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PRESIDENT CLINTON'S CLEAN WATER INITIATIVE:

Analysis of Benefits and Costs

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Executive Summary

Introduction

This report summarizes the costs and benefits of provisions contained in President Clinton's Clean Water Initiative. As noted in Executive Orders 12866 and 12893, such comparisons are necessary because resources committed to implement the Initiative can be used for alternative productive purposes. Therefore, the opportunity costs of these resources should be compared with the economic benefits. Such comparisons should be used to help fashion policies that offer the largest possible net benefits.

In addition to estimated costs and benefits, many factors need to be taken into account in supporting an environmental initiative. These include large uncertainties and gaps in estimating benefits and costs, the distribution of benefits and costs among segments of the American people, and support of the public for environmental controls. Regarding these matters, the Administration believes that it is appropriate to be on the side of environmental caution because of the large uncertainty about the effectiveness of proposed controls, and about the benefits and costs generally. The Administration also recognizes the continuing support for the Clean Water Act (CWA) both in Congress and by the general public. Finally, the Administration believes that cleaner water is especially important because it provides benefits that are distributed broadly among all Americans, irrespective of income levels or ethnic background.

The Initiative will require incremental expenditures of $5 to $9.6 billion per year. However, compared with the costs of a stringent interpretation of the current law, the Initiative will yield potential savings (or avoid future costs) of $29 to $33.8 billion.

Approach

Scope. This report presents the costs of the Initiative, measures of physical benefits of the Initiative, and estimates of the costs and monetized benefits of provisions of the Initiative applicable to urban areas only.

Costs are reported in two different ways. First, they are provided by sector: (1) private sources (i.e., industry, commercial and private individuals), (2) agriculture (farmers), (3) municipalities (including operators of public wastewater treatment facilities), (4) state governments, through their water programs, and (5) federal agencies. It is recognized that some of the effects of the Initiative are transfers rather than costs. Second, costs are provided for each major provision of the Initiative. For comparison with monetized benefits in urban areas, incremental costs are also reported for three general provisions: storm water Phase I and II, combined sewer overflow controls, and toxics.

Benefits of the Initiative are reported in physical terms, such as stream miles of improvements. For urban areas only, benefits are reported in monetized terms; we account for

a large variety of benefit categories, the most important being recreational fishing and swimming.

Estimates of the Initiative's impact were developed by the U.S. Environmental Protection Agency (EPA) Office of Water in consultation with EPA's Office of Policy, Planning, and Evaluation and other federal agencies, including the U.S. Department of Agriculture (USDA), U.S. Department of the Interior (DOI), U.S. Department of Commerce (DOC) - National Oceanographic and Atmospheric Administration (NOAA), U.S. Department of Defense (DOD), and U.S. Department of Energy (DOE), as well as with the White House Office of Management and Budget (OMB), Council of Economic Advisers (CEA), and National Economic Council (NEC).

Baseline. Some provisions of the 1987 Clean Water Act Amendments have not yet been implemented. Some provisions of the Initiative will impose new responsibilities and costs beyond those called for in the 1987 Amendments. Others scale back obligations under the Amendments and will save the private sector, municipalities, and the federal government billions of dollars while not compromising environmental quality. Therefore, it is legitimate to view the baseline from which costs of the Initiative are estimated in two ways: as increments above current and pending spending or as reductions in costs from stringent interpretations of the 1987 CWA. The stringent interpretations reflect the reading of the law proposed by various outside groups but do not represent EPA's best interpretation of the law. However, while EPA believes that these interpretations are stringent and inflexible, they could potentially be adopted by a court in litigation challenging EPA's interpretation. This report carefully distinguishes estimates from these two baselines.

Consistency in Benefit and Cost Estimation. To assure that urban area benefits and costs are comparable, a number of steps were taken. The costs and benefits are presented in annualized 1993 dollars. Benefits are discounted using three different discount rates (zero, three, and seven percent), and assuming that they are fully in place in 15 years. This procedure is necessary to account for the fact that benefits or costs experienced later in time are worth less than those experienced sooner. The nature of environmental risks is that it will take time to fully attain many of the projected water quality improvements and economic benefits. Costs are annualized at seven percent.

Uncertainties in Estimating Costs. To account for the uncertainty inherent in estimating costs for various provisions, we have used ranges of likely values where possible. The cost estimates are based on the best available evidence and best professional judgment about the controls likely to be imposed. In some instances, however, these controls may be insufficient to meet either current or future water quality standards, and additional more stringent controls could be adopted. The cost estimates do not include any such additional controls because of the difficulty of estimating their magnitude. To the extent that additional controls are needed to meet water quality standards, there would be additional costs.

Sector-Specific Costs

Table ES-1 presents information on current and planned expenditures associated with the current implementation of the existing CWA requirements. Table ES-2 summarizes the incremental costs of the Initiative. Table ES-3 presents information on the potential cost savings (or costs avoided) compared with a stringent interpretation of CWA requirements. Table ES-4 summarizes the current and potential spending under a stringent interpretation of CWA requirements. The annual cost of major provisions is presented in Figure ES-1.[1] The highlights from the tables are as follows:

- **Private sources** will likely incur incremental costs of $1.6 billion to $3.5 billion per year, but these costs are substantially less than under existing statutory requirements for storm water controls. The major new cost items, as shown in Table ES-2, are the storm water controls ($345 to $1,670 million per year), nonpoint source controls/watersheds ($233 to $388 million), groundwater protection ($150 to $600 million per year) and the permit fee program ($290 million per year). These additional costs are much smaller than the projected $15.7 billion to $17.5 billion in avoided storm water control costs for both Phase I and Phase II (see Table ES-3). These savings represent the projected cost difference between the Initiative and a stringent interpretation of the existing CWA requirements. One area with potentially significant cost implications that is not included in the current estimates is the cost of complying with future water quality standards and toxic pollutant control. These costs are not estimated because of the difficulty in predicting whether and how these provisions will be implemented. Figure ES-2 presents this information graphically.

- **Agriculture** will likely incur incremental costs of $595 to $985 million per year, net of savings from reduced use of fertilizers and pesticides. Farmers will incur these costs to control agricultural runoff by using best management practices on farms that are located on impaired or threatened water bodies. Net increases in costs are shown graphically in Figure ES-4.

- **Municipalities** will likely incur incremental costs of $1.2 billion to $2.1 billion per year, as shown in Table ES-2, but they will realize savings from changes in the storm water provisions. As shown in Table ES-3, the storm water control provisions (Phase I and Phase II) will produce savings of between $0.76 billion and $0.85 billion per year from a stringent interpretation of current CWA requirements. The CSO provisions will codify the final CSO Policy (estimated to cost $3.45 billion annually) and will save municipalities an estimated $10.7 billion per year compared with the projected compliance costs under a stringent interpretation of the current CWA requirements. Total municipal cost savings or

[1] Mid-points of ranges are used in preparing figures. The numbers in figures and tables may not match due to rounding.

costs avoided are estimated at $11.5 billion to $11.6 billion per year. Figure ES-3 presents this information graphically.

- **States** will likely incur incremental costs of $416 million to implement numerous new provisions. The two major cost elements are: $118 million for monitoring and $188 million for NPDES enforcement and permitting. The states will receive about $301 million annually in fees collected from National Pollutant Discharge Elimination System (NPDES) permittees. Thus, the net increase in costs for states is about $115 million per year, most of which is associated with implementing the NPS provisions. See also Figure ES-5 for a graphical presentation.

- **Federal agencies** will incur additional costs of approximately $118 to $210 million to implement and comply with the nonpoint source (NPS) and watershed provisions.[2] The Department of Energy estimated an overall incremental annual cost of $520 million for the Initiative's provisions. Costs for remediating abandoned mines are estimated to be between $330 million and $1,100 million per year. These estimates are presented in Table ES-2. Major savings over current CWA requirements will occur as a result of a more targeted approach to remediation of abandoned mine sites that affect surface water quality. Net impacts on federal agencies are a cost savings of between $1.1 billion and $3.5 billion annually compared with a stringent interpretation of existing law, as shown in Table ES-3. Figure ES-6 presents this information graphically.

Provision-Specific Costs

The impacts of major provisions of the Initiative are summarized below (see also Figure ES-1):

Nonpoint Source Control/Watershed Approach - The implementation of the NPS management programs for both agricultural and non-agricultural (urban) areas will cost private entities and municipalities an estimated $828 million to $1.37 billion per year, net of cost savings from reduced fertilizer and pesticides usage. States will oversee the development of NPS programs at a cost of $92 million per year. Federal agency costs, meanwhile, are estimated to be between $118 million and $210 million per year. Figure ES-4 presents information separately for agriculture.

Storm Water - EPA estimates that the control of storm water discharges, under a stringent interpretation of the 1987 CWA, would impose large costs on private sources

[2] USDA's Soil Conservation Service has indicated that if implementation is their responsibility, the cost would range between $211 and $540 million per year to assist the farmers with implementing NPS control measures. Also excluded are permitting costs that the Forest Service has estimated to apply to federal lands ($716 to $718 million) under a provision of S. 1114 that required reissuance of all Forest Service permits on an accelerated basis. Under the Initiative, permits would be reissued on existing schedules and therefore not result in a significant cost increase.

(approximately $20.2 billion) and municipalities (between $3.4 and $5.3 billion), as shown in Table ES-4. The Initiative presents a more targeted storm water plan that, compared with the stringent plan, would save private sources between $15.7 billion and $17.5 billion per year and would save municipalities an estimated $0.76 billion to $0.85 billion per year for both Phase I and Phase II. The total projected impacts of the storm water provisions, therefore, are savings in the range of $16.5 billion to $18.4 billion per year.

CSOs - The current CSO Policy, negotiated with the municipalities, environmental groups and states, is estimated to cost about $3.45 billion per year. Full implementation of the CSO requirements, under a stringent interpretation of the CWA, could cost as much as $14.14 billion. The Initiative is proposing to codify the more cost-effective, site-specific CSO control strategy that could potentially save municipalities about $10.7 billion per year in avoided costs.

Toxics Control - Under the Initiative's toxics provision, EPA would have additional opportunity to limit releases of the most toxic and bioaccumulative pollutants in certain circumstances. The Initiative would also refocus the development of water quality criteria and standards. The Administration's approach would encourage examining multi-media strategies to restrict or ban the discharge of toxic pollutants, which would allow the Agency the flexibility to select the most cost-effective controls. The toxics provision is estimated to cost Federal agencies, including EPA, between $66 million and $105 million per year.

Discharge Fees - The Initiative would require states (and EPA, in states administered by EPA) to have in place a permit fee system that would produce sufficient revenues to fully fund the NPDES, pretreatment, and sludge programs. EPA estimates that unfunded costs associated with these programs total $394 million per year and would have to be collected from industrial and municipal dischargers. States would receive approximately $301 million in revenues, with the remainder going to EPA for the permits it issues.

Groundwater Protection - The Initiative acknowledges the connection between surface water contamination and groundwater quality and establishes the protection of groundwater as a specific goal of surface water programs. EPA believes that implementation of these provisions will help protect groundwater and drinking water supplies from contamination originating from surface water discharges. Costs to private sources responsible for this cleanup will average between $150 million and $600 million per year.

Pollution Prevention Planning - The Initiative would give EPA and authorized States the discretionary authority to require pollution prevention plans as a condition of NPDES permits for industrial users. EPA estimates that at most 6,000 permittees each year would be required to prepare such plans, at an annual cost of between $60 million and $120 million. The cost of implementing such plans has not been estimated. States would be responsible for writing this provision into NPDES permits and for reviewing plans prepared by the permittees. Estimates of these costs, however, are not available because not all facilities will be required to implement such plans.

Domestic Sewage Exclusion - The Initiative would retain the domestic sewage exclusion (DSE) for facilities subject to local limits set by publicly owned treatment works (POTWs), national standards, or the 304(m) plan. Facilities subject to toxic reduction action plans (TRAPs) by their POTWs would also be exempt, as would households and noncommercial and nonindustrial facilities that discharge de minimis amounts of waste. EPA estimates that the impacts of these additional measures on dischargers will average $282 million per year.

Enforcement - The enforcement provisions in the Initiative include a variety of measures that provide additional incentives to assure compliance, to ensure that penalties more closely match the economic benefits of noncompliance, and to facilitate the processing of violation cases. The Initiative also recommends a waiver of sovereign immunity for federal facilities in violation of Clean Water Act provisions. Fines and penalties for violations are not economic costs but instead are considered a transfer to the federal government. The new enforcement provisions are estimated to cost States an additional $90 million per year.

State Revolving Fund/Construction Grants - The revised state revolving fund (SRF) and construction grants program will impose limited additional costs. State costs are estimated at $8 million per year.

Monitoring - The monitoring provisions will largely impact State governments, with an estimated cost of $118 million per year. Federal agency impacts are negligible, with the exception of the Forest Service, which will incur costs of approximately $37 million per year to perform the monitoring function on federal lands managed by that agency.

Abandoned Mines - Under a stringent interpretation of the current CWA provisions, an estimated 500,000 sites would require remediation at a cost of between $1.38 billion and $4.58 billion per year. Because a vast majority of these mines do not contribute to water quality problems, the Initiative introduces a targeted approach so as to achieve the greatest environmental improvement for the limited federal resources that may be available. The costs of this approach are estimated at between $330 million and $1,100 million per year. The net impact of the Initiative is, therefore, a savings of between $1.1 billion and $3.5 billion per year.

To summarize, the annual <u>incremental</u> cost of the Initiative on all sectors ranges from $5.0 billion to $9.6 billion. The annual cost savings (or costs avoided) by all sectors range between $29.1 and $33.8 billion.

<u>Potential Cost Savings From Economic Incentives - Effluent Trading</u>

The Initiative contains provisions that would encourage the establishment of mechanisms for trading pollution reduction among sources, similar to the trading provisions of the 1990 Clean Air Act Amendments. A preliminary analysis by EPA indicates that trading could achieve pollution reduction at significantly lower costs. These potential decreases in costs should be viewed as future costs avoided (or not incurred) because dischargers will not be installing additional controls to meet new requirements. These potential cost savings should not be viewed

as decreasing other costs discussed in this report but instead would represent reductions in the cost of additional controls needed for growth or to meet water quality standards. The decreased costs of pollution prevention and control, by type of trading, were estimated as follows:

Point source/nonpoint source	$611 million to $5.6 billion
Point source/point source	$8.4 million to $1.9 billion
Nonpoint source/nonpoint source	Potential exists but limited data
Pretreatment	$39 million
TOTAL	$658 million to $7.5 billion

Physical Measures of National Benefits

This report contains summaries of the physical benefits of individual provisions contained in the Initiative (e.g., toxics control, NPS prevention, abandoned mines, etc.). The benefits descriptions for the individual provisions are intended to indicate the scope of the problems addressed by the Initiative (in terms of water quality and human and ecological impacts) and the magnitude of the benefits obtained from addressing these problems. Results from these benefits analyses indicate that the Initiative's provisions could cause substantial improvements in water quality.

- NPS controls have a high or medium likelihood of producing measurable water quality improvements in 52 percent of impaired or threatened rivers and 63 percent of impaired or threatened lakes acres based on data from 28 states. For all 54 states and territories, EPA projects that about 156,200 river miles and 7.1 million lake acres will show measurable water quality improvements.
- Storm water control can reduce loadings of urban pollutants (sediment, toxics, nutrients) by 75 to 80 percent in developing areas and by 15 to 25 percent in areas already developed.
- Implementation of EPA's CSO Policy will provide adequate treatment for over one billion gallons of raw sewage, urban runoff, and industrial wastewater that are currently discharged without treatment during an average year (reducing pollutant loadings of 2,050 million pounds of total suspended solids (TSS) and 445 million pounds of biological oxygen demand (BOD) annually).
- Further control over the discharge of toxic and/or bioaccumulative pollutants will reduce impacts on human health and aquatic life impacts.

Monetized Benefits: Urban Areas

EPA estimates further that the aggregate benefits of pollution control in urban areas will eventually produce quantifiable benefits of between $0.8 billion and $6.0 billion per year (Table ES-6). The range recognizes the uncertainty associated with these estimates. For example, the upper end of the range may be an underestimate in the extreme case where the new provisions

are 100 percent effective, households care very much about the resultant improvements relative to the other waters in their state, and the unquantified benefits turn out to be significant relative to the quantified benefits. Similarly, the lower end of the range may be an overestimate in the extreme event that the new provisions fail to improve water quality to fishable and swimmable levels, or the changes in water quality have no effect on the economic activities of consumers and producers.

The benefit estimates are based on household valuation of clean water for a variety of purposes. However, several important additional categories of benefits which are either not quantified because relevant data are not available or are not amenable to estimation via quantitative techniques will also accrue. Examples include:

- Enhanced recreational swimming and boating in marine waters.
- Improved recreational hunting opportunities as watershed habitats improve.
- Avoided costs for water storage, flood control and water purification as natural systems improve.
- Reduced dredging costs as watershed and wet weather programs reduce siltation.
- Lower costs for sediment remediation over time as toxics and permitting provisions are adopted.
- Increases in biodiversity and overall ecological integrity.

Limitations. The analysis of the economic benefits focusing on urban areas draws upon information provided by a number of disparate data sources, and relies upon a number of assumptions. The synthesis of information introduces considerable uncertainty into the final numeric values. Major sources of uncertainty that limit our ability to be confident in the numeric results include: (1) the actual extent of impaired waters; (2) the method of attributing responsibility for impairment; (3) our assumptions about the efficacy of the provisions; and (4) the reliance upon secondary sources of information when estimating the economic values of environmental quality. The absence of reliable information on all of these elements plays a critical role in our ability to draw conclusions about the benefits that will result from the Initiative.

One of the more significant points of uncertainty in the analysis relates to the monetary valuation of economic benefits for the dominant benefit category--the enhanced freshwater recreation, aesthetics, and non-use benefits that ensue with the proposed water quality improvements. The absence of alternative data sources constrained us to make use of a published, yet dated, contingent valuation research study that measured a household's use and non-use values for national and, by apportionment techniques, more localized improvements in freshwater rivers and lakes. Criticism has been levied against the validity of empirical results for non-use values derived using prior contingent valuation research methods. Several issues raised in the ongoing debate about this valuation method bear directly upon the interpretation of the numeric results provided by our source materials.

Independent of this debate, further uncertainties are introduced by transferring the research results to the policies and environmental concerns addressed by the Initiative. The wide range of values demonstrates an attempt to capture the impact of these uncertainties on the numeric estimate. All told, it is difficult to conclude whether the presented numeric ranges underestimate or overestimate the actual benefits. We suggest that the numerical results best serve to indicate the overall order-of-magnitude of the benefits. Based upon our experience in undertaking the analysis, we can further conclude that considerable gaps persist in our ability to measure and evaluate the relationships between water quality conditions and economic activities, even twenty years after the passage of the principal legislation designed to identify and address water pollution problems. The Administration's Initiative contains provisions to help rectify this situation in the future.

Costs: Urban Areas

Provisions in the Initiative that address urban areas are loosely defined to include storm water Phase I and Phase II, CSOs and toxics controls. The annualized costs of these provisions for all sectors is estimated to be between $9.9 billion and $13.9 billion, as shown in Table ES-5.

Net Benefits: Urban Areas

The monetized benefits of the Initiative ($0.8 billion to $6.0 billion), assuming benefits are realized immediately, contrast with between $9.9 billion to $13.9 billion in incremental annualized costs for urban areas.

However, benefits are unlikely to be realized immediately. To illustrate how the gradual attainment of the benefits may influence the benefit-cost comparison, the figures in Tables ES-5 and ES-6 show the annualized monetary costs and benefits from control of urban sources under proposed and pending spending. In Table ES-6, two of the three aggregate benefit estimates provide for the gradual attainment of benefits, applying different discount rates to an assumed future stream of benefits. The selection of the two discount rates reflects Administration guidelines on the application of discounting to costs and benefits (seven percent), as compared with the use of a social rate of time preference (three percent). The discounted annualized benefits are some twenty to thirty percent lower than the annualized benefit estimate that fails to account for the expected delays in achieving tangible water quality improvements. This serves to demonstrate the sensitivity of the results to both the time and discounting features of the analysis.

Comparing the annualized costs and benefits under any of the three annualized benefit estimation scenarios, it is apparent that the range of estimated monetary costs and benefits do not presently overlap. Despite information of this type, the Administration feels it is important to proceed with the Initiative for several reasons. As stated throughout the text, and documented in the supplemental materials, there are great uncertainties associated with both the cost and benefit estimates that are not captured in the presentation of the numerical results. For example, although the national cost estimates have attempted to account for targeting of watersheds in

need of improvement and emphasized prevention measures over command-and-control strategies, there are uncertainties in the analysis because of the difficulty of fully accounting for the consequences of providing flexibility in the identification of problems and solutions. There are also a number of tangible benefits for which monetary estimates have not been developed. So as to better inform decisionmakers and the public in the future EPA is proposing a comprehensive benefit-cost study of the pollution controls in the CWA reauthorization. This study will reduce the uncertainties surrounding the benefits and cost estimates.

Despite the uncertainties, an important contribution of the economic analysis has been its ability to document the significant savings the Initiative is proposing compared with the requirements called for in the existing legislation. In addition, considerable effort was given to developing cost-effective policies where new efforts are needed to achieve the goals of the Clean Water Act. Therefore, the Initiative demonstrates a genuine effort to achieve cost-effective regulatory management approaches to improving the nation's polluted waters. Equally important, the public's right to enjoy clean waters, and the demonstration of their preferences through environmentally protective federal legislation, have served as inputs into the development of Administration policy. Strong public support for additional pollution control programs persists, and the Initiative will address what the Administration believes are the most significant remaining problems.

Table ES-1

Summary of Current and Planned Spending Under the Existing CWA ($millions/year)

Provisions	Private Sources	Municipalities	Agriculture	State Water Programs[1]	Federal Agencies[2]	Total (Quantified)
Pre-1987 Act	$25,286	$17,190	$191	$373	$9,564	$52,604
Nonpoint Source Controls/watershed		$389 - $591	$240 - $389	$125	$234	$988 - $1,339
Storm Water: Phase I	$3,990	$1,650 - $2,555				$5,640 - $6,545
CSOs		$3,450				$3,450
Other Costs	$943 - $1,073	$88				$1,031 - $1,161
TOTALS	$30,219 - $30,349	$22,767 - $23,874	$431 - $580	$498	$9,798	$63,713 - $65,099

[1] Pre-1987 expenditures, estimated to be about $2.7 billion per year for administration and compliance, are not shown here because the cost of complying with the current and future water quality standards could not be estimated. The values shown here are only for administering the program.

[2] Some obligations under the current law, e.g., remediation of abandoned mines are shown in Table ES-4.

Source: U.S.EPA, Office of Water.

Table ES-2

Summary of Incremental Costs of the Initiative ($millions/year)

Provisions	Private Sources	Municipalities	Agriculture	State Water Programs	Federal Agencies	Total (Quantified)
Nonpoint Source Controls/watersheds	$233 - $388	[included with private sources]	$1,056 - $1,830	$92	$118 - $210	$1,499 - $2,520
Storm Water: Phase II	$ 345 - $1,670	$1,030 - $1,910			$19	$1,394 - $3,599
CSOs		[b]				
Toxics Control	[a]				$66 - $105	$66 - $105
Discharge Fees	$290	$94		$10		$394
Groundwater	$150 - $600					$150 - $600
Pollution Prevention Planning	$60 - $120			no est.		$60 - $120
Domestic Sewage Exclusion	$282					$282
NPDES & WQS/WQC[1]	[c]			$188	$32 - $33	$220 - $221
SRF/Construction Grants				$8		$8
Monitoring				$118	[d]	$118
Abandoned Mines					$330 - $1,100	$330 - $1,100
Department of Energy					$520	$520
TOTALS	$1,360 - $3,350	$1,124 - $2,004	$1,056 - $1,830	$416	$1,085 - $1,987	$5,041 - $9,587

Blank cell implies negligible impact
no est. = estimates not available
[a] No aggregate estimates of the potential costs of further restrictions on discharges of toxic/bioaccumulative pollutants; bans of some pollutants (e.g., dioxin) could be very costly but would have to be justified based on risk reduction potential and cost.
[b] No incremental cost over current policy.
[c] Additional enforcement costs to private sources (i.e., fines) which deter environmental damages are not considered a resource cost.
[d] Federal agency costs of monitoring are included under the nonpoint source costs.
[1] Cost of compliance with current and future water quality standards is not estimated and hence is not included.

Source: U.S.EPA, Office of Water.

Table ES-3

Summary of Cost Savings/Cost Avoided of the Initiative Compared With Stringent Interpretation of Existing CWA Requirements[1] ($millions/year)

Provisions	Private Sources	Municipalities	Agriculture	State Water Programs	Federal Agencies	Total (Quantified)
Nonpoint Source Controls/Watersheds			$461 - $845			$461 - $845
Storm Water:						
Phase I	$1,140 - $1,630					$1,140 - $1,630
Phase II	$14,565 - $15,890	$755 - $850				$15,320 - $16,740
CSOs		$10,700				$10,700
Discharge Fees/WQC&S				$301	$83	$384[2]
Abandoned Mines					$1,053 - $3,481	$1,053 - $3,481
TOTALS	$15,705 - $17,520	$11,455 - $11,550	$461 - $845	$301	$1,136 - $3,564	$29,058 - $33,780

[1] Cost savings (or cost avoided) associated with effluent trading are not included. These range between $47 million and $1,900 million for private sources, and between $611 million and $5,600 million for municipal sources.

[2] Reflects the revenues from the permit fee provision to state and federal permitting authorities.

Source: U.S.EPA, Office of Water.

Table ES-4

Summary of Current and Potential Spending Under Stringent Interpretations of CWA ($millions/year)

Provisions	Private Sources	Municipalities	Agriculture	State Water Programs	Federal Agencies	Total (Quantified)
Pre-1987 Act	$25,286	$17,190	$191	$560	$9,564	$52,791
Nonpoint Source Controls/watershed		$389 - $591	$240 - $389	$150	$234	$1,013 - $1,364
Storm Water: Phase I Phase II	 $3,990 $16,235	 $1,650 - $2,555 $1,785 - $2,760				 $5,640 - $6,545 $18,020 - $18,995
Abandoned Mines					$1,383 - $4,481	$1,383 - $4,581
CSOs		$14,140				$14,140
Other Costs	$943 - $1,073	$88				$1,031 - $1,161
TOTALS	$46,454 - $46,584	$35,242 - $37,324	$431 - $580	$710	$11,181 - $14,279	$94,018 - $99,577

Source: U.S.EPA, Office of Water.

Table ES-5

Summary of Aggregate Annualized Costs from Control of Urban Sources Under the Initiative and Pending Spending (CSOs, Storm water, Toxics)

Cost Category	Range: Low - High (Millions of 1993 $)
Municipal Costs	
Phase I Storm water	$ 1,650 - $ 2,555
Phase II Storm water	$ 1,030 - $ 1,910
CSO Controls	$ 3,450
CZARA Non-Point Controls	$ 390 - $ 590
Pending Spending (Great Lakes, Sludge)	$ 90
Subtotal Municipal	$ 6,610 - $ 8,595
Private Sector	
Phase I Storm water	$ 2,360 - $ 2,850
Phase II Storm water	$ 345 - $ 1,670
Pollution Prevention Plans	$ 60 - $ 120
Domestic Sewage Exclusion	$ 280
Nonpoint Source Controls	$ 233 - $ 388
Subtotal Private Sector	$ 3,278 - $ 5,308
Total Quantified Costs in Urban Areas	$ 9,888 - $ 13,903
Non-Quantified Costs	
State Administration Costs (Urban portion of $650m)	
Federal Compliance (Urban portion of $945m) - excludes abandoned mines.	
Groundwater Controls (Urban portion of $150m to $600m)	
Further Water Quality Criteria and Standards and sediment criteria	
Toxics Bans	
Other Pending Spending (e.g., Great Lakes, Pulp and Paper Effluent Guidelines, Air MACT standards)	

Source: Tables ES-1 and ES-2.

Table ES-6

Summary of Aggregate Annualized Benefits from Control of Urban Sources Under the Initiative and Pending Spending (CSOs, Storm water, Toxics)

Benefit Category	Range: Low - High (Millions of 1993 $)
Quantified Benefits	
Freshwater Recreational Fishing and Swimming (use and nonuse)	$ 650 - $ 4,670
Marine Recreational Fishing (use only)	$ 40 - $ 440
Marine Nonconsumptive Recreation (use only)	$ 30 - $ 300
Marine and Freshwater Commercial Fishing	$ 40 - $ 190
Withdrawal or Diversionary Uses	$ 20 - $ 80
Human Health Effects (from risks associated with exposure to pollutants via swimming activity and seafood consumption)[1]	$ 40 - $ 320
Sub-total: Quantified Benefits[2]	
Assuming immediate attainment of benefits[3]	
(i) Annualized Benefits (no lag and no discounting, thus a simple summation of individual categories)	(i) $ 820 - $ 6,000
Assuming a gradual attainment of benefits over the first 15 year period that all Urban Source Controls are adopted.[4]	
(ii) Annualized Benefits (seven percent discount rate, gradual attainment over first 15 years)	(ii) $ 560 - $ 4,100
(iii) Annualized benefits (three percent discount rate, gradual attainment over first 15 years)	(iii) $ 660 - $ 4,900
Non-Quantified Benefits	
- Marine Recreational Swimming (nonhealth effects) - Other Human Health Effects in Marine and Freshwaters (see Note 1) - Recreational Hunting- Freshwater Nonconsumptive Recreation (see Note 1) - Marine Recreational Boating - Other Non-use Benefits (Marine Waters - see Note 1) - Other avoided costs (e.g., water storage, dredging, damages from floods) - Restoration of biodiversity and ecosystem integrity	

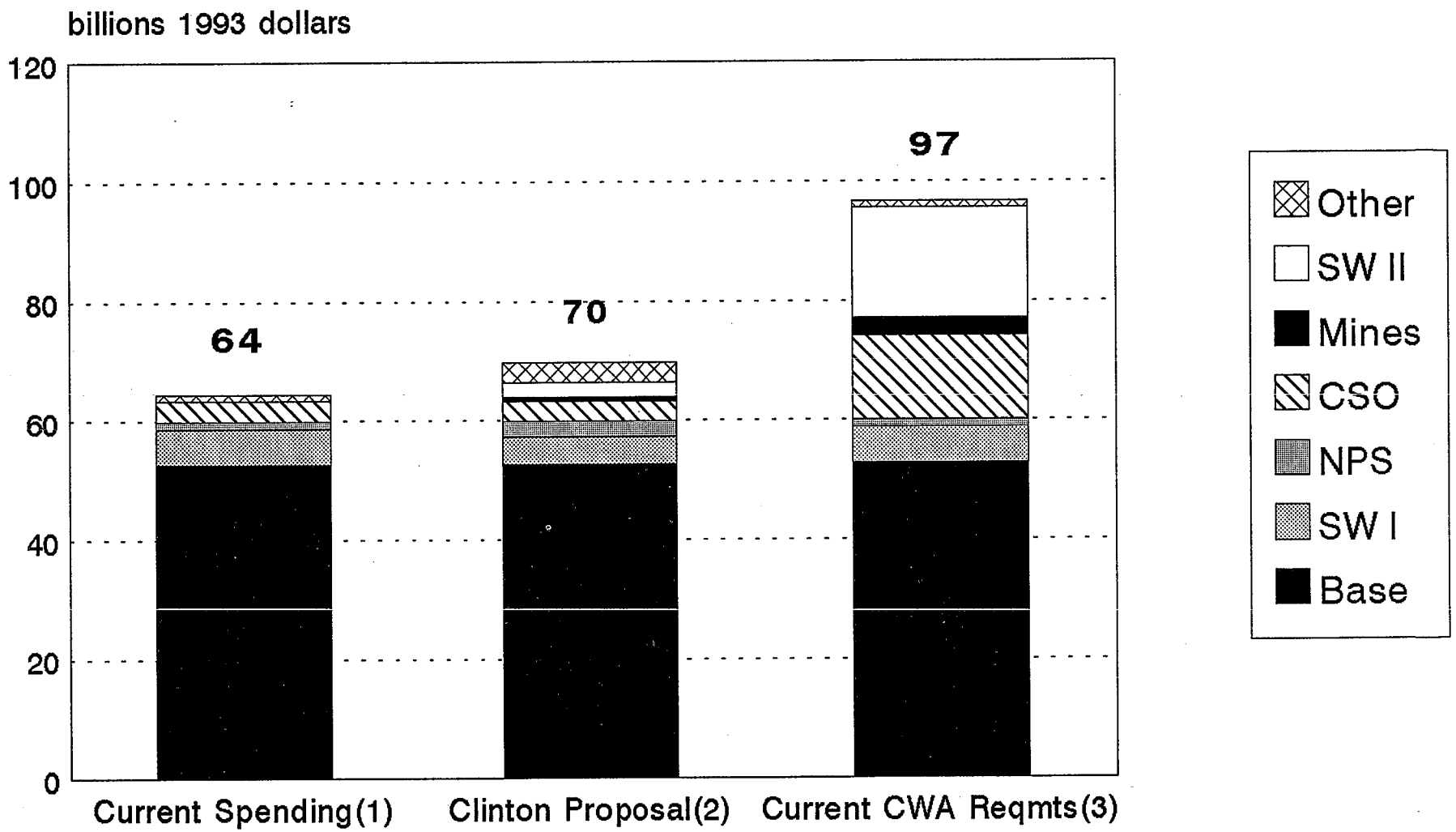
[1] Given information and methods used to calculate the quantified benefits, some portion of the benefits associated with these categories may be captured in the monetary range ascribed to freshwater recreation fishing and swimming.

[2] Assumes no double counting of benefits or substitution effects between different categories when developing aggregate national estimates. Also assumes that all lower and upper ends of the range for each quantified category describe the aggregate lower and upper bound estimate. Absent information on the distribution or probability of attaining benefits defined by the estimated range, we can not calculate a "most likely" estimate.

[3] Assuming no lag between implementation of controls, recovery of natural ecological systems, and economic behavior that forms the basis for the economic benefit measures.

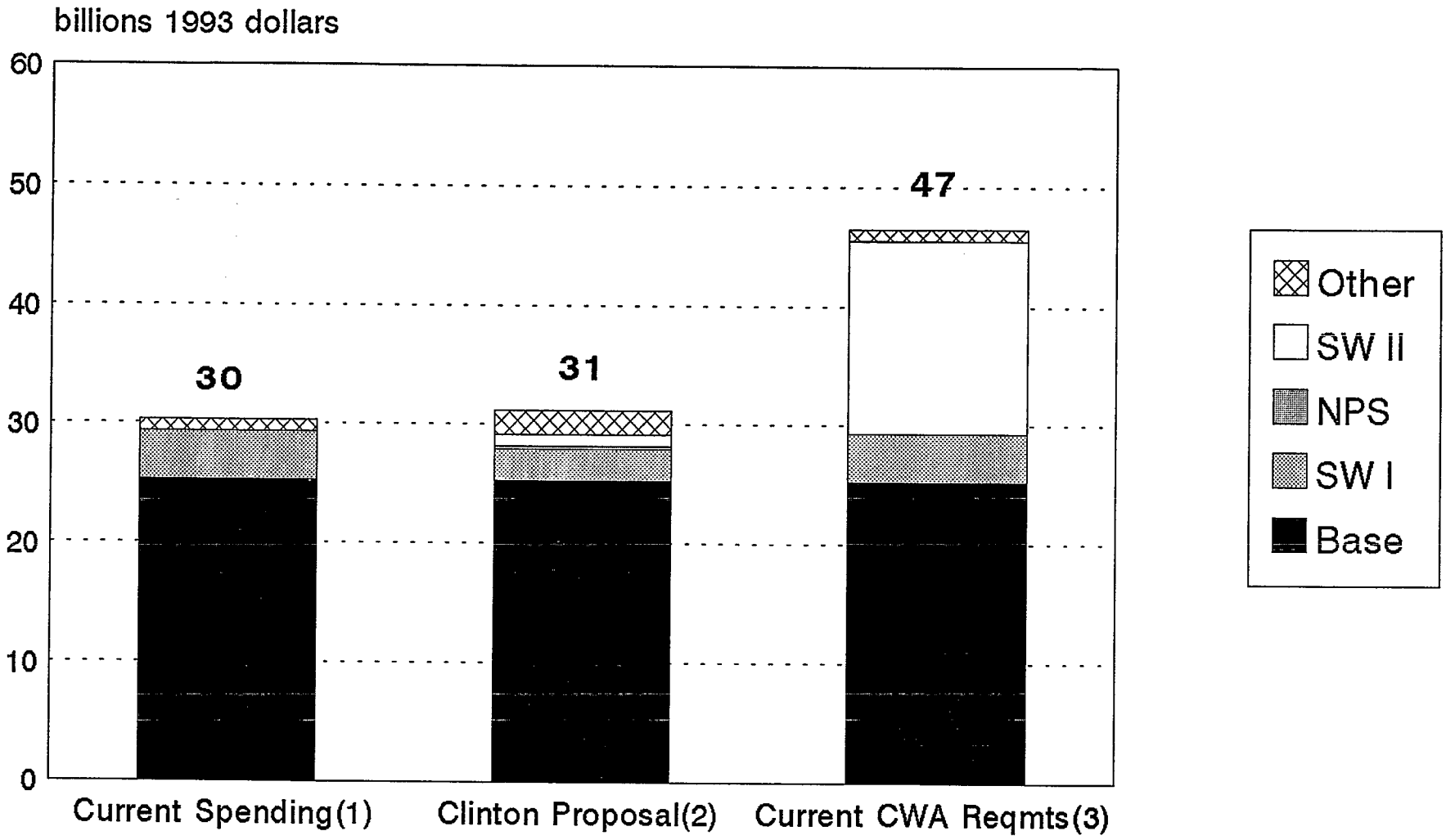
[4] These estimates of the economic benefits are more appropriate to use when comparing quantified costs and benefits, given the anticipated lag time between introduction of the control measures and full realization of the environmental and economic benefits. The calculated annualized figure is based on assuming a gradual attainment of benefits up through year fifteen, and a constant future benefits stream after the fifteenth year has been reached.

Figure ES-1
Annual Cost of Major Provisions



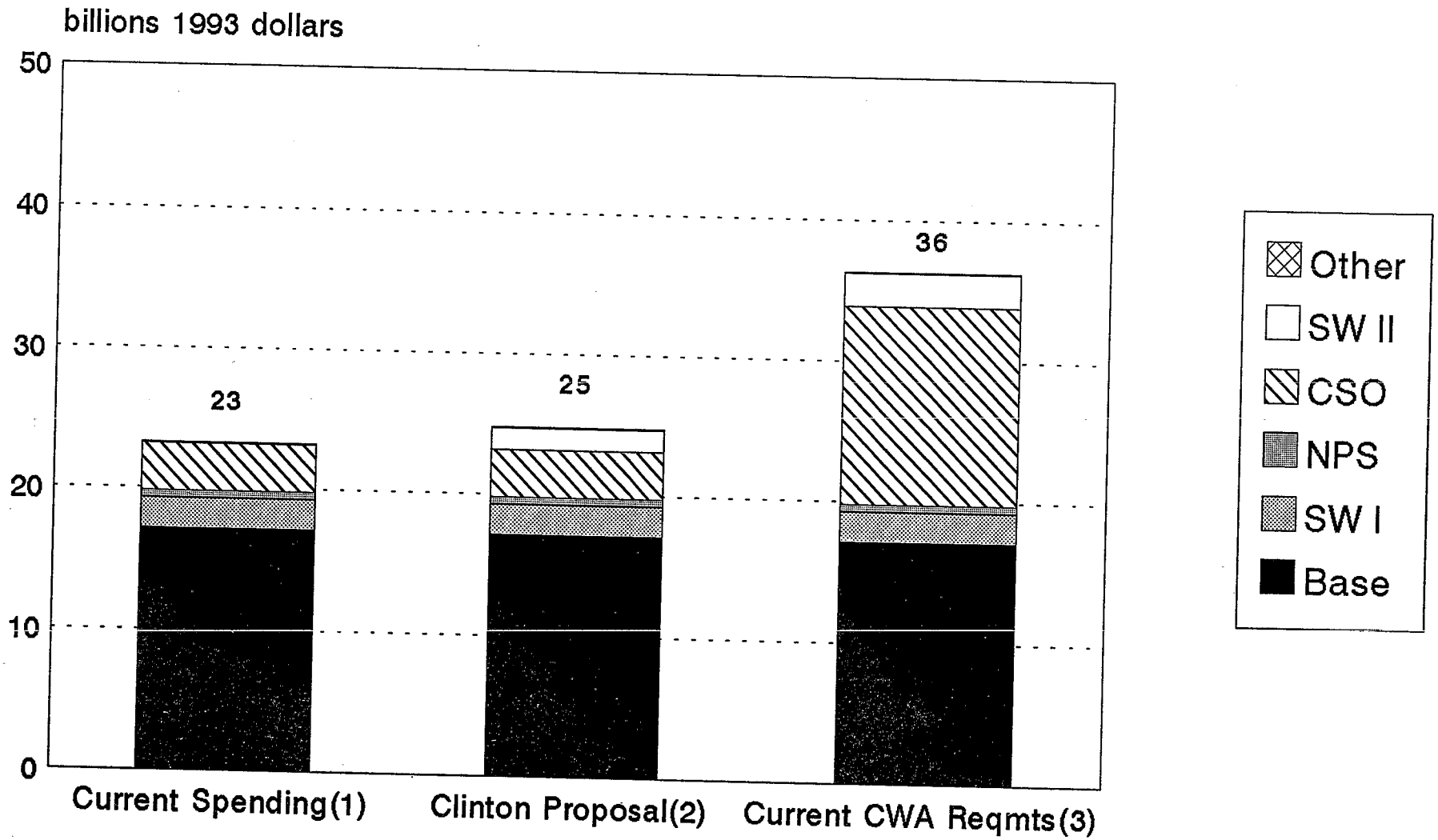
(1) Includes cost of proposed and final rules
(2) Does not include potential cost savings (or future costs avoided) from effluent trading
(3) Under strict interpretation of CWA

Figure ES-2
Annual Cost of Major Provisions: Private Sources



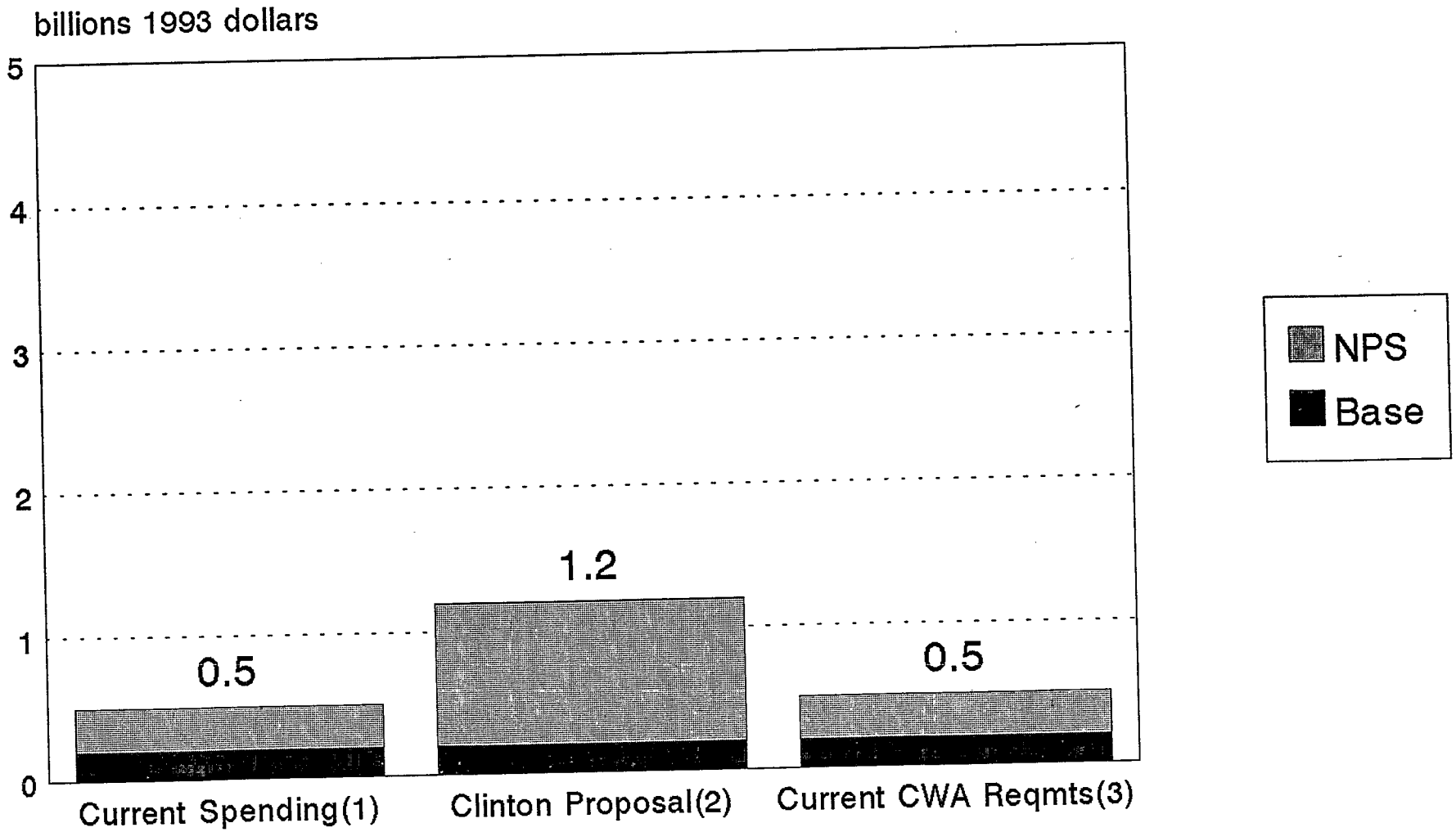
(1) Includes cost of proposed and final rules
(2) Does not include potential cost savings (or future costs avoided) from effluent trading
(3) Under strict interpretation of the CWA

Figure ES-3
Annual Cost of Major Provisions: Municipalities



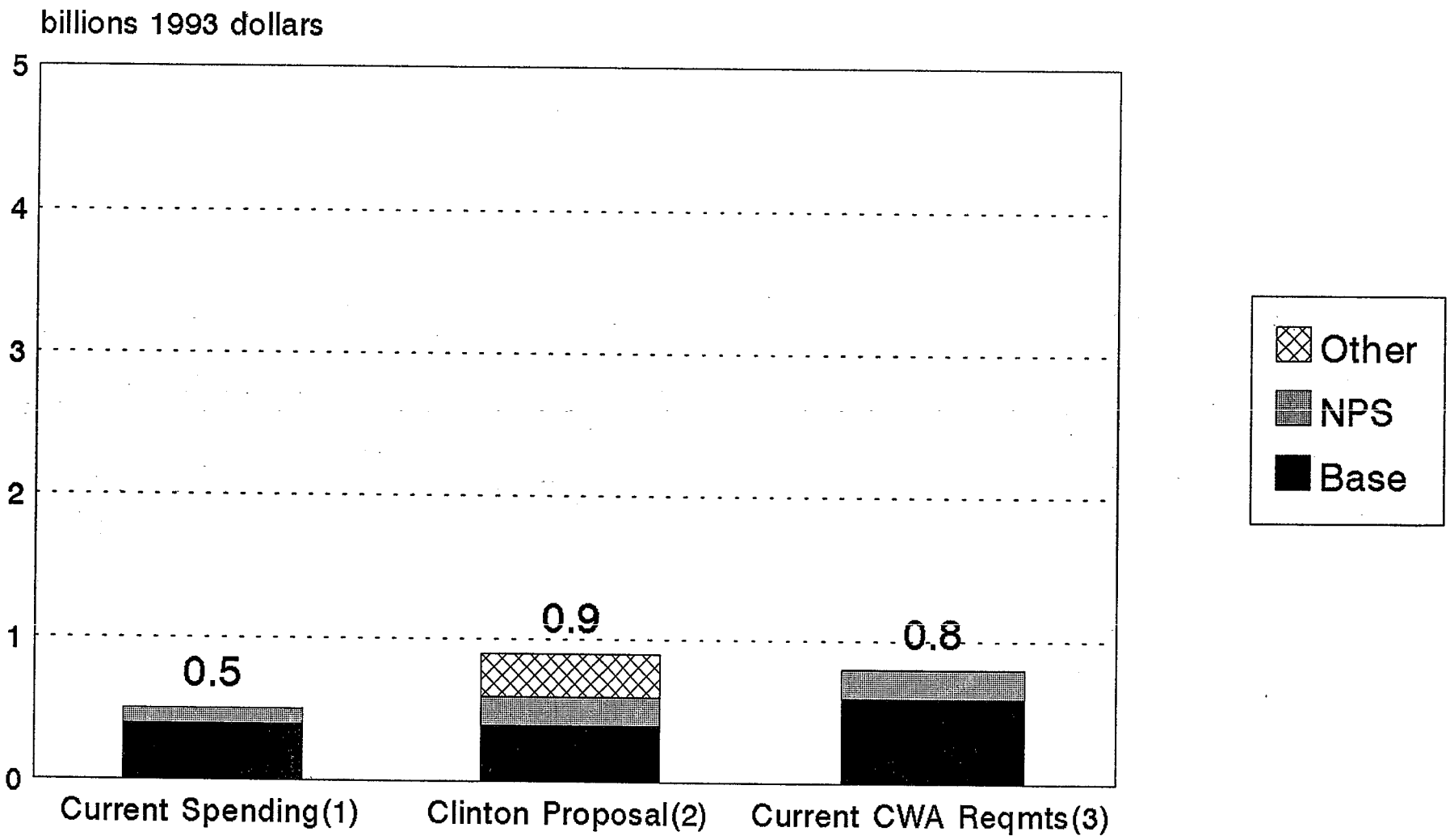
(1) Includes cost of proposed and final rules
(2) Does not include potential cost savings (or future costs avoided) from effluent trading
(3) Under strict interpretation of the CWA

Figure ES-4
Annual Cost of Major Provisions: Agriculture



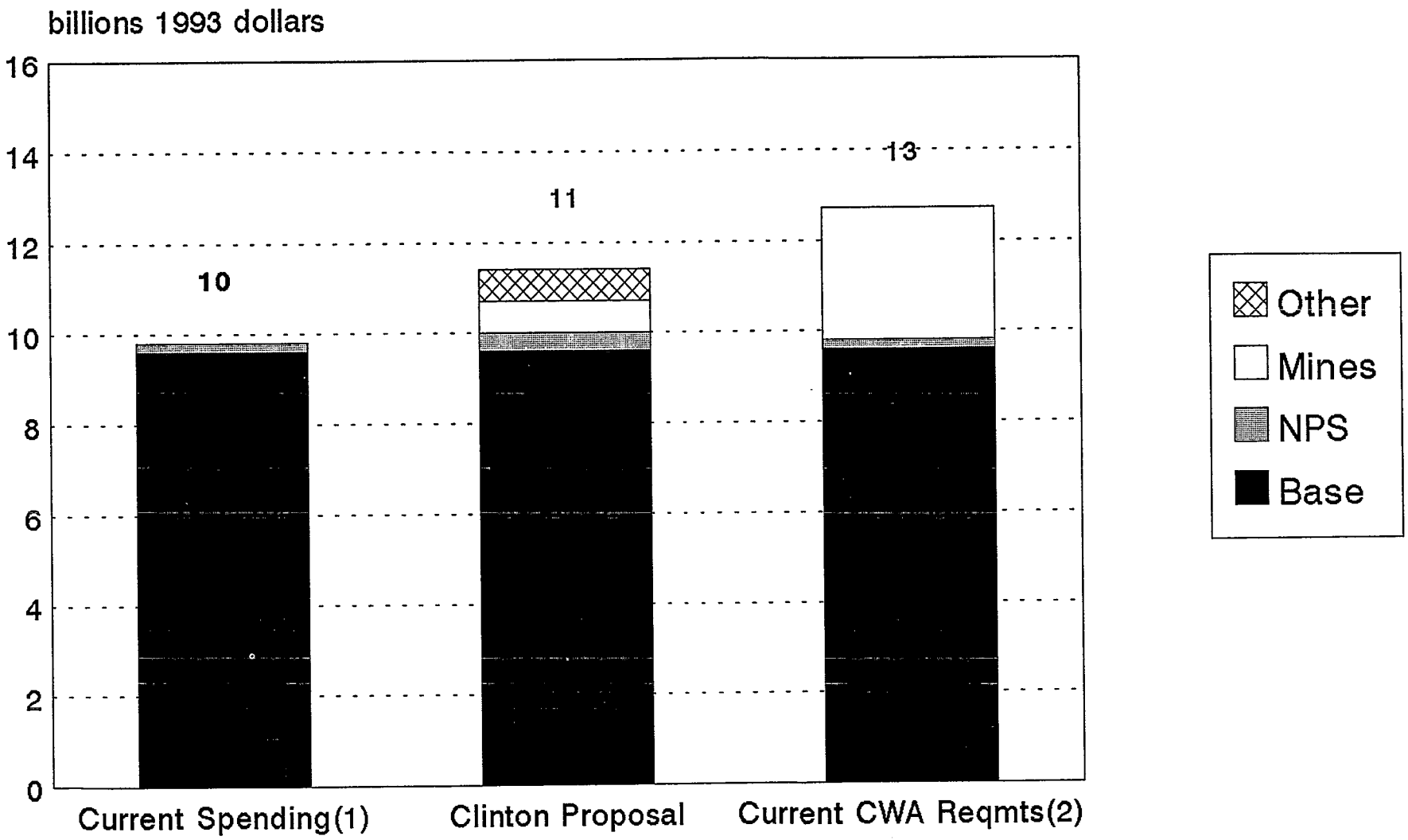
(1) Includes cost of proposed and final rules
(2) Does not include potential cost savings (or futue costs avoided) from effluent trading
(3) Under strict interpretation of the CWA

Figure ES-5
Annual Cost of Major Provisions: States



(1) Includes cost of proposed and final rules
(2) Does not include potential revenues of $301 million from NPDES fees
(3) Under strict interpretation of the CWA

Figure ES-6
Annual Cost of Major Provisions: Federal Agencies



(1) Includes cost of proposed and final rules
(2) Under strict interpretation of the CWA

1.0 Introduction

This report summarizes the costs and benefits of provisions contained in President Clinton's Clean Water Initiative. As noted in Executive Orders 12866 and 12893, such comparisons are necessary because resources committed to implement the Initiative can be used for alternative productive purposes. Therefore, the opportunity costs of these resources should be compared with the economic benefits. Such comparisons should be used to help fashion policies that offer the largest possible net benefits.

In addition to estimated costs and benefits, many factors need to be taken into account in supporting an environmental initiative. These include large uncertainties and gaps in estimating benefits and costs, the distribution of benefits and costs among segments of the American people, and support of the public for environmental controls. Regarding these matters, the Administration believes that it is appropriate to be on the side of environmental caution because of the large uncertainty about the effectiveness of proposed controls, and about the benefits and costs generally. The Administration also recognizes the continuing support for the Clean Water Act (CWA) both in Congress and by the general public. Finally, the Administration believes that cleaner water is especially important because it provides benefits that are distributed broadly among all Americans, irrespective of income levels or ethnic background.

The Initiative will require incremental expenditures of $5 to $9.6 billion per year. However, compared with the costs of a stringent interpretation of the current law, the Initiative will yield potential savings (or avoid future costs) of $29 to $33.8 billion.

2. Approach

Scope. This report presents the costs of the Initiative, measures of physical benefits of the Initiative, and estimates of the costs and monetized benefits of provisions of the Initiative applicable to urban areas only.

Costs are reported in two different ways. First, they are provided by sector: (1) private sources (i.e., industry, commercial and private individuals), (2) agriculture (farmers), (3) municipalities (including operators of public wastewater treatment facilities), (4) state governments, through their water programs, and (5) federal agencies. It is recognized that some of the effects of the Initiative are transfers rather than costs. Second, costs are provided for each major provision of the Initiative. For comparison with monetized benefits in urban areas, incremental costs are also reported for three general provisions: storm water Phase I and II, combined sewer overflow controls, and toxics.

Benefits of the Initiative are reported in physical terms, such as stream miles of improvements. For urban areas only, benefits are reported in monetized terms; we account for a large variety of benefit categories, the most important being recreational fishing and swimming.

Estimates of the Initiative's impact were developed by the U.S. Environmental Protection Agency (EPA) Office of Water in consultation with EPA's Office of Policy, Planning, and Evaluation and other federal agencies, including the U.S. Department of Agriculture (USDA), U.S. Department of the Interior (DOI), U.S. Department of Commerce (DOC) - National Oceanographic and Atmospheric Administration (NOAA), U.S. Department of Defense (DOD), and U.S. Department of Energy (DOE), as well as with the White House Office of Management and Budget (OMB), Council of Economic Advisers (CEA), and National Economic Council (NEC).

Data Sources. All of the costing work was done in a similar fashion. Given the time available to prepare the estimates, we could not commission specific new analyses of, for example, compliance with the CSO policy on actual or model municipal systems. Instead, our general approach was to first examine the literature of existing studies pertaining to a given issue. Typically this process identified at least a few relevant studies. Some provisions (e.g., nonpoint source controls and certain trading scenarios) had many relevant analyses from which to draw cost data or information. Other provisions (e.g., the toxics provisions) had few directly relevant studies for comparison purposes.

The cost estimates are thus largely built on secondary data sources and limited "original" analysis. Regulatory analyses prepared by EPA for specific program actions also were quite useful data sources. These included regulatory impact analyses (RIAs) for the Agency's CSO Policy; the Pulp and Paper and Offshore Oil and Gas Effluent Guideline regulations; the Economic Impact Analysis of the CZARA; the RIA for the Great Lakes Water Quality Initiative proposal; and previous reauthorization studies conducted by the Agency in 1991-1992 (draft

studies were prepared covering storm water, CSOs, and several other topics).

All of the literature and secondary sources described here were used as the basis for our Initiative cost estimates. When possible, estimates were drawn "as is" from the reports. In other cases, modifications and re-analyses were required. The specific procedures are described in more detail in later sections of this report.

Baseline. Some provisions of the 1987 Clean Water Act Amendments have not yet been implemented. Some provisions of the Initiative will impose new responsibilities and costs beyond those called for in the 1987 Amendments. Others scale back obligations under the Amendments and will save the private sector, municipalities, and the federal government billions of dollars while not compromising environmental quality. Therefore, it is legitimate to view the baseline from which costs of the Initiative are estimated in two ways: as increments above current and pending spending or as reductions in costs from stringent interpretations of the 1987 CWA. The stringent interpretations reflect the reading of the law proposed by various outside groups but do not represent EPA's best interpretation of the law. However, while EPA believes that these interpretations are stringent and inflexible, they could potentially be adopted by a court in litigation challenging EPA's interpretation. This report carefully distinguishes estimates from these two baselines.

The analysis presented here centers on five "sectors" that the Initiative is expected to affect: the private sector, municipalities, agriculture, state governments, and federal agencies. Each of these sectors has been the subject of separate analytical efforts, which are described briefly below:

- **Private Sector** - The impacts of the Initiative on the private sector (commercial and industrial) are based on analyses prepared by the Office of Water. Impacts on the private sector are largely estimated in terms of annualized costs.

- **Municipalities** - The major impacts of the Initiative on municipalities are a result of the combined sewer overflow (CSO) and storm water provisions. The Office of Water developed estimates of the costs of compliance with these provisions.

- **Agriculture** - The impacts of nonpoint source provisions in the Initiative on agriculture, primarily farmers, are estimated using the methodology for estimating costs for the CZARA guidance. These are presented separately to show the magnitude of the costs on this sector.

- **State Governments** - Estimates of the Initiative impacts on state water programs were prepared by the Office of Water, in consultation with water programs officials from seven states (Maryland, Missouri, North Carolina, Nevada, Ohio, South Carolina, and Texas). The state analysis considered the administrative costs of new provisions on the state water programs as well as unfunded 1987 CWA requirements. Pre-1987 expenditures, estimated to be about $2.7 billion

per year for administration and compliance (EPA, 1990b) are not included here because the cost of complying with current and future water quality standards could not be estimated.

- **Federal Agencies** - The impacts of the Initiative on federal agencies were developed by the respective agencies and reported to EPA. Impacts include the costs of additional staff (including salaries, benefits, and overhead), as well as additional extramural contract support necessary to implement and comply with the Initiative provisions. Federal agencies represented in the analysis include EPA, USDA Soil Conservation Service (SCS) and Forest Service (FS), DOI, NOAA, DOD, and DOE.[1]

Consistency in Benefit and Cost Estimation. To assure that urban area benefits and costs are comparable, a number of steps were taken. The costs and benefits are presented in annualized 1993 dollars. Benefits are discounted using three different rates (zero, three, and seven percent), and assuming that they are fully in place in 15 years. This procedure is necessary to account for the fact that benefits or costs experienced later in time are worth less than those experienced sooner. The nature of environmental risks is that it will take time to fully attain many of the projected water quality improvements and economic benefits. Costs are annualized at seven percent.

Uncertainties in Estimating Costs. To account for the uncertainty inherent in estimating costs for various provisions, we have used ranges of likely values where possible. The cost estimates are based on best professional judgment about the controls likely to be imposed. In some instances, however, these controls may be insufficient to meet either current or future water quality standards, and additional more stringent control could be adopted. The cost estimates do not include any such additional controls because of the difficulty of estimating their magnitude. To the extent that additional controls are needed to meet water quality standards, there would be additional costs.

The remainder of this report presents the results of cost and benefit analyses of the Initiative's provisions.

[1] Sources include: USDA (1994); DOI (1994); DOD (1993a and 1993b); NOAA (1993); and DOE (1993).

3.0 Nonpoint Source Controls

The Initiative's provisions would require all states to strengthen their nonpoint source (NPS) management program for impaired, threatened, or special protection areas. EPA would develop guidance for states to use in developing and implementing their nonpoint source management program which would require nonpoint "sources" to adopt incremental compliance actions, including best available management measures.

As an alternative to a comprehensive NPS program, states could address NPS pollution problems under a watershed approach using site-specific plans adapted to local conditions. EPA estimates that under either alternative, similar sources would be addressed using similar mitigation methods. Controls under a watershed approach would be developed following an assessment of water quality problems at the local level, and would be more targeted in comparison with the comprehensive NPS program. Therefore, the NPS control costs would probably be somewhat less under the watershed approach, although the order of magnitude of costs would be similar using either approach.

States will have 2½ years to develop and submit their revised NPS management programs, with implementation to occur over a subsequent 5-year period.

3.1 Private Sources

Nonpoint sources that these provisions address can be divided into several "sectors," each of which may contribute one or more categories of pollutant loadings in a variety of ways. The major NPS sectors are shown in Table 1, with some of the activities that contribute nonpoint pollutant loadings and some of the control alternatives that may be called upon to mitigate them.

ERG, 1993, developed estimates of the costs of a national NPS control program using models developed for EPA in support of the 1990 Coastal Zone Act Reauthorization Amendments (CZARA) (RCG/Hagler, Bailly, 1992; hereafter referenced as the CZARA Regulatory Impact Analysis, or RIA). These models calculate the costs and impacts of NPS controls in the above sectors. The CZARA RIA estimated the costs of control in the U.S. coastal zone, which was defined to include counties in which at least 15 percent of land area drains into coastal waters. Costs of controlling nonpoint sources in the coastal zone were estimated to be between $260 million and $436 million per year (see Table 2).

To estimate the cost of the Initiative's NPS provisions, a coastal NPS program is assumed to be fully implemented in the coastal zone, as required under CZARA. The focus of the Initiative NPS provisions will therefore be on nonpoint sources in the noncoastal zone.

Table 3 shows a marked difference between the coastal and noncoastal zone in terms of population density and land area. Accounting for 82 percent of the land area and only 48 percent of the population, the population density in the noncoastal zone, at 41.4 persons per square mile, is only one-fifth that of the coastal areas. Because of this, agricultural and forestry

NPS control measures will be relatively more important in the noncoastal zone, and urban runoff measures will be relatively less important.

Cost estimates developed for the coastal zone were extrapolated to the noncoastal zone using appropriate factors such as the noncoastal zone's share of land area, population, farmland, cultivated cropland, and so on. A detailed methodology can be found in ERG, 1993.[2] The CZARA RIA's costs used for the extrapolation were based on unit control costs (e.g., $/acre) and need estimates (e.g., percent of acres requiring treatment) that may differ between the coastal and noncoastal zone. While values for these variables may differ between the coastal and noncoastal zone, time did not permit the development of specific parameters for the noncoastal zone. In some cases, however, the coastal zone parameters are themselves based on national data, hence no additional bias is introduced by using them here.

The Initiative recommends application of NPS management measures in impaired, threatened, or special protection areas only, making it necessary to identify the sources located in such areas. Although no comprehensive data exists to link sources of nonpoint pollution to specific water body impairment, EPA's Section 305(b) survey does provide estimates of the number of water bodies (river miles, lake acres, and estuary square miles) that do not fully support their designated uses. This data was judged to be appropriate and to provide a reasonable basis for estimating the extent of need for a national NPS control program.[3] Because of the uncertainty in predicting the number of new sources that would be impacted by the Initiative, no attempt is made to estimate costs of NPS management measures for new sources.

EPA's most recent Section 305(b) survey indicates that approximately 33 to 50 percent of water bodies nationally do not support, only partially support, or threaten their designated uses (EPA, 1992). ERG used these percentages to calculate the potential cost of nonurban NPS controls in impaired or threatened noncoastal watersheds from the cost estimates derived for the entire noncoastal zone. In urban areas, the factor used to represent impaired or threatened waters was 25 percent.[4]

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[2] For example, the costs of grazing management control in the coastal zone were estimated at $2.8 million per year. The coastal zone accounts for 25.3 million of a total of $515.8 million grazing acres, or 4.9 percent of total. The total costs of grazing controls nationally are $424.5 million ($2.8 million divided by 0.049). Costs outside the coastal zone are then $403.7 million. In Table 2 these costs are further adjusted to account for the fact that NPS controls would be required in impaired areas only. Assuming that between 33 percent and 50 percent of grazing acres in the noncoastal zone are impaired, the costs of grazing controls are between $133 million and $202 million.

[3] The 305(b) data indicate the water quality and impairment sources of water bodies assessed by the states. Nationally, the assessed percent of river miles, lake acres, and estuary square miles varies significantly. EPA assumes that the water bodies assessed are reasonably representative of all water bodies nationally, i.e., neither higher nor lower quality water bodies are over-represented in these data.

[4] Best Professional judgment applied to 305(b) data shows impairment in urban areas as follows: rivers (5 percent); lakes (14 percent); and estuaries (19 percent). The sum of rivers and lakes is used a basis for percent impairment.

The national costs of a NPS control program, extrapolated from the CZARA analysis of costs in the coastal zone, were then adjusted to account for the fact that NPS controls would be required in impaired or threatened areas only. The percentage of land area requiring treatment or the percentage of sources requiring control is assumed to be proportional to the percentage of water bodies that are either impaired or threatened. Thus, the costs of control in impaired or threatened nonurban areas are estimated to be between 33 and 50 percent of the costs for a national program in noncoastal zone. Similarly, the costs of control in urban impaired or threatened areas are estimated at 25 percent of the national costs. The costs of the NPS program in threatened or impaired areas are shown in the final column of Table 2.

Because the noncoastal zone is, relatively speaking, more rural than the coastal zone, the nonpoint source control costs are dominated by agricultural sources, while control costs for urban sources are relatively less important. In the noncoastal zone, agricultural controls are estimated to account for between $1.06 billion and $1.83 billion, as shown in Table 20. The costs of nutrient and pesticide management, while estimated at between $461 million and $845 million, are largely offset by savings in chemical consumption that will accompany the application of these measures. Thus, total net costs for all sources are $595 to $985 million per year [$1.06 billion - $1.83 billion (from Table 20) less $461 million - $845 million (from Table 21)].

Potential incremental cost for urban nonpoint sources due to hydromodification and storm water controls is estimated to range between $233 million and $388 million per year (Table 20). Thus, the total incremental cost to all private sources is between $0.83 billion and $1.37 billion annually (sum of $595 million to $985 million and $233 million to $388 million). Current expenditures on nonpoint sources are between $1 and $1.3 billion, as shown in Table 19.

In a separate analysis, USDA's Soil Conservation Service (SCS) has estimated that the agricultural NPS controls alone will lower producers' surplus in the agricultural sector by approximately $1.8 billion per year (USDA, 1994). The annual increase in consumer cost for food is roughly equal to the decline in government subsidy payments. This figure was derived using an entirely different modeling methodology that simulates the impact of the NPS controls on the affected agricultural sectors. This approach allows for the effects of increases in producers' costs for bringing various commodities (e.g., crops, dairy, livestock) to market to filter through the economy. One reason for the considerably higher cost estimate compared with the extrapolation discussed above is that credits for savings in pesticides and nutrients (through the nutrient and pesticide NPS management measure) are considerably lower. This reflects differences between USDA and EPA beliefs concerning the potential for such measures to reduce chemical requirements. USDA/SCS believes that these estimates are high and that available alternatives, if used, could result in lower costs.

3.2 Municipalities

The NPS control provisions, particularly the urban runoff measures, will affect municipalities that will be required to implement controls for road, highway, and bridge

maintenance, among others. Costs for these measures are included in the costs for urban controls shown in Section 3.1, Private Sources.

3.3 State Water Programs

The NPS control provisions are estimated to cost state water programs $10 million per year, based on estimates derived in the State Program Costs study (EPA, 1993f).

3.4 Federal Agencies

The impacts of the NPS control and watershed provisions on federal agencies are estimated to range from $118 million to $210 million per year, as shown in Table 4.[5] These resources will be used by: USDA/FS to develop watershed management plans for federal forests; DOI, to assist in identifying impaired waters and preparing NPS plans; EPA, to provide guidance to states on nonpoint sources and watershed management; NOAA, to assist in watershed identification and designation; and DOD, to address NPS discharges from defense facilities.

3.5 Benefits[6]

Methodology

To derive a qualitative estimate of the potential environmental benefits that could result from implementation of the Initiative's recommendations for strengthened State NPS programs, the following steps were taken:

(1) An analysis of State section 305(b) Water Body System (WBS) data was performed to determine the most prevalent combinations of nonpoint sources and causes (pollutants) associated with impaired and threatened waters,

(2) Management measures specified by EPA in its "Management Measures Guidance" were assumed to be the "best available management measures" that would be implemented within 7½ years of passage of Clean Water Act amendments,

(3) The likelihood that the management measures would measurably improve the water quality (within 10 to 20 years) in those threatened and impaired waters was projected for

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[5] USDA's Soil Conservation Service has indicated that if implementation is their responsibility, the cost would range between $211 and $540 million per year to assist the farmers with implementing NPS control measures.

[6] See also the EPA (1994) background paper "CWA Benefits of Nonpoint Source Controls," January 1994. These estimates are not net of CZARA benefits and do not account for potential benefits from the implementation of the Farm Bill of 1990. Therefore, the benefits associated with nonpoint source controls may be somewhat overestimated.

each combination of water body type, use support status, and prevalent combination of nonpoint sources and causes. The 10- to 20-year timeframe was chosen based upon extensive experience in NPS programs, as well as on studies that either demonstrate or project lag times of 10 or more years before the water quality benefits from pollution control efforts can be measured in water bodies;

(4) The overall impact of implementation of the best available management measures was estimated by summing, by water body type, the length or area of water body for which measurable water quality improvements could be expected,

(5) Factors that could either increase or decrease the likelihood of measurable water quality improvement were identified,

(6) All major assumptions made in the analysis were identified and evaluated with regard to their impact upon the validity of the analytic results,

(7) Selected case studies were identified to gauge the validity of the analytic results and to illustrate the significance and specifics of study findings.

Discussion

The Water Body System (WBS) currently contains data from 1992 for 30 entities. Not all of the 30 entities reported data for all water body types, however. Some key States for which data are not reported in the WBS include California, New York, North Carolina, Florida, Illinois, Minnesota, Arizona, Colorado, Idaho, and Oregon.

For this analysis, rivers (28 entities) and lakes (24 entities) were selected. Very little data were available for estuaries, coastal waters, and wetlands. The sources considered in the analysis were agriculture, silviculture, construction/urban, hydromodification/habitat modification, point sources, and other. Mining, land disposal, septic systems, and marinas were among the sources included under "other." Point sources included all point source categories and subcategories.

The causes (pollutants) selected for the analysis were nutrients, pesticides, metals, siltation, organic enrichment/dissolved oxygen, salinity, flow alteration, other habitat alteration, pathogens, oil and grease, suspended solids, and total toxics. The beneficial uses affected were not explored in this analysis, but EPA (1992) has summarized such information from State section 319 assessment reports. For the 20 states reporting in this analysis, EPA showed that wildlife (37 percent of threatened or impaired waters), recreation (22 percent), fishery (15 percent), agriculture (12 percent), and drinking (9 percent) were the major river uses affected, while for 18 states reporting the major lake uses affected were recreation (25 percent), wildlife (19 percent), fishery (16 percent), agriculture (13 percent), and drinking (13 percent).

To obtain summaries of the most prevalent combinations of sources and pollutants by

water body type and use support type (fully supported, fully supported but threatened, partially supported, not supported), some initial assumptions were made of the most likely candidates for "prevalent combinations." These assumptions were based upon 305(b) report data and related data. The goal was to account for two-third to three-fourth of the impaired or threatened waters for each water body type with information on prevalent combinations. In other words, if 75 percent of the threatened lake acres for the 30 reporting states was accounted for by identifying three combinations of sources and pollutants, then those three combinations would be identified as the "prevalent combinations," with the remaining 25 percent accounted for by "other."

Table 5 shows the impaired and threatened river miles for the 28 entities reporting. It also shows the share of those miles for which each of the major sources contributes to the water quality problem. For example, agriculture is a source listed for 79 percent of the partially supported river miles. Table 6 shows the mileage for each of the major sources where it is the only listed source. It is important to note that data in Table 5 are not additive, while data in Table 6 are additive.

While agriculture contributes to the problems in 44,700 of 56,600 partially supported river miles (Table 5), only 18,400 of those miles (32 percent) (Table 6) have agriculture listed as the only source. This finding supports the approach of looking at prevalent combinations of sources and pollutants. Due to the very large number of possible combinations of sources and pollutants for each water body, selecting a subset of combinations for analysis was necessary based upon knowledge of the WBS data base. The combinations of sources shown in Tables 5 and 6 are those for which a significant percentage of threatened and impaired waters were identified. Due to the extremely small numbers resulting for the combinations of sources and causes, those data are excluded from the analysis.

Table 7 shows the impaired and threatened lake acres for the 24 entities reporting, excluding the Great Lakes. It also shows the share of those acres for which each of the major sources contributes to the water quality problem. For example, "urban" is listed as contributing to the water quality problems in 15 percent of lake acres not supporting uses. Data in Table 7 are not additive. Table 8 shows the acreage for each of the major sources where it is the only listed source. Data in Table 8 are additive. While "urban" contributes to the problems in 75,200 of 490,000 lake acres not supporting uses (Table 7), only 39,300 of those acres (52 percent) (Table 8) have urban listed as the only source. Due to the extremely small numbers resulting for the combinations of sources and causes, those data are excluded from the analysis.

The management measures applied in this analysis are listed in Figure 1. These measures are primarily pollution prevention measures, yet the analysis for CWA calls for attention to impaired and threatened waters. The general lack of remediation measures in this list will cause a lower expectation of water quality improvement than would otherwise be assumed if remediation measures were included. The analysis assumes that all measures were applied as systems and that whole watersheds were treated.

The relative likelihood that the management measures would measurably improve the

water quality (within 10 to 20 years) of those threatened and impaired waters was projected for each combination of water body type, use support status, and prevalent combination of nonpoint sources. These projections were based upon best professional judgment, as applied in a round-table discussion of each "prevalent combination" of sources, the management measures that could be applied to address them, the needs for addressing fully the types of problems identified, and the type and level of pollution control or treatment provided by the management measures compared with the needs for addressing the problems.

The projected likelihood that the management measures will measurably improve water quality is expressed as "high," "medium," and "low." High likelihood can be interpreted as a 67 to 100 percent chance that measurable water quality improvement will occur within the 10- to 20-year timeframe, subject to the assumptions specified in this analysis. Medium likelihood is a 34 to 66 percent chance, and low likelihood is a 0 to 33 percent chance.

It is important to note that because the management measures being considered are largely pollution prevention measures, we believe that these measures have a high probability of protecting waters currently fully supporting beneficial uses. In other words, we believe that full implementation of the management measures will maintain full support of uses on 63,500 miles of river (28 entities) and 1.15 million acres of lake (24 entities). The results of this analysis for rivers is shown in Table 9, while the lake results are shown in Table 10.

Summing by water body type, the data in Tables 9 and 10 provides an overall estimate of the likelihood that full implementation of the management measures will result in measurable water quality improvement.[7] Table 11 shows that measurable water quality improvement is anticipated to occur with high likelihood in 8,300 miles of impaired and threatened river miles in the 28 entities reporting. This represents 7 percent of the total impaired and threatened river miles reported by those entities. Water quality in an additional 50,200 miles, or 45 percent, has a medium likelihood of improving measurably.

The preceding projections only apply to the 28 states that reported under section 305(b). Given similarities in use support and major sources, EPA projected that for all 54 states and territories, 156,200 river miles, that are impaired or threatened, will show measurable water quality improvements, as shown in Table 12. About 10 percent of these river miles are given a high likelihood and roughly 46 percent a medium likelihood. EPA estimates that less than 30,800 threatened and impaired river miles are covered under CZARA and would not be affected by this provision.

Table 13 shows that measurable water quality improvements are anticipated to occur with high likelihood in 225,200 acres of impaired and threatened lake acres in the 24 entities reporting, excluding the Great Lakes. This represents 10 percent of the total impaired and

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[7] For the purposes of this assessment, EPA has defined the term "measurable water quality improvements" to generally mean: "statistically significant improvements in measured chemical, physical, and/or biological monitoring parameters over a 10- to 20-year period."

threatened lake acres reported by those entities. Water quality in an additional 1.15 million acres, or 53 percent, have a medium likelihood of improving measurably. Given similarities in use support and major sources, EPA projected that for all 54 states and territories, 7.1 million lake acres, that are impaired or threatened, will show measurable water quality improvements, as shown in Table 14. About 10 percent of these lake acres are given a high likelihood of improvement and about 58 percent are given a medium likelihood. The total lake acreage that may benefit from the implementation of CZARA, which is oriented towards coastal water bodies, will be nominal except in Florida and Louisiana. (The Great Lakes were not included in either projection.)

Many factors and assumptions were identified that could either increase or decrease the likelihood of measurable water quality improvements. These include:

- Management measures are generally pollution prevention measures. If remedial activities accompany the measures, then the likelihood of water quality improvement should increase.

- Rapidly flowing systems and systems with short hydrologic retention times have a greater chance of achieving water quality improvement in 10- to 20-years, while slow-moving systems and systems with long hydrologic retention times have a lesser chance of achieving water quality improvement.

- The intensity of land-based activity will affect the likelihood of achieving water quality improvement. For example, a rapidly urbanizing area will result in much more construction and pollutant loading than a slowly urbanizing area where the same measures are applied.

- Rapid changes in pollutant loadings to lakes may result in changes at the sediment-water interface that cause a short-term increase in flux of pollutants (e.g., phosphorus) from bottom sediments. This may cause temporary delays in achieving water quality improvements, and sometimes temporary decreases in water quality.

- Management measures are fully applied within 2 to 3 years. This includes full application of measures such as in-stream and riparian habitat restoration, and other measures for which states are given considerable latitude.

- Management measures are well designed, implemented, operated, and maintained.

- Point source controls will be needed in conjunction with NPS controls where both sources exist, so these situations could not be evaluated in this analysis.

- The analysis assumed a baseline of low to nonexistent watershed management. This results in an assumption of greater possible water quality improvement than would be possible if some management existed. To partially adjust for this, the analysis employed

conservative assumptions of water quality improvement resulting from management measure implementation.

- Each source identified as a "prevalent combination" was considered to be a typical example rather than an extreme example. In other words, the treatment needs were considered to be "average."

- Each water body problem was assumed to be independent of the other water bodies.

- Water bodies were assumed to be "normal" (e.g., second order stream) rather than "special" (e.g., ephemeral stream).

Selected case studies were identified to gauge the validity of the analytic results, and to illustrate the significance and specifics of study findings. These can be found in Appendix A.

4.0 Storm Water

EPA's current Phase I storm water program requires NPDES permits of cities and counties with municipal separate storm sewer systems (MS4s) serving populations of 100,000 or more and "storm water discharges associated with significant industrial activity." The Phase II program, currently suspended due to a Congressional moratorium, could require permits for all private sources of storm water (commercial, industrial, retail, and institutional) and all MS4s serving all populations that have the potential to affect water quality. In the Initiative, EPA has addressed the potentially high costs of the Phase II program while still providing protection from private sources and additional MS4s.

The "worse case" scenario for storm water permitting reflects the most inclusive option of all potential options that EPA would consider in proposing rules for the types of facilities covered under Phase II. If EPA were to propose regulations for permitting Phase II facilities, EPA may propose to cover only a portion of these facilities, based on consideration of costs incurred and environmental benefits gained. EPA could propose regulations covering the same facilities to the same extent as suggested in the Initiative.

The Initiative's Phase II program will focus on system-wide permits for MS4s in Census-designated urbanized areas--i.e., areas with a population of 50,000 or more and a population density of 1,000 persons per square mile. The Census Bureau has identified 396 such urbanized areas nationwide. Phase II MS4s will be required to implement storm water management programs that are subject to a "maximum extent practicable" (MEP) standard. These programs will, at a minimum, address: (1) nonstorm water discharges to their systems (i.e., illicit connections) and (2) storm water runoff from growth and development and significant redevelopment activities (including discharges from construction of less than 5 acres) and, where appropriate, those Phase II sources causing water quality impairment.

Where the NPDES authority deems it necessary, MS4s in the 138 urbanized areas associated with a Phase I permitted MS4 may be required to have a more comprehensive storm water management program (consistent with the Phase I storm water requirements). The comprehensive storm water management programs would cover Phase II light industrial, commercial, retail, and institutional storm water sources under a municipality's storm water permit. The NPDES program would not cover Phase II sources not addressed through a municipal program. Such discharges could be addressed by the NPS program if they were a targeted source.

4.1 Private Sources

Under a stringent interpretation of the CWA, the current Phase I program is estimated to cost industrial permittees $3.99 billion per year, while Phase II under a similarly stringent interpretation could cost as much as $16.23 billion in annual costs.

To account for the uncertainty in estimating the potential costs, EPA has developed ranges. These ranges account for variations in both the number of sources affected and the costs incurred. The Initiative's Phase II plan would reduce these impacts on commercial, service, and institutional facilities considerably, imposing costs of between $0.34 billion and $1.67 billion per year, as follows:

	Low	High
10,000 facilities x $22,340/facility 28,000 facilities x $34,700/facility	$0.22 billion	$0.97 billion
96,000 facilities x $630/facility 269,000 facilities x $1,885/facility	$0.06 billion	$0.51 billion
100,000 sites x $630/site 100,000 sites x $1,885/site	$0.06 billion	$0.19 billion
TOTAL	**$0.34 billion**	**$1.67 billion**

From a universe of 1.1 million significant sources, EPA has identified 100,000 that are similar to Phase I industrial sources while the remaining 1.0 million are retail, commercial, and institutional. Of the 100,000 industrial sources, approximately 60 percent or 60,000 have no storm water exposure. Of the remaining 40,000 sources, EPA has assumed that municipalities will require between 25 and 70 percent of the facilities to install storm water controls. To further account for the uncertainty inherent in projecting costs, EPA has used $22,340 per facility at the low end and $34,700 per facility at the high end of the estimated cost to comply (EPA, 1994c). The total cost for industrial look-a-likes is estimated to be between $0.22 billion and $0.97 billion per year.

Of the remaining 1.0 million sources, 60 percent are located in urbanized areas and may be addressed under storm water management programs for the urbanized areas. As above, 36 percent, or 216,000 sources, are estimated to have no storm water exposure. Of the remaining 384,000 sources, or 64 percent, the low-end number of facilities (96,000 sources or 25 percent) could incur costs as low as $630 per facility, while the high-end number of facilities (269,000 sources or 70 percent) could incur costs as high as $1,884 per facility.

In addition, 40 percent of the private sources that are not covered by a municipal program would be covered by the NPS program. Under the NPS program, only the sites located in impaired watersheds would need controls. EPA believes roughly 25 percent of these sites are in impaired watersheds. At a range of $630 and $1,885 per site and 100,000 sites, the annual costs will be between $0.06 billion and $0.19 billion.

Based on these estimates, the Initiative's total cost on private sources is between $0.34 billion and $1.67 billion. Compared to EPA's best interpretation of current law and assuming

that the moratorium will expire, the Initiative will avoid costs (or yield a cost savings) of between $14.6 billion and $15.9 billion.

The Initiative may also result in potential cost savings for those facilities currently or soon to be permitted under the existing storm water Phase I regulations. About 60 percent of existing permitted industrial sources and 100 percent of potentially permitted light industrial sources will not require NPDES permits under the Initiative's provisions. In addition, small (less than 5 acre) construction sites will be considered Phase II sources, and this would result in additional cost savings of $70 million per year. As a result, additional cost savings to private sources from Phase I requirements will be between $1.1 billion and $1.6 billion.

The above estimates are derived in EPA, 1994c, and are summarized here. Based on a stringent interpretation of the current law, the overall cost savings (or costs avoided) to private sources from these provisions would be in the range of $15.7 billion and $17.5 billion, as shown in Table 21.

4.2 Municipalities

Costs for the current Phase I program for municipal sources are estimated at between $1.6 billion and $2.6 billion annually, based on a covered population of 69.3 million people and per person costs of between $23.91 and $37.00 per person.[8]

If the Phase II moratorium expires, EPA could be required to promulgate regulations covering an additional population of at least 74.1 million people (25.3 million in 138 urbanized areas associated with Phase I MS4s, 29 million in 258 additional urbanized areas between the population of 50,000 and 100,000, and potentially 19.8 million in other MS4s). EPA's best interpretation of the current law is that it would not include these additional 28 million in other MS4s. Using the same unit costs ($23.91 to $37.00), the existing Phase II program could cost between $1.8 and $2.7 billion per year.

To account for the uncertainty of the impact in terms of the number of municipalities affected and the costs incurred, EPA has estimated a range of costs for the Phase II provision in the Initiative. The following estimates are derived in EPA, 1994c, and are summarized here. About 25.3 million people live in 138 urbanized areas (UAs) with growth and development and illicit discharge. Costs range from a low of $15.33 per capita to a high of $23.72 per capita. The range of total costs for these urbanized areas is between $0.39 billion and $0.60 billion. Next, EPA assumed that between 25 and 70 percent of the population in these UAs will be covered by a comprehensive program based in part on the percentage of impaired urban waters. The population affected will be between 6.33 million and 17.7 million. The additional cost of

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[8] Population estimates for the municipal storm water costs are from the draft "Report to Congress on Storm Water Dischargers Not Regulated Under Phase I of the NPDES Storm Water Program" (EPA, 1993d). Average costs are from the draft EPA report "Review of Program Costs in Part 2 NPDES Municipal Storm Water Permit Applications" (EPA, 1993c).

a comprehensive plan above the cost of addressing growth and development and illicit discharges will be in the range of $8.58 and $13.28 per capita. The total cost of the comprehensive coverage will vary from a low of $0.05 billion to a high of $0.24 billion.

EPA identified 29 million people in another 258 UAs who will be affected by the Phase II provisions. The cost of compliance will vary from $15.33 per capita to $23.72 per capita. The total cost of this coverage will be in the range of $0.44 billion and $0.69 billion. The final element of this cost on municipalities is the cost of addressing private sources and industrial look-a-likes that impact water quality in areas without the comprehensive program and in areas with combine sewers. At a per capita cost of $2.00, EPA estimates that about 75.7 million people will incur $0.15 billion. At a per capita cost of $5.00, the upper-end cost would be $0.38 billion.

	Low	High
25.3 million population x $15.33 per capita	$0.39 billion	
25.3 million population x $23.72 per capita		$0.60 billion
6.33 million population x $8.58 per capita	$0.05 billion	
17.7 million population x $13.28 per capita		$0.24 billion
29.0 million population x $15.33 per capita	$0.44 billion	
29.0 million population x $23.72 per capita		$0.69 billion
75.7 million population x $2.00 per capita	$0.15 billion	
75.7 million population x $5.00 per capita		$0.38 billion
TOTAL	**$1.03 billion**	**$1.91 billion**

The total cost to the municipalities of the proposed Phase II requirements is between $1.03 billion and $1.91 billion, as shown in Table 20.

Compared with the cost of Phase II requirements under a stringent interpretation of the current law, total savings to municipalities will be between $755 million and $850 million per year.

4.3 State Water Programs

The impacts of the Phase II storm water provisions on states have not been estimated but are expected to be minimal.

4.4 Federal Agencies

Additional costs of the storm water provisions on federal agencies will total $19 million per year. EPA will account for $2 million per year of this cost, and DOI will account for $17

million per year.

4.5 Benefits[9]

The benefits of storm water control as proposed in the Initiative are based on numerous case studies and are summarized as follows:

- 75 to 80 percent reduced loadings in urbanized areas prior to and during development,
- 15 to 25 percent reduced loadings in areas already developed,
- Greater environmental protection at lower cost,
- Improved water resource quality, habitat, and aquatic life; reduced flooding; improved recreational opportunities; increased commercial fishing; improved human health; and increased employment.

(Note that more cost-effective and institutionally feasible prevention and management methods are available for new development than for areas that have already been developed.)

Case Studies[10]

Bellevue, Washington (see longer summary in Appendix B)

Bellevue has a population of nearly 87,000 and covers a 30-square mile area that contains five lakes and over 50 miles of open streams. The city established a storm water utility in 1974 to maintain a hydrologic balance, prevent property damage, and protect water quality.

The city requires newly developing areas to include on-site storm water management that provides protection for 24-hour, 100-year storm events.

Examples of program benefits:

-- Flood control. One of the most successful aspects of the program is flood control, which relies on eight remote-controlled regional detention basins along major stream corridors to monitor rainfall, stream flow, and water levels. This helps ensure that flood gates control peak flows. Small detention basins reduce peak flow rates up to 60 percent, providing flood and stream-bank erosion control and protecting stream-side property.

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[9] See also the EPA (1994e) background paper "CWA Benefits of Storm Water Controls," January 1994.

[10] Costs for these case studies were not available and hence are not included here.

-- Reduced property damage. As a result of storm water controls over the previous 10 years, property damages were avoided during a 100-year storm in January 1986.

-- Reduced pollutant loadings. Runoff concentrations of lead and total solids were reduced by 10 to 25 percent through biannual cleaning of storm drainage inlet pumps and catch basins; oxygen demanding substances, nutrients, and zinc concentrations were reduced by 5 to 10 percent. Conventional street-sweeping operations reduced toxic loadings by 5 to 10 percent. Installation and maintenance of oil/water separators reduced floatables in the drainage system.

-- Reduced illegal dumping. Dumping of motor oil and debris in storm drains was significantly reduced through increasing public awareness of storm water issues and volunteer stenciling of storm drains. A recent survey indicates that 85 percent of area residents dispose of used oil at a recycling facility.

-- Increased recreational opportunities. Clean-up of Mercer Slough (a 325-acre wetland) along with stream and wildlife enhancement of the park resulted in increased canoeing on the slough and increased visitation to the park's trails.

Murray City, Utah

Murray City (population 31,000) worked with the Utah Department of Transportation (DOT) to develop a storm water control system for runoff from a 4.5-mile stretch of highway in conjunction with the construction of an 18-hole, 135-acre municipal golf course.

Storm water runoff from the highway and subsurface waters is collected and routed through a series of streams and wetlands into four ponds on the golf course.

Examples of program benefits:

-- Reduction in pollutant loadings. The pond system removes approximately 90 percent of the sediment, oil and grease, and dissolved materials from the highway runoff.

-- Flood control. The system successfully handled the runoff from two 25-year storms.

-- Savings in irrigation water costs. The detention ponds provide 7 acres of flood retention area and created nearly 11 acres of wetlands. The ponds also provide water to irrigate the golf course, which saves nearly $80,000 per year in watering costs.

-- Savings in highway construction costs. Because runoff was diverted to irrigate

the golf course, DOT saved $300,000 in land acquisition and storm water piping costs by eliminating the need to construct a separate storm water discharge system for the highway.

Orlando, Florida

The city of Orlando (population 160,000) receives over 50 inches of rain annually, over half of which converts to storm water runoff and flows into the city's 83 lakes. One example of a project to manage storm water is the creation of the Greenwood Urban Wetland, which consists of several ponds in a series.

Examples of program benefits:

-- Increased property values. Overall, whenever Orlando constructs a storm water control lake, property values in that area increase.

-- A savings was realized in construction of the Greenwood Urban Storm Water Control Wetland with the sale of fill dirt that was excavated ($5/cubic yard).

-- Creation of a natural park. The Greenwood Urban Wetland created a natural park atmosphere (with footbridges, walking paths, picnic areas, and opportunities for observing wetland wildlife) in an urbanized area.

-- Irrigation and drinking water supply. Cleansed storm water is used to irrigate the upland areas of the park, which conserves the drinking water supply.

Santa Clara Valley, California

Santa Clara Valley has a municipal storm water permit covering 15 co-permittees (14 municipal entities and one water control district). Three of the municipalities have populations over 100,000, four are between 50,000 and 100,000, and seven are less than 50,000.

Transportation activities have been identified as potentially the most significant source of storm water pollutants. Copper and zinc have been identified as significant contaminants in the storm water runoff into south San Francisco Bay. These metal are carried by suspended particles. Brake pad dust is believed to be a major source of the copper.

Examples of program benefits:

-- Significant reduction in copper loadings. Street sweeping activities clean 19,000 miles per month and have prevented 2,500 pounds of copper and 46,000 cubic yards of material throughout the area from entering storm sewers.

-- Reduction in floatables. Cleaning 34,000 catch basins has removed 1,000 cubic

yards of material. Inspection and cleaning of 160 miles of conveyances has removed 400 cubic yards of material.

-- Identification of illegal dumping activities. The co-permittees identified 867 cases of illegal dumping, of which 700 have been resolved.

Tulsa, Oklahoma

The city of Tulsa (population 367,000) has been recognized as having an effective storm water management program. EPA recently issued a draft municipal storm water permit for Tulsa.

Discharges from Tulsa's storm sewer collection system were identified as a source of pollutant loadings in the Zinc Lake portion of the Arkansas River. The storm sewer's discharges showed a high concentration of bacteria.

Examples of program benefits:

-- Removal of suspended solids. Tulsa estimates that its construction site storm water controls average 70 percent effectiveness in removing total suspended solids from storm water runoff. In addition, the city estimates that its street sweeping and structural operation and maintenance reduce suspended solids by up to 50 percent; metals by up to 10 percent; total solids and lead by 10 to 25 percent; and oxygen demanding substances, nutrients, and zinc by 5 to 10 percent.

-- Improved Water Quality in the Arkansas River. The city identified 35 illicit storm sewer connections drained into Zinc Lake and the Arkansas River. Tulsa removed these discharges from the storm sewer system and states that water resource quality has improved as a result.

5.0 Combined Sewer Overflows

Combined sewer overflows (CSOs) occur in sewer systems that combine sanitary sewage and surface runoff. When storms occur, the combined sewer system (CSS) capacity is exceeded, and the mixture of sewage, untreated industrial and commercial wastes, storm water runoff, and other waste in the system is discharged to surface waters. Human and animal waste, pollutants from industrial and commercial sources, trash, and oil and grease are discharged.

EPA's CSO Control Policy (EPA, 1993) establishes a national framework and clear expectations for the control of CSOs. The CSO Policy is largely the result of a successful negotiations with key CSO stakeholders, including municipal groups, environmental groups and states. It addresses the unique characteristics of CSO controls and balances considerations of the site-specific nature of CSOs and their environmental impacts. The Policy also provides for an evaluation of the cost effectiveness of CSO controls; consideration of a community's ability to pay for CSO abatement; and other factors necessary for developing flexible and cost effective CSO control measures. The Initiative would clarify EPA's authority to implement the CSO Policy and would provide legislative reference in the CWA for this policy.

5.1 Private Sources

The impacts of the CSO provisions on private sources have not been estimated but are expected to be minimal.

5.2 Municipalities

EPA's 1992 CSO Needs Survey estimates that the national costs of CSO control with 85 percent capture and primary clarification is $41.2 billion in 1992 dollars (Metcalf & Eddy, 1993).[11] EPA estimates that these costs will be borne in years 3 to 15 following CWA reauthorization (or in some cases, over longer periods). Annual operating and maintenance (O&M) expenditures associated with these capital expenditures are estimated at $300 million per year. Annual costs for CSO abatement are thus $3.45 billion per year (see Table 19), derived by dividing the total CSO capital needs by 13 years and adding the O&M costs ($41.2 billion ÷ 13 years + $300 million = $3.45 billion). EPA plans to implement the Policy and hence no incremental costs are shown in Table 20.

During the negotiations, CSO stakeholders considered a range of controls and alternatives that achieved various degrees of environmental and public health benefits at different national costs. Figure 2 and Table 15 are examples of the data considered and the relationships that exist between controls and costs. The negotiations focused on the reduction of raw sewage overflow events rather than on the reduction of pounds of pollutants. Raw sewage overflows were viewed

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[11] CSO "control" is defined based on the goal of "... the elimination or capture of 85 percent by volume of the combined sewage collected in the combined sewer system during precipitation events on a system-wide average basis..." (EPA, 1993).

as the key concern because they result in immediate violations of water quality standards and created immediate public health concerns for the downstream beaches, shellfish beds and drinking water intakes. With this as a guiding principle, stakeholders focused on the extent of the reductions of CSO overflow events. Four to six overflow events, equivalent to 85 percent capture and primary clarification, was determined to be an appropriate target of control, in the absence of clear data that show the level of control necessary to meet water quality standards. A municipality may demonstrate that another level of control is adequate to meet water quality standards.

Full implementation of the CSO requirements, according to one interpretation that is not shared by EPA, could cost as much as $14.14 billion per year (EPA, 1994d) based on an assumption of 85 percent capture with secondary treatment, as shown in Table 22. The Initiative is proposing to codify the CSO control strategy that could potential save municipalities about $10.7 billion annually in avoided costs.

5.3 State Water Programs

The impacts of the CSO provisions on states have not been estimated but are expected to be minimal.

5.4 Federal Agencies

The additional impacts of the CSO provisions on federal agencies have not been estimated but are expected to be minimal.

5.5 Benefits

The benefits of the Initiative's CSO provisions will be to reduce the discharge of untreated sewage and pollutant loadings associated with CSSs. In the affected areas, this will have potentially major economic and environmental impacts, which are discussed below.

Reductions in Volumes of Untreated Sewage and Pollutant Loadings Reduction from CSOs

On average, CSSs experience 50 to 80 overflow events per year. The number will be reduced to approximately 3 to 4 events. This will have major implications for the water quality of the receiving waters, including:

- Reduce the number of water quality standards (WQS) violations for each system from 100 to 200 days per year to no more than 10 to 20 days per year.
- Reduce CSO discharges from 1,200 billion gallons per year to 180 billion gallons per year.
- Reduce annual TSS discharges from 3.7 billion pounds to 1.29 billion pounds.

- Reduce annual BOD discharges from 1,150 million pounds to 635 million pounds.

- Reduce by 35 to 65 percent the current annual amounts of the following discharges: 19 million pounds of ortho phosphate (PO_4-P), 95 million pounds of total nitrogen, 18 Million pounds of metals (zinc, copper, cadmium, cooper, lead, nickel), and 4 million pounds of toxic volatile organics.

Reduced Uncertainty Regarding Compliance with CWA and Water Quality Standards

The extent of failure to meet water quality and designated uses because of CSO affects the following 1990 305(b) data:

- 503 square miles of estuaries
- 132 shore-miles of coastal waters
- 93 shore-miles of impaired Great Lakes
- 21,360 lake-acres in fresh lakes
- 5,163 river-miles

Policy implementation will streamline the permit writing and water quality standards processes, better define the criteria appropriate to support the designated uses of CSO receiving waters, and result in compliance with applicable state water quality standards.

Shellfishing Restrictions

In 1990, CSOs contributed to prohibitions, conditions, or restrictions on 597,000 acres, or 9.4 percent of the total harvest-limited acreage. Sixteen percent of the limited shellfish harvest areas in the North and Mid-Atlantic are caused by CSOs. Substantial reduction in closing of shellfish beds are expected (see the case studies).

Fish Kills

In EPA's 1988 National Water Quality Inventory, 38 states reported 996 fish kill incidents (EPA, 1990a). Twenty-four of those states reported the number of fish killed: a total of 36 million. Of the incidents reported, 605 were caused by conventional pollutants (primarily oxygen-demanding substances), while 135 were caused by toxic pollutants. Sixteen states reported municipal facilities, which may include CSOs, as a source of fish kills. The controls implemented under the CSO policy will significantly eliminate discharges of oxygen demanding pollutants (BOD) and toxics in concentrations that deplete dissolved oxygen concentrations below those required to support fish resulting in substantial reductions in Fish Advisories.

Beach Closures

According to NRDC, 1,592 days of beach closures or advisories were issued in 1990,

2,008 days in 1991, and 2,619 in 1992. CSOs were implicated as an important contributor to those beach closures.

The presence of plastics and other floatable waste or debris, which in some cases can be traced to CSOs, may also prompt health authorities to close public beaches or issue beach advisories. The floatables problem has become particularly acute in some urban areas, particularly in the vicinity of New York City.

Flooding

Most cities' CSSs were built over 40 years ago. New developments and increased flow often result in sewer surcharge and basements flooding during wet weather. In addition to property damage related to the flooding, clean-up poses serious heath risks. CSO abatement efforts will also help eliminate basement flooding. This has been demonstrated in the City of Portland, Oregon.

Avoided Drinking Water Treatment Costs

Under the CSO Policy, the discharge of undisinfected CSOs to surface waters used as public drinking water supplies will be dramatically reduced, reducing pathogens and bacteria to levels that can be adequately treated by water supply facilities and resulting in savings in the cost of drinking water disinfection and a reduction in human health risks.

Aesthetic Improvements

CSO abatement efforts will eliminate the discharge of condoms, tampon applicators, and other sewage-related floatables that degrade the aesthetic quality of receiving waters, limit recreational uses, damage property values, and threaten wildlife (by ingestion of or entanglement in plastic debris).

Other Effects

Jobs Supported

The estimated number of direct and indirect jobs supported by a $1 billion investment in water and wastewater infrastructure is 16,500, with an additional 16,500 "induced" jobs supported nationwide. According to these estimates, implementation of the CSO Policy will support about 57,000 direct and indirect jobs and another 57,000 induced jobs per year.

Public Access

In concert with the construction of CSO controls, Columbus, Georgia, cleaned up a hazardous waste site, refurbished the shoreline of the Chattahoochee River, and built a bicycle/walking path along the River, thus greatly enhancing public access. CSO abatement

efforts in many other cities will create similar opportunities for significant indirect benefits.

6.0 Toxics Controls

The Initiative provides additional authority to EPA to limit releases of the most toxic and bioaccumulative pollutants.

6.1 Private Sources

Currently EPA's primary pollution control efforts are focused on point source discharges to water. For many pollutants, other sources are the largest contributors of contaminants. Mercury, for example, one of a limited number of highly toxic and bioaccumulative pollutants, is present in surface water largely from atmospheric deposition. Restricting or banning the point source discharge of toxic pollutants may not be the most cost effective approach. A cross-media approach allows the Agency the flexibility to select the most cost-effective controls.

Due to our inability to predict which pollutants might be impacted and what costs might be incurred by dischargers, EPA has not estimated the costs of the Initiative's toxics control provision. The toxics ban/restriction provision would affect private sources, leading industry to use pollution prevention measures, in-plant controls, and/or new technologies. Restrictions or bans could be costly. For example, industry estimates the cost of eliminating dioxin from bleached kraft pulp production at $1.3 billion annually (Phillips et al., 1993). Setting effluent standards at the detection limit is estimated to cost about $140 million annually (Nicoll, 1994). However, other sources of dioxin may be more cost effective to control. This provision will allow the review of <u>all</u> sources in selecting an appropriate source of control.

6.2 Municipalities

The impacts of the toxics provision on municipal sources have not been estimated but are expected to be minimal.

6.3 State Water Programs

The impacts of the toxics provisions on states have not been estimated but are expected to be minimal.

6.4 Federal Agencies

The toxics provisions will impose additional administrative costs on EPA, and further compliance costs on agencies such as USDA, DOI, DOD, and NOAA. EPA will not incur incremental costs. Compliance by other agencies will impose estimated annual costs of between $66 million and $105 million. Table 4 summarizes the impacts of these provisions on the federal agencies.

6.5 Benefits[12]

The Initiative's toxics provisions provide EPA with further authority to restrict or eliminate discharges of the most highly toxic and/or bioaccumulative pollutants. Reductions in the magnitude of such releases will have potential benefits on human health and the environment. Several categories of benefits are discussed below.

Reduced Human Health and Aquatic Life Impacts

- Toxics (bioaccumulative pollutants in particular) are linked with birth defects, cancer, neurological disorders, reduced IQ, heart disease, and kidney ailments.
- Many aquatic organisms are more sensitive than humans to toxics.
- Toxics can alter species composition/diversity, increase susceptibility to disease, interfere with reproduction, reduce viability of young, and increase mortality.
- Some pollutants are extremely harmful in small quantities and/or build up in the food chain to produce adverse and long-term effects to human health and the environment. This is recognized in the Great Lakes, where the United States has formed an international joint commission with Canada to develop a virtual elimination strategy for persistent toxic substances. In addition, EPA has proposed the Great Lakes Water Quality Initiative, which requires more stringent water quality standards for persistent bioaccumulative pollutants.
- Bioaccumulative pollutants can damage ecosystems by directly eliminating sensitive species or indirectly causing increased incidence of disease in the remaining species.
- Some bioaccumulative pollutants may persist in the environment for decades, posing a continuing threat to humans, aquatic organisms, birds, and other wildlife.

Decreased Fish Consumption Advisories

- Some 1,280 water bodies have fish consumption advisories or bans in place to protect human health,
- Most of the total number of advisories are in Minnesota and Wisconsin. However, no uniform approach exists among states for issuing advisories,

[12] See also the EPA (1994f) background paper "CWA Benefits of Toxics Controls," January 1994.

- Of the advisories, 60 percent are for mercury, 21 percent for PCBs, and 6 percent for chlordane.

Decreased Amount of Contaminated Sediments

- The U.S. Army Corps of Engineers dredges from 300 to 400 million cubic yards annually; based on Corps data for 19 districts (out of 30), almost 10 percent of the dredged material required special handling because of toxics,

- Costs of special handling are highly variable, from as little as $10 per cubic yard to more than $100 per cubic yard (total cost of special handling equals $160 million to $1.6 billion),

- Costs of normal handling is $1 to $10 per cubic yard (total cost if toxics are not present equals $16 million to $160 million),

- Total estimated remediation costs of PCB-contaminated sediments at five Superfund sites ranged from $93 million to $520 million ($1991).

Case studies illustrating the potential benefits of toxics reduction can be found in Appendix C.

7.0 Comprehensive Watershed Management

The Initiative provides support for the "watershed management approach," a geographic-based strategy for addressing water quality problems. Under these provisions, states would identify and prioritize watersheds, designate watershed management entities, and oversee the development of watershed management plans. EPA would provide guidance to the states and to watershed management entities, and would approve state watershed programs. As an incentive to participate in the watershed approach, states would be eligible to consolidate several existing grants (SRF excluded) into a multipurpose grant.

7.1 Private Sources

The impacts of the watershed management provisions will be felt when watershed management plans are developed and the sources contributing to impairment are identified. The plans will define measures necessary to ensure further progress within the economic capability of the sources and will include such pollution load reduction allocations for point and nonpoint sources as are necessary to ensure further progress.

Because of the number of steps that must occur before affected parties would be required to undertake compliance actions, estimating the potential scope of these impacts is impossible. For a particular impaired watershed, one can envision a plan that identifies point or nonpoint sources as contributors to impairment and imposes upon them economically achievable measures to reduce discharges and improve water quality. Until such plans are developed, however, the potential overall costs of such requirements cannot be estimated.

7.2 Municipalities

In some watersheds, municipal sources (e.g., sewage treatment facility operation, road salting, municipal construction, landscaping) may be important contributors to water quality problems. Watershed management plans may identify these sources and propose new controls or provide new incentives to reduce their pollutant contribution. As indicated under the private sources section above, however, the impacts on municipalities will be felt only after watersheds are assessed, problems are identified, and plans are developed and approved. The contingent nature of any changes that would be required makes it difficult to estimate the potential impacts at this time.

7.3 State Water Programs

Impacts of the comprehensive watershed management provisions on state water programs are estimated at $82 million per year (EPA, 1993f). These costs are attributable to the new responsibilities states will have for identifying watersheds, designating watershed management entities, overseeing the development of watershed management plans, and pursuing and administering any funding for watershed activities.

7.4 Federal Agencies

Impacts of the comprehensive watershed management provisions on federal agencies are combined with the costs of NPS control and are shown in Table 4 to total between $329 and $750 million per year.

7.5 Benefits[13]

The benefits of the watershed approach are best characterized as including cost savings due to administrative efficiency and the use of cost-effective control strategies that take all sources into account.

- A watershed approach allows the development of controls that enable ecosystems to function properly and recreational opportunities (e.g., fishing, boating, and enhanced tourist visitation) to increase.

- A watershed approach, particularly when used in conjunction with technical tools such as Total Maximum Daily Load (TMDL), allows development and implementation of alternative, cost effective approaches for reducing adverse impacts on water bodies.

- A watershed approach can go beyond traditional regulatory relationships and techniques to solve environmental problems. Stakeholder involvement improvements chances of success. Experience has shown the voluntary participation of interested parties at the watershed level can yield more gains than a traditional top-down regulatory approach. Watershed management can facilitate local actions and decisions such as changes in zoning laws that cannot be made effectively at the federal or state level.

Numerous ongoing watershed projects exist across the country. Below are summaries of some of the notable projects and their successes:

- The Boulder Creek, Colorado, Enhancement Project, following a parallel approach to the TMDL process, addressed elevated in-stream pH, temperature, and ammonia concentrations, as well as reductions in fish and macroinvertebrate species density and diversity. A partnership of local, state, and federal entities crafted a holistic strategy that combined a point source upgrade at the local wastewater treatment plant (WWTP), with agricultural NPS best management practices and riparian zone and in-stream habitat restoration. The total cost of restoring approximately 5 stream miles is currently estimated at $1.3 to $1.4

[13] See also the EPA (1994g) background paper "CWA Benefits of a Watershed Protection Approach," January 1994.

million, far less than relying on wastewater treatment plant upgrades alone, which was estimated at $23 million. Restoration of the physical condition of the creek and its riparian zone has enhanced fish habitat, improved aesthetics, made the creek more appealing and useful to the community, and resulted in attainment of water quality goals. Restoration of the creek, as part of a broader watershed improvement effort, has also increased recreational benefits through the development of bicycle pathways and educational displays.

- The Patuxent River watershed, which drains into the Chesapeake Bay, is situated between Baltimore and Washington, a rapidly growing area that has experienced large increases in population over the past decade. By the 1970s the Patuxent had become one of the most nutrient-enriched systems in the Bay region, with associated dissolved oxygen and water clarity problems. A plan was developed in the early 1980s, with the involvement of state agencies, elected officials, local governments, and scientists, to reduce point and NPS loadings of nitrogen and phosphorus. Total capital costs for plant improvements from 1980 to 1992 were $196 million.

  Nutrient Loads from the WWTPs have been reduced substantially in the Patuxent Watershed since 1984. Specifically, phosphorus loads have been reduced by approximately 75 percent through chemical addition methods and a phosphate detergent ban instituted in 1986. Nitrogen loads have been reduced by approximately 35 percent annually and by about 50 percent during warmer months through implementation of Biological Nutrient Removal (BNR) methods. The Patuxent River Estuary is already showing positive responses. In the Upper estuary, total nitrogen concentrations have significantly declined since 1984, ranging from about 40 percent in the upper tidal fresh water region to about 30 percent in the Oligohaline (slightly brackish) region of the estuary. Total phosphorus concentrations have declined significantly throughout the estuary, ranging from 70 percent in the upper tidal fresh water region to about 20 percent in the Mesohalic (brackish water) region.

- In the Tar Pamlico Basin, North Carolina, a nutrient trading program was developed by a coalition of dischargers, environmental groups, and the North Carolina Department of Environmental Management. The program allows dischargers to pay for the development and implementation of agricultural best management practices, which reduce nutrients by 200,000 kg/yr. When fully implemented, the trading program will achieve the state's nutrient reduction goals and address NPS loadings while also reducing the economic burden to municipal dischargers. In addition, the program is flexible, allowing discharges to trade reduction debits and credits among themselves, as long as the loading standards for the basin are met. The trading program is cost effective, with an estimated cost of $11.8 million for achieving the state's nutrient reduction goal using agricultural best management practices alone.

- A pollution reduction trading strategy was designed for the Dillon Reservoir, Colorado, by a committee of local, state, and EPA representatives to control increased phosphorus loading from urban nonpoint sources, and to accommodate future development. The trading strategy provides an innovative solution for controlling phosphorus loading while still meeting water quality goals. The trading strategy allows wastewater treatment plants to use low-tech, inexpensive NPS controls for phosphorus removal in lieu of costly point source controls. Total cost savings are estimated to be $1.33 million.

- New York City is seeking an alternative to installing filtration on its Catskill and Delaware drinking water supplies. By implementing a series of water quality, operational, and watershed protection criteria, the City anticipates being able to ensure drinking water quality. The City estimates that the cost of implementing the criteria would total $1 billion, while the cost of filtration would total $5 to $6 billion. Although New York City has the authority to mandate land use changes, it has elected to pursue a collaborative effort with other watershed communities. The plan for watershed protection would include $120 million in cost share to communities and farmers for both point and NPS controls in addition to land purchases. Specific land use plans are to be initiated by watershed communities and farmers, and evaluated to make sure that pollution prevention goals are reached.

8.0 Permit Discharge Fees

The Initiative recommends the collection of permit fees to partially offset the cost of operating the National Pollutant Discharge Elimination System (NPDES), pretreatment, and sludge programs. For States authorized to administer these programs, the Initiative recommends collection of fees to cover these programs, and the portion of other State water quality programs that support these programs, to the extent that these programs are not currently funded by other sources such as State appropriations or current State permit fees. For the states where EPA is the regulatory authority, the Initiative recommends collection of fees to cover the full cost of the NPDES, pretreatment, and sludge programs.

EPA has calculated that States are currently spending $498 million per year to operate State water quality programs (EPA, 1993f). Of this cost, $250 million per year is for administering the NPDES and pretreatment point source programs (no State has yet received authorization to administer the sludge program), and $70 million per year is for nonpoint source control program. In addition, States are spending $165 million per year for the standards, monitoring, and watershed programs. Because these programs support both the point and nonpoint source programs, EPA attributes 80 percent of the cost of these programs to support the NPDES and pretreatment programs, with the remaining 20 percent to support nonpoint source programs.

EPA projects that the Initiative would add $416 million per year to the existing cost for all States to operate their existing programs. Of this total cost, $179 million per year is for operation of the NPDES and pretreatment programs in the authorized States and $218 million per year for the standards, monitoring, and watershed programs in all States. Since only 40 States and Territories are authorized out of a potential total of 57 and only 80 percent of the standards, monitoring, and watershed programs can be attributed to point source controls, permit fees would only need to recover $122 million per year (80 percent of 70 percent of States & Territories of $218 million per year). The total additional fees collected by States would be the sum of these two components, or a total of $301 million per year.

In the 17 States and Territories where EPA administers the NPDES, pretreatment, and sludge programs, the cost to EPA of operating these programs is estimated as $83 million per year. The total fees to be collected under the Initiative is the sum of the EPA and State collections, or a total of $384 million per year.

8.1 Private Sources

EPA estimates the total permit fees required of private sources to be $290 million per year. These sources represent roughly 75.6 percent of all the facilities permitted under the NPDES program. The total fee is based on 75.6% of the total of the fees collected by EPA and the authorized States.

8.2 Municipal Sources

EPA estimates the total permit fees required of municipal sources to be $94 million per year. These sources represent roughly 24.4 percent of all the facilities permitted under the NPDES program. The total fee is based on 24.4% of the total of the fees collected by EPA and the authorized States.

8.3 Federal Sources

These costs are included in the total fees for private sources. EPA's Permit Compliance System does not distinguish permits held by federal agencies from non-municipal permits.

8.4 States

EPA estimates that States will spend $10 million per year to newly develop or modify existing fee systems.

9.0 Groundwater Protection

The Initiative acknowledges the connection between surface water contamination and groundwater quality and establishes the protection of groundwater as a specific goal of surface water programs. EPA believes that implementation of these provisions may help protect groundwater from contamination originating from surface water discharges.

9.1 Private Sources

EPA estimates that the costs of groundwater protection measures could be between $150 million and $600 million per year (EPA, 1994a). Of a total of approximately 190,000 surface impoundments, EPA estimates that 17,000 receive nonhazardous industrial waste (and hence are not covered by the hazardous waste disposal provisions of the Resource Conservation and Recovery Act, or RCRA) and are located in urban areas. These include 16,232 industrial and 993 municipal impoundments. Of these, 70 percent or 12,000 are located in vulnerable groundwater areas and an estimated 6 percent of these (or 720) are located in areas where groundwater is directly connected to surface water (e.g., floodplains).

The costs to protect groundwater at these sites would range from $740 million (if all impoundments require clay liners, (the minimum technology) to $2.9 billion (if all impoundments require clay, plastic and second clay liners, plus leak detection systems, the maximum technology). These impoundments would be addressed over the first 5 years following reauthorization, hence the annual costs are between $150 million and $600 million per year.

9.2 Municipalities

The impacts of the groundwater provisions on municipalities have not been estimated but are expected to be minimal.

9.3 State Water Programs

The impacts of the groundwater provisions on states have not been estimated but are expected to be minimal.

9.4 Federal Agencies

The impacts of the groundwater provisions on federal agencies have not been estimated but are expected to be minimal.

9.5 Benefits[14]

The two major categories of benefits from additional groundwater protection measures are reductions in human health risks and protecting surface water aquatic habitat.

Reduced Human Health Risk

In meeting human health objectives, watershed management programs could play a major role in helping prevent contamination of all sources of drinking water for public water systems. Preventing contamination of source waters represents the first line of defense against public health risks and escalated monitoring and treatment costs associated with meeting surface and drinking water quality standards.

Protection of Surface Water Aquatic Habitat

Clean groundwater discharging to surface water also has significant ecological benefits, including:

- Protection of economic benefits of in-stream recreation, fisheries and other activities,
- Improved water quality and flows,
- In-stream aquatic habitat protection,
- Preservation of aquatic biodiversity and avoided costs of future endangered species actions.

In addition, coordinating CWA and Safe Drinking Water Act requirements results in additional benefits from more efficient management of resource by states.

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[14] See also the EPA (1994a) background paper "Costs and Benefits Related to Groundwater Provisions in the Green Book," January 1994.

10.0 Pollution Prevention Plans

The Initiative would give EPA and authorized states the discretionary authority to require pollution prevention plans as an NPDES industrial user (IU) permit condition.

10.1 Private Sources

EPA estimates that approximately 65,000 NPDES permittees would be required to prepare pollution prevention plans covering toxic pollutants. The costs of preparing such plans are based on costs reported by the State of Washington, which requires similar plans to be prepared under its Hazardous Waste Reduction Act. Over 500 plans have been developed so far in Washington, at an average cost of between $10,000 and $20,000 in labor per plan over the life of the permit (Hamner, 1993).

Some facilities may already be required to prepare similar plans under other prevention-oriented statutes or regulations. For example, some 20 states have now passed facility pollution prevention planning legislation. To the extent that NPDES or IU facilities may have recently prepared such plans, and the plans are relevant to the requirements under this provision, most of these costs would not be incurred by these facilities.

Most likely, the costs of pollution prevention plans required under the Initiative will be similar to those in Washington. Assuming that only 30,000 NPDES permittees would need to prepare such plans and that EPA phases in this requirement using a 5-year permit renewal cycle, one-fifth or 6,000 facilities will prepare the plans in each of the first 5 years. Total annual costs in years 1 through 5 will be between $60 million and $120 million, and probably much less in later years.

10.2 Municipalities

The impacts of the pollution prevention provisions on municipalities have not been estimated but are expected to be minimal.

10.3 State Water Programs

States will incur additional costs for reviewing the facilities' pollution prevention plans. No estimates of the costs for this activity, however, have been developed.

10.4 Federal Agencies

EPA may need to develop a regulation defining its authority to require pollution prevention plans as a permit condition, and to provide guidance to states on implementing these requirements. No estimates of the costs for these activities, however, have been developed.

11.0 Domestic Sewage Exclusion/Pretreatment

Under the domestic sewage exclusion (DSE) industrial facilities releasing hazardous waste to sewers are exempt from the requirements of RCRA on the assumption that Clean Water Act requirements (categorical standards and local limits under the pretreatment program) provide adequate protection. The Initiative would retain the DSE for facilities subject to local limits set by the publicly owned treatment works (POTW), national standards, or the 304(m) plan. Facilities subject to toxic reduction action plans (TRAPs) by their POTW would also be exempt, as would households and noncommercial facilities that discharge de minimis amounts of waste. All other dischargers, however, would no longer be exempt from the provisions of RCRA.

11.1 Private Sources

EPA assumes that POTWs would set additional local limits or develop TRAPs that would allow facilities facing the loss of the DSE to avoid RCRA impacts. EPA estimates that the Initiative restrictions on the DSE would impose additional costs of $282 million per year. Table 16 summarizes the costs of this provision on private sources.

This restriction of the DSE would have significantly lower impacts compared with the costs of its complete elimination. Elimination of the DSE would largely require dischargers to treat wastes containing hazardous constituents according to RCRA requirements. EPA estimates that the costs of eliminating the DSE could be about $3.8 billion per year (177,500 facilities at $21,500 per facility per year).

11.2 Municipalities

The impacts of the DSE provisions on municipalities have not been estimated but are expected to be minimal. EPA has assumed that municipalities will pass on the cost of developing TRAPs to their dischargers.

11.3 State Water Programs

The impacts of the DSE provisions on states have not been estimated but are expected to be minimal.

11.4 Federal Agencies

The impacts of the DSE provisions on federal agencies have not been estimated but are expected to be minimal. EPA's costs would be for preparing guidance on development and implementation of TRAPs.

12.0 Permits/Enforcement/Water Quality Standards

The enforcement provisions described in the Initiative include a variety of measures that provide additional incentives for compliance, ensure that penalties more closely match the economic benefits of noncompliance, and facilitate the processing of violation cases. The Initiative also recommends a waiver of sovereign immunity for federal facilities in violation of Clean Water Act provisions.

12.1 Private Sources

Numerous revisions to the enforcement provisions of the CWA will affect private sources, including new enforcement authorities, changes in fines and penalties, and the introduction of alternative enforcement tools. EPA considers any impacts of these provisions on violating facilities to be a transfer to the federal government, not a true resource cost. The potential magnitude of the impacts on violators have not been estimated.

12.2 Municipalities

The impacts of the enforcement provisions on municipalities have not been estimated but are expected to be minimal.

12.3 State Water Programs

Impacts of the enforcement provisions on state water programs are estimated at $188 million per year, based on the State Program Costs study (EPA, 1993f).

12.4 Federal Agencies

Costs to federal agencies of the new enforcement provisions include additional costs to EPA to develop and implement the new authorities and enforcement tools. These costs range from $32 million to $33 million and are summarized in Table 4.[15]

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[15] Costs for issuing NPDES permits of federal lands are not included. Forest Service estimated these costs to range between $716 and $718 million. Forest Service's estimates were based on a provision of S. 1114 that required reissuance of all Forest Service permits on federal lands on an accelerated basis. Under the Initiative, permits would be reissued on existing schedules and therefore not result in a significant cost increase.

13.0 State Revolving Fund/Construction Grants

The Initiative will expand the scope of projects eligible for State Revolving Fund (SRF) assistance, encourage project targeting and priority setting, and stimulate the delivery of further assistance to disadvantaged communities.

13.1 Private Sources

The impacts of the new SRF and construction grants provisions on private sources have not been estimated but are expected to be minimal.

13.2 Municipalities

The new SRF and construction grants provisions will have little impact on municipalities. Communities that qualify as disadvantaged may benefit from SRF loan forgiveness.

13.3 State Water Programs

State water programs will incur an estimated $8 million annually in additional costs as a consequence of the revised SRF and construction grants provisions. These estimates are based upon the State Program Costs study (EPA, 1993f).

13.4 Federal Agencies

The impact of changes in the SRF and construction grants programs on federal agencies (namely, EPA) are estimated to be negligible.

14.0 Monitoring

The Initiative will encourage EPA to work with states and other federal agencies to establish minimum requirements for water quality monitoring and reporting. States will be required to develop a comprehensive water body inventory under a new Section 305(c).

14.1 Private Sources

Changes to the monitoring provisions of the CWA will not have significant additional impacts on private sources beyond what is currently being performed.

14.2 Municipalities

Changes to the monitoring provisions of the CWA will not have significant additional impacts on municipalities beyond what is currently being performed.

14.3 State Water Programs

To implement the new monitoring requirements contained in the Initiative, states will incur an estimated $118 million annually in additional costs. These estimates are based upon the State Program Costs study (EPA, 1993f).

14.4 Federal Agencies

Federal agency impacts of the monitoring provisions will be relatively modest and are included with the costs of the NPS provisions (Section 3) and watershed provisions (Section 7). Among the federal agencies, the Forest Service has estimated costs of $37 million per year to perform monitoring in federal forests.

15.0 Abandoned Mines

The Initiative recommends that CWA be amended to change and clarify the NPDES permitting program to target control measures so as to achieve the greatest improvement in environmental quality for the limited Federal resources available for inactive and abandoned mine sites (IAMs) on federal lands without an identifiable operator.

15.1 Private Sources

The Initiative addresses IAMs only on federal lands, and thus there are no impacts on private sources.

15.2 Municipalities

The Initiative addresses IAMs only on federal lands, and thus there are no impacts on private sources.

15.3 State Water Programs

The Initiative addresses IAMs only on federal lands, and thus there are no impacts on private sources.

15.4 Federal Agencies

Under a stringent interpretation of the CWA, remediation efforts would be needed on all of the estimated 500,000 IAMs. EPA estimates that, under this interpretation, IAMs that would need extensive controls range from 15,000 to 50,000. At an average cost of $220,000 per site, the total remediation cost incurred over three years would be between $3.3 billion and $11.00 billion, or between $1.1 billion and $3.67 billion per year. For the remaining 450,000 to 485,000 IAMs, the annual remediation costs for minimal controls are assumed to be in the range of $630 per site to $1,885 per site, or between $283 million and $914 million per year. Thus, the total cost would range between $1.38 billion and $4.48 billion per year, as shown in Table 22.

Under the Initiative, EPA could issue general permits to all federal land managers responsible for these sites in each state (rather than individual permits to each IAM). These general permits would require remediation at 15,000 to 50,000 sites that are estimated to cause water quality impairments. However, these expenditures would be incurred over a ten year period. Therefore, the total cost would range between $3.3 billion and $11.00 billion, or between $330 million and $1.10 billion per year, as shown in Table 20. The remaining IAMs, between 450,000 and 485,000 sites, would not require any controls because they are assumed to not cause any water quality impairment.

The impacts of the Initiative, compared with the potential mitigation required under

current programs, will be to reduce potential costs. Total annual cost savings (or costs avoided) would be between $1.05 billion and $3.48 billion per year (Table 21).

15.5 Benefits[16]

The major categories of benefits associated with IAM mitigation include:

- Improved ecological and human health benefits,
- Increased property values,
- Increased commercial and recreational fishery production,
- Avoided costs of treating drinking water supplies, and
- Decreased water treatment costs for existing mining operations and other industrial activities.

Mitigating IAMs not only results in restoration of aquatic resources but also can significantly contribute to the enhancement of water-related activities. In so doing, mitigation will strengthen an important part of the West's economic base and contribute to ongoing economic development.

Specific examples of benefits from mitigating IAMs are discussed below.

Fish, Wildlife, and Recreation

- The economic value of recreational fishing on DOI lands has been estimated to be $4.0 billion per year. EPA estimates that the fishing-related benefits associated with reducing all IAM impairments total $42 million per year.
- The State of Colorado estimates that the annual revenue associated with fishing in Golden would increase by $750,000 per year if releases from IAMs discharging to Clear Creek were mitigated.

Drinking Water

- Westminster, Colorado, estimates that it costs about $15,000 to $20,000 per year to provide additional treatment of its water supply to remove metals from upstream IAM sites.

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[16] See also the EPA (1994b) background paper "CWA Benefits of Mitigation of Inactive and Abandoned Mines on Federal Lands," January 1994.

- High concentrations of zinc from IAMs have forced Golden to provide special waste disposal for sludge from its drinking water system serving 14,000 people. The city estimates that it spends an additional $15,000 per year for sludge testing, transporting, and landfilling.

Agriculture

- IAMs can have adverse impacts on irrigation water supplies. EPA has warned that the Summitville mine in Colorado may have possible toxic discharges into the Alamosa River, which irrigates many farms and ranches in the area.

Human Safety and Health

- Based on data in the Western Governors Association report, IAMs on federal lands are responsible for accidents resulting in an average of 20 fatalities and 40 serious injuries each year.

- The National Park Service has identified 9,934 hazards associated with the 2,000 IAMs in the parks, including unmarked mine openings, abandoned explosives, unidentified chemicals and other wastes, and contaminated streams and lakes used by park visitors and wildlife.

- Safety risks are expected to increase as rural areas of western states become more populated, and recreation expands on the BLM and FS lands.

- Some 179 children living within a mile of the Bunker Hill silver mine were at risk of suffering cognitive skill impairments as consequence of levels of lead in their blood.

Economic

- A 1993 study of the impacts of the reform of the Mining Act of 1872 estimates that IAM reclamation activities could generate between 2,000 and 10,000 jobs in communities suffering from the effects of the mining industry's shrinking unemployment base. Many of these jobs will rely on workers with experience in the mining and mineral services who have lost employment with a sluggish mining industry.

16.0 Market Incentives - Effluent Trading

The Initiative provides opportunities for innovative approaches to water quality improvement. The goal is to stimulate cost savings for dischargers, better institutional efficiency in program design and implementation, and support for continuous efforts to loadings reductions and environmental gains. In addition, the Initiative will provide incentive for developing new technologies and creating new markets.

The Initiative promotes trading in four types of effluent reduction:

- Point Source - Nonpoint Source Trading
- Point Source - Point Source Trading
- Nonpoint Source - Nonpoint Source Trading
- Pretreatment Trading

The sections below describe the potential for cost savings to private sources from each type of trading, based upon an EPA Office of Water analysis of Clean Water Act economic incentives (EPA, 1993a).

16.1 Point Source - Nonpoint Source Trading

Cost savings from two case studies indicate that the range in savings could be between $1 million and $12 million per site. EPA's Water Body System has identified about 940 water bodies that can benefit from nutrient trading. The number could be smaller after future NPS and pending point source controls are implemented in impaired water bodies. Assuming the actual number of appropriate sites is half the 940 (i.e., 470), the potential savings overall could range from $611 million to $5.6 billion.

16.2 Point Source - Point Source

Actual savings from point-point trading will vary from site to site because of differences between sites: size, water quality needs, availability of technology, number of participants, program design costs, etc. EPA's Water Body System has identified about 210 water bodies that can benefit from trading. Data from 12 simulation studies show that the potential savings range from $40,000 to $9.2 million per site. Potential cost savings could thus be in the range of $8.4 million to $1.9 billion.

16.3 Nonpoint Source - Nonpoint Source

The potential for nonpoint-nonpoint trading exists, but sufficient information is not available at this time to develop estimates.

16.4 Pretreatment Trading

Potential savings due to pretreatment trading are based on a case study of one large POTW (Field's Point in Providence, RI) that has a large number of industrial dischargers, including 117 metal finishing facilities. Simulation shows that the loading of nickel can be reduced by 20 percent, at a cost savings of $580,000 (81 percent) from the costs of across-the-board reduction of 20 percent for all metal finishers. Sixteen industrial dischargers can install advanced treatment systems, and the POTW could provide removal credits to 97 dischargers, thus eliminating the need to install additional treatment at these facilities.

The simulation study identified 62 POTWs as potential candidates for trading. These POTWs support a large number of industrial dischargers, including a fair number that discharge a single pollutant. Extrapolation from the Field's Point data suggests that the potential cost savings is $39 million. Actual savings will depend on the POTW, the type of pollutant(s) traded, the number of dischargers participating, program design costs, etc. Potential savings could be larger if additional POTWs could participate.

These potential decreases in costs should not be viewed as future costs avoided (or not incurred) because dischargers will not be installing additional controls to meet new requirements. These potential cost savings should not be viewed as decreasing other costs discussed in this report but instead would represent reductions in the cost of additional controls needed for growth or to meet water quality standards.

Total potential savings from all types of trading range from $658 million to $7.5 billion per year.

17.0 Monetized Benefits: Urban Areas[17]

This section presents an estimate of the overall benefits that are likely to result from adoption of the Initiative's provisions that address urban sources of water pollution, including CSO, storm water, and toxics.

17.1 Introduction

The nation's lakes, rivers, bays, and oceans are enjoyed for their aesthetic qualities and for their recreation opportunities (e.g., fishing, waterfowl hunting, swimming, boating, and viewing). They also support a commercial fishing industry, and surface waters are diverted for food processing, other industrial uses (e.g., cooling), forestry, animal husbandry, and agriculture (i.e., irrigation). In addition to supplying these and other current services for humans, the preservation of some aquatic ecosystems may provide nonuse or passive values. For example, these values may stem from the desires of the current generation to preserve certain ecosystems for the uses that future generations may have for them. Furthermore, some individuals believe that society has a stewardship responsibility even if the human uses for those particular ecosystems are unknown.

Surface waters have yet another use: as a waste receptacle for discharges from industry and run-off from both rural and urban areas. In spite of the great assimilative capacity of these waters, they can be degraded by excessive pollutant loadings to the detriment of the other beneficial uses to society. This section presents an estimate of the range of economic benefits that may result from adoption of the Initiative's provisions dealing with urban sources in the CWA. Due to uncertainties along each step of the process from implementation of the provisions to the resultant changes in water quality and finally to the effects on human welfare, the estimate of the economic benefit range may understate or overstate actual benefits.

17.1 Limitations

The analysis of the economic benefits focusing on urban areas draws upon information provided by a number of disparate data sources, and relies upon a number of assumptions. The synthesis of information introduces considerable uncertainty into the final numeric values. Major sources of uncertainty that limit our ability to be confident in the numeric results include: (1) the actual extent of impaired waters; (2) the method of attributing responsibility for impairment; (3) our assumptions about the efficacy of the provisions; and (4) the reliance upon secondary sources of information when estimating the economic values of environmental quality. The absence of reliable information on all of these elements plays a critical role in our ability to draw conclusions about the benefits that will result from the Initiative.

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[17] See also the EPA (1994h) background paper "Aggregate Economic Benefits for Controlling Selected Urban-Based Pollution Sources," February 1994.

One of the more significant points of uncertainty in the analysis relates to the monetary valuation of economic benefits for the dominant benefit category--the enhanced freshwater recreation, aesthetics, and non-use benefits that ensue with the proposed water quality improvements. The absence of alternative data sources constrained us to make use of a published, yet dated, contingent valuation research study that measured a household's use and non-use values for national and, by apportionment techniques, more localized improvements in freshwater rivers and lakes. Criticism has been levied against the validity of empirical results for non-use values derived using prior contingent valuation research methods. Several issues raised in the ongoing debate about this valuation method bear directly upon the interpretation of the numeric results provided by our source materials.

Independent of this debate, further uncertainties are introduced by transferring the research results to the policies and environmental concerns addressed by the Initiative. The wide range of values demonstrates an attempt to capture the impact of these uncertainties on the numeric estimate. All told, it is difficult to conclude whether the presented numeric ranges underestimate or overestimate the actual benefits. We suggest that the numerical results best serve to indicate the overall order-of-magnitude of the benefits. Based upon our experience in undertaking the analysis, we can further conclude that considerable gaps persist in our ability to measure and evaluate the relationships between water quality conditions and economic activities, even twenty years after the passage of the principal legislation designed to identify and address water pollution problems. The Administration's Initiative contains provisions to help rectify this situation in the future.

17.3 Methodology and Assumptions

This analysis begins with informed judgement about the extent of water quality improvement that may result from implementation of CSO and storm sewer provisions relative to current conditions. We assume that in all cases where CSOs or storm sewers are thought to be the leading source of impaired urban waters (i.e., based upon the 305(b) Reports), the implementation of these provisions will restore these waters to fishable and swimmable quality. Furthermore, for those waters where other sources must share significant responsibility with CSOs and storm sewers for precluding the attainment of fishable and swimmable quality, we assume two things. First, we attribute 50% of the responsibility to CSOs and storm sewers. Second, we assume that the implementation of other provisions of the act in combination with the CSO and storm sewer provisions will result in the attainment of fishable and swimmable quality in the affected waters. Thus, although we recognize that uncertainty about the actual extent of impaired waters may lead to an over or underestimate of the economic benefit range, our method of attributing responsibility for impairments and our assumptions about the efficacy of the provisions may tend to overestimate the economic benefit range.

Beyond the physical, chemical, and biological changes that may result from the CSO and storm sewer provisions, for the economic evaluation it is also necessary to estimate the effects these changes have on humans and other economic entities (i.e., industry). For the purposes of this assessment we aggregate these sources of benefits into four primary categories: 1. enhanced

freshwater recreation, aesthetics, and nonuse benefits; 2. enhanced marine recreation, aesthetic, and nonuse benefits; 3. cost savings or increased output for withdrawal or diversionary users; and, 4. cost savings or increased output for commercial fisheries. In the event that human health effects were not subsumed in the benefit estimates of one or more of the four primary categories we include it as a fifth category. In addition to quantifying an economic benefit range for each of these categories, we mention the other potential changes in the economic activities of consumers and producers that could not be quantified.

The existing economic literature on the benefits of water quality improvements suggests that enhanced water-based recreation and aesthetics and the non-use values that people may hold for the preservation of the nation's aquatic ecosystems is the largest source of quantifiable economic benefits. The sheer numbers of people who recreate in a water setting each year testifies to the importance of this resource. More to the point, a growing number of economic studies are documenting the influence that water quality characteristics have on which water bodies people choose to visit, how often they engage in water-based recreation activities, and how much they are willing to pay for incremental improvements in water quality. Less abundant are the studies that demonstrate the linkage between water quality improvements and the resultant increases in individuals' non-use values, but there is general agreement that these values exist. This is based in part upon survey responses from people who do not currently use the nation's surface waters for recreation or for their aesthetics but nonetheless indicate a willingness to pay for achieving certain water quality standards.

There are no primary studies that attempt to estimate the enhanced recreation, aesthetics, and non-use benefits of water quality improvements that may be attributed to the CSO and storm sewer provisions of the Initiative. However, there is a study that attempts to ascertain the total economic value that households place on the achievement of incremental improvements in virtually all of the nation's lakes, rivers, and streams (i.e., marine waters were not included) (Mitchell and Carson, 1984, 1986; Carson and Mitchell, 1993; and Lyon and Farrow, 1992). As a part of this research effort, a method of allocating the household's willingness to pay for improvements in local water quality was also devised. This method of apportioning total willingness to pay for subnational changes in water quality was "validated" by comparing the resultant estimates with those of studies that valued similar incremental improvements (i.e., from boatable to fishable and from fishable to swimmable) at the local level (Mitchell and Carson, 1986; Carson and Mitchell, 1993). Therefore, we use Mitchell and Carson's research to suggest the range in enhanced recreation, aesthetics and non-use benefits from improvements in urban freshwaters that may result from the Initiative. Key assumptions in this analysis involve: the number of households proximate to the improved waters versus all other households, the proportion of improved waters in the household's State relative to all of the State's degraded waters, the abundance of clean alternatives proximate to the household, the abundance of substitute clean waters in the state, and the accuracy of the original study. Uncertainty about each of these factors leads to a wide range for the economic benefit estimate. Moreover, to say whether the range itself underestimates or overestimates the actual benefits is impossible, especially when uncertainties about the actual physical water quality changes are factored into the analysis.

The remaining quantifiable economic benefits (i.e., enhanced marine recreation, aesthetics, and non-use values; commercial fishing; water diversions; and human health) are small by comparison with the freshwater benefits. In addition, the economic basis for estimating these benefits is less defensible. We rely entirely upon secondary studies to suggest a plausible range of benefits for these categories. Finally, we mention briefly other possible economic benefits to people and economic entities that may or may not be subsumed in the foregoing analyses. We believe that mentioning these potential economic effects is important because we cannot rule them out on the basis of current knowledge. A more detailed discussion of how the benefits are quantified and monetized is included in Appendix D.

17.4 Summary of Benefits Results

Monetized Benefits: Urban Areas. EPA estimates further that the aggregate benefits of pollution control in urban areas will eventually produce quantifiable benefits of between $0.8 billion and $6.0 billion per year (Table 18). The range recognizes the uncertainty associated with these estimates. For example, the upper end of the range may be an underestimate in the extreme case where the new provisions are 100 percent effective, households care very much about the resultant improvements relative to the other waters in their state, and the unquantified benefits turn out to be significant relative to the quantified benefits. Similarly, the lower end of the range may be an overestimate in the extreme event that the new provisions fail to improve water quality to fishable and swimmable levels, or the changes in water quality have no effect on the economic activities of consumers and producers.

Quantified Benefit Categories. The first beneficial category relates to the total value that households place on the enhanced recreation, aesthetics, and non-use values associated with improved urban freshwaters. The most comprehensive assessment of such benefits is actually too inclusive. A contingent valuation study conducted by Mitchell and Carson (1984, 1986), and updated by Carson and Mitchell (1991, 1993) values freshwater quality improvements beyond the expanse of waters whose quality will be improved as a consequence of the urban provisions of the Initiative. However, Mitchell and Carson (1986) show how their research results can be used to value localized improvements such as may occur once the CSO, storm water, and other urban-based provisions are implemented. According to Mitchell and Carson (1986), respondents to their survey were willing to allocate 67% of their national willingness to pay to achieve improvements at the state level. Then, Mitchell and Carson (1986) devised guidelines for further reducing this percentage for sub-state water quality improvements.

To implement their strategy, we divided the population into two types of people; those living in urban areas proximate to the water quality change, and all other households. The allocation of households into these two groups was based upon an estimate of the number of households living in urban areas proximate to waters that have not attained fishable and swimmable conditions. The simulations from a water quality model that linked urban populations to waters in EPA's Reach File 1 (Bondelid and Cooter, 1994) provided an estimate of the urban populations that are proximate to impaired waters. By "proximate" is meant living in a city or town that has the same reach designation as the river segment. The 305(b) reports

provided the estimate of the percentage of impaired urban waters that are due, at least in part, to CSOs, storm water, and other urban-based pollution. Both estimates were based upon nonrandom samples of their respective populations, and yet we used these estimates to extrapolate to the full national populations of households and freshwaters. Unfortunately, we do not know whether the effect of this extrapolation is to under- or over- estimate the number of households that are most proximate to improved waters.

The households living proximate to improved urban waters are likely to benefit most from the successful implementation of the urban provisions in the Initiative. We assign them a range of benefits using Mitchell and Carson's lower bound of 12% and upper bound of 67% of their total willingness to pay. The high end of the range is only appropriate if the improved waters represent virtually all of the previously degraded waters in the household's state and/or the households care most about their state waters they adjoin. Households not located along these improved waters are assigned a lower bound of 0% and an upper bound of 12%, as the improved waters are located further away and substitution possibilities are relatively abundant. For both types of households, the estimates are further reduced by 50% in cases where other sources of pollutants besides CSOs and storm water are assumed to be limiting factors that may preclude fishable and swimmable water quality conditions.

The number of urban households expected to directly benefit from improvements in their local waters are considerable. We estimate that 29 million urban households border waters currently incapable of supporting suitable fishing conditions, and 41 million households adjoin water that fail to meet criteria used to classify swimmable designated use conditions. Of these households, nearly 4 out of every 10 are expected to experience a full recovery of their waters to support these designated uses as a consequence of implementing the urban-based Initiative provisions. The remainder may see partial or no improvement because additional measures will be required to bring the affected waters to fishable and swimmable conditions, measures that are presently mandated under existing environmental statutes but have yet to be fully implemented.

The annual economic benefits to the first group of households expecting full recovery of their waters ranges from $0.4 to $2.0 billion. For households in those urban areas where these provisions will serve to eliminate some of the problems, when the remaining limiting factors are overcome, their benefits are expected to range between $0.3 to $1.6 billion. Lastly, the range of benefits to persons outside of these affected areas but expected to enjoy use or non-use benefits as a result of improvements in these areas is zero to $1.1 billion. Adding these three categories of households, the consequences of bringing these urban area waters into designated fishable and swimmable water quality conditions yields a national total annual benefit estimate between $650 million and $4.7 billion. As can be seen, the majority of the monetary benefits are associated with those urban households that are located in areas having water quality problems.

The wide range in estimated benefits reflects, in part, the uncertainties in the analysis regarding the strength of these households' preferences for achieving improvements in their local impaired waters. Their values should be dependent upon the availability of possible substitutes,

which is a function of the scope and magnitude of the severity of water quality problems present in the state from both urban and other pollution sources. The statistics provided by the draft 1992 305(b) report (EPA, 1993b), identify urban runoff and storm water as a leading source of impairment in 24,100 assessed river miles (30% of non-agricultural impaired and assessed miles, or 10% of all impaired and assessed miles, or 3% of all assessed miles, or 0.7% of all river miles in the nation). Similarly, for lakes, reservoirs, and ponds, urban runoff and storm water are leading sources of impairment in 1.31 million acres (52% of non-agricultural impaired and assessed acres, or 24.1% of impaired and assessed acres, or 7.1% of all assessed acreage, or 4.8% of all lake acreage in the nation). These types of statistics could be used to attempt to locate where along the range of values expressed in the Mitchell and Carson research, these specific urban provisions would be expected to fulfill. The 305(b) data provided on mileage and acreage of freshwater that was assessed and found to be impaired by urban-based sources of pollution does not, absent further assumptions or additional information, permit us to select a narrower range of values to assign to households. Still, we believe that the 305(b) data suggests that the calculated upper end of the range constitutes a very optimistic (i.e., high) estimate of the quantified benefits in this category.

The marine recreational fishing category captures the anticipated economic benefits to persons who now participate or would likely participate in marine sportfishing and shellfishing activities in the event water quality improvements would result from controls placed on urban sources identified in the Initiative. The range of estimated economic benefits is due to the uncertain relationship between water quality changes, reductions in urban pollution sources, and the expected economic value of achieving water quality improvements. Unlike the freshwater recreation benefits, these estimates do not include possible non-use values households may hold for improvements in these areas. At present, an estimated 92 million marine recreational trips are taken every year. As a result of water quality improvements due to the Initiative, these numbers are expected to increase by 10 percent to 20 percent above current rates. Using these increases, in combination with estimates on the economic benefits associated with each trip, we estimate that the anticipated annual economic benefits to marine recreational fishing from the urban-based provisions will be between $40 million and $440 million. The literature does not support including other consumptive recreation activities despite evidence of the influence of water quality parameters on swimming and boating in coastal waters. National estimates of marine recreation participation rates are not available currently for these activities, and it is not known how water pollution controls have improved water quality and influenced recreation behavior. Finally, the literature on nonuse values associated with nondegraded or improved marine water quality is almost nonexistent, with the exception of lost nonuse values due to oil spills.

The marine nonconsumptive recreation benefit category consists of recreational activity other than fishing and swimming that occurs within estuaries or along the coast. Current participation rates and estimates of the economic benefits associated with viewing of wildlife are used as a foundation for the benefits of attaining further water quality improvements. The range in benefits is the result of the same uncertainties described in the marine recreation fishing discussion above. Also, non-use values to households for water quality improvements affecting

these activities are not included in the estimates. Recent surveys of recreational activity indicate that nearly 7 million persons engage in oceanside viewing of wildlife, and an estimated 5.6 million persons visit wetlands and marshes to observe wildlife. Water quality improvements due to the Initiative's provisions are expected to increase participation in these activities by 10 percent to 20 percent above current rates. The estimated number of trips per person and economic benefits per trip are used to calculate the potential benefits to nonconsumptive recreation activity from water quality improvements associated with the urban-based provisions. The range of annual benefits is estimated at between $30 million and $300 million.

The estimated benefits to marine and freshwater commercial fisheries from anticipated improvements in water quality conditions are based upon information about current commercial activity. The potential gains from reducing urban source loadings of pollution are assumed to be a function of current benefits associated with existing water quality conditions and the estimated contribution these urban sources make to overall water quality limitations. The estimated values capture benefits to both commercial producers and households resulting from expected increases in stocks of fish and shellfish and other efficiency gains to commercial fishing operations. The current ex-vessel value of coastal fisheries is approximately $1.8 billion per year. Water quality improvements due to the Initiative are expected to increase baseline economic values associated with these activities by 10 to 20 percent above current rates. Given the expected contribution of changes in urban-based pollution loadings to these improvements, the total range of economic benefits to commercial fisheries is estimated between $40 million and $190 million. These figures include benefits to the commercial industry and consumers of seafood from an expected increase in the quantity and quality of harvested seafood.[18] We should note that a recent review of studies that demonstrate linkages between fish populations and water quality was conducted by Strand (1993). He found only two studies that demonstrated credible relationships between pollution and fish populations for some species in a few coastal locations. The paucity of analysis may be due to a lack of trend data on pollution and fish populations or, alternatively, because the effects are not generally present. The study submits that the infrastructure for assessing the incremental benefits of implementing existing or new policies is not present, and recommends collecting the data and doing the analysis in order to guide spending on water pollution control to the areas where it will have an effect. Such an investment in research may be necessary to protect the billion-dollar fishing industry, while avoiding wasting resources on programs that do not work.

Improvements in urban water quality are expected to result in reduced costs to commercial, industrial, and municipal consumers who use these waters as an input to production of goods and services, including drinking water. For example, improved surface water that is diverted to the public water supply results in cost savings for treating drinking water. In the manufacturing sector, the cooling and processing costs in the food and beverages, textiles, paper, chemicals, and steel industries are somewhat reduced by higher quality intake water. For

[18] The health benefits of uncontaminated seafood is included in the health benefit estimates. Consumers benefit in this category as a result of the lower prices or the greater supply of seafood.

thermoelectric energy production, treated water is used for reactor and condenser cooling to reduce corrosion, particularly in cases where cooling water is recirculated. The treatment costs may be reduced by higher quality intake water. The influence of urban source controls on withdrawal or diversionary uses is not expected to be substantial, due to the presence of other limiting factors associated with these waters (e.g., naturally occurring elements), but some marginal cost savings may occur. In this analysis, only manufacturing and drinking water suppliers are included in the quantitative estimates. Estimates of the current costs of water treatment, or damages caused by poor water quality, serve as the baseline measure of potential benefits. Current conditions are expected to improve after having reduced urban-based pollution discharges identified in the Initiative. The overall level of improvements reflected in costs savings to some industries and manufacturing facilities is expected to be fairly low, probably no more than 1 to 5 percent of current costs. As a result, the expected annual economic benefits to diversionary uses of water will fall between $20 million and $80 million.

The ability to provide greater opportunities to swim and fish in the nation's waters also provides for the reduction from acute and chronic risks posed by chemicals and bacteria discharged from urban-based pollution sources. The human health benefits of reduced exposure to these types of compounds are calculated, using information on changes in the expected number of persons exposed to a subset of pollutants originating with urban dischargers. As a consequence of controls, the number of beach closures and advisories will be expected to decline, and participation will rise. Current participation rates in freshwater and marine swimming are estimated at 450 million person-days per year. Of these, between two and four million acute illnesses are expected to result from current exposures to pathogens. Given information on the duration and costs associated with these types of illnesses, the expected reductions in risks from the urban-based Initiative provisions will result in annual economic benefits of $30 million to $100 million. Risks from the consumption of contaminated seafood are also expected to diminish as a consequence of reducing urban-based pollution sources. In particular, risks to those persons that partake in greater than average consumption rates of seafood (e.g., subsistence fishingpersons) will be reduced. The expected reduction in cases of chronic illnesses attributed to consumption of contaminated seafood, and the value of reducing these types of risks, results in an estimated range of benefits between $40 million and $220 million. Adding these two separate estimates together yields a total health benefit range of $40 million to $320 million.

Unquantified Benefit Categories. There are a number of benefit categories that are known to be affected by water quality conditions, and hence are likely to be affected by the adoption of the urban-based provisions in the Initiative. However, the absence of information limits the capability to produce monetary estimates for these categories. Rather than completely omit them from the discussion, we have elected to briefly discuss some of the more significant categories so as to enable the policies to be evaluated with as much information as feasible, whether it be quantitative or qualitative in nature.

The impacts of the provisions on marine recreation swimming are not fully captured in the above section on quantitative impacts. Some of the human health benefits are considered,

but the non-health benefits from the provision of more and higher quality marine recreation opportunities have not been included. In addition to the selected acute and chronic effects of a few of the many pollutants that will be addressed by the Initiative provisions, there are many other human health effects that have not been quantified. Potential effects on reproductive systems and several other acute and chronic effects from pollutants discharged from urban sources were excluded from the quantitative measures. Recreational hunting activities are likely to benefit from the provision of a greater number and higher quality habitat necessary to support different forms of wildlife. The availability of living space, supply of food sources and impacts on reproduction have been associated with environmental pollutants. Reductions of pollutants that limit the ability of natural systems to support wildlife will result in economic benefits to hunters and other persons interested in nonconsumptive recreation activity occurring on or near freshwater. Although most of the nation's waters are thought to support boating activity, it is plausible that further improvements in both freshwater and marine water quality conditions will enhance the enjoyment of recreational boating, and thus may have positive economic value to persons engaged in these activities. These are thought the constitute some of the more significant benefit categories, as measured by current participation rates or level of economic activity.

In addition to measuring the benefits to parties that make direct use of resources supported by cleaner marine and freshwater, there is another economic value individuals may hold for environmental protection that does not rely on the use of the amenity in question. Individuals can express a willingness to pay for the protection of environmental conditions, absent any personal desire to participate in the above activities supported by these conditions. In the freshwater fishing and swimming benefit estimates, we were able to include the non-user benefits in the range of estimates because of the type of source material used in the valuation step for this part of the analysis. For the remaining benefit categories, the nonuse value component, if positive, has been omitted. Studies on nonuse values have documented substantial economic values for some types of environmental goods. The lack of reliable information on these other categories prevents the inclusion of these values in the quantitative estimates.

The ability to support better functioning natural systems may provide a way to substitute for currently operated and maintained manmade systems. For example, natural systems can help provide flood control services, water storage, and purification processes, and reduce the need for dredging of disposed sediment. The potential avoided costs from improvements in water quality can be significant. Estimates for some of these avoided costs have been captured in parts of the cost analysis for the Initiative's provisions (e.g., agricultural practices).

A final category of unquantified benefits not listed in the table concerns the potential enhancements in overall economic productivity and efficiency that may be gained as a consequence of improving the quality of the nation's waters. In some cases, underutilized economic resources devoted to the protection of the environment can lead to greater levels of overall production and social welfare than if these resources were to remain underemployed. Most often, these types of benefits are treated as secondary benefits, and are not expected to contribute to net improvements to overall economic activity measures. In general this is

probably true, but it is possible that for some specific local areas, shifting of economic resources into the protection of the environment may yield positive net economic benefits. However, were we to include this information in the analysis, we would need to introduce other indirect costs not fully captured in the description of economic costs estimated to result from these provisions. Failure to develop a fully balanced description of costs and benefits could distort comparisons between the two categories. As the cost analysis was not developed along these lines, a reference to potential indirect benefits is omitted in Table 18.

Costs: Urban Areas. Provisions in the Initiative that address urban areas are loosely defined to include storm water Phase I and Phase II, CSOs and toxics controls. The annualized costs of these provisions for all sectors is estimated to be between $9.9 and $13.9 billion, as shown in Table 17.

Net Benefits: Urban Areas. The monetized benefits of the Initiative ($0.8 billion to $6.0 billion), assuming benefits are realized immediately, contrast with between $9.9 billion to $13.9 billion in incremental annualized costs for urban areas.

However, benefits are unlikely to be realized immediately. To illustrate how the gradual attainment of the benefits may influence the benefit-cost comparison, the figures in Tables 17 and 18 show the annualized monetary costs and benefits from control of urban sources under proposed and pending spending. In Table 18, two of the three aggregate benefit estimates provide for the gradual attainment of benefits, applying different discount rates to an assumed future stream of benefits. The selection of the two discount rates reflects Administration guidelines on the application of discounting to costs and benefits (seven percent), as compared with the use of a social rate of time preference (three percent). The discounted annualized benefits are some twenty to thirty percent lower than the annualized benefit estimate that fails to account for the expected delays in achieving tangible water quality improvements. This serves to demonstrate the sensitivity of the results to both the time and discounting features of the analysis.

Comparing the annualized costs and benefits under any of the three annualized benefit estimation scenarios, it is apparent that the range of estimated monetary costs and benefits do not presently overlap. Despite information of this type, the Administration feels it is important to proceed with the Initiative for several reasons. As stated throughout the text, and documented in the supplemental materials, there are great uncertainties associated with both the cost and benefit estimates that are not captured in the presentation of the numerical results. For example, although the national cost estimates have attempted to account for targeting of watersheds in need of improvement and emphasized prevention measures over command-and-control strategies, there are uncertainties in the analysis because of the difficulty of fully accounting for the consequences of providing flexibility in the identification of problems and solutions. There are also a number of tangible benefits for which monetary estimates have not been developed. So as to better inform decisionmakers and the public in the future EPA is proposing a comprehensive benefit-cost study of the pollution controls in the CWA reauthorization. This study will reduce the uncertainties surrounding the benefits and cost estimates.

Despite the uncertainties, an important contribution of the economic analysis has been its ability to document the significant savings the Initiative is proposing compared with the requirements called for in the existing legislation. In addition, considerable effort was given to developing cost-effective policies where new efforts are needed to achieve the goals of the Clean Water Act. Therefore, the Initiative demonstrates a genuine effort to achieve cost-effective regulatory management approaches to improving the nation's polluted waters. Equally important, the public's right to enjoy clean waters, and the demonstration of their preferences through environmentally protective federal legislation, have served as inputs into the development of Administration policy. Strong public support for additional pollution control programs persists, and the Initiative will address what the Administration believes are the most significant remaining problems.

REFERENCES

Bondelid, T. and W.S. Cooter. 1994. "A Tool for Evaluating the Effectiveness of the Clean Water Act." Research Triangle Institute Project No. 35U-5726-3, Center for Environmental Analysis, Research Triangle Institute, P.O. Box 12194, Research Triangle Park, NC 27709.

Carson, R.T. and R.C. Mitchell. 1991. "The Value of Clean Water: The Public's Willingness to Pay for Boatable, Fishable, and Swimmable Quality Water." Economics Department, University of California, San Diego.

Carson, R.T. and R.C. Mitchell. 1993. "The Value of Clean Water: The Public's Willingness to Pay for Boatable, Fishable, and Swimmable Quality Water." Water Resources Research 29(7): 2445-2454.

DOD. 1993a. "Clean Water Act Reauthorization 'Initiative' Resource Requirements." Memorandum from Michael L. Davis, U.S. Department of Defense, Department of the Army, Office of the Assistant Secretary of Army (Civil Works), to the EPA Office of Water. November 19, 1993.

DOD. 1993b. "Federal Agency Costing of the Administration Initiative." Memorandum from Josephine S. Huang, U.S. Department of Defense, Office of the Undersecretary of Defense, to EPA Office of Water. November 17, 1993.

DOE. 1993. "S. 1114 Federal Agency Cost Estimates." Memorandum from David Moses to Mark Luttner, EPA Office of Water. September 13, 1993.

DOI. 1994. "Incremental Impacts of S. 1114 and the EPA Initiative for the Department of the Interior." Memorandum from Gregory E. Schwartz, U. S. Department of the Interior, Geological Survey, to Mahesh Podar, EPA Office of Water. January 27, 1994.

EPA 1990a. "National Water Quality Inventory: 1988 Report to Congress." EPA Office of Water. 1990.

EPA. 1990b. "Environmental Investments: The Cost of a Clean Environment." EPA-230-11-90-283. EPA Office of Policy, Planning and Evaluation. November 1990.

EPA. 1992. "National Water Quality Inventory: 1990 Report to Congress." EPA 503/9-92/006. EPA Office of Water. April 1992.

EPA. 1993. "Draft Combined Sewer Overflow Control Policy." EPA Office of Water.

EPA. 1993a. "Economic Incentives in the Clean Water Act: Some Preliminary Results." Presented by Mahesh Podar and Mark Luttner, EPA Office of Water, at the 86th Annual Meeting of the Air & Waste Management Association, Denver, CO. June 13-18, 1993.

EPA. 1993b. "National Water Quality Inventory: 1992 Report to Congress." Draft report. EPA Office of Water. July 1993.

EPA. 1993c. "Review of Program Costs in Part 2 NPDES Municipal Storm Water Permit Applications." Draft report. EPA Office of Water. August, 1993.

EPA. 1993d. "Report to Congress on Storm Water Dischargers Not Regulated Under Phase I of the NPDES Storm Water Program." Draft report. November, 1993.

EPA. 1993e. "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters." 840-B-92-002. EPA Office of Water. January 1993.

EPA. 1993f. "State Program Costs for Implementing the Federal Clean Water Act." EPA Office of Water. December 6, 1993.

EPA. 1994. "CWA Benefits of Nonpoint Source Controls." EPA background paper. January 1994.

EPA. 1994a. "Costs and Benefits Related to Groundwater Provisions of the Green Book." EPA Office of Water background paper. January 1994.

EPA. 1994b. "CWA Benefits of Mitigation of Inactive and Abandoned Mines on Federal Lands." EPA background paper. January 1994.

EPA. 1994c. "Detailed Cost Estimates for Storm Water." EPA Office of Water. January 1994.

EPA. 1994d. "Summary of CSO Costs and Benefits of Various CSO Controls." EPA Office of Water. January 18, 1994.

EPA. 1994e. "CWA Benefits of Storm Water Controls." EPA background paper. January 1994.

EPA. 1994f. "CWA Benefits of Toxic Controls." EPA Office of Watr background paper. January 1994.

EPA. 1994g. "CWA Benefits of a Watershed Protection Approach." EPA Office of Water background paper. January 1994.

EPA. 1994h. "Aggregate Economic Benefits for Controlling Selected Urban-Based Pollution Sources." February 1994.

ERG. 1993. "Documentation of Costs of NPS Control Under Reauthorized CWA." Memorandum from Jeff Cantin, ERG, to Mark Luttner, EPA Office of Water. December 22,

1993.

Hamner, B. 1993. Personal communication between Burt Hamner, Washington Department of Ecology, Hazardous Waste and Toxics Reduction Program, and Jeff Cantin, ERG. November 16, 1993. (206--649--7180).

Lyon, R. and S. Farrow. 1992. "An Economic Analysis of Clean Water Act Issues: Preliminary Results." Office of Management and Budget. February 1992.

Metcalf & Eddy. 1993. "1992 CSO Needs Survey: Technical Report on the Estimation of CSO Needs." Draft report. September 29, 1993.

Mitchell, R.C. and R.T. Carson. 1984. "Willingness to Pay for National Freshwater Quality Improvements." CR 810224-01. EPA, Washington, D. C.

Mitchell, R.C. and R.T. Carson. 1986. "The Use of Contingent Valuation Data for Benefit/Cost Analysis in Water Pollution Control." CR 810224-02. EPA, Washington, D. C.

Nicoll, D. 1994. Personal communication between Debra Nicoll, Office Water, and Jeff Cantin, ERG. January 1994.

NOAA. 1993. Personal communication between Bess Gillelan, U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, and Jim Pendergast, EPA Office of Water. November 15, 1993.

Phillips et al. 1993. "The Effects of Alternative Pulping and Bleaching Processes on Product Performance - Economic and Environmental Concerns." In Proceedings: International Symposium on Pollution Prevention in the Manufacture of Pulp and Paper - Opportunities and Barriers, August 18-20, 1992. EPA-744R-93-002. EPA Office of Pollution Prevention and Toxics. February 1993.

RCG/Hagler, Bailly, 1992. "Regulatory Impact Analysis: Management Measures Guidance for Nonpoint Source Controls in Coastal Watershed Areas." Prepared for the Nonpoint Source Control Branch, EPA/OW/OWOW. December 28, 1992.

Strand, I. 1993. "The Contribution of Clean Water to Commercial Fisheries." In Proceedings of Clean Water and the American Economy Conference. EPA 800-R-93-001a. Washington, D. C.

USDA. 1994. "Impacts of Selected Clean Water Provisions on the Agricultural Sector." Letter from John Stierna, U.S. Department of Agriculture, Soil Conservation Service, to Mark Luttner, EPA Office of Water. January 24, 1994.

Table 1

Classification of Nonpoint Source Sectors

NPS Sector	Activities/Controls
Agriculture	Soil erosion from cultivated cropland Annual grazing, espcially in streamside areas Management of nutrient applications Control of irrigation flows Animal waste management
Forestry	Pre-harvest planning Streamside management areas Forest road construction/reconstruction Timber harvesting Site preparation and forest regeneration Fire management Revegetation of disturbed areas Management of forest chemical use Management of forest wetland areas
Urban areas	Construction site runoff Developing areas runoff Existing development runoff On-site sewage disposal systems Road/highway/bridge runoff Household/commercial/landscaping waste disposal
Hydromodification	Channelization and channel modification Dam construction and maintenance Shore erosion
Marinas	Marina siting and design Operation and maintenance practices
Wetlands, riparian areas, and vegetated treatment systems	Protection of wetlands and riparian areas Restoration of wetlands and riparian areas Use of constructed wetlands, filter strips, buffer strips

Source: EPA. 1993e. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. 840-B-92-002. Office of Water, January 1993.

Table 2

Impacts of the Initiative's Nonpoint Source Control Requirements on Private Sources Coastal Zone and Impaired Waters in the Noncoastal Zone ($millions/year)

NPS Sector		Coastal Zone (CZARA)	Noncoastal Zone (Impaired or Threatened Areas Only) [1]
Agri-culture	Erosion	$36.4 million	$129.2 - $195.8 million
	Grazing	$2.8 million	$133.2 - $201.9 million
		Assumes availability of $3,500 per farm in federal cost shares; cost estimates are incremental (net of federal).	
	Nutrient/ Pesticide Management	$134.7 - $162.7 million based on costs of scouting Offsetting benefit assuming 15-18% chemical savings: $264.7 - $317.6 million	$461.3 - $844.7 million Offsetting benefit assuming 15-18% chemical savings and proportional savings in impaired and non-impaired areas: $475.1 - $865.0 million
	Irrigation	$12.8 million	$41.7 - $63.2 million
	Confined Animals	$37.3 - $59.1 million	$125.3 - $310.3 million
		Assumes availability of $3,500 per farm in federal cost shares; cost estimates are incremental (net of federal).	
Forestry		$11.1 million cost of BMP implementation $40.5 million loss of producer and consumer surplus	$5.5 - $8.4 million cost of BMP implementation $13.3 - $200.1 million loss in producer and consumer surplus
Urban, Hydromodification, Wetlands		$240.9- $388.7 million	$168.8 million
Marinas		$14.7 - $45.6 million	$1.8 - $8.8 million
TOTAL		$259.8 - $435.4 million	$595.4 - $984.8 million.

[1] Assumes that 25 percent of urban watersheds and 33 to 50 percent of non-urban watersheds are impaired or threatened.

Source: ERG (1993).

Table 3

Descriptive Statistics of the Coastal and Noncoastal Zone

Statistic	Total U.S.	Coastal Zone	Noncoastal Zone	Noncoastal Zone as Percent of Total
Counties (1990)	3,130	678	2,452	78.3%
Population (1990)	246,750,237	127,351,147	119,399,090	48.4%
Land area - sq. mi. (1990)	3,521,131	635,166	2,885,965	82.0%
Surface water area - sq. mi. (1990)	241,151	122,402	118,749	49.2%
Farms (1987)	2,081,085	405,844	1,675,241	80.5%
Farm land - acres (1987)	958,775,957	98,677,897	860,098,060	89.7%

Source: U.S. Department of Commerce, Bureau of the Census, *USA Counties* (CD-ROM).

Table 4

Impact of the Initiative on Federal Agencies[1]
($ millions/year)

AGENCY	NPS/WATERSHED	TOXICS	PERMITS/ ENFORCEMENT	MISCELLANEOUS	TOTAL
EPA	$12 - $24		$1 - $2	$2	$15 - $28
USDA/SCS[2]					
USDA/FS[3]	$40 - $93	$8 - $21			$48 - $114
DOI	$3 - $22	$49 - $74	$9	$227 - $617[4]	$288 - $722
DOD	$13	$7	$22		$42
NOAA	$50 - $58	$2 - $3			$52 - $61
DOE				$520	$520
TOTAL	$118 - $210	$66 - $105	$32 - $33	$749 - $1,139	$965 - $1,487

[1] Total costs include both extramural and intramural funds.

[2] If farmers incur the cost of implementing best management practices, the estimated cost would be $211 million per year. If SCS provides assistance, the estimated annual cost would be $540 million.

[3] If Forest Service has to reissue all NPDES permits, the annual cost would be between $716 and $718 million.

[4] Includes DOI's estimate for storm water and EPA's estimate for remediating abandoned mines.

Table 5

Use Support Status of Assessed River Miles and Miles Impacted in Part by Selected Sources (28 Entities Reporting)

Use Support Status	Total Miles at Use Support Status	Miles (% of Total) for Which These Sources Contribute to Use Support Problems					
		Agriculture	Forestry	Construction	Urban	Hydrologic and Habitat Modification	Point Sources
Fully Supporting	63,518						
Fully Supporting but Threatened	11,472	8,196 (71%)	2,360 (20%)	2,499 (22%)	768 (7%)	3,424 (30%)	2,972 (26%)
Partially Supporting	56,622	44,657 (79%)	8,962 (16%)	9,181 (16%)	6,868 (12%)	16,002 (28%)	21,095 (37%)
Not Supporting	44,229	32,921 (74%)	2,293 (5%)	2,899 (6%)	7,961 (17%)	6,961 (16%)	20,285 (46%)
Total Impaired or Threatened	112,323	85,774 (76%)	13,615 (12%)	14,579 (13%)	15,597 (14%)	26,387 (23%)	44,352 (39%)

Table 6

Use Support Status of Assessed River Miles and Miles Impacted Solely by Selected Sources (28 Entities Reporting)

Use Support Status	Total Miles at Use Support Status	Miles (% of Total) for Which These Sources Cause the Use Support Problems							
		Agriculture	Forestry	Construction	Urban	Hydrologic and Habitat Modification	Agriculture & Hydro/Hab Modification	Other NPS	Point Source & NPS
Fully Supporting	63,518								
Fully Supporting but Threatened	11,472	3,579 (31%)	228 (2%)	94 (1%)	34 (0%)	160 (1%)	999 (9%)	3,406 (30%)	2,972 (26%)
Partially Supporting	56,622	18,369 (32%)	808 (1%)	237 (0%)	480 (1%)	881 (2%)	6,224 (11%)	8,528 (15%)	21,095 (37%)
Not Supporting	44,229	14,604 (33%)	62 (0%)	11 (0%)	181 (0%)	271 (1%)	2,532 (6%)	6,283 (14%)	20,285 (46%)
Total Impaired or Threatened	112,323	36,552 (32%)	1,098 (1%)	342 (0%)	695 (1%)	1,312 (1%)	9,755 (9%)	18,217 (16%)	44,352 (39%)

Table 7

Use Support Status of Assessed Lake Acres and Acres Impacted in Part by Selected Sources (24 Entities Reporting)

Use Support Status	Total Acres at Use Support Status	Acres (% of Total) for Which These Sources Contribute to Use Support Problems					
		Agriculture	Forestry	Construction	Urban	Hydrologic and Habitat Modification	Point Sources
Fully Supporting	1,151,157						
Fully Supporting but Threatened	521,938	304,868 (58%)	42,708 (8%)	29,762 (6%)	104,664 (20%)	67,707 (13%)	96,126 (18%)
Partially Supporting	1,152,150	851,717 (74%)	63,391 (6%)	83,154 (7%)	46,333 (4%)	422,890 (37%)	237,469 (21%)
Not Supporting	490,039	147,582 (30%)	5,405 (1%)	17,608 (4%)	75,169 (15%)	58,741 (12%)	62,680 (13%)
Total Impaired or Threatened	2,164,127	1,304,167 (60%)	111,504 (5%)	130,524 (6%)	226,166 (10%)	549,338 (25%)	396,275 (18%)

Table 8

Use Support Status of Assessed Lake Acres and Acres Impacted Solely by Selected Sources (24 Entities Reporting)

Use Support Status	Total Acres at Use Support Status	Acres (% of Total) for Which These Sources Cause the Use Support Problems									
		Agriculture	Forestry	Construction	Urban	Hydro/Hab Modification	Agriculture & Hydro/Hab Modification	Agriculture & Forestry	Forestry & Hydro/Hab Modification	Other NPS	Point Source & NPS
Fully Supporting	1,151,157										
Fully Supporting but Threatened	521,938	207,325 (40%)	3,350 (1%)	0 (0%)	48,861 (9%)	1,251 (0%)	29,090 (6%)	13,250 (2%)	0 (0%)	204,847 (39%)	13,964 (3%)
Partially Supporting	1,152,150	320,862 (28%)	15,364 (1%)	4,061 (0%)	9,454 (1%)	56,145 (5%)	260,308 (22%)	1,854 (0%)	30,799 (3%)	424,746 (37%)	28,557 (2%)
Not Supporting	490,039	52,261 (11%)	162 (0%)	17 (0%)	39,278 (8%)	4,087 (1%)	46,143 (9%)	0 (0%)	0 (0%)	334,712 (68%)	13,379 (3%)
Total Impaired or Threatened	2,164,127	580,448 (27%)	18,876 (1%)	4,078 (0%)	97,593 (4%)	61,483 (3%)	335,541 (16%)	15,104 (1%)	30,799 (1%)	964,305 (44%)	55,900 (2%)

Table 9

Likelihood That Full Implementation of Management Measures Will Improve Water Quality in Threatened and Impaired Rivers

Use Support Status	Sources that Cause the Use Support Problems						
	Agriculture	Forestry	Construction	Urban	Hydrologic and Habitat Modification	Agriculture & Hydro/Hab Modification	Other NPS (Combined)
Fully Supporting but Threatened	High	High	Medium	Medium	High	Medium	High
Partially Supporting	Medium	Medium	Medium	Low	High	Medium	Medium
Not Supporting	Medium	Low	Low	Low	Medium	Low	Low

Table 10

Likelihood That Full Implementation of Management Measures Will Improve Water Quality in Threatened and Impaired Lakes

Use Support Status	Sources that Cause the Use Support Problems								
	Agriculture	Forestry	Construction	Urban	Hydro/Hab Modification	Agriculture & Hydro/Hab Modification	Agriculture & Forestry	Forestry & Hydro/Hab Modification	Other NPS (Combined)
Fully Supporting but Threatened	High	High	Medium	Medium	High	Medium	High	High	Medium
Partially Supporting	Medium	Medium	Medium	Medium	Medium	Low	Medium	Medium	Medium
Not Supporting	Low	Low	Low	Low	Medium	Low	Low	Low	Low

Table 11

Summary of Likelihood That Full Implementation of NPS Management Measures Will Measurably Improve Water Quality - Rivers (28 Entities)

Use Support Status	Likelihood of Achieving Measurable Water Quality Improvement in 10 to 20 Years (Miles)		
	High	Medium	Low
Fully Supporting but Threatened	7,373	1,127	0
Partially Supporting	881	34,166	480
Not Supporting	0	14,875	9,069
TOTAL	8,254	50,168	9,549

Table 12

Summary of Likelihood That Full Implementation of NPS Management Measures Will Measurably Improve National Water Quality[1] - Rivers

Use Support Status	Likelihood of Achieving Measurable Water Quality Improvement in 10 to 20 Years (Miles)		
	High	Medium	Low
Fully Supporting but Threatened	24,791	3,789	0
Partially Supporting	2,501	96,979	1,362
Not Supporting	0	28,107	17,136
TOTAL	27,292	128,875	18,498

[1] Projected for 54 states and territories based on WBS analysis.

Table 13

Summary of Likelihood That Full Implementation of NPS Management Measures Will Measurably Improve Water Quality - Lakes (24 Entities)

Use Support Status	Likelihood of Achieving Measurable Water Quality Improvement in 10 to 20 Years (Acres)		
	High	Medium	Low
Fully Supporting but Threatened	225,176	282,798	0
Partially Supporting	0	863,285	260,308
Not Supporting	0	4,087	472,573
TOTAL	225,176	1,150,170	732,881

Table 14

Summary of Likelihood That Full Implementation of NPS Management Measures Will Measurably Improve National Water Quality[1] - Lakes

Use Support Status	Likelihood of Achieving Measurable Water Quality Improvement in 10 to 20 Years (Acres)		
	High	Medium	Low
Fully Supporting but Threatened	1,026,355	1,288,996	0
Partially Supporting	0	4,799,150	1,447,097
Not Supporting	0	13,736	1,588,298
TOTAL	1,026,355	6,101,882	3,035,395

[1] Projected for 54 states and territories based on WBS analysis.

Table 15

Summary of CSO Costs and Benefits of Various Control Options

LEVEL OF CONTROL IN CSO POLICY - PRESUMPTION APPROACH		BENEFITS					ANNUAL COSTS
Untreated Overflow Events	% Capture w/Treatment[1]	Number of Untreated Overflows	Number of Days WQS Violated	Million Pounds BOD Removed	Million Pounds TSS Removed	Presumption Reasonable to Meet WQS	Billion Dollars/ Year[4]
1 - 2	95% w/Primary	1 - 2	3 - 6	900	2920	YES	6.82
2 - 4	90% w/Primary	2 - 4	6 - 12	805	2700	YES	4.80
4 - 6	85% w/Primary	4 - 6	12 - 18	700	2480	YES	3.45
8 - 12	80% w/Primary	8 - 12	24 - 36	610	2260	NO	2.61
18 - 20	75% w/Primary	18 - 20	35 - 60	545	2035	NO	2.02
21 - 26	70% w/Primary	21 - 26	60 - 75	490	1815	NO	1.60
25 - 30	65% w/Primary	25 - 30	75 - 90	435	1610	NO	1.26
4 - 6	85% w/Secondary	4 - 6	12 - 18	830	2675	YES	14.14
8 - 12	80% w/Secondary	8 - 12	24 - 36	780	2516	NO	8.75
50 - 80	NO CONTROLS	50 - 80	150 -240	0[2]	0[3]	NO	0

[1] "85% capture w/Treatment" means that a treatment system is to be provided to treat all the instantaneous flows except 4 to 6 times per year and the untreated flow which is in excess of the treatment capacity of the treatment system is to be less than 15% of the total yearly flow.

[2] Total annual loading of BOD in CSOs without control is 1150 million pounds.

[3] Total annual loading of TSS in CSOs without control is 3700 million pounds.

[4] Annual costs include capital and O&M costs. Capital costs are annualized over a 20 year period at an interest rate of 7%.

Table 16

Impacts of the Initiative's Domestic Sewage Exclusion Provision on Private Sources ($millions/year)

Cost Category	Cost ($million)	Basis for Cost Estimate
Industrial users subject to additional technology-based local limits	$114	5,319 facilities
Industrial users subject to additional TRAPs	$134	8,848 facilities (comprehensive TRAPs) 168,112 facilities (minimal TRAPs)
POTWs that must develop and implement additional TRAPs	$34[1]	1,500 pretreatment POTWs
TOTAL	$282	

TRAPs - toxic reduction action plans

[1] Note that private sources are assumed to ultimately bear the costs (through discharge fees) incurred by POTWs in developing such programs.

Table 17

Summary of Aggregate Annualized Costs from Control of Urban Sources Under the Initiative and Pending Spending (CSOs, Storm Water, Toxics)

Cost Category	Range: Low - High (Millions of 1993 $)
Municipal Costs	
Phase I Storm water	$ 1,650 - $ 2,555
Phase II Storm water	$ 1,030 - $ 1,910
CSO Controls	$ 3,450
CZARA Non-Point Controls	$ 390 - $ 590
Pending Spending (Great Lakes, Sludge)	$ 90
Subtotal Municipal	$ 6,610 - $ 8,595
Private Sector	
Phase I Storm water	$ 2,360 - $ 2,850
Phase II Storm water	$ 345 - $ 1,670
Pollution Prevention Plans	$ 60 - $ 120
Domestic Sewage Exclusion	$ 280
Nonpoint Source Controls	$ 233 - $ 388
Subtotal Private Sector	$ 3,278 - $ 5,308
Total Quantified Costs in Urban Areas	$ 9,888 - $ 13,903
Non-Quantified Costs	
State Administration Costs (Urban portion of $650m) Federal Compliance (Urban portion of $945m) - excludes abandoned mines. Groundwater Controls (Urban portion of $150m to $600m) Further Water Quality Criteria and Standards and sediment criteria Toxics Bans Other Pending Spending (e.g., Great Lakes, Pulp and Paper Effluent Guidelines, Air MACT standards)	

Source: Summary of Tables 19 and 20

Table 18

Summary of Aggregate Annualized Benefits from Control of Urban Sources Under the Initiative and Pending Spending (CSOs, Storm Water, Toxics)

Benefit Category	Range: Low - High (Millions of 1993 $)
Quantified Benefits	
Freshwater Recreational Fishing and Swimming (use and nonuse)	$ 650 - $ 4,670
Marine Recreational Fishing (use only)	$ 40 - $ 440
Marine Nonconsumptive Recreation (use only)	$ 30 - $ 300
Marine and Freshwater Commercial Fishing	$ 40 - $ 190
Withdrawal or Diversionary Uses	$ 20 - $ 80
Human Health Effects (from risks associated with exposure to pollutants via swimming activity and seafood consumption)[1]	$ 40 - $ 320
Sub-total: Quantified Benefits[2]	
Assuming immediate attainment of benefits[3]	
(i) Annualized Benefits (no lag and no discounting, thus a simple summation of individual categories)	(i) $ 820 - $ 6,000
Assuming a gradual attainment of benefits over the first 15 year period that all Urban Source Controls are adopted.[4]	
(ii) Annualized Benefits (seven percent discount rate, gradual attainment over first 15 years)	(ii) $ 560 - $ 4,100
(iii) Annualized benefits (three percent discount rate, gradual attainment over first 15 years)	(iii) $ 660 - $ 4,900
Non-Quantified Benefits	
- Marine Recreational Swimming (nonhealth effects) - Other Human Health Effects in Marine and Freshwaters (see Note 1) - Recreational Hunting- Freshwater Nonconsumptive Recreation (see Note 1) - Marine Recreational Boating - Other Non-use Benefits (Marine Waters - see Note 1) - Other avoided costs (e.g., water storage, dredging, damages from floods). - Restoration of biodiversity and ecosystem integrity.	

[1] Given information and methods used to calculate the quantified benefits, some portion of the benefits associated with these categories may be captured in the monetary range ascribed to freshwater recreation fishing and swimming.

[2] Assumes no double counting of benefits or substitution effects between different categories when developing aggregate national estimates. Also assumes that all upper ends of the range for each quantified category describe the aggregate lower and upper bound estimate. Absent information on the distribution or probability of attaining benefits defined by the estimated range, we can not calculate a "most likely" estimate.

[3] Assuming no lag between implementation of controls, recovery of natural ecological systems, and economic behavior that forms the basis for the economic benefit measures.

[4] These estimates of the economic benefits are more appropriate to use when comparing quantified costs and benefits, given the anticipated lag time between introduction of the control measures and full realization of the environmental and economic benefits. The calculated annualized figure is based on assuming a gradual attainment of benefits up through year fifteen, and a constant future benefits stream after the fifteenth year has been reached.

Table 19

Summary of Current and Planned Spending Under the Existing CWA ($millions/year)

Provisions	Private Sources	Municipalities	Agriculture	State Water Programs[1]	Federal Agencies[2]	Total (Quantified)
Pre-1987 Act	$25,286	$17,190	$191	$373	$9,564	$52,604
Nonpoint Source Controls/watershed		$389 - $591	$240 - $389	$125	$234	$988 - $1,339
Storm Water: Phase I	$3,990	$1,650 - $2,555				$5,640 - $6,545
CSOs		$3,450				$3,450
Other Costs	$943 - $1,073	$88				$1,031 - $1,161
TOTALS	$30,219 - $30,349	$22,767 - $23,874	$431 - $580	$498	$9,798	$63,713 - $65,099

[1] Pre-1987 expenditures, estimated to be about $2.7 billion per year for administration and compliance, are not shown here because the cost of complying with the current and future water quality standards could not be estimated. The values shown here are only for administering the program.

[2] Some obligations under the current law, e.g., remediation of abandoned mines are shown in Table 22.

Source: U.S.EPA, Office of Water.

Table 20

Summary of Incremental Costs of the Initiative
($millions/year)

Provisions	Private Sources	Municipalities	Agriculture	State Water Programs	Federal Agencies	Total (Quantified)
Nonpoint Source Controls/watersheds	$233 - $388	[included with private sources]	$1,056 - $1,830	$92	$118 - $210	$1,499 - $2,520
Storm Water: Phase II	$ 345 - $1,670	$1,030 - $1,910			$19	$1,394 - $3,599
CSOs		[b]				
Toxics Control	[a]				$66 - $105	$66 - $105
Discharge Fees	$290	$94		$10		$394
Groundwater	$150 - $600					$150 - $600
Pollution Prevention Planning	$60 - $120			no est.		$60 - $120
Domestic Sewage Exclusion	$282					$282
NPDES & WQS[1]	[c]			$188	$32 - $33	$220 - $221
SRF/Construction Grants				$8		$8
Monitoring				$118	[d]	$118
Abandoned Mines					$330 - $1,100	$330 - $1,100
Department of Energy					$520	$520
TOTALS	$1,360 - $3,350	$1,124 - $2,004	$1,056 - $1,830	$416	$1,085 - $1,987	$5,041 - $9,587

Blank cell implies negligible impact
no est. = estimates not available
[a] No aggregate estimates of the potential costs of further restrictions on discharges of toxic/bioaccumulative pollutants; bans of some pollutants (e.g., dioxin) could be very costly but would have to be justified based on risk reduction potential and cost.
[b] No incremental cost over current policy.
[c] Additional enforcement costs to private sources (i.e., fines) which deter environmental damages are not considered a resource cost.
[d] Federal agency costs of monitoring are included under the nonpoint source costs.
[1] Cost of compliance with current and future water quality standards is not estimated and hence is not included.

Source: U.S.EPA, Office of Water.

Table 21

Summary of Cost Savings/Cost Avoided of the Initiative Compared With Stringent Interpretation of Existing CWA Requirements[1] ($millions/year)

Provisions	Private Sources	Municipalities	Agriculture	State Water Programs	Federal Agencies	Total (Quantified)
Nonpoint Source Controls/Watersheds			$461 - $845			$461 - $845
Storm Water:						
Phase I	$1,140 - $1,630					$1,140 - $1,630
Phase II	$14,565 - $15,890	$755 - $850				$15,320 - $16,740
CSOs		$10,700				$10,700
Discharge Fees/WQC/WQS				$301	$83	$384[2]
Abandoned Mines					$1,053 - $3,481	$1,053 - $3,481
TOTALS	$15,705 - $17,520	$11,455 - $11,550	$461 - $845	$301	$1,136 - $3,564	$29,058 - $33,780

[1] Cost savings (or cost avoided) associated with effluent trading are not included. These range between $47 million and $1,900 million for private sources, and between $611 million and $5,600 million for municipal sources.

[2] Reflects the revenues from the permit fee provision to state and federal permitting authorities.

Source: U.S.EPA, Office of Water.

Table 22

Summary of Current and Potential Spending Under Stringent Interpretations of CWA ($millions/year)

Provisions	Private Sources	Municipalities	Agriculture	State Water Programs	Federal Agencies	Total (Quantified)
Pre-1987 Act	$25,286	$17,190	$191	$560	$9,564	$52,791
Nonpoint Source Controls/watershed		$389 - $591	$240 - $389	$150	$234	$1,013 - $1,364
Storm Water: Phase I Phase II	 $3,990 $16,235	 $1,650 - $2,555 $1,785 - $2,760				 $5,640 - $6,545 $18,020 - $18,995
Abandoned Mines					$1,383 - $4,481	$1,383 - $4,581
CSOs		$14,140				$14,140
Other Costs	$943 - $1,073	$88				$1,031 - $1,161
TOTALS	$46,454 - $46,584	$35,242 - $37,324	$431 - $580	$710	$11,181 - $14,279	$94,018 - $99,577

Source: U.S.EPA, Office of Water.

Figure 1

Nonpoint Source Management Measures Applied in Benefits Analysis

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Agriculture

- Erosion and Sediment Control
- Facility Wastewater and Runoff from Confined Animal Facility Management (Large and Small Units not permitted under NPDES)
- Nutrient Management
- Pesticide Management
- Grazing Management
- Irrigation Water Management

Forestry

- Preharvest Planning
- Streamside Management Areas
- Road Construction/Reconstruction
- Road Management
- Timber Harvesting
- Site Preparation and Forest Regeneration
- Fire Management
- Revegetation of Disturbed Areas
- Forest Chemical Management
- Wetlands Forest Management

Urban Runoff

- New Development
- Watershed Protection
- Site Development

Construction

- Construction Site Erosion and Sediment Control
- Construction Site Chemical Control

Existing Development

- Existing Development

Pollution Prevention

- Pollution Prevention

Roads, Highways, and Bridges

- Planning, Siting, and Developing Roads and Highways
- Bridges
- Construction Projects
- Construction Site Chemical
- Operation and Maintenance
- Road, Highway, and Bridge Runoff Systems

Channelization and Channel Modification

- Physical and Chemical Characteristics of Surface Waters
- Instream and Riparian Habitat Restoration

Streambank and Shoreline Erosion

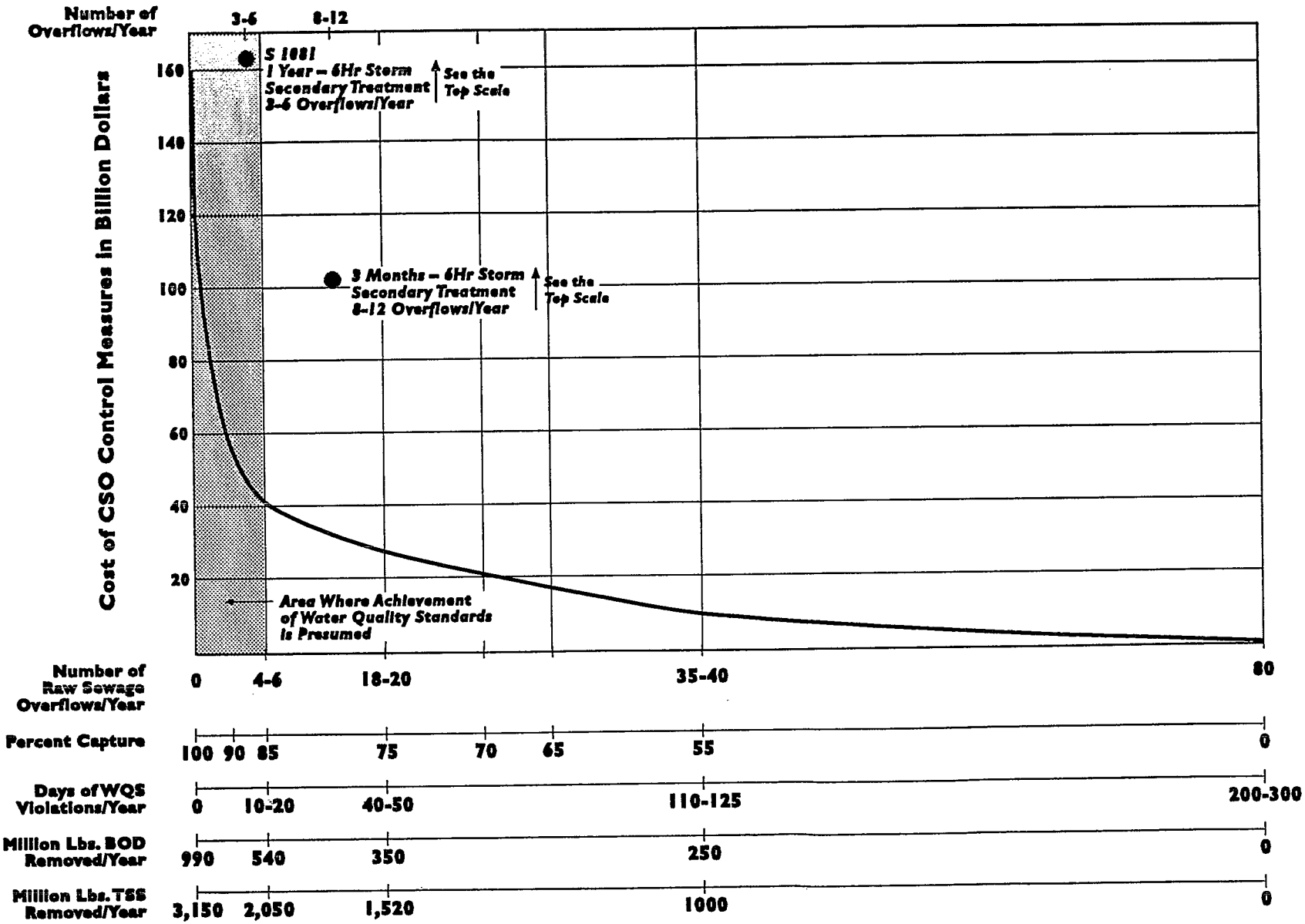
- Eroding Streambanks and Shorelines

Wetlands, Riparian Areas, and Vegetated Treatment Systems

- Protection of Wetlands and Riparian Areas
- Restoration of Wetlands and Riparian Areas
- Vegetated Treatment Systems

FIGURE 2

Costs and Benefits of CSO Controls



APPENDICES

Nonpoint Source Case Studies

Selected case studies were identified to gauge the validity of the analytic results, and to illustrate the significance and specifics of study findings. These case studies were selected to correspond with the prevalent combinations of sources and pollutants to the extent possible. Case studies were found for agriculture, forestry, urban, and hydromodification.

(a) Agricultural Case Studies:

Seiders, K. 1993. "Moxie Drain BMP Implementation Demonstration Project Water Quality Monitoring Report." Washington State Department of Ecology. September 1993.

This 2-year project in the Moxie Drain watershed demonstrated the benefits of implementing a sediment settling basin, irrigation system retrofits (valves, piping, sprinkler heads, etc.), irrigation water management, reduced tillage, and furrow mulching. These practices, which are similar to the irrigation and erosion management measures, were implemented on 87% of the irrigated land.

Water quality improvements at the study site included median pollutant reductions for total suspended solids (TSS) (86%), TSS load (90%), Imhoff Settleable Solids (99%), nephelometric turbidity (63%), absorbtometric turbidity (75%), ammonia (56%), and ammonia load (60%). Much of the improvement was due to climatic factors, but data from a reference watershed were used to show that the best management practices (BMPs) improved water quality.

Gunsalus, B., E.G. Flaig, and G. Ritter. 1992. "Effectiveness of Agricultural Best Management Practices Implemented in the Taylor Creek/Nubbin Slough Watershed and the Lower Kissimmee River Basin." In: The National Rural Clean Water Program Symposium: 10 years of Controlling Agricultural Nonpoint Source Pollution: The RCWP Experience. EPA Office of Water.

Implementation of animal waste collection and nutrient recycling systems similar to the management measures for confined animal facilities and nutrient management caused a significant decrease in the median total phosphorus concentrations at most sites in this dairy area. Median total phosphorus concentration values decreased by 84 percent, and phosphorus load decreased by 40 percent in the basin.

Nevada. "Restoring the Quinn River, An Important Riparian Resource." Draft of EPA Section 319 Success Stories. September 30, 1993.

Using techniques similar to the grazing management measure, a riparian pasture was fenced to control the amount, timing, and location of grazing, and to allow the riparian area of the East

Fork Quinn River to recover from the impacts of poor grazing practices. Implementation also included streambank stabilization measures, such as the planting of juniper and sagebrush to slow the velocity of water and the planting of 1,700 willows to reduce thermal pollution.

Monitoring showed the bioconcentration index (BCI) climbed from poor to fair due to the BMPs. Habitat parameters such as bank cover, bank soil stability, and bank vegetation stability have also improved over 5 years.

Oklahoma. "BMPs Reduce Nutrients in Battle Branch Watershed." Draft of EPA Section 319 Success Stories. September 30, 1993.

Waste management plans, poultry composters, and waste storage ponds were implemented by 84 percent of landowners in this 36,000-acre poultry and dairy watershed. These practices are addressed in the confined animal facility management measures. As a result of implementing these BMPs, nitrate levels during runoff have decreased by as much as 72 percent and total phosphorus levels by as much as 35 percent.

The following paragraphs were taken from EPA's "Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters."

In many instances landowners can actually save money by implementing nutrient management plans. For example, Maryland has estimated (based on the over 750 nutrient management plans that were completed prior to September 30, 1990) that if plan recommendations are followed, the landowners will save an average of $23 per acre per year (Maryland Department of Agriculture, 1990). The average savings may be high because most plans were for farms using animal waste. Future savings may be reduced as more farms using commercial fertilizer are included in the program.

In the South Dakota Rural Clean Water Program (RCWP) project, the total cost (1982-1991) for implementing fertilizer management on 46,571 acres was $50,109, or $1.08 per acre (USDA-ASCS, 1991a). In the Minnesota RCWP project, the average cost for fertilizer management for 1982-1988 was $20 per acre (Wall et al., 1989). Assuming a cost of $0.15 per pound of nitrogen, the savings in fertilizer cost due to improved nutrient management of Iowa corn was about $2.25 per acre as rates dropped from 145 pounds per acre in 1985 to about 130 pounds per acre in 1989 and 1990 (Iowa State University, 1991a).

Magleby, R., J. Kasal, D. Walker, R. Gum. 1989. "The Economics of Controlling Sediment from Irrigation: An Idaho Example." Report No. AGES 89-33. USDA, ERS.

This project addresses irrigated agriculture in the Rock Creek, Idaho, RCWP Project. This project implemented many of the practices addressed in the erosion and irrigation water management measures including conservation tillage and irrigation water management (IWM). IWM follows the basic principle of the irrigation management measure by controlling the amount of water applied, rather than constructing expensive irrigation systems. Both practices reduce

production costs below those of conventional systems and produce a net cost savings or benefit to the farmer. The change in annualized cost per acre for conservation tillage is a savings of $33.00 compared with conventional tillage; for IWM the savings is $4.50 compared with dirt-ditch irrigation.

Hall, D., and D. Risser. 1992. "Effects of Nutrient Management on Nitrogen Flux through a Karst Aquifer, Conestoga River Headwaters Basin, Pennsylvania." In: The National Rural Clean Water Program Symposium: 10 years of Controlling Agricultural Nonpoint Source Pollution: The RCWP Experience. EPA Office of Water.

This RCWP project studied the effects of nutrient management on groundwater quality at an agricultural field site. Nutrient management, and the nutrient management measure, will in most cases result in reduced applications of manure and fertilizer to fields. Analysis of pre- and post-nutrient management periods for groundwater samples resulted in statistically significant decreases in median nitrate concentrations at four of the five wells tested.

"Public Rangelands: Some Riparian Areas Restored But Widespread Improvement Will Be Slow." GAO Report/RCED-88-105. June 1988.

In Oregon, Bear Creeks' riparian areas were heavily overgrazed, causing the creek to dry up in the summer. After a new cattle management system resembling the grazing management measure, the riparian area was greatly improved. The permittee stated that he cut his yearly feed costs by $10,000 as his AUMs increased from 75 to 400 in 1993.

(b) Forestry Case Studies:

Curtis, J.G. et al. 1990. "Effectiveness of Best Management Practices in Preventing Degradation of Streams Caused by Silvicultural Activities in Pickett State Forest." Tennessee Technological University for the Tennessee Department of Conservation.

Three stands of timber in Tennessee had BMPs implemented prior to, during, and after harvest. The BMPs applied generally conformed to the forestry management measures from the (g) Guidance. Monitoring was conducted before, during, and after timber harvest activities and showed that the timber harvest had no apparent detrimental impact on the adjacent streams.

Lynch and Corbett. 1990. "Evaluations of Best Management Practices for Controlling Nonpoint Pollution From Silvicultural Operations." Water Resources Bulletin 26(1): 41-52.

In the Leading Ridge Watershed in Pennsylvania, BMPs were employed to control NPS pollution. The BMPs used, such as buffer strips, design of skid trails and roads, and preharvest planning, closely followed the forestry management measures. Monitoring results indicate that the BMPs were effective in minimizing increases in turbidity, with no major increases observed during or immediately following cutting.

Swank, W.T. et al. 1989. "Effects of Timber Management Practices on Soil and Water." In: The Scientific Basis for Silvicultural and Management Decisions in the National Forest System. R.M. Burns, ed. General Technical Report WO-55. USDA Forest Service, pp. 79-106.

This paper discusses the effects of BMPs, including BMPs addressed in the forestry management measures. The general effect on soil and water are discussed, along with the effects of BMPs in different forest types. The three water quality characteristics most affected by timber harvesting are sediment, dissolved nutrients, and water temperature. The paper stated that providing buffer strips--or "streamside management areas," as it is called in the guidance--can mitigate the negative impact on these water quality characteristics.

The following paragraph was taken from EPA's "Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters" and illustrates the economic benefits of preharvest planning.

A cost-benefit analysis by Dissmeyer and others (USDA, 1987) reveals the dramatic, immediate savings from considering water quality during the design phase of a road reconstruction project (Table A-1). Expertise on soil and water protection provided by a hydrologist resulted in 50 percent of the savings alone. Other long-term economic benefits of careful planning such as longer road life and reduced maintenance costs were not quantified in this analysis.

Table A-1. Costs and Benefits of Proper Road Design (With Water Quality Considerations) Versus Reconstruction (Without Water Quality Considerations) (USDA Forest Service, 1987)

	Without Soil/ Water Input[a]	With Soil/Water Input[a]
Miles of road	3.0	3.0
Reconstruction costs	$796,000	$372,044
Soil/water input costs	--	$800
Immediate benefit (savings) of soil/water input	--	$211,978

[a] Soil/water inputs are design adjustments made by a hydrologist and include narrower road width and steeper road bank cuts in soils of low erodibility and low revegetation potential.

(c) Urban case studies:

Bath Club Concourse Storm Water Rehabilitation project, Tampa Bay, Florida

BMP: Porous Pavement

Benefits: Reduced loadings to Boca Ciega Bay

Hollywood, South Carolina (Success Stories, page 35)

BMP: Rock/Plant onsite disposal system for wastewater

Benefits: 95% fecal coliform removal, 85% BOD treatment, 65% TSS treatment, 10% N removal - predicted removal rates 80-90%

Boulder Creek, Colorado, TMDL Case Study

BMPs: Cattle exclusions/crossings, streambank stabilization log revetments, riparian zone willow and cottonwood plantings, replacement of channelized berms with sculpted streambanks, channel modification (thalweg pools), wetland enhancement, and boulder aeration structures.

Benefit: Successful improvement of instream conditions

Fourche Creek, Alaska, National Urban Runoff Program (NURP)

BMPs: Retention basins, rip-rap and vegetation, grass planting and sodding, reduced slopes, check dams, grassed drainage or overflow areas, gabions and channel clearing with bank relocation

Benefits: Loading reductions from BMP implementation

Expected benefits: Improved parks and recreational systems in several disadvantaged and minority neighborhoods; improvements of Fourche Creek waters to meet water quality standards; reductions of health hazards from contact and fishing

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Jordon River Parkway Demonstration Project, Utah
(§319 Success Stories: Cost: $150,000)

BMPs: Streambank stabilization including rip-rap and vegetative stabilization, slope grading and wetland pond systems

Benefits: Decreased concentrations of arsenic, zinc, TSS, DO, nitrate and phosphorus; park enhancement, flourishing riparian vegetation (trees, shrubs, wildflowers, and grasses), wetland plant communities

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Lake Barcroft, Virginia (Natural Lawn, personal communication, 1991)

BMP: Use of low-phosphate and phosphate-free fertilizers

Benefit: Estimated 7,000-pound loading reduction in fall P loadings, and 80-85% decrease in spring loadings to the lake

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Anacostia River Case Study (Converse example)

Retrofitting example to illustrate high costs of remediating system

The Anacostia watershed is predominantly residential/commercial and is not dominated by industrial discharges. Estimated capital cost for structural BMPs identified in the restoration plan is $27.6 million without adding planning, design, permitting and land acquisition costs. Stream restoration and reforestation costs will incur additional costs of at least $800,000 to the restoration effort. (Anacostia Watershed Restoration Committee, 1992)

Alternative example consistent with CZAR §6217(g) Guidance

Woodlands, Texas. "Design With Nature." Sykes, R. 1989. Chapter 3.1, Minnesota Pollution Control Agency Handbook, "Protecting Water Quality in Urban Areas."

BMPs: Site planning, minimization of impervious surface, protection of natural drainageway, grassed swales

Benefits: $14 million was saved by the developer by selecting natural drainage/vegetative retention systems instead of conventional storm water management systems for water quantity and quality controls when designing the site.

(d) Hydromodification case study:

Chesapeake Bay Shoreline Erosion study, U.S. Corps of Engineers, States of Maryland and Virginia

BMPs: Revetments, groins, bulkheads, vegetative stabilization

(erosion reduction ranges from 30 to 100%)

Benefits: Water-oriented recreation, land loss prevention, property damage prevention, and loss of access protection, water quality protection, and habitat protection (sediment control). The elimination of sediment was estimated to increase productivity 20%. Baywide benefits total $15 million for level 1 and $9 million for level 2.

References

EPA. 1992. "Managing Nonpoint Source Pollution." EPA-506/9-90. Office of Water, Washington, D. C.

Clausen, J.C., D.W. Meals, and E.A. Cassell. 1992. "Estimation of Lag Time for Water Quality Response to BMPS." In: Seminar Publication - The National Rural Clean Water Program Symposium. EPA/625/R-92/006. Office of Research and Development/Office of Water, Washington, D. C.

Rosa, F. 1987. "Lake Erie Central Basin Total Phosphorus Trend Analysis From 1968 to 1982." J. Great Lakes Res. 13(4): 667-673.

Hallberg, G.R., R.D. Libra, Zhi-Jun Liu, R.D. Rowden, and K.D. Rex. 1993. "Watershed-Scale Water-Quality Response To Changes in Landuse and Nitrogen Management." In: Proceedings of Agricultural Research to Protect Water Quality. February 21-24, 1993. Soil and Water Conservation Society, Ankeny, IA.

CWA Benefits Under CZARA Management Scenario

- Ecosystem protection. Maintain water body current status. The costs of streambank stabilization, hardening of conveyances, and wetlands remediation can be decreased or eliminated. Prevention or reduction of habitat destruction due to physical alteration of water quality and quantity, sedimentation, scouring, and flooding.

- Protection of property values, e.g., loss of fastland and streambank property. Enhancement of property values as a result of riparian buffer protection or restoration. Increased property value due to proximity to aesthetically pleasing storm water treatment systems such as constructed wetlands.

- Protection of fisheries and estuarine incubators and spawning areas. (Economic data may be available from NOAA on commercial fishers adversely impacted by NPS.)

- Protection of water oriented recreational values.

- Reduction of water costs by the use of low-flow plumbing fixtures; high quality water-efficient plumbing fixtures can reduce 50% of residential water use and wastewater volume, with resulting savings in water bills and corresponding decreases in wastewater treatment costs.

- Reduce pesticide and fertilizer costs. Education programs for proper lawn care, turf management, and xeriscaping programs can reduce residential and commercial fertilizer, pesticide, and water costs and associated pollutant loadings. Pesticide loadings can be reduced 85-90 percent where spot applications are substituted for blanket applications depending on site specific conditions. Northern Virginia Soil and Water Conservation District estimated that two-thirds less fertilizer can be applied to residential lawns than commonly recommended by manufacturers. Such practices could result in nitrogen loading reductions of up to 50%.

- Protect and improve groundwater and surface water quality by reducing nitrogen loadings to groundwater and water bodies. Use of denitrifying Onsite Disposal Systems (OSDS) can significantly reduce nitrogen loadings to groundwater. (Chesapeake Bay studies indicate that 55-85% of the nitrogen loadings to OSDS system can pass directly to groundwater and hydrologically connected surface waters.)

- Phosphorus loading reductions and cost savings from the elimination of phosphate detergents. Estimated savings of $1.8 to $2.8 million in POTW costs.

STORM AND SURFACE WATER UTILITY
BELLEVUE, WASHINGTON

Bellevue, Washington, is a suburban community located in the Puget Sound area east of Lake Washington in the Seattle metropolitan area. The city experienced substantial population growth during the last 30 years and particularly rapid growth over the last 20 years. When Bellevue incorporated as a city in 1953, the population was approximately 6,000 and the city limits covered five square miles. By 1990, Bellevue had grown to a population of 86,000 and an area that covered 30 square miles, making it the fourth largest city in Washington State. Recent estimates indicate that the watershed is over 90 percent developed, primarily with residential units and commercial and light industrial uses.

Rapid growth and development created storm water runoff problems in most of the natural streams draining the area. The city's 30-square mile area contains over 50 miles of open streams and five lakes. Much of the average annual rainfall of 42 inches is carried by existing streams into the following receiving waters: Kelsey Creek, Meydenbauer Bay and the Lake Washington East Channel, Yarrow Bay on Lake Washington, Lake Sammamish, and Coal Creek. Of these, Lake Washington is considered the primary receiving water body. The types of storm water runoff problems documented in the Bellevue area include increased flooding and streambank erosion; property damage; stream sedimentation/siltation; diminished salmon runs; water quality degradation by discharges of nutrients, heavy metals, pesticides, and oil; and illicit connections.

In response to citizen concerns about environmental degradation caused by storm water runoff, the city of Bellevue established a storm water utility in 1974. The mission of Bellevue's Storm and Surface Water Utility (SSWU) is to manage the storm and surface water system in Bellevue, to maintain a hydrologic balance, to prevent property damage, and to protect water quality for the safety and enjoyment of citizens and the preservation and enhancement of wildlife habitat.

STORM AND SURFACE WATER UTILITY PROGRAMS

When first established, Bellevue's utility focused on examining various solutions to control flooding and preserve waterways. The utility selected an "open stream concept" using streams as the main conveyance system for storm water runoff. This system uses regional, in-stream flood control facilities to attenuate peak flows for older development. The utility also manages the municipal storm drainage system. In addition, regulations require developers to provide erosion and sedimentation controls at all construction sites and on-site storm water controls for new development. With successful flood control systems in place, the focus has recently shifted to water quality controls, including requirements mandated by the federal Clean Water Act. For the most part, SSWU's comprehensive effort to solve storm water quality

problems is preventive in nature, but the utility also recognizes the need for retrofitting and new capital improvements for treatment.

Management of Bellevue's storm drainage system and open streams involves five major programs: a capital improvement program, operations and maintenance, water quality control, public education, and administration. Activities conducted under each of the major programs are summarized below.

- **Capital improvement program.** SSWU's capital improvement program (CIP) involves planning, design, property acquisition, flood control construction, water quality treatment, and stream enhancement projects. The utility constructed a series of 11 in-stream flood control facilities (detention basins) within the Bellevue stream system to provide protection for the 24-hour, 100-year storm event. SSWU also improves stream passages for carrying capacity, stability, wildlife habitat, and migratory fish passage.

- **Operations and maintenance.** The operations and maintenance (O&M) program involves those functions typically associated with urban drainage, such as repair and minor replacement of SSWU's structural facilities. Bellevue's O&M program also includes operation of structures for flood control, including a telemetry control system for structures and an emergency storm response program, a drainage system inventory, and advice to private citizens on private drainage concerns.

- **Water quality control.** Activities conducted for water control include drainage system cleaning, routine monitoring of receiving waters, investigative monitoring of pollution events and sources, emergency response for water pollution events, coordination with other water quality control agencies, participation in lake restoration studies and projects, a private maintenance inspection program, and a streams enhancement program.

- **Public education.** SSWU's public education efforts focus on available services and the environment. Specific activities include articles in local publications about SSWU services and the effects of human practices on the environment, the Stream Team Program (includes a water quality newsletter, workshops, and citizen activities), City Hall's "Mini Salmon Hatchery" and annual salmon release, storm drain stenciling projects, and a business water quality program.

- **Administration.** Administrative programs for SSWU include financial management, rate administration, comprehensive drainage planning, general administration, and support for the City Council and Storm and Surface Water Advisory Commission. SSWU assures quality control of utility services by tracking all service requests through an automated Customer Action Request system.

UTILITY FINANCING

The city decided that the most equitable system of drainage service charges entails basing changes on the estimated amount of runoff that individual properties contribute to the surface water system. All properties are classified according to their intensity of development. Each classification is assigned a rate (per 2,000 square feet of property area), with current rates set as follows: undeveloped ($0.17), light development ($0.99), moderate development ($1.23), heavy development ($1.83), and very heavy development ($2.46). Wetlands are also a class; however, wetlands are not charged due to their value in water quantity and quality control. The classification combined with the total square footage of the property determines the service charge, which is billed every two months.

Revenues grew slowly until rates were raised to fund the adopted Capital Improvement Program, which was initiated by issuance of $10 million in revenue bonds. Three major rate increases occurred in 1980 (70 percent), 1982 (90 percent), and 1986 (35 percent), and subsequent rate increases have remained in the single-digit category largely to cover inflation. Although the majority of SSWU revenue is from service charges, other revenue sources include clearing and grading permit fees, general facilities charges, and interest on fund accounts. Revenues from the utility service charges and these other sources cover the full costs of Bellevue's storm and surface water management program.

Single-family customers make up 92 percent of the 24,000 accounts and contribute 45 percent of the revenue. An average single-family household pays $16.44 every two months ($98 per year) for 10,000 to 12,000 square feet of property with a typical home. Tax-exempt properties are not exempt from the utility charges. (Washington State highways and Bellevue streets are the SSWU's two biggest ratepayers.)

BENEFITS OF THE STORM AND SURFACE WATER PROGRAM

One of the most successful of SSWU's programs is flood control, and several different approaches to managing storm water discharges are achieving water quality improvements. In addition, Bellevue's reputation as a well-planned, environmentally sensitive city is enhanced through SSWU programs that preserve the city's numerous streams.

Reductions in Peak Flows

- Bellevue's use of the natural stream system to manage storm water preserves the environment and reduces costs. Bellevue's storm water management activities to address flooding and stream erosion problems range from four to ten times less costly than traditional storm sewer improvements.

- Small detention basins (detention times of 30 minutes or less) reduced peak flow rates by up to 60 percent, providing flood and streambank erosion control that protects streamside property.

- With a computerized remote control system, maximum flood protection along major stream corridors is achieved through eight regional detention basins. The remote control system monitors rainfall, stream flow, and water levels to ensure optimal operation of flood gates to control peak flows.

- During a 100-year storm experienced by the Bellevue area in January 1986, property damages occurred only where planned improvements were not yet constructed. Capital improvements totalling $15 million and constructed over the previous 10 years reduced flooding and streambank erosion, thereby avoiding property damages.

- Calls for emergency service during storm events continue to decrease, indicating that SSWU's flood control system has significantly reduced hazards to life and property.

Reductions in Pollutant Loadings/Discharges

- Runoff concentrations of lead and total solids were reduced by between 10 to 25 percent over a two-year period through biannual cleaning of storm drainage inlet sumps and catch basins. Chemical oxygen demand (COD), nutrient, and zinc concentrations were reduced by between 5 to 10 percent over a two-year period.

- Toxic loadings were reduced by between 5 and 10 percent by conventional street-sweeping operations.

- Introduction of floatables to the drainage system was reduced by the installation and maintenance of oil/water separators, some of which have the capability of reducing oil and grease during oil spill events to levels generally associated with background levels in urban storm water.

- Dumping of motor oil and debris in storm drains was significantly reduced by increasing public awareness of storm water issues through SSWU's Stream Team Program and volunteer stenciling of storm drains. A recent survey indicates that 85 percent of area residents dispose of used oil at a recycling facility.

- Dumping of motor oil and household chemicals was also reduced through SSWU's Oil Recycling and Hazardous Waste Program. SSWU collected 2,100 gallons of petroleum products at a recycling event in October 1993.

- Total solids in urban runoff originating from residential yards were reduced by increasing public awareness of practices such as pet waste and litter control.

- A wide variety of local businesses work with SSWU water quality staff to prevent storm water pollution at the source through an innovative program called Business

Partners for Clean Water.

Protection or Restoration of Ecological Resources

- Volunteers have planted thousands of native trees and shrubs along 10 miles of Bellevue's open streams to shade stream waters and enhance fish habitat. Other stream enhancement projects conducted through the Stream Team Program have reduced streambank erosion which also lowered water temperatures and provided shade to enhance fish habitat.

- Kelsey Creek's salmon fishery was enhanced through installation of regional detention basins that help mitigate peak flows and habitat improvements from streambank revegetation projects. Previously, this salmon fishery was limited and unhealthy because of high peak flows from urban runoff that altered the stream channel and carried pollutants.

- Anadramous fish populations are enhanced because SSWU's flood control system is designed to provide maximum flood protection with minimum impact on fisheries and fish migration. During salmon spawning season, flood control gates remain open until significant heavy rainfall occurs.

- Sensitive areas (floodplains, wetlands, and steep slopes) are protected through the city's Natural Determinants Regulations, which prohibit development of designated areas, including 740 acres of wetlands.

- The city is restoring Phantom and Larsen Lakes in partnership with the Washington Department of Ecology. Restoration measures for Phantom Lake over a two-year period reduced annual internal phosphorus loading to the lake by approximately 75 percent and reduced annual external phosphorus loading by 39 to 54 percent. The trophic status of Phantom Lake improved substantially after implementation of restoration measures, although it remains a eutrophic lake.

- Ecological and aesthetic features of the natural environment are preserved through regulation of new development under city codes and a Comprehensive Plan to reflect the philosophy that development should be integrated naturally with the environment and preserve rather than overcome natural features.

Recreation Activity

- Kelsey Creek, a natural water channel that was developed to convey storm water from the city of Bellevue to Lake Washington, provides recreational opportunities such as canoeing, birdwatching, and hiking.

- Cleanup of Mercer Slough (a 325-acre wetland), along with stream and wildlife

enhancement in Mercer Slough Nature Park, resulted in increased canoeing on the slough and increased visitation to the park's interpretive trail.

- Phantom and Larsen Lakes furnish recreational opportunities such as fishing and educational opportunities for school children, who visit the lakes for environmental education projects.

Economic Activity

- Clean water in Bellevue and the surrounding Puget Sound area is important for drinking, food sources, recreation, and industry.

References

"Bellevue Washington: A Leader in Surface Water Management." Storm and Surface Water Utility Department, City of Bellevue, Washington.

Diessner, D. "The Bellevue Storm and Surface Water Utility: A Case History of a Successful Urban Surface Water Management Program." prepared for Storm and Surface Water Utility Department, City of Bellevue, Washington.

"The Metro Monitor," Municipality of Metropolitan Seattle, October 1993.

Personal communication with Wendy Skony, Program Coordinator, Bellevue Storm and Surface Water Utility, December 8, 1993.

Personal communication with John Frodge, Municipality of Metropolitan Seattle, December 9, 1993.

"Phantom/Larsen Lake Phase IIB Restoration Project." Final report prepared by KCM, October 1993.

"Storm Water Utilities: Innovative Financing for Storm Water Management." Prepared by Apogee Research, Inc., for the Water Policy Branch, Office of Policy Analysis, Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency. Draft final report, March 1992.

EPA. 1992. "Environmental Impacts of Storm Water Discharges: A National Profile." EPA 841-R-92-001. Office of Water. June 1992.

EPA. 1990. "Storm Water Guidance Impact Analysis: Volume II: Case Studies." Draft. Office of Water. May 15, 1990.

APPENDIX C

BENEFITS OF TOXICS REDUCTION CASE STUDIES

A. Toxics discharge ban or restriction

Sources of bioaccumulative pollutants include direct releases to water, atmospheric deposition, and contaminated surface run-off. A multi-media approach is necessary to reduce the amount of bioaccumulative pollutants in the environment (EPA, 1993c).

Mercury

- Elevated levels in humans may result in damage to the kidneys and nervous system, and may cause developmental effects.

- Human exposure to mercury is generally through ingestion of fish. From 0.1 to 0.2 percent of the U.S. population (250,000 to 500,000 people) currently exceed the World Health Organization "safe level" for daily methylmercury intake (EPA, 1993b).

- Of fish advisories in the United States, 60 percent are due to mercury (issued in 27 states) (EPA, 1993a).

- The Toxic Release Inventory (TRI) reports 19,742 pounds of mercury released to air in 1991 and 735 pounds released to surface waters or POTWs in 1991 (EPA, 1993c).

- Atmospheric deposition of mercury accounts for almost 60 percent of the mercury loadings to Lake Superior (IJC, 1993).

B. Intermediate Controls

Over 20 years of effluent guideline development, facilities have used end-of-pipe treatment to comply with limitations. Setting limits prior to end-of-pipe control technologies would promote source reduction and prevent multi-media transfer of pollutants.

1. Pulp, Paper, and Paperboard (EPA, 1987b)

   EPA's recently proposed best available technology (BAT) regulations requires in-plant control of chlorinated organics (e.g., dioxin) potentially eliminating 19 fish advisories.

2. Organic Chemicals, Plastics, and Synthetic Fibers (EPA, 1987a)

Steam stripping could remove up to 46,000 metric tons per year of volatile organic compounds and one annual cancer case, with resulting monetized benefits of steam stripping ranging from $10 to $64 million ($1982).

3. Pharmaceutical Manufacturing (Radian Corp., 1993) (under development)

The current release of up to 61,000 metric tons per year could be eliminated by intermediate controls, such as steam stripping.

References

EPA. 1993a. "A National Fish Consumption Advisory Database: A Step Toward Consistency." Office of Water/Office of Science and Technology.

EPA. 1993b. "Draft Report to Congress: Deposition of Toxic Air Pollutants to the "Great Waters." Office of Air Quality Planning and Standards.

EPA. 1993c. "1991 Toxics Release Inventory." EPA 745-R-93-003.

EPA. 1987a. "Regulatory Impact Analysis of the Effluent Guidelines Regulation for the Organic Chemicals, Plastics, and Synthetic Fibers Industry."

EPA. 1987b. "Regulatory Impact Assessment for the Proposed Effluent Guidelines and NESHAP for the Pulp, Paper, and Paperboard Industry. EPA-821-R-93-020.

International Joint Commission. 1993. "A Strategy for Virtual Elimination of Persistent Toxic Substances." ISBN 1-895085-65-9.

Radian Corporation. 1993. Technical memorandum to J. Keating at Versar, Inc.

Additional Material

Baker, J., T. Church, S. Eisenreich, W. Fitzgerald, and Scudlark, J., 1993. Relative Atmospheric Loadings of Toxic Contaminants and Nitrogen to the Great Waters. Prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards.

DETAILED AGGREGATE BENEFIT ANALYSIS
Selected Urban-based Pollution Sources

EXECUTIVE SUMMARY

This paper provides information on the anticipated economic benefits of controlling urban-based sources of water pollution as called for in the Initiative. We have estimated values for a limited number of economic categories. Although we have identified other categories for which positive benefits from water quality improvements are likely, these other categories have not been quantified in this paper due to limited information.

This analysis begins with informed judgement about the extent of water quality improvement that may result from implementing the Initiative's CSO and storm sewer provisions relative to current conditions. We assume that in all cases where CSOs or storm sewers are thought to be the leading source of impaired urban waters (i.e., based upon the 305(b) reports), the implementation of these provisions will restore these waters to fishable and swimmable quality. Furthermore, for those waters where other sources share significant responsibility with CSOs and storm sewers for precluding the attainment of fishable and swimmable quality, we assume two things: first, 50 percent of the responsibility lies with CSOs and storm sewers; second, that implementation of other provisions of the act in combination with the CSO and storm sewer provisions will result in fishable and swimmable quality in the affected waters. Thus, we recognize that uncertainty about the actual extent of impaired waters may lead to over- or underestimating the economic benefit range, but that our method of attributing responsibility for impairments and our assumptions about the efficacy of the provisions may tend to overestimate the economic benefit range.

Beyond the physical, chemical, and biological changes that may result from the CSO and storm sewer provisions, for economic evaluation it is also necessary to estimate the effects these changes have on humans and other economic entities (i.e., industry). For the purposes of this assessment, we aggregate these sources of benefits into four primary categories: (1) enhanced freshwater recreation, aesthetics, and nonuse benefits; (2) enhanced marine recreation, aesthetic, and nonuse benefits; (3) cost savings or increased output for withdrawal or diversionary users; and (4) cost savings or increased output for commercial fisheries. In the event that human health effects were not subsumed in the benefit estimates of one or more of the four primary categories we include it as a fifth category. In addition to quantifying an economic benefit range for each of these categories, we mention the other potential changes in the economic activities of consumers and producers that we failed to quantify.

According to the existing economic literature on the benefits of water quality improvements, enhanced water-based recreation and aesthetics, and perhaps the non-use values

that people may hold for the preservation of the nation's aquatic ecosystems are the largest sources of quantifiable economic benefits. The vast number of people who recreate in a water setting each year testifies to the importance of this resource. More to the point, a growing number of economic studies document the influence that water quality characteristics have on which water bodies people choose to visit, how often they engage in water-based recreation activities, and, how much they are willing to pay for incremental improvements in water quality. Less abundant are studies demonstrating the link between water quality improvements and increases in peoples' non-use values. These values are believed to exist, based in part upon survey responses from people who do not currently use the nation's surface waters for recreation or for their aesthetics but nonetheless indicate a willingness to pay for achieving certain water quality standards.

No primary studies attempt to estimate the enhanced recreation, aesthetics, and non-use benefits of water quality improvements that attributable to the CSO and storm sewer provisions of the Initiative. However, there have been studies that attempt to ascertain the total economic value that households place on the achievement of incremental improvements in virtually all of the nation's lakes, rivers, and streams (i.e., marine waters were not included) (Mitchell and Carson, 1984, 1986; Carson and Mitchell, 1993; Lyon and Farrow, 1992). As a part of this research effort, a method of allocating households' willingness to pay for improvements in local water quality was also devised. This method of apportioning total willingness to pay for sub-national changes in water quality is described in more detail in the following section on freshwater benefits.

The remaining quantifiable economic benefits (i.e., enhanced marine recreation, aesthetics, and non-use values; commercial fishing; water diversions; and human health) are small compared with the freshwater benefits. In addition, the economic basis for estimating these benefits is less defensible. We rely entirely upon secondary studies to suggest a plausible range of benefits for these categories. Finally, we mention briefly other possible economic benefits to people and economic entities that may or may not be subsumed in the foregoing analyses. We believe mentioning these potential economic effects is important because we cannot rule them out on the basis of current knowledge.

Analysis of Net Benefits for Urban Provisions of the Initiative

Public and private capital and human resources committed to implement the Initiative can be used for alternative productive purposes, so the opportunity costs of these resources should be compared with the economic benefits. When attempting to describe the relation of benefits to costs, it is necessary to know the schedule of these improvements. Discounting and annualizing both the costs and benefits captures the opportunity costs of the resources, and provides an analytical framework that enables one to make a more precise comparison between costs and benefits when values for either of the two categories varies with time. The nature of environmental risks the Initiative is intended to reduce suggests that despite significant initial investments in capital and human resources, the immediate effects on water quality will be modest, and it will take time to fully attain many of the projected water quality improvements

and economic benefits.

To illustrate how the gradual attainment of the benefits may influence the benefit-cost comparison, the figures in Tables D-1 and D-2 show the annualized monetary costs and benefits from control of urban sources under proposed and pending spending. In Table **Y.**, two of the three aggregate benefit estimates provide for the gradual attainment of benefits, applying different discount rates to an assumed future stream of benefits. The selection of the two discount rates reflects Administration guidelines on the application of discounting to costs and benefits (seven percent), as compared to the adoption of a social rate of time preference (three percent). The discounted annualized benefits are some twenty to thirty percent lower than the annualized benefit estimate that fails to account for the expected delays in achieving tangible water quality improvements. This serves to demonstrate the sensitivity of the results to both the time and discounting features of the analysis. Specifically, it illustrates that a more favorable depiction of the benefits in relation to the cost estimates occurs when timing and discounting are not introduced in the analysis.

Comparing the annualized costs and benefits under any of the three annualized benefit estimation scenarios, it is apparent that the range of estimated monetary costs and benefits do not presently overlap. Despite information of this type, the Administration feels it is important to proceed with the Initiative for several reasons. As stated throughout the text, and documented in the supplemental materials, there are great uncertainties associated with both the cost and benefit estimates that are not captured in the presentation of the numerical results. For example, although the national cost estimates have attempted to account for targeting of watersheds in need of improvement and emphasized prevention measures over command-and-control strategies, the data used for the analysis still do not fully reflect the consequences of providing flexibility in the identification of problems and solutions. There are also a number of tangible benefits for which monetary estimates have not been developed. So as to better inform decisionmakers and the public in the future, EPA is proposing a comprehensive benefit-cost study of the pollution controls in the CWA reauthorization. This study will reduce the uncertainties surrounding the benefits and cost estimates.

Despite the uncertainties, an important contribution of the economic analysis has been its ability to document the significant savings the Initiative is proposing compared to requirements called for in existing legislation. Therefore, the Initiative demonstrates a genuine effort to achieve cost-effective regulatory management approaches to improving the nation's polluted waters. Equally important, the public's right to enjoy clean waters, and the demonstration of their preferences through consistent aggressive federal legislation, have served as inputs into the development of Administration policy. Strong public support for additional pollution control programs persists, as documented by national opinion polls, some of which report that a strong majority of respondents agree that the nation has not gone far enough to control water pollution.

The results of the aggregate analysis of incremental costs and benefits from controlling urban sources are provided in Tables D-1 and D-2. Following these tables, the paper provides

information used in calculating the economic value for each of the benefit categories. We have attempted to provide information on all of the facts and assumptions used to formulate the economic benefit estimates.

Table D-1

Summary of Aggregate Annualized Costs from Control of Urban Sources Under the Initiative and Pending Spending (CSOs, Storm water, Toxics)

Cost Category	Range: Low - High (Millions of 1993 $)
Municipal Costs	
Phase I Storm water	$ 1,650 - $ 2,555
Phase II Storm water	$ 1,030 - $ 1,910
CSO Controls	$ 3,450
CZARA Non-Point Controls	$ 390 - $ 590
Pending Spending (Great Lakes, Sludge)	$ 90
Subtotal Municipal	$ 6,610 - $ 8,595
Private Sector	
Phase I Storm water	$ 2,360 - $ 2,850
Phase II Storm water	$ 345 - $ 1,670
Pollution Prevention Plans	$ 60 - $ 120
Domestic Sewage Exclusion	$ 280
Nonpoint Source Controls	$ 233 - $ 388
Subtotal Private Sector	$ 3,278 - $ 5,308
Total Quantified Costs in Urban Areas	$ 9,888 - $ 13,903
Non-Quantified Costs	
State Administration Costs (Urban portion of $650m) Federal Compliance (Urban portion of $945m) - excludes abandoned mines. Groundwater Controls (Urban portion of $150m to $600m) Further Water Quality Criteria and Standards and sediment criteria Toxics Bans Other Pending Spending (e.g., Great Lakes, Pulp and Paper Effluent Guidelines, Air MACT standards)	

Source: Summary of Tables 19-22.

Table D-2

Summary of Aggregate Annualized Benefits from Control of Urban Sources Under the Initiative and Pending Spending (CSOs, Storm water, Toxics)

Benefit Category	Range: Low - High (Millions of 1993 $)
Quantified Benefits	
Freshwater Recreational Fishing and Swimming (use and nonuse)	$ 650 - $ 4,670
Marine Recreational Fishing (use only)	$ 40 - $ 440
Marine Nonconsumptive Recreation (use only)	$ 30 - $ 300
Marine and Freshwater Commercial Fishing	$ 40 - $ 190
Withdrawal or Diversionary Uses	$ 20 - $ 80
Human Health Effects (from risks associated with exposure to pollutants via swimming activity and seafood consumption)[1]	$ 40 - $ 320
Sub-total: Quantified Benefits[2]	
Assuming immediate attainment of benefits[3]	
(i) Annualized Benefits (no lag and no discounting, thus a simple summation of individual categories)	(i) $ 820 - $ 6,000
Assuming a gradual attainment of benefits over the first 15 year period that all Urban Source Controls are adopted.[4]	
(ii) Annualized Benefits (seven percent discount rate, gradual attainment over first 15 years)	(ii) $ 560 - $ 4,100
(iii) Annualized benefits (three percent discount rate, gradual attainment over first 15 years)	(iii) $ 660 - $ 4,900
Non-Quantified Benefits	
- Marine Recreational Swimming (nonhealth effects) - Other Human Health Effects in Marine and Freshwaters (see Note 1) - Recreational Hunting- Freshwater Nonconsumptive Recreation (see Note 1) - Marine Recreational Boating - Other Non-use Benefits (Marine Waters - see Note 1) - Other avoided costs (e.g., water storage, dredging, damages from floods) - Restoration of biodiversity and ecosystem integrity	

[1] Given information and methods used to calculate the quantified benefits, some portion of the benefits associated with these categories may be captured in the monetary range ascribed to freshwater recreation fishing and swimming.

[2] Assumes no double counting of benefits or substitution effects between different categories when developing aggregate national estimates. Also assumes that all lower and upper ends of the range for each quantified category describe the aggregate lower and upper bound estimate. Absent information on the distribution or probability of attaining benefits defined by the estimated range, we can not calculate a "most likely" estimate.

[3] Assuming no lag between implementation of controls, recovery of natural ecological systems, and economic behavior that forms the basis for the economic benefit measures.

[4] These estimates of the economic benefits are more appropriate to use when comparing quantified costs and benefits, given the anticipated lag time between introduction of the control measures and full realization of the environmental and economic benefits. The calculated annualized figure is based on assuming a gradual attainment of benefits up through year fifteen, and a constant future benefits stream after the fifteenth year has been reached.

FRESHWATER-SPECIFIC CATEGORIES

Freshwater Recreational Fishing and Swimming

1. Baseline Water Resource Quality for Urban Households

Facts

- 24% of water bodies in urban areas are fully supporting their designated uses, while nationwide 50% of water bodies are fully meeting designated uses.

- At the national level, 32% of all water bodies are partially or not supporting aquatic life use, and 24% of all water bodies are partially or not supporting fish consumption use. 21% of all water bodies are not or are partially supporting swimming.

- For modeled urban population (generally, urban areas), Kealy et al. (1993) estimate that 48 percent households are located by waters not fully fishable, and 69 percent of households are located by waters not fully swimmable.

Assumptions

- All water bodies are boatable (conservative assumption, given modeling and water quality reporting data).

- The Kealy et al. estimates for populations adjacent to fishable and swimmable are reasonable, given that information from state reported data on water quality conditions in urban areas tends to be significantly poorer than the reported nationwide statistics.

Finding Used for Analysis

- 48 percent of the national urban population lives by water bodies that do not fully support fishable uses.

- 69 percent of the national urban population lives by water bodies that do not fully support swimming uses.

Information on Urban Population[1]

Total population: 247 million persons

[1] Information from the storm water section of the Initiative indicates that 158 million persons are served by storm water systems. The combined sewer overflow section of the Initiative identifies approximately 43 million persons who are served by combined sewer overflow systems. The union of these two samples is thought to encompass the vast majority of households listed as urban by the Census bureau. Therefore, for purposes of analysis in this paper, the universe of urban households is used when calculating the percentages of households proximate to urban waters failing to meet fishing or swimming uses.

Urban population: 185.7 million persons (75%)
Population served by storm water: 158 million persons (64%)
Rural population: 61.4 million persons (25%)
Total households: 93.9 million households (2.63 per household)
Urban households: 70.6 million (2.63 per household)
Urban/Storm water households: 60.1 million (2.63 per household)
Non-Urban/Storm water households: 10.5 million (2.63 per household)
Rural households: 23.2 million (2.63 per household)

- Using the urban/storm water population figures as a baseline population, 29 million households (48% of 60.1 million households nationwide) could benefit from improved fishable use support, and 41 million (69% times 60.1 million households) households could benefit from improved swimming use support.

2. Water Quality Improvements From the Initiative's CSO, Storm Water, and Toxics Provisions

Facts

- According to the 1992 305(b) report, urban runoff and storm water are a leading source of impairment in 24,100 assessed river miles (30% of non-agricultural impaired and assessed miles, or 10% of all impaired and assessed miles, or 3% of all assessed miles, or 0.7% of all river miles in the nation). Similarly, for lakes, reservoirs and ponds, urban runoff and storm water are a leading source of impairment in 1.31 million acres (52% of non-agricultural impaired and assessed acres, or 24.1% of impaired and assessed acres, or 7.1% of all assessed acreage, or 4.8% of all lake acreage in the nation).

Assumptions

- Control of urban runoff and storm sewers, where they are a leading source of impairment, will restore fishable/swimmable conditions. Existing municipal wastewater pollution concerns, where they are limiting water quality in these urban waters, will be controlled under existing CWA authority.

- The Initiative's CSO, storm water and toxics provisions will restore fishable/swimmable conditions in 39% of those urban water bodies where urban runoff and storm sewers are the leading source of impairment. Excluding agriculturally impaired rivers and lakes, urban runoff and storm sewers are the leading sources of impairment in approximately 39% of the remaining water bodies. This figure is based on averaging the percentages provided for river miles and lakes acreage where urban runoff and storm water is a leading source of impairment. Assume that the other 61% of the impaired waters located next to these urban households will improve, in part, from these provisions. The contribution of these sources relative to the problem is assumed to be 50%. To the extent that other sources of pollution or other natural limitations not considered in these figures would preclude these waters from fully supporting fishing and swimming, the quantified benefits from the Initiative's provisions will not be realized. This number is

not founded on empirical research on relative loadings of pollutants from different sources occurring in these affected waters but is based on the informed judgement of EPA staff.[2]

Findings Used for Analysis

- The Initiative's CSO, storm water and toxics provisions will be necessary and sufficient for restoring swimmable/fishable conditions in approximately 39% of the impaired water bodies proximate to urban populations.

- For the remaining 61% of impaired water bodies near urban populations, the Initiative's urban provisions will be necessary but insufficient to ensure improvements occur. The relative proportion of the impairment that can be attributed to these sources is assumed to be 50%. This figure will be used to attribute the anticipated economic benefits of improvements to the Initiative's policies that control urban nonpoint pollution sources.

- Therefore, 11.3 million urban households are expected to achieve fishable conditions, and 16 million urban households are expected to achieve swimmable conditions solely due to the Initiative's CSO, storm water, and toxics provisions. Thus, we apportion 100% of the estimated economic benefits of these improvements to the Initiative's provisions. The remaining 17.7 million urban households will see improvements in fishing from control of these and other pollution problems. Likewise, the remaining 25 million urban households will achieve improvements in their swimming conditions as a result of these provisions and other pollution control requirements. For these last two segments of the urban population, the benefits from these water quality changes will be partially apportioned (50% of the total benefits) to urban nonpoint control policies.

3. Economic Benefits from Initiative's CSO, Storm Water and Toxics Provisions

Facts

- Mitchell and Carson estimate the following willingness to pay for certain use and non-use recreational opportunities from water resource quality improvements:

  Valuation:

  > Boatable to fishable $104 ($70*1.33 inflation factor*1.11 real income growth above adjustments)

  > Fishable to swimmable $115 ($78 above adjustments)

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[2] Statistics on urban nonpoint loadings relative to total point and non-rural nonpoint loadings suggest that urban nonpoint loadings constitute a significant fraction of total pollution loadings. Using information on point source loadings and average wet weather conditions for the early 1990s, 39% of total suspended solid loadings originated from point sources and 61% from urban nonpoint sources.

Assumptions

- The Mitchell and Carson study is representative of actual willingness to pay.

- When calculating fishing benefits, assume that affected waters are already at boatable status. Likewise when calculating swimming benefits, assume that all affected waters have reached fishable status, either as a baseline condition or as a consequence of these policies. In doing this, we can aggregate the estimated benefits of improving fishing and swimming without fear of double-counting the economic benefits of achieving fishable or swimmable water quality conditions.

- We draw upon information from Carson and Mitchell on their surveyed households' allocation of economic benefits from the attainment of water quality conditions in the nation's freshwaters. As an upper bound estimate, we assume that for those urban households located in places having impaired water quality, that two-thirds of their national stated WTP for a particular level of use support (i.e., fishable or swimmable water quality) is directed at water quality improvements in their immediate area. As a lower bound estimate, we assume that these households are willing to allocate 12% of their total national stated WTP for local water quality improvements. Note that when a greater proportion of their WTP is directed at local waters, it follows that these same persons will not be willing-to-pay much for achieving the same fishing and swimming uses in remaining waters located beyond their immediate area.

- Where it is both necessary and sufficient to undertake the Initiative's urban provisions to attain improvement in fishing and swimming conditions, 100% of the benefits are attributed to these provisions. For those waters where it is necessary but not sufficient to undertake the Initiative's urban provisions to attain fishing and swimming uses, 50% of the benefits to households located near these waters are attributed to these provisions. In other words, the assignment of benefits to provisions in the Initiative is organized by source (e.g., CSOs, storm water), which is consistent with the information on the assignment or attribution of causes of impairment to sources identified in the Initiative.

- We use the Carson and Mitchell research to estimate the benefits to urban households not located by impaired urban waters and to all rural households of the water quality improvements that can be achieved as a result of the Initiative's urban provisions. As an upper bound, we assume that these households are willing to allocate 12% of their total national stated WTP for these water quality improvements. As a lower bound, we assume that they would be unwilling to allocate any part of their national WTP for these improvements. This is based, in part, upon Carson and Mitchell research on the non-urban survey respondents' stated WTP for improvements in all areas, as compared to improvements in all but the nation's urban areas. The incremental benefits to these persons for achieving fishable quality in urban areas could be zero, given the availability of substitutes and the relative fraction of the nation's waters that the affected urban waters constitute.

The results of these assumptions and analysis are summarized in Table D-3. Additional

information and issues to consider in using the freshwater recreational results.

Reason To Think Values Could Be Underestimated

- The Mitchell and Carson survey was conducted in 1983. If the survey was repeated, values might be higher today due to greater awareness of water quality conditions (publications), stronger preferences for water quality improvements (consumer survey results), and improved economic conditions.

Reasons To Think Values Could Be Overestimated

- Mitchell and Carson found that a sub-sample of respondents were almost as satisfied (based on WTP estimates) with partial improvements in waters as they were with achieving a 99% improvement. For example, non-urban respondents were WTP $74 to make waters 95% fishable and $80 to make waters 99% fishable. We assume that WTP is linearly related to overall national water quality. If the relationship is non-linear, then marginal values of improvements as one approaches virtually nationwide use attainment for a particular use could be overstated.

- Both professional and trade literature on contingent valuation issues and Federal agency deliberations on the use of contingent valuation research for developing economic measures of proposed regulatory and damage award purposes cite serious concerns regarding the reliability of economic values based upon responses to survey questions. The majority of critical reviews of contingent valuation research suggest that these survey responses are larger than monitored cash payments made to obtain the desired outcome (Arrow, et al., 1993; Cambridge Economics, 1992; and Cummings and Harrison, 1991). For this and other reasons, some persons within the economic and policy analysis community are reluctant to make use of contingent valuation research that has not been conducted using a number of recommended operating standards that are designed to provide for more reliable empirical estimates. The Mitchell and Carson study referenced here does not conform to the full set of these recommendations, and thus may be considered too unreliable for use as a reference for this analysis.

Additional Uncertainty

- Mitchell and Carson's survey instrument elicited total willingness-to-pay estimates for nationwide changes in water quality conditions. The need to disaggregate the national estimates to local waters and to assign some portion of these estimates to localized changes is severely constrained by the information contained in the survey. As a result, the attempt to distribute the values to local waters goes beyond information contained in the author's report. If the assumptions made here are incorrect, they can substantially affect the household and national estimates of the benefits of improving

Table D-3

Estimated National Swimming and Fishing Benefits to Controlling Urban Sources, National (1992 dollars)

Households Benefitting From Water Quality Improvements Attributable to the Initiative's Urban Provisions	Lower Bound National Benefit Estimate: For affected urban households, use 12% of national WTP; for non-affected households, use 0% of national WTP.	Upper Bound National Benefit Estimate: For affected urban households, use 67% of national WTP; for non-affected households, use 12% of national WTP.
Affected urban population where urban sources are sufficient (assign 100% of benefits) to relieve cause of impairments: 39% of impaired urban waters	Fishing: 11.3 million households @ $12.5/household = $141 million Swimming: 16 million households @ $13.8/household = $221 million **TOTAL = $365 million**	Fishing: 11.3 million households @ $69.7/household = $788 million Swimming: 16 million households @ $77.1/household = $1,234 million **TOTAL = $2,022 million**
Affected urban population where urban sources are necessary but not sufficient (assign 50% of benefits) to relieve cause of impairments: 61% of impaired urban waters	Fishing: 17.7 million households @ $12.5/household * (50 percent) = $111 million Swimming: 25 million households @ $13.8/household * (50 percent) = $173 million **TOTAL = $284 million**	Fishing: 17.7 million households @ $69.7/household * (50 percent) = $617 million Swimming: 25 million households @ $77.1/household * (50 percent) = $964 million **TOTAL = $1,581 million**
Other population (rural and unaffected urban households) WTP to see attainment of fishing and swimming uses in impaired in-state urban waters	Fishing and swimming: $0	Fishing: 41.6 million (urban) + 23.2 million (rural) households @ $12.5/household * (100%*39% + 50%*61%) = $563 million Swimming: 29.6 million (urban) + 23.2 million (rural) households @ $13.8/household * (100%*39% + 50%*61%) = $506 million **TOTAL = $1,069 million**
Total WTP Estimate	**Lower Bound: $649 million**	**Upper Bound: $4,672 million**

the identified sample of urban waters. For example, survey responses tried to distinguish in-state and out-of state values. Whether these values are distributed equally among all waters or would be focused on specific waters (e.g., those having known unique habitat or having significant economic value) is not contained in the survey results.

- Mitchell and Carson focus only on freshwaters. The survey expressly asks that respondents do not consider marine waters in their answers. Nevertheless, it is possible that respondents may have included some marine waters in describing their WTP. No test was conducted to elicit whether respondents truly considered this in their responses.

- The survey attempted clarify that drinkable water quality was distinctly different from swimmable water quality. However, it is unclear to what extent responses could be associated with improvements beyond swimmable. For example, some aquatic uses may still be impaired, even though the waters are swimmable.

- Limited research suggests that individual fishermen may be willing to pay to move fishable waters to levels that provide for the consumption of fish. If correct values could possibly be adjusted upward to account for this additional value if not incorporated into the responses.

- The analysis relies on information and assumptions that are used to attribute changes in water quality conditions (and economic benefits) to anticipated changes in loadings of pollutants from urban sources. If these assumptions are incorrect, then the attribution of benefits to these programs when following this methodology will result in an incorrect estimate of the quantified benefits from these provisions.

MARINE WATER-SPECIFIC CATEGORIES

1. Baseline Marine Water Resource Quality

- 24% of water bodies in urban areas are fully supporting their designated uses, which compares with 56% of estuaries nationwide that are fully supporting their designated uses. 80% of coastal waters are fully meeting their designated uses.

- At the national level, 22% of estuaries are partially or not supporting aquatic life use support, 5% are partially or not supporting fish consumption, 30% are partially or not supporting shellfishing, and 17% are partially or not supporting swimming.

2. Marine Water Quality Improvement from Initiative's CSO, Storm Water, and Toxics Provisions

- At the national level, urban runoff and storm sewers are the leading source of impairment in 43% of the estuaries and 58% of coastal areas.

Finding Used for Analysis

- Given that 44% of estuaries are not fully meeting their designated uses (20% for coastal areas) and that urban runoff and storm sewers are a leading cause in 43% of the estuaries, it is reasonable to conclude that recreational and commercial activity levels from the Initiative's CSO, storm water, and toxics provisions will increase from a low of 10% to a high of 20% over existing activity levels.

- Given that 75% of population lives in urban areas and that storm sewers and urban runoff is a leading cause in 43% of estuaries, it is reasonable to conclude that 40% to 60% of the increased activity will accrue to urban users.

Marine Recreational Fishing

Following Freeman (1993), use information on the current number of saltwater fishingpersons and shellfishing persons. Assign a range of benefits per trip under existing water conditions. Provide a for range of water quality improvements and effects on benefits.

Facts

Baseline number of trips per year: 92,000,000 (FWS, 1993)

Assumptions

Estimated economic values:
Lower bound: Average surplus value per trip = $10 (FWS, 1988)
Upper bound: Average surplus value per trip = $40 (FWS, 1988)

Potential gain from water quality improvements:
Lower bound: 10% proportionate gain from baseline
Upper bound: 20% proportionate gain from baseline

Contributions from urban sources:
Lower bound: 40% contribution to nonattainment
Upper bound: 60% contribution to nonattainment

Estimated Economic Benefits From the Initiative's CSO, Storm Water, and Toxics Provisions

Lower bound total benefit: 92,000,000 trips per year * $10/trip * 10% gain
Upper bound total benefit: 92,000,000 trips per year * $40/trip * 20% gain

Range of benefits: $ 92 million - $736 million

Benefits attributable to control of urban sources:
Lower bound: $92 million * 40% contribution = $37 million

Upper bound: $736 million * 60% contribution = $442 million

Nonconsumptive Recreation: Marine

Facts

Baseline number of persons engaged in oceanside wildlife viewing per year: 6,900,000 (FWS, 1993)
Baseline number of persons engaged in wetland, marsh, and swamp activities per year: 11,700,000 (FWS, 1993)

Assumptions

Because the FWS survey did not distinguish between marine and freshwater wetlands and marshes, we assume 50% of the baseline total is on marine waters: 50% of 11,700,000 per year = 5,850,000 persons/year.

Estimated participation rates for both types of activities:
Lower bound on number of activity days for each purpose: 5 days/person/year
Upper bound on number of activity days for each purpose: 10 days/person/year

Therefore, the number of days of activity are:
Lower bound: 12,750,000 persons per year * 5 days/year = 63.8 million total days
Upper bound: 12,750,000 persons per year * 10 days/year = 127.5 million total days

Potential gain from water quality improvements:
Lower bound: 10% proportionate gain from baseline
Upper bound: 20% proportionate gain from baseline

Contributions from urban sources:
Lower bound: 40% contribution to nonattainment
Upper bound: 60% contribution to nonattainment

Estimated Economic Benefits from the Initiative's CSO, Storm Water, and Toxics Provisions

Estimated economic values assumed to be the same for both types of activities:
Lower bound: 63.8m days * $10/day * 10% gain
Upper bound: 127.5m days * $20/day * 20% gain

Range of benefits = $64 million - $510 million

Benefits attributable to control of urban sources:
Lower bound: $64 million * 40% contribution = $26 million
Upper bound: $510 million * 60% contribution = $306 million

OTHER CATEGORIES - NOT SPECIFIC TO MARINE AND FRESHWATERS

Marine and Freshwater Commercial Fishing

Facts

The national ex-vessel (wholesale) value is $3.6 billion (EPA, Clean Water and American Economy, 1992).
Near coastal fishery represents approximately 50% of the total ex-vessel value. Figures are dominated by marine commercial fishery.

Assumptions

Estimated consumer and producer surpluses (low: 50%, high: 90%) of ex-vessel value (RIA for GLWQI, EPA, 1993)

Baseline surplus values for current near-coastal marine fisheries and water quality conditions:
Lower bound: $3.6 billion * 50% near-coastal * 50% surplus = $900 million
Upper bound: $3.6 billion * 50% near-coastal * 90% surplus = $1,620 million

Potential gain from water quality improvements:
Lower bound: 10% proportionate gain from baseline
Upper bound: 20% proportionate gain from baseline

Contributions from urban sources:
Lower bound: 40% contribution to nonattainment
Upper bound: 60% contribution to nonattainment

Estimated Economic Benefits from the Initiative's CSO, Storm Water, and Toxics Provisions

Estimated economic values:
Lower bound: $900 million * 10% gain
Upper bound: $1,620 million * 20% gain

Range of benefits = $90 million - $324 million

Benefits attributable to control of urban sources:
Lower bound: $90 million * 40% contribution = $36 million
Upper bound: $324 million * 60% contribution = $194 million

Withdrawal or Diversionary Uses

SOURCES: Freeman, 1982, and Kealy, 1993 (citing Morris and Cushman 1993 report to EPA).

Very little information is available on the actual effects of water quality conditions on the costs

of treating intake water. Therefore, the Morris and Cushman paper first estimated or reported the costs of treating water, given recent rates of consumption for a variety of economic sectors. They include a number of sectors (see below). In most sectors, total treatment costs were estimated using recent figures on quantities consumed and unit cost estimates. For irrigated agriculture, changes in net revenues from elimination of anthropogenic sources of salinity formed the basis for the estimate. Using these figures, one could attempt to define what proportion of costs have reduced as a result of improvements to current water quality and what further improvements from additional steps to reduce water pollutants could be realized.

The sectors and their treatment costs are as follows:

Facts

Manufacturing: $550 million (1990$)
Thermoelectric: $370 million (1990$)
Drinking water treatment: $1,500 million (1990$)
Materials damage to household items: $2,100 million (1990$)
Household health through drinking water exposure: $3,000 million (1990$)
Irrigated agriculture: $430 million (1990$)

These total approximately $8 billion in treatment costs that could be influenced by intake water quality. Of this amount, the savings that could be attributed to less polluted water quality is highly uncertain. Kealy (1994) attempt to describe the reduced costs from existing CWA-based improvements (see attachment), although their paper, and the original Morris and Cushman paper, are highly critical of the data and assumptions used to construct these estimates.

Assumptions

To date, as a result of CWA activities, water quality improvements have reduced these costs as follows:

Manufacturing: $110 million
Drinking water treatment: $ 200 million
Uncertain for remaining sectors, assumed to be zero

If we assume that further water quality improvements could have the effect of reducing the remaining costs by 1% (low) to 5% (high) and that the CWA amendments would be distributed to urban areas using 40% (from marine and freshwater attribution figures), then the additional benefits range for the following categories are as follows:

Estimated Economic Benefits From the Initiative's CSO, Storm Water, and Toxics Provisions

Illustrate with manufacturing sector

$550 million (original cost) - $110 million (cost savings to date) = $440 million

Lower bound cost saving of further water quality improvements: $440 million * 1%
Upper bound cost saving of further water quality improvements: $440 million * 5%

Range of potential cost savings: $4 million - $20 million

Savings attributable to control of urban sources:
Lower bound: $4m * 40% = $1.6 million
Upper bound: $20m * 40% = $8.8 million

Summary of affected categories:
Manufacturing: urban sources $2 million - $9 million
Drinking water treatment: urban sources $5 million - $25 million
Materials damage: urban sources $8 million - $40 million
Thermoelectric: urban sources $2 million - $7 million
Human health: not estimated.
Irrigation agriculture: not estimated

Totals: urban sources $17 million - $81 million

Human Health Benefits

Background Regarding Public Health Effects

Recreational benefits associated with enhanced water quality extend well beyond the increased level of economic activity that can be enjoyed at the state and local level. In some instances, economic benefits are secondary to (and derived from) the public health implications of recreational water activities. Public health effects can result from activities such as swimming and fishing through the following routes of exposure:

- Swimming -- ingestion of and/or dermal exposure to chemical contaminants or pathogens.

- Fishing -- consumption of contaminated fish by recreational anglers and those fishing for subsistence.

The Agency believes that the probability of adverse health effects (identified below) may correlate with socioeconomic status, race, and age. This is due to the susceptibility and practices associated with specific age and ethnic groups. This paper summarizes readily available information regarding the risks associated with certain recreational activities[3] and provides some information regarding particular populations at risk.

Swimming

- A number of studies document the risks of acute gastroenteritis resulting from bathing in contaminated water (NRC, 1993). In fact, swimming in even "marginally" polluted

[3] Note that boating, water skiing, or hiking (while relevant) have not been included in the analysis.

marine bathing water results in a significant route of exposure.

- One study found that the risks of incurring gastrointestinal illnesses are three times greater for children less that 2 years old who are entirely submerged in the course of swimming in contaminated water, compared with the risks to adults exposed to the same water quality conditions (NRC, 1993). This suggests that differential dose-response functions may exist for adults and children, or that the hazards of exposure to these types of pathogens is dependent on the physiology of the exposed individual. Note that the empirical estimates below do not attempt to introduce sub-population risk calculations into the analysis, but rely on the dose-response relationships developed for the full distribution of the exposed population.

- The methodology for estimating risks comprises the following steps:
  - -- Determine the level of contamination.
  - -- Identify the interaction of the pathogen with the host (dose/response).
  - -- Determine the population at risk (considering age, sex, and the presence of underlying conditions that make one more susceptible).

- Each swimming event results in exposure to approximately 100 ml of water, assuming that one's head is submerged. The current allowable level of pathogen indicators in bathing water is 35/100 ml for saltwater and 33/100 ml for freshwater. This results in a predicted rate of 19 cases and 8 cases, respectively, of gastroenteritis per 1,000 people exposed (NRC, 1993 and EPA, 1992).

- Larger cities tend to have higher concentrations of pathogens in surrounding waters (i.e., water bodies effected by wastewater discharges).

- People of color and hispanics are less likely to engage in overnight travel and, therefore, are subject to greater exposure near urban centers (NRDC, 1993).

- There have been 7,700 beach closures or advisories since 1988, 2,600 of which took place in 1992. Significant inconsistencies exist in water quality monitoring and the criteria for closing beaches at the state level (NRDC, 1993).

- Approximately 40 million people swim outdoors in natural bodies of water (i.e., not in pools). Nineteen percent swim 1 to 2 days per year, 42 percent 3 to 10 days per year, 20 percent 11 to 25 days per year, and 19 percent more than 25 days per year (NPS, 1986).

- Using the above data, there are an estimated 455 million person-swim-days per year during which one is exposed to a rate of illness ranging from 8 to 19 per 1,000, or 3.6 million to 8.6 million potential cases of gastroenteritis per year.

- A case of giardiasis costs about $50 to $100 per day (Harrington, 1986, 1993).

- Assuming one day of gastrointestinal illness (low-end estimate), costs are estimated to

be between $180 and $860 million per year. The extent to which these costs can be avoided is unknown.

- Other diseases include ear infections, eye irritation, skin rashes, and sore throats.

Fishing

- A recent EPA study of 388 fishing sites (many of which were targeted on the basis of their being suspected of having high concentrations of pollutants due to their locations) found 66 pollutants. EPA performed a closer analysis of pollutants and sites for which adequate data were available--resulting in 110 sites analyzed (EPA, 1993). PCB, biphenyl, mercury and DDE were detected at almost every site.

- Lifetime cancer risks exceeded 10^{-4} at 42 sites for PCB contamination of fish alone (38 percent of sites analyzed), for an average fish consumption rate of 6.5 grams/day. Again, these sites are "hot spots" and do not represent the average toxicity at fishing sites across the country.

- Recreational anglers consume on average 30 grams per day, while subsistence fisherman consume 50 to 100 grams per day. Average consumption remains 6.5 grams per day.

- In 1990, 36.9 million fishing licenses were sold (Department of Commerce, 1992). Assuming 38 percent of these fisherman are exposed to risks of 10^{-4}, 1,402 excess cancer cases occur over a 70 year period, or about 20 cases per year. Valuing each cancer case at $2 to $10 million, results in costs of $40 to $200 million per year. The extent to which these costs can be avoided is unknown.

- Results of the Wisconsin Tribes Comparative Risk Project indicated excess lifetime cancer risks of $4x10^{-3}$. This study assumed half the consumption rate for these subsistence fisherman than the recent Columbia River study.

- Between 1984 and 1986, 38 states reported fish consumption advisories, sport fishing restrictions, or sport fishing closures. Specifically, these measures included 3 closures, 7 restrictions, and 427 advisories (Sports Fishing Institute).

- In addition, 10 states in three regions reported shellfishing restrictions attributable to CSOs alone. This affected nearly 600,000 acres of shellfish area (Industrial Economics Inc.).

Summary

- Total estimated costs resulting from exposure to fish and water contaminants and related to recreational activities is $220 million to $1.06 billion per year.

- We have assumed that 50 percent of these costs can be avoided due to implementation of the proposed amendments, and that 40 to 60 percent of this amount is related to urban

sources. Accounting for these factors results in cost avoidance estimates of approximately $44 to $320 million per year.

Totals: urban sources $44 million - $320 million

OTHER NONQUANTIFIED BENEFIT CATEGORIES

Marine Recreation Swimming: Relationship between user days and water quality, access, substitutes, and the effectiveness of control programs is uncertain (e.g., average consumer surplus per swimming day ≈ $25/day; Walsh et al., 1988). Alternative source of information found that annual benefits per beach user for a 20% decrease in pollution for Chesapeake Bay beaches showed that users of heavily attended beaches would be WTP $50 to $70 per year, while 20% reductions at less desirable beaches would be valued at $1-$20 per year per person (Bockstael et al., 1987).

Human Health Effects: Uncertain about how many and what type of health effects would be avoided from improvements in national water quality conditions. Might expect reduced numbers of gastrointestinal disease from exposures to contaminated water and foods. Reduced morbidity and mortality risks associated with toxic pollutants in drinking water and foods, particularly those foods that bioaccumulate toxics. Unclear how many subsistence fishermen follow consumption advisories.

Recreational Hunting: Some forms of hunting are affected by water quality conditions due to the influence of water quality on habitat (availability of living space, food sources, and impacts on reproduction). It is unclear how many additional trip days and their value for specific water quality programs are included in the Carson and Mitchell survey. For example, average consumer surplus per migratory bird hunting day is about $ 40 per day (Walsh et al., 1988); of the total number of migratory hunting days 22 million, 9 million are for ducks, and 7 million are for geese (FWS, 1993).

Freshwater-based Nonconsumptive Uses: It is unclear whether the Mitchell and Carson survey captured all freshwater-based nonconsumptive recreation benefits. It may be of particular importance that attainment of swimmable quality still leaves room for improvement to water quality that will support other aquatic life. However, the survey may not capture these effects in the base case. The number of persons engaged in nonconsumptive activities is substantial. For example, 19.2 million persons were engaged in nonconsumptive activity by lakes and rivers (FWS, 1993), and the average consumer surplus per day for nonconsumptive wildlife activities is ≈ $25/day (Walsh et al., 1988).

Marine Recreational Boating: It is unclear how responsive boaters are to changes in water quality alone. Some portion of this has presumably been captured in the estimates of benefits for marine recreational fishing. In a study of Chesapeake Bay boaters, individuals responded that, depending upon their destination site, they would be WTP $1 to $20 per year for a 20% reduction in water pollutants in the Bay (Bockstael et al., 1987).

Nonuser Benefits for Marine Water Quality Improvements: Freshwater benefit estimates likely

included use and nonuse benefits. The above marine recreational benefits only attempted to include potential welfare changes associated with active participants.

Potential Avoided Costs: Better functioning natural systems may be able to provide a number of services that are currently provided by manmade systems (e.g., flood control, water purification, sediment disposal).

(a) Water Storage

The amount of water storage capacity and the capacity lost annually due to sedimentation in the 48 states has been estimated for reservoirs with 5,000 acre-feet or more of total capacity at:
Total storage capacity: 728.3 million acre-feet
Usable storage capacity: 472.1 million acre-feet
Water storage capacity lost: 1.64 million acre-feet (average 0.22%)
Reservoir sedimentation from cropland: 0.39 million acre-feet.

SOURCE: Crowder, 1987

(b) Dredging Operations

Federal and non-federal dredging in coastal areas disposal methods and costs:
Upland - 27 million cubic yards ; $127 million (1991$)
Open ocean - 92 million cu yds.; $143 million (1991$)
Beach nourishment - 8 million cu yds; $33 million (1991$)
Aquatic confined - 52 million cu.yds; $518 million (1991$)
Mixed - 36 million cu yds.; $130 million (1991$)
Total - 216 million cu yds.; $ 950 million (1991$)
SOURCE: EPA, 1993c

ADDITIONAL ECONOMIC INFORMATION

EMPLOYMENT (Administration Infrastructure Stimulus Package, 1993)

- Each $1.0 billion in environmental investment creates about 33,000 jobs.
  - 13,000 direct jobs
  - 20,000 indirect jobs

COMMERCIAL MARINE ECONOMIC ACTIVITY
(EPA, Clean Water and American Economy paper, 1993a)

- Contributes about $16.5 billion to GNP
- 1988 employment: about 363,703

RECREATION ECONOMIC ACTIVITY
(EPA, Clean Water and American Economy paper, 1993a; and FWS, 1993))

- FISHING
  31 million freshwater anglers and 8.9 million saltwater anglers (1991)
  440 million freshwater fishing days and 75 million saltwater fishing days
  Total spending for fishing: $24 billion (1991$)

- HUNTING
  14.1 million hunters
  22 million migratory bird related hunting days
  Total spending for waterfowl hunting: $0.7 billion (1991$)

- SWIMMING
  14.8 million swimming days in lakes or streams (1985)
  8.4 million in marshes and wetlands
  5.7 million in oceans

- NONCONSUMPTIVE USES
  76.1 million participants (1991)
  54.7 million observe wildlife
  19.1 million observe waterfowl and shorebirds
  Total spending: $18.1 billion (1991$)

- BOATING
  Total spending: $20 billion in 1988.
  Supports 6,200 manufacturers of boats, motors, and trailers
  Supports 8,300 marinas, boat yards, and yacht clubs
  Employs 600,000 people

POLLUTION CONTROL INDUSTRY

- EMPLOYMENT (EPA, 1993a)
  120,000 design, engineering, and consulting.
  88,000 water treatment equipment
  25,000 analytical services
  13,000 instruments
  12,325 chemical suppliers
  198,000 construction
  Total: 456,000 direct

- NATIONAL EXPENDITURES (EPA, Cost of Clean, 1990)
  $50 billion in 1992 for CWA related (annualized, 7%, 1992$)
  $5 billion in 1992 for drinking water (annualized, 7%, 1992$)

- EXPORTS (EPA, International Trade study, 1993b)
  $450 million (1991)

- IMPORTS
  $216 million (1991)

Appended Material on Chesapeake Bay

Various illustrations of economic benefit studies for changes in Chesapeake Bay water quality. SOURCE: Benefits From Improvement in Chesapeake Bay Water Quality (Bockstael et al. 1987).

1. Estimated Aggregate Willingness to Pay for Water Quality Acceptable for Swimming in the Entire Bay* (1984$)

Users	$43 to $81 million
Non-users	$17 to $26 million
Total	$60 to $107 million

*Population in Washington, DC, and Baltimore SMSAs

2. Aggregate Benefits/Losses to Users From Changes in Chesapeake Bay Water Quality, by Beach (1984)

	Scenarios (Ranges) (millions of dollars)		
Beach	improvement 20%	improvement 10%	20% degradation
Sandy Point	$8 - $14	$3 - $6	$5 - $8
Chesapeake Beach	$1 - $4	$0.2 - $2	$0.1 - $1
Point Lookout	$1 - $2	$0.4 -$0.6	$0.1 - $0.2

3. Aggregate Benefits for Three Water-Related Activities from a "20%" Improvement in the Chesapeake Bay's Water Quality (1984$)

Activity	Benefit Range
Public western shore beach use	$8.3 to $22.6 million (1984 data)
Boating with trailered boats	$0.6 to $7.1 million (1983 data)
Striped bass sportfishing	$0.5 to $1.5 million (1980 data)

References

Arrow, K. et al. 1993. "Report of the NOAA Panel on Contingent Valuation." U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Rockville, MD. January 11, 1993.

Bockstael, N. et al. 1987. "Benefit Analysis Using Indirect or Imputed Market Methods." CR 811043. Prepared for EPA Office of Policy, Planning and Evaluation.

Bondelid, T. and W.S. Cooter. 1994. "A Tool for Evaluating the Effectiveness of the Clean Water Act." Research Triangle Institute Project No. 35U-5726-3, Center for Environmental Analysis, Research Triangle Institute, P.O. Box 12194, Research Triangle Park, NC 27709.
Bondelid, T., W.S. Cooter, and M.J. Kealy. 1994. "How Much Has Water Quality Improved Due to Investments in Water Pollution Controls?" Draft working paper.

Cambridge Economics. 1992. "Contingent Valuation. A Critical Assessment." Cambridge, MA.

Carson, R.T. and R.C. Mitchell. 1991. "The Value of Clean Water: The Public's Willingness to Pay for Boatable, Fishable, and Swimmable Quality Water." Mimeograph, Economics Department, University of California, San Diego.

Carson, R.T. and R.C. Mitchell. 1993. "The Value of Clean Water: The Public's Willingness to Pay for Boatable, Fishable, and Swimmable Quality Water." Water Resources Research. 29(7): 2445-2454.

Crowder. 1987. "Economic Costs of Reservoir Sedimentation." Journal of Soil and Water Conservation.

Cummings, R. and G. Harrison. 1991. "Identifying and Measuring Nonuse Values for Natural and Environmental Resources: A Critical Review of the State of the Art." Final Report. April 1991.

EPA. 1983. "Health Effects Criteria for Marine Recreational Waters." Health Effects Research Labs, Office of Research and Development, August 1983.

EPA. 1990. "Environmental Investments: The Costs of a Clean Environment." EPA-230-11-90-083. EPA Office of Policy, Planning and Evaluation. November 1990.

EPA. 1993. "National Water Quality Inventory: 1992 Report to Congress." Draft Report. EPA Office of Water, Washington, D.C.

EPA and Resources for the Future. 1993a. "Clean Water and the American Economy." Proceedings: Surface Water, Volume 1. EPA-800-R-93-001a. EPA Office of Water. March 1993.

EPA. 1993b. "International Trade in Environmental Protection Equipment. An Assessment of Existing Data." EPA-230-R-93-006. EPA Office of Policy, Planning and Evaluation. July 1993.

Freeman,III, A.M. 1982. "Air and Water Pollution Control: A Benefit-Cost Assessment." Wiley Press. New York, NY.

Freeman III, A.M. 1993. "The Economics of Valuing Marine Recreation: A Review of the Empirical Evidence," Economics Working Paper 93-102, Bowdoin College, Brunswick, ME.

Kealy, M.J. 1994. "Benefits of Investments in Clean Water." Darft paper. EPA Office of Policy, Planning and Evaluation, February 1994.

Lyon, R. and S. Farrow. 1992. "An Economic Analysis of Clean Water Act Issues: Preliminary Results." Office of Management and Budget. February 1992.

Mitchell, R.C. and R.T. Carson. 1984. "Willingness to Pay for National Freshwater Quality Improvements." CR 810224-01. EPA, Washington, DC.

Mitchell, R.C. and R.T. Carson. 1986. "The Use of Contingent Valuation Data for Benefit/Cost Analysis in Water Pollution Control." CR 810224-02. EPA, Washington, DC.

Mitchell, R.C. and R.T. Carson. 1989. "Using Surveys to Value Benefits for Public Goods." Resources for the Future, Washington, DC.

Morris, G.E. and R.A. Cushman. 1993. "Benefits of Improved Water Quality to Diversionary Users: Phase I Assessment." Project No. 35U- 5726-3FR. Center for Economic Research, Research Triangle Park, NC.

National Park Service. "1982-1983 Nationwide Recreation Survey." April 1986.

National Research Council. 1993. "Managing Wastewater in Coastal Urban Areas." National Academy of Science, Washington DC.

Strand, I. 1993. "The Contribution of Clean Water to Commercial Fisheries." in Proceedings of the Clean Water and the American Economy Conference. EPA 800-R-93-001a, EPA, Washington, DC.

U.S. Department of Commerce. 1991. "1990 National Shellfish Register of Classified Estuarine Waters." NOAA, July 1991.

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