Economic Impact Analysis
Virginia Department of Planning and Budget

9 VAC 25-260 – Water Quality Standards in Chesapeake Bay and its Tidal Tributaries

Department of Environmental Quality

September 24, 2004

The Department of Planning and Budget (DPB) has analyzed the economic impact of this proposed regulation in accordance with Section 2.2-4007.G of the Administrative Process Act and Executive Order Number 21 (02). Section 2.2-4007.G requires that such economic impact analyses include, but need not be limited to, the projected number of businesses or other entities to whom the regulation would apply, the identity of any localities and types of businesses or other entities particularly affected, the projected number of persons and employment positions to be affected, the projected costs to affected businesses or entities to implement or comply with the regulation, and the impact on the use and value of private property. The analysis presented below represents DPB's best estimate of these economic impacts.

Summary of the Proposed Regulation

The General Assembly mandates in §62.1-44.15 of the Code of Virginia that the State Water Control Board establish standards of quality and policies for any state waters consistent with the purpose and general policy of the State Water Control Law. The code also mandates that the State Water Control Board modify, amend, or cancel any such standards or policies and take all appropriate steps to prevent an alteration to water quality contrary to the public interest or contrary to established standards and policies. The federal Clean Water Act, enacted with the purpose of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters so that they can support the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water, requires states to review water quality standards at least once every three years, modifying and adopting standards as deemed appropriate. 40 CFR 131 of federal regulations describes the requirements and procedures for developing, reviewing,

revising, and approving water quality standards by states, as authorized under the Clean Water Act.

The proposed regulation establishes five subcategories of designated use for the Chesapeake Bay and its tidal tributaries: migratory fish spawning and nursery designated use, shallow water submerged aquatic vegetation designated use, open water aquatic life designated use, deep water aquatic life designated use, and deep channel seasonal refuge designated use.[1] It also provides new and updated criteria (numerical and narrative) to protect these designated uses from the impact of nutrients and suspended sediments. The criteria include a dissolved oxygen criteria, a submerged aquatic vegetation criteria, a water clarity criteria, and a chlorophyll *a* criteria. The proposed regulation also establishes two additional site-specific criteria: a seasonal dissolved oxygen criteria for open water aquatic life use designation in the Mattaponi and Pamunkey rivers and their tidal tributaries and a seasonal chlorophyll *a* criteria for open water aquatic life use designation in the James river. Since the proposed regulation provides for a new method for controlling nutrients, Chesapeake Bay and its tidal tributaries are removed from the list of state waters designated as nutrient-enriched waters.

The proposed regulation also specifies assessment requirements for determining the attainment of criteria for each designated use. It also allows the State Water Control Board to issue or modify Virginia Pollutant Discharge Elimination System (VPDES) permits for point sources located in the Potomac river basin, the James and Appomattox river basins, the Rappahannock river basin, the York river basin, and the Chesapeake Bay/Small Coastal Basins such that the requirements of the regulation are met.

Estimated Economic Impact

In May 1999, the Environmental Protection Agency (EPA) placed Virginia's portion of the Chesapeake Bay and several tidal tributaries on the impaired waters list. The 2000 Chesapeake Bay agreement[2] set a goal of removing the Chesapeake Bay and its tidal tributaries from the list of impaired water bodies for nutrients and sediments by 2010. If water quality standards are not met by 2010, a total maximum daily load (TMDL) is to be developed for the

[1] The subcategories fall under the existing propagation and growth of a balanced indigenous population of aquatic life designated use category.

entire Chesapeake Bay. One of the key aspects of the agreement was to define water quality conditions necessary to protect aquatic living resources. In response, the EPA issued a regional criteria guidance entitled, "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity, and Chlorophyll *a* for the Chesapeake Bay and Its Tidal Tributaries"[3]. The regional criteria guidance was developed in order to assist the Chesapeake Bay states (Maryland, Virginia, Delaware, and Washington, D.C.) in adopting revised water quality standards to address nutrient and sediment-based pollution in the Chesapeake Bay and its tidal tributaries. The guidance document defined the water quality conditions called for in the 2000 Chesapeake Bay agreement by developing Chesapeake Bay-specific water quality criteria for dissolved oxygen, water clarity, and chlorophyll *a*. The guidance document also identified and described five habitats, or designated uses, which provided the context for deriving water quality criteria that were adequately protective.

Based on EPA's regional criteria guidance, the proposed regulation establishes five subcategories of designated use for the Chesapeake Bay and its tidal tributaries. The five new subcategories are migratory fish spawning and nursery, shallow water submerged aquatic vegetation, open water aquatic life, deep-water aquatic life, and deep channel seasonal refuge. All five fall under the propagation and growth of a balanced indigenous population of aquatic life designated use category. The proposed regulation also provides new and updated criteria (numerical and narrative) to protect the new designated uses from the impact of nutrients and suspended sediments, including criteria for dissolved oxygen, submerged aquatic vegetation, water clarity, and chlorophyll *a*. It also establishes two additional site-specific criteria: a seasonal dissolved oxygen criteria for open water aquatic life use designation in the Mattaponi and Pamunkey rivers and their tidal tributaries and a seasonal chlorophyll *a* criteria for open water aquatic life use designation in the James river.

[2] The signatories to the 2000 Chesapeake Bay agreement were Pennsylvania, Maryland, Virginia, Washington, D.C., the Chesapeake Bay Commission, and EPA. However, in a separate six-state memorandum of understanding with EPA, New York, Delaware, and West Virginia also made the same commitment.

[3] Prepared by Region III of the U.S. Environmental Protection Agency, in coordination with the Office of Water and the Office of Science and Technology, Washington, D.C.

According to the Department of Environmental Quality (DEQ), the proposed designated use subcategories and criteria are based on published EPA guidelines[4]. The EPA offers several approaches to some of the criteria and use designations. For example, the proposed regulation does not use application depths at which to apply the water clarity criteria. Instead, the regulation opts to apply the submerged aquatic vegetation (SAV) acre criteria as the first method of assessment for determining attainment of the water clarity criteria. The attainment of water clarity criteria in the corresponding water clarity acres is to be used as a secondary method of assessment. EPA guidelines allow for the use of either approach. However, according to DEQ, the proposed regulation does vary from EPA guidelines in one respect. For five of the 35 Chesapeake Bay program segments, the SAV acres do not match the restoration goals published by EPA. Virginia-specific modeling reports showed that, even with best management practices, these five segments would not meet the SAV restoration goals. DEQ instead proposed more achievable goals for these segments, which were reviewed and approved by EPA.

DEQ also believes the proposed designated use subcategories and criteria to be similar to those being implemented by other Chesapeake Bay states. According to DEQ, Maryland, Delaware, and Washington, D.C. (the three other watershed jurisdictions with Chesapeake Bay tidal waters) are currently in the process of promulgating water quality standard regulations. Delaware and the Washington, D.C. are much smaller jurisdictions with fewer designated uses and, thus, their regulations do not contain as much detail as the regulations for Virginia and Maryland. Some of the major differences between Virginia and other Chesapeake Bay states are: (i) Virginia places site-specific dissolved oxygen criteria for open waters affected by surrounding tidal wetlands. While the site-specific requirements are consistent with EPA guidelines, no other state has chosen to include such requirements. (ii) Virginia's water quality standards propose SAV acres that do not match EPA-published restoration goals. Differences between Maryland and Virginia include: (i) Maryland allows for the application of restoration variances for dissolved oxygen in some deep-water aquatic life designated use areas that are not provided for under Virginia's regulations. These variances are consistent with EPA designated use and attainability findings. However, as there were no findings to support the application of these variances to Virginia's Chesapeake Bay tidal waters, they were not included in the

[4] *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity, and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries* (2003) and its 2004 addendum and the *Technical Support Document for Identification of*

proposed regulation. (ii) Maryland applies narrative chlorophyll *a* criteria to all its affected waters. While Virginia has chosen to apply narrative criteria to most of its affected waters, numerical chlorophyll *a* criteria have been applied to the James River due to the impairment of these waters by algae. (iii) Maryland uses a combination of the SAV acres and application depths to assess attainment of the water clarity criteria. As mentioned above, Virginia has chosen to apply the submerged aquatic vegetation (SAV) acre criteria as the first method of assessment for determining attainment of the water clarity criteria.

According to DEQ, existing water quality standards are not appropriate for protecting water quality in Chesapeake Bay and its tidal tributaries. In spite of existing standards, Virginia's portion of Chesapeake Bay and portions of several of its tidal tributaries were put on EPA's impaired waters list in 1999. Moreover, according to DEQ, some of the existing criteria have been ineffective in protecting water quality in the bay. For example, existing criteria for dissolved oxygen have never been attained for some of the deeper waters of Chesapeake Bay during the summer months. The agency believes that the current designated use categories and criteria do not adequately reflect the diversity of aquatic life in the bay and its tidal tributaries. These waters are currently designated for aquatic life protection at all depths and during all times of the year. Thus, existing numerical criteria (dissolved oxygen, pH, and temperature) apply to all areas of Chesapeake Bay and its tidal tributaries, at all depths, and during all times of the year. The determination that the current designated uses do not fully reflect the natural conditions in the bay and its tidal tributaries and are too broad to support the adoption of more habitat-specific water quality criteria was one of the principle reasons in the development of the five new designated use subcategories. The new designations provide the context in which to derive adequately protective water quality criteria. By implementing water quality criteria specific to the natural conditions and habitats in Chesapeake Bay and its tidal tributaries, the proposed water quality standards are likely to be more effective than existing standards in achieving water quality improvement goals for these waters.

The proposed requirements are more stringent than existing requirements in some instances and less stringent in others. Waters to be included under the shallow water submerged aquatic vegetation designated use will now be required to meet a new seasonal SAV or water

Chesapeake Bay Designated Uses and Attainability (2003) and its 2004 addendum.

clarity criteria. Waters to be included under the open water aquatic life designated use will now be required to meet a new chlorophyll *a* criteria. In addition, all five new designations will be required to meet a modified dissolved oxygen criteria. While the dissolved oxygen criteria have been made more stringent for some of the designated uses (migratory fish spawning and nursery), they have been made less stringent for others (deep water aquatic life designated use and deep channel seasonal refuge designated use).

Estimated Economic Impact:

The proposed regulation is likely to impose *economic costs*. In order to meet the water quality criteria specified in the proposed regulation, reductions in the discharge of nutrient and sediments into the Chesapeake Bay and its tidal tributaries are required from all point and non-point sources. DEQ estimates that, based on 2002 conditions, approximately 33% of the nitrogen occurring in Chesapeake bay and its tidal tributaries can be attributed to point sources, with the remaining 66% attributable to non-point sources. Approximately 24% of the phosphorus occurring in these waters can be attributed to point sources, with the remaining 76% attributable to non-point sources. All sedimentation occurring in these waters is attributable to non-point sources. However, only point sources are regulated under the proposed regulation.

The proposed water quality standards are to be used in calculating the nutrient (nitrogen and phosphorus) load allocation for all point sources. The load allocation so determined is then used to set VPDES permit limits. According to DEQ, limits are to be set on all significant discharges into Chesapeake Bay and its tidal tributaries allowed under a VPDES permit. Entities with permitted discharges greater than 0.5 million gallons per day and with nutrients and oxygen-demanding substances in their discharge are likely to be affected. These entities include sewage treatment plants and businesses involved in the food processing, chemical, and pulp and paper industries. DEQ's best estimate of affected entities is 118, 98 municipal point sources and 20 industrial point sources.

In order to meet the new VPDES permit discharge limits, point sources are likely to incur additional capital and other costs related to nutrient removal. The estimated cost to point sources of reducing the discharge of nitrogen and phosphorus to required levels is summarized below.

Table 1: Summary of Point Source Costs, by Area

	Total Cost (millions)
Eastern Shore Basin	$9
James River Basin	$446
York River Basin	$29
Rappahannock River Basin	$47
Potomac/Shenandoah River Basin	$415

The total cost to point sources of meeting their nutrient reduction allocation is $946 million, with approximately 95% of the cost attributed to municipal point sources and 5% of the cost attributed to industrial point sources. The cost estimates are accurate within a –30% to +50% range.

In order to meet the proposed water quality standards, nutrient and sediment reductions are also required from non-point sources.[5] However, non-point sources are not regulated under the proposed regulation. Thus, implementation of the proposed water quality standards for non-point sources (i.e., implementation of the non-point source nutrient and sediment load allocation) is not required by the proposed regulation. Any reduction in non-point nutrient and sediment discharge into Chesapeake Bay and its tidal tributaries from current levels would have to be done on a voluntary basis.

Meeting the nutrient and sediment load allocation for non-point sources requires the implementation of best management practices for agriculture, urban, mixed open, forest, and septic non-point sources of discharge. If the non-point source nutrient and sediment load allocation were to be met, the estimated costs of implementing the required best management practices are summarized below.

[5] According to DEQ, even if all point sources were to meet their nutrient load allocation, it would not be enough to remove Chesapeake Bay and its tidal tributaries from the list of impaired water bodies for nutrients and sediments by 2010.

Table 2: Summary of Non-Point Source Costs, by Area

	Total Cost (millions)
Eastern Shore Basin	$32
James River Basin	$1,032
York River Basin	$119
Rappahannock River Basin	$128
Potomac/Shenandoah River Basin	$664

The total cost to non-point sources of meeting their nutrient and sediment load allocation is $1.975 billion, with a little over half these costs attributed to localities through implementation of urban best management practices. However, it should be noted that because of the voluntary nature of non-point nutrient and sediment load reduction from current levels, the actual non-point costs of implementing the proposed water quality standards could be much lower.

To the extent that the non-point source nutrient and sediment load allocation is implemented, the proposed regulation may also impose additional costs on the state funds. These costs relate to any technical assistance that the state provides to localities and private property owners in implementing the required best management practices. The estimated costs to the state in providing technical assistance are summarized below.

Table 3: Summary of Technical Assistance Costs, by Area

	Total Cost (millions)
Eastern Shore Basin	$5
James River Basin	$121
York River Basin	$14
Rappahannock River Basin	$16
Potomac/Shenandoah River Basin	$91

Total technical assistance costs to the state are estimated to be $247 million. However, as for non-point source costs, because of the voluntary nature of non-point nutrient and sediment load

reduction from current levels, actual technical assistance costs associated with implementing the proposed water quality standards could be much lower.

All the above cost estimates are taken from the April 2004 Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy for the Eastern Shore, James River, Lynnhaven, and Poquoson Coastal Basins, Shenandoah and Potomac River Basins, Rappahannock River and Northern Neck Coastal Basins, and York River and Lower York Coastal Basins. According to DEQ, updated cost information was presented to the Blue Ribbon Task Force earlier this month. While estimates for both point and non-point sources have been revised upwards, the estimates for non-point sources are significantly higher[6] than those reported in the Tributary Strategies. The revisions to point source cost estimates is within the uncertainty band reported in the Tributary Strategies[7].

Some of these costs are likely to be met by federal cost-share programs. Barring any change in federal legislation and appropriation, DEQ estimates that approximately 90% of the estimated cost to point sources are likely to be met by in-state resources. The remaining 10% are likely to be met through federal cost-share programs. DEQ anticipates that existing federal grants to the Virginia Revolving Loan Fund will be used as a primary funding source for point source costs. However, to the extent that any additional federal funds are provided to defray some of the estimated point and non-point costs, the cost to in-state resources (state, locality, and private) in implementing the proposed water quality standards will be reduced.

The proposed regulation is also likely to produce *economic benefits*. The benefits accruing from the restoration of water quality include benefits to public health, commercial fisheries, tourism and recreation, property values in surrounding areas, and the regional economy in general. According to EPA, the Chesapeake Bay affects industries such as commercial fishing, boat building and repair industry, and tourism that generate approximately $20 billion in output and 340,000 in jobs[8]. Based on 1998 conditions, tourism was by far the largest of these industries, accounting for approximately $19.6 billion. It should be noted that while Chesapeake

[6] According to DEQ, total non-point source costs (including the costs of providing technical assistance) have been revised to over $6.2 billion.
[7] According to DEQ, point source cost estimates have been revised to approximately $1.1 billion.
[8] *Economic Analyses of Nutrient and Sediment Reduction Actions to Restore Chesapeake Bay Water Quality*, 2003 - September. Prepared by Region III of the U.S. Environmental Protection Agency.

Bay is likely to affect a number of industries, the exact extent to which these industries rely on water quality in the bay is not known.

There is an existing body of literature on the benefits of water quality improvements. Leggett and Bockstael (2000)[9] find that water quality improvements (in terms of fecal coliform levels) have a positive and significant effect on property values along the Chesapeake Bay. Lipton (2004)[10] concludes that there is reasonable evidence that boaters are willing to pay for improvements in water quality. According to the study, water quality does impact the enjoyment of boating and boaters would benefit by a significant amount if it were to improve. Lipton and Hicks (1999)[11] establish a link between water quality improvements and recreational fishing values in the Chesapeake Bay. They conclude that while water quality improvements from current levels will have little benefit to striped bass recreational fishermen, allowing water quality to deteriorate from current levels will produce significant effects. Freedman (1995)[12] concludes that existing literature establishes that some measures of pollution reduce the value of trips to the beach. A study by Hanley, Bell, and Alvarez-Farizo (2003)[13] on the effect of water quality on trips to beaches in South-West Scotland found that hypothetical improvements in water quality did increase predicted trip frequency, but by only 1.3%. However, other analyses by Bockstael, McConnell, and Strand (1989)[14] and Krupnick (1988)[15] estimate the beach value component of the benefits of water quality improvements to recreational uses to be much higher. Studies such as McConnell and Strand (1989)[16] examine the welfare gains associated with commercial fisheries. Based on 2000 information, the value of commercial landings of some

[9] Leggett, C. G. and N. E. Bockstael, 2000. Evidence of the Effects of Water Quality on Residential Land Prices. *Journal of Environmental Economics and Management* 39: 121-144.
[10] Lipton, D.W., 2004. The Value of Improved Water Quality to Chesapeake Bay Boaters. *Marine Resource Economics* 19(2):1-6.
[11] Lipton, D.W. and R. Hicks, 1999. Linking Water Quality Improvements to Recreational Fishing Values: The Case of Chesapeake Bay Striped Bass. Proceedings evaluating the benefits of recreational fishing. *Fisheries Centre Research Reports* 7(2): 105-110.
[12] Freedman, A.M., 1995. The Benefits of Water Quality Improvements for Marine Recreation: A Review of the Empirical Evidence. *Marine Resource Economics* 10(4): 385-406.
[13] Hanley, N., Bell, D., and B. Alvarez-Farizo, 2003. Valuing the Benefits of Coastal Water Quality Improvements Using Contingent and Real Behavior. *Environmental and Resource Economics* 24: 273-285.
[14] Bockstael, N.E., McConnell, K.E., and I.E. Strand, 1989. Measuring the Benefits of Improvements in Water Quality: The Chesapeake Bay. *Marine Resource Economics* 6(1): 1-18.
[15] Krupnick, A., 1988. Reducing Bay Nutrients: An Economic Perspective. *Maryland Law Review* 47(2): 453-480.
[16] McConnell, K.E. and I.E. Strand, 1989. Benefits from Commercial Fisheries When Demand and Supply Depend on Water Quality. *Journal of Environmental Economics and Management* 17(3): 284-292.

Chesapeake Bay species (Striped Bass, Quahog Clam, Blue Crab, and Eastern Oyster) in Virginia are estimated at approximately $33 million.

Thus, while existing literature indicates significant economic benefits accruing from improvements in water quality, estimates of these benefits cover a wide range of values. Moreover, not all of the benefits accruing from water quality improvements are easily quantifiable. Benefits are likely to accrue from recreation (fishing, boating, and swimming), commercial fishing, public health, non-use value, property values, and regional economic impacts. However, recreational use benefits are likely to represent the largest benefit category. Bockstael, et al. (1989) estimate that a 20% improvement in nitrogen and phosphorus concentrations is likely to produce annual recreational use benefits for the Maryland portion of Chesapeake Bay of between $17 million and $76 million (in 1996 dollars) or an inflation-adjusted range of between $21 million and $92 million. Krupnick (1988) estimates that a 40% improvement in nitrogen and phosphorus concentrations is likely to produce annual recreational use benefits for the Chesapeake Bay area as a whole of between $43 million and $123 million (in 1996 dollars) or an inflation-adjusted range of between $52 million and $149 million. Based on Bockstael et al. (1989) and Krupnick (1988), Morgan and Owens (2001)[17] estimate the benefits to the Chesapeake Bay area of improvements in water quality between 1972 and 1996. A 60% improvement in water quality is estimated to have provided annual benefits to people living in Washington, D.C., Virginia, and portions of Maryland of between $358 million and $1.8 billion (in 1996 dollars) or an inflation-adjusted range of between $432 million and $2.2 billion. The methodology used by Morgan and Owens (2001) can be applied to Virginia to arrive at a better estimate of recreation use benefits accruing to the state from the proposed water quality standards. However, the range estimated recreation use benefits is likely to underestimate the actual benefits of water quality improvement in Chesapeake Bay. The study does not quantify a number of the benefits that accrue from water quality improvements such as the effect on property values, the effects on commercial fishing, and human health effects. Moreover, the study does not address the benefits accruing from a reduction in sediment load in Chesapeake Bay and its tidal tributaries. According to DEQ, meeting the point and non-point nutrient and sediment load allocations is likely to reduce nitrogen to 51.4 million lbs/year (from 77.8 million

[17] Morgan, C. and N. Owens, 2001. Benefits of Water Quality Policies: The Chesapeake Bay. *Ecological Economics* 39: 271-284.

lbs/year in 2002), reduce phosphorus to 6.0 million lbs/year (from 9.84 million lbs/year in 2002), and reduce sediment to 1.941 million tons/year (from 2.370 million tons/year in 2002). However, actual nutrient and sediment load reductions will depend on the extent of voluntary compliance of non-point sources with the proposed water quality standards.

The proposed regulation is also likely to provide some additional economic benefits. As mentioned above, some of the costs associated with implementing the proposed water quality standards are likely to be met by federal cost-share programs. To the extent that additional federal funds are provided to defray some of these costs, it is likely to produce economic benefits for the state. Unlike in-state resources, any additional federal funds will inject money into the state economy without any offsetting economic effects elsewhere in the state. These federal funds are likely to be spent in the state on nutrient control and the implementation of best management practices, increasing Virginia income and output. Moreover, the additional federal funds will be subject to an economic multiplier as the injected cash is spent on goods and services in Virginia.

In addition to the economic benefits mentioned above, the proposed regulation is also likely to produce benefits by making Virginia's water quality policies more consistent with those of other states. As discussed previously, Maryland, Delaware, and Washington, D.C. (the three other watershed jurisdictions with Chesapeake Bay tidal waters) are currently in the process of promulgating similar water quality standard regulations. Moreover, Virginia is committed to implementing these water quality standards as part of the 2000 Chesapeake Bay agreement and the 2000 six-state memorandum of understanding with EPA. Failure to do so could result in EPA promulgating and implementing water quality standards for the state and continued litigation from environmental groups. Thus, there are many significant non-monetary benefits to the state of implementing these water quality standards. At the same time, there are no significant benefits to the state of not implementing these standards. Failure to meet required water quality standards by 2010 will result in the development of a TMDL for the entire Chesapeake Bay. According to DEQ, a TMDL is not likely to result in any additional limits being placed on point source discharges than those likely to be placed under the proposed regulation. Thus, by not implementing the proposed regulation, the state would only be putting off the costs associated with its implementation by a few years.

The net economic impact of the proposed change will depend on whether the costs of implementing the proposed water quality standards are greater than or less than the benefits of doing so. Estimates of the costs and the benefits of implementing the proposed regulation are likely to be large, with both estimates ranging from the millions to the billions of dollars. However, estimates of both the costs and benefits are subject to great uncertainty. (i) The cost estimates for point sources alone are subject to an uncertainty band of –30% to +50% (as demonstrated by the latest revisions to these cost estimates). (ii) The costs to non-point sources (including technical assistance costs) appear to be subject to even greater uncertainty. The almost three-fold increase in non-point cost estimates in the latest revision is a testament to the magnitude of the uncertainties in estimating non-point source costs even without any non-point enforcement issues. This, along with the lack of enforcement ability and the voluntary nature of any steps taken to reduce non-point nutrient and sediment loads from current levels make accurate estimates of non-point source costs virtually impossible. (iii) Benefit estimates are also subject to great uncertainty. The actual nutrient and sediment load reduction in Chesapeake Bay and its tidal tributaries, and hence the benefits accruing from it, are dependant on the extent of voluntary compliance of non-point source with the proposed water quality standards. Moreover, existing benefits estimates fall within a wide range of values and are not necessarily applicable to the water quality standards being proposed. Finally, due to the problems in quantifying them, it is very difficult to arrive at precise estimates for many of the benefits that are likely to accrue from improvements in the water quality of Chesapeake Bay and its tidal tributaries. Thus, given the many large uncertainties, it is not possible at this time to make a precise determination of the net economic impact of the proposed change. However, it is possible that annual benefits accruing to the state from water quality improvements could eventually outweigh the costs of implementing these water quality standards. For example, annual benefits of approximately $76 million will outweigh $1 billion in current costs in 20 years (at a 5% discount rate). Over a ten-year horizon, current costs of $1 billion will be outweighed by annual benefits of approximately $123 million (assuming a 5% discount rate).

Businesses and Entities Affected

The proposed regulation is likely to affect businesses and entities with significant point source discharges into Chesapeake Bay and its tidal tributaries. Limits are to be set on all significant discharges (greater than 0.5 million gallons per day) allowed under a VPDES permit.

In order to meet the new VPDES permit discharge limits, these businesses and entities are likely to incur additional capita and other costs related to nutrient removal. DEQ's best estimate of such entities is 20. The cost to these entities of meeting their nutrient load allocation is estimated at a little under $43 million.

The proposed water quality standards could also affect non-point sources. Non-point sources are not regulated under the proposed regulation. Thus, implementation of the non-point source nutrient and sediment load allocation is not required by the proposed regulation. Meeting the nutrient and sediment load allocation for non-point sources requires the implementation of best management practices for agriculture, urban, mixed open, forest, and septic non-point sources of discharge. Some businesses and entities engaged in activities giving rise to non-point discharges could incur additional costs if they choose to implement best management practices aimed at reducing nutrient and sediment discharge. The number of such entities is not known. However, if non-point sources are to meet their nutrient and sediment reduction allocation, the costs of doing so are estimated at $928 million (non-point source costs for urban best management practices are not included in this estimate as these are costs likely to be incurred by localities, not private businesses and entities). However, given the voluntary nature of non-point nutrient and sediment load reductions from current levels, businesses can choose not to implement the required best management practices.

Some of the costs to businesses and entities of implementing nutrient control are likely to be met by federal and state cost-share programs. According to EPA's economic analysis, based on current practice, federal and state cost-share programs could provide for between 25% and 33% of estimated costs. Moreover, depending on the elasticity of demand for their product and the market structure within which they operate, these businesses will be able to pass on some of the increased costs to consumers in the form of higher prices for their product (the degree to which they will be able to pass the costs on to consumers will depend on the elasticity of demand and the type of market structure).

The proposed regulation is also likely to have an impact on businesses and entities involved in industries that depend on the Chesapeake Bay and its tidal tributaries. These industries include commercial fisheries, tourism and recreation, and boat building and repair in industries in the Chesapeake Bay area. Businesses and entities involved in such industries are

likely to benefit from any improvement in water quality in the bay or its tidal tributaries. The beneficial effect of water quality on these industries is, in turn, is likely to have a secondary beneficial effect on related support and value-added industries.

Localities Particularly Affected

The proposed regulation is likely to affect all cities and counties within the Chesapeake Bay watershed area. These localities are likely to incur additional costs of meeting the new VPDES discharge limits for discharges for municipal point sources. DEQ's best estimate of affected entities is 98. The estimated cost to these entities of meeting the nutrient load allocation is $904 million. In addition, all cities and localities that touch Chesapeake Bay drainage waters may also face non-point source costs related to storm water control and erosion and sediment control. However, implementation of best management practices such that non-point nutrient and sediment load allocation are met is not required under the proposed regulation. If localities were to meet the non-point nutrient and sediment load allocation, the cost of implementing urban best management practices is estimated at $1 billion.

Some of the costs to localities of implementing nutrient and sediment control are likely to be met by federal and state cost-share programs. In addition, some of the increased cost to localities could also be passed on to tax payers in the form of higher taxes.

On the other hand, localities are likely to benefit from economic development due to improvements in water quality of the Chesapeake Bay and its tidal tributaries. Industries such as commercial fisheries, tourism and recreation, and boat building and repair are likely to benefit directly from water quality improvements. Related support and value-added industries are, in turn, likely to reap secondary benefits. This is likely to have a positive effect on output and employment in localities in and around Chesapeake Bay and its tidal tributaries.

Projected Impact on Employment

The proposed regulation could affect employment in industries with significant discharges into Chesapeake Bay and its tidal tributaries. Examples of these industries include the food processing industry, the chemical industry, and the pulp and paper industry. The increased costs to these industries could reduce the profitability, potentially reducing the number of people employed in these sectors. To the extent that non-point source best management practices are implemented, the proposed change is likely to impose additional costs on

businesses and entities engaged in activities giving rise to non-point discharges, potentially reducing the number of people employed in these sectors.

On the other hand, the proposed regulation could have a beneficial effect on employment in industries such as commercial fisheries, tourism and recreation, and boat building and repairs that are likely to benefit from improvements in water quality in the Chesapeake Bay area.

Moreover, to the extent that the proposed regulation results in additional federal funds flowing into the state, it is likely to increase Virginia income and output and could result in an overall increase in employment in the state.

Effects on the Use and Value of Private Property

The proposed regulation is likely to impose additional costs on businesses and entities with significant point source discharges into Chesapeake Bay and its tidal tributaries. These businesses are likely to incur significant capital and other costs related to nutrient removal. This, in turn, is likely to increase operating costs and lower the asset value of these businesses. Moreover, to the extent that some businesses and entities engaged in activities that contribute to non-point discharges implement best management practices, they could incur significant additional costs, increasing their operating costs and lowering their asset values.

On the other hand, the proposed regulation is likely to have a positive effect on businesses involved in industries such as commercial fisheries, tourism and recreation, and boat building and repairs that are likely to benefit from improvements in water quality. Improved water quality is likely to increase revenues and raise the asset value of these businesses. In addition, improvements in water quality and any subsequent increase in economic activity in surrounding areas could also have a positive impact on property values in the area.