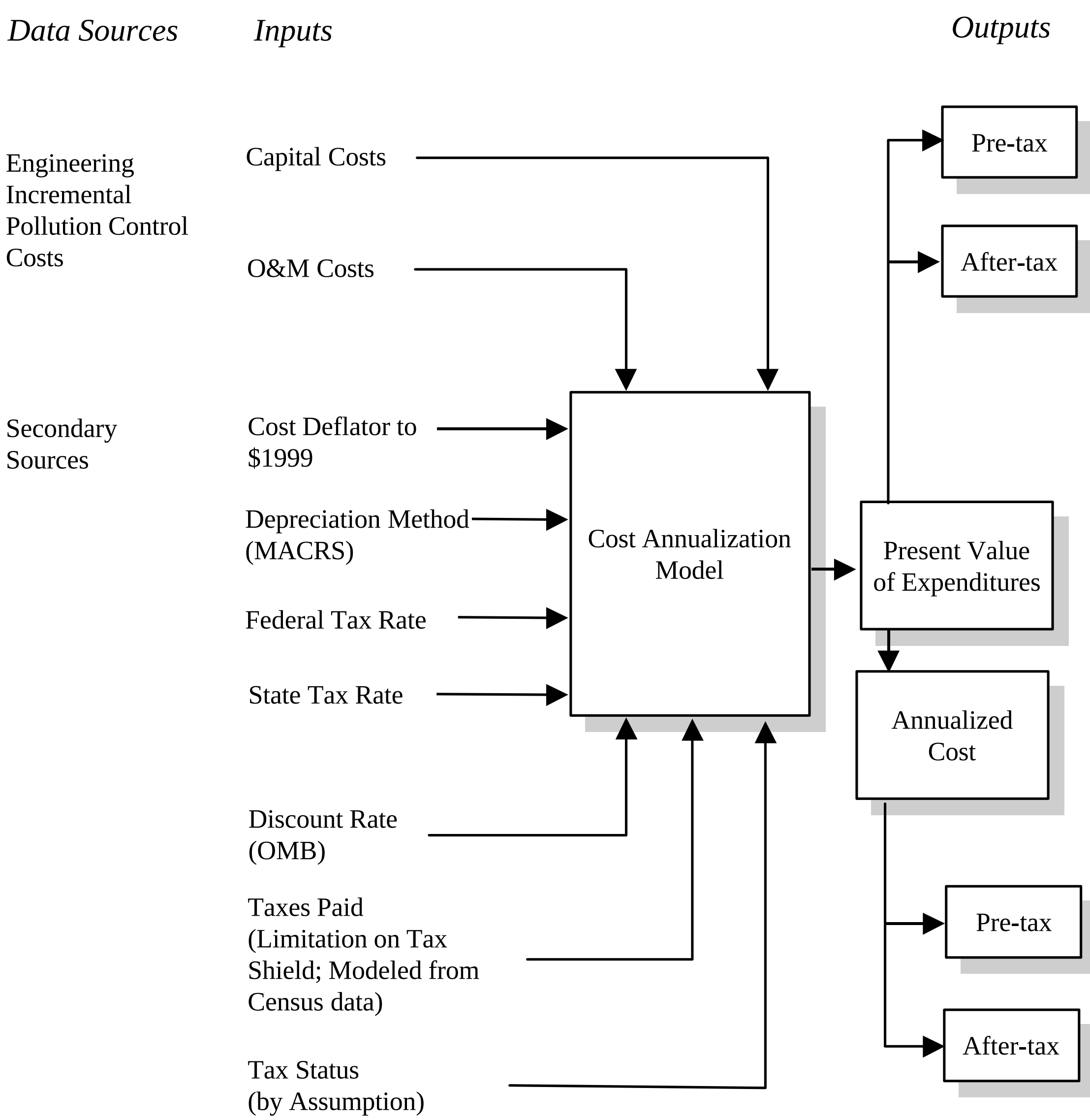

Figure 3-1

Cost Annualization Model

The Internal Revenue Code Section 168 classifies an investment with a lifetime of at least 20 years but less than 25 years as 15-year property. Therefore, the cost annualization model uses a 15-year depreciable lifetime for the capital cost. A mid-year depreciation convention is used; that is, EPA assumes that a 6-month period elapses between purchase of equipment and time of operation. As such, the model covers a 16-year period, with a 6-month period in the first year and a 6-month period in the sixteenth year.

Tax rates are determined by the national average state tax rate plus the federal tax rate. Taxable income—earnings before interest and taxes (EBIT)—was derived from Census data. EPA used the value of each site's EBIT to determine the tax bracket for that site. Derivation of EPA's estimate of EBIT is discussed in Section 3.1.2 below, and in more detail in Appendix B. EPA assumed that all model facilities pay federal and state taxes at the corporate rate. EPA used its estimates of taxes to ensure that a facility's tax shield could not be greater than the taxes it paid.

A sample cost annualization spreadsheet is located in Appendix A of this document. Section A.3 of Appendix A details the calculations used to determine annualized costs (before and after taxes) and present value of costs (before and after taxes).

The cost annualization model calculates the present value of the pre- and posttax cost streams. Then it calculates the annualized cost based on the site-specific discount rate. Thus, the model calculates four types of compliance costs for each site: present value of expenditures (pre- and posttax) and annualized cost (pre- and posttax). The latest year for which financial data will be available from the detailed survey is 1999, so the model uses 1999 dollars.

The cost annualization model's outputs feed into the other economic analyses. Pretax annualized costs are used to project economic impacts in:

- The market model
- Facility-level income
- Financial ratio analysis

- Corporate financial distress analysis
- The cost-effectiveness analysis (see Appendix F; not part of economic achievability)

Posttax annualized costs are used to project economic impacts at the site level based on estimated net income and cash flow.

3.1.2 Facility-Level Impact Analysis

EPA used publicly available information to project facility-level impacts under the proposed effluent guidelines. This section briefly outlines the primary features of the methodology used for this facility-level analysis; Appendix B provides a detailed explanation of data sources, methodology, and assumptions used to develop the analysis. Section 3.2.2 discusses the facility-level methodology for the final rule.

EPA based its facility-level analysis on the U.S. Census Bureau's *1997 Economic Census* of the following four industries: Animal (Except Poultry) Slaughtering (NAICS 311611), Meat Processed From Carcasses (NAICS 311612), Rendering and Meat Byproduct Processing (NAICS 311613), and Poultry Processing (NAICS 311615). The Census provides detailed revenue and cost information by employment class, which EPA used to build model facilities.

To analyze facility-level impacts based on the *Economic Census* data, EPA compared estimated compliance costs with four types of income measures:

- Average establishment revenues
- Average establishment EBIT
- Average establishment net income
- Average establishment cash flow

Each level of analysis more closely approaches the goal of using estimated compliance costs to draw strong inferences about definable impacts on the establishment, but each level of analysis requires additional assumptions to generate the test data. Thus, each level of analysis presents a tradeoff. For example, the relationship between facility cash flow and the impact of compliance costs is much more clearly defined than the relationship between facility revenues and compliance cost impacts. Estimating average facility cash flow requires more assumptions than estimating average facility revenues, however, and that increases the uncertainty about the baseline benchmark against which impacts are measured.

Section 3.1.2.1 provides an overview of the basic strategy EPA followed to develop its facility-level analysis. Section 3.1.2.2 explains how EPA measured model facility income. Section 3.1.2.3 describes how EPA estimated the distribution of income for each model facility. Section 3.1.2.4 presents a simple example of how EPA used the model to assess potential impacts of the regulation. In Section 3.1.2.5 negative baseline facility income and its implications are discussed. Section 3.1.2.6 discusses how EPA matched its economic model facilities to the engineering models used to estimate compliance costs.

3.1.2.1 Overview of Basic Model Framework

The microeconomic basis for the model framework is that a profit-maximizing firm will shut down when average variable costs exceed average revenues. Economic theory states that sunk costs (i.e., costs attributable to past capital purchases) are irrelevant to a firm's current decision making; only variable costs matter in the short run. This basic microeconomic principle can be observed in modern corporate finance where a firm is expected to close if its cash flow (i.e., net income plus depreciation) turns negative. Accounting cash flow, which is primarily composed of operating costs and revenues, is analogous to measuring short-run variable costs. By excluding depreciation (the accounting charge for the utilization of previously purchased capital equipment) from the cash flow calculation, cash flow essentially measures current operating revenues net of current operating costs.[1] Negative cash flow is equivalent to average variable costs exceeding average revenues where the firm is expected to close.

[1] The cash flow calculation includes interest payments. Some may argue that interest payments also reflect costs associated with past capital purchases and therefore should be excluded from consideration in the shut down analysis. However, interest payments cannot be excluded from the analysis; if the facility cannot meet its interest payments, it will be in default on its loan and the bank will foreclose.

The model developed assesses when and to what extent a facility is impacted by regulatory costs by measuring the facility's pre- and post-regulatory cash flows. If cash flow becomes negative after regulatory costs are subtracted from a facility's pre-regulatory cash flow, it can be reasonably inferred that facility closure was a result of the regulatory cost burden. Impacts of the regulation then would include closure of a facility along with its lost output and employment. The model framework also evaluates impacts utilizing three alternative income measures, revenues and net income. Although cash flow is the most appropriate measure of short-run variable costs, and hence the best predictor of facility survival, the additional income measures act as sensitivity analyses to check for consistency in model results.

The basic model framework is composed of the following stages:

- Develop model facility income measures, including revenues, earnings before interest and taxes (EBIT), net income, and cash flow, for establishments of different sizes,

- Estimate the frequency distribution of different income measures for the class of facilities represented by each model facility,

- Estimate the percentage of facilities with income less than estimated compliance costs within each model facility class, which forms the basis for employment and output impacts of the regulation.

A detailed discussion of each of the above stages is provided in the following sections.

3.1.2.2 Development of Model Facility Income Measures

In the first step of the modeling procedure, EPA developed a series of model facilities for the industry to be analyzed. The model facilities represent establishments of different sizes within the industry, where facility size is measured by facility employment. The *1997 Economic Census: Manufacturing – Industry Series* data provide detailed revenue and cost information by employment class that EPA primarily used to build model facilities. EPA also utilized other data sources, such as the *Annual Survey of Manufactures* (ASM), and Federal and state corporate tax rates, to estimate interest payments and relevant tax rates (see Appendix B for a detailed discussion of the various data sources). For each model facility, EPA estimates the following income measures:

- Revenues,
- Earnings before interest and taxes (EBIT) – used to estimate net income and cash flow,
- Net income, and
- Cash flow.

The following sections describe in more detail how model facility income measures are constructed from the various data sources.

Model Facility Revenues

The Census Bureau publishes the value of total shipments by employment size for each NAICS code, along with the number of facilities in that size class. The value of total shipments includes the value of primary and secondary shipments as well as resale, contract, and other miscellaneous receipts. This makes the value of total shipments a reasonable proxy for total revenues. EPA calculated average model facility revenues by employment class within each industry as:

- revenues = value of total shipments / number of establishments

Model Facility EBIT

In order to calculate model facility net income and cash flow from model facility revenues, EPA first estimated model facility EBIT. EPA calculated EBIT by employment class data, then estimated net income and cash flow from EBIT using additional assumptions.

Census provides most of the significant categories of operating costs that would be included in EBIT. For each of the four meat product NAICS industries, facility revenues were estimated by value of shipments. Census also provides:

- payroll and material costs directly attributed to the employment class level[2]
- benefits, depreciation, rent, and purchased services attributed at the industry level

EPA used a few reasonable assumptions to distribute industry-level costs to the employment class level. For example, EPA assumed that employment benefits are proportionate to payroll and that depreciation is proportionate to capital expenditures. See Appendix B for more detail on similar assumptions.

EPA calculated model facility EBIT as:

- EBIT = (Value of Shipments – Operating Costs) / Number of Facilities

where:

- Operating Costs = Payroll + Material Costs + Benefits + Depreciation + Rent + Purchased Services

Because revenues, payroll, and cost of materials are the most significant components of EBIT, the relative error introduced by distributing industry-level data among employment classes should be small. For NAICS 311613 (rendering), payroll and material costs make up over 86 percent of estimated costs (where estimated costs equal the sum of payroll, material costs, benefits, depreciation, rent, and purchased services). For NAICS 311611 (slaughter), 311612 (processing), and 311615 (poultry), payroll and material costs exceed 90 percent of estimated costs.

Model Facility Net Income and Cash Flow

EPA then calculated net income for each employment class model facility in each industry from EBIT, using additional assumptions to estimate tax and interest payments. Data for these two additional components of net income were derived from two Census Bureau publications, *Annual Survey of Manufactures* (ASM) and *Economic Census*, along with the Internal Revenue Service code. Because one

[2] In addition, Census provides capital expenditures and value added directly attributed to the employment class level. These are not direct components of operating costs, but are used to attribute industry level components of cost to the employment class level.

must use an additional layer of assumptions, albeit reasonable ones, to estimate net income from EBIT, the uncertainty associated with the net income estimate is greater than that for EBIT.

Estimating tax payments is relatively straightforward. EPA assumed that establishment EBIT is equal to business entity EBIT as the basis for calculating taxes. To estimate facility tax payments, EPA multiplied the model facility's EBIT by the sum of the relevant federal corporate income tax rate and the average state corporate income tax. To estimate net income, EPA subtracted the estimated tax payment from EBIT for each model facility.

EPA estimated interest payments using a combination of ASM data on past investment by industry, Census data on relative investment in buildings and equipment, and assumptions about investment behavior. EPA first scaled ASM time series data on industry investment, which is based on Standard Industrial Classification (SIC) codes, to represent the current NAICS meat product industries. EPA then used the average percentages of meat product industry investment in equipment and structures, as presented in the *Economic Census,* to divide the ASM investment time series into those two components.

In estimating interest payments from the time series of past investment in equipment and structures, EPA assumed:

- all investment in each year was funded through bank loans,
- the interest rate on those loans was equal to the nominal prime rate for that year plus 1 percent, and
- the average loan period was 7 years for equipment and 25 years for structures.

Using these assumptions, EPA developed a time series estimate of loan payments made by the industry, and of the portion of each year's loan payments accounted for by interest (e.g., using the Lotus @IPAYMT function). Total interest payments in the baseline year equals the sum of this year's interest payments on the stream of past years' investment.[3] Interest payments were then attributed to each

[3] For example, interest payments on equipment investment for the year 1997 would equal the sum of interest paid in year 25 of loans from 1973 plus the interest paid in year 24 of loans from 1974, and so on.

employment class based on the percentage of industry investment accounted for by that employment class in the 1997 Census.

EPA calculated net income as:

$$\text{Net Income} = \text{EBIT} \times (1 - \text{Tax Rate}) - \text{Interest Payments}$$

Then, based on net income above, cash flow is computed as

$$\text{Cash Flow} = \text{Net Income} + \text{Depreciation}$$

where depreciation was estimated for the calculation of model facility EBIT.

The link between impacts measured by comparing cash flow with compliance costs is much stronger than the link between either EBIT or revenues and compliance costs: when post-compliance cash flow is negative, the facility can be reasonably projected to close. Because the estimate of cash flow is dependent upon a series of assumptions, however, the uncertainty concerning the accuracy of the cash flow measure is much greater than for revenues or EBIT. Thus, this analytic approach presents a tradeoff between the accuracy of the income measure and the certainty of the impacts based on that measure.

3.1.2.3 Distribution of Income Represented by Model Facilities

The objective of the model framework is not simply to examine the revenues, costs, and impacts on a series of model meat products facilities. The model facility reflects the average of a group of facilities, not a group of identical facilities. Thus, income for a given group of facilities will lie in a distribution around the average; some facilities will have smaller and some will have larger incomes. Ignoring this distribution of facility income will result in impact estimation errors. If the model facility is projected to remain open after incurring regulatory costs, then some facilities that it represents with smaller than average income may, in fact, close due to the regulation despite the model results. Conversely, if the model facility is projected to close as a result of regulatory costs, then some larger than average facilities that it represents may in reality remain open despite the regulatory costs. To incorporate this concept into the model framework, EPA estimated the distribution of income represented by model facilities. By modeling a facility income distribution with known mean and variance, the model can project how compliance costs impact not just the model facility, but the facilities represented by it as well.

To estimate the distribution of income, EPA obtained special tabulations of the variances and covariances of relevant income components for each employment class (i.e., model facility) from the Census Bureau (U.S. Census Bureau, 2001). Combining these data along with the assumption that these observations are normally distributed around their mean, EPA constructed cumulative probability distributions for the four income measures, revenues, EBIT, net income, and cash flow. The following sections describe the cumulative probability distribution constructs for the individual income measures in further detail.

Distribution of Revenues

For each sector of the four NAICS codes representing the meat products industry, EPA directly obtained the variance of the value of shipments, σ_R, around its mean, $\overline{x}_R$, for each model facility to estimate the cumulative probability function of revenues. Based on the assumption of normality (i.e., $x_R \sim N(\overline{x}_R, \sigma_R)$), the model evaluates impacts as the number and percentage of facilities in an employment class for which compliance costs exceed 1 percent and 3 percent of revenues.

Distribution of EBIT

Although the variance of revenues (value of shipments) is directly provided by the Census special tabulation, the variance of EBIT needs to be estimated. EBIT is a linear function of its revenue and cost components. Thus, the variance of EBIT can be estimated using the standard statistical relationship where the variance of a linear function is itself a linear function of the variance and covariance of its constituents.

To estimate the distribution of EBIT for each model facility, EPA used the variance and covariance of the value of shipments (R), payroll (P) and material costs (M) for each employment class provided by Census. Given that mean EBIT, $\overline{x}_E$, for an employment class is:

$$\overline{x}_E = \overline{x}_R - \overline{x}_P - \overline{x}_M$$

where $\overline{x}_i$ denotes the mean value of revenues, R, payroll, P, and material costs, M. EPA computed the variance of EBIT, σ_E^2, as:

$$\sigma_E^2 = \sigma_R^2 + \sigma_P^2 + \sigma_M^2 - 2\sigma_{RM} - 2\sigma_{RP} + 2\sigma_{PM}$$

where σ_i^2 and σ_{ij} represent the variance and covariance of revenues, payroll, and material costs respectively (Mendenhall et al., 1990). Although payroll and material cost do not comprise all operating expenses included in EBIT, they do comprise the vast majority of EBIT. Hence, excluding the variance for the remaining components should not cause a significant error in the variance estimate.

Distribution of Net Income and Cash Flow

EPA estimates the variance of net income and cash flow for each model facility from its estimated variance for EBIT. If some scalar, *a*, is added to the mean of a distribution, the variance of that distribution will be unchanged. However, if the mean of the distribution is multiplied by some scalar, *k*, then the variance of that distribution increases by the square of *k*.

Cash flow, for example, is estimated by: (1) multiplying EBIT by (1 - tax rate), (2) subtracting interest payments, then (3) adding depreciation. If the scalar *k* represents (1- tax rate), and the scalar *a* represents depreciation less interest payments, then mean cash flow for a model facility is equal to:

$$\bar{\bar{x}}_{CF} = a + k\,\bar{\bar{x}}_{E}$$

The variance of facility cash flow will be equal to:

$$\sigma^2_{CF} = k^2\,\sigma^2_{E}$$

(Harnett, 1982). EPA used these relationships to derive the variances for net income and cash flow from the variance for EBIT.

Table 3-1 presents the mean and variance EPA estimated for each model facility and income measure.

3.1.2.4 Use of Model Facility and Distribution to Project Closure Impacts

As discussed above, both economic and corporate finance theory predict that a firm will close if cash flow becomes negative. EPA's strategy for assessing facility closure impacts therefore compares pre-regulatory cash flow with post-regulatory cash flow; post-regulatory cash flow is calculated by subtracting post-tax annualized compliance costs from pre-regulatory cash flow. EPA estimated cash flow for a series of model facilities from Census data; moreover, EPA estimated the distribution of cash flow for facilities represented by each model facility. This section provides an intuitive example of how EPA uses this information to project facility closures.

Table 3-1
Model Facility Income Mean and Standard Deviation by Employment Class

NAICS Establishment Employment Size	INCOME MEASURE Revenues x $1,000	Net Income x $1,000	Cash Flow x $1,000	STANDARD DEVIATION Revenues	Net Income	Cash Flow
311611						
Emp. 1 to 4	$439.6	$27.7	$32.6	292.5	56.2	56.2
Emp. 5 to 9	$1,265.2	$46.3	$55.2	841.8	89.1	89.1
Emp. 10 to 19	$2,654.6	$64.1	$85.6	1766.4	147.1	147.1
Emp. 20 to 49	$8,412.6	$336.3	$382.4	5597.6	617.2	617.2
Emp. 50 to 99	$22,489.8	$1,303.0	$1,437.6	14964.3	2259.7	2259.7
Emp. 100 to 249	$69,474.3	$2,696.1	$3,248.2	46227.0	5210.8	5210.8
Emp. 250 to 499	$160,913.7	$4,004.8	$4,713.6	107069.3	8024.0	8024.0
Emp. 500 to 999	$262,734.0	$4,982.8	$6,924.2	174818.7	10402.7	10402.7
Emp. 1,000 to 2,499	$677,948.1	$29,321.4	$33,489.1	451095.1	53662.4	53662.4
Emp. >= 2,500	$1,426,054.3	$9,933.5	$18,501.2	948872.3	31988.4	31988.4
311612						
Emp. 1 to 4	$412.6	$29.6	$40.2	380.8	81.4	81.4
Emp. 5 to 9	$1,393.5	$152.2	$181.5	1286.1	320.5	320.5
Emp. 10 to 19	$2,844.8	$160.3	$204.4	2625.5	367.4	367.4
Emp. 20 to 49	$7,451.6	$462.3	$562.4	6877.4	1079.2	1079.2
Emp. 50 to 99	$19,048.8	$1,823.4	$2,044.6	17580.9	3819.5	3819.5
Emp. 100 to 249	$52,075.1	$4,510.3	$5,449.7	48062.0	9935.8	9935.8
Emp. 250 to 499	$105,065.6	$6,308.4	$7,555.0	96968.9	13265.6	13265.6
Emp. 500 to 999 [1]	$172,089.3	$14,363.6	$16,840.2	158827.5	31591.3	31591.3
Emp. 1,000 to 2,499	NA	NA	NA	NA	NA	NA
Emp. >= 2,500	NA	NA	NA	NA	NA	NA
311613						
Emp. 1 to 4	$859.9	$14.1	$39.9	1154.9	310.5	310.5
Emp. 5 to 9	$3,818.0	$509.8	$571.7	5127.6	793.9	793.9
Emp. 10 to 19	$6,475.8	$608.3	$730.5	8697.2	1047.2	1047.2
Emp. 20 to 49	$11,680.8	$1,879.1	$2,244.0	15687.5	3198.6	3198.6
Emp. 50 to 99 [2]	$17,107.8	$2,406.5	$3,069.3	22976.2	4476.2	4476.2
Emp. 100 to 249	NA	NA	NA	NA	NA	NA
Emp. 250 to 499	NA	NA	NA	NA	NA	NA
Emp. 500 to 999	NA	NA	NA	NA	NA	NA
Emp. 1,000 to 2,499	NA	NA	NA	NA	NA	NA
Emp. >= 2,500	NA	NA	NA	NA	NA	NA

Table 3-1 (cont.)
Model Facility Income Mean and Standard Deviation by Employment Class

NAICS Establishment Employment Size	INCOME MEASURE			STANDARD DEVIATION		
	Revenues x $1,000	Net Income x $1,000	Cash Flow x $1,000	Revenues	Net Income	Cash Flow
311615						
Emp. 1 to 4	$257.9	$6.5	$18.1	158.1	28.3	28.3
Emp. 5 to 9	$759.4	$23.2	$39.9	465.4	69.5	69.5
Emp. 10 to 19	$3,291.5	$452.9	$484.5	2017.3	631.3	631.3
Emp. 20 to 49	$11,721.5	$2,428.2	$2,564.0	7183.8	3265.5	3265.5
Emp. 50 to 99	$14,880.7	$1,462.6	$1,618.4	9120.0	2224.7	2224.7
Emp. 100 to 249	$29,999.3	$2,323.7	$2,744.6	18385.8	3966.2	3966.2
Emp. 250 to 499	$71,300.2	$3,466.3	$4,602.5	43698.1	5955.6	5955.6
Emp. 500 to 999	$117,768.1	$13,361.8	$14,783.8	72177.1	20657.6	20657.6
Emp. 1,000 to 2,499	$182,579.1	$17,044.9	$20,179.0	111898.1	29094.2	29094.2
Emp. >= 2,500	$321,884.5	$1,072.1	$7,855.7	197274.9	4551.3	4551.3

[1] Due to disclosure issues, data for 2 facilities with 1,000 < employment < 2,499, and 1 facility with 2,500 employment combined in lower category for NAICS 311612.
[2] Due to disclosure issues, data for 10 facilities with 100 < employment < 249, and 1 facility with 250 < employment < 499 combined in lower category for NAICS 311613.
Data for combined size class calculated as (total minus sum of all other size classes).

Figure 3-2 presents graphically the cumulative normal distribution function for the cash flow of all facilities in a model class with a mean of $100,000 and a standard deviation of 100,000.[4] If EPA estimates that annualized compliance costs equal $40,000 for the model facility, then in this example the model facility itself would not be projected to close. However, any facilities in the same model class with cash flow of $40,000 or less would be projected to close. Given the mean and variance of cash flow for that model class, the probability of facilities in that class earning less than $40,000 can be readily calculated; about 27.4 percent of facilities in this class earn cash flow less than $40,000 per year. Multiplying that probability by the number of facilities in the class results in the projected number of closures for that class. Multiplying that same probability by the number of employees in the employment class estimates the projected employment impacts of those closures.

Note that EPA actually calculates the *incremental* probability of closure. That is, EPA calculates the probability that facilities have cash flow of less than $40,000 minus the probability that facilities have negative cash flow. EPA's methodology compares positive pre-regulatory cash flow with post-regulatory cash flow; if pre-regulatory cash flow is positive and post-regulatory cash flow is negative, then the facility is projected to close. If the facility's pre-regulatory cash flow is negative, EPA cannot evaluate it. In the above example, the incremental probability of closure would be equal to the probability a facility's pre-regulatory cash flow is less than $40,000 (27.4 percent) minus the probability a facility's pre-regulatory cash flow is less than zero (15.9 percent), or 11.5 percent. The issue of negative pre-regulatory cash flow is discussed in more detail in section 3.1.2.5 and in Appendix B.

Similarly, EPA constructs distributions for revenues, EBIT, and net income. Although there are not well-defined thresholds for these facility income measures that EPA can use to project facility closure if exceeded by compliance costs, EPA can use these distributions to estimate, for example, the probability that facilities incur pre-tax annualized compliance costs exceeding 3 percent of revenues. This provides useful information concerning the magnitude of impacts on facilities not projected to close. EPA also measures impacts by estimating pre-tax compliance costs as a percentage of model facility EBIT.

[4] Standard deviation is equal to the square root of the variance, and provides an equivalent means of characterizing a distribution.

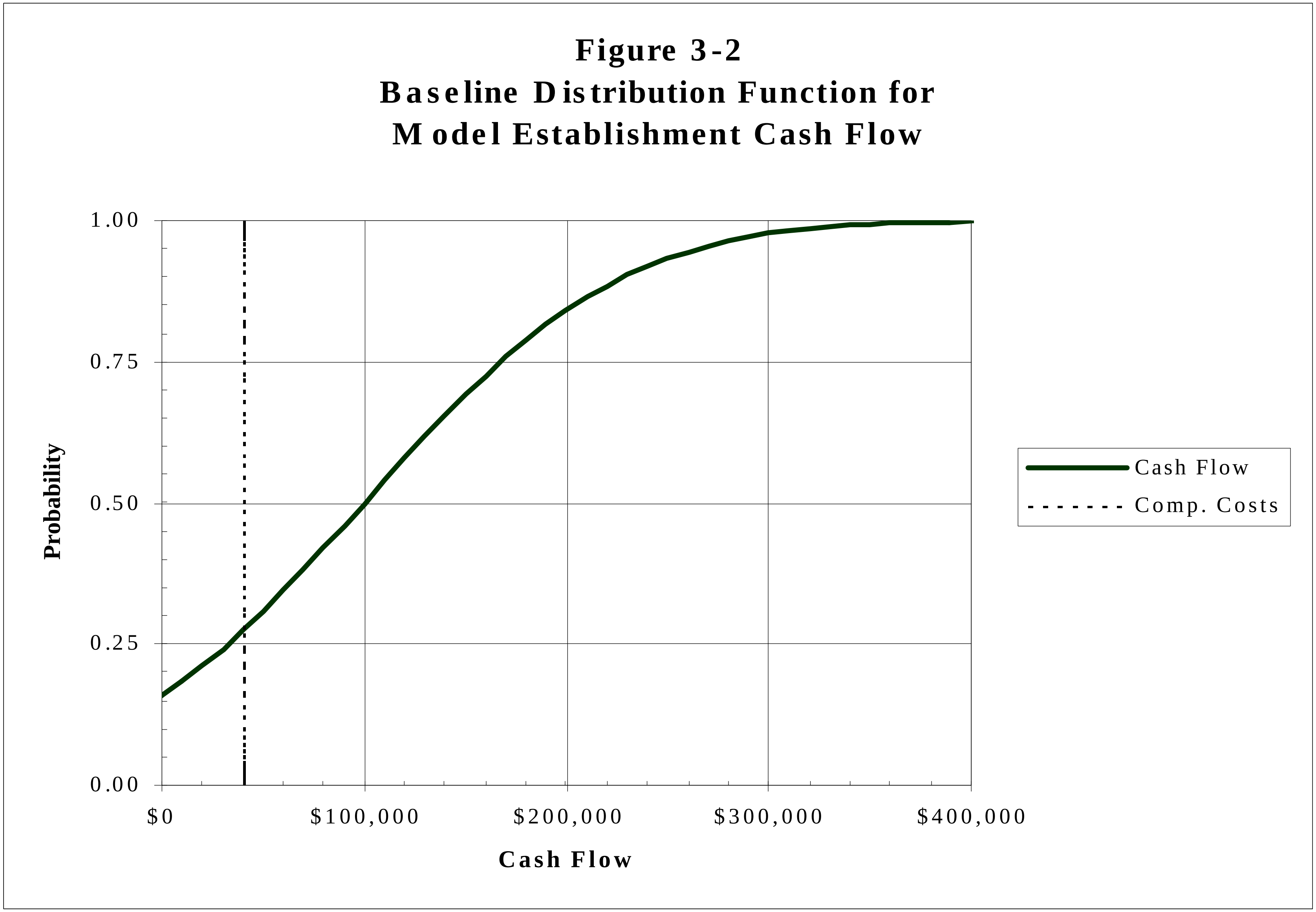
Figure 3-2
Baseline Distribution Function for
Model Establishment Cash Flow
1.00
0.75
0.50
0.25
0.00
Probability
$0
$100,000
$200,000
$300,000
$400,000
Cash Flow
Cash Flow
Comp. Costs

In summary, EPA first estimates measures of average income for a series of model facilities. EPA then estimates the distribution of income around the average for all establishments represented by the model. The distribution allows EPA to project the probability that compliance costs exceed some specified percentage of facility income for that class of facilities, and use that probability to estimate the number of establishments incurring that impact. Without use of the probability distribution, EPA would be required to project "all or nothing" impacts based on the average income measure for the representative model facilities. That is, either all facilities in a class would be projected to close if annualized compliance costs exceed model facility cash flow, or all facilities in that class would be projected to remain open if annualized compliance costs were less than model facility cash flow.

3.1.2.5 Negative Baseline Facility Income

The estimated means and variances for the distribution of each model facility's income results in some probability greater than zero that facilities in each employment class earn negative income. There are three primary reasons that these distributions do show some probability of negative establishment income:

- Actual establishment income is less than zero.
- EPA assumed the distribution of income around the model facility mean is normally distributed when, in fact, it may be positively skewed.
- EPA could not directly measure the variance of the income distributions, but instead had to estimate it from incomplete data.

This section discusses these reasons, and their implications for the model.[5]

[5] Table B-7 in Appendix B presents the model facility mean and standard deviation for each income measure by employment class and NAICS code, as well as the probability that income is less than zero (based on that mean and standard deviation, and assuming income is normally distributed).

Actual Establishment Income is Less Than Zero

The actual establishment financial data collected by Census on which the estimated distribution is based might reveal negative income for two reasons:

- the parent company that owns the establishment does not assign costs and revenues that reflect the true financial health of the establishment. Two important examples are cost centers and captive sites, which exist primarily to serve other facilities under the same ownership.[6]

- the establishment is in financial trouble; that is, true costs exceed revenues.

To the extent that these types of establishments are contained in an employment class, the projection of negative baseline income is accurate. In either case, EPA would be unable, even with the use of facility specific survey data, to evaluate impacts to these establishments *as a result of the rule*.

Skewed Distributions

EPA assumed the distribution of income around the model facility mean is normally distributed based on the "law of large numbers." However, establishment income may be positively skewed. The use of a normal distribution instead of a positively skewed distribution would result in a model with a higher percentage of establishments having negative baseline income than would actually occur in the industry.

The effects of a positively skewed income distribution can be most apparent when considering the distribution of establishment revenues. While it is possible, even probable, that some establishments earn negative income – whether measured by EBIT, net income, or cash flow – they will not earn negative revenues (although they may earn zero revenues). Thus, the distribution of establishment

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[6] Captive sites may show revenues, but the revenues are set approximately equal to the costs of the operation. Cost centers have no revenues assigned to them.

revenues for an employment class should show zero facilities earning negative revenues.[7] If, however, some facilities earn atypically large revenues, then the distribution may be positively skewed (e.g., the cumulative distribution function in Figure 3-2 would initially rise more steeply than the normal distribution, but would then flatten out – reaching a probability of 1.0 at a higher level of income).

Using a normal, symmetric distribution to approximate a skewed distribution would likely result in an over estimate of the percentage of establishments earning negative income. Census confirmed that in general, the distributions of revenues, payroll, and material costs in an employment class tend to be positively skewed (Quash, 2001). However, even if the distribution of a variable such as revenues, payroll, or material costs is positively skewed, the distribution of a function of those variables (e.g., revenues minus payroll and material costs) will not necessarily be skewed. Thus, while there is intuitive reason to believe the distribution of establishment income measures is skewed, the degree of skewness is difficult to determine.

Adjustments to Variance

EPA used the Census special tabulation to directly calculate the variance for:

- value of shipments - (payroll + material costs)

in each NAICS code and employment class. However, the actual measures of facility income used in the facility level economic impact model are:

- EBIT = value of shipments - (payroll + material costs + benefits + all other costs)
- Net Income = EBIT × (1 - tax rate) - estimated interest payments

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[7] EPA estimated the percentage of establishments that would earn negative revenues assuming revenues are normally distributed with mean and variance determined by the Census special tabulation. As presented in Table B-7, from 5 percent to 23 percent of establishments are estimated to earn negative revenues based on these assumptions.

- Cash Flow = Net Income + depreciation

Because the actual income measures (EBIT, net income and cash flow) differed from the approximate income measure [value of shipments - (payroll + material costs)] on which variance was estimated, EPA adjusted the variance of [value of shipments - (payroll + material costs)] associated with each of the actual income measures used in the model.

To adjust income variance, EPA used standard rules concerning the expected value of mean and variance. Intuitively, if one multiplies the mean of a distribution by some scalar k, the variance of that distribution expands or shrinks by the square of that scalar value. However, if instead of scaling the mean, its value is changed by adding or subtracting some constant, then the distribution shifts to the right or left on its x-axis, but its variance does not change.

Applying these rules to the mean and variance for the various measures of income for Meat Products model facilities yields the following results (see Appendix B for details):

- mean EBIT is smaller than the mean of [value of shipments - (payroll + material costs)], but the variance for EBIT equals the variance for [value of shipments - (payroll + material costs)]; the probability of negative EBIT is larger than the probability of negative [value of shipments - (payroll + material costs)].

- both the mean and the variance of net income are proportionate to the mean and variance of EBIT ; the probability of negative net income equals the probability of negative net income.

- mean cash flow is larger than mean net income, but the variance of cash flow equals the variance of net income; the probability of negative cash flow is smaller than the probability of negative net income.

The probability that the [value of shipments - (payroll + material costs)] is less than zero in the four Meat Products NAICS codes ranges from 22 percent to 26 percent, while the probability EBIT and net income are less than zero generally ranges, in most cases, from 26 percent to 30 percent. The probability that cash flow is less than zero tends to be about 3 percent to 5 percent smaller than the probability that net income is less than zero.

Effect on Modeling Impacts

The effects of this issue on EPA's projection of economic impacts cannot be generalized. In any model class with a given mean income, incremental closure impacts may be overestimated or underestimated by a cumulative distribution function with too high a probability of negative baseline income. If compliance costs are small relative to mean income, the model will tend to overestimate closures, as compliance costs increase relative to mean income the model will, at some point, start to underestimate incremental closure impacts. Within the range of income and estimated compliance costs relevant for this analysis, the difference in incremental closures tends to be small.[8]

3.1.2.6 Matching Economic Model Facilities to Engineering Model Facilities

In addition to economic model facilities, EPA developed engineering model facilities in order to estimate compliance costs. EPA estimated engineering model facility effluent loads based on data such as: wastewater samples, the type and level of facility production, and wastewater treatment typical facilities currently have in place. EPA then estimated the cost of technologies that, if purchased and installed, would enable the model facility to meet specified effluent guidelines (see the Development Document, U.S. EPA, 2002, for details).

Because data to develop engineering model facilities and economic model facilities had to be drawn from diverse sources, EPA then had to match its engineering model facilities with its economic

[8] EPA performed a sensitivity analysis to determine the importance of this issue. EPA projected closure impacts using the variance of model establishment income as estimated above and compared the results to those from a model with an identical mean income, but a smaller variance and a much smaller probability of negative baseline income (about 7 percent). For the relevant range of income and compliance costs, the difference between the two results was not significant. Details of this sensitivity analysis are included in Appendix E.

model facilities in order to project the financial impacts of the proposed effluent guidelines.[9] This section describes how EPA matched the economic model facilities to the engineering model facilities in order to project economic and financial impacts.

Basis for Engineering Model Facility Classes

In order to develop a comprehensive series of representative engineering model facilities, EPA classified the meat products industry based on the type of meat produced at the facility:

- Red meat (primarily beef and pork),
- Poultry (primarily chicken and turkey),
- Mixed (both red meat and poultry), or
- Rendering products or meat byproducts (either red meat or poultry);

the type of processes performed at facilities:

- First processing (slaughter),
- Further processing, and/or
- Rendering (the process resulting in meat byproducts), and

facility size (small, medium, large or very large) based on production and wastewater flow.

[9] For the economic analysis of the final regulation, EPA will be able to use Section 308 survey data. This data enables EPA to directly determine the financial characteristics of the facilities used to estimate engineering compliance costs.

This results in a set of model facility classes reflecting different combinations of the characteristics listed above. For example, a model facility might be classified as a large poultry facility (based on production and meat type) that performs one of the following six process combinations: first processing, (2) further processing, (3) first and further processing, (4) first processing and rendering, (5) further processing and rendering, or (6) first processing, further processing, and rendering.

Matching Engineering and Economic Model Facility Classes

EPA matched its economic model facilities to the engineering model facilities on the basis of two characteristics: (1) the relationship between production process, meat type, and NAICS industry, and (2) the relationship between facility production and revenues.

The Census Bureau classifies the meat product industry into four groups. Census distinguishes red meat facilities (either beef or pork) that perform animal slaughter (first processing), whether alone or in combination with other processes (NAICS 311611) from red meat facilities that perform further processing (with or without rendering), but no slaughtering activities (NAICS 311612). Census classifies all facilities that perform poultry slaughter, poultry further processing, or both (with or without rendering), in the same NAICS code (311615). Finally, facilities that perform rendering, but no other processing activities, are classified in NAICS 311613 by Census.

Thus, model economic facilities were matched to the model engineering facilities, based on production, as follows:

- Engineering facilities that process either beef or pork, and perform first processing (alone or in combination with further processing and/or rendering) were assigned an economic model facility from NAICS 311611.

- Engineering facilities that process either beef or pork, and do not perform any first processing, were assigned an economic model facility from NAICS 311612.

- Engineering facilities that perform any combination of processes on chicken or turkey, were assigned an economic model facility from NAICS 311615.

- Engineering facilities that perform rendering—whether red meat or poultry—but no other processes were assigned an economic model facility from NAICS 311613.

- Engineering facilities that process both red meat and poultry were assigned an economic model facility from NAICS 311612.[10]

All model engineering facilities were assigned an economic model from one NAICS code only.

Because of data availability, economic model facilities were sized by employment class, while engineering cost models were sized by production and flow. EPA classified engineering models into small, medium, large, or very large based on examination of production and flow characteristics of facilities. After determining the appropriate size for each engineering cost model facility, EPA calculated the median production for all facilities in that class based on screener survey data. EPA then combined median production data for the engineering model facilities with meat product indicator prices to estimate revenues for each engineering model facility. These estimated revenues were then compared with average revenues for each economic model facility. EPA then selected the appropriate employment class for the economic model facility based on the closest revenue match within the NAICS code assigned to each meat type and process combination.[11] For more detail on matching economic model facilities to engineering model facilities, see Appendix B.

3.1.3 Financial Ratio Analysis

EPA also examined the impact of the proposed effluent guidelines on the model establishment's balance sheet as well as its income statement. EPA performed two analyses of balance sheet impacts. First, EPA examined the effect of compliance costs on model establishment return on assets (ROA). Second, EPA examined if compliance costs cause corporate financial distress for a select group of firms. EPA selected the Altman Z′ score as its means of measuring financial distress. For reasons stated below,

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[10] No mixed meat model facilities estimated to incur costs were found to perform slaughter activities.

[11] EPA used the baseline prices from the market model as the indicator prices for the meat products (for more detail on the market model see Section 3.1.4.2).

EPA would prefer to use the Altman Z′ score as the sole measure of financial distress for this industry's effluent guidelines. However, EPA cannot construct balance sheet statements for its economic model facilities due to lack of appropriate data. Therefore, a limited analysis of projected impacts on model facility ROA is utilized. For many large, multi-establishment companies, including many of those listed in Section 2.5 of the industry profile, EPA was able to obtain sufficient financial data to perform the Altman Z′ analysis. For the final rule, EPA will use the Altman Z′ score measure of financial health to assess impacts to all affected firms based on Section 308 survey data. Section 3.1.3.1 describes the ROA analysis, while section 3.1.3.2 presents Altman Z′ score methodology.

3.1.3.1 Return on Assets

EPA selected return on assets (ROA) as perhaps the single best financial ratio to indicate facility profitability. ROA provides a reflection of the opportunity cost of investing in the meat product industry. Investors look for their best opportunity to receive a high rate of return on their capital. If the estimated compliance costs of the proposed effluent guidelines are projected to significantly lower the rate of return earned in the meat products industry, investors may exit that market in search of better opportunities; the meat products industry would then be likely to contract.

EPA obtained data on ROA for SIC codes in the meat products industry from Dun & Bradstreet's *Industry Norms and Key Business Ratios, 1997–1998* (D&B, 1998). D&B provides the median, upper quartile, and lower quartile ratio for companies submitting financial data in each SIC code.[12] Therefore, these data are not obtained from a representative sample and must be interpreted with care. D&B did not provide data for the rendering industry; EPA used the lowest median ROA ratio from among the other meat product industries as a conservative proxy for the rendering ROA ratio.

[12] The relationship between NAICS and SIC codes is presented in Section 2.1.

To project impacts on model facility ROA, EPA first used the median ROA for the appropriate industry, combined with each model facility's net income, to estimate model facility total assets. ROA equals net income divided by total assets. Therefore, EPA calculated:

$$\text{model facility total assets} = \frac{\text{model facility net income}}{\text{median ROA}}$$

Given each model facility's total assets, net income, and compliance costs, EPA then calculated:

$$\text{post-regulatory ROA} = \frac{(\text{net income} - \text{posttax annualized compliance costs})}{(\text{total assets} + \text{capital costs})}$$

In addition to baseline and post-compliance ROA, EPA calculated the percent change in ROA as an impact of the proposed rule.

In past effluent guidelines, EPA has typically considered a firm impacted if its post-compliance ROA falls below the lower quartile ROA for the industry. Because EPA has information only on the distribution of income (not, that is, on the distribution of total assets), it did not try to estimate the probability that the post-regulatory ROA will fall below the lower quartile value. EPA does, however, present each industry's lower quartile ROA for informational purposes.

3.1.3.2 Corporate Financial Distress Analysis

The corporate financial distress analysis examines whether a company can afford the aggregate costs of upgrading all of its sites. EPA has chosen to use a weighted average of financial ratios to examine the impacts of increased pollution control on companies. Many banks use financial ratio analysis to assess the credit worthiness of a potential borrower. If regulatory costs cause a company's financial ratios to move into an unfavorable range, the company will find it more difficult to borrow money. EPA will consider a company in such a condition to be in financial distress.

Financial ratios are calculated at the business entity or corporate parent level because:

- Accounting procedures maintain complete financial statements (balance sheet and income statement) at the business entity or corporate level, but not necessarily at the site level. The survey data indicate that many companies do not keep complete financial statements at the site level.

- Significant financial decisions, such as expansion of a site's capacity, are typically made or approved at the corporate level.

- The business entity (or corporate parent) is the legal entity responsible for repayment of a loan. The lending institution evaluates the credit worthiness of the business entity, not the site.

First, EPA describes the Altman Z′score, a weighted average of financial ratios used to assess financial distress. EPA then summarizes the data and methodology used for the analysis. Finally, the implications of a score below the cutoff are discussed.

Altman Z′ score

EPA performed a literature search to review bankruptcy prediction literature from 1990 to 1998 (Kaplan, 1999). Although new approaches have been developed (e.g., neural networks, logit models, and multiple discriminant analyses), there no clearly superior method and no consensus on what is the best approach. EPA has determined that—given the goal of selecting a methodologically sound, reproducible, and defensible approach—the Altman Z-score, a multiple discriminant analysis (e.g., a weighted-average) of financial ratios, is appropriate.

The Altman Z-score is a well accepted standard technique of financial analysis with nearly two decades of use (see Brealey and Meyers, 1996, and Brigham and Gapenski, 1997). The Z-score has advantages over consideration of an individual ratio or a collection of individual financial ratios:

- It is a simultaneous consideration of liquidity, leverage, profitability, and asset management. It addresses the problem of how to interpret the data when some financial ratios look "good" while other ratios look "bad."

- There are defined threshold or cut-off values for classifying firms as in good, indeterminate, and poor financial health. "Rules of thumb" are available for some financial ratios, such as current ratio and times interest earned, but these frequently vary with the industry (U.S. EPA, 1995).

Altman (1993) developed several variations on the multidiscriminant function. EPA selected the Z′score because it was developed to evaluate public and private manufacturing firms. The model is:

$$Z' = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_4 + 0.998X_5$$

where the pre-compliance components are:

Z'	=	overall index
X_1	=	working capital/total assets
X_2	=	retained earnings/total assets
X_3	=	EBIT/total assets
X_4	=	book value of equity (or net worth)/total debt
X_5	=	sales/total assets

The detailed survey requested each piece of information for the analysis. (Working capital is equal to current assets less current liabilities). Book value of equity is also called net worth (i.e., total assets minus total debt). Total debt is the sum of current and non-current liabilities.

EPA estimates financial distress based on changes in the Altman Z′score as a result of pollution control compliance costs. The estimates of post-compliance scores are calculated as follows:

Z'	=	overall index
X_1	=	working capital/(total assets + capital costs)
X_2	=	retained earnings/(total assets + capital costs)
X_3	=	(EBIT - pretax annualized compliance costs)/(total assets + capital costs)
X_4	=	book value of equity (or net worth)/(total debt + capital costs)
X_5	=	sales/(total assets + capital costs)

Capital costs are those developed by the engineering staff for use in the cost annualization model. The annualized pollution control costs for each option were calculated from the engineering estimates of capital and operating and maintenance costs in the cost annualization model (see Appendix A).

Taken individually, each of the ratios given above (X_1 through X_5) is higher for firms in good financial condition and lower for firms in poor financial condition. Consequently, the greater a firm's distress potential, the lower its discriminant score. The thresholds for evaluating financial distress are:

- Altman Z′score below 1.23: financial distress is likely
- Altman Z′score above 2.9 indicates that financial distress is unlikely.
- Altman Z′scores between 1.23 and 2.9 are indeterminate.

As can be observed from the components of the post-compliance Z′score, incremental compliance costs will lower a company’s score. EPA examines a firm’s pre- and post-compliance score to determine if it crosses one of the thresholds.

Data and Methodology

EPA performed a preliminary Altman Z′ analysis based on a partial database of detailed survey responses to questions on the income statement and balance sheet at the corporate level, information presented in the industry profile, and estimated facility level compliance costs.

EPA first identified major meat product companies contained in both the industry profile listing of largest companies (Section 2.5) and the preliminary detailed survey database. For this analysis, EPA identified 20 major multi-facility meat product companies with sufficiently consistent data on which to perform this preliminary Altman Z′ analysis. EPA used data presented in the industry profile to determine the number of facilities owned by each of the 20 companies listed above. In general, EPA did not have sufficient information to further classify facilities by operation, size, or discharge type.

For compliance costs, EPA used an average of estimated compliance costs by meat type (i.e., red meat, poultry, rendering) weighted by the median production for each process combination, size and discharge type. Thus each company in the analysis incurred an average cost that reflected in some measure, costs for slaughter, further processing, and rendering operations, a range of sizes, and both direct and indirect dischargers.

Implications of a Z′ score Below the Financial Distress Threshold

What does it mean if a company’s Altman Z′score falls below the threshold for “distress likely”?

First, it should be noted that Altman used the phrase “bankruptcy likely” as well as “distress.” This does not mean, however, that a company will immediately declare bankruptcy once its score falls into that danger zone. It is a warning flag. A company has the opportunity to change its behavior during this warning period to avoid the projected bankruptcy. The Chrysler Corporation is an example; Altman (1993) cites other examples.

Second, taking Chapter 11 (bankruptcy) is not the same as taking Chapter 7 (liquidation). A company that takes Chapter 11 is protected from its creditors for a period of time while it reorganizes itself. A company can continue to operate while it is in Chapter 11, and has the chance to emerge from bankruptcy. In contrast, a firm is liquidated when there is no hope for rehabilitation. Altman notes, “Economically, liquidation is justified when the value of the assets sold individually exceeds the capitalized value of the assets in the marketplace” (Altman, 1993, p. 33).

Third, other forms of response are possible. Shedding non-productive assets, merging with another company, or being purchased by another company are all possible responses to financial distress.

What this means for the economic analysis is that:

- A company that moves into the “distress likely” category as a result of added pollution control costs is considered to be distressed as a result of the regulation. It does not mean that EPA expects the company to liquidate immediately upon promulgation. The company, however, will have to change the way it operates to respond to the regulation and remain out of bankruptcy. In either case, EPA expects serious economic disruption for the firm.

- A company in the “distress likely” category before the rulemaking cannot be evaluated for a change in status. It does not mean that EPA expects the company to liquidate in the very near future.

3.1.4 Market Model

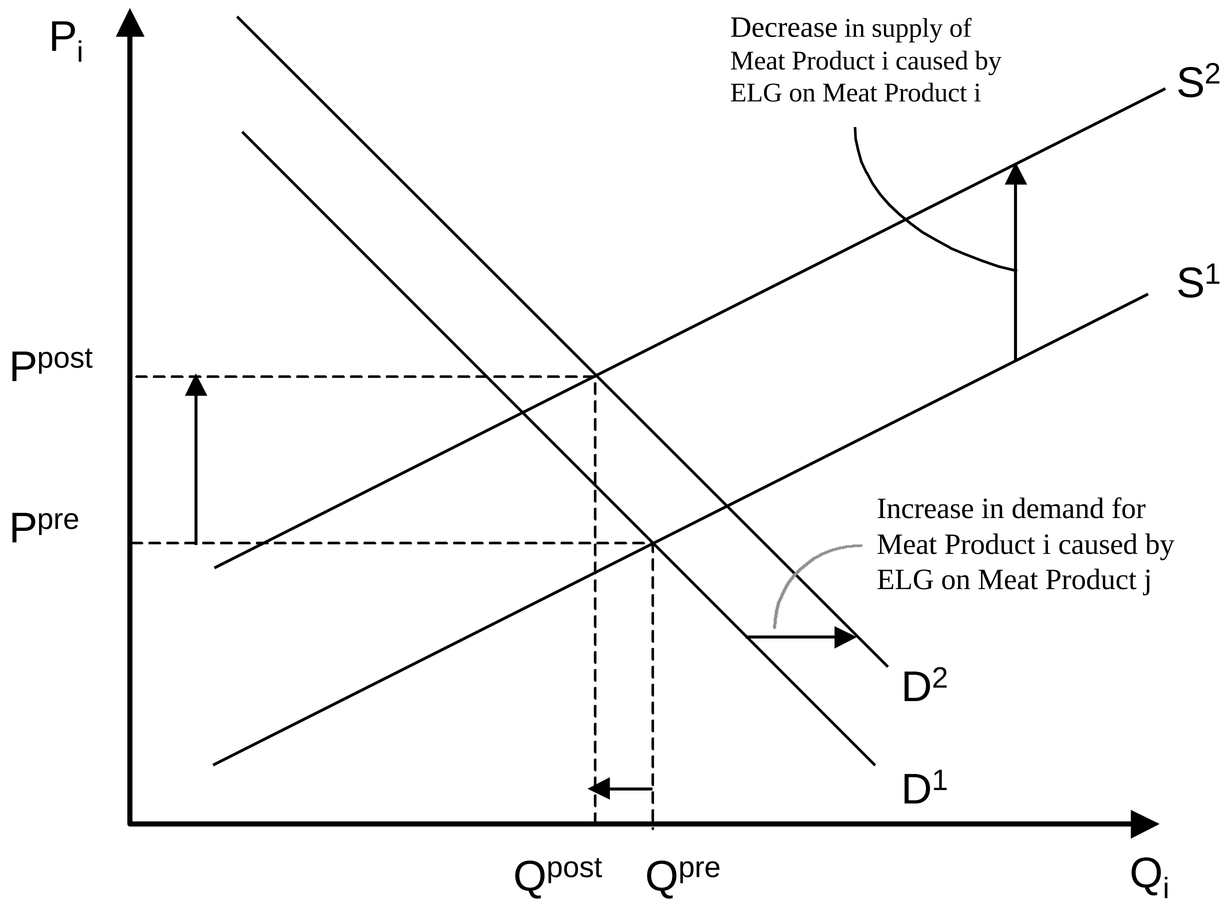
EPA developed a market model to examine the impacts of the meat products industry effluent guidelines on the price and output of various meat products. The distinguishing feature of EPA’s market model is that it explicitly incorporates cross-market impacts among meat types into the analysis. The demand for meat products such as beef, pork, broilers, and turkey is closely related; an increase in the price of pork, for example, may cause a fall in the quantity of pork demanded and an increase in demand for beef.

In the context of EPA's proposed effluent guidelines for the meat products industry, this increases the complexity of the market analysis. Because EPA's proposed effluent guidelines may simultaneously affect the price of beef, pork, chicken, and turkey, the market analysis for each product depends not only on the compliance costs for that product but on the impact of compliance on the prices of the other three meat products.

For example, if the proposed effluent guidelines impose compliance costs on the producers of beef products, then the supply of beef products will tend to decrease (i.e., the supply curve for beef will shift to the left; a smaller quantity of beef will be offered for sale at the current price). If all other things remain constant, this would tend to increase the price of beef products while decreasing the quantity sold. However, EPA's proposed effluent guidelines may also impose compliance costs on pork producers, tending to increase the price of pork. All other things being constant, the increase in the price of pork would increase the demand for beef products; the demand curve for beef will shift to the right. This would tend to increase the price of beef as well as increase the quantity of beef sold. The final impact on the price and output of beef products will depend on the relative magnitude of supply and demand shifts. Figure 3-3 illustrates the general rule behind this example.

If all meat products incur relatively similar per-unit compliance costs, cross-market impacts would tend to be roughly offsetting. However, if per-unit compliance costs are asymmetric (e.g., per-unit compliance costs are significantly larger for some subcategories than for others), then potentially significant shifts could occur between meat product markets. EPA's model was developed with the flexibility to analyze the latter situation as well as the former.

In order to incorporate both cross-market effects and international trade into the model, EPA specified linear supply and demand equations in each market to make the model tractable. The slopes of the equations were derived from estimated price elasticities of supply and demand found in existing research. These elasticities were then converted to slopes at the baseline equilibrium price and quantity. Because domestic supply, domestic demand, import supply, and export demand are all specified as linear functions, the model components are additive, and simultaneous equilibrium can be solved for multiple markets using linear algebra.



D^1, S^1 = preregulatory market supply and demand conditions
D^2, S^2 = postregulatory market supply and demand conditions
P^{pre}, Q^{pre} = prerequlatory equilibrium price and quantity
P^{post}, Q^{post} = postrequlatory equilibrium price and quantity

Figure 3-3

Impact of the Effluent Guideline on Market for Meat Product i

Of major concern to observers of the meat product industry is the issue of potential market power. EPA selected a perfectly competitive structure for the meat products market model after performing an extensive literature search. EPA found that most researchers were unable to reject the existence of perfectly competitive markets in the beef and pork markets; in the poultry market, market power was found to exist for meat processors vis-a-vis livestock suppliers, but not against customers in the output market. The results of this literature search are presented in Section 2.4 of the industry profile.

Section 3.1.4.1 presents the basic market model specification and solution. Section 3.1.4.2 discusses data sources for the model. The market model as outlined below will be used for the impact analyses of both the proposed and the final rules.

3.1.4.1 Market Model Approach

The market model for meat products follows five basic steps. Details on each step are provided in Appendix C.

First, standard domestic supply, domestic demand, import supply, and export demand equations are developed for each meat product. These equations express quantity as a linear function of a product's domestic price. The linear function's slope is expressed by a price parameter, derived from elasticities in the literature. Domestic demand for each meat product is specified as a function of the price of the other three meat products in addition to its own price. For the market for each meat product to be in equilibrium, U.S. domestic demand for a meat product and foreign demand for U.S. production of that meat product (exports) must be equal to U.S. domestic supply of the product plus foreign sales of that product to the U.S. (imports) at its current market price. This equilibrium condition is used to derive an excess demand function for each meat product.

Second, the excess demand equations are solved. Because the excess demand function for each meat product is linear, expressing the equations for the four meat products in matrix form results in a convenient way to solve the equations simultaneously. Given pre-regulatory prices, quantities, and price parameters, linear algebra is used to solve for the pre-regulatory intercept for all four excess demand equations.

Third, the supply curve shift for each meat product is calculated (imposing effluent guidelines on the industry causes the supply curve for each meat product to shift.) The supply curve shift for a meat product is estimated as a function of average per-unit compliance costs for that product. Once the post-regulatory (i.e., post-shift) supply curve is estimated, the excess demand equation for each meat product is re-written.

Fourth, the post-regulatory excess demand equations for all four meat products—like the pre-regulatory equations—are expressed in matrix form. The post-regulatory intercept for each excess demand equation, however, is already known: it is a function of the pre-regulatory intercept, per-unit compliance costs, and the supply equation price parameter. By using linear algebra to invert the matrix containing the price parameters, then multiplying the post-regulatory intercept vector by that inverted matrix, EPA can evaluate the set of meat prices that results in simultaneous equilibrium for all four meat products.

Finally, the individual component equations for each meat product's domestic supply, domestic demand, import supply, and export demand are evaluated using the post-regulatory prices to solve for post-regulatory quantities. Changes in these four quantities for each meat product, as well as changes in the price of each meat product, measure the market-level impacts of a meat products effluent guidelines.

3.1.4.2 Data Sources for Market Model Analysis

Baseline Market Quantities and Prices

EPA examined a number of possible sources for baseline quantity and price data, including: (1) the U.S. Census Bureau's *1997 Economic Census of Manufacturers,* (2) USDA's *Livestock, Dairy and Poultry Situation and Outlook* (Outlook), and (3) USDA's *Food Consumption, Prices, and Expenditures, 1970–97* (Putnam and Allshouse, 1999). EPA selected Outlook data for the baseline price and quantity. EPA chose not to use Census data because a large percentage of the listed meat products did not have data on both output and value data, which is necessary to calculate a transactions price. Outlook's primary advantage over the Putnam and Allshouse data is that it is more up to date.[13] Furthermore, although Putnam and Allshouse present data on retail and boneless production, it is directly derived from essentially the same carcass weight data as presented in Outlook, and thus does not reflect true retail sales.

Given the highly aggregated nature of Outlook data and the fact that the data is tracked at the carcass weight level, EPA selected Outlook's wholesale price measures to use as baseline price; these are best interpreted as indicator prices rather than the explicit price of all output. EPA determined that Putnam's retail price measures were not linked closely enough to the carcass weight output to be suitable for use as the baseline prices.

Compliance Costs

In order to estimate the supply curve shift for each meat type, EPA calculated average compliance costs per unit of output. Conceptually, per-unit compliance costs for each meat type are simply the sum of annualized compliance costs divided by meat output.

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[13] Putnam cites small quantities of broiler and turkey imports (e.g., 5 million pounds, ready-to-cook weight (RTC) for broilers, less than 0.02 percent of domestic production), while both Outlook and the FATUS database report no imports for these two meat products. EPA used Putnam's import quantity data for chicken and turkey rather than Outlook's data.

EPA initially estimated compliance costs by process (first, further, and rendering) within general meat type categories (e.g., red meat and poultry; see Section 3.1.2.3 for details). This meant that EPA had to attribute (1) estimated compliance costs for red meat to beef and pork and (2) estimated compliance costs for poultry to chicken and turkey. To do this, EPA first estimated total annualized compliance costs for each subcategory and size class (e.g., red meat, further processors, medium size). Then, for each subcategory size class, EPA calculated the quantity and percent of total meat production accounted for by each meat type (beef, pork, chicken, and turkey). Costs were attributed by the percent each meat type made up of total meat production for that subcategory size class (e.g., if red meat, further processors, medium sized facilities produced 70 percent beef, 70 percent of annualized compliance costs for that subcategory size class would be attributed to beef). Per-unit costs were estimated by dividing the attributed compliance costs for each meat type by the quantity of that meat type produced.

To determine the average per-unit compliance costs for each meat type over all subcategories and size classes, EPA calculated a weighted average of the per-unit costs for each subcategory and size class by meat type. The weights were calculated as the meat type output within each subcategory and size class expressed as a percent of total output of that meat type over all subcategories and size classes. (Note that, to an estimation of market-level compliance costs per unit, the distinction between direct and indirect dischargers is irrelevant.) Finally, to estimate market-level impacts, EPA entered average per-unit compliance costs by meat type directly into the market model.

Price Elasticities of Demand

Domestic price elasticities of demand are widely available from a variety of sources, including USDA and academic research. The results of the literature search for demand elasticities is documented in the record. For use in its market model, EPA selected K. S. Huang's *A Complete System of U.S. Demand for Food* (1993).

The advantage of Huang's estimates is that they were generated in a single, coherent, consistent framework that satisfies theoretical constraints of symmetry, homogeneity, and Engel aggregation. This should make using them better than selecting individual elasticities from among several sources with varying methodologies, degrees of aggregation, and time horizons. The internal consistency of Huang's work is of particular importance because EPA is modeling cross-product impacts in the market model. The own- and cross-price elasticities of demand are presented in Table 3-2.

Price Elasticities of Supply

EPA undertook a literature search for estimates of the price elasticities of meat supply for both the feedlots and meat products effluent guidelines. This search resulted in a wide range of estimated elasticities with little apparent consensus.

Because of this lack of consensus, EPA chose to use the elasticities from the effluent guidelines for concentrated animal feeding operations (CAFOs). These were selected with the concurrence of EPA's expert consultants (U.S. EPA, 2001). It is reasonable to use these elasticities for the meat products market model, because meat (in the form of both live animals for slaughter and meat products) makes up the majority of material costs in the meat products industry (79 percent in animal slaughtering, 63 percent in meat processing, and 76 percent in poultry (U.S. Census Bureau, 1999a through 1999d). In addition, the other major cost component of meat production is unskilled labor, and the price elasticity of primarily unskilled supply tends to be large. Thus, the CAFOs supply elasticities should represent a reasonable lower-bound estimate for the price elasticity of meat supply. The supply elasticities selected for use in the model are presented in Table 3-2.

Import and Export Elasticities With Respect to Domestic Price

EPA used an Armington-type specification to model the effects of international trade on U.S. meat products markets. If foreign-produced and domestically produced goods are perceived as perfect substitutes for each other—that is, if consumers do not differentiate between foreign and domestically produced goods—then one would expect a country to either import those goods or export them, but not

Table 3-2
Price Elasticities of Supply and Demand Identified in Feedlots Literature Searches

Sector	Range of Estimated Price Elasticity of Livestock Supply[1]			Range of Estimated Price Elasticity of Meat Demand			Cross Price Elasticities of Meat Demand			
	Low Value	Selected Value	High Value	Low Value[1]	Selected Value[2]	High Value[1]	Beef	Pork	Broilers[3]	Turkey
Beef	-0.170	1.020	3.240	-2.590	-0.621	-0.150	NA	0.114	0.018	0.004
Pork	0.007	0.628	0.628	-1.234	-0.728	-0.070	0.192	NA	0.013	0.013
Broilers	0.064	0.200	0.587	-1.250	-0.372	-0.104	0.103	0.047	NA	-0.023
Turkey	0.210	0.200	0.518	-0.680	-0.535	-0.372	0.089	0.141	-0.077	NA

[1] Based on literature reviews; "selected" supply elasticities represent a consensus of expert opinion for CAFOs market model.
[2] Huang, K. S. A Complete System of U.S. Demand for Food. USDA Economic Research Service, 1993.

Table 3-3
EPA Estimates of Armington Trade Elasticities with respect to Domestic Price

Sector	Elasticity of Meat Imports w.r.t. Domestic Price				Elasticity of Meat Exports w.r.t. Domestic Price			
	Domestic Demand Elasticity[1]	U.S. Imports as Percent of U.S. Market[2]	Armington Elasticity (ξ)[3]	Import Elasticity	Domestic Demand Elasticity[1]	U.S. Exports as Percent of ROW Market[2]	Armington Elasticity (ξ)[3]	Export Elasticity
Beef	-0.621	9.17%	1.580	0.097	-0.621	2.20%	1.580	-1.558
Pork	-0.728	3.90%	1.580	0.035	-0.728	0.64%	1.580	-1.575
Broilers	-0.372	0.02%	1.249	0.000	-0.372	5.12%	1.249	-1.202
Turkey	-0.535	0.02%	1.249	0.000	-0.535	8.04%	1.249	-1.187

[1] Huang, K. S. A Complete System of U.S. Demand for Food. USDA Economic Research Service, 1993.
[2] EPA calculation based on United Nation's Food and Agriculture Organization (UNFAO) data.
[3] Gallaway, M. P., et. al. Industry-level Estimates of U.S. Armington Elasticities. Office of Economics Working Paper. U.S. ITC, 2000.

to both import and export them simultaneously. However, if consumers perceive that foreign and domestically produced goods in a particular class are close but not perfect substitutes, then their country may import and export that class of products simultaneously. The U.S. both imports and exports meat products; the Armington specification that EPA selected incorporates product differentiation in the meat products industry market model.

Econometrically, the Armington model measures the degree of substitutability between traded products. This is expressed as the percentage change in market share of the imported product relative to the domestically produced good caused by a change in the relative prices of the imported and domestic goods. An elasticity of zero implies that consumers will not substitute imported meat products for domestic meat products; the higher the elasticity, the more willing consumers are to make this substitution. This means that if the elasticity of substitution is equal to one, then market shares remain constant; if this elasticity is greater than one, then an increase in U.S. price means that U.S. market share will decrease (Armington, 1969a).

The Armington elasticity of substitution cannot be directly used in EPA's market model. However, Armington demonstrated that own price and cross price trade elasticities are a function of domestic demand elasticities, market shares of domestic and foreign products, and the value of the elasticity of substitution (Armington, 1969a, 1969b). EPA used Armington's results to derive formulae for the trade elasticities used in its market model.[14]

The U.S. elasticity of demand for imports of each meat product with respect to the U.S. domestic price of that product is a function of its domestic elasticity of demand, the ratio of "rest of world" (ROW) and U.S. market shares (EPA assumed for simplicity that there are only two countries, the U.S. and the ROW), and the elasticity of substitution between U.S. and ROW meat products. The value of the import price elasticity is positive: that is, an increase in the U.S. domestic price of meat products is expected to increase U.S. demand for ROW meat products.

[14] Further details of this derivation may be found in Appendix C and the rulemaking record.

EPA calculated the elasticity of ROW demand for U.S. meat products with respect to U.S. price in a similar fashion. The value of this elasticity is negative: an increase in U.S. domestic meat price will decrease U.S. exports of meat products. Due to a lack of data availability, EPA calculated a numerical value for this elasticity assuming that: (1) the ROW elasticity of substitution for U.S. meat products is identical to the U.S. elasticity of substitution for ROW meat products, and (2) the elasticity of ROW demand for meat products with respect to ROW price equals the elasticity of U.S. demand for meat products with respect to U.S. price.[15]

Market shares of meat production were estimated at the carcass weight level of aggregation using quantity data from the United Nations Food and Agriculture Organization (UN FAO). Long-run Armington elasticities were obtained from Gallaway et al. (2000).[16] Table 3-3 presents a summary of the trade parameters and elasticities with respect to changes in domestic price that were used in the model. Note that, in general, the elasticities of meat imports are relatively low; this is because meat imports make up a small share of the U.S. domestic market.

3.1.5 National Direct and Indirect Impacts

Impacts on the meat product industry are known as direct effects, impacts that continue to resonate through the economy are known as indirect effects (effects on input industries), and effects on consumer demand are known as induced effects. The U.S. Department of Commerce's Bureau of Economic Analysis (BEA) tracks these effects both nationally and regionally in massive "input-output" tables, published as the Regional Input-Output Model (RIMS II) multipliers. For every dollar in a "spending" industry, these tables identify the portion spent in contributing, or "vendor," industries.

[15] Note that because the U.S. share of ROW expenditures on meat products is small, the value of the ROW trade elasticity approaches the value for the elasticity of substitution. Therefore, the assumption that the elasticity of ROW meat product demand equals the elasticity of U.S. domestic meat demand is not crucial to the results of the analysis.

[16] Gallaway et al. (2000) estimated elasticities at the four-digit SIC level for Meat Packing (SIC 2011) and Poultry and Egg Processing (SIC 2015). Because these SIC codes contain more than one product, but do not distinguish between beef and pork (SIC 2011) or chicken and turkey (SIC 2015), EPA used the same elasticity of substitution for each product described by a code.

For this analysis, EPA calculated direct and indirect impacts using the national-level final-demand multipliers for BEA industries 14.0103 (meat packing plants, sausages, and other prepared meats):

- Output: 4.9661 dollars of total output per dollar of meat products
- Employment: 46.9297 FTEs per $1 million in output in 1992 dollars

and these multipliers for BEA 14.0105, poultry slaughtering and processing:

- Output: 4.3518 dollars of total output per dollar of meat products
- Employment: 45.1800 FTEs per $1 million in output in 1992 dollars

Note that because employment multipliers are based on 1992 data, the value of lost output needs to be deflated to 1992 dollars before estimating employment impacts. (U.S. DOC, 1996). EPA used Gross Domestic Product (GDP) data by industry for the years 1947 to 2000, compiled by the Bureau of Economic Analysis (BEA), to calculate the implicit price deflator for the Food and Kindred Products industry in the period 1992 to 1999 (U.S. DOC, 2001).

3.2 METHODOLOGY FOR THE FINAL RULE

Much of the methodology for the final rule follows the same principles as the methodology for the proposed rule, but uses site-specific data obtained from the detailed survey. Thus, the cost annualization model is essentially identical for both the proposed rule and the final rule. For the proposed rule, however, the model used general industry average data obtained from publicly available sources for certain key parameters. For the final rule, the model will use facility-specific values from survey data for those parameters. Similarly, the facility-level impact model compares facility income with estimated compliance costs. For the proposed rule, facility income was measured as an average based on Census data, while for the final rule, facility income will be measured directly from detailed survey data.

Section 3.2.1 explains how the use of survey data will change the cost annualization model as used for the final rule. Section 3.2.2 presents the methodology for projecting facility closure impacts for the final rule. The corporate financial distress analysis, market model, and the national and community impact methodologies will essentially be unchanged from the proposed to the final rule except where appropriate, data from the Section 308 detailed survey will be used.

3.2.1 Cost Annualization Model

The cost annualization model for the final rule has essentially the same structure as the model used for the proposed rule. However, certain inputs for the final rule's model—such as facility income and the discount rate—will be based on facility-specific data from the Section 308 detailed survey instead of averages from publicly available information sources. Inputs to the cost annualization model will come from three sources: EPA's engineering staff, secondary data, and the 2001 Meat Products Industry Survey. The capital and O&M costs for incremental pollution control were developed by EPA's engineering staff. Differences in the methodologies for developing engineering costs for the proposed rule and for the final rule are discussed in the Development Document (U.S. EPA, 2002).

As with the proposed rule, EPA will use the MACRS as the depreciation method in the cost annualization model. Secondary data will provide the average inflation rate from 1987 to 1999 as measured by the Gross Domestic Product (GDP) Price Deflator. EPA will use the average inflation rate to convert the nominal discount rate to the real discount rate. To determine tax rates, EPA will add the national average state tax rate and the federal tax rate.

The 2001 EPA survey data provide discount rates or interest rates (the weighted average cost of capital or the interest rate supplied by the site) for survey sites. For any site that supplied neither a discount rate nor an interest rate, EPA will use the median discount rate of all sites. Figures for taxable income—EBIT—will also come from the EPA survey. The value of EBIT for each site will determine that site's tax bracket. EPA will calculate average taxes paid from its survey data, using taxes for the years 1997, 1998, and 1999. These numbers will be used to ensure that a site's tax shield cannot be greater than the average taxes that site paid in 1997, 1998, and 1999. Tax shields will be estimated according to corporate structure. In the model, a "C" corporation pays federal and state taxes at the corporate rate, an "S" corporation or a limited liability corporation (LLC) pays taxes at the individual rate (since EPA has no way of determining how many individuals receive earnings or those individuals' tax rates, these rates are set to zero), and all other entities pay taxes at the individual rate.

A sample cost annualization spreadsheet is located in Appendix A of this document. Section A.3 of Appendix A details the calculations used to determine annualized costs (before and after taxes) and present value of costs (before and after taxes).

The cost annualization model calculates the present value of the pre- and posttax cost streams. Then it calculates the annualized cost based on the site-specific discount rate. Thus, as in proposal, the model will calculate four types of compliance costs for each site: present value of expenditures (pre- and posttax) and annualized cost (pre- and posttax). The latest year for which financial data is available is 1999, hence, the model will use 1999 dollars.

3.2.2 Facility Closure Model

EPA has developed a financial model based on facility specific data from the detailed questionnaire to estimate whether the additional costs of complying with the proposed regulation will make a site unprofitable. Sites designated as unprofitable are projected to close as a result of the regulation, leading to site-level impacts such as losses in employment and revenue. Hence, the site financial model is also called the closure model within this report. In essence, this model will perform the same type of analysis for the final rule as the facility level model performs for the proposed rule.

The difference is that the facility level model for the proposed rule is based on averages of aggregate industry data, while the closure model is based on facility specific data.

In terms of perspective, the closure model focuses on individual sites. It attempts to answer the question “does it make financial sense to upgrade this site?” using data and methodology available to corporate financial analysts. The closure model interacts with the market model (see Section 3.1.4); the industry proportion of costs that meat processors passes through to their customers via price increases is derived from the market model. EPA performs its primary analysis of facility level impacts assuming that firms can pass zero percent of costs on to customers in the form of higher prices; impacts will be more severe under this scenario. However, unless the demand for meat products is perfectly price elastic (or supply perfectly price inelastic), some percentage of increased production costs due to the proposed rule will tend to be passed through to customers. This is the point of interaction between the closure model and the market model.

In contrast, the corporate financial distress model evaluates whether a company could afford to upgrade *all* of its facilities (see Section 3.2.3). In other words, each model provides a different perspective on the industry and the impacts potentially caused by the effluent limitations guidelines requirements.

The closure model turns the question “does it make sense to upgrade this site?” into a comparison of future facility income with and without the regulation. The closure decision is modeled as:

Post-regulatory status = Present value of future earnings
- (Present value of after-tax incremental pollution control costs * (1-percent cost pass-through)

The site closure model calculates the long-term effects on earnings reduced by the added pollution control costs. If the post-regulatory status is less than zero, it does not make economic sense for the site owner to upgrade the site. Under these circumstances, the site is projected to close.[17]

Although simple in concept, the model incorporates numerous choices, including:

- Whether or not to include salvage value.
- Net income or cash flow as the basis of projecting future earnings.
- Time frame for consideration.

Section 3.2.2.1 reviews the choices EPA has made in these three areas for the site closure model. Section 3.2.2.2 describes the data preparation and forecasting methods used in this analysis. Section 3.2.2.3 presents EPA's methodology for determining site closure when evaluating different approaches to estimating future earnings.

3.2.2.1 Assumptions and Choices

Salvage Value

The closure decision equation can be modified to include consideration of the salvage value of the site. If salvage value is taken into account, that is, the post-regulatory status is zero if the present value of post-regulatory earnings *exceeds the salvage value of the site*. For the meat product industry, EPA will not include salvage value in the site closure model. EPA made this decision for several reasons.

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[17] EPA assumes that, when a site is liquidated, it no longer operates and closure-related impacts will result. In contrast, facilities that are sold because a new owner presumably can generate a greater return are considered *transfers*. Transfers cause no closure-related impacts, even if prompted by increased regulatory costs. Transfers will not be estimated in this analysis.

First, the market for used capital equipment appears to be limited. Having few alternative uses, capital assets tend to be specific to the industry and have limited mobility (Anderson et al., 1998). These assets are not viable in their current locations (otherwise the site would not be shut down), but it would be expensive to move them to a different location.

Second, a significant percentage of salvage value may be composed of current assets. It is not appropriate to calculate salvage value based on significant current assets because the value of cash, cash-equivalents, and inventory is so liquid that an owner would not base a long-term decision on it. That is, an owner would not liquidate a site because it shows a relatively high cash position on the balance sheet, and thus has a high salvage value relative to cash flow. The cash could be transferred to other corporate operations without such a drastic step as closing down operations.

Third, excluding salvage value brings the site closure model into greater consistency with economic modeling approaches. That is, if salvage value is left out, a site is assumed to remain in operation as long as its revenues meet or exceed its operating costs. Sunk (i.e., capital) costs are not considered.

Fourth, firms often do not record the value of assets at individual facilities; this information tends to be tracked at the corporate level. Therefore, even with the availability of Section 308 data, EPA frequently cannot reliably determine the salvage value of individual facilities.

Net Income Versus Cash Flow

EPA examined two ways to estimate the present value of future plant operations:

- Net income from all operations, calculated as revenues minus operating costs; selling, general, and administrative expenses; depreciation; interest; and taxes (as these items are recorded on the site’s income statement).

- Cash flow, which equals net income plus depreciation.

EPA could not collect reliable data on depreciation from the detailed survey. Therefore, EPA will use net income as the measure of facility income. Excluding depreciation from the evaluation of facility income may be likened to setting aside an allowance for replacement of current capital equipment when it wears out.[18]

Time Frame for Consideration

EPA will use a 16-year time period in forecasting future income. (This corresponds to the time period used in the cost annualization model—see Appendix A.) Although it might be appropriate to use the estimated actual lifetime of the equipment rather than the depreciation period, doing so would yield a lower estimated annualized cost because of the greater number of years over which to spread the capital investment. EPA prefers to use the more conservative (shorter) time frame. The first year's data will not be discounted, again to keep the cost annualization and forecasting projections on a consistent basis.

3.2.2.2 Present Value of Future Earnings

Adjusting Earnings to an After-Tax Basis

Depending on the corporate hierarchy of which a site is part, the earnings reported in the survey may have to be adjusted for taxes. A site may fall into one of several categories:

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[18] The trend in corporate finance appears to prefer cash flow as the appropriate basis for evaluating investment decisions because depreciation reflects previous, rather than current, expenditures and does not actually absorb incoming revenues. For example, Brigham and Gapenski (1997) note that in capital budgeting it is critical to base decisions on cash flows or the actual dollars that flow into and out of a company during the evaluation period. The Financial Accounting Standards Board, in SFAS Nos. 105, 107 and 119, recommends using the present value of future cash flows to identify market value (FASB, 1996). In addition, although depreciation may intuitively be thought of as a capital replenishment allowance, in general, the value of historical capital expenditures (as reflected in depreciation) is not a reliable indication of future capital requirements to maintain operations.

- It is part of a multi-site corporation. If so, its EBIT will be adjusted to an after-tax level according to the taxable income of the corporation, using the appropriate corporate tax rate.

- It is part of a multi-site organization whose income is taxed at the rate for individuals (e.g., partnerships, sole proprietorships, etc.). If so, its EBIT will be adjusted to an after-tax level according to the taxable income of the business entity, using the appropriate individual tax rate.

- The site is, or is part of, an S corporation or LLC. If so, no adjustment will be needed.

- The site is the business entity, so the complete income statement data are supplied for the site. If so, because net income is presented on an after-tax basis, no adjustments need to be made.

Adjusting Earnings to After-Tax Net Income

For the first two categories (multiple facilities under the same ownership), net income will be calculated as:

$$\text{net income} = [(\text{EBIT}) * (1 - (\text{federal} + \text{state tax rates}))]$$

where the federal and state tax rates are dependent on corporation type and income at the business entity level. (See Section A.1 for more details.) That is, EPA will reduce operating earnings by estimated taxes. EPA will not make a similar adjustment for interest, because interest is generally not held at the site level and it may vary widely from company to company (while tax rates are consistent).

S corporations and LLCs (the third category) distribute income to the partners and tax is paid by the partners at each partner’s personal tax level. (That is, the company does not pay taxes, the partners pay taxes.) Therefore, no adjustment is needed. For the fourth category—single-site businesses—net income will be taken directly from the survey.

Forecasting Methods for Future Net Income

Site net income must be forecast over the 16-year project lifetime. All forecasting methods to be examined for and used in the closure analysis incorporate the following assumptions and procedures:

- No growth in real terms.
- Constant 1999 dollars. Data from 1997 and 1998 are inflated using the change in the GDP price deflator.

EPA is making the "no growth" assumption to avoid assuming that a site can grow its way out of an economic impact associated with additional pollution control costs; essentially, EPA will assume that sites are running at or near capacity and that significant growth is unlikely without a major capacity addition.

EPA will examine several different forecasting methods to address site-specific variations:

- Most recent year (1999 data) as best indicator of future net income.
- Three-year average (1997 to 1999 data after inflation to 1999 dollars).[19]
- Time-varying income option #1 (called "Cycle 1"), according to which net income follows this 3-year pattern:
  1999 = 1999 net income
  2000 = 1998 net income
  2001 = 1997 net income
  2002 = 1998 net income
  2003 = 1999 net income (pattern begins again)

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[19] EPA requested 3 years of data in the survey to mitigate the uncertainty in the analysis resulting from a single data point. For new or newly acquired facilities, however, 1 year of data may be all that is available for analysis. For facilities with a trend in income, the most recent year may be the more conservative estimate of future net income. If only 2 years of data are available, the model will calculate the average of the two values. If only 1999 data are available, that year's data are used.

2004 = 1998 net income, and so forth

If the facility had a good/bad year in 1998, the result will be a good/bad year every 2 years.

- Time-varying income option #2 (called “Cycle 2”), according to which net income follows this 3-year pattern:

  1999 = 1999 net income

  2000 = 1999 net income

  2001 = 1998 net income

  2002 = 1997 net income

  2003 = 1997 net income

  2004 = 1998 net income

  2005 = 1999 net income (pattern begins again)

  2006 = 1999 net income, and so forth

  If the facility had a good/bad year in 1998, the result will be a good/bad year every three years.

After detailed survey data become available, EPA will examine the implications of the four forecasting methods. EPA will select three forecasting options that provide a spectrum ranging from relatively optimistic to relatively pessimistic forecasts.

Discount Rate

The final step in estimating each site’s pre-regulatory present value is to discount the stream of net income back to the first year in the time series. This step does not adjust the stream for inflation, because the projections are in constant dollars. Thus, the discount rate used for discounting must be a real discount rate, obtained by adjusting the nominal discount rate for the expected annual rate of inflation (see Appendix A). The same site-specific real discount rate is used in both the cost annualization and closure models.

3.2.2.3 Projecting Site Closures As a Result of the Rule

With three forecasting methods, there are three ways to evaluate a site's status. If a site's post-regulatory status is less than zero, the site will be assigned a score of "1" for that forecasting method. A site, then, may have a score ranging from 0 to 3.

Closure is the most severe impact that can occur at the site level and represents a final, irreversible decision in the analysis. The decision to close a site is not made lightly; the business making the decision is aware of and concerned with the turmoil introduced into its workers' lives, community impacts, and how the action might be interpreted by stockholders. The business will likely investigate several business forecasts and several methods of valuing their assets. In its decision to close a site, a corporation would weigh not only all data, assumptions, and projections of future market behavior, but also the uncertainties associated with the projections. When a corporation examines the results of several analyses, it is likely to find that the results are mixed. Some indicators may be negative while others indicate that the site can weather the current difficult situation. A decision to close a site is likely to be made only when the weight of evidence indicates that closing the site is the appropriate path for the company to take.

EPA will emulate corporate decision-making patterns when determining if sites will close. A score of 1 for a site may result from an unusual year of data. If the score is 2 or 3, in EPA's judgement, the weight of the evidence indicates poor financial health. EPA believes that this scoring approach represents a reasonable and conservative method for projecting closures.

Pre-Regulatory Conditions

The closure analysis will begin with an evaluation of the pre-regulatory status of each site. Several conditions may lead to a site having a score of 2 or 3 under pre-regulatory conditions:

- The company does not record sufficient information at the site level for the closure analysis to be performed.

- The company does not assign costs and revenues that reflect the site’s true financial health. Two important examples are cost centers and captive sites, which exist primarily to serve other facilities under the same ownership. Captive sites may show revenues, but the revenues are set approximately equal to the costs of the operation (cost centers have no revenues assigned to them).

- The site already appears to be in financial trouble.

The first two conditions would exist if a site’s earnings data are held at the company level, or if the site has been established not to show a profit, but to serve the company of which it is part. In either case, EPA would not have sufficient information to evaluate impacts at the site level *as a result of the rule*. The impact analysis would default to the company level, because that is the level at which relevant decisions are made.

The third condition identifies a site with complete site-level financial information and no confounding factors (i.e., it is not a captive site, a start-up site, or a cost center) to obscure the financial condition of the site. If the site is unprofitable prior to the regulation, the company involved may decide to close the site. This is likely to occur before the rule is implemented: the company will likely seek to avoid additional investments in an unprofitable site. The projected closure of a site that is unprofitable prior to a regulatory action should not be attributed to the regulation.

Estimation of Site Closures As a Result of the Rule

EPA will consider the rule to have an impact on any site that has a score of 1 or zero in the pre-regulatory condition and a score of 2 or 3 after incurring the costs of responding to the regulation. That is, any site that is profitable before the regulation, but not after.

Direct Impacts

Again, closure represents a final, irreversible decision in the analysis. EPA will therefore estimate direct impacts from site closures as the loss of all employment, production, exports, and revenue associated with the closed sites. This is an upper bound analysis; that is, it will project the most severe effects, because it will not account for other sites increasing production or hiring workers in response to the closure of a site.[20] The losses will be aggregated over all sites to estimate the national direct effect of the regulation.

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CHAPTER 4

POLLUTION CONTROL OPTIONS

4.1 EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS

The Federal Water Pollution Control Act (commonly known as the Clean Water Act [CWA, 33 U.S.C. §1251 et seq.]) establishes a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (§101(a)). EPA is authorized under sections 301, 304, 306, and 307 of the CWA to establish effluent limitations guidelines and pretreatment standards of performance for industrial dischargers. The standards EPA establishes include:

- Best Practicable Control Technology Currently Available (BPT) . Required under section 304(b)(1), these rules apply to existing industrial direct dischargers. BPT limitations are generally based on the average of the best existing performances by plants of various sizes, ages, and unit processes within a point source category or subcategory.

- Best Available Technology Economically Achievable (BAT). Required under section 304(b)(2), these rules control the discharge of toxic and nonconventional pollutants and apply to existing industrial direct dischargers.

- Best Conventional Pollutant Control Technology (BCT). Required under section 304(b)(4), these rules control the discharge of conventional pollutants from existing industrial direct dischargers.[1] BCT limitations must be established in light of a two-part cost-reasonableness test. BCT replaces BAT for control of conventional pollutants.

- Pretreatment Standards for Existing Sources (PSES). Required under section 307. Analogous to BAT controls, these rules apply to existing indirect dischargers (whose discharges flow to publicly owned treatment works (POTWs).

- New Source Performance Standards (NSPS). Required under section 306(b), these rules control the discharge of toxic and nonconventional pollutants and apply to new source industrial direct dischargers.

- Pretreatment Standards for New Sources (PSNS). Required under section 307. Analogous to NSPS controls, these rules apply to new source indirect dischargers (whose discharges flow to POTWs).

[1] Conventional pollutants include biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, pH, and oil and grease.

EPA is proposing effluent limitations guidelines and pretreatment standards for the meat products industry in this rulemaking effort.

4.2 TECHNOLOGY OPTIONS

EPA does not mandate technologies when establishing effluent limitations guidelines and pretreatment standards. However, EPA evaluates various technology options in order to base the limitations on demonstrated technologies and to evaluate the economic impact of the cost of those technologies on the regulated industry. This section briefly describes the pollution control options evaluated for each subcategory within the meat products industry. The Development Document (U.S. EPA, 2002) provides a detailed description of the meat products industry subcategories and pollution control options for each subcategory.

Table 4-1 summarizes the technology options considered for each meat products industry subcategory. The first column indicates the option number that appears in the cost and impact tables in Chapters 5 through 9. The second column identifies contains a brief description of the technology option.

In assessing costing technologies, EPA distinguished between direct and indirect discharging facilities. All direct dischargers in the industry were costed for four sets of technology options regardless of meat type (i.e., red meat or poultry) or processing stage (i.e., slaughter, further processing, rendering), except for poultry processors, who were costed for a technology option incremental to option 4 (BAT 5). Similarly, all indirect dischargers were costed for four technology options regardless of subcategory. However, indirect dischargers were costed for a different set of technologies than were direct discharging facilities. In general, wastewater treatment technology options for direct dischargers included lagoons and ultra-violet disinfection; indirect dischargers were costed instead for equalization tanks. That is the primary distinction between technologies for direct and indirect dischargers.

For both direct and indirect discharging facilities, the treatment train costed in the higher numbered options builds upon the set of technologies costed for the first option. Thus, under BAT 1, direct dischargers were costed for: preliminary treatment, dissolved air flotation, lagoon, and ultra-violet

Table 4-1
Meat Products Industry Treatment Technology Options

Option	Treatment Unit
Direct Dischargers	
BAT 1 (nonsmall facilities)	Preliminary Treatment, Dissolved Air Flotation, Lagoon, Ultra-Violet Disinfection
BAT 1 (small facilities)	Preliminary Treatment, Dissolved Air Flotation, Lagoon, Ultra-Violet Disinfection, *Drying Beds*
BAT 2	Preliminary Treatment, Dissolved Air Flotation, Lagoon, *Nitrification - Suspended Growth*, Ultra-Violet Disinfection, Drying Beds
BAT 3	Preliminary Treatment, Dissolved Air Flotation, Lagoon, *Biological Nitrogen Removal*, Ultra-Violet Disinfection, Drying Beds
BAT 4	Preliminary Treatment, Dissolved Air Flotation, Lagoon, *Biological Nutrient Removal - 3/5 Stage*, Ultra-Violet Disinfection, Drying Beds
BAT 5 (poultry only)	Preliminary Treatment, Dissolved Air Flotation, Lagoon, Biological Nutrient Removal - 3/5 Stage, *Filtration*, Ultra-Violet Disinfection, Drying Beds
Indirect Dischargers	
PSES 1	Preliminary Treatment, Dissolved Air Flotation, Equalization
PSES 2	Preliminary Treatment, Dissolved Air Flotation, Equalization, *Nitrification - Suspended Growth, Drying Beds*
PSES 3	Preliminary Treatment, Dissolved Air Flotation, Equalization, *Biological Nitrogen Removal*, Drying Beds
PSES 4	Preliminary Treatment, Dissolved Air Flotation, Equalization, *Biological Nutrient Removal - 3/5 Stage*, Drying Beds

Changes between technology options indicated by italics.

disinfection.[2, 3] These components are also included in BAT options 2 through 5. BAT 2, 3, and 4 are distinguished by a single component: BAT 2 utilizes nitrification (suspended growth technology), BAT 3 replaces nitrification with biological nitrogen removal technology, and BAT 4 replaces nitrogen removal with biological nutrient removal (3/5 stage). BAT 5, which only applies to poultry processors, adds filtration to nutrient removal.

Similarly, under PSES 1, indirect dischargers were costed for: preliminary treatment, dissolved air flotation, and equalization. These components are also included in PSES options 2 through 4. PSES 2 adds drying beds to the costed treatment train, which then become components of PSES 3 and 4. PSES 2, 3, and 4 are thus distinguished by a single component: PSES 2 utilizes nitrification (suspended growth technology), PSES 3 replaces nitrification with biological nitrogen removal technology, and PSES 4 replaces nitrogen removal with biological nutrient removal (3/5 stage).

Table 4-2 summarizes the technology options proposed for direct discharging facilities in each meat products industry subcategory. Note that in all subcategories, EPA is proposing different standards for small facilities than for nonsmall facilities. EPA defines small facilities as:

- Subcategory A through D: facilities that slaughter less than 50 million pounds (live weight kill) per year;
- Subcategory E through I: facilities that produce less than 50 million pounds of finished product per year. Because Subcategory E (small processors) is defined as facilities that produce less than 6,000 pounds of finished product per day, all facilities in Subcategory E are by definition small;
- Subcategory J: facilities that render less than 10 million pounds of raw material per year;
- Subcategory K: facilities that slaughter less than 10 million pounds per year;
- Subcategory L: facilities that produce less than 7,000 pounds of finished product per day.

In general, EPA is excluding small facilities in subcategories A though J from the revised standards, and is setting less stringent standards for subcategories K and L. EPA is not currently proposing any changes to pretreatment standards for indirect dischargers in any subcategory.

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[2] BAT 1 for small model facilities includes drying beds in the costed treatment train; drying beds also included in BAT 2 through 5 for nonsmall facilities.

[3] Note that EPA's survey results indicate that all potentially affected nonsmall direct dischargers have the BAT option 1 treatment technologies in place.

Table 4-2
Technology Options for Meat Products Industry Subcategories

Selected Option for Final Rule	Subcategory A - D	Subcategory E - I	Subcategory J	Subcategory K	Subcategory L
BAT 1 (small facilities)				BPT, BCT, BAT, NSPS[4]	BPT, BCT, BAT, NSPS[5]
BAT 2	BPT, BCT[1]	BPT, BCT[2]	BPT, BCT, BAT, NSPS[3]		
BAT 3	BAT, NSPS[1]	BAT, NSPS[2]		BPT, BCT, BAT, NSPS[4]	BPT, BCT, BAT, NSPS[5]
BAT 4					
BAT 5					

[1] For Subcategory A though D, EPA excludes small facilities (those that slaughter less than 50 million pounds live weight kill per year) from the proposed revisions to the effluent guidelines.
[2] For Subcategory E though I, EPA excludes small facilities (those that produce less than 50 million pounds of finished product per year) from the proposed revisions to the effluent guidelines. Note that all facilities in Subcategory E (those that produce less than 6,000 pounds of finished product per day) are therefore excluded by definition from the revised effluent guidelines.
[3] For Subcategory J, EPA excludes small facilities (those that render less than 10 million pounds of raw product per year) from the proposed revisions to the effluent guidelines.
[4] The selected option for small facilities in Subcategory K (facilities that slaughter up to 10 million pounds per year) is BAT 1 for BPT, BCT, BAT, and NSPS.
[5] The selected option for small facilities in Subcategory L (facilities that produce up to 7,000 pounds of finished product per day), is BAT 1 for BPT, BCT, BAT, and NSPS.

4.3 REFERENCES

U.S. EPA. 2002. Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Meat Products Industry. EPA-821-B-01-007. Washington, DC: U.S. Environmental Protection Agency, Office of Water.

CHAPTER 5

ECONOMIC IMPACTS

This chapter presents the projected economic impacts resulting from the costs of complying with the proposed effluent limitations and guidelines (ELG) on the meat products industry. The impacts are estimated using the methodology outlined in Chapter 3. Impacts are estimated from the smallest scale to industry-wide impacts, i.e., in the following order — facility level, corporate level, market level, and national level. Impacts presented in this chapter are for medium, large, and very large model facilities combined. Because small model facilities are almost without exception small business owned facilities, impacts for small model facilities are presented in Chapter 6.[1]

For each of the four facility level analyses, impacts are presented at a two-tier level, by:

- 40 CFR 432 subcategory (hereafter, subcategory), and
- meat type and process class (hereafter, class; see Section 2.4 for more detail).

In addition, EPA presents a range of impacts. EPA first estimated the incremental compliance costs of purchasing new equipment to match the technology train used as a basis for analyzing an option; costs are incremental in that facilities are costed only for additions to current treatment in place necessary to match the technology train.

However, EPA determined that it may be possible for some establishments to upgrade (or retrofit) current treatment in place to meet the specified technology train at lower cost than if they purchase new equipment. For example, a facility that currently owns a nitrification system (specified for option 2) can be retrofitted to become a nitrification and denitrification system, which will meet the requirements of option 3 (see Development Document, Section 4.6.4 for details). EPA only estimated retrofit costs for options 3 and 4. For the remainder of Chapter 5, EPA will present, where applicable, the costs (and associated impacts)

[1] No small facility impacts are included in the analyses presented in Chapter 5. As documented in Chapter 6, EPA estimates that a total of four small facilities in Subcategory L are potentially affected by the proposed rule. EPA projects that these four facilities will incur posttax annualized compliance costs of $2,600 ($700 per facility) and that none of these facilities should close as a result of the proposed rule.

of purchasing new equipment as an upper-bound estimate, and the upgrade or retrofit costs that will meet the same requirements as a lower-bound estimate.

The facility level analysis is discussed in Sections 5.1 through 5.4. Section 5.1 presents total and average facility compliance costs for the industry. Section 5.2 discusses projected facility level incremental closure and employment impacts. Section 5.3 reports facility nonclosure impacts and Section 5.4 completes the facility level impact analysis with a financial ratio analysis. Section 5.5 discusses financial distress at the corporate or business entity level. Market level and international trade impacts are presented in Section 5.6. EPA examines secondary and indirect employment and output impacts in Section 5.7. EPA estimates new sources in the meat products industry in Section 5.8. Finally, EPA summarizes impacts under the proposed options in Section 5.9.

The economic analysis is based on a wide variety of sources including the screener survey and publicly available data. However, the facility counts in each class and subcategory are based on estimates derived from the stratified random sampling procedure used to determine survey recipients. Sixty-five facilities were specifically selected to receive surveys ("certainty facilities"). Information on these 65 certainty facilities was not available in time to complete subcategorization and analysis of these facilities because information on these facilities was collected in the detailed survey and it could not be processed as quickly as the screener survey. Therefore, to project potential impacts to these 65 certainty facilities, EPA totaled impacts by subcategory (or class) and discharge type, then inflated these impacts by 8 percent. EPA is thus implicitly assuming that the 65 certainty facilities are similar to the model facilities used in the remainder of the analysis, and impacts are therefore proportionate to impacts projected for other facilities. However, EPA could not identify the subcategories or classes in which these impacts may occur in time to include precise estimates for all aspects of the analysis.

5.1 TOTAL AND AVERAGE COMPLIANCE COSTS

In order to estimate impacts, EPA calculated total and average facility compliance costs in 1999 dollars by subcategory, meat type and process class, discharge type, and technology option. The compliance costs include estimated capital costs, annual operating and maintenance costs, pretax annualized, and posttax annualized compliance costs. The annualized costs are analogous to a mortgage payment that spreads the one-time investment of a home over a series of constant monthly payments. They are calculated as the equal annual payments of an annuity that has the same present value as the stream of cash outflow over the project life and includes the opportunity cost of money or interest (see Section 3.1.1 for more detail).

In general, estimated annualized compliance costs for direct dischargers consistently increase with the technology option. Also, all direct discharging facilities have sufficient treatment in place to meet the requirements of BAT 1, and therefore costs for BAT 1 are zero for all classes. For indirect dischargers, PSES 2 has the highest cost per facility in several classes, and PSES 3 is estimated to have lower costs than either PSES 2 or PSES 4. Within each subcategory, generally, indirect dischargers incur higher compliance costs than direct dischargers on a per facility basis for equivalent technology options.

5.1.1 Total and Average Compliance Costs by Subcategory

5.1.1.1 Upper-Bound Costs

Table 5-1 presents total and annual compliance costs by subcategory, discharge type, and technology option. As the table shows, for the direct dischargers, total posttax annualized compliance costs range from a low of $0.2 million under BAT 2 for Subcategory E through I, to a high of $72 million under BAT 4 for Subcategory A through D. Estimated average posttax annualized costs range from $11,000 per facility under BAT 2 in Subcategory L, to $1.1 million under BAT 4 for Subcategory A through D. Under the proposed option, BAT 2 for Subcategory J and BAT 3 for all other subcategories, average posttax annualized costs per facility are as follows:

- Subcategory A through D: $550,000
- Subcategory E through I: $22,000
- Subcategory J: $14,500
- Subcategory K: $335,000
- Subcategory L: $120,000

Table 5-1
Total and Average Upper-Bound Costs
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Subcategory A through D									
66	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$8,246,826	$8,341,357	$9,196,724	$5,494,885	$124,952	$126,384	$139,344	$83,256
	BAT3	$274,636,709	$26,093,418	$55,110,687	$36,314,715	$4,161,162	$395,355	$835,010	$550,223
	BAT4	$567,299,659	$49,288,019	$109,236,897	$72,333,508	$8,595,449	$746,788	$1,655,105	$1,095,962
60	PSES1	$32,125,587	$3,134,010	$6,528,128	$4,295,462	$535,426	$52,234	$108,802	$71,591
	PSES2	$624,536,780	$74,314,195	$140,269,188	$91,307,635	$10,408,946	$1,238,570	$2,337,820	$1,521,794
	PSES3	$460,188,220	$40,491,298	$89,120,196	$58,965,506	$7,669,804	$674,855	$1,485,337	$982,758
	PSES4	$602,773,174	$47,996,617	$111,703,367	$74,297,961	$10,046,220	$799,944	$1,861,723	$1,238,299
Subcategory E through I									
19	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$151,167	$358,916	$374,160	$221,466	$7,935	$18,841	$19,641	$11,626
	BAT3	$2,466,851	$380,659	$640,990	$414,948	$129,494	$19,982	$33,648	$21,782
	BAT4	$32,064,579	$3,104,328	$6,492,050	$4,282,839	$1,683,180	$162,957	$340,790	$224,821
234	PSES1	$61,732,331	$10,888,392	$17,400,228	$11,127,499	$263,622	$46,498	$74,306	$47,519
	PSES2	$388,978,549	$53,466,015	$94,529,413	$61,369,561	$1,661,095	$228,321	$403,679	$262,073
	PSES3	$360,164,620	$39,439,013	$77,481,871	$50,875,028	$1,538,048	$168,420	$330,879	$217,257
	PSES4	$529,275,394	$46,103,239	$102,033,687	$67,840,206	$2,260,219	$196,879	$435,725	$289,705
Subcategory J									
21	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$512,217	$511,135	$303,614	$0	$24,391	$24,340	$14,458
	BAT3	$24,235,794	$2,813,796	$5,373,396	$3,547,442	$1,154,085	$133,990	$255,876	$168,926
	BAT4	$27,388,270	$2,949,043	$5,842,070	$3,872,096	$1,304,203	$140,431	$278,194	$184,386

Table 5-1 (cont.)
Total and Average Upper-Bound Costs
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
75	PSES1	$3,497,420	$862,033	$1,230,440	$782,204	$46,632	$11,494	$16,406	$10,429
	PSES2	$82,708,839	$12,803,252	$21,531,566	$14,003,452	$1,102,785	$170,710	$287,088	$186,713
	PSES3	$121,046,542	$13,057,455	$25,843,571	$17,127,366	$1,613,954	$174,099	$344,581	$228,365
	PSES4	$130,924,926	$13,224,592	$27,056,058	$17,992,542	$1,745,666	$176,328	$360,747	$239,901
Subcategory K									
88	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$1,484,907	$4,319,010	$4,467,074	$2,633,176	$16,874	$49,080	$50,762	$29,922
	BAT3	$221,276,114	$21,409,816	$44,788,353	$29,500,825	$2,514,501	$243,293	$508,959	$335,237
	BAT4	$292,840,006	$25,768,368	$56,713,282	$37,545,775	$3,327,727	$292,822	$644,469	$426,657
	BAT5	$327,080,644	$26,630,326	$61,198,053	$40,681,300	$3,716,826	$302,617	$695,432	$462,287
138	PSES1	$42,407,911	$5,560,401	$10,037,855	$6,499,979	$307,304	$40,293	$72,738	$47,101
	PSES2	$771,398,217	$93,495,543	$174,956,419	$113,790,293	$5,589,842	$677,504	$1,267,800	$824,567
	PSES3	$637,073,223	$55,838,473	$123,159,578	$81,513,370	$4,616,473	$404,627	$892,461	$590,677
	PSES4	$670,720,969	$55,543,183	$126,426,783	$83,927,632	$4,860,297	$402,487	$916,136	$608,171
Subcategory L									
15	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$154,729	$263,420	$279,242	$167,488	$10,350	$17,620	$18,678	$11,203
	BAT3	$12,148,868	$1,446,099	$2,729,095	$1,793,953	$812,633	$96,729	$182,548	$119,997
	BAT4	$19,180,890	$1,978,115	$4,004,380	$2,652,967	$1,283,003	$132,315	$267,851	$177,456
13 [1]	BAT5	$17,719,557	$1,695,960	$3,568,128	$2,371,868	$1,363,043	$130,458	$274,471	$182,451
208	PSES1	$50,931,088	$8,752,574	$14,125,528	$9,118,799	$245,061	$42,114	$67,967	$43,876
	PSES2	$375,177,189	$57,932,593	$97,525,576	$63,254,471	$1,805,212	$278,750	$469,256	$304,357
	PSES3	$319,733,512	$35,269,247	$69,040,972	$45,583,767	$1,538,438	$169,702	$332,199	$219,332
	PSES4	$444,047,365	$40,216,343	$87,137,188	$58,144,408	$2,136,589	$193,506	$419,271	$279,769

Table 5-1 (cont.)
Total and Average Upper-Bound Costs
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Total Costs Excluding 65 Certainty Facilities									
209	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$10,037,629	$13,794,920	$14,828,336	$8,820,629	$48,027	$66,004	$70,949	$42,204
	BAT3	$534,764,336	$52,143,788	$108,642,520	$71,571,883	$2,558,681	$249,492	$519,821	$342,449
	BAT4	$938,773,404	$83,087,873	$182,288,680	$120,687,185	$4,491,739	$397,550	$872,195	$577,451
101 [1]	BAT5	$344,800,201	$28,326,286	$64,766,180	$43,053,168	$3,413,863	$280,458	$641,249	$426,269
715	PSES1	$190,694,337	$29,197,410	$49,322,180	$31,823,943	$266,705	$40,836	$68,982	$44,509
	PSES2	$2,242,799,574	$292,011,598	$528,812,162	$343,725,412	$3,136,783	$408,408	$739,597	$480,735
	PSES3	$1,898,206,117	$184,095,486	$384,646,188	$254,065,036	$2,654,834	$257,476	$537,967	$355,336
	PSES4	$2,377,741,828	$203,083,974	$454,357,082	$302,202,748	$3,325,513	$284,034	$635,464	$422,661
Total Costs Including 65 Certainty Facilities									
226	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$10,840,639	$14,898,514	$16,014,603	$9,526,279	$47,967	$65,923	$70,861	$42,152
	BAT3	$577,545,483	$56,315,291	$117,333,922	$77,297,634	$2,555,511	$249,183	$519,177	$342,025
	BAT4	$1,013,875,276	$89,734,903	$196,871,775	$130,342,159	$4,486,174	$397,057	$871,114	$576,735
	BAT5	$372,384,217	$30,592,389	$69,947,475	$46,497,421	$1,647,718	$135,365	$309,502	$205,741
772	PSES1	$205,949,884	$31,533,203	$53,267,954	$34,369,859	$266,774	$40,846	$69,000	$44,521
	PSES2	$2,422,223,540	$315,372,526	$571,117,135	$371,223,445	$3,137,595	$408,514	$739,789	$480,859
	PSES3	$2,050,062,606	$198,823,125	$415,417,883	$274,390,239	$2,655,522	$257,543	$538,106	$355,428
	PSES4	$2,567,961,174	$219,330,692	$490,705,649	$326,378,968	$3,326,375	$284,107	$635,629	$422,771

[1] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

Among the indirect dischargers, PSES 1 under Subcategory J has the lowest total posttax annualized compliance cost at $0.8 million, while PSES 2 under Subcategory K has the highest cost at $114 million. The range for average posttax annualized cost is from $10,000 for PSES 1 under Subcategory J to $1.5 million under PSES 2 for Subcategory A through D. EPA has chosen not to propose any options for indirect dischargers.

5.1.1.2 Upgrade Costs

Table 5-2 presents total and annual upgrade compliance costs by subcategory, discharge type, and technology option. For the direct dischargers, average posttax annualized costs for upgrading range from $16,000 per facility under BAT 3 in Subcategory E through I, to $600,000 under BAT 4 for Subcategory A through D. The lower end of the retrofit cost range is not much different than the lower end of the upper-bound cost range. However, at the top of the range, retrofit costs are about 45 percent lower than the comparable upper-bound costs. For the proposed direct discharger options, average posttax annualized upgrade costs per facility are as follows:

- Subcategory A through D: $374,000
  68 percent of upper-bound costs
- Subcategory E through I: $16,000
  73 percent of upper-bound costs
- Subcategory J: $14,500
  100 percent of upper-bound costs
- Subcategory K: $229,000
  68 percent of upper-bound costs
- Subcategory L: $85,000
  71 percent of upper-bound costs

In general, except for Subcategory J for which retrofit costs were not estimated under option 2, retrofit costs are 27 to 32 percent lower than the upper-bound costs presented in Section 5.1.1.1.

Table 5-2
Total and Average Retrofit Costs
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Subcategory A through D									
66	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$123,586,518	$26,093,418	$39,120,869	$24,705,496	$1,872,523	$395,355	$592,740	$374,326
	BAT4	$178,513,861	$49,288,019	$68,080,947	$42,449,366	$2,704,755	$746,788	$1,031,530	$643,172
60	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$374,210,631	$40,491,298	$80,018,811	$52,357,553	$6,236,844	$674,855	$1,333,647	$872,626
	PSES4	$473,484,033	$47,996,617	$98,017,122	$64,361,225	$7,891,401	$799,944	$1,633,619	$1,072,687
Subcategory E through I									
19	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$1,110,083	$380,659	$497,365	$309,922	$58,272	$19,982	$26,108	$16,269
	BAT4	$1,603,454	$3,104,328	$3,267,507	$1,938,441	$84,171	$162,957	$171,523	$101,755
234	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$356,436,194	$39,439,013	$77,087,189	$50,588,473	$1,522,126	$168,420	$329,193	$216,033
	PSES4	$526,021,835	$46,103,239	$101,689,273	$67,590,148	$2,246,325	$196,879	$434,254	$288,637
Subcategory J									
21	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$10,906,107	$2,813,796	$3,962,346	$2,513,674	$519,338	$133,990	$188,683	$119,699
	BAT4	$15,753,267	$2,949,043	$4,610,416	$2,969,757	$750,156	$140,431	$219,544	$141,417

Table 5-2 (cont.)
Total and Average Retrofit Costs
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
75	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$78,857,861	$13,057,455	$21,377,577	$13,855,472	$1,051,438	$174,099	$285,034	$184,740
	PSES4	$92,106,957	$13,224,592	$22,946,879	$14,982,060	$1,228,093	$176,328	$305,958	$199,761
Subcategory K									
88	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$99,574,251	$21,409,816	$31,905,280	$20,143,296	$1,131,526	$243,293	$362,560	$228,901
	BAT4	$143,829,474	$25,768,368	$40,939,378	$26,088,491	$1,634,426	$292,822	$465,220	$296,460
	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
138	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$575,708,468	$55,838,473	$116,663,649	$76,797,077	$4,171,800	$404,627	$845,389	$556,501
	PSES4	$625,628,026	$55,543,183	$121,653,350	$80,461,937	$4,533,536	$402,487	$881,546	$583,058
Subcategory L									
15	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$5,466,991	$1,446,099	$2,021,767	$1,276,874	$365,685	$96,729	$135,235	$85,410
	BAT4	$7,896,763	$1,978,115	$2,809,869	$1,779,422	$528,212	$132,315	$187,951	$119,025
13 [1]	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
208	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$316,967,008	$35,269,247	$68,748,116	$45,371,142	$1,525,126	$169,702	$330,790	$218,309
	PSES4	$442,131,680	$40,216,343	$86,934,399	$57,997,174	$2,127,372	$193,506	$418,296	$279,061

Table 5-2 (cont.)
Total and Average Retrofit Costs
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
Total Costs Excluding 65 Certainty Facilities									
209	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$240,643,950	$52,143,788	$77,507,628	$48,949,261	$1,151,406	$249,492	$370,850	$234,207
	BAT4	$347,596,819	$83,087,873	$119,708,118	$75,225,477	$1,663,143	$397,550	$572,766	$359,931
101 [1]	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
715	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$1,702,180,162	$184,095,486	$363,895,342	$238,969,718	$2,380,672	$257,476	$508,945	$334,223
	PSES4	$2,159,372,531	$203,083,974	$431,241,022	$285,392,544	$3,020,101	$284,034	$603,134	$399,150
Total Costs Including 65 Certainty Facilities									
226	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$259,895,466	$56,315,291	$83,708,238	$52,865,202	$1,149,980	$249,183	$370,390	$233,917
	BAT4	$375,404,565	$89,734,903	$129,284,767	$81,243,516	$1,661,082	$397,057	$572,056	$359,485
	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
772	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$1,838,354,575	$198,823,125	$393,006,969	$258,087,295	$2,381,288	$257,543	$509,076	$334,310
	PSES4	$2,332,122,333	$219,330,692	$465,740,304	$308,223,948	$3,020,884	$284,107	$603,291	$399,254

[1] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

Among indirect dischargers, the average facility posttax annualized costs for upgrading range from $185,000 for PSES 3 under Subcategory J to $1.1 million under PSES 4 for Subcategory A through D.

5.1.2 Total and Average Compliance Costs by Class

5.1.2.1 Upper-Bound Costs

Table 5-3 presents total and average compliance costs by meat type and process class, discharge type, and technology option. For the 12 direct discharging classes:

- BAT 4 is the highest cost option (posttax annualized costs) in seven classes:
  - red meat first processing;
  - red meat further processing;
  - red meat first processing and rendering;
  - red meat further processing and rendering;
  - red meat first processing, further processing, and rendering;
  - mixed further processing;
  - rendering.
- BAT 5 is the highest cost option (posttax annualized costs) in five classes (there is no BAT 5 option for the red meat classes):
  - poultry first processing;
  - poultry further processing;
  - poultry first and further processing;
  - poultry first processing and rendering;
  - poultry first processing, further processing, and rendering.

For the 13 indirect discharging meat type and process classes:

- PSES 2 is the highest cost option (posttax annualized costs) in nine classes:
  - red meat first and further processing;
  - red meat first processing and rendering;
  - red meat further processing and rendering;
  - poultry first processing;
  - poultry further processing;
  - poultry first and further processing;
  - poultry first processing and rendering;
  - poultry further processing and rendering;

Table 5-3
Total and Average Upper-Bound Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
Red Meat First Processing (Subcategory A - D)									
6	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$0	$0	$0	$0	$0	$0	$0
	BAT3	$0	$68,389	$68,245	$40,537	$0	$11,398	$11,374	$6,756
	BAT4	$4,805,019	$600,155	$1,107,535	$728,387	$800,837	$100,026	$184,589	$121,398
Red Meat Further Processing (Subcategory E - I)									
12	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$45,683	$95,879	$100,512	$59,386	$3,807	$7,990	$8,376	$4,949
	BAT3	$247,412	$84,983	$110,994	$68,540	$20,618	$7,082	$9,249	$5,712
	BAT4	$12,693,792	$1,374,783	$2,715,614	$1,776,780	$1,057,816	$114,565	$226,301	$148,065
168	PSES1	$39,599,365	$8,001,879	$12,176,869	$7,706,701	$235,711	$47,630	$72,481	$45,873
	PSES2	$206,835,648	$26,194,735	$48,034,529	$31,162,111	$1,231,165	$155,921	$285,920	$185,489
	PSES3	$205,401,202	$24,303,150	$45,995,094	$29,949,512	$1,222,626	$144,662	$273,780	$178,271
	PSES4	$289,011,365	$28,015,273	$58,550,149	$38,538,813	$1,720,306	$166,758	$348,513	$229,398
Red Meat First and Further Processing (Subcategory A - D)									
28	PSES1	$7,674,552	$998,181	$1,808,482	$1,171,547	$274,091	$35,649	$64,589	$41,841
	PSES2	$109,691,736	$17,407,204	$28,982,138	$18,574,875	$3,917,562	$621,686	$1,035,076	$663,388
	PSES3	$105,932,768	$9,853,671	$21,046,647	$13,884,029	$3,783,313	$351,917	$751,666	$495,858
	PSES4	$110,184,632	$9,662,992	$21,306,463	$14,099,692	$3,935,165	$345,107	$760,945	$503,560
Red Meat First Processing and Rendering (Subcategory A - D)									
36	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$6,252,839	$4,379,159	$5,031,818	$3,032,598	$173,690	$121,643	$139,773	$84,239
	BAT3	$269,463,940	$24,631,985	$53,104,765	$35,064,797	$7,485,109	$684,222	$1,475,132	$974,022
	BAT4	$312,997,176	$27,564,305	$60,639,216	$40,119,474	$8,694,366	$765,675	$1,684,423	$1,114,430

Table 5-3 (cont.)
Total and Average Upper-Bound Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
15	PSES1	$9,946,909	$968,639	$2,019,549	$1,328,977	$663,127	$64,576	$134,637	$88,598
	PSES2	$311,479,620	$29,063,331	$61,974,430	$40,876,422	$20,765,308	$1,937,555	$4,131,629	$2,725,095
	PSES3	$210,194,072	$17,629,646	$39,843,050	$26,428,784	$14,012,938	$1,175,310	$2,656,203	$1,761,919
	PSES4	$211,683,958	$16,790,708	$39,163,601	$26,054,387	$14,112,264	$1,119,381	$2,610,907	$1,736,959
Red Meat Further Processing and Rendering (Subcategory E - I)									
4	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$86,867	$195,813	$204,595	$120,790	$21,717	$48,953	$51,149	$30,197
	BAT3	$263,930	$79,640	$107,411	$66,696	$65,983	$19,910	$26,853	$16,674
	BAT4	$13,428,162	$1,206,290	$2,625,215	$1,735,029	$3,357,041	$301,573	$656,304	$433,757
7	PSES1	$3,588,406	$417,189	$796,168	$518,917	$512,629	$59,598	$113,738	$74,131
	PSES2	$37,076,732	$5,762,126	$9,674,808	$6,207,567	$5,296,676	$823,161	$1,382,115	$886,795
	PSES3	$30,127,418	$2,774,500	$5,957,856	$3,932,379	$4,303,917	$396,357	$851,122	$561,768
	PSES4	$34,521,628	$2,955,317	$6,603,452	$4,375,477	$4,931,661	$422,188	$943,350	$625,068
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)									
24	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$1,993,987	$3,962,198	$4,164,906	$2,462,286	$83,083	$165,092	$173,538	$102,595
	BAT3	$5,172,769	$1,393,044	$1,937,678	$1,209,381	$215,532	$58,044	$80,737	$50,391
	BAT4	$249,497,464	$21,123,559	$47,490,147	$31,485,647	$10,395,728	$880,148	$1,978,756	$1,311,902
17	PSES1	$14,504,126	$1,167,190	$2,700,097	$1,794,938	$853,184	$68,658	$158,829	$105,585
	PSES2	$203,365,424	$27,843,660	$49,312,621	$31,856,339	$11,962,672	$1,637,862	$2,900,742	$1,873,902
	PSES3	$144,061,380	$13,007,981	$28,230,498	$18,652,693	$8,474,199	$765,175	$1,660,618	$1,097,217
	PSES4	$280,904,584	$21,542,917	$51,233,303	$34,143,882	$16,523,799	$1,267,230	$3,013,724	$2,008,464

Table 5-3 (cont.)
Total and Average Upper-Bound Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Poultry First Processing (Subcategory K)									
49	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$1,601,603	$1,598,219	$933,360	$0	$32,686	$32,617	$19,048
	BAT3	$97,162,006	$9,435,462	$19,700,869	$12,966,219	$1,982,898	$192,560	$402,059	$264,617
	BAT4	$130,989,236	$11,432,437	$25,274,496	$16,729,838	$2,673,250	$233,315	$515,806	$341,425
	BAT5	$146,285,848	$11,991,237	$27,451,379	$18,231,135	$2,985,425	$244,719	$560,232	$372,064
92	PSES1	$33,447,312	$4,230,148	$7,761,865	$5,035,837	$363,558	$45,980	$84,368	$54,737
	PSES2	$406,506,200	$44,725,586	$87,662,886	$57,307,284	$4,418,546	$486,148	$952,857	$622,905
	PSES3	$351,742,064	$30,821,401	$67,990,873	$44,995,404	$3,823,283	$335,015	$739,031	$489,080
	PSES4	$376,110,848	$31,078,478	$70,827,029	$47,018,124	$4,088,161	$337,810	$769,859	$511,067
Poultry Further Processing (Subcategory L)									
13	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$142,827	$220,440	$235,094	$141,089	$10,987	$16,957	$18,084	$10,853
	BAT3	$10,898,624	$1,307,978	$2,458,917	$1,615,121	$838,356	$100,614	$189,147	$124,240
	BAT4	$15,381,507	$1,643,575	$3,268,353	$2,160,013	$1,183,193	$126,429	$251,412	$166,155
	BAT5	$17,719,557	$1,695,960	$3,568,128	$2,371,868	$1,363,043	$130,458	$274,471	$182,451
155	PSES1	$36,434,378	$6,769,999	$10,612,554	$6,825,233	$235,061	$43,677	$68,468	$44,034
	PSES2	$236,758,364	$37,249,453	$62,233,441	$40,360,737	$1,527,473	$240,319	$401,506	$260,392
	PSES3	$201,922,369	$23,615,045	$44,940,181	$29,603,100	$1,302,725	$152,355	$289,937	$190,988
	PSES4	$271,880,434	$26,775,209	$55,499,265	$36,890,941	$1,754,067	$172,743	$358,060	$238,006

Table 5-3 (cont.)
Total and Average Upper-Bound Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
Poultry First and Further Processing (Subcategory K)									
16	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$1,018,875	$699,373	$805,751	$485,878	$63,680	$43,711	$50,359	$30,367
	BAT3	$37,748,307	$3,804,541	$7,792,450	$5,118,368	$2,359,269	$237,784	$487,028	$319,898
	BAT4	$60,619,846	$5,217,951	$11,624,002	$7,699,887	$3,788,740	$326,122	$726,500	$481,243
	BAT5	$67,733,811	$5,418,106	$12,576,801	$8,363,286	$4,233,363	$338,632	$786,050	$522,705
29	PSES1	$0	$288,848	$288,238	$168,331	$0	$9,960	$9,939	$5,805
	PSES2	$96,159,047	$17,508,211	$27,650,393	$17,593,660	$3,315,829	$603,731	$953,462	$606,678
	PSES3	$116,164,392	$10,938,662	$23,212,442	$15,302,694	$4,005,669	$377,195	$800,429	$527,679
	PSES4	$122,980,483	$10,898,009	$23,893,410	$15,802,865	$4,240,706	$375,793	$823,911	$544,926
Poultry First Processing and Rendering (Subcategory K)									
17	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$466,032	$998,177	$1,045,401	$619,599	$27,414	$58,716	$61,494	$36,447
	BAT3	$47,375,431	$4,531,251	$9,536,730	$6,299,136	$2,786,790	$266,544	$560,984	$370,537
	BAT4	$61,101,413	$5,498,110	$11,954,546	$7,922,291	$3,594,201	$323,418	$703,209	$466,017
	BAT5	$68,021,691	$5,490,193	$12,679,210	$8,451,130	$4,001,276	$322,953	$745,836	$497,125
5	PSES1	$0	$95,268	$95,067	$55,752	$0	$19,054	$19,013	$11,150
	PSES2	$46,412,547	$6,499,784	$11,399,175	$7,372,101	$9,282,509	$1,299,957	$2,279,835	$1,474,420
	PSES3	$29,064,025	$2,639,010	$5,710,084	$3,780,942	$5,812,805	$527,802	$1,142,017	$756,188
	PSES4	$30,098,859	$2,568,155	$5,748,924	$3,819,477	$6,019,772	$513,631	$1,149,785	$763,895
Poultry Further Processing and Rendering (Subcategory L)									
15	PSES1	$2,640,352	$403,827	$682,475	$438,265	$176,023	$26,922	$45,498	$29,218
	PSES2	$45,671,602	$6,931,386	$11,751,431	$7,549,546	$3,044,773	$462,092	$783,429	$503,303
	PSES3	$38,125,831	$3,751,035	$7,779,021	$5,116,202	$2,541,722	$250,069	$518,601	$341,080
	PSES4	$40,626,708	$3,766,161	$8,058,852	$5,317,226	$2,708,447	$251,077	$537,257	$354,482

Table 5-3 (cont.)
Total and Average Upper-Bound Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
Poultry First Processing, Further Processing, and Rendering (Subcategory K)									
6	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$1,019,857	$1,017,702	$594,338	$0	$169,976	$169,617	$99,056
	BAT3	$38,990,370	$3,638,562	$7,758,304	$5,117,102	$6,498,395	$606,427	$1,293,051	$852,850
	BAT4	$40,129,511	$3,619,870	$7,860,238	$5,193,760	$6,688,252	$603,312	$1,310,040	$865,627
	BAT5	$45,039,294	$3,730,790	$8,490,662	$5,635,750	$7,506,549	$621,798	$1,415,110	$939,292
12	PSES1	$8,960,599	$946,137	$1,892,686	$1,240,059	$746,717	$78,845	$157,724	$103,338
	PSES2	$222,320,423	$24,761,962	$48,243,965	$31,517,248	$18,526,702	$2,063,497	$4,020,330	$2,626,437
	PSES3	$140,102,742	$11,439,400	$26,246,179	$17,434,330	$11,675,229	$953,283	$2,187,182	$1,452,861
	PSES4	$141,530,779	$10,998,541	$25,957,420	$17,287,166	$11,794,232	$916,545	$2,163,118	$1,440,597
Mixed Further Processing (61 percent Subcategory E - I, 39 percent Subcategory L)									
5	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$30,519	$110,204	$113,202	$67,690	$6,104	$22,041	$22,640	$13,538
	BAT3	$3,205,753	$354,157	$692,762	$458,543	$641,151	$70,831	$138,552	$91,709
	BAT4	$9,742,008	$857,795	$1,887,249	$1,263,984	$1,948,402	$171,559	$377,450	$252,797
97	PSES1	$30,400,918	$4,048,072	$7,257,689	$4,757,183	$313,412	$41,733	$74,822	$49,043
	PSES2	$237,813,392	$35,260,908	$60,360,780	$39,344,070	$2,451,684	$363,515	$622,276	$405,609
	PSES3	$204,321,312	$20,264,530	$41,850,691	$27,857,602	$2,106,405	$208,913	$431,450	$287,192
	PSES4	$337,282,624	$24,807,622	$60,459,157	$40,862,157	$3,477,140	$255,749	$623,290	$421,259
Rendering (Subcategory J)									
21	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$512,217	$511,135	$303,614	$0	$24,391	$24,340	$14,458
	BAT3	$24,235,794	$2,813,796	$5,373,396	$3,547,442	$1,154,085	$133,990	$255,876	$168,926
	BAT4	$27,388,270	$2,949,043	$5,842,070	$3,872,096	$1,304,203	$140,431	$278,194	$184,386

Table 5-3 (cont.)
Total and Average Upper-Bound Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
75	PSES1	$3,497,420	$862,033	$1,230,440	$782,204	$46,632	$11,494	$16,406	$10,429
	PSES2	$82,708,839	$12,803,252	$21,531,566	$14,003,452	$1,102,785	$170,710	$287,088	$186,713
	PSES3	$121,046,542	$13,057,455	$25,843,571	$17,127,366	$1,613,954	$174,099	$344,581	$228,365
	PSES4	$130,924,926	$13,224,592	$27,056,058	$17,992,542	$1,745,666	$176,328	$360,747	$239,901
Total Costs Excluding 65 Certainty Facilities									
209	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$10,037,629	$13,794,920	$14,828,336	$8,820,629	$48,027	$66,004	$70,949	$42,204
	BAT3	$534,764,336	$52,143,788	$108,642,520	$71,571,883	$2,558,681	$249,492	$519,821	$342,449
	BAT4	$938,773,404	$83,087,873	$182,288,680	$120,687,185	$4,491,739	$397,550	$872,195	$577,451
101 [1]	BAT5	$344,800,201	$28,326,286	$64,766,180	$43,053,168	$3,413,863	$280,458	$641,249	$426,269
715	PSES1	$190,694,337	$29,197,410	$49,322,180	$31,823,943	$266,705	$40,836	$68,982	$44,509
	PSES2	$2,242,799,574	$292,011,598	$528,812,162	$343,725,412	$3,136,783	$408,408	$739,597	$480,735
	PSES3	$1,898,206,117	$184,095,486	$384,646,188	$254,065,036	$2,654,834	$257,476	$537,967	$355,336
	PSES4	$2,377,741,828	$203,083,974	$454,357,082	$302,202,748	$3,325,513	$284,034	$635,464	$422,661
Total Costs Including 65 Certainty Facilities									
226	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$10,840,639	$14,898,514	$16,014,603	$9,526,279	$47,967	$65,923	$70,861	$42,152
	BAT3	$577,545,483	$56,315,291	$117,333,922	$77,297,634	$2,555,511	$249,183	$519,177	$342,025
	BAT4	$1,013,875,276	$89,734,903	$196,871,775	$130,342,159	$4,486,174	$397,057	$871,114	$576,735
	BAT5	$372,384,217	$30,592,389	$69,947,475	$46,497,421	$1,647,718	$135,365	$309,502	$205,741
772	PSES1	$205,949,884	$31,533,203	$53,267,954	$34,369,859	$266,774	$40,846	$69,000	$44,521
	PSES2	$2,422,223,540	$315,372,526	$571,117,135	$371,223,445	$3,137,595	$408,514	$739,789	$480,859
	PSES3	$2,050,062,606	$198,823,125	$415,417,883	$274,390,239	$2,655,522	$257,543	$538,106	$355,428
	PSES4	$2,567,961,174	$219,330,692	$490,705,649	$326,378,968	$3,326,375	$284,107	$635,629	$422,771

[1] Option BAT 5 is only found in Poultry operations.

— poultry first processing, further processing, and rendering.

- PSES 4 is the highest cost option (posttax annualized costs) in four classes:
  - — red meat further processing;
  - — red meat first processing, further processing, and rendering;
  - — mixed further processing;
  - — rendering.

For each subcategory in Section 5.1.1.1, average facility costs actually consist of a weighted average of class level impacts. Hence, under the proposed BAT options (BAT 3 for Subcategory A through D, E through I, K, and L, and BAT 2 for Subcategory J), the range of average facility costs by class within each subcategory are as follows:

• Subcategory A through D	$550,000
— red meat first processing	$7,000
— red meat first processing and rendering	$970,000
• Subcategory E through I:	$22,000
— red meat further processing	$6,000
— mixed further processing	$92,000
• Subcategory J:	$14,500
— rendering[2]	
• Subcategory K:	$335,000
— poultry first processing	$265,000
— poultry first processing, further processing, and rendering	$853,000
• Subcategory L:	$120,000
— mixed further processing	$92,000
— poultry further processing	$124,000

In sum, average posttax annualized costs per facility for the proposed options range from a low of $6,000 for the red meat further processing class to a high of $970,000 for the red meat first processing and rendering class.

[2] In Subcategory J, the class (rendering) is identical to the subcategory.

5.1.2.2 Upgrade Costs

Table 5-4 presents total and average upgrading compliance costs by meat type and process class, discharge type, and technology option. The rank order of costs among classes is unchanged: BAT 4 is the highest cost option (posttax annualized costs) for red meat, mixed, and rendering classes. EPA did not estimate upgrade costs for BAT 5, which thus remains the highest cost option for poultry processors. Because upgrade costs do not apply to option PSES 2, it remains the high cost option for most indirect discharging classes; PSES 4 is the highest upgrading cost option for the remaining classes.

The range of average facility costs for the proposed options and a percentage comparison to upper-bound costs under each subcategory are:

• Subcategory A through D	$374,000
— red meat first processing	$7,000
— red meat first processing and rendering	$658,000
• Subcategory E through I:	$16,000
— red meat further processing	$5,000
— mixed further processing	$64,000
• Subcategory J:	$14,500
— rendering	
• Subcategory K:	$229,000
— poultry first processing	$181,000
— poultry first processing, further processing, and rendering	$578,000
• Subcategory L:	$85,000
— mixed further processing	$64,000
— poultry further processing	$89,000

Average upgrade posttax annualized costs for the proposed direct discharger options range from a low of $5,000 under the red meat further processing class to a high of $658,000 under the red meat first processing and rendering class (about 33 percent lower than the upper-bound costs for this class).

Table 5-4
Total and Average Retrofit Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Red Meat First Processing (Subcategory A - D)									
6	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$0	$68,389	$68,245	$40,537	$0	$11,398	$11,374	$6,756
	BAT4	$0	$600,155	$598,887	$355,739	$0	$100,026	$99,815	$59,290
Red Meat Further Processing (Subcategory E - I)									
12	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$111,335	$84,983	$96,589	$58,082	$9,278	$7,082	$8,049	$4,840
	BAT4	$160,818	$1,374,783	$1,388,902	$813,537	$13,402	$114,565	$115,742	$67,795
168	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$205,401,202	$24,303,150	$45,995,094	$29,949,512	$1,222,626	$144,662	$273,780	$178,271
	PSES4	$289,011,365	$28,015,273	$58,550,149	$38,538,813	$1,720,306	$166,758	$348,513	$229,398
Red Meat First and Further Processing (Subcategory A - D)									
28	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$91,985,869	$9,853,671	$19,570,261	$12,812,116	$3,285,210	$351,917	$698,938	$457,576
	PSES4	$99,994,413	$9,662,992	$20,227,751	$13,316,505	$3,571,229	$345,107	$722,420	$475,589
Red Meat First Processing and Rendering (Subcategory A - D)									
36	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$121,258,772	$24,631,985	$37,416,114	$23,674,237	$3,368,299	$684,222	$1,039,337	$657,618
	BAT4	$175,151,561	$27,564,305	$46,047,203	$29,525,116	$4,865,321	$765,675	$1,279,089	$820,142

Table 5-4 (cont.)
Total and Average Retrofit Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
15	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$210,194,072	$17,629,646	$39,843,050	$26,428,784	$14,012,938	$1,175,310	$2,656,203	$1,761,919
	PSES4	$211,683,958	$16,790,708	$39,163,601	$26,054,387	$14,112,264	$1,119,381	$2,610,907	$1,736,959
Red Meat Further Processing and Rendering (Subcategory E - I)									
4	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$118,769	$79,640	$92,044	$55,540	$29,692	$19,910	$23,011	$13,885
	BAT4	$171,555	$1,206,290	$1,221,902	$716,170	$42,889	$301,572	$305,475	$179,043
7	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$26,398,992	$2,774,500	$5,563,174	$3,645,824	$3,771,285	$396,357	$794,739	$520,832
	PSES4	$31,268,069	$2,955,317	$6,259,038	$4,125,419	$4,466,867	$422,188	$894,148	$589,346
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)									
24	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$2,327,746	$1,393,044	$1,636,511	$990,722	$96,989	$58,044	$68,188	$41,280
	BAT4	$3,362,300	$21,123,559	$21,434,857	$12,568,512	$140,096	$880,148	$893,119	$523,688
17	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$72,030,690	$13,007,981	$20,605,499	$13,116,653	$4,237,099	$765,175	$1,212,088	$771,568
	PSES4	$161,805,662	$21,542,917	$38,625,771	$24,990,333	$9,517,980	$1,267,230	$2,272,104	$1,470,020

Table 5-4 (cont.)
Total and Average Retrofit Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
Poultry First Processing (Subcategory K)									
49	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$43,722,902	$9,435,462	$14,043,932	$8,859,066	$892,304	$192,560	$286,611	$180,797
	BAT4	$63,155,304	$11,432,437	$18,093,756	$11,516,346	$1,288,884	$233,315	$369,260	$235,027
	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
92	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$332,158,512	$30,821,401	$65,917,804	$43,490,277	$3,610,419	$335,015	$716,498	$472,720
	PSES4	$362,017,073	$31,078,478	$69,335,095	$45,934,923	$3,934,968	$337,810	$753,642	$499,293
Poultry Further Processing (Subcategory L)									
13	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$4,904,381	$1,307,978	$1,824,381	$1,151,371	$377,260	$100,614	$140,337	$88,567
	BAT4	$7,084,105	$1,643,575	$2,390,009	$1,518,100	$544,931	$126,429	$183,847	$116,777
	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
155	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$201,922,369	$23,615,045	$44,940,181	$29,603,100	$1,302,725	$152,355	$289,937	$190,988
	PSES4	$271,880,434	$26,775,209	$55,499,265	$36,890,941	$1,754,067	$172,743	$358,060	$238,006
Poultry First and Further Processing (Subcategory K)									
16	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA

Table 5-4 (cont.)
Total and Average Retrofit Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
	BAT3	$16,986,738	$3,804,541	$5,594,679	$3,522,702	$1,061,671	$237,784	$349,667	$220,169
	BAT4	$24,536,399	$5,217,951	$7,804,293	$4,926,632	$1,533,525	$326,122	$487,768	$307,915
	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
29	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$82,391,629	$10,938,662	$19,637,336	$12,707,031	$2,841,091	$377,195	$677,150	$438,173
	PSES4	$94,558,645	$10,898,009	$20,884,741	$13,618,456	$3,260,643	$375,793	$720,163	$469,602
Poultry First Processing and Rendering (Subcategory K)									
17	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$21,318,944	$4,531,251	$6,778,451	$4,292,594	$1,254,056	$266,544	$398,732	$252,506
	BAT4	$30,794,030	$5,498,110	$8,746,278	$5,588,139	$1,811,414	$323,418	$514,487	$328,714
	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
5	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$29,064,025	$2,639,010	$5,710,084	$3,780,942	$5,812,805	$527,802	$1,142,017	$756,188
	PSES4	$30,098,859	$2,568,155	$5,748,924	$3,819,477	$6,019,772	$513,631	$1,149,785	$763,895
Poultry Further Processing and Rendering (Subcategory L)									
15	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$35,359,327	$3,751,035	$7,486,165	$4,903,577	$2,357,288	$250,069	$499,078	$326,905
	PSES4	$38,711,023	$3,766,161	$7,856,062	$5,169,993	$2,580,735	$251,077	$523,737	$344,666

Table 5-4 (cont.)
Total and Average Retrofit Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
Poultry First Processing, Further Processing, and Rendering (Subcategory K)									
6	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$17,545,667	$3,638,562	$5,488,218	$3,468,933	$2,924,278	$606,427	$914,703	$578,155
	BAT4	$25,343,741	$3,619,870	$6,295,051	$4,057,374	$4,223,957	$603,312	$1,049,175	$676,229
	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
12	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$132,094,302	$11,439,400	$25,398,424	$16,818,827	$11,007,858	$953,283	$2,116,535	$1,401,569
	PSES4	$138,953,449	$10,998,541	$25,684,590	$17,089,081	$11,579,454	$916,545	$2,140,383	$1,424,090
Mixed Further Processing (61 percent Subcategory E - I, 39 percent Subcategory L)									
5	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$1,442,589	$354,157	$506,118	$321,803	$288,518	$70,831	$101,224	$64,361
	BAT4	$2,083,739	$857,795	$1,076,562	$670,056	$416,748	$171,559	$215,312	$134,011
97	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$204,321,312	$20,264,530	$41,850,691	$27,857,602	$2,106,405	$208,913	$431,450	$287,192
	PSES4	$337,282,624	$24,807,622	$60,459,157	$40,862,157	$3,477,140	$255,749	$623,290	$421,259
Rendering (Subcategory J)									
21	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$10,906,107	$2,813,796	$3,962,346	$2,513,674	$519,338	$133,990	$188,683	$119,699
	BAT4	$15,753,267	$2,949,043	$4,610,416	$2,969,757	$750,156	$140,431	$219,544	$141,417

Table 5-4 (cont.)
Total and Average Retrofit Costs
Meat Type and Process Classes

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
75	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$78,857,861	$13,057,455	$21,377,577	$13,855,472	$1,051,438	$174,099	$285,034	$184,740
	PSES4	$92,106,957	$13,224,592	$22,946,879	$14,982,060	$1,228,093	$176,328	$305,958	$199,761
Total Costs Excluding 65 Certainty Facilities									
209	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$240,643,950	$52,143,788	$77,507,628	$48,949,261	$1,151,406	$249,492	$370,850	$234,207
	BAT4	$347,596,819	$83,087,873	$119,708,118	$75,225,477	$1,663,143	$397,550	$572,766	$359,931
101 [1]	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
715	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$1,702,180,162	$184,095,486	$363,895,342	$238,969,718	$2,380,672	$257,476	$508,945	$334,223
	PSES4	$2,159,372,531	$203,083,974	$431,241,022	$285,392,544	$3,020,101	$284,034	$603,134	$399,150
Total Costs Including 65 Certainty Facilities									
226	BAT1	NA	NA	NA	NA	NA	NA	NA	NA
	BAT2	NA	NA	NA	NA	NA	NA	NA	NA
	BAT3	$259,895,466	$56,315,291	$83,708,238	$52,865,202	$1,149,980	$249,183	$370,390	$233,917
	BAT4	$375,404,565	$89,734,903	$129,284,767	$81,243,516	$1,661,082	$397,057	$572,056	$359,485
	BAT5	NA	NA	NA	NA	NA	NA	NA	NA
772	PSES1	NA	NA	NA	NA	NA	NA	NA	NA
	PSES2	NA	NA	NA	NA	NA	NA	NA	NA
	PSES3	$1,838,354,575	$198,823,125	$393,006,969	$258,087,295	$2,381,288	$257,543	$509,076	$334,310
	PSES4	$2,332,122,333	$219,330,692	$465,740,304	$308,223,948	$3,020,884	$284,107	$603,291	$399,254

[1] Option BAT 5 is only found in Poultry operations.

5.1.3 Comparison of Upper-Bound and Retrofit Compliance Costs by Class

Table 5-5 compares upper-bound (new equipment) and upgrade (retrofit) capital costs by meat type and process class. Estimating upgrade costs reduces capital investment for options 3 and 4 because facilities now pay to modify equipment already purchased rather than having to pay the entire cost of a new piece of equipment. O&M costs, however, are unchanged for options 3 and 4.

Retrofit has a much larger impact on costs for direct dischargers than for indirect dischargers. Overall, upgrade costs are 55 percent lower than new equipment costs under BAT 3, and 63 percent lower under BAT 4. For indirect dischargers, upgrading capital costs for PSES 3 and PSES 4 are 10 and 9 percent lower than new equipment costs respectively. Within classes, the difference between upper-bound costs and upgrade costs may vary substantially.

5.2 FACILITY CLOSURE ANALYSIS

Facility level closure impacts are estimated using the closure model described in Chapter 3. The closure model addresses the impact of compliance costs on the financial health of the individual facility. In effect, the closure analysis models the financial evaluation a facility owner might make when deciding whether to upgrade pollution controls, or to close the facility because, with pollution controls in place, the facility is no longer economically viable.

In general, because the methodology is based on a cumulative probability distribution (see Section 3.1.2.1), the relative size of impacts is directly related to:

- the average estimated compliance costs per facility as a percent of cash flow in a subcategory or meat type and process class, and
- the number of facilities in the subcategory or meat type and process class.

As per facility costs as a percent of cash flow increase, so will the incremental probability of closure. As the number of facilities in a subcategory or meat type and process class increase, so will the number of

Table 5-5
Comparison of Upper-Bound and Retrofit Capital Costs

Number of Facilities	Option	UPPER-BOUND Total Capital Costs	UPPER-BOUND Average Capital Costs	RETROFIT Total Capital Costs	RETROFIT Average Capital Costs	Difference in Capital Costs	Percent Difference
Red Meat First Processing (Subcategory A - D)							
6	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$0	$0	NA	NA	NA	NA
	BAT3	$0	$0	$0	$0	$0	0.00%
	BAT4	$4,805,019	$800,836	$0	$0	$4,805,019	100.00%
Red Meat Further Processing (Subcategory E - I)							
12	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$45,683	$3,807	NA	NA	NA	NA
	BAT3	$247,412	$20,618	$111,335	$9,278	$136,077	55.00%
	BAT4	$12,693,792	$1,057,816	$160,818	$13,402	$12,532,974	98.73%
168	PSES1	$39,599,365	$235,711	NA	NA	NA	NA
	PSES2	$206,835,648	$1,231,165	NA	NA	NA	NA
	PSES3	$205,401,202	$1,222,626	$205,401,202	$1,222,626	$0	0.00%
	PSES4	$289,011,365	$1,720,306	$289,011,365	$1,720,306	$0	0.00%
Red Meat First and Further Processing (Subcategory A - D)							
28	PSES1	$7,674,552	$274,091	NA	NA	NA	NA
	PSES2	$109,691,736	$3,917,562	NA	NA	NA	NA
	PSES3	$105,932,768	$3,783,313	$91,985,869	$3,285,210	$13,946,899	13.17%
	PSES4	$110,184,632	$3,935,165	$99,994,413	$3,571,229	$10,190,219	9.25%
Red Meat First Processing and Rendering (Subcategory A - D)							
36	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$6,252,839	$173,690	NA	NA	NA	NA
	BAT3	$269,463,940	$7,485,109	$121,258,772	$3,368,299	$148,205,168	55.00%
	BAT4	$312,997,176	$8,694,366	$175,151,561	$4,865,321	$137,845,615	44.04%
15	PSES1	$9,946,909	$663,127	NA	NA	NA	NA
	PSES2	$311,479,620	$20,765,308	NA	NA	NA	NA
	PSES3	$210,194,072	$14,012,938	$210,194,072	$14,012,938	$0	0.00%
	PSES4	$211,683,958	$14,112,264	$211,683,958	$14,112,264	$0	0.00%
Red Meat Further Processing and Rendering (Subcategory E - I)							
4	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$86,867	$21,717	NA	NA	NA	NA
	BAT3	$263,930	$65,982	$118,769	$29,692	$145,161	55.00%
	BAT4	$13,428,162	$3,357,040	$171,555	$42,889	$13,256,607	98.72%

Table 5-5 (cont.)
Comparison of Upper-Bound and Retrofit Capital Costs

Number of Facilities	Option	UPPER-BOUND Total Capital Costs	UPPER-BOUND Average Capital Costs	RETROFIT Total Capital Costs	RETROFIT Average Capital Costs	Difference in Capital Costs	Percent Difference
7	PSES1	$3,588,406	$512,629	NA	NA	NA	NA
	PSES2	$37,076,732	$5,296,676	NA	NA	NA	NA
	PSES3	$30,127,418	$4,303,917	$26,398,992	$3,771,285	$3,728,426	12.38%
	PSES4	$34,521,628	$4,931,661	$31,268,069	$4,466,867	$3,253,559	9.42%
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)							
24	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$1,993,987	$83,083	NA	NA	NA	NA
	BAT3	$5,172,769	$215,532	$2,327,746	$96,989	$2,845,023	55.00%
	BAT4	$249,497,464	$10,395,728	$3,362,300	$140,096	$246,135,164	98.65%
17	PSES1	$14,504,126	$853,184	NA	NA	NA	NA
	PSES2	$203,365,424	$11,962,672	NA	NA	NA	NA
	PSES3	$144,061,380	$8,474,199	$72,030,690	$4,237,099	$72,030,690	50.00%
	PSES4	$280,904,584	$16,523,799	$161,805,662	$9,517,980	$119,098,922	42.40%
Poultry First Processing (Subcategory K)							
49	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$0	$0	NA	NA	NA	NA
	BAT3	$97,162,006	$1,982,898	$43,722,902	$892,304	$53,439,104	55.00%
	BAT4	$130,989,236	$2,673,250	$63,155,304	$1,288,884	$67,833,932	51.79%
	BAT5	$146,285,848	$2,985,425	NA	NA	NA	NA
92	PSES1	$33,447,312	$363,558	NA	NA	NA	NA
	PSES2	$406,506,200	$4,418,546	NA	NA	NA	NA
	PSES3	$351,742,064	$3,823,283	$332,158,512	$3,610,419	$19,583,552	5.57%
	PSES4	$376,110,848	$4,088,161	$362,017,073	$3,934,968	$14,093,775	3.75%
Poultry Further Processing (Subcategory L)							
13	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$142,827	$10,987	NA	NA	NA	NA
	BAT3	$10,898,624	$838,356	$4,904,381	$377,260	$5,994,243	55.00%
	BAT4	$15,381,507	$1,183,193	$7,084,105	$544,931	$8,297,402	53.94%
	BAT5	$17,719,557	$1,363,043	NA	NA	NA	NA
155	PSES1	$36,434,378	$235,061	NA	NA	NA	NA
	PSES2	$236,758,364	$1,527,473	NA	NA	NA	NA
	PSES3	$201,922,369	$1,302,725	$201,922,369	$1,302,725	$0	0.00%
	PSES4	$271,880,434	$1,754,067	$271,880,434	$1,754,067	$0	0.00%

Table 5-5 (cont.)
Comparison of Upper-Bound and Retrofit Capital Costs

Number of Facilities	Option	UPPER-BOUND Total Capital Costs	UPPER-BOUND Average Capital Costs	RETROFIT Total Capital Costs	RETROFIT Average Capital Costs	Difference in Capital Costs	Percent Difference
Poultry First and Further Processing (Subcategory K)							
16	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$1,018,875	$63,680	NA	NA	NA	NA
	BAT3	$37,748,307	$2,359,269	$16,986,738	$1,061,671	$20,761,569	55.00%
	BAT4	$60,619,846	$3,788,740	$24,536,399	$1,533,525	$36,083,447	59.52%
	BAT5	$67,733,811	$4,233,363	NA	NA	NA	NA
29	PSES1	$0	$0	NA	NA	NA	NA
	PSES2	$96,159,047	$3,315,829	NA	NA	NA	NA
	PSES3	$116,164,392	$4,005,669	$82,391,629	$2,841,091	$33,772,763	29.07%
	PSES4	$122,980,483	$4,240,706	$94,558,645	$3,260,643	$28,421,838	23.11%
Poultry First Processing and Rendering (Subcategory K)							
17	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$466,032	$27,414	NA	NA	NA	NA
	BAT3	$47,375,431	$2,786,790	$21,318,944	$1,254,056	$26,056,487	55.00%
	BAT4	$61,101,413	$3,594,201	$30,794,030	$1,811,414	$30,307,383	49.60%
	BAT5	$68,021,691	$4,001,276	NA	NA	NA	NA
5	PSES1	$0	$0	NA	NA	NA	NA
	PSES2	$46,412,547	$9,282,509	NA	NA	NA	NA
	PSES3	$29,064,025	$5,812,805	$29,064,025	$5,812,805	$0	0.00%
	PSES4	$30,098,859	$6,019,772	$30,098,859	$6,019,772	$0	0.00%
Poultry Further Processing and Rendering (Subcategory L)							
15	PSES1	$2,640,352	$176,023	NA	NA	NA	NA
	PSES2	$45,671,602	$3,044,773	NA	NA	NA	NA
	PSES3	$38,125,831	$2,541,722	$35,359,327	$2,357,288	$2,766,504	7.26%
	PSES4	$40,626,708	$2,708,447	$38,711,023	$2,580,735	$1,915,685	4.72%
Poultry First Processing, Further Processing, and Rendering (Subcategory K)							
6	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$0	$0	NA	NA	NA	NA
	BAT3	$38,990,370	$6,498,395	$17,545,667	$2,924,278	$21,444,703	55.00%
	BAT4	$40,129,511	$6,688,252	$25,343,741	$4,223,957	$14,785,770	36.85%
	BAT5	$45,039,294	$7,506,549	NA	NA	NA	NA

Table 5-5 (cont.)
Comparison of Upper-Bound and Retrofit Capital Costs

Number of Facilities	Option	UPPER-BOUND Total Capital Costs	UPPER-BOUND Average Capital Costs	RETROFIT Total Capital Costs	RETROFIT Average Capital Costs	Difference in Capital Costs	Percent Difference
12	PSES1	$8,960,599	$746,717	NA	NA	NA	NA
	PSES2	$222,320,423	$18,526,702	NA	NA	NA	NA
	PSES3	$140,102,742	$11,675,228	$132,094,302	$11,007,858	$8,008,440	5.72%
	PSES4	$141,530,779	$11,794,232	$138,953,449	$11,579,454	$2,577,330	1.82%
Mixed Further Processing (61 percent Subcategory E - I, 39 percent Subcategory L)							
5	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$30,519	$6,104	NA	NA	NA	NA
	BAT3	$3,205,753	$641,151	$1,442,589	$288,518	$1,763,164	55.00%
	BAT4	$9,742,008	$1,948,402	$2,083,739	$416,748	$7,658,269	78.61%
97	PSES1	$30,400,918	$313,412	NA	NA	NA	NA
	PSES2	$237,813,392	$2,451,684	NA	NA	NA	NA
	PSES3	$204,321,312	$2,106,405	$204,321,312	$2,106,405	$0	0.00%
	PSES4	$337,282,624	$3,477,140	$337,282,624	$3,477,140	$0	0.00%
Rendering (Subcategory J)							
21	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$0	$0	NA	NA	NA	NA
	BAT3	$24,235,794	$1,154,085	$10,906,107	$519,338	$13,329,687	55.00%
	BAT4	$27,388,270	$1,304,203	$15,753,267	$750,156	$11,635,003	42.48%
75	PSES1	$3,497,420	$46,632	NA	NA	NA	NA
	PSES2	$82,708,839	$1,102,785	NA	NA	NA	NA
	PSES3	$121,046,542	$1,613,954	$78,857,861	$1,051,438	$42,188,681	34.85%
	PSES4	$130,924,926	$1,745,666	$92,106,957	$1,228,093	$38,817,969	29.65%
Total Costs Excluding 65 Certainty Facilities							
209	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$10,037,629	$48,027	NA	NA	NA	NA
	BAT3	$534,764,336	$2,558,681	$240,643,950	$1,151,406	$294,120,386	55.00%
	BAT4	$938,773,404	$4,491,739	$347,596,819	$1,663,143	$591,176,585	62.97%
101 [1]	BAT5	$344,800,201	$3,413,863	NA	NA	NA	NA
715	PSES1	$190,694,337	$266,705	NA	NA	NA	NA
	PSES2	$2,242,799,574	$3,136,783	NA	NA	NA	NA
	PSES3	$1,898,206,117	$2,654,834	$1,702,180,162	$2,380,672	$196,025,955	10.33%
	PSES4	$2,377,741,828	$3,325,513	$2,159,372,531	$3,020,101	$218,369,297	9.18%

Table 5-5 (cont.)
Comparison of Upper-Bound and Retrofit Capital Costs

Number of Facilities	Option	UPPER-BOUND Total Capital Costs	UPPER-BOUND Average Capital Costs	RETROFIT Total Capital Costs	RETROFIT Average Capital Costs	Difference in Capital Costs	Percent Difference
Total Costs Including 65 Certainty Facilities							
226	BAT1	$0	$0	NA	NA	NA	NA
	BAT2	$10,840,639	$51,869	NA	NA	NA	NA
	BAT3	$577,545,483	$2,763,376	$259,895,466	$1,243,519	$317,650,017	55.00%
	BAT4	$1,013,875,276	$4,851,078	$375,404,565	$1,796,194	$638,470,712	62.97%
	BAT5	$372,384,217	$3,686,972	NA	NA	NA	NA
772	PSES1	$205,949,884	$288,042	$0	$0	$205,949,884	100.00%
	PSES2	$2,422,223,540	$3,387,725	$0	$0	$2,422,223,540	100.00%
	PSES3	$2,050,062,606	$2,867,220	$1,838,354,575	$2,571,125	$211,708,031	10.33%
	PSES4	$2,567,961,174	$3,591,554	$2,332,122,333	$3,261,710	$235,838,841	9.18%

[1] Option BAT 5 is only found in Poultry operations.

incremental closures for a given probability of closure. Because the number of projected closures is so directly related to the number of establishments in a category, this presentation will focus on the ratio of compliance costs to net income and the probability that posttax compliance costs exceed cash flow, rather than the absolute number of closures. These measures can be directly compared between subcategories and classes to get a sense of the relative magnitude of impacts.

Section 5.2.1 below outlines impacts by subcategory and Section 5.2.2 does the same by meat type and process class. Results presented include pretax and posttax annualized compliance costs per facility, the ratio of compliance costs to model facility net income and cash flow, the probability that cash flow is less than compliance costs, and finally, projected incremental facility closure and employment impacts.[3]

5.2.1 Projected Closure Impacts by Subcategory

5.2.1.1 Upper-Bound Cost Closure Impacts

Table 5-6 presents a summary of facility closure and employment impact results by subcategory groupings, discharge type, and technology option. For direct dischargers, facilities in Subcategory J have the highest probability of closure under BAT 4: 1.6 percent. Given that there are 21 facilities in this subcategory, 0.3 facilities are projected to close under this option. Although facilities in Subcategory K have a lower probability of closure under BAT 5 (about 1 percent), with 88 facilities in the subcategory, 1 closure is projected, the largest impact among the direct dischargers. For the proposed direct discharging options, BAT 3 for all subcategories except J for which the proposed option is BAT 2, the ratio of compliance costs to net income and the incremental probability of closure in each subcategory is as follows:

•	Subcategory A through D:	costs / net income:	1.90 percent
		probability of closure:	0.34 percent
•	Subcategory E through I:	costs / net income:	0.40 percent
		probability of closure:	0.06 percent

[3] Closure impacts under alternative assumptions about the cumulative distribution function can be found in Appendix E.

Table 5-6
Economic Closure Impacts: Upper-Bound Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Subcategory A through D								
BAT1	66	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$139,344	$83,256	0.28%	0.25%	0.05%	0.0	0
BAT3		$835,010	$550,223	1.90%	1.66%	0.34%	0.2	318
BAT4		$1,655,105	$1,095,962	4.11%	3.58%	0.74%	0.5	794
PSES1	60	$108,802	$71,591	0.57%	0.44%	0.09%	0.0	0
PSES2		$2,337,820	$1,521,794	10.35%	8.09%	1.73%	1.1	1,230
PSES3		$1,485,337	$982,758	7.21%	5.59%	1.19%	0.6	609
PSES4		$1,861,723	$1,238,299	8.14%	6.39%	1.36%	0.7	768
Subcategory E through I								
BAT1	19	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$19,641	$11,626	0.14%	0.12%	0.02%	0.0	0
BAT3		$33,648	$21,782	0.40%	0.33%	0.06%	0.0	0
BAT4		$340,790	$224,821	2.91%	2.44%	0.46%	0.0	0
PSES1	234	$74,306	$47,519	0.80%	0.67%	0.13%	0.3	91
PSES2		$403,679	$262,073	4.53%	3.77%	0.72%	1.8	495
PSES3		$330,879	$217,257	3.72%	3.09%	0.59%	1.3	346
PSES4		$435,725	$289,705	5.06%	4.21%	0.81%	1.9	492
Subcategory J								
BAT1	21	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$24,340	$14,458	0.68%	0.56%	0.12%	0.0	0
BAT3		$255,876	$168,926	8.03%	6.55%	1.45%	0.3	14
BAT4		$278,194	$184,386	8.78%	7.16%	1.59%	0.3	14
PSES1	75	$16,406	$10,429	0.50%	0.41%	0.09%	0.0	0
PSES2		$287,088	$186,713	8.78%	7.13%	1.58%	1.2	66
PSES3		$344,581	$228,365	10.79%	8.78%	1.95%	1.5	81
PSES4		$360,747	$239,901	11.36%	9.25%	2.06%	1.6	89

Table 5-6 (cont.)
Economic Closure Impacts: Upper-Bound Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Subcategory K								
BAT1	88	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$50,762	$29,922	0.34%	0.27%	0.06%	0.0	0
BAT3		$508,959	$335,237	3.98%	3.20%	0.72%	0.5	265
BAT4		$644,469	$426,657	5.14%	4.13%	0.93%	0.7	537
BAT5		$695,432	$462,287	5.61%	4.50%	1.02%	0.9	591
PSES1	138	$72,738	$47,101	0.55%	0.43%	0.10%	0.1	38
PSES2		$1,267,800	$824,567	8.71%	6.95%	1.59%	2.1	1,653
PSES3		$892,461	$590,677	6.53%	5.18%	1.51%	1.5	1,035
PSES4		$916,136	$608,171	6.80%	5.40%	1.23%	1.7	1,208
Subcategory L								
BAT1	15	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$18,678	$11,203	0.39%	0.32%	0.07%	0.0	0
BAT3		$182,548	$119,997	4.23%	3.54%	0.77%	0.1	16
BAT4		$267,851	$177,456	6.04%	5.04%	1.10%	0.1	16
BAT5	13 [5]	$274,471	$182,451	6.71%	5.61%	1.24%	0.1	16
PSES1	208	$67,967	$43,876	1.50%	1.26%	0.27%	0.6	93
PSES2		$469,256	$304,357	9.63%	8.06%	1.75%	3.6	751
PSES3		$332,199	$219,332	7.00%	5.87%	1.27%	2.6	462
PSES4		$419,271	$279,769	8.96%	7.51%	1.62%	3.3	583
Total Excluding 65 Certainty Facilities								
BAT1	209	NA	NA	NA	NA	NA	0.0	0
BAT2		NA	NA	NA	NA	NA	0.0	0
BAT3		NA	NA	NA	NA	NA	1.1	613
BAT4		NA	NA	NA	NA	NA	1.6	1,361
BAT5	101 [5]	NA	NA	NA	NA	NA	1.0	607
PSES1	715	NA	NA	NA	NA	NA	1.0	222
PSES2		NA	NA	NA	NA	NA	9.8	4,195
PSES3		NA	NA	NA	NA	NA	7.5	2,533
PSES4		NA	NA	NA	NA	NA	9.2	3,140

Table 5-6 (cont.)
Economic Closure Impacts: Upper-Bound Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Total Including 65 Certainty Facilities								
BAT1	226	NA	NA	NA	NA	NA	0.0	0
BAT2		NA	NA	NA	NA	NA	0.0	0
BAT3		NA	NA	NA	NA	NA	1.2	662
BAT4		NA	NA	NA	NA	NA	1.7	1,470
BAT5		NA	NA	NA	NA	NA	1.1	656
PSES1	772	NA	NA	NA	NA	NA	1.1	240
PSES2		NA	NA	NA	NA	NA	10.6	4,531
PSES3		NA	NA	NA	NA	NA	8.1	2,736
PSES4		NA	NA	NA	NA	NA	9.9	3,391

All impacts presented in this table are the average of results for each subcategory, discharge type and model facility size combination, weighted by the number of facilities in each combination.
[1] Total annualized compliance costs for subcategory and discharge class divided by number of facilities in that class.
[2] Ratio of posttax annualized compliance costs to net income and cash flow.
[3] Probability net income or cash flow less than posttax annualized compliance costs minus probability net income or cash flow less than zero.
[4] Closures: probability cash flow less than annualized compliance costs multiplied by the number of facilities in the subcategory.
[5] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

•	Subcategory J:	costs / net income:	0.68 percent
		probability of closure:	0.12 percent
•	Subcategory K:	costs / net income:	3.98 percent
		probability of closure:	0.72 percent
•	Subcategory L:	costs / net income:	4.23 percent
		probability of closure:	0.77 percent

Projected closure impacts total about 2 facilities under the proposed option with associated employment losses of about 600 workers. The largest impacts measured in terms of the highest ratio of compliance cost to net income and the highest incremental probability of closure occur in Subcategory L. The largest closure impacts occur in Subcategory A through D because there are four times more establishments in that subcategory than Subcategory L.

For indirect dischargers, Subcategory L incurs the largest impacts with 3.6 projected incremental closures under PSES 2. However, Subcategory J actually has a higher cost to net income ratio and a higher incremental probability of closure under PSES 4. Larger impacts are projected for Subcategory L because there are a total of 208 facilities in Subcategory L as opposed to 75 in Subcategory J. In general, impacts to indirect dischargers are larger than impacts to direct dischargers for each option. This is because: (1) indirect dischargers tend to incur higher compliance costs per facility resulting in a higher incremental probability of closure, and (2) there are usually more indirect dischargers than direct dischargers in each subcategory.

5.2.1.2 Upgrade Cost Closure Impacts

Since costs for upgrading are lower than new equipment costs under options 3 and 4, generally closure impacts for the upgrade scenario are lower than under the upper-bound cost estimates presented above. There will generally be lower cost to net income ratios, lower incremental probabilities of closure, and lower projected closure impacts.

A summary of facility closure and employment impact results using upgrade costs by subcategory groupings, discharge type, and technology option is presented in Table 5-7. For direct dischargers,

Table 5-7
Economic Closure Impacts: Retrofit Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Subcategory A through D								
BAT1	66	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$592,740	$374,326	1.30%	1.13%	0.23%	0.1	159
BAT4		$1,031,530	$643,172	2.38%	2.07%	0.43%	0.1	159
PSES1	60	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$1,333,647	$872,626	6.53%	5.05%	1.07%	0.6	609
PSES4		$1,633,619	$1,072,687	7.36%	5.75%	1.22%	0.7	768
Subcategory E through I								
BAT1	19	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$26,108	$16,269	0.29%	0.24%	0.05%	0.0	0
BAT4		$171,523	$101,755	1.36%	1.14%	0.22%	0.0	0
PSES1	234	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$329,193	$216,033	3.71%	3.09%	0.59%	1.3	346
PSES4		$434,254	$288,637	5.05%	4.20%	0.81%	1.9	492
Subcategory J								
BAT1	21	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$188,683	$119,699	5.70%	4.65%	1.02%	0.3	14
BAT4		$219,544	$141,417	6.74%	5.49%	1.21%	0.3	14
PSES1	75	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$285,034	$184,740	8.74%	7.11%	1.58%	1.2	66
PSES4		$305,958	$199,761	9.47%	7.71%	1.71%	1.2	66

Table 5-7 (continued)
Economic Closure Impacts: Retrofit Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Subcategory K								
BAT1	88	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$362,560	$228,901	2.73%	2.19%	0.49%	0.2	54
BAT4		$465,220	$296,460	3.56%	2.86%	0.64%	0.5	265
BAT5		NA	NA	NA	NA	NA	NA	NA
PSES1	138	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$845,389	$556,501	6.16%	4.89%	0.98%	1.4	997
PSES4		$881,546	$583,058	6.52%	5.17%	1.18%	1.5	1,035
Subcategory L								
BAT1	15	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$135,235	$85,410	3.01%	2.52%	0.55%	0.1	16
BAT4		$187,951	$119,025	4.12%	3.44%	0.75%	0.1	16
BAT5	13 [5]	NA	NA	NA	NA	NA	NA	NA
PSES1	208	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$330,790	$218,309	6.99%	5.86%	1.27%	2.6	462
PSES4		$418,296	$279,061	8.95%	7.50%	1.62%	3.3	583
Total Excluding the 65 Certainty Facilities								
BAT1	209	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		NA	NA	NA	NA	NA	0.7	243
BAT4		NA	NA	NA	NA	NA	1.0	454
BAT5	101 [5]	NA	NA	NA	NA	NA	0.0	0
PSES1	715	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		NA	NA	NA	NA	NA	7.1	2,480
PSES4		NA	NA	NA	NA	NA	8.6	2,944

Table 5-7 (cont.)
Economic Closure Impacts: Retrofit Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Total Including the 65 Certainty Facilities								
BAT1	226	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		NA	NA	NA	NA	NA	0.8	262
BAT4		NA	NA	NA	NA	NA	1.1	490
BAT5		NA	NA	NA	NA	NA	0.0	0
PSES1	772	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		NA	NA	NA	NA	NA	7.7	2,678
PSES4		NA	NA	NA	NA	NA	9.3	3,180

All impacts presented in this table are the average of results for each subcategory, discharge type and model facility size combination, weighted by the number of facilities in each combination.
[1] Total annualized compliance costs for subcategory and discharge class divided by number of facilities in that class.
[2] Ratio of posttax annualized compliance costs to net income and cash flow.
[3] Probability net income or cash flow less than posttax annualized compliance costs minus probability net income or cash flow less than zero.
[4] Closures: probability cash flow less than annualized compliance costs multiplied by the number of facilities in the subcategory.
[5] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations.

Subcategory K incurs the largest impacts under BAT 4 with an incremental probability of closure of 0.6 percent and 0.5 projected closures. This is, however, 44 percent lower than the largest facility closure impacts assuming upper-bound costs. For the proposed direct discharging options, the ratio of compliance costs to net income and the incremental probability of closure are also lower than in Section 5.2.1.1. They are as follows:

•	Subcategory A through D:	costs / net income: probability of closure:	1.30 percent 0.23 percent
•	Subcategory E through I:	costs / net income: probability of closure:	0.29 percent 0.05 percent
•	Subcategory J:	costs / net income: probability of closure:	0.68 percent 0.12 percent
•	Subcategory K:	costs / net income: probability of closure:	2.73 percent 0.49 percent
•	Subcategory L:	costs / net income: probability of closure:	3.01 percent 0.55 percent

Projected closure impacts are 0.5 facilities under the upgrade cost scenario, with employment losses of about 230 workers under the proposed options. Note that impacts to Subcategory J are unchanged from the upper-bound cost estimates because retrofit costs were not estimated for BAT 2.

5.2.2 Projected Closure Impacts by Meat Type and Process Class

5.2.2.1 Upper-Bound Cost Closure Impacts

Table 5-8 summarizes projected facility closure and employment impacts by meat type and process class, discharge type, as well as technology option. The class level data allows more insight into the range of impacts projected to occur under the proposed option than does the subcategory data. The impacts listed for each subcategory in Section 5.2.1.1 above actually consist of a weighted average of class level impacts. Thus, for each subcategory, the overall ratio of compliance costs to net income and the range of those impacts in component classes is as follows:

Table 5-8
Economic Closure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Red Meat First Processing (Subcategory A - D)								
BAT1	6	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT3		$11,374	$6,756	0.25%	0.21%	0.04%	0.0	0
BAT4		$184,589	$121,398	4.50%	3.74%	0.77%	0.0	0
Red Meat Further Processing (Subcategory E - I)								
BAT1	12	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$8,376	$4,949	0.07%	0.06%	0.01%	0.0	0
BAT3		$9,249	$5,712	0.08%	0.07%	0.01%	0.0	0
BAT4		$226,301	$148,065	2.19%	1.83%	0.35%	0.0	0
PSES1	168	$72,481	$45,873	0.71%	0.60%	0.12%	0.2	71
PSES2		$285,920	$185,489	2.89%	2.42%	0.47%	0.8	282
PSES3		$273,780	$178,271	2.78%	2.32%	0.45%	0.7	247
PSES4		$348,513	$229,398	3.58%	2.99%	0.58%	1.0	353
Red Meat First and Further Processing (Subcategory A - D)								
PSES1	28	$64,589	$41,841	0.84%	0.60%	0.13%	0.0	0
PSES2		$1,035,076	$663,388	13.31%	9.58%	2.08%	0.6	436
PSES3		$751,666	$495,858	9.95%	7.16%	1.55%	0.4	291
PSES4		$760,945	$503,560	10.11%	7.27%	1.57%	0.4	291
Red Meat First Processing and Rendering (Subcategory A - D)								
BAT1	36	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$139,773	$84,239	0.29%	0.25%	0.05%	0.0	0
BAT3		$1,475,132	$974,022	3.32%	2.91%	0.60%	0.2	318
BAT4		$1,684,423	$1,114,430	3.80%	3.33%	0.69%	0.3	476
PSES1	15	$134,637	$88,598	0.30%	0.26%	0.05%	0.0	0
PSES2		$4,131,629	$2,725,095	9.29%	8.14%	1.71%	0.3	476
PSES3		$2,656,203	$1,761,919	6.01%	5.26%	1.09%	0.1	159
PSES4		$2,610,907	$1,736,959	5.92%	5.19%	1.08%	0.1	159

Table 5-8 (cont.)
Economic Closure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Red Meat Further Processing and Rendering (Subcategory E - I)								
BAT1	4	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$51,149	$30,197	0.21%	0.18%	0.03%	0.0	0
BAT3		$26,853	$16,674	0.12%	0.10%	0.02%	0.0	0
BAT4		$656,304	$433,757	3.02%	2.58%	0.48%	0.0	0
PSES1	7	$113,738	$74,131	0.52%	0.44%	0.08%	0.0	0
PSES2		$1,382,115	$886,795	6.17%	5.27%	0.98%	0.1	74
PSES3		$851,122	$561,768	3.91%	3.34%	0.62%	0.0	0
PSES4		$943,350	$625,068	4.35%	3.71%	0.69%	0.0	0
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)								
BAT1	24	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$173,538	$102,595	0.35%	0.31%	0.06%	0.0	0
BAT3		$80,737	$50,391	0.17%	0.15%	0.03%	0.0	0
BAT4		$1,978,756	$1,311,902	4.47%	3.92%	0.81%	0.2	318
PSES1	17	$158,829	$105,585	0.36%	0.32%	0.06%	0.0	0
PSES2		$2,900,742	$1,873,902	6.39%	5.60%	1.16%	0.2	318
PSES3		$1,660,618	$1,097,217	3.74%	3.28%	0.68%	0.1	159
PSES4		$3,013,724	$2,008,464	6.85%	6.00%	1.24%	0.2	318
Poultry First Processing (Subcategory K)								
BAT1	49	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$32,617	$19,048	0.24%	0.19%	0.04%	0.0	0
BAT3		$402,059	$264,617	3.33%	2.61%	0.59%	0.3	211
BAT4		$515,806	$341,425	4.31%	3.38%	0.77%	0.3	211
BAT5		$560,232	$372,064	4.72%	3.69%	0.84%	0.4	249
PSES1	92	$84,368	$54,737	0.69%	0.54%	0.12%	0.1	38
PSES2		$952,857	$622,905	7.72%	6.06%	1.39%	1.2	844
PSES3		$739,031	$489,080	6.11%	4.78%	1.10%	1.0	671
PSES4		$769,859	$511,067	6.42%	5.03%	1.15%	1.1	807

Table 5-8 (cont.)
Economic Closure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Poultry Further Processing (Subcategory L)								
BAT1	13	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$18,084	$10,853	0.40%	0.33%	0.07%	0.0	0
BAT3		$189,147	$124,240	4.56%	3.81%	0.84%	0.1	16
BAT4		$251,412	$166,155	6.11%	5.10%	1.13%	0.1	16
BAT5		$274,471	$182,451	6.71%	5.61%	1.24%	0.1	16
PSES1	155	$68,468	$44,034	1.72%	1.45%	0.32%	0.5	80
PSES2		$401,506	$260,392	10.20%	8.59%	1.91%	2.9	488
PSES3		$289,937	$190,988	7.45%	6.28%	1.39%	2.1	360
PSES4		$358,060	$238,006	9.33%	7.86%	1.75%	2.7	456
Poultry First and Further Processing (Subcategory K)								
BAT1	16	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$50,359	$30,367	0.30%	0.24%	0.05%	0.0	0
BAT3		$487,028	$319,898	3.38%	2.68%	0.60%	0.1	38
BAT4		$726,500	$481,243	5.12%	4.06%	0.92%	0.2	174
BAT5		$786,050	$522,705	5.62%	4.45%	1.01%	0.2	174
PSES1	29	$9,939	$5,805	0.07%	0.05%	0.01%	0.0	0
PSES2		$953,462	$606,678	5.92%	4.73%	1.07%	0.3	211
PSES3		$800,429	$527,679	5.42%	4.31%	0.97%	0.2	174
PSES4		$823,911	$544,926	5.70%	4.52%	1.02%	0.3	211
Poultry First Processing and Rendering (Subcategory K)								
BAT1	17	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$61,494	$36,447	0.49%	0.42%	0.09%	0.0	0
BAT3		$560,984	$370,537	5.24%	4.43%	0.98%	0.1	16
BAT4		$703,209	$466,017	6.68%	5.65%	1.25%	0.2	152
BAT5		$745,836	$497,125	7.24%	6.12%	1.36%	0.3	168
PSES1	5	$19,013	$11,150	0.17%	0.14%	0.03%	0.0	0
PSES2		$2,279,835	$1,474,420	18.27%	15.45%	3.50%	0.1	16
PSES3		$1,142,017	$756,188	10.02%	8.48%	1.89%	0.1	16
PSES4		$1,149,785	$763,895	10.30%	8.72%	1.94%	0.1	16

Table 5-8 (cont.)
Economic Closure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1] Pretax	Posttax	Compliance Cost as a Percentage of Model Facility [2] Net Income	Cash Flow	Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4] Closures	Employment
Poultry Further Processing and Rendering (Subcategory L)								
PSES1	15	$45,498	$29,218	0.36%	0.28%	0.06%	0.0	0
PSES2		$783,429	$503,303	5.25%	4.17%	0.94%	0.2	174
PSES3		$518,601	$341,080	3.97%	3.13%	0.71%	0.1	38
PSES4		$537,257	$354,482	4.24%	3.33%	0.76%	0.1	38
Poultry First Processing, Further Processing, and Rendering (Subcategory K)								
BAT1	6	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$169,617	$99,056	0.83%	0.67%	0.15%	0.0	0
BAT3		$1,293,051	$852,850	7.38%	5.96%	1.34%	0.0	0
BAT4		$1,310,040	$865,627	7.61%	6.14%	1.38%	0.0	0
BAT5		$1,415,110	$939,292	8.29%	6.68%	1.51%	0.0	0
PSES1	12	$157,724	$103,338	0.82%	0.67%	0.15%	0.0	0
PSES2		$4,020,330	$2,626,437	19.07%	15.69%	3.58%	0.5	582
PSES3		$2,187,182	$1,452,861	10.96%	8.98%	2.02%	0.2	174
PSES4		$2,163,118	$1,440,597	10.97%	8.98%	2.03%	0.2	174
Mixed Further Processing (61 percent in Subcategory E - I, 39 percent in Subcategory L)								
BAT1	5	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$22,640	$13,538	0.30%	0.25%	0.05%	0.0	0
BAT3		$138,552	$91,709	2.03%	1.68%	0.32%	0.0	0
BAT4		$377,450	$252,797	5.60%	4.64%	0.88%	0.0	0
PSES1	97	$74,822	$49,043	1.09%	0.90%	0.17%	0.2	33
PSES2		$622,276	$405,609	8.99%	7.44%	1.42%	1.4	228
PSES3		$431,450	$287,192	6.37%	5.27%	1.00%	1.0	163
PSES4		$623,290	$421,259	9.34%	7.73%	1.47%	1.4	228
Rendering (Subcategory J)								
BAT1	21	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$24,340	$14,458	0.68%	0.56%	0.12%	0.0	0
BAT3		$255,876	$168,926	8.03%	6.55%	1.45%	0.3	14
BAT4		$278,194	$184,386	8.78%	7.16%	1.59%	0.3	14

Table 5-8 (cont.)
Economic Closure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
PSES1	75	$16,406	$10,429	0.50%	0.41%	0.09%	0.0	0
PSES2		$287,088	$186,713	8.78%	7.13%	1.58%	1.2	66
PSES3		$344,581	$228,365	10.79%	8.78%	1.95%	1.5	81
PSES4		$360,747	$239,901	11.36%	9.25%	2.06%	1.6	89
Total Excluding 65 Certainty Facilities								
BAT1	209	NA	NA	NA	NA	NA	0.0	0
BAT2		NA	NA	NA	NA	NA	0.0	0
BAT3		NA	NA	NA	NA	NA	1.1	613
BAT4		NA	NA	NA	NA	NA	1.6	1,361
BAT5	101 [5]	NA	NA	NA	NA	NA	1.0	607
PSES1	715	NA	NA	NA	NA	NA	1.0	222
PSES2		NA	NA	NA	NA	NA	9.8	4,195
PSES3		NA	NA	NA	NA	NA	7.5	2,533
PSES4		NA	NA	NA	NA	NA	9.2	3,140
Total Including 65 Certainty Facilities								
BAT1	226	NA	NA	NA	NA	NA	0.0	0
BAT2		NA	NA	NA	NA	NA	0.0	0
BAT3		NA	NA	NA	NA	NA	1.2	662
BAT4		NA	NA	NA	NA	NA	1.7	1,470
BAT5		NA	NA	NA	NA	NA	1.1	656
PSES1	772	NA	NA	NA	NA	NA	1.1	240
PSES2		NA	NA	NA	NA	NA	10.6	4,531
PSES3		NA	NA	NA	NA	NA	8.1	2,736
PSES4		NA	NA	NA	NA	NA	9.9	3,391

All impacts presented in this table are the average of results for each meat type and process class, discharge type and model facility size combination, weighted by the number of facilities in each combination.
[1] Total annualized compliance costs for class and discharge class divided by number of facilities in that class.
[2] Ratio of posttax annualized compliance costs to net income and cash flow.
[3] Probability net income or cash flow less than posttax annualized compliance costs minus probability net income or cash flow less than zero.
[4] Closures: probability cash flow less than annualized compliance costs multiplied by the number of facilities in the subcategory.
[5] Option BAT 5 is only found in Poultry operations.

•	Subcategory A through D:	costs / net income:	1.90 percent
	— red meat first processing, further processing, and rendering		0.17 percent
	— red meat first processing and rendering		3.32 percent
•	Subcategory E through I	costs / net income:	0.40 percent
	— red meat further processing		0.08 percent
	— mixed further processing		2.03 percent
•	Subcategory J:	costs / net income:	0.68 percent
	— rendering		
•	Subcategory K:	costs / net income:	3.98 percent
	— poultry first processing		3.33 percent
	— poultry first processing, further processing, and rendering		7.38 percent
•	Subcategory L:	costs / net income:	4.23 percent
	— mixed further processing		2.03 percent
	— poultry further processing		4.56 percent

The largest ratio of compliance costs to net income under the proposed options is projected in the poultry first processing, further processing, and rendering class (7.38 percent — Subcategory K), followed by poultry first processing and rendering (5.24 percent — Subcategory K), and poultry further processing (4.56 percent — Subcategory K).

5.2.2.2 Upgrade Cost Closure Impacts

Table 5-9 summarizes projected facility closure and employment impacts based on upgrade costs by meat type and process class, discharge type, and technology option.

Under the proposed options, (BAT 3 for all classes except rendering and BAT 2 for rendering), there are a total of 0.4 facility closures projected with employment losses totaling 229 for all classes combined. Comparing the range of disaggregated class level cost to net income ratio for the proposed option with the subcategory level ratio:

Table 5-9
Economic Closure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Red Meat First Processing (Subcategory A - D)								
BAT1	6	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$11,374	$6,756	0.25%	0.21%	0.04%	0.0	0
BAT4		$99,815	$59,290	2.20%	1.83%	0.38%	0.0	0
Red Meat Further Processing (Subcategory E - I)								
BAT1	12	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$8,049	$4,840	0.07%	0.06%	0.01%	0.0	0
BAT4		$115,742	$67,795	0.99%	0.83%	0.16%	0.0	0
PSES1	168	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$273,780	$178,271	2.78%	2.32%	0.45%	0.7	247
PSES4		$348,513	$229,398	3.58%	2.99%	0.58%	1.0	353
Red Meat First and Further Processing (Subcategory A - D)								
PSES1	28	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$698,938	$457,576	9.18%	6.61%	1.43%	0.4	291
PSES4		$722,420	$475,589	9.54%	6.87%	1.48%	0.4	291
Red Meat First Processing and Rendering (Subcategory A - D)								
BAT1	36	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$1,039,337	$657,618	2.24%	1.96%	0.40%	0.1	159
BAT4		$1,279,089	$820,142	2.80%	2.45%	0.51%	0.1	159
PSES1	15	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$2,656,203	$1,761,919	6.01%	5.26%	1.09%	0.1	159
PSES4		$2,610,907	$1,736,959	5.92%	5.19%	1.08%	0.1	159

Table 5-9 (cont.)
Economic Closure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Red Meat Further Processing and Rendering (Subcategory E - I)								
BAT1	4	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$23,011	$13,885	0.10%	0.08%	0.02%	0.0	0
BAT4		$305,475	$179,043	1.25%	1.06%	0.20%	0.0	0
PSES1	7	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$794,739	$520,832	3.63%	3.09%	0.57%	0.0	0
PSES4		$894,148	$589,346	4.10%	3.50%	0.65%	0.0	0
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)								
BAT1	24	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$68,188	$41,280	0.14%	0.12%	0.03%	0.0	0
BAT4		$893,119	$523,688	1.79%	1.56%	0.32%	0.0	0
PSES1	17	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$1,212,088	$771,568	2.63%	2.30%	0.47%	0.1	159
PSES4		$2,272,104	$1,470,020	5.01%	4.39%	0.91%	0.2	318
Poultry First Processing (Subcategory K)								
BAT1	49	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$286,611	$180,797	2.28%	1.78%	0.40%	0.1	38
BAT4		$369,260	$235,027	2.97%	2.32%	0.53%	0.3	211
BAT5		NA	NA	NA	NA	NA	NA	NA
PSES1	92	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$716,498	$472,720	5.90%	4.63%	1.06%	0.9	633
PSES4		$753,642	$499,293	6.27%	4.91%	1.13%	1.0	671

Table 5-9 (cont.)
Economic Closure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Poultry Further Processing (Subcategory L)								
BAT1	13	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$140,337	$88,567	3.25%	2.72%	0.60%	0.1	16
BAT4		$183,847	$116,777	4.29%	3.59%	0.79%	0.1	16
BAT5		NA	NA	NA	NA	NA	NA	NA
PSES1	155	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$289,937	$190,988	7.45%	6.28%	1.39%	2.1	360
PSES4		$358,060	$238,006	9.33%	7.86%	1.75%	2.7	456
Poultry First and Further Processing (Subcategory K)								
BAT1	16	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$349,667	$220,169	2.34%	1.85%	0.42%	0.0	0
BAT4		$487,768	$307,915	3.30%	2.62%	0.59%	0.1	38
BAT5		NA	NA	NA	NA	NA	NA	NA
PSES1	29	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$677,150	$438,173	4.50%	3.58%	0.81%	0.2	174
PSES4		$720,163	$469,602	4.88%	3.88%	0.88%	0.2	174
Poultry First Processing and Rendering (Subcategory K)								
BAT1	17	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$398,732	$252,506	3.59%	3.04%	0.67%	0.1	16
BAT4		$514,487	$328,714	4.70%	3.98%	0.88%	0.1	16
BAT5		NA	NA	NA	NA	NA	NA	NA
PSES1	5	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$1,142,017	$756,188	10.02%	8.48%	1.89%	0.1	16
PSES4		$1,149,785	$763,895	10.30%	8.72%	1.94%	0.1	16

Table 5-9 (cont.)
Economic Closure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Poultry Further Processing and Rendering (Subcategory L)								
PSES1	15	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$499,078	$326,905	3.81%	3.00%	0.68%	0.1	38
PSES4		$523,737	$344,666	4.11%	3.23%	0.73%	0.1	38
Poultry First Processing, Further Processing, and Rendering (Subcategory K)								
BAT1	6	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$914,703	$578,155	5.02%	4.05%	0.91%	0.0	0
BAT4		$1,049,175	$676,229	5.89%	4.76%	1.07%	0.0	0
BAT5		NA	NA	NA	NA	NA	NA	NA
PSES1	12	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$2,116,535	$1,401,569	10.55%	8.65%	1.95%	0.2	174
PSES4		$2,140,383	$1,424,090	10.81%	8.85%	1.99%	0.2	174
Mixed Further Processing (61 percent in Subcategory E - I, 39 percent in Subcategory L)								
BAT1	5	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$101,224	$64,361	1.43%	1.18%	0.22%	0.0	0
BAT4		$215,312	$134,011	2.97%	2.46%	0.46%	0.0	0
PSES1	97	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$431,450	$287,192	6.37%	5.27%	1.00%	1.0	163
PSES4		$623,290	$421,259	9.34%	7.73%	1.47%	1.4	228
Rendering (Subcategory J)								
BAT1	21	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$188,683	$119,699	5.70%	4.65%	1.02%	0.3	14
BAT4		$219,544	$141,417	6.74%	5.49%	1.21%	0.3	14

Table 5-9 (cont.)
Economic Closure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
PSES1	75	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$285,034	$184,740	8.74%	7.11%	1.58%	1.2	66
PSES4		$305,958	$199,761	9.47%	7.71%	1.71%	1.2	66
Total Excluding 65 Certainty Facilities								
BAT1	209	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$3,529,916	$2,228,633	NA	NA	NA	0.7	243
BAT4		$5,732,634	$3,590,047	NA	NA	NA	1.0	454
BAT5	101 [5]	NA	NA	NA	NA	NA	NA	NA
PSES1	715	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$11,793,448	$7,748,641	NA	NA	NA	7.1	2,480
PSES4		$13,423,111	$8,861,884	NA	NA	NA	8.6	2,944
Total Including 65 Certainty Facilities								
BAT1	226	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA
BAT3		$3,812,309	$2,406,923	NA	NA	NA	0.8	262
BAT4		$6,191,244	$3,877,251	NA	NA	NA	1.1	490
BAT5		NA	NA	NA	NA	NA	NA	NA
PSES1	772	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA
PSES3		$12,736,923	$8,368,532	NA	NA	NA	7.7	2,678
PSES4		$14,496,959	$9,570,835	NA	NA	NA	9.3	3,180

All impacts presented in this table are the average of results for meat type and process class, discharge type and model facility size combination, weighted by the number of facilities in each combination.

[1] Total annualized compliance costs for subcategory and discharge class divided by number of facilities in that class.

[2] Ratio of posttax annualized compliance costs to net income and cash flow.

[3] Probability net income or cash flow less than posttax annualized compliance costs minus probability net income or cash flow less than zero.

[4] Closures: probability cash flow less than annualized compliance costs multiplied by the number of facilities in the subcategory.

[5] Option BAT 5 is only found in Poultry operations.

• Subcategory A through D:	costs / net income:	1.30 percent
— red meat first processing, further processing, and rendering		0.14 percent
— red meat first processing and rendering		2.24 percent
• Subcategory E through I:	costs / net income:	0.29 percent
— red meat further processing		0.07 percent
— mixed further processing		1.43 percent
• Subcategory J:	costs / net income:	0.68 percent
— rendering		
• Subcategory K:	costs / net income:	2.73 percent
— poultry first processing		2.28 percent
— poultry first processing, further processing, and rendering		5.02 percent
• Subcategory L:	costs / net income:	3.01 percent
— mixed further processing		1.43 percent
— poultry further processing		3.25 percent

The largest ratio of compliance costs to net income under the proposed option is projected in the poultry first processing, further processing, and rendering class (5.02 percent — Subcategory K), followed by poultry first processing and rendering (3.59 percent — Subcategory K), and poultry further processing (3.25 percent — Subcategory L).

5.3 FACILITY NONCLOSURE IMPACTS

EPA calculated nonclosure impacts for facilities impacted by the proposed effluent guideline. These impacts include:[4]

- ratio of pretax annualized compliance costs to model facility revenues,

[4] As discussed in Chapter 3, nonclosure impacts are estimated assuming that the distribution for each of the four income measures is normal. Appendix E presents a sensitivity analysis based on the assumption that revenues have a lognormal (i.e., positively skewed) distribution. Also note that in the above analysis, EPA nets out the probability that facilities earn negative baseline income under each of the four income measures.

- ratio of pretax annualized compliance costs to model facility EBIT,
- ratio of posttax annualized compliance costs to model facility net income,
- ratio of posttax annualized compliance costs to model facility cash flow,
- number of facilities expected to incur pretax annualized compliance costs exceeding 1, 3, 5, and 10 percent of revenues, and
- number of facilities expected to incur posttax annualized compliance costs exceeding 3, 5, and 10 percent of cash flow.

Because there are generally no definitive thresholds for any one of these four income measures that will cause a facility to close if exceeded (other than if the ratio of compliance costs to cash flow exceeds 100 percent), EPA calls these ratio measures "nonclosure impacts."

As discussed in the closure analysis, the relative size of impacts is directly related to the estimated compliance costs per facility as a percent of facility income and the number of facilities in the subcategory or meat type and process class. Hence, in general, the larger the: (1) ratio of pretax annualized costs to revenues or EBIT, (2) ratio of posttax annualized costs to net income or cash flow, and (3) the number of facilities in the subcategory, the greater will be the number of facilities projected to incur compliance costs exceeding any given impact threshold (e.g., greater than 3 percent of revenues).

Note that for any given option, the size of some ratios relative to each other can be unambiguously ranked. The ratio of pretax compliance costs to revenues will always be smaller than the ratio of pretax compliance costs to EBIT; both ratios have the same numerator (pretax compliance costs), but because the denominator EBIT is always smaller than denominator revenues (since EBIT equals revenues minus costs), the resulting ratio is always larger. Similarly, the ratio of posttax compliance costs to net income will always be smaller than the ratio of posttax compliance costs to cash flow; both ratios have the same numerator (posttax compliance costs), but because the denominator net income is always smaller than denominator cash flow (since cash flow equals net income plus depreciation) a larger ratio will result. In general, the cash flow and EBIT ratios cannot be unambiguously ranked. The denominator cash flow should be smaller than the denominator EBIT. However, the numerator posttax compliance costs is also smaller than the numerator pretax compliance costs, therefore the relative size of the two ratios will depend on taxes and depreciation, which may vary. For the meat products industry analysis, the cash flow ratio is, with the exception of some options in the rendering subcategory, larger than the EBIT ratio.

5.3.1 Nonclosure Impacts by Subcategory

5.3.1.1 Upper-Bound Cost Nonclosure Impacts

Table 5-10 presents a summary of impacts by subcategory, discharge type, and technology option (the ratio of compliance costs to net income may be found on closure impact tables 5-6 through 5-9). Among the direct dischargers, the largest impacts are seen under BAT 5 for Subcategory K. Of the 88 facilities in that subcategory, 19 are projected to incur compliance costs greater than 1 percent of revenues (22 percent of all facilities in Subcategory K), and 4 will face compliance cost greater than 3 percent of revenues (5 percent). Twenty-one facilities are projected to incur costs greater than 5 percent of cash flow (24 percent).

Results for the proposed direct discharging options, BAT 3 (Subcategories A through D, E through I, K, and L) and BAT 2 (Subcategory J), are presented below. The ratio of compliance costs to average facility revenues, and the number of facilities projected to incur compliance costs greater than 1 percent of revenues or 3 percent of revenues are:

• Subcategory A through D:	costs / revenues:	0.12 percent
	exceeding 1 percent:	2.1 facilities
	exceeding 3 percent:	0.6 facilities
• Subcategory E through I:	costs / revenues:	0.05 percent
	exceeding 1 percent:	0.2 facilities
	exceeding 3 percent:	0.1 facilities
• Subcategory J:	costs / revenues:	0.17 percent
	exceeding 1 percent:	0.9 facilities
	exceeding 3 percent:	0.3 facilities
• Subcategory K:	costs / revenues:	0.43 percent
	exceeding 1 percent:	12.2 facilities
	exceeding 3 percent:	2.8 facilities

Table 5-10
Nonclosure Impacts: Upper-Bound Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Compliance Cost as a Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Subcategory A through D											
BAT1	66	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.02%	0.25%	0.25%	0.2	0.0	0.0	0.0	1.1	0.7	0.3
BAT3		0.12%	1.51%	1.66%	2.1	0.6	0.3	0.1	8.5	5.1	2.3
BAT4		0.27%	3.23%	3.58%	4.8	1.3	0.7	0.3	18.3	10.9	5.2
PSES1	60	0.02%	0.32%	0.44%	0.1	0.0	0.0	0.0	1.9	1.0	0.5
PSES2		0.46%	6.18%	8.09%	9.1	2.1	1.3	0.5	33.1	22.9	11.6
PSES3		0.30%	4.11%	5.59%	5.0	1.4	0.8	0.4	25.7	16.3	7.9
PSES4		0.36%	4.80%	6.39%	6.3	1.7	0.9	0.5	29.4	18.6	8.9
Subcategory E through I											
BAT1	19	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.02%	0.11%	0.12%	0.1	0.0	0.0	0.0	0.1	0.0	0.0
BAT3		0.05%	0.30%	0.33%	0.2	0.1	0.1	0.0	0.5	0.2	0.1
BAT4		0.33%	1.92%	2.44%	1.7	0.5	0.3	0.2	3.2	1.8	0.9
PSES1	234	0.09%	0.51%	0.67%	5.1	1.6	0.9	0.5	10.3	6.1	3.0
PSES2		0.52%	3.02%	3.77%	40.8	11.2	6.4	3.0	61.0	36.9	17.8
PSES3		0.41%	2.38%	3.09%	30.1	8.5	4.9	2.3	51.0	30.0	14.6
PSES4		0.55%	3.22%	4.21%	43.4	11.9	6.8	3.2	68.3	41.3	20.1
Subcategory J											
BAT1	21	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.17%	0.60%	0.56%	0.9	0.3	0.2	0.0	0.9	0.5	0.3
BAT3		1.85%	6.38%	6.55%	10.7	3.3	1.8	1.0	11.5	7.2	3.4
BAT4		2.02%	6.95%	7.16%	11.4	3.7	2.1	1.0	12.3	7.8	3.7

Table 5-10 (cont.)
Nonclosure Impacts: Upper-Bound Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Compliance Cost as a Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	75	0.12%	0.41%	0.41%	2.2	0.6	0.3	0.3	2.3	1.3	0.7
PSES2		2.04%	7.07%	7.13%	40.7	13.4	7.6	3.7	42.9	27.7	13.3
PSES3		2.47%	8.54%	8.78%	46.9	16.5	9.4	4.5	48.8	33.9	16.7
PSES4		2.60%	8.96%	9.25%	48.4	17.4	9.9	4.7	50.2	35.6	17.7
Subcategory K											
BAT1	88	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.04%	0.25%	0.27%	0.6	0.0	0.0	0.0	1.8	1.1	0.2
BAT3		0.43%	2.59%	3.20%	12.2	2.8	1.4	0.6	24.7	14.6	6.9
BAT4		0.54%	3.31%	4.13%	16.9	3.6	1.8	1.0	31.2	19.3	9.0
BAT5		0.59%	3.59%	4.50%	19.2	4.2	2.2	1.0	33.6	20.9	10.0
PSES1	138	0.06%	0.34%	0.43%	1.3	0.4	0.2	0.1	4.7	2.7	1.4
PSES2		0.94%	5.59%	6.95%	50.0	12.7	6.5	2.6	66.9	48.2	25.2
PSES3		0.67%	4.04%	5.18%	35.6	7.5	3.9	1.8	58.5	38.2	18.3
PSES4		0.70%	4.18%	5.40%	37.3	7.8	4.1	1.9	60.2	39.6	19.2
Subcategory L											
BAT1	15	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.05%	0.31%	0.32%	0.1	0.0	0.0	0.0	0.3	0.2	0.1
BAT3		0.48%	3.16%	3.54%	2.5	0.4	0.2	0.1	4.6	2.6	1.2
BAT4		0.69%	4.48%	5.04%	4.0	0.8	0.4	0.2	6.3	3.9	1.8
BAT5	13 [3]	0.75%	4.95%	5.61%	4.0	0.8	0.4	0.2	6.2	3.8	1.8
PSES1	208	0.18%	1.17%	1.26%	8.8	2.4	1.4	0.6	20.6	11.9	5.9
PSES2		1.15%	7.40%	8.06%	110.1	23.2	11.7	5.1	120.2	83.3	41.3
PSES3		0.82%	5.30%	5.87%	70.9	14.7	7.7	3.5	98.4	61.5	29.2
PSES4		1.05%	6.72%	7.51%	97.4	20.3	10.4	4.7	116.1	78.0	38.1

Table 5-10 (cont.)
Nonclosure Impacts: Upper-Bound Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Compliance Cost as a Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Total Excluding 65 Certainty Facilities											
BAT1	209	NA	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		NA	NA	NA	1.9	0.3	0.2	0.0	4.2	2.5	0.9
BAT3		NA	NA	NA	27.7	7.2	3.8	1.8	49.8	29.7	13.9
BAT4		NA	NA	NA	38.8	9.9	5.3	2.7	71.3	43.7	20.6
BAT5	101 [3]	NA	NA	NA	23.2	5.0	2.6	1.2	39.8	24.7	11.8
PSES1	715	NA	NA	NA	17.5	5.0	2.8	1.5	39.8	23.0	11.5
PSES2		NA	NA	NA	250.7	62.6	33.5	14.9	324.1	219.0	109.2
PSES3		NA	NA	NA	188.5	48.6	26.7	12.5	282.4	179.9	86.7
PSES4		NA	NA	NA	232.8	59.1	32.1	15.0	324.2	213.1	104.0
Total Including 65 Certainty Facilities											
BAT1	226	NA	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		NA	NA	NA	2.1	0.3	0.2	0.0	4.5	2.7	1.0
BAT3		NA	NA	NA	29.9	7.8	4.1	1.9	53.8	32.1	15.0
BAT4		NA	NA	NA	41.9	10.7	5.7	2.9	77.0	47.2	22.2
BAT5		NA	NA	NA	25.1	5.4	2.8	1.3	43.0	26.7	12.7
PSES1	772	NA	NA	NA	18.9	5.4	3.0	1.6	43.0	24.8	12.4
PSES2		NA	NA	NA	270.8	67.6	36.2	16.1	350.0	236.5	117.9
PSES3		NA	NA	NA	203.6	52.5	28.8	13.5	305.0	194.3	93.6
PSES4		NA	NA	NA	251.4	63.8	34.7	16.2	350.1	230.1	112.3

Compliance costs as a percent of facility income results are presented as the average for each subcategory, discharge type and model facility size combination, weighted by the number of facilities in each combination. Number of facilities incurring those impacts is the sum over all facility sizes by subcategory and discharge type.

[1] Ratio of pretax annualized compliance cost to revenues and EBIT; ratio of posttax annualized compliance costs to cash flow.

[2] Probability compliance costs exceed specified percentage of income measure (less probability income measure is equal to zero) multiplied by the number of facilities in the subcategory size class.

[3] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

•	Subcategory L:	costs / revenues:	0.48 percent
		exceeding 1 percent:	2.5 facilities
		exceeding 3 percent:	0.4 facilities

For indirect dischargers, PSES 2 for Subcategory L has the largest nonclosure impacts. There are a total of 208 facilities in that subcategory, of which 53 percent (110 facilities) are projected to incur compliance costs exceeding the 1 percent of revenues threshold and 11 percent (23 facilities) face costs greater than the 3 percent revenue threshold. Eighty-three facilities (40 percent of the total in the subcategory) are expected to incur costs greater than the 5 percent of cash flow threshold.

5.3.1.2 Upgrade Cost Nonclosure Impacts

Using upgrade costs instead of new equipment costs in the analysis, the projected impacts are smaller. The ratio of compliance costs to average facility revenues, and the number of facilities projected to incur compliance costs greater than 1 percent of revenues or 3 percent of revenues are:

•	Subcategory A through D:	costs / revenues:	0.09 percent
		exceeding 1 percent:	1.4 facilities
		exceeding 3 percent:	0.3 facilities
•	Subcategory E through I:	costs / revenues:	0.04 percent
		exceeding 1 percent:	0.2 facilities
		exceeding 3 percent:	0.1 facilities
•	Subcategory J:	costs / revenues:	0.17 percent
		exceeding 1 percent:	0.9 facilities
		exceeding 3 percent:	0.3 facilities
•	Subcategory K:	costs / revenues:	0.30 percent
		exceeding 1 percent:	7.6 facilities
		exceeding 3 percent:	1.7 facilities
•	Subcategory L:	costs / revenues:	0.36 percent
		exceeding 1 percent:	1.5 facilities
		exceeding 3 percent:	0.3 facilities

Results for all options and discharge types at the subcategory level are presented for upgrade costs in Table 5-11.

5.3.2 Nonclosure Impacts by Meat Type and Process Class

5.3.2.1 Upper-Bound Cost Nonclosure Impacts

Table 5-12 shows nonclosure impacts by meat type and process class, discharge type, and technology option. From this table, EPA presents the upper and lower nonclosure impacts by class within each overall subcategory average for the proposed direct discharging options (BAT 3: Subcategories A through D, E through I, K, and L, and BAT 2: Subcategory J) below. The range for the ratio of estimated compliance costs to average facility revenues in each subcategory is:

• Subcategory A through D:	costs / revenues:	0.12 percent
— red meat first processing, further processing, and rendering		0.01 percent
— red meat first processing and rendering		0.22 percent
• Subcategory E through I:	costs / revenues:	0.05 percent
— red meat further processing		0.01 percent
— mixed further processing [5]		0.27 percent
• Subcategory J	costs / revenues:	0.17 percent
— rendering		
• Subcategory K	costs / revenues:	0.43 percent
— poultry first processing		0.32 percent
— poultry first processing, further processing and rendering		0.84 percent

[5] The number of mixed further processing facilities for which compliance costs are greater than any given income threshold is allocated to Subcategory E through I and Subcategory L in the following way: 0.61 percent of them are placed in Subcategory E through I and 0.39 percent are placed in Subcategory L. For example, the number of facilities with costs greater than 1 percent of revenues in the mixed further processing class is 0.4. This number is scaled by 0.61 to estimate the number of impacted mixed meat facilities in Subcategory E through I, and by 0.39 to estimate those impacted facilities in Subcategory L. This results in 0.2 impacted facilities (rounding to the nearest tenth of a facility) allocated to each subcategory (see Section 2.2.2.1 for more detail).

Table 5-11
Nonclosure Impacts: Retrofit Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Subcategory A through D											
BAT1	66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.09%	1.07%	1.13%	1.4	0.3	0.2	0.1	5.7	3.3	1.6
BAT4		0.16%	1.99%	2.07%	2.7	0.8	0.4	0.1	10.4	6.1	2.9
PSES1	60	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.27%	3.74%	5.05%	4.5	1.2	0.7	0.2	23.5	14.7	7.0
PSES4		0.32%	4.32%	5.75%	5.5	1.6	0.8	0.4	26.9	16.7	7.9
Subcategory E through I											
BAT1	19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.04%	0.22%	0.24%	0.2	0.1	0.0	0.0	0.2	0.1	0.1
BAT4		0.17%	1.00%	1.14%	0.9	0.3	0.2	0.1	1.4	0.9	0.4
PSES1	234	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.41%	2.37%	3.09%	30.0	8.5	4.9	2.3	50.9	30.0	14.6
PSES4		0.55%	3.22%	4.20%	43.3	11.9	6.8	3.2	68.2	41.3	20.1
Subcategory J											
BAT1	21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		1.37%	4.72%	4.65%	8.0	2.4	1.4	0.7	8.5	5.0	2.4
BAT4		1.60%	5.49%	5.49%	9.2	2.8	1.6	0.8	9.9	6.0	2.8

Table 5-11 (cont.)
Nonclosure Impacts: Retrofit Costs
40 CFR 432 Subcategories

		Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
Option	Number of Facilities	Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		2.05%	7.07%	7.11%	41.2	13.3	7.7	3.7	43.3	27.8	13.3
PSES4		2.21%	7.60%	7.71%	43.5	14.5	8.3	4.0	45.6	30.1	14.5
Subcategory K											
BAT1	88	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.30%	1.85%	2.19%	7.6	1.7	1.0	0.3	16.9	9.8	4.6
BAT4		0.39%	2.39%	2.86%	10.9	2.6	1.3	0.5	22.3	13.0	6.2
BAT5		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES1	138	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.64%	3.83%	4.89%	33.2	7.1	3.7	1.6	55.8	36.0	17.2
PSES4		0.67%	4.02%	5.17%	35.5	7.6	3.8	1.7	57.8	38.0	18.3
Subcategory L											
BAT1	15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.36%	2.35%	2.52%	1.5	0.3	0.2	0.1	3.2	1.8	0.8
BAT4		0.49%	3.19%	3.44%	2.3	0.5	0.2	0.1	4.5	2.6	1.2
BAT5	13 [3]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES1	208	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.82%	5.30%	5.86%	70.9	14.7	7.7	3.5	98.3	61.4	29.2
PSES4		1.04%	6.71%	7.50%	97.4	20.3	10.4	4.7	115.9	77.9	37.9

Table 5-11 (cont.)
Nonclosure Impacts: Retrofit Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Total Excluding 65 Certainty Facilities											
BAT1	209	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		NA	NA	NA	18.7	4.8	2.8	1.2	34.5	20.0	9.5
BAT4		NA	NA	NA	26.0	7.0	3.7	1.6	48.5	28.6	13.5
BAT5	101 [3]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES1	715	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		NA	NA	NA	179.8	44.8	24.7	11.3	271.8	169.9	81.3
PSES4		NA	NA	NA	225.2	55.9	30.1	14.0	314.4	204.0	98.7
Total Including 65 Certainty Facilities											
BAT1	226	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		NA	NA	NA	20.2	5.2	3.0	1.3	37.3	21.6	10.3
BAT4		NA	NA	NA	28.1	7.6	4.0	1.7	52.4	30.9	14.6
BAT5		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES1	772	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		NA	NA	NA	194.2	48.4	26.7	12.2	293.5	183.5	87.8
PSES4		NA	NA	NA	243.2	60.4	32.5	15.1	339.6	220.3	106.6

Compliance costs as a percent of facility income results are presented as the average for each subcategory, discharge type and model facility size combination, weighted by the number of facilities in each combination.
Number of facilities incurring those impacts is the sum over all facility sizes by subcategory and discharge type.
[1] Ratio of pretax annualized compliance cost to revenues and EBIT; ratio of posttax annualized compliance costs to cash flow.
[2] Probability compliance costs exceed specified percentage of income measure (less probability income measure is equal to zero) multiplied by the number of facilities in the subcategory size class.
[3] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

Table 5-12
Nonclosure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Red Meat First Processing (Subcategory A - D)											
BAT1	6	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT3		0.02%	0.21%	0.21%	0.0	0.0	0.0	0.0	0.1	0.1	0.0
BAT4		0.27%	3.40%	3.74%	0.4	0.1	0.1	0.0	1.8	1.0	0.5
Red Meat Further Processing (Subcategory E - I)											
BAT1	12	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.01%	0.04%	0.06%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT3		0.01%	0.05%	0.07%	0.0	0.0	0.0	0.0	0.1	0.0	0.0
BAT4		0.21%	1.20%	1.83%	0.6	0.2	0.1	0.1	1.5	0.8	0.4
PSES1	168	0.07%	0.40%	0.60%	2.8	0.9	0.5	0.3	6.6	3.9	1.9
PSES2		0.27%	1.57%	2.42%	12.6	3.7	2.2	1.1	28.9	16.8	8.1
PSES3		0.26%	1.50%	2.32%	12.0	3.6	2.1	1.0	27.6	16.0	7.9
PSES4		0.33%	1.91%	2.99%	15.8	4.6	2.7	1.3	36.1	21.0	10.2
Red Meat First and Further Processing (Subcategory A - D)											
PSES1	28	0.02%	0.38%	0.60%	0.1	0.0	0.0	0.0	1.3	0.7	0.4
PSES2		0.39%	6.15%	9.58%	3.2	0.8	0.5	0.2	18.9	13.3	6.6
PSES3		0.29%	4.47%	7.16%	2.1	0.6	0.3	0.2	15.9	10.1	4.8
PSES4		0.29%	4.52%	7.27%	2.1	0.6	0.3	0.2	16.1	10.2	4.9
Red Meat First Processing and Rendering (Subcategory A - D)											
BAT1	36	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.02%	0.25%	0.25%	0.1	0.0	0.0	0.0	0.6	0.4	0.1
BAT3		0.22%	2.63%	2.91%	2.1	0.6	0.3	0.1	8.1	4.8	2.3
BAT4		0.25%	3.00%	3.33%	2.5	0.7	0.3	0.1	9.2	5.5	2.7

Table 5-12 (continued)
Nonclosure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	15	0.02%	0.24%	0.26%	0.0	0.0	0.0	0.0	0.3	0.1	0.0
PSES2		0.61%	7.36%	8.14%	3.6	0.8	0.5	0.1	7.0	5.2	2.9
PSES3		0.39%	4.73%	5.26%	1.9	0.5	0.3	0.1	5.5	3.6	1.8
PSES4		0.39%	4.65%	5.19%	1.9	0.5	0.3	0.1	5.5	3.6	1.7
Red Meat Further Processing and Rendering (Subcategory E - I)											
BAT1	4	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.03%	0.18%	0.18%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT3		0.02%	0.10%	0.10%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT4		0.38%	2.34%	2.58%	0.4	0.1	0.1	0.0	0.7	0.4	0.2
PSES1	7	0.07%	0.41%	0.44%	0.1	0.0	0.0	0.0	0.2	0.1	0.1
PSES2		0.80%	4.93%	5.27%	1.9	0.5	0.3	0.1	2.5	1.5	0.7
PSES3		0.49%	3.04%	3.34%	1.1	0.3	0.2	0.1	1.6	0.9	0.4
PSES4		0.55%	3.37%	3.71%	1.2	0.3	0.2	0.1	1.8	1.0	0.5
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)											
BAT1	24	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.03%	0.31%	0.31%	0.1	0.0	0.0	0.0	0.5	0.3	0.2
BAT3		0.01%	0.14%	0.15%	0.0	0.0	0.0	0.0	0.3	0.2	0.0
BAT4		0.29%	3.53%	3.92%	1.9	0.5	0.3	0.2	7.3	4.4	2.0
PSES1	17	0.02%	0.28%	0.32%	0.0	0.0	0.0	0.0	0.3	0.2	0.1
PSES2		0.43%	5.17%	5.60%	2.3	0.5	0.3	0.2	7.2	4.4	2.1
PSES3		0.24%	2.96%	3.28%	1.0	0.3	0.2	0.1	4.3	2.6	1.3
PSES4		0.44%	5.37%	6.00%	2.3	0.6	0.3	0.2	7.8	4.8	2.3

Table 5-12 (continued)
Nonclosure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Poultry First Processing (Subcategory K)											
BAT1	49	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.03%	0.16%	0.19%	0.2	0.0	0.0	0.0	0.8	0.4	0.1
BAT3		0.32%	1.95%	2.61%	4.3	1.1	0.6	0.2	11.6	6.7	3.1
BAT4		0.41%	2.51%	3.38%	6.1	1.4	0.7	0.4	14.7	8.9	4.1
BAT5		0.45%	2.73%	3.69%	7.0	1.6	0.9	0.4	15.9	9.7	4.7
PSES1	92	0.07%	0.41%	0.54%	1.2	0.4	0.2	0.1	4.0	2.3	1.2
PSES2		0.75%	4.57%	6.06%	28.1	5.7	3.0	1.3	41.8	29.5	14.7
PSES3		0.59%	3.57%	4.78%	19.4	4.1	2.2	1.0	36.2	23.7	11.4
PSES4		0.61%	3.73%	5.03%	20.8	4.3	2.3	1.1	37.3	24.8	12.2
Poultry Further Processing (Subcategory L)											
BAT1	13	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.05%	0.32%	0.33%	0.1	0.0	0.0	0.0	0.3	0.2	0.1
BAT3		0.52%	3.40%	3.81%	2.3	0.4	0.2	0.1	4.4	2.5	1.1
BAT4		0.69%	4.53%	5.10%	3.5	0.7	0.3	0.2	5.7	3.5	1.6
BAT5		0.75%	4.95%	5.61%	4.0	0.8	0.4	0.2	6.2	3.8	1.8
PSES1	155	0.20%	1.35%	1.45%	7.3	2.0	1.1	0.5	18.1	10.4	5.1
PSES2		1.20%	7.91%	8.59%	90.3	18.2	8.9	3.7	95.6	68.1	34.0
PSES3		0.86%	5.71%	6.28%	58.4	11.4	5.9	2.6	80.2	50.8	24.1
PSES4		1.07%	7.07%	7.86%	78.8	15.4	7.7	3.3	92.0	63.1	30.8
Poultry First and Further Processing (Subcategory K)											
BAT1	16	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.04%	0.21%	0.24%	0.1	0.0	0.0	0.0	0.2	0.2	0.0
BAT3		0.35%	2.10%	2.68%	1.5	0.4	0.2	0.1	3.8	2.1	1.1
BAT4		0.53%	3.15%	4.06%	2.7	0.5	0.3	0.2	5.9	3.5	1.6
BAT5		0.57%	3.43%	4.45%	3.1	0.7	0.4	0.2	6.4	3.8	1.8

Table 5-12 (continued)
Nonclosure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	29	0.01%	0.04%	0.05%	0.0	0.0	0.0	0.0	0.1	0.0	0.0
PSES2		0.66%	3.90%	4.73%	7.0	1.4	0.8	0.3	12.4	7.3	3.5
PSES3		0.57%	3.39%	4.31%	5.6	1.2	0.7	0.3	11.3	6.7	3.1
PSES4		0.59%	3.53%	4.52%	5.9	1.3	0.8	0.3	11.8	7.0	3.2
Poultry First Processing and Rendering (Subcategory K)											
BAT1	17	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.07%	0.42%	0.42%	0.2	0.0	0.0	0.0	0.5	0.3	0.1
BAT3		0.65%	4.06%	4.43%	4.3	0.9	0.4	0.2	6.2	3.8	1.8
BAT4		0.83%	5.17%	5.65%	6.0	1.3	0.6	0.3	7.3	4.9	2.4
BAT5		0.89%	5.56%	6.12%	6.6	1.4	0.7	0.3	7.8	5.3	2.6
PSES1	5	0.02%	0.15%	0.14%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PSES2		2.36%	14.51%	15.45%	4.3	1.6	0.8	0.3	3.6	3.0	2.0
PSES3		1.25%	7.77%	8.48%	2.8	0.6	0.3	0.1	2.8	2.1	1.0
PSES4		1.28%	7.96%	8.72%	2.9	0.7	0.3	0.1	2.9	2.1	1.0
Poultry Further Processing and Rendering (Subcategory L)											
PSES1	15	0.04%	0.22%	0.28%	0.1	0.0	0.0	0.0	0.3	0.2	0.1
PSES2		0.56%	3.34%	4.17%	3.0	0.6	0.3	0.2	5.7	3.3	1.5
PSES3		0.40%	2.39%	3.13%	1.7	0.4	0.2	0.1	4.2	2.4	1.1
PSES4		0.42%	2.53%	3.33%	1.8	0.4	0.2	0.2	4.6	2.6	1.3
Poultry First Processing, Further Processing, and Rendering (Subcategory K)											
BAT1	6	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.11%	0.63%	0.67%	0.1	0.0	0.0	0.0	0.3	0.2	0.0
BAT3		0.84%	4.90%	5.96%	2.1	0.4	0.2	0.1	3.1	2.0	0.9
BAT4		0.86%	5.01%	6.14%	2.1	0.4	0.2	0.1	3.3	2.0	0.9
BAT5		0.93%	5.43%	6.68%	2.5	0.5	0.2	0.1	3.5	2.1	0.9

Table 5-12 (continued)
Nonclosure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	12	0.10%	0.57%	0.67%	0.1	0.0	0.0	0.0	0.6	0.4	0.2
PSES2		2.41%	13.75%	15.69%	10.6	4.0	1.9	0.7	9.1	8.4	5.0
PSES3		1.34%	7.64%	8.98%	7.8	1.6	0.7	0.4	8.2	5.7	2.8
PSES4		1.33%	7.60%	8.98%	7.7	1.5	0.7	0.4	8.2	5.7	2.8
Mixed Further Processing (61 percent in Subcategory E - I, 39 percent in Subcategory L))											
BAT1	5	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.04%	0.25%	0.25%	0.1	0.0	0.0	0.0	0.1	0.0	0.0
BAT3		0.27%	1.54%	1.68%	0.4	0.1	0.1	0.0	0.6	0.3	0.2
BAT4		0.72%	4.20%	4.64%	1.2	0.3	0.2	0.1	1.6	1.0	0.5
PSES1	97	0.14%	0.83%	0.90%	3.6	1.1	0.7	0.3	5.7	3.4	1.7
PSES2		1.19%	6.92%	7.44%	43.1	11.4	6.4	3.0	48.5	30.5	14.8
PSES3		0.83%	4.80%	5.27%	27.8	7.5	4.2	2.0	35.8	21.4	10.3
PSES4		1.20%	6.93%	7.73%	43.2	11.5	6.4	3.0	49.9	31.6	15.4
Rendering (Subcategory J)											
BAT1	21	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.17%	0.60%	0.56%	0.9	0.3	0.2	0.0	0.9	0.5	0.3
BAT3		1.85%	6.38%	6.55%	10.7	3.3	1.8	1.0	11.5	7.2	3.4
BAT4		2.02%	6.95%	7.16%	11.4	3.7	2.1	1.0	12.3	7.8	3.7
PSES1	75	0.12%	0.41%	0.41%	2.2	0.6	0.3	0.3	2.3	1.3	0.7
PSES2		2.04%	7.07%	7.13%	40.7	13.4	7.6	3.7	42.9	27.7	13.3
PSES3		2.47%	8.54%	8.78%	46.9	16.5	9.4	4.5	48.8	33.9	16.7
PSES4		2.60%	8.96%	9.25%	48.4	17.4	9.9	4.7	50.2	35.6	17.7

Table 5-12 (continued)
Nonclosure Impacts: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Total Excluding 65 Certainty Facilities											
BAT1	209	NA	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		NA	NA	NA	1.9	0.3	0.2	0.0	4.2	2.5	0.9
BAT3		NA	NA	NA	27.7	7.2	3.8	1.8	49.8	29.7	13.9
BAT4		NA	NA	NA	38.8	9.9	5.3	2.7	71.3	43.7	20.6
BAT5	101 [3]	NA	NA	NA	23.2	5.0	2.6	1.2	39.8	24.7	11.8
PSES1	715	NA	NA	NA	17.5	5.0	2.8	1.5	39.8	23.0	11.5
PSES2		NA	NA	NA	250.7	62.6	33.5	14.9	324.1	219.0	109.2
PSES3		NA	NA	NA	188.5	48.6	26.7	12.5	282.4	179.9	86.7
PSES4		NA	NA	NA	232.8	59.1	32.1	15.0	324.2	213.1	104.0
Total Including 65 Certainty Facilities											
BAT1	226	NA	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		NA	NA	NA	2.1	0.3	0.2	0.0	4.5	2.7	1.0
BAT3		NA	NA	NA	29.9	7.8	4.1	1.9	53.8	32.1	15.0
BAT4		NA	NA	NA	41.9	10.7	5.7	2.9	77.0	47.2	22.2
BAT5		NA	NA	NA	25.1	5.4	2.8	1.3	43.0	26.7	12.7
PSES1	772	NA	NA	NA	18.9	5.4	3.0	1.6	43.0	24.8	12.4
PSES2		NA	NA	NA	270.8	67.6	36.2	16.1	350.0	236.5	117.9
PSES3		NA	NA	NA	203.6	52.5	28.8	13.5	305.0	194.3	93.6
PSES4		NA	NA	NA	251.4	63.8	34.7	16.2	350.1	230.1	112.3

Compliance costs as a percent of facility income results are presented as the average for each meat type and process class, discharge type and model facility size combination, weighted by the number of facilities in each combination.
Number of facilities incurring those impacts is the sum over all facility sizes by class and discharge type.
[1] Ratio of pretax annualized compliance cost to revenues and EBIT; ratio of posttax annualized compliance costs to cash flow.
[2] Probability compliance costs exceed specified percentage of income measure (less probability income measure is equal to zero) multiplied by the number of facilities in the meat type and process size class.
[3] Option BAT 5 is only found in Poultry operations.

•	Subcategory L:	costs / revenues:	0.48 percent
	— mixed further processing		0.27 percent
	— poultry further processing		0.52 percent

5.3.2.2 Upgrade Cost Nonclosure Impacts

Table 5-13 contains the results of the nonclosure impact analysis by meat type and process class, discharge type, and technology option for retrofit or upgrade costs. From this table, EPA presents the upper and lower nonclosure impacts by class within each overall subcategory average for the proposed direct discharging options (BAT 3: Subcategories A through D, E through I, K, and L, and BAT 2: Subcategory J) below. Using upgrade costs instead of new equipment costs in the analysis, the range for the ratio of estimated compliance costs to average facility revenues in each subcategory is:

•	Subcategory A through D:	costs / revenues:	0.09 percent
	— red meat first processing, further processing, and rendering		0.01 percent
	— red meat first processing and rendering		0.15 percent
•	Subcategory E through I:	costs / revenues:	0.04 percent
	— red meat further processing		0.01 percent
	— mixed further processing		0.19 percent
•	Subcategory J	costs / revenues:	0.17 percent
	— rendering		
•	Subcategory K	costs / revenues:	0.30 percent
	— poultry first processing		0.23 percent
	— poultry first processing, further processing and rendering		0.60 percent
•	Subcategory L:	costs / revenues:	0.36 percent
	— mixed further processing		0.19 percent
	— poultry further processing		0.38 percent

Table 5-13
Nonclosure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Red Meat First Processing (Subcategory A - D)											
BAT1	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.02%	0.21%	0.21%	0.0	0.0	0.0	0.0	0.1	0.1	0.0
BAT4		0.14%	1.84%	1.83%	0.2	0.1	0.0	0.0	0.8	0.5	0.2
Red Meat Further Processing (Subcategory E - I)											
BAT1	12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.01%	0.04%	0.06%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT4		0.10%	0.61%	0.83%	0.3	0.1	0.1	0.0	0.6	0.4	0.2
PSES1	168	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.26%	1.50%	2.32%	12.0	3.6	2.1	1.0	27.6	16.0	7.9
PSES4		0.33%	1.91%	2.99%	15.8	4.6	2.7	1.3	36.1	21.0	10.2
Red Meat First and Further Processing (Subcategory A - D)											
PSES1	28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.27%	4.16%	6.61%	1.9	0.5	0.3	0.1	15.0	9.3	4.4
PSES4		0.27%	4.29%	6.87%	2.0	0.6	0.3	0.2	15.5	9.7	4.6
Red Meat First Processing and Rendering (Subcategory A - D)											
BAT1	36	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.15%	1.85%	1.96%	1.4	0.3	0.2	0.1	5.4	3.1	1.6
BAT4		0.19%	2.28%	2.45%	1.8	0.5	0.3	0.1	6.8	4.0	1.9

Table 5-13 (continued)
Nonclosure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.39%	4.73%	5.26%	1.9	0.5	0.3	0.1	5.5	3.6	1.8
PSES4		0.39%	4.65%	5.19%	1.9	0.5	0.3	0.1	5.5	3.6	1.7
Red Meat Further Processing and Rendering (Subcategory E - I)											
BAT1	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.01%	0.08%	0.08%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT4		0.18%	1.09%	1.06%	0.2	0.1	0.0	0.0	0.3	0.2	0.1
PSES1	7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.46%	2.84%	3.09%	1.0	0.3	0.2	0.1	1.5	0.9	0.4
PSES4		0.52%	3.19%	3.50%	1.1	0.3	0.2	0.1	1.7	1.0	0.5
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)											
BAT1	24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.01%	0.12%	0.12%	0.0	0.0	0.0	0.0	0.2	0.1	0.0
BAT4		0.13%	1.59%	1.56%	0.7	0.2	0.1	0.0	2.8	1.6	0.8
PSES1	17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.18%	2.16%	2.30%	0.7	0.2	0.1	0.0	3.0	1.8	0.8
PSES4		0.34%	4.05%	4.39%	1.6	0.5	0.2	0.1	5.9	3.4	1.6

Table 5-13 (continued)
Nonclosure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Poultry First Processing (Subcategory K)											
BAT1	49	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.23%	1.39%	1.78%	2.7	0.7	0.4	0.2	7.7	4.5	2.1
BAT4		0.30%	1.80%	2.32%	3.9	0.9	0.6	0.2	10.2	6.0	2.8
BAT5		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES1	92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.57%	3.46%	4.63%	18.6	4.0	2.1	0.9	35.5	23.0	11.0
PSES4		0.60%	3.65%	4.91%	20.2	4.3	2.2	1.0	36.7	24.3	11.8
Poultry Further Processing (Subcategory L)											
BAT1	13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.38%	2.53%	2.72%	1.4	0.3	0.2	0.1	3.0	1.7	0.8
BAT4		0.50%	3.31%	3.59%	2.1	0.4	0.2	0.1	4.2	2.4	1.1
BAT5		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES1	155	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.86%	5.71%	6.28%	58.4	11.4	5.9	2.6	80.2	50.8	24.1
PSES4		1.07%	7.07%	7.86%	78.8	15.4	7.7	3.3	92.0	63.1	30.8
Poultry First and Further Processing (Subcategory K)											
BAT1	16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.25%	1.51%	1.85%	1.0	0.2	0.2	0.0	2.6	1.4	0.7
BAT4		0.36%	2.13%	2.62%	1.5	0.4	0.2	0.1	3.8	2.1	1.1
BAT5		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 5-13 (continued)
Nonclosure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.48%	2.86%	3.58%	4.3	1.0	0.6	0.2	9.5	5.4	2.6
PSES4		0.52%	3.07%	3.88%	4.8	1.1	0.6	0.2	10.1	5.9	2.8
Poultry First Processing and Rendering (Subcategory K)											
BAT1	17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.47%	2.90%	3.04%	2.7	0.5	0.3	0.1	4.4	2.6	1.2
BAT4		0.60%	3.77%	3.98%	3.9	0.9	0.4	0.2	5.7	3.4	1.6
BAT5		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES1	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		1.25%	7.77%	8.48%	2.8	0.6	0.3	0.1	2.8	2.1	1.0
PSES4		1.28%	7.96%	8.72%	2.9	0.7	0.3	0.1	2.9	2.1	1.0
Poultry Further Processing and Rendering (Subcategory L)											
PSES1	15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.38%	2.30%	3.00%	1.7	0.4	0.2	0.1	4.1	2.3	1.1
PSES4		0.41%	2.46%	3.23%	1.8	0.4	0.2	0.2	4.4	2.5	1.1
Poultry First Processing, Further Processing, and Rendering (Subcategory K)											
BAT1	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.60%	3.47%	4.05%	1.2	0.3	0.1	0.0	2.2	1.3	0.6
BAT4		0.69%	4.00%	4.76%	1.6	0.4	0.1	0.0	2.6	1.5	0.7
BAT5		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 5-13 (continued)
Nonclosure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		1.29%	7.39%	8.65%	7.5	1.5	0.7	0.4	8.0	5.5	2.6
PSES4		1.31%	7.51%	8.85%	7.6	1.5	0.7	0.4	8.1	5.7	2.7
Mixed Further Processing (61 percent in Subcategory E - I, 39 percent in Subcategory L)											
BAT1	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		0.19%	1.13%	1.18%	0.3	0.1	0.0	0.0	0.4	0.2	0.1
BAT4		0.41%	2.39%	2.46%	0.6	0.2	0.1	0.1	0.8	0.5	0.2
PSES1	97	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		0.83%	4.80%	5.27%	27.8	7.5	4.2	2.0	35.8	21.4	10.3
PSES4		1.20%	6.93%	7.73%	43.2	11.5	6.4	3.0	49.9	31.6	15.4
Rendering (Subcategory J)											
BAT1	21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		1.37%	4.72%	4.65%	8.0	2.4	1.4	0.7	8.5	5.0	2.4
BAT4		1.60%	5.49%	5.49%	9.2	2.8	1.6	0.8	9.9	6.0	2.8
PSES1	75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		2.05%	7.07%	7.11%	41.2	13.3	7.7	3.7	43.3	27.8	13.3
PSES4		2.21%	7.60%	7.71%	43.5	14.5	8.3	4.0	45.6	30.1	14.5

Table 5-13 (continued)
Nonclosure Impacts: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Total Excluding 65 Certainty Facilities											
BAT1	209	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		NA	NA	NA	18.7	4.8	2.8	1.2	34.5	20.0	9.5
BAT4		NA	NA	NA	26.0	7.0	3.7	1.6	48.5	28.6	13.5
BAT5	101 [3]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES1	715	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		NA	NA	NA	179.8	44.8	24.7	11.3	271.8	169.9	81.3
PSES4		NA	NA	NA	225.2	55.9	30.1	14.0	314.4	204.0	98.7
Total Including 65 Certainty Facilities											
BAT1	226	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BAT3		NA	NA	NA	20.2	5.2	3.0	1.3	37.3	21.6	10.3
BAT4		NA	NA	NA	28.1	7.6	4.0	1.7	52.4	30.9	14.6
BAT5		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES1	772	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES2		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PSES3		NA	NA	NA	194.2	48.4	26.7	12.2	293.5	183.5	87.8
PSES4		NA	NA	NA	243.2	60.4	32.5	15.1	339.6	220.3	106.6

Compliance costs as a percent of facility income results are presented as the average for each meat type and process class, discharge type and model facility size combination, weighted by the number of facilities in each combination.
Number of facilities incurring those impacts is the sum over all facility sizes by subcategory and discharge type.
[1] Ratio of pretax annualized compliance cost to revenues and EBIT; ratio of posttax annualized compliance costs to cash flow.
[2] Probability compliance costs exceed specified percentage of income measure (less probability income measure is equal to zero) multiplied by the number of facilities in the meat type and process size class.
[3] Option BAT 5 is only found in Poultry operations.

5.4 FINANCIAL RATIO ANALYSIS

EPA also examined the impact of the proposed ELG on the model establishment's balance sheet as well as its income statement, using the methodology outlined in Section 3.1.3. As explained in that section, return on assets (ROA) was used as the financial ratio to indicate firm profitability. ROA provides a reflection of the opportunity cost of investing in the meat product industry. Investors look for their best opportunity to receive a high rate of return on their capital. If the proposed ELG significantly lowers the rate of return earned in the meat products industry, investors may exit that market in search of better opportunities; the meat products industry would therefore tend to contract.

5.4.1 Financial Ratio Analysis by Subcategory

5.4.1.1 Upper-Bound Cost Financial Ratio Analysis

Table 5-14 displays median ROA, model facility net income, estimated model facility total assets, the post-compliance ROA, and the percent change in ROA as an impact of the proposed rule by subcategory and technology option. EPA presents impacts in terms of the percent change from baseline ROA to post-compliance ROA. The greatest change in ROA is witnessed under BAT 4 in Subcategory J: the baseline ROA is 2 percent and the post-compliance ROA is 1.8 percent, resulting in a 10 percent drop in ROA due to compliance costs. For the proposed options (BAT 2 for Subcategory J and BAT 3 for all others), the subcategories have the following percentage change in ROA:

- Subcategory A through D: -2.6 percent
- Subcategory E through I: -0.5 percent
- Subcategory J: -0.7 percent
- Subcategory K: -4.5 percent
- Subcategory L: -4.8 percent

Table 5-14
Impacts to Return on Assets Ratio: Upper-Bound Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Model Facility [1] Net Income (x $1,000)	Model Facility [1] Total Assets (x $1,000)	Baseline Return on Assets [2] Median	Baseline Return on Assets [2] Lower Quartile	Post-Compliance ROA [3]	Percent Change ROA [4]
Subcategory A through D							
BAT1	66	$26,901	$507,564	5.3%	2.2%	5.30%	0.00%
BAT2						5.28%	-0.31%
BAT3						5.16%	-2.60%
BAT4						5.00%	-5.68%
PSES1	60	$17,963	$338,932	5.3%	2.2%	5.26%	-0.78%
PSES2						4.60%	-13.29%
PSES3						4.78%	-9.80%
PSES4						4.71%	-11.15%
Subcategory E through I							
BAT1	19	$8,558	$155,592	5.5%	1.3%	5.50%	0.00%
BAT2						5.49%	-0.14%
BAT3						5.47%	-0.54%
BAT4						5.28%	-4.05%
PSES1	234	$6,370	$115,819	5.5%	1.3%	5.44%	-1.05%
PSES2						5.17%	-3.15%
PSES3						5.22%	-5.08%
PSES4						5.11%	-7.05%
Subcategory J							
BAT1	21	$2,080	$104,002	2.0%	-0.5%	2.00%	0.00%
BAT2						1.99%	-0.68%
BAT3						1.82%	-9.03%
BAT4						1.80%	-9.90%
PSES1	75	$2,076	$103,801	2.0%	-0.5%	1.99%	-0.54%
PSES2						1.81%	-9.70%
PSES3						1.76%	-12.12%
PSES4						1.74%	-12.79%

Table 5-14 (cont.)
Impacts to Return on Assets Ratio: Upper-Bound Costs
40 CFR 432 Subcategories

Option	Number of Facilities	Model Facility [1] Net Income (x $1,000)	Total Assets (x $1,000)	Baseline Return on Assets [2] Median	Lower Quartile	Post-Compliance ROA [3]	Percent Change ROA [4]
Subcategory K							
BAT1	88	$12,016	$600,816	2.0%	-0.5%	2.00%	0.00%
BAT2						1.99%	-0.34%
BAT3						1.91%	-4.54%
BAT4						1.88%	-5.88%
BAT5						1.87%	-6.43%
PSES1	138	$12,305	$615,266	2.0%	-0.5%	1.99%	-0.62%
PSES2						1.81%	-9.72%
PSES3						1.85%	-7.43%
PSES4						1.84%	-7.77%
Subcategory L							
BAT1	15	$4,655	$214,016	2.5%	-0.3%	2.46%	0.00%
BAT2						2.45%	-0.39%
BAT3						2.35%	-4.84%
BAT4						2.28%	-7.02%
BAT5	13 [5]	$4,676	$233,818	2.0%	-0.5%	1.85%	-7.63%
PSES1	208	$4,493	$198,535	2.6%	-0.2%	2.59%	-1.71%
PSES2						2.34%	-10.93%
PSES3						2.42%	-8.16%
PSES4						2.34%	-10.58%

Aggregating impacts to account for the 65 certainty facilities is not applicable for these impacts
All impacts presented in this table are the average of results for each subcategory, discharge type and model facility size combination, weighted by the number of facilities in each combination.
[1] Model facility net income calculated from Census data; model facility total assets calculated as (net income/median ROA) = total assets.
[2] Source: Dun & Bradstreet. Industry Norms and Key Business Ratios, 1997-98. Median and lower quartile Return on Assets ratios.
[3] Calculated as: (Net Income - Posttax Annualized Costs)/(Total Assets + Capital Costs).
[4] Calculated as: (Postcompliance ROA - Baseline ROA)/Baseline ROA.
[5] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

For indirect dischargers under PSES 2 in Subcategory A through D, the percentage drop in ROA is 13 percent — the largest among the indirect subcategories. The baseline ROA is 5.3 percent and the post-compliance ROA is 4.6 percent.

5.4.1.2 Upgrade Cost Financial Ratio Analysis

Table 5-15 presents ROA impacts with the use of upgrade costs in place of new equipment costs. The percentage change in ROA for the proposed options (BAT 2 for Subcategory J and BAT 3 for all others) are as follows:

- Subcategory A through D: -1.6 percent
- Subcategory E through I: -0.4 percent
- Subcategory J: -0.7 percent
- Subcategory K: -3.0 percent
- Subcategory L: -3.3 percent

Using upgrade costs, projected impacts to model facility ROA range from about 25 percent smaller for Subcategory E through I to 50 percent smaller in Subcategory K.

5.4.2 Financial Ratio Analysis by Meat Type and Process Class

5.4.2.1 Upper-Bound Cost Financial Ratio Analysis

A summary of impacts on ROA for meat type and process classes in presented in Table 5-16. For direct dischargers, BAT 4 in the Rendering class sees the largest decrease in ROA of almost 10 percent. Results for the proposed direct discharging options (BAT 3 for all classes except rendering for which the proposed option is BAT 2), are relatively lower. The range of percentage change in ROA for the proposed options by component class within the subcategories are as follows:

Table 5-15
Impacts to Return on Assets Ratio: Retrofit Costs
40 CFR 432 Subcategories

Number of Facilities	Option	Model Facility [1] Net Income (x $1,000)	Model Facility [1] Total Assets (x $1,000)	Baseline Return on Assets [2] Median	Baseline Return on Assets [2] Lower Quartile	Post-Compliance ROA [3]	Percent Change ROA [4]
Subcategory A through D							
66	BAT1	$26,901	$507,564	5.3%	2.2%	NA	NA
	BAT2					NA	NA
	BAT3					5.21%	-1.62%
	BAT4					5.15%	-2.84%
60	PSES1	$17,963	$338,932	5.3%	2.2%	NA	NA
	PSES2					NA	NA
	PSES3					4.84%	-8.73%
	PSES4					4.77%	-9.92%
Subcategory E through I							
19	BAT1	$8,558	$155,592	5.5%	1.3%	NA	NA
	BAT2					NA	NA
	BAT3					5.48%	-0.36%
	BAT4					5.42%	-1.45%
234	PSES1	$6,370	$115,819	5.5%	1.3%	NA	NA
	PSES2					NA	NA
	PSES3					5.22%	-5.06%
	PSES4					5.11%	-7.04%
Subcategory J							
21	BAT1	$2,080	$104,002	2.0%	-0.5%	NA	NA
	BAT2					NA	NA
	BAT3					1.88%	-6.16%
	BAT4					1.85%	-7.40%
75	PSES1	$2,076	$103,801	2.0%	-0.5%	NA	NA
	PSES2					NA	NA
	PSES3					1.81%	-9.63%
	PSES4					1.79%	-10.50%

Table 5-15 (cont.)
Impacts to Return on Assets Ratio: Retrofit Costs
40 CFR 432 Subcategories

Number of Facilities	Option	Model Facility [1] Net Income (x $1,000)	Model Facility [1] Total Assets (x $1,000)	Baseline Return on Assets [2] Median	Baseline Return on Assets [2] Lower Quartile	Post-Compliance ROA [3]	Percent Change ROA [4]
Subcategory K							
88	BAT1	$12,016	$600,816	2.0%	-0.5%	NA	NA
	BAT2					NA	NA
	BAT3					1.94%	-2.98%
	BAT4					1.92%	-3.93%
	BAT5					NA	NA
138	PSES1	$12,305	$615,266	2.0%	-0.5%	NA	NA
	PSES2					NA	NA
	PSES3					1.86%	-6.99%
	PSES4					1.85%	-7.42%
Subcategory L							
15	BAT1	$4,655	$214,016	2.5%	-0.3%	NA	NA
	BAT2					NA	NA
	BAT3					2.38%	-3.29%
	BAT4					2.35%	-4.51%
13 [5]	BAT5	$4,676	$233,818	2.0%	-0.5%	NA	NA
208	PSES1	$4,493	$198,535	2.6%	-0.2%	NA	NA
	PSES2					NA	NA
	PSES3					2.42%	-8.14%
	PSES4					2.34%	-10.57%

Aggregating impacts to account for the 65 certainty facilities is not applicable for these impacts
All impacts presented in this table are the average of results for each subcategory, discharge type and model facility size combination, weighted by the number of facilities in each combination.
[1] Model facility net income calculated from Census data; model facility total assets calculated as (net income/median ROA) = total assets.
[2] Source: Dun & Bradstreet. Industry Norms and Key Business Ratios, 1997-98. Median and lower quartile Return on Assets ratios.
[3] Calculated as: (Net Income - Posttax Annualized Costs)/(Total Assets + Capital Costs).
[4] Calculated as: (Postcompliance ROA - Baseline ROA)/Baseline ROA.
[5] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

Table 5-16
Impacts to Return on Assets Ratio: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Model Facility [1]		Baseline Return on Assets [2]		Post-Compliance ROA [3]	Percent Change ROA [4]
		Net Income (x $1,000)	Total Assets (x $1,000)	Median	Lower Quartile		
Red Meat First Processing (Subcategory A - D)							
BAT1	6	$2,696.1	$50,870.6	5.3%	2.2%	5.30%	0.00%
BAT2						5.30%	0.00%
BAT3						5.29%	-0.25%
BAT4						4.98%	-5.98%
Red Meat Further Processing (Subcategory E - I)							
BAT1	12	$7,650.9	$139,107.7	5.5%	1.3%	5.50%	0.00%
BAT2						5.50%	-0.08%
BAT3						5.49%	-0.10%
BAT4						5.33%	-3.02%
PSES1	168	$6,692.0	$121,672.2	5.5%	1.3%	5.45%	-0.91%
PSES2						5.29%	-3.91%
PSES3						5.29%	-3.78%
PSES4						5.23%	-4.98%
Red Meat First and Further Processing (Subcategory A - D)							
PSES1	28	$4,982.8	$94,015.5	5.3%	2.2%	5.24%	-1.13%
PSES2						4.41%	-16.78%
PSES3						4.59%	-13.43%
PSES4						4.57%	-13.72%
Red Meat First Processing and Rendering (Subcategory A - D)							
BAT1	36	$29,321.4	$553,233.8	5.3%	2.2%	5.30%	0.00%
BAT2						5.28%	-0.32%
BAT3						5.06%	-4.59%
BAT4						5.02%	-5.26%
PSES1	15	$29,321.4	$553,233.8	5.3%	2.2%	5.28%	-0.42%
PSES2						4.65%	-12.35%
PSES3						4.86%	-8.24%
PSES4						4.87%	-8.18%
Red Meat Further Processing and Rendering (Subcategory E - I)							
BAT1	4	$14,363.6	$261,155.9	5.5%	1.3%	5.50%	0.00%
BAT2						5.49%	-0.22%
BAT3						5.49%	-0.14%
BAT4						5.27%	-4.25%

Table 5-16 (cont.)
Impacts to Return on Assets Ratio: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Model Facility [1] Net Income (x $1,000)	Model Facility [1] Total Assets (x $1,000)	Baseline Return on Assets [2] Median	Baseline Return on Assets [2] Lower Quartile	Post-Compliance ROA [3]	Percent Change ROA [4]
PSES1	7	$14,363.6	$261,155.9	5.5%	1.3%	5.46%	-0.71%
PSES2						5.06%	-8.04%
PSES3						5.20%	-5.47%
PSES4						5.16%	-6.12%
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)							
BAT1	24	$29,321.4	$553,233.8	5.3%	2.2%	5.30%	0.00%
BAT2						5.28%	-0.36%
BAT3						5.29%	-0.21%
BAT4						4.97%	-6.23%
PSES1	17	$29,321.4	$553,233.8	5.3%	2.2%	5.27%	-0.51%
PSES2						4.86%	-8.35%
PSES3						5.02%	-5.19%
PSES4						4.79%	-9.54%
Poultry First Processing (Subcategory K)							
BAT1	49	$12,333.9	$616,696.9	2.0%	-0.5%	2.00%	0.00%
BAT2						2.00%	-0.24%
BAT3						1.92%	-3.80%
BAT4						1.90%	-4.94%
BAT5						1.89%	-5.41%
PSES1	92	$12,321.9	$616,094.5	2.0%	-0.5%	1.98%	-0.78%
PSES2						1.83%	-8.68%
PSES3						1.86%	-6.96%
PSES4						1.85%	-7.33%
Poultry Further Processing (Subcategory L)							
BAT1	13	$4,676.4	$233,817.9	2.0%	-0.5%	2.00%	0.00%
BAT2						1.99%	-0.41%
BAT3						1.90%	-5.14%
BAT4						1.86%	-6.91%
BAT5						1.85%	-7.63%
PSES1	155	$4,062.7	$203,135.5	2.0%	-0.5%	1.96%	-1.90%
PSES2						1.78%	-11.25%
PSES3						1.83%	-8.38%
PSES4						1.79%	-10.54%

Table 5-16 (cont.)
Impacts to Return on Assets Ratio: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Model Facility [1] Net Income (x $1,000)	Model Facility [1] Total Assets (x $1,000)	Baseline Return on Assets [2] Median	Baseline Return on Assets [2] Lower Quartile	Post-Compliance ROA [3]	Percent Change ROA [4]
Poultry First and Further Processing (Subcategory K)							
BAT1	16	$11,952.9	$597,645.2	2.0%	-0.5%	2.00%	0.00%
BAT2						1.99%	-0.31%
BAT3						1.92%	-3.85%
BAT4						1.88%	-5.86%
BAT5						1.87%	-6.46%
PSES1	29	$11,894.4	$594,718.8	2.0%	-0.5%	2.00%	-0.07%
PSES2						1.87%	-6.52%
PSES3						1.88%	-6.18%
PSES4						1.87%	-6.51%
Poultry First Processing and Rendering (Subcategory K)							
BAT1	17	$10,983.2	$549,160.5	2.0%	-0.5%	2.00%	0.00%
BAT2						1.99%	-0.50%
BAT3						1.88%	-5.95%
BAT4						1.85%	-7.60%
BAT5						1.83%	-8.27%
PSES1	5	$11,156.4	$557,820.1	2.0%	-0.5%	2.00%	-0.17%
PSES2						1.60%	-19.98%
PSES3						1.77%	-11.33%
PSES4						1.77%	-11.67%
Poultry Further Processing and Rendering (Subcategory L)							
PSES1	15	$8,897.7	$444,885.5	2.0%	-0.5%	1.99%	-0.40%
PSES2						1.88%	-5.84%
PSES3						1.91%	-4.51%
PSES4						1.90%	-4.83%
Poultry First Processing, Further Processing, and Rendering (Subcategory K)							
BAT1	6	$12,518.7	$625,934.1	2.0%	-0.5%	2.00%	0.00%
BAT2						1.98%	-0.83%
BAT3						1.83%	-8.40%
BAT4						1.83%	-8.68%
BAT5						1.81%	-9.48%

Table 5-16 (cont.)
Impacts to Return on Assets Ratio: Upper-Bound Costs
Meat Type and Process Classes

Option	Number of Facilities	Model Facility [1] Net Income (x $1,000)	Total Assets (x $1,000)	Baseline Return on Assets [2] Median	Lower Quartile	Post-Compliance ROA [3]	Percent Change ROA [4]
PSES1	12	$13,650.2	$682,511.7	2.0%	-0.5%	1.98%	-0.93%
PSES2						1.58%	-21.13%
PSES3						1.75%	-12.48%
PSES4						1.75%	-12.53%
Mixed Further Processing (61 percent in Subcategory E - I, 39 percent in Subcategory L)							
BAT1	5	$4,510.3	$82,004.8	5.5%	1.3%	5.50%	0.00%
BAT2						5.48%	-0.31%
BAT3						5.35%	-2.79%
BAT4						5.07%	-7.80%
PSES1	97	$4,510.3	$82,004.8	5.5%	1.3%	5.42%	-1.46%
PSES2						4.86%	-11.63%
PSES3						5.02%	-8.71%
PSES4						4.78%	-13.03%
Rendering (Subcategory J)							
BAT1	21	$2,080.0	$104,001.6	2.0%	-0.5%	2.00%	0.00%
BAT2						1.99%	-0.68%
BAT3						1.82%	-9.03%
BAT4						1.80%	-9.90%
PSES1	75	$2,076.0	$103,800.7	2.0%	-0.5%	1.99%	-0.54%
PSES2						1.81%	-9.70%
PSES3						1.76%	-12.12%
PSES4						1.74%	-12.79%

Aggregating impacts to account for the 65 certainty facilities is not applicable for these impacts
All impacts presented in this table are the average of results for each class, discharge type and model facility size combination, weighted by the number of facilities in each class.
[1] Model facility net income calculated from Census data; model facility total assets calculated as (net income/median ROA) = total assets.
[2] Source: Dun & Bradstreet. Industry Norms and Key Business Ratios, 1997-98. Median and lower quartile Return on Assets ratios.
[3] Calculated as: (Net Income - Posttax Annualized Costs)/(Total Assets + Capital Costs).
[4] Calculated as: (Postcompliance ROA - Baseline ROA)/Baseline ROA.

•	Subcategory A through D:	-2.6 percent
—	red meat first processing, further processing, and rendering	-0.2 percent
—	red meat first processing and rendering	-4.6 percent
•	Subcategory E through I:	-0.5 percent
—	red meat further processing	-0.1 percent
—	mixed further processing	-2.8 percent
•	Subcategory J:	-0.7 percent
—	rendering	
•	Subcategory K:	-4.5 percent
—	poultry first processing	-3.8 percent
—	poultry first processing, further processing, and rendering	-8.4 percent
•	Subcategory L:	-4.8 percent
—	mixed further processing	-2.8 percent
—	poultry further processing	-5.1 percent

For indirect dischargers, the largest decrease in ROA takes place under PSES 2 in the poultry first processing, further processing, and rendering class. The percentage change in ROA for this class is negative 21 percent, followed closely by PSES 2 in the poultry first processing and rendering class with a 20 percent drop in the ROA.

5.4.2.2 Upgrade Cost Financial Ratio Analysis

Table 5-17 presents ROA impacts by meat type and process class using retrofit costs in place of new-equipment costs. The percentage change in ROA by class within each subcategory are:

•	Subcategory A through D:	-1.6 percent
—	red meat first processing, further processing, and rendering	-0.2 percent
—	red meat first processing and rendering	-2.8 percent
•	Subcategory E through I:	-0.4 percent
—	red meat further processing	-0.1 percent
—	mixed further processing	-1.8 percent

Table 5-17
Impacts to Return on Assets Ratio: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Model Facility [1] Net Income (x $1,000)	Model Facility [1] Total Assets (x $1,000)	Baseline Return on Assets [2] Median	Baseline Return on Assets [2] Lower Quartile	Post-Compliance ROA [3]	Percent Change ROA [4]
Red Meat First Processing (Subcategory A - D)							
BAT1	6	$2,696.1	$50,870.6	5.3%	2.2%	NA	NA
BAT2						NA	NA
BAT3						5.29%	-0.25%
BAT4						5.18%	-2.20%
Red Meat Further Processing (Subcategory E - I)							
BAT1	12	$7,650.9	$139,107.7	5.5%	1.3%	NA	NA
BAT2						NA	NA
BAT3						5.50%	-0.08%
BAT4						5.44%	-1.00%
PSES1	168	$6,692.0	$121,672.2	5.5%	1.3%	NA	NA
PSES2						NA	NA
PSES3						5.29%	-3.78%
PSES4						5.23%	-4.98%
Red Meat First and Further Processing (Subcategory A - D)							
PSES1	28	$4,982.8	$94,015.5	5.3%	2.2%	NA	NA
PSES2						NA	NA
PSES3						4.65%	-12.25%
PSES4						4.62%	-12.85%
Red Meat First Processing and Rendering (Subcategory A - D)							
BAT1	36	$29,321.4	$553,233.8	5.3%	2.2%	NA	NA
BAT2						NA	NA
BAT3						5.15%	-2.83%
BAT4						5.11%	-3.63%
PSES1	15	$29,321.4	$553,233.8	5.3%	2.2%	NA	NA
PSES2						NA	NA
PSES3						4.86%	-8.24%
PSES4						4.87%	-8.18%
Red Meat Further Processing and Rendering (Subcategory E - I)							
BAT1	4	$14,363.6	$261,155.9	5.5%	1.3%	NA	NA
BAT2						NA	NA
BAT3						5.49%	-0.11%
BAT4						5.43%	-1.26%

Table 5-17 (cont.)
Impacts to Return on Assets Ratio: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Model Facility [1] Net Income (x $1,000)	Model Facility [1] Total Assets (x $1,000)	Baseline Return on Assets [2] Median	Baseline Return on Assets [2] Lower Quartile	Post-Compliance ROA [3]	Percent Change ROA [4]
PSES1	7	$14,363.6	$261,155.9	5.5%	1.3%	NA	NA
PSES2						NA	NA
PSES3						5.23%	-5.00%
PSES4						5.19%	-5.72%
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)							
BAT1	24	$29,321.4	$553,233.8	5.3%	2.2%	NA	NA
BAT2						NA	NA
BAT3						5.29%	-0.16%
BAT4						5.20%	-1.81%
PSES1	17	$29,321.4	$553,233.8	5.3%	2.2%	NA	NA
PSES2						NA	NA
PSES3						5.12%	-3.37%
PSES4						4.95%	-6.62%
Poultry First Processing (Subcategory K)							
BAT1	49	$12,333.9	$616,696.9	2.0%	-0.5%	NA	NA
BAT2						NA	NA
BAT3						1.95%	-2.49%
BAT4						1.93%	-3.27%
BAT5						NA	NA
PSES1	92	$12,321.9	$616,094.5	2.0%	-0.5%	NA	NA
PSES2						NA	NA
PSES3						1.87%	-6.71%
PSES4						1.86%	-7.15%
Poultry Further Processing (Subcategory L)							
BAT1	13	$4,676.4	$233,817.9	2.0%	-0.5%	NA	NA
BAT2						NA	NA
BAT3						1.93%	-3.52%
BAT4						1.91%	-4.67%
BAT5						NA	NA
PSES1	155	$4,062.7	$203,135.5	2.0%	-0.5%	NA	NA
PSES2						NA	NA
PSES3						1.83%	-8.38%
PSES4						1.79%	-10.54%

Table 5-17 (cont.)
Impacts to Return on Assets Ratio: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Model Facility [1]		Baseline Return on Assets [2]		Post-Compliance ROA [3]	Percent Change ROA [4]
		Net Income (x $1,000)	Total Assets (x $1,000)	Median	Lower Quartile		
Poultry First and Further Processing (Subcategory K)							
BAT1	16	$11,952.9	$597,645.2	2.0%	-0.5%	NA	NA
BAT2						NA	NA
BAT3						1.95%	-2.55%
BAT4						1.93%	-3.61%
BAT5						NA	NA
PSES1	29	$11,894.4	$594,718.8	2.0%	-0.5%	NA	NA
PSES2						NA	NA
PSES3						1.90%	-5.04%
PSES4						1.89%	-5.51%
Poultry First Processing and Rendering (Subcategory K)							
BAT1	17	$10,983.2	$549,160.5	2.0%	-0.5%	NA	NA
BAT2						NA	NA
BAT3						1.92%	-3.92%
BAT4						1.90%	-5.17%
BAT5						NA	NA
PSES1	5	$11,156.4	$557,820.1	2.0%	-0.5%	NA	NA
PSES2						NA	NA
PSES3						1.77%	-11.33%
PSES4						1.77%	-11.67%
Poultry Further Processing and Rendering (Subcategory L)							
PSES1	15	$8,897.7	$444,885.5	2.0%	-0.5%	NA	NA
PSES2						NA	NA
PSES3						1.91%	-4.30%
PSES4						1.91%	-4.67%
Poultry First Processing, Further Processing, and Rendering (Subcategory K)							
BAT1	6	$12,518.7	$625,934.1	2.0%	-0.5%	NA	NA
BAT2						NA	NA
BAT3						1.89%	-5.49%
BAT4						1.87%	-6.57%
BAT5						NA	NA

Table 5-17 (cont.)
Impacts to Return on Assets Ratio: Retrofit Costs
Meat Type and Process Classes

Option	Number of Facilities	Model Facility [1] Net Income (x $1,000)	Model Facility [1] Total Assets (x $1,000)	Baseline Return on Assets [2] Median	Baseline Return on Assets [2] Lower Quartile	Post-Compliance ROA [3]	Percent Change ROA [4]
PSES1	12	$13,650.2	$682,511.7	2.0%	-0.5%	NA	NA
PSES2						NA	NA
PSES3						1.76%	-11.99%
PSES4						1.75%	-12.32%
Mixed Further Processing (61 percent in Subcategory E - I, 39 percent in Subcategory L)							
BAT1	5	$4,510.3	$82,004.8	5.5%	1.3%	NA	NA
BAT2						NA	NA
BAT3						5.40%	-1.77%
BAT4						5.31%	-3.46%
PSES1	97	$4,510.3	$82,004.8	5.5%	1.3%	NA	NA
PSES2						NA	NA
PSES3						5.02%	-8.71%
PSES4						4.78%	-13.03%
Rendering (Subcategory J)							
BAT1	21	$2,080.0	$104,001.6	2.0%	-0.5%	NA	NA
BAT2						NA	NA
BAT3						1.88%	-6.16%
BAT4						1.85%	-7.40%
PSES1	75	$2,076.0	$103,800.7	2.0%	-0.5%	NA	NA
PSES2						NA	NA
PSES3						1.81%	-9.63%
PSES4						1.79%	-10.50%

Aggregating impacts to account for the 65 certainty facilities is not applicable for these impacts
All impacts presented in this table are the average of results for each class, discharge type and model facility size combination, weighted by the number of facilities in each class.
[1] Model facility net income calculated from Census data; model facility total assets calculated as (net income/median ROA) = total assets.
[2] Source: Dun & Bradstreet. Industry Norms and Key Business Ratios, 1997-98. Median and lower quartile Return on Assets ratios.
[3] Calculated as: (Net Income - Posttax Annualized Costs)/(Total Assets + Capital Costs).
[4] Calculated as: (Postcompliance ROA - Baseline ROA)/Baseline ROA.

•	Subcategory J:	-0.7 percent
—	rendering	
•	Subcategory K:	-3.0 percent
—	poultry first processing	-2.5 percent
—	poultry first processing, further processing, and rendering	-5.5 percent
•	Subcategory L:	-3.3 percent
—	mixed further processing	-1.8 percent
—	poultry further processing	-3.5 percent

5.5 CORPORATE FINANCIAL DISTRESS

The relevant decision making entity above the site level is the parent company, which may own multiple sites that produce meat products. The corporate financial distress analysis identifies situations where it might make financial sense to upgrade each individual site but the company as a whole cannot bear the combined costs of upgrading all of its sites. Using the methodology describes in Chapter 3, EPA performed a preliminary Altman Z′ analysis based on responses to the detailed survey, information presented in the industry profile (Chapter 2), and estimated facility level compliance costs.

Table 5-18 summarizes the results of the preliminary Altman Z′ analysis performed for the 20 companies with sufficient data available. In the table, first, the number of companies whose baseline Altman Z′ score falls into the "financially healthy" (Z′ score greater than 2.9), indeterminate (Z′ score less than 2.9 but greater than 1.23), and "financially distressed" (Z′ score less than 1.23) ranges are presented. This is followed by the number of companies whose Z′ score changes from one category to another as a result of incurred compliance costs. Thus, for example, under BAT 1/PSES 1 compliance costs, the "-1" indicates that the Z′ score for one poultry company that was "financially healthy" in the baseline fell below the 2.9 threshold, and the "+1" indicates that its Z′ score moved into the "indeterminate" range; the zero indicates that no companies had Z′ scores that moved into the "financially distressed" range due to the compliance costs. Although a change from "financially healthy" to "indeterminate" is considered an impact, it is not as significant in magnitude as a change from "financially healthy" or "indeterminate" to "financially distressed."

Table 5-18
Altman Z′ Results

Option	Meat Type	Number of Companies with Z′ Score:		
		Greater Than 2.9	Less Than 2.9; Greater Than 1.23	Less Than 1.23
Baseline	Red Meat	7	3	0
	Poultry	7	3	0
Post-Regulatory Incremental Change (Relative to Baseline)				
BAT1/PSES1	Red Meat	0	0	0
	Poultry	-1	+1	0
BAT2/PSES2	Red Meat	0	-1	+1
	Poultry	-3	+3	0
BAT3/PSES3	Red Meat	0	-1	+1
	Poultry	-3	+3	0
BAT4/PSES4	Red Meat	-1	+1, -1	+1
	Poultry	-3	+3	0
BAT5/PSES4	Red Meat	0	-1	+1
	Poultry	-3	+3	0
BAT3/PSES0[1]	Red Meat	0	0	0
	Poultry	-2	+2	0
BAT3[2]	Red Meat	0	0	0
	Poultry	-2	+2	0

[1] Compliance costs per pound of meat type are a weighted average of BAT costs for direct dischargers and zero costs for indirect dischargers (i.e., the realistic scenario).
[2] BAT 3 costs assigned to all facilities (i.e., the worst case scenario).

EPA performed the Altman Z′ analysis on 9 red meat companies, 10 poultry companies, and one rendering company. For the purpose of presenting the results of this analysis, rendering is included in the red meat sector.

In short, essentially one major red meat company has an Altman Z′ score that is in the "indeterminate" region in the baseline, but is close to the "financially distressed" threshold. Under BAT2/PSES2, BAT3/PSES3, and BAT4/PSES4, this company is projected to become "financially distressed." Furthermore, one major red meat company with a baseline Altman Z′ score in the "financially healthy" range is projected to become "indeterminate" under BAT4/PSES4. There are no financial distress impacts under the proposed option.

Similarly, three major poultry companies have an Altman Z′ score that is in the "financially healthy" region in the baseline, but is close to the "indeterminate" range. Under options BAT2/PSES2, BAT3/PSES3, BAT4/PSES4 and BAT5/PSES5, all three of these companies are projected to move into the "indeterminate" region. Under the proposed option two of the companies are projected to move into the "indeterminate" region, and under BAT1/PSES1 one company moves into the "indeterminate" threshold.

Altman Z′ analysis was also performed to determine the impact of the proposed option if all facilities owned by each company were direct dischargers. This was done by removing the indirect discharging model facilities from the production weighted averages used in the analysis. Although this scenario is highly unlikely, it is useful as a worst-case scenario analysis. As observed in Table 5-18, the worst case scenario does not show any impacts significantly greater than the above analysis.

5.6 MARKET AND TRADE IMPACTS

The market model estimates the impact of compliance costs on the price and output of various meat products. The distinguishing feature of EPA's market model is that it explicitly incorporates cross-market impacts among meat types into the analysis. The demand for meat products such as beef, pork, broilers, and turkey is closely related; a one percent increase in the price of pork, for example, may cause a 0.7 percent fall in quantity of pork demanded, and a 0.2 percent increase in demand for beef.

The final impact on the price and output of beef products will depend on the relative magnitude of supply and demand shifts. If all meat products incur relatively similar per unit compliance costs, cross-market impacts would tend to be roughly offsetting. However, if per unit compliance costs are asymmetric (e.g., per unit compliance costs are significantly larger for some subcategories than for others), then potentially significant shifts could occur between meat product markets. EPA's model was developed with the flexibility to analyze the latter situation as well as the former (see Section 3.1.4.1. for a discussion of the market model approach).

EPA estimated the cost per pound by meat type used to shift the supply curve for two scenarios. In the first scenario, EPA estimates the compliance costs per pound as a weighted average of BAT 3 costs for direct dischargers, and zero costs for indirect dischargers. In the second scenario, EPA sets the compliance costs per pound for each meat sector equal to the estimated BAT 3 costs per pound for direct dischargers. The estimated costs per pound measure the vertical shift in the supply curve for each meat type. The second scenario is a worst case scenario; it overestimates the shift in the supply curve because it implicitly assigns costs to facilities that would not incur costs under the proposed rule. If impacts are reasonable under the worst case scenario, they will be reasonable under the proposed rule. The first scenario represents EPA's more realistic scenario. Competitive pressure from facilities that do not incur any compliance costs under the proposed rule (i.e., indirect dischargers) will keep downward pressure on prices relative to the worst case scenario. Direct dischargers will be reluctant to increase their market price by the full amount of the compliance costs per pound to avoid losing business to facilities that do not incur compliance costs.

Table 5-19 presents the estimated cost per pound by meat type and option for each option examined, and for the two scenarios described above. Table 5-20 presents projected market level impacts on each meat type for the first scenario and Table 5-21 presents the same for the worst case scenario.

Under the "realistic" scenario — the weighted average of BAT 3 costs to direct dischargers and zero costs to indirect dischargers — shift the supply curve, the price of chicken is projected to increase by 0.12 percent, the largest price increase among the four meat types. Domestic supply under this option combination is projected to decrease by about 0.05 percent for chicken and pork products, and chicken exports are expected to decrease by 0.14 percent (see Table 5-20). Impacts to other meat types are

Table 5-19
Estimated Compliance Costs per Pound of Output by Meat Type and Options

Compliance Costs per Pound of Meat Type						Proposed Options: Scenario 1	Proposed Options: Scenario 2
Meat Type	**BAT 1 PSES 1**	**BAT 2 PSES 2**	**BAT 3 PSES 3**	**BAT 4 PSES 4**	**BAT 5 PSES 0**	**BAT 3 PSES 0 [1]**	**BAT 3 [2]**
Beef	$0.0003499	$0.0041163	$0.0038038	$0.0053792	NA	$0.0010688	$0.0016714
Pork	$0.0009338	$0.0081573	$0.0073207	$0.0115712	NA	$0.0015757	$0.0027344
Broilers	$0.0010777	$0.0125478	$0.0107952	$0.0123023	$0.0063001	$0.0021826	$0.0075119
Turkey	$0.0008672	$0.0081525	$0.0072051	$0.0088346	$0.0005301	$0.0010059	$0.0042623
Rendering [3]	$0.0001298	$0.0023262	$0.0032944	$0.0034718	NA	$0.0000539	$0.0002453

Cost per pound estimated as an average over all subcategory size classes by meat type and discharge type (e.g., BAT, PSES), weighted by production.
[1] Compliance costs per pound of meat type are a weighted average of BAT costs for direct dischargers and zero costs for indirect dischargers (i.e., the realistic scenario).
[2] BAT 3 costs assigned to all facilities (i.e., the worst case scenario).
[3] A market model could not be developed for the rendering subcategory due to lack of data.

Table 5-20
Projected Compliance Cost Impacts on Meat Product Markets
Proposed Option Scenario 1: BAT 3 Costs for Direct Dischargers Only
With Cross-Market Impacts, Armington Trade

Meat	Subcategory	Price ($/lb.)	Net Quantity (lbs. x 1 mil.)	Domestic Supply (lbs. x 1 mil.)	Quantity Imported (lbs. x 1 mil.)	Domestic Demand (lbs. x 1 mil.)	Quantity Exported (lbs. x 1 mil.)	Per Unit Compliance Costs	Percent Shift in Supply	Percent Shift in Demand
Beef										
	Baseline	$1.11	29,260	26,386	2,874	26,843	2,417	$0.0011	-0.10%	0.02%
	Post-regulatory	$1.11	29,251	26,376	2,874	26,836	2,415			
	% Change	*0.06%*	*-0.03%*	*-0.04%*	*0.01%*	*-0.03%*	*-0.09%*			
Pork										
	Baseline	$1.00	20,105	19,278	827	18,827	1,278	$0.0016	-0.16%	0.02%
	Post-regulatory	$1.00	20,095	19,268	827	18,819	1,276			
	% Change	*0.08%*	*-0.05%*	*-0.05%*	*0.00%*	*-0.04%*	*-0.12%*			
Chicken										
	Baseline	$0.58	29,746	29,741	5	24,826	4,920	$0.0022	-0.38%	0.02%
	Post-regulatory	$0.58	29,731	29,726	5	24,817	4,913			
	% Change	*0.12%*	*-0.05%*	*-0.05%*	*0.00%*	*-0.03%*	*-0.14%*			
Turkey										
	Baseline	$0.69	5,298	5,297	1	4,919	379	$0.0010	-0.15%	0.01%
	Post-regulatory	$0.69	5,297	5,296	1	4,918	379			
	% Change	*0.05%*	*-0.02%*	*-0.02%*	*0.00%*	*-0.02%*	*-0.05%*			

Table 5-21
Projected Compliance Cost Impacts on Meat Product Markets
Proposed Option Scenario 2: BAT 3 Costs for Direct and Indirect Dischargers
With Cross-Market Impacts, Armington Trade

Meat	Subcategory	Price ($/lb.)	Net Quantity (lbs. x 1 mil.)	Domestic Supply (lbs. x 1 mil.)	Quantity Imported (lbs. x 1 mil.)	Domestic Demand (lbs. x 1 mil.)	Quantity Exported (lbs. x 1 mil.)	Per Unit Compliance Costs	Percent Shift in Supply	Percent Shift in Demand
Beef										
	Baseline	$1.11	29,260	26,386	2,874	26,843	2,417	$0.0017	-0.15%	0.04%
	Post-regulatory	$1.11	29,246	26,372	2,874	26,833	2,413			
	% Change	0.10%	-0.05%	-0.05%	0.01%	-0.04%	-0.15%			
Pork										
	Baseline	$1.00	20,105	19,278	827	18,827	1,278	$0.0027	-0.27%	0.04%
	Post-regulatory	$1.01	20,088	19,261	827	18,813	1,275			
	% Change	0.14%	-0.08%	-0.09%	0.00%	-0.07%	-0.21%			
Chicken										
	Baseline	$0.58	29,746	29,741	5	24,826	4,920	$0.0075	-1.29%	0.03%
	Post-regulatory	$0.58	29,692	29,687	5	24,794	4,898			
	% Change	0.38%	-0.18%	-0.18%	0.00%	-0.13%	-0.46%			
Turkey										
	Baseline	$0.69	5,298	5,297	1	4,919	379	$0.0043	-0.62%	-0.00%
	Post-regulatory	$0.69	5,293	5,292	1	4,915	378			
	% Change	0.16%	-0.09%	-0.09%	0.00%	-0.09%	-0.19%			

projected to be somewhat lower. Under the worst case scenario, the largest impacts are again seen under chicken; the price of chicken increases by 0.4 percent, domestic supply decreases by 0.2 percent, and exports by almost 0.5 percent (see Table 5-21).

5.7 IMPACTS ON OUTPUT AND EMPLOYMENT

Changes in output and employment are directly proportional to costs of compliance, that is, higher costs lead to lower output and employment. The impacts resonate through the economy causing a “ripple” effect. EPA used the Department of Commerce’s national final demand multipliers from the Regional Input-Output Modeling System to estimate these effects (RIMS II; U.S. DOC, 1996).

The methodology used for the input-output analysis is explained in Section 3.1.5. The final demand output multipliers used here are 4.96 for red meat and 4.35 for poultry, which means that for every $1 million of output lost in the red meat and poultry industry, an additional $3.96 million and $3.35 million respectively is lost throughout the U.S. economy. The employment multipliers are 46.93 for red meat and 45.18 for poultry. That is, for every $1 million in output loss in the red meat industry, 46.93 full-time equivalent (FTEs: 1 FTE equals 2,080 hours and can be equated with one full-time job) jobs are lost in the U.S. economy (see Section 3.1.5.1 for more detail).

The larger the compliance costs, the greater the output and employment impacts. This is the reason why the subcategories with the largest impacts will be the same as those with the largest costs presented in Section 5.1.1. Moreover, impacts estimated with the use of upper-bound costs will be higher than those estimated with retrofit costs. Table 5-22 presents the output and employment impacts stemming from the various subcategories and discharge options using both upper-bound and retrofit costs. As the table shows, for the direct dischargers with the use of new equipment costs, the largest impacts are seen under BAT 4 in Subcategory A through D. This option results in a loss of $542 million per year in output (0.006 percent of 1999 U.S. GDP, $9,268.6 billion (U.S. DOC, 2001)) and a loss of 4,084 FTEs (0.003 percent of 1999 U.S. employment, 128.9 million (U.S. DOL, 2002)) for the U.S. economy as a whole. These losses are spread over a wide variety of industries in addition to the meat products industry. Also note that the input-output methodology used for this analysis overestimates changes in output and

Table 5-22
Output and Employment Impacts

Subcategory and Option	Pretax Annualized Costs ($Millions)		Total Loss in Output [1] ($Millions)		Total Loss in Employment [2] ($Millions)	
	Upper-Bound	Retrofit	Upper-Bound	Retrofit	Upper-Bound	Retrofit
Subcategory A through D						
BAT1	$0		$0		0	
BAT2	$9		($46)		(344)	
BAT3	$55	$39	($274)	($194)	(2,061)	(1,463)
BAT4	$109	$68	($542)	($338)	(4,084)	(2,545)
PSES1	$7		($32)		(244)	
PSES2	$140		($697)		(5,245)	
PSES3	$89	$80	($443)	($397)	(3,332)	(2,992)
PSES4	$112	$98	($555)	($487)	(4,176)	(3,665)
Subcategory E through I						
BAT1	$0		$0		0	
BAT2	$0		($2)		(14)	
BAT3	$1	$0	($3)	($2)	(24)	(19)
BAT4	$6	$3	($32)	($16)	(243)	(122)
PSES1	$17		($86)		(651)	
PSES2	$95		($469)		(3,534)	
PSES3	$77	$77	($385)	($383)	(2,897)	(2,882)
PSES4	$102	$102	($507)	($505)	(3,815)	(3,802)
Subcategory J						
BAT1	$0		$0		0	
BAT2	$1		($3)		(19)	
BAT3	$5	$4	($27)	($20)	(201)	(148)
BAT4	$6	$5	($29)	($23)	(218)	(172)
PSES1	$1		($6)		(46)	
PSES2	$22		($107)		(805)	
PSES3	$26	$21	($128)	($106)	(966)	(799)
PSES4	$27	$23	($134)	($114)	(1,012)	(858)
Subcategory K						
BAT1	$0		$0		0	
BAT2	$4		($19)		(161)	
BAT3	$45	$32	($195)	($139)	(1,612)	(1,148)
BAT4	$57	$41	($247)	($178)	(2,041)	(1,474)
BAT5	$61		($266)		(2,203)	

Table 5-22 (cont.)
Output and Employment Impacts

Subcategory and Option	Pretax Annualized Costs ($Millions)		Total Loss in Output [1] ($Millions)		Total Loss in Employment [2] ($Millions)	
	Upper-Bound	Retrofit	Upper-Bound	Retrofit	Upper-Bound	Retrofit
PSES1	$10		($44)		(361)	
PSES2	$175		($761)		(6,298)	
PSES3	$123	$117	($536)	($508)	(4,433)	(4,199)
PSES4	$126	$122	($550)	($529)	(4,551)	(4,379)
Subcategory L						
BAT1	$0		$0		0	
BAT2	$0		($1)		(10)	
BAT3	$3	$2	($12)	($9)	(98)	(73)
BAT4	$4	$3	($17)	($12)	(144)	(101)
BAT5	$4		($16)		(128)	
PSES1	$14		($61)		(508)	
PSES2	$98		($424)		(3,510)	
PSES3	$69	$69	($300)	($299)	(2,485)	(2,475)
PSES4	$87	$87	($379)	($378)	(3,137)	(3,129)

Source: U.S. DOC, 1996 and U.S. DOC, 2001a

[1] Based on a total loss of $4.96 million for the red meat industry and $4.35 million for the poultry industry for each $1 million loss in output in the affected industry.

[2] Based on 47 jobs lost in the red meat industry and 45 in the poultry industry per $1 million change in output.

employment because it does not allow for impact reducing substitutions between final products by consumers or inputs by producers.

The output and employment losses under the proposed options (BAT 3 for Subcategories A through D, E through I, K, and L, and BAT 2 for Subcategory J), with the use of upper-bound costs are as follows:

• Subcategory A through D:	$274 million	2,061 FTEs
• Subcategory E through I:	$3 million	24 FTEs
• Subcategory J:	$3 million	19 FTEs
• Subcategory K:	$195 million	1,612 FTEs
• Subcategory L:	$12 million	98 FTEs

For the indirect dischargers, the largest impacts are seen under PSES 2 in Subcategory K. Under this option, output losses total $761 million and employment losses equal 6,298 FTEs for the economy as a whole.

Using retrofit costs, output and employment impacts are less severe. For the proposed options, the impacts are as follows:

• Subcategory A through D:	$194 million	1,463 FTEs
• Subcategory E through I:	$2 million	19 FTEs
• Subcategory J:	$3 million	19 FTEs
• Subcategory K:	$139 million	1,148 FTEs
• Subcategory L:	$9 million	73 FTEs

5.8 NEW SOURCES

EPA examined the possibility that the proposed rule may create incremental barriers to entry in the meat products industry. EPA used a variety of sources to estimate the entry rate of new firm into the meat products market. Using the U.S. Small Business Administration's "births and deaths" database (U.S. SBA, 1998), EPA determined that over the 1995 to 1998 time frame, new establishments entered the meat products industry ("births") at a rate of about 5.7 percent per year (i.e., the average ratio of new establishments to existing establishments). Conversely, the same data show that existing firms have exited the industry ("deaths") at a rate of 6.8 percent per year.[3]

However, as reflected in the industry profile (Chapter 2), other sources indicate that the sectors composing the meat products industry are experiencing very different growth rates. Because the "births and deaths" database only tracks changes at the industry level (i.e., the 3 digit SIC level), EPA estimated the differential growth rates for the poultry and red meat sectors based on other data sources. EPA used a published study of structural change in the poultry industry (Ollinger, et. al., 2000) based on Census' longitudinal database to estimate that ratio of new establishments to existing establishments over the 1967 to 1992 period. Because the overall industry new establishment rate is a weighted average of the different rates in the poultry and red meat sectors, EPA was able to calculate that the ratio of new establishments to existing establishments in the red meat sectors over the same time period.

In summary, EPA estimated the ratio of new establishments to existing establishments in the meat products industry as:

- Overall industry average: 5.7 percent per year, which reflects a weighted average of the:
  - Poultry sector: 19 to 26 percent per year, and the
  - Red Meat sectors: 3 to 3.9 percent per year.

Note that due to disparate data sources and time frames for these analyses, the rate of new entrants can only be interpreted as an approximate measure.

A potential source of barriers to entry is the incremental capital costs the proposed rule may impose on an entrepreneur entering the meat products market. If, in addition to the capital necessary to

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[3] Note that an overall decrease in the number of establishments is not identical to a decrease in the size of the industry. If the entering facilities are larger than the exiting facilities, then industry will still grow. Thus these data are consistent with the industry profile presented in Chapter 2.

build and equip a new facility (as well as the working capital necessary to start operations), the entrepreneur has to invest considerable capital in wastewater treatment equipment to meet the proposed effluent guidelines, then the entrepreneur could be discouraged from entering the market — perhaps due to a decrease in the anticipated rate of return — or may have difficulty in obtaining additional financing.

Other potential barriers to entry from the proposed rule could result if the entrepreneur has to pay higher prices for inputs than existing firms, or if an artificial limitation was placed on the availability of some resource necessary for production (e.g., the number of wastewater permits allowed). Both of these types of barriers to entry could place a new firm at a competitive disadvantage relative to existing sources and would therefore act as a barrier to entry.

EPA finds no reason to believe that the proposed rule will create differentials in input prices or artificial limitations on the availability of resources that would create a competitive disadvantage for new entrants. All inputs for wastewater treatment are readily available in competitive markets. New entrants would pay the same prices for labor, equipment, and other costs of wastewater treatment that existing firms would pay. Furthermore, the proposed rule places no artificial barriers — such as limitations on the number of wastewater permits issued — on the market. Therefore EPA's barriers to entry analysis focuses on the incremental capital necessary to enter the meat products industry.

To examine the impact of the proposed rule on the incremental capital requirements for new entrants, EPA estimated the total assets owned by each of the model facilities developed for the economic impact analysis. EPA scaled total assets for each model facility from the model facility's revenues (based on Census data) and the median return on assets ratio from Dun & Bradstreet's *Industry Norms and Key Financial Ratios* (1998; see Section 3.1.3.1 for details). In essence, then, estimated model facility total assets are those used in the financial ratio analysis presented in Section 5.4.1. EPA calculated the ratio of incremental capital costs (Section 5.1) to total assets as a measure of the potential for barriers to entry due to the proposed rule. If this ratio is large, then the possibility exists that the proposed rule will discourage entry into the meat products market.

Table 5-23 presents the ratio of incremental upper-bound capital costs to total assets at the subcategory level. The largest impact is observed under PSES 2 in Subcategory A through D, where the

Table 5-23
Ratio of Capital Costs to Total Assets
40 CFR 432 Subcategories

Option	Number of Facilities	Model Facility Total Assets (x $1,000)	Average Capital Costs (x $1,000)	Capital Costs to Total Assets Ratio
Subcategory A through D				
BAT1	66	$507,564	$0	0.00%
BAT2			$125	0.02%
BAT3			$4,161	0.82%
BAT4			$8,595	1.69%
PSES1	60	$338,932	$535	0.16%
PSES2			$10,409	3.07%
PSES3			$7,670	2.26%
PSES4			$10,046	2.96%
Subcategory E through I				
BAT1	19	$155,592	$0	0.00%
BAT2			$8	0.01%
BAT3			$129	0.08%
BAT4			$1,683	1.08%
PSES1	234	$115,819	$264	0.23%
PSES2			$1,661	1.43%
PSES3			$1,538	1.33%
PSES4			$2,260	1.95%
Subcategory J				
BAT1	21	$104,002	$0	0.00%
BAT2			$0	0.00%
BAT3			$1,154	1.11%
BAT4			$1,304	1.25%
PSES1	75	$103,801	$47	0.04%
PSES2			$1,103	1.06%
PSES3			$1,614	1.55%
PSES4			$1,746	1.68%
Subcategory K				
BAT1	88	$600,816	$0	0.00%
BAT2			$17	0.00%
BAT3			$2,515	0.42%
BAT4			$3,328	0.55%
BAT5			$3,717	0.62%

Table 5-23 (cont.)
Ratio of Capital Costs to Total Assets
40 CFR 432 Subcategories

Option	Number of Facilities	Model Facility Total Assets (x $1,000)	Average Capital Costs (x $1,000)	Capital Costs to Total Assets Ratio
PSES1	138	$615,266	$307	0.05%
PSES2			$5,590	0.91%
PSES3			$4,616	0.75%
PSES4			$4,860	0.79%
Subcategory L				
BAT1	15	$214,016	$0	0.00%
BAT2			$10	0.00%
BAT3			$813	0.38%
BAT4			$1,283	0.60%
BAT5	13 [1]	$233,818	$1,363	0.64%
PSES1	208	$198,535	$245	0.12%
PSES2			$1,805	0.91%
PSES3			$1,538	0.77%
PSES4			$2,137	1.08%

[1] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

capital costs compose an average of 3.1 percent of facility assets. For direct dischargers, the largest impact is 1.7 percent, which occurs under BAT 4 in Subcategory A through D.

Under the proposed options — BAT3 for all subcategories except J, for which BAT 2 is specified — the ratio of incremental capital costs to total assets for each subcategory is:

- Subcategory A through D: 0.82 percent
- Subcategory E through I: 0.08 percent
- Subcategory J: 0.00 percent
- Subcategory K: 0.42 percent
- Subcategory L: 0.38 percent

The largest impacts thus occur in Subcategory A through D.

Table 5-24 presents the ratio of incremental upper-bound capital costs to total assets at the meat type and process class level. The largest impact is observed under PSES 4 in the mixed further processing class, where the capital costs compose an average of 4.24 percent of facility assets. For direct dischargers, the largest impact also occurs in the mixed further processing class, where incremental capital costs are 2.4 percent of total assets under BAT 4.

Under the proposed options the overall ratio of incremental capital costs to total assets at the subcategory level represents a range among the component classes of:

- Subcategory A through D: 0.82 percent
  - — red meat first processing 0.00 percent
  - — red meat first processing and rendering 1.35 percent
- Subcategory E through I: 0.08 percent
  - — red meat further processing 0.01 percent
  - — mixed further processing 0.78 percent
- Subcategory J 0.00 percent
  - — rendering

Table 5-24
Ratio of Capital Costs to Total Assets
Meat Type and Process Classes

Option	Number of Facilities	Total Assets (x $1,000)	Average Capital Costs (x $1,000)	Capital Costs to Total Assets Ratio
Red Meat First Processing (Subcategory A - D)				
BAT1	6	$50,870.6	$0	0.00%
BAT2			$0	0.00%
BAT3			$0	0.00%
BAT4			$801	1.57%
Red Meat Further Processing (Subcategory E - I)				
BAT1	12	$139,107.7	$0	0.00%
BAT2			$4	0.00%
BAT3			$21	0.01%
BAT4			$1,058	0.76%
PSES1	168	$121,672.2	$236	0.19%
PSES2			$1,231	1.01%
PSES3			$1,223	1.00%
PSES4			$1,720	1.41%
Red Meat First and Further Processing (Subcategory A - D)				
PSES1	28	$94,015.5	$274	0.29%
PSES2			$3,918	4.17%
PSES3			$3,783	4.02%
PSES4			$3,935	4.19%
Red Meat First Processing and Rendering (Subcategory A - D)				
BAT1	36	$553,233.8	$0	0.00%
BAT2			$174	0.03%
BAT3			$7,485	1.35%
BAT4			$8,694	1.57%
PSES1	15	$553,233.8	$663	0.12%
PSES2			$20,765	3.75%
PSES3			$14,013	2.53%
PSES4			$14,112	2.55%
Red Meat Further Processing and Rendering (Subcategory E - I)				
BAT1	4	$261,155.9	$0	0.00%
BAT2			$22	0.01%
BAT3			$66	0.03%
BAT4			$3,357	1.29%

Table 5-24 (cont.)
Ratio of Capital Costs to Total Assets
Meat Type and Process Classes

Option	Number of Facilities	Total Assets (x $1,000)	Average Capital Costs (x $1,000)	Capital Costs to Total Assets Ratio
PSES1	7	$261,155.9	$513	0.20%
PSES2			$5,297	2.03%
PSES3			$4,304	1.65%
PSES4			$4,932	1.89%
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)				
BAT1	24	$553,233.8	$0	0.00%
BAT2			$83	0.02%
BAT3			$216	0.04%
BAT4			$10,396	1.88%
PSES1	17	$553,233.8	$853	0.15%
PSES2			$11,963	2.16%
PSES3			$8,474	1.53%
PSES4			$16,524	2.99%
Poultry First Processing (Subcategory K)				
BAT1	49	$616,696.9	$0	0.00%
BAT2			$0	0.00%
BAT3			$1,983	0.32%
BAT4			$2,673	0.43%
BAT5			$2,985	0.48%
PSES1	92	$616,094.5	$364	0.06%
PSES2			$4,419	0.72%
PSES3			$3,823	0.62%
PSES4			$4,088	0.66%
Poultry Further Processing (Subcategory L)				
BAT1	13	$233,817.9	$0	0.00%
BAT2			$11	0.00%
BAT3			$838	0.36%
BAT4			$1,183	0.51%
BAT5			$1,363	0.58%
PSES1	155	$203,135.5	$235	0.12%
PSES2			$1,527	0.75%
PSES3			$1,303	0.64%
PSES4			$1,754	0.86%

Table 5-24 (cont.)
Ratio of Capital Costs to Total Assets
Meat Type and Process Classes

Option	Number of Facilities	Total Assets (x $1,000)	Average Capital Costs (x $1,000)	Capital Costs to Total Assets Ratio
Poultry First and Further Processing (Subcategory K)				
BAT1	16	$597,645.2	$0	0.00%
BAT2			$64	0.01%
BAT3			$2,359	0.39%
BAT4			$3,789	0.63%
BAT5			$4,233	0.71%
PSES1	29	$594,718.8	$0	0.00%
PSES2			$3,316	0.56%
PSES3			$4,006	0.67%
PSES4			$4,241	0.71%
Poultry First Processing and Rendering (Subcategory K)				
BAT1	17	$549,160.5	$0	0.00%
BAT2			$27	0.00%
BAT3			$2,787	0.51%
BAT4			$3,594	0.65%
BAT5			$4,001	0.73%
PSES1	5	$557,820.1	$0	0.00%
PSES2			$9,283	1.66%
PSES3			$5,813	1.04%
PSES4			$6,020	1.08%
Poultry Further Processing and Rendering (Subcategory L)				
PSES1	15	$444,885.5	$176	0.04%
PSES2			$3,045	0.68%
PSES3			$2,542	0.57%
PSES4			$2,708	0.61%
Poultry First Processing, Further Processing, and Rendering (Subcategory K)				
BAT1	6	$625,934.1	$0	0.00%
BAT2			$0	0.00%
BAT3			$6,498	1.04%
BAT4			$6,688	1.07%
BAT5			$7,507	1.20%

Table 5-24 (cont.)
Ratio of Capital Costs to Total Assets
Meat Type and Process Classes

Option	Number of Facilities	Total Assets (x $1,000)	Average Capital Costs (x $1,000)	Capital Costs to Total Assets Ratio
PSES1	12	$682,511.7	$747	0.11%
PSES2			$18,527	2.71%
PSES3			$11,675	1.71%
PSES4			$11,794	1.73%
Mixed Further Processing (61 percent in Subcategory E - I, 39 percent in Subcategory L)				
BAT1	5	$82,004.8	$0	0.00%
BAT2			$6	0.01%
BAT3			$641	0.78%
BAT4			$1,948	2.38%
PSES1	97	$82,004.8	$313	0.38%
PSES2			$2,452	2.99%
PSES3			$2,106	2.57%
PSES4			$3,477	4.24%
Rendering (Subcategory J)				
BAT1	21	$104,001.6	$0	0.00%
BAT2			$0	0.00%
BAT3			$1,154	1.11%
BAT4			$1,304	1.25%
PSES1	75	$103,800.7	$47	0.04%
PSES2			$1,103	1.06%
PSES3			$1,614	1.55%
PSES4			$1,746	1.68%

• Subcategory K :		0.42 percent
—	poultry first processing	0.32 percent
—	poultry first processing, further processing, and rendering	1.04 percent
• Subcategory L:		0.38 percent
—	poultry further processing	0.36 percent
—	mixed further processing	0.78 percent

5.9 SUMMARY AND OBSERVATIONS

Table 5-25 presents a summary of the costs and impacts under the proposed options for the meat products industry as a whole. Using upper-bound costs, total posttax annualized costs for the proposed options under all subcategories are estimated at $68 million. Of the total 209 nonsmall, noncertainty facilities affected by the rule, 0.8 facilities are projected to close as a result of the rule. Compliance costs exceed: 1 percent of revenues for 18 facilities (8 percent of facilities), 3 percent of revenues for 4 facilities (2 percent of all facilities), and 5 percent of cash flow for 22 facilities or 10 percent of facilities. Output losses in U.S. are expected to total $487 million per year and employment losses are estimated at a total of 3,800 FTEs per year. Including the 65 certainty facilities, costs and impacts increase by a margin of 8 percent. Total posttax industry compliance costs increase by $6 million and now equal $74 million. Facility impacts include 1 facility closure and 24 facilities with compliance costs greater than 5 percent of cash flow.

With the use of retrofit costs instead of new equipment costs, total posttax annualized costs for the industry are $47 million. The number of facilities projected to close as a result of the rule are 0.4. Five percent or 12 facilities have compliance costs greater than 1 percent of revenues, 3 facilities have costs greater than 3 percent of revenues, and costs for 16 facilities are greater than 5 percent of cash flow. Annual output losses for the entire U.S. are estimated at $347 million and employment losses at 2,700 FTEs. With the 65 certainty facilities, total posttax costs increase to $50.5 million, 0.4 facility closures are projected, and for 17 facilities, compliance costs are greater than 5 percent of cash flow.

Table 5-25
Summary of Impacts Under the Proposed Options

Cost	Proposed Option	Number of Facilities	Total Posttax Annualized Costs ($Millions)	Prob. Cash Flow Less than Costs	Number of Facility Closures	Number of Facilities Incurring Costs Greater Than 1 percent revenues	Number of Facilities Incurring Costs Greater Than 3 percent revenues	Number of Facilities Incurring Costs Greater Than 5 percent cash flow	Percent change in ROA	Output Losses ($ mil)	Employment Losses (FTEs)
Subcategory A through D											
Upper-Bound	BAT 3	66	$36.3	0.34%	0.2	2.0	0.6	4.8	-2.6%	($274)	(2,061)
Retrofit	BAT 3	66	$24.7	0.23%	0.1	1.4	0.3	3.3	-1.6%	($194)	(1,463)
Subcategory E through I											
Upper-Bound	BAT 3	19	$0.4	0.06%	0.0	0.2	0.1	0.2	-0.5%	($3)	(24)
Retrofit	BAT 3	19	$0.3	0.05%	0.0	0.2	0.1	0.1	-0.4%	($2)	(19)
Subcategory J											
Upper-Bound	BAT 2	21	$0.3	0.12%	0.0	0.9	0.3	0.5	-0.7%	($3)	(19)
Subcategory K											
Upper-Bound	BAT 3	88	$29.5	0.72%	0.5	12.0	2.7	13.9	-4.5%	($195)	(1,612)
Retrofit	BAT 3	88	$20.1	0.49%	0.2	7.6	1.7	9.8	-3.9%	($139)	(1,148)

Table 5-25 (continued)
Summary of Impacts Under the Proposed Options

Cost	Proposed Option	Number of Facilities	Total Posttax Annualized Costs ($Millions)	Prob. Cash Flow Less than Costs	Number of Facility Closures	Number of Facilities Incurring Costs Greater Than: 1 percent revenues	3 percent revenues	5 percent cash flow	Percent change in ROA	Output Losses ($ mil)	Employ ment Losses (FTEs)
Subcategory L											
Upper-Bound	BAT 3	15	$1.8	0.77%	0.1	2.5	0.4	2.5	-4.8%	($12)	(98)
Retrofit	BAT 3	15	$1.3	0.55%	0.1	1.5	0.3	1.8	-3.3%	($9)	(73)
Total Upper-Bound		**209**	**$68.3**	**NA**	**0.8**	**17.6**	**4.1**	**21.9**	**NA**	**($487)**	**(3,814)**
Total Upper-Bound Including 65 Certainty Facilities		**226**	**$73.8**	**NA**	**0.9**	**19.0**	**4.4**	**23.7**	**NA**	**($526)**	**(4,119)**
Total Retrofit [1]		**209**	**$46.7**	**NA**	**0.4**	**11.6**	**2.7**	**15.5**	**NA**	**($347)**	**(2,722)**
Total Retrofit Including 65 Certainty Facilities		**226**	**$50.4**	**NA**	**0.4**	**12.5**	**2.9**	**16.7**	**NA**	**($375)**	**(2,940)**

[1] Used upper-bound costs and impacts for Subcategory J.
Numbers may not sum due to rounding.

5.10 REFERENCES

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CHAPTER 6

INITIAL REGULATORY FLEXIBILITY ANALYSIS

6.1 INTRODUCTION

This chapter analyzes the projected effects of incremental pollution control costs on small entities. This analysis is required by the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA). The RFA acknowledges that small entities have limited resources and makes it the responsibility of the regulating federal agency to avoid burdening such entities unnecessarily. In response to the RFA, EPA has prepared an initial regulatory flexibility analysis (IRFA). Section 6.2 provides the initial assessment to determine if an IRFA is necessary. Section 6.3 describes the components of the IRFA. Section 6.4 presents the analysis of economic impacts to small businesses in the meat products industry, while Section 6.5 summarizes the steps EPA has taken to minimize small business impacts under the proposed rule.

6.2 INITIAL ASSESSMENT

EPA guidance on implementing RFA requirements suggests the following must be addressed in an initial assessment. First, EPA must indicate whether the proposal is a rule subject to notice-and-comment rulemaking requirements. EPA has determined that the proposed meat products effluent limitations guidelines (ELG) are subject to notice-and-comment rulemaking requirements. Second, EPA should develop a profile of the affected small entities. EPA has developed a profile of the meat products industry, which includes all affected operations as well as small businesses. This information is provided in Chapter 2. Chapter 5 of this EA presents the analysis of projected economic impacts to the industry as a whole, including both small and large businesses. Much of the information covered in these chapters applies to small businesses. Additional information on small businesses in the meat products industry is provided in Section 6.4 of this chapter. Third, EPA's assessment needs to determine whether the rule would affect small entities and whether the rule would have an adverse economic impact on small entities.

EPA has determined that some small entities may incur costs for incremental pollution control as a result of the rule, if promulgated as proposed. EPA examines the adverse impacts of these additional costs in Section 6.4.

6.3 REGULATORY FLEXIBILITY ANALYSIS COMPONENTS

Section 603 of the RFA requires that an IRFA must contain the following:

- An explanation of why the rule may be needed.
- A short explanation of the objectives and legal basis for the proposed rule.
- A description of, and where feasible, an estimate of the number of small business entities to which the proposed rule will apply.
- A description of the proposed reporting, recordkeeping, and other compliance requirements (including estimates of the types of small entities that will be subject to the requirement and the type of professional skills necessary for the preparation of the report or record).
- An identification, to the extent practicable, of all relevant federal rules that may duplicate, overlap, or conflict with the proposed rule.
- A description of "any significant regulatory alternatives" to the proposed rule that accomplish the statement objectives of the applicable statutes and minimize any significant economic impact of the rule on small entities.

The Sections 6.3.1 through 6.3.5 below address each of these issues in turn.

6.3.1 Need for Objectives of the Rule

EPA is authorized under sections 301, 304, 306, and 307 of the CWA to establish effluent limitations guidelines and standards of performance for industrial dischargers. The objective of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." To assist in achieving this objective, EPA issues effluent limitations guidelines, pretreatment standards, and new source performance standards for industrial dischargers. Sections 301(b)(1) and 304(b)(1) authorize

EPA to issue BPT effluent limitations guidelines. Section 304(b)(4) authorizes EPA to issue BCT guidelines for conventional pollutants; Sections 301(b)(2)(E) and 304(b)(2) authorize EPA to issue BAT guidelines to control nonconventional and toxic pollutants; Section 306 authorizes EPA to issue NSPS for all pollutants; and Sections 304(g) and 307(b) authorize EPA to issue PSES and PSNS for all pollutants.

6.3.2 Estimated Number of Small Business Entities to Which the Regulation Will Apply

The RFA defines a "small entity" as a: (1) small not-for-profit organization, (2) small governmental jurisdiction, or (3) small business. EPA expects that the principal impact of the proposed rule will fall on small businesses in the meat products industry, rather than not-for-profit organizations or small governmental jurisdictions. Therefore, this analysis will focus on small meat products businesses.

The RFA defines a "small business" as having the same meaning as the term "small business concern" under Section 3 of the Small Business Act (unless an alternative definition has been approved). The latter identifies a small business at the business entity or company level, not the facility level. The analysis, then, needs to determine whether a facility is owned by a small business entity, not whether the facility itself may be considered "small."

A small business is generally defined according to NAICS code by standards set by the Small Business Administration (SBA). Under NAICS codes 311611, 311612, 311613, and 311615, a small business is defined as one with fewer than 500 employees. Note that a facility may employ fewer than 500 employees but not be considered "small" by this standard if it is owned by a larger parent company and total employment among all facilities that company owns exceeds 500 workers (U.S. SBA, 2000).

As stated above, it is important in determining the number of small business entities in the meat products industry to differentiate between facilities owned by small businesses and small facilities owned by large businesses. To make this differentiation, EPA used ratios of firms to establishments in the meat product industry derived from data compiled by the U.S. Census Bureau for the Small Business Administration's Office of Advocacy (U.S. SBA, 1998). These ratios were calculated by dividing the number of firms within each NAICS code and employment class by the number of establishments in that code and class. EPA then applied this ratio to model facilities in each meat type and process class determined to have an employment range below 500 employees in order to estimate the proportion of facilities that are stand alone small businesses relative to facilities owned by large businesses.[1, 2]

In essence, EPA is assuming that within any NAICS code and employment class combination where the ratio of firms to establishments is less than one, establishments in excess of the number of firms are all owned by large, multi-facility business entities. This is a reasonable assumption for the meat products industry IRFA. EPA determined the employment ranges for each meat type and process class based on its model facilities, which were matched to Census employment classes using annual production, estimated revenues, and other Census data (see Section 3.1.2.6 and Appendix B for details). In this matching process, EPA found:

- small model facilities invariably fell into employment classes with fewer than 10 workers; the ratio of firms to establishments for the 1 to 4 and 5 to 9 employment classes is 1.0 based on SBA's database;
- medium, large, and very large model facilities (hereafter, "nonsmall") almost always fell into employment classes with at least 250 to 499 workers (see Table B-6 for details), and often larger. If two facilities employing between 250 and 499 employees are owned by a single company, that company in all likelihood would be a large business.

For example, EPA determined there are 170 medium sized facilities in the red meat further processing class. The medium sized facility was matched to Census data in the 250 to 499 employment range. The ratio of firms to establishments in this employment range and NAICS code is 0.825. Therefore, EPA assumes that 140 (= 170 × 0.825) of these facilities are small stand alone businesses; the remaining 30 facilities are owned by large business entities.[3]

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[1] Clearly individual facilities employing more than 500 workers are large business owned, whether they are a stand alone business or owned by a larger entity.

[2] EPA determined from publicly available sources that this methodology was likely to result in a significant underestimation of large business owned facilities among renderers. Therefore, EPA used screener survey data to distinguish small businesses from large business owned facilities in Subcategory J. However, the procedure outlined in the text above was used for 98 percent of all facilities in the meat products industry.

[3] EPA did not try to estimate the number of large businesses, and therefore only distinguishes small business establishments (equal to the number of small businesses) from large business owned establishments (which is greater than the number of large businesses).

Tables 6-1 and 6-2 present the estimated number of stand alone small businesses, the number of facilities that are owned by a large business, and the total number of entities in each model facility size classification for the meat products industry. Table 6-1 provides the information by subcategory, while Table 6-2 presents the information by meat type and process class.

EPA estimates that a total of 5,174 out of 5,671 potentially affected facilities (91 percent) are small business owned under the 500 employee standard; an estimated 497 facilities (9 percent) are owned by large businesses.[4] Subcategory E through I contains the most small business entities, 3,179 (98 percent of the subcategory), followed by Subcategory A through D with 1,065 (90 percent of the subcategory). Subcategory L is estimated to have 745 small businesses (94 percent). Seventy-three of the 119 facilities in Subcategory J (61 percent) are estimated to be small business owned. Subcategory K is the only subcategory in which less than half of facilities are estimated to be small (45 percent).

By meat type and process class, facilities that perform poultry first processing operations, whether alone or in combination with other processes, tend to be owned by large business entities (Table 6-2). This tendency is not as strong among red meat first processors. Conversely, facilities that only perform further processing operations, whether for red meat or poultry, tend to be small stand alone businesses.

6.3.3 Description of the Proposed Reporting, Recordkeeping, and Other Compliance Requirements

EPA has incorporated no incremental reporting or recordkeeping requirements in the proposed rule. Technical requirements are described in detail in the Development Document (U.S. EPA, 2002). A brief summary of treatment technologies that will meet the effluent guidelines is presented in Chapter 4 of this document.

[4] EPA determined from publicly available sources that the 65 certainty facilities (see Chapter 5) are all owned by large business entities.

Table 6-1
Meat Product Industry Estimated Small Business Owned Facilities
40 CFR 432 Subcategories

Model Facility Size	Number of Facilities*	Estimated Number of Facilities	
		Small Business Owned*	Large Business Owned*
Subcategory A through D			
Small	1,060	1,060	0
Medium	87	5	81
Large	22	0	22
Very Large	17	0	17
Subcategory E through I			
Small	2,988	2,988	0
Medium	243	191	52
Large	5	0	5
Very Large	5	0	5
Subcategory J			
Small	23	18	5
Medium	33	19	14
Large	27	9	18
Very Large	36	27	9
Subcategory K			
Small	39	39	0
Medium	80	71	9
Large	99	0	99
Very Large	47	0	47
Subcategory L			
Small	572	572	0
Medium	192	168	24
Large	11	4	6
Very Large	20	0	20
Small Total	4,682	4,677	5
Medium Total	634	455	179
Large Total	164	13	150
Very Large Total	125	27	98
Certainty Facilities	65	0	65
TOTAL	**5,670**	**5,174**	**497**

* Numbers may not sum due to rounding.
Based on Screener Survey, Census Model Facilities, and SBA Special Tabulations.
Small business to large business owned ratio calculated from the Small Business Administration's establishment and facility comparison data compiled by the U.S. Census Bureau.
Subcategories not multiplied by the ratio were those classified as having over 500 employees.

Table 6-2
Meat Product Industry Estimated Small Business Owned Facilities
Meat Type and Process Classes

Model Facility Size	Number of Facilities*	Estimated Number of Facilities	
		Small Business Owned*	Large Business Owned*
Red Meat First Processing (Subcategory A - D)			
Small	282	282	0
Medium	6	5	0
Red Meat Further Processing (Subcategory E - I)			
Small	2,532	2,532	0
Medium	170	140	30
Large	5	0	5
Very Large	5	0	5
Red Meat First and Further Rendering (Subcategory A - D)			
Small	674	674	0
Medium	28	0	28
Red Meat First Processing and Rendering (Subcategory A - D)			
Small	29	29	0
Medium	24	0	24
Large	10	0	10
Very Large	17	0	17
Red Meat Further Processing and Rendering (Subcategory E - I)			
Small	32	32	0
Medium	11	0	11
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)			
Small	75	75	0
Medium	29	0	29
Large	12	0	12
Poultry First Processing (Subcategory K)			
Small	19	19	0
Medium	49	44	5
Large	73	0	73
Very Large	19	0	19
Poultry Further Processing (Subcategory L)			
Small	272	272	0
Medium	143	127	16
Large	5	4	1
Very Large	20	0	20

Table 6-2 (cont.)
Meat Product Industry Estimated Small Business Owned Facilities
Meat Type and Process Classes

Model Facility Size	Number of Facilities*	Estimated Number of Facilities: Small Business Owned*	Large Business Owned*
Poultry First and Further Processing (Subcategory K)			
Small	20	20	0
Medium	17	15	2
Large	6	0	6
Very Large	22	0	22
Poultry First Processing and Rendering (Subcategory K)			
Medium	9	8	1
Large	10	0	10
Very Large	3	0	3
Poultry Further Processing and Rendering (Subcategory L)			
Small	4	4	0
Medium	9	8	1
Large	6	0	6
Poultry First Processing, Further Processing, and Rendering (Subcategory K)			
Medium	5	4	1
Large	10	0	10
Very Large	3	0	3
Mixed Further Processing (59% Subcategory E- I and 41% Subcategory L) [1]			
Small	716	716	0
Medium	102	84	18
Mixed Further Processing and Rendering (59% Subcategory E - I and 41% Subcategory L) [1]			
Small	4	4	0
Renderer (Subcategory J)			
Small	23	18	5
Medium	33	19	14
Large	27	9	18
Very Large	36	27	9
Small Total	4,682	4,677	5
Medium Total	634	456	179
Large Total	164	13	150
Very Large Total	125	27	98
Certainty Facilities	65	0	65
TOTAL	**5,671**	**5,174**	**497**

[1] For nonsmall facilities, the allocation is 61% in Subcategory E through I and 39% in Subcategory L.
* Numbers may not sum due to rounding.
Based on Screener Survey, Census Model Facilities, and SBA Special Tabulations.
Classes with zero number of facilities were excluded from the table.
Small business to large business owned ratio calculated from the Small Business Administration's establishment and facility comparison data compiled by the U.S. Census Bureau.
Classes not multiplied by the ratio were those classified as having over 500 employees.

6.3.4 Identification of Relevant Federal Rules That May Duplicate, Overlap, or Conflict with the Proposed Rule

The current meat products rule, 40 CFR Part 432, set effluent guidelines and limitations for the beef and pork sectors of the meat products industry. These standards were set and revised over a number of years, most recently in 1995 (see Table 1-1 for details). The proposed rule revises the current industry standards in existing subcategories and thus does not conflict with them. The proposed rule does set new standards for facilities that perform poultry slaughter and processing operations. Prior to this proposal, EPA had set no national effluent limitations guidelines or standards for poultry slaughterers or processors.

Much of the water used by meat products industry establishments is for sanitation purposes. Through contact with USDA's Food Safety and Inspection Service (FSIS), EPA ensured that its proposed rule would not conflict with food safety sanitation requirements. FSIS stated that water use is only one way for facilities to comply with food safety regulations; alternative means to meeting the requirements are available. In addition, if facilities do use water for sanitation purposes, operators have options for recycle/reuse or end of pipe treatment that will not affect compliance (*citation needed*). Therefore, EPA has determined that the proposed rule does not conflict with FSIS food safety regulations.

6.3.5 Significant Regulatory Alternatives

EPA took steps to minimize the regulatory burden associated with the rulemaking. First, EPA categorized the industry based upon meat type (i.e., red meat or poultry), process class (i.e., slaughter, further processing, rendering), and facility size (small, medium, large, and very large based on production), then these categories were grouped into 40 CFR 432 subcategories. Both the meat type and process classes and the 40 CFR 432 subcategories differentiate between direct and indirect dischargers. All direct dischargers were costed for four sets of technology options regardless of meat type or processing stage; direct dischargers that process poultry were costed for a fifth technology option. Similarly, all indirect dischargers were costed for four technology options regardless of subcategory. Indirect dischargers were costed for a different set of technologies than were direct discharging facilities. Thus, EPA's analysis provided significant flexibility for tailoring the proposed guidelines according to sector specific characteristics. Finally, EPA also performed a small business analysis of all alternatives considered for each subcategory.

6.4 SMALL BUSINESS ANALYSIS

This section presents the projected economic impacts on small businesses resulting from the costs of complying with the proposed ELG for the meat products industry. The impacts are estimated using the methodology outlined in Chapter 3. Closure impacts, costs, and nonclosure impacts for small businesses are presented at the subcategory level and the meat type and process class level by discharge type.

Tables 6-3 and 6-4 provide the estimated number of small business owned facilities by both discharge type and facility size according to subcategory and meat type and process class respectively. Among both direct and indirect dischargers, the majority of facilities are owned by small business entities. However, while just a little more than half of direct dischargers are small business owned (56 percent), 95 percent of indirect discharging facilities are small business owned.

In the discussion of small business impacts below, EPA adopts the following convention for referring to different establishment sizes. Essentially all establishments enumerated in the tables below are *small businesses* (i.e., independent business entities employing fewer than 500 workers). However, within this group of small business entities, EPA distinguishes small facilities from nonsmall facilities (i.e., medium, large, or very large) based on facility production.[5] EPA has set the following production thresholds to define small facilities in each subcategory:

- Subcategory A through D: facilities that slaughter less than 50 million pounds (live weight kill) per year;
- Subcategory E through I: facilities that produce less than 50 million pounds of finished product per year. Because Subcategory E (small processors) is defined under the existing

[5] There is a single exception to the above rule. In Subcategory J (rendering), EPA determined that 5 small model facilities are owned by large business entities. With that exception, all small model facilities are also small business entities.

Table 6-3
Meat Product Industry Estimated Direct and Indirect Discharge Small Business Owned Facilities
40 CFR 432 Subcategories

Model Facility Size	Number of Facilities		Direct Discharge Facilities		Indirect Discharge Facilities	
	Direct*	Indirect*	Small Business Owned*	Large Business Owned*	Small Business Owned*	Large Business Owned*
Subcategory A through D						
Small	59	1,001	59	0	1,001	0
Medium	40	47	5	34	0	47
Large	14	8	0	14	0	8
Very Large	12	5	0	12	0	5
Subcategory E through I						
Small	48	2,940	48	0	2,940	0
Medium	17	226	10	7	181	45
Large	1	4	0	1	0	4
Very Large	1	4	0	1	0	4
Subcategory J						
Small	6	17	5	1	13	4
Medium	7	26	4	3	15	11
Large	6	21	2	4	7	14
Very Large	8	28	6	2	21	7
Subcategory K						
Small	0	39	0	0	39	0
Medium	32	48	28	4	44	5
Large	38	61	0	38	0	61
Very Large	18	29	0	18	0	29
Subcategory L						
Small	4	568	4	0	568	0
Medium	12	180	11	1	158	22
Large	1	10	1	0	4	6
Very Large	2	18	0	2	0	18
Small Total	117	4,565	116	1	4,561	4
Medium Total	108	527	58	50	398	130
Large Total	60	104	3	57	11	93
Very Large Total	41	84	6	35	21	63
TOTAL	**326**	**5,280**	**183**	**143**	**4,991**	**290**

* Numbers may not sum due to rounding.
Based on Screener Survey, Census Model Facilities, and SBA Special Tabulations.
Small business to large business owned ratio calculated from the Small Business Administration's establishment and facility comparison data compiled by the U.S. Census Bureau.
Subcategories not multiplied by the ratio were those classified as having over 500 employees.
EPA did not distribute the 65 certainty facilities between direct and indirect dischargers.

Table 6-4
Meat Product Industry Estimated Direct and Indirect Discharge Small Business Owned Facilities
Meat Type and Process Classes

Model Facility Size	Number of Facilities		Direct Discharge Facilities		Indirect Discharge Facilities	
	Direct*	Indirect*	Small Business Owned*	Large Business Owned*	Small Business Owned*	Large Business Owned*
Red Meat First Processing (Subcategory A- D)						
Small	17	265	17	0	265	0
Medium	6	0	5	0	0	0
Red Meat Further Processing (Subcategory E - I)						
Small	43	2,489	43	0	2,489	0
Medium	10	160	8	2	132	28
Large	1	4	0	1	0	4
Very Large	1	4	0	1	0	4
Red Meat First and Further Rendering (Subcategory A - D)						
Small	0	674	0	0	674	0
Medium	0	28	0	0	0	28
Red Meat First Processing and Rendering (Subcategory A - D)						
Small	17	12	17	0	12	0
Medium	17	7	0	17	0	7
Large	7	3	0	7	0	3
Very Large	12	5	0	12	0	5
Red Meat Further Processing and Rendering (Subcategory E - I)						
Small	0	32	0	0	32	0
Medium	4	7	0	4	0	7
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)						
Small	25	50	25	0	50	0
Medium	17	12	0	17	0	12
Large	7	5	0	7	0	5
Poultry First Processing (Subcategory K)						
Small	0	19	0	0	19	0
Medium	17	32	15	2	29	3
Large	25	48	0	25	0	48
Very Large	7	12	0	7	0	12
Poultry Further Processing (Subcategory L)						
Small	0	272	0	0	272	0
Medium	10	133	9	1	119	14
Large	1	4	1	0	4	0
Very Large	2	18	0	2	0	18
Poultry First and Further Processing (Subcategory K)						
Small	0	20	0	0	20	0
Medium	6	11	5	1	10	1
Large	2	4	0	2	0	4
Very Large	8	14	0	8	0	14

Table 6-4 (cont.)
Meat Product Industry Estimated Direct and Indirect Discharge Small Business Owned Facilities
Meat Type and Process Classes

Model Facility Size	Number of Facilities		Direct Discharge Facilities		Indirect Discharge Facilities	
	Direct*	Indirect*	Small Business Owned*	Large Business Owned*	Small Business Owned*	Large Business Owned*
Poultry First Processing and Rendering (Subcategory K)						
Medium	7	2	6	1	2	0
Large	8	2	0	8	0	2
Very Large	2	1	0	2	0	1
Poultry Further Processing and Rendering (Subcategory L)						
Small	0	4	0	0	4	0
Medium	0	9	0	0	8	1
Large	0	6	0	0	0	6
Poultry First Processing, Further Processing, and Rendering (Subcategory K)						
Medium	2	3	2	0	3	0
Large	3	7	0	3	0	7
Very Large	1	2	0	1	0	2
Mixed Further Processing (59% Subcategory E- I and 41% Subcategory L) [1]						
Small	9	707	9	0	707	0
Medium	5	97	4	1	80	17
Mixed Further Processing and Rendering (59% Subcategory E- I and 41% Subcategory L) [1]						
Small	0	4	0	0	4	0
Renderer (Subcategory J)						
Small	6	17	5	1	13	4
Medium	7	26	4	3	15	11
Large	6	21	2	4	7	14
Very Large	8	28	6	2	21	7
Small Total	117	4,565	116	1	4,561	4
Medium Total	108	527	59	49	397	130
Large Total	60	104	3	57	11	93
Very Large Total	41	84	6	35	21	63
TOTAL	**326**	**5,280**	**184**	**142**	**4,990**	**290**

[1] For nonsmall facilities, the allocation is 61% in Subcategory E through I and 39% in Subcategory L.
* Numbers may not sum due to rounding.
Based on Screener Survey, Census Model Facilities, and SBA Special Tabulations.
Classes with zero number of facilities were excluded from the table.
Small business to large business owned ratio calculated from the Small Business Administration's establishment and facility comparison data compiled by the U.S. Census Bureau.
Classes not multiplied by the ratio were those classified as having over 500 employees.
EPA did not distribute the 65 certainty facilities between direct and indirect dischargers.

guidelines as facilities that produce less than 6,000 pounds of finished product per day, all facilities in Subcategory E are by definition small;

- Subcategory J: facilities that render less than 10 million pounds of raw material per year;
- Subcategory K: facilities that slaughter less than 10 million pounds per year;
- Subcategory L: facilities that produce less than 7,000 pounds of finished product per day.

Based on median production, all small model facilities fall below these thresholds and are thus synonymous with small producers; all other model facilities exceed the thresholds (see Appendix B, Table B-6 for details).

For each level of impact analysis, EPA first presents the results for small model facilities, then the impacts for those nonsmall model facilities that EPA estimates are owned by small businesses. The latter group of facilities is a subset of the facilities analyzed in Chapter 5. Thus, impacts to nonsmall facilities presented in Chapter 6 are not additional impacts of the proposed rule, but are a subset of those impacts presented in Chapter 5.

6.4.1 Total and Average Compliance Costs

Tables 6-5 and 6-6 present total and per facility costs for small business owned meat products facilities. The tables include estimated capital costs, annual operating and maintenance (O&M) costs, pretax annualized, and posttax annualized compliance costs.[6] Annualized costs are analogous to a mortgage payment that spreads the one-time investment of a home over a series of constant monthly payments. They are calculated as the equal annual payments of an annuity that has the same present value as the stream of cash outflow over the project life and includes the opportunity cost of money or interest (see Section 3.1.1 of this document for more detail on cost annualization, and the Development Document (U.S. EPA, 2002) for details on the estimation of capital and O&M costs).

[6] EPA did not estimate retrofit costs for small model facilities. In Section 6.4, EPA will not present retrofit costs for medium, large, and very large model facilities owned by small businesses. These may be found by scaling results from Chapter 5 appropriately.

6.4.1.1 Total and Average Compliance Costs by Subcategory

Small Model Facilities

As seen in the Table 6-5A, estimated posttax annualized costs for small model direct dischargers are less than $700 per facility under BAT 1. Small model indirect dischargers average from $24,000 in Subcategory A through D to $42,100 in Subcategory L per facility under option 1. Option 3 is the highest cost option per facility for direct dischargers (BAT 4 was not costed for small model facilities), and option 4 has the highest cost per facility for indirect dischargers (with the exception of Subcategory J). Per facility costs for indirect dischargers exceed $137,000 under options 2, 3, and 4 for all subcategories.

Under the proposed option (BAT 1) for small model facilities in subcategories K and L, posttax annualized costs per facility are:

- Subcategory K: NA[7]
- Subcategory L: $711

No option is proposed for small model direct dischargers in subcategories A through J. No option is proposed for small model indirect dischargers in any subcategories.

Nonsmall Model Facilities

Table 6-5B provides costs for nonsmall model facilities owned by small businesses. Under the proposed option (BAT 3 in all subcategories except J; BAT 2 in Subcategory J) for nonsmall model facilities that are owned by small businesses, posttax annualized costs per facility are:

- Subcategory A through D: $6,756
- Subcategory E through I: $26,020

[7] BAT 1 is the proposed option for subcategory K, but EPA currently estimates that there are no small model facilities in the subcategory.

Table 6-5A
Total and Average Costs: Small Model Facilities
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Subcategory A through D									
59	BAT1	$209,270	$7,002	$29,140	$20,380	$3,547	$119	$494	$345
	BAT2	$209,270	$486,666	$507,791	$338,587	$3,547	$8,249	$8,607	$5,739
	BAT3	$14,646,645	$2,752,231	$4,296,876	$3,387,443	$248,248	$46,648	$72,828	$57,414
1,001	PSES1	$119,827,472	$17,343,753	$29,991,766	$24,322,160	$119,708	$17,326	$29,962	$24,298
	PSES2	$584,635,684	$100,720,499	$162,395,869	$152,095,190	$584,052	$100,620	$162,234	$151,943
	PSES3	$592,231,249	$90,024,749	$152,526,764	$141,732,228	$591,640	$89,935	$152,374	$141,591
	PSES4	$722,696,546	$96,489,992	$172,789,097	$160,786,458	$721,975	$96,394	$172,616	$160,626
Subcategory E through I									
48	BAT1	$137,394	$4,547	$19,082	$16,033	$2,844	$94	$395	$332
	BAT2	$137,394	$273,721	$287,687	$226,619	$2,844	$5,666	$5,955	$4,691
	BAT3	$1,452,166	$421,892	$574,724	$463,121	$30,059	$8,733	$11,897	$9,586
2,940	PSES1	$482,890,365	$70,670,503	$121,638,838	$99,126,884	$164,221	$24,034	$41,367	$33,711
	PSES2	$1,559,519,390	$271,993,926	$436,506,348	$403,342,638	$530,360	$92,500	$148,447	$137,169
	PSES3	$1,863,372,051	$281,690,378	$478,347,443	$445,189,371	$633,694	$95,797	$162,676	$151,400
	PSES4	$2,207,411,046	$296,282,919	$529,328,313	$496,151,770	$750,695	$100,760	$180,014	$168,731
Subcategory J									
6	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$172,632	$172,267	$135,058	$0	$28,772	$28,711	$22,510
	BAT3	$8,192,232	$909,610	$1,774,899	$1,734,571	$1,365,372	$151,602	$295,816	$289,095

Table 6-5A (cont.)
Total and Average Costs: Small Model Facilities
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
17	PSES1	$2,796,848	$513,318	$808,301	$697,563	$164,520	$30,195	$47,547	$41,033
	PSES2	$43,635,312	$6,030,492	$10,636,883	$10,522,621	$2,566,783	$354,735	$625,699	$618,978
	PSES3	$36,320,992	$3,752,576	$7,589,503	$7,475,240	$2,136,529	$220,740	$446,441	$439,720
	PSES4	$39,443,676	$3,717,570	$7,885,131	$7,770,868	$2,320,216	$218,681	$463,831	$457,110
Subcategory K									
39	PSES1	$4,546,294	$936,533	$1,415,814	$1,219,462	$116,572	$24,014	$36,303	$31,268
	PSES2	$22,583,519	$3,641,817	$6,024,761	$5,767,343	$579,065	$93,380	$154,481	$147,881
	PSES3	$26,520,704	$3,821,424	$6,620,770	$6,363,351	$680,018	$97,985	$169,763	$163,163
	PSES4	$31,865,901	$4,032,023	$7,396,754	$7,139,335	$817,074	$103,385	$189,660	$183,060
Subcategory L									
4	BAT1	$22,523	$738	$3,120	$2,622	$6,104	$200	$846	$711
	BAT2	$22,523	$26,343	$28,672	$22,655	$6,104	$7,139	$7,770	$6,139
	BAT3	$682,701	$134,053	$206,039	$167,698	$185,014	$36,329	$55,837	$45,447
568	PSES1	$103,367,146	$16,382,036	$27,289,629	$23,928,696	$182,142	$28,867	$48,087	$42,164
	PSES2	$376,477,774	$61,642,849	$101,365,670	$96,962,459	$663,385	$108,620	$178,615	$170,856
	PSES3	$377,942,407	$54,773,060	$94,665,437	$90,268,388	$665,966	$96,515	$166,808	$159,060
	PSES4	$445,865,875	$57,547,505	$104,624,239	$100,191,085	$785,653	$101,404	$184,357	$176,545
Total Costs Excluding 65 Certainty Facilities									
117	BAT1	$369,187	$12,287	$51,342	$39,035	$3,155	$105	$439	$334
	BAT2	$369,187	$959,362	$996,416	$722,918	$3,155	$8,200	$8,516	$6,179
	BAT3	$24,973,744	$4,217,786	$6,852,537	$5,752,833	$213,451	$36,049	$58,569	$49,170
4565	PSES1	$713,428,125	$105,846,143	$181,144,349	$149,294,765	$156,282	$23,186	$39,681	$32,704
	PSES2	$2,586,851,679	$444,029,583	$716,929,531	$668,690,250	$566,671	$97,268	$157,049	$146,482
	PSES3	$2,896,387,403	$434,062,187	$739,749,916	$691,028,579	$634,477	$95,085	$162,048	$151,375
	PSES4	$3,447,283,044	$458,070,009	$822,023,534	$772,039,516	$755,155	$100,344	$180,071	$169,121

Table 6-5B
Total and Average Costs : Nonsmall Model Facilities Owned by Small Businesses
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Subcategory A through D									
5	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$0	$0	$0	$0	$0	$0	$0
	BAT3	$0	$56,991	$56,870	$33,781	$0	$11,398	$11,374	$6,756
	BAT4	$4,004,182	$500,129	$922,946	$606,989	$800,836	$100,026	$184,589	$121,398
Subcategory E through I									
10	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$47,534	$120,959	$125,735	$74,691	$4,553	$11,586	$12,044	$7,154
	BAT3	$1,740,079	$231,822	$415,533	$271,650	$166,674	$22,205	$39,802	$26,020
	BAT4	$13,792,724	$1,370,629	$2,827,798	$1,866,311	$1,321,142	$131,286	$270,862	$178,765
181	PSES1	$46,917,105	$8,397,212	$13,346,006	$8,530,490	$259,497	$46,445	$73,816	$47,182
	PSES2	$285,722,252	$38,664,926	$68,829,125	$44,752,708	$1,580,322	$213,855	$380,692	$247,526
	PSES3	$267,215,645	$29,546,954	$57,771,351	$37,929,673	$1,477,963	$163,423	$319,532	$209,788
	PSES4	$402,074,282	$34,830,145	$77,319,199	$51,442,768	$2,223,862	$192,645	$427,650	$284,529
Subcategory J									
12	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$305,816	$305,170	$181,271	$0	$25,485	$25,431	$15,106
	BAT3	$14,464,214	$1,655,818	$3,183,467	$2,103,233	$1,205,351	$137,985	$265,289	$175,269
	BAT4	$16,300,625	$1,730,405	$3,452,295	$2,289,865	$1,358,385	$144,200	$287,691	$190,822
43	PSES1	$2,104,216	$503,232	$724,917	$461,479	$48,935	$11,703	$16,859	$10,732
	PSES2	$50,192,890	$7,728,341	$13,025,315	$8,473,587	$1,167,277	$179,729	$302,914	$197,060
	PSES3	$73,135,125	$7,768,577	$15,494,077	$10,276,695	$1,700,817	$180,665	$360,327	$238,993
	PSES4	$78,829,687	$7,844,804	$16,172,955	$10,763,513	$1,833,249	$182,437	$376,115	$250,314

Table 6-5B (cont.)
Total and Average Costs : Nonsmall Model Facilities Owned by Small Businesses
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Subcategory K									
28	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$233,976	$794,388	$817,478	$482,706	$8,356	$28,371	$29,196	$17,239
	BAT3	$44,582,917	$4,443,329	$9,153,384	$6,030,795	$1,592,247	$158,690	$326,907	$215,386
	BAT4	$60,747,899	$5,495,607	$11,914,627	$7,890,501	$2,169,568	$196,272	$425,522	$281,804
	BAT5	$69,162,826	$5,720,870	$13,030,198	$8,669,877	$2,470,101	$204,317	$465,364	$309,638
44	PSES1	$9,338,163	$1,324,906	$2,310,623	$1,490,044	$212,231	$30,112	$52,514	$33,865
	PSES2	$138,264,804	$17,199,621	$31,799,671	$20,667,066	$3,142,382	$390,900	$722,720	$469,706
	PSES3	$125,915,177	$11,565,808	$24,870,458	$16,426,838	$2,861,709	$262,859	$565,238	$373,337
	PSES4	$136,569,528	$11,771,980	$26,204,039	$17,366,139	$3,103,853	$267,545	$595,546	$394,685
Subcategory L									
12	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$119,389	$216,748	$228,928	$137,321	$10,328	$18,750	$19,803	$11,879
	BAT3	$9,918,568	$1,164,479	$2,211,975	$1,456,446	$858,008	$100,733	$191,347	$125,990
	BAT4	$15,654,866	$1,591,365	$3,245,190	$2,153,384	$1,354,227	$137,661	$280,726	$186,279
10 [1]	BAT5	$14,522,378	$1,366,062	$2,900,480	$1,931,724	$1,256,261	$118,171	$250,907	$167,104
162	PSES1	$40,451,722	$6,957,133	$11,224,559	$7,254,471	$249,394	$42,892	$69,202	$44,725
	PSES2	$281,559,101	$43,636,383	$73,349,378	$47,644,506	$1,735,876	$269,028	$452,216	$293,739
	PSES3	$240,346,744	$26,828,239	$52,214,101	$34,505,780	$1,481,793	$165,402	$321,912	$212,736
	PSES4	$344,192,247	$30,999,712	$67,369,602	$45,024,538	$2,122,024	$191,120	$415,349	$277,587

Table 6-5B (cont.)
Total and Average Costs : Nonsmall Model Facilities Owned by Small Businesses
40 CFR 432 Subcategories

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Total Costs Excluding 65 Certainty Facilities									
67	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$400,899	$1,437,910	$1,477,311	$875,989	$5,984	$21,461	$22,049	$13,074
	BAT3	$70,705,777	$7,552,438	$15,021,230	$9,895,905	$1,055,310	$112,723	$224,197	$147,700
	BAT4	$110,500,296	$10,688,135	$22,362,856	$14,807,049	$1,649,258	$159,524	$333,774	$221,001
38 [1]	BAT5	$83,685,204	$7,086,932	$15,930,678	$10,601,602	$2,202,242	$186,498	$419,228	$278,990
430	PSES1	$98,811,207	$17,182,484	$27,606,105	$17,736,483	$229,794	$39,959	$64,200	$41,248
	PSES2	$755,739,047	$107,229,271	$187,003,489	$121,537,867	$1,757,533	$249,370	$434,892	$282,646
	PSES3	$706,612,692	$75,709,578	$150,349,986	$99,138,985	$1,643,285	$176,069	$349,651	$230,556
	PSES4	$961,665,744	$85,446,641	$187,065,794	$124,596,958	$2,236,432	$198,713	$435,037	$289,760

[1] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations.
The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

- Subcategory J: $15,106
- Subcategory K: $215,386
- Subcategory L: $125,990

Estimated compliance costs for nonsmall model direct dischargers in the poultry subcategories are significantly higher than for red meat and rendering subcategories. This may occur because red meat and renderers are currently subject to effluent guidelines, but poultry establishments are not. No option is proposed for nonsmall model indirect discharging facilities.

6.4.1.2 Total and Average Compliance Costs by Meat Type and Process Class

Small Model Facilities

Table 6-6A presents estimated costs for small model facilities by meat type and process class. The range of per facility costs within any given subcategory can cover a wide variation among the meat type and process classes that compose that subcategory. For example, in Subcategory A through D, the average posttax cost per facility for BAT is $57,000; however, this reflects a range of per facility costs from $4,000 in the red meat first processing, further processing, and rendering class, to $119,000 in the red meat first processing class. The range of posttax annualized costs for small model facilities under the proposed option (BAT 1) within each subcategory is:

- Subcategory K: NA
- Subcategory L: $711
  — mixed first processing[8]

No option is proposed for small model direct dischargers in subcategories A through J. No option is proposed for small model indirect dischargers in any subcategories.

[8] Throughout the remainder of this chapter, EPA will use the convention that if the results for a single class are listed below a subcategory, then that is the only model size, class, and discharge type combination owned by small businesses in that subcategory.

Table 6-6A
Total and Average Costs: Small Model Facilities
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
Red Meat First Processing (Subcategory A - D)									
17	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$178,736	$178,358	$139,833	$0	$10,514	$10,492	$8,225
	BAT3	$7,299,355	$1,413,095	$2,182,802	$2,023,866	$429,374	$83,123	$128,400	$119,051
265	PSES1	$26,895,344	$3,873,826	$6,712,720	$5,472,746	$101,492	$14,618	$25,331	$20,652
	PSES2	$151,499,760	$26,848,712	$42,829,398	$40,351,864	$571,697	$101,316	$161,620	$152,271
	PSES3	$152,128,864	$23,960,492	$40,013,875	$37,536,341	$574,071	$90,417	$150,996	$141,647
	PSES4	$183,388,576	$25,021,890	$44,382,110	$41,904,576	$692,032	$94,422	$167,480	$158,130
Red Meat Further Processing (Subcategory E - I)									
43	BAT1	$104,984	$3,486	$14,592	$12,260	$2,441	$81	$339	$285
	BAT2	$104,984	$235,812	$246,427	$194,019	$2,441	$5,484	$5,731	$4,512
	BAT3	$469,743	$228,987	$278,229	$221,799	$10,924	$5,325	$6,470	$5,158
2489	PSES1	$412,294,080	$58,444,990	$101,965,997	$83,160,148	$165,646	$23,481	$40,967	$33,411
	PSES2	$1,276,559,616	$223,432,938	$358,094,497	$330,102,582	$512,881	$89,768	$143,871	$132,625
	PSES3	$1,578,774,784	$238,175,152	$404,797,353	$376,805,437	$634,301	$95,691	$162,635	$151,388
	PSES4	$1,867,879,936	$250,308,432	$447,508,990	$419,517,075	$750,454	$100,566	$179,795	$168,548
Red Meat First and Further Processing (Subcategory A - D)									
674	PSES1	$91,858,632	$12,875,693	$22,572,430	$18,413,931	$136,289	$19,103	$33,490	$27,320
	PSES2	$419,484,096	$71,069,328	$115,324,782	$109,023,431	$622,380	$105,444	$171,105	$161,756
	PSES3	$420,050,720	$62,482,176	$106,815,753	$100,514,402	$623,221	$92,704	$158,480	$149,131
	PSES4	$498,965,536	$65,781,584	$118,461,927	$112,160,576	$740,305	$97,599	$175,760	$166,410

Table 6-6A (cont.)
Total and Average Costs: Small Model Facilities
Meat Type and Process Classes

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Red Meat First Processing and Rendering (Subcategory A - D)									
17	BAT1	$148,233	$4,969	$20,650	$14,441	$8,720	$292	$1,215	$849
	BAT2	$148,233	$146,722	$162,104	$98,465	$8,720	$8,631	$9,536	$5,792
	BAT3	$7,057,751	$1,207,726	$1,952,291	$1,263,229	$415,162	$71,043	$114,841	$74,308
12	PSES1	$0	$0	$0	$0	$0	$0	$0	$0
	PSES2	$0	$135,533	$135,247	$80,337	$0	$11,294	$11,271	$6,695
	PSES3	$6,334,605	$988,796	$1,657,273	$1,080,517	$527,884	$82,400	$138,106	$90,043
	PSES4	$7,825,042	$1,049,669	$1,875,792	$1,254,805	$652,087	$87,472	$156,316	$104,567
Red Meat Further Processing and Rendering (Subcategory E - I)									
32	PSES1	$2,221,331	$418,784	$653,044	$529,329	$69,417	$13,087	$20,408	$16,542
	PSES2	$14,641,294	$3,224,597	$4,767,677	$4,407,797	$457,540	$100,769	$148,990	$137,744
	PSES3	$15,218,554	$3,073,139	$4,677,647	$4,317,767	$475,580	$96,036	$146,176	$134,930
	PSES4	$20,195,592	$3,475,733	$5,606,248	$5,246,368	$631,112	$108,617	$175,195	$163,949
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)									
25	BAT1	$61,037	$2,033	$8,490	$5,939	$2,441	$81	$340	$238
	BAT2	$61,037	$161,208	$167,329	$100,289	$2,441	$6,448	$6,693	$4,012
	BAT3	$289,539	$131,410	$161,782	$100,347	$11,582	$5,256	$6,471	$4,014
50	PSES1	$1,073,496	$594,234	$706,616	$435,483	$21,470	$11,885	$14,132	$8,710
	PSES2	$13,651,828	$2,666,926	$4,106,442	$2,639,559	$273,037	$53,339	$82,129	$52,791
	PSES3	$13,717,060	$2,593,285	$4,039,862	$2,600,968	$274,341	$51,866	$80,797	$52,019
	PSES4	$32,517,392	$4,636,849	$8,069,268	$5,466,501	$650,348	$92,737	$161,385	$109,330

Table 6-6A (cont.)
Total and Average Costs: Small Model Facilities
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
Poultry First Processing (Subcategory K)									
19	PSES1	$4,546,294	$902,655	$1,382,008	$1,192,958	$239,279	$47,508	$72,737	$62,787
	PSES2	$16,988,052	$2,405,367	$4,198,600	$4,003,641	$894,108	$126,598	$220,979	$210,718
	PSES3	$17,149,222	$2,127,847	$3,938,728	$3,743,768	$902,591	$111,992	$207,301	$197,040
	PSES4	$20,165,204	$2,257,294	$4,387,166	$4,192,207	$1,061,327	$118,805	$230,903	$220,642
Poultry Further Processing (Subcategory L)									
272	PSES1	$55,658,488	$8,136,523	$14,011,210	$13,161,766	$204,627	$29,914	$51,512	$48,389
	PSES2	$187,852,080	$29,771,220	$49,593,903	$48,744,459	$690,633	$109,453	$182,331	$179,208
	PSES3	$188,329,104	$26,325,620	$46,206,079	$45,356,635	$692,386	$96,785	$169,875	$166,752
	PSES4	$221,011,072	$27,650,150	$50,987,447	$50,138,003	$812,541	$101,655	$187,454	$184,331
Poultry First and Further Processing (Subcategory K)									
20	PSES1	$0	$33,878	$33,806	$26,504	$0	$1,694	$1,690	$1,325
	PSES2	$5,595,467	$1,236,450	$1,826,161	$1,763,702	$279,773	$61,822	$91,308	$88,185
	PSES3	$9,371,482	$1,693,577	$2,682,042	$2,619,583	$468,574	$84,679	$134,102	$130,979
	PSES4	$11,700,697	$1,774,729	$3,009,588	$2,947,129	$585,035	$88,736	$150,479	$147,356
Poultry Further Processing and Rendering (Subcategory K)									
4	PSES1	$193,859	$40,837	$61,272	$39,240	$48,465	$10,209	$15,318	$9,810
	PSES2	$2,167,089	$366,679	$595,307	$385,413	$541,772	$91,670	$148,827	$96,353
	PSES3	$2,417,926	$343,616	$598,846	$391,196	$604,482	$85,904	$149,712	$97,799
	PSES4	$2,943,681	$364,323	$675,164	$444,244	$735,920	$91,081	$168,791	$111,061
Mixed Further Processing (59 percent Subcategory E - I, 41 percent Subcategory L)									
9	BAT1	$54,933	$1,799	$7,610	$6,395	$6,104	$200	$846	$711
	BAT2	$54,933	$64,252	$69,931	$55,255	$6,104	$7,139	$7,770	$6,139
	BAT3	$1,665,124	$326,958	$502,533	$409,020	$185,014	$36,329	$55,837	$45,447

Table 6-6A (cont.)
Total and Average Costs: Small Model Facilities
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
707	PSES1	$115,647,168	$19,957,532	$32,157,506	$26,114,349	$163,574	$28,228	$45,484	$36,937
	PSES2	$452,671,584	$76,483,208	$124,240,374	$116,289,275	$640,271	$108,180	$175,729	$164,483
	PSES3	$454,453,536	$68,212,416	$116,175,688	$108,224,590	$642,791	$96,481	$164,322	$153,076
	PSES4	$538,625,664	$71,655,976	$128,522,237	$120,571,138	$761,847	$101,352	$181,785	$170,539
Mixed Further Processing and Rendering (59 percent Subcategory E - I, 41 percent Subcategory L)									
4	PSES1	$242,585	$53,873	$79,439	$50,746	$60,646	$13,468	$19,860	$12,687
	PSES2	$2,105,501	$358,133	$580,260	$375,571	$526,375	$89,533	$145,065	$93,893
	PSES3	$2,120,554	$333,495	$557,267	$362,135	$530,138	$83,374	$139,317	$90,534
	PSES4	$2,620,976	$375,810	$652,466	$426,026	$655,244	$93,952	$163,117	$106,507
Rendering (Subcategory J)									
6	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$172,632	$172,267	$135,058	$0	$28,772	$28,711	$22,510
	BAT3	$8,192,232	$909,610	$1,774,899	$1,734,571	$1,365,372	$151,602	$295,816	$289,095
17	PSES1	$2,796,848	$513,318	$808,301	$697,563	$164,520	$30,195	$47,547	$41,033
	PSES2	$43,635,312	$6,030,492	$10,636,883	$10,522,621	$2,566,783	$354,735	$625,699	$618,978
	PSES3	$36,320,992	$3,752,576	$7,589,503	$7,475,240	$2,136,529	$220,740	$446,441	$439,720
	PSES4	$39,443,676	$3,717,570	$7,885,131	$7,770,868	$2,320,216	$218,681	$463,831	$457,110
Total Costs Excluding 65 Certainty Facilities									
117	BAT1	$369,187	$12,287	$51,342	$39,035	$3,155	$105	$439	$334
	BAT2	$369,187	$959,362	$996,416	$722,918	$3,155	$8,200	$8,516	$6,179
	BAT3	$24,973,744	$4,217,786	$6,852,537	$5,752,833	$213,451	$36,049	$58,569	$49,170
4565	PSES1	$713,428,125	$105,846,143	$181,144,349	$149,294,765	$156,282	$23,186	$39,681	$32,704
	PSES2	$2,586,851,679	$444,029,583	$716,929,531	$668,690,250	$566,671	$97,268	$157,049	$146,482
	PSES3	$2,896,387,403	$434,062,187	$739,749,916	$691,028,579	$634,477	$95,085	$162,048	$151,375
	PSES4	$3,447,283,044	$458,070,009	$822,023,534	$772,039,516	$755,155	$100,344	$180,071	$169,121

Nonsmall Model Facilities

Table 6-6B provides costs for nonsmall model facilities owned by small businesses. Under the proposed option (BAT 3 in all subcategories except J; BAT 2 in Subcategory J) for nonsmall model facilities that are owned by small businesses, the range of posttax annualized costs per facility within each subcategory is:

• Subcategory A through D: — red meat first processing	$6,756
• Subcategory E through I: — red meat further processing: — mixed first processing:	$26,020 $5,985 $91,709
• Subcategory J: — rendering	$15,106
• Subcategory K: — poultry first and further processing: — poultry first processing, further processing, and rendering:	$215,386 $174,281 $309,969
• Subcategory L: — mixed first processing: — poultry further processing:	$125,990 $91,709 $131,338

No option is proposed for nonsmall model indirect discharging facilities.

6.4.2 Closure Impacts

Facility level closure impacts are estimated using the site closure model described in Section 3.1.2 and Appendix B. The site closure model addresses the impact of compliance costs on the financial health of the individual facility. In effect, the closure analysis estimates whether or not it makes economic sense for a facility to upgrade pollution controls, or if under these controls the facility would lose economic viability and therefore close.

Table 6-6B
Total and Average Costs : Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Number of Facilities	Option	TOTAL Capital Costs	TOTAL O&M Costs	TOTAL Pretax Annualized	TOTAL Posttax Annualized	AVERAGE Capital Costs	AVERAGE O&M Costs	AVERAGE Pretax Annualized	AVERAGE Posttax Annualized
Red Meat First Processing (Subcategory A - D)									
5	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$0	$0	$0	$0	$0	$0	$0
	BAT3	$0	$56,991	$56,870	$33,781	$0	$11,398	$11,374	$6,756
	BAT4	$4,004,182	$500,129	$922,946	$606,989	$800,836	$100,026	$184,589	$121,398
Red Meat Further Processing (Subcategory E - I)									
8	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$32,641	$67,179	$70,493	$41,658	$4,080	$8,397	$8,812	$5,207
	BAT3	$175,671	$58,994	$77,465	$47,881	$21,959	$7,374	$9,683	$5,985
	BAT4	$9,038,624	$952,025	$1,906,821	$1,249,487	$1,129,828	$119,003	$238,353	$156,186
132	PSES1	$31,622,623	$6,360,656	$9,694,714	$6,137,186	$239,565	$48,187	$73,445	$46,494
	PSES2	$166,080,050	$20,925,417	$38,462,052	$24,958,990	$1,258,182	$158,526	$291,379	$189,083
	PSES3	$164,423,068	$19,352,015	$36,716,570	$23,914,714	$1,245,629	$146,606	$278,156	$181,172
	PSES4	$232,389,828	$22,349,610	$46,902,633	$30,885,312	$1,760,529	$169,315	$355,323	$233,980
Poultry First Processing (Subcategory K)									
15	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$409,704	$408,838	$238,762	$0	$27,314	$27,256	$15,917
	BAT3	$24,892,583	$2,445,826	$5,075,729	$3,338,506	$1,659,506	$163,055	$338,382	$222,567
	BAT4	$33,903,116	$2,990,196	$6,572,783	$4,348,267	$2,260,208	$199,346	$438,186	$289,884
	BAT5	$38,231,273	$3,140,870	$7,181,307	$4,768,722	$2,548,752	$209,391	$478,754	$317,915
29	PSES1	$8,666,041	$1,140,522	$2,055,479	$1,330,701	$298,829	$39,328	$70,879	$45,886
	PSES2	$104,252,745	$11,570,626	$22,582,131	$14,755,491	$3,594,922	$398,987	$778,694	$508,810
	PSES3	$90,947,900	$8,147,485	$17,757,803	$11,738,034	$3,136,134	$280,948	$612,338	$404,760
	PSES4	$98,486,233	$8,289,526	$18,697,534	$12,400,182	$3,396,077	$285,846	$644,743	$427,592

Table 6-6B (cont.)
Total and Average Costs : Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
Poultry Further Processing (Subcategory L)									
10	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$109,867	$182,364	$193,609	$116,202	$10,987	$18,236	$19,361	$11,620
	BAT3	$8,918,373	$1,053,982	$1,995,833	$1,313,381	$891,837	$105,398	$199,583	$131,338
	BAT4	$12,615,360	$1,323,733	$2,656,369	$1,759,021	$1,261,536	$132,373	$265,637	$175,902
	BAT5	$14,522,378	$1,366,062	$2,900,480	$1,931,724	$1,452,238	$136,606	$290,048	$193,172
123	PSES1	$30,185,341	$5,529,386	$8,713,053	$5,613,578	$245,409	$44,954	$70,838	$45,639
	PSES2	$197,110,537	$31,060,501	$51,860,539	$33,658,767	$1,602,525	$252,524	$421,630	$273,649
	PSES3	$166,958,837	$19,362,637	$36,995,600	$24,403,868	$1,357,389	$157,420	$300,777	$198,405
	PSES4	$226,998,947	$22,016,023	$45,999,086	$30,626,803	$1,845,520	$178,992	$373,976	$248,998
Poultry First and Further Processing (Subcategory K)									
5	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$152,592	$101,912	$117,849	$71,118	$30,518	$20,382	$23,570	$14,224
	BAT3	$6,287,069	$666,133	$1,330,260	$871,403	$1,257,414	$133,227	$266,052	$174,281
	BAT4	$10,145,403	$952,314	$2,024,271	$1,334,719	$2,029,081	$190,463	$404,854	$266,944
	BAT5	$11,724,882	$997,256	$2,236,317	$1,482,303	$2,344,976	$199,451	$447,263	$296,461
10	PSES1	$0	$61,935	$61,805	$36,094	$0	$6,194	$6,180	$3,609
	PSES2	$14,821,059	$2,687,985	$4,251,228	$2,705,564	$1,482,106	$268,798	$425,123	$270,556
	PSES3	$19,707,251	$1,976,975	$4,058,962	$2,666,749	$1,970,725	$197,698	$405,896	$266,675
	PSES4	$21,829,565	$2,039,181	$4,345,699	$2,866,114	$2,182,957	$203,918	$434,570	$286,611
Poultry First Processing and Rendering (Subcategory K)									
6	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$81,383	$172,780	$181,030	$108,726	$13,564	$28,797	$30,172	$18,121
	BAT3	$8,777,277	$877,672	$1,804,960	$1,200,947	$1,462,880	$146,279	$300,827	$200,158
	BAT4	$11,639,057	$1,087,333	$2,317,119	$1,547,165	$1,939,843	$181,222	$386,186	$257,861
	BAT5	$13,445,493	$1,097,106	$2,518,096	$1,693,054	$2,240,915	$182,851	$419,683	$282,176

Table 6-6B (cont.)
Total and Average Costs : Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
2	PSES1	$0	$23,373	$23,324	$13,854	$0	$11,686	$11,662	$6,927
	PSES2	$7,641,977	$1,182,946	$1,989,409	$1,293,850	$3,820,988	$591,473	$994,704	$646,925
	PSES3	$5,595,342	$536,207	$1,127,384	$751,774	$2,797,671	$268,104	$563,692	$375,887
	PSES4	$5,986,901	$538,194	$1,170,816	$783,319	$2,993,450	$269,097	$585,408	$391,659
Poultry Further Processing and Rendering (Subcategory L)									
8	PSES1	$487,941	$125,687	$177,074	$110,748	$60,993	$15,711	$22,134	$13,843
	PSES2	$7,956,009	$1,234,228	$2,073,825	$1,330,739	$994,501	$154,279	$259,228	$166,342
	PSES3	$7,668,063	$947,526	$1,757,248	$1,141,528	$958,508	$118,441	$219,656	$142,691
	PSES4	$8,706,517	$1,004,330	$1,923,859	$1,254,444	$1,088,315	$125,541	$240,482	$156,805
Poultry First Processing, Further Processing, and Rendering (Subcategory K)									
2	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$109,992	$109,760	$64,100	$0	$54,996	$54,880	$32,050
	BAT3	$4,625,987	$453,697	$942,435	$619,937	$2,312,994	$226,848	$471,217	$309,969
	BAT4	$5,060,322	$465,764	$1,000,454	$660,351	$2,530,161	$232,882	$500,227	$330,176
	BAT5	$5,761,179	$485,638	$1,094,477	$725,799	$2,880,590	$242,819	$547,238	$362,899
3	PSES1	$672,122	$99,076	$170,016	$109,395	$224,041	$33,025	$56,672	$36,465
	PSES2	$11,549,023	$1,758,065	$2,976,903	$1,912,161	$3,849,674	$586,022	$992,301	$637,387
	PSES3	$9,664,684	$905,141	$1,926,309	$1,270,281	$3,221,561	$301,714	$642,103	$423,427
	PSES4	$10,266,829	$905,079	$1,989,989	$1,316,524	$3,422,276	$301,693	$663,330	$438,841
Mixed Further Processing (61 percent Subcategory E - I, 39 percent Subcategory L)									
4	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$24,415	$88,163	$90,561	$54,152	$6,104	$22,041	$22,640	$13,538
	BAT3	$2,564,602	$283,326	$554,210	$366,835	$641,151	$70,831	$138,552	$91,709
	BAT4	$7,793,606	$686,236	$1,509,799	$1,011,187	$1,948,402	$171,559	$377,450	$252,797

Table 6-6B (cont.)
Total and Average Costs : Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Number of Facilities	Option	TOTAL				AVERAGE			
		Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized	Capital Costs	O&M Costs	Pretax Annualized	Posttax Annualized
80	PSES1	$25,072,922	$3,338,616	$5,985,723	$3,923,449	$313,412	$41,733	$74,822	$49,043
	PSES2	$196,134,756	$29,081,161	$49,782,086	$32,448,718	$2,451,684	$363,515	$622,276	$405,609
	PSES3	$168,512,422	$16,713,014	$34,516,034	$22,975,342	$2,106,405	$208,913	$431,450	$287,192
	PSES4	$278,171,236	$20,459,894	$49,863,222	$33,700,748	$3,477,140	$255,749	$623,290	$421,259
Rendering (Subcategory J)									
12	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$0	$305,816	$305,170	$181,271	$0	$25,485	$25,431	$15,106
	BAT3	$14,464,214	$1,655,818	$3,183,467	$2,103,233	$1,205,351	$137,985	$265,289	$175,269
	BAT4	$16,300,625	$1,730,405	$3,452,295	$2,289,865	$1,358,385	$144,200	$287,691	$190,822
43	PSES1	$2,104,216	$503,232	$724,917	$461,479	$48,935	$11,703	$16,859	$10,732
	PSES2	$50,192,890	$7,728,341	$13,025,315	$8,473,587	$1,167,277	$179,729	$302,914	$197,060
	PSES3	$73,135,125	$7,768,577	$15,494,077	$10,276,695	$1,700,817	$180,665	$360,327	$238,993
	PSES4	$78,829,687	$7,844,804	$16,172,955	$10,763,513	$1,833,249	$182,437	$376,115	$250,314
Total Costs Excluding 65 Certainty Facilities									
67	BAT1	$0	$0	$0	$0	$0	$0	$0	$0
	BAT2	$400,899	$1,437,910	$1,477,311	$875,989	$5,984	$21,461	$22,049	$13,074
	BAT3	$70,705,777	$7,552,438	$15,021,230	$9,895,905	$1,055,310	$112,723	$224,197	$147,700
	BAT4	$110,500,296	$10,688,135	$22,362,856	$14,807,049	$1,649,258	$159,524	$333,774	$221,001
38 [1]	BAT5	$83,685,204	$7,086,932	$15,930,678	$10,601,602	$2,202,242	$186,498	$419,228	$278,990
430	PSES1	$98,811,207	$17,182,484	$27,606,105	$17,736,483	$229,794	$39,959	$64,200	$41,248
	PSES2	$755,739,047	$107,229,271	$187,003,489	$121,537,867	$1,757,533	$249,370	$434,892	$282,646
	PSES3	$706,612,692	$75,709,578	$150,349,986	$99,138,985	$1,643,285	$176,069	$349,651	$230,556
	PSES4	$961,665,744	$85,446,641	$187,065,794	$124,596,958	$2,236,432	$198,713	$435,037	$289,760

[1] Option BAT 5 is only found in Poultry operations.

In general, because the methodology is based on a cumulative probability function, the relative size of impacts are directly related to:

- the average estimated compliance costs per facility as a percent of cash flow in a combination class, and
- the number of facilities in the subcategory or meat type and process class.

As per facility costs increase as a percentage of cash flow, so will the incremental probability of closure. The number of incremental closures for a given probability of closure will increase as the number of facilities in a subcategory or meat type and process class increases. Because the number of projected closures is so directly related to the number of establishments in a category, this presentation will focus on the ratio of compliance costs to net income and the probability that posttax compliance costs exceed cash flow, rather than the absolute number of closures. These measures can be directly compared between subcategories and classes to get a sense of the relative magnitude of impacts.

Section 6.4.2.1 below outlines closure impacts on small businesses by subcategory and Section 6.4.2.2 does the same by meat type and process class. Tables 6-7 and 6-8 present a summary of the results. The tables include pretax and posttax annualized compliance costs per facility, the ratio of compliance costs to model facility net income and cash flow, the probability that cash flow is less than compliance costs, and finally, projected incremental facility closure and employment impacts.

6.4.2.1 Projected Closure Impacts by Subcategory

Small Model Facilities

Table 6-7A provides closure impacts for small model facilities by subcategory. With one exception, the ratio of compliance costs to net income for indirect dischargers exceeds 100 percent for all options in all subcategories (the single exception is PSES 1 in Subcategory A through D). The corresponding probability of compliance costs exceeding cash flow (i.e., the probability of incremental closure) is also relatively high. For direct dischargers, the ratio of compliance costs to net income under

Table 6-7A
Economic Closure Impacts: Small Model Facilities
40 CFR 432 Subcategories

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Subcategory A through D								
BAT1	59	$494	$345	0.75%	0.63%	0.13%	0.1	1
BAT2		$8,607	$5,739	15.82%	13.38%	2.74%	1.7	8
BAT3		$72,828	$57,414	173.65%	147.23%	28.70%	17.0	63
PSES1	1,001	$29,962	$24,298	87.03%	74.08%	15.97%	160.0	353
PSES2		$162,234	$151,943	544.23%	463.24%	67.41%	674.8	1,511
PSES3		$152,374	$141,591	505.49%	430.24%	67.01%	670.8	1,520
PSES4		$172,616	$160,626	569.76%	484.88%	69.35%	694.1	1,628
Subcategory E through I								
BAT1	48	$395	$332	1.12%	0.83%	0.14%	0.1	0
BAT2		$5,955	$4,691	15.87%	11.67%	2.06%	1.0	2
BAT3		$11,897	$9,586	32.44%	23.85%	4.39%	2.1	4
PSES1	2,940	$41,367	$33,711	114.05%	83.86%	15.75%	463.2	979
PSES2		$148,447	$137,169	463.97%	341.16%	57.02%	1,676.6	3,545
PSES3		$162,676	$151,400	512.14%	376.57%	60.30%	1,773.1	3,749
PSES4		$180,014	$168,731	570.75%	419.67%	63.18%	1,857.8	3,928
Subcategory J								
BAT1	6	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$28,711	$22,510	159.92%	56.44%	2.88%	0.2	0
BAT3		$295,816	$289,095	2053.90%	724.85%	34.00%	2.0	5
PSES1	17	$47,547	$41,033	291.52%	102.88%	5.26%	0.9	2
PSES2		$625,699	$618,978	4397.57%	1551.96%	52.00%	8.8	20
PSES3		$446,441	$439,720	3124.02%	1102.51%	45.22%	7.7	17
PSES4		$463,831	$457,110	3247.57%	1146.11%	46.16%	7.8	18
Subcategory K								
PSES1	39	$36,303	$31,268	142.48%	80.33%	17.64%	6.9	43
PSES2		$154,481	$147,881	1134.79%	506.58%	72.17%	28.2	114
PSES3		$169,763	$163,163	1441.58%	611.01%	72.22%	28.2	115
PSES4		$189,660	$183,060	1619.66%	686.15%	72.62%	28.3	115

Table 6-7A (cont.)
Economic Closure Impacts: Small Model Facilities
40 CFR 432 Subcategories

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Subcategory L								
BAT1	4	$846	$711	2.40%	1.77%	0.31%	0.0	0
BAT2		$7,770	$6,139	20.78%	15.28%	2.71%	0.1	0
BAT3		$55,837	$45,447	153.79%	113.08%	21.50%	0.8	2
PSES1	568	$48,087	$42,164	418.51%	174.97%	37.49%	212.8	419
PSES2		$178,615	$170,856	1597.97%	683.34%	67.47%	382.9	776
PSES3		$166,808	$159,060	1486.97%	635.90%	66.48%	377.3	764
PSES4		$184,357	$176,545	1646.03%	704.63%	67.92%	190.4	781
Total Excluding 65 Certainty Facilities								
BAT1	117	NA	NA	NA	NA	NA	0.2	1
BAT2		NA	NA	NA	NA	NA	3.0	10
BAT3		NA	NA	NA	NA	NA	21.9	74
PSES1	4,565	NA	NA	NA	NA	NA	683.8	1,443
PSES2		NA	NA	NA	NA	NA	2,256.5	4,808
PSES3		NA	NA	NA	NA	NA	2,861.1	6,156
PSES4		NA	NA	NA	NA	NA	2,755.0	6,362

All impacts presented in this table are the average of results for each class, discharge type and model facility size combination, weighted by the number of facilities in each subcategory.

[1] Total annualized compliance costs for subcategory and discharge class divided by number of facilities in that class.

[2] Ratio of posttax annualized compliance costs to net income and cash flow.

[3] Probability net income or cash flow less than posttax annualized compliance costs minus probability net income or cash flow less than zero.

[4] Closures: probability cash flow less than annualized compliance costs multiplied by the number of facilities in the subcategory. Employment: employees per model facility multiplied by the number of projected closures.

option 1 is less than 2.5 percent for all subcategories, although it becomes very high under option 3 (and sometimes option 2) for all subcategories.

Under the proposed option (BAT 1) for small model facilities in subcategories K and L, the ratio of posttax compliance costs to net income, and the incremental probability of closure for each subcategory are:

•	Subcategory K:	costs / net income: probability of closure:	NA NA
•	Subcategory L:	costs / net income: probability of closure:	2.40 percent 0.31 percent

EPA projects that no small direct discharging model facilities will close under the proposed option. No option is proposed for small model direct dischargers in subcategories A through J. No option is proposed for small model indirect dischargers in any subcategories.

Nonsmall Model Facilities

Table 6-7B presents the closure analysis for nonsmall facilities by subcategory. Under the proposed option (BAT 3 in all subcategories except J; BAT 2 in Subcategory J) for nonsmall model facilities that are owned by small businesses, the ratio of posttax compliance costs, and the incremental probability of closure for each subcategory is:

•	Subcategory A through D:	costs / net income: probability of closure:	0.25 percent 0.04 percent
•	Subcategory E through I:	costs / net income: probability of closure:	0.55 percent 0.09 percent
•	Subcategory J:	costs / net income: probability of closure:	0.69 percent 0.12 percent
•	Subcategory K:	costs / net income: probability of closure:	6.82 percent 1.22 percent

Table 6-7B
Economic Closure Impacts: Nonsmall Model Facilities Owned by Small Businesses
40 CFR 432 Subcategories

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Subcategory A through D								
BAT1	5	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT3		$11,374	$6,756	0.25%	0.21%	0.04%	0.0	0
BAT4		$184,589	$121,398	4.50%	3.74%	0.77%	0.0	0
Subcategory E through I								
BAT1	10	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$12,044	$7,154	0.13%	0.11%	0.02%	0.0	0
BAT3		$39,802	$26,020	0.55%	0.45%	0.09%	0.0	0
BAT4		$270,862	$178,765	3.21%	2.67%	0.51%	0.0	0
PSES1	181	$73,816	$47,182	0.83%	0.69%	0.13%	0.3	81
PSES2		$380,692	$247,526	4.62%	3.84%	0.74%	1.3	321
PSES3		$319,532	$209,788	3.82%	3.17%	0.61%	1.1	291
PSES4		$427,650	$284,529	5.23%	4.35%	0.84%	1.5	402
Subcategory J								
BAT1	12	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$25,431	$15,106	0.69%	0.56%	0.12%	0.0	0
BAT3		$265,289	$175,269	8.07%	6.52%	1.44%	0.1	8
BAT4		$287,691	$190,822	8.80%	7.12%	1.57%	0.2	11
PSES1	43	$16,859	$10,732	0.50%	0.40%	0.09%	0.0	0
PSES2		$302,914	$197,060	8.97%	7.22%	1.60%	0.7	43
PSES3		$360,327	$238,993	10.94%	8.83%	1.96%	0.9	56
PSES4		$376,115	$250,314	11.48%	9.27%	2.06%	0.9	56
Subcategory K								
BAT1	28	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$29,196	$17,239	0.55%	0.43%	0.10%	0.0	0
BAT3		$326,907	$215,386	6.82%	5.31%	1.22%	0.3	91
BAT4		$425,522	$281,804	8.91%	6.94%	1.59%	0.4	129
BAT5		$465,364	$309,638	9.79%	7.62%	1.75%	0.4	129
PSES1	44	$52,514	$33,865	0.98%	0.74%	0.17%	0.1	38
PSES2		$722,720	$469,706	13.97%	10.64%	2.50%	1.1	392
PSES3		$565,238	$373,337	11.01%	8.36%	2.33%	0.9	317
PSES4		$595,546	$394,685	11.64%	8.84%	2.07%	0.9	317

Table 6-7B (cont.)
Economic Closure Impacts: Nonsmall Model Facilities Owned by Small Businesses
40 CFR 432 Subcategories

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Subcategory L								
BAT1	12	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$19,803	$11,879	0.44%	0.37%	0.08%	0.0	0
BAT3		$191,347	$125,990	4.87%	4.06%	0.89%	0.1	16
BAT4		$280,726	$186,279	6.91%	5.76%	1.26%	0.1	16
BAT5	10 [5]	$290,048	$193,172	7.81%	6.52%	1.45%	0.1	16
PSES1	162	$69,202	$44,725	1.68%	1.41%	0.30%	0.4	70
PSES2		$452,216	$293,739	10.64%	8.91%	1.94%	3.1	548
PSES3		$321,912	$212,736	7.75%	6.49%	1.41%	2.3	416
PSES4		$415,349	$277,587	9.94%	8.32%	1.81%	3.0	522
Total Excluding 65 Certainty Facilities								
BAT1	67	NA	NA	NA	NA	NA	0.0	0
BAT2		NA	NA	NA	NA	NA	0.0	0
BAT3		NA	NA	NA	NA	NA	0.5	115
BAT4		NA	NA	NA	NA	NA	0.7	156
BAT5	38 [5]	NA	NA	NA	NA	NA	0.5	145
PSES1	430	NA	NA	NA	NA	NA	0.8	189
PSES2		NA	NA	NA	NA	NA	6.2	1,304
PSES3		NA	NA	NA	NA	NA	5.2	1,080
PSES4		NA	NA	NA	NA	NA	6.3	1,297

All impacts presented in this table are sum of the average of results for each subcategory, discharge type and model facility size combination, weighted by the number of facilities in each subcategory.
[1] Total annualized compliance costs for subcategory and discharge class divided by number of facilities in that class.
[2] Ratio of posttax annualized compliance costs to net income and cash flow.
[3] Probability net income or cash flow less than posttax annualized compliance costs minus probability net income or cash flow less than zero.
[4] Closures: probability cash flow less than annualized compliance costs multiplied by the number of facilities in the subcategory. Employment: employees per model facility multiplied by the number of projected closures.
[5] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

•	Subcategory L:	costs / net income: probability of closure:	4.87 percent 0.89 percent

EPA projects that 0.4 nonsmall direct discharging model facilities will close under the proposed option, with an associated employment loss of 107 workers. As would be expected, given the pattern of compliance costs in Section 6.4.1, these impacts are projected among poultry processing establishments. No option is proposed for nonsmall model indirect discharging facilities.

6.4.2.2 Projected Closure Impacts by Meat Type and Process Class

Small Model Facilities

Table 6-8A provides closure impacts for small model facilities by meat type and process class. In this particular case, the closure impacts at the meat type and process class mirror the pattern at the subcategory level. Almost without exception, the ratio of compliance costs to net income for indirect dischargers exceeds 100 percent under options PSES 2, 3, and 4. The ratio for most direct dischargers is much smaller, but still substantial under options BAT 2 and 3.

Under the proposed option (BAT 1) for small model facilities in the following subcategories, the range for the ratio of posttax compliance costs to net income within each subcategory is:

•	Subcategory K:	costs / net income:	NA
•	Subcategory L: — mixed further processing	costs / net income:	2.40 percent

The incremental probability of closure due to the proposed rule is 0.31 percent in the mixed further processing class. No option is proposed for small model direct dischargers in subcategories A through J. No option is proposed for small model indirect dischargers in any subcategories.

Table 6-8A
Economic Closure Impacts: Small Model Facilities
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Red Meat First Processing (Subcategory A - D)								
BAT1	17	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$10,492	$8,225	29.68%	25.26%	5.13%	0.9	2
BAT3		$128,400	$119,051	429.50%	365.64%	65.70%	11.2	24
PSES1	265	$25,331	$20,652	74.51%	63.43%	13.49%	35.8	77
PSES2		$161,620	$152,271	549.35%	467.67%	70.23%	186.1	403
PSES3		$150,996	$141,647	511.02%	435.04%	69.28%	183.6	397
PSES4		$167,480	$158,130	0.00%	0.00%	0.00%	0.0	0
Red Meat Further Processing (Subcategory E - I)								
BAT1	43	$339	$285	0.96%	0.71%	0.12%	0.1	0
BAT2		$5,731	$4,512	15.27%	11.23%	1.98%	0.9	2
BAT3		$6,470	$5,158	17.46%	12.83%	2.27%	1.0	2
PSES1	2,489	$40,967	$33,411	113.06%	83.13%	15.61%	388.5	821
PSES2		$143,871	$132,625	448.80%	330.00%	56.12%	1,396.9	2,951
PSES3		$162,635	$151,388	512.30%	376.69%	60.34%	1,501.8	3,173
PSES4		$179,795	$168,548	570.37%	419.39%	63.19%	1,572.8	3,323
Red Meat First and Further Processing (Subcategory A - D)								
PSES1	674	$33,490	$27,320	98.56%	83.91%	18.17%	122.5	265
PSES2		$171,105	$161,756	583.57%	496.80%	70.81%	477.3	1,033
PSES3		$158,480	$149,131	538.02%	458.03%	69.99%	471.7	1,021
PSES4		$175,760	$166,410	600.36%	511.10%	71.03%	478.7	1,036
Red Meat First Processing and Rendering (Subcategory A - D)								
BAT1	17	$1,215	$849	1.83%	1.54%	0.31%	0.1	1
BAT2		$9,536	$5,792	12.50%	10.50%	2.18%	0.4	3
BAT3		$114,841	$74,308	160.42%	134.65%	31.70%	5.4	36
PSES1	12	$0	$0	0.00%	0.00%	0.00%	0.0	0
PSES2		$11,271	$6,695	14.45%	12.13%	2.53%	0.3	2
PSES3		$138,106	$90,043	194.39%	163.17%	38.42%	4.6	30
PSES4		$156,316	$104,567	225.74%	189.48%	44.22%	5.3	35

Table 6-8A (cont.)
Economic Closure Impacts: Small Model Facilities
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Red Meat Further Processing and Rendering (Subcategory E - I)								
PSES1	32	$20,408	$16,542	55.98%	41.16%	7.50%	2.4	5
PSES2		$148,990	$137,744	466.13%	342.74%	57.39%	18.4	39
PSES3		$146,176	$134,930	456.61%	335.74%	56.71%	18.1	38
PSES4		$175,195	$163,949	554.81%	407.94%	62.51%	20.0	42
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)								
BAT1	25	$340	$238	0.51%	0.43%	0.09%	0.0	0
BAT2		$6,693	$4,012	8.66%	7.27%	1.50%	0.4	3
BAT3		$6,471	$4,014	8.67%	7.27%	1.50%	0.4	3
PSES1	50	$14,132	$8,710	18.80%	15.78%	3.31%	1.7	11
PSES2		$82,129	$52,791	113.97%	95.66%	22.13%	11.1	73
PSES3		$80,797	$52,019	112.30%	94.26%	21.79%	10.9	72
PSES4		$161,385	$109,330	236.02%	198.12%	46.03%	23.0	152
Poultry First Processing (Subcategory K)								
PSES1	19	$72,737	$62,787	271.13%	157.19%	34.59%	6.6	42
PSES2		$220,979	$210,718	909.93%	527.53%	71.01%	13.5	86
PSES3		$207,301	$197,040	850.87%	493.29%	70.52%	13.4	86
PSES4		$230,903	$220,642	952.79%	552.37%	71.25%	13.5	86
Poultry Further Processing (Subcategory L)								
PSES1	272	$51,512	$48,389	739.90%	267.05%	59.73%	162.5	313
PSES2		$182,331	$179,208	2740.20%	989.02%	73.93%	201.1	387
PSES3		$169,875	$166,752	2549.75%	920.28%	73.93%	201.1	387
PSES4		$187,454	$184,331	2818.54%	1017.29%	73.93%	201.1	387
Poultry First and Further Processing (Subcategory K)								
PSES1	20	$1,690	$1,325	20.26%	7.31%	1.55%	0.3	1
PSES2		$91,308	$88,185	1348.41%	486.68%	73.27%	14.7	28
PSES3		$134,102	$130,979	2002.76%	722.85%	73.93%	14.8	29
PSES4		$150,479	$147,356	2253.18%	813.24%	73.93%	14.8	29
Poultry Further Processing and Rendering (Subcategory L)								
PSES1	4	$15,318	$9,810	2.17%	2.02%	0.46%	0.0	0
PSES2		$148,827	$96,353	21.27%	19.89%	4.79%	0.2	3
PSES3		$149,712	$97,799	21.59%	20.19%	4.87%	0.2	3
PSES4		$168,791	$111,061	24.52%	22.93%	5.57%	0.2	3

Table 6-8A (cont.)
Economic Closure Impacts: Small Model Facilities
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Mixed Further Processing (59 percent Subcategory E - I, 41 percent Subcategory L)								
BAT1	9	$846	$711	2.40%	1.77%	0.31%	0.0	0
BAT2		$7,770	$6,139	20.78%	15.28%	2.71%	0.2	0
BAT3		$55,837	$45,447	153.79%	113.08%	21.50%	1.9	4
PSES1	707	$45,484	$36,937	124.99%	91.91%	17.33%	122.6	259
PSES2		$175,729	$164,483	556.61%	409.27%	62.59%	442.5	935
PSES3		$164,322	$153,076	518.01%	380.89%	60.66%	428.8	906
PSES4		$181,785	$170,539	577.11%	424.34%	63.47%	448.7	948
Mixed Further Processing and Rendering (59 percent Subcategory E - I, 41 percent Subcategory L)								
PSES1	4	$19,860	$12,687	7.91%	6.21%	1.19%	0.0	0
PSES2		$145,065	$93,893	58.57%	45.94%	9.28%	0.4	6
PSES3		$139,317	$90,534	56.48%	44.29%	8.93%	0.4	6
PSES4		$163,117	$106,507	66.44%	52.11%	10.60%	0.4	6
Rendering (Subcategory J)								
BAT1	6	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$28,711	$22,510	159.92%	56.44%	2.88%	0.2	0
BAT3		$295,816	$289,095	2053.90%	724.85%	34.00%	2.0	5
PSES1	17	$47,547	$41,033	291.52%	102.88%	5.26%	0.9	2
PSES2		$625,699	$618,978	4397.57%	1551.96%	52.00%	8.8	20
PSES3		$446,441	$439,720	3124.02%	1102.51%	45.22%	7.7	17
PSES4		$463,831	$457,110	3247.57%	1146.11%	46.16%	7.8	18
Total Excluding 65 Certainty Facilities								
BAT1	117	NA	NA	NA	NA	NA	0.2	1
BAT2		NA	NA	NA	NA	NA	3.0	10
BAT3		NA	NA	NA	NA	NA	21.9	74
PSES1	4,565	NA	NA	NA	NA	NA	843.8	1,796
PSES2		NA	NA	NA	NA	NA	2,771.3	5,966
PSES3		NA	NA	NA	NA	NA	2,857.1	6,165
PSES4		NA	NA	NA	NA	NA	2,786.3	6,065

All impacts presented in this table are the average of results for each class, discharge type and model facility size combination, weighted by the number of facilities in each subcategory.
[1] Total annualized compliance costs for subcategory and discharge class divided by number of facilities in that class.
[2] Ratio of posttax annualized compliance costs to net income and cash flow.
[3] Probability net income or cash flow less than posttax annualized compliance costs minus probability net income or cash flow less than zero.
[4] Closures: probability cash flow less than annualized compliance costs multiplied by the number of facilities in the subcategory. Employment: employees per model facility multiplied by the number of projected closures.

Nonsmall Model Facilities

Table 6-8B presents the closure analysis for nonsmall facilities by class. Under the proposed option (BAT 3 in all subcategories except J; BAT 2 in Subcategory J) for nonsmall model facilities that are owned by small businesses, the range for the ratio of posttax compliance costs to net income within each subcategory is:

• Subcategory A through D:	costs / net income:	0.25 percent
— red meat first processing		
• Subcategory E through I:	costs / net income:	0.55 percent
— red meat further processing		0.09 percent
— mixed further processing		2.03 percent
• Subcategory J:	costs / net income:	0.69 percent
— rendering		
• Subcategory K:	costs / net income:	6.82 percent
— poultry first and further processing		5.03 percent
— poultry first processing, further processing and rendering		8.94 percent
• Subcategory L:	costs / net income:	4.87 percent
— mixed further processing		2.03 percent
— poultry further processing		5.31 percent

The largest incremental probability of closure occurs in the poultry first processing and rendering class: 1.61 percent. No option is proposed for nonsmall model indirect discharging facilities.

6.4.3 Facility Nonclosure Impacts

EPA estimated nonclosure impacts for small business owned facilities affected by the proposed effluent guideline. These impacts include:

- ratio of pretax annualized compliance costs to model facility revenues,
- ratio of pretax annualized compliance costs to model facility EBIT,
- ratio of posttax annualized compliance costs to model facility net income,

Table 6-8B
Economic Closure Impacts: Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Red Meat First Processing (Subcategory A - D)								
BAT1	5	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT3		$11,374	$6,756	0.25%	0.21%	0.04%	0.0	0
BAT4		$184,589	$121,398	4.50%	3.74%	0.77%	0.0	0
Red Meat Further Processing (Subcategory E - I)								
BAT1	8	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$8,812	$5,207	0.08%	0.07%	0.01%	0.0	0
BAT3		$9,683	$5,985	0.09%	0.08%	0.02%	0.0	0
BAT4		$238,353	$156,186	2.48%	2.07%	0.40%	0.0	0
PSES1	132	$73,445	$46,494	0.74%	0.62%	0.12%	0.2	71
PSES2		$291,379	$189,083	3.00%	2.50%	0.49%	0.6	212
PSES3		$278,156	$181,172	2.87%	2.40%	0.47%	0.6	212
PSES4		$355,323	$233,980	3.71%	3.10%	0.60%	0.8	282
Poultry First Processing (Subcategory K)								
BAT1	15	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$27,256	$15,917	0.46%	0.35%	0.08%	0.0	0
BAT3		$338,382	$222,567	6.42%	4.84%	1.12%	0.2	75
BAT4		$438,186	$289,884	8.36%	6.30%	1.47%	0.2	75
BAT5		$478,754	$317,915	9.17%	6.91%	1.61%	0.2	75
PSES1	29	$70,879	$45,886	1.32%	1.00%	0.23%	0.1	38
PSES2		$778,694	$508,810	14.68%	11.06%	2.61%	0.8	300
PSES3		$612,338	$404,760	11.68%	8.79%	2.06%	0.6	225
PSES4		$644,743	$427,592	12.34%	9.29%	2.18%	0.6	225
Poultry Further Processing (Subcategory L)								
BAT1	10	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$19,361	$11,620	0.47%	0.39%	0.08%	0.0	0
BAT3		$199,583	$131,338	5.31%	4.43%	0.98%	0.1	16
BAT4		$265,637	$175,902	7.11%	5.93%	1.32%	0.1	16
BAT5		$290,048	$193,172	7.81%	6.52%	1.45%	0.1	16
PSES1	123	$70,838	$45,639	1.92%	1.62%	0.35%	0.4	64
PSES2		$421,630	$273,649	11.44%	9.63%	2.15%	2.6	440
PSES3		$300,777	$198,405	8.34%	7.02%	1.56%	1.9	327
PSES4		$373,976	$248,998	10.45%	8.79%	1.96%	2.4	408

Table 6-8B (cont.)
Economic Closure Impacts: Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Poultry First and Further Processing (Subcategory K)								
BAT1	5	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$23,570	$14,224	0.41%	0.31%	0.07%	0.0	0
BAT3		$266,052	$174,281	5.03%	3.79%	0.88%	0.0	0
BAT4		$404,854	$266,944	7.70%	5.80%	1.35%	0.1	38
BAT5		$447,263	$296,461	8.55%	6.44%	1.50%	0.1	38
PSES1	10	$6,180	$3,609	0.10%	0.08%	0.02%	0.0	0
PSES2		$425,123	$270,556	7.81%	5.88%	1.37%	0.1	38
PSES3		$405,896	$266,675	7.69%	5.79%	1.35%	0.1	38
PSES4		$434,570	$286,611	8.27%	6.23%	1.45%	0.1	38
Poultry First Processing and Rendering (Subcategory K)								
BAT1	6	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$30,172	$18,121	0.78%	0.66%	0.14%	0.0	0
BAT3		$300,827	$200,158	8.61%	7.29%	1.61%	0.1	16
BAT4		$386,186	$257,861	11.10%	9.40%	2.09%	0.1	16
BAT5		$419,683	$282,176	12.14%	10.28%	2.29%	0.1	16
PSES1	2	$11,662	$6,927	0.30%	0.25%	0.05%	0.0	0
PSES2		$994,704	$646,925	27.84%	23.57%	5.40%	0.1	16
PSES3		$563,692	$375,887	16.18%	13.70%	3.07%	0.1	16
PSES4		$585,408	$391,659	16.86%	14.27%	3.20%	0.1	16
Poultry Further Processing and Rendering (Subcategory L)								
PSES1	8	$22,134	$13,843	0.40%	0.30%	0.07%	0.0	0
PSES2		$259,228	$166,342	4.80%	3.61%	0.84%	0.1	38
PSES3		$219,656	$142,691	4.12%	3.10%	0.72%	0.1	38
PSES4		$240,482	$156,805	4.52%	3.41%	0.79%	0.1	38
Poultry First Processing, Further Processing, and Rendering (Subcategory K)								
BAT1	2	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$54,880	$32,050	0.92%	0.70%	0.16%	0.0	0
BAT3		$471,217	$309,969	8.94%	6.73%	1.57%	0.0	0
BAT4		$500,227	$330,176	9.53%	7.17%	1.68%	0.0	0
BAT5		$547,238	$362,899	10.47%	7.88%	1.85%	0.0	0
PSES1	3	$56,672	$36,465	1.05%	0.79%	0.18%	0.0	0
PSES2		$992,301	$637,387	18.39%	13.85%	3.30%	0.1	38
PSES3		$642,103	$423,427	12.22%	9.20%	2.16%	0.1	38
PSES4		$663,330	$438,841	12.66%	9.53%	2.24%	0.1	38

Table 6-8B (cont.)
Economic Closure Impacts: Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Option	Number of Facilities	Annualized Compliance Costs per Facility [1]		Compliance Cost as a Percentage of Model Facility [2]		Probability Cash Flow Less Than Compliance Costs [3]	Projected Facility Impacts [4]	
		Pretax	Posttax	Net Income	Cash Flow		Closures	Employment
Mixed Further Processing (61 percent in Subcategory E - I, 39 percent in Subcategory L)								
BAT1	4	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$22,640	$13,538	0.30%	0.25%	0.05%	0.0	0
BAT3		$138,552	$91,709	2.03%	1.68%	0.32%	0.0	0
BAT4		$377,450	$252,797	5.60%	4.64%	0.88%	0.0	0
PSES1	80	$74,822	$49,043	1.09%	0.90%	0.17%	0.1	16
PSES2		$622,276	$405,609	8.99%	7.44%	1.42%	1.1	179
PSES3		$431,450	$287,192	6.37%	5.27%	1.00%	0.8	130
PSES4		$623,290	$421,259	9.34%	7.73%	1.47%	1.2	196
Rendering (Subcategory J)								
BAT1	12	$0	$0	0.00%	0.00%	0.00%	0.0	0
BAT2		$25,431	$15,106	0.69%	0.56%	0.12%	0.0	0
BAT3		$265,289	$175,269	8.07%	6.52%	1.44%	0.1	8
BAT4		$287,691	$190,822	8.80%	7.12%	1.57%	0.2	11
PSES1	43	$16,859	$10,732	0.50%	0.40%	0.09%	0.0	0
PSES2		$302,914	$197,060	8.97%	7.22%	1.60%	0.7	43
PSES3		$360,327	$238,993	10.94%	8.83%	1.96%	0.9	56
PSES4		$376,115	$250,314	11.48%	9.27%	2.06%	0.9	56
Total Excluding 65 Certainty Facilities								
BAT1	67	NA	NA	NA	NA	NA	0.0	0
BAT2		NA	NA	NA	NA	NA	0.0	0
BAT3		NA	NA	NA	NA	NA	0.5	115
BAT4		NA	NA	NA	NA	NA	0.7	156
BAT5	38 [5]	NA	NA	NA	NA	NA	0.5	145
PSES1	430	NA	NA	NA	NA	NA	0.8	189
PSES2		NA	NA	NA	NA	NA	6.2	1,304
PSES3		NA	NA	NA	NA	NA	5.2	1,080
PSES4		NA	NA	NA	NA	NA	6.3	1,297

All impacts presented in this table are sum of the average of results for each class, discharge type and model facility size combination, weighted by the number of facilities in each class.
[1] Total annualized compliance costs for subcategory and discharge class divided by number of facilities in that class.
[2] Ratio of posttax annualized compliance costs to net income and cash flow.
[3] Probability net income or cash flow less than posttax annualized compliance costs minus probability net income or cash flow less than zero.
[4] Closures: probability cash flow less than annualized compliance costs multiplied by the number of facilities in the subcategory. Employment: employees per model facility multiplied by the number of projected closures.
[5] Option BAT 5 is only found in Poultry operations.

- ratio of posttax annualized compliance costs to model facility cash flow,
- number of facilities expected to incur pretax annualized compliance costs exceeding 1, 3, 5, and 10 percent of revenues, and
- number of facilities expected to incur posttax annualized compliance costs exceeding 3, 5, and 10 percent of cash flow.

EPA identifies the sales test — annualized compliance costs as a percentage of revenues — as one method of screening whether the proposed rule's perceived significant impact on a substantial number of small entities. Therefore, in this small business analysis, EPA examines as key nonclosure impacts the: (1) ratio of compliance costs to revenues, and (2) number of facilities expected to incur pretax annualized compliance costs exceeding 1 percent and 3 percent of revenues. The methodology used to estimate these impacts is described in Section 3.1.3.

6.4.3.1 Nonclosure Impacts by Subcategory

Small Model Facilities

Table 6-9A presents a summary of nonclosure impacts for small model facilities by subcategory, discharge type, and technology option. Among small model direct dischargers, the largest impacts are observed under BAT 3 for Subcategory J: average estimated compliance costs compose almost 35 percent of average model facility revenues. With two exceptions, BAT costs compose less than 3.5 percent of average facility revenues for other options and other subcategories. Among small model indirect dischargers, average costs generally exceed 10 percent of average revenues under PSES 1, and 30 percent of revenues under options PSES 2 through 4; estimated compliance costs generally exceed 100 percent of model facility cash flow regardless of option. Thus, the number of facilities exceeding any given threshold varies little between options within a subcategory. This is because all, or almost all, facilities that can exceed that threshold[9] do exceed that threshold.

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[9] That is, those facilities that have positive baseline revenues or cash flow and thus are not netted out of the impact analysis.

Table 6-9A
Nonclosure Impacts: Small Model Facilities
40 CFR 432 Subcategories

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Subcategory A through D											
BAT1	59	0.04%	0.47%	0.63%	0.5	0.1	0.1	0.0	2.7	1.5	0.7
BAT2		1.13%	12.79%	13.38%	24.8	7.4	3.7	1.6	37.2	28.9	17.3
BAT3		11.25%	125.55%	147.23%	35.9	32.8	30.5	22.5	38.2	33.2	28.7
PSES1	1,001	6.71%	72.99%	74.08%	901.8	853.0	625.6	251.1	711.4	707.1	693.3
PSES2		36.28%	394.61%	463.24%	927.7	922.2	907.4	888.4	720.0	718.1	715.0
PSES3		33.82%	368.03%	430.24%	934.5	932.2	917.2	893.9	720.4	720.4	720.4
PSES4		37.80%	411.62%	484.88%	934.5	934.5	933.8	913.2	720.4	720.4	720.4
Subcategory E through I											
BAT1	48	0.10%	0.81%	0.83%	1.2	0.4	0.3	0.1	2.4	1.5	0.7
BAT2		1.44%	12.24%	11.67%	26.2	7.2	3.9	1.9	29.4	20.9	10.7
BAT3		2.88%	24.45%	23.85%	29.9	11.5	8.2	4.5	31.1	23.9	14.2
PSES1	2,940	10.02%	84.98%	83.86%	2,529.3	2,505.1	2,117.4	1,063.9	2,026.2	2,025.9	2,023.1
PSES2		35.95%	304.86%	341.16%	2,530.8	2,530.3	2,529.7	2,520.3	2,026.9	2,026.9	2,026.9
PSES3		39.40%	334.11%	376.57%	2,530.8	2,530.3	2,529.6	2,527.0	2,026.9	2,026.9	2,026.8
PSES4		43.60%	369.70%	419.67%	2,530.8	2,530.5	2,529.8	2,528.9	2,026.9	2,026.9	2,026.9
Subcategory J											
BAT1	6	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		3.34%	98.73%	56.44%	4.4	1.8	1.0	0.5	3.2	2.7	1.7
BAT3		34.40%	1017.20%	724.85%	4.6	4.6	4.6	4.4	3.3	3.3	3.3
PSES1	17	5.53%	163.50%	102.88%	13.1	8.6	5.2	2.4	9.4	9.3	7.4
PSES2		72.76%	2151.54%	1551.96%	13.1	13.1	13.1	13.1	9.4	9.4	9.4
PSES3		51.92%	1535.14%	1102.51%	13.1	13.1	13.1	13.1	9.4	9.4	9.4
PSES4		53.94%	1594.94%	1146.11%	13.1	13.1	13.1	13.1	9.4	9.4	9.4

Table 6-9A (cont.)
Nonclosure Impacts: Small Model Facilities
40 CFR 432 Subcategories

Option	Number of Facilities	Compliance Cost as Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Subcategory K											
PSES1	39	5.00%	86.23%	80.33%	22.7	19.0	17.2	8.2	24.8	20.7	17.0
PSES2		32.33%	589.02%	506.58%	37.0	37.0	37.0	37.0	28.4	28.4	28.4
PSES3		39.96%	736.42%	611.01%	37.0	37.0	37.0	37.0	28.4	28.4	28.4
PSES4		44.73%	824.48%	686.15%	37.0	37.0	37.0	37.0	28.4	28.4	28.4
Subcategory L											
BAT1	4	0.20%	1.74%	1.77%	0.2	0.1	0.0	0.0	0.4	0.2	0.1
BAT2		1.88%	15.97%	15.28%	2.5	0.7	0.4	0.2	2.5	2.0	1.1
BAT3		13.53%	114.75%	113.08%	3.2	3.2	3.1	1.9	2.5	2.5	2.5
PSES1	568	15.21%	230.48%	174.97%	508.5	507.2	479.8	361.3	402.3	401.7	401.3
PSES2		55.68%	831.40%	683.34%	512.7	511.5	509.6	508.2	405.1	405.1	404.2
PSES3		51.95%	775.25%	635.90%	512.7	511.5	509.7	508.1	405.1	405.1	404.2
PSES4		57.39%	855.96%	704.63%	512.7	511.9	510.1	508.3	405.1	405.1	404.5
Total Excluding 65 Certainty Facilities											
BAT1	117	NA	NA	NA	1.9	0.6	0.4	0.1	5.5	3.2	1.5
BAT2		NA	NA	NA	57.9	17.1	9.0	4.2	72.3	54.5	30.8
BAT3		NA	NA	NA	73.6	52.1	46.4	33.3	75.1	62.9	48.7
PSES1	4,565	NA	NA	NA	3,975.4	3,892.9	3,245.2	1,686.9	3,174.1	3,164.7	3,142.1
PSES2		NA	NA	NA	4,021.3	4,014.1	3,996.8	3,967.0	3,189.8	3,187.9	3,183.9
PSES3		NA	NA	NA	4,028.1	4,024.1	4,006.6	3,979.1	3,190.2	3,190.2	3,189.2
PSES4		NA	NA	NA	4,028.1	4,027.0	4,023.8	4,000.5	3,190.2	3,190.2	3,189.6

Compliance costs as a percent of facility income results are presented as the average for each subcategory, discharge type and model facility size combination, weighted by the number of facilities in each combination.
Number of facilities incurring those impacts is the sum over all facility sizes by subcategory and discharge type.
[1] Ratio of pretax annualized compliance cost to revenues and EBIT; ratio of posttax annualized compliance costs to cash flow.
[2] Probability compliance costs exceed specified percentage of income measure (less probability income measure is equal to zero) multiplied by the number of facilities in the subcategory size class.

Under the proposed option (BAT 1) for small model facilities in subcategories K and L, the ratio of pretax compliance costs to revenues, and the number of establishments incurring costs exceeding 1 percent of revenues and 3 percent of revenues are:

•	Subcategory K:	costs / revenues:	NA
		exceeding 1 percent:	NA
		exceeding 3 percent:	NA
•	Subcategory L:	costs / revenues:	0.20 percent
		exceeding 1 percent:	0.2 facilities
		exceeding 3 percent:	0.1 facilities

EPA projects that about 0.2 small direct discharging model facilities will incur costs exceeding 1 percent of revenues under the proposed option. Also note that the ratio of posttax compliance costs to cash flow is 1.77 percent for small direct dischargers in Subcategory L. No option is proposed for small model direct dischargers in subcategories A through J. No option is proposed for small model indirect dischargers in any subcategories.

Nonsmall Model Facilities

Table 6-9B presents a summary of nonclosure impacts for nonsmall model facilities by subcategory, discharge type, and technology option. For nonsmall model facilities, the impacts in terms of the ratio of costs to revenues and cash flow are relatively much smaller than impacts to small model facilities for any given option in any given subcategory. In only one case, (Subcategory J, PSES 4) do average compliance costs exceed 2.5 percent of model facility average revenues, or 10 percent of model facility average cash flow (Subcategory K, PSES 2). To the extent that impacts under the proposed option for nonsmall model facilities exceed impacts to small model facilities, it is because a higher option is proposed for nonsmall model facilities.

Under the proposed options (BAT 2 for Subcategory J; BAT 3 for all other subcategories) for nonsmall model facilities, the ratio of pretax compliance costs to revenues, and the number of establishments incurring costs exceeding 1 percent of revenues and 3 percent of revenues is:

Table 6-9B
Nonclosure Impacts: Nonsmall Model Facilities Owned by Small Businesses
40 CFR 432 Subcategories

Option	Number of Facilities	Compliance Cost as a Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percenatage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Subcategory A through D											
BAT1	5	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT3		0.02%	0.21%	0.21%	0.0	0.0	0.0	0.0	0.1	0.0	0.0
BAT4		0.27%	3.40%	3.74%	0.3	0.1	0.1	0.0	1.5	0.9	0.4
Subcategory E through I											
BAT1	10	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.02%	0.10%	0.11%	0.0	0.0	0.0	0.0	0.1	0.0	0.0
BAT3		0.07%	0.40%	0.45%	0.2	0.1	0.1	0.0	0.3	0.2	0.1
BAT4		0.34%	1.99%	2.67%	1.1	0.4	0.2	0.1	2.0	1.2	0.5
PSES1	181	0.09%	0.52%	0.69%	4.1	1.2	0.8	0.4	8.3	4.9	2.5
PSES2		0.53%	3.04%	3.84%	31.9	8.8	5.0	2.4	47.9	29.0	14.0
PSES3		0.42%	2.42%	3.17%	23.7	6.7	3.8	1.9	40.4	23.8	11.5
PSES4		0.57%	3.31%	4.35%	34.6	9.6	5.4	2.6	54.5	33.0	16.0
Subcategory J											
BAT1	12	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.17%	0.61%	0.56%	0.5	0.1	0.1	0.0	0.5	0.4	0.1
BAT3		1.83%	6.39%	6.52%	6.0	1.9	1.1	0.5	6.5	4.1	1.9
BAT4		1.99%	6.94%	7.12%	6.5	2.1	1.1	0.6	7.0	4.4	2.1
PSES1	43	0.12%	0.41%	0.40%	1.2	0.4	0.2	0.1	1.3	0.7	0.4
PSES2		2.05%	7.20%	7.22%	23.3	7.6	4.4	2.1	24.7	16.1	7.8
PSES3		2.46%	8.62%	8.83%	26.8	9.5	5.3	2.6	28.0	19.5	9.6
PSES4		2.58%	9.02%	9.27%	27.6	9.9	5.6	2.6	28.7	20.4	10.2

Table 6-9B (cont.)
Nonclosure Impacts: Nonsmall Model Facilities Owned by Small Businesses
40 CFR 432 Subcategories

Option	Number of Facilities	Compliance Cost as a Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percenatage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Subcategory K											
BAT1	28	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.05%	0.35%	0.43%	0.2	0.0	0.0	0.0	0.9	0.6	0.2
BAT3		0.58%	3.85%	5.31%	5.9	1.2	0.8	0.2	13.5	8.2	3.9
BAT4		0.76%	5.00%	6.94%	8.4	1.7	1.0	0.5	16.8	10.7	5.1
BAT5		0.83%	5.46%	7.62%	9.5	1.9	1.0	0.5	18.0	11.7	5.7
PSES1	44	0.07%	0.49%	0.74%	0.6	0.2	0.1	0.1	2.7	1.5	0.8
PSES2		1.10%	7.26%	10.64%	20.7	4.7	2.3	1.0	31.4	24.5	13.1
PSES3		0.84%	5.55%	8.36%	15.2	3.1	1.6	0.8	29.8	20.7	10.0
PSES4		0.89%	5.84%	8.84%	16.3	3.4	1.6	0.8	30.6	21.8	10.7
Subcategory L											
BAT1	12	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.05%	0.36%	0.37%	0.1	0.0	0.0	0.0	0.2	0.1	0.1
BAT3		0.55%	3.62%	4.06%	2.2	0.4	0.2	0.1	4.1	2.4	1.0
BAT4		0.78%	5.10%	5.76%	3.6	0.8	0.4	0.1	5.6	3.4	1.7
BAT5	10 [3]	0.86%	5.73%	6.52%	3.6	0.8	0.3	0.2	5.5	3.4	1.6
PSES1	162	0.20%	1.31%	1.41%	7.6	2.2	1.2	0.6	18.1	10.5	5.1
PSES2		1.26%	8.16%	8.91%	95.2	20.1	10.0	4.4	103.1	72.0	35.8
PSES3		0.90%	5.85%	6.49%	61.7	12.7	6.8	3.0	85.0	53.3	25.3
PSES4		1.15%	7.43%	8.32%	85.0	17.6	9.0	3.9	100.3	67.8	33.1

Table 6-9B (cont.)
Nonclosure Impacts: Nonsmall Model Facilities Owned by Small Businesses
40 CFR 432 Subcategories

Option	Number of Facilities	Compliance Cost as a Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percenatage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Total Excluding 65 Certainty Facilities											
BAT1	67	NA	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		NA	NA	NA	0.8	0.1	0.1	0.0	1.7	1.1	0.4
BAT3		NA	NA	NA	14.3	3.6	2.2	0.8	24.5	14.9	6.9
BAT4		NA	NA	NA	19.9	5.1	2.8	1.3	32.9	20.6	9.8
BAT5	38 [3]	NA	NA	NA	13.1	2.7	1.3	0.7	23.5	15.1	7.3
PSES1	430	NA	NA	NA	13.5	4.0	2.3	1.2	30.4	17.6	8.8
PSES2		NA	NA	NA	171.1	41.2	21.7	9.9	207.1	141.6	70.7
PSES3		NA	NA	NA	127.4	32.0	17.5	8.3	183.2	117.3	56.4
PSES4		NA	NA	NA	163.5	40.5	21.6	9.9	214.1	143.0	70.0

Compliance costs as a percent of facility income results are presented as the average for each subcategory, discharge type and model facility size combination, weighted by the number of facilities in each combination.
Number of facilities incurring those impacts is the sum over all facility sizes by subcategory and discharge type.
[1] Ratio of pretax annualized compliance cost to revenues and EBIT; ratio of posttax annualized compliance costs to cash flow.
[2] Probability compliance costs exceed specified percentage of income measure (less probability income measure is equal to zero) multiplied by the number of facilities in the subcategory size class.
[3] Option BAT 5 is only found in Poultry operations. Subcategory L includes poultry further operations and mixed further operations. The count for BAT 5 is for poultry further operations only and hence, the number of facilities is smaller than for other BAT options.

•	Subcategory A through D:	costs / revenues: exceeding 1 percent: exceeding 3 percent:	0.02 percent 0.0 facilities 0.0 facilities
•	Subcategory E through I:	costs / revenues: exceeding 1 percent: exceeding 3 percent:	0.07 percent 0.2 facilities 0.1 facilities
•	Subcategory J:	costs / revenues: exceeding 1 percent: exceeding 3 percent:	0.17 percent 0.5 facilities 0.1 facilities
•	Subcategory K:	costs / revenues: exceeding 1 percent: exceeding 3 percent:	0.58 percent 5.9 facilities 1.2 facilities
•	Subcategory L:	costs / revenues: exceeding 1 percent: exceeding 3 percent:	0.55 percent 2.2 facilities 0.4 facilities

EPA projects that about nine nonsmall direct discharging model facilities will incur costs exceeding 1 percent of revenues under the proposed option. No option is proposed for nonsmall model indirect discharging facilities.

6.4.3.2 Nonclosure Impacts by Meat Type and Process Class

Small Model Facilities

Table 6-10A presents nonclosure impacts for small model facilities by meat type and process class. Under the proposed option (BAT 1) for small model facilities in subcategories K and L, the range for the ratio of pretax compliance costs to revenues within each subcategory is:

•	Subcategory K:	costs / revenues:	NA
•	Subcategory L: — mixed further processing	costs / revenues:	0.20 percent

Table 6-10A
Nonclosure Impacts: Small Model Facilities
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percentage of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Red Meat First Processing (Subcategory A - D)											
BAT1	17	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		2.39%	25.94%	25.26%	15.6	5.3	2.5	1.0	12.2	12.1	9.0
BAT3		29.21%	317.42%	365.64%	15.9	15.9	15.9	15.8	12.2	12.2	12.2
PSES1	265	5.76%	62.62%	63.43%	247.4	225.4	138.9	51.9	190.5	190.5	190.2
PSES2		36.77%	399.54%	467.67%	247.4	247.4	247.4	247.4	190.5	190.5	190.5
PSES3		34.35%	373.27%	435.04%	247.4	247.4	247.4	247.4	190.5	190.5	190.5
PSES4		38.10%	414.02%	485.67%	247.4	247.4	247.4	247.4	190.5	190.5	190.5
Red Meat Further Processing (Subcategory E - I)											
BAT1	43	0.08%	0.70%	0.71%	0.9	0.3	0.2	0.1	1.8	1.1	0.5
BAT2		1.39%	11.78%	11.23%	22.5	6.1	3.3	1.6	25.9	18.1	9.2
BAT3		1.57%	13.30%	12.83%	25.4	7.0	3.8	1.8	27.4	20.2	10.5
PSES1	2,489	9.93%	84.19%	83.13%	2,142.3	2,126.9	1,786.9	890.1	1,715.6	1,715.6	1,715.2
PSES2		34.87%	295.67%	330.00%	2,142.3	2,142.3	2,142.3	2,133.5	1,715.6	1,715.6	1,715.6
PSES3		39.41%	334.23%	376.69%	2,142.3	2,142.3	2,142.3	2,140.5	1,715.6	1,715.6	1,715.6
PSES4		43.57%	369.49%	419.39%	2,142.3	2,142.3	2,142.3	2,142.0	1,715.6	1,715.6	1,715.6
Red Meat First and Further Processing (Subcategory A - D)											
PSES1	674	7.62%	82.79%	83.91%	629.2	622.3	483.9	198.0	484.5	484.5	484.5
PSES2		38.93%	422.99%	496.80%	629.2	629.2	629.2	629.2	484.5	484.5	484.5
PSES3		36.06%	391.78%	458.03%	629.2	629.2	629.2	629.2	484.5	484.5	484.5
PSES4		39.99%	434.49%	511.10%	629.2	629.2	629.2	629.2	484.5	484.5	484.5
Red Meat First Processing and Rendering (Subcategory A - D)											
BAT1	17	0.10%	1.16%	1.54%	0.4	0.1	0.1	0.0	1.9	1.1	0.5
BAT2		0.75%	9.07%	10.50%	4.9	1.1	0.6	0.3	11.4	8.2	4.2
BAT3		9.08%	109.27%	134.65%	15.9	15.9	14.0	6.4	12.4	12.4	12.4

Table 6-10A (cont.)
Nonclosure Impacts: Small Model Facilities
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percentage of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	12	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PSES2		0.89%	10.72%	12.13%	4.4	0.9	0.5	0.2	8.4	6.5	3.4
PSES3		10.92%	131.40%	163.17%	11.2	11.2	10.8	5.9	8.8	8.8	8.8
PSES4		12.36%	148.73%	189.48%	11.2	11.2	11.0	6.9	8.8	8.8	8.8
Red Meat Further Processing and Rendering (Subcategory E - I)											
PSES1	32	4.95%	41.94%	41.16%	27.5	19.8	11.4	4.9	22.1	22.1	20.1
PSES2		36.11%	306.19%	342.74%	27.5	27.5	27.5	27.5	22.1	22.1	22.1
PSES3		35.42%	300.41%	335.74%	27.5	27.5	27.5	27.4	22.1	22.1	22.1
PSES4		42.46%	360.04%	407.94%	27.5	27.5	27.5	27.5	22.1	22.1	22.1
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)											
BAT1	25	0.03%	0.32%	0.43%	0.1	0.0	0.0	0.0	0.8	0.4	0.2
BAT2		0.53%	6.37%	7.27%	4.3	1.0	0.6	0.3	13.6	8.6	4.1
BAT3		0.51%	6.16%	7.27%	4.1	1.0	0.6	0.3	13.6	8.6	4.1
PSES1	50	1.12%	13.45%	15.78%	25.2	5.3	2.8	1.2	36.4	32.1	18.6
PSES2		6.49%	78.14%	95.66%	46.7	44.7	30.3	11.6	36.6	36.6	36.6
PSES3		6.39%	76.88%	94.26%	46.7	44.4	29.8	11.4	36.6	36.6	36.6
PSES4		12.76%	153.55%	198.12%	46.7	46.7	46.2	29.7	36.6	36.6	36.6
Poultry First Processing (Subcategory K)											
PSES1	19	9.58%	163.83%	157.19%	18.0	18.0	16.7	8.0	13.6	13.6	13.6
PSES2		29.10%	497.73%	527.53%	18.0	18.0	18.0	18.0	13.6	13.6	13.6
PSES3		27.30%	466.93%	493.29%	18.0	18.0	18.0	18.0	13.6	13.6	13.6
PSES4		30.41%	520.09%	552.37%	18.0	18.0	18.0	18.0	13.6	13.6	13.6
Poultry Further Processing (Subcategory L)											
PSES1	272	19.97%	381.22%	267.05%	258.0	258.0	258.0	243.9	201.1	201.1	201.1
PSES2		70.69%	1349.37%	989.02%	258.0	258.0	258.0	258.0	201.1	201.1	201.1
PSES3		65.86%	1257.19%	920.28%	258.0	258.0	258.0	258.0	201.1	201.1	201.1
PSES4		72.67%	1387.29%	1017.29%	258.0	258.0	258.0	258.0	201.1	201.1	201.1

Table 6-10A (cont.)
Nonclosure Impacts: Small Model Facilities
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percentage of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Poultry First and Further Processing (Subcategory K)											
PSES1	20	0.66%	12.51%	7.31%	4.7	1.0	0.5	0.2	11.2	7.1	3.4
PSES2		35.40%	675.74%	486.68%	19.0	19.0	19.0	19.0	14.8	14.8	14.8
PSES3		51.99%	992.45%	722.85%	19.0	19.0	19.0	19.0	14.8	14.8	14.8
PSES4		58.34%	1113.65%	813.24%	19.0	19.0	19.0	19.0	14.8	14.8	14.8
Poultry Further Processing and Rendering (Subcategory L)											
PSES1	4	0.47%	1.66%	2.02%	0.6	0.1	0.1	0.0	0.7	0.4	0.2
PSES2		4.52%	16.14%	19.89%	3.8	3.0	1.5	0.5	3.1	3.1	2.2
PSES3		4.55%	16.24%	20.19%	3.8	3.0	1.6	0.5	3.1	3.1	2.2
PSES4		5.13%	18.31%	22.93%	3.8	3.3	1.9	0.6	3.1	3.1	2.5
Mixed Further Processing (59 percent Subcategory E - I, 41 percent Subcategory L)											
BAT1	9	0.20%	1.74%	1.77%	0.5	0.2	0.1	0.0	1.0	0.6	0.3
BAT2		1.88%	15.97%	15.28%	6.2	1.8	1.0	0.5	6.0	4.8	2.6
BAT3		13.53%	114.75%	113.08%	7.7	7.7	7.5	4.6	6.2	6.2	6.2
PSES1	707	11.02%	93.47%	91.91%	608.5	607.2	540.7	286.2	487.3	487.3	487.3
PSES2		42.59%	361.14%	409.27%	608.5	608.5	608.5	608.4	487.3	487.3	487.3
PSES3		39.82%	337.70%	380.89%	608.5	608.5	608.5	608.1	487.3	487.3	487.3
PSES4		44.05%	373.58%	424.34%	608.5	608.5	608.5	608.4	487.3	487.3	487.3
Mixed Further Processing and Render (59 percent Subcategory E - I, 41 percent Subcategory L)											
PSES1	4	0.70%	4.39%	6.21%	0.9	0.3	0.1	0.1	1.7	1.1	0.5
PSES2		5.10%	32.06%	45.94%	3.4	2.5	1.5	0.6	2.8	2.8	2.8
PSES3		4.90%	30.79%	44.29%	3.4	2.5	1.4	0.6	2.8	2.8	2.7
PSES4		5.73%	36.05%	52.11%	3.4	2.8	1.7	0.7	2.8	2.8	2.8
Rendering (Subcategory J)											
BAT1	6	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		3.34%	98.73%	56.44%	4.4	1.8	1.0	0.5	3.2	2.7	1.7
BAT3		34.40%	1017.20%	724.85%	4.6	4.6	4.6	4.4	3.3	3.3	3.3

Table 6-10A (cont.)
Nonclosure Impacts: Small Model Facilities
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as Percentage of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [2]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	17	5.53%	163.50%	102.88%	13.1	8.6	5.2	2.4	9.4	9.3	7.4
PSES2		72.76%	2151.54%	1551.96%	13.1	13.1	13.1	13.1	9.4	9.4	9.4
PSES3		51.92%	1535.14%	1102.51%	13.1	13.1	13.1	13.1	9.4	9.4	9.4
PSES4		53.94%	1594.94%	1146.11%	13.1	13.1	13.1	13.1	9.4	9.4	9.4
Total Excluding 65 Certainty Facilities											
BAT1	117	NA	NA	NA	1.9	0.6	0.4	0.1	5.5	3.2	1.5
BAT2		NA	NA	NA	57.9	17.1	9.0	4.2	72.3	54.5	30.8
BAT3		NA	NA	NA	73.6	52.1	46.4	33.3	75.1	62.9	48.7
PSES1	4,565	NA	NA	NA	3,975.4	3,892.9	3,245.2	1,686.9	3,174.1	3,164.7	3,142.1
PSES2		NA	NA	NA	4,021.3	4,014.1	3,996.8	3,967.0	3,189.8	3,187.9	3,183.9
PSES3		NA	NA	NA	4,028.1	4,024.1	4,006.6	3,979.1	3,190.2	3,190.2	3,189.2
PSES4		NA	NA	NA	4,028.1	4,027.0	4,023.8	4,000.5	3,190.2	3,190.2	3,189.6

Compliance costs as a percent of facility income results are presented as the average for each meat type and process class, discharge type and model facility size combination, weighted by the number of facilities in each combination.

Number of facilities incurring those impacts is the sum over all facility sizes by class and discharge type.

[1] Ratio of pretax annualized compliance cost to revenues and EBIT; ratio of posttax annualized compliance costs to cash flow.

[2] Probability compliance costs exceed specified percentage of income measure (less probability income measure is equal to zero) multiplied by the number of facilities in the meat type and process size class.

No option is proposed for small model direct dischargers in subcategories A through J. No option is proposed for small model indirect dischargers in any subcategories.

Nonsmall Model Facilities

Table 6-10B presents nonclosure impacts for nonsmall model facilities by meat type and process class. Under the proposed options (BAT 2 for Subcategory J; BAT 3 for all other subcategories) for nonsmall model facilities, the range for the ratio of pretax compliance costs to revenues is:

- Subcategory A through D: costs / revenues: 0.02 percent
  — red meat first processing

- Subcategory E through I: costs / revenues: 0.07 percent
  — red meat further processing 0.01 percent
  — mixed further processing 0.27 percent

- Subcategory J: costs / revenues: 0.17 percent
  — rendering

- Subcategory K: costs / revenues: 0.58 percent
  — poultry first and further processing 0.37 percent
  — poultry first processing and rendering 1.00 percent

- Subcategory L: costs / revenues: 0.55 percent
  — mixed further processing 0.27 percent
  — poultry further processing 0.59 percent

No option is proposed for nonsmall model indirect discharging facilities.

6.5 REGULATORY FLEXIBILITY ANALYSIS

Based on the results presented in Tables 6-5 through 6-10, EPA has chosen to minimize economic impacts to small business establishments in the meat products industry by tailoring its proposed guidelines to differences in subcategory, discharge type, and facility size. Specifically, EPA is:

Table 6-10B
Nonclosure Impacts: Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as a Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [3]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Red Meat First Processing (Subcategory A - D)											
BAT1	5	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT3		0.02%	0.21%	0.21%	0.0	0.0	0.0	0.0	0.1	0.0	0.0
BAT4		0.27%	3.40%	3.74%	0.3	0.1	0.1	0.0	1.5	0.9	0.4
Red Meat Further Processing (Subcategory E - I)											
BAT1	8	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.01%	0.05%	0.07%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT3		0.01%	0.05%	0.08%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT4		0.23%	1.32%	2.07%	0.5	0.2	0.1	0.0	1.2	0.7	0.3
PSES1	132	0.07%	0.41%	0.62%	2.3	0.7	0.4	0.2	5.4	3.2	1.6
PSES2		0.28%	1.61%	2.50%	10.2	3.1	1.8	0.9	23.5	13.7	6.6
PSES3		0.26%	1.54%	2.40%	9.7	2.9	1.7	0.9	22.4	13.1	6.3
PSES4		0.34%	1.97%	3.10%	12.9	3.8	2.2	1.1	29.4	17.1	8.3
Poultry First Processing (Subcategory K)											
BAT1	15	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.04%	0.25%	0.35%	0.1	0.0	0.0	0.0	0.4	0.2	0.1
BAT3		0.47%	3.13%	4.84%	2.2	0.5	0.3	0.1	6.9	4.1	1.9
BAT4		0.61%	4.05%	6.30%	3.2	0.7	0.4	0.2	8.7	5.4	2.5
BAT5		0.67%	4.42%	6.91%	3.7	0.8	0.4	0.2	9.3	5.9	2.8
PSES1	29	0.10%	0.65%	1.00%	0.6	0.2	0.1	0.1	2.4	1.4	0.7
PSES2		1.09%	7.19%	11.06%	14.7	2.9	1.4	0.6	22.1	17.6	9.1
PSES3		0.86%	5.66%	8.79%	10.4	2.1	1.1	0.5	20.7	14.5	7.0
PSES4		0.90%	5.96%	9.29%	11.2	2.2	1.1	0.5	21.1	15.3	7.5

Table 6-10B (cont.)
Nonclosure Impacts: Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as a Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [3]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Poultry Further Processing (Subcategory L)											
BAT1	10	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.06%	0.37%	0.39%	0.1	0.0	0.0	0.0	0.2	0.1	0.1
BAT3		0.59%	3.94%	4.43%	2.1	0.4	0.2	0.1	3.9	2.3	1.0
BAT4		0.79%	5.24%	5.93%	3.2	0.7	0.3	0.1	5.1	3.1	1.5
BAT5		0.86%	5.73%	6.52%	3.6	0.8	0.3	0.2	5.5	3.4	1.6
PSES1	123	0.23%	1.50%	1.62%	6.4	1.8	1.0	0.5	16.1	9.3	4.5
PSES2		1.33%	8.84%	9.63%	80.6	16.2	7.9	3.3	84.8	60.6	30.3
PSES3		0.96%	6.37%	7.02%	52.1	10.1	5.3	2.3	71.2	45.1	21.4
PSES4		1.19%	7.90%	8.79%	70.4	13.7	6.8	2.9	81.6	56.1	27.4
Poultry First and Further Processing (Subcategory K)											
BAT1	5	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.03%	0.22%	0.31%	0.0	0.0	0.0	0.0	0.1	0.1	0.0
BAT3		0.37%	2.46%	3.79%	0.5	0.1	0.1	0.0	1.8	1.0	0.5
BAT4		0.57%	3.74%	5.80%	0.9	0.2	0.1	0.1	2.7	1.6	0.8
BAT5		0.63%	4.13%	6.44%	1.1	0.2	0.1	0.1	3.0	1.8	0.9
PSES1	10	0.01%	0.06%	0.08%	0.0	0.0	0.0	0.0	0.1	0.0	0.0
PSES2		0.60%	3.93%	5.88%	2.0	0.4	0.2	0.1	5.5	3.3	1.6
PSES3		0.57%	3.75%	5.79%	1.9	0.4	0.2	0.1	5.4	3.3	1.5
PSES4		0.61%	4.02%	6.23%	2.1	0.5	0.2	0.1	5.8	3.6	1.7
Poultry First Processing and Rendering (Subcategory K)											
BAT1	6	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.10%	0.67%	0.66%	0.1	0.0	0.0	0.0	0.3	0.2	0.1
BAT3		1.00%	6.65%	7.29%	2.7	0.5	0.3	0.1	3.6	2.3	1.1
BAT4		1.29%	8.53%	9.40%	3.8	0.7	0.4	0.2	4.1	2.9	1.4
BAT5		1.40%	9.27%	10.28%	4.1	0.8	0.4	0.2	4.3	3.1	1.6

Table 6-10B (cont.)
Nonclosure Impacts: Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as a Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [3]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
PSES1	2	0.04%	0.26%	0.25%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PSES2		3.32%	21.98%	23.57%	1.9	1.0	0.5	0.2	1.5	1.5	1.2
PSES3		1.88%	12.45%	13.70%	1.7	0.4	0.2	0.1	1.5	1.3	0.7
PSES4		1.95%	12.93%	14.27%	1.8	0.5	0.2	0.1	1.5	1.3	0.7
Poultry Further Processing and Rendering (Subcategory L)											
PSES1	8	0.03%	0.20%	0.30%	0.0	0.0	0.0	0.0	0.2	0.1	0.1
PSES2		0.36%	2.40%	3.61%	0.8	0.2	0.1	0.1	2.7	1.6	0.7
PSES3		0.31%	2.03%	3.10%	0.6	0.2	0.1	0.0	2.3	1.3	0.6
PSES4		0.34%	2.22%	3.41%	0.7	0.2	0.1	0.0	2.6	1.5	0.7
Poultry First Processing, Further Processing, and Rendering (Subcategory K)											
BAT1	2	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.08%	0.51%	0.70%	0.0	0.0	0.0	0.0	0.1	0.1	0.0
BAT3		0.66%	4.35%	6.73%	0.5	0.1	0.1	0.0	1.2	0.8	0.4
BAT4		0.70%	4.62%	7.17%	0.5	0.1	0.1	0.0	1.3	0.8	0.4
BAT5		0.77%	5.06%	7.88%	0.6	0.1	0.1	0.0	1.4	0.9	0.4
PSES1	3	0.08%	0.52%	0.79%	0.0	0.0	0.0	0.0	0.2	0.1	0.1
PSES2		1.39%	9.17%	13.85%	2.1	0.4	0.2	0.1	2.3	2.1	1.2
PSES3		0.90%	5.93%	9.20%	1.2	0.2	0.1	0.1	2.2	1.6	0.8
PSES4		0.93%	6.13%	9.53%	1.2	0.2	0.1	0.1	2.2	1.6	0.8
Mixed Further Processing (61 percent in Subcategory E - I, 39 percent in Subcategory L)											
BAT1	4	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.04%	0.25%	0.25%	0.0	0.0	0.0	0.0	0.1	0.0	0.0
BAT3		0.27%	1.54%	1.68%	0.3	0.1	0.1	0.0	0.5	0.3	0.1
BAT4		0.72%	4.20%	4.64%	1.0	0.3	0.2	0.1	1.3	0.8	0.4
PSES1	80	0.14%	0.83%	0.90%	3.0	0.9	0.6	0.3	4.7	2.8	1.4
PSES2		1.19%	6.92%	7.44%	35.5	9.4	5.2	2.5	40.0	25.1	12.2
PSES3		0.83%	4.80%	5.27%	23.0	6.2	3.5	1.7	29.5	17.6	8.5
PSES4		1.20%	6.93%	7.73%	35.6	9.5	5.3	2.5	41.2	26.1	12.7

Table 6-10B (cont.)
Nonclosure Impacts: Nonsmall Model Facilities Owned by Small Businesses
Meat Type and Process Classes

Option	Number of Facilities	Compliance Cost as a Percent of Model Facility [1]			Facilities Incurring Compliance Costs Greater Than Percentage of Revenues [2]				Facilities Incurring Compliance Costs Greater Than Percentage of Cash Flow [3]		
		Revenues	EBIT	Cash Flow	1 Percent	3 Percent	5 Percent	10 Percent	3 Percent	5 Percent	10 Percent
Rendering (Subcategory J)											
BAT1	12	0.00%	0.00%	0.00%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		0.17%	0.61%	0.56%	0.5	0.1	0.1	0.0	0.5	0.4	0.1
BAT3		1.83%	6.39%	6.52%	6.0	1.9	1.1	0.5	6.5	4.1	1.9
BAT4		1.99%	6.94%	7.12%	6.5	2.1	1.1	0.6	7.0	4.4	2.1
PSES1	43	0.12%	0.41%	0.40%	1.2	0.4	0.2	0.1	1.3	0.7	0.4
PSES2		2.05%	7.20%	7.22%	23.3	7.6	4.4	2.1	24.7	16.1	7.8
PSES3		2.46%	8.62%	8.83%	26.8	9.5	5.3	2.6	28.0	19.5	9.6
PSES4		2.58%	9.02%	9.27%	27.6	9.9	5.6	2.6	28.7	20.4	10.2
Total Excluding 65 Certainty Facilities											
BAT1	67	NA	NA	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BAT2		NA	NA	NA	0.8	0.1	0.1	0.0	1.7	1.1	0.4
BAT3		NA	NA	NA	14.3	3.6	2.2	0.8	24.5	14.9	6.9
BAT4		NA	NA	NA	19.9	5.1	2.8	1.3	32.9	20.6	9.8
BAT5	38 [3]	NA	NA	NA	13.1	2.7	1.3	0.7	23.5	15.1	7.3
PSES1	430	NA	NA	NA	13.5	4.0	2.3	1.2	30.4	17.6	8.8
PSES2		NA	NA	NA	171.1	41.2	21.7	9.9	207.1	141.6	70.7
PSES3		NA	NA	NA	127.4	32.0	17.5	8.3	183.2	117.3	56.4
PSES4		NA	NA	NA	163.5	40.5	21.6	9.9	214.1	143.0	70.0

Compliance costs as a percent of facility income results are presented as the average for each subcategory, discharge type and model facility size combination, weighted by the number of facilities in each combination.

Number of facilities incurring those impacts is the sum over all facility sizes by subcategory and discharge type.

[1] Ratio of pretax annualized compliance cost to revenues and EBIT; ratio of posttax annualized compliance costs to cash flow.

[2] Probability compliance costs exceed specified percentage of income measure (less probability income measure is equal to zero) multiplied by the number of facilities in the subcategory size class.

[3] Option BAT 5 is only found in Poultry operations.

- not proposing new effluent limitations and guidelines for indirect dischargers in any subcategory;
- proposing to exclude small producers (i.e., small model facilities) from revisions to effluent guidelines for subcategories A through D, E through I, and J (red meat and rendering subcategories);
- proposing to set less stringent guidelines (BAT 1 instead of BAT 3) for small producers than for nonsmall producers in subcategories K and L (poultry subcategories).

EPA presents its estimate of the number and model size of small business owned facilities that will be affected by the proposed rule in Tables 6-11 and 6-12. Table 6-11 presents the estimates by subcategory; Table 6-12 presents them by meat type and process class.

By not proposing new guidelines for indirect dischargers, EPA excludes 96 percent of all small business entities (4,990 out of 5,174 small business owned facilities) in the meat products industry from additional regulatory burden. By excluding low production volume facilities in subcategories A through D, E though I, and J, 112 of 140 small business entities in the red meat and rendering subcategories incur no new costs under the proposed rule. Finally, by proposing a lower option — based on current performance — for low production facilities in subcategories K and L, EPA minimizes potential regulatory costs to those 72 affected small business establishments. Thus, EPA anticipates that 1.4 percent (72 of 5,174) of small business owned facilities in the meat products industry will incur costs under the proposed rule.

Table 6-13 summarizes projected impacts to 71 small business owned meat products facilities that are expected to incur compliance costs.[10] The four small model facilities are expected to incur total posttax annualized compliance costs of $2,600, about $700 per facility. Average projected costs exceed 0.2 percent of model facility revenues; about two of these facilities are projected to incur costs statistically exceeding 1 percent of revenues.

For the 67 nonsmall model facilities owned by small businesses, posttax annualized compliance costs total $8.0 million, about $119,000 per facility. However, the overall average is somewhat misleading. Twenty-seven establishments in subcategories A through J are projected to incur about

[10] Small differences appear in facility counts due to rounding (e.g., Table 6-11 shows 72 affected small business establishments, Table 6-13 shows 71).

Table 6-11
Meat Product Industry Estimated Direct and Indirect Discharge
Affected Small Business Owned Facilities by 40 CFR 432 Subcategories

Model Facility Size	Direct Discharge Facilities: Small Business Owned*	Direct Discharge Facilities: Affected Small Business Owned*	Indirect Discharge Facilities: Small Business Owned*	Indirect Discharge Facilities: Affected Small Business Owned*
Subcategory A through D				
Small	59	0	1,001	0
Medium	5	5	0	0
Subcategory E through I				
Small	48	0	2,941	0
Medium	10	10	181	0
Subcategory J				
Small	5	0	13	0
Medium	4	4	15	0
Large	2	2	7	0
Very Large	6	6	21	0
Subcategory K				
Small	0	0	39	0
Medium	28	28	44	0
Subcategory L				
Small	4	4	568	0
Medium	11	11	158	0
Large	1	1	4	0
Small Total	116	4	4,562	0
Medium Total	58	58	398	0
Large Total	3	3	11	0
Very Large Total	6	6	21	0
TOTAL	**183**	**71**	**4,991**	**0**

*Numbers may not sum due to rounding.
Based on Screener Survey, Census Model Facilities, and SBA Special Tabulations.
EPA did not distribute the 65 certainty facilities between direct and indirect dischargers.

Table 6-12
Meat Product Industry Estimated Direct and Indirect Discharge
Affected Small Business Owned Facilities by Meat Type and Process Classes

Model Facility Size	Direct Discharge Facilities		Indirect Discharge Facilities	
	Small Business Owned*	Affected Small Business Owned*	Small Business Owned*	Affected Small Business Owned*
Red Meat First Processing (Subcategory A- D)				
Small	17	0	265	0
Medium	5	5	0	0
Red Meat Further Processing (Subcategory E - I)				
Small	43	0	2,489	0
Medium	8	8	132	0
Red Meat First and Further Rendering (Subcategory A - D)				
Small	0	0	674	0
Red Meat First Processing and Rendering (Subcategory A - D)				
Small	17	0	12	0
Red Meat Further Processing and Rendering (Subcategory E - I)				
Small	0	0	32	0
Red Meat First Processing, Further Processing, and Rendering (Subcategory A - D)				
Small	25	0	50	0
Poultry First Processing (Subcategory K)				
Small	0	0	19	0
Medium	15	15	29	0
Poultry Further Processing (Subcategory L)				
Small	0	0	272	0
Medium	9	9	119	0
Large	1	1	4	0
Poultry First and Further Processing (Subcategory K)				
Small	0	0	20	0
Medium	5	5	10	0
Poultry First Processing and Rendering (Subcategory K)				
Medium	6	6	2	0
Poultry Further Processing and Rendering (Subcategory L)				
Small	0	0	4	0
Medium	0	0	8	0
Poultry First Processing, Further Processing, and Rendering (Subcategory K)				
Medium	2	2	3	0

Table 6-12 (cont.)
Meat Product Industry Estimated Direct and Indirect Discharge
Affected Small Business Owned Facilities by Meat Type and Process Classes

	Direct Discharge Facilities		Indirect Discharge Facilities	
Model Facility Size	**Small Business Owned***	**Affected Small Business Owned***	**Small Business Owned***	**Affected Small Business Owned***
Mixed Further Processing (Subcategory E- I and Subcategory L) [1]				
Small	9	4	707	0
Medium	4	4	80	0
Mixed Further Processing and Rendering (Subcategory E- I and Subcategory L) [1]				
Small	0	0	4	0
Renderer (Subcategory J)				
Small	5	0	13	0
Medium	4	4	15	0
Large	2	2	7	0
Very Large	6	6	21	0
Small Total	116	4	4,562	0
Medium Total	59	59	397	0
Large Total	3	3	11	0
Very Large Total	6	6	21	0
TOTAL	**184**	**71**	**4,991**	**0**

*Numbers may not sum due to rounding.
**5 facilities allocated to Subcategory E through I are excluded.
[1] For small facilities, the allocation is 59% in Subcategory E through I and 41% in Subcategory L. For nonsmall facilities, the allocation is 61% in Subcategory E through I and 39% in Subcategory L.
Based on Screener Survey, Census Model Facilities, and SBA Special Tabulations.
Classes with zero facilities were excluded from the table.
EPA did not distribute the 65 certainty facilities between direct and indirect dischargers.

Table 6-13
Summary of Impacts Under the Proposed Options
Small Business Owned Facilities

Size	Proposed Option	Number of Facilities	Posttax Annualized Costs ($1,000's)		Ratio of Cost to Net Income	Probability of Closure	Ratio of Cost to Revenues	Number of Facilities Incurring Costs Greater Than:	
			Total	Average				1 Percent of Revenues	3 Percent of Revenues
Subcategory A through D									
Nonsmall	BAT 3	5	$33.8	$6.8	0.25%	0.04%	0.02%	0.0	0.0
Subcategory E through I									
Nonsmall	BAT 3	10	$271.7	$26.0	0.55%	0.09%	0.07%	0.2	0.1
Subcategory J									
Nonsmall	BAT 2	12	$181.3	$15.1	0.69%	0.12%	0.17%	0.5	0.1
Subcategory K									
Small[1]	BAT 1	NA	NA	NA	NA	NA	NA	NA	NA
Nonsmall	BAT 3	28	$6,030.8	$215.4	6.82%	1.22%	0.58%	5.9	1.2
Subcategory L									
Small	BAT 1	4	$2.6	$0.7	2.44%	0.31%	0.20%	0.2	0.1
Nonsmall	BAT 3	12	$1,456.4	$126.0	4.87%	0.89%	0.55%	2.2	0.4
Total Small		**4**	**$2.6**	**$0.7**	**NA**	**NA**	**NA**	**0.2**	**0.1**
Total Nonsmall		**67**	**$7,974.0**	**$119.0**	**NA**	**NA**	**NA**	**8.8**	**1.8**

[1] EPA is proposing option BAT 1 for small producers in Subcategory K, but currently estimates zero facilities in that subcategory.
Numbers may not sum due to rounding.

$18,000 in compliance costs per facility, while the remaining 40 facilities in the poultry subcategories (K and L) incur an average of about $187,000 in costs. This disparity is presumably because there are currently no guidelines for poultry processors. Even in subcategories K and L, average compliance costs compose less than 0.6 percent of facility revenues, and about 9 of the 67 potentially affected small businesses are statistically projected to incur costs exceeding 1 percent of revenues.

6.6 REFERENCES

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CHAPTER 7

ENVIRONMENTAL BENEFITS

7.1 BENEFIT VALUATION METHODOLOGY

The proposed meat products industry effluent limitations guideline will reduce emissions into the waters of the United States. The reduction in emissions will reduce the levels of fecal coliform and biological oxygen demand and improve other indicators of water quality. As water quality improves waters may become suitable for increasingly demanding human uses. A primary benefit of the regulation is the restoration of waters to conditions conducive to fishing and swimming.

Each use category can be defined in terms of a set of water quality indicators. If the indicators meet or exceed all of the criteria for a given use, then the water body can be used for that use. Vaughan (1986) developed a water quality criteria ladder which describes the type of recreational use that a water body can support (none, boating, fishing, or swimming). For example, a water body with a biological oxygen demand (BOD) between 3 and 4 mg/l is suitable for boating and fishing but not for swimming. All of the indicators must achieve the prescribed level for the water body to support a given level of use. Thus, if a water body had BOD between 3 and 4 mg/l, but a fecal coliform count greater than 2,000 per 100 ml, it would be classified as not boatable because of the high coliform count. The overall use category is the least demanding use supported by any of the water quality indicators.

Once the use of the water body is defined by the Vaughan ladder, the public willingness to pay for changes in use category can be estimated. Mitchell and Carson (1986) conducted a national contingent valuation survey which sought households' willingness to pay for improvements in the quality of the nation's waters in terms of a use ladder. This survey characterized households' annual willingness to pay for improvements in freshwater resources from their baseline conditions to fishable and swimmable conditions. The survey sought to estimate the value of discrete changes from one use category to another corresponding to the Vaughan water quality ladder.

Several regulatory impact analyses have operationalized the Vaughan/Mitchell and Carson approach in estimating the benefits from proposed regulations. The National Water Pollution Control Assessment Model (NWPCAM) manages information on 635,000 water reaches in the EPA's Reach File 3 (RF3) Lite database of rivers and streams. NWPCAM contains baseline information on the characteristics, flow, and water quality of each reach. Modeling the technology used to comply with a proposed regulation estimates changes in pollutant loads delivered to the river. From these changes, NWPCAM projects the change in water quality indicators for each reach. See the environmental assessment for more information about effluent loadings and NWPCAM (U.S. EPA 2002). The water quality measures are converted to use categories based on the Vaughan criteria, and the new overall use category for each reach is identified.

When the proposed regulation causes a reach to change use category, household annual willingness to pay from the Mitchell and Carson study is applied to estimate the value of the benefits resulting from the change. Mitchell and Carson (1993) also established that families place a higher value on water quality changes in their own region than on generic national improvements. EPA therefore attributes two-thirds of the willingness to pay value to households within the state and one-third to households elsewhere. EPA then aggregates over in-state and out-of-state values and households to estimate the national benefit accrued due to the regulation.

One criticism of the water quality ladder approach is that a rule is only credited with a benefit when it results in a change from one use category to another. Thus, even if regulation significantly improves water quality, if it does not result in a change to a higher use category, no benefits are attributed to it. Conversely, if a marginal improvement in water quality results in a change in use category, large benefits are ascribed to it. This critique is unimportant for major rules affecting many point sources of pollution. It is more significant for rules affecting non-point sources where the diffuse nature of the contaminant makes it unlikely a single rule will shift use categories for many reaches. There has been considerable debate about how to measure benefits continuously in the non-point emissions context.

7.1.1 A Continuous Approach to Valuation

As an alternative to the stepwise ladder approach, EPA has adopted a change in a single unified index as an indicator of water quality improvement for valuation for this proposed regulation. The Water

Quality Index (WQI) combines information from four water quality measures rather than using only the limiting lowest quality criterion to define use category. For this benefit valuation, EPA used NWPCAM to compile a WQI from turbidity, BOD, fecal coliforms, and dissolved oxygen indexes; this WQI is based on work by McClelland (1974). Vaughn's breakpoints on the water quality ladder can be translated into the WQI as shown in Table 7-1. However, the translation results in almost all reaches falling into the top use category in the baseline, that is, their WQI was greater than 76.19. This demonstrates the difference between applying a limiting quality rule among four criteria and using a single aggregated measure. Some criteria are apparently more difficult to achieve than others. Merely achieving the WQI represented by the values in the Vaughan criteria misses the fact that any one criteria that is not satisfied can reduce the use level. An alternative mapping from WQI to the Mitchell and Carson WTP values is necessary for the results to be comparable with prior benefit valuations.

Since the baseline distribution of use categories is well understood and generally accepted, it is desirable for the distribution based on WQI to match the existing distribution of use categories in the baseline. EPA derived WQI values to represent the breakpoints on the water quality ladder based on empirical observation of the WQI distribution among use categories in the baseline data. EPA calculated the mean and standard deviation of WQIs for the reaches in each use category in the baseline population of reaches. If reaches are normally distributed within each use category, 84 percent of observed WQI for each category should be less than the mean WQI plus one standard deviation (SD). The Mean + SD value serves as the criterion for the boundary with the next higher use category. Table 7-2 shows the calculation and the resulting criteria.

Table 7-3 shows how applying this set of criteria to the baseline NWPCAM data predicts baseline use category. The first column indicates the use category using the standard most restrictive criterion method. The second column indicates the distribution of use categories assigned using the Mean + SD criteria given the baseline use category. Shaded rows indicate agreement between both methods. Sixty-four percent of reaches fall into the same use category using this method as in the most restrictive use method (= 19.0 + 7.4 + 14.9 + 22.4). About 88 percent of reaches fall into use categories the same or lower than their category in the baseline. Clearly, the two methods frequently agree and, except for the lowest category, the Mean + SD criteria usually places the reach in a lower category.

Table 7-1
Applying WQI to Vaughn's Use Category Criteria

Characteristic	Measure	Weight	No Use to Boatable		Boatable to Fishable		Fishable to	
			Criteria	Weighted	Criteria	Weighted	Criteria	Weighted
Fecal Coliforms	#/100ml	0.314	2000	2.388	1000	2.562	200	3.559
Dissolved Oxygen	percent	0.333	45	3.267	51	3.526	83	4.475
BOD - Max -day	mg/l	0.216	4	2.376	3	2.534	1.5	2.643
Turbidity	JTU	0.137	100	1.474	50	1.646	10	1.810
Product/Implied WQI				27.337		37.668		76.190

Source: Weights: Bondelied, 2001; Values: Vaughan, 1986; Values were scaled by eye from graphs in McClelland, 1974, Appendix A.

Table 7-2
Empirical Calculation of Criteria from the Baseline Scenario

Use Category	Mean (WQI)	Standard Deviation	Criterion (Mean + SD) (WQI)	Household Annual WTP[a] ($ 1999)	Rate, R ($/WQI, 1999)
No Use, 0	54.1	24.8	79.0	$245	$3.10
Boatable, 1	84.9	9.5	94.4	$429	$11.91
Fishable, 2	92.5	6.5	99.0	$634	$44.92
Swimmable, 3	98.5	2.3			

Source: EPA analysis of Baseline Access database, 10/2/2001; WTP values from EPA, 2001, CAFOs Economic Analysis.
[a] Total annual willingness to pay for upgrading all U.S. freshwater bodies from baseline quality to the next designated use category, i.e. annual WTP is $634 to move all sub-swimmable waters to use category 3, swimmable.

Table 7-3
Comparison of Baseline Scenario Categorization under Most Restrictive Use and Mean + SD criteria

Use Category by Most Restrictive Use	Use Category by Mean + SD	Number of Reaches in Category	Percent of Most Restrictive Use Category	Percent of All Reaches
0	0	125,727	71.6%	19.0%
0	1	49,110	28.0%	7.4%
0	2	758	0.4%	0.1%
1	0	8,161	11.7%	1.2%
1	1	49,107	70.5%	7.4%
1	2	12,416	17.8%	1.9%
2	0	5,468	2.6%	0.8%
2	1	89,383	42.7%	13.5%
2	2	98,320	47.0%	14.9%
2	3	16,031	7.7%	2.4%
3	0	103	0.1%	0.0%
3	1	6,759	3.3%	1.0%
3	2	50,942	24.8%	7.7%
3	3	147,994	71.9%	22.4%

Source: EPA Analysis of Baseline Access database, 10/2/2001.

The Mitchell and Carson willingness to pay values were updated to 1999 values for the recent Concentrated Animal Feeding Operations (CAFOs) regulation benefit assessment to account for changes in income and the value of the dollar. The CAFOs assessment, however, valued only changes in use categories. The continuous WQI method requires that the Mitchell and Carson willingness to pay values be converted to continuous measures of benefits. This rate of change for each use category is calculated so that the total willingness to pay at each breakpoint is equal to the total in the Mitchell and Carson benefit ladder (as adapted to 1999 values for the CAFOs benefits assessment). The resulting rates are shown in column 5 of Table 7-2. The not boatable category is arbitrarily spread over the whole range from 0 to 79.[1] No value is associated with improvements above the swimmable level, which is a very small range. The result is a linear approximation of an increasing marginal benefit curve, $f(W_0, W_1)$, as shown in Figure 7-1. With each step, the rate of increase in benefits is roughly four times higher than the previous step. As the rate of increase in willingness to pay per household increases with use category, the tendency of the WQI mean + SD breakpoints to categorize reaches lower than they would have been under the most restrictive use criterion will cause the benefits to be conservatively valued. However, a method which values any change in WQI will most likely generate higher values than a method which only includes changes in use categories.

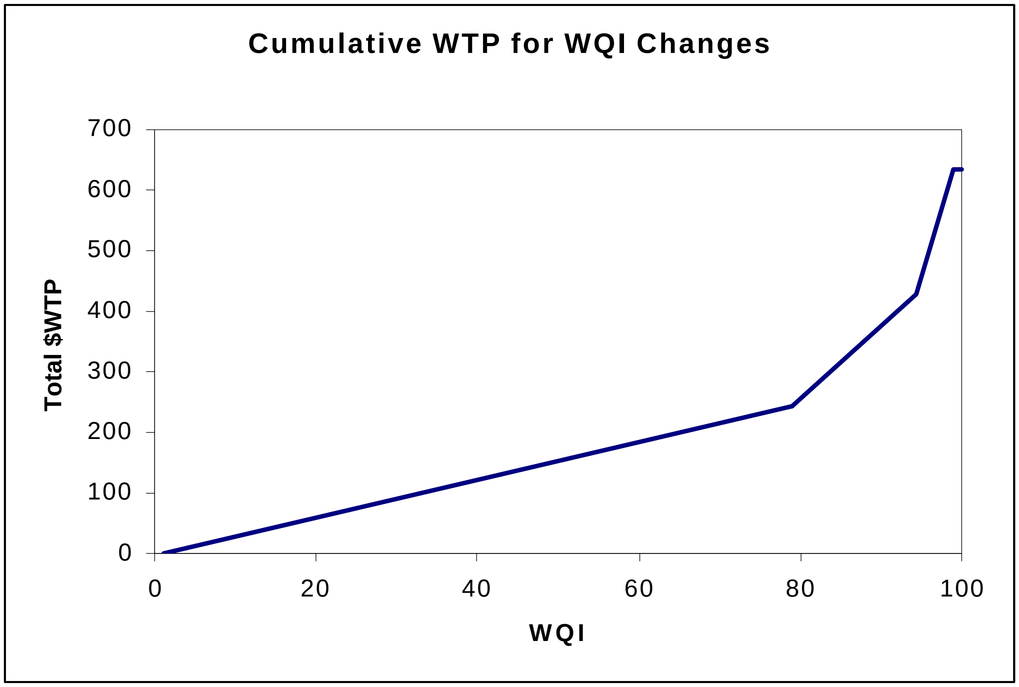
EPA used the NWPCAM model to estimate changes in water quality indicators. NWPCAM produces a Microsoft Access database for the baseline conditions and each regulatory scenario. Each database is then processed to generate weighted estimates of household willingness to pay. For each reach, the model calculates the household willingness to pay for a national change in water quality between the reach's baseline WQI (W_0) and its WQI in the regulatory scenario (W_1) and scales it by the length of the reach, k_i.

$$B_{ni} = k_i \, [f(W_{1i}) - f(W_{0i})] \tag{1}$$

where: f(W) is the average household benefit of a change in water quality from W_0 to W_1 at the national level and k is the length of reach i. This yields a mileage weighted benefit measure, B_{ni}, for each reach, i, in each state, n.

[1] Mitchell and Carson described non-boatable waters in graphic terms so their value for the change may be an overestimate. However, few water bodies approach a zero WQI, so much less than the full value for the improvement to boatable can ever be attributed to the regulation.

Figure 7-1
Cumulative Willingness to Pay for Changes in WQI, f(W)



Waters closer to one's home are easier to access and use, so it might be expected to command a higher value. Mitchell and Carson asked respondents to apportion their willingness to pay between improving local waters, i.e. in-state, and improving more distant waters. On average, respondents allocated two-thirds of their WTP to in-state waters. So, benefits are calculated on a state-by-state basis in terms of benefits to the state's households from in-state and out-of-state improvements. For in-state benefits, S_n, the mileage weighted value is divided by the total stream miles within the state, L_n, and multiplied by two-thirds. In essence, the WTP value is weighted by the proportion of in-state waterways affected and the proportion of the total household value for in-state water quality improvements. This quantity multiplied by the number of households[2] in the state, H_n, yields the value of the in-state changes in water quality to state households.

$$S_n = H_n \frac{0.67 \sum B_{ni}}{L_n} \tag{2}$$

Households in every state also value the improvement in water quality in other states. The sum of WTP weighted by mileage for states other than the home state is divided by the sum of reach mileage in all other states, $L_{\sim n}$.[3] One third of this sum multiplied by the number of households in the state yields the willingness of one state's households to pay for improvements in distant states.

$$S_{\sim n} = H_n \frac{0.33 \sum B_{\sim ni}}{L_{\sim n}} \tag{3}$$

The sum of in-state and out-of-state values is the total willingness to pay of all households within the state for the water quality improvements of the scenario. The sum of state values is the national benefit estimate.

[2] The number of households in each state in 1999 was not available at the time this analysis was performed. As an estimate the number of households in each state in 1998 was multiplied by 1.034 the ratio of households nationwide in 1999 versus 1998.

[3] There are actually 632,552 miles of unique reaches but the state database sums to 663,156 miles. The difference is made up of reaches shared by more than one state. Using the larger divisor compensates for the double counting.

7.1.2 Use Category Approach to Valuation

As a comparison, EPA also estimated the benefits of the proposed regulation using the change in use category method as in previous benefits assessments. The 4 use categories (none, boatable, fishable, and swimmable) were labeled from 0 to 3. There are 6 possible positive changes in use categories. Changes in category from a more demanding use to a less demanding one are possible but were ignored in this estimate. Table 7-4 shows the possible changes and the annual WTP values per household ascribed to each change in national water quality from the Mitchell and Carson WTP values as updated to 1999 values. Larger changes are valued more highly.

Each reach in the database was placed in one of these categories of use change or a no change category. The assumption that two-thirds of value applies in-state and one-third applies out of state is maintained. So two-thirds of the household's value would have been achieved if all of the state's waterways made the identified change. As only k_{nj} miles are estimated to make change, j, the total length in each category in state, n, is divided by the total length of rivers in the state, L_n, to weight the WTP value.

$$S_n = H_n \sum 0.67 \, V_j \frac{k_{nj}}{L_n} \tag{4}$$

Out of state values are estimated similarly with all of the out of state mileage in each category weighted by the total out of state mileage, $L_{\sim n}$.

$$S_{\sim n} = H_n \sum 0.33 \, V_j \frac{k_{\sim nj}}{L_{\sim n}} \tag{5}$$

As in the continuous method, state values are summed to yield national benefit estimates.

Table 7-4
WTP Values for Changes in Use Category

No Use to	No Use to Fishable	No Use to Swimmable	Boatable to Fishable	Boatable to Swimmable	Fishable to Swimmable
0 > 1	**0 > 2**	**0 > 3**	**1 > 2**	**1 > 3**	**2 > 3**
$245	$429	$634	$184	$389	$205

7.2 BENEFIT VALUATION RESULTS

Benefits of the proposed regulation are modeled based on 97 (36 direct dischargers) meat processing plants for which data were available nationwide. These plants provided a sample set of impacts for evaluation. The mileage affected by the changes is small. The most effective scenarios result in net upgrades in use categories on less than 45 river miles. Table 7-5 shows the number of river miles that change use category in each scenario. Many of these changes occur in states with relatively small populations, e.g., Nebraska, so the benefits generated from in-state improvements are also small. Table 7-6 summarizes the valuation results by scenario and compares the continuous WQI method of assessing benefits with the change in use category method used in CAFOs. The continuous method generates a higher estimate of the dollar value of benefits. However, counting from lowest to highest benefit values, the two methods place the scenarios in essentially the same order. This indicates that the change in category approach may have been capturing the significant effects of the water quality change on a national basis though perhaps missing detail at the state level.

Tables 7-7 through 7-10 show the state level changes and values. Table 7-7 shows the mileage that changes from one use category to another by state as well as the number of households and number of households per river mile. Waters in only 6 states change use categories. The Mitchell and Carson WTP results place a premium on in-state waters. Both methodological approaches generate higher benefit values for states with greater population per river mile. Arkansas, Iowa, and Nebraska are geographically large states with small populations so they generate fewer benefits per river mile improved. On the other hand, Maryland is a small state with a large population and so generates disproportionately high benefit totals. Improvements in Wisconsin water quality affect less mileage but result in use categories increasing more than one step. One reach in Wisconsin increases from no use to swimmable.

Table 7-8 indicates which states will experience the largest changes in WQI under the proposed Scenario 7. Wisconsin, Iowa, Illinois, and Minnesota show large total mileage changes in WQI indicating large changes in the water quality of many water bodies. Wisconsin, Texas, and Minnesota have large average changes in WQI. Reaches in these states will be improved to a greater extent than reaches which will be improved in other states. Note that while the WQI scale ranges from 0 to 100, it is not a ratio scale so an average change of 14 cannot be interpreted as a 14 percent change. Nevertheless a 14 point change is

Table 7-5
Reach Use Category Changes from Alternative Scenarios (97 Facilities)
(Reach Miles)

		One Step Changes			Two Step Changes		Three	Total
		0 > 1	1 > 2	2 > 3	0 > 2	1 > 3	0 > 3	
Scenario 1	BAT2 Only	-	-	13.39	-	2.94	0.98	17.31
Scenario 2	BAT3 Only	-	-	17.27	-	2.94	0.98	21.19
Scenario 3	BAT4 Only	-	-	17.27	-	2.94	0.98	21.19
Scenario 4	BAT2 + PSES1	5.92	5.72	20.26	4.91	2.94	0.98	40.74
Scenario 5	BAT2 + PSES1	5.92	5.72	24.14	4.91	2.94	0.98	44.62
Scenario 6	BAT4 + PSES1	5.92	5.72	24.14	4.91	2.94	0.98	44.62
Scenario 7	BAT3 (M&P)+BAT2	-	-	17.27	-	2.94	0.98	21.19
Scenario 8		5.92	5.72	24.14	4.91	2.94	0.98	44.62

Source: EPA Analysis of NWPCAM results databases, 1/10/2002.

Table 7-6
Summary of Monetized Benefits (97 Facilities)
(Willingness to pay for changes from baseline water quality, $ 1999)

		Total Monetized Benefits		Rank Order of Scenarios	
		Continuous	Use Change	Continuous	Use Change
Scenario 1	BAT2 Only	$15,469,000	$1,032,000	1	1
Scenario 2	BAT3 Only	$15,578,000	$1,115,000	2	2
Scenario 3	BAT4 Only	$15,615,000	$1,115,000	4	2
Scenario 4	BAT2 + PSES1	$15,919,000	$1,806,000	5	5
Scenario 5	BAT3 + PSES1	$16,029,000	$1,890,000	6	6
Scenario 6	BAT4 + PSES1	$16,066,000	$1,890,000	8	6
Scenario 7	BAT3 (M&P)+BAT2	$15,578,000	$1,115,000	2	2
Scenario 8		$16,029,000	$1,890,000	6	6

Source: EPA Analysis of NWPCAM results databases, 1/10/2002.

Table 7-7
Households and River Mileage Affected by State, Proposed Scenario 7 (97 Facilities)
(Miles, unless otherwise noted)

State	Households (Thousands)	Households per River Mile	One Step Changes	Two Step Changes	Three Step Changes
Arkansas	1,003	78.1	3.88	-	-
Georgia	2,941	190.9	5.47	-	-
Iowa	1,141	73.4	1.97	-	-
Maryland	1,971	634.2	5.00	-	-
Nebraska	658	41.4	0.95	-	-
Wisconsin	2,041	163.9	-	2.94	0.98
Totals	**103,874**		**17.27**	**2.94**	**0.98**

Source: EPA Analysis of NWPCAM results databases, 1/10/2002.

Table 7-8
Households and Changes in WQI by State, Proposed Scenario 7 (97 Facilities)

State	Households (Thousands)	Households per River Mile	Total Mileage Change in WQI	Average Change in WQI
Alabama	1,720	119.4	290.0	1.9
Arkansas	1,003	78.1	52.6	0.6
Florida	6,083	926.7	1.0	1.0
Georgia	2,941	190.9	41.2	0.7
Illinois	4,590	383.5	1,255.3	4.0
Iowa	1,141	73.4	1,964.9	4.7
Kansas	1,033	60.6	3.9	1.0
Kentucky	1,548	123.0	1.0	1.0
Louisiana	1,654	158.1	12.6	1.0
Maryland	1,971	634.2	46.0	2.7
Minnesota	1,852	111.2	977.7	9.0
Mississippi	1,031	87.7	35.2	0.8
Missouri	2,161	121.5	123.1	0.9
Nebraska	658	41.4	76.1	1.7
Oklahoma	1,332	88.2	2.7	0.1
South Dakota	287	15.6	1.0	0.5
Tennessee	2,172	171.4	4.8	1.0
Texas	7,357	155.9	107.0	11.9
Virginia	2,668	217.3	4.8	0.4
Wisconsin	2,041	163.9	3,699.0	14.7

Source: EPA Analysis of NWPCAM results databases, 1/10/2002.
Note: Total Mileage Change in WQI is the sum of the differences between WQI under Option 7 and WQI in the baseline for each reach that changed in the state multiplied by the length of the reach, i.e., for each state, $\sum_i (W_{7i} - W_{0i}) k_i$. The average change in WQI is this value divided by the total length of rivers in the state that are affected by the proposed option. Thus, the average refers only to the average among water bodies affected, not all waters in the state, and is weighted by the length of water bodies affected.

Table 7-9
Total Benefits by State, by Use Category Change Method (97 Facilities)
(Willingness to pay for changes from baseline water quality, thousand $1999)

State	Scenario							
	1	2	3	4	5	6	7	8
Alabama	4	5	5	9	10	10	5	10
Arizona	4	5	5	10	11	11	5	11
Arkansas	2	44	44	14	56	56	44	56
California	28	33	33	65	70	70	33	70
Colorado	4	4	4	9	9	9	4	9
Connecticut	3	3	3	7	7	7	3	7
Delaware	1	1	1	2	2	2	1	2
District of Columbia	1	1	1	1	1	1	1	1
Florida	14	16	16	32	35	35	16	35
Georgia	148	150	150	183	184	184	150	184
Idaho	1	1	1	3	3	3	1	3
Illinois	10	12	12	86	88	88	12	88
Indiana	5	6	6	12	13	13	6	13
Iowa	22	23	23	176	176	176	23	176
Kansas	2	3	3	6	6	6	3	6
Kentucky	4	4	4	8	9	9	4	9
Louisiana	4	4	4	9	9	9	4	9
Maine	1	1	1	3	3	3	1	3
Maryland	439	440	440	518	519	519	440	519
Massachusetts	5	6	6	13	14	14	6	14
Michigan	9	10	10	20	22	22	10	22
Minnesota	4	5	5	10	11	11	5	11
Mississippi	2	3	3	6	6	6	3	6
Missouri	5	6	6	45	46	46	6	46
Montana	1	1	1	2	2	2	1	2

Table 7-9 (cont.)
Total Benefits by State, by Use Category Change Method
(Total willingness to pay for changes from baseline water quality, thousand $1999)

State	Scenario							
	1	2	3	4	5	6	7	8
Nebraska	7	7	7	35	36	36	7	36
Nevada	2	2	2	4	4	4	2	4
New Hampshire	1	1	1	2	3	3	1	3
New Jersey	7	8	8	16	17	17	8	17
New Mexico	2	2	2	4	4	4	2	4
New York	16	19	19	37	40	40	19	40
North Carolina	7	8	8	16	17	17	8	17
North Dakota	1	1	1	1	1	1	1	1
Ohio	10	12	12	24	25	25	12	25
Oklahoma	3	4	4	30	30	30	4	30
Oregon	3	4	4	7	8	8	4	8
Pennsylvania	11	13	13	25	27	27	13	27
Rhode Island	1	1	1	2	2	2	1	2
South Carolina	3	4	4	8	9	9	4	9
South Dakota	1	1	1	2	2	2	1	2
Tennessee	5	6	6	12	12	12	6	12
Texas	18	21	21	42	45	45	21	45
Utah	2	2	2	4	4	4	2	4
Vermont	1	1	1	1	1	1	1	1
Virginia	6	7	7	68	69	69	7	69
Washington	5	6	6	12	13	13	6	13
West Virginia	2	2	2	4	4	4	2	4
Wisconsin	197	198	198	203	204	204	198	204
Wyoming	0	1	1	1	1	1	1	1
Totals	**$1,032**	**$1,115**	**$1,115**	**$1,806**	**$1,890**	**$1,890**	**$1,115**	**$1,890**

Source: EPA Analysis of NWPCAM results databases, 1/10/2002.

Table 7-10
Benefits by State, by Continuous Method (97 Facilities)
(Willingness to pay for changes from baseline water quality in state, thousand $1999)

State	Scenario							
	1	2	3	4	5	6	7	8
Alabama	344	346	346	347	349	349	346	349
Arizona	84	85	85	88	89	89	85	89
Arkansas	52	67	72	72	87	92	67	87
California	555	561	563	581	587	589	561	587
Colorado	75	76	76	79	79	80	76	79
Connecticut	58	58	59	60	61	61	58	61
Delaware	13	13	13	14	14	14	13	14
District of Columbia	10	11	11	17	17	17	11	17
Florida	284	287	288	295	298	299	287	298
Georgia	218	220	222	275	278	280	220	278
Idaho	22	22	22	22	23	23	22	23
Illinois	4,301	4,328	4,328	4,312	4,338	4,339	4,328	4,338
Indiana	105	106	107	110	111	111	106	111
Iowa	1,360	1,360	1,361	1,446	1,447	1,447	1,360	1,447
Kansas	48	52	52	50	54	54	52	54
Kentucky	71	72	72	74	75	75	72	75
Louisiana	80	80	81	83	84	84	80	84
Maine	23	23	23	24	24	24	23	24
Maryland	845	846	846	865	866	866	846	866
Massachusetts	110	111	111	114	115	116	111	115
Michigan	175	177	177	182	184	184	177	184
Minnesota	717	718	719	726	727	727	718	727
Mississippi	57	57	57	64	64	64	57	64
Missouri	131	132	140	149	150	158	132	150

Table 7-10 (cont.)
Total Benefits by State, by Continuous Method
(Total willingness to pay for changes from baseline water quality in state, thousand $1999)

State	Scenario 1	2	3	4	5	6	7	8
Montana	17	17	17	18	18	18	17	18
Nebraska	34	46	46	46	58	58	46	58
Nevada	32	32	32	33	34	34	32	34
New Hampshire	21	21	21	22	22	22	21	22
New Jersey	138	139	140	144	145	146	139	145
New Mexico	30	30	31	31	32	32	30	32
New York	321	324	325	334	338	339	324	338
North Carolina	137	138	139	143	144	145	138	144
North Dakota	12	12	12	12	12	12	12	12
Ohio	203	205	206	212	214	215	205	214
Oklahoma	61	64	70	84	87	93	64	87
Oregon	62	63	63	65	66	66	63	66
Pennsylvania	217	219	220	226	228	229	219	228
Rhode Island	17	18	18	18	18	18	18	18
South Carolina	68	69	69	71	71	72	69	71
South Dakota	13	13	13	14	14	14	13	14
Tennessee	101	102	103	105	107	107	102	107
Texas	585	589	590	600	604	605	589	604
Utah	32	32	33	33	34	34	32	34
Vermont	11	11	11	11	11	11	11	11
Virginia	128	129	130	143	145	146	129	145
Washington	106	107	107	110	111	112	107	111
West Virginia	34	34	34	38	38	38	34	38
Wisconsin	3,343	3,344	3,345	3,347	3,348	3,349	3,344	3,348
Wyoming	9	9	9	9	9	9	9	9
Totals	**$15,469**	**$15,578**	**$15,615**	**$15,919**	**$16,029**	**$16,066**	**$15,578**	**$16,029**

Source: EPA Analysis of NWPCAM results databases, 11/15/01.

substantial. In several states, only a small number of water bodies will be affected by the proposed regulation so both total and average WQI changes are quite small. The conversion from change in WQI to monetized benefits is non-linear as changes in some use categories are more valued than others. Thus, a rank ordering of states from Table 7-8 may not match the rank ordering of states by total monetized benefits.

The difference between the two methods is much more pronounced at the state level than at the national level. Table 7-9 shows the state totals for the sample plants using the change in use category method. All states show a benefit from the proposed rule because their residents value the change in out of state water quality. The largest benefits accrue to Maryland households. Maryland has a large population relative to the mileage of streams in the state and a larger proportion of river miles affected by the regulation than other states. Georgia, for example, has 5.5 miles of streams changing categories because of the regulation compared to 5 miles in Maryland. However, Maryland has three times the number of households per river mile and generates almost three times the value of benefits from similar mileage affected.

Table 7-10 presents the total benefits by state using the continuous method. Many more states are shown to generate benefits from the regulation. Illinois and Wisconsin generate markedly greater benefit values because water quality improvements that do not generate use category changes are included. The difference in results from each method depends on the number of water bodies that were near one of the breakpoints on the Vaughan water quality ladder. The rate of accrual of benefits changes at the breakpoints under the continuous method but there is no substantial reward for crossing a breakpoint. The use category change method only rewards crossing the breakpoints.

In addition, states with large populations generate greater benefits for improvement in out of state waters. California and New York together now generate almost $1 million in benefits even though few of the water quality changes are near their waters.

The monetizable benefits from the proposed rule, Scenario 7, for the 97 sampled plants are $15.6 million by the continuous method and $1.1 million by the use category method. If the ratio of costs to benefits for all facilities is the same as the ratio of costs to benefits for these facilities, the total benefits of the rule would be $37.0 million. There is less than a $1 million difference between the least and most beneficial scenarios.

7.3 REFERENCES

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CHAPTER 8

COST-BENEFIT COMPARISON AND UNFUNDED MANDATES REFORM ACT ANALYSIS

8.1 COST-BENEFIT COMPARISON

The pretax annualized costs of the proposed rule range from $80.0 million (retrofit costs) to $112.1 million (upper-bound costs). The pretax cost is a proxy for the social cost of the regulation because it incorporates the cost to industry (posttax costs), and costs to State and Federal governments (i.e., lost income from tax shields).[1] In other words, the cost part of the equation is well-identified and estimated.

The estimated quantified and monetized benefits of the rule range from $1.1 million (use category change method) to $15.6 million (continuous method). These benefits estimates reflect only the 94 plants (36 direct dischargers) actually analyzed for water quality improvements. The corresponding annualized costs for these facilities are $33.7 million. If the ratio of costs to benefits for these facilities is the same as the ratio of costs to benefits for all facilities, the total (continuous) benefits of the rule would be $37.0 million. This, however, is an underestimate because EPA can fully characterize only a limited set of benefits to the point of monetization. Chapter 7 focuses mainly on the public's willingness to pay for improvements in the recreational use of water bodies (e.g., boating, swimming). However, other benefits may accrue due to the proposed rule that are not included in these monetized values. Water withdrawn for municipal or industrial uses may need less pretreatment. The value of waterfront property may be increased if water quality is improved. The benefits estimates do not include improved POTW operations and reduced costs at POTWs. Finally, the proposed regulation will generate improvements in habitat and ecosystem services which are valued for their existence. Therefore, the reported benefit estimate understates the total benefits of this proposed rule.

[1] All sites are currently permitted and permits are reissued on a periodic basis, so incremental costs administrative costs of the regulation are negligible.

8.2 UNFUNDED MANDATES REFORM ACT ANALYSIS

Title II of the Unfunded Mandates Reform Act of 1995 (Public Law 104-4; UMRA) establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and tribal governments as well as the private sector. Under Section 202(a)(1) of UMRA, EPA must generally prepare a written statement, including a cost-benefit analysis, for proposed and final regulations that "includes any Federal mandate that may result in the expenditure by State, local, and tribal governments, in the aggregate or by the private sector" of annual costs in excess of $100 million.[2] As a general matter, a federal mandate includes Federal Regulations that impose enforceable duties on State, local, and tribal governments, or on the private sector (Katzen, 1996). Significant regulatory actions require Office of Management and Budget review and the preparation of a Regulatory Impact Assessment that compares the costs and benefits of the action.

The proposed meat products industry effluent limitations guidelines are not an unfunded mandate on state, local, or tribal governments because industry bears the cost of the regulation. The pretax cost estimate to industry ranges from $80.0 million per year to $112.1 million per year, while posttax costs — costs out of industry's pocket — range from $50.5 million (retrofit costs) to $73.8 million (upper-bound costs). Thus, it is not clear that the proposed rule is an unfunded mandate on industry. EPA, however, is responsive to all required provisions of UMRA. In particular, this Economic Analysis (EA) addresses the requirements of UMRA:

- Section 202(a)(1) — authorizing legislation (Chapter 1 and the preamble to the rule);
- Section 202(a)(2) — a qualitative and quantitative assessment of the anticipated costs and benefits of the regulation, including administration costs to state and local governments (Chapters 5 and 7);
- Section 202(a)(3)(A) — accurate estimates of future compliance costs (as reasonably feasible; Chapter 5);
- Section 202(a)(3)(B) — disproportionate effects on particular regions or segments of the private sector. EPA projects one meat products site to close as a result of the costs of the proposed combination of options and one large company to move into a financially

[2] The $100 million in annual costs is the same threshold that identifies a "significant regulatory action" in Executive Order 1

distressed position but no disproportionate effects on a particular region or segments of the private sector (Chapters 5 and 6);

- Section 202(a)(3)(B) — disproportionate effects on local communities. EPA projects one meat products site to close as a result of the costs of the proposed combination of options and one large company to move into a financially distressed position but no disproportionate effects on local communities (Chapter 5) .

- Section 202(a)(4) — estimated effects on the national economy (Chapter 5);

- Section 205(a) — least burdensome option or explanation required (this Chapter).

The preamble to the proposed rule summarizes the extent of EPA's consultation with stakeholders including industry, environmental groups, states, and local governments (UMRA, sections 202(a)(5) and 204). Because this rule does not "significantly or uniquely" affect small governments, section 203 of UMRA does not apply.

Pursuant to section 205(a)(1)-(2), EPA has selected the "least costly, most cost-effective or least burdensome alternative" consistent with the requirements of the Clean Water Act (CWA) for the reasons discussed in the preamble to the rule. EPA is required under the CWA (section 304, Best Available Technology Economically Achievable (BAT), and section 307, Pretreatment Standards for Existing Sources (PSES)) to set effluent limitations guidelines and standards based on BAT considering factors listed in the CWA such as age of equipment and facilities involved, and processes employed. EPA is also required under the CWA (section 306, New Source Performance Standards (NSPS), and section 307, Pretreatment Standards for New Sources (PSNS)) to set effluent limitations guidelines and standards based on Best Available Demonstrated Technology. EPA determined that the rule constitutes the least burdensome alternative consistent with the CWA.

8.3 REFERENCES

Katzen. 1996. Economic Analysis of Federal Regulations Under Executive Order No. 12866. Memorandum for Members of the Regulatory Work Group from Sally Katzen, Ad, OIRA. January 11, 1996.