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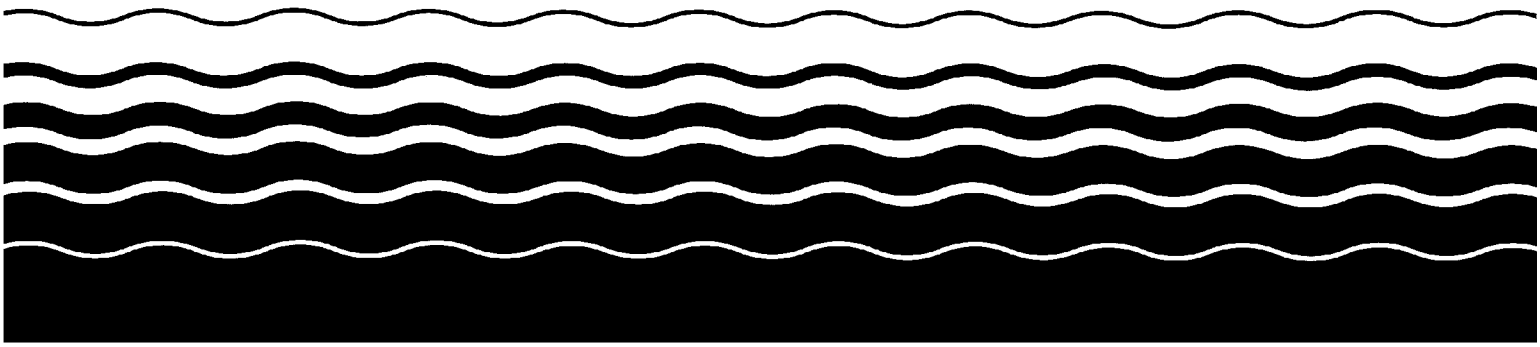
Economic Analysis of the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations



Economic Analysis for the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) is revising and updating the two primary regulations that ensure that manure, wastewater, and other process waters generated by concentrated animal feeding operations (CAFOs) do not impair water quality. EPA's proposed regulatory changes affect the existing National Pollutant Discharge Elimination System (NPDES) provisions and the existing effluent limitations guidelines (ELG) for "feedlots." The NPDES provisions define and establish permit requirements for CAFOs and the ELG establish the technology-based effluent discharge standard that is applied to CAFOs. Both of these existing regulations were originally promulgated in the 1970s.

EPA is revising the regulations to address changes that have occurred in the animal industry sectors over the last 25 years, to clarify and improve implementation of CAFO requirements, and to improve the environmental protection achieved under these rules. The revisions EPA is proposing would affect who must apply for a permit under the NPDES program, who is subject to the ELG, and what the ELG requires. A summary of the current and the proposed NPDES and ELG regulations for CAFOs are presented in Sections 1 and 3 of this report, respectively. More detailed information on the current and proposed regulations is presented in Sections II, VII, and VIII of the preamble.

This Economic Analysis (EA) summarizes EPA's analysis of the estimated annual compliance costs and the economic impacts that may be incurred by affected operations that are subject to the proposed revisions. EPA also provides additional material on the proposed CAFO regulations in the *Development Document for the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations*, which discusses how EPA estimated compliance costs of the proposed regulations. EPA's benefits analysis, titled *Environmental and Economic Benefit Analysis of the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations*, provides information about existing water quality impairments associated with animal production operations and estimates the extent to which these impairments may be mitigated by the proposed CAFO regulations.

ES.2 DATA AND METHODOLOGY

ES.2.1 Data Sources

EPA did not conduct an industry-wide survey of all CAFOs. Rather, EPA is relying on existing data sources and expertise provided by numerous government agencies, state agricultural extension services, land grant universities, and information from industry trade associations and

agricultural professionals. Major data sources are discussed in detail where they are used to conduct the analyses presented in this report. Two major sources of primary USDA data were instrumental to the economic analysis. These include USDA's 1997 Census of Agriculture and data from the 1997 Agricultural Resource Management Study (ARMS).

The 1997 Census of Agriculture is conducted by the National Agricultural Statistical Service (NASS) and provides information on the number of feedlots, their geographic distributions, the amount of cropland available to land apply animal manure generated from animal confinement operations, and other information. These data are compiled by NASS, with the assistance of personnel at USDA's Natural Resources Conservation Service (NRCS) who developed a methodology to identify information specific to animal confinement operations. All Census data provided to other government agencies, including EPA, are aggregated to preserve confidential business information. EPA uses these data to develop its model CAFOs and to extrapolate CAFO level costs to all operations nationwide. A discussion of the Census data used for this analysis is provided in Section 4 of this report; more detailed information is provided in the *Development Document.*

The 1997 ARMS data, compiled by NASS and the Economic Research Service (ERS), provide complete financial accounting data for U.S. farms for each of the major commodity sectors affected by the proposed CAFO regulations. These data are used to depict farm financial conditions to evaluate regulatory impacts. Data for representative farms were obtained by ERS through special tabulations of the ARMS data, conducted by ERS, that differentiate the financial conditions among operations by commodity sector, facility size (number of animals on site), and major farm producing region. As with the Census data, these data were aggregated by USDA in a manner to preserve both the statistical representativeness and confidentiality of the respondent survey data. Section 4 discusses the ARMS data in more detail.

ES.2.2 Methodology

EPA estimates the economic impacts of the proposed CAFO regulations using a representative farm approach. A representative farm approach is consistent with past research conducted by USDA and many land grant universities to assess a wide range of policy issues, including environmental legislation pertaining to animal agriculture. This approach provides a means to assess average impacts across numerous facilities by grouping facilities into broader categories to account for differences among operations.

EPA developed two sets of models for determining economic impacts at animal confinement operations–cost models and financial models. EPA evaluated compliance costs based on more than 170 farm level cost models that were developed to depict conditions at and to evaluate compliance costs for select representative CAFOs. EPA's cost models are differentiated by commodity sector, farm production region, facility size, and land availability for application of manure. EPA's cost models provide the estimated compliance costs that are compared to

corresponding financial models that characterize financial conditions across different types of operations. (Similar to the cost models, the financial models are also differentiated by sector, facility size, and production region.) Economic impacts under a post-regulatory scenario are approximated by extrapolating the average impacts for a given model CAFO across the larger number of operations that share similar production characteristics and are identified by that CAFO model.

For this analysis, EPA evaluates the economic achievability of the proposed regulatory options at existing animal feeding operations based on changes in representative financial conditions across three criteria. These criteria are: a comparison of incremental costs to total revenue (sales test), projected post-compliance cash flow over a 10-year period, and an assessment of an operation's debt-to-asset ratio under a post-compliance scenario. To evaluate economic impacts to CAFOs in some sectors, impacts are evaluated two ways—assuming that a portion of the costs may be passed on from the CAFO to the consumer and assuming that no costs passthrough so that all costs are absorbed by the CAFO.

Additional information on how EPA developed the cost models is provided in the *Development Document*. Section 4 of this report discusses how EPA developed the financial models and addresses additional methodological issues.

ES.3 REGULATED COMMUNITY

The animal sectors covered in this analysis include the cattle, veal, heifer, dairy, hog, broiler, egg layer, and turkey sectors. Not all confinement operations (or animal feeding operations, AFOs) in these sectors may be CAFOs and thus subject to the proposed regulations. Table ES-1 presents the estimated number of operations that would be defined as a CAFO under each of the co-proposed alternatives, as well as other regulatory scenarios considered by EPA. The two co-proposed alternatives include the "*two-tier structure*" that would define as CAFOs all AFOs with more than 500 AU and the "*three-tier structure*" that would define as CAFOs all AFOs with more than 1,000 AU and any operation with more than 300 AU, if they meet certain "risk-based" conditions, as defined in the preamble (also summarized in Section 3 of this report).

EPA estimates that both proposed alternative structures would regulate about 12,660 operations with more than 1,000 AU, accounting for operations with more than a single animal type. The two-tier structure would also regulate an additional 12,880 operations with between 500 and 1,000 AU, for a total of 25,540 operations. Under the three-tier structure, an estimated 39,330 operations would be subject to the proposed regulations (10 percent of all AFOs), estimated as the total number of animal confinement operations with more than 300 AU. See Table ES-1. Of these, EPA estimates that a total of 31,930 AFOs would be defined as CAFOs (9 percent of all AFOs) and would need to obtain a permit (Table ES-1), while an estimated 7,400 operations would certify that they do not need to obtain a permit.

Table ES-1. Number of Potential Operations *Defined* as CAFOs by Select Regulatory Alternative, 1997

Sector/Size Category	"Two-Tier"						"Three-Tier" >300 AU	
	>300 AU	>500 AU	>750 AU	>300 AU	>500 AU	>750 AU		
	(# operations)			(% total)			(#)	(% total)
Cattle	4,080	3,080	2,480	4%	3%	2%	3,210	3%
Veal	210	90	40	25%	10%	4%	140	16%
Heifers	1,050	800	420	84%	64%	34%	980	78%
Dairy	7,140	3,760	2,260	6%	3%	2%	6,480	6%
Hogs: GF [a/]	4,920	2,690	2,300	9%	5%	4%	2,650	5%
Hogs: FF [a/]	9,450	5,860	3,460	15%	9%	5%	5,700	9%
Broilers	14,140	9,780	7,780	41%	28%	22%	13,740	39%
Layers: wet [b/]	360	360	210	12%	12%	7%	360	12%
Layers: dry [b/]	1,690	1,280	1,250	2%	2%	2%	1,650	2%
Turkeys	2,100	1,280	740	15%	9%	5%	2,060	15%
Total [c/]	**39,320**	**25,540**	**19,100**	**10.5%**	**6.8%**	**5.1%**	**31,930**	**8.5%**

Source: See Section 2, Table 2-3.
[a/]"Hogs: FF" are farrow-finish (includes nursery and breeder pigs); "Hogs: GF" are grow-finish only.
[b/]"Layers: wet" are operations with liquid manure systems. "Layers: dry" are operations with dry systems.
[c/]"Total" eliminates double counting of operations with mixed animal types.

In addition to being defined as CAFOs, AFOs can be designated as CAFOs, even if they have less than 500 AU (two-tier structure) or 300 AU (three-tier structure). EPA estimates that designation may bring an additional 50 operations under the proposed two-tier structure (500 AU threshold) and 10 operations under the proposed three-tier structure each year nationwide.

The proposed regulations may also affect businesses that contract out the raising or finishing production phase to a CAFO but exercise "substantial operational control" over the CAFO (described in Section 3 of this report). EPA estimates that 94 meat packing plants that slaughter hogs and 270 poultry processing facilities may be subject to the proposed co-permitting requirements. Other types of processing firms, such as further processors, food manufacturers, dairy cooperatives, and renderers, are not expected to be affected by the co-permitting requirements since these operations are further up the marketing chain and do not likely contract with CAFOs to raise animals. Fully vertically integrated companies (e.g., where the packer owns the CAFO) are not expected to require a co-permit since the firm as the owner of the CAFO would require only a single permit.

EPA also expects that crop farmers who receive manure from CAFOs would be affected under one of the two co-proposed options relating to offsite management of manure. EPA's

Development Document documents how EPA estimated the number of potentially affected crop producers. These estimates are presented in Section 5 as part of EPA's overall analysis.

Section 2 of this EA presents more detailed information on the regulated community, including a profile of the various CAFO sectors and meat and poultry processors.

ES.4 ANNUAL INCREMENTAL COSTS

EPA estimates the annual incremental costs of compliance using the capital and recurring costs derived in the *Development Document*. EPA converts these costs to incremental annualized costs, as described in Section 4 of this report. Annualized costs better describe the actual compliance costs that a model CAFO would incur, allowing for the effects of interest, depreciation, and taxes. EPA uses these annualized costs to estimate the total annual compliance costs and to assess the economic impacts of the proposed requirements to regulated CAFOs by taking the annualized costs for each CAFO model and aggregating them on the basis of the number of affected CAFOs represented by each model. Section 4 and Appendix A provide more details on the cost annualization methodology and results.

EPA calculates two types of compliance costs–pre-tax and post-tax. The post-tax costs reflect the fact that a CAFO would be able to depreciate or expense these costs, thus generating a tax savings. Post-tax costs thus are the actual costs the CAFO would face. Pre-tax costs reflect the estimated total social cost of the proposed regulations, including lost tax revenue to governments. Pre-tax dollars are used when comparing estimated costs to monetized benefits that are estimated to accrue under the proposed regulations (see Section 10). In this Executive Summary, EPA presents aggregate incremental costs on a pre-tax basis (and in 1999 dollars). The preamble to this rulemaking also presents all costs on a pre-tax basis. Throughout this report, aggregate costs presented and those that are used to assess financial impacts on CAFOs are presented as post-tax costs and in 1997 dollars, since 1997 is the base year of the analysis.

Table ES-2 summarizes the total annualized 1999 pre-tax compliance costs to CAFOs attributed to the proposed two-tier structure and three-tier structure. The table shows these costs broken out by sector and by broad facility size group. These costs represent the cost of the proposed BAT Option under the ELG and reflect a combination of two options that vary depending on regulated sector. The "BAT Option" refers to EPA's proposal to require nitrogen-based and, where necessary, phosphorus-based land application controls of all livestock and poultry CAFOs (Option 2), with the additional requirement that all cattle and dairy operations must conduct groundwater monitoring and implement controls, if the groundwater beneath the production area has a direct hydrologic connection to surface water (Option 3 BAT), and with the additional requirement that all hog, veal, and poultry CAFOs must also achieve zero discharge from the animal production area with no exception for storm events (Option 5 BAT).

Under the two-tier structure and the proposed BAT Option, EPA estimates that the incremental annualized compliance cost to CAFO operators would be approximately $831 million annually (Table ES-2). Under the three-tier structure and proposed BAT option, EPA estimates that the total cost to CAFO operators would be $930 million annually (Table ES-2). Estimated total annualized costs for the three-tier structure include the cost to permitted CAFOs as well as the estimated cost to operations to certify to the permit authority that they do not meet any of the conditions and are thus are not required to obtain a permit. EPA estimates certification costs at about $80 million annually.

Estimated total annualized costs shown in Table ES-2 include costs to animal confinement operations that may be designated as CAFOs. Total annualized cost to designated facilities is estimated at about $5 million or less than $1 million annually, depending on tier structure. More information on these costs and how they are calculated is provided in Section 5.

Estimated costs in Table ES-2 also include costs to offsite recipients of manure. EPA is proposing that offsite recipients of CAFO manure certify that manure will be land applied in accordance with proper agriculture practices. EPA estimates the annualized cost of this requirement to offsite recipients to be $9.6 to $11.3 million across the co-proposed alternatives. This analysis is provided in the *Development Document*. See Section 5 for more details.

Table ES-2 Annual Pre-tax Cost of Co-Proposed Two-Tier and Three-Tier Structure, $1999

Sector	All Scenarios >1000 AU	Two-Tier Structure (500 AU)			Three-Tier Structure (Scenario 3)		
		500 - 1000 AU	<500 AU	Total	300 - 1000 AU	<300 AU	Total
	($1999, millions, pre-tax)						
Regulated CAFOs							
Beef	$191.5	$24.7	$0.1	$216.4	$36.2	$0.0	$227.7
Veal	$0.03	$0.3	NA	$0.3	$0.8	$0.0	$0.8
Heifer	$3.7	$7.9	NA	$11.6	$10.7	$0.0	$14.4
Dairy	$108.6	$65.4	$3.6	$177.6	$115.3	$0.7	$224.6
Hog	$225.5	$67.0	$1.5	$294.0	$80.4	$0.2	$306.1
Broiler	$55.4	$41.6	$0.1	$97.1	$61.2	$0.0	$116.6
Layer	$9.9	$4.3	NA	$14.2	$5.4	$0.0	$15.3
Turkey	$10.4	$9.2	NA	$19.6	$14.5	$0.0	$24.9
Subtotal	**$605.0**	**$220.2**	**$5.4**	**$830.7**	**$324.5**	**$0.8**	**$930.4**
Other Farming Operations							
Offsite Recipients	**NA**	**NA**	**NA**	**$9.6**	**NA**	**NA**	**$11.3**
TOTAL	**NA**	**NA**	**NA**	**$840.3**	**NA**	**NA**	**$941.7**

Source: USEPA. See Section 5.

Table ES-3 summarizes the total annualized (pre-tax, $1999) costs of alternative technology options for each NPDES scenario and ELG technology basis considered by EPA. As shown in the table, the total estimated costs across these options range from $355 million (Option 1/Scenario 1) to $1.7 billion annually (Option 5, applicable to all the animal sectors, and Scenario 4b). By scenario, this reflects the fact that fewer CAFOs would be affected under Scenario 1 (a total of about 16,400 operations) as compared to Scenario 4b (about 39,300 operations affected). EPA's estimate of the number of CAFOs and corresponding compliance costs does not adjust for operations with mixed animal types and may be overstated. By technology option, with the exception of Options 1 and 4, costs are evaluated incremental to Option 2 (see Table ES-3). Compared to Option 2, Option 5 costs are greatest.

Table ES-3. Annualized Pre-tax Costs for the Alternative NPDES Scenarios ($1999, million)

Option/ Scenario	Scenario 4a "Two-Tier"	Scenario 2/3 "Three-Tier"	Scenario 1	Scenario 5 >750 AU	Scenario 4b >300 AU
# CAFOs	**25,540**	**31,930**	**16,420**	**19,100**	**39,320**
Option 1	$432.1	$459.1	$354.6	$384.3	$493.6
Option 2	$548.8	$578.7	$444.4	$484.0	$633.3
Option 3	$746.7	$859.7	$587.0	$649.5	$883.6
Option 4	$903.9	$1,087.1	$707.0	$768.0	$1,121.2
Option 5	$1,515.9	$1,629.6	$1,340.9	$1,390.4	$1,671.3
Option 6	$621.6	$706.6	$501.5	$541.3	$706.6
Option 7	$671.3	$756.6	$542.4	$585.1	$756.6
BAT Option	**$830.7**	**$930.4**	**$680.3**	**$720.8**	**$979.6**

Source: See Section 5.

ES.5 ECONOMIC IMPACTS

ES.5.1 CAFO Impacts

EPA uses the financial criteria described previously to divide the impacts of the proposed regulations into three impact categories: affordable, moderate, and financial stress. EPA does not consider impacts under the affordable or moderate categories to result in closure of the CAFO as a result of compliance. Impacts under the stress category, however, may result in CAFOs being vulnerable to closure post-compliance, taking other factors into consideration. More information on these criteria and how they are used to determine economic achievability is provided in Section 4.

Table ES-4 presents the estimated CAFO level impacts in terms of the number of operations that are estimated to incur affordable, moderate, or stress impacts for each of the co-proposed alternatives by sector. Based on results shown in Table ES-4, EPA proposes that the regulatory alternatives are economically achievable for all representative model CAFOs in the veal, turkey and egg laying sectors. The proposed requirements under the two-tier structure are also expected to be economically achievable by all affected heifer operations. Furthermore, although operations across most sectors may experience moderate impacts, EPA does not expect moderate financial impacts to result in closure and considers this level of impact to be economically achievable.

In the beef cattle, heifer, dairy, hog and broiler sectors, however, EPA's analysis indicates that the proposed regulations will cause some operations to experience financial stress, assuming no cost passthrough. These operations may be vulnerable to closure by complying with the proposed regulations. Across all sectors, an estimated 1,890 operations would experience financial stress under the two-tier structure and an estimated 2,410 operations would experience stress under the three-tier structure. For both tier structures, EPA estimates that the percentage of operations that would experience impacts under the stress category represent 7 percent of all affected CAFOs or 8 percent of all affected operations in the sectors where impacts are estimated to cause financial stress (cattle, dairy, hog, and broiler sectors).

Table ES-4 shows results for the two-tier structure at the 500 AU threshold. By sector, EPA estimates that 1,420 hog operations (17 percent of affected hog CAFOs), 320 dairies (9 percent of operations), 150 broiler operations (2 percent), and 10 beef operations (less than one percent) would experience financial stress. The broiler and hog operations with these impacts have more than 1,000 AU on-site (i.e., no operations with between 500 and 1,000 AU fall in the stress category). The dairy and cattle operations with stress impacts are those that have a ground water link to surface water.

Table ES-4 also presents results for the three-tier structure. By sector, EPA estimates that 1,420 hog operations (17 percent of affected hog CAFOs under that alternative), 610 dairies (9 percent of operations), 330 broiler operations (2 percent), and 50 beef and heifer operations (1 percent) will experience financial stress. Hog operations with stress impacts all have more than 1,000 AU. Affected broiler facilities include operations with more than 1,000 AU, as well as operations with less than 1,000 AU. Dairy and cattle operations in the stress category are operations that have a hydrologic link from ground water to surface water. Based on these results, EPA is proposing that the proposed regulations are economically achievable.

In the hog and broiler sectors, EPA also evaluates financial impacts with an assumption of cost passthrough. For the purpose of this analysis, EPA assumes that the hog sector could passthrough 46 percent of compliance costs and the broiler sector could passthrough 35 percent of compliance costs. EPA derives cost passthrough estimates from price elasticities of supply and demand for each sector reported in the academic literature (Section 4). Assuming these levels of cost passthrough, the magnitude of the estimated impacts decreases to the affordable or moderate

impact category. Even in light of the uncertainty of cost passthrough (both in terms of whether the operations are able to pass cost increases up the marketing chain and the amount of any cost passthrough), EPA proposes that the proposed regulations will be economically achievable to all hog and broiler operations. Although EPA's analysis does not evaluate impacts assuming cost passthrough in other sectors, EPA expects that long-run market and structural adjustment by producers will diminish the estimated impacts in all sectors.

Table ES-4. Number of CAFOs Affected under the Co-Proposed Alternatives (Zero Cost Passthrough)

Sector	Two-Tier Structure (500 AU Threshold)				Three-Tier Structure (Scenario 3)			
	No. of CAFOs	Aff.	Mod.	Stress	No. of CAFOs	Aff.	Mod.	Stress
		(number)				(number)		
Fed Cattle	3,080	2,830	240	10	3,210	2,540	650	20
Veal	90	90	0	0	140	140	0	0
Heifer	800	680	120	0	980	800	150	30
Dairy	3,760	3,240	200	320	6,480	5,300	560	610
Hogs	8,550	6,920	210	1,420	8,360	6,720	220	1,420
Broilers	9,780	1,960	7,670	150	13,740	1,850	11,560	330
Layers - Wet	360	360	0	0	360	360	0	0
Layers - Dry	1,280	1,280	0	0	1,660	1,660	0	0
Turkeys	1,280	1,230	50	0	2,060	1,950	110	0
Total	**28,970**	**18,580**	**8,490**	**1,890**	**37,000**	**21,300**	**13,250**	**2,410**

Source: USEPA. See Section 5.

ES.5.2 Processor Impacts

EPA did not conduct a detailed estimate of the costs and impacts that would accrue to individual co-permittees due to lack of data and market information. However, EPA believes that the framework used to estimate costs to CAFO provides a means to evaluate the possible upper bound of costs that could accrue to potential co-permittees, based on the potential share of (pre-tax) costs that may be passed on from the CAFO.

Using this approach, the potential magnitude of costs to co-permittees is derived from the amount of cost passthrough assumed in the CAFO level analysis. Based on the results of this analysis, EPA estimates that the range of potential annual costs to hog processors is $135 million

(partial cost passthrough, $1999) to $306 million (full cost passthrough). EPA estimates that the range of potential annual costs to broiler processors as $34 million (partial cost passthrough) to $117 million (full cost passthrough).

To assess the magnitude of impacts that could accrue to processors using this approach, EPA compares the passed through compliance costs both to aggregate processor production costs and to revenues (a sales test). The results of this analysis indicate that, even under full cost passthrough, incremental cost changes to processors in these industries are estimated at less than two percent of total costs and less than one percent of total revenues. Additional information is provided in Section 5.

ES.5.3 Market Impacts

EPA's market analysis evaluates the effects of the proposed regulations on commodity prices and quantities at the national level. EPA expects that predicted changes in animal production may raise producer prices, as the market adjusts to the proposed regulatory requirements. For most sectors, EPA estimates that producer price changes will rise by less than one percent compared to the pre-regulation baseline price. At the retail level, EPA estimates that poultry and red meat prices will rise about one cent per pound. EPA also estimates that egg prices will rise by about one cent per dozen and that milk prices will rise by about one cent per gallon.

This analysis also presents EPA's estimate of employment changes associated with the proposed regulations. Within the farming sector, EPA predicts that the proposed CAFO regulations will result in employment losses ranging from 2,700 to 3,000 jobs, depending on tier structure. This estimated reduction compares to an estimated total farm level employment of over one million jobs in these sectors nationwide. Estimated employment and job losses in the agricultural sector include CAFO owner-operators and employed family members, as well as hired farm labor.

ES.6 OTHER REGULATORY REQUIREMENTS

ES.6.1 Small Business Analysis

Table ES-5 shows EPA's estimate of the number of small businesses in the livestock and poultry sectors and the number of small businesses that are expected to be affected by the proposed regulations. Under the two-tier structure, EPA estimates that 10,550 operations that will be subject to the proposed requirements are small businesses. Under the three-tier structure, an estimated 14,630 affected operations are small businesses. Under the two-tier structure, EPA estimates also include an additional 330 designated operations that meet the small business definition, projected over a 10-year time frame (i.e., 33 AFOs designated annually). Under the

three-tier structure, EPA estimates that 100 operations with fewer than 300 AU that meet the small business definition may be designated over a 10-year period (i.e., 10 AFOs designated annually). Additional information is provided in Section 9.

EPA's assessment of the financial impacts of the proposed rule on small entities uses the same approach as that used to evaluate the impact to CAFOs under the proposed regulations (see Section 4). EPA is proposing that the proposed regulations are economically achievable by small businesses in the livestock and poultry sectors. The results of this analysis are presented in Table ES-5. As defined for this analysis, EPA's analysis indicates that the proposed requirements are economically achievable to all affected small businesses in the beef, veal, heifer, dairy, hog, and egg laying sectors ("Affordable" and also "Moderate"). Under the two-tier structure, EPA expects that there are no small CAFO businesses in the turkey sector. Under the three-tier structure, EPA expects that there are an estimated 500 small CAFO businesses that confine turkeys (Table ES-5).

Table ES-5. Results of EPA's Small Business Analysis Under the BAT Option/Two-Tier Structure

Sector	Number of Small CAFOs	Aff.	Mod.	Stress	Number of Small CAFOs	Aff.	Mod.	Stress
		(Number of Operations)				(Number of Operations)		
Fed Cattle	1,390	1,130	250	10	1,490	1,100	380	10
Veal	90	90	0	0	140	140	0	0
Heifer	800	680	120	0	980	800	150	30
Dairy	50	40	10	0	50	40	10	0
Hogs	300	300	0	0	300	300	0	0
Broilers	9,470	1,860	7,460	150	13,410	1,910	11,220	280
Layers	200	200	0	0	590	590	0	0
Turkeys	0	0	0	0	500	460	40	0
TOTAL	**10,550**	**4,300**	**7,840**	**160**	**14,630**	**5,340**	**11,800**	**320**

Source: USEPA. See Section 5.

EPA's analysis indicates that the proposed requirements will not result in financial stress to any affected small businesses in the veal, heifer (two-tier only), hog, dairy, egg laying, and turkey sectors. In the beef, heifer (three-tier only), and broiler sectors, however, EPA's analysis indicates that proposed regulations could result in financial stress to some small CAFO businesses, making these businesses vulnerable to closure. Overall, these operations comprise about 2 percent of all affected small CAFO businesses. For the two-tier structure, EPA estimates that 10 small beef operations and 150 small broiler operations will experience financial stress. For the

three-tier structure, EPA estimates that 40 small beef and heifer operations and 280 small broiler operations will experience financial stress. Small broiler facilities with stress impacts are larger operations with more than 1,000 AU under both tier structures. Small cattle and heifer operations with stress impacts are those that have a ground water link to surface water. This analysis is conducted assuming that no costs are passed through between the CAFO and processor segments of these industries. Based on the results of this analysis, EPA is proposing that the proposed regulations are economically achievable to small businesses in these sectors.

ES.6.2 Cost Benefit Analysis

EPA estimated and compared the costs and benefits attributed to the proposed regulations. The cost and benefit categories that EPA is able to quantify and monetize for the proposed regulations are shown in Table ES-6. Total social costs of the proposed regulations in 1999 dollars range from $847 million to $949 million annually, depending on the co-proposed approach. These costs include compliance costs to industry, costs to recipients of CAFO manure, and administrative costs to States and Federal governments. EPA estimates that the monetized benefits of the proposed regulations range from $146 million to $182 million annually, depending on the co-proposed approach (Table ES-6). Section 10 provides additional information on these analyses.

Table ES-6. Total Annual Social Costs and Monetized Benefits, $1999

Total Social Costs	**"Two-Tier" Structure (500 AU threshold)**	**"Three-Tier" Structure (Scenario 3)**
Industry Compliance Costs (pre-tax):	$830.7 million	$930.4 million
NPDES Permitting Costs:	$6.2 million	$7.7 million
Offsite Recipients of CAFO Manure:	$9.6 million	$11.3 million
Total Social Costs	***$846.5 million***	***$949.4 million***
Monetized Benefits		
Improved surface water quality	$108.5 million	$127.1 million
Reduced shellfish bed closures	$0.2 - 2.4 million	$0.2 - 2.7 million
Reduced fish kills	$0.2 - 0.4 million	$0.2 - 0.4 million
Improved water quality in private wells	$36.6 - 53.9 million	$35.4 - 52.1 million
Total Monetized Benefits	***$145.5 - 165.1 million***	***$163.0 - 182.3 million***

Source: See Section 10.

ES.7 OTHER INFORMATION

This report contains a detailed industry profile of the affected regulated livestock and poultry sectors and meat and poultry processors (Section 2). It also presents a summary of estimated per-animal and per-facility costs by animal sector (Sections 6 through 8 and Appendix A). Additionally, it presents an overview of the cost annualization approach (Appendix A), details on the model used to estimate economic impacts on CAFOs and national level markets (Section 4 and Appendix B), results of sensitivity analyses (Appendix D), and results of cost-effectiveness analyses (Appendix E). See Section 1 for a guide to the contents of this report.

SECTION ONE

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) is revising and updating the two primary regulations that ensure that manure, wastewater, and other process waters generated by concentrated animal feeding operations (CAFOs) do not impair water quality. EPA's proposed regulatory changes affect the existing National Pollutant Discharge Elimination System (NPDES) provisions and the existing effluent limitations guidelines (ELG) for "feedlots." The NPDES provisions define and establish permit requirements for CAFOs and the ELG establish the technology-based effluent discharge standard that is applied to CAFOs. Both of these existing regulations were originally promulgated in the 1970s. EPA is revising the regulations to address changes that have occurred in the animal industry sectors over the last 25 years, to clarify and improve implementation of CAFO requirements, and to improve the environmental protection achieved under these rules. Proposed revisions to the NPDES and ELG regulations are referred to in this report as the proposed CAFO regulations.

This Economic Analysis (EA) summarizes EPA's analysis of the estimated annual compliance costs and the economic impacts that may be incurred by affected operations that are subject to these requirements. It examines in detail EPA's regulatory proposal and several regulatory alternatives that were considered by EPA. The report covers financial impacts to CAFOs, potential impacts on processors of livestock and poultry products, and market and other secondary impacts such as impacts on prices, quantities, trade, employment, and output. It also responds to requirements for small business analyses under the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) and for cost-benefit analyses under Executive Order 12866 and the Unfunded Mandates Reform Act (UMRA).

This section begins with a discussion of the current regulatory framework and, in the course of this discussion, defines and describes animal feeding operations and CAFOs (Section 1.1). The reasons why EPA is revising these regulations are also discussed. Sources of data that are critical to the analyses presented in this EA are then briefly described (Section 1.2) and the section concludes with an outline of the report (Section 1.3).

1.1 EXISTING REGULATORY FRAMEWORK

In 1972, Congress passed the Federal Water Pollution Control Act, also known as the Clean Water Act (CWA), to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." 33 U.S.C. § 1251(a). The CWA establishes a comprehensive program for protecting our nation's waters. Among its core provisions, the CWA prohibits the discharge of pollutants from a point source to waters of the U.S. except those authorized by a NPDES

permit. The CWA also provides for the development of technology-based effluent limitations that are imposed through NPDES permits to control direct discharges of pollutants.

In response to the CWA, EPA established several regulatory programs, of which two pertain to livestock and poultry operations that confine animals (commonly referred to by EPA as "animal feeding operations," or AFOs). These regulations include the requirements for discharge permits for CAFOs under the NDPES program (40 CFR Part 122.23) (see Section 1.1.1) and the ELG for animal feeding operations ("feedlots") (40 CFR Part 412) (see Section 1.1.2).

1.1.1 NPDES Permit Regulation of CAFOs

The NPDES permit program controls pollution from identifiable discharge points or sources (e.g., discharge pipes or ditches). Under the NPDES permit program, all point sources that directly discharge pollutants to waters of the U.S. must apply for a NPDES permit and may only discharge pollutants under the terms of that permit. Such permits must include nationally established effluent discharge limitations. In the absence of national effluent limitations, NPDES permit writers must establish limitations and standards on a case-by-case basis, based on their "best professional judgement (BPJ)." Effluent limitations guidelines and BPJ provide the basis for technology-based effluent limits in NPDES permits.

Under the CWA, CAFOs are defined as point sources of pollution and are thus subject to NPDES permitting requirements (33 U.S.C. § 1362). The existing NPDES provisions that define which operations are CAFOs and that establish permit requirements for CAFOs (40 C.F.R. § 122.23) were promulgated on March 18, 1976 (41 FR 11458).

Before an operation may be defined as a CAFO, it must first meet the definition of an AFO. AFOs are agricultural enterprises where animals are kept and raised in confined situations for a specified time during the year and congregate animals, feed, manure, dead animals, and production operations on a small land area. As defined by federal regulation, AFOs are lots or facilities where animals:

> "...have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12 month period and crops, vegetation forage growth, or post-harvest residues are not sustained in the normal growing period over any portion of the lot or facility." (40 CFR 122.23(b)(1)).

As discussed in more detail in the preamble to the CAFO regulations, this definition is being broadened to include as AFOs all operations that confine animals unless crops or other vegetation are grown at all times over all parts of the lot or facility.

In 1976, EPA issued regulations defining which AFOs met the definition of a CAFO under the NPDES permit program. CAFOs are AFOs that confine a specified number of animals and in

some cases meet specific discharge criteria. The specified number of animals is determined using the concept of an "animal unit" (AU). The term AU is a metric established in the 1970 regulations that attempted to equate the characteristics of the wastes produced by different animal types. For each animal type, EPA's regulations identify the number of animals that is equivalent to one AU.

As defined in the existing regulation (40 CFR 122), one AU is equivalent to:

- 1 slaughter or feeder beef cattle
- 0.7 mature dairy cows
- 2.5 swine weighing more than 55 pounds
- 55 turkeys
- 100 laying hens or broilers (facility with continuous flow watering systems); 30 hens or broilers (facility with liquid manure handling system)
- 0.5 horses
- 10 sheep or lambs
- 5 ducks

As discussed in more detail in the preamble to the CAFO regulations, EPA is proposing to change how an AFO is defined as a CAFO and, therefore, subject to regulation.

The existing NPDES regulation defines AFOs with 1,000 AU or more as CAFOs. These facilities are not CAFOs if they discharge only in the event of a 25-year, 24-hour storm. The regulation also states that AFOs with between 300 and 1000 AU are CAFOs if they meet certain conditions. These conditions include the discharge of pollutants into waters through a ditch, flushing system, or other man-made device. An AFO with between 300 and 1000 AU may also be defined as a CAFO if pollutants are discharged to waters that originate outside of and pass over, across, or through the facility or come in to contact with confined animals. The state agency or other authority that issues NPDES permits may also designate AFOs with fewer that 300 AU as CAFOs, if they are considered to have discharges that could significantly impair surface water.

As discussed in more detail in the preamble to the proposed CAFO regulations, EPA is proposing to revise these criteria for determining when an AFO is a CAFO, as well as other key provisions in the existing regulation, including the exemption under a storm event. Section 3 of

this report provides a brief summary of the recommended changes that are being proposed for the NPDES requirements affecting CAFOs.

All NPDES permits for CAFOs with more than 1,000 AU must include requirements equivalent to or more stringent than the established ELG. As noted above, certain smaller operations can also be defined or designated as CAFOs, but the ELG does not apply to these CAFOs. In these cases, the permit writer must develop technology-based limitations based on BPJ for inclusion in the NPDES permit.

1.1.2 Effluent Limitations Guidelines for Feedlots

The CWA authorizes EPA to establish restrictions on the types and amounts of pollutants discharged from various industrial, commercial, and public sources of wastewater. Effluent guidelines define the type and amount of pollutants an NPDES permitted facility is allowed to discharge. Direct dischargers must comply with effluent limitations guidelines and new source performance standards (NSPS). These limitations and standards are established by regulation for categories of industrial dischargers and are based on the degree of control that can be achieved using various levels of pollution control technology. These guidelines base the discharge (or effluent) amount of the best available technology, or BAT, that is economically achievable.

The existing national effluent limitations guidelines for the feedlots category, including beef, dairy, swine, and poultry subcategories (40 CFR §412), were established on February 14, 1974 (39 FR. 5704). The feedlot ELG allow for no discharge of process wastewater pollutants into the Nation's waters except when chronic or catastrophic storm events cause an overflow from a facility designed, constructed, and operated to hold process-generated wastewater plus runoff from a 25-year, 24-hour storm event. As a result, the current effluent guidelines for feedlots are usually referred to as "zero discharge" requirements. Many feedlots meet the "zero discharge" requirement by containing wet manure in lagoons and by land applying manure. The current ELG are applicable to NPDES permits issued to CAFOs with more than 1,000 AU. Discharge limits for facilities with fewer than 1,000 AU are established using BPJ.

As discussed in more detail in the preamble to the CAFO regulations, EPA is proposing to revise the applicability of the ELG along with other key provisions in the existing regulation. Section 3 of this report provides a brief summary of the recommended changes that are being proposed for the ELG affecting CAFOs.

1.1.3 Industries Affected by the Proposed CAFO Regulations

In this EA, information is organized by sector rather than by subcategory. For example, information is presented on fed cattle, heifer, and veal operations (often referred to as the "cattle" sector), because heifer and veal operations are more similar to beef operations than to dairy

operations. Under the regulation, however, the beef subcategory includes fed cattle and heifers, but veal operations are covered under a separate subcategory. The dairy and swine subcategories are discussed separately. Information on the types of operations in the poultry sector (i.e., broiler, egg layer, and turkey operations) is also presented together, although the chicken and turkey subcategories are distinct in the regulation. The proposed NPDES revisions do affect other types of animal confinement operations, such as operations that raise sheep, lambs, goats, horses, and other miscellaneous animal species. These sectors are not covered in this analysis.

This report focuses on the major livestock and poultry industries affected by the ELG and the NPDES program requirements. By North American Industry Classification System (NAICS)[1] code, these include:

- Cattle feedlots, NAICS 112112 [includes veal] (SIC 0211, beef cattle feedlots).
- Beef cattle ranching and farming, NAICS 112111 (SIC 0241, dairy heifer replacement farms).
- Dairy cattle and milk production, NAICS 11212 (SIC 0241, dairy farms).
- Hog and pig farming, NAICS 11221 (SIC 0213, hogs).
- Broilers and other meat-type chickens, NAICS 11232 (SIC 0251, broiler, fryer, and roaster chickens).
- Turkey production, NAICS 11233 (SIC 0253, turkey and turkey eggs).
- Chicken egg production, NAICS 11231 (SIC 0252, chicken eggs).

USDA reports that in 1997 there were 1.1 million livestock and poultry operations in the United States, corresponding to these affected industry sectors. This number includes both confinement and non-confinement operations (i.e., grazing and range fed) production as well as commercial and noncommercial operations. Of these operations, EPA estimates that there are about 376,000 AFOs that raise or house animals in confinement, as defined by the existing regulations. Table 1-1 summarizes the estimated total number of AFOs of all sizes in each of the four major livestock categories in 1997. EPA estimates that only a small subset of these AFOs would be regulated as CAFOs, since most would not meet the size definitions or other criteria. More information is provided in Section 2 of this report.

[1]NAICS recently replaced the SIC (Standard Industrial Classification) system.

Table 1-1. Number of Animal Feeding Operations (1997)

Sector	Total AFOs
Beef operations, including both cattle, veal, and heifer operations	108,180
Dairy operations (milk production operations only)	116,870
Hog operations, including both "farrow-finish" and "grow-finish" operations [a/]	117,880
Poultry operations, including broilers, layers (both wet and dry operations) and turkeys [b/]	123,750
Sum Total	466,670
Total AFOs [c/]	**375,700**

Source: USEPA. See Section 2.

[a/] Grow-finish operations finish more mature pigs while farrow-finish operations handle all stages of production from breeding to finishing.

[b/] Utilize either liquid or dry manure handling systems present at the facility.

[c/] "Total AFOs" eliminates double counting of operations with more than a single animal type (see Section 2).

1.1.4 Reasons Why EPA is Revising the Existing CAFO Regulations

EPA is proposing to revise the existing regulations to meet the following goals:

- Address continued and persistent reports of discharge and runoff of manure and manure nutrients from livestock and poultry operations.
- Update the existing regulations to reflect major structural changes in these industries over the last few decades.
- Improve the effectiveness of the existing regulations at protecting or restoring water quality.

Each of these stated goals is briefly discussed below and in other sections of this report (Sections 9 and 10). More detail is presented in Section IV and V of the preamble to this proposed rulemaking. These reasons are summarized briefly below:

First, despite more than twenty years of regulation, there are persistent reports of discharge and runoff of manure and manure nutrients from confined animal operations. The proposed revisions to the existing ELG and NPDES regulations for CAFOs are expected to mitigate future water quality impairment and the associated human health and ecological risks by reducing pollutant discharges from the animal production industry.

Evidence that manure discharge and runoff is resulting in water quality impairment is presented in the *National Water Quality Inventory: 1998 Report to Congress* (USEPA, 2000h). In this report, the agriculture sector is identified as the leading cause of water quality impairments

in the nation's rivers, streams, lakes, ponds, and reservoirs and also a major contributor to identified water quality impairments in estuaries. The animal production industry is associated with impairments caused by nutrients, pathogens, oxygen-depleting substances, and solids (siltation). Animal production facilities also may contribute metals, pesticides, priority toxic organic chemicals, and oil and grease and can contribute to the growth of noxious aquatic plants due to the discharge of excess nutrients. Other documents that support this rulemaking, including EPA's *Environmental and Economic Benefit Analysis of the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations* ("Benefits Analysis" [USEPA, 2000d]) and EPA's *Environmental Assessment of the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations* ("Environmental Assessment" [USEPA, 2000b]), provide additional information about existing water quality impairments associated with animal production operations.

Second, the existing regulations are being updated to reflect structural changes in these industries over the last few decades. Periodic review and revision of existing regulations is envisioned in the CWA. More animals are produced annually at fewer AFOs, leading to a increasing share of animal production at larger operations that concentrate more animals (and thus manure and wastewater) at a single location. This trend has coincided with increased reports of large-scale discharges from these facilities. Furthermore, farming in traditional rural, agricultural areas where the manure nutrients generated could be readily incorporated as a fertilizer in crop production is giving way to animal production operations located close to slaughtering and processing plants and near end-consumer markets, where land is often unavailable for land application of manure and wastewater. These geographic shifts in farming operations may be shifting the flow of manure nutrients away from areas where these nutrients can be effectively used to areas where they cannot be easily absorbed. Section 2 of this EA discusses these industry changes in more detail.

Finally, EPA believes it must improve the effectiveness of the regulations, first, by making the regulations simpler and easier to understand and implement, second, by clarifying the conditions under which an AFO is a CAFO and thus subject to NDPES regulatory requirements, and third, by removing provisions that are no longer appropriate. Section 3 of this EA discusses these changes, as well as the changes proposed to address industry trends and the need for increased control of manure nutrients and discharges from CAFOs.

1.2 OVERVIEW OF SOURCES OF DATA

EPA is undertaking an expedited approach to this rulemaking effort and did not conduct an industry-wide survey of all CAFOs using a CWA Section 308 questionnaire. Rather, EPA is relying on existing data sources and expertise provided by numerous government agencies, state agricultural extension services, land grant universities, and information from industry trade associations and agricultural professionals. Major data sources are discussed in detail where they

are used to conduct the analyses presented in this report. This section provides an overview of these sources and their importance to the economic analysis of the proposed CAFO regulations.

The key sources of data to conduct analyses presented in this EA include those used to estimate compliance costs and economic impacts to the regulated community. The data that EPA uses to estimate compliance costs are discussed in detail in EPA's *Development Document for the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations* (referred to as the "Development Document"[USEPA, 2000a]). EPA's compliance cost estimates are based on information compiled through EPA site visits to over 100 animal confinement operations and on information developed by various agencies within the U.S. Department of Agriculture (USDA), including the National Agricultural Statistics Service (NASS), the Animal and Plant Health Inspection Service (APHIS), the Natural Resources Conservation Service (NRCS), and the Economic Research Service (ERS).

Two major sources of primary USDA data are instrumental to the economic analysis. These include USDA's 1997 Census of Agriculture and data from the 1997 Agricultural Management Study (ARMS).

The 1997 Census of Agriculture is conducted by the National Agricultural Statistical Service (NASS) and provides information on the number of feedlots, their geographic distributions, the amount of cropland available to land apply animal manure generated from animal confinement operations, and other information. These data are compiled by NASS, with the assistance of personnel at USDA's Natural Resources Conservation Service (NRCS) who developed a methodology to identify information specific to animal confinement operations. All Census data provided to other government agencies, including EPA, are aggregated to preserve confidential business information. EPA uses these data to develop its model CAFOs and to extrapolate CAFO level costs to all operations nationwide. A discussion of the Census data used for this analysis is provided in Section 4 of this report; more detailed information is provided in the *Development Document* (USEPA, 2000a).

The 1997 ARMS data, compiled by NASS and ERS, provide complete financial accounting data for U.S. farms for each of the major commodity sectors affected by the proposed CAFO regulations. These data are used to depict farm financial conditions to evaluate regulatory impacts. Data for representative farms were obtained by ERS through special tabulations of the ARMS data, conducted by ERS, that differentiate the financial conditions among operations by commodity sector, facility size (number of animals on site), and major farm producing region. As with the Census data, these data were aggregated by USDA in a manner to preserve both the statistical representativeness and confidentiality of the respondent survey data. Section 4 discusses the ARMS data in more detail.

Industry and the associated trade groups also provided information for the economic and financial analyses. In particular, the National Cattlemen's Beef Association (NCBA) conducted a

survey of their membership to obtain financial statistics specific to cattle feeding operations. Industry data were also obtained from the National Milk Producers Federation (NMPF) and the National Pork Producers Council (NPPC). Much of the information on food processors is from the Census of Manufactures data series. Section 4 and other sections of this report provide more information on how these and other data sources contribute to EPA's analyses.

Other key sources of data and information to conduct analyses presented in this EA include information from university experts and the published agricultural literature, as well as information from the Natural Resources Defense Council, Clean Water Network, state cooperatives and extension services, and state and EPA regional representatives and information from previous EPA studies of animal feeding operations. Section 11 of this EA presents the bibliographic citation of all materials used in this EA. Additional citations on data used for this analysis are provided in the *Development Document* (USEPA, 2000a).

1.3 ORGANIZATION OF THE REPORT

This report is organized to allow those interested in the impacts on a specific industry sector to find information easily. The sections of the report are as follows:

- Section 2 provides an industry profile of the animal feeding industries, including livestock and poultry farms and food processors.

- Section 3 describes the proposed CAFO regulations, including a description of the various technology options considered for the ELG and regulatory scenarios considered for the NDPES regulation.

- Section 4 presents the methodology that EPA is using to estimate compliance costs and economic impacts and reviews the data used for this analyses in more detail.

- Section 5 presents a summary of the estimated national, annual costs and the economic impacts to regulated facilities of the proposed CAFO regulations.

- Sections 6, 7, and 8 provide additional industry profile data and economic analyses of the regulatory impacts to the poultry, hog, and cattle and dairy sectors.

- Section 9 presents the results of EPA's Initial Regulatory Flexibility Analysis and describes the possible impacts on small businesses.

- Section 10 presents a discussion of the regulatory costs and benefits pursuant to Executive Order 12866 and UMRA.

- Section 11 presents the references used throughout the report and its appendices.

- Appendix A presents a description of EPA's method to annualize costs and more detailed information on the annualized costs used as inputs to EPA's CAFO level economic analysis.

- Appendix B presents background information on EPA's market level model to estimate supply and quantity changes, as well as changes in national level economic output and total employment (direct and indirect).

- Appendix C presents a summary of a literature review of the price elasticity of supply and demand for the livestock and poultry sectors.

- Appendix D presents the results of EPA's sensitivity analysis.

- Appendix E presents EPA's analysis of the cost-effectiveness of the proposed regulatory revisions, in terms of pollutant removal effectiveness for nutrients and other priority pollutants, and background information on the methods EPA used for this analysis.

This report does not include a detailed presentation of the economic benefits that are expected to accrue as a result of the proposed regulations. This analysis is provided in the *Benefits Analysis* (USEPA, 2000d) that supports this rulemaking. The *Development Document* (USEPA, 2000a) provides more detailed information on EPA's farm level costs estimated for this analysis.

SECTION TWO

PROFILE OF THE LIVESTOCK AND POULTRY INDUSTRIES

The proposed revision of the CAFO regulations would affect operations that confine cattle and calves, milking cows, hogs and pigs, and poultry, including broilers, egg laying chickens, and turkeys.[1] Businesses that contract out the raising or finishing phase of production might also be affected by the proposed co-permitting requirements in the proposed CAFO regulations. Affected businesses may include meat packing plants and poultry processing firms.

The purpose of this industry profile is to provide an overview of the livestock and poultry industries in terms of their current activities, structure, and key trends since the promulgation of the original CAFO regulations in the 1970s. Section 2.1 reviews the trends that have influenced the perceived need to revise the existing regulations. Section 2.2 profiles livestock and poultry producers at the farm production level. Key topics include the number and size of potentially affected operations, characterization of the financial performance of the farming sector, and an overview of the amount of manure and nutrients generated. Section 2.3 describes the industrial organization and structure of these industries, focusing on the role of vertical integration and coordination between the animal feeding and the processing sectors. Section 2.4 profiles livestock and poultry processors within the manufacturing segments of these industries. Key topics include the number and types of potentially affected operations and an overview of the financial characteristics of these sectors. Finally, Section 2.5 further characterizes these industries in terms of their economic output, overall supply and demand conditions, and industry employment.

This overview covers all of the livestock and poultry sectors together. Other sections of this report provide a detailed profile of each production sector, including an overview of the poultry sectors (Section 6), the hog sector (Section 7), and the beef and dairy sectors (Section 8). The information in this Section 2 profile is used to provide a baseline description of these sectors and to aid in understanding the methodology used to analyze the potential economic impacts associated with the proposed CAFO regulations.

2.1 RECENT TRENDS IN THE LIVESTOCK AND POULTRY INDUSTRIES

Major structural changes in the livestock and poultry industries have occurred since the 1970s, when the regulatory controls for CAFOs were first instituted. These changes are discussed in more detail in the sections that follow and include, but are not limited to:

[1]Other types of animal confinement operations are not covered in this report, including operations that confine sheep, lambs, goats, horses, and other nontraditional animal species.

- Increased number of animals produced annually.

- Fewer, larger, more industrialized operations that concentrate more animals and also more manure in a single location.

- Geographical shifts in where animals are raised.

- Increased coordination between animal feeding operations and processing firms.

The continued trend toward fewer but larger operations, coupled with greater emphasis on more intensive production methods and specialization, is concentrating more manure nutrients and other animal waste constituents within some geographic areas. This trend has coincided with increased reports of accidental large-scale spills from these facilities and has fueled concern that manure runoff is contributing to the overnutrification of certain vulnerable U.S. waterways. Additional information on water quality impairment and risks associated with manure discharge and runoff is provided in the *Environmental Assessment* that supports this proposed rulemaking (USEPA, 2000b).

2.1.1 Increased Livestock and Poultry Production

Since the 1970s, when the existing regulations for CAFOs were first instituted, total consumer demand for meat, eggs, milk, and dairy products has continued to increase. To meet this demand, U.S. livestock and poultry production has risen sharply, resulting in an increase in the number of animals produced and the amount of manure and wastewater generated annually.

Increased sales from U.S. farms is particularly dramatic in the poultry sectors, as reported in the Census of Agriculture (various years). In 1997, turkey sales totaled 299 million birds (USDA/NASS, 1999a). This compares to 1978 when 141 million turkeys were sold for slaughter (USDC, 1980). Broiler sales totaled 6.4 billion in 1997, up from 2.5 billion broilers sold in 1974 (USDC, 1976; USDA/NASS, 1999a). The existing CAFO regulations effectively do not cover broiler operations due to the exclusion of operations that use dry manure management systems, which comprise the majority of operations (USEPA, 2000a). Red meat production also rose during the 1974-1997 period. The number of hogs and pigs sold in 1974 totaled 79.9 million, compared to 142.6 million by 1997 (USDC, 1976; USDA/NASS, 1999a). Sales data of fed cattle (i.e., USDA's data category on "cattle fattened on grain and concentrates") for 1975 show that 20.5 million head were marketed. By 1997, fed cattle marketings totaled 22.8 million head (USDA/NASS, 1999a). The total number of egg laying hens rose from 0.3 million birds in 1974 to 0.4 million birds in 1997. The number of dairy cows on U.S. farms, however, dropped from more than 10.7 million cows to 9.1 million cows over the same period (USDA/NASS, 1999a). (Data that show increases in farm level production are also presented in Section 2.2.3).

Not only are more animals produced and sold each year, but the animals are larger in size. Efficiency gains have raised animal yields in terms of higher average slaughter weight. Likewise, production efficiency gains at egg laying and dairy operations have resulted in higher per-animal yields of eggs and milk. The average number of eggs produced per egg laying hen was 218 eggs per bird in 1970 compared to 255 eggs per bird in 1997 (USDA/ERS, 1996c; USDA/NASS, 1999a). Average annual milk production rose from under 10,000 pounds per cow in 1970 to more than 16,000 pounds per cow in 1997 (NMPF, 1999). In the case of milk production, these efficiency gains have allowed farmers to maintain or increase production levels with fewer animals. Although animal inventories at dairy farms may be lower, however, this may not necessarily translate to reduced manure volumes generated because higher yields are largely attributable to improved and often more intensive feeding strategies that may exceed the animal's ability for uptake. This excess is not always incorporated (i.e., digested) by the animal and may be excreted (Smith, 1998).

2.1.2 Fewer, Larger, and More Industrialized Livestock and Poultry Operations

Recent trends across the U.S. livestock and poultry sectors are marked by a decline in the number of operations due to ongoing consolidation in the animal production industry (MacDonald, et al., 2000; McBride, 1997). Increasingly, larger, more industrialized, and highly specialized operations now account for a greater share of all animal production. This concentrates more animals, and thus more manure and wastewater, in a single location, and raises the potential for significant environmental damages unless manure is properly handled.

USDA reports that there were 1.1 million livestock and poultry farms in the United States in 1997, about 50 percent fewer than the 2.3 million farms reported in 1974 (USDA/NASS, 1999a; USDC, 1976). (See Table 2-1.) In general, farms are closing, especially smaller operations that cannot compete with large-scale, highly specialized, often lower cost producers. USDA reports that in a normal year, 3 percent to 4 percent of all farm operators discontinue farming for a variety of financial and personal reasons (Stam, et al., 1991).[2] Of these, USDA has estimated that about 2 percent to 3 percent of farm exits are "involuntary" (i.e., due to bankruptcies, foreclosures, debt repayment problems, or inadequate farm incomes (Bentley, et al., 1989). Involuntary farm exits caused by financial stress vary considerably by farm size and production region, and commodity produced (Bentley, et al., 1989).

Livestock and poultry production are increasingly dominated by larger operations, although these operations constitute a small share of the total number of operations. As shown in Figure 2-1, based on USDA data that are grouped by farm typology described in Table 2-2, about

[2]The mid-1980s, however, were a period of peak farm financial stress and were associated with a farm exit rate of 5-6 percent per year (Stam, et al., 1991).

Table 2-1. Number of Livestock and Poultry Operations (Year-end Animal Inventory), 1969-1997

Year	All Beef	Fed Cattle	Dairy	Hogs	Layers Pullets	Broilers	Turkeys	Sum Total [a/]
Total Number of Operations (based on year-end inventory)								
1969	1,076,200	NA	568,200	686,100	471,300	33,800	NA	2,835,500
1974	1,024,900	NA	403,800	470,300	316,200	34,300	12,800	2,262,300
1978	954,400	NA	312,100	445,100	240,900	31,700	18,900	2,003,100
1982	957,700	240,000	277,800	329,800	215,800	30,100	25,400	1,836,600
1987	841,800	190,000	202,100	243,400	144,400	27,600	19,000	1,478,400
1992	803,200	147,200	155,300	191,300	88,200	23,900	13,800	1,275,900
1997	804,600	110,600	116,900	109,800	72,600	23,900	12,100	1,139,900
%69-97 [b/]	**-25%**	**NA**	**-79%**	**-84%**	**-85%**	**-29%**	**NA**	**-60%**
Average Number of Animals per Operation (based on year-end inventory)								
1969	NA	NA	20	81	787	71,987	NA	NA
1974	40	NA	26	97	1,100	73,300	2,100	NA
1978	36	NA	33	130	1,500	96,500	1,900	NA
1982	36	115	39	168	1,700	116,800	1,800	NA
1987	38	146	50	215	2,600	157,800	3,900	NA
1992	41	179	61	301	4,000	226,700	6,400	NA
1997	42	247	78	558	5,100	281,700	8,600	NA
%69-97 [b/]	**5%**	**NA**	**290%**	**588%**	**548%**	**291%**	**NA**	**NA**

NA=Not available

[a/]Sum Total" is across all operations shown (less 'Fed Cattle") and may double count some operations with more than a single animal type. The average number of animals per operation is calculated from corresponding data on the number of animals on site at year-end (inventory). The number of beef operations in 1969 is not available and is estimated from the total number of cattle and calf operations less dairies and estimated number of steer and heifer operations. Numbers include both grazing and confinement operations, as well as commercial and noncommercial operations.

[b/]Percentage change from the 1969 to the 1997 Census, except for All Beef, which is calculated from 1974 to 1997.

Source: USDA/NASS, 1999a, 1997 Census of Agriculture (Table 1: Historical Highlights). Data for turkeys and fed cattle ("cattle fattened on grains and concentrates") are from USDA/NASS (1999a) and USDC, Census of Agriculture (Census years 1969, 1974, 1978, 1982, 1987, and 1992).

10 percent of all farms—both crop and livestock operations with more than $250,000 in annual sales— accounted for about 60 percent of the total value of production in 1997 (USDA/ERS, 2000h). Economies of size account for much of the growth in farm size (MacDonald, et al., 2000; McBride, 1997). At the same time, cost and efficiency considerations are pushing farms to become more specialized and intensive. Steep gains in production efficiency have allowed farmers to produce more with fewer animals because of higher per-animal yields and quicker turnover of animals between farm production and consumer market. As a result, annual production and sales have increased, even though the number of animals on farms at any one time has declined (i.e., an increase in the number of marketing cycles over the course of the year allows operators to maintain production levels with fewer animals at any given time, although the total number of animals produced by the facility over the year may be greater). (Table 2-1.)

The increase in animal densities at operations is evident by comparing the average number of animals per operation between 1974 and 1997, as derived from Census of Agriculture data. These data are shown in Table 2-1. In the poultry sectors, the average number of birds across all operations is four to five times greater in 1997 compared to 1974. In 1997, the number of broilers per operation averaged 281,700 birds, up from 73,300 birds in 1974 (USDC, 1976; USDA/NASS, 1999a). The average number of egg laying hens per operation rose from 1,100 layers to 5,100 layers per farm, and the average number of turkeys per operation rose from 2,100 turkeys to 8,600 turkeys over the 1974 to 1997 period (USDC, 1976; USDA/NASS, 1999a). The average number of hogs raised per operation rose from under 100 hogs to more than 500 hogs between 1974 and 1997 (USDC, 1976; USDA/NASS, 1999a). The average number of fed cattle and dairy cows per operation more than doubled during this period, rising to nearly 250 fed cattle and 80 milking cows by 1997 (USDC, 1976; USDA/NASS, 1999a).

The trend toward fewer, larger, and more industrialized operations has contributed to large amounts of manure being concentrated within a single geographic location. The greatest potential risk is from the largest operations with the most animals, given the sheer volume of manure generated at these facilities. Larger, specialized facilities often do not have an adequate land base for manure disposal through land application. A USDA analysis of 1997 Census data shows that animal confinement operations with more than 1,000 AU account for more than 42 percent of all confined animals but hold only 3 percent of all cropland on these operations (Letson and Gollehon, 1996). As a result, large facilities need to store significant volumes of manure and wastewater that have the potential, if not properly handled, to cause significant water quality impacts. By comparison, smaller operations manage fewer animals and tend to concentrate less manure nutrients at a single farming location. Smaller operations also tend to be more diversified, engaging in both animal and crop production. These operations often have sufficient cropland and fertilizer needs to land apply manure nutrients generated by the farm's livestock or poultry business.

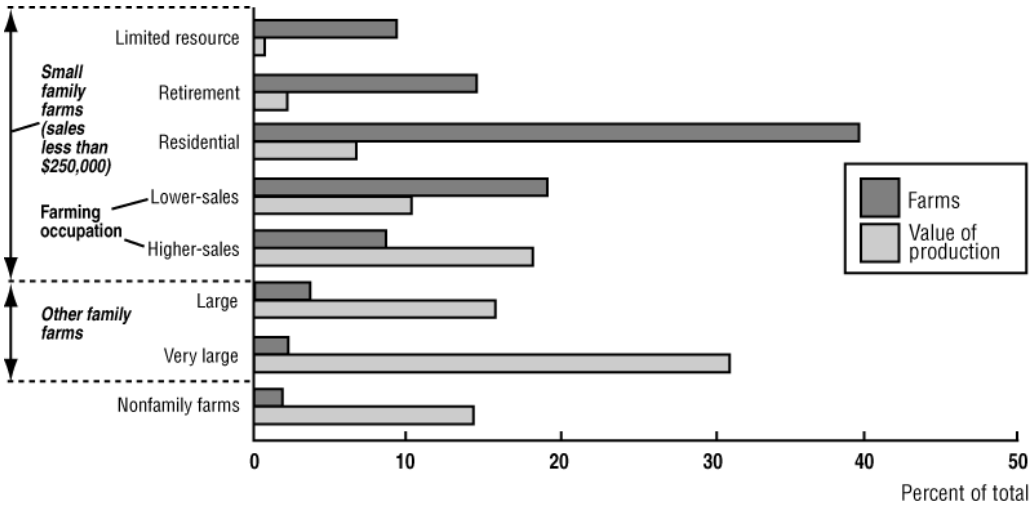

Figure 2-1. Share of Farms and Value of Production, by Typology Group, 1997
Source: USDA/ERS, 2000h. Farm typology groups are described in Table 2-2.

Another recent analysis from USDA confirms that as animal production operations have become larger and more specialized, the opportunity to jointly manage animal waste and crop nutrients has decreased, because these larger operations typically have inadequate land available for utilizing manure nutrients (Gollehon and Caswell, 2000). Estimates by USDA indicate that the amount of manure nitrogen produced by confinement operations increased about 20 percent between 1982 and 1997, while average acreage on livestock and poultry farms declined (Gollehon and Caswell, 2000). Overall, USDA estimates that cropland controlled by operations with confined animals have the assimilative capacity to absorb about 40 percent of the calculated manure nitrogen generated by these operations (Gollehon and Caswell, 2000). EPA expects that these excess manure nutrients will need to be transported offsite for use as a fertilizer substitute by other agricultural producers.

2.1.3 Geographic Shifts in Animal Production

During the 1970s, the majority of farming operations were concentrated in rural, agricultural areas, and manure nutrients generated at animal feeding operations were readily incorporated as a fertilizer in crop production. In an effort to reduce transportation costs and streamline distribution between the animal production and food processing sectors, livestock and

Table 2-2. USDA's Farm Typology Groups

Typology Groups	Description	1999 Share [/a]
Limited-resource	Any small farm with gross sales less than $100,000, total farm assets less than $150,000, and total operator household income (from all sources) less than $20,000. Limited resource farmers may report farming, a nonfarm occupation, or retirement as their major occupation.	5.9%
Retirement	Small farms whose operators report they are retired (excludes limited-resource farms operated by retired farmers).	13.9%
Residential/lifestyle	Small farms whose operators report their major occupation as other than farming, again excluding those with limited resources.	43.4%
Farming occupation /low sales	Small farms with sales less than $100,000, whose operators report farming as their major occupation (excludes limited-resource farms whose operators report farming as their major occupation).	22.4%
Farming occupation /high sales	Small farms with sales between $100,000 and $249,000, whose operators report farming as their major occupation.	8.2%
Additional Farm Groupings		
Large family farms	Farms with sales between $250,000 and $499,999.	3.6%
Very large family farms	Farms with sales of $500,000 or more	2.7%
Nonfamily farms	Farms organized as nonfamily corporations or cooperatives, as well as farms operated by hired managers.	<3% [/b]

Source: USDA farm typology groups (USDA/ERS, 2000b).
[/a]Share of farms and households in 1999 for all farms, except non-family farms (USDA/ERS, 2000g)
[/b]Information for non-family is for 1997 (USDA/ERS, 2000h).

poultry operations have tended to cluster near slaughtering and manufacturing plants as well as near end-consumer markets (McBride, 1997; USGAO, 1995; Kohls and Uhl, 1998). Ongoing structural and technological change in these industries is also influencing where facilities operate and is contributing to locational shifts between the more traditional production regions and the more emergent regions (Schrader, 1998; Lawrence et al., 1998; Kohls and Uhl, 1998; McBride, 1997; MacDonald, et al., 2000).

Operations in more traditional producing states tend to grow both livestock and crops and tend to have adequate cropland for land application of manure. Operations in these regions also tend to be smaller in size (McBride, 1997; Outlaw et al., 1996; USDA/NASS, 1999a). In contrast, confinement operations in more emergent areas, such as hog operations in North Carolina or dairy operations in the Southwest, tend to be larger in size and more intensive types of operations (USDA/NASS, 1999a; Schrader, 1998; Lawrence et al., 1998; Outlaw, et al., 1996;

McBride, 1997). These operations tend to be more specialized and often do not have adequate land for application of manure nutrients (McBride, 1997; Letson and Gollehon, 1999; Gollehon and Caswell, 2000). Production is growing rapidly in these regions due to competitive pressures from more specialized producers who face lower per-unit costs of production (McBride, 1997). This may be shifting the flow of manure nutrients away from more traditional agricultural areas, often to areas where these nutrients cannot be easily absorbed.

As reported by Census data, shifts in where animals are grown is especially pronounced in the pork sector (McBride, 1997; Iowa State University, 1998; Martinez, 1999; MacDonald, et al., 2000). Traditionally, Iowa has been the top ranked pork producing state. Between 1982 and 1997, however, the number of hogs raised in that state remained relatively constant with a year-end inventory average of about 14.2 million pigs (USDC, 1984; USDA/NASS, 1999a). In comparison, year-end hog inventories in North Carolina increased from 2.0 million pigs in 1982 to 9.6 million pigs in 1997 (USDC, 1984; USDA/NASS, 1999a). This locational shift has coincided with reported nutrient enrichment of the waters of the Pamlico Sound in North Carolina (USEPA, 2000b). Growth in hog production also occurred in other emergent areas, including South Dakota, Oklahoma, Wyoming, Colorado, Arizona, and Utah. Meanwhile, production dropped in Illinois, Indiana, Wisconsin, and Ohio (USDC, 1994, and 1989; USDA/NASS, 1999a).

The dairy industry has seen similar shifts in where milk is produced, moving from the more traditional Midwest and Northeast states to the Pacific and Southwestern states (McBride, 1997; El-Osta and Johnson, 1998). Between 982 and 1997, the number of milk cows in Wisconsin dropped from 1.9 million to 1.3 million (USDC, 1984; USDA/NASS, 1999a). Milk cow inventories have also declined in other traditional states, including Illinois, Indiana, Iowa, Minnesota, Missouri, New York, Pennsylvania, Ohio, Connecticut, Maryland, and Vermont. During the same period, milk cow inventories in California rose from 0.9 million in 1982 to 1.4 million in 1997. In 1994, California replaced Wisconsin as the top milk producing state (USDA/NASS, 1999c). Milk cow inventories have also increased in Texas, Idaho, Washington, Oregon, Colorado, Arizona, Nevada, and Utah (USDC, 1994, and 1989; USDA/NASS, 1999a). These locational shifts have coincided with reported nutrient enrichment of waters, including the Puget Sound and Tillamook Bay in the northwest, the Everglades in Florida, and Erath County in Texas, and also elevated salinity levels due to excess manure near milk production areas in southern California's Chino Basin (USEPA, 2000b).

2.1.4 Increased Farmer-Processor Linkages

Over the past few decades, closer ties have been forged between growers and various industry middlemen, including packers, processors, and cooperatives (USDA/ERS, 1996c). Increased integration and coordination is being driven by the competitive nature of agricultural production and the dynamics of the food marketing system, in general, as well as seasonal fluctuations of production, perishability of farm products, and inability to store and handle raw farm output. Closer ties between the animal production facility and processing firms—either

through contractual agreement or through corporate ownership of CAFOs—raises questions of who is responsible for ensuring proper manure disposal and management at the animal feeding site. This is especially true given current trends toward an increasing number of large animal confinement operations and the resultant need for increased animal waste management. As farms become larger and more specialized, they may contract out some phases of the production process. The contract farm might be less able to make decisions about environmental concerns and to cover the costs of addressing these concerns (USDA/ERS, 1996c). Since environmental controls may raise the cost of production to the farmer, the farmer may wait to implement best management practices until the contractor (processor) specifies and/or compensates the farmers for the additional costs (USDA/ERS, 1996c).

Farmers and ranchers have long used contracts to market agricultural commodities. However, increased use of production contracts is changing the organizational structure of the individual industries and may raise policy questions regarding ownership responsibility as well as environmental concerns (USDA/ERS, 1996c). Under a production contract, a business other than the feedlot where the animals are raised and housed, such as a processing firm, feed mill, or animal feeding operation, may own the animals and may exercise further substantial operational control over the operations of the feedlot. In some cases, the processor may specify in detail the production inputs used, including the genetic material of the animals, the types of feed used, and the production facilities where the animals are raised (USDA/ERS, 1996c; Martinez, 1999; Ogishi and Zilberman, 1999). The processor may also influence the number of animals produced at a site (Ogishi and Zilberman, 1999). In general, these contracts do not deal with management of manure and waste disposal (USDA/ERS, 1996c; Martinez, 1999). Recently, however, some processors have become increasingly involved in how manure and waste is managed at the animal production site. This information is available in the rulemaking record (for example: Associated Press, 2000; Huslin, 2000a and 2000b; Montgomery, 2000; Goodman, 1999).

The use of production contracts in the livestock and poultry industries varies by commodity group. Information from USDA indicates that production contracts are widely used in the poultry industry and dominate broiler production (USDA/ERS, 1996c and 1999a). Production contracting is becoming increasingly common in the hog sector, particularly for the finishing stage of production in regions outside the Corn Belt (USDA/ERS, 1999a; Schrader, 1998; Lawrence et al., 1998). In the poultry sectors, vertical integration has progressed to the point where large, multifunction producer-packer-processor-distributor firms are the dominant force in poultry and egg production and marketing (Aust, 1997; Kohls and Uhl, 1998). Production contracting has played a critical role in the growth of integrators in the poultry sectors. Data from USDA on animal ownership at U.S. farms demonstrates the use of production contracts in these sectors. In 1997, USDA reported that 97 percent of all broilers raised on U.S. farms were not owned by the farmer. In the turkey and egg laying sectors, use of production contracts is less extensive, since 70 percent and 43 percent of all birds in these sectors, respectively, were not owned by the farmer (USDA/ERS, 1999a). In the hog sector, data from USDA indicate that production contracting may account for 66 percent of hog production among larger producers in the Southern and Mid-Atlantic states (USDA/ERS, 1999a). This differs from

the Midwest, where production contracting accounted for 18 percent of hog production in 1997 (USDA/ERS, 1999a).

By comparison, production contracts are not widely used in the beef and dairy sectors. Data from USDA indicate that less than 4 percent of all beef cattle and 1 percent of all milking cows were not owned by the farmer in 1997 (USDA/ERS, 1999a). However, production contracts are used in these industries that specialize in a single stage of livestock production, such as to "finish" cattle prior to slaughter or to produce replacement breeding stock. However, this use constitutes a small share of overall production across all producers. More detailed information on contracting use in animal agriculture is discussed in Section 2.3.

To further examine the linkages between the animal production facility and the food processing firms, and to evaluate the geographical implications of this affiliation, EPA conducts an analysis that shows a relationship between areas of the country with an excess of manure nutrients from animal production operations and areas with a large number of meat packing and poultry slaughtering facilities. This manure—if land applied—would be in excess of crop uptake needs and result in over application and enrichment of nutrients. Across the pork and poultry sectors, this relationship is strongest in northwest Arkansas, where EPA estimates a high concentration of excess manure nutrients and a large number of poultry and hog processing facilities. By sector, EPA's analysis shows that there is excess poultry manure nutrients and a large number of poultry processing plants in the Delmarva Peninsula in the mid-Atlantic, North Carolina, northern Alabama, and also northern Georgia. In the hog sector, the analysis shows excess manure nutrients and a large number of meat packing plants in Iowa, Nebraska and Alabama. The analysis also shows excess manure nutrients from hogs in North Carolina, but relatively fewer meat packing facilities, which is likely explained by continuing processing plant closure and consolidation in that state. More information on this analysis is provided in the rulemaking record. The results of this research is contained in the record (DCN 20786).

2.2 CHARACTERISTICS OF ANIMAL CONFINEMENT OPERATIONS THAT MAY BE AFFECTED BY THE PROPOSED CAFO REGULATIONS

This report examines the economic effects of the proposed CAFO regulations on agricultural operations that confine livestock and poultry. This section provides an overview of the animal production sectors, focusing on facilities that confine animals and identifying those production facilities that are likely to be affected by the proposed requirements.

Section 2.2.1 discusses how EPA identifies the number of operations that may be affected by the proposed CAFO regulations. This section first identifies all livestock and poultry operations, then estimates which ones are likely to be confined operations and thus potentially affected operations, and finally estimates the number of such operations likely to be considered CAFOs, given the size definitions in the proposed CAFO regulations. A brief summary of the financial characteristics of U.S. livestock and poultry operations is provided in Section 2.2.2 (and

is discussed in more detail in other sections of this report). Section 2.2.3 characterizes the amount and nutrient content of manure generated at confined livestock and poultry operations.

2.2.1 Identification and Number of Affected CAFOs

There are three steps involved in determining the number of CAFOs that may be affected by the proposed regulations. First, EPA identifies all livestock and poultry operations using USDA data. Second, EPA estimates the total number of operations that confine animals, using available Census data and other supplemental information from USDA and industry. Third, based on the regulatory thresholds being proposed, EPA identifies the number of operations that meet the CAFO definition or may be designated as CAFOs by the Permitting Authority, using farm size distribution data from USDA and other information. These steps are described in the following sections.

2.2.1.1 All Livestock and Poultry Operations

The agricultural sectors that are the focus of the proposed CAFO regulations, identified by North American Industry Classification System (NAICS)[3] code, include:

- Cattle feedlots, NAICS 112112 [includes veal] (SIC 0211, beef cattle feedlots).
- Beef cattle ranching and farming, NAICS 112111 (SIC 0241, dairy heifer replacement farms).
- Dairy cattle and milk production, NAICS 11212 (SIC 0241, dairy farms).
- Hog and pig farming, NAICS 11221 (SIC 0213, hogs).
- Broilers and other meat-type chickens, NAICS 11232 (SIC 0251, broiler, fryer, and roaster chickens).
- Turkey production, NAICS 11233 (SIC 0253, turkey and turkey eggs).
- Chicken egg production, NAICS 11231 (SIC 0252, chicken eggs).

As shown in Table 2-1, USDA reports that there were 1.1 million livestock and poultry farms in the United States in 1997 (USDA/NASS, 1999a). This number includes all operations

[3]NAICS recently replaced the SIC (Standard Industrial Classification) system.

that raise beef, dairy, pork, broilers, egg layers, and turkeys, and includes both confinement and non-confinement (grazing and rangefed) production. These data on the number of farms include both commercial and non-commercial operations. (USDA generally defines a commercial operation to include operations with annual farm revenues of more than 50,000 per year (USDA/ERS, 1997b)).

The primary source of data on the number of livestock and poultry operations is USDA's 1997 Census of Agriculture (Census). The Census is a complete accounting of United States agricultural production and is the only source of uniform, comprehensive agricultural data for every county in the nation (USDA/NASS, 2000a). NASS conducts the Census every 5 years.[4] The Census is a mail questionnaire that is sent to a list of known U.S. operations from which $1,000 or more of agricultural products were produced and sold or normally would have been sold during the census year (USDA/NASS, 2000b). Census survey respondents are on their own to interpret its questions.

Aggregated Census data are readily available from USDA. In general, the published compendium provides summary inventory and sales data for the nation and for states. The Census database itself, however, contains more detailed information that can be aggregated by more precise facility size groupings, such as the regulatory thresholds specified by EPA for the proposed CAFO regulations. USDA periodically publishes summary data from its databases and provides customized analyses of the data to the public and other government agencies. EPA obtained these data through a formal request to USDA. The requested data summaries that EPA uses for its analyses are compiled by NASS, with the assistance of staff at USDA's NRCS who developed a methodology for identifying farms likely to be CAFOs based on reported survey information and developed estimates of animal units on these operations based on reported data (described in the *Development Document* (USEPA, 2000a)). This methodology allows USDA to perform special tabulations of the data to obtain information on the characteristics of facilities at specific size thresholds for each sector, which were provided to the EPA and other government agencies. All data provided to EPA is sufficiently aggregated to ensure the confidentiality of an individual farming operation.

In some cases, data obtained by USDA on the number of farms by inventory size distribution do not always correspond with the facility size definitions examined by EPA. Where data were not available in the desired size ranges, the data were linearly interpolated from available data (USEPA, 2000a). USDA data also are not available on the number and distribution of poultry operations with wet manure management systems and are instead estimated by EPA using available data and supplemental information from industry experts and agricultural extension agency personnel (USEPA, 2000a). Also, limited information on the number of farms that raise more than a single animal type is available. To the extent that combinations of animal types are located at livestock and poultry operations, these counts may be overstated.

[4]In prior years, the Census was conducted by the Department of Commerce's Bureau of the Census.

USDA Census data report the number and size of livestock and poultry operations as of year-end (December 31) and may not adequately reflect seasonal fluctuations in inventory and the number and timing of animals sold. EPA used the Census data to calculate average herd size over the year. The resultant industry summary data are based on both reported inventory and sales, adjusted by expected turnovers. This approach is consistent with that developed by USDA to estimate potential manure nutrient loadings from animal agriculture (Lander, et al., 1998). More information is provided in the *Development Document* (USEPA, 2000a).

2.2.1.2 Animal Confinement Operations

Census data on the number of livestock and poultry farms include both confinement and non-confinement operations. However, only operations that confine animals are subject to the proposed CAFO regulations.[5] For many of the animal sectors, it is not possible to precisely determine what proportion of the total livestock operations are confinement operations and what proportion are grazing operations only. EPA has estimated the number of AFOs using available data and other information from the Census as well as other USDA and industry publications (USDA/NASS, 1999b and 1999c and 1999d and 1998b; USDA/APHIS, 1995b; NPPC, 1998). Data on the number of beef and hog operations that raise animals in confinement are available from USDA. Since most large dairies have milking parlors, EPA assumes that all dairy operations are potentially confinement operations. In the poultry sectors, there are few small non-confinement operations and EPA assumes that all poultry operations confine animals. EPA's analysis focuses on the largest facilities in these sectors only. The data and assumptions used to derive EPA's estimates of the number of affected confinement operations have undergone extensive review by USDA personnel. Detailed information on how EPA estimated the number of AFOs that may be subject to the proposed CAFO regulations can be found in the *Development Document* (USEPA, 2000a).

Using available 1997 data from USDA, EPA estimates that there are about 376,000 AFOs that raise or house animals in confinement, as defined by the existing regulations (Table 2-3). Table 2-3 presents the estimated number of AFOs and the corresponding animal inventories for 1997 across select size groupings. These estimates are based on the number of "animal units" (AU) as defined in the existing regulations at 40 CFR 122 (Appendix B), with the addition of the revisions that are being proposed for immature animals and chickens.[6] Data shown in Table 2-3 are grouped by operations with more than 1,000 AU and operations with fewer than 300 AU.

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[5]Under the existing regulations, confinement operations are considered to be CAFOs where animals have been, are, or will be stabled or confined and fed and maintained for a total of at least 45 days in any 12-month period. These confinement areas must not sustain crops, vegetation, forage growth, or post-harvest residues in the normal growing season.

[6]As defined for the proposed CAFO regulations, one AU is equivalent to one slaughter or feeder cattle, calf or heifer; 0.7 mature dairy cattle; 2.5 hogs (over 55 pounds) or 5 nursery pigs; 55 turkeys; and 100 chickens regardless of the animal waste system used.

As shown in Table 2-3, there were an estimated 12,660 AFOs with more that 1,000 AU in 1997 that accounted for about 3 percent of all confinement operations. In most sectors, these larger-sized operations account for the majority of animal production. For example, in the beef, turkey and egg laying sectors, operations with more than 1,000 AU accounted for more than 70 percent of all animal inventories in 1997; operations with more than 1,000 AU accounted for more than 50 percent of all hog, broiler, and heifer operations (Table 2-3). In contrast, operations with fewer than 300 AU accounted for 90 percent of all operations, but a relatively smaller share of animal production.

USDA data on the total number of operations, shown in Table 2-3, include corporate-owned operations. Despite industry trends toward larger facility size, increased specialization and

Table 2-3. Number of AFOs and Animals On Site, by Size Group, 1997

Sector/ Size Category	All AFOs	>1,000 AU [a/]	<300 AU	Total	>1000AU	<300 AU
	number of operations			number of animals on site, 1,000s		
Cattle	106,080	2,080	102,000	26,840	22,790	2,420
Veal	850	10	640	270	10	210
Heifers	1,250	300	200	850	450	80
Dairy	116,870	1,450	109,740	9,100	2,050	5,000
Hogs: GF [b/]	53,620	1,670	48,700	18,000	9,500	2,700
Hogs: FF [b/]	64,260	2,420	54,810	38,740	21,460	5,810
Broilers	34,860	3,940	20,720	1,905,070	1,143,040	476,270
Layers: wet [c/]	3,110	50	2,750	392,940	275,060	58,940
Layers: dry [c/]	72,060	590	70,370			
Turkeys	13,720	370	12,020	112,800	95,880	2,260
Total [d/]	**375,700**	**12,660**	**336,590**	**NA**	**NA**	**NA**

Source: USEPA, 2000a. Derived by USDA from published USDA/NASS data, including 1997 Census of Agriculture. In some cases, available data are used to interpolate data for some AU size categories. Data for veal and heifer operations are estimated by EPA (USEPA, 2000a). May not add due to rounding. NA=Not available.

[a/]As defined for the proposed CAFO regulations, one AU is equivalent to one slaughter or feeder cattle, calf or heifer; 0.7 mature dairy cattle; 2.5 hogs (over 55 pounds) or 5 nursery pigs; 55 turkeys; and 100 chickens regardless of the animal waste system used.

[b/]"Hogs: FF" are farrow-finish (includes breeder and nursery pigs); "Hogs: GF" are grower-finish only.

[c/]"Layers: wet" are operations with liquid manure systems; "Layers: dry" are operations with dry systems.

[d/]"Total AFOs" eliminates double counting of operations with mixed animal types. Based on survey level Census data for 1992, operations with mixed animal types account for roughly 25 percent of total AFOs.

scale efficiencies, and closer farmer-processor linkages (discussed in Section 2.1.4), the majority of facilities remain independently owned and operated. USDA reports that there were roughly 3,000 incorporated livestock and poultry operations that were not family held in 1997, constituting less than one-half of one percent of all operations (USDA/NASS, 1999a). Other USDA data indicate that non-family farms (both crop and livestock operations) account for less than 3 percent of all U.S. farms (see Table 2-2 and Figure 2-1).

2.2.1.3 CAFOs Subject to the Proposed Regulations

Table 2-4 presents the estimated number of operations that would be defined as a CAFO under each of the two alternative regulatory alternatives. The "*two-tier structure*" would define as CAFOs all animal feeding operations with more than 500 AU. The "*three-tier structure*" would define as CAFOs all animal feeding operations with more than 1,000 AU and any operation with more than 300 AU, if they meet certain "risk-based" conditions, as defined in Section VII of the preamble (also summarized in Section 3 of this report). Table 2-4 presents the number of AFOs in terms of number of operations with more than 1,000 AU and operations for each co-proposed middle category (operations with between 500 and 1,000 AU and between 300 and 1,000 AU, respectively).

Table 2-4. Number of Potential Operations *Defined* as CAFOs by Select Regulatory Alternative, 1997

Sector/Size Category	"Two-Tier"						"Three-Tier" >300 AU	
	>300 AU	>500 AU	>750 AU	>300 AU	>500 AU	>750 AU		
	(# operations)			(% total)			(#)	(% total)
Cattle	4,080	3,080	2,480	4%	3%	2%	3,210	3%
Veal	210	90	40	25%	10%	4%	140	16%
Heifers	1,050	800	420	84%	64%	34%	980	78%
Dairy	7,140	3,760	2,260	6%	3%	2%	6,480	6%
Hogs: GF	4,920	2,690	2,300	9%	5%	4%	2,650	5%
Hogs: FF	9,450	5,860	3,460	15%	9%	5%	5,700	9%
Broilers	14,140	9,780	7,780	41%	28%	22%	13,740	39%
Layers: wet	360	360	210	12%	12%	7%	360	12%
Layers: dry	1,690	1,280	1,250	2%	2%	2%	1,650	2%
Turkeys	2,100	1,280	740	15%	9%	5%	2,060	15%
Total	**39,320**	**25,540**	**19,100**	**10.5%**	**6.8%**	**5.1%**	**31,930**	**8.5%**

Source: See Table 2-3.

Based on available USDA data for 1997, EPA estimates that both proposed alternative structures would regulate about 12,660 operations with more than 1,000 AU, accounting for operations with more than a single animal type (USEPA, 2000a).[7] The two alternatives differ in the manner in which operations with less than 1,000 AU would be defined as CAFOs and, therefore, subject to regulation, as described in Section 3 of this report. As shown in Table 2-4, in addition to the 12,660 facilities with more than 1,000 AU, the two-tier structure would regulate an additional 12,880 operations with between 500 and 1,000 AU (USEPA, 2000a).

Under the three-tier structure, an estimated 39,330 operations would be subject to the proposed regulations (10 percent of all AFOs), estimated as the total number of animal confinement operations with more than 300 AU. See Table 2-4. Of these, EPA estimates that a total of 31,930 AFOs would be defined as CAFOs (9 percent of all AFOs) and would need to obtain a permit (Table 2-4), while an estimated 7,400 operations would certify that they do not need to obtain a permit. Among those operations needing a permit, an estimated 19,270 operations have between 300 to 1,000 AU.

As shown in Table 2-4, the three-tier structure would regulate an additional 6,400 operations, compared to the two-tier structure. Overall, the three-tier structure would define as CAFOs more operations in all sectors, with the exception of the hog sector. Including mixed operations, the three-tier structure would define as CAFOs 5,100 more poultry operations, about 2,700 more dairies, and 400 more cattle operations, but 200 fewer hog operations (Table 2-4), than the two-tier structure.

EPA estimates the number of operations that may be defined as CAFOs under the three-tier structure using available information and compiled data from USDA, State Extension experts, and agricultural professionals. These estimates rely on information about the percentage of operations in each sector that would be impacted by the "risk-based" criteria described in Section VII. In some cases, this information is available on a state or regional basis only and is extrapolated to all operations nationwide. EPA's estimates reflect information from a majority of professional experts in the field. Greater weight is given to information obtained by State Extension agents, since they have broader knowledge of the industry in their state. More detailed information on how EPA estimated the number of operations that may be affected by the proposed regulations under the three-tier structure is available in the *Development Document* (USEPA, 2000a).

EPA is also requesting comment on two additional options for the scope of the rule. One of these is an alternative two-tier structure with a threshold of 750 AU. Under this option, an estimated 19,100 operations, adjusting for operations with more than a single animal type, would be defined as CAFOs (Table 2-4). This represents about 5 percent of all CAFOs, and would affect an estimated 2,930 beef, veal, and heifer operations, 2,260 dairies, and 5,750 swine and

[7]1992 Census data indicate that approximately 200 operations with more than 1,000 AU have multiple animal types, so a corresponding reduction in these operations is calculated to adjust for mixed operations.

9,980 poultry operations (including mixed operations). Under the other alternative—a variation of the three-tier structure that is being co-proposed—the same 39,320 operations with 300 AU or greater would potentially be defined as CAFOs. However, the certification conditions for being defined as a CAFO would be different for operations with 300 to 1,000 AU (described later in Section VII of the preamble). EPA has not estimated how many operations would be defined as CAFOs under this alternative three-tier approach, although EPA expects that it would be fewer than the 31,930 estimated for the three-tier approach being proposed today. If after considering comments, EPA decides to further explore this approach, it will conduct a full analysis of the number of potentially affected operations.

EPA does not anticipate that many AFOs with less than 500 AU (two-tier structure) or 300 AU (three-tier structure) will be subject to the proposed requirements. In the past 20 years, EPA is aware of very few AFOs that have been designated as CAFOs. Based on available USDA analyses that measure excessive nutrient application on cropland in some production areas and other farm level data by sector, facility size and region, EPA estimates that designation may bring an additional 50 operations under the proposed two-tier structure (500 AU threshold) each year nationwide. EPA assumed this estimate to be cumulative such that over a 10-year period approximately 500 AFOs may become designated as CAFOs and therefore subject to the proposed regulations. EPA expects these operations to consist of beef, dairy, farrow-finish hog, broiler and egg laying operations that are determined to be significant contributors to water quality impairment (Table 2-5). Table 2-5 also shows EPA's estimates of designated facilities under an alternative two tier structure at the 750 AU threshold. Under the three-tier structure, EPA estimates that fewer operations would be designated as CAFOs, with 10 dairy and hog operations may be designated each year, or 100 operations over a 10-year period (Table 2-5). For the purpose of this analysis, EPA assumes that all potentially designated operations are located in the more traditional farm production regions in the Midwest and Northeast.

EPA expects that the proposed CAFO regulations would mainly affect livestock and poultry operations that confine animals. In addition to CAFOs, however, the proposed regulations may also affect businesses that contract out the raising or finishing production phase to a CAFO but exercise "substantial operational control" over the CAFO (described in Section 3 of this report). As discussed later in Sections 2.3 and 2.4, EPA estimates that 94 meat packing plants that slaughter hogs and 270 poultry processing facilities may be subject to the proposed co-permitting requirements. Other types of processing firms, such as further processors, food manufacturers, dairy cooperatives, and renderers, are not expected to be affected by the co-permitting requirements since these operations are further up the marketing chain and do not likely contract with CAFOs to raise animals. Fully vertically integrated companies (e.g., where the packer owns the CAFO) are not expected to require a co-permit since the firm as the owner of the CAFO would require only a single permit.

Table 2-5. Number of Potential Operations *Designated* as CAFOs by Select Regulatory Alternative, 1997

Sector/Size Category	"Two-Tier"			"Three-Tier" >300 AU
	>300 AU	>500 AU	>750 AU	
	(# operations)			
Cattle	ND	40	60	0
Veal	ND	0	0	0
Heifers	ND	0	0	0
Dairy	ND	220	380	50
Hogs: GF	ND	0	0	0
Hogs: FF	ND	200	350	50
Broilers	ND	20	30	0
Layers: wet	ND	20	30	0
Layers: dry	ND	0	0	0
Turkeys	ND	0	0	0
Total	**ND**	**500**	**850**	**100**

Source: See Table 2-3. Estimates are shown projected over a 10-year period. ND=Not Determined.

EPA also expects that crop farmers who receive manure from CAFOs would be affected under one of the two co-proposed options relating to offsite management of manure. EPA's *Development Document* (USEPA, 2000a) documents how EPA estimated the number of potentially affected crop producers. These estimates are presented in Section 5 as part of EPA's overall analysis.

2.2.2 Financial Characteristics of Livestock and Poultry Farms

Table 2-6 provides a summary of USDA's financial performance classification by farm typology groups across all crop and livestock producers for 1999 (USDA/ERS, 2000g). This compilation is based on USDA's Agricultural Resource Management Study (ARMS) data. (This database in described in greater detail in Section 4 of this report.) Farm financial information presented in this section and used for this analysis does not include off-farm income, which may account for between 16 percent of total household income at USDA-recognized "very large family farms" (operations with more than $500,000 in annual sales) to 130 percent of total household income at "small family farms," as defined in Table 2-2 (USDA/ERS, 2000d).

USDA classifies farm financial performance as "favorable" or "vulnerable", using two measures (USDA/ERS, 1997e and 1997a). The first measure is the debt-to-asset ratio, a ratio

that compares total debt to total assets and is useful for determining the relative debt burden a farm might be under. The second is net farm income, which if negative, could indicate relatively poor financial performance. Used together, these terms define a farm's vulnerability to closure. Vulnerable farms are those with both negative net farm income and high levels of debt, indicated by a debt-to-asset ratio over 40 percent. (See Section 4.2.5 for more information on USDA's farm performance classification.)

Using this performance classification, Table 2-6 shows that about 4 percent of all farms are considered by USDA to be in a financially vulnerable position (USDA/ERS, 2000g). These farms are highly leveraged and may experience income deficiencies (USDA/ERS, 1997b; Sommer, et al., 1998).

Across U.S. commercial farms—defined by USDA as operations with revenues of $50,000 or more per year—the share of operations that are considered financially vulnerable is lower, estimated at less than one percent (USDA/ERS, 1997b). Additional information across all commercial farms (both crop and livestock enterprises) indicate that net farm income averaged $57,600 per operation (USDA/ERS, 2000j). Including non-commercial operations, farm income tends to average much lower (Table 2-6). On average, net farm income was relatively stable for commercial farms during the early 1990s (USDA/ERS, 1997b). Average debt-to-asset ratio across all commercial farm businesses was 14 percent in 1999, indicating relatively low debt burdens (USDA/ERS, 2000j). Average return on assets at commercial farm businesses was 3 percent; operating profit margins averaged 11 percent (USDA/ERS, 2000j). Including non-commercial operations, average financial statistics for the farming sector as a whole (shown in Table 2-6) tend to be more variable and generally lower overall (USDA/ERS, 1993 and 1996a).

The following summarizes the financial conditions of operations in the livestock and poultry sectors. Financial conditions vary among these sectors, as well as by size and region within these sectors, in some cases. Overall, available USDA ARMS data on the baseline financial conditions of the livestock and poultry sectors that will be affected by the proposed CAFO regulations indicate that operations in these sectors, on average, are not in a vulnerable financial position. As is discussed below, on average, these operations have positive net farm income and acceptable debt-to-asset ratios (less than 40 percent) indicating a low potential for cash flow problems and a low relative risk of insolvency. Additional information is provided in Sections 6, 7 and 8 of this report.

Beef operations experienced poor profitability in the 1990s due to falling prices and declining receipts, in spite of increasing production.[8] In 1997, net farm income averaged $10,100

[8]ARMS data do not differentiate between fed cattle operations and cow-calf operations. All data presented here are for all beef operations only.

Table 2-6. Financial Performance by Farm Typology Group, All Crop and Livestock Production, 1999

Item	Small family farms			Farming occupation		Large family farms	Very Large family farms	All
	Limited-resource	Retire-ment	Resid./ lifestyle	Low	High			
	(percent)							
Share farms/ households	5.9	13.9	43.4	22.4	8.2	3.6	2.7	100.0
Percent Distribution by Financial Performance								
Favorable	54.2	71.4	57.9	62.0	71.4	71.1	60.6	62.1
Marginal Income	38.4	27.8	34.1	32.2	15.2	14.1	13.0	30.2
Marginal Solvency	d	d	* 2.2	* 3.4	9.2	8.6	22.4	3.5
Vulnerable	d	d	5.9	2.3	4.3	6.2	3.9	4.2
Percent Distribution by Typology Group								
Favorable	5.2	15.9	40.4	22.3	9.4	4.1	2.7	100.0
Marginal Income	7.5	12.8	49.0	23.9	4.1	1.7	1.2	100.0
Marginal Solvency	d	d	* 27.3	* 21.7	21.5	8.8	17.4	100.0
Vulnerable	d	d	60.9	12.3	8.4	5.3	2.5	100.0
Other performance measures								
Net farm income ($)	** -800	4,400	2,100	5,400	33,700	64,700	220,500	13,800
Debt-to-asset (%)	7.8	2.0	9.5	6.4	13.5	16.7	20.0	10.5
Return on assets (%)	-12.2	-1.2	-1.6	-2.5	* 0.7	3.2	8.7	** 0.2
Operating profit margin (%)	-96.3	-25.2	-24.7	-29.9	* 3.5	11.8	18.8	** 1.4

Source: USDA/ERS, 2000g. Dollars are rounded to nearest hundred.
Farm types are defined in Table 2-2. Financial performance classification is defined in Section 4.2.5.
d=data suppressed due to insufficient observations.
*=standard error is between 25-50% of the estimate. **=standard error is between 50-75% of the estimate.

per operation, 20 percent lower than 1994, not accounting for inflation (USDA/ERS, 1999a and 1997b). Average debt-to-asset ratios in this sector ranged from 9 percent to 13 percent in 1997, depending on operation size—a reduction in debt burden since 1994 when the average farm had a debt-to-asset ratio of 16 percent (USDA/ERS, 1999a and 1997b). Average returns on assets (derived by EPA using 1997 ARMs data on average revenues to average assets) ranged from 2 percent to 4 percent, depending on facility size. Additional financial information on the beef sector is provided in Section 8.

Among dairy operations, net farm income remained relatively stable during the mid- to late 1990s. USDA reports in 1997 net dairy farm income averaged $36,600 per operation, slightly lower than in 1994 (USDA/ERS, 1999a and 1997b). Average debt-to-asset ratios ranged from 17 percent to 26 percent, depending on size (USDA/ERS, 1999a). Differences in debt-to-asset ratio region were generally modest. Dairy operations, however, are among the most profitable of the affected industry sectors. Returns on assets at dairy farms in 1997 averaged from 4 percent to 9 percent, depending on facility size (calculated by EPA from ARMS data as average revenues to average assets). Additional financial information on the dairy sector is provided in Section 8.

Hog operations experienced low profitability and high debt in the mid-1990s, which caused substantial financial stress among producers, though not reaching critical levels. In 1997, debt and profitability improved on average. Net farm income averaged $21,700 per operation in 1997, a 10 percent increase from the 1994 average, not accounting for inflation (USDA/ERS, 1999a and 1997b). Average debt-to-asset ratios among hog operators ranged from 15 percent to 39 percent, depending on size, and also vary by production region, tending to be lower in the Mid-Atlantic compared to the more traditional Midwest region (USDA/ERS, 1999a). High debt levels were prevalent in 1994, with mean debt-to-asset ratio among commercial hog farms averaging 24 percent (USDA/ERS, 1997b). By 1997, the average debt-to-asset ratio was 18 percent (USDA/ERS 1999a). This decrease in debt levels, along with relatively high returns on assets, indicates some upturn in the hog sector between 1994 and 1997. This may have buffered the period of severe stress in the hog sector during 1997-1998 period when hog and wholesale pork prices plummeted due to expanded production and decreased export demand (Southard, 1999). In 1997, the largest farms had debt levels near 40 percent and could be nearing financial vulnerability; however, these operations had relatively high net income, averaging $157,700 per operation in 1997 (USDA/ERS, 1999a). Average return on assets at larger-sized hog operations (more than 300 AU) ranged from 4 percent to 10 percent, varying by facility size and region (USDA/ERS 1999a). Additional financial information on this sector is provided in Section 7.

In 1997, average net farm income at poultry operations was about $11,000 at broiler and egg laying operations and $23,500 at turkey operations. Debt-to-asset ratios at poultry operations ranged from 7 percent to 30 percent, depending on operation size and sector (USDA/ERS 1999a). Across all sized operations, broiler, layer, and turkey operations had average debt-to-asset ratios of 19 percent, 11 percent, and 15 percent, respectively (USDA/ERS 1999a). Regionally, there is little difference in the average debt-to-asset ratios operations across these sectors compared to the national level. Reported average return on assets at larger-sized

broiler and turkey operations (more than 300 AU) ranged from 2 percent to 6 percent across sectors (USDA/ERS 1999a). Additional financial information on the broiler, egg, and turkey sectors is provided in Section 6.

2.2.3 Manure and Manure Nutrients Generated Annually at CAFOs

USDA's Natural Resources Conservation Service (NRCS) estimates that 128.2 billion pounds of manure are "available for land application from confined AU" from the major livestock and poultry sectors (Kellogg, et al., 2000). EPA believes these estimates equate to the amount of manure that is generated at animal feeding operations, since USDA's methodology accounts for all manure generated at confinement facilities. USDA reports that manure nutrients available for land application totaled 2.6 billion pounds of nitrogen and 1.4 billion pounds of phosphorus in 1997 (Kellogg, et al., 2000). (See Table 2-7.) USDA's estimates do not include manure generated from other animal agricultural operations, such as sheep and lamb, goats, horses, and other farm animal species.

Table 2-7. Manure and Manure Nutrients "Available for Land Application," 1997

Sector	USDA Estimates: "Available for Application" from Confined AU" [a/]			EPA Estimates: Percentage Share by Facility Size Group [b/]			
	Total Manure	Total Nitrogen	Total Phosphorus	>1,000 AU	>750 AU	>500 AU	>300 AU
	bill. lbs	million pounds		percent of total manure nutrients applied			
Cattle [b/]	32.9	521	362	83%	85%	86%	90%
Dairy	45.5	636	244	23%	31%	37%	43%
Hogs	16.3	274	277	55%	63%	69%	78%
All Poultry	33.5	1,153	554	49%	66%	77%	90%
Total	**128.2**	**2,583**	**1,437**	**49%**	**58%**	**64%**	**72%**

Source: USDA and EPA, as indicated.

[a/]Nutrients are from USDA/NRCS using 1997 Census of Agriculture and procedures documented developed by USDA. Numbers are "dry state" and reflect the amount of manure nutrient "available for application from confined AU" and are assumed by EPA to coincide with manure generated at confined operations).

[b/]Percentage shares are by EPA based on the share of animals within each facility size group for each sector (shown in Table 2-3) across three facility size groups.

[c/]"Cattle" is the sum of USDA's estimate for livestock operations "with fattened cattle" and "with cattle other than fattened cattle and milk cows." [c/]Cattle" is the sum of USDA's estimate for livestock operations "with fattened cattle" and "with cattle other than fattened cattle and milk cows" (Kellogg, et al., 2000).

The contribution of manure and manure nutrients varies by animal type. Table 2-7 shows that the poultry industry was the largest producer of CAFO manure nutrients in 1997, accounting for 45 percent (1.2 billion pounds) of all nitrogen and 39 percent (0.6 billion pounds) of all

phosphorus available for land application that year (Kellogg, et al., 2000). Among the poultry sectors, EPA estimates that approximately 55 percent of all poultry manure was generated by broilers, while layers generated 20 percent and turkeys generated 25 percent. The dairy industry was the second largest producer of CAFO manure nutrients, generating 25 percent (0.6 billion pounds) of all nitrogen and 17 percent (0.2 billion pounds) of all phosphorus (Table 2-7). Together, the hog and beef sectors accounted for about one-fourth of all nitrogen and nearly 40 percent of all phosphorus from CAFO manure.

Table 2-7 shows EPA's estimate of the relative contribution of manure generated by select major facility size groupings, including coverage for all operations with more than 1,000 AU, all operations with more than 750 AU or 500 AU (two-tier structure), and all operations with more than 300 AU (three-tier structure). EPA estimates these shares based on the share of animals within each facility size group for each sector, as shown in Table 2-3. Given the number of AFOs that may be defined as CAFOs and subject to the proposed regulations (Table 2-4), EPA estimates that the proposed effluent guidelines and NPDES regulations will regulate 5 to 7 percent (two-tier structure) to 10 percent (three-tier structure) percent of AFOs nationwide. Coverage in terms of manure nutrients generated will vary by the proposed regulatory approach. As shown in Table 2-7, under the 500 AU two-tier structure, EPA estimates that the proposed requirements will capture 64 percent of all CAFO manure; under the 750 AU two-tier structure, EPA estimates that the proposed requirements will capture 58 percent of all CAFO manure. Under the three-tier structure, EPA estimates that the proposed requirements will capture 72 percent of all CAFO manure generated annually (Table 2-7). The majority of this coverage (49 percent) is attributable to regulation of operations with more than 1,000 AU.

Additional information on the constituents found in livestock and poultry manure and wastewater is described in *Environmental Assessment* (USEPA, 2000b). Information on USDA's estimates of nutrients available for land application and on the relative consistency of manure (e.g., wetter or drier) for the main animal types is provided in the *Development Document* (USEPA, 2000a).

2.3 INDUSTRIAL ORGANIZATION OF LIVESTOCK AND POULTRY INDUSTRIES

This section presents a discussion of the industrial organization and structure of the livestock and poultry industries, focusing on the role of vertical integration and coordination between the animal feeding and the processing sectors. Section 2.3.1 describes the use of contracts in animal agriculture and Section 2.3.2 discusses the role that contracting plays in determining the degree of affiliation between a CAFO and the processing sector. These issues have implications for this rulemaking and may determine whether producers are able to pass on increases in production costs through higher prices and also whether processors are subject to the proposed CAFO regulations as co-permittees.

2.3.1 Contracting in Animal Agriculture

As briefly discussed in Section 2.1.4, over the past few decades, closer ties have been forged between farmers and their respective manufacturing operations. Increased integration and coordination are being driven by the competitive nature of agricultural production and the dynamics of the food marketing system, as well as seasonal fluctuations of production, perishability of farm products, and limited resources among farmers to handle raw farm output.[9]

"Contracting" in U.S. agriculture refers to arrangements between farmers and companies or other farmers that specify conditions of producing and/or marketing an agricultural product. Contracts can specify price, quantity, and/or quality requirements. There are two basic types of contracts (USDA/ERS, 1996c):

- ***Marketing contracts*** refer to verbal or written agreements between contractors and growers that set the price (or pricing mechanism) and an outlet for the commodity before harvest or before the commodity is ready to be marketed. Most management decisions remain with farmers, since ownership is retained while the commodity is produced. The contractee (grower) also assumes all the risks of production but shares price risk with the contractor (processor). Types of marketing contracts include forward sales of a growing crop, price setting after delivery, and pre-harvest polling arrangements.

- ***Production contracts***[10] specify in detail the production inputs supplied by the contractor (processor, feed mill, or other farm operations), the quality and quantity of a particular commodity, and the type of compensation to the grower for services rendered. The contractor (processor or integrator) may either own the animals and/or may exercise substantial operational control over the type of production practices used. The contractor may specify in detail the production inputs supplied by the contractor, the quality and quantity of a particular commodity, and the type of compensation to the grower for services rendered. In general, these contracts do not deal with management of manure and waste disposal, although, the contract may require the grower to be in compliance with all relevant environmental requirements.

Martinez (1999) notes that, in the broiler industry, most major processors control the vertical stages of production, from breeders to market-ready products, through vertical integration and production contracts. These processor-integrators, such as Tysons, breed the

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[9]Ownership of all aspects of production is the key to vertical integration (Aust, 1997). Vertical coordination differs from vertical integration in that it includes "all means of vertically harmonizing production, processing, and distributive activities (Aust, 1997) and covers the use of contracting in livestock and poultry production, which occurs when an operation contracts with a packer, processor, or feed company to feed animals.

[10]Also known as "resource-providing contract" (Martinez, 1999).

parent stock, produce hatchling eggs, and hatch the eggs; they provide chicks, feed, veterinary services, but contract out the rasing of the chicken to farmers or growers (Martinez, 1999). The growers provide the chicken houses and labor. The contract specifies a payment per pound of live broiler produced, depending on the grower's relative performance. In such an integrated marketing system, price discovery is at the interface between the processor and the retailer (Martinez, 1999).

Increased use of contracts may be changing the organizational structure of the individual industries and may raise policy questions regarding ownership responsibility as well as environmental concerns (USDA/ERS, 1996c). This is especially true given current trends toward an increasing number of large confined animal feeding operations and the resultant need for increased animal waste management. Farmers raising animals under production contract with processors face different risks and decisions than farmers raising animals under their own ownership or under marketing contracts because farm management decisions are often tightly controlled by the processor (Bastian et al., 1994). See Section 2.1.4. As farms become larger and more specialized, they may contract out some phases of the production process. The contract farm might be less able to make decisions about environmental concerns and to cover the costs of addressing these concerns (USDA/ERS, 1996c). Since environmental controls may raise the cost of production to the farmer, the farmer may wait to implement best management practices until the contract specifies and/or compensates the farmers for the additional costs (USDA/ERS, 1996c).

Continued growth in contract farming is anticipated because of its benefits to both the processor and the contract farmer. Contracts reduce farmer exposure to price risk by combining market functions and allowing them to secure a constant price and buyer (Kohls and Uhl, 1998). Factors other than income stability include improved efficiency, market security, and access to capital and new technologies (USDA/ERS, 1996c). The farmer also frequently receives production inputs from the processor, including animals (chicks, breeder pigs, replacement heifers), feed, technical support, and transportation of animals. Receipt of feed supplies from integrators reduces uncertainty and risk in feed costs, often the single largest cost component of livestock and poultry production (USDA/ERS, 1996c).

Processing firms benefit from contracting since they can realize rapid growth without the need to own and maintain land and facilities while exerting control over the production process, input supply, and genetics (Hayenga et al., 1996). Among hog processors, a recent survey indicated that the top three advantages to processors of contracting is increased financial leverage, reduced environmental/regulatory problems, and access to motivated labor (i.e., farmer growers) (Hennessey and Lawrence, 2000).

Figure 2-2 depicts the flow of activities and typical sharing of responsibilities in a contractual agricultural relationship, as summarized by Ogishi and Zilberman (1999).

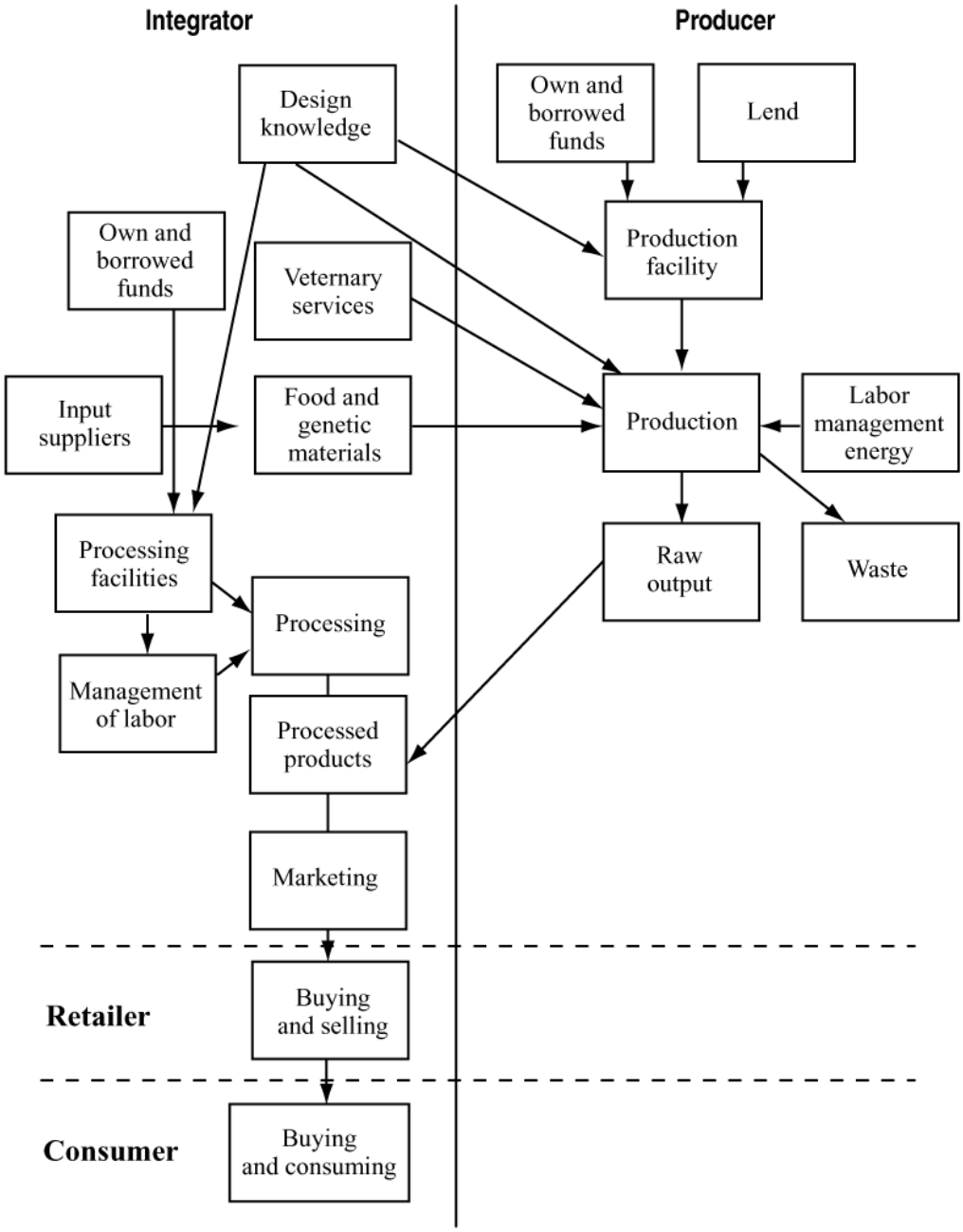

Figure 2-2 Flow of Activities and Sharing of Responsibilities in a Contractual System

Source: Ogishi and Zilberman, 1999

2.3.2 Degree of Affiliation between CAFOs and Processors

EPA uses information on the degree of affiliation between CAFOs and processing firms within a sector, based on the types of contractual arrangements used within a sector, to support its assumptions on whether processors within an industry may be subject to the proposed CAFO regulations as co-permittees (Section 2.4). These data are from USDA that report the use of production contracts and the degree of animal ownership by the farm operator in these sectors.

Use of production contracts in the livestock and poultry industries varies by commodity group. Information from USDA indicate that production contracts are widely used in the poultry industry and dominate broiler production (Aust, 1997; USDA/ERS, 1999a and 1996c; Heffernan, et al., 1999; Perry, et al., 1999; Martinez, 1999). Production contracts are also common in the hog sector, and use in the finishing stage of production is rising rapidly in some regions (Pritchett and Lui, 1998). By comparison, production contracts are not widely used in the beef and dairy sectors (USDA/ERS, 1996c and 1999a; Heffernan, et al., 1999). Additional details on vertical coordination and contracting for each sector are presented in Sections 6, 7, and 8 of this report.

Production contracting in the poultry sectors differs from that in the other livestock sectors, since it is dominated by near vertical integration between a farmer ("grower") and a processing firm ("integrator"). In the poultry sectors, vertical integration has progressed to the point where large, multifunction producer-packer-processor-distributor firms are the dominant force in poultry and egg production and marketing (Kohls and Uhl, 1998). Production contracting has also played an important role in the growth of integrators in the poultry sectors (Aust, 1997).

In a 1993 study, USDA showed that almost 90 percent of all poultry farms use contracts, most of which are production contracts (Table 2-8). Across all poultry sectors, production contracting accounted for 86 percent of the value of all production in 1993 (USDA/ERS, 1996c). Information from USDA on animal ownership at U.S. farms further indicates the potential degree of processor control in these sectors (USDA/ERA, 1999a). These data indicate that production contracting accounts for virtually all (98 percent) of U.S. broiler production in 1997 (USDA/ERS, 1999a). (See Table 2-9.) This indicates that nearly all broiler production may be under the ownership or control of processing firms that are affiliated with broiler operations. Production contracting accounts for a smaller share of turkey and egg production, accounting for 70 percent and 37 percent, respectively (USDA/ERS, 1999a). See Table 2-9.

Production contracts are also common in the hog sector, but still account for a smaller share of total production. In 1993, 6 percent of all hog farms grew animals under a production contract, accounting for 11 percent of all hog marketings during that year (USDA/ERS, 1996c). (See Table 2-8.) However, the hog sector is rapidly evolving into an industry of larger firms that are specialized and vertically coordinated through production contracting, particularly in production regions outside the Corn Belt (Pritchett and Lui, 1998). More recent data indicate

that contracting use is rising rapidly. In 1997, an estimated 40 percent of the hogs farrowed and 44 percent of the finished hogs were produced by farms with production contracts (Lawrence, et al., 1998).[11] Most contract hogs are produced by large farms in emerging regions, such as North Carolina (Hayenga et al., 1996).

Table 2-8. Contracting Use in the Livestock and Poultry Sectors, 1993

Commodity Group	All [a/]	Cattle	Dairy [b/]	Hogs	Poultry
Number of Farms					
Farms (number)	**2,063,300**	**740,138**	**125,408**	**82,132**	**27,589**
Farms with Contracts (number)	225,308	13,278	34,903	9,232	24,500
Percentage under Contract	11%	2%	28%	11%	89%
Farm with Production Contracts (number)	43,609	2,827	2,661	4,701	23,379
Farm with Marketing Contracts (number)	185,736	10,625	32,441	4,749	2,081
Value of Production					
Total Value of Production ($million)	**$150,493**	**$33,870**	**$23,833**	**$8,436**	**$11,237**
Production Value under Contract ($million)	$47,454	$7,787	$10,185	$1,155	$9,642
Percentage under Contract	32%	23%	43%	14%	86%
Value under Production Contract ($million)	$17,706	$6,038	$178	$958	$8,845
Value under Marketing Contract ($million)	$27,748	$1,749	$10,007	$197	$796

Source: USDA/ERS, 1996c.

[a/] Includes all crops and livestock farms.

[b/] Most milk is produced under marketing orders. Milk producers usually have a verbal agreement with their buyer or cooperative. Because a quantity and final price are not specified before the sale, producers do not consider this a "contract." Farmers may have production contracts with other operators to produce a stream of replacement heifers.

[11] Use of marketing contracts has also risen sharply, accounting for 57 percent of 1997 hog marketings (Lawrence, et al., 1998).

Table 2-9. Percent of Animals Owned and Not Owned by Farmers by Sales-Based Size Categories, 1997

Number/Percent	All Farms	Small Family Farms		Large Family Farms	Very Large Family Farms	Non-Family Farms [a/]
		Low Sales	High Sales			
All Cattle and Calves [b/]						
No. of Animals (millions)	99.3	21.0	17.9	9.3	15.0	8.9
Percent not owned (%)	7.4%	4.1%	6.3%	5.6%	7.0%	26.5%
Beef Cows						
No. of Animals (millions)	39.6	10.7	6.8	2.5	2.5	2.2
Percent not owned (%)	4.7%	3.9%	7.4% [c/]	7.0%	3.5% [c/]	3.6% [d/]
Heifers and Heifer Calves [a/]						
No. of Animals (millions)	25.7	4.7	4.9	2.9	4.6	2.8
Percent not owned (%)	8.8%	3.7%	5.1%	4.9% [c/]	10.2%	33.9%
Milking Cows						
No. of Animals (millions)	10.5	1.2	2.8	1.4	3.7	0.8
Percent not owned (%)	1.4%	0.3% [c/]	1.7% [d/]	1.6% [c/]	0.4% [c/]	3.4%
Hogs and Pigs						
No. of Animals (millions)	40.6	3.4	6.5	9.8	13.4	5.1
Percent not owned (%)	27.6%	31.1% [c/]	13.3% [c/]	29.8% [c/]	40.2%	7.4% [d/]
Broilers, Fryers and other Meat-type Chickens						
No. of Animals (millions)	763.8	50.6	62.2 [d/]	233.9 [c/]	385.5	ND
Percent not owned (%)	97.6%	93.7%	78.9% [c/]	100.0%	99.6%	ND
Turkeys						
No. of Animals (millions)	154.0	ND	1.5 [d/]	7.8 [d/]	99.9 [d/]	37.2 [d/]
Percent not owned	70.0%	94.5% [c/]	90.2%	93.3%	78.3% [c/]	36.2% [e/]
Layers						
No. of Animals (millions)	163.6	10.7	4.5	18.1	89.4	38.6 [d/]
Percent not owned (%)	37.3%	94.0%	89.9%	85.2%	34.3% [c/]	0.6%

Source: USDA/ERS, 1999a. See Table 2-2 for USDA farm typology group definitions.

ND= not disclosed; data insufficient for disclosure (fewer than 30 observations).

[a/]Nonfamily farms include nonfamily corporations or cooperatives, as well as farms operated by hired managers.

[b/]Includes all feedlots as well as cow-calf operations and stocker or backgrounding operations.

[c/]Relative standard estimate (RSE) of estimate >25% but <50%.

[d/]RSE of estimate >50% but <75%.

[e/]RSE of estimate >75%.

Information from USDA on animal ownership at U.S. hog farms in 1997 provides an indication of the potential degree of processor control in this sector. These data indicate that nationally production contracts accounted for about 30 percent of total hog production in 1997 (Table 2-9). Production contract use in the hog sector varies by production region. Production contracts accounted for 66 percent of hog production in the Southern and Mid-Atlantic states in 1997, with use concentrated among the larger producers (USDA/ERS, 1999a). In comparison, production contracting accounted for 18 percent of hog production in the Midwest (USDA/ERS, 1999a). (See Table 2-5.) This indicates that a large share of hog production may be under the ownership or control of processing firms in the Southern and Mid-Atlantic states. Production contracting is less common in the Midwest because coordination efforts are more diversified and because independent producers enter into networks that are similar in many ways to highly integrated systems (Kliebenstein and Lawrence, 1995). Production contracting in the hog sector is becoming more like that in the poultry sector in that it is increasingly focused on the finishing stage of production, with the farmer ("grower") entering into an agreement with a meat packing or processing firm ("integrator"). Production contracts are also used in the hog sector to raise immature animals between two independent animal feeding operations (USDA/ERS, 1996c).

Because of the frequency of production contract use and the increased probability of animal ownership by processors in the poultry and hog sectors, EPA concludes that processors within these industries may be subject to the proposed CAFO regulations as co-permittees (as described in Section 2.4), and therefore assumes this for the purpose of this analysis. This is because, under a production contract, many farm management decisions may remain with the processor, who controls the level of production and the types of production practices used by the contract grower. In many cases, the processor also retains ownership of the animals. The nature of this relationship is believed to trigger the co-permittee requirements due to "substantial operational control." (Additional information on EPA's proposed co-permitting requirements are provided in Section VII of the preamble to the proposed CAFO regulations.).

By contrast, production contracts account for only a small share of beef and milk production (USDA/ERS, 1999a and 1996c; Heffernan, et al., 1999). Contractual agreements in these sectors are typified by marketing contracts (Table 2-8). Animal ownership on beef and dairy farms is mostly by the farm operator (Table 2-9). Accordingly, EPA concludes that processors within the beef and dairy industries would not be subject to the proposed CAFO regulations as co-permittees.

The majority of cattle and calves are sold through private arrangements and spot market agreements (USDA/GIPSA, 1997). Production contracting is not common in the beef sector. As shown in Table 2-8, less than two percent of all beef operations produced under contract in 1993, accounting for 23 percent of the value of all beef produced (USDA/ERS, 1996c). Most beef sector contracts are marketing-based, in which operations agree to sell packers a certain amount of cattle on a predetermined schedule. As shown by 1997 USDA data of animal ownership, production contracting accounts for a relatively small share (5 percent) of beef production (USDA/ERS, 1999a). See Table 2-9. In recent years, however, the relationship between cattle

producers and processors has become more interconnected, either through contractual arrangements or through actual ownership (integration) by processors, particularly for some phases of production (Bastian, et al., 1994).

Milk and dairy food production has become increasingly specialized, but has not experienced vertical integration in the same way as other livestock industries. Most farm milk is produced by independent, privately owned facilities (Manchester and Blaney, 1997). Production contracting is uncommon in milk production (USDA/ERS, 1996c). In part, this is attributable to the large role of farmer-owned, farmer-controlled dairy cooperatives, which handle about 80 percent of the milk delivered to plants and dealers. Milk is generally produced under marketing-type contracts through verbal agreement with their buyer or cooperative. About a quarter of all dairy farms were involved in contracting arrangements in 1993, accounting for 43 percent of all milk produced (USDA/ERS, 1996c). Data from USDA further indicate that little more than one percent of milk was produced under a production contract in 1997 (USDA/ERS, 1999a). See Table 2-9.

Production contracts are used in the beef and dairy industries to establish a contractual relationship to specialize in one stage of livestock production (USDA/ERS, 1996c). However, this constitutes a small share of overall production in these sectors, as discussed above (also see Table 2-9). Production contracts are used in these industries for custom feeding, cattle backgrounding, and heifer replacement. For example, a beef feedlot operation may agree to fatten or "finish" cattle not owned by the operation for a fee, based on weight gain prior to slaughter; these custom feeding operations provide finish feeding under contract. Backgrounding or stocker operations raise cattle under contract from the time the calves are weaned until they are on a finishing ration in a feedlot. This arrangement allows operators to increase business volume with limited facilities through specialization. In the dairy sector, farms may use production contracts with other operators to produce a stream of replacement heifers (USDA/ERS, 1996c). Additional information is provided in Section 8 of this report.

Among non-family farms, production contracts account for a relatively larger proportion of total production in the beef and dairy sectors. See Table 2-9. USDA data on animal ownership for 1997 indicate that 26 percent of total cattle and calf production and 34 percent of heifer and heifer calf production by non-family farms is not owed by the farmer (USDA/ERS, 1999a). Despite the limited use of contracts for the finishing and raising phase of production, EPA expects that no businesses, other than the CAFO where the animals are raised, will be subject to the proposed co-permitting requirements in the beef and dairy sectors.

2.4 CHARACTERISTICS OF PROCESSING FIRMS THAT MAY BE AFFECTED BY THE PROPOSED CAFO REGULATIONS

EPA expects that the proposed CAFO regulations will mainly affect livestock and poultry operations that confine animals. In addition to CAFOs, however, the proposed regulation may also affect businesses that contract out the raising or finishing production phase to a CAFO under the proposed co-permitting requirements. These proposed co-permitting requirements are described in Section 3; more detailed information is provided in Section VII of the preamble. The proposed co-permitting requirements could affect meat packing plants and poultry slaughtering facilities that exercise "substantial operational control" over a CAFO. This section provides an overview of the livestock and poultry processing sectors, focusing on processing firms that enter into contract with CAFOs and are likely to be affected by the proposed rule.

Section 2.4.1 builds on the farmer-processor discussion in Section 2.3 by identifying the types and number of livestock and poultry processing firms that may be affected by the proposed CAFO regulations. This section first identifies all livestock and poultry processors, then estimates which ones are likely to contract out to CAFOs and thus potentially be affected operations. A summary of available financial data and information on the livestock and poultry processing sectors is provided in Section 2.4.2. (An overview of the supply and demand conditions for livestock and poultry products is provided in Section 2.5, expressed in terms of farm level production.)

2.4.1 Identification and Number of Potential Co-Permittees

There are three steps involved in determining the number of processing firms that may be affected by the proposed co-permittee requirements. First, EPA identified all livestock and poultry processors, using data from the Department of Commerce. Second, EPA examined the potential for "substantial operational control" between CAFOs and processing firms within different livestock and poultry sectors. Third, once a sector was identified as having the potential for "substantial operational control," EPA identified the number of facilities that are likely to be affected by the proposed co-permitting requirements, using available industry information. These steps are described in the following sections.

2.4.1.1 All Livestock and Poultry Processors

The food processing sectors supporting the animal production sectors that are the focus of the proposed CAFO regulations encompass a broad group of businesses that process red meat, milk and dairy products, and poultry products. These processors can be further subdivided into meat packers and slaughterers, processors, further processors, and renderers. By NAICS code, these operations include:

- Animal (except poultry) slaughtering, NAICS 311611 (SIC 2011, meat packing plants).[12]

- Meat processed from carcases, NAICS 311612 (SIC 2013, sausages and other prepared meats).

- Poultry processing, NAICS 311615 (SIC 2015, poultry slaughtering and processing).

- Liquid, dried, and frozen eggs, NAICS 311999(G) (SIC 2015, poultry slaughtering and processing).

- Fluid milk manufacturing, NAICS 311511, (SIC 2026, fluid milk manufacturing).

- Creamery butter, NAICS 311512 (SIC 2021, creamery butter).

- Cheese manufacturing, NAICS 311513 (SIC 2022, cheese manufacturing).

- Dry, condensed and evaporated dairy manufacturing, NAICS 311514 (SIC 2023, processed milk products).

- Ice cream and frozen dessert manufacturing, NAICS 31152 (SIC 2024, ice cream and frozen desserts).

- Rendering and meat by-product processing, NAICS 311613 (SIC 2077, animal and marine fats and oils).

The U.S. Department of Commerce's 1997 Census of Manufactures reports that there were a total of 1,393 meat packing establishments (NAICS 311611) and 1,297 red meat processing facilities (NAICS 311612) in the United States (USDC, 1999a). Another 474 establishments were involved in poultry slaughter and processing (NAICS 311615), as well as 84 establishments engaged in poultry and egg processing (NAICS 311999(G)) (USDC, 1999a). There were also 240 rendering plants (NAICS 311613) in 1997 (USDC, 1999a).

Table 2-10 presents the key NAICS product class codes for the broader group of establishments initially considered likely to be affected by the proposed CAFO regulations. Detailed data are not disclosed for pork processors. More information on the market and financial characteristics of these industry sectors is described in more detail in Section 2.4.2.

[12]Covers the slaughter of cattle, calves, steer, heifers, pork, sheep, and lamb.

Table 2-10. Processing Industry Statistics by Primary Product Class and Sector, 1997

NAICS Industry or Product Class Code and Primary Class	All Est.	All Employ.	Value Added ($MM)	Cost of Materials ($MM)	Value of Shipments ($MM)	Total Capital Expend. ($MM)
Beef						
311611(1), Fresh and frozen beef, not canned or made into sausage [a/]	228	71,070	$4,174.3	$29,220.9	$33,347.7	$0.3
Dairy						
311511, Fluid milk	612	58,217	$6,311.3	$15,887.8	$22,212.1	$428.3
311512, Creamery butter	34	1,827	$241.9	$1,133.9	$1,367.5	$8.5
311513, Cheese	524	36,918	$4,411.7	$15,918.2	$20,326.3	$485.9
311514, Dry, condensed, & evap. dairy product	213	15,325	$4,015.9	$4,991.4	$9,021.6	$261.7
311520, Ice cream & frozen dessert	451	19,818	$2,533.4	$3,312.8	$5,863.5	$159.4
Hog						
311611(A), Fresh and frozen pork	83	d	d	d	d	d
311611(G), Pork, processed or cured [a/]	11	d	d	d	d	d
311612(1), Pork, processed or cured [b/]	143	21,501	$1,838.6	$3,778.1	$5,635.5	$177.3
Poultry						
311615(1), Young chickens	212	137,674	$6,228.8	$11,150.0	$17,347.8	$310.8
311615(4), Hens and-or fowl	15	3,527	$130.4	$179.7	$309.2	$11.2
311615(7), Turkeys	39	27,339	$1,756.0	$2,501.1	$4,252.2	$102.9
311999(G), Liquid, dried, and frozen eggs [b/]	44	4,651	$433.3	$991.5	$1,426.2	$30.6

Source: USDC, 1999a. d = data not disclosed.

[a/]Made from animals slaughtered at this plant.

[b/]Identified as further processors and excluded from processor impact analysis.

2.4.1.2 Sectors with Potential for "Substantial Operational Control"

Not all of the livestock and poultry processors identified in Section 2.4.1.1 are expected to be subject to the proposed CAFO regulations as co-permittees. However, there are no publicly available data on the number of farms or processing firms that enter into a production contract arrangement. Market information is not available on the number and location of firms that contract out the raising of animals to CAFOs and the number and location of contract growers, and the share of production, that raise animals under a production contract. EPA also does not have data on the exact terms of the contractual agreements between processors and CAFOs to assess when a processor would be subject to the proposed co-permitting requirements, nor does EPA have financial data for processing firms or contract growers that utilize production contracts. This is proprietary business information.

To estimate the number of potentially affected operations, EPA uses readily available published data from USDA and the Department of Commerce. To distinguish potentially affected operations, EPA examined all types of commodity processors and facility types in order to methodologically eliminate those groups of processors that are unlikely to be affected by the proposed regulations. To do this, EPA examined the potential for "substantial operational control" between CAFOs and processing firms at the sector level based on the type of contractual agreements used in that industry.

EPA expects that the proposed co-permitting requirements under the proposed CAFO regulations will affect processing firms that have substantial operational control of a CAFO. Generally, substantial operational control is found under a situation of vertical integration (where the packer owns the CAFO) or vertical coordination (where production is controlled under a production contract). Vertically integrated companies are not expected to be required to obtain a co-permit, since the firm would be required to obtain only a single permit as owner of the CAFO. Companies that contract out to CAFOs may be required to obtain a co-permit under some types of contracting agreements.

As described in Section 2.3, under a production contract, most farm management decisions are dictated by the contractor (processing firm) who controls the level of production and the types of production practices used by the contract grower (farmer). In many cases, the processor also retains ownership of the animals. In circumstances where production contracts are widely used between CAFO and processor, EPA expects that the processor may be subject to co-permitting requirements because of operational control and/or ownership by the processor. Thus, a permit would be issued at a CAFO and another would be issued at the affiliated processing firm that controls production at the CAFO. As noted previously, marketing contracts are unlikely to allow the processor to exercise operational control over a CAFO and are thus not considered likely to trigger the co-permit requirements under the proposed CAFO regulations.

Only the pork and poultry sectors are identified as sectors where use of production contracts is common. Production contracting is uncommon in the beef and dairy sectors; also,

most beef and dairy operations own their own animals (USDA/NASS, 1999a; USDA/ERS, 1996c), as discussed in Section 2.3. EPA believes that this supports its conclusions that processors in the beef and dairy sectors are unlikely to be affected by the proposed co-permitting requirements. These same data show that the vast majority of poultry operations and a sizeable portion of pork production operations are under production contracts. Based on this information, EPA concludes that only pork and poultry processors would be potentially affected by the proposed CAFO regulations as possible co-permittees. This narrows the scope of potentially affected facilities identified by EPA to these two sectors.

To further narrow the scope, EPA eliminates broad groups of processors as potential co-permittees, including most food processing firms, such as further processors, food manufacturers, and renderers. These operations are not expected to be affected by the co-permitting requirements because these operations are further up the marketing chain and do not likely contract with CAFOs to raise animals. In general, these types of establishments do not directly purchase product from or have direct relations with CAFOs but rather obtain products from other processors. Since EPA believes that these establishments do not generally establish contractual relationships with CAFOs, these facilities are excluded from the count of potentially affected processors. For similar reasons EPA also excludes in its count of potential co-permittees any establishments whose primary classification indicates wholesale or retail trade (egg processors, e.g., egg graders and packers, are classified under wholesale trade). Given the types of contract arrangements that are common in the hog and poultry industries, EPA expects that only packers and slaughterers in these industries will be subject to the proposed co-permitting requirements.

2.4.1.3 Identification of Potential Co-Permittees based on Facility Type and Size

As discussed in the preceding section, EPA expects that the proposed co-permitting requirements will primarily affect meat packers and poultry slaughters/processors in the pork and poultry sectors only. This narrows the number of potential co-permittees to two NAICS industry classifications for “animal (except poultry) slaughtering” (NAICS 311611) and “poultry processing” (NAICS 311615).

To further eliminate broad categories of processors, EPA identifies the number of potential co-permittees among pork and poultry processors based on available information about facility type and operation size.

The meat packing industry is composed of slaughterhouses (where livestock are slaughtered and further processed) and specialized meat processors (who do not slaughter but instead manufacture sausage, luncheon meats, and other prepared products) (Kohls and Uhl, 1998). In 1997, there were 1,308 meat packing companies (NAICS 311611) in the United States (USDC, 1999a). These companies cover all meat product types, including cattle, calves, steer

and heifers, pork, and sheep and lambs. These 1,308 meat packing companies comprise 1,393 establishments.[13]

Although 1,393 meat packing establishments are identified, far fewer of these are considered likely to be affected by the proposed regulations. First, a majority of meat processors were excluded because of facility size considerations. Hayenga et al. (1996) indicates that production contracts in the hog sector are generally associated with the largest processors and producers. Hayenga's study focused on the largest packers, feed companies, and hog producers/contractors, "which both embody and transmit the driving forces toward change in pork sector coordination and organization linkages" (Hayenga et al. (1996)). Accordingly, EPA believes that only the largest firms are likely to have the capacity to process larger volumes of raw farm product that are generated at CAFOs with more than 300 or 500 AU; also, only the largest firms are likely to have the necessary resources and organizational structure that would allow them to fully realize the benefits of production contracting. By contrast, smaller-sized processors are unlikely to contract out to larger CAFOs or be able to handle the production volumes generated at a regulated CAFO.

The 1997 Economic Census (USDC, 1999a) provides a simple way of identifying the larger processors through their product class breakdowns, which identify numbers of establishments by product class specialization (e.g., NAICS 311611A, Fresh and frozen pork, not canned or made into sausage, made from animals slaughtered at this plant). Product class specialization is determined on the basis of a detailed survey. USDC provides detailed surveys only to a select group of mostly larger firms in the manufacturing industry. Included in this group are large- and medium-sized establishments that are surveyed in the Annual Survey of Manufactures (ASM). Historical information is used for product classifications for about 30 percent of additional large and medium non-ASM establishments, and about 15 percent of smaller establishments with more than 20 employees are provided a short survey form, which includes product information. Those not receiving surveys are not broken out by product class but are included in the overall count of 1,393 establishments, with some additional information on employment and value of shipments obtained by USDC through administrative records. The establishments not sent surveys are those with fewer than 20 employees. EPA believes, as discussed above, that these small-sized processors are unlikely to enter into production contracts with CAFOs and thus assumes they are not directly affected by the proposed CAFO regulations.

Among meat packing firms (NAICS 311611), 437 establishments provided information on product class (USDC, 1999a). Among these 437 establishments, however, only 94 were

[13]For the purpose of this analysis, EPA assumes that one establishment identified as a possible co-permittee equals one affected entity, since data to determine which processors are most likely to have production contracts are only available at the establishment level. Although firms may own multiple establishments, these establishments generally are sited in different geographic locations and would be associated with different CAFOs. Thus each establishment with production contracts could be required to obtain a co-permit. The number of establishments, therefore, is a reasonable estimate of the number of co-permits.

identified as pork processors (USDC, 1999a).[14] Of these, Department of Commerce's 1997 product class specialization identifies 83 establishments that process fresh and frozen pork and 11 establishments that process or cure pork. These data generally account for larger processing facilities that have more than 20 employees. EPA believes that processing firms that may be affected by the proposed co-permitting requirements will mostly be larger facilities that have the administrative and production capacity to take advantage of various contract mechanisms. This estimate does not include other processors under NAICS 311611, including sausage makers and facilities that "further process" hog hides and other by-products because these operations are considered to be further up the marketing chain and likely do not contract out to CAFOs.

Thus, of the 437 meat processors, EPA considers that 94 pork processors are potentially subject to the proposed co-permitting requirements. Not all of these firms are expected to engage in production contracting. Survey data from Hayenga et al. (1996) indicate that only 5 of 19 (about a quarter) of the largest pork packers used production contracts or produced hogs themselves in 1995. Assuming only a quarter of the 94 pork processors have contracts, only about 25 pork processors might be subject to co-permitting requirements. However, the use of production contracts is increasing rapidly in the hog sector; at the same time, there is ongoing consolidation and plant closures are occurring. As a conservative measure, EPA assumes that all the 94 identified pork processors may be potential co-permittees. This estimate is likely an overestimate of the number of potential co-permittees since the top six processing firms account for 75 percent of all pork production (as cited in Heffernan, et al., 1999).

The Department of Commerce reports that there were a total of 558 poultry and egg slaughtering and processing facilities in 1997. Among poultry processors (NAICS 311615), EPA identified 259 firms with 474 establishments in the poultry processing industry using the 1997 Economic Census, consisting of 212 establishments that process young chickens, 15 that process hens or fowl, and 39 that process turkeys, for a total of 266 chicken and turkey establishments (USDC, 1999a). EPA's estimate excludes 44 reported egg processing facilities (NAICS 311999) since these are considered to be further up the marketing chain and likely do not contract out to CAFOs (see Table 2-10).[15] Because production contracts are so widespread in the poultry industry, EPA assumes that about 270 poultry processors identified in this manner might be subject to co-permitting requirements. This estimate is likely an overestimate of the number of potential co-permittees: Heffernan et al. (1999) note that 95 percent of all broilers are produced under production contracts with fewer than 40 firms. As discussed previously, these data generally account for larger-sized processing facilities with more than 20 employees to account for the expectation that processing firms that may be affected by the proposed co-permitting requirements have adequate administrative and production capacity to contract out to CAFOs.

[14]EPA did not include beef and veal processors, since these processors are considered unlikely to have production contracts, as discussed in Section 2.3. Other meat packers that slaughter other animals (lamb, sheep, etc.) under this NAICS code were also not included.

[15]EPA did not include establishments that process other poultry (such as ducks and small game).

2.4.2 Financial Characteristics of the Livestock and Poultry Processing Sector

The meat and poultry processing industries are characterized by the dominance of a few, very large firms, many with worldwide influence. For example, Smithfield Foods, Inc., is the world's largest pork processor, with record sales of $3.9 billion in 1997 (Hoovers, 1998). Farmland Foods, Inc., also one of the top four pork processors, is expanding its global market in South Korea, Japan, and Mexico. Tyson Foods, Inc., is the world's largest poultry producer, with revenues of $4.7 billion in 1997 (Hoovers, 1998).

In 1997, the top ten meat and poultry processors had combined sales of $59.0 billion compared to a total value of shipments of $86.2 billion for the meat processing and poultry slaughtering sectors (NAICS 311611 and 311615) (IBP, Inc., 1997; USDC, 1999a), or nearly 70 percent of the market. Employment by these top 10 processors totals approximately 220,000 workers compared to total industry employment of 366,885 (IBP, Inc., 1997; USDC, 1999a). The top 10 poultry processors controlled over 60 percent of the broiler market in 1997 (Thornton, 1999); an estimated 95 percent of all contract broiler production was controlled by fewer than 40 firms (Heffernan, et al., 1999). In 1998, the top four broiler processors (Tyson, Gold Kist, Perdue, and Pilgrim's Pride) comprise almost 50 percent of total production[16] (Heffernan, et al., 1999; IBP, Inc., 1999). The four largest turkey processors (Jennie-O, Butterball, Wampler, and Cargill) controlled more than 40 percent of the market[17] (Heffernan, et al., 1999; Heffernan, 1999). In 1998, the top four pork meat packers (Smithfield, IBP, Inc., ConAgra, Cargill) controlled nearly 60 percent of all hog production[18] (Heffernan, et al., 1999; USDA/GIPSA, 1998). Daily hog slaughter capacity of the top 10 pork packers is 83 percent of the industry (NPPC, 1998).

Geographical distribution of processing plants mirrors distribution of farms. The top 10 pork packing companies in 1997, ranked by estimated daily slaughter capacity, operated 30 plants. Almost 40 percent of these plants were located in Iowa, with another 10 percent in North Carolina, 10 percent in Nebraska, and 10 percent in Illinois (NPPC, 1998). The country's largest sow farms are clustered in the Corn Belt region and in North Carolina (Freese, 1997). Broiler processing plant distribution among the top 10 broiler processors is most dense in the southeastern states of Georgia and Arkansas (Thornton, 1999). As discussed later in Section 6, Georgia and Arkansas were the largest broiler producing states in 1997. Plant distribution among the top 10 turkey processors is greatest in Minnesota (24 percent), North Carolina (18 percent),

[16]Commonly measured by the "four-firm concentration ratio" or CR4. For broilers, the CR4 was 49 percent in 1998; the CR6 was 58 percent (*Feedstuffs*, as referenced in Heffernan, et al., 1999).

[17]For turkeys, the CR4 was 42 percent in 1998 (*Turkey World*, as referenced in Heffernan, et al., 1999).

[18]For hog meat packer, the CR4 was 57 percent in 1998 (*National Hog Farmer*, as referenced in Heffernan, et al., 1999). The CR6 was 75 percent (*NY Times*, as referenced in Heffernan, et al., 1999).

and Virginia (12 percent) which corresponds to higher turkey farm distribution in these states (see Section 6).

The financial health of red meat processors relies to a great extent on foreign and domestic demand, as well as various production factors (USDC, 1999b). Generally, product shipments of red meat and poultry products have risen in recent years. Product shipments of beef and pork processors increased 3.4 percent between 1997 and 1998, despite a decrease in beef production between 1997 and 1998 (USDC, 1999b). Product shipments of poultry products were expected to increase by 3 percent in 1998; net returns were also expected to increase among poultry producers as lower feed costs offset low prices caused by increased broiler supply in 1998 (USDC, 1999b). However, the costs of assembling large quantities of raw farm products and transporting final products long distances to consumers tend to be high and may not be offset by operating efficiency gains of large, central processing facilities (Kohls and Uhl, 1998).

EPA uses available company level data for certain publicly owned slaughterers and processors to characterize the financial conditions in these industries. The results of some of this research, *Preliminary Profile of Poultry, Hog, Beef and Dairy Processors and Integrators*, is contained in the record (ERG, 1999c—see, DCN 70232). The majority of these companies are privately owned and financial information is not readily available. To the extent that data are available, EPA evaluates the general financial health of the processing sectors using data from the Security and Exchange Commission (SEC) (ERG, 2000e) and information on publicly held firms reported by Robert Morris Associates (RMA, 1996, 1997, and 1998) and Dun & Bradstreet (Dun & Bradstreet, 1996, 1997, and 1998).

For this brief summary, EPA examines three financial variables, where available. These include pre-tax net return on assets (ROA), interest coverage ratios (ICR), and debt-to-asset ratios. The pre-tax net return on assets among these firms is a measure of financial health that indicates profitability and whether the "investment" in terms of the firms' assets is providing an adequate return on that investment, or whether investment elsewhere would be more profitable. EPA has utilized ROA to assess the financial health of manufacturing firms in the Pulp, Paper and Paperboard (USEPA, 1993), Pharmaceutical Manufacturing (USEPA, 1995a), Metal Products and Machinery (USEPA, 1995d), and the Pesticide Formulating, Packaging and Repackaging (USEPA, 1996) industries.

The interest coverage ratio, which measure earnings before interest and taxes divided by interest (also referred to as EBIT/Interest), indicates the ability of a firm to take on additional debt. EPA has previously used ICRs, in conjunction with ROAs, to assess the financial health of firms in the Pharmaceutical Manufacturing (USEPA, 1995a) and Metal Products and Machinery (USEPA, 1995d) industries.[19] Generally, ICRs over 3 indicate the ability of a firm to take on

[19]In addition, EPA used the closely-related times-interest-earned ratio (TIE) for the Pulp and Paper (USEPA, 1993) and Transportation Equipment Cleaning (USEPA 1998) industries. TIE is defined as the sum of EBIT and depreciation divided by interest payments. The terms ICR and TIE are sometimes used interchangeably.

additional debt (Van Horne, 1986). ICR is also sometimes compared to a lowest quartile ICR based on public data such as that published by RMA to determine vulnerability (USEPA, 1995a and 1995d).

Debt-to-asset ratios also measure a firm's ability to take on additional debt. EPA has used the debt-to-asset ratio to assess the financial health of firms in the Pulp, Paper and Paperboard (USEPA, 1993) industry, although no benchmark was developed for that analysis.

Well-defined benchmarks for financial ratios do not, in general, exist for use in analyzing the financial health of a firm. Instead analysts compare ratios over time and between firms to assess financial health (Brigham and Gapenski, 1997). For this analysis—as in analyses conducted for previous effluent guidelines—EPA uses the value of ROA for the lowest quartile of firms (as published by RMA) as a benchmark for competitive financial performance (USEPA, 1995a, 1995d, 1996). For debt-to-asset ratios, EPA uses a benchmark of 0.40 to indicate vulnerability among U.S. farms, as developed by USDA (USDA/ERS, 1997e; Sommer et al., 1998). This benchmark is similar to the average debt-to-asset ratio for all manufacturing firms, reported by Brigham and Gapenski (1997).

To evaluate the financial health of processing firms, EPA uses SEC 10K filings for 10 firms that operate in the pork and/or poultry processing industries (ERG, 2000e). Table 2-11 presents summary data derived from balance sheets and income statements for these 10 firms, averaging each firm's data over the years 1996, 1997, and 1998. These average data are then used to develop ranges and medians across all the firms in the data set.[20] Of the 10 pork and poultry processing firms EPA investigated, 9 firms show an average positive net income before taxes during this period. The median net income for this group was $30.1 million. Assets ranged from $182.3 million to $11.3 billion with a median of $831.4 million. Liabilities ranged from $178.5 million to $11.4 billion with a median of $775.6 million. Estimated ROA among these firms, shown in Table 2-11, indicates that 60 percent of the firms listed generated returns that exceeded 4 percent; the median was 5.7 percent. The debt-to-asset ratios among these firms ranged from 0.52 to 0.78, with a median of 0.64, which is greater than the average debt-to-asset ratio for manufacturing firms as a whole (ERG, 2000e). Of the 10 firms investigated, seven had ICRs that could be used informatively, and of these, all but two had an ICR greater than 3. These latter two firms, however, had ICRs near 3 (2.37 and 2.58).

Thus, despite the fairly high debt-to-asset ratio, the ICR indicator suggests that debt levels among these firms might not be so high as to prohibit additional debt acquisition. The sheer size of these firms, however, gives them the ability to absorb fairly large costs before any real effect on their financial condition would be felt. For example, an additional debt of $5 million would be only 0.7 percent of the $755 million debt at the median firm.

[20]Generally, 1997 and 1998 were better years for these firms than 1996, in which 4 firms reported negative pre-tax income.

Table 2-11. Key Financial Characteristics of Selected Publicly Held Processing Firms (1996-1998)

Firm	Net Income (Post-tax)	Total Assets	Total Liabilities	% Pre-tax Profit to Total Assets	ICR	Debt-to-Asset Ratio
	$1,000, average of 1996, 1997, and 1998			average of 1996, 1997, and 1998		
Pork Only						
One firm	$38,074	$978,839	$675,169	5.9	6.6	0.69
Pork and Poultry						
Low	$109,397	$1,506,855	$706,499	7.1	3.81	0.47
High	$472,367	$11,392,167	$8,890,133	11.3	-- [a/]	0.78
Median	$290,882	$6,449,511	$4,798,316	9.2	3.81 [a/]	0.63
Poultry Only						
Low	($20,741)	$178,491	$134,429	-8.8	2.37	0.52
High	$99,267	$1,732,533	$3,021,333	9.7	8.14	0.68
Median	$23,208	$473,277	$286,711	5.8	3.19	0.64
All Firms						
Low	($20,741)	$178,491	$111,128	-8.8	2.37	0.52
High	$472,367	$11,392,167	$8,890,133	11.3	8.14 [a/]	0.78
Median (all firms)	$30,086	$775,634	$531,045	5.7	4.24	0.64

Source: 1996, 1997, and 1998 SEC 10-K filings for the following firms: Cal Maine Foods, Inc., ConAgra, Inc., Hormel Foods Corp., Michael Foods, Inc., Pilgrims Pride Corp., Sanderson Farms, Inc., Seaboard Corp., Smithfield Foods, Inc., Tyson Foods, Inc., WLR Foods, Inc. See ERG, 2000e for excerpted filings.

[a/]Three firms reported negative interest payments averaged over the 3 year time frame, resulting in negative ICRs, were not used in the ranges nor are they used to calculate medians, since these firms may still be able to take on additional debt.

Table 2-12. Published Industry Key Financial Characteristics

SIC Code	Number of Observations [a/]	Quartile		
		Lower	Median	Upper
ICR (EBIT/Interest)				
2011 - Meat packing	26	1.1	4.2	12.6
2015 - Poultry slaughtering and processing	13	1.2	3.6	10.0
ROA (% Profit Before Taxes/Total Assets)				
2011 - Meat packing	28	0.8	7.8	17.3
2015 - Poultry slaughtering and processing	14	-1.1	10.5	12.0

Source: RMA, 1997.
[a/]Within the $10-50MM asset group.

Table 2-12 presents information for 1997 on 28 firms in the red meat packing (hogs and beef) industry and 14 firms in the poultry industry. These published financial data are from Robert Morris Associates (RMA) on pork and poultry processing firms (RMA, 1996, 1997, 1998). The largest group of firms reported in the RMA data are those in the $10 million to $50 million asset class, which represents firms that are smaller in size than those represented by the data in Table 2-11. RMA reports pre-tax return on assets and ICR, among other financial ratios, but does not report the debt-to-asset ratio. As Table 2-12 shows, the median firm had an ICR above 3 and a ROA of over 7 percent in 1997. This indicates substantially better financial performance than the lowest quartile firms, which may be vulnerable financially given considerably lower estimates for these indicators compared to the median value.[21]

EPA also reviewed available Dun & Bradstreet data for all red meat packers and poultry slaughterers (Dun & Bradstreet, 1996, 1997, and 1998). This source does not provide ICR or debt-to-asset ratios, but does provide ROA in the form of post-tax returns. Among meat packing firms, the median ROA was 6.0 percent for 142 meat packing establishments in 1996, 5.3 percent for 83 meat packing establishments in 1997, and 5.1 percent for 59 establishments in 1998. Among poultry processors, the median ROA was 2.2 percent for 55 poultry processing establishments in 1996, 2.0 percent for 33 establishments in 1997, and 4.2 percent for 27 establishments in 1998 (Dun & Bradstreet, 1996, 1997, and 1998). Average asset levels across 1996-1998 for this group were $2.0 million for meat packers and $13.5 million for poultry processors, which is generally smaller in size than the firms represented by both the SEC and the RMA data.

[21]EPA also reviewed RMA data for 1996 and 1998 to see if there were any major differences by year and concluded that the 1997 data for meat processors was not substantially different from data in the other years. For poultry processors, however, 1997 median ROA was somewhat higher than the medians for 1996 and 1998, reported at 4.2 percent for 1996 and 7.3 percent for 1998, compared to 10.5 for 1997 (RMA, 1996, 1997, 1998).

Based on these readily available data, EPA concludes that livestock and poultry processing firms that could be affected by the proposed co-permitting requirements, particularly the larger firms, are generally not financially vulnerable, showing some ability to take on additional debt and showing reasonable returns on investment.

2.5 OTHER MARKET CHARACTERISTICS OF THE LIVESTOCK AND POULTRY INDUSTRIES

The following sections discuss annual farm receipts and manufacturing value of shipments (Section 2.5.1), supply and demand conditions (Section 2.5.2), and employment (Section 2.5.3) in the livestock and poultry industries. Other market characteristics are discussed in more detail in the individual sector sections of this report (Sections 6, 7, and 8).

2.5.1 Annual Marketing Receipts

USDA estimates that total economic output from the farm and processing sectors was $231 billion in 1997 and accounted for nearly 3 percent of gross domestic product (estimated at $8.7 trillion during that year) (Council of Economic Advisors, 2000). Table 2-13 summarizes these data.

2.5.1.1 Total Farm Receipts from Marketings

The 1997 Census of Agriculture reports that farm revenue across each of the regulated sectors totaled $95.6 billion in 1997 (Table 2-13). This represents nearly one-half of total farm marketing across all the livestock and crop sectors, estimated at $196.9 billion in 1997 (USDA/NASS, 1999a). Farm revenues from cattle farming make up the largest portion of total U.S. farm receipts. In 1997, revenues from farm cattle sales totaled $40.5 billion and accounted for almost one-half of the total value of U.S. livestock and poultry farming. Of this, fed cattle operations accounted for $20.4 billion (USDA/NASS, 1999a). Farm milk sales totaled $19.0 billion in 1997 (USDA/NASS, 1999a). The poultry industry had combined revenues of $22.3 billion in 1997, up nearly 50 percent compared to 1992 (USDA/NASS, 1999a). The bulk of poultry revenues is attributable to broiler sales (estimated at $14.2 billion in 1997); eggs and turkeys accounted for $8.1 billion. EPA estimates these shares based on reported state level revenues for the three main poultry sectors (USDA/ERS, 1996b). Hog farm revenues also rose from 1992 levels, reaching $13.8 billion in 1997 (USDA/NASS, 1999a).

2.5.1.2 Total Manufacturing Value of Shipments

The 1997 Census of Manufactures reports that the value of shipments across each of the manufacturing businesses in the livestock and poultry industries totaled $159.5 billion in 1997 (Table 2-13). Total receipts across each of the livestock and poultry industries examined totaled $147.9 billion in 1992. Table 2-13 also shows estimated total sales of livestock and poultry products in the U.S. economy, estimated at more than $230 billion in 1997. EPA calculates this total using farm-to-retail price spreads reported by USDA in its monthly *Agricultural Outlook* reports (USDA/ERS, 2000f), adjusted by farm level revenues reported by USDA (USDA/NASS, 1999a).

Table 2-13. Farm Receipts and Manufacturing Value of Shipments (1992 and 1997)

Sector	Farm		Processing		Total
	1992	1997	1992	1997	1997
	($million)	($million)	($ million)	($million)	($billion)
Beef	$41,700	$40,500	$44,500	$50,300	$82.7
Fed Cattle	$21,100	$20,400			
Dairy	$17,800	$19,000	$53,800	$48,300	$58.8
Hogs	$10,000	$13,800	$25,900	$29,200	$35.4
Poultry	$15,400	$22,300	$23,800	$31,700	$54.0
Layers	$3,300	$4,800			
Broilers	$9,800	$14,200			
Turkeys	$2,300	$3,300			
Total	**$84,900**	**$95,600**	**$147,900**	**$159,500**	**$230.9**

Source: Farm revenues for beef, fed cattle, dairy, hogs, and all poultry are from the 1997 Census (USDA/NASS, 1999a). Shares for each of the three poultry sectors are estimated from shares reported for states (USDA/ERS, 1996c). Manufacturing shipment values are from USDC, 1999a. Total is estimated to avoid possible double counting from vertically integrated facilities. "Total" is calculated using farm-to-retail price spreads reported by USDA (USDA/ERS, 2000f), adjusted by farm level revenues reported by USDA (USDA/NASS, 1999a).

2.5.2 Supply and Demand Conditions for Livestock and Poultry Products

Livestock and poultry operations are part of a production chain that includes suppliers, meat packing plants, food processors, cooperatives, and retailers. These operations provide the raw materials to slaughterers, packers, and processors in the form of live animals, raw milk, and eggs. These raw materials are converted into cuts of meat and various processed foods, milk, and dairy products, which are eventually sold to consumers at retail establishments.

This section includes a summary of recent trends in domestic supply and demand and net trade in the U.S. livestock and poultry sectors. Selected years that approximate Census of Agriculture years are shown. For this discussion, production and utilization (demand and traded volumes) are expressed in terms of farm level production equivalents (i.e., animal carcass weight, milk equivalents, number of eggs). These data are summarized in Tables 2-14, 2-15, and 2-16.

2.5.2.1 Farm Production

Production of red meat, milk, and poultry products increased over the period from 1970 to 1997. Table 2-14 shows these trends for selected years. The largest gains were in poultry meat production: both turkey and broiler production more than tripled from 1970 to 1997 (Putnam and Allshouse, 1999). Egg production rose by more than 10 percent over this period. Pork and beef production has increased nearly 20 percent since 1970. Milk production rose more than 30 percent from 1970 to 1997.

Table 2-14. Total Livestock and Poultry Production, Selected Years (1970-1997)

Year	Beef	Pork	Chicken	Turkey	Eggs	Milk
	(billion pounds carcass weight)				(billion dozen)	(billion lbs)
1970	21.7	14.7	8.5	1.7	5.7	117.0
1974	23.1	14.3	8.7	1.9	5.5	115.6
1978	24.2	13.4	10.4	2.0	5.6	121.5
1982	22.5	14.2	12.6	2.5	5.8	135.5
1987	23.6	14.4	16.0	3.7	5.9	142.7
1992	23.1	17.2	21.4	4.8	5.9	150.9
1997	25.5	17.3	27.6	5.4	6.4	156.1
%70-97	**18%**	**18%**	**225%**	**218%**	**12%**	**33%**

Source: Putnam and Allshouse (1999).

2.5.2.2 Domestic Demand

Americans are among the highest per capita consumers of poultry, meat, and dairy products in the world. Since the 1980s, per capita U.S. demand for poultry meat, in particular, increased dramatically, outpacing the rate of population growth. As shown in Table 2-15, domestic demand for poultry meat has more than doubled: demand for chicken meat rose from 40 pounds per person in 1970 to more than 80 pounds per person in 1997 and turkey demand rose from 8 pounds per person in 1970 to nearly 18 pounds per person in 1997 (Putnam and Allshouse, 1999). Per capita egg demand dropped over the period from more than 300 eggs to about 240 eggs per person per year. Per capita red meat demand also dropped from 1970 to

1997: beef demand declined from 114 pounds per person to 96 pounds per person and pork demand dropped from 72 pounds to 63 pounds per person (Putnam and Allshouse, 1999). Per capita demand for fluid milk and dairy products, however, rose from an aggregate of 531 pounds per person in 1970 to 569 pounds per person in 1997 (NMPF, 1999).

Table 2-15. Per Capita Demand for Livestock and Poultry Products, Selected Years (1970-1997)

Year	Beef	Veal	Pork	Chicken	Turkey	Eggs	Milk
	(lbs./person)					(doz./person)	(lbs., ME/person)
1970	114.1	3.0	72.1	40.1	8.1	308.1	530.9
1974	115.5	2.3	68.2	39.6	8.7	283.0	520.5
1978	117.7	2.9	60.2	44.8	8.7	271.5	531.1
1982	103.9	2.0	62.6	51.5	10.6	264.1	519.4
1987	103.8	1.8	62.7	62.0	14.7	253.8	550.2
1992	94.7	1.2	67.8	76.9	17.9	235.0	569.6
1997	95.2	1.2	62.5	83.8	17.6	242.4	568.6
%70-97	**-17%**	**-60%**	**-13%**	**109%**	**117%**	**-21%**	**7%**

Source: Putnam and Allshouse (1999), except data on dairy utilization (demand and traded volumes), which are expressed in terms of milk equivalent (ME), total solids basis (NMPF, 1999).

Table 2-16. Livestock and Poultry Product Trade, Selected Years (1970-1997)

Year	Beef		Pork		Chicken	Turkey	Eggs	Milk	
	Imports	Exports	Imports	Exports	Exports			Imports	Exports
	(million lbs.)						(mill. doz.)	(mill. lbs., ME)	
1970	1,792	101	491	194	183	43	45	3,165	884
1974	1,615	115	488	204	235	43	56	4,937	1,158
1978	2,297	214	495	421	505	57	121	3,902	760
1982	1,939	305	612	365	674	56	185	4,184	10,640
1987	2,269	656	1,195	236	920	37	136	4,206	5,597
1992	2,440	1,400	645	552	1,732	186	175	4,245	7,032
1997	2,343	2,136	633	1,044	5,048	598	220	4,383	5,244
%70-97	**31%**	**2015%**	**29%**	**438%**	**2658%**	**1291%**	**389%**	**38%**	**493%**

Source: Putnam and Allshouse (1999), except data on dairy utilization (demand and traded volumes), which are expressed in terms of milk equivalent (ME), total solids basis (NMPF, 1999). Annual poultry (chicken, turkey, egg) imports are low and are not shown.

2.5.2.3 Imports and Exports

Despite its position as one of the largest agricultural producers in the world, historically the U.S. has not been a major player in world markets for red meat (beef and pork) or dairy products. In fact, until recently, the U.S. was a net importer of these products (Putnam and Allshouse, 1997 and 1999; USDA/WAOB, 1999 and 2000; NMPF, 1999). The presence of a large domestic market for value-added meat and dairy products has limited U.S. reliance on developing export markets for its products (NDB, 1995; USDA/ERS, various). In recent years, however, slowing growth and/or saturation in domestic demand has forced U.S. industries to step up efforts to export products abroad. As the U.S. has taken steps to expand export markets for red meat and dairy products, one major obstacle has been that it remains a relatively high cost producer of these products, particularly of milk and dairy products, as compared to other established net exporters, such as New Zealand, Australia, and Latin America, as well as other more established and government-subsidized exporting countries, including the European Union and Canada (NDB, 1995; USITC, 1998a).

Increasingly, however, continued efficiency gains and low-cost feed is making the U.S. more competitive in world markets for these products, particularly for red meat (Iowa State University, 1998; USDA/WAOB, 1999 and 2000). The U.S. is among the world's lowest cost producer of pork, but still ranks close to competitors Australia and Argentina in terms of cost of production (Iowa State University, 1998). The U.S. is currently the world's second largest beef exporter, after Australia, and is among the world's top producer of high grade beef (USDA/WAOB, 1999 and 2000). While the proposed CAFO regulations may raise production costs and potentially reduce production quantities that would otherwise be available for export, EPA believes that any quantity and price changes resulting from the proposed requirements will not significantly alter the competitiveness of U.S. export markets for red meat or dairy foods.

U.S. poultry products account for a controlling share of world trade and exports account for a sizable and growing share of annual U.S. production (Putnam and Allshouse, 1997 and 1999; USDA/WAOB, 1999 and 2000; USITC; 1998b). The U.S. is among the world's lowest cost producer of poultry products due to higher feed efficiency and lower overall feed costs (USITC, 1998b). Given the established presence of the U.S. in world poultry markets and the relative strength in export demand for these products, EPA does not expect that the predicted quantity and price changes resulting from today's proposed regulations will have a significant impact on the competitiveness of U.S. poultry exports.

Table 2-16 shows recent trends in U.S. livestock and poultry trade. As shown, U.S. exports of meat and dairy products have grown dramatically. U.S. beef exports more than doubled and pork exports have nearly doubled since the early 1990s (Putnam and Allshouse, 1997 and 999). Chicken and turkey exports also rose sharply and nearly tripled over the period (Putnam and Allshouse, 1997 and 1999). Historically, dairy product exports have been more variable year-to-year; however, in recent years commercial exports have been steadily increasing, while subsidized exports and foreign aid have dropped (NMPF, 1999).

2.5.3 Industry Employment

Employment figures presented in this report include total farm labor (hired labor only and total, which also includes self-employed and family) and employment in the processing sector. Where published data are not available, EPA estimates employment in terms of full-time equivalents (FTEs) using available information from USDA survey data.

Combined, total employment within the farm and processing sectors is estimated at 1.7 million in 1997 and accounted for more than one percent of national civilian employment (estimated at 129.6 million employed during that year) (Council of Economic Advisors, 2000). This estimate reflects total *direct* employment only, representing the number of jobs related to the production and processing of these products. This estimate does not include *indirect* or *induced* employment, or workers throughout the economy that provide additional support to the industry. These data are summarized in Table 2-17.

Table 2-17. Livestock and Poultry Industry Employment by Industry Segment (1997)

Animal Commodity Group	Total Farm Labor [a/]	Hired Labor as % Total [b/]	Total Processing Labor [c/]	Total Farm and Processing	Farm % Agric. Labor [d/]	Farm&Mfg % Total Labor [d/]
	(FTEs)	(percent)	(FTEs)		(percent)	
Fed Cattle [a/]	336,700	NA	145,617	482,317	10%	0.4%
Pork	195,900	8%	84,723	280,623	6%	0.2%
Dairy	483,800	17%	141,400	625,200	14%	0.5%
Poultry	71,800	39%	204,200	276,000	2%	0.2%
Total	**1,088,200**	**NA**	**575,940**	**1,664,140**	**32%**	**1.3%**

[a/] Total farm employment is updated by EPA from 1990 estimates by Abel, Daft & Earley (1993) to account for changes between 1990 and 1997 (Council of Economic Advisors, 2000). Estimates are allocated by sector based on its share of annual farm revenue (USDA/NASS, 1999a) and exclude employment at cattle grazing operations.
[b/] Hired labor is expressed as a percent of total estimated farm employment from labor estimates provided by USDA from its Farm Labor Survey database (Milton, 1999 and 1998).
[c/] Processing sector employment is from the 1997 Census of Manufactures (USDC, 1999a).
[d/] Shows total farm employment as a share of civilian (agricultural) employment and total farm and processing level employment as a share of civilian (total) employment, seasonally adjusted annual averages (Council of Economic Advisors, 2000).

2.5.3.1 Total Farm Employment

EPA estimates total farm sector employment by updating 1990 estimates developed by an agricultural consultancy group, Abel, Daft & Earley (1993). The Abel, Daft & Earley study estimated total farm sector employment by calculating FTEs based on labor hours worked

reported by USDA converted to person-year equivalents.[22] EPA is unable to duplicate this approach using more recent data because similar farm labor information is not regularly updated by USDA. Instead, EPA adjusts these 1990 estimates to account for changes in agricultural employment between 1990 and 1997. This is done by projecting USDA's 1990 farm labor hours based on changes in civilian employment reported by the Department of Labor (Council of Economic Advisors, 2000).

EPA's calculated changes in agriculture sector FTEs from 1990 to 1997 are allocated to the livestock and poultry sectors using Able, Daft and Earley's assumption that one-half of total farm level employment is in these sectors (with the remaining employed by the crop production sectors). The additional FTEs are allocated across each of the livestock and poultry sectors based on each sector's share of annual livestock and poultry receipts (USDA/NASS, 1999a). In addition, EPA adjusts the 1990 labor estimates for the beef sector to exclude farm employment by rangeland operations, also based on the share of farm level sales in that subsector (USDA/NASS, 1999a).

The resulting farm labor estimates for 1997 are shown in Table 2-17. This table shows that total farm level FTEs in the livestock and poultry sectors listed are estimated at about 1.1 million in 1997. As a share of total agricultural employment, total farm employment by the regulated sectors accounts for roughly 30 percent, excluding employment at cattle grazing facilities. Across EPA's estimate of 376,000 AFOs (see Table 2-3), this translates to an average of nearly 3 FTEs per operation. Because farm labor is seasonal and because independent owners might work more than 40 hours per week, these figures may not represent the actual number of individuals who work on farms.

This estimate of total farm employment includes operator labor, unpaid family labor, and hired labor. The bulk of farm employment consists of owner-operators and other family members. USDA defines these as *self-employed workers*, including operators or partners who complete unpaid agricultural work (including the contractee); and *unpaid workers*, including workers, other than self-employed workers, who did at least 15 hours of unpaid agricultural work (e.g., family members) (USDA/NASS, 1998c). Limited available information indicate that hired farm labor accounts for roughly 40 percent of total farm employment in the poultry sectors but a small share in the hog and dairy sectors. Hired labor numbers are not available for confinement beef operations only. Hired workers may be full-time or part-time, and seasonal or year-round employees.

[22]USDA-reported labor hours were converted to person-year equivalents by dividing by 2,080 (i.e., 52 forty-hour weeks). Data used for these estimates are from various ERS publications, including *Production and Efficiency Statistics, 1990* and *State Financial Summary, 1990*.

2.5.3.2 Total Manufacturing Employment

Employment in the processing sector is available from U.S. Census of Manufactures for 1997 (USDC, 1999a). As shown in Table 2-17, processing level employment totaled 0.6 million in 1997. For the red meat sectors, the Census of Manufactures data are expressed across all plants engaged in NAICS 311611, Animal (except poultry) slaughtering, and NAICS 311612, Meat processed from carcasses, which encompass both the beef and pork meat industries as well as other miscellaneous sectors, including lamb and sheep.[23] As reported by the Department of Commerce, the pork processing sector employed 84,700 persons and the beef processing sector employed 145,600 persons in 1997 (Table 2-17).

Dairy manufacturing employment is an aggregate of reported employment across the dairy product codes (NAICS 311511, Fluid milk manufacturing; NAICS 311512, Creamery butter manufacturing; NAICS 311513, Cheese manufacturing; NAICS 311514, Dry, condensed and evaporated dairy product manufacturing; and NAICS 311520, Ice cream and frozen dessert manufacturing). In 1997, there were 141,400 people employed in dairy processing (corrected by the Department of Commerce to avoid double counting).

Poultry employment is the aggregate of reported employment for NAICS 311615, Poultry processing, and NAICS 311999G, Liquid, dried, and frozen eggs. In 1997, employment in poultry processing totaled at 204,200 jobs (Table 2-17).

[23] Employment by firms engaged in the manufacture of "Prepared Feeds" (SIC 2048) were not included for this analysis since these data cannot be proportioned out across each of the beef, dairy, pork, and poultry sectors. Typically, however, it is recognized that employment in the feed grains sector constitutes part of direct employment in the livestock and poultry sectors, since it includes workers engaged in the manufacture of agricultural inputs and their supplies and employment in supplier industries (Abel, Daft & Earley, 1993).

SECTION THREE

THE PROPOSED CAFO REGULATIONS

Section 1 provides a summary of the existing NPDES permit regulations and technology-based pollutant limits affecting CAFOs that have been in place since the 1970s. This section summarizes the proposed revisions to the CAFO regulations (Section 3.1) and describes the ELG Options and NPDES Scenarios that EPA is proposing, as well as the regulatory alternatives that were considered by EPA during the development of this rulemaking (Section 3.2).

3.1 SUMMARY OF THE PROPOSED REVISIONS

The major regulatory revisions being proposed by EPA include changes to the scope of the regulations (i.e., which operations are subject to the proposed regulations) and other changes to the regulatory requirements for CAFOs. This section summarizes these changes briefly. More detailed information on the proposed regulatory changes is available in the preamble (see, Section VII, "What Changes to the NPDES CAFO Regulations Are Being Proposed?" and Section VIII, "What Changes to the Feedlot Effluent Limitations Guidelines Are Being Proposed?").

EPA is proposing to make the provisions of this rule effective three years from promulgation for facilities newly defined as CAFOs (approximately December, 2005). For facilities that are currently defined as CAFOs, the effluent guideline requirements are immediately applicable upon permit renewal or permit application.

3.1.1. Revised Scope Requirements under the Proposed Regulations

The existing NPDES regulation uses the term "animal unit" (AU) to describe sizes of facilities that are CAFOs and therefore subject to the regulations. The metric AU was established in the 1970 regulations to equate the wastes produced by different animal types based on waste characteristics. The existing regulation defines facilities with 1,000 AU or more as CAFOs. Facilities with 300 AU to 1,000 AU are CAFOs if they meet certain conditions, or if they are designated as a CAFO by the permit authority. Those facilities with fewer than 300 AU are CAFOs only if designated by the permit authority.

EPA's proposal clarifies the definition of a CAFO to include both the production areas (animal confinement areas, manure storage areas, raw materials storage areas and waste containment areas) and the land application areas that are under the control of the CAFO owner or operator.

EPA's proposal also broadens the applicability of the existing permit regulation with regard to the size of a facility that is defined as a CAFO. EPA is co-proposing two alternatives for determining who is affected by the NPDES program for CAFOs, including the two-tier structure and the three-tier structure. The alternatives offer comparable environmental benefits but differ in administrative approach.

The proposed two-tier structure simplifies the definition of which facilities are CAFOs by establishing a single threshold for each animal sector at the equivalent of 500 AU. Facilities with more than 500 AU would be defined as CAFOs; facilities with fewer than 500 AU are CAFOs only if designated by the permit authority. EPA believes this two-tier approach will simplify the regulation by making it clear which CAFOs are subject to the proposed requirements and will also enhance compliance and facilitate enforcement. EPA is also soliciting comment on whether to propose an alternative AU threshold under the two-tier structure, that would establish a single threshold for each animal sector at the equivalent of 750 AU. Facilities with more than 750 AU would be defined as CAFOs; facilities with less than 750 AU are CAFOs only if designated by the permit authority.

The proposed three-tier structure retains the framework of the existing regulation: all confinement operations with more than 1,000 AU are defined as CAFOs; operations with between 300 AU and 1,000 AU are CAFOs if they meet certain conditions or if designated by the permit authority; and operations with fewer than 300 AU are CAFOs only if they are designated by the permit authority. However, EPA's proposal would alter the conditions for defining which operations in the middle tier are CAFOs and would require all facilities with 300 AU to 1,000 AU either to apply for a permit or to certify that they do not meet the conditions for being defined as a CAFO.

Under the three-tier structure, EPA is proposing certain "risk-based" conditions, among which are included: there is direct contact of animals with waters of the U.S. at the operation; there is insufficient storage and containment at the production area to prevent discharge from reaching waters of the U.S.; there is evidence of discharge in the last five years; the operation's production area is located within 100 feet of waters of the U.S.; the operator does not have, or is not implementing, a Permit Nutrient Plan; and manure of more than twelve tons annually is transported to off-site recipients without following proper manure management. Additional information on the set of conditions for defining which operations in the middle tier are CAFOs is provided in Section VII of the preamble. The proposed "risk-based" conditions are described in Part 122.23(a)(3)(ii)(B) Option 2 of the proposed regulation.

Also under the three-tier structure, EPA is soliciting comment on whether to propose an alternative AU threshold that would alter the conditions for defining which operations in the middle tier are CAFOs. This scenario would use a similar but less inclusive set of conditions that would result in fewer AFOs meeting the definition of a CAFO. Information on the set of conditions for defining which operations in the middle tier are CAFOs under this alternative is also provided in Section VII of the preamble.

EPA's proposal also expands the regulatory definition of CAFOs to include all types of poultry operations regardless of the type of manure handling system or watering system they use. EPA's proposal would also include stand-alone immature swine and heifer operations. The existing regulation only applies to chicken operations which use either a specific type of drinking water delivery system or liquid manure handling systems. Most chicken operations use neither of these technologies, therefore, EPA is proposing to redefine CAFOs with respect to chickens eliminating any distinctions about how the birds are raised or how the manure is handled. The existing regulations also applies to swine weighing more than 55 pound or mature dairy cows only. For the purpose of identifying CAFOs, EPA is proposing to redefine CAFOs with respect to immature pigs and heifers. These proposed changes account for industry trends over the past 25 years toward specialization, including the practice of confining immature swine that weigh less than 55 pounds in separate nursery facilities

The 300 AU, 500 AU, 750 AU and 1,000 AU equivalent number of animals for each sector would be as follows:

Animal Type	**1,000 AU**	**750 AU**	**500 AU**	**300 AU**
		(number of animals)		
Cattle[a/]	1,000	750	500	300
Veal	1,000	750	500	300
Mature Dairy Cattle	700	525	350	200
Mature Swine	2,500	1,875	1,250	750
Immature Swine	10,000	7,500	5,000	3,000
Chickens	100,000	75,000	50,000	30,000
Turkeys	55,000	41,250	27,500	16,500
Ducks	5,000	3,750	2,500	1,500
Horses	500	375	250	150
Sheep or Lambs	10,000	7,500	5,000	3,000

[a/]Other than mature dairy cattle or veal.

EPA's estimate of the number of animal confinement operations that would be defined or designated as CAFOs is presented in Section 2 of this report.

EPA's proposal retains the permit writer's discretion to "designate" a confinement facility as a CAFO, even if below the AU threshold that defines CAFOs. EPA is proposing to simplify the criteria, however, by eliminating two criteria that have proven difficult to implement—the "direct contact" criterion and the "man made device" criterion. EPA is proposing to eliminate these criteria for the 300 to 1,000 AU tier in the proposed three-tier alternative and, for simplicity's sake, for the less than 500 AU tier in the proposed two-tier alternative. The proposal retains the existing requirement for the permit authority to consider a number of factors when determining whether the facility is a significant contributor of pollution to waters of the U.S., as well as the requirement for an on-site inspection in order to make that determination. EPA is also

proposing to clarify its authority to designate facilities in States with NPDES authorized programs.

EPA's proposal also broadens the applicability of the existing effluent guidelines affecting feedlot operations. The existing effluent guidelines regulations apply to only those CAFOs with more than 1,000 AU. EPA is proposing to broaden the applicability of the effluent guidelines to be consistent with the definition of a CAFO for key sectors. The proposed effluent guidelines revisions would apply to beef, dairy, swine, poultry and veal operations that are defined or designated as CAFOs under either of the co-proposed structures and that are above the threshold for the effluent guideline. For those operations below the threshold defining them as CAFOs (designated CAFOs), the permit writer would use best professional judgment (BPJ) to develop the site-specific permit conditions.

EPA's proposed effluent guidelines revisions do not alter the existing effluent guideline regulations for horses, ducks, sheep or lambs. In these sectors, only facilities with more than 1,000 AU are subject to the effluent guidelines. Permits for operations in these subcategories with fewer than 1,000 AU would continue to be developed based on the best professional judgement of the permit writer.

EPA is further proposing to clarify that entities that exercise "substantial operational control" over the CAFO are "operators" of the CAFO and thus would need to obtain a permit along with the CAFO owner or operator. The trend toward specialized animal production under contract with processors, packers, and other integrators has increasingly resulted in concentrations of excess manure beyond agricultural needs in certain geographic areas. Especially in the poultry and swine sectors, the processor provides the animals, feed, medication and/or specifies growing practices. EPA believes that clarifying that both parties are liable for compliance with the terms of the permit as well as responsible for the excess manure generated by CAFOs will lead to better management of manure. EPA's estimate of the number of processing firms that may be subject to the proposed regulations as co-permittees is presented in Section 2 of this report.

3.1.2 Other Revised Requirements under the Proposed Regulations

Additional regulatory requirements that are being proposed for CAFOs are summarized as follows. Additional information on these proposed changes, along with EPA's justification for proposing these requirements is presented in Sections VII and VIII of the preamble.

Eliminate the 25-year, 24-hour Storm Event Permit Exemption

Under the current rule, an operator, whose facility is designed, constructed and operated to contain a 25-year, 24-hour storm event is not required to apply for a permit if discharges occur only as a result of such an event. EPA is proposing to eliminate the 25-year, 24-hour storm event permit exemption and to impose a broader, more explicit duty for all CAFOs to apply for a permit. However, EPA is proposing to retain the 25-year, 24-hour storm standard as a design standard in the effluent guidelines for certain sectors (specifically, the beef and dairy sectors). CAFOs in those sectors would need to obtain permits, but the permits would allow certain discharges as long as the facility meets the 25-year, 24-hour storm design standard.

Include Land Application Area as Part of the CAFO

The proposal clarifies the definition of a CAFO as including the production area (animal confinement area, manure storage area, waste containment area) as well as the land application area that is under the control of the CAFO owner or operator. EPA is also co-proposing options for off-site handling of manures. Under the first co-proposal, EPA would require that the CAFO operator obtain a certification from off-site recipients of CAFO manure that the manure is being land applied according to proper agricultural practices. Under the second co-proposal, EPA would require that the CAFO operator provide off-site recipients of CAFO manure with information about the nutrient content of the manure and proper agronomic use of the manure, and that the CAFO operator maintain records on the identity of manure recipients, the volumes received, and the dates the manure was received.

Increase the Stringency of the Effluent Guidelines

EPA is proposing to establish Best Practicable Control Technology Currently Available (BPT), Best Available Technology Economically Achievable (BAT) and Best Control Technology for Conventional Pollutants (BCT), and New Source Performance Standards (NSPS) for CAFOs. EPA is proposing to establish requirements for discharges from the production area and land application of manure, including the requirement that all CAFOs develop a Permit Nutrient Plan (PNP). More detailed information on the proposed revisions to the effluent guidelines and standards is provided in Section VIII of the preamble.

The BPT requirements in the existing regulations apply to beef, dairy, swine, veal, and poultry operations with more than 1,000 AU. These requirements establish a zero discharge requirement from the production area with a design standard or the 10-year, 24 hour storm event. The proposed revisions to BPT limitations for these subcategories requires zero discharge from the CAFO production area with a design criteria of the 25-year, 24-hour storm event. BPT requires that all CAFOs obtain a PNP to control the discharge of pollutants from the land

application fields. The PNP defines the rate at which manure can be applied to land owned or controlled by the CAFO.

EPA is proposing to restrict manure application to a phosphorus basis where necessary due to soil conditions. In situations where the build up of phosphorus in the soil is excessive, manure application would be prohibited. In all other areas, application of manure to meet the nitrogen requirements of the crop will be allowed. In addition, manure and wastewater application is prohibited within 100 feet of surface water, tile drain inlets, agricultural drainage wells, and sinkholes. EPA is proposing that manure must be applied to cropland at rates not to exceed the crop requirements for nutrients and the ability of the soil to absorb any excess phosphorus. BPT establishes specific recordkeeping requirements associated with ensuring the achievement of the zero discharge limitation for the production area and that the application of manure and wastewater is done in accordance with land application requirements. EPA is also proposing to require the CAFO operator to maintain records of any excess manure that is transported off-site.

EPA is also proposing to establish BCT limitations that are equivalent to the BPT limitations for the control of conventional pollutant discharges from CAFOs.[1]

EPA is proposing to revise BAT requirements for the beef and dairy subcategories based on the BPT requirements with the additional requirement that the CAFO achieve zero discharge to ground water beneath the production area in locations where the ground water has a direct hydrological connection to surface water. The land application requirements of the proposed BAT requirements are the same as BPT. The existing regulation requires zero discharge from the production area with the 25-year, 24-hour storm design standard, which allows for discharges when catastrophic or chronic storms exceed this design criteria. The preamble also solicits comment on basing BAT on BPT without the additional ground water controls. For the hog, veal and poultry subcategories, the proposed BAT requirements include elimination of the current exemption for overflows in the event of a chronic or catastrophic storm at the production area. The preamble also solicits comment on basing BAT on BPT without the additional controls precluding overflow due to rain events.

EPA's proposal also revises standards for new operations (New Source Performance Standards, or NSPS). For the beef and dairy subcategories, EPA is proposing new source standards based on the same technology requirements as BAT. NSPS for the hog, veal and poultry subcategories is based on the proposed BAT requirement with the additional requirement that there be no discharge from the production area of pollutants through ground water that has a direct hydrological connection to surface water. Both the BAT and NSPS requirements have the same land application and record keeping requirements as proposed for BPT.

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[1]Conventional pollutants are defined as Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), fecal coliform, oil and grease and pH.

Additional information and EPA's justification for proposing these requirements is presented in Section VIII of the preamble.

Other Regulatory Changes

EPA's proposal would make several other changes to the existing regulations, which would require permit authorities to include the following conditions in permits. These conditions would: require retention of a permit until proper facility closure; establish the method for operators to calculate the allowable manure application rate; specify restrictions on timing and methods of application of manure and wastewater to assure use for an agricultural purpose (e.g., certain applications to frozen, snow covered or saturated land) to prevent impairment of water quality; address risk of contamination via groundwater with a direct hydrological connection to surface water for existing swine, poultry and veal CAFOs; address the risk of improper manure application off-site by either requiring that the CAFO operator obtain from off site recipients a certification that they are land applying CAFO manure according to proper agricultural practices or requiring the CAFO to provide information to manure recipients and keep appropriate records of off-site transfers, or both; and establish design standards to account for chronic storm events.

More detailed information on the proposed revisions to the NPDES permit requirements and the effluent guidelines affecting CAFOs is provided in the preamble.

3.2 Summary of ELG Options and NPDES Scenarios Considered by EPA

This section describes the guidelines' technology options ("ELG Options ") and NPDES alternative scenarios ("NPDES Scenarios") that EPA is proposing, as well as the regulatory alternatives that were considered by EPA during the development of this rulemaking. These proposed and alternative options and scenarios are summarized in Table 3-1.

3.2.1 Effluent Guidelines Options

The technology options considered during this rulemaking include the following:

Option 1. This option is equivalent to Option 1 previously described under BPT (Section 3.1.2). It requires zero discharge from the production area with liquid storage designed, constructed, and maintained to handle all process wastewater and storm water runoff from the 25-year, 24-hour storm event. In addition, Option 1 requires management practices to ensure that the production area, including manure and wastewater storage areas, are being adequately maintained. Option 1 also establishes a requirement to develop a PNP which establishes the proper land application rate for manure and wastewater to meet the nitrogen requirements for the crops being grown by the CAFO.

Table 3-1. Summary Description of Options/Scenarios Considered by EPA

Technology Options (ELG)	
Option 1	N-based land application controls and inspection and recordkeeping requirements for the production area (described in Section VIII.C.3 of the preamble)
Option 2 (BPT – all subcategories)	Same as Option 1, but restricts the rate of manure application to a P-based rate where necessary (depending on specific soil conditions at the CAFO)
Option 3 (BAT – Beef/Heifers/Dairy)	Adds to Option 2 by requiring all operations to determine whether the groundwater beneath the production area has a direct hydrologic connection to surface water; if so, requires groundwater monitoring and controls
Option 4	Adds to Option 3 by requiring sampling of surface waters adjacent to production area and/or land under control of the CAFO to which manure is applied
Option 5 (BAT – Swine/Poultry/Veal)	Adds to Option 2 by establishing a zero discharge requirement from the production area that does not allow for an overflow under any circumstances
Option 6	Adds to Option 2 by requiring that large hog and dairy operations install and implement anaerobic digestion and gas combustion to treat their manure
Option 7	Adds to Option 2 by prohibiting manure application to frozen, snow covered or saturated ground
Regulatory Scope Options (NPDES)	
Scenario 1	Retains existing 3-tier structure and establishes additional requirements would remove the 25-year,24-hour storm exemption
Scenario 2	Same as Scenario 1; operations with 300-1,000 AU would be subject to the regulations based on certain "risk-based" conditions (described in Part 122.23(a)(3)(ii)(B) Option 2 of the proposed regulation)
Scenario 3 "Three-Tier"	Same as Scenario 2, but requires all operations with 300-1,000 AU to either apply for a NPDES permit or to certify to the permit authority that they do not meet any of the conditions and thus are not required to obtain a permit
Scenario 4a "Two-Tier" (500 AU)	Establishes 2-tier structure and applies ELG standard to all operations with more than 500 AU
Scenario 4b	Establishes 2-tier structure and applies ELG standard to all operations with more than 300 AU
Scenario 5 "Two-Tier" (750 AU)	Establishes 2-tier structure and applies ELG standard to all operations with more than 750 AU
Scenario 6	Retains existing 3-tier structure and establishes a simplified certification process (described in Section VII.C.2 of the preamble)

Option 2. This option is equivalent to Option 2 previously described under BPT. Option 2 builds on the requirements established under Option 1 retaining the same requirements for the production area. Option 2 further restricts the amount of manure that can be applied to crop land owned or controlled by the CAFO. Manure and wastewater would have to be applied at the appropriate rate, taking into account the nutrient requirements of the crop and soil conditions. Option 2 requires that manure be applied to meet the phosphorus requirements of the crops grown if soil conditions warrant and if soils have a very high level of phosphorus build-up, no manure or wastewater could be applied to the crop land owned or controlled by the CAFO.

Option 3. This option is the proposed BAT Option for the beef and dairy subcategories and the proposed NSPS option for all subcategories (described in Section 3.1.2). Option 3 adds to the requirements for Option 2 by requiring that all CAFO operations perform an assessment to determine whether the ground water beneath the feedlot and manure storage area has a direct hydrological connection to surface water beneath the production area. If a link is established, the facility must monitor ground water upstream and downstream of the production area to ensure that they are achieving zero discharge to ground water. EPA assumes that CAFOs will comply with the zero discharge requirement by installing liners of synthetic material beneath lagoons and ponds and impervious pads below storage of dry manure stockpiles. EPA's costs for liners reflect both a synthetic liner and compacted clay to protect the liner and prolong its useful life. Additional information on why EPA is proposing this option for BAT and NSPS is presented in Section VIII of the preamble.

Option 4. Option 4 adds to the requirements for Option 3 by requiring sampling of surface waters adjacent to feedlots and/or land under control of the feedlot to which manure is applied. This option requires CAFOs to sample surface water both upstream and downstream from the feedlot and land application areas following a one half inch rain fall not to exceed 12 samples per year. The samples would be analyzed for concentrations of nitrogen, phosphorus and total suspended solids (TSS). These pollutants are believed to provide an adequate indication of whether a discharge is occurring from the operation. Any difference in concentration between the upstream and downstream samples would be noted. This monitoring requirement could provide some indication of discharges from the land application or feedlot areas.

Option 5. This option is the proposed BAT Option for the swine, poultry, and veal subcategories and the proposed NSPS option for these sectors (with the addition of the groundwater requirements under Option 3, as described in Section 3.1.2). Option 5 establishes a zero discharge requirement from the production area that does not allow for an overflow under any circumstances. By keeping precipitation from coming in contact with the animals, raw materials and waste handling and storage areas, CAFOs could operate the confinement areas and meet zero discharge regardless of rainfall events. Option 5 includes the same land application requirements as Option 2, which would restrict the rate of manure and wastewater application to a phosphorus based rate where necessary depending on the specific soil conditions at the CAFO. Additionally, application of manure and wastewater would be prohibited within 100 feet of

surface water. Additional information on why EPA is proposing this option for BAT and NSPS is presented in Section VIII of the preamble.

Option 6. Option 6 adds to the requirements of Option 2 by requiring that large hog and dairy operations (EPA would apply Option 6 to hog operations and dairies with more than 2,000 AU) install and implement anaerobic digestion and gas combustion to treat their manure. With proper management, such a system can be used to generate additional on-farm revenue. Anaerobic digestion requires that the treatment be performed in an enclosed system to allow for the capture, collection and transmission of the methane gas, to a combustion device (i.e., engine, generator, boiler, and/or absorption cooler). The enclosed system will reduce air emissions, especially odor and hydrogen sulfide, and potentially reduce nitrogen losses from ammonia volatilization. The treated effluent will also have less odor and should be more transportable relative to undigested manure, making off-site transfer of manure more economical.

Option 7. Option 7 adds to the requirements of Option 2 by prohibiting manure application to frozen, snow covered, or saturated ground. This prohibition requires that CAFOs have adequate storage to hold manure for the period of time during which the ground is frozen, or saturated. The necessary period of storage ranges from 45 to 270 days depending on the region. In practice, this may result in some facilities needing storage to hold manure and wastes for 12 months. EPA is requesting comment on whether there are specific conditions which warrant a national standard that prohibits application when the ground is frozen, snow covered, or saturated.

3.2.2 NPDES Scenarios

Under the NPDES permit program, all point sources that directly discharge pollutants to waters of the U.S. must apply for a NPDES permit and may only discharge pollutants in compliance with the terms of that permit. NPDES permits may be issued by EPA or a State, Territory, or Tribe authorized by EPA to implement the NPDES program.

A NPDES permit may be either an individual permit tailored for a single facility or a general permit applicable to multiple facilities within a specific category. General NPDES permits are available to address a category of discharges that involve similar operations with similar wastes. The general permit specifies the type or category of facilities that may obtain coverage under the permit. Those facilities that fall within this category then must submit a “notice of intent” (NOI) to be covered under the general permit to gain permit coverage. EPA anticipates that the Agency and authorized States will use general NPDES permits to a greater extent than individual permits to address CAFOs.

EPA’s NPDES Scenarios differ in terms of the number of operations that would be affected by the proposed regulations. EPA’s estimate of the number of animal confinement

operations that would be defined or designated as CAFOs is presented in Section 2 of this report. The NPDES scenarios considered during this rulemaking include the following:

Scenario 1. This scenario retains the existing three-tier structure and the conditions for defining the middle tier AFOs as CAFOs. That is, any AFO that meets the size condition (operations with between 300 AU to 1,000 AU) would be defined as a CAFO if it also meets one of the two specific criteria governing the method of discharge, namely, pollutants are discharged through a man-made ditch, flushing system, or other similar man-made device, or pollutants are discharged directly into waters of the United States that originate outside of the facility and pass over, across, or through the facility or otherwise come into direct contact with the confined animals. EPA is not proposing this scenario because these conditions have proven to be difficult to interpret and implement for AFOs in the 300 to 1,000 AU size category and have not facilitated compliance or enforcement. For more information, see Section VII of the preamble.

Scenario 2. This scenario also retains the existing three-tier structure but modifies the conditions for defining the middle tier AFOs as CAFOs. That is, any AFO that meets the size condition (operations with between 300 AU to 1,000 AU) would be defined as a CAFO if it met one or more of the risk-based conditions, described in Section 3.1.1. In this scenario, owners or operators of AFOs in the middle tier would not be required to certify to the permit authority that the facility is not a CAFO. However, all facilities that do meet one or more of the conditions would have a duty to apply for an NPDES permit. This scenario is not being proposed because of concerns that there would be no way for the permit authority to know which operations were taking the exemption and which should, in fact, be applying for a permit. For more information, see Section VII of the preamble.

Scenario 3. This scenario is the co-proposed three-tier structure that retains the existing three-tier framework but modifies the conditions for defining AFOs in the middle tier as CAFOs. That is, any AFO that meets the size condition (operations with between 300 AU to 1,000 AU) would be defined as a CAFO if it met one or more of the risk-based conditions, briefly described in Section 3.1.1. (More detailed information is available in the proposed regulation and in Section VII of the preamble). Under this co-proposal, EPA would require all middle tier AFOs to either apply for an NPDES permit or to certify to the permit authority that they do not meet any of the conditions which would require them to obtain a permit. Additional information on why EPA is co-proposing this scenario is presented in Section VII of the preamble.

Scenario 4a. This scenario is the co-proposed two-tier structure that establishes which operations are defined as CAFOs based on size alone (described in Section 3.1.1). In this alternative, EPA is proposing that the threshold for defining operations as CAFOs be equivalent to 500 animal units (AU). All operations with more than 500 AU would be defined as CAFOs. Operations with fewer than 500 AU would be CAFOs only if designated by EPA or the State permit authority. Additional information on why EPA is co-proposing this scenario is presented in Section VII of the preamble.

Scenario 4b. This scenario is an alternative to Scenario 4a under the co-proposed two-tier that establishes which operations are defined as CAFOs based on size alone. In this alternative, EPA would define operations as CAFOs be equivalent to 300 AU. All operations with 300 or more animal units would be defined as CAFOs. Operations with fewer than 300 animal units would be CAFOs only if designated by EPA or the State permit authority.

Scenario 5. This scenario is an alternative to Scenario 4a under the co-proposed two-tier structure that establishes which operations are defined as CAFOs based on size alone. In this alternative, EPA would define operations as CAFOs be equivalent to 750 AU. All operations with 750 or more animal units would be defined as CAFOs. Operations with fewer than 750 animal units would be CAFOs only if designated by EPA or the State permit authority. After considering each of these alternatives (Scenarios 4a and 5), EPA is proposing 500 AU as the appropriate threshold for a two-tier structure, but is also requesting comment on a threshold of 750 AU.

Scenario 6. This scenario is an alternative to Scenario 3 under the co-proposed three-tier structure that retains the existing tiers but amends the conditions under which middle tier AFOs with between 300 AU to 1,000 AU are defined as CAFOs. These operations would be required to obtain an NPDES permit unless they can certify that they do not meet the conditions for definition as a CAFO, as is being proposed in Scenario 3. However, the conditions for making this certification would be different than those under Scenario 3, and the substantive permit requirements for operations between 300 and 1,000 AU that do not certify would be different than those for CAFOs with more than 1,000 AU. For more information, see Section VII of the preamble.

SECTION FOUR

METHODOLOGY FOR ESTIMATING COMPLIANCE COSTS AND ECONOMIC IMPACTS

This section presents the data and methodologies EPA uses to estimate the total annual incremental costs and the economic impacts that would be incurred by the livestock and poultry industry as a result of the proposed revisions to the ELG and NPDES regulations affecting CAFOs ("proposed CAFO regulations"). EPA's regulatory impact analysis examines potential effects across three industry segments: CAFOs (e.g., feedlots and feedyards), processors (e.g., meat packers and slaughtering facilities), and consumer markets.

Section 4.1 briefly summarizes the methods and assumptions used to estimate annual CAFO level compliance costs (described in greater detail in other rulemaking support documents). Section 4.2 presents the development and characterization of EPA's representative "model CAFOs" that are differentiated by commodity sector, facility size, and major production region, among other factors. These model CAFOs are the basis for calculating the total annual costs of the proposed CAFO regulations and are used to evaluate potential financial impacts to regulated CAFOs. The approach EPA uses to evaluate impacts to CAFOs provides a general framework to assess the potential upper bound of costs and impacts that could accrue to processors and meat packers, as discussed in Section 4.3. Finally, Section 4.4 discusses the methodology EPA uses to assess additional market impacts, including national level changes in prices and available quantities, as well as changes in national aggregate employment and economic output.

4.1 ANNUAL COMPLIANCE COSTS

The sections that follow briefly summarize the methodology EPA uses to develop the incremental compliance costs that are used to estimate total annual regulatory costs and economic impacts. Topics include: (1) EPA's assumptions regarding the degree of compliance with the existing regulatory program; (2) the methodology EPA uses to develop the incremental compliance costs for each of the regulatory options under consideration; and (3) the inputs and assumptions EPA uses to annualize those compliance costs. More detailed information on EPA's baseline assumptions and the data used to calculate costs are provided in EPA's *Development Document* (USEPA, 2000a). Appendix A of this report provides additional detail on EPA's approach for annualizing compliance costs for input into the economic model.

4.1.1 Baseline Compliance Assumption

For the purpose of this analysis, EPA assumes that all CAFOs that would be subject to the proposed regulations are currently in compliance with the existing regulatory program (including the NPDES regulations and the effluent limitations guidelines and standards for feedlots) and existing state laws and regulations. As a practical matter, EPA recognizes that this is not true, since only 2,500 operations out of an estimated 12,700 CAFOs with more than 1,000 AU have actually obtained coverage under an NPDES permit and the remainder may in fact experience additional costs to comply with the existing requirements. EPA has not estimated these additional costs in the analysis that is presented in the preamble because the Agency did not consider these costs part of the incremental costs of complying with the proposed CAFO rule.

To assess the incremental costs attributable to the proposed rules, EPA's analysis evaluates current federal and state requirements for animal feeding operations and calculates compliance costs of the proposed requirements that exceed the current requirements. Operations located in states that currently have requirements that meet or exceed the proposed regulatory changes would already be in compliance with the proposed regulations and would not incur any additional cost. These operations are not included as part of the cost analysis. A review of current state waste management requirements for determining baseline conditions is included in the *Development Document* and also in other sections of the record. See *State Compendium: Programs and Regulatory Activities Related to Animal Feeding Operations* compiled by EPA (USEPA, 2000l).

EPA's analysis also accounts for current structures and practices that are assumed to be already in place at operations that may contribute to compliance with the proposed regulations. Additional information is also provided in the following section (Section 4.1.2). This information is also provided in the *Development Document* (USEPA, 2000a).

4.1.2 Method for Estimating CAFO Compliance Costs

4.1.2.1 Compliance Costs to CAFO Operators

For the purpose of estimating total costs and economic impacts, EPA calculates the costs of compliance for CAFOs to implement each of the regulatory options being considered. (Section 3 of this report describes each of the regulatory technology options considered in this proposed rulemaking.) EPA estimates costs associated with four broad cost components: nutrient management planning, facility upgrades, land application, and technologies for balancing on-farm nutrients. Nutrient management planning costs include manure and soil testing, record keeping, monitoring of surface water and groundwater, and plan development. Facility upgrades reflect costs for manure storage, mortality handling, storm water and field runoff controls, reduction of fresh water use, and additional farm management practices. Land application costs address agricultural application of nutrients and reflect differences among operations based on cropland

availability for manure application. Specific information on the capital costs, annual operating and maintenance costs, start-up or first year costs, and also recurring costs that EPA uses to estimate costs and impacts of the proposed regulations is provided in the *Development Document* (USEPA, 2000a). EPA uses these model CAFOs to estimate aggregate incremental costs to the CAFO industry.

EPA evaluates compliance costs using a representative facility approach based on more than 170 farm level models that were developed to depict conditions and to evaluate compliance costs for select representative CAFOs (USEPA, 2000a). The major factors used to differentiate individual model CAFOs include the commodity sector, the farm production region, and the facility size (based on herd or flock size or the number of animals on-site). EPA's model CAFOs primarily reflect the major animal sector groups, including beef cattle, dairy, hog, broiler, turkey, and egg laying operations. Practices at other subsector operations are also reflected in the cost models, such as replacement heifer operations, veal operations, flushed caged layers, and hog grow- and farrow-finish facilities (USEPA, 2000a).[1] EPA uses model facilities with similar waste management and production practices to depict operations in regions that were not separately modeled.

Another key distinguishing factor incorporated into EPA's model CAFOs is information on the availability of crop and pasture land for land application of manure nutrients. For this analysis, nitrogen and phosphorus rates of land application are evaluated for three categories of cropland availability: Category 1 CAFOs are assumed to have sufficient cropland for all on-farm nutrients generated, Category 2 CAFOs are assumed to have insufficient cropland, and Category 3 CAFOs are assumed to have no cropland (USEPA, 2000a). EPA uses 1997 information from USDA to determine the number of CAFOs within each category. This information takes into account which nutrient (nitrogen or phosphorus) is used as the basis to assess land application and nutrient management costs.

For Category 2 and Category 3 CAFOs, EPA evaluates additional technologies that may be necessary to balance nutrients. EPA evaluates additional technologies that reduce off-site hauling costs associated with excess on-farm nutrients, as well as to address ammonia volatization, pathogens, trace metals, and antibiotic residuals. These technologies may include Best Management Practices (BMPs) and various farm production technologies, such as feed management strategies, solid-liquid separation, composting, anaerobic digestion, and other retrofits to existing technologies. EPA considers all these technologies for identification of "best available technologies" under the various options for BAT described in Section VIII of the preamble.

EPA uses soil sample information compiled by researchers at various land grant universities to determine areas of phosphorus and nitrogen saturation, as described in the

[1]Grow-finish operations finish more mature pigs while farrow-finish operations handle all stages of production from breeding to finishing.

Development Document (USEPA, 2000a). This information provides the basis for EPA's assumptions of which facilities would need to apply manure nutrients on a phosphorus- or nitrogen-based standard.

EPA's cost models also take into account other production factors, including climate and farmland geography, land application and waste management practices and other major production practices typically found in the key producing regions of the country. Model facilities reflect major production practices used by larger confined animal farms, generally those with more than 300 AU. Therefore, the models do not reflect pasture and grazing type farms, nor do they reflect typical costs to small farms. EPA's cost models also take into account practices required under existing state regulations and reflect cost differences within sectors depending on manure composition, bedding use, and process water volumes. More information on the development of EPA's cost models is provided in the *Development Document* (USEPA, 2000a).

To estimate aggregate incremental costs to the CAFO industry from implementing a particular technology option, EPA first estimates the total cost to a model facility to employ a given technology, including the full range of necessary capital, annual, start-up, and recurring costs. Additional detailed information on the baseline and compliance costs attributed to model CAFOs across all sectors and across all the technology options considered by EPA is provided in the *Development Document* (USEPA, 2000a).

After estimating the total cost to an individual facility to employ a given technology, EPA then weights the average facility level cost to account for current use of the technology or management practice nationwide. This is done by multiplying the total cost of a particular technology or practice by the percent of operations that are believed to use this particular technology or practice in order to derive the average expected cost that could be incurred by a model CAFO. EPA refers to this adjustment factor as the "frequency factor" and has developed such a factor for each individual cost (i.e. each technology) and cost component (i.e. capital and annual costs) in each of its CAFO models (USEPA, 2000a). The frequency factor reflects the percentage of facilities that are, technically, already in compliance with a given regulatory option since they already employ technologies or practices that are protective of the environment. The frequency factor also accounts for compliance with existing federal and state regulatory requirements as well as the extent to which an animal sector has already adopted or established management practices to control discharges.

EPA has developed its frequency factors based on data and information from USDA's NRCS and NAHMS, state agricultural extension agencies, industry trade groups and industry-sponsored surveys, academic literature, and EPA's farm site visits. More detailed information on how EPA developed and applied these weighting factors is provided in the *Development Document* (USEPA, 2000a). To identify where farm level costs may be masked by this weighting approach, EPA evaluates costs with and without frequency factors. The results of this sensitivity analysis indicate that the model CAFO costs used to estimate aggregate costs and impacts, as presented in this preamble, are stable across a range of possible frequency factor assumptions.

The data and information EPA uses to develop its model CAFOs are compiled by USDA, in combination with other information collected by EPA from extensive literature searches, more than 100 farm site visits, and numerous consultations with industry, universities, and agricultural extension agencies. Additional detailed information on the data and assumptions EPA uses for its model CAFOs is provided in the *Development Document* (USEPA, 2000a).

4.1.2.2 Compliance Costs to Recipients of CAFO Manure

To calculate the cost to offsite recipients of CAFO manure under the proposed regulations, EPA builds upon the cropland availability information in the CAFO models, focusing on the two categories of farms that have excess manure nutrients and that need to haul manure offsite for alternative use or to be spread as fertilizer (i.e., Category 2 and Category 3 CAFOs, where facilities are assumed to have insufficient or no available cropland to land apply nutrients, respectively). EPA also uses this information to determine the number of affected operations under select regulatory alternatives, discussed in Section 2, as well as to determine the number of offsite recipients affected under select regulatory alternatives (USEPA, 2000a).

USDA defines farm level "excess" of manure nutrients on a confined livestock farm as manure nutrient production less crop assimilative capacity (Gollehon and Caswell, 2000). USDA estimates manure nutrient production using the number of animals by species, standard manure production per animal unit, and nutrient composition of each type of manure. Recoverable manure is the amount that can be collected and disposed by spreading on fields or transporting off the producing farm (Gollehon and Caswell, 2000).

Depending on the nutrient used to determine the rate of manure application (nitrogen or phosphorus), EPA estimates that approximately 7,500 to 10,000 CAFOs with more than 300 AU are expected to generate excess manure. This includes about 2,600 animal feeding operations that have no major crop or pasture land. These estimates are derived from a USDA analysis of manure nutrients relative to the capacity of cropland and pastureland to assimilate nutrients. EPA's estimate does not account for excess manure that is already disposed of via alternative uses such as pelletizing or incineration. More detailed information is provided in the *Development Document* (USEPA, 2000a).

For the purpose of this analysis, EPA assumes that affected offsite facilities are field crop producers who use CAFO manure as a fertilizer substitute. Information on crop producers that currently receive animal manure for use as a fertilizer substitute is not available. Instead, EPA approximates the number of operations that receive CAFO manure and may be subject to the proposed regulations based on the number of acres that would be required to land apply manure nutrients generated by Category 2 and Category 3 CAFOs. EPA assumes that offsite recipients will only accept manure when soil conditions allow for application on a nitrogen basis. Therefore, the manure application rate at offsite acres in a given region is the nitrogen-based application rate for the typical crop rotation and yields obtained in that region. EPA then estimates the number of

farms that receive CAFO manure by dividing the acres needed to assimilate excess manure nitrogen by the national average farm size of 487 acres, based on USDA data. The results of this analysis indicate that 18,000 to 21,000 offsite recipients would receive excess CAFO manure (USEPA, 2000a).

EPA's estimated costs to manure recipients include the costs of soil testing and incremental recordkeeping. EPA evaluates these costs using the approach described in Section 4.1.2.1. Excess manure hauling costs are already included in costs assessed to CAFOs with excess manure. For the purpose of this analysis, EPA assumes that crop farmers already maintain records documenting crop yields, crop rotations, and fertilizer application, and that crop farmers already have some form of nutrient management plan for determining crop nutrient requirements. EPA estimates, on average, per-farm incremental costs of approximately $540 to CAFO manure recipients for complying with the offsite certification requirements. This analysis is provided in the *Development Document* (USEPA, 2000a).

4.1.3 Cost Annualization Methodology

EPA develops CAFO compliance costs from estimated startup (first-year) costs, recurring 3- and 5-year costs, and annual operating and maintenance costs (described in Section 4.1.2). To compare estimated costs to available farm financial data in any one year, EPA annualizes these costs using the approach described below. A 1997 time frame is used for comparison with available USDA data on livestock and poultry farms, as reported in the 1997 Census of Agriculture and other related databases. The inputs and assumptions of the cost annualization model are summarized below.

Additional detail on the input costs used for this analysis are provided in the *Development Document* (USEPA, 2000a). A summary of the annualized costs by CAFO model is provided later in this EA in Sections 6, 7, and 8, depending on commodity sector. Additional details on the annualization model are provided in Appendix A of this report. Annualized compliance costs are also presented in Appendix A (expressed in 1997 dollars).

Annualized costs account for the time value of money and reflect the annual repayment amount of an on-farm capital investment by spreading the initial costs over the expected life of the structure. EPA calculates both pre-tax and post-tax annual costs. Pre-tax costs are used to estimate the total cost of the proposed CAFO regulations to society (social costs). Post-tax costs are used to measure the economic impacts at CAFOs and to account for the reduction in a CAFO's tax liability. This reduction in taxes paid ("tax shield") acts to offset the expected compliance costs incurred by a facility. This portion of costs is borne by federal and state governments through a reduction in tax revenue. Accordingly, the economic impacts of the proposed CAFO regulations are measured as the impact of the expected compliance cost incurred by a CAFO minus an appropriate tax shield.

The major inputs to and assumptions used in the cost annualization model are: (1) the discount rate; (2) the life of the asset; and (3) tax rates.

EPA uses the *discount rate* to calculate the present values of the cash flows and is analogous to an interest rate used to compute a mortgage payment. The annualization model uses a real discount/interest rate of 7 percent, as recommended by the Office of Management and Budget (OMB, 1992), and does not have to be adjusted for inflation.

The *life of the asset* is the time period over which the costs are to be annualized (like a mortgage time period) and is determined according to the Internal Revenue Code's classes of depreciable property. The time period over which the annualization is made depends on the serviceable life of the structure and also on the depreciable life, which affects what portion of a capital cost can be used each year to reduce taxable income. IRS rules govern the designation of depreciable life, which is assigned on the basis of serviceable life. Most of the types of capital investments that will be required under these proposed regulations are typically depreciated over 10 years (IRS, 1999).[2] The cost annualization model thus incorporates a 10-year annualization period to compute both pre-tax and post-tax annual costs. The equation EPA uses to calculate annual cost operates from mid-year to mid-year (mid-year convention); thus the entire time frame of the analysis begins in Year 1 and concludes in Year 11 but is discussed here as a 10-year time frame (see Appendix A).

The assumed *tax rates* are used to determine a facility's tax benefit or tax shield. Estimated tax savings are subtracted from the actual outlay in each year and are used to calculate the annual post-tax cost of compliance. The tax shield calculation uses three inputs: marginal tax rates (composed of the federal tax rates and an assumed state tax rate); an estimate of CAFO taxable income (net cash minus depreciation plus value of inventory change, assuming the CAFO is using the accrual method of accounting); and a depreciation schedule.

Appendix A provides a description of how the tax rates are assigned to each model CAFO. Revenue estimates are derived from USDA data for representative model CAFOs (discussed in Section 4.2.3). The depreciation schedule is dictated by IRS rules, but there are several choices of depreciation schedule within those rules. For reasons outlined in Appendix A, EPA has chosen the Modified Accelerated Cost Recovery System (MACRS), which is a commonly used and generally advantageous depreciation schedule for tax minimization purposes. The tax shield is calculated using the depreciable capital cost in each year plus any recurring expenditures that are allowed to be expensed in each year. Each model CAFO is assigned a tax rate (marginal federal rate plus an assumed state tax rate) based on the estimated amount of

[2]Many of the types of investments would best be classified as single-purpose agricultural structures, which are defined by IRS as any enclosure or structure specifically designed, constructed, and used for housing, raising, and feeding a particular kind of livestock, including structures to contain produce or equipment necessary for housing, raising, and feeding livestock.

taxable income. The tax rate times the depreciated and expensed compliance costs in each year equals the estimated tax shield.

Appendix A presents a sample spreadsheet that shows how all of the computations are made and also documents all annualized incremental costs estimated by EPA. Section 5 of this report presents the aggregate, national level annualized compliance costs (post-tax), by regulatory option, that are calculated by the cost annualization model. Sections 6, 7 and 8 present the per-head and per-CAFO annualized costs and the economic impacts (post-tax) for selected model CAFOs for each of the major livestock and poultry sectors.

4.2 CAFO ANALYSIS

4.2.1 Overview of the Representative CAFO Approach

EPA estimates incremental costs and economic impacts of the proposed CAFO regulations using a representative farm approach. For this analysis, EPA developed "model CAFOs" for each sector to assess the average costs and economic impacts of the proposed regulations across differently sized, differently managed, and geographically distinct operations.

Using a representative farm approach, EPA constructs a series of model facilities that reflect the EPA's estimated compliance costs and available financial data. EPA uses these model CAFOs to develop an average characterization for a group of operations. EPA's cost models are described in Section 4.1.2.1. From these models, EPA estimates total annualized compliance costs by aggregating the average facility costs across all operations that are identified for a representative group. As with EPA's cost models, EPA's financial models are grouped according to certain distinguishing characteristics for each sector, such as facility size and production region, that may be shared across a broad range of facilities. Economic impacts under a post-regulatory scenario are approximated by extrapolating the average impacts for a given model CAFO across the larger number of operations that share similar production characteristics and are identified by that CAFO model. EPA compares its estimated compliance costs at select model CAFOs to corresponding financial conditions at these model facilities.

The representative farm approach is consistent with past research conducted by USDA and the land grant universities and their affiliated research organizations, including the Food and Agricultural Policy Research Institute (FAPRI), the Center for Agriculture and Rural Development (CARD), Texas A&M's Agriculture and Food Policy Center, the Texas Institute for Applied Environmental Research (TIAER) and the University of Missouri's Commercial Agriculture Program. These organizations and others have widely adopted the representative farm approach to assess a broad range of policy issues, including changes in federal agricultural policy and pricing programs, domestic food programs, environmental legislation, and international trade. This approach has been used to assess agricultural market changes for both livestock and crop commodities (AFPC, 1999 and 2000; Skinner, 1981). Studies conducted by Heimlich and

Barnard (1995), Outlaw et al. (1993), Christensen et al. (1981), and DPRA (1995) have used the representative farm approach to evaluate the financial impact of implementing management measures and installing animal waste systems on livestock CAFOs. A representative approach has been used to evaluate financial impacts in rulemakings where actual facility level data were not available (DPRA, 1995).

A representative approach provides a means to assess average impacts across numerous facilities by grouping facilities into broader categories to account for the multitude of differences among animal confinement operations. Use of this approach is considered necessary to account for differences in performance among farming operations.

Costs to manage animal waste are site specific and depend on the waste disposal and storage requirements of an individual operation. Estimates of the range of potential costs to operations show that costs may vary with respect to equipment and maintenance procedures necessary to meet regulatory requirements (USGAO, 1995; Fleming et al., 1997; Bennet et al., 1992). The ability of an operation to absorb these costs may vary across producers. For example, the number of animals raised or housed on site directly affects the magnitude of total costs; however, a facility's size can also influence an operation's ability to pay. Many studies suggest that there is a statistically positive relationship between farm size and per-unit production costs, such that as farm size (number of animals) increases, costs per-animal are generally lower (Perry and Green, 1999; Van Arsdall and Nelson, 1985; Kumbhakar et al., 1989; Purdy et al., 1997; Weersink and Howard, 1991; Lazarus, et al., 1999). This may result in lower per-unit capital costs and create a relative advantage among larger operations.

Previous studies have also noted that on-farm improvement costs may vary by farm production region (Westerbarger and Letson, 1995; Outlaw et al., 1993). Regional differences may also affect farm financial performance and may influence an operation's ability to pay for these improvements (Outlaw et al., 1993; El-Osta and Johnson, 1998). Specific requirements for handling livestock and poultry manure may vary because conditions differ across farms and among producing regions (NMPF, 1996). Compliance costs may be higher in some regions than in others, depending on the types of technologies that may be required to manage waste and on various site-specific farmland characteristics. Such factors include topography, climate, average rainfall, soil type and conditions, underlying rock formations, and local evaporation rates. For example, producers in regions with limited cropland on which to apply manure may face higher disposal costs. Producers that are located near targeted or vulnerable waterways may also face higher costs.

A literature review of the research that examines the potential for size and scale economies in these industries, among other factors that contribute to differences in farm performance among producers, is available in the rulemaking record (ERG, 2000d—see DCN 70641).

At various stages in the proposed rulemaking, EPA has presented its proposed methodological approach to USDA personnel and to researchers at various land grant universities

for informal review and feedback (Foster, 2000a; Johnson et al., 1999a and 2000a; USDA, 1999; USEPA, 1999b and 1999c; Vukina, 2000). The *Development Document* (USEPA, 2000a) documents additional review of EPA's cost models. (See Section XII of the preamble for a summary of EPA's outreach activities; additional information is available in the rulemaking record.)

4.2.2 Construction of EPA's Model CAFOs

EPA's model CAFOs are developed to conform to a representative farm approach. These model CAFOs reflect average conditions for selected groups of CAFO operations. EPA's model CAFOs consist of two major modeling components: cost models and financial models.

Three factors are recognized to have a major impact on the way CAFOs operate and therefore are assumed as key factors to differentiate the individual model CAFOs. These factors include: (1) commodity sector (beef, veal, heifers, dairy, hogs, broilers, layers, turkeys), (2) farm production region, and (3) facility size (based on herd or flock size or the number of animals on site). Both EPA's cost models and financial models are differentiated by sector and select region and size group.

The CAFO models EPA uses for this analysis represent the interface between a larger number of cost models and a smaller number of financial models. Fewer financial models are developed because of data availability issues (discussed in detail in Section 4.2.3). The cost models are able to accommodate a number of additional distinguishing factors compared to the financial models. EPA's cost models can divide sectors into various subsectors (e.g., hogs are divided into grow-finish and farrow-finish operations, and egg layers are divided into operations that utilize liquid and dry manure management systems). The cost models also provide more refined production regions (e.g., five regions as opposed to two) and additional facility size representations. Furthermore, the cost models can account for the type of animal production facility, the availability of crop and pasture land to land apply manure nutrients, farmland geography, and existing state regulatory requirements, as well as reflect cost differences within sectors based on manure composition, bedding use, and process water volumes. For more detailed information on the cost models EPA uses for this analysis, see the *Development Document* (USEPA, 2000a).

The sections below highlight the three primary factors (sector, region, and size group) that can be differentiated by both the cost models and the financial models and briefly discuss how model CAFOs are distinguished by these factors. Additional details on the development of the model CAFOs are presented in Sections 4.2.3 and 4.2.4.

4.2.2.1 Livestock and Poultry Sectors

EPA's model CAFOs cover the following livestock and poultry sectors:

- Fed beef cattle operations
- Veal operations
- Heifer operations
- Dairy farms
- Hog farms, including grow-finish and farrow-finish operations
- Egg laying operations, including facilities with both liquid and dry manure management systems
- Broiler operations
- Turkey operations

EPA's cost models distinguish all these sectors and subsectors. The financial models, however, are based on USDA data that are collected across all beef, dairy, hog, egg laying, broiler, and turkey sectors. These data do not distinguish finances at various subsector levels within these sectors, for example, at the level of grow- versus farrow-finish operations in the hog sector, or fed cattle versus stand-alone veal or heifer operations in the cattle sector.

4.2.2.2 Farm Producing Regions

As a starting point for determining the relevant farm production regions for its model CAFOs, EPA refers to USDA's ten farm regions (Figure 4-1). EPA's cost models aggregate USDA's regions into five broad production regions for the purposes of estimating costs: Midwest (MW); Central (CE); Pacific (PA); Mid-Atlantic (MA); and South (SO).[3] The financial models, however, cannot distinguish this many regions per sector because available USDA financial data do not allow for aggregation at this level of detail.[4] Therefore, two regions are represented by the model CAFOs per sector, representing the major production regions for each sector.

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[3]Information on these regional groupings is provided in the *Development Document* (USEPA, 2000a).

[4]Aggregation of data into broader regional groups is necessary to ensure the confidentiality of USDA's respondent level survey data and to maintain a statistically representative sample of survey data.

Figure 4-1. USDA Farm Producing Regions
Source: USDA/ERS, 2000a.

Table 4-1 shows the regions represented by the model CAFOs for each sector. Section 4.2.4 discusses in more detail how the model CAFO regions relate to the ten USDA regions. CAFOs in regions other than the two major production regions in each sector are allocated to the two major regions on an equally weighted basis (i.e., within each sector, 50 percent of CAFOs in regions other than the two primary production regions are assigned to one major production region and the other 50 percent are assigned to the other). The only exceptions are the veal, heifer, and wet layer sectors, which are modeled using only one region each due to limited data and information on these subsectors.

4.2.2.3 Facility Size

EPA establishes its model CAFOs based on three broad facility size groups: CAFOs with more than 1,000 AU;[5] CAFOs with between 500 and 1,000 AU; and CAFOs with less than 500 AU. For most sectors, EPA's model CAFOs generally distinguish between two facility sizes within each group, i.e., "Large 1" and "Large 2" operations among CAFOs with more than 1,000 AU; and "Medium 1" and "Medium 2" operations among CAFOs with between 500 and 1,000

[5]As defined for the proposed CAFO regulations, one AU is equivalent to one slaughter or feeder cattle, calf or heifer; 0.7 mature dairy cattle; 2.5 hogs (over 55 pounds) or 5 nursery pigs; 55 turkeys; and 100 chickens regardless of the animal waste system used.

Table 4-1: Model CAFOs by Sector, Size, and Region (Size Ranges and Average Inventory)

Sector	Region	Medium 1(a)	Medium 1(b)	Medium 2	Large 1	Large 2
		300-1000AU			>1,000 AU	
Fed Cattle	MW, CE	300-500 (455)		500-1,000 (777)	1,000-8,000 (1,877)	>8,000 (30,003)
Veal	MW	300-500 (400)		>750 (540)		
Dairy	PA, MW	200-350 (235)		525-700 (460)	>700 (1,419)	
Heifers	MW	300-500 (400)		750-1,000 (750)	>1,000 (1,500)	
Hog: FF	MA	750-1,250 (814)	1,250-1,875 (1,460)	1,875-2,500 (2,152)	2,500-5,000 (3,444)	>5,000 (13,819)
	MW	750-1,250 (846)	1,250-1,875 (1,518)	1,875-2,500 (2,165)	2,500-5,000 (3,509)	>5,000 (17,118)
Hog: GF	MA	750-1,250 (900)	1,250-1,875 (1,422)	1,875-2,500 (2,124)	2,500-5,000 (3,417)	>5,000 (10,029)
	MW	750-1,250 (963)	1,250-1,875 (1,521)	1,875-2,500 (2,184)	2,500-5,000 (3,554)	>5,000 (8,893)
Layers: Wet	SO			9,000-30,000 (3,624)	>30,000 (86,898)	
Layers: Dry	MW	30,000-41,700 (32,375)	41,700-62,500 (44,909)	62,500-180,000 (97,413)	180,000-600,000 (293,512)	>600,000 (884,291)
	SO	30,000-41,700 (37,906)	41,700-62,500 (52,582)	62,500-180,000 (97,484)	180,000-600,000 (279,202)	>600,000 (1,229,095)
Broilers	MA	30,000-40,000 (36,634)	40,000-60,000 (51,362)	60,000-90,000 (73,776)	90,000-180,000 (117,581)	>180,000 (281,453)
	SO	30,000-40,000 (36,796)	40,000-60,000 (51,590)	60,000-90,000 (73,590)	90,000-180,000 (115,281)	>180,000 (303,155)
Turkeys	MA, SO	16,500-25,700 (18,539)	25,700-38,500 (31,267)	38,500-55,000 (45,193)	>55,000 (97,111)	
	MA, MW	16,500-25,700 (18,092)	25,700-38,500 (30,514)	38,500-55,000 (45,469)	>55,000 (158,365)	

Source: USEPA, 2000a. Shaded cells indicate model CAFO not developed. Values shown in parentheses are the average number of animals (inventory) assumed for each model CAFO. EPA's model regions cover USDA farm regions (Figure 4-1):
Beef/Veal/Dairy/Heifer: Midwest (MW)–N. Plains, Lake States, Corn Belt, Northeast, Appalachia; Central (CE)– Mountain, S. Plains, Delta States, Southeast; Pacific (PA)–Mountain, S. Plains, Delta States, Southeast.
Hogs: Mid-Atlantic (MA)–Northeast, Appalachia; MW–Northern Plains, Lake States, Corn Belt.
Layers/Broilers: South (SO)–Northeast, Appalachia, Mountain, S. Plains, Delta States, Southeast, Mountain, Pacific; Midwest (MW)–N. Plains, Lake States, Corn Belt; Mid-Atlantic (MA)–Northeast, Appalachia, Delta States, Pacific; S. Plains, Mountain.
Turkeys: MW–N. Plains, S. Plains, Pacific, Mountain, Lake States, Corn Belt; MA–Appalachia, Delta States, NE and SE.

AU ("Medium" operations are further differentiated between CAFOs with between 300 and 500 AU). Facility size categories vary by sector; the average number of animals represented by each model CAFO is based on typical inventory estimates that are common for that size range in a particular sector. Table 4-1 shows the range of facility sizes and the average number of animals associated with this range that EPA assumes for this analysis for each model CAFO. See the *Development Document* (USEPA, 2000a) for more information on the development of the model sizes shown in the table.

Data limitations restrict the number of facility size categories available for EPA's financial models. However, as will be discussed later, EPA uses the available data to derive estimates of financial data for the given sizes of model CAFOs and to match financial models to cost models for each model CAFO shown in Table 4-1.

EPA develops the costs to confinement operations with less than 300 or 500 AU that may be designated as CAFOs by scaling the estimated compliance costs for the available "medium" and "large" CAFO models. (See Section 2 for information on expected designated facilities under each co-proposed alternative.) The resulting costs–derived on a per-head basis–are adjusted by the average head counts at operations with fewer than 500 AU or 300 AU to derive the annualized per-facility compliance cost. Costs for CAFOs with fewer than 500 AU or 300 AU assume that these operations have sufficient cropland for all on-farm nutrients generated (identified in the cost model as Category 1 costs). More detailed cost information is provided in the *Development Document* (USEPA, 2000a).

4.2.3 Sources of Data for EPA's Model CAFOs

For this analysis, EPA is relying on existing data sources and expertise provided by USDA, industry, state agriculture extension agencies, and various land grant universities.[6] Two major sources of farm level data include USDA's Census of Agriculture and USDA's ARMS. These databases provide farm level descriptive and financial data and are used to develop representative model CAFOs for EPA's cost and economic impact assessment. USDA's Census of Agriculture and ARMS databases are compiled from farm surveys conducted by USDA that contribute to long-standing data summaries of the U.S. farm sector.

The Census and ARMS databases are maintained by USDA, which periodically publishes aggregated data from these databases and also compiles customized analyses of the data for members of the public and other government agencies. The data EPA uses for this analysis are produced as a customized analysis, and are compiled with the assistance of staff at USDA's National Agricultural Statistics Service (NASS) and USDA's Economic Research Service (ERS).

[6]In past ELG rulemakings, EPA has exercised its legal authority under Section 308 of the Clean Water Act and has conducted an industry-wide survey of all affected facilities to obtain actual facility level business and financial information.

In providing such analyses, USDA maintains a sufficient level of aggregation to ensure the confidentiality of an individual operation's activities or holdings.

The Census is the primary data source used to depict general (nonfinancial) farm conditions for EPA's model CAFOs and serves as the basis for estimating the range of compliance costs that may be incurred by CAFOs under the proposed regulations.[7] In subsequent stages of the economic analysis, EPA uses estimates of the number of affected CAFOs to extrapolate the results of impact analyses to the national level and to aggregate costs across all sectors and nationally. A more detailed description of the Census data and how these data are used to develop EPA's model CAFOs are provided in the *Development Document* (USEPA, 2000a).

The ARMS database is the primary source of farm financial data used to assess the potential CAFO level economic impacts. Other sources of data also contribute to this analysis as described in this report.

The following sections focus on EPA's use of the ARMS data, since these data are the primary source of financial data used to analyze CAFO level economic impacts in EPA's representative farm approach. Section 4.2.3.1 provides an overview of the ARMS data, Section 4.2.3.2 discusses the special compilation of data ERS made available to the public, and Section 4.2.3.3 presents a general discussion of which level of ARMS data aggregation was used to develop each of the model CAFOs.

4.2.3.1 Overview of ARMS Financial Data

The ARMS is USDA's primary method for collecting data covering a broad range of issues about agricultural production practices and costs. These data provide the only national perspective on annual changes in the financial conditions of production agriculture (USDA/ERS, 2000a). The ARMS is an annual survey conducted using a probability sample, which in 1997 included information from 11,724 surveyed farms nationwide. The sample survey is hand-enumerated by trained personnel. USDA extrapolates the data from the sample survey to represent farming and ranching operations in the 48 contiguous states. These national level data are published in a series of annual and periodic reports, such as USDA ERS's annual compendiums on farm cost of production and also farm financial performance (data formerly identified as the Farm Costs and Returns Survey data).

[7]EPA uses available Census data to characterize the animal feeding sectors and provide information on a range of factors, including the number of feedlot operations, how these operations are distributed geographically, and general size ranges for these operations. Other farm production data reported in the Census are used to compare the amount of cropland available to land-apply manure nutrients generated relative to crop need. These latter calculations were provided with the assistance of researchers at USDA's Natural Resources Conservation Service (NRCS). For more information, see the *Development Document* (USEPA, 2000a).

To develop a reasonably complete financial model of a representative CAFO, information on farm assets and liabilities (balance sheet information) and revenues, costs, earnings, taxes, and net income (income statement information) is required at a minimum. The ARMS data generally provide breakouts of critical financial line items that are required to construct a financial profile of the representative CAFOs. ARMS data provide USDA with the means to compile complete income statements and balance sheets from surveys of operations in each of the major farming sectors.[8] This full financial accounting is a major advantage, since no other sources of farm financial data are as complete.

The Census does collect some financial data, but they are not sufficiently detailed to construct financial models. Complete income statement information is not available from this source, since most survey respondents do not fully report revenue and cost information, thus requiring that USDA impute missing values. Complete balance sheet data are also not available.

Information available in the ARMS data includes:

Income statement information. Revenue and expense data include:

– *Gross cash income*—includes livestock and crop sales (including net Commodity Credit Corporation loan proceeds), government payments, and other farm-related income.

– *Cash operating expenses*—includes variable expenses such as livestock, feed, seed, fertilizer, and hired labor, and fixed expenses including land, insurance, and property taxes.

– *Net cash income*—gross cash income minus variable and fixed cash operating expenses.

– *Net farm income*—includes gross cash income minus variable cash expenses, fixed expenses, depreciation charges, and labor noncash benefits, plus the value of inventory change and non-money income.

Balance sheet information. Asset and liability data include:

– *Current assets*—such as farm inventory and purchased inputs, excluding noncurrent assets (such as breeding animals and farm equipment).

– *Current liabilities*—such as accounts payable, excluding noncurrent liabilities (such as real estate).

[8]Farms are classified by sector based on the source of 50 percent of its annual farm revenue (McElroy, 1993). For example, a farm is defined as a hog operation if it generates 50 percent of its farm sales from hogs.

- *Total farm assets*—includes current and noncurrent assets (such as investment in cooperatives, land and buildings, breeding herd, and farm equipment).

- *Total farm liabilities*—includes current and non-current liabilities (such as real estate and debt other than real estate).

Financial ratios. Indicators of farm financial health include measures of liquidity (current ratio), solvency (debt-to-asset ratio), profitability (return on assets and return on equity), and other measures of financial efficiency.

A copy of the income statement and balance sheet summary information received from ERS is contained in the rulemaking record (USDA/ERS, 1999a—see DCN 70063). See Sections 6, 7, and 8 for examples of the available data by sector.

With the ARMS data, farm operations can be classified (grouped or typed) in many ways based on the information collected on the survey. ERS usually reports the data by farm typology, which divides farms into small farms (limited-resource, retirement, residential or lifestyle, low sales, and high sales) and other farms (large family farms, very large family farms, and non-family farms). An alternative method of typing is by farm business (legal) organization as reported by the respondent. The mutually exclusive categories for this item include individual proprietorship, partnerships, family corporations, non-family corporations and other. Farms can also be grouped by the occupation of the operator. The categories for operator occupation include farming, hired manager, non-farm work, and retired. The ARMS data also provide other farm typology data useful for financial characterization. This information includes a farm classification, developed by USDA's ERS, that separates U.S. farms into mutually exclusive and homogeneous groups based on legal organization of family farms by proprietorships, partnerships, and family corporations that are not operated by a hired manager. USDA's farm typology groups are shown in Table 2-2.

Data on both family and nonfamily farms are included in the ARMS data (USDA/ERS, 2000b and 1999a). (See Table 2-2 and Figure 2-1.) USDA's farm typology data also provide information on animal ownership based on the percentage of animals raised at the farm site that are owned or not owned by the farmer (e.g., raised under contract for another business entity) (USDA/ERS, 1999a). This information is useful for understanding the average data that include all the different farm structure types that are captured in the aggregated ARMS data for each livestock and poultry sector.

An advantage of the ARMS data is that data collected for 1997 include information on the total number of farms and the total number of animals in the sample set. Data of the total number of animals and farms in the 1997 ARMS data set correspond to the financial data compiled by ERS for each aggregated data grouping by commodity, production region, and facility size groups, described in Table 4-2 (USDA/ERS, 1999a—DCN 70063). The match between average financial information and total numbers of farms and animals allows EPA to calculate average

financial data on a per-animal basis for each sector. Section 4.2.4.2 discusses how EPA converts the ARMS financial data onto a per-animal basis to construct its model CAFOs.

The ARMS revenue data are separable by enterprise (livestock and crops), as well as other farm-related income and government payments. Off-farm revenue is not included in the ARMS data used by EPA for this analysis, as described previously under revenue definitions for "Income statement information." However, the ARMS operating expense data are not separable by enterprise (e.g., buildings, labor and equipment for crop versus livestock production), but represent average production costs for an operation as a whole. This generally limits the types of analyses that EPA may conduct using these data for its regulatory impact analysis.

The main limitation of survey data sets, including the ARMS data, is that they reflect average financial conditions across an entire sector and may not be representative of certain subsectors within that sector. For example, as discussed in Section 2.2, ARMS financial data are mixed across farms that graze animals and ones that grow animals under confinement. The cost structures between these types of operations may vary depending on differences in expenditures for production inputs, such as feed, labor, equipment, land, and buildings. USDA's data are also mixed across operations where farming is not the major occupation of farm operator (e.g., noncommercial, part-time operations). The inclusion of all types of operations—noncommercial, higher cost producers, as well as smaller scale production units—may result in the average financial statistics being too low to be representative. In particular, the inclusion of noncommercial farms, when expressed across all farms, will result in a lower average annual gross and net income than would be the case if noncommercial farms were excluded from the data (USDA/ERS, 1996a). The ARMS data are representative of the population, which contains more smaller-sized operations and fewer larger-sized operations. As a result, the data may be less representative of the types of larger scale operations that would be affected by the proposed CAFO regulations.

In general, the inclusion of financial information on the vast range of operations may result in lower average data such that the revenue and cost data that are used for this analysis are lower even higher. This possibility is not very problematic since this would mean that EPA's analysis is overly conservative. Of more concern are those cases where use of average data may understate the effects of compliance by overstating a CAFO's baseline financial conditions and its ability to pay for on-farm improvements under the proposed regulation (i.e., concluding that a model CAFO is able to afford the estimated regulatory costs when, in fact, it cannot). Examples where financial conditions may be overstated may include facilities that may perform below the USDA average (e.g., contract growers) and operations with little available land that are represented by the average debt-to-asset ratios reported by USDA. Section 4.2.4.5 discusses how EPA matched up the number of CAFO cost models to the limited number of available financial models. EPA addresses concerns about the limitations of the financial data, in part, by undertaking extensive sensitivity analysis of the model CAFO results, which is presented in Appendix D. Variance analysis of the ARMS financial data is not available.

Table 4-2. EPA-Requested ARMS Data for Model CAFOs by Sector, Size, and Region

Sector	Number of Animals			EPA-Requested Aggregations (Regions)	USDA Farm Producing Regions Represented	Cost Model Match
	"Small"	"Medium"	"Large"			
Beef	<200	200 to 800	>800	U.S.	Average U.S.	
				S. Plains (SP)	Southern Plains	CE
				Mt./Plains (MP)	Northern Plains + Mountain	MW
				All Other	U.S. less other regions	
Dairy	<100	100 to 500	>500	U.S.	Average U.S.	
				South (SO)	Southern Plains + Delta + SE	
				West (W)	Pacific + Mountain	PA
				Mid-Atlantic (MA)	Northeast + Appalachian	
				Midwest (MW)	Lake St. + Corn Belt + N. Plains	MW
Hogs	<800	800 to 2,500	>2,500	U.S.	Average U.S.	
				Mid-Atlantic (MA)	Northeast + Appalachian	MW
				Midwest (MW)	Lake St. + Corn Belt + N. Plains	MA
Layers/ Broilers	<90,000 (layers)	90,000 to 120,000	>120,000	U.S.	Average U.S.	
				Southwest (SW)	S. Plains + Pacific + Mountain	
	<30,000 (broilers)	30,000 to 90,000	>90,000	East (E)	NE + Appalachian + Delta + SE	SO
				Midwest (MW)	Lake St. + Corn Belt + N. Plains	MW
Turkeys	<10,000	10,000 to 40,000	>40,000	U.S.	Average U.S.	
				West/Midwest (W/MW)	Pacific + Mountain + Lake St. + Corn Belt + N. Plains + S. Plains	MW
				East (E)	NE + Appalachian + Delta + SE	SO

Source: USEPA, 2000a and USDA/ERS, 1999a. USDA's Farm Producing Regions shown in Figure 1; region names for EPA's CAFO cost models are defined in Table 4-1. EPA aggregations of USDA regions (as indicated) are used to avoid disclosure of ARMS data. Shaded cells indicate model CAFO not developed.

EPA investigated several other potential sources of farm level financial information before deciding to use the ARMS data. As already discussed, cost and revenue data in the Census are unsuitable for developing EPA's model CAFOs since they do not provide complete financial information. Other frequently used sources of financial data, such as Robert Morris and Associates (RMA) and Dunn & Bradstreet, are not useful for EPA's analysis because they do not provide detailed farm financial statistics and corresponding information on facility size, such as the number of animals raised on site, which is needed to present revenue data on a per-animal basis (which is essential for scaling the financial models to match cost models as explained in Section 4.2.4). An alternative approach that is commonly used by the land grant universities is to consult an "expert panel" or "focus group" that would consist of state or regional extension specialists to compile representative, regional financial budgets for each sector. EPA decided not pursue this approach since it is common practice at the Agency to rely on statistically validated data obtained from survey questionnaires; also, such an alternative approach would have been time and resource intensive.

EPA also obtained financial information from industry. In particular, the National Cattlemen's Beef Association (NCBA) provided aggregated summary information on financial conditions at cattle feeding operations based on responses to a survey questionnaire of its membership. Although not intended as a statistical and conclusive financial analysis, these data do provide a summary of information gathered and submitted on a voluntary basis by individual feedyards throughout the nation. This information is useful to EPA since it allows the Agency to evaluate how well the ARMS data for cow and calf operations represent conditions at cattle feedyards. More information on these data and how EPA uses these data is provided in Section 8 of this report.

Finally, EPA also explored a modeling approach that calculates the amount of livestock revenue that is likely to be generated for each representative CAFO based on key market data, including the USDA-reported price received by producers for raw farm output and average yield, expressed either as animal weight at slaughter or the volume of milk or number of eggs produced annually. For farms producing meat animals, the model also accounts for the number of "turnovers" or annual marketing cycles, representing the total number of meat animals produced and sold for slaughter in a full year cycle. (More information on this approach is provided in the rulemaking record, see USEPA, 2000e and Appendix J of docket item DCN 93080) EPA did not use this approach because it most likely understates financial conditions at CAFOs. This approach cannot account for income from crops or other secondary livestock raised on site, nor can it account for other supplemental income, such as other farm-related revenue and government payments.

4.2.3.2 Special Compilation of Representative ARMS Data

Aggregated ARMS data are readily available through periodic compendiums published by USDA. In general, these publications provide financial information on a total, national basis

across all farms for four aggregated sectors only: beef, dairy, hogs, poultry (which combines all broiler, turkey, and egg laying operations). However, the underlying ARMS database compiled during 1997, in conjunction with USDA efforts to collect the Census, contains more detailed information. These data can be grouped to show differences among farms by factors such as facility size and production region. Data are also available on average end-of-year farm inventories for a particular size and regional group. The 1997 ARMS database also allows for the breakout of data for the poultry category across the broiler, turkey, and egg laying sectors.

To depict financial conditions for selected representative farm groups, EPA requested that USDA provide the 1997 ARMS data on a more disaggregated basis than that found in the published data. As previously noted, USDA periodically publishes summary data from the ARMS database and provides customized analyses of the data to the public and other government agencies. The requested ARMS data summaries were compiled with the assistance of staff at USDA's ERS, who performed special tabulations of the data to differentiate the financial conditions among farms by selected facility size categories and by primary producing region for each sector. ERS developed a methodology for identifying farms likely to be CAFOs based on reported survey information, and developed estimates of animal units on these operations based on reported data. Given these estimates, farms were grouped into animal unit size categories and provided to the EPA and other government agencies.

All data provided to EPA are sufficiently aggregated to ensure the confidentiality of an individual farming operation and to maintain the statistical representativeness of the sample data.

Initially, EPA requested these representative data for the U.S. and for each of the USDA farm producing regions shown in Figure 4-1. However, data are not available at this level of aggregation for each of the sectors and size groups requested. Table 4-2 shows the facility size and production regions ultimately requested by EPA. The table also shows that the ARMS database supports data disaggregation across three broad size categories only, roughly but not exactly matching EPA's model CAFO groups. With some exception, data obtained by USDA fall into three facility size groups: CAFOs with more than 1,000 AU, CAFOs with between 300 and 1,000 AU, and CAFOs with fewer than 300 AU (Table 4-1). Even at this level of aggregation, there are some sectors for which ERS is not able to release data for all sizes and regions requested because of concerns about confidentiality and statistical representativeness. Where data at one level of aggregation are not available, EPA uses data at higher levels of aggregation, as discussed below in Section 4.2.3.3.

It is because of ARMS data disclosure limitations that EPA's financial models do not exactly match EPA's cost model across the range of regions and facility sizes represented in the costs models. In spite these limitations, the average U.S. (published) data and the representative level data (the disaggregated data provided by ERS and used as the basis for the representative farm approach) are instrumental in the development of EPA's model CAFOs. EPA uses these data, along with accompanying farm descriptive data, to construct the model CAFOs as discussed in Section 4.2.4.

4.2.3.3 ARMS Data Aggregations for Model CAFOs

Generally, EPA uses the ARMS data associated with the applicable sector, size, and region to characterize a model CAFO's financial situation. In some cases, however, USDA did not disclose representative farm data for a particular size or region for a sector. In other cases, EPA judged certain disclosed data as potential outliers that would likely understate the impact to a facility.

Table 4-2 lists the available representative farm breakouts of the ARMS data. For those sectors where representative financial data are not disclosed by USDA, EPA uses national level data for its model CAFOs, usually specified for a particular size group. Sectors for which representative financial data (gross and net cash income) are not disclosed include (USDA/ERS, 1999a):

- Beef operations with >800 head in SP and "All Other" regions.
- Dairy operations with >500 head in MW, MA, & SO; dairies <100 head in SO region.
- Hog operations with between 800-2,500 head in MA region.
- Egg operations with >120,000 and between 90,000 and 120,000 birds (US, E, SW, MW).
- Broiler operations, all facility sizes in SW region.
- Turkey operations with >40,000 (US, SO, MW regions); operations with between 10,000 and 40,000 birds (MW region); operations with <10,000 birds (MW, SO regions).

In a few cases, EPA has judged the disclosed representative level data (data for a particular sector, region, and size) to be potential outliers, based on a determination that the data substantially differed from the national average. In these cases, EPA substitutes the reported data with national level values, usually specified for a sector as a whole. As a result, these data may be more reflective of national level conditions and less reflective of representative financial conditions characterizing model CAFOs. In most cases, EPA's decision to substitute available representative data with national level data for some sectors results in the use of a more conservative input value, such that estimates of farm impacts would be higher than those estimated using the representative level data (e.g., egg laying and turkey operations in the Midwest and some hog and beef operations).

Table 4-3 summarizes the per-animal financial data derived by EPA using the 1997 ARMS data and describes the criteria EPA used for selecting/omitting variables used for this analysis. As

shown, in most cases data are substituted due to non-disclosure of data. In some cases data are substituted because the ARMS data for a particular aggregated variable resulted in values with a relative standard error (RSE) of more than 75 percent (indicated in Table 4-3 as "RSE >75%"). In general, data with a high RSE are not used. The only case where EPA uses ARMS data despite an RSE of more than 75 percent was for turkey operations (U.S., All sizes); EPA uses this data because limited useful data were disclosed for this sector. In the beef sector, national data are substituted for regional data because either data are not disclosed or available data have a RSE of more than 75 percent. National data are also used because of non-disclosure of data for some regions in the dairy, hog and broiler sectors. National data are used for the layer and turkeys sectors because a complete set of regional values at the different size categories are not available; some of these data also have a high RSE (Table 4-3).

Table 4-4 also summarizes the data EPA uses, highlighting those data that are substituted for this analysis. This table identifies the level of USDA data aggregation used for each model CAFO and indicates, where footnoted, which data are substitutes. Any other cells where "US" or "All" is shown indicate that substitutions are made to use available average national data or average data across all facility size categories. In some cases, EPA uses sector level data to depict conditions for a subsector within that commodity group.

In some cases, EPA has decided to use national average available data despite limited available regional data because of notable differences between regions. For example, in the turkey sector, total entity revenues average $26 per animal across all turkey operations in the Midwest compared to $7 in the East region (Table 4-3). In the layer sector, total entity revenues average $45 per animal across all egg operations in the Midwest compared to $13 in the East region (Table 4-3).[9] In some cases these omitted data have an RSE of more than 75 percent. For both the turkey and egg laying sectors, EPA substitutes national level data for regional data. Use of the national level data for egg laying and turkey operations in the Midwest may overstate the impact to a facility; conversely, use of national data for egg laying and turkey operations in the East may understate the impact to a facility.

In the case of hogs, EPA justifies sizable regional per-animal differences because of additional information on the reported percentage of animal (Table 4-3). For example, in the Mid-Atlantic, total entity per animal at hog operations in the Midwest are estimated at $80 to $170 per animal, depending on facility size, compared to $230 to 300 per animal in the Midwest region. Animal ownership by hog operators is more than 60 percent at operations in the Mid-Atlantic (Table 4-3) where overall revenues are likely lower due to lower prices paid to contract growers who comprise the bulk of production. This is compared to under 20 percent at operations in the Midwest where overall revenues are likely higher due to higher prices paid to

[9]One explanation is that operations in the East may have lower overall farm revenues due to a larger number of contract growers compared to the Midwest where average revenues are higher and where contract growers constitute a small share of production (as indicated by data in Table 4-3).

Table 4-3. EPA-derived Per-Animal Financial Data from the 1997 ARMS Data

Sector	Size	Region	Total Revenue	Livestock Revenue	Total Expenses	NetCash	%Not Own	Explantion
Beef	All	US	$1,060	$503	$916	$144	4.7%	
	L	US	$862	$512	$606	$256	3.9%	Substitute data (Table 4-5 and 4-6)
	M	US	$535	$329	$455	$79	6.9%	Substitute data (Table 4-5 and 4-6)
	S	US	$1,074	$463	$947	$127	4.2%	
	All	US	$1,012	$513	$821	$190	7.8%	
	L	MP	$854	$479	$532	$322	d	Data used (Table 4-5 and 4-6)
	M	MP	$502	$340	$421	$81	6.9%	Data used (Table 4-5 and 4-6)
	S	MP	$1,097	$470	$918	$178	8.7%	
	All	SP	$718	$440	$683	$35	4.6%	Data not used; RSE >75%
	L	SP	d	d	d	d	d	Data not disclosed
	M	SP	$461	$357	$417	$44	10.6%	Data not used; RSE >75%
	S	SP	$710	$398	$687	$23	2.9%	Data not used; RSE >75%
Dairy	All	US	$2,573	$2,279	$2,086	$487	1.4%	
	L	US	$2,613	$2,470	$2,178	$435	0.1%	Substitute data (Table 4-5 and 4-6)
	M	US	$2,524	$2,239	$2,058	$466	1.7%	
	S	US	$2,584	$2,172	$2,041	$543	2.2%	
	All	W	$2,672	$2,473	$2,300	$372	0.3%	
	L	W	$2,567	$2,412	$2,166	$402	0.0%	Data used (Table 4-5 and 4-6)
	M	W	$2,343	$2,166	$2,118	$225	1.4%	Data used (Table 4-5 and 4-6)
	S	W	$6,786	$5,540	$6,221	$565	0.5%	
	All	MW	$2,584	$2,207	$2,048	$535	2.0%	
	L	MW	d	d	d	d	d	Data not disclosed
	M	MW	$2,498	$2,250	$2,054	$444	0.6%	Data used (Table 4-5 and 4-6)
	S	MW	$2,620	$2,148	$2,022	$598	3.0%	Data used (Table 4-5 and 4-6)
	All	MA	$2,561	$2,218	$1,965	$595	2.5%	
	L	MA	d	d	d	d	d	Data not disclosed
	M	MA	$2,866	$2,358	$2,138	$728	4.5%	
	S	MA	$2,283	$2,036	$1,793	$490	1.1%	
Hogs	All	US	$363	$213	$293	$70	27.6%	
	L	US	$185	$141	$144	$41	37.6%	
	M	US	$297	$187	$233	$64	20.5%	
	S	US	$644	$328	$533	$110	20.9%	
	All	MW	$377	$228	$301	$76	17.9%	
	L	MW	$229	$186	$182	$47	16.8%	Data used (Table 4-5 and 4-6)
	M	MW	$304	$193	$238	$66	17.9%	Data used (Table 4-5 and 4-6)
	S	MW	$606	$307	$487	$119	19.1%	Data used (Table 4-5 and 4-6)
	All	MA	$174	$102	$144	$31	66.3%	Substitute data (Table 4-5 and 4-6)
	L	MA	$84	$47	$52	$31	80.3%	Data used (Table 4-5 and 4-6)
	M	MA	d	d	d	$0	d	Data not disclosed
	S	MA	$383	$232	$352	$31	36.5%	Data not used; RSE >75%

Table 4-3. EPA-derived Per-Animal Financial Data from the 1997 ARMS Data (continued)

Sector	Size	Region	Total Revenue	Livestock Revenue	Total Expenses	NetCash	%Not Own	Explantion
Broilers	All	US	$1.9	$0.5	$1.4	$0.5	97.6%	
	L	US	$1.1	$0.2	$0.6	$0.5	92.2%	Substitute data (Table 4-5 and 4-6)
	M	US	$1.5	$0.2	$0.9	$0.6	96.3%	Substitute data (Table 4-5 and 4-6)
	S	US	$10.9	$4.4	$10.9	$0.0	99.6%	Data not used; RSE >75%
	All	East	$1.5	$0.2	$1.0	$0.5	97.9%	
	L	East	$1.2	$0.2	$0.7	$0.5	99.5%	Data used (Table 4-5 and 4-6)
	M	East	$1.4	$0.1	$0.9	$0.6	96.1%	Data used (Table 4-5 and 4-6)
	S	East	$5.2	$1.6	$5.0	$0.2	98.7%	Data not used; RSE >75%
	All	MW	d	d	d	d	d	Data not disclosed
	L	MW	d	d	d	d	d	Data not disclosed
	M	MW	d	d	d	d	d	Data not disclosed
	S	MW	d	d	d	d	d	Data not disclosed
Layers	All	US	$24.6	$17.0	$20.6	$4.1	43.3%	Substitute data (Table 4-5 and 4-6)
	L	US	d	d	d	d	d	Data not disclosed
	M	US	d	d	d	d	d	Data not disclosed
	S	US	$46.3	$27.7	$41.1	$5.1	83.5%	
	All	East	$13.0	$8.9	$11.7	$1.3	61.3%	Data not used; RSE >75%
	L	East	d	d	d	d	d	Data not disclosed
	M	East	d	d	d	d	d	Data not disclosed
	S	East	$16.5	$9.3	$17.1	($0.5)	85.6%	Data not used; RSE >75%
	All	MW	$45.3	$33.2	$33.9	$11.4	28.7%	
	L	MW	d	d	d	d	d	Data not disclosed
	M	MW	d	d	d	d	d	Data not disclosed
	S	MW	$140.8	$97.7	$110.1	$30.7	65.3%	
Turkeys	All	US	$20.1	$16.6	$18.3	$1.8	70.0%	Substitute data; RSE >75%
	L	US	d	d	d	d	d	Data not disclosed
	M	US	$11.2	$6.5	$8.7	$2.5	83.1%	Substitute data (Table 4-5 and 4-6)
	S	US	$4.9	$1.6	$3.5	$1.5	85.5%	Data not used; RSE >75%
	US	East	$5.8	$2.0	$4.5	$1.2	99.8%	
	L	East	d	d	d	d	d	Data not disclosed
	M	East	$6.5	$1.4	$3.5	$2.9	100.0%	Value substituted w/ average US
	S	East	d	d	d	d	d	Data not disclosed
	All	MW	$26.3	$23.0	$24.3	$2.0	56.9%	Data not used; RSE >75%
	L	MW	d	d	d	d	d	Data not disclosed
	M	MW	d	d	d	d	d	Data not disclosed
	S	MW	d	d	d	d	d	Data not disclosed

Source: Derived by EPA using 1997 ARMS data. "%Not Own"= Percentage of animals not owned by the farmer.

Table 4-4. ARMS Data Aggregation for Model CAFOs by Sector, Size, and Region

Sector	Regions [a/]	CAFOs <300 AU	CAFOs Medium 1(a)	CAFOs Medium 1(b)	CAFOs Medium 2	CAFOs Large 1	CAFOs Large 2
			300-1000AU			>1,000 AU	
Fed Cattle	MW		Beef US Medium			Beef US Large	
	CE		Beef MP Medium			Beef MP Large	
Dairy	MW	Dairy MW Small	Dairy MW Medium			Dairy MW Large	
	PA		Dairy West Medium			Dairy W Large	
Heifer	MW		Beef US Medium			Beef US Large	
Veal	MW			Beef U.S. Medium			
Hog: FF	MA		Hog MA All			Hog MA Large	
	MW	Hog MW Small	Hog MW Medium			Hog MW Large	
Hog: GF	MA		Hog MA All			Hog MA Large	
	MW		Hog MW Medium			Hog MW Large	
Layer: Wet	SO			Layer US All [a/]			
Layer: Dry	MW		Layer US All [a/]				
	SO						
Broiler	MA		Broiler US Medium [a/]			Broiler US Large [a/]	
	SO		Broiler East Medium			Broiler East Large	
Turkey	MA		Turkey US Medium [a/]			Turkey US All [a/]	
	MW						

Source: USEPA, 2000a and USDA/ERS, 1999a. Descriptions of model CAFOs used for EPA's CAFO Model. Region names defined in Tables 4-1 and 4-2. Size groups by AU are approximate (see Table 4-2).
Shaded cells indicate model CAFO not developed. Cells with "US" or "All" indicate substitutions made based on available average national data or average data across all facility size categories. The commodity sector indicated in the cell is, in some cases, used to depict conditions at model CAFOs for a subsector of that commodity group.
[a/]Higher level of data aggregation substituted for suspected outlier.

independent owner-operators. Contract hog growers comprise a smaller share of production in the Midwest, as shown in Table 4-3.

Table 4-3 shows the reported ARMS revenue expressed both as average total entity revenue and revenue from primary livestock sales only. The ARMS operating expenses data are not distinguishable by business enterprise, but are total for the business (Table 4-3). EPA recognizes that the mix of enterprises at operations and EPA's use of total entity revenue for this analysis may affect the results of its analysis in some sectors and regions. To address this concern, EPA conducted additional sensitivity analyses related to the use of ARMS livestock revenue data only versus total entity revenue, which is provided in Appendix D of this report. Although annual revenue sources are distinguishable in the ARMS data, it is not clear that this precisely reflects an entity's different business enterprises. Producers generally make business decisions taking into consideration all components of the business, some of which are interdependent. For example, some livestock producers grow crops to offset feed costs in addition to revenue considerations. EPA typically conducts analyses of regulated entities using data for a business entity as opposed to an individual product line at an entity.

ARMS financial data are not available for the different types of beef feedlot operations (fed cattle, veal, heifer operations), hog operations (farrow-finish and grow-finish hog operations), and egg laying operations based on manure management system used (liquid versus dry). For this analysis, EPA uses available ARMS data for the broad commodity sector categories: beef sector data are used for fed cattle, heifers, and veal; hog sector data are used for farrow-finish and grow-finish operations; and egg sector data are used for layer operations with both wet and dry manure systems. Refer to Table 4-2 for sector, size, and region designations shown in the model CAFO cells.

For the purpose of this analysis and because of lack of other statistically validated survey data, EPA uses the ARMS data for beef operations to depict conditions at regulated cattle feeding operations. Additional information on EPA's use of ARMS data for this sector is provided in Section 8 and in the rulemaking record (Stott, 2000a; USEPA, 2000n and 2000m; ERG, 2000b; NCBA, 1999).

4.2.4 Development of the Financial Characterization of Model CAFOs

The following sections discuss the key financial variables EPA uses to assess post-compliance impacts (Section 4.2.4.1), calculation of the key variables on a per-animal basis (Section 4.2.4.2), calculation of present value of cash flow (Section 4.2.4.3), use of USDA's debt-to-asset ratios (Section 4.2.4.4), and construction of EPA's financial models used to depict representative CAFOs (Section 4.2.4.5). Section 4.2.4.6 discusses some of the general limitations of the farm financial data used to characterize model CAFOs for this analysis.

When the individual components of the financial model are derived, EPA matches the financial models to the cost models (described in Section 4.2.4.5). This intersection of financial models and cost models forms the basis for the analysis of economic impacts using this representative farm approach.

4.2.4.1 Key Financial Variables

For this analysis, EPA focuses on three financial measures that are used to assess the affordability of the proposed CAFO regulations. These are: (1) total gross revenue; (2) net cash income; and (3) debt-to-asset ratio. All are taken or derived from data in the 1997 ARMS data summaries prepared by ERS and form the basis for the financial characterization of the model CAFOs. These reported measures (at the level of aggregation shown in Table 4-4) are used directly by EPA to represent baseline conditions at the model CAFOs.

Gross cash income is used to measure the ratio of compliance costs to sales (sales test). EPA and others frequently have used a sales test to evaluate post-compliance impacts in previous regulatory analyses (USEPA, 1987, 1994 and 1996; DPRA, 1995; USGPO, 1999; Heimlich and Barnard, 1995). For this analysis, EPA uses average USDA-reported gross cash income for representative farms, defined in Section 4.2.3.1, to evaluate post-compliance costs at model CAFOs. This measure includes total farm income from both an operation's livestock business as well as income from other sources, such as sales of crops and other secondary livestock on site. Other farm-related revenue and government payments are also included. USDA's farm revenue data are available for 1997 only. To account for potential changes in farm revenue since 1997, EPA conducted additional sensitivity analyses that are presented Appendix D.

The financial position of a farm can be calculated using either net cash income or net farm income. *Net farm income* is an effective measure of long-term profitability because it accounts for capital replacement costs and non-cash business income (i.e., land, capital, and labor services). *Net cash income* reflects current or short-term cash earnings. For this analysis, EPA uses cash-based measures, for reasons cited in Section 4.2.5. The reported net cash income, or gross income less operating expenses, is used as an estimate for cash flow to construct baseline per-animal annual cash flow (Section 4.2.4.1) and baseline and post-compliance discounted cash flow (Section 4.2.4.2).

The *debt-to-asset ratio* is a measure of a company's solvency and its ability to finance regulatory costs through additional debt. This measure is calculated by USDA as the ratio of business debt to business assets and reflects the share of assets owed to lenders. USDA uses a combination of a farm's net income and debt-to-asset ratio to classify the overall financial position of a farm based on annual earnings and solvency (USDA/ERS, 1997a and 1997e). EPA also uses the reported total farm assets and liabilities (assets divided by liabilities equal the USDA reported debt-to-asset ratio) to construct post-compliance debt-to-asset ratios, as discussed in Section 4.2.4.4.

Section 4.2.5 provides additional information on how these financial variables are evaluated to demonstrate the economic achievability of the proposed CAFO regulations.

4.2.4.2 Calculation of Financial Variables on a Per-Animal Basis

ARMS financial data obtained from ERS include representative farm financial data and corresponding summary information that match the reported average revenue to the total number of farms and total number of animals in the sample set. From these data, EPA converts the relevant financial statistics in the ARMS data to per-animal values for each model farm. Financial data derived on a per-animal basis include gross cash income and net cash income.

Per-animal financial data are calculated by multiplying the average value of the reported financial data per farm by the total number of farms (also obtained form the 1997 ARMS data) and then dividing by the total number of animals, as follows:

$$\frac{\text{Avg. Value (\$)}}{\text{Animal}} = \frac{\text{Avg. Value (\$) per Farm}_{(i,\,j)}}{\text{Total \# Animals}_{(i,\,j)}} * \text{Total \# Farms}_{(i,\,j)}$$

Where:

i = animal sector
j = selected representative size/region for that sector

The resulting per-animal calculations for the key financial variables are presented in Tables 4-5 and 4-6. EPA derives these data from the ARMS database for calendar year 1997. Descriptive farm data on the total number of farms and the total number of animals on those farms reflect total farm inventory during that year. These data correspond exclusively to the average income statement and balance sheet information for representative farms compiled by ERS. In some cases, the data shown in the table are at a higher level of aggregation than the sector, region, and size a CAFO model is representing because of data collection or disclosure issues or because EPA judges the data to be possible outliers, as discussed in Section 4.2.3.3.

To establish consistency with the cost model outputs, EPA scales the financial data using the same number of animals assumed for each of EPA's cost models, whose outputs also are expressed on a per-animal basis. This approach allows for greater accuracy by aligning the the compliance costs incurred and revenues generated at a facility. This approach also allows for more flexibility. Since the models are initially expressed on a per-unit basis, EPA can readily use financial data for one CAFO model as a substitute for another simply by adjusting the number of animals at a facility (assuming that per-unit costs and revenues between these representative facilities may be considered similar).

Table 4-5. Per-Animal Total Gross Revenue for Model CAFOs, 1997

Sector	Region	Revenue per Animal ($)					
		CAFOs <300 AU	CAFOs Medium 1(a)	CAFOs Medium 1(b)	CAFOs Medium 2	CAFOs Large 1	CAFOs Large 2
			300-1000AU			>1,000 AU	
Beef	MW		$535			$862	
	CE		$502			$854	
Dairy	MW	$2,620	$2,498			$2,613	
	PA		$2,343			$2,567	
Heifer	MW		$535			$862	
Veal	MW		$535				
Hog: FF	MA		$174			$84	
	MW	$606	$304			$229	
Hog: GF	MA		$174			$84	
	MW		$304			$229	
Layer: Wet	SO				$24.6		
Layer: Dry	MW		$24.6				
	SO						
Broiler	MA		$1.5			$1.1	
	SO		$1.4			$1.2	
Turkey	MA		$11.2			$20.0	
	MW						

Source: Derived from USDA/ERS, 1999a. Shaded cells indicate model CAFO not developed. See Table 4-4 for level of data aggregation used for each model. Rounded to nearest dollars (beef, dairy, hogs) or nearest ten cents (poultry). Size groups by AU are approximate (see Table 4-2).

Table 4-6. Per-Animal Net Cash Income for Model CAFOs (One Year), 1997

Sector	Region	Net Cash Income per Animal ($)					
		CAFOs <300 AU	CAFOs Medium 1(a)	CAFOs Medium 1(b)	CAFOs Medium 2	CAFOs Large 1	CAFOs Large 2
			300-1000AU			>1,000 AU	
Beef	MW		$79			$256	
	CE		$81			$322	
Dairy	MW	$598	$444			$435	
	PA		$225			$402	
Heifer	MW		$79			$256	
Veal	MW				$79		
Hog: FF	MA		$31			$31	
	MW	$119	$66			$47	
Hog: GF	MA		$31			$31	
	MW		$66			$47	
Layer: Wet	SO				$4.1		
Layer: Dry	MW		$4.1				
	SO						
Broiler	MA		$0.6			$0.5	
	SO		$0.6			$0.5	
Turkey	MA		$2.6			$1.8	
	MW						

Source: Derived from USDA/ERS, 1999a. Shaded cells indicate model CAFO not developed. See Table 4-4 for level of data aggregation used for each model. Rounded to nearest dollars (beef, dairy, hogs) or nearest ten cents (poultry). Size groups by AU are approximate (see Table 4-2).

In addition to providing modeling flexibility, agriculture sector analyses routinely express costs and revenues as a unit metric, such as dollars per animal or dollars on a unit weight basis. Expressing an increase in production costs on a per unit basis provides a quick assessment of the potential effects of such increases on a farming operation, often without further analysis. For example, in an analysis of the economic impacts on livestock producers from wastewater and runoff control requirements in coastal areas, incremental costs were reported on a per-animal basis (Heimlich and Barnard, 1995; DPRA, 1995). The range of estimated costs—$17 to $49 per dairy cow and $2 to $5 per hog—were determined to be affordable for producers (DPRA, 1995). These assessments agree with other studies. In evaluating a range of technology options to regulate hog producers in North Carolina, researchers at North Carolina State University (NCSU) have established a cutoff of $3 to $5 per marketed hog as being "economically feasible," implying that per-head costs in excess of that threshold might be prohibitive (NCSU, 1999). Similarly, researchers at Cornell University surveyed milk producers in New York who indicated that they would likely stay in business if they had to pay up to $50 per cow for environmental improvements (Poe et al., 1999). EPA's estimates of per-animal and per-facility costs for the proposed regulations are provided in Section 6, 7, and 8 for each of the commodity sectors.

4.2.4.3 Calculation of Present Value of Net Cash Flow

The 1997 ARMS data are limited by the fact that they represent a snapshot of conditions in a single year and do not account for the expected variability of farm financial conditions over time. To account for changes in an operation's cash flow post-compliance, EPA estimates the present value of projected farm earnings, measured as a future cash flow stream in 1997 dollars. The present value of cash flow, also known as the discounted cash flow, or DCF, represents the value in terms of today's dollars of a series of future receipts. EPA calculates baseline cash flow as the present value of a 10-year stream of farm cash flow.

EPA projects future earnings over the period of the analysis (1997 to 2006) using net cash flow values derived on a per-animal basis from the ARMS data, USDA's projections of farm level earnings from 1997 through 2006, and other market data to translate USDA's projected per-unit returns into per-animal returns. EPA approximates future earnings using USDA's projected changes (expressed in dollars per unit) by applying the equivalent incremental change (expressed in dollars per animal) for each year during the forecast period to the 1997 ARMS data for that variable (Table 4-6). EPA uses the resultant time series data to calculate the present value of net cash income used for this analysis. This approach is outlined below.

Future earnings at livestock and poultry operations are projected annually by USDA. For this analysis, EPA forecasts out future earnings from the 1997 ARMS baseline data based on USDA's *Agricultural Baseline Projections to 2009* (USDA/WAOB, 1999 and 2000). USDA's projections are shown in Table 4-7(a) and are expressed on a per-unit basis (i.e., cash returns per animal or per- unit output).

To translate USDA-projected changes shown in Table 4-7(a) on a per-animal basis, EPA uses available market information, such as average per-animal yields reported by USDA and/or annual marketing cycles based on industry data. For dairy, the 1997 average output of 16,781 pounds of milk per cow is assumed (USDA/NASS, 1999c). An average weight of 257 pounds per finished hog is assumed, based on reported weights for "swine for slaughter" and "farrow-finish" (NPPC, 1998), averaged according to the market share of each (USDA/APHIS, 1995b). The average number of 255 eggs per egg laying chicken in 1997 is assumed (USDA/NASS, 1998b and 1998f). An average broiler weight of 5.5 pounds per bird is assumed, derived from the total number of animal and pounds of production, reported in 1997 (USDA/NASS, 1999d). For turkeys, EPA assumes an average weight of 23.8 pounds per bird derived from weight estimates and market share information for turkey toms and hens (USEPA, 1999j; USDA/NASS, 1999d).

Equivalent per-animal values that represent USDA's projected changes are also shown in Table 4-7(b) for the dairy, hog, and poultry sectors. No translation is needed for projections for the beef cattle sector, since USDA already reports projected returns on a per bred cow basis.

Once USDA's projections are expressed on a per-animal basis, future earnings are approximated by applying the incremental national average change (dollars per animal) between each year during the forecast period to the 1997 baseline data for each representative model CAFO. These revised cash streams over the forecast period are shown in Table 4-8.

EPA then calculates adjusted per-animal values reflecting future earnings (Table 4-8) in terms of present value using a 7 percent discount rate. The equation EPA uses to calculate the present value of cash flow is :

$$NPV = v_1 + \sum_{i=2}^{n} \frac{v_i}{(1+r)^{i-1}}$$

Where:

$v_1 ... v_n$ = series of cash flows
r = interest rate
n = number of cash flow periods
i = current iteration

EPA calculates the present value of the capital and annual pollution control costs for the same 10-year period with the same discount rate (7 percent) as for the cash flow analysis (Section 4.1.3).

The adjustment of the DCF analysis to represent post-compliance conditions for each model CAFO is as follows:

Post-regulatory Status = PVCF – [PVCC x (1 – CPT)]

Table 4-7(a). USDA Baseline Projections, Returns Per Unit, 1997-2006

Sector/ Year	Beef	Dairy	Hogs	Broilers	Egg Layers	Turkeys
	($/cow)	($/cwt)	($/cwt)	(¢/lb)	(¢/doz)	(¢/lb)
1997	-0.91	11.62	3.26	3.14	8.69	-3.83
1998	-16.80	12.41	-5.75	10.60	10.15	-3.3
1999	18.45	9.85	-0.91	11.74	5.30	9.8
2000	45.58	9.83	4.28	8.97	1.89	4.76
2001	34.23	10.46	8.51	6.62	6.58	1.45
2002	25.76	10.89	7.30	9.29	2.85	-2.13
2003	19.24	11.05	5.69	10.42	-0.66	-3.70
2004	25.79	11.28	5.17	13.29	1.08	-1.90
2005	32.63	11.48	4.39	15.75	0.50	-1.66
2006	38.98	11.69	3.86	15.20	-0.14	-0.07

Source: USDA/WAOB, 1999 and 2000. Values shown for 1997 are back-calculated from 1998, reported in the *2000 Baseline Projections* based on the percentage change projected for 1997 to 1998, as reported in *1999 Baseline Projections.* Time series data projected by USDA include: Beef (Costs and returns to cow-calf enterprise, $/cow); Dairy (Returns above feed concentrate costs, $/cwt; Hogs (Returns above cash costs, $/cwt); Broilers (Net returns, cents/pound); Layers (Net returns, cents/dozen); Turkeys (Net returns, cents/pound).

Table 4-7(b). EPA-derived Equivalent Baseline Projections, Returns Per Animal, 1997-2006

Sector/ Year	Beef	Dairy	Hogs	Broilers	Egg Layers	Turkeys
	($/animal)					
1997	($0.9)	$1,960	$8.4	$0.17	$1.85	$(0.91)
1998	$(16.8)	$2,094	($14.8)	$0.58	$2.16	$(0.79)
1999	$18.5	$1,662	($2.3)	$0.65	$1.13	$2.33
2000	$45.6	$1,658	$11.0	$0.49	$0.40	$1.13
2001	$34.2	$1,765	$21.9	$0.36	$1.40	$0.35
2002	$25.8	$1,837	$18.8	$0.51	$0.61	$(0.51)
2003	$19.2	$1,864	$14.6	$0.57	$(0.14)	$(0.88)
2004	$25.8	$1,903	$13.3	$0.73	$0.23	$(0.45)
2005	$32.6	$1,937	$11.3	$0.87	$0.11	$(0.40)
2006	$39.0	$1,972	$9.9	$0.84	$(0.03)	$(0.02)

Source: Derived by EPA from USDA/WAOB, 1999 and 2000 (Table 4-6). Per-animal equivalents are calculated using USDA and industry information on per-animal yields and marketing turns (NPPC, 1998; USDA/APHIS, 1995b; USEPA, 1999j; USDA/NASS, 1999c, 1999d, 1998b and 1998f). Original USDA/WAOB values are used for beef cattle, since USDA reports projected returns on a per-bred-cow basis. Rounded to nearest dollar (dairy) or nearest ten cents (beef, hogs).

Table 4-8. Projected Cash Stream (1998-2006) based on USDA Projections of Per-Unit Returns

Sector	Region	Size	1997 ARMS	Revised cash stream (1997-2006)								
				1998	1999	2000	2001	2002	2003	2004	2005	2006
Beef	US	L	$256	$240	$276	$303	$291	$283	$276	$283	$290	$296
Beef	US	M	$79	$63	$99	$126	$115	$106	$100	$106	$113	$119
Beef	CE	L	$322	$306	$341	$368	$357	$349	$342	$349	$355	$362
Beef	CE	M	$81	$65	$100	$127	$116	$107	$101	$107	$114	$121
Dairy	US	L	$435	$569	$137	$134	$240	$312	$339	$378	$412	$447
Dairy	MW	M	$444	$577	$145	$142	$248	$321	$348	$387	$420	$456
Dairy	MW	S	$598	$732	$300	$296	$403	$475	$502	$541	$575	$610
Dairy	PA	L	$402	$535	$103	$100	$206	$279	$306	$345	$378	$414
Dairy	PA	M	$225	$358	$(74)	$(77)	$29	$102	$129	$168	$201	$237
Hogs	MA	L	$31	$8	$20	$34	$45	$42	$37	$36	$34	$33
Hogs	MA	All	$31	$7	$20	$33	$44	$41	$37	$36	$34	$32
Hogs	MW	L	$47	$23	$36	$49	$60	$57	$53	$51	$49	$48
Hogs	MW	M	$66	$43	$55	$69	$80	$76	$72	$71	$69	$68
Hogs	MW	S	$119	$95	$108	$121	$132	$129	$125	$124	$122	$120
Broilers	US	L	$0.5	$0.9	$1.0	$0.8	$0.7	$0.8	$0.9	$1.0	$1.2	$1.1
Broilers	US	M	$0.6	$1.0	$1.0	$0.9	$0.8	$0.9	$1.0	$1.1	$1.3	$1.2
Broilers	SO	L	$0.5	$0.9	$1.0	$0.8	$0.7	$0.8	$0.9	$1.1	$1.2	$1.2
Broilers	SO	M	$0.6	$1.0	$1.0	$0.9	$0.8	$0.9	$1.0	$1.1	$1.3	$1.2
Layers	US	All	$4.1	$4.4	$3.3	$2.6	$3.6	$2.8	$2.1	$2.4	$2.3	$2.2
Turkeys	US	All	$1.8	$1.9	$5.0	$3.8	$3.0	$2.2	$1.8	$2.2	$2.3	$2.7
Turkeys	US	M	$2.6	$2.7	$5.8	$4.6	$3.8	$3.0	$2.6	$3.0	$3.1	$3.4

Source: Derived by EPA using *USDA Baseline Projections* (USDA/WAOB, 1999 and 2000), expressed on a per-unit basis (Table 4-7(a)), translated onto a per-animal basis (Table 4-7(b)); resultant change in dollar returns per animal are applied to the 1997 ARMS data (Table 4-6) for each year in the forecast period (1997-2006). Rounded to nearest dollars (beef, dairy, hogs) or nearest ten cents (poultry).

Where:

PVCF = present value of future model CAFO cash flow

PVCC = present value of after-tax incremental pollution control costs for the CAFO model

CPT = cost pass-through assumed for the CAFO model (selected sectors only)

EPA's cost passthrough estimates (the percentage of costs that CAFOs are expected to be able to pass through to higher levels of the marketing chain in the form of higher product prices) are presented later in Section 4.2.6 of this report.

This methodology estimates the long-term reduction to earnings that result from the costs of complying with the proposed CAFO regulations. If the post-regulatory status is less than or equal to zero, it does not make economic sense for the owner to upgrade the farm. Under these circumstances, the average farm represented by that model might be vulnerable to closure.

Unlike previous regulatory analyses conducted by EPA, this approach does not consider salvage value of liquidated assets at a CAFO. There are a number of reason why using salvage value in this analysis might be inappropriate. First, identifying the true market value of a facility using the value of fixed assets is a very uncertain means of determining true salvage value. The assets of livestock and poultry farms include land, animal housing structures, and waste disposal operations. All of these are highly specific, immobile assets without alternative uses (Aust, 1997). Second, the accuracy of the components of salvage value from the ARMS survey is questionable, with some valuations based on the personal judgement of individual farmers. Also the appropriate markdowns from market value of the value realized post-closure must be generated. Third, the salvage value analysis ignores liquidation costs (e.g., legal fees, real estate broker fees, etc.), which can be difficult to estimate. Finally, small family-owned farms may not base a decision of whether to remain in business on salvage value and projected cash flow. Other less tangible reasons for staying in business might include the satisfaction of working for oneself and the ability to employ family members. Furthermore, in many cases, the farm is not just a business but is the family home. Decisions to liquidate are complicated, and many farmers would try to stay in business under nearly all adversities unless forced to close under circumstances of persistent negative cash flows that undermine their ability to make payments on loans or to survive financially.

4.2.4.4 USDA's Debt-to-Asset Ratios for Model CAFOs

To model the regulatory baseline, EPA uses the debt-to-asset ratio reported by USDA for 1997 (USDA/ERS, 1999a) for each model CAFO. These ratios are identical to those calculated

using the reported assets and liabilities on the same balance sheet summary. The baseline debt-to-asset ratios EPA uses for this analysis are shown in Table 4-9.

EPA calculates the postregulatory debt-to-asset ratio as:

$$\text{Postcompliance Debt-to-Asset Ratio} = \frac{\text{debt + capital compliance cost}}{\text{asset + capital compliance cost}}$$

4.2.4.5 Construction of Representative Model CAFOs

The final step in the creation of model CAFOs is the linking of the cost models to the financial models. Using the ARMS data, EPA develops more than 40 unique financial models that differentiate by sector, facility size, and producing region. EPA then matches these financial models to more than 170 individual cost models that are more finely differentiated. The cost models break out sector, facility size, and producing region, as well as land availability and facility type.

Facility Size

EPA's cost models provide a greater number of breakouts by facility size than do the financial models. Specifically, the cost models estimate regulatory costs for two medium and two large facility financial models are expressed on a per-animal basis, EPA believes that this will limit misrepresentation when the models are matched up.

As noted previously, the cost models are able to differentiate more facility sizes and producing regions than the financial models, which are limited by the level at which ARMS data must be aggregated to avoid disclosure of financial data. The ARMS data also cannot be used to distinguish the differences in financial conditions associated with the amount of land available for manure applications. Furthermore, the representative ARMS data do not reflect differences in financial conditions associated with specific enterprises (i.e., data are for an average entity and do not distinguish between livestock enterprise and other farm-related business) and with facility types (e.g., the data cannot differentiate hog farrow-finish and hog grow-finish operations, while the cost models are developed to account for potential compliance cost differences between these two types of operations).

The following discussion presents how EPA uses the available data, accounting for limitations, to link the financial models and the costs models to create representative CAFO models that reflect varying facility sizes, producing regions, land availability, and facility types. In some cases EPA has identified a potential for model CAFOs to underestimate impacts due to the

Table 4-9. Debt-to-Asset Ratios for Model CAFOs, 1997

Sector	Region	Debt-to-Asset Ratio (%)				
		CAFOs <300 AU	CAFOs Medium 1(a)	CAFOs Medium 1(b)	CAFOs Medium 2	CAFOs Large 1
			300-1000AU			>1,000 AU
Beef	MW		13%		9%	
	CE		17%		9%	
Dairy	MW	20%	23%		26%	
	PA		23%		24%	
Heifer	MW		13%		9%	
Veal	MW			13%		
Hog: FF	MA		13%		31%	
	MW	17%	25%		40%	
Hog: GF	MA		13%		31%	
	MW		25%		40%	
Layer: Wet	SO			11%		
Layer: Dry	MW		11%			
	SO					
Broiler	MA		21%		30%	
	SO		19%		26%	
Turkey	MA		23%		15%	
	MW					

Source: USDA/ERS, 1999a. Shaded cells indicate model CAFO not developed. See Table 4-4 for level of data aggregation used for each model. Size groups by AU are approximate (see Table 4-2).

use of a limited number of financial models as estimators for conditions at operations with size categories (Table 4-1), but financial data are available only for a single size per group (see Table 4-2). EPA is able, however, to account for the differences in financial conditions between Medium 1 and Medium 2 CAFOs and between Large 1 and Large 2 CAFOs using the per-animal financial data and the average number of animals associated with the cost models developed for these model sizes to create an estimate of financial conditions at each model CAFO. The number of animals at an operation drives not only the magnitude of expected compliance costs, but also directly affects financial conditions such as revenues at a CAFO. EPA can match the expected

financial conditions at an operation of the same size as that assumed in estimating compliance costs for each model CAFO. This is accomplished by multiplying the number of animals (Table 4-1) and per-animal financial data (shown in Tables 4-5 and 4-6) for each respective model CAFO. The result is an estimate of CAFO level revenues and net present value of cash flow at each model CAFO. Tables 4-10 and 4-11 show EPA's estimates of total CAFO revenues and total net present value of cash flow for each model CAFO that is assumed in the baseline.

EPA's cost models evaluate costs for some of the largest facilities, which are often much larger than what is reflected in the ARMS financial data. In part, EPA can account for this difference, since all cost and revenue data are converted to a per-animal basis. Per-animal financial data readily allow EPA to use USDA financial data aggregated over a broader facility size grouping as an estimator for financial data at model CAFOs within that size range. For example, EPA uses USDA data for a larger-sized farm (as shown in Table 4-2) to develop estimated financial conditions at both the Large 1 and Large 2 model CAFOs through the use of the per-animal conversion. Since the ARMS data are more reflective of smaller-sized operations within each facility size group, EPA's use of these data likely overstate impacts since financial conditions at the largest operations are likely more favorable than the reported average for that size group.

Production Regions

EPA's cost models also provide greater breakout of farms across production regions than EPA's financial models. Table 4-12 compares the regional breakouts for the financial and cost components of the model CAFOs. As shown in the table, many of the same key producing states are represented within both the comparable financial and cost model regions, and EPA is confident that the major performance differences between the regions are captured when the financial and cost models are linked. For example, the ARMS data show significantly lower per-animal revenues among hog farms in the Mid-Atlantic region compared to those in the Midwest (see Table 4-5). Higher revenues in the Midwest most likely reflect additional income from crop sales, as well as generally higher per-animal farm prices received by independent operators compared to contract growers. Contract growers are more common among hog operations in the Mid-Atlantic than they are among those in the Midwest.

Land Availability

As described in Section 4.1, estimated compliance costs distinguish among three categories of land availability: Category 1 CAFOs (sufficient cropland for all manure nutrients generated), Category 2 CAFOs (insufficient cropland), and Category 3 CAFOs (no cropland). However, the ARMS data EPA uses for its financial models are averages by animal sector, facility size, and producing region only. Data are not available to represent differential land availability among operations within a sector. EPA recognizes that there may be some financial differences

Table 4-10. Total Estimated Gross Farm Revenues for Representative Model CAFOs

Sector	Reg.	Annual Gross Revenue per CAFO ($)					
		CAFOs <300 AU	CAFOs Medium 1(a)	CAFOs Medium 1(b)	CAFOs Medium 2	CAFOs Large 1	CAFOs Large 2
			300-1000AU			>1,000 AU	
Beef	MW		$243,363		$415,589	$1,617,656	$25,857,501
	CE		$228,405		$390,045	$1,602,960	$25,622,596
Dairy	MW	$523,949	$587,055		$1,149,129	$3,707,777	
	PA		$550,552		$1,077,676	$3,462,984	
Heifer	MW		$213,945		$401,148	$1,292,746	
	PA		$200,796		$376,492	$1,281,002	
Veal	MW		$213,945		$288,826		
Hog: FF	MA		$147,601	$264,845	$377,727	$293,340	$1,431,002
	MW	$454,594	$247,363	$443,673	$653,962	$788,657	$3,164,473
Hog: GF	MA		$168,014	$265,369	$381,042	$297,101	$743,422
	MW		$273,497	$432,125	$645,453	$782,474	$2,296,584
Layer: Wet	SO				$89,989	$2,140,077	
Layer: Dry	MW		$933,528	$1,294,961	$2,400,783	$6,876,035	$30,269,485
	SO		$797,314	$1,105,995	$2,399,035	$7,228,454	$21,777,839
Broiler	MA		$54,051	$75,783	$108,100	$130,311	$342,679
	SO		$52,203	$73,190	$105,130	$135,919	$325,349
Turkey	MA		$208,440	$351,545	$508,119	$1,949,711	
	MW		$203,414	$343,079	$511,223	$3,179,516	

Source: Derived by USEPA from USDA/ERS, 1999a. Total farm revenues are estimated based on per-unit revenues derived from USDA data, shown in Table 4-5, multiplied by the average number of animals shown for each model CAFO in Table 4-1. Shaded cells indicate model CAFO not developed. Size groups by AU are approximate (see Table 4-2).

Table 4-11. Present Value of Total Net Cash Farm Income for Model CAFOs

Sector	Reg.	Annual Net Cash Income per CAFO ($)					
		CAFOs <300 AU	CAFOs Medium 1(a)	CAFOs Medium 1(b)	CAFOs Medium 2	CAFOs Large 1	CAFOs Large 2
			300-1000AU			>1,000 AU	
Beef	CE		$36,723		$62,712	$604,075	$9,655,865
	MW	$119,612	$104,272		$204,107	$617,506	
Dairy	PA		$52,182		$103,376	$570,069	
Heifer	MW		$31,748		$59,527	$384,420	
	PA		$32,284		$60,533	$482,745	
Veal	MW		$31,748		$42,860		
Hog: FF	MA		$25,921	$46,512	$66,336	$109,340	$533,397
	MW	$88,980	$53,740	$96,389	$142,075	$160,180	$642,722
Hog: GF	MA		$29,506	$46,603	$66,918	$110,743	$277,106
	MW		$59,418	$93,880	$140,226	$158,925	$466,449
Layer: Wet	SO				$14,835	$352,806	
Layer: Dry	MW		$153,898	$213,483	$395,785	$1,133,560	$4,990,126
	SO		$131,443	$182,331	$395,497	$1,191,659	$3,590,221
Broiler	MA		$20,974	$29,406	$41,946	$55,335	$145,514
	SO		$20,881	$29,276	$42,052	$57,615	$137,912
Turkey	MA		$47,274	$79,731	$115,242	$171,886	
	MW		$46,135	$77,811	$115,946	$280,306	

Source: Derived from USDA/ERS, 1999a. Present value calculations of forecasted earnings are based on per-unit cash flow (Table 4-6) and USDA projections (Table 4-7) and are used to estimate total net present value of cash flow at each model CAFO using the average number of animals assumed for each model (Table 4-1). Shaded cells indicate model CAFO not developed. Size groups by AU are approximate (see Table 4-2).

Table 4-12. Comparison of Regional Coverage between EPA's Cost and Financial CAFO Models

Sector	Region	ARMS Regional Data Aggregation Used for the Financial Models	USDA Regional Data Aggregation Used for the Engineering Cost Models
Fed Cattle, Veal & Heifers	MW	Not disclosed by USDA. Average, national data used as proxy.	Lake States + Corn Belt + Northern Plains + Northeast + Appalachian
	CE	Mountain/Plains (Northern Plains + Mountain)	Pacific + Mountain + Southern Plains + Delta + Southeast
Dairy	MW	Midwest (Lake States + Corn Belt + Northern Plains)	Lake States + Corn Belt + Northern Plains + Northeast + Appalachian
	PA	West (Pacific + Mountain)	Pacific + Mountain + Southern Plains + Delta + Southeast
Hogs	MA	Mid-Atlantic (Northeast + Appalachian)	Northeast + Appalachian
	MW	Midwest (Lake States + Corn Belt + Northern Plains)	Lake States + Corn Belt + Northern Plains
Layers	SO	Full coverage not disclosed by USDA. Average, national data used as proxy.	Northeast + Appalachian + Delta + Southern Plains + Pacific + Mountain
	MW	Full coverage not disclosed by USDA. Average, national data used as proxy.	Lake States + Corn Belt + Northern Plains
Broiler	MA	Not disclosed by USDA. Average, national data used as proxy.	Northeast + Appalachian + Delta + Southern Plains + Pacific + Mountain
	SO	East (Northeast + Appalachian + Delta + Southeast)	Lake States + Corn Belt + Northern Plains
Turkey	MA	Full coverage not disclosed by USDA. Average, national data used as proxy.	Northeast + Appalachian + Delta + Southeast
	MW	Full coverage not disclosed by USDA. Average, national data used as proxy.	Pacific + Mountain + Lake States + Corn Belt + Northern Plains + South Plains

between CAFOs with land available for land application of manure nutrients and those with little or no land available for land application, both in terms of CAFO level assets and also expenditures to manage animal waste. For this analysis, EPA uses data that incorporate an assumption that asset levels are the same for a given model CAFO across all land-use categories (Table 4-9).

In general, EPA expects that compliance costs are lower at operations that grow crops in addition to livestock, since these operations often tend to have sufficient cropland to land apply manure nutrients as a means of waste disposal. ARMS data, however, cannot be used to differentiate the financial conditions at operations with varying land availability. Specifically, EPA's engineering cost models for Category 1 CAFOs and some Category 2 CAFOs assume

these operations have more land for manure application and, thus, generally lower compliance costs compared to Category 3 and some Category 2 CAFOs which EPA assumes will incur additional compliance costs in lieu of land application. EPA's financial models are not able to reflect the higher asset levels for Category 1 CAFOs and some Category 2 CAFOs due to data limitations. Therefore the financial impact on these farms using the financial ratios might be overstated. Likewise, the financial models are not able to reflect the lower asset levels for Category 3 CAFOs and some Category 2, and impacts might be understated.

For the purpose of this analysis, EPA assumes that the available financial data for the sector as a whole (with appropriate breakouts for size and producing region) roughly approximate the financial conditions at all three CAFO categories. Thus each model CAFO is associated with one financial model and three cost models representing the three land availability categories.

Facility Type

As described in Section 4.1, EPA's estimated compliance costs distinguish among the types of facilities within a sector. However, the ARMS data available for the financial models are averages by animal sector, facility size, and producing region only. Data are not available to represent subsectors within a sector. For example, in the hog and poultry sectors, the ARMS data are mixed across farms where the farmer owns the animals (e.g., independently owned and operated farms) and farms where the farmer raises animals on behalf of a corporate entity that typically retains ownership of the animals (e.g., contract grower). However, the financial conditions across these two types of farms differ. Gross farm revenues generated by contract growers tend to be lower compared to independent operation since the contract price is often lower than the market price received by independent operators; however, the contract grower typically faces lower production costs since the processor supplies much of the contract grower's production inputs. In addition, a grower operation's current assets may be lower since these operations do not own the chickens they grow, nor produce crops requiring storage (Perry et al., 1999).

The average ARMS data also do not differentiate between different types of operations in some sectors and between multiple enterprises within an operation. For example, ARMS data are available across all hog operations, but profits tend to be higher at the more specialized grow-finish operation compared to a farrow-finish operation (Yeske, 1996; USDA/ERS, 2000c). The ARMS data span all beef operations, including cow-calf and grazing, as well as cattle feeding operations that are company-owned and custom feedyards. Returns tend to be more favorable at more specialized feedlot operations; among those, financial conditions may vary depending on whether the operation is company-owned and a custom feedyard or is a contract heifer operation. More information on the differences among facility types is provided by commodity sector in Sections 6, 7, and 8 of this report.

As a result, EPA's financial models do not distinguish among financial conditions by facility type in the cattle sector (for which cost models differentiate fed cattle, veal, and heifer operations), in the hog sector (for which cost models differentiate between farrow-finish and grow-finish operations), and in the egg laying sector (for which cost models differentiate wet manure management system and dry manure management system operations). A more homogenous facility type was modeled for costing purposes in the dairy, broiler, and turkey sectors. EPA uses available ARMS financial data for the beef sector to approximate conditions across the varying operations of cattle feedyards, veal operations, and contract heifer operations. EPA uses financial data for the hog sector as a whole to depict conditions at both farrow-finish and grow-finish operations. Among egg laying operations, EPA uses available financial data for facilities with either wet or dry manure management systems.

Finally, as noted previously, EPA's analysis uses data for an average entity. The ARMS data count among an operation's total farm income the revenue from the sales of both livestock, crops, and other farm-related income, as well as government payments. Off-farm revenue is not included in this analysis. Although the ARMS revenue data are roughly distinguishable by enterprise, the ARMS cost data are not. Due to similar data limitations in previous rulemakings, EPA routinely examines economic impacts using financial data that reflect an entity's total revenue and costs across all enterprises at a business entity. Accordingly, EPA measures economic achievability at the entity level in terms of potential closure of the facility and not as a potential product line closure.

4.2.5 Criteria for Assessing Regulatory Impacts

EPA uses its model CAFOs, described in Section 4.2.4, to assess the economic impacts of the proposed CAFO regulations across differently sized, differently managed, and geographically distinct operations. EPA evaluates the economic achievability of the proposed regulatory options at existing animal feeding operations based on changes in representative financial conditions across three criteria. These criteria are: a comparison of incremental costs to total gross farm revenue (sales test), projected post-compliance cash flow over a 10-year period, and an assessment of an operation's debt-to-asset ratio under a post-compliance scenario. EPA evaluates economic impacts to CAFOs in some sectors two ways—assuming that a portion of the costs may be passed on from the CAFO to the consumer and assuming that no costs passthrough so that all costs are absorbed by the CAFO.

EPA uses the financial criteria to divide the impacts of the proposed regulations into three impact categories. The first category is the affordable category, which means that the regulations have little or no financial impact on CAFO operations. The second category is the moderate impact category, which means that the regulations will have some financial impact on operations at the affected CAFOs, but EPA does not consider these operations to be vulnerable to closure as a result of compliance. The third category is the financial stress category, which means that EPA considers these operations to be vulnerable to closure post-compliance.

The basis for EPA's economic achievability criteria for this rulemaking is as follows. USDA's financial classification of U.S. farms identifies an operation with negative income and a debt-asset ratio in excess of 40 percent as "vulnerable." An operation with positive income and a debt-asset ratio of less than 40 percent is considered "favorable." EPA adopts this classification scheme as part of its economic achievability criteria, using net cash flow to represent income. This threshold and cash flow criterion is established by USDA and other land grant universities (discussed later). The threshold values EPA uses for the cost-to-sales test (3 percent, 5 percent and 10 percent) are those EPA has determined to be appropriate for this rulemaking and are consistent with threshold levels used by EPA to measure impacts of regulations for other point source dischargers (also discussed later).

For this analysis, EPA uses all three criteria to determine economic achievability. EPA considers the proposed regulations to be economically achievable for a representative model CAFO if the average operation has a post-compliance sales test estimate within an acceptable range, positive post-compliance cash flow over a 10-year period, and a post-compliance debt-to-asset ratio not exceeding 40 percent. If the sales test shows that compliance costs are less than 3 percent of sales, or if post-compliance cash flow is positive and the post-compliance debt-to-asset ratio does not exceed 40 percent and compliance costs are less than 5 percent of sales, EPA considers the options to be "Affordable" for the representative CAFO group. A sales test of greater than 5 percent but less than 10 percent of sales with positive cash flow and a debt-to-asset ratio of less than 40 percent is considered indicative of some impact at the CAFO level, but at levels not as severe as those indicative of financial distress or vulnerability to closure. These impacts are labeled "Moderate" for the representative CAFO group. EPA considers both the "Affordable" and "Moderate" impact categories to be economically achievable by the CAFO.

If (with a sales test of greater than 3 percent) post-compliance cash flow is negative or the post-compliance debt-to-asset ratio exceeds 40 percent, or if the sales test shows costs equal to or exceeding 10 percent of sales, EPA considers the proposed regulations to be associated with potential financial stress for the entire representative CAFO group. In such cases, each of the operations that are represented by that group may be vulnerable to closure. These impacts are labeled as "Stress." EPA considers the "Stress" impact category to indicate that the proposed requirements may not be economically achievable by the CAFO, subject to other considerations.[10] Table 4-13 shows a summary of these criteria.

[10]Commonly used measures of "farm financial stress" include bankruptcies, foreclosures, and net exits (Stam, et al., 1991). Indicators of stress in agriculture as reported by farm banks include delinquent loans, discontinued financing, farm closures, liquidation, bankruptcy (Stam, et al., 1991 and 2000)

Table 4-13. Economic Achievability Criteria for the Proposed CAFO Regulations

Criteria	"Affordable"	"Moderate"	"Stress"
Sales test < 3%	X		
Sales test > 3% AND negative cash flow OR debt-to-asset ≥ 40%			X
Sales test < 5% AND positive cash flow AND debt-to-asset < 40%	X		
Sales test ≥ 5% but < 10% AND positive cash flow AND debt-to-asset < 40%		X	
Sales test ≥ 10%			X
Economically Achievable	X	X	

EPA's choice of criteria in any economic assessment of a regulation is variable and highly dependent on the industry being regulated. EPA recognizes that each industry has its own special attributes and each requires an individual assessment of appropriate financial criteria. As such, the Agency does not advocate a "one size fits all" benchmark for all industries but assesses each industry's general conditions and uses generally accepted analytical approaches for identifying economic impacts in that industry, if available, among other factors. Where appropriate, these other factors include, but are not limited to, what criteria have been developed to analyze other industries.

Federal agencies such as EPA, USDA, and others have been analyzing the impacts of regulatory requirements on regulated communities for many years. For example, the CWA, with its requirement to assess economic achievability, has prompted EPA since the early 1970s to analyze the economic and financial impacts of effluent guidelines on affected industries. Generally, EPA measures impacts using a variety of approaches that attempt to assess changes in key financial variables post-compliance. In many cases a benchmark is developed. This benchmark may be based on, for example, the lowest quartile performance of firms in the industry (e.g., USEPA, 1998b) or on an assessment of what has been generally accepted in past analyses or by the financial community, tempered by any specifics of the industry. Usually EPA uses more than one financial variable in an assessment since a single variable is rarely sufficient to fully describe the relative financial health of an affected entity.

For this rulemaking, EPA has selected criteria based on those commonly used in the agricultural sector to measure financial stress, in conjunction with criteria that EPA has used in the past to determine the affordability of effluent guidelines that have been developed for other industries.

The basis for EPA's economic achievability criteria for this rulemaking (Table 4-11) is as follows. In its analyses of the financial performance of U.S. commercial farms, USDA uses a combination of a farm's net income and debt-to-asset ratio to classify the overall financial position

of a farm based on annual earnings and solvency (USDA/ERS, 1997e). Net farm income is an effective measure of long-term profitability; the debt-to-asset ratio is a useful measure of a farm's financial risk. Together these two measures provide an indicator of the farm's long-term financial health and viability (Sommer et al., 1998). For example, if a farm earns enough income to service debt and meet its other financial obligations, then a high debt-to-asset ratio may be acceptable, while a farm carrying a low debt load may be able to weather periods of low or negative farm income (Sommer et al., 1998).

USDA considers net income and debt-to-asset ratio jointly to classify farm performance into one of the following financial positions (Sommer et al., 1998; USDA/ERS, 2000g, 1997a and 1997e):

- ***Favorable***—Farms with positive net farm income and a debt-to-asset ratio of less than 0.40. USDA considers these farms to be financially stable.

- ***Marginal Income***—Farms with negative net farm income and a debt-to-asset ratio of 0.40 or less. USDA feels that periods of negative income may not pose financial difficulties if the farm is carrying a low debt load and can either borrow against equity or obtain income from off-farm sources.

- ***Marginal Solvency***—Farms that generate positive net farm income, despite higher debt service requirements. USDA states that a high debt-to-asset ratio may be acceptable if the farm can generate enough income to service its debt and meet other financial obligations.

- ***Vulnerable***—Farms with negative net farm income and a debt-to-asset ratio above 0.40. These farms do not generate sufficient income either to meet current expenses or to reduce existing indebtedness (USDA/ERS, 1997e). USDA considers these farms to be financially unstable and least likely to survive an economic shock.

EPA has adopted this classification scheme as part of its economic achievability criteria, but uses net cash income instead of net farm income in order to conduct a cash flow analysis. USDA's debt-to-asset ratio threshold of 0.40 that defines whether a farm is highly leveraged, which is consistent with other recommendations (Ohio State University, 1999). While a higher ratio generally indicates financial risk, debt-to-asset ratios tend to be higher for large farms and for those specialized in livestock feeding (Iowa State University, 1999b). For example, ratios of 0.30 to 0.40 are common among Iowa farms, although many operate with little or no debt (Iowa State University, 1999b). Another caution when considering debt-to-asset ratios is that a high debt load does not make farms less efficient; high efficiency farms are able to service a higher debt load and maintain a higher debt-to-asset ratio with less risk than a low efficiency farm (Iowa State University, 1999b). Therefore, the range of acceptable values for an operation's debt-to-asset ratio will vary depending on income variability, the proportion of owned land (or other assets)

used in the farming operation, risks associated with normal production, and fluctuations in farm asset values that may occur due to changes in demand for agricultural assets (FFSC, 1997).

EPA also frequently uses negative post-compliance cash flow calculated over the period of the impact analysis to identify regulated entities that are vulnerable to closure. Several economic analyses for other effluent guidelines have used this measure as the only criterion or as part of a group of criteria for a closure analysis (see USEPA, 2000c, 1999g, and 1998b). In these analyses, EPA considers negative cash flow over the period of analysis as at least one indicator that a facility might be likely to close post-compliance.

In addition to USDA's measure of debt-to-asset ratio in conjunction with net income, EPA uses a "sales test" that compares estimated compliance costs to total revenues. For this analysis, EPA evaluates the ratio of costs to sales using post-tax cost estimates since this more accurately reflect the impact on a business' bottom line. Previous ELG analyses have evaluated cost-to-sales ratios using both post-tax and pre-tax costs.[11]

EPA frequently uses a sales test to evaluate post-compliance impacts in previous regulatory analyses (USEPA, 1987, 1994 and 1996; DPRA, 1995; USGPO, 1999). EPA's use of a sales test is also common practice to evaluate small business impacts for most regulatory development. Other agencies also use a sales test, including OSHA (1999). USDA has also considered cost-to-sales impacts to evaluate impacts to animal confinement operations (Heimlich and Barnard, 1995).[12] In general, however, the sales test is not widely used to measure impacts in the agricultural sector (Foster, 2000a).

The threshold values EPA uses for this analysis (cost-to-sales in excess of 3 percent, 5 percent, and 10 percent) are those determined to be appropriate for this rulemaking. EPA has used 1 percent and 3 percent sales test benchmarks to screen for the potential for impacts in many small business analyses (e.g., USEPA, 1997b and 1999g). These benchmarks are only screening tools, but do support EPA's contention that a sales test of less than 3 percent generally indicates minimal impact (Snyder, 2000). Heimlich and Barnard (1995) do not define a threshold where the management measures would not be considered economically achievable since "...there are no hard and fast guidelines for what is economically achievable, any appraisal of overall achievability... is subjective" (Heimlich and Barnard, 1995).

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[11]For example, ELGs that were evaluated using post-tax costs include the Landfills, the Commercial Hazardous Waste Combustors, and the Centralized Waste Treatment industries. Pre-tax costs were used to evaluate the Pulp, Paper, and Paperboard, the Pesticide Formulating, Packaging and Repackaging, and the Metal Products and Machinery industries. EPA used both pre- and post-tax costs to evaluate the Transportation Equipment Cleaning industry.

[12]Heimlich and Barnard (1995) also compared costs with cash operating expenses and net farm income (i.e., a profit-test).

The 5 percent benchmark is consistent with threshold values established by EPA in previous regulations for other point source dischargers. Generally, EPA's analyses have assumed that sales tests less than 5 percent indicate compliance costs that are achievable (see, for example USEPA 1987 and 1994). Other analyses have assumed the same threshold but have further assumed that ratio values in excess of 5 percent may constitute moderate impacts, taking into consideration other factors (USEPA 2000o, 1999o, and 1996). This analysis adopts this framework to analyze regulatory impacts to CAFOs. In another analysis, a sales test result of greater than 5 percent was labeled a "sales impact" (USEPA, 1987). Sales impacts were assessed separately from impacts that could make a facility vulnerable to closure.

EPA uses an upper limit on a sales test result of 10 percent (whereby this result alone indicates financial stress), rather than to assume that there is no upper limit on a sales test percentage if other financial variables are also analyzed (such as in USEPA, 1996). EPA believes, in this case, that if a sales impact is very high, this result should be considered a substantial impact and might make an operation vulnerable to closure in spite of positive cash flow and an adequate debt-to-asset ratio. EPA thus uses the 10 percent benchmark to ensure that potential vulnerability will not be underestimated. In fact, relatively few operations could incur costs greater than 10 percent of revenues while continuing to show positive cash flow.

Because EPA does not use a sales test alone as a measure of financial vulnerability, use of a sales test operates more as a screening tool. In most cases (results between 3 percent and 10 percent), a finding of financial stress is driven by cash flow and debt burden considerations. Thus, over the key range of sales impacts, EPA's methodology is consistent with many USDA analyses, which very frequently use net income and debt-to-asset ratios to assess impacts (e.g., USDA/ERS, 1997e). The exception is that EPA does not consider noncash income and depreciation (that is, EPA uses a *net cash income*-type analysis rather than a *net farm income* analysis). This is consistent with current views on the use of cash flow analysis in preference to net income analysis among financial analysts (Brigham and Gapenski, 1997; Jarnagin, 1996).[13]

Use of a sales test is one of the more common metrics used in regulatory analyses. Another common metric is an examination of earnings before taxes as a percentage of gross income or revenues (called a "profit test"), where the change in ratio post-compliance is used as an indicator of the impact that compliance costs may have on profits. Profit tests or net income analyses are frequently used by federal agencies.

Heimlich and Barnard (1995) measured economic achievability by comparing estimated regulatory costs with gross cash income (i.e., a sales-test) as well as cash operating expenses and net farm income (i.e., a profit-test). In recent years, however, EPA has tended to move away

[13]Net cash income corresponds to total farm cash revenues minus cash expenses; i.e., it is the agricultural term corresponding to the financial term "cash flow." Net farm income includes both non-cash income and non-cash expenses (e.g., depreciation) and corresponds to the term "net income" in accounting.

from using net income analysis and profit tests as an indicator of the financial strength of a regulated entity for a number of reasons. First, many financial analysts are now acknowledging that net income analysis is a less accurate measure of financial health than a cash flow analysis, since net income includes depreciation as a cost even though depreciation is not a cash outlay (see, e.g., Brigham and Gapenski, 1997). Also, for valuing corporate loans, the Financial Analysis Standards Board considers discounted cash flow the best estimator for assessing fair value for enterprises lacking a quoted market price (Jarnagin, 1996). Second, profitability can be highly variable since a firm has a certain amount of leeway in calculating earnings in any given year in order to minimize tax liability. Privately held entities (which predominate in the livestock and poultry industries, for example) have few incentives to show large profits, but every incentive to show minimal earnings for tax purposes. Third, if a large segment of an industry is showing negative net income, it is difficult to assess the impact of a regulation on profitability.

Typically, EPA considers that if a regulated entity is not profitable before pollution control investments are made, the entity "may not claim that substantial impacts would occur due to compliance...." (USEPA, 1995c). EPA has, in some cases, used the concept of "baseline closure" if only a few entities have negative net income and cannot be analyzed (see, for example, USEPA, 1997b). These entities may not necessarily close prior to implementation of a rule, yet they cannot be analyzed within a profit test or net income analysis framework.

The problem with analyses that are based on profitability is especially an issue in the agricultural sector. Heimlich and Barnard (1995) point out that many farms "may be motivated by noneconomic considerations and should be considered hobby or recreational activities, rather than businesses, particularly when net farm income is negative." They further contend that the majority of farm operators reporting negative net income have nonfarm sources of income and that they may be using the farm losses to offset off-farm income to reduce income tax liability. They also find, as does EPA, that when net farm income is negative, costs as percentages of net income are difficult to interpret.

EPA, therefore, considers a sales test to be a more analytically useful tool than a profit test for assessing impacts in the livestock and poultry industries for three major reasons. First, EPA has concerns that profit-based measures may overstate vulnerability. Second, revenues are generally not as sensitive to incentives to show minimum values for tax purposes as profits and thus are not as likely as profits to be understated. Third, sales are never negative and thus a comparison between costs and sales can be adequately interpreted.

4.2.6 Cost Passthrough

EPA generally measures the economic impacts of the proposed CAFO regulations on the basis of the estimated compliance costs incurred at the CAFO (discussed in Section 4.1.3). Even when post-tax costs are considered, however, there may be other mitigating factors that influence what costs the CAFO ultimately incurs. For the purpose of this analysis, EPA assumes that

producers in the livestock and poultry sectors will be able to pass on some portion of costs through the market levels. Passthrough of compliance costs will occur either in the long-run through market adjustment (i.e., higher prices through changes in supply and demand) or in the shorter term as processors take steps to ensure a steady and continued supply of raw farm input (i.e., raise production prices for live animals or animal products produced by CAFOs).

Individual farms may be considered competitive and may not individually be able to raise prices. Collectively, however, if production costs rise across the industry as a whole (as it would under the proposed CAFO regulations), economic theory indicates that prices will rise except in highly unusual circumstances. Prices will rise unless demand for a product is perfectly elastic (that is, consumers, including processors or packers, are not willing to pay more for a product even in a scarcity situation, an unusual scenario) or unless supply of a product is perfectly inelastic (no matter what the price, the producer would not change the quantity supplied, another unusual situation). In the real world, even nearly perfectly elastic demand or nearly perfectly inelastic supply at the sector or industry level for most products is rare. For this analysis, cost passthrough due to market adjustment assumes that the demand for agricultural commodities— including meat, milk and dairy products, and eggs—is generally considered price inelastic (i.e., food is a necessity and demand will not decrease at a rate proportional to an increase in price).

Whether the price increase is small or large depends on the relative elasticities of supply and demand. When demand is more elastic than supply (which means consumer demand has more effect on price than supplier production), prices tend to rise less than when demand is less elastic than supply. The relative elasticities of supply and demand and their role in computing the extent to which prices would be likely to rise are discussed in more detail in Section 4.2.6.1.

When farmers can raise their prices, the increased costs of compliance are covered in some part by these price increases. In such cases, compliance costs thus are effectively "passed through" to the next economic level (e.g., processor or packer). EPA has undertaken a number of approaches for determining an appropriate assumption for cost passthrough (CPT). The following sections discuss the ways in which EPA computed a point estimate for CPT and also document the decisions EPA made to construct several scenarios that can be used to bound the estimates of CPT and thus economic impacts at the farm (and, as discussed in Section 4.3, the processor) level.

Actual cost passthrough from the farm to the processing sectors is difficult to predict. Some potential scenarios include the following. First, an affiliated processing firm (integrator) may raise the contract price paid to its growers, thus offsetting increased production costs due to compliance. Second, an integrator may pay for all or a portion of on-farm disposal costs as part of the production inputs typically supplied to contract growers. Alternatively, an integrator may pay for all or some portion of off-site manure disposal costs, such as transportation and disposal at a centralized waste treatment facility. Finally, an integrator may offset costs by funding research or market development of alternative uses of manure by-products, such as pelletization, etc., that will benefit producers by offsetting costs. Some states have proposed to mandate shared

responsibility for manure and CAFO waste, including Kentucky (Associated Press, 2000) and Maryland (Huslin, 2000a). Other examples of how processors are sharing the cost of environmental regulations with the agricultural sector is available in the rulemaking record (see, for example: Huslin, 2000b; Montgomery, 2000; Goodman, 1999).

EPA believes that the assumptions of cost passthrough are appropriate for this analysis, particularly for the pork and poultry sectors. As discussed in Section 2, EPA expects that meat packing plants and slaughtering facilities in the pork and poultry industries may be affected by the proposed co-permitting requirements in the proposed CAFO regulations. Given the efficiency of integration and closer producer-processor linkages, the processor has an incentive to ensure a continued production by contract growers. EPA expects that these operations will be able to pass on a portion of all incurred compliance costs and will, thus, more easily absorb the costs associated with the proposed CAFO regulations. This passthrough may be achieved either through higher contract prices or through processor-subsidized centralized off-site or on-site waste treatment and/or development of marketable uses for manure.

EPA recognizes, however, that some industry representatives do not support assumptions of cost passthrough from contract producers to integrators, as also noted by many small entity representatives during the SBREFA outreach process as well as by members of the Small Business Advisory Review (SBAR) Panel. These commenters have noted that integrators have a bargaining advantage in negotiating contracts, which may ultimately allow them to force producers to incur all compliance costs as well as allow them to pass any additional costs down to growers that may be incurred by the processing firm.

To examine this issue, EPA has conducted an extensive review of the agricultural literature on market power and price transmission in each of the livestock and poultry sectors and concluded that there is little evidence to suggest that increased production costs would be prevented from being passed on through the market levels. EPA believes that this literature generally supports a determination that agricultural producers in the livestock and poultry sectors will be able to pass on compliance costs. A summary of this research is provided in the rulemaking record (ERG, 2000c—DCN 70640). As is discussed in this literature summary, while there is a potential for market power in each of the animal products industries, and while vertical integration has squeezed the rents out of many farming activities, the general conclusion in the literature is that there is little evidence that these factors will prevent increased production costs from being passed through the marketing chain of these industries.

Given the uncertainty of whether costs will be passed on, EPA presents the results of this analysis assuming some degree of cost passthrough and also no cost passthrough (i.e., the highest level of impacts projected). EPA requests comment on its cost passthrough assumptions. Although EPA does consider the results of both of these analyses in making its determination of economic achievability, EPA's overall conclusions do not rely on assumptions of cost passthrough.

4.2.6.1 Methodology for Computing Cost Passthrough

The first step in computing CPT is to identify appropriate demand and supply elasticities for the products in question. Elasticities measure how markets respond to changes in price. In this case, supply elasticities measure how, in theory, farmers respond to changes in the price they receive: generally, rising farm prices will encourage producers to expand production, whereas falling prices will result in production cutbacks. Demand elasticities, in this case, measure the price response at the processor and consumer levels. Generally, an increase in the price paid for a good—whether it is raw farm product purchased by processors or is retail foods purchased by consumers—usually results in a decrease in aggregate demand. A decrease in prices will generally boost the amount demanded and thus raise the amount purchased of that good.

Economists use elasticities to explain market behavior and also to predict price and quantity changes in markets. For the purpose of this analysis, EPA uses estimates of elasticities of supply and demand obtained through an extensive search of the agricultural economics literature and consultation with leading experts in the field. Much of this research is conducted by the various land grant universities and is published in the leading academic journals. Before selecting an estimate for use in the analysis, EPA compiled a range (i.e., the lowest estimate and highest estimate) of these published supply and demand elasticities to estimate a CPT range for each sector. Since cost passthrough usually reflects longer term market adjustment, elasticities that are specified in the long run are the most appropriate for this analysis. In particular, estimates of supply elasticities are highly dependent on time frame. Generally, the longer the time frame, the more elastic is supply because farms have time to change, either expanding or contracting their operations. In the short-term, however, farms have less flexibility. The supply elasticities identified in the literature, however, include short-, intermediate- and long-run estimates. The demand elasticities identified generally do not specify a time period.

The results of this literature search are summarized in Table 4-14. The low and high values shown in the table correspond to the range of values found in the literature (see Appendix C for a complete listing of studies and values found). EPA uses these values to compute the low and high values estimated for CPT in Table 4-14. The low supply elasticity estimates in Table 4-14 are generally short-run and result in lower CPT estimates. For comparison, EPA also uses the high supply elasticity values, which tend to reflect long-run conditions of highly elastic supply.[14] In those cases, EPA estimates CPT to be almost complete (i.e., approaches 100 percent). The "selected" elasticity values represent a consensus of expert opinion on a reasonable estimate of supply and demand elasticities for each sector (Vukina, 2000, and Foster, 2000a) and are considered to reflect long-run conditions. EPA uses these "selected" values to compute the "selected" CPT values, shown in Table 4-14, as discussed below.

[14]In discussions with USDA, ERS staff have indicated that they generally assume that supply is less than perfectly elastic in the short-run and almost perfectly elastic in the long run (Hahn, 1999).

Table 4-14. Estimated CPT Based on Elasticity Estimates Identified in Recent Literature Searches

Sector	Range of Estimated Price Elasticity of Supply [a/]			Range of Estimated Price Elasticity of Demand			Estimated CPT [c/]		
	Low Value	Selected Value [b/]	High Value	Low Value	Selected Value [b/]	High Value	Low Value	Selected Value	High Value
Beef	-0.170	1.020	3.240	-2.590	-0.621	-0.150	NE	62%	96%
Dairy	-0.322	1.527	6.690	-0.650	-0.247	-0.050	NE	86%	99%
Hogs	0.007	0.628	0.628	-1.234	-0.728	-0.070	1%	46%	90%
Broiler [d/]	0.064	0.200	0.587	-1.250	-0.372	-0.104	5%	35%	85%
Layer	0.031	0.942	0.942	-0.780	-0.110	-0.022	4%	90%	98%
Turkey	0.210	0.200	0.518	-0.680	-0.535	-0.372	24%	27%	58%

Sources: Various, see Appendix C.

[a/]Estimated elasticities as identified in Tables C-1 through C-12, Appendix C.

[b/]Elasticities representing a consensus of expert opinion (Vukina, 2000, and Foster, 2000a).

[c/]Values for supply elasticities less than zero not estimated (NE).

[d/]Includes elasticity estimates for both broilers and chickens because studies vary between the two terms when analyzing the markets for meat from chickens.

EPA employs a simple method for calculating estimated CPT percentages using supply and demand elasticities. The price elasticity of supply is divided by the difference of the price elasticity of supply and the price elasticity of demand for each sector, as shown below:

$$\text{CPT} = \frac{\text{price elasticity of supply}}{\text{price elasticity of supply} - \text{price elasticity of demand}}$$

The resulting "selected" CPT estimate for each sector, shown in Table 4-14, is the "Partial CPT" estimate that provides the basis for EPA's CPT analysis.[15] This approach is consistent with that used by EPA in past regulatory analyses (see, for example: USEPA, 2000c, 1999g, and 1997a).

[15]The CPT calculated in this manner is an average over all farms and may not reflect the actual CPT of any one farm.

Given the wide range of supply and demand elasticities in the literature, the resulting CPT estimates cover a wide range (Table 4-14). As a conservative measure, EPA selects elasticities that represent a consensus of expert opinion for a reasonable estimate of elasticities for its analysis. These "selected" sets of elasticities result in CPT of 27 percent to 90 percent.

4.2.6.2 Three CPT Scenarios

To fully address the entire range of possibilities with regard to cost passthrough, EPA evaluates impacts of the proposed CAFO regulations under three CPT scenarios. Two of these scenarios are bounding scenarios that define the limits of worst-case and best-case from both the farm and market perspectives. In the two scenarios, EPA assumes either that all costs at the CAFO level can be passed through (100% CPT) or that none of the costs at the CAFO level can be passed through (Zero CPT). The 100% CPT scenario leads to worst-case impacts at the market level, but is associated with no impacts at the CAFO level. Therefore, CAFO level results for this scenario are not reported in subsequent sections, since there are no impacts at the CAFO level when 100% CPT is assumed. Alternatively, the Zero CPT scenario leads to worst-case impacts at the CAFO level, but is associated with no impacts at the market level. Under this scenario, all costs are assumed to be absorbed at the CAFO and no costs are passed on to consumers.

To provide a more reasonable estimate of likely impacts at both the CAFO and other levels in the marketing chain, EPA uses the point estimates of CPT values discussed in Section 4.2.6.1. This scenario is the Partial CPT scenario, shown in Table 4-14 as the "selected value" CPT estimate. These CPT values result in impacts that fall between the numbers seen under the 100% and Zero CPT scenarios. EPA believes that the results obtained under the Partial CPT scenario are likely to be more realistic than those obtained under the two bounding scenarios in most cases.

4.2.7 Potential Cost Offsets

Available cost-sharing and technical assistance, as well as manure sales, particularly for more valuable poultry litter, may provide potential offsets to compliance costs incurred by CAFOs under the proposed CAFO regulations. As a conservative measure, EPA does not to consider such offsets as part of its analysis. As a result, the impacts of the economic impact analysis are likely overstated.

EPA has investigated the potential for compliance costs to be offset by cost-share and technical assistance from various federal and state conservation programs (ERG, 2000a—DCN 70130). In these programs, cost-sharing dollars are provided for animal waste management practices that are included in the regulation. However, certain eligibility requirements may limit program availability. Eligibility criteria can include size of operation, location in a geographic

priority area, and high pollution potential. Because it is not certain which operations could take advantage of cost-share assistance or to what degree, EPA determined that cost-share assistance could not be reliably used as a cost offset in the impact analysis and thus did not incorporate any assumptions of cost share assistance into the economic impact methodology.[16]

Generally, EQIP funds are not available to operations with more than 1,000 AU; however, applicability based on animal units is not straightforward because USDA's AU definitions differ for some sectors compared to EPA's regulatory thresholds (Featherston and Atwood, 1999). Differing AU definitions may allow some larger-sized facilities to access to EQIP funds for environmental improvements. For example, broiler and egg operations with more than 100,000 birds are defined by EPA to have more than 1,000 AUs; the EQIP program covers operations with up to 250,000 layers and up to 455,000 broilers (USDA's definition of 1,000 AU for these sectors). Because of this AU definition discrepancy, a large proportion of poultry operations will actually be eligible for EQIP funding for waste storage and treatment (ERG, 2000a). EQIP funding would be available to eligible operations with fewer than 1,000 AU. However, EPA does not incorporate estimates of cost-sharing because program funds from these programs are subject to funding limitations, and current allocations may not be able to cover all new applicants that may be affected by the proposed regulation (ERG, 2000a; Featherston and Atwood, 1999).

EPA has also evaluated the potential for some operations, particularly poultry operations, to offset costs based on poultry litter sales. This analysis is conducted based on the typically higher value of dry poultry litter. A summary of this analysis is provided in Section 6 of this report but the results are not incorporated into the main impact analysis. EPA did not estimate the value of manure sold for the wetter manures that are common in the hog and dairy sectors.

4.3 PROCESSOR LEVEL ANALYSIS

As discussed in Section 2.4 of this report, EPA estimates that 94 meat packing plants that slaughter hogs and 270 poultry processing facilities may be subject to the proposed co-permitting requirements. This section presents an overview of the modeling framework (Section 4.3.1) and the data used by EPA (Section 4.3.2) to assess potential national level aggregate costs to the processing sectors in these industries. EPA does not evaluate the potential magnitude of costs to egg and turkey processors because the compliance costs to CAFOs in these industries is projected to be easily absorbed by CAFOs, as presented in Section 5. EPA expects that no meat packing or processing facilities in the cattle and dairy sectors will be subject to the proposed co-permitting requirements, for reasons outlined in Section 2.

[16]Previous research has included cost-share program dollars as an offset to compliance costs associated with environmental regulation (DPRA, 1995; Heimlich and Barnard, 1995).

4.3.1 Overview of Methodology

EPA did not precisely estimate the costs and impacts that would accrue to individual co-permittees. Information on contractual relationships between contract growers and processing firms is proprietary and EPA does not have the necessary market information and data to conduct such an analysis. Market information is not available on the number and location of firms that contract out the raising of animals to CAFOs and the number and location of contract growers, and the share of production, that raise animals under a production contract. EPA also does not have data on the exact terms of the contractual agreements between processors and CAFOs to assess when a processor would be subject to the proposed co-permitting requirements, nor does EPA have financial data for processing firms or contract growers that utilize production contracts.

EPA, however, believes that the framework EPA uses to estimate costs to CAFO does provide a means to evaluate the possible upper bound of costs that could accrue to processing facilities in those industries where production contracts are more widely utilized and where EPA believes the proposed co-permitting requirements may affect processors. EPA's CAFO level analysis examines the potential share of costs that may be passed on from the CAFO, based on market information for each sector. Assuming that a share of the costs that accrue to the CAFO are eventually borne by processors, EPA is proposing that this amount approximates the magnitude of the costs that may be incurred by processing firms in those industries that may be affected by the proposed co-permitting requirements. To assess the impact of the regulations on processors, EPA compares the passed through compliance costs to both aggregate processor costs of production and to revenues (a sales test), using cost and revenue data described in Section 4.3.2.

This approach does not assume any addition to the total costs of the rule as a result of co-permitting, yet it does not assume that there will be a cost savings to contract growers as result of a contractual arrangement with a processing firm. This approach merely attempts to quantify the potential magnitude of costs that could accrue to processors that may be affected by the co-permitting requirements. Due to lack of information and data, EPA does not analyze the effect of relative market power between the contract grower and the integrator on the distribution of costs, nor the potential for additional costs to be imposed by the integrator's need to take steps to protect itself against liability and perhaps to indemnify itself against such liability through its production contracts. EPA also does not specifically analyze the environmental effects of co-permitting.

EPA has conducted an extensive review of the agricultural literature on market power in each of the livestock and poultry sectors and concluded that there is little evidence to suggest that increased production costs would be prevented from being passed on through the market levels. This information is provided in the docket (ERG, 2000c—DCN 70640). However, as discussed in Section 4.2.6, EPA recognizes that some industry representatives do not support assumptions of cost passthrough from contract producers to integrators and requests comments on its cost

passthrough assumptions in general and as they relate to the analysis of processor level impacts under the proposed co-permitting requirements.

EPA's processor analysis does not specifically account for the few large corporate operations that are vertically integrated, to the extent that the corporation owns and operates all aspects of the operation from animal production to final consumer product. These operations are covered by EPA's CAFO analysis to the extent that they are captured by USDA's farm survey and are included among EPA's model CAFOs. While the ARMS data may include data on CAFOs that are owned by corporate operations, these data cannot be broken out to create a model specifically designed to represent these operations. Since EPA's analysis uses farm financial data and not corporate data, this analysis does not reflect the ability of corporations to absorb compliance costs that may be incurred at CAFOs that are owned by a higher corporate entity. EPA expects that its analysis overestimates the impact to corporate entities since revenues of corporate entities are, in most cases, no less and likely exceed those at independently owned and operated CAFOs.

EPA believes, therefore, that impacts on corporate operations that manage CAFOs would be minimal. Impacts at the CAFO level in these operations would generally not be felt at the higher corporate level because the farms in such a vertically integrated corporate structure are typically operated as cost centers. Because each farm owned by the corporate entity is a vital part of the whole structure of the operation, the corporation does not necessarily expect profitability at the farm level; the corporation tends to look at the whole operation and judge financial conditions and make financial decisions at higher levels of the organization. As long as profitability at the last stage of processing appears adequate, there is no point to closing a farm or farms because of increased costs or lack of profitability at the farm production level.

At the corporate level, these operations have the advantage of size as well. Large size generally provides a corporation with many more financial and personnel resources for dealing with regulatory costs and minimizing the impacts of those costs. Furthermore, large corporations can often benefit from economies of scale, allowing for smaller per-unit costs of construction or equipment than might be the case in smaller operations. For these reasons, EPA believes that these large corporations will have the resources to comply with the proposed CAFO regulations without undue financial strain.

4.3.2 Sources of Data

EPA evaluates processor level impacts using delivered costs and revenues from the 1997 Census of Manufactures for the pork and poultry processing industries (USDC, 1999a). Delivered costs reflect the raw materials, parts, scraps, and supplies consumed or put into production by processing companies, but do not include the cost of fuels consumed, electricity purchased, or work performed under contract. Revenues reflect values of shipments at the sector level. Delivered costs and revenues are estimated by industry and classified by NAICS material code for major raw materials consumed.

NAICS codes used for the hog processing industry are 311611 (Animal, except poultry, slaughtering) and 311612 (Meat processed from carcasses). The NAICS codes used for the poultry processing industry are 311615 (Poultry processing) and 311999 (All Other Misc. Food Manufacturing). NAICS material codes were used to break poultry processing into the broiler, egg, and turkey sectors. Table 4-15 presents the 1997 cost and revenue data for the hog and broiler processing sectors EPA uses for this analysis.

Table 4-15. 1997 Estimated Delivered Cost for the Hog and Poultry Processing Sectors

NAICS Material Code [a/]	Materials Consumed	Value of Shipments ($ Millions)	Delivered Cost ($ Millions)
Hog Processing			
11221003	Hogs slaughtered (NAICS Code 311611, Animal (Except Poultry) Slaughtering)	--	$10,607.2
31161113	Fresh and frozen pork (NAICS Code 311611, Animal (Except Poultry) Slaughtering)	--	$1,146.9
11221003	Hogs slaughtered (NAICS Code 311612, Meat Processed from Carcasses)	--	$29.5
31161113	Fresh and frozen pork (NAICS Code 311612, Meat Processed from Carcasses)	--	$3,928.5
Total		**$38,510.9**	**$15,712.2**
Broiler Processing			
11232001	Young chickens slaughtered	--	$8,946.7
11232003	Hens and other chickens slaughtered	--	$188.3
Total		**$17,656.9**	**$9,135.0**

Source: Derived from USDC, 1999a.

[a/]NAICS Material Code denotes the industry group that produced the raw materials consumed by the hog and poultry processing industries.

4.4 MARKET LEVEL ANALYSIS

EPA's CAFO and processor analyses measure the effects of the proposed regulations on CAFOs and the manufacturing sectors. As these effects influence the decisions of farmers, processors and packers, and ultimately consumers, they translate into changes in the price and quantity of farm commodities and retail foods and generate changes throughout the national economy. To better understand the potential impacts, EPA conducts a market level analysis.

EPA's market analysis evaluates the effects of the proposed regulations on national markets. The analysis uses a linear partial equilibrium model adapted from the COSTBEN model developed by researchers at USDA. The modified EPA model provides a means to conduct a long-run static analysis to measure the market effects of the proposed regulations in terms of predicted changes in farm and retail prices and product quantities. Once price and quantity changes are predicted by the model, EPA uses input-out multipliers that relate changes in sales to other national level market changes.

Measured impacts include changes in price and available quantities as well as changes in national employment and economic output. Other market changes examined by EPA include changes in regional employment and changes in U.S. livestock and poultry trade (imports and exports). This section presents an overview of the model (Section 4.4.1) and the data sources for the analysis (Section 4.4.2).

4.4.1 Overview of Methodology

The market model predicts and quantifies the broader market changes that may result from regulatory compliance costs imposed on CAFOs. The mechanisms that produce these effects are relatively simple. Compliance costs increase farmers' costs of production. The supply function represents the amount of a product a producer is willing to supply at a given price. When producers' costs go up the supply function shifts up, indicating producers require a higher price to supply a given quantity. A new market equilibrium is reached when supply eventually equals demand. EPA estimates the impact of the regulations by how that shift in the supply function changes the overall market equilibrium.

Individual farmers generally have a limited ability to pass on increased costs associated with regulations because of the competitive nature of livestock and poultry production and the dynamics of the food marketing system. The marketing system is often characterized by local oligopsony conditions, or "few buyers" (Rogers and Sexton, 1994). Since farmers may be considered "price-takers," farms with unusually high costs or those requiring major investment to meet the regulatory standards may be forced to drop out of the industry. The decline in the number of farms and their lost production is what shifts the supply function. To the extent that lower cost producers step in to fill the void as other firms exit, the supply function will shift less than might otherwise be expected.

An economy is a tightly woven web of interactions at many levels. A change in any one sector (a direct impact) results in changes in others (indirect impacts). The supply shifts in farm production that are predicted by EPA's market model would cause manufacturers to alter their production patterns. As some industries increase production and others decrease, employees are hired and fired, in turn changing their income and spending patterns (induced impacts).

Changes in prices, trade, and social welfare are measured as differences between the baseline equilibrium before the regulation—preregulation—and the shocked equilibrium after the regulation has been implemented—postregulation. As discussed in the following sections, EPA's market model provides a means to measure the direct impact of a policy change on affected markets. Indirect and induced impacts can also be estimated by applying the results of the market model to an input-output model of the national economy.

4.4.1.1 Market Model

EPA's market model is adapted from the COSTBEN model developed by the USDA's Economic Research Service (Hahn, 1996). EPA's model is designed to estimate the results of the policy once it is fully implemented, so it does not include the additional short-run results that COSTBEN calculates. Long-run static analysis is appropriate for measuring the final market effects of the proposed CAFO regulations because the compliance costs being considered are long-run costs that include both annualized capital investments and ongoing maintenance costs. The EPA model assesses only the final outcome and does not address the steps taken to reach that outcome. Appendix B provides a more detailed discussion of the market model's structure and operation.

The market model analysis uses a simple, linear partial equilibrium model to predict the effects of the proposed CAFO regulations on national markets. It measures conditions at two market stages: farm and retail. These markets are interconnected. The supply of farm products influences the supply of retail products, and the demand for retail products results in a derived demand for farm products. The model puts farm level supply and retail demand functions into the same units and sets them equal to estimate a long-run equilibrium. EPA models the effect of the estimated compliance costs as an additive shift in the domestic supply function, and their impacts are measured as the change from the baseline equilibrium to the new post-regulatory equilibrium. The model finds the equilibrium price and quantity in the two markets and calculates the related production, imports, exports, and economic impacts.

The model assumes perfect competition in all markets and is similar to models typically found in agricultural economics literature (Kohls and Uhl, 1998; Pearce and Turner, 1990; Tomek and Robinson, 1972).[17] EPA defines each supply and demand function by its elasticity and the baseline price and quantity values. Each animal sector is modeled separately, so interaction effects between products are not included. For example, substitution of pork for beef when beef prices rise is not included in the model. The implications of this limitation are unclear, as prices in several sectors would be affected at the same time.

[17]Although EPA recognizes the possibility of oligopsony in certain sectors, data are insufficient to develop a more complex model of market behavior.

EPA estimates market level changes in terms of changes in consumer and farm level prices for the selected products and also changes in the amount of commodities produced and traded internationally (expressed as changes in U.S. product exports and imports).

4.4.1.2 Input-Output Analysis

The market model assesses the estimated direct impacts associated with complying with the proposed regulations, measured in terms of dollars of industry output per year. EPA uses these model results in an input-output analysis framework to estimate the affect of the proposed CAFO regulations on national total employment and regional agricultural employment (farm and processors) and also national economic output.

Changes in economic output are measured in terms of changes in Gross Domestic Product (GDP). Changes in employment are measured in terms of full-time equivalents. Predicted changes in aggregate employment are measured in terms of both direct and indirect/induced employment. *Direct* employment measures the number of jobs related to the production and processing including workers engaged in the manufacture of agricultural inputs and their supplies. Other employment provides a broader measure of industry-related employment and includes workers throughout the economy that provide support to the industry. *Indirect* employment covers veterinary service providers, feed suppliers, agricultural supplies and farm services, and trucking and transportation industries. *Induced* employment covers other local goods and services, such as bank tellers, grocery store clerks, restaurant employees and gas station attendants. EPA's analysis does not adjust for offsetting increases in other parts of the economy and other sector employment that may be stimulated as a result of the proposed regulations, such as the construction and farm services sectors.

Input-output analysis uses multipliers that forecast how much more or less output the whole economy would produce as a result of each dollar increase or decrease in spending by a given industry. Once the change in output (price times quantity) is estimated using EPA's market model, EPA evaluates these changes using input-output multipliers to estimate the ripple effects as changes in one industry pass through its suppliers and the rest of the economy. Multiplying the original change by the multiplier gives a measure of the total direct effects (on immediate suppliers), indirect effects (on the suppliers' suppliers and all other industries), and induced effects (on households' spending and labor decisions). These estimates may be driven by an original change in final demand, output, earnings, or employment and yield results in terms of final demand, output, earnings, tax revenue, or employment changes.

Although the application of multipliers is as simple as multiplication, the multipliers themselves embody a great deal of information. Basically, they are a synopsis of all the interactions of an industry with the rest of the economy. The change in spending by each industry affected by the proposed CAFO regulations is multiplied by a multiplier unique to that industry. Multipliers for the processing industries are adjusted to avoid double counting the effects of

changes in those industries with changes in the agricultural sectors that supply them. Consumer spending is treated as separate industry. When consumers must adjust their spending patterns to pay higher meat prices, they have less money to spend on other things. Because the market model predicts that much of the cost of the proposed CAFO regulations would be shifted to consumers, this shift in consumer spending is often a significant portion of the economy-wide impact of a regulation.

4.4.2 Sources of Data and Parameters

The market model requires specification of only a small number of parameters. A base year provides the starting conditions for the model. EPA uses 1997 as the base year, which is consistent with the engineering cost estimates that reflect 1997 conditions. Detailed citations for each base year value appear in Tables 4-16 and 4-17 and Appendix B.

4.4.2.1 Market Model Data

Data and parameter inputs to the market model include prices and quantities of supply and demand, as well as various elasticities. All the data used for the market model are from published historical series. A summary of the key input data is presented in Table 4-16. More information on the data sources and variables used for this analysis are described in Appendix B.

Price and quantity data for each market are mostly from USDA publications that summarize national market conditions. ERS collates data from USDA/NASS, U.S. Department of Commerce's Bureau of Labor Statistics (BLS), and other sources, as well as its own research, to develop consistent price and quantity series for many agricultural activities. These series are published in many formats such as USDA's *Agricultural Outlook* and also the *Livestock, Dairy, and Poultry Situation and Outlook* reports (USDA/ERS, various dates). Much of this information is readily available on-line at ERS' website. The USDA World Agricultural Outlook Board (WAOB) bases many of its projections on these series and provides a concise summary of the information in its annual series, titled *USDA Agricultural Baseline Projections* (USDA/WAOB, 1999 and 2000). Another compendium series EPA uses for this analysis is USDA/ERS' *Food Consumption, Prices and Expenditures, 1970-1997* (Putnam and Allshouse, 1999). Other source material is from NASS statistical bulletins for these sectors, *Agricultural Prices Annual Summary*, and USDA's Foreign Agricultural Service (FAS).

Where necessary, EPA supplements USDA market data with information from other sources. Prices for choice fed steers and veal and choice retail beef were compiled with the assistance of the National Cattlemen's Beef Association (NCBA) through their membership with Cattle-Fax, a member-owned information organization. Milk utilization (domestic demand and traded volumes) is reported on a milk equivalent, total solids basis, as calculated by the National Milk Producers Federation (NMPF, 1999). This measure aggregates the milk content across a

Table 4-16. Market Model Baseline Values (1997)

Variable	Beef [a/]	Dairy [b/]	Hog	Broiler [c/]	Turkey [c/]	Layer [d/]
Farm Products						
Price	$66.09/cwt	$13.38/cwt	$54.30/cwt	37¢/lb	40¢/lb	70¢/doz.
Quantity Produced	40,893 thous. head	156,100 mil. lbs	91,960 thous. head	--	--	6,473 mil. doz.
Quantity Exported	282 thous. head	0	55 thous. head	--	--	895 mil. doz.
Quantity Imported	2,046 thous. head	0	3,178 thous. head	--	--	0
Retail Products						
Price	$2.80/lb	145.5	$2.45/lb	151¢/lb	105¢/lb	106¢/doz.
Quantity Demanded	25,824 mil. lbs	156,100 mil. lbs	17,274 mil. lbs	27,551 mil. lbs	5,412 mil. lbs	5,578 mil. doz.
Quantity Exported	2,136 mil. lbs	5,244 mil. lbs	1,044 mil. lbs.	5,048 mil. lbs	598 mil. lbs	228 mil. doz.
Quantity Imported	2,343 mil. lbs	4,383 mil. lbs	633 mil. lbs	5 mil. lbs	0	7 mil. doz.
Elasticities						
Price Elasticity of Demand	-0.621	-0.247	-0.728	-0.372	-0.535	-0.110
Price Elasticity of Supply	1.020	1.527	0.628	0.200	0.200	0.942

Sources:
Prices: Beef (NCBA, 2000); Dairy (USDA/ERS, 1998b); Hog (USDA/ERS, 1999c); Poultry (USDA/WAOB, 1999).
Quantities: Beef/Veal (USDA/ERS, 1998b and 1999d; USDA/NASS, 1998d; USDA/WAOB, 1999; Putnam and Allshouse, 1999); Dairy (USDA/ERS, 1998; NMPF, 1999); Hogs (USDA/ERS, 1998b; USDA/NASS, 1998d; USDA/WAOB, 1999); Poultry (USDA/ERS, 1998a).
Price Elasticities: Demand, all sectors (Huang, 1993); Beef (Foster and Burt, 1992; Foster, 2000a); Dairy (Chavas, Kraus, and Jesse, 1990); Hog (Holt and Johnson, 1988); Chicken and Turkey (Vukina, 2000); Eggs (Chavas and Johnson, 1981).
[a/]Includes veal and heifer.
[b/] Consumer Price Index for Dairy Products as a composite good. Output is on a milk equivalent, total solids basis.
[c/]Includes various forms of chicken meat, e.g. broilers, mixed poultry meat. Because of coordination between the broiler feeding and processing sectors, it is not possible to determine prices per animal at the farm level. The chicken and turkey markets are modeled in terms of pounds of production.
[d/]Egg quantities are in million dozens. Layer "Exports" represent eggs diverted to hatcheries, which is a fixed number in the model.

wide range of fluid milk and dairy foods and allows for easy comparison with annual farm milk supplies.

Another model input includes elasticities that measure the change in quantity relative to a change in price. As described in Section 4.2.6 on cost passthrough, the elasticity measures that EPA uses are the same as the "selected values" in Table 4-14. These values are selected based on an extensive search of the agricultural economics literature and consultation with leading experts in the field. Price response research is conducted by various land grant universities and is published in the leading academic journals. Limited information is available on the effects of price on traded quantities. Although there is a general consensus that overseas markets are more sensitive to prices than domestic markets (Foster, 2000a), elasticities for animal product imports and exports have not been widely studied. EPA assumes that elasticities for imports and exports are the same as domestic elasticities. Because price elasticities are critical to the outcome of the model, EPA has performed a sensitivity analysis to see how alternative assumptions affect the results. These sensitivity analyses are reported in Appendix D.

4.4.2.2 Input-Output Model Data

EPA uses multipliers from the Regional Input-Output Modeling System, version 2 (RIMS II) (USDC, 1997b) to estimate the impact on the national economy of changes in the animal products industry. RIMS II was developed to facilitate the use of input-output analysis in regional planning. It is widely used to assess the impacts of changes in economic activity, such as military base closings and economic development projects. A summary of the multipliers that EPA uses for the input-output analysis are presented in Table 4-17. Estimated effects include changes in national employment (measured in terms of full-time equivalents) and changes in economic output (measured in terms of changes in Gross Domestic Product). These estimated changes are based on the estimated direct impacts, described in the preceding section, which are measured in terms of dollars of industry output per year. More information is provided in Appendix B.

Table 4-17 also illustrates the differences between RIMS II and another set of multipliers from USFOOD, which is published by Ohio State University. USFOOD multipliers focus on the agricultural sector and are based on the IMPLAN (Impact Analysis and Planning) input-output software, developed by researchers at the U.S. Forest Service and University of Minnesota. Multipliers from the IMPLAN model are commonly used for input-output analyses of agricultural commodities (see, for example: Boggess, et al., 1997; Seidl and Weiler, 2000; Gray, et al., 1999; Able, Daft & Early, 1993).

EPA has selected the RIMS II model for this analysis because it offers a more detailed breakout of processing and nonagricultural industries, as well as household multipliers. The version of USFOOD available at the time of this research was based on 1977 production patterns

Table 4-17. RIMS II Multipliers for Secondary Impact Analysis (Comparison with USFOOD)

Sector Name	Total Output		Total Employment [a/]		Own Industry Employment [a/]
	RIMS II	USFOOD	RIMS II	USFOOD	RIMS II
Farm Products					
Poultry and Eggs	2.8217	2.5882	26.3665	35.5598	12.1043
Meat Animals	2.1692	--	20.8698	--	10.2072
Hogs	--	2.6823	--	32.2572	--
Cattle Feeding	--	2.7146	--	32.1979	--
Dairy Farm Products	2.3215	1.8188	23.5130	42.3332	11.5267
Food and Kindred Products[b/]					
Meat Packing Plants	2.4755	--	18.2332	--	3.3511
Meat/Egg Processing	--	3.0777	--	32.1910	--
Poultry Processing	2.1822	--	18.0150	--	6.1750
Fluid Milk Processing	2.3968	--	16.3311	--	2.6981
Dairy Processing	--	2.6917	--	32.1408	--
Other					
Construction	3.0851	1.9332	32.4816	26.8497	10.9000
Households [c/]	2.1642	--	23.8483	—	0.2823

Sources: RIMS II: USDC, 1996, RIMS II 6/19/96 based on 1987 benchmark I-O accounts and 1992 employment and salary data, region is entire United States, adjusted to be output-driven. USFOOD: USDC, 1996, and Sporleder and Liu, 1992.

[a/]Employment multipliers adjusted for inflation to 1997 values based on CPI-U.

[b/]Processing sector multipliers adjusted to eliminate CAFO level impacts.

[c/]USFOOD does not include household multipliers. The RIMS II household multiplier used in the USFOOD results.

updated to 1985 output and prices while RIMS II is based on 1987 production patterns updated with 1992 data. RIMS II is based on more up-to-date information as well as providing greater detail in the households and processing industries. Other available models provide the ability to perform more detailed input-output analysis, which is not warranted given the likely uses and level of detail needed for this analysis.

As Table 4-17 shows, RIMS II and USFOOD have slightly different industry definitions and so are not exactly comparable. Only those multipliers with the same component standard industrial classifications (SIC codes) are shown on the same line in the table. While the output multipliers are similar, RIMS II employment multipliers are 25 to 50 percent smaller than

USFOOD employment multipliers. Some of the difference may be attributable to changes in farm and food processing technology between 1977 and 1987 and employment changes between 1985 and 1992. Methodological differences between the two approaches may also cause multipliers to differ. Rickman and Schwer (1995) found that when the IMPLAN and RIMS II models were adjusted to control for differing closure methods, the multipliers did not differ significantly.

Once national level employment impacts are determined, these estimated impacts are used to estimate potential regional impacts at the community level. EPA distributes national employment estimates onto a regional basis using state level data that reflect livestock and poultry production by the largest facilities in each sector. The data EPA uses to allocate national employment impacts in the agriculture sectors are from the 1997 Census (USDA/NASS, 1999a), which are supplemented with other state level data from USDA (USDA/NASS, 1998b) and with imputed values to correct for omitted values (Westat, 2000).

4.4.3 Criteria for Assessing Regulatory Impacts

Impacts at the market level must be carefully assessed. Unless a rule has a profound effect on all levels of the U.S. economy, market level effects at the national level are usually quite small. Conversely, however, small market level effects do not preclude the possibility of large impacts on smaller units of the economy–at the sector level, regional level, or regulated entity level (in the latter case, at individual CAFOs). Therefore, EPA closely scrutinizes the results of its input-output analysis to avoid summary judgments regarding the affordability of the CAFO regulations, given the likely modest reductions in overall economic output and employment that EPA calculates (even when the gains in employment and output associated with compliance cost expenditures are not considered).

The proposed CAFO regulations could result in disproportionate effects in some producing areas and could induce out-migration or relocation among producing regions. These changes could affect rural communities that may depend on the farming sectors in an area to sustain regional employment and support local businesses (such as input supply industries and other supporting infrastructure) as well as to contribute to local tax revenues (CARD, 1993). These regional impacts may not be readily apparent in a review of the aggregate market level impacts. To the extent that data are available, EPA's analysis examines regional effects that may occur under the proposed CAFO regulations (as described in Section 4.4.2.2).

Furthermore, affordability judgments may require some consideration of who bears the impacts. It may not be equitable to assume that because few impacts can be seen at the highest levels of the economy, a rule is affordable if major dislocations are expected to occur at the regulated-entity level (e.g., a large number of CAFOs becoming vulnerable to closure).

With these concerns in mind, EPA assesses the affordability of the regulatory options and the proposed CAFO regulations from a market standpoint in a more qualitative way than it does

affordability at the CAFO or processor level. EPA evaluates the predicted market changes by comparing these to reported actual changes over the last decade. This comparison provides a benchmark for evaluating the affordability of predicted changes and also takes into account year-to-year variability of the affected markets.

This comparison alone, however, is overly simplistic. Agricultural markets constantly respond to change, whether it be year-to-year volatility in producer prices or input prices (such as the cost of feed), or even reductions in output due to severe weather events. At the same time, consumer markets for these products are large and relatively stable: a constant stream of suppliers is almost certain and retail prices, when expressed in real terms, have remained fairly flat or have actually been decreasing. While it is true that these markets must constantly adapt to change, this does not address the fact that the proposed CAFO regulations would result in a sustained increase in production costs (and result in a permanent upward shift in the supply curve).

Although these markets as a whole appear able to absorb most any market shock, large-scale disruption within individual segments of these markets, such as the farm and processing sectors, can occur (as discussed above) and also warrant consideration. Thus, to the extent possible, EPA considers affordability at all three levels–CAFO, processor, and national level markets–when assessing the overall affordability of the proposed CAFO regulations.

SECTION FIVE

TOTAL COSTS AND ECONOMIC IMPACTS OF THE PROPOSED CAFO REGULATIONS (ALL SUBCATEGORIES)

This section presents the national level aggregate compliance costs and economic impacts to regulated facilities under the proposed CAFO regulations. Section 5.1 presents EPA's analysis of the expected post-tax costs to industry as a result of the proposed CAFO regulations. Sections 5.2 through 5.4 present the results of EPA's analysis that evaluates the financial impacts across three industry segments: CAFOs, processors, and national markets. Section 5.2 presents the results of EPA's analysis at the CAFO level in terms of the expected costs to both existing and new facilities, as well as the cost to other farming operations that use CAFO manure as a fertilizer substitute. Section 5.3 presents an analysis of the potential costs and impacts to the processing sectors in some industries. Finally, Section 5.4 presents the results of EPA's market level analysis, focusing on the potential secondary impacts of the proposed regulations on both consumer and farm level prices and quantities, and changes in national level employment and economic output.

The results presented in this section span various technology options and also different scope scenarios considered by EPA during the development of the proposed revisions. These ELG Options and NPDES Scenarios are described in Section 3 of this report.[1] A summary overview of the ELG Options and NPDES Scenarios is provided in Table 3-1.

For the purpose of this analysis, the "BAT Option" refers to EPA's proposal to require nitrogen-based and, where necessary, phosphorus-based land application controls at all livestock and poultry CAFOs (Option 2), with the additional requirement that all cattle and dairy operations (except veal) must conduct groundwater monitoring and implement controls, if the groundwater beneath the production area has a direct hydrologic connection to surface water (Option 3), and with the additional requirement that all hog, veal, and poultry CAFOs achieve zero discharge from the animal production area with no exception for storm events (Option 5).

EPA is jointly proposing two NPDES Scenarios that differ in terms of the manner in which operations are defined as a CAFO. Scenario 4a is the two-tier approach that defines as CAFOs all animal feeding operations with more than 500 AU; facilities with fewer than 500 AU are CAFOs only if designated by the permit authority. (Alternatively, Scenario 5 is the two-tier alternative that defines all animal feeding operations with more than 750 AU as CAFOs.)

[1]More detail of the technology options considered by EPA is provided in Section VIII of the preamble. Section VII of the preamble provides additional information on the alternative scope scenarios considered by EPA. The preamble presents the Agency's rationale for each regulatory decision.

Scenario 3 is the three-tier approach that defines as CAFOs all animal feeding operations with more than 1,000 AU and any operation with more than 300 AU, if they meet certain "risk-based" conditions. Facilities with fewer than 300 AU are CAFOs only if designated by the permit authority. Under Scenario 3, EPA would require all confinement operations with between 300 and 1,000 AU to either apply for a NPDES permit or to certify to the permit authority that they do not meet certain conditions and thus are not required to obtain a permit. EPA is also soliciting comment on an alternative to co-proposed three-tier structure (Scenario 6). EPA did not evaluate the costs and economic impacts under this alternative, however, EPA expects that the numbers of CAFOs affected under Scenario 6 would be fewer than the 31,930 estimated for Scenario 3; therefore, costs and impacts should be no more than those for Scenario 3. If after considering comments, EPA decides to further explore this approach, it will conduct a full analysis of this scenario. Scenario 6 will not be further addressed in this section.

For the purpose of this discussion, the "*two-tier structure*" refers to the combination of BAT Option 3 (beef and dairy subcategories, except veal) and BAT Option 5 (swine, veal, and poultry subcategories) and NPDES Scenario 4a, which covers all operations with more than 500 AU. Where indicated, the two-tier structure may refer to the alternative threshold at 750 AU. The "*three-tier structure*" refers to the combination of proposed BAT Option by subcategory and NPDES Scenario 3 that covers operations down to 300 AU based on certain conditions.

More detail of the technology options and scoping options that are being proposed by EPA as well as alternatives that were considered by EPA during the development of this rulemaking is provided in Section 3 of this report. More detailed information is provided in Sections VII and VIII of the preamble.

5.1 ANNUAL COMPLIANCE COSTS OF THE PROPOSED CAFO REGULATIONS

This section presents EPA's estimates of the compliance costs that would be incurred by existing sources under the regulatory options being considered for the beef, veal, heifer, dairy, pork, broiler, turkey, and egg laying sectors under both the two-tier (Scenario 4a and Scenario 5) and three-tier (Scenario 3) structure. Section 5.1.1 presents EPA's estimate of the annual incremental costs of the proposed BAT Option under both tier structures. Section 5.1.2 presents EPA's estimate of the annual costs of other ELG Options and NPDES Scenarios considered by EPA during the development of this rulemaking.

5.1.1 Annual Costs under Two-Tier and Three-Tier Structures

Tables 5-1 through 5-3 summarize the total annualized compliance costs to CAFOs attributed to the proposed BAT Option/Scenario 4a (two-tier structure at 500 AU threshold), the proposed BAT Option/Scenario 5 (two-tier structure at 750 AU threshold) and the proposed BAT Option/Scenario 3 (three-tier structure). The tables show these costs broken out by sector

and by broad facility size group. EPA calculates these costs using the data, methodology, and assumptions described in Section 4 and Appendix A. More detailed cost data are provided in the *Development Document* (USEPA, 2000a).

Under the two-tier structure, EPA estimates that 25,540 CAFOs with more than 500 AU may be defined as CAFOs and subject to the proposed regulations (Table 5-1). EPA estimates that 19,100 CAFOs may be defined as CAFOs under the alternative two-tier threshold of 750 AU (Table 5-2). Under the three-tier structure, an estimated 31,930 CAFOs would be defined as CAFOs (Table 5-3) and an additional 7,400 operations in the 300 to 1,000 AU size range would need to certify that they do not need to apply for a permit. Additional operations would be affected by the proposed regulations if designated as CAFOs by the permitting authority. More information on EPA's estimate of the number of affected CAFOs is provided in Section 2.

Table 5-1. Annualized Post-Tax Costs, Two-Tier (500 AU), BAT Option/Scenario 4a, $1997 millions

Sector	No. of Operations [a/]	Total	>1000 AU	500 - 1000 AU	<500 AU
Beef	3,080	$135.0	$118.5	$16.5	$0.1
Veal	90	$0.2	$0.03	$0.2	NA
Heifer	800	$8.6	$2.8	$5.8	NA
Dairy	3,760	$111.4	$65.7	$43.3	$2.4
Hog	8,550	$198.9	$148.8	$48.9	$1.2
Broiler	9,780	$74.4	$41.8	$32.5	$0.1
Layer	1,640	$9.1	$6.3	$2.8	NA
Turkey	1,280	$13.3	$6.8	$6.5	NA
Total	**25,540**	**$550.9**	**$390.7**	**$156.4**	**$3.8**

Source: USEPA. Options/Scenarios are defined in Table 3-1. May not add due to rounding. NA=Not Applicable.
[a/]Total number of affected facilities adjusts for operations with more than a single animal type and includes expected defined CAFOs only (excludes designated facilities). However, estimated costs include costs to designated CAFOs. Section 2 provides additional information on the number of affected facilities.

Table 5-2. Annualized Post-Tax Costs, Two-Tier (750 AU), BAT Option/Scenario 5, $1997 millions

Sector	No. of Operations [a/]	Total	>1000 AU	750 - 1000 AU	<750 AU
Beef	2,480	$125.3	$118.5	$6.7	$0.1
Veal	40	$0.1	$0.03	$0.1	NA
Heifer	420	$4.2	$2.8	$1.4	NA
Dairy	810	$86.9	$65.7	$15.0	$6.3
Hog	5,750	$171.1	$148.8	$21.5	$0.9
Broiler	7,780	$66.1	$41.8	$23.4	$1.0
Layer	1,460	$9.0	$6.3	$2.6	NA
Turkey	740	$9.6	$6.8	$2.7	NA
Total	**20,920**	**$472.2**	**$390.7**	**$73.3**	**$8.2**

Source: USEPA. Options/Scenarios are defined in Table 3-1. May not add due to rounding. NA=Not Applicable.
[a/]Total number of affected facilities adjusts for operations with more than a single animal type and includes expected defined CAFOs only (excludes designated facilities). However, estimated costs include costs to designated CAFOs. Section 2 provides additional information on the number of affected facilities.

Table 5-3. Annualized Post-Tax Costs, Three-Tier Structure, BAT Option/Scenario 3 ($1997 millions) [a/]

Sector	No. of Operations [b/]	Total	>1000 AU	300 - 1000 AU	<300 AU
Beef	3,210	$143.5	$118.5	$25.0	NA
Veal	140	$0.5	$0.03	$0.5	NA
Heifer	980	$10.6	$2.8	$7.8	NA
Dairy	6,480	$146.9	$65.7	$81.0	$0.4
Hog	8,350	$214.9	$148.8	$65.5	$0.2
Broiler	13,740	$90.0	$41.8	$48.1	NA
Layer	2,010	$9.8	$6.3	$3.5	NA
Turkey	2,060	$17.4	$6.8	$10.5	NA
Total	**31,930**	**$633.7**	**$390.7**	**$242.0**	**$0.6**

Source: USEPA. Options/Scenarios are defined in Table 3-1. May not add due to rounding. NA=Not Applicable.
[a/]Total number of affected facilities adjusts for operations with more than a single animal type and includes expected defined CAFOs only (excludes designated facilities). However, estimated costs include costs to designated CAFOs. Section 2 provides additional information on the number of affected facilities.

EPA's estimate of the number of affected CAFOs counts operations with more than a single animal type only once.[2] However, EPA's analysis computes total compliance costs (and also financial impacts to facilities) based on the total number of CAFOs in each sector, including mixed operations that have more than the threshold number of animals (300, 500, or 750 AU) of at least one animal type. This approach avoids understating costs at operations with more than one animal type. Such operations may incur costs to comply with the proposed requirements for each type of animal raised on site that meets the size threshold for a CAFO or is designated as a CAFO by the permitting authority. Therefore, EPA's compliance costs estimates likely represent the upper bound, since costs at facilities with more than a single animal type may, in some cases, be lower due to shared production technologies and practices across all animal types that are produced on site.

EPA calculates two types of compliance costs–pre-tax and post-tax. The post-tax costs reflect the fact that a CAFO would be able to depreciate or expense these costs, thus generating a tax savings. Post-tax costs thus are the actual costs the CAFO would face. Pre-tax costs reflect the estimated total social cost of the proposed regulations, including lost tax revenue to governments. Pre-tax dollars are used when comparing estimated costs to monetized benefits that are estimated to accrue under the proposed regulations (see Section 10). All costs presented in this section are presented in terms of post-tax 1997 dollars and account for annual tax savings to CAFOs. Post-tax costs are also used to evaluate impacts to regulated facilities, presented in Section 5.2.). EPA's estimated compliance costs presented in the *Development Document* are also estimated in 1997 dollars, since 1997 is the base year of the analysis (USEPA, 2000a). Cost results presented in the preamble to this rulemaking (and the Executive Summary to this report) are converted from 1997 dollars to 1999 dollars using the Construction Cost Index (ENR, 2000).

Under the two-tier structure at 500 AU threshold, EPA estimates that the total incremental compliance cost to CAFO operators would be approximately $551 million annually, 1997 post-tax dollars (Table 5-1). Under the alternative two-tier structure at 750 AU threshold, EPA estimates that the total incremental compliance cost to CAFO operators would be approximately $472 million annually (Table 5-2). Under the three-tier structure, EPA estimates that the total cost to CAFO operators would be $634 million annually (Table 5-2). (Pre-tax costs are estimated at $831 million, $721 million, and $980 million annually, respectively, expressed in 1999 dollars.[3]) Most of this cost (roughly 70 percent) is incurred by CAFOs with more than 1,000 AU. Overall, about one-third of all estimated compliance costs are incurred within the hog sectors.

Estimated costs for the three-tier structure include the cost to permitted CAFOs and the cost to operations to certify to the permit authority that they do not meet any of the "risk-based"

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[2]Census data for 1992 indicate that operations with mixed animal types account for 25 percent of operations with 300 and 1000 AU. Fewer operations are mixed among operations with more than 1,000 AU (USEPA, 2000a).

[3]These pre-tax costs are presented in Section X.E of the preamble.

conditions and thus are not required to obtain a permit. Under Scenario 3, EPA estimates that 31,930 livestock and poultry operations with more than 300 AU are defined as CAFOs under the proposed regulations and required to obtain a permit (Table 5-3). An estimated 7,400 operations would certify that they do not need to obtain a permit (estimated as the difference between permitted operations under Scenario 3 and Scenario 4b, as shown in Table 5-5). Certification costs incurred by these operations are included in the total annual estimated costs and are estimated at about $40 million annually (post-tax, 1997 dollars) for each of the technology options that build on Option 2 (Options 3, 5, 6, and 7). This amount is based on the estimated difference between costs for Scenario 3 and Scenario 4b, under the ELG Option 2, for permitted CAFOs.[4] EPA expects that this difference reflects the cost to operations to certify out of the permit program associated with phosphorus-based PNP costs, facility upgrades, and letters of certification from manure recipients. The cost to certify out of the program is assumed to be the same as the estimated costs incurred under Option 2, since this option covers basic facility upgrades and nutrient management planning.

Estimated costs shown in Tables 5-1 through 5-3 include costs to animal confinement operations that may be designated as CAFOs. As discussed in Section 2, EPA assumes that designation may bring an additional 50 operations each year under the two-tier structure at 500 AU threshold, an additional 85 each year under the two-tier structure at 750 AU threshold, and an additional 10 operations each year under the three-tier structure. In this analysis, estimated costs to designated facilities are expressed on an average annual basis over a projected 10-year period. For the purpose of this analysis, EPA assumes that operations that may be designated as CAFOs and subject to the proposed regulations would consist of dairy and farrow-finish hog operations located in more traditional farming regions. EPA also expects that some beef, egg laying, and broiler operations may also be designated as CAFOs under either two-tier structure (see Table 2-5). Total annualized costs to designated facilities are estimated at under $4 million (Table 5-1), under $8 million (Table 5-2), under $1 million dollars annually (Table 5-3), depending on scenario.

Table 5-4 shows EPA's estimated incremental costs to offsite recipients. Offsite recipients include field crop producers who use CAFO manure as a fertilizer substitute. As described in the preamble, EPA is proposing that offsite recipients of CAFO manure certify to the CAFO that manure that will be land applied in accordance with proper agriculture practices. EPA estimates that 18,000 crop operations will receive manure and therefore be required to certify proper manure utilization under the proposed two-tier structure (Scenario 4a). Under the three-tier structure, up to 3,000 additional crop operations may be affected (Table 5-4). Annualized costs to offsite recipients are estimated at $9.2 to $10.9 million annually across the two-tier (500 AU threshold) and three-tier structures, respectively (1997 dollars) (Table 5-4).[5] Costs to offsite recipients for

[4]Total costs to CAFOs that certify out are calculated as the difference in the estimated cost of Option 2 under Scenario 4b ($423 million) and the cost of Option 2 under Scenario 3 ($384 million). See Table 5-5.

[5]These costs do not account for possible tax savings associated with the expenditure.

the two-tier structure at the 750 AU threshold costs have not been estimated. EPA's estimates the costs to recipients of CAFO manure that cover incremental recordkeeping and soil tests every 3 years, the cost of soil and manure sampling at the CAFO site, training for manure applicators, application equipment calibration, and the hauling cost of excess manure generated by the CAFO. These costs do not include the costs of spreading manure at the offsite location or any additional payments made to brokers or manure recipients in counties with excess manure. This analysis is provided in the *Development Document* (USEPA, 2000a).

Table 5-4. Annualized Costs to Offsite Recipients of CAFO Manure, $1997 and $1999 millions

Sector	>1000 AU	>500 AU	>300 AU
Number of Recipients	13,489	17,923	21,155
Total Costs ($1999 million)	$7.2	$9.6	$11.3
Total Costs ($1997 million)	$6.9	$9.2	$10.9

Source: *Development Document* (USEPA, 2000a). Options/Scenarios are defined in Table 3-1. May not add due to rounding. NA = Not Applicable. Costs are indexed to 1997 dollars using the Construction Cost Index (ENR, 2000).

5.1.2 Costs to CAFOs of Alternative Regulatory Options and Scenarios

Alternative regulatory options considered by EPA during the development of proposed CAFO regulations include various technology options and also different regulatory scope scenarios, as summarized in Table 3-1 (Section 3). The following sections provide additional break out of these costs.

Table 5-5 summarizes the total annualized (post-tax) costs of alternative technology options for each NPDES scenario and ELG technology basis considered by EPA. As shown in the table, the total estimated costs across these options range from $230 million (Option 1/Scenario 1) to $1.1 billion annually (Option 5, applicable to all the animal sectors, and Scenario 4b). By scenario, this reflects the fact that fewer CAFOs would be affected under Scenario 1 (a total of about 16,400 operations) as compared to Scenario 4b (about 39,300 operations affected). Since EPA's estimate of the number of CAFOs and corresponding compliance costs do not adjust for operations with mixed animal types, costs may be overstated. By technology option, with the exception of Options 1 and 4, costs are evaluated incremental to Option 2 (see Table 3-1). Incremental to Option 2, Option 5 costs are greatest.

5.1.2.1 Annual Costs of the Alternative ELG Options

Table 5-6 summarizes the total annualized (post-tax) costs to CAFOs of the proposed BAT Option along with six alternative technology options considered by EPA under the two-tier (500 AU threshold), two-tier (750 AU threshold), and three-tier structures, respectively. These costs are broken out by each sector in the tables below.

Table 5-5. Annualized Post-tax Costs for All ELG Options and NPDES Scenarios ($1997, millions)

Option/ Scenario	Scenario 4a "Two-Tier"	Scenario 2/3 "Three-Tier"	Scenario 1	Scenario 5 >750 AU	Scenario 4b >300 AU
#CAFOs[1/]	**25,540**	**31,930**	**16,420**	**19,100**	**39,320**
Option 1	$286.7	$308.6	$230.3	$252.9	$335.3
Option 2	$359.2	$383.6	$284.2	$313.2	$423.1
Option 3	$490.8	$576.7	$396.0	$422.2	$594.1
Option 4	$598.3	$736.5	$460.0	$502.3	$760.9
Option 5	$940.7	$1,027.5	$819.7	$853.5	$1,057.5
Option 6	$418.8	$500.3	$331.9	$361.2	$482.9
Option 7	$438.8	$517.9	$347.3	$378.2	$503.5
BAT Option	**$550.9**	**$633.7**	**$444.7**	**$472.2**	**$664.4**

Source: USEPA. Cost estimates shown include costs to designated operations. Numbers may not add due to rounding. Option/Scenario definitions provided in Table 10-2.

As shown in Table 5-6, the total estimated costs across these options range from $287 million (Option 1) to $941 million (Option 5, all subcategories) in annual 1997 dollars. Table 5-6 also presents these same results for the two-tier structure at the 750 AU threshold. As shown, the total estimated costs across these options range from $253 million (Option 1) to $854 million (Option 5) in annual 1997 dollars, as applicable to all the animal sectors. For the three-tier structure, the total estimated costs across these options range from $309 million (Option 1) to $1,028 million (Option 5) in annual 1997 dollars.

5.1.2.2 Annual Costs of the Alternative NPDES Scenarios

Table 5-7 summarizes the total annualized post-tax compliance costs associated with the alternative NPDES scenarios that were considered but not proposed by EPA, in 1997 dollars. (Results for Scenario 2 are the same as those for Scenario 3 since each scenario affects the same number of CAFOs and both costs and impacts are the same.) As shown, the estimated annual post-tax compliance costs for the proposed BAT Option range from $445 million (Scenario 1) to $664 million (Scenario 4b) in annual 1997 dollars. This outcome is consistent with expectations, since fewer CAFOs are affected under Scenario 1 compared to Scenario 4b.

Table 5-6. Annualized Post-Tax Costs All ELG Options ($1997, millions)

Option	Beef	Veal	Heifer	Dairy	Hog	Broiler	Layer	Turkey	Total
Two-Tier Structure (500 AU)									
Option 1	$47.8	$0.1	$3.6	$64.6	$88.8	$66.2	$7.3	$8.3	**$286.7**
Option 2	$77.2	$0.2	$5.7	$60.7	$118.7	$74.4	$9.1	$13.3	**$359.2**
Option 3	$135.0	$0.2	$8.6	$111.4	$131.1	$80.7	$9.6	$14.3	**$490.8**
Option 4	$146.4	$0.6	$12.0	$125.5	$154.7	$124.0	$15.7	$19.4	**$598.3**
Option 5	$532.5	$0.2	$6.7	$105.6	$198.9	$74.4	$9.1	$13.3	**$940.7**
Option 6	$77.2	$0.2	$5.7	$83.2	$155.7	$74.4	$9.1	$13.3	**$418.8**
Option 7	$85.9	$0.2	$5.7	$120.4	$129.8	$74.4	$9.1	$13.3	**$438.8**
BAT Option	**$135.0**	**$0.2**	**$8.6**	**$111.4**	**$198.9**	**$74.4**	**$9.1**	**$13.3**	**$550.9**
Two-Tier Structure (750 AU)									
Option 1	$43.3	$0.1	$1.2	$53.2	$83.1	$58.7	$7.1	$6.3	**$252.9**
Option 2	$71.5	$0.1	$2.5	$49.0	$105.5	$66.1	$8.9	$9.6	**$313.2**
Option 3	$125.3	$0.1	$4.2	$86.9	$114.9	$71.2	$9.4	$10.2	**$422.2**
Option 4	$134.4	$0.2	$6.0	$96.3	$131.6	$106.2	$14.7	$12.9	**$502.3**
Option 5	$513.6	$0.1	$3.1	$81.1	$171.1	$66.1	$9.0	$9.6	**$853.5**
Option 6	$71.5	$0.1	$2.5	$59.9	$142.5	$66.1	$8.9	$9.6	**$361.2**
Option 7	$79.6	$0.1	$2.5	$95.7	$115.6	$66.1	$8.9	$9.6	**$378.2**
BAT	**$125.3**	**$0.1**	**$4.2**	**$86.9**	**$171.1**	**$66.1**	**$9.0**	**$9.6**	**$472.2**
Three-Tier Structure (Scenario 3)									
Option 1	$48.6	$0.2	$4.5	$73.5	$85.8	$78.1	$7.7	$10.2	**$308.6**
Option 2	$77.8	$0.3	$6.9	$72.2	$111.9	$87.8	$9.6	$17.1	**$383.6**
Option 3	$143.5	$0.6	$10.6	$146.9	$147.6	$98.4	$10.5	$18.8	**$576.8**
Option 4	$160.4	$1.2	$15.1	$177.8	$176.9	$159.7	$18.1	$27.4	**$736.7**
Option 5	$544.4	$0.5	$8.8	$141.7	$214.9	$90.0	$9.8	$17.4	**$1,027.5**
Option 6	$90.7	$0.5	$7.6	$102.1	$182.3	$90.0	$9.8	$17.4	**$500.3**
Option 7	$98.9	$0.5	$7.6	$137.6	$156.1	$90.0	$9.8	$17.4	**$517.9**
BAT	**$143.5**	**$0.5**	**$10.6**	**$146.9**	**$214.9**	**$90.0**	**$9.8**	**$17.4**	**$633.6**

Source: USEPA. Options/Scenarios are defined in Table 3-1. Numbers may not add due to rounding. Estimated costs include costs to designated CAFOs.

Across all other alternative technology options and scope scenarios, EPA estimates that costs range from a low of $230 million (Option 1/Scenario 1) to a high of over $1 billion annually (Option 5/Scenario 4b). Under the proposed BAT Option and alternative NPDES scenarios, the hog sector bears the largest costs among the regulated subcategories, followed by the beef subcategory. Lowest costs are associated with the poultry sector (Table 5-7).

Table 5-7. Annualized Post-Tax Costs of Options Under Alternative NPDES Scenarios ($1997, millions)

Sector	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	BAT Option
	($1997 millions)							
Scenario 1								
Cattle	$43.7	$72.8	$127.1	$138.0	$509.7	$72.7	$80.5	$127.1
Dairy	$57.0	$53.7	$98.8	$112.5	$91.2	$63.4	$98.3	$98.8
Hog	$80.3	$100.7	$109.6	$125.7	$161.6	$138.6	$111.3	$161.6
Poultry	$49.3	$57.1	$60.5	$83.8	$57.2	$57.1	$57.1	$57.2
Total	**$230.3**	**$284.2**	**$396.0**	**$460.0**	**$819.7**	**$331.9**	**$347.3**	**$444.7**
Scenario 4b								
Cattle	$60.1	$93.6	$159.8	$180.7	$564.2	$93.6	$102.4	$159.8
Dairy	$77.3	$76.4	$152.4	$180.4	$141.1	$99.2	$134.9	$152.4
Hog	$98.1	$136.2	$153.8	$192.5	$235.3	$173.3	$149.3	$235.3
Poultry	$99.9	$116.9	$128.0	$207.2	$116.9	$116.9	$116.9	$116.9
Total	**$335.3**	**$423.1**	**$594.1**	**$760.9**	**$1,057.5**	**$482.9**	**$503.5**	**$664.4**

Source: USEPA. Options/Scenarios are defined in Table 3-1. Numbers may not add due to rounding.

5.2 CAFO IMPACTS

This section presents the CAFO level impacts under each of the ELG options and many of the NPDES scenarios considered by EPA during the development of the proposed regulations. Section 5.2.1 discusses the pre-regulatory, or baseline, financial health of EPA's model CAFOs developed for this analysis. Section 5.2.2 examines the impact to existing facilities to comply with the proposed ELG requirements for Best Available Technologies Economically Achievable (BAT). Section 5.2.3 examines the affect of the proposed offsite requirements to recipients of CAFO manure. Section 5.2.4 examines the impact to new facilities to comply with the proposed ELG requirements for New Source Performance Standards (NSPS).

Results are shown for the two-tier (500 AU threshold) and three-tier structures. The impacts of the two-tier structure at 750 AU threshold are also discussed. Results are also shown for other alternative regulatory scenarios considered by EPA during the development of this rulemaking.

5.2.1 Baseline Financial Health of Model CAFOs

As discussed in Section 4, EPA's CAFO analysis examines compliance cost impacts for representative model CAFOs. All baseline model CAFOs, regardless of sector or size or production region, are considered to be financially healthy in the baseline before the impacts of the proposed CAFO regulations are considered. Based on these data, all model CAFOs currently are estimated to have positive discounted cash flow and debt-to-asset ratios of approximately 40 percent or less. Post-regulatory impacts are measured against this baseline. EPA considers that negative cash flow or debt-to-asset ratios greater than about 40 percent in the impact analysis can be attributed to the compliance costs associated with the regulatory options considered.

5.2.2 Post-compliance Impacts to Existing Operations (BAT Analysis)

5.2.2.1 Impacts under the Two-Tier and Three-Tier Structures

Economic achievability is determined by applying the proposed criteria described in Section 4.2.5. These criteria include a sales test and also analysis of post-compliance cash flow and debt-to-asset ratio for an average model CAFO. EPA uses these financial criteria to divide the impacts of the proposed regulations into three impact categories. The first category is the affordable category, which means that the regulations have little or no financial impact on CAFO operations. The second category is the moderate impact category, which means that the regulations will have some financial impact on operations at the affected CAFOs, but EPA does not consider these operations to be vulnerable to closure as a result of compliance. The third category is the financial stress category, which means that EPA considers these operations to be vulnerable to closure post-compliance. EPA considers the stress impact category to indicate that the proposed requirements may not be economically achievable by the CAFO, subject to other considerations.

For this analysis, impacts under the affordable and moderate category are associated with positive post-compliance cash flow over a 10-year period and a debt-to-asset ratio not exceeding 40 percent, in conjunction with a sales test result that shows that compliance costs are less than 5 percent of sales ("affordable") or between 5 and 10 percent ("moderate"). "Stress" impacts are associated with negative cash flow or if the post-compliance debt-to-asset ratio exceeds 40 percent, or sales test results that show costs equal to or exceeding 10 percent of sales. Additional information on these criteria and a discussion of the basis for EPA choosing these criteria for this analysis is provided in Section 4.2.5. Table 4-13 provides a summary of the proposed threshold values for each of these impact categories used for this analysis.

EPA's model analyzes impacts under two sets of conditions for ELG Option 3. Option 3 would impose additional requirements (such as liners, groundwater monitoring, and recordkeeping) if a hydrologic connection from the confinement areas to surface water is present. (See Section 3.2 for additional information.) To depict the possibility of either condition, EPA estimates impacts under two sets of alternative assumptions: one alternative assumes that there is a hydrologic connection from groundwater to surface waters at the CAFO (Option 3A); the other alternative uses average costs conditions across all operations—including those operations with and without a hydrologic link (Option 3) (USEPA, 2000a).[6] For this analysis, based on available data and information, EPA's analysis assumes that 24 percent of the affected operations have a hydrologic connection to surface waters (as described in the *Development Document*, [USEPA, 2000a]). These operations will incur costs associated with groundwater monitoring controls. This affects results shown for the cattle (beef, veal, and heifer) and dairy sectors. Impacts for Options 3 and 3A are aggregated in the results tables. However, of the estimated impacts shown for the cattle and dairy sectors, all impacts under the moderate and stress categories, along with a portion of impacts under the affordable category, are attributable to Option 3A costs and assumptions.

Tables 5-8 through 5-11 present the estimated CAFO level impacts for the proposed BAT Option under the two-tier and three-tier structures by sector. Tables 5-9 through 5-10 show these results across all facility sizes; Table 5-11 breaks out these results by broad size categories. Results are expressed in terms of the number of operations that fall within the affordable, moderate, or stress impact categories for facilities that are defined as CAFOs. For some sectors, impacts are shown for both the zero and the partial cost passthrough assumptions.

Based on these results, EPA proposes that the regulatory alternatives are economically achievable for all representative model CAFOs in the veal, turkey and egg laying sectors. The proposed requirements under the two-tier structure are also expected to be economically achievable by all affected heifer operations. Furthermore, although operations across most sectors may experience moderate impacts, EPA does not expect moderate financial impacts to result in closure and considers this level of impact to be economically achievable.

In the beef cattle, heifer, dairy, hog and broiler sectors, however, EPA's analysis indicates that the proposed regulations will cause some operations to experience financial stress, assuming no cost passthrough. These operations may be vulnerable to closure by complying with the proposed regulations. Across all sectors, an estimated 1,890 operations would experience financial stress under the two-tier structure and an estimated 2,410 operations would experience stress under the three-tier structure. Under the two-tier structure at the 750 AU threshold, EPA estimates that 1,700 operations would experience financial stress. For both tier structures, EPA estimates that the percentage of operations that would experience impacts under the stress category represent 7 percent of all affected CAFOs (or 8 percent of all affected operations in the

[6]Alternatively, estimated costs for "Option 3B" reflect representative facility level costs where no hydrologic link is present. Option 3, 3A, and 3B costs are provided in the *Development Document.*

sectors where impacts are estimated to cause financial stress in the cattle, dairy, hog, and broiler sectors).

Results shown in Tables 5-8 through 5-11 do not include designated facilities. In addition to impacts evaluated for operations that are defined as CAFOs, EPA estimates that the proposed regulations could result in financial stress to 20 designated dairies under both the co-proposed two-tier and the three-tier structures. EPA does not expect that designated operations in other sectors will experience financial stress due to compliance. Designated dairies that are expected to experience stress based on the results of this analysis are operations that are designated due to a hydrologic link to surface waters, projected over a 10-year period. Under the alternative two-tier structure (750 AU threshold), no designated operations would experience financial stress based on the results of this analysis.

Table 5-8. Impacted Operations Under the Two-Tier Structure (BAT Option/Scenario 4a)

Sector	Number of CAFOs	Affordable	Moderate	Stress	Affordable	Moderate	Stress
		Zero Cost Passthrough			Partial Cost Passthrough		
		(Number of Affected Operations)					
Fed Cattle	3,080	2,830	240	10	ND	ND	ND
Veal	90	90	0	0	ND	ND	ND
Heifer	800	680	120	0	ND	ND	ND
Dairy	3,760	3,240	200	320	ND	ND	ND
Hogs: GF	2,690	1,710	180	810	2,690	0	0
Hogs: FF	5,860	5,210	30	610	5,860	0	0
Broilers	9,780	1,960	7,670	150	8,610	1,170	0
Layers - Wet	360	360	0	0	ND	ND	ND
Layers - Dry	1,280	1,280	0	0	ND	ND	ND
Turkeys	1,280	1,230	50	0	ND	ND	ND
Total	**28,970**	**18,580**	**8,490**	**1,890**	**26,840**	**1,800**	**330**

Source: USEPA. Impact estimates shown include impacts to designated operations. Numbers may not add due to rounding. ND = Not Determined. Option/Scenario definitions provided in Table 3-1. Category definitions ("Affordable," "Moderate" and "Stress") are provided in Table 4-13.

Table 5-8 shows results for the two-tier structure at the 500 AU threshold. By sector, EPA estimates that 1,420 hog operations (17 percent of affected hog CAFOs), 320 dairies (9 percent of operations), 150 broiler operations (2 percent), and 10 beef operations (less than 1 percent) would experience financial stress. The broiler and hog operations with these impacts have more than 1,000 AU on-site (i.e., no operations with between 500 and 1,000 AU fall in the stress category). The dairy and cattle operations with stress impacts are those that have a ground water link to surface water. The results of the two-tier structure at the 750 AU threshold are very similar in terms of number of operations affected, although no cattle operations and 190 fewer dairy operations would experience financial stress (Table 5-9).

Table 5-9. Impacted Operations Under the Two-Tier Structure (BAT Option/Scenario 5)

Sector	Number of CAFOs	Affordable	Moderate	Stress	Affordable	Moderate	Stress
		Zero Cost Passthrough			Partial Cost Passthrough		
		(Number of Affected Operations)					
Fed Cattle	2,480	2,370	100	0	ND	ND	ND
Veal	40	40	0	0	ND	ND	ND
Heifer	420	390	30	0	ND	ND	ND
Dairy	2,260	2,070	50	130	ND	ND	ND
Hogs: GF	2,300	1,310	180	810	2,300	0	0
Hogs: FF	3,460	2,820	30	610	3,460	0	0
Broilers	7,780	1,650	5,980	150	6,740	1,040	0
Layers - Wet	210	210	0	0	ND	ND	ND
Layers - Dry	1,260	1,260	0	0	ND	ND	ND
Turkeys	740	720	10	0	ND	ND	ND
Total	**20,920**	**12,830**	**6,390**	**1,700**	**19,540**	**1,230**	**130**

Source: USEPA. Impact estimates shown include impacts to designated operations. Numbers may not add due to rounding. ND = Not Determined. Option/Scenario definitions provided in Table 3-1. Category definitions ("Affordable," "Moderate" and "Stress") are provided in Table 4-13.

Table 5-10 presents results for the three-tier structure, and show that 1,420 hog operations (17 percent of affected hog CAFOs under that alternative), 610 dairies (9 percent of operations), 330 broiler operations (2 percent), and 50 beef and heifer operations (1 percent) will be adversely impacted. Hog operations with stress impacts all have more than 1,000 AU. Affected broiler facilities include operations with more than 1,000 AU, as well as operations with less than 1,000

AU. Dairy and cattle operations in the stress category are operations that have a hydrologic link from ground water to surface water. Based on these results, EPA is proposing that the proposed regulations are economically achievable.

Table 5-10. Impacted Operations Under the Three-Tier Structure (BAT Option/Scenario 3)

Sector	Number of CAFOs	Affordable	Moderate	Stress	Affordable	Moderate	Stress
		Zero Cost Passthrough			Partial Cost Passthrough		
		(Number of Affected Operations)					
Fed Cattle	3,210	2,540	650	20	ND	ND	ND
Veal	140	140	0	0	ND	ND	ND
Heifer	980	800	150	30	ND	ND	ND
Dairy	6,480	5,300	560	610	ND	ND	ND
Hogs: GF	2,650	1,660	190	810	2,650	0	0
Hogs: FF	5,710	5,070	30	610	5,710	0	0
Broilers	13,740	1,850	11,560	330	12,320	1,440	0
Layers - Wet	360	360	0	0	ND	ND	ND
Layers - Dry	1,660	1,660	0	0	ND	ND	ND
Turkeys	2,060	1,950	110	0	ND	ND	ND
Total	**37,000**	**21,300**	**13,250**	**2,410**	**33,410**	**2,930**	**660**

Source: USEPA. Impact estimates shown include impacts to designated operations. Numbers may not add due to rounding. ND = Not Determined. Option/Scenario definitions provided in Table 3-1. Category definitions ("Affordable," "Moderate" and "Stress") are provided in Table 4-13.

In the hog and broiler sectors, EPA also evaluates financial impacts with an assumption of cost passthrough. For the purpose of this analysis, EPA assumes that the hog sector could pass through 46 percent of compliance costs and the broiler sector could pass through 35 percent of compliance costs. EPA derives these estimates from price elasticities of supply and demand for each sector reported in the academic literature. More detailed information is provided in Section 4.2.6. Assuming these levels of cost passthrough in these sectors, the magnitude of the estimated impacts decreases to the affordable or moderate impact category. Even in light of the uncertainty of cost passthrough (both in terms of whether the operations are able to pass cost increases up the marketing chain and the amount of any cost passthrough), EPA proposes that the proposed regulations will be economically achievable to all hog and broiler operations.

Although EPA's analysis does not consider cost passthrough among cattle or dairy operations, EPA does expect that long-run market and structural adjustment by producers in this sector will diminish the estimated impacts. However, EPA did determine that an evaluation of economic impacts to dairy producers would require that EPA assume cost passthrough levels in excess of 50 percent before operations in the financial stress category would, instead, fall into the affordable or moderate impact category. In this analysis, EPA evaluates impacts under a 67 percent cost passthrough assumption, which indicates that no dairy operations would experience financial stress under the co-proposed tier structures. Additional information on this analysis is provide in Section 8. EPA did not conduct a similar evaluation of estimated impacts to beef cattle and heifer operations.

Table 5-11 breaks out EPA's estimated CAFO level impacts by broad size categories, including operations with more than 1,000 AU and operations with fewer than 1,000 AU, for each of the co-proposed tier structures. Impacts are shown for the zero cost passthrough scenario only.

EPA believes its estimated impacts may be overstated since the analysis does not quantify various cost offsets that are available to most operations, some of which are described in Section 4.2.7. One source of potential cost offset is cost share and technical assistance available to operators for on-site improvements that are available from various state and federal programs, such as the Environmental Quality Incentives Program (EQIP) administered by USDA. Another source of cost offset is revenue from manure sales, particularly of relatively higher value dry poultry litter. EPA's analysis does not account for these possible sources of cost offsets because the amount of cost offset is likely variable among facilities, depending on certain site-specific conditions. If EPA were to quantify the potential cost offsets as part of its analysis, this would further support EPA's proposed determination that the proposed requirements are economically achievable to affected operations. This analysis is provided in Section 6.

Appendix D provides results of sensitivity analyses, conducted by EPA, to examine the impact under differing model assumptions. This analysis examine the change in the modeling results from varying the baseline assumptions on gross and net cash income, debt-to-asset ratios as well as other variability factors for model CAFOs. These sensitivity analyses conclude that the results presented here are stable across a range of possible modeling assumptions. EPA also conducted sensitivity analysis of the compliance costs developed for the purpose of estimating CAFO level impacts, as documented in the *Development Document* (USEPA, 2000a).

Table 5-11. Number of CAFOs Affected under the Co-Proposed Alternatives by Size (Zero Cost Passthrough)

Sector	Two-Tier Structure (500 AU Threshold)				Three-Tier Structure			
	No. of CAFOs [a/]	Aff.	Mod.	Stress	No. of CAFOs [a/]	Aff.	Mod.	Stress
		(number)				(number)		
CAFOs >1,000 AU								
Fed Beef	2,080	2,080	0	0	2,080	2,080	0	0
Veal	10	10	0	0	10	10	0	0
Heifer	300	300	0	0	300	300	0	0
Dairy	1,450	1,450	0	0	1,450	1,450	0	0
Hogs	4,090	2,460	210	1,420	4,090	2,460	210	1,420
Broilers	3,940	200	3,600	150	3,940	200	3,600	150
Layers - Wet	50	50	0	0	50	50	0	0
Layers - Dry	590	590	0	0	590	590	0	0
Turkeys	370	370	0	0	370	370	0	0
Total	**12,870**	**7,500**	**3,810**	**1,560**	**12,870**	**7,500**	**3,810**	**1,560**
CAFOs <1,000 AU								
Fed Beef	1,000	760	240	10	1,140	460	680	20
Veal	80	80	0	0	130	130	0	0
Heifer	500	380	120	0	680	500	150	30
Dairy	2,310	1,790	200	320	5,030	3,850	560	610
Hogs	4,460	4,460	0	0	4,270	4,260	10	0
Broilers	5,840	1,760	4,080	0	9,800	1,650	7,970	180
Layers - Wet	310	310	0	0	310	310	0	0
Layers - Dry	690	690	0	0	1,060	1,060	0	0
Turkeys	910	860	50	0	1,690	1,580	110	0
Total	**16,100**	**11,080**	**4,690**	**330**	**24,100**	**13,810**	**9,450**	**850**

Source: USEPA. Impact estimates shown include impacts to designated operations. Numbers may not add due to rounding. ND = Not Determined. Option/Scenario definitions provided in Table 3-1. Category definitions ("Affordable," "Moderate" and "Stress") are provided in Table 4-13.

5.2.2.2 Impacts under Other Regulatory Alternatives

Tables 5-12 through 5-14 present the CAFO level impacts across the alternative ELG options and NPDES scenarios considered but not proposed by EPA during the development of this rulemaking. In some cases, the results for alternative options are shown for Options 1 through 5 only, along with the proposed BAT Option, but are not shown for Options 6 and 7. As shown in Table 3-1, for all technology options, with the exception of Options 1 and 4, EPA evaluates costs in relation to Option 2. Results for Option 6 and 7 are not shown because these costs are not evaluated in relation the proposed BAT Option combination (Option 3 for beef/dairy and Option 5 for pork/veal/poultry). If the full cost of Options 6 and 7 are considered, in addition to estimated impacts under the proposed BAT Option, impacts to facilities would likely be more severe than those shown for the proposed BAT Option.

Table 5-12 presents EPA's estimate of CAFO level impacts for the alternative ELG options, assuming zero cost passthrough, under both the two-tier (Scenario 4a) and three tier structure (Scenario 3). The results shown are partially aggregated and combine impacts in the cattle sector, including all beef, veal, and heifer operations, and in the hog sector, including all farrow-finish and grow-finish operations. Results are broken out to show estimated impacts under the two sets of Option 3 assumptions (i.e., Option 3 across all operations and Option 3A for operations with a hydrologic link to surface waters). As shown, the proposed BAT Option is associated with the same or slightly higher impacts than some of the other options. Under alternative Option 4, however, EPA estimates that a substantial number of affected poultry operations would experience financial stress, as defined for this analysis, assuming no passthrough of costs.

Table 5-13 shows the impacts of the proposed BAT Option and the alternative options under a partial cost passthrough assumption for the hog and poultry sectors only. For both co-proposed alternatives, assuming modest levels of cost passthrough, the model shows that no hog and poultry operations would experience financial stress impacts under the proposed BAT Option. Under some other ELG options, some operations would experience impacts under the stress category, even assuming cost passthrough. Under the two-tier structure at 500 AU threshold, stress impacts are estimated at hog operations under the alternative Option 6 and also at poultry operations under Option 4. Under the three-tier structure, additional operations would experience financial stress under these options. Based on these results, the number of potential closures is likely greatest under Option 4, which would require all CAFOs to conduct both groundwater monitoring and surface water sampling.

Table 5-12. Number of CAFOs Adversely Affected under Alternative Options (Zero Cost Passthrough)

Option	Cattle	Dairy	Hog	Broiler	Layer	Turkey
Stress Impacts under the Two-Tier Structure (500 AU Threshold)						
Option 1	0	0	610	0	0	0
Option 2	0	0	300	150	0	0
Option 3	0	0	230	260	0	0
Option 3A	10	320	310	90	0	0
Option 4	0	0	570	6,660	0	10
Option 5	30	0	1,420	150	0	0
Option 6	0	0	1,210	150	0	0
Option 7	0	0	500	150	0	0
BAT Option	**10**	**320**	**1,420**	**150**	**0**	**0**
Stress Impacts under the Three-Tier Structure						
Option 1	0	0	610	0	0	0
Option 2	0	0	300	330	0	0
Option 3	0	0	230	470	0	0
Option 3A	50	610	320	360	0	10
Option 4	20	0	570	10,750	0	10
Option 5	100	0	1,420	330	0	0
Option 6	0	0	1,210	330	0	0
Option 7	0	0	500	330	0	0
BAT Option	**50**	**610**	**1,420**	**330**	**0**	**0**

Source: USEPA. Options/Scenarios are defined in Table 3-1. Category definitions ("Stress") are provided in Table 4-13. Numbers may not add due to rounding. Option 3A impacts reflect operations where there is a determined groundwater hydrologic connection to surface waters (assumed at 24 percent of affected operations). Option 3 impacts reflect average costs conditions across all operation for this option.

Table 5-13. Number of CAFOs Adversely Affected under Alternative Options (Partial Cost Passthrough)

Option	Hog	Poultry	Hog	Poultry
	Stress Impacts–Two-Tier Structure (500 AU Threshold)		Stress Impacts–Three-Tier Structure (Scenario 3)	
	(number of operations)			
Option 1	0	0	0	0
Option 2	0	0	0	0
Option 3	0	0	0	0
Option 4	0	130	0	2,610
Option 5	0	0	0	0
Option 6	440	0	440	0
Option 7	0	0	0	0
BAT Option	**0**	**0**	**0**	**0**

Source: USEPA. Options/Scenarios are defined in Table 3-1. Category definitions ("Stress") are provided in Table 4-13. Numbers may not add due to rounding. Option 3 includes impacts to facilities with a hydrologic link.

Table 5-14 compares the CAFO level impacts across the proposed and the alternative NPDES scenarios. Results for Options 1 through 5 are shown, along with the proposed BAT Option. Results also break out estimated impacts under the two sets of Option 3 assumptions. As shown in the table, the number of potential closures range from 450 operations (Option 2/Scenario 1) to nearly 12,000 potential closures (Option 4/Scenario 4b). Among options, the number of possible closures is highest under the more stringent options, including Options 3A (i.e., requires groundwater controls at operations where there is a determined groundwater hydrologic connection to surface waters), Option 4 (groundwater controls and surface water sampling), and Option 5 (i.e., zero discharge from the animal production area with no exception for storm events). Differences across scenarios reflect differences in the number of affected operations; accordingly, the number of potential closures is likely greatest under Scenario 4b, which would define as CAFOs all confinement operations with more than 300 AU.

5.2.3 Post-compliance Impacts to Offsite Recipients of CAFO Manure

As discussed in Section 4.1.2.2, EPA assesses the economic impact to offsite recipients of CAFO manure by comparing the estimated cost of this requirement to both aggregate and average per-farm production costs and revenues. For the purpose of this analysis, EPA assumes that these regulatory costs would be borne by a non-CAFO farming operation that uses animal manures as a fertilizer substitute.

Table 5-14. Number of CAFOs Adversely Affected under Alternative Scenarios (Zero Cost Passthrough)

Sector	No. of CAFOs	Option 1	Option 2	Option 3	Option 3A	Option 4	Option 5	BAT Option
		(number of operations with stress impacts)						
NPDES Scenario 1								
Cattle	2,860	0	0	0	10	0	20	10
Dairy	3,480	0	0	0	110	0	0	110
Hogs	5,480	610	300	230	310	570	1,420	1,420
Poultry	5,500	0	150	120	40	2,530	150	150
Total	**17,320**	**610**	**450**	**340**	**480**	**2,980**	**1,590**	**1,690**
NPDES Scenario 4a (>500 AU)								
Cattle	3,960	0	0	0	10	0	30	10
Dairy	3,760	0	0	0	320	0	0	320
Hogs	8,550	610	300	230	310	570	1,420	1,420
Poultry	12,700	0	150	260	100	6,660	150	150
Total	**28,970**	**610**	**450**	**490**	**730**	**7,230**	**1,590**	**1,890**
NPDES Scenario 3 (>300 AU with certification)								
Cattle	4,330	0	0	0	50	0	100	50
Dairy	6,480	0	0	0	610	0	0	610
Hogs	8,360	610	300	230	320	570	1,420	1,420
Poultry	17,830	0	330	470	370	10,740	330	330
Total	**37,000**	**610**	**630**	**700**	**1,350**	**11,310**	**1,850**	**2,410**
NPDES Scenario 4b (>300 AU)								
Cattle	5,330	0	0	0	90	30	180	90
Dairy	7,140	0	0	0	700	0	0	700
Hogs	14,370	610	300	230	330	570	1,420	1,420
Poultry	18,300	0	320	470	380	11,030	320	320
Total	**45,140**	**610**	**620**	**700**	**1,500**	**11,630**	**1,910**	**2,530**

Source: USEPA. Options/Scenarios are defined in Table 3-1. Category definitions ("Stress") are provided in Table 4-13. Option 3A impacts reflect operations where there is a determined groundwater hydrologic connection to surface waters (assumed at 24 percent of affected operations). Option 3 impacts reflect average costs conditions across all operation for this option.

As shown in Table 5-4, EPA estimates that 17,900 to 21,200 farming operations would incur $9.2 million to $10.9 million in costs associated with requirements for the offsite transfer of CAFO manure, depending on the co-proposed alternative ($1997). This translates to a cost of roughly $500 per recipient, calculated as the average cost across the number of recipients (Table 5-4).[7] As reported by USDA, farm production expenses in 1997 totaled $150.6 billion nationwide. Revenue from farm sales totaled $196.9 billion. Averaged across the total number of farms, average per-farm costs and revenues were $78,800 and $113,000 in 1997, respectively. Using these data, the ratio of incremental costs to offsite recipients to average operating expenses is less than one percent. Compliance costs as a share of average farm revenue are estimated to be even lower. Total estimated compliance costs as a share of aggregate farm expenses and sales are also estimated at well below one percent.

5.2.4 Post-compliance Impacts to New Operations (NSPS Analysis)

EPA's proposed rule requires existing CAFOs to meet the BAT requirements of Option 3 for the beef and dairy subcategories (except veal) and Option 5 for the swine, veal, and poultry subcategories. For new beef and dairy sources, EPA proposes that operations meet the same performance standards required under the proposed BAT Option for these subcategories (Option 3 BAT). For new hog, veal, and poultry sources, EPA proposes an option that combines Option 5 BAT with the additional requirement that if there is a hydrologic link to surface water, the new operations will also implement groundwater controls. This combined option is referred to as Option 5+3 NSPS for the swine, veal, and poultry subcategories.

During the development of this rulemaking, EPA considered a similar combined "zero overflow" and groundwater control option for new cattle and dairy operations (Option 8 NSPS), which would have required all animals to be confined within a covered structure (see Section VIII of the preamble for a description of this NSPS option). EPA rejected Option 8 NSPS for the beef and dairy subcategory based on the results of a barrier to entry analysis.

EPA's economic analysis of the proposed NSPS options assesses whether the proposed standards constitute a "barrier" for new businesses wishing to enter the animal production market. This determination is based on whether new sources would be subject to higher costs than existing sources. Higher compliance costs for new sources could be considered a barrier to entry, since existing sources would have a cost advantage. Generally, an NSPS option will have similar or lower costs than the corresponding BAT option for an existing operation. This is because new sources do not need to undertake expensive retrofits when installing pollution controls. NSPS options are considered by EPA to result in no barriers to entry for new sources if the costs are the same as or no greater than the BAT costs for existing sources since existing operators do not gain a cost advantage over new operators. A significant cost advantage would be a barrier to entry for

[7]However, EPA calculates the total cost to offsite recipients based on an estimated cost to recipients of roughly $1,000 per facility, which is assessed across 54 percent of facilities that are assumed to incur incremental costs. For more information, see the *Development Document* (USEPA, 2000a).

new sources. For NSPS options that are more stringent (and more costly) than requirements for existing sources, EPA must determine whether the additional costs constitute a barrier to entry.

This section reviews all the analyses conducted by EPA to assess the NSPS options that are being proposed. Detailed results are presented in the rulemaking record (ERG, 2000f—see DCN 70599).

5.2.4.1 Impacts of the NSPS Options on the Beef and Dairy Subcategories

For this proposed rulemaking, EPA has evaluated the proposed option for new sources for the beef and dairy subcategories (Option 3 NSPS). EPA's analysis indicates that requiring Option 3 for new sources for the beef and dairy subcategories would not create any barriers to entry since the estimated costs for new sources are the same as or less expensive than the BAT costs for existing sources. This determination is based on a comparison of the costs of Option 3 BAT to the costs of Option 3 NSPS on a model-by-model basis. For this comparison, EPA uses the weighted average of Option 3A and Option 3B costs for both Option 3 BAT and Option 3 NSPS. Estimated Option 3 NSPS costs for new beef and dairy operations are lower than Option 3 BAT costs since they do not include retrofitting costs that would be incurred by existing sources. EPA's comparison of the estimated NSPS and BAT costs shows that the new source costs for some model facilities were estimated to be more than 10 percent lower than those for existing facilities (ERG, 2000f). However, EPA assumes that new operations will not incur costs estimated under Option 3A, which includes groundwater controls, since they are not likely to establish a new operation where there is a hydrologic link to surface waters (and where operating expenses would be more costly). Thus Option 3 NSPS costs are likely to be even lower compared to Option 3 BAT costs than was determined in this analysis. Since the estimated costs for new sources are the same as or lower than the costs to existing facilities, EPA concludes that the proposed NSPS option for the beef and dairy subcategory poses no barriers to entry in the beef and dairy sectors.

This section also presents EPA's evaluation of an alternative option for new sources for the beef and dairy subcategories (NSPS Option 8). This option is evaluated by comparing the estimated Option 8 NSPS costs to the Option 3 BAT costs for each sector on a model-by-model basis. The difference in costs is determined by calculating the percent difference between the costs of the NSPS options and the BAT options for each CAFO model. This percent difference is used to judge whether to conduct additional analysis to determine whether a barrier to entry might exist. The results of this comparison are presented in Table 5-15. Where Option 8 NSPS costs are lower than Option 3 BAT costs, a negative percentage is shown (Table 5-15). As shown in the table, Option 8 NSPS costs are less expensive than Option 3 BAT for beef and heifer operations. For the dairy sector, however, costs of Option 8 are significantly higher, estimated at more than 10 times higher than Option 3 BAT for most models. Because of this large cost difference in the dairy sector, EPA conducted the following additional analysis.

Table 5-15. Percent Difference in Costs between Option 8 NSPS and Option 3 BAT, Beef and Dairy Sectors

Sector	Region	Facility Size	Percent Difference		
			Category 1	Category 2	Category 3
Fed Cattle	MW	M1	-34%	-29%	-58%
		M2	-39%	-34%	-69%
		L1	-79%	-42%	-89%
		L2	-80%	-47%	-95%
	CE	M1	-16%	-11%	-41%
		M2	-17%	-13%	-53%
		L1	-31%	-16%	-81%
		L2	-35%	-13%	-95%
Dairy	PA	M1	1220%	1095%	1484%
		M2	1604%	1073%	1994%
		L1	2346%	1143%	2791%
	MW	M1	918%	878%	1070%
		M2	1210%	967%	1423%
		L1	1642%	1160%	1849%
Heifers	CE	M1	-18%	-16%	-33%
		M2	-19%	-16%	-38%
		L1	-52%	-34%	-74%
	MW	M1	-33%	-30%	-49%
		M2	-35%	-36%	-56%
		L1	-76%	-64%	-82%

Source: USEPA. Where percentages are negative, Option 3 NSPS is less expensive than Option 3 BAT. See Table 4-1 (Section 4) for CAFO model definitions (region and size) and definitions of land availability categories.

To assess the cost differences shown in Table 5-15, EPA examines the potential economic impacts to new dairy operations using the same model CAFO approach EPA uses to examine options for existing sources (described in Section 4). This approach compares NSPS compliance costs to financial conditions for a representative model CAFO. Potential impacts to new sources are determined based on the sales test, a post-compliance cash flow analysis, and post-compliance debt-to-asset ratio analysis for each model CAFO. The results of this analysis indicate whether the costs will result in affordable or moderate impacts to a facility (considered by EPA to not result in facility closure) or whether the expected costs will result in financial stress impact (i.e., facility or product line closure). Section 4.2.5 provides additional information on this approach.

Where the resulting impacts are "affordable" or "moderate" for the BAT Options but result in "stress" under the NSPS Option, EPA considers this to be an indication that barriers to entry may exist (i.e., few, if any, new sources would enter the market). EPA assesses cost-to-sales ratios to evaluate the magnitude of the cost differences and judge whether this cost difference is significant in terms of the impact it might have on new operations. If the sales test result for the NSPS option does not differ greatly from the sales test results for the BAT option, EPA judges that the cost difference will not pose a barrier to entry.

The results of this analysis indicate that while Option 8 will not result in stress impacts at beef or heifer operations, all (100 percent) of all dairy operations would experience financial stress under Option 8 NSPS. The results of this analysis are expressed as percentages, since EPA has not estimated numbers of new sources. This analysis is conducted assuming that all costs are incurred at the facility under the zero cost passthrough scenario. Based on these results, EPA determined that Option 8 would pose a barrier to entry in the dairy sector; therefore, EPA decided not to propose Option 8 NSPS. More detailed information is available in the docket (DCN 70599).

5.2.4.2 Impacts of the NSPS Options on the Swine, Veal, and Poultry Subcategories

For this proposed rulemaking, EPA has evaluated the proposed option for new sources for the swine, veal, and poultry subcategories (Option 5+3 NSPS). EPA's analysis indicates that requiring Option 3 and Option 5 for new sources for the swine, poultry and veal subcategories would not create any barriers to entry since the estimated costs for new sources are the same as or less expensive than the BAT costs for existing sources. This determination is based on a comparison of the costs of Option 5 BAT to the costs of Option 5+3 NSPS on a model-by-model basis. For this analysis, EPA assumes that new operations will not incur costs estimated under Option 3A, which includes groundwater controls, since they are not likely to establish a new operation where there is a hydrologic link to surface waters (and where operating expenses would be more costly). Without Option 3A costs, the cost of Option 5+3 NSPS is identical to the cost of Option 5 BAT. Since the estimated costs for new sources are the same as the costs to existing facilities, EPA concludes that the proposed NSPS option for these subcategories poses no barriers to entry in the hog, poultry and veal sectors.

EPA also conducted additional analyses that evaluate other scenarios, including the possibility that some new facilities might be sited in hydrologically sensitive areas and may incur higher costs than those assumed in the analysis presented here. This analysis is provided in the rulemaking record (ERG, 2000f—see DCN 70599).

5.3 PROCESSOR IMPACTS

As discussed in Section 4, EPA did not conduct a detailed estimate of the costs and impacts that would accrue to individual co-permittees due to lack of data and market information. However, EPA believes that the framework used to estimate costs to CAFOs provides a means to evaluate the possible upper bound of costs that could accrue to co-permittees, based on the potential share of (pre-tax) costs that may be passed on from the CAFO. EPA is proposing that this amount approximates the magnitude of the costs that may be incurred by processing firms in those industries that may be affected by the proposed co-permitting requirements. More information on this approach is provided in Section 4.2.6.

Table 5-16 presents the results of EPA's analysis. This analysis focuses on the potential magnitude of costs to co-permittees in the pork and poultry sectors only since these are the sectors where the proposed co-permitting requirements are likely to affect processing facilities. However, EPA did not evaluate the potential magnitude of costs to egg and turkey processors because the compliance costs to CAFOs in these industries is projected to be easily absorbed by CAFOs (see Tables 5-8 through 5-10). The results presented in Table 5-16 are for the pork and broiler industries only. EPA also did not evaluate the potential costs to cattle and dairy processors because EPA does not expect that the proposed co-permitting requirements to affect meat packing and processing facilities in these industries, for reasons outlined in Section 2.4 of this report.

The potential magnitude of costs to co-permittees is derived from the amount of cost passthrough assumed in the CAFO level analysis. For this analysis, EPA evaluates two scenarios of cost passthrough to processors: partial cost passthrough (greater than zero) and also 100 percent cost passthrough. EPA's partial cost passthrough scenario assumes that 46 percent of all hog compliance costs and 35 percent of all broiler compliance costs are passed on through the marketing chain. Based on the results of this analysis, EPA estimates that the range of potential annual costs to hog processors is $135 million (partial cost passthrough) to $306 million (full cost passthrough). EPA estimates that the range of potential annual costs to broiler processors as $34 million (partial cost passthrough) to $117 million (full cost passthrough). Table 5-16 presents these results, expressed in 1999 pre-tax dollars. (EPA did not evaluate results for the two-tier structure at 750 AU threshold, but results for this scenario would be lower than those for the two-tier structure at 500 AU threshold.)

To assess the magnitude of impacts that could accrue to processors using this approach, EPA compares the passed through compliance costs to both aggregate processor costs of production and to revenues. Table 5-16 presents the results of this analysis, which are presented

in terms of the assumed costs that are assumed to be passed through, compared to 1997 data from the Department of Commerce on the revenue and costs among processors in the hog and broiler industries. As shown, EPA estimates that, even under full cost passthrough, incremental cost changes are less than two percent, and passed through compliance costs as a share of revenue are less than one percent.

Table 5-16. Estimated Costs and Impact to Broiler and Hog Processors, BAT Option (500 AU Threshold)

Sector	Passed Through Compliance Cost [a/]		1997 Revenues	1997 Delivered Cost [b/]	Passed through Cost-to-Revenues		Passed through Cost-to-Delivered Cost	
	Partial CPT	100% CPT			Partial CPT	100% CPT	Partial CPT	100% CPT
	($1999, million)		($1997, million)		(percent, comparing costs in $1997)			
Hog Processors								
Two-Tier	$135	$294	$38,500	$15,700	0.3%	0.7%	0.8%	1.8%
Three-Tier	$141	$306			0.4%	0.8%	0.9%	1.9%
Broiler Meat Processors								
Two-Tier	$34	$97	$17,700	$9,100	0.2%	0.5%	0.4%	1.0%
Three-Tier	$41	$117			0.2%	0.6%	0.4%	1.2%

Source: USDC, 1999a and USEPA.

[a/]Compliance costs that are estimated to be passed through from the CAFO to the processors using a mid-range CPT of 46 percent for the hog sector and 35 percent for the broiler sector (see Section 4.2.6).

[b/]Delivered costs include all raw materials put into production during the year.

5.4 MARKET IMPACTS

EPA's market model analysis predicts the effects of the proposed CAFO regulations on national markets in terms of the broader market changes that may result due to compliance with requirements. This analysis examines changes throughout the economy as impacts are absorbed at various stages of the food marketing chain. EPA measures impacts in terms of changes in consumer and farm level price and quantity as predicted by EPA's market model (Section 5.4.1), changes in national employment and economic output based on estimated reductions in market value, as predicted by the market model (Sections 5.4.2 and 5.4.3), and also other potential market changes, including an evaluation of regional impacts and changes in U.S. trade (Section 5.4.4). EPA's model measures impacts to economic activities in the livestock and poultry sectors (direct), economic activity in industries that provide good and services to livestock and poultry producers (indirect impacts) and activities associated with expenditures of income earned in direct and indirect activities (induced effects). The framework for this analysis is described in Section 4.4 of this report.

The following sections present a summary of the key results of EPA's market model and present predicted changes in farm and retail prices, quantities, national and regional employment, and national economic output. Results are shown for the two-tier (500 AU threshold) and three-tier (Scenario 3) structures, along with the results for alternative ELG options considered by EPA during the development of this rulemaking (expressed across a range). EPA did not evaluate market impacts under the two-tier structure at the 750 AU threshold, but impacts under this alternative should be less than those at the 500 AU threshold.

Appendix D provides results of sensitivity analyses, conducted by EPA, to examine the impact under differing model assumptions. EPA examined variations in the price elasticities and prices assumed for these industries, based on information reported in the agricultural literature and statistical compendiums. These sensitivity analyses demonstrate that the results presented here are stable across a range of possible modeling assumptions.

5.4.1 Changes in Commodity Price and Quantity Production

Tables 5-17 and 5-18 show predicted farm and retail price changes, as compared to pre-regulation baseline price levels. Results across alternative NPDES scenarios are provided in the record and are not presented here since they do not differ substantially from the results presented for each co-proposed alternative. For comparison purposes, the average annual percentage change in price from 1990 to 1998 is provided.

EPA expects that predicted changes in animal production may raise producer prices, as the market adjusts to the proposed regulatory requirements. For most sectors, EPA estimates that producer price changes will rise by less than one percent of the pre-regulation baseline price (Table 5-17). The exception is in the hog sector, where estimated compliance costs slightly exceed one percent of the baseline price. Predicted farm level price changes are modest when compared to the historical year-to-year changes attributable to weather, feed costs, and other factors.

At the retail level, EPA expects that the proposed regulations will not have a substantial impact on overall production or consumer prices for value-added meat, eggs, and fluid milk and dairy products. EPA estimates that retail price increases resulting from the proposed regulations will be under one percent of baseline prices in all sectors, averaging below the rate of general price inflation for all foods (Table 5-18). In terms of retail level price changes, EPA estimates that poultry and red meat prices will rise about one cent per pound. EPA also estimates that egg prices will rise by about one cent per dozen and that milk prices will rise by about one cent per gallon. Results of this analysis do not differ substantially across the range of alternative ELG options (Tables 5-17 and 5-18).

Table 5-19 summarizes the forecast reductions in farm level production, following a shift in the supply curve under post-compliance. As shown, predicted quantity reductions are under one-half of one percent of pre-regulation production levels for all sectors. Other than export and

import changes, quantity changes at the retail level (not shown) are expected to be directly proportional to changes at the farm level because the model assumes a fixed proportions production process. Results of this analysis do not differ substantially across the range of alternative ELG options (Table 5-23). EPA uses these estimated production changes, multiplied by the appropriate per-unit market price, to compute the overall change in market value associated with complying with the proposed CAFO regulations. EPA uses these derived values as inputs to its input-output analysis framework and allows EPA to compute changes in employment and economic output under post-compliance.

Table 5-17. Post-Compliance Farm Level Price Changes, Selected Regulatory Alternatives

Option	Beef	Dairy	Hogs	Broilers	Layers	Turkeys
	($/cwt)			(cents/lb.)	(cents/doz.)	(cents/lb.)
Pre-reg. Avg. Price (1997)	66.09	13.38	54.30	37.00	69.80	40.10
Price Increases						
Two-Tier Structure (500 AU Threshold)						
BAT Option	0.21	0.06	0.59	0.19	0.13	0.12
Range of Alt. Options	0.08-0.80	0.03-0.07	0.26-0.59	0.17-0.31	0.11-0.23	0.08-0.18
Three-Tier Structure						
BAT Option	0.23	0.08	0.63	0.22	0.14	0.16
Range of Alt. Options	0.08-0.82	0.04-0.10	0.25-0.63	0.19-0.40	0.11-0.26	0.09-0.25
Percent Change						
Avg. Annual Change (%) (1990-1998)	4.60	8.00	15.20	5.70	11.50	4.40
Two-Tier Structure (500 AU Threshold)						
BAT Option	0.30	0.50	1.10	0.50	0.20	0.30
Range of Alt. Options	0.1-1.2	0.2-0.5	0.5-1.1	0.4-0.8	0.2-0.3	0.2-0.4
Three-Tier Structure (500 AU Threshold)						
BAT Option	0.30	0.60	1.20	0.60	0.20	0.40
Range of Alt. Options	0.1-1.2	0.3-0.7	0.5-1.2	0.5-1.1	0.2-0.4	0.2-0.6

Source: USEPA, except historical data (pre-regulatory average price and average annual change data) that are from USDA/ERS, 1999c and 1998b; USDA/WAOB, 1999; and NCBA, 2000.

Table 5-18. Post-Compliance Retail Level Price Changes, Selected Regulatory Alternatives

Option	Beef	Dairy	Hogs	Broilers	Layers	Turkeys
	($/lb.)	(index)	($/lb.)	(cents/lb.)	(cents/doz.)	(cents/lb.)
Pre-reg. Avg. Price (1997)	2.80	145.50	2.45	151.00	106.00	105.10
Price Increases						
Two-Tier Structure (500 AU Threshold)						
BAT Option	0.00	0.61	0.01	0.19	0.13	0.12
Range of Alt. Options	0.00-0.02	0.33-0.68	0.00-0.01	0.17-0.31	0.11-0.23	0.08-0.18
Three-Tier Structure						
BAT Option	0.00	0.78	0.01	0.22	0.14	0.16
Range of Alt. Options	0.00-0.02	0.39-0.97	$0.00-0.01	0.19-0.40	0.11-0.26	0.09-0.25
Percent Change						
Avg. Annual Change (%) (1990-1998)	2.30	2.40	5.10	3.00	7.20	2.40
Two-Tier Structure (500 AU Threshold)						
BAT Option	0.10	0.40	0.30	0.10	0.10	0.10
Range of Alt. Options	0.1-0.6	0.2-0.5	0.2-0.3	0.1-0.2	0.1-0.2	0.1-0.2
Three-Tier Structure						
BAT Option	0.20	0.50	0.40	0.10	0.10	0.20
Range of Alt. Options	0.1-0.6	0.3-0.7	0.1-0.4	0.1-0.3	0.1-0.2	0.1-0.2

Source: USEPA, except historical data (pre-regulatory average price and average annual change data)that are from USDA/ERS, 1999c and 1998b; USDA/WAOB, 1999; and NCBA, 2000.

5.4.2 Changes in Total National Employment

The proposed CAFO regulations are not expected to result in significant changes in aggregate employment (measured in terms of full-time equivalents (FTEs).[8] Losses in employment are associated with decreases in commodity production in response to higher compliance costs (Table 5-19). Predicted changes in aggregate employment are measured in terms of both direct and indirect/induced employment. *Direct* employment measures the number of jobs related to production and processing including workers engaged in the manufacture of agricultural inputs and their suppliers. Other *indirect* or *induced* employment provides a broader measure of industry-related employment and includes workers throughout the economy. More information is provided in Section 4.4.

[8] 1 FTE = 2,080 hours of labor.

Table 5-19. Post-Compliance Farm Production Changes, Selected Regulatory Alternatives

Option	Beef	Dairy	Hogs	Broilers	Layers	Turkeys
	(million pounds)				(mil. doz.)	(mil. lbs.)
Pre-regulatory Quantity	47,967	156,100	23,542	27,551	6,473	5,412
Farm Level Quantity Reduction						
Two-Tier Structure (500 AU Threshold)						
BAT Option	65	193	70	13	1	3
Range of Alt. Options	23 - 244	105 - 217	31 - 70	11 - 21	1 - 1	2 - 5
Three-Tier Structure						
BAT Option	70	248	75	15	1	4
Range of Alt. Options	24 - 250	125 - 308	30 - 75	13 - 27	1 - 2	3 - 7

Source: USEPA, except historical data (pre-regulatory quantity data) that are from USDA/ERS, 1998a, and 1998b; USDA/WAOB, 1999; and Putnam and Allshouse, 1999.

Absorption of compliance costs by the producers and declines in production and trade are expected to result in fewer jobs in the livestock and poultry industries. Tables 5-20 and 5-21 present EPA's estimates of both the direct (i.e., farm and processor level) and total (i.e., national level) employment losses across all sectors. Total direct farm level employment is expected to drop by 2,700 FTEs to 3,000 FTEs, depending on tier structure. These estimates include CAFO owner-operator job losses due to business closure. Farm level employment losses are greatest in the hog sector, coinciding with EPA's estimate that this sector would incur over one-third of estimated total compliance costs (Section 5.1.1). Predicted direct employment losses in the food processing sector constitute a small share of overall employment losses, estimated at less than 500 FTEs under either co-proposed scenario (less than 3 percent), compared to pre-regulatory baseline conditions. Compared to total employment in the farm and processing sectors of these industries (see Section 2.5.3), employment losses are modest.

The remaining approximately 80 percent of predicted job losses are estimated to occur as a result of indirect or induced effects on nationwide employment (Tables 5-20 and 5-21). These additional losses occur outside the affected livestock and poultry sectors and include loses in those industries that support the agricultural community. These predicted job losses are likely to be offset by stimulated employment in other sectors throughout the economy, such as the construction and farm services sectors. Potential offsets in terms of gains in employment to other sectors were not evaluated by EPA.

The total reduction in aggregate national level employment in all sectors of the economy (both direct and indirect employment) is estimated at 16,600 FTEs under the two-tier structure and 18,100 FTEs under the three-tier structure (Tables 5-20 and 5-21). These predicted employment losses represent shifts in employment requirements from one industry to another.

Compared to the 129.6 million people employed in 1997 (Council of Economic Advisers, 2000), this loss is less than one-hundredth of one percent of national level employment. Under the alternative technology options considered by EPA, estimated total employment losses that range from 8,400 FTEs (Option 1/Scenario 4a) to 31,600 FTEs (Option 5/Scenario3), compared to pre-regulatory baseline conditions (Tables 5-20 and 5-21).

Table 5-20. Post-Compliance Total National Employment Changes, Two-Tier Structure (500 AU Threshold)

Option	Beef	Dairy	Hogs	Poultry	Total [a/]
	(FTEs)				
Direct CAFO Level Employment Reductions					
BAT Options	793	492	931	449	2,666
Range of Alt. Options	284 - 2,969	268 - 554	416 - 931	373 - 730	1,358 - 4,816
Direct Wholesale/Processing Employment Reductions					
BAT Options	109	19	250	69	448
Range of Alt. Options	39 - 410	11 - 22	111 - 250	59 - 114	221 - 747
Consumer/Indirect/Induced Employment Reductions					
BAT Options	3,697	2,688	5,195	1,921	13,501
Range of Alt. Options	1,325 - 13,839	1,465 - 3,028	2,322 - 5,195	1,622 - 3,156	6,827 - 23,502
Total Employment Reductions					
BAT Options	4,599	3,200	6,376	2,439	16,615
Range of Alt. Options	1,648 - 17,218	1,744 - 3,604	2,849 - 6,376	2,053 - 4,000	8,406 - 29,066

Source: USEPA's market model results, in conjunction with RIMS II multipliers (USDC, 1997b).
Totals may not add due to rounding and may include double counting since each sector is modeled separately.
Note: Total employment in 1997 was 129.6 million (Council of Economic Advisors, 2000).

5.4.3 Changes in Total National Economic Output

EPA does not expect that the proposed regulations will result in significant changes in aggregate employment or national economic output, measured in terms of Gross Domestic Product (GDP). EPA expects, however, that there will be losses in employment and economic output associated with decreases in animal production due to rising compliance costs. These losses are estimated throughout the entire economy, using available modeling approaches, and are not attributable to the regulated community only. As with estimated employment losses, the estimated changes in economic output do not account for any possible increases in spending in those sectors of the economy supplying the goods and services needed to meet regulatory requirements. Net output losses are expected to be minimal.

Table 5-22 shows EPA's predicted changes in total gross output (not including gains in other sectors) attributable to complying with the proposed regulations. Compared to 1997 baseline levels, EPA estimates reductions in national economic output that range from $1.7 billion to $1.9 billion under the two-tier and three-tier structure, respectively (Table 5-26). This projected change is modest when compared to total GDP, estimated at $8.3 trillion in 1997 (Council of Economic Advisors, 2000). Under the alternative technology options considered by EPA, estimated GDP losses range from $0.8 billion (Option 1/Scenario 4a) to $3.1 billion (Option 5/Scenario3) (if applicable to all sectors), compared to pre-regulatory baseline conditions.

Table 5-21. Post-Compliance Total National Employment Changes, Three-Tier Structure

Option	Beef	Dairy	Hogs	Poultry	Total
	(FTEs)				
Direct CAFO Level Employment Reductions					
BAT Options	850	633	1,005	552	3,040
Range of Alt. Options	294 - 3,045	319 - 784	402 - 1,005	442 - 954	1,462 - 5,235
Direct Wholesale/Processing Employment Reductions					
BAT Options	117	25	269	84	496
Range of Alt. Options	41 - 421	13 - 31	108 - 269	70 -148	231 - 799
Consumer/Indirect/Induced Employment Reductions					
BAT Options	3,963	3,459	5,602	2,329	15,353
Range of Alt. Options	1,370 - 14,195	1,743 - 4,283	2,242 - 5,602	1,903 - 4,071	7,290 - 25,583
Total Employment Reductions					
BAT Options	4,929	4,117	6,876	2,966	18,889
Range of Alt. Options	1,704 - 17,661	2,075 - 5,099	2,752 - 6,876	2,415 - 5,173	8,983 - 31,617

Source: USEPA's market model results, in conjunction with RIMS II multipliers (USDC, 1997b).
Totals may not add due to rounding and may include double counting since each sector is modeled separately.
Note: Total employment in 1997 was 129.6 million (Council of Economic Advisors, 2000).

Table 5-22. Total National Gross Output Reductions, Selected Regulatory Alternatives

Option	Beef	Dairy	Hogs	Poultry	Total
	($1997 million)				
Two-Tier Structure (BAT Option/Scenario 4a)					
BAT Options	458	296	655	242	1,651
Range of Alt. Options	164 - 1,715	161 - 333	293 - 655	204 - 397	832 - 2,893
Three-Tier Structure (BAT Option/Scenario 3)					
BAT Options	491	381	707	295	1,874
Range of Alt. Options	170 - 1,760	192 - 472	283 - 707	240 - 513	888 - 3,141

Source: USEPA's market model results, in conjunction with RIMS II multipliers (USDC, 1997b).
Totals may not add due to rounding and may include double counting since each sector is modeled separately.
Note: U.S. Gross Domestic Product in 1997 was $8,300.8 billion (Council of Economic Advisors, 2000).

5.4.4 Other Market Impacts

This section presents the results of EPA's analyses to examine other market effects that may occur as a result of the proposed CAFO regulations. Estimated impacts include changes in regional level employment (used as a measure to evaluate community level impacts) and also changes in international trade (evaluated in terms of U.S. import and export volumes).

5.4.4.1 Regional Employment

For this analysis, EPA examines the potential impacts to the agricultural community by assessing whether the proposed CAFO regulations could have community or regional level impacts, particularly in the agricultural sectors. Such impacts could alter the competitive position of livestock and poultry production across the nation or lead to growth or reductions in farm production (in- or out-migration) in different regions and communities. Ongoing structural and technological change in these industries has influenced where farmers operate and has contributed to locational shifts between the more traditional production regions and the emerging, nontraditional regions. Production is growing rapidly in the non-traditional regions due to competitive pressures from more specialized, lower cost producers. This is especially true in hog and dairy production (El-Osta and Johnson, 1998; McBride, 1999; Iowa State University, 1998; Martinez, 1999).

EPA does not expect that the proposed CAFO regulations would have a significant impact on where animals are raised. On the one hand, on-site improvements in waste management and disposal, as required by this regulation, could accelerate recent shifts in production to more

nontraditional regions (such as the South and Pacific and parts of the Southeast) as higher-cost producers in some regions exit the market to avoid relatively higher retrofitting costs of existing facilities. On the other hand, the proposed regulations may favor more traditional production systems where operators grow both livestock and crops, since these operations tend to have available cropland for land application of manure nutrients. These types of operations tend to be more diverse and generally smaller in size. Long-standing farm services and input supply industries in these more traditional areas (such as the Midwest and Mid-Atlantic) could likewise benefit from the proposed CAFO regulations given the need to support on-site improvements in manure management and disposal. Local and regional governments, and other nonfarm enterprises, could also benefit.

The market model is national in scope and cannot address specific subregions. For this analysis, EPA approximates changes in regional employment by disaggregating the national employment reductions (both direct and indirect) to indicate regions where impacts of the proposed CAFO regulations are most likely to occur. For each animal sector, EPA distributes the national direct employment impacts at the CAFO and processor/wholesale level onto a regional basis using state level data that reflect livestock and poultry production by the largest facilities in each state. These data include the 1997 Census (USDA/NASS, 1999a) and other USDA data (USDA/NASS, 1998b), with imputed values for omitted USDA data (Westat, 2000). EPA allocates total national indirect and induced employment changes onto a regional basis according to each state's share of 1997 total U.S. population as reported for 1997 from U.S. Census data (U.S. Census Bureau, 1999). The direct and indirect/induced results are summed to show the total impact for each state. EPA evaluates regional impacts from these state level estimates, aggregated to USDA's farm producing regions, shown in Figure 4-1.

Table 5-23 breaks out the estimated regional employment impacts between direct (farm and processing level) and indirect/induced (other economy-wide) job losses. As shown, EPA estimates direct employment losses to be greatest in the Midwest region given the sheer volume of animal production in the region, which includes the Dakotas, Nebraska, and Kansas as well as the Corn Belt and Lake states. In the Midwest region, estimated direct job loses range from 1,300 to or 1,400 jobs, depending on tier structure, which is about one-half of the direct job losses estimated nationwide following compliance with the proposed regulations. Estimated job losses include CAFO owner-operator job losses due to business closure. Including the estimated indirect and induced employment impacts, overall job losses are more evenly distributed among the regions and are greatest in the Mid-Atlantic, which covers areas with both high consumer populations and concentrated hog and poultry operations in North Carolina, Virginia, and the Delmarva Peninsula. Based on these results, EPA concludes that more traditional agricultural regions would not be disproportionately affected by the proposed CAFO regulations.

5.4.4.2 International Trade

As part of its market analysis, EPA evaluates the potential for changes in U.S. trade (imports, exports) of meat, eggs, and dairy products. Foreign trade impacts are difficult to predict, since exports are determined by economic conditions in foreign markets and changes in

the international exchange rate for the U.S. dollar that cannot be incorporated into a simple market model. Nevertheless, predicted higher prices could attract more imports and discourage exports with the net effect of the proposed regulations resulting in an increase in U.S. imports and a corresponding decrease in U.S. exports of meat, eggs, and dairy products.

Table 5-23. Regional Distribution of Predicted National Employment Reductions

Region [a/]	Agricultural Sectors Direct	Indirect/ Induced	Total	Percent of Labor Force
	(FTEs)			
Two-Tier Structure (BAT Option/Scenario 4a)				
Pacific	346	2,160	2,506	0.012%
Central	690	1,976	2,666	0.013%
Midwest	1,289	3,157	4,446	0.013%
South	323	2,011	2,334	0.012%
Mid-Atlantic	466	4,196	4,662	0.011%
Total	**3,114**	**13,501**	**16,614**	**0.012%**
Three-Tier Structure (BAT Option/Scenario 3)				
Pacific	432	2,457	2,888	0.013%
Central	779	2,247	3,026	0.015%
Midwest	1,405	3,590	4,995	0.015%
South	390	2,287	2,677	0.014%
Mid-Atlantic	530	4,771	5,302	0.013%
Total	**3,536**	**15,353**	**18,888**	**0.014%**

Source: USEPA's market model results, in conjunction with RIMS II multipliers (USDC, 1997b). State level employment data are from the U.S. Census Bureau (1999).
Totals may not add due to rounding and may include double counting since each sector is modeled separately.
[a/]Regions are based on the USDA Farm Production Regions (see Figure 4-1): Pacific=Pacific, Central=Mountain and Southern Plains, Midwest=Corn Belt, Lake States, and Northern Plains, South=Delta and Southeast, Mid-Atlantic=Northeast and Appalachia.

Table 5-24 summarizes the impacts on retail level trade forecast from EPA's market model. The results of this analysis show that U.S. trade will not be significantly impacted by the proposed CAFO regulations. EPA estimates that U.S. imports (exports) will increase (decrease) by less than one percent compared to baseline (pre-regulation) levels in each of the commodity sectors. By sector and by co-proposed alternative, the potential change in imports compared to baseline trade levels ranges from a 0.02 percent increase in broiler imports to a 0.82 percent increase in dairy product imports. The predicted drop in U.S. exports ranges from a 0.01 percent reduction

in turkey exports to a 0.27 percent reduction in hog exports. Baseline information on U.S. imports and exports of livestock and poultry products is presented in Section 2.5.

Table 5-24. Post-Compliance Retail Product Import and Export Changes, Selected Regulatory Alternatives

Option	Beef	Dairy	Hogs	Broilers	Layers	Turkeys
	(percent)					
Percentage Increase in Imports						
Two-Tier Structure (500 AU Threshold)						
BAT Option	0.15	0.64	0.21	0.02	0.12	NA
Range of Alt. Options	0.05 - 0.56	0.35 - 0.72	0.09 - 0.21	0.02 - 0.04	0.09 - 0.20	NA
Three-Tier Structure						
BAT Option	0.16	0.82	0.23	0.03	0.13	NA
Range of Alt. Options	0.06 - 0.58	0.41 - 1.01	0.09 - 0.23	0.03 - 0.05	0.10 - 0.23	NA
Percentage Decrease in Exports						
Two-Tier Structure (500 AU Threshold)						
BAT Option	0.09	0.10	0.25	0.05	0.01	0.06
Range of Alt. Options	0.03 - 0.34	0.06 - 0.12	0.11 - 0.25	0.04 - 0.08	0.01 - 0.02	0.04 - 0.09
Three-Tier Structure						
BAT Option	0.10	0.13	0.27	0.06	0.01	0.08
Range of Alt. Options	0.03 - 0.35	0.07 - 0.16	0.11 - 0.27	0.05 - 0.10	0.01 - 0.03	0.05 - 0.13

Source: USEPA, except historical data that are from Putnam and Allshouse, 1999. NA = Not applicable.