Chapter B6: Benefits Analysis for the Delaware Estuary

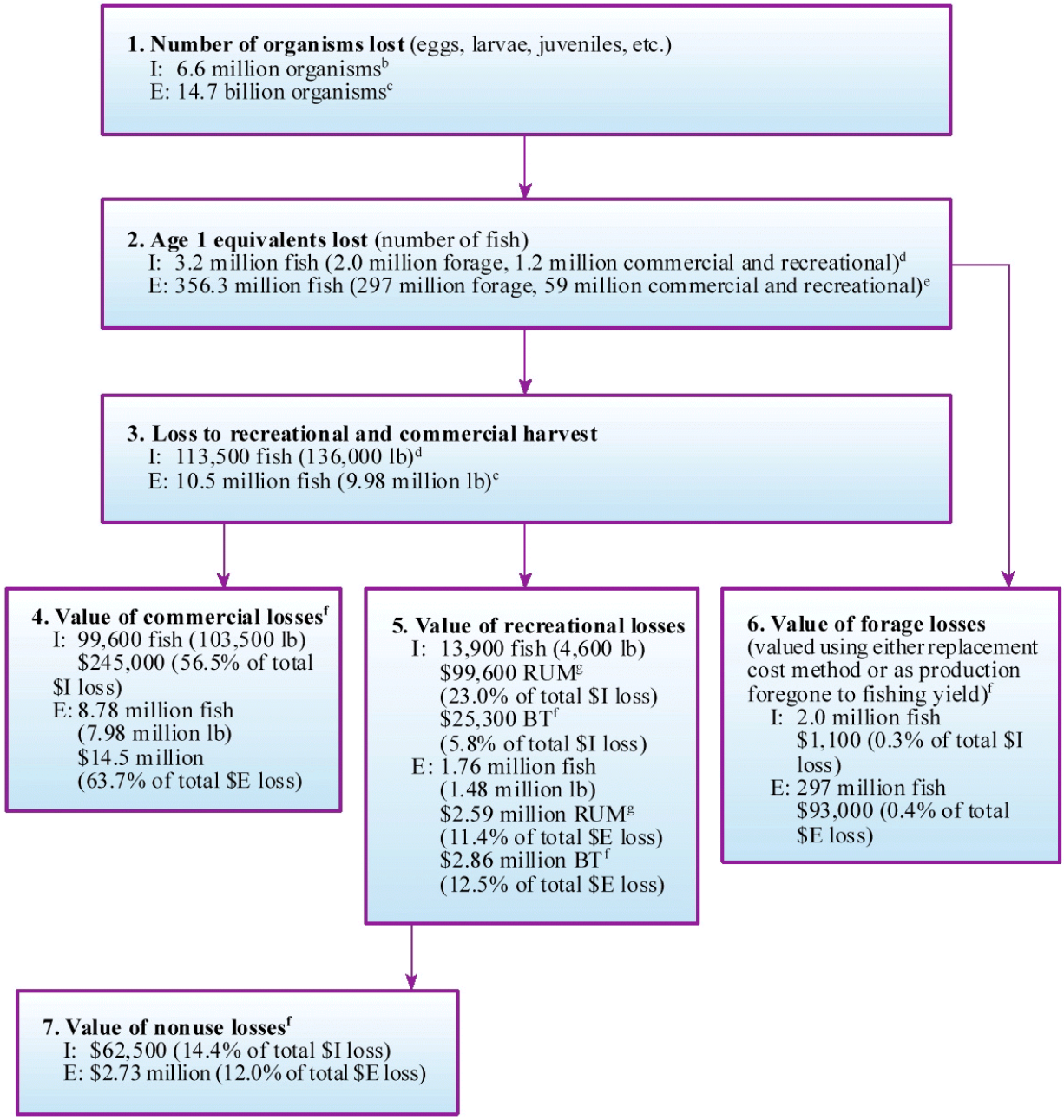
This chapter presents the results of EPA's evaluation of the economic benefits associated with reductions in estimated current I&E at CWIS in the transition zone of the Delaware Estuary. The economic benefits that are reported here are based on the values presented in Chapter B4, and EPA's estimates of current I&E at in-scope facilities (summarized in Section B3-9 of Chapter B3). Sections B6-1 and B6-2 summarize the estimates of economic loss developed in Chapters B4 and B5. Section B6-3 presents the economic benefits of reducing I&E with the proposed rule, and Section B6-4 discusses uncertainties in the analysis.

CHAPTER CONTENTS

B6-1 Summary Figures of Salem's Baseline Losses

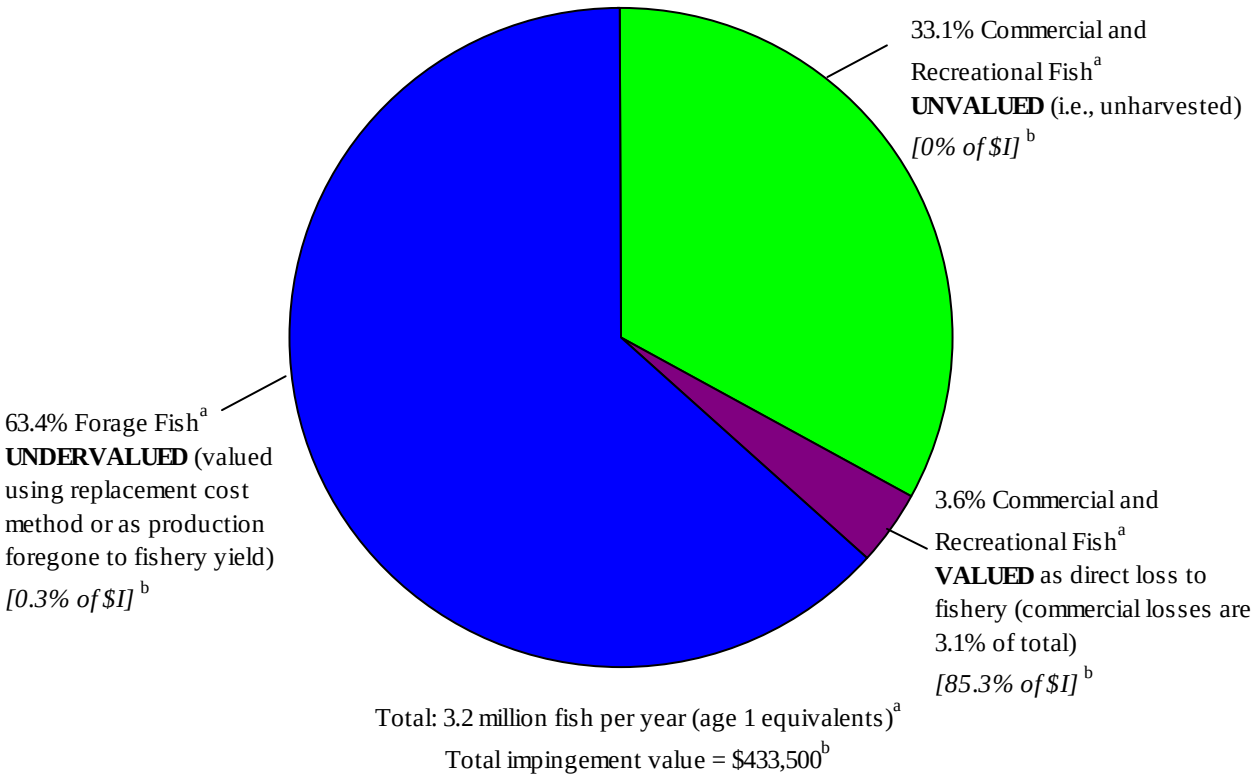
The flowchart in Figure B6-1 summarizes how the economic estimates for the Salem facility were derived from the I&E estimates presented in Chapter B3. Figures B6-2 and B6-3 indicate the distribution of I&E losses by species category and associated economic values. These diagrams reflect the baseline losses based on current technology (including screens). All dollar values (and loss percents) reflect midpoints of the ranges for the categories of commercial, recreational, nonuse, and forage.

Figure B6-1: Overview and Summary of Average Annual I&E at Salem and Associated Economic Values (based on current in-place technologies, e.g., Ristroph screens; all results are annualized)[a]



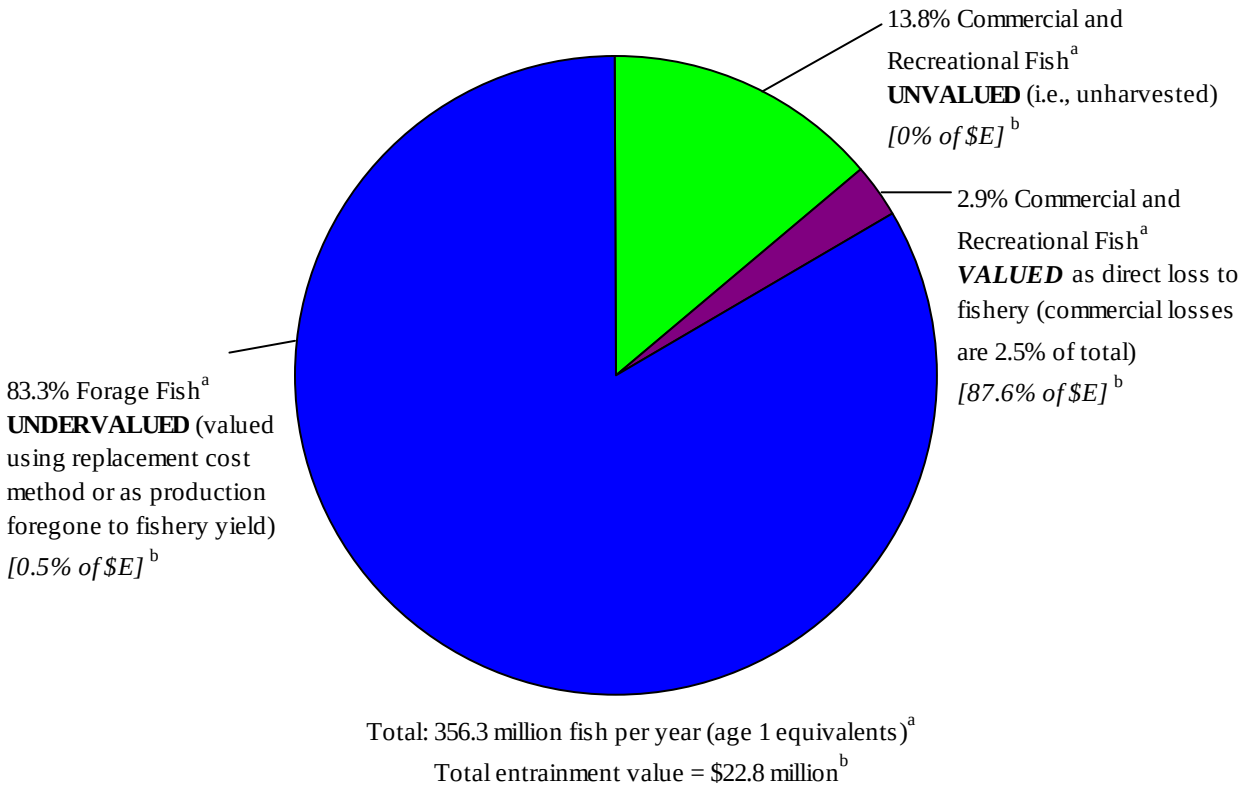
[a] All dollar values are the midpoint of the range of estimates.
[b] From Table B3-21 in Chapter B3.
[c] From Table B3-22 in Chapter B3.
[d] From Tables B4-2 and B4-10 in Chapter B4.
[e] From Tables B4-3 and B4-11 in Chapter B4.
[f] Benefits transfer, Chapter B4.
[g] Random Utility Model, Chapter B5.

Figure B6-2: Salem: Distribution of Impingement Losses by Species Category and Associated Economic Values



[a] Impacts shown are to age 1 equivalent fish, except impacts to the commercially and recreationally harvested fish include impacts for all ages vulnerable to the fishery.
[b] Midpoint of estimated range. Nonuse values are 14.4 percent of total estimated $I loss.

Figure B6-3: Salem: Distribution of Entrainment Losses by Species Category and Associated Economic Values



[a] Impacts shown are to age 1 equivalent fish, except impacts to the commercially and recreationally harvested fish include impacts for all ages vulnerable to the fishery.
[b] Midpoint of estimated range. Nonuse values are 12.0 percent of total estimated $E loss.

Tables B6-1 and B6-2 summarizes losses to commercial and recreational landings due to I&E at CWIS of the Delaware Estuary transition zone.

Tables B6-3 and B6-4 display the economic losses to recreation combining the benefits transfer and RUM analysis methods. For all of the in-scope facilities, the losses range from $173,800 to $219,100 per year for impingement and from $6,069,900 to $10,984,800 per year for entrainment.[1]

[1] The RUM results have been disaggregated between impingement (3.7 percent) and entrainment (96.3 percent) on the basis of their relative impacts on weakfish and striped bass. Although the RUM results are nonlinear with respect to the number of fish impacted, the relatively small amount of impingement effects (relative to those for entrainment) suggests that linearity may be acceptable as a disaggregation approach for the small increment involved.

Table B6-1: EPA's Estimate of Current Average Annual I&E of Commercial Fishery Species at Delaware Transition Zone Facilities Expressed as Lost Commercial Fishery Yield (in pounds). Commercial Yield is a Species-Specific Fraction of Total Yield as Outlined in Table B4-1. I&E Estimates are Discussed in Section B3-6 of Chapter B3.

Species	Salem		In-Scope Facilities (Salem, Hope Creek, Deepwater, Edge Moor)		All Transition Zone Facilities	
	Loss to Commercial Catch from Impingement (lb of fish)	Loss to Commercial Catch from Entrainment (lb of fish)	Loss to Commercial Catch from Impingement (lb of fish)	Loss to Commercial Catch from Entrainment (lb of fish)	Loss to Commercial Catch from Impingement (lb of fish)	Loss to Commercial Catch from Entrainment (lb of fish)
Alewife	19	14	158	22	185	25
American shad	41	7	184	12	215	14
Atlantic croaker	42,478	3,014,877	46,437	4,675,471	54,378	5,475,017
Atlantic menhaden	NA	1,177,437	NA	1,825,969	NA	2,138,225
Blue crab	14,357	0	81,220	0	95,110	0
Silversides	NA	43	NA	67	NA	79
Spot	1,741	2,190,202	33,542	3,396,565	39,278	3,977,407
Striped bass	249	17,468	1,836	27,089	2,150	31,721
Weakfish	30,300	659,380	85,919	1,022,567	100,612	1,197,435
White perch	43	309	433	480	507	562
Non RIS fishery species[a]	14,267	917,552	20,953	1,422,940	24,536	1,666,274
Total	103,495	7,977,290	270,684	12,371,181	316,973	14,486,758

[a] Non-RIS species are listed in Table B3-1.
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Table B6-2: EPA's Estimate of Current Average Annual I&E of Recreational Fishery Species at Delaware Transition Zone Facilities Expressed as Lost Recreational Fishery Yield (number of fish). Recreational Yield is a Species-Specific Fraction of Total Yield as Outlined in Table B4-1. I&E Estimates are Discussed in Section B3-6 of Chapter B3.

Species	Salem		In-scope Facilities (Salem, Hope Creek, Deepwater, Edge Moor)		All Transition Zone Facilities (in-scope and out of scope)	
	Loss to Recreational Catch from Impingement (number of fish)	Loss to Recreational Catch from Entrainment (number of fish)	Loss to Recreational Catch from Impingement (number of fish)	Loss to Recreational Catch from Entrainment (number of fish)	Loss to Recreational Catch from Impingement (number of fish)	Loss to Recreational Catch from Entrainment (number of fish)
American shad	13	2	33	4	42	4
Atlantic croaker	2,806	199,188	3,896	308,915	4,420	361,719
Blue crab	2,131	0	6,413	0	8,473	0
Blueback herring						
Non-RIS fishery species[a]	4,653	299,224	7,080	464,059	8,248	543,383
Spot	922	1,159,488	7,229	1,798,217	10,265	2,105,596
Striped bass	721	50,624	2,611	78,511	3,521	91,931
Weakfish	2,486	54,104	4,990	83,908	6,195	98,250
White perch	134	964	613	1,495	844	1,751
Total	13,865	1,763,594	32,866	2,735,107	42,010	3,202,634

[a] Non-RIS species are listed in Table B3-1.
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Table B6-3: EPA's Estimate of Current Recreational Economic Losses from Impingement at Facilities Located in the Delaware Estuary Transition Zone ($2000).

Species	Salem				In-scope Facilities in the Transition Zone				All Transition Zone Facilities			
	Basic Analysis		Rum Analysis		Basic Analysis		Rum Analysis		Basic Analysis		Rum Analysis	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Striped bass	$2,491	$11,206	$15,424	$15,679	$3,861	$17,369	$23,934	$24,552	$4,524	$20,350	$27,990	$28,727
Weakfish[a]	$2,881	$6,762	$83,961	$84,143	$4,466	$10,481	$132,712	$133,166	$5,232	$12,280	$155,282	$155,918
Other species	$11,045	$39,633	NA	NA	$17,120	$61,431	NA	NA	$20,058	$71,974	NA	NA
Total[b]	$110,430 to $139,455				$173,766 to $219,149				$203,330 to $256,619			

NA = Not Available.
Salem baseline losses stated here will differ slightly from the historical losses reported in Chapter B4 because different years are used in the baseline analysis of current I&E than in the historical analysis.
[a] Weakfish results include RUM results for "no target" anglers because there is virtually no overlap between the catch reported by "no target anglers" and the species included in the "other species" category.
[b] Total are based on summing results of the RUM analysis for weakfish and striped bass with the "other species" results from the basic benefits transfer analysis.

Table B6-4: EPA's Estimate of Current Recreational Economic Losses from Entrainment at Facilities Located in the Delaware Estuary Transition Zone ($2000).

Species	Salem				In-scope Facilities in the Transition Zone				All Transition Zone Facilities			
	Basic Analysis		Rum Analysis		Basic Analysis		Rum Analysis		Basic Analysis		Rum Analysis	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Striped bass	$175,000	$787,199	$401,449	$408,072	$271,250	$1,220,158	$622,938	$639,009	$317,800	$1,429,553	$728,490	$747,674
Weakfish[a]	$62,690	$147,162	$2,185,247	$2,189,985	$97,170	$228,101	$3,454,102	$3,465,921	$113,845	$267,246	$4,041,535	$4,058,084
Other species	$1,285,711	$4,438,627	NA	NA	$1,992,852	$6,879,872	NA	NA	$2,334,851	$8,060,547	NA	NA
Total[b]	$3,872,407 to $7,036,684				$6,069,892 to $10,984,802				$7,104,876 to $12,866,305			

NA = Not Available.
Salem baseline losses stated here will differ slightly from the historical losses reported in Chapter B4 because different years are used in the baseline analysis of current I&E than in the historical analysis.
[a] Weakfish results include RUM results for "no target" anglers because there is virtually no overlap between the catch reported by "no target anglers" and the species included in the "other species" category.
[b] Total are based on summing results of the RUM analysis for weakfish and striped bass with the "other species" results from the basic benefits transfer analysis.

B6-2 Potential Economic Benefits due to Regulation

Table B6-5 summarizes the total annual benefits from I&E reductions, as well as remaining economic losses, under scenarios ranging from 10 percent to 90 percent reductions in I&E. Table B6-6 considers the benefits of two options with varying percent reductions of I&E. Table B6-6 indicates that the benefits are expected to range from $107,000 to $162,000 for a 20 percent reduction in impingement and from $10.2 million to $18.1 million for a 40 percent reduction in entrainment. The benefits of another option range from $320,000 to $487,000 for a 60 percent reduction in impingement and from $15.3 million to $27.2 million for a 60 percent reduction in entrainment.

B6-5: Summary of Current Economic Losses and Benefits of a Range of Potential I&E Reductions at Four In-Scope Facilities on the Delaware Estuary ($2000).

		Impingement	Entrainment	Total
Baseline losses	low	$533,000	$25,493,000	$26,027,000
	high	$812,000	$45,268,000	$46,080,000
Benefits of 10 percent reductions	low	$53,000	$2,549,000	$2,603,000
	high	$81,000	$4,527,000	$4,608,000
Benefits of 20 percent reductions	low	$107,000	$5,099,000	$5,205,000
	high	$162,000	$9,054,000	$9,216,000
Benefits of 30 percent reductions	low	$160,000	$7,648,000	$7,808,000
	high	$243,000	$13,581,000	$13,824,000
Benefits of 40 percent reductions	low	$213,000	$10,197,000	$10,411,000
	high	$325,000	$18,107,000	$18,432,000
Benefits of 50 percent reductions	low	$267,000	$12,747,000	$13,013,000
	high	$406,000	$22,634,000	$23,040,000
Benefits of 60 percent reductions	low	$320,000	$15,296,000	$15,616,000
	high	$487,000	$27,161,000	$27,648,000
Benefits of 70 percent reductions	low	$373,000	$17,845,000	$18,219,000
	high	$568,000	$31,688,000	$32,256,000
Benefits of 80 percent reductions	low	$427,000	$20,395,000	$20,821,000
	high	$649,000	$36,215,000	$36,864,000
Benefits of 90 percent reductions	low	$480,000	$22,944,000	$23,424,000
	high	$730,000	$40,742,000	$41,472,000

Table B6-6: Summary of Benefits of Potential I&E Reductions at Four In Scope Facilities on the Delaware Estuary ($2000).

		Impingement	Entrainment	Total
Option A	low	$107,000	$10,197,000	$10,304,000
(20% reduced impingement, 40% reduced entrainment)	high	$162,000	$18,107,000	$18,269,000
Option B	low	$320,000	$15,296,000	$15,616,000
(60% reduced impingement, 60% reduced entrainment)	high	$487,000	$27,161,000	$27,648,000

B6-3 Summary of Omissions, Biases, and Uncertainties in the Benefits Analysis

Table B6-7 presents an overview of omissions, biases, and uncertainties in the benefits estimates. Factors with a negative impact on the benefits estimate bias the analysis downward, and therefore would raise the final estimate if they were properly accounted.

Table B6-7: Omissions, Biases, and Uncertainties in the Benefits Estimates.

Issue	Impact on Benefits Estimate	Comments
Long-term fish stock affects not considered	Understates benefits[a]	EPA assumed that the effects on stocks are the same each year, and that the higher fish kills would not have cumulatively greater impact.
Effect of interaction with other environmental stressors	Understates benefits[a]	EPA did not analyze how the yearly reductions in fish may make the stock more vulnerable to other environmental stressors. In addition, as water quality improves over time due to other watershed activities, the number of fish impacted by I&E may increase.
Recreation participation is held constant[a]	Understates benefits[a]	Recreational benefits only reflect anticipated increase in value per activity outing; increased levels of participation are omitted. RUM analyses for striped bass and weakfish do embody participation increases, however.
Boating, bird-watching, and other in-stream or near-water activities are omitted[a]	Understates benefits[a]	The only impact to recreation considered is fishing.
Effect of change in stocks on number of landings	Uncertain	EPA assumed a linear stock to harvest relationship, that a 13 percent change in stock would have a 13 percent change in landings; this may be low or high, depending on the condition of the stocks.
Nonuse benefits	Uncertain	EPA assumed that nonuse benefits are 50 percent of recreational angling benefits.
Use of unit values from outside Delaware Estuary	Uncertain	The recreational and commercial values used are from the state and or mid-Atlantic region, but are not from studies of Delaware Estuary specifically.
Extrapolation from Salem to Other Facilities	Uncertain	Unknown whether $/MGD basis for extrapolation over- or understates benefits of other facilities in the estuary.

[a] Benefits would be greater than estimated if this factor were considered.