APPENDIX A

COST ANNUALIZATION MODEL

This appendix provides an overview of the cost annualization model used by EPA. This model calculates four types of compliance costs for a model CAFO:

- Present value of expenditures—before-tax basis
- Present value of expenditures—after-tax basis
- Annualized cost—before-tax basis
- Annualized cost—after-tax basis

The following sections present the input data and assumptions (Section A.1) and provide details about the workings of the model (Section A.2). All supporting tables are provided at the end of this section.

A.1 INPUT DATA SOURCES

The cost annualization model requires four key data inputs:

- Capital and O&M costs (including startup, recurring, and annual O&M costs)
- Depreciable life of the asset
- Discount rate
- Marginal tax rate

The *capital and O&M* costs that EPA uses in the cost annualization model are developed by the Agency. The capital cost is the initial investment needed to purchase and install the structure; it is a one-time cost. The O&M cost is the annual cost of operating and maintaining the structure. O&M costs can be incurred in the first year (start-up O&M costs), at periodic intervals (recurring O&M costs), or every year of the structure's operation (annual O&M costs).

The *depreciable life of the asset* refers to EPA's assumption of the time period used to depreciate capital improvements that are made because of the proposed CAFO regulations.

EPA's annualization model uses a real *discount rate* of 7 percent, as recommended by the Office of Management and Budget (OMB) (OMB, 1992). EPA assumes this input to be a real interest rate, and therefore it is not adjusted for inflation.

The *marginal tax rate* (used to compute the tax shield) depends on the amount of taxable earnings (estimated as net cash income minus depreciation plus value of inventory) at the model CAFO. Inputs to the cost annualization model to calculate an average operation's tax shield include both federal and state tax rates.

Additional information about compliance cost estimates and development of the model CAFOs is provided in Section 2.2 of this report. Detailed information about the costs used as inputs to the annualization model is provided in the *Development Document* (USEPA, 2002). Section A.1.1 presents the tax rates EPA assumes; Section A.1.2 discusses the depreciation method in more detail.

A.1.1 Marginal Tax Rate

EPA conducts its financial analysis at the CAFO level using representative average models. The cost annualization model uses both federal and state tax rates as inputs to calculate an average operation's tax shield (see Table A-3 for sample worksheet). For this analysis, EPA uses federal and state corporate income tax rates because it is not possible to definitively identify whether CAFOs represented by each model pay taxes at the corporate or the individual rate.

Table A-1 lists the range of federal tax rates that EPA assumes for this analysis and attributes to model CAFOs based on estimated taxable earnings. As shown, federal tax rates range from 15 percent to 34 percent, depending on the amount of taxable income at a facility (CCH, 1999b). As an example, using these rates, model CAFOs with earnings greater than or equal to $335,000 would be assigned the federal tax rate of 34 percent; model CAFOs with earnings greater than or equal to $100,000 but less than $335,000 would be assigned a tax rate of 28.3 percent.

Table A-1 (provided at the end of this section) lists each state's top corporate tax rates and rates on individual income (CCH, 1999a, 1995). The cost annualization model refers to reported average state tax rates; however, because of the uncertainty over which state tax rate to apply to a given model CAFO, EPA uses the national average across all states. Table A-1 lists the national average values EPA assumes for this analysis (CCH, 1999a, 1995). As shown, the average national rates are 6.6 percent (corporate income) and 5.8 percent (personal income). EPA uses the higher corporate income tax rate for this analysis.

The cost annualization model can incorporate variable tax rates according to the level of income to address differences between small and large model CAFOs. For example, a large model CAFO might have a combined tax rate of 40.6 percent (34 percent federal rate plus 6.6 percent state rate). After tax shields, this model CAFO would pay 59.4 cents for every dollar of incremental animal waste management costs. A small model CAFO might be in the 21.6 percent tax rate (15 percent federal rate plus 6.6 percent state rate). After tax shields, the small model CAFO would pay 78.4 cents for every dollar of incremental animal waste management costs. For the DCF analysis, EPA uses the net present value of after-tax cost because it reflects the impact the business would actually see in its net income. [1]

[1]The cost annualization model does not consider tax shields on interest paid to finance animal waste management investments. The cost annualization model assumes a cost to the operation to use the money (the discount/interest rate), whether the money is paid as interest or is the opportunity cost of internal funding. Tax shields on interest payments are not included in the cost annualization model because it is not known what mix of debt and capital an operation will use to finance the cost of incremental animal waste management investments and to maintain a conservative estimate of the after-tax annualized cost.

A.1.2 Depreciation Method

After examining three alternatives to depreciate capital investments, including Modified Accelerated Cost Recovery System (MACRS) , straight-line depreciation, and section 179 of the Internal Revenue Code, EPA chose to use the MACRS. MACRS allows businesses to depreciate a higher percentage of an investment in the early years and a lower percentage in the later years. In contrast, straight-line depreciation writes off a constant percentage of the investment each year. MACRS offers companies a financial advantage over the straight-line method because a model CAFO's taxable income may be reduced under MACRS by a greater amount in the early years when the time value of money is greater. EPA also considered using the Internal Revenue Code section 179 provision to elect to expense up to $17,500 in the year the investment is placed in service, assuming that the investment costs do not exceed $200,000 (IRS, 1999a). EPA assumes, however, that this provision is already applied to other investments at the CAFO.

To determine the recovery period of depreciable property, IRS identifies asset classes based on the activity in which the property is being used. If no activity matches the use, IRS provides classes for specific depreciable assets that are used across multiple business activities such as office furniture, information systems, and automobiles. Under MACRS, the cost of property is recovered over a set period. The recovery period is based on the property class to which your property is assigned. If the property of interest is not identified by the IRS, it usually has a recovery period of 7 years (IRS, 1999b).

The capital costs required by this regulation fall across three IRS asset classes: land improvements (15-year recovery period), agriculture (7-year recovery period), and single-purpose agricultural or horticultural structures (10-year recovery period). Table A-2 (also provided at the end of this section) presents these IRS asset classes as well as the capital costs associated with them. EPA has identified the appropriate class for each type of cost and has judged that a 10-year time frame is appropriate for this analysis for the following reasons:

- A 10-year depreciation time frame is consistent with the 10-year property classification of a single-purpose livestock structure, which is defined under section(i)(13)(B) as any enclosure or structure specifically designed, constructed and used for housing, raising, and feeding a particular kind of livestock, including their produce, or for housing the equipment necessary for the housing, rasing, and feeding of livestock (IRS, 1999a).

- A 10-year depreciation time frame is a fairly conservative assumption considering that some assets, such as land improvements, have a longer 15-year time frame whereas others, such as agricultural equipment, have a shorter 7-year time frame.

- This assumption provides a uniform time frame for use in the annualization model and prevents the use of separate annualization calculations for individual capital costs.

- A 10-year time frame is consistent with the practice of cost-share programs, which typically organize contracts over 5- to 10-year periods.

EPA conducted initial sensitivity analyses of the annualization model using initial cost estimates and determined that the differences between using a 7-, 10-, or 15-year time frame for depreciation did not result in large changes in annualized costs.

A.2 SAMPLE COST ANNUALIZATION SPREADSHEET

Table A-3 shows a sample cost annualization worksheet. The top of the spreadsheet shows the data inputs described in Section A.1. The spreadsheet contains numbered columns that calculate the before- and after-tax annualized cost of the investment to the CAFO. Column 1 of Table A-3 lists each year of the investment's life span, from its installation through its 10-year depreciable lifetime (shown over years 1 through 11, because a mid-year convention is used).

Column 2 of Table A-3 represents the percentage of the capital costs that can be written off or depreciated each year. These rates are based on the MACRS and are taken from the *2000 U.S. Master Tax Guide* (CCH, 1999b). Multiplying these depreciation rates by the capital cost gives the annual amount the model CAFO may depreciate, which is listed in Column 3. EPA uses depreciation expense to offset annual income for tax purposes; Column 4 shows the tax shield provided from the depreciation expense—the overall tax rate times the depreciation amount for the year.

Column 5 of Table A-3 is the annual O&M expense. Because of the mid-year convention assumption for depreciation, Year 1 and Year 11 show only 6 months of annual O&M costs. Year 1 O&M also includes the startup O&M cost. Years 2 through 10 include annual O&M plus recurring O&M costs for every third and fifth year. Column 6 is the tax shield or benefit provided from expensing the O&M costs.

Columns 7 and 8 represent any negative costs that should be evaluated when considering compliance costs for model CAFOs. This example includes a scenario where EPA considers payments from Federal, State, or local cost-share programs as well as other offsets measured in terms of cost savings from use of manure as a fertilizer substitute. (These two examples are shown for illustrative purposes only and do not necessarily reflect assumptions for EPA's final analysis.)

Column 9 lists a model CAFO's annual cash outflow, or total expenses, associated with the additional animal waste management, under the analysis assumptions presented here. Total expenses include capital costs, assumed to be incurred during the first year when the structure is installed, plus each year's O&M expense.

Column 10 lists the annual cash outflow less the tax shields from the O&M expenses and depreciation; a model CAFO will recover these costs in the form of reduced income taxes. The sum of the 11 years of after-tax expenses is $106,546 (1997 dollars). The equation EPA uses to calculate the present value of cash flow is :

$$NPV = v1 + \sum_{i=2}^{n} \frac{v_i}{(1+r)^{i-1}}$$

where:

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

EPA uses the present value of the after-tax cash outflow in the CAFO level impact analysis to calculate the post-regulatory present value of future earnings for a model CAFO.

EPA transforms the present value of the cash outflow into a constant annual payment for use as the annualized model CAFO's compliance cost. Column 9 calculates the annualized cost as a 10-year annuity that has the same present value as the total cash outflow. The annualized cost represents the annual payment required to finance the cash outflow after tax shields. In essence, paying the annualized cost each year and paying the amounts listed in Column 8 for each year are equivalent. EPA calculates the annualized cost as follows (where *n* is the number of payment periods):

$$\text{Annualized Cost} = \text{present value of cash outflows} * \frac{\text{real discount rate}}{1 - (\text{real discount rate} + 1)^{-n}}$$

In the example used in Table A-3 (provided at the end of this section), based on the capital investment of $100,000, start-up O&M costs of $1,000, 3-year recurring O&M costs of $500, 5-year recurring O&M costs of $1,500, annual O&M costs of $10,000 per year, a tax rate of 40.6 percent, and a real discount rate of 7 percent, the model CAFO's annualized cost is $20,591 on a pre-tax basis and $12,729 on a post-tax basis.[2]

EPA uses the pre-tax annualized cost to calculate the total social cost of the regulation (presented in Section 10). This approach incorporates the cost to industry for the purchase, installation, and operation of additional animal waste management structures, as well as the cost to Federal and State government from lost tax revenues. (Every tax dollar that a business does not pay due to a tax shield is a tax dollar lost to the government.)

EPA uses the post-tax annualized cost to reflect what a business actually pays to comply with incremental animal waste management requirements. The post-tax present value of incremental animal waste management expenditures is used in the CAFO level impact analysis.

Appendix B of this report shows post-tax annualized costs to regulated CAFOs to comply with the proposed revisions to the CAFO regulations. Annualized costs are shown in 1997 dollars and are expressed on a per-facility and a per-animal (inventory) basis. Costs are shown for the BAT option only.

[2] There are two ways to calculate post-tax annualized cost. One is to calculate the annualized cost as the difference between the annuity value of the cash flows (Column 9) and the tax shields (Columns 4 and 6). The second is to calculate the annuity value of the cash flows after tax shields (Column 10). Both methods yield the same result.

Table A-1. State Income Tax Rates

State	Corporate Income Tax Rate	Basis for States With Graduated Tax Tables	Personal Income Tax Upper Rate	Basis for States With Graduated Tax Tables
Alabama	5.00%		5.00%	$3,000+
Alaska	9.40	$90,000+	0.00%	
Arizona	9.00%		6.90%	$150,000+
Arkansas	6.50%	$100,000+	7.00%	$25,000+
California	9.30%		11.00%	$215,000+
Colorado	5.00%		5.00%	
Connecticut	11.50%		4.50%	
Delaware	8.70%		7.70%	$40,000+
Florida	5.50%		0.00%	
Georgia	6.00%		6.00%	$7,000+
Hawaii	6.40%	$100,000+	10.00%	$21,000+
Idaho	8.00%		8.20%	$20,000+
Illinois	4.80%		3.00%	
Indiana	3.40%		3.40%	
Iowa	12.00%	$250,000+	9.98%	$47,000+
Kansas	4.00%	$50,000+	7.75%	$30,000+
Kentucky	8.25%	$250,000+	6.00%	$8,000+
Louisiana	8.00%	$200,000+	6.00%	$50,000+
Maine	8.93%	$250,000+	8.50%	$33,000+
Maryland	7.00%		6.00%	$100,000+
Massachusetts	9.50%		5.95%	
Michigan	2.30%		4.40%	
Minnesota	9.80%		8.50%	$50,000+
Mississippi	5.00%	$10,000+	5.00%	$10,000+
Missouri	6.25%		6.00%	$9,000+
Montana	6.75%		11.00%	$63,000+
Nebraska	7.81%	$50,000+	6.99%	$27,000+
Nevada	0.00%		0.00%	

Table A-1. State Income Tax Rates

State	Corporate Income Tax Rate	Basis for States With Graduated Tax Tables	Personal Income Tax Upper Rate	Basis for States With Graduated Tax Tables
New Hampshire	7.00%		0.00%	
New Jersey	7.25%		6.65%	$75,000+
New Mexico	7.60%	$1 Million+	8.50%	$42,000+
New York	9.00%		7.88%	$13,000+
North Carolina	7.75%		7.75%	$60,000+
North Dakota	10.50%	$50,000+	12.00%	$50,000+
Ohio	8.90%	Based on stock value	7.50%	$200,000+
Oklahoma	6.00%		7.00%	$10,000+
Oregon	6.60%		9.00%	$5,000+
Pennsylvania	9.90%	1997 and thereafter	2.80%	
Rhode Island	9.00%		10.40%	$250,000+
South Carolina	5.00%		7.00%	$11,000+
South Dakota	0.00%		0.00%	
Tennessee	6.00%		0.00%	
Texas	0.00%		0.00%	
Utah	5.00%		7.20%	$4,000+
Vermont	8.25%	$250,000+	9.45%	$250,000+
Virginia	6.00%		5.75%	$17,000+
Washington	0.00%		0.00%	
West Virginia	9.00%		6.50%	$60,000+
Wisconsin	7.90%		6.93%	$20,000+
Wyoming	0.00%		0.00%	
Average:	6.61%		5.84%	

Source: CCH, 1999a, 1995.

Basis for rates is reported to nearest $1,000. Personal income tax rates for Rhode Island and Vermont based on federal tax (not taxable income). Tax rates given here are equivalents for highest personal federal tax rate.

Table A-2. IRS Asset Class Lives and Recovery Periods for the Annualization of Capital Costs

Asset Class	Description of Assets Included	Recovery Period (in years)		Sample Capital Costs (Beef/Dairy Facilities)	Sample Capital Costs (Beef/Dairy Facilities)
		Class Life	MACRS		
00.3	**Land Improvements:** Includes improvements directly to or added to land, whether such improvements are section 1245 property[a] or section 1250 property[b], provided such improvements are depreciable. Examples of such assets might include sidewalks, roads, canals, waterways, drainage facilities, sewers (not including municipal sewers in Class 51), wharves and docks, bridges, fences, landscaping shrubbery, or radio and television transmitting towers. Does not include land improvements that are explicitly included in any other class, and buildings and structural components as defined in section 1.48-1(e) of the regulations. Excludes public utility initial clearing and grading land improvements as specified in Rev. Rul. 72-403, 1972-2 C.B. 102.	20	15	- Earthen settling basin - Concrete settling basin - Storage pond ("regular" and clay-lined) - Vegetated filter strip (including wastewater distribution system) - Concrete pad to store dry manure	- Trenching to divert storm water around structures - Lagoon liner - Groundwater monitoring well
01.1	**Agriculture:** Includes machinery and equipment, grain bins, and fences (but no other land improvements), that are used in the production of crops or plants, vines, and trees; livestock; the operation of farm dairies, nurseries, greenhouses, sod farms, mushroom cellars, cranberry bogs, apiaries, and fur farms; and the performance of agriculture, animal husbandry, and horticultural services.	10	7	- Windrow turning equipment (composting) - Long-stem dial thermometer (composting) - Lagoon marker - Scale for manure spreader calibration - Irrigation center pivot device - Truck (solid waste/ slurry waste transport options)	- Soil auger/sampler - Manure sampler - Scale for manure spreader calibration - Lagoon marker - Disk harrow for surface incorporation - Manure injector - Center pivot for irrigation - Truck to transport manure - Storage for poultry litter
01.4	**Single -purpose agricultural or horticultural structures (within the meaning of section 168(l)(13) of the code)**	15	10		- Mortality composting facility

Source: IRS, 1999b. [a/] Section 1245 property: Property that is or has been subject to an allowance for depreciation or amortization. Section 1245 property includes personal property, single-purpose agricultural and horticultural structures, storage facilities used in connection with the distribution of petroleum or primary products of petroleum, and railroad grading or tunnel bores. [b/] Section 1250 property: Real property (other than section 1245 property) that is or has been subject to an allowance for depreciation.

Table A-3. Cost Annualization Model Inputs

Initial capital cost	$100,000	
Annual O&M Cost	$10,000	
Startup O&M Cost	$1,000	
Recurring O&M Cost	$500 (3 year)	$1,500 (5-yr)
Real discount rate	7.0%	
Taxable income	$400,000	
Marginal income tax rate		
Federal	34.0%	
State	6.6%	
Combined	40.6%	

Federal Corp. Tax Table:

If Taxable Earnings			then tax rate is:	Average Effective Tax Rate
>= $0	and	< $50,000	→	15.0%
>= $50,000	and	< $75,000	→	16.7%
>= $75,000	and	< $100,000	→	20.4%
>= $100,000	and	< $335,000	→	28.3%
>= $335,000			→	34.0%

1 Year	2 Depreciation Rate	3 Depreciation for Year	4 Tax Shield from Dep.	5 O&M Cost	6 O&M Tax Shield	7 Cost-Share	8 Manure Offset	9 Cash	10 Cash After Tax
1	10.00%	$10,000	$3,491	$5,000	$2,095	$0	$0	$106,000	$100,414
2	18.00%	$18,000	$6,284	$10,000	$3,491	$0	$0	$10,000	$225
3	14.40%	$14,400	$5,027	$12,189	$4,255	$0	$0	$12,189	$2,907
4	11.52%	$11,520	$4,022	$10,000	$3,491	$0	$0	$10,000	$2,487
5	9.22%	$9,220	$3,219	$10,180	$3,554	$0	$0	$10,180	$3,407
6	7.37%	$7,370	$2,573	$12,189	$4,255	$0	$0	$12,189	$5,361
7	6.55%	$6,550	$2,287	$10,000	$3,491	$0	$0	$10,000	$4,222
8	6.55%	$6,550	$2,287	$10,000	$3,491	$0	$0	$10,000	$4,222
9	6.56%	$6,560	$2,290	$12,189	$4,255	$0	$0	$12,189	$5,644
10	6.55%	$6,550	$2,287	$10,180	$3,554	$0	$0	$10,180	$4,340
11	3.28%	$3,280	$1,145	$5,000	$1,746	$0	$0	$5,000	$2,109
Sum	100.00%	$100,000	$34,910	$106,927	$37,677	$0	$0	$207,927	$135,340
Present value		$73,443	$25,639	$72,594	$25,669	$0	$0	$166,987	$115,679

	Before Tax	After Tax
Present value of	$166,987	$115,679
annualized cost	$22,269	$15,427

Notes: This spreadsheet assumes that a modified accelerated cost recovery system (MACRS) is used to depreciate capital expenditures. Depreciation rates are from 2000 U.S. Master Tax Guide for 10-year property and mid-year convention (CCH, 1999b).