Economic Impact Analysis
Virginia Department of Planning and Budget

9 VAC 10-20 – Chesapeake Bay Preservation Area Designation and Management Regulation, Chesapeake Bay Local Assistance Board
June 21, 2000

The Department of Planning and Budget (DPB) has analyzed the economic impact of this proposed regulation in accordance with Section 9-6.14:7.1.G of the Administrative Process Act and Executive Order Number 25 (98). Section 9-6.14:7.1.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 purpose of the Chesapeake Bay Local Assistance Department (CBLAD) area designation and management regulations is to "protect and improve the water quality of the Chesapeake Bay, its tributaries, and other state waters by minimizing the effects of human activity upon these waters." (§30) The mechanism for protecting water quality in the Bay is to regulate the use and development of certain lands in the Bay watershed where such use and development would be expected to result in deterioration of water quality in the Bay or its tributaries. These rules

- establish the criteria that local governments shall use to determine the extent of the Chesapeake Bay Preservation Areas within their jurisdictions;
- establish criteria for use by local governments in granting, denying, or modifying requests to rezone, subdivide, or to use and develop land in Chesapeake Bay Preservation Areas; and

- identify the requirements for changes which local governments shall incorporate into their comprehensive plans, zoning ordinances, and subdivision ordinances.

In other words, the regulations establish mandatory land-use rules which must be implemented by local governments on those lands designated as part of the Chesapeake Bay Preservation Areas. Local governments are required to implement a planning process that ensures that their land-use controls meet the criteria specified in the regulations.

The changes proposed here do not change the basic structure of the regulations. Many of the changes are intended to update and clarify the language in the regulation, to eliminate conflicts and redundancies, to delete obsolete provisions, and to update references. However, some of the changes may be significant and can be expected to have significant economic impact.

In analyzing the economic impact of this regulation, DPB will pay special attention to those parts of the proposal that will make significant changes in the regulation. The analysis will also examine the overall economic impact of the proposed regulation. In addition, this analysis will, as required by Executive Order 25 (1998), assess whether there are alternatives to the proposed language that are likely to be more efficient or less intrusive than the language proposed.

Estimated Economic Impact

The Chesapeake Bay provides an impressive array of economic benefits to the people of Virginia and also to many people who are not residents of the state. (Simpson and Christensen 1997; Bockstael, McConnell and Strand, 1989; Grambsch, Michaels and Peskin, 1993) Many of these benefits are obvious and are relatively easy to measure. Among these are the contribution to the economy from the commercial harvesting of the renewable natural resources that thrive in the protected boundary between land and sea, between fresh and salt water, between shallow and deep areas. Other benefits of the Bay, although every bit as real and probably larger in magnitude, are much more difficult to measure reliably in the traditional currency of economic analysis. People value the Bay for its recreational opportunities, aesthetic “services”, and its contribution to a healthy environment. This last characteristic, often referred to as non-use values, is different from all of the others yet mentioned because, unlike the others, it may exist

even for people who never expect to use the services of the Bay, and for those who do use the Bay it may add to the value they place on using the Bay for commerce or recreation.

Another important characteristic of the Bay is that, by in large, its services are freely available to all who care to use it. Yet, it is often the case that one person's use has an impact on the value that other people derive from the Bay. The use of the Bay and its tributaries for the disposal of human generated waste products is a well-known and obvious example of one person's direct impact on the value of the Bay to others. In economic parlance, this is known as an externality; it is a transfer of value between individuals that is not the result of a voluntary exchange mediated by a market. When this happens, the person who benefits does not have to face the "opportunity cost" of that benefit. In this case, the opportunity cost is the lost value to others; that is, someone else pays a cost for the benefits this person receives.

There are many other examples of externalities in the use of Bay resources. One person's catch of fish from the bay may lower another's. People on the beach and boaters in the water may become so numerous as to interfere with each other's activities, congestion. Building on the water's edge may be aesthetically offensive to some and may degrade water quality.

The presence of externalities may lead to economically inefficient use of resources. For example, when a person living upstream uses a river for waste disposal, he has little incentive to account for the damage he does to downstream users. So he would tend to use the disposal services even if they were only of small value to him but cleaner water was of great value to someone downstream. A given pattern of resource use is "inefficient" if some different arrangement for allocating resource use results in a higher social value for the resource once you subtract off the costs of implementing the new arrangement. (Gramlich, 1990) In this way, externalities give rise to a potential justification for governmental action. Government actions can improve the economic value of a resource by establishing policies that rearrange resource use in a way that is more consistent with what would occur if users had to pay the opportunity cost of their use.

One way of measuring whether a change in resource patterns constitutes an efficiency improvement is to add up all of the costs imposed on individuals by the government action and then subtract these costs from the benefits that people derive from the change. (Gramlich, 1990) If the net change is positive then we may reasonably conclude that economic efficiency has been

advanced by the governmental policy. In the case of the upstream and downstream users of a river, a government regulation would constitute an efficiency improvement if the costs to the government and the upstream user were less than the benefits in cleaner water to the downstream user.

The regulation being analyzed here establishes a set of rules determining how land in the Chesapeake Bay watershed may be used and developed. The purpose of these land-use restrictions is, primarily, to protect water quality in the Bay and its tributaries. Economic theory assumes that people will adjust their behavior in response to the incentives they face, so the first step in measuring the costs of these restrictions is to determine what will be people's response to the rules. This must include an assessment of the rate of non-compliance with the rules given the anticipated level of monitoring and enforcement. One must also keep in mind that, as people respond to the rules, the prices of various resources will change and this will also affect what people do. How prices change will depend on the alternatives available to people.

Once we have established what responses people will make to the rules, we can work toward a measure of the expected benefits. The first step in measuring the benefits is to determine what will be the physical consequences of the behavioral changes made in response to the rules. These physical changes in flows of pollutants, sediment and runoff into the Bay watershed must be translated into changes in ambient water quality and then into changes in the biological systems of the Bay. Once this is known, we can attempt to assess the value that people would place on such a change.

In the next several sections, we will examine the specific provisions of the proposed regulation to assess the likely impact of each of the provisions and to examine whether there are feasible alternatives that could improve the economic performance of the rules. Following that, we will assess the likely overall economic consequences of the proposed regulations. Throughout this analysis, the proposed rule, when quoted, will be quoted in strike-out form so that the agency's changes will be apparent.

1) Definitions (§40)

With a few exceptions, the definitions do not, by themselves, have significant content. There are a few cases, however, that merit some mention. The definition of "buffer area" is

discussed at some length later in this document where we discuss the use and development criteria for resource protection areas.

The definition of "shoreline" is given as:

…the line describing the interface between land that is continually or, in the case of tidal flows, routinely submerged under water and land that is not continually or routinely submerged.

This definition, while necessary for implementation of the regulation, is somewhat vague. It is hard to figure out what the shoreline is for tidal lands. In tidal areas, is this "interface" landward or seaward of the mean high tide line? How often would water have to cover part of a riverbank before it was considered "routinely" submerged? This is important because it affects the delineation of areas subject to these regulations. It is may be costly to leave the determination of which lands are and are not subject to these rules to local interpretation of what it means for land to be "routinely submerged." This could raise administrative costs at the local level and increase uncertainty for landowners.

The definition of "tributary stream" has been changed to add some flexibility in making that determination. The new language will allow local governments and applicants the option of choosing a default definition of tributary stream based on drainage area rather than proving whether each stream is or is not perennial. CBLAD indicates that it has chosen a somewhat conservative definition which ensures that, if this default definition is used it is unlikely to eliminate any truly perennial streams. Applicants and localities still have the option of using USGS maps or hydrologic investigations if that is preferable. This change can be expected to reduce somewhat the costs of the permitting process.

2) Local Government Programs (§§50-60)

This part of the proposal specifies that

Local programs shall encourage and promote:

1. *protection of existing high quality state waters and restoration of all other state waters;*
2. *safeguarding the clean waters of the Commonwealth from pollution;*
3. *prevention of any increase in pollution;*
4. *reduction of existing pollution;*
5. *promotion of water resource conservation in order to provide for the health, safety and welfare of the present and future citizens of the Commonwealth;*
6. *assurance, to the extent feasible, that all streams and shorelines will be protected by a forested or other riparian buffer area.*

All but this last item are specifically listed in the authorizing legislation. Item number six in the list is different from the rest in that it is not reasonably described as a desired end of the enabling legislation but, rather, as a means toward achieving the other ends specified in the Act.

CBLAD staff have provided evidence to show that vegetated buffers have intrinsic value aside from their function in protecting water quality. In 1996, Virginia joined with the other states in the Chesapeake Bay Executive Council in a commitment to conserve and restore riparian buffers.

That said, one possible difficulty with placing this language here is that it may prevent, as a matter of fundamental policy, applicants and localities from choosing techniques other than vegetated riparian buffers even if those other techniques would produce greater gains than would be expected of vegetated buffers. As we will discuss at some length in a later section of this analysis,[1] the best available scientific evidence indicates that there are many cases where alternative techniques for protecting water quality may actually perform better than vegetated buffers.[2] As a default policy, vegetated buffers may have much to recommend them. However, the uniform application of a vegetated buffer requirement could, under some reasonably foreseeable circumstances, actually result in both lower water quality and increased costs of compliance.

The language of item 6, by specifying "to the extent feasible", does appear to envision a balancing of the interest in a "forested or other" buffer area against other considerations in the act. Thus it does not require the use of vegetated buffers in such cases where the use of vegetated buffers would work against the explicitly stated legislative authorization for these regulations. So long as this language is interpreted in a way that allows the balancing of other considerations against the policy favoring vegetated buffers, then this language is consistent with the economically efficient use of resources.

3) Area Designation Criteria (§§70-105)

The next part of the proposed regulation, comprising sections 70 through 105, specifies the criteria for designating portions of the regulated localities as "resource protection areas" (RPAs), "resource management areas" (RMAs) and Intensely Developed Areas (IDAs). RPAs

[1] See pages 26-31.

are lands more intrinsically connected with water quality and thus subject to stringent land-use controls. RMAs comprise lands where use and development have the potential to significantly degrade water quality. Lands in RMAs are subject to less stringent controls.

Section 80 specifies the criteria for determining the extent of the RPAs. In particular, subsection B requires that the RPA in a jurisdiction include:

> *1. Tidal wetlands;*
>
> *2. Nontidal wetlands connected by surface flow and contiguous to tidal wetlands or tributary streams;*
>
> *3. Tidal shores;*
>
> *4. Such other lands ~~under~~ considered by the local government to meet the provisions of subsection A of ~~9VAC10-20-80~~ this section and to be necessary to protect the quality of state waters;*
>
> *5. A buffer area not less than 100 feet in width located adjacent to and landward of the components listed in subdivisions 1 through 4 above, and along both sides of any tributary stream. The full buffer area shall be designated as the landward component of the Resource Protection Area notwithstanding the presence of permitted uses ~~or equivalent measures~~ , encroachments, and permitted vegetation clearing in compliance with Part IV of this chapter. ~~Designation of this area shall not be subject to reduction unless based on reliable site-specific information as provided in subsection B of 9VAC10-20-110, and subsections C and E of 9VAC10-20-220~~.*
>
> *6. Designation of the components listed in subdivisions 1-4 above shall not be subject to reduction unless based on reliable site-specific information as provided for in 9VAC10-20-105, subsection F of 9VAC10-20-130 of this chapter.*

Paragraph 80-B.5 appears to be the source of some confusion in these proposed rules. The word "buffer" is used to apply to two distinct ideas. In the definition section, "buffer area" is defined as:

> *an area of natural or established vegetation managed to protect other components of a Resource Protection Area and state waters from significant degradation due to land disturbances.*

Combining this definition with the language of paragraph 80-B.5, we conclude that a buffer area is a vegetated 100 foot strip landward of waters and wetlands, but that the buffer area includes the landward 100 foot strip even if it is not vegetated because of permitted uses and encroachments. This has lead to substantial confusion in the past by mixing the definition of the RPA with a vague inference about how that RPA along streams will be managed.

Since it is not true that this 100 foot strip that is part of the RPA is always a "buffer area," that is, a vegetated area, then the regulations should use language to distinguish these two things.

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[2] See Chesapeake Bay Program, 1995. Information also came from personal conversations with CBLAD staff, Conrad Heatwole and Leonard Shabman of Virginia Tech, and Geoff Cowan of Dubury & Davis.

The term "buffer area" should simply be defined here as the 100 feet landward of the components listed in subdivisions 1 through 4. The phrase "vegetated buffer" could be used to refer to that part of the buffer area that is vegetated or required to be vegetated. This change allows the rule to be written in a much less confusing and convoluted way. Permitted uses would never reduce the size of the buffer area although they might reduce the extent of the vegetated part of the buffer area. This will make it perfectly clear that the RPA itself is not reduced by the use of best management practices (BMPs) or alternative management practices. The only justification for reducing the size of the RPA, if any, would be clear evidence that some portion of the 100 foot strip does not have any significant relationship to water quality in adjacent areas.

The language of 80-B.5 is primarily intended to specify a boundary. It does not seem appropriate to use this paragraph to specify implicitly what amounts to a particular management practice. The designation of appropriate management practices should be reserved for that part of the rule that establishes allowable management practices. While it may be appropriate to draw the conclusion that the land within 100 feet of a stream is important enough to stream quality to justify making it part of the RPA, it is another thing altogether to infer, without specifically saying so, that all of these lands will be managed as riparian buffers. What is done in the RPA is appropriately treated in the part of the regulation that specifies acceptable management practices and should, as far as possible, take into account the relative effectiveness of the available management practices in particular circumstances.

In §90, CBLAD specifies what land areas (in the jurisdictions subject to these rules) are to be included in the resource management areas. Section B lists certain land types that "shall be considered for inclusion" in the RMA, and new language specifies that, if any of these land types are found adjacent to the RPA, then they must be included in the RMA. CBLAD staff indicate that this change merely clarifies the language of the regulation to make it more clearly consistent with the actual practice. The indicated land types are chosen because of their close connection with the quality of adjacent waters.

Section 90-C.5 helpfully clarifies that localities are not required to place all lands in their jurisdictions in the preservation areas. However, this should not preclude localities from doing so if such a choice is perceived to be in the best interest of the locality.

Section105 explicitly allows localities to deviate from the area designations in this part if actual field evaluations provide sufficient information to justify alternative area designations. This gives localities the opportunity to fine-tune area designations to local conditions once the information is available to justify the change. Not only is this flexibility valuable in its own right, but it has the added advantage of giving localities and potential applicants incentive to develop information that will be valuable for better managing land-use and water quality in the Bay region.

4) Purpose of the Land Use and Development Performance Criteria (§110)

Section 110 enunciates the overall goals of the specific regulations on land-use and development. These are to:

a. prevent a net increase in non-point source pollution from new development and older development with BMPs,
b. achieve up to a 10% reduction in non-point source pollution from older development without BMPs, and
c. achieve up to a 40% reduction in non-point source pollution from agricultural and silvicultural uses.

These goals are not stated in terms of improvements in the flow of services from the Bay. The relationship between non-point source pollution to fishery production, the value of recreational opportunities, and even human health are still not well understood. So, it is not known whether, even if the goals established in this section are reached, the improvement in water quality will generate a significant increase in the flow of services from the Bay. If the requirements of this regulation, in conjunction with the other requirements affecting the Bay region, are not sufficient to substantially increase the flow of value derived from the Bay, then little would be gained relative to the costs experienced, and the expenditure on meeting these goals would not be efficient. The value of improvements in water quality in the Bay is an issue that will be explicitly addressed later in this report.

Data from CBLAD and other sources of information about the economic value of the Bay seem to suggest that these rules, if fully implemented, would be more likely than not to have a positive impact at the margin on the flow of economic services from the Bay.[3] However, even this tentative conclusion rests on the assumption that the provisions of this regulation will be

[3] Later on we will discuss some of the provisions of this regulation that may prove to be counterproductive to the purposes listed in this section.

effectively enforced. The prospect of sufficient resources being made available to CBLAD to provide for effective enforcement appears to be the most uncertain link in the chain of causality between the promulgation of these rules and improvements in the flow of services from the Bay.

Another way to view this is to say that investments in monitoring and enforcement, and to some degree in improved regulatory design, may be the cheapest ways of ensuring that these rules actually do have a measurable impact on the flow of economic value from the Bay. Enforcement issues will be discussed in their specific context as we examine the rules that are intended to force localities to meet the stated performance criteria.

5) General Performance criteria (§120)

Section 120 contains eleven standards for assessing the adequacy of local programs to regulate land use in all lands designated by localities as Chesapeake Bay Preservation Areas. In order to discuss this section effectively, some clarification in the standard use of language in economic analysis is required. While these ten requirements are called *general performance criteria* in the regulation, an economist would use the term *technology standards* because the standards are not stated in terms of the primary goal of the regulation, protecting water quality. Instead, these criteria specify, sometimes in great detail, exactly what types of things may or may not be done in a given circumstance. Because localities have limited discretion in the technique they use to satisfy the requirement no specific demonstration by the locality that their actions have actually improved water quality is required.

Another possible way of regulating localities would be to state the regulatory requirements in terms of actual reductions in pollution or, even more directly, in improvements in water quality. This type of rule would leave to the locality with the decision about how to achieve the required level of performance and generally would require that localities monitor their performance and report it to the regulatory authority. The standard term used in the economics literature for this type of regulation is *performance standard*.

The relative merits of performance versus technology standards have been discussed at great length elsewhere. (Baumol and Oates, 1988; Bohm and Russell, 1985) The difference can be stated succinctly. Performance standards give the maximum flexibility to sources on how to achieve the ends of the rule. This lowers cost and increases incentive to discover innovative techniques that further lower costs. Performance standards also open the door to the trading of

responsibilities for water quality improvements between various parties, which further reduces compliance costs, and may provide greater assurance that the goals of the rules are actually met.

With all of these advantages, why would anyone ever choose technology standards? The answer is that performance standards generally involve higher monitoring and enforcement costs. (Bohm and Russell, 1985) Observing performance, especially in efforts to reduce non-point source effluents, is notoriously difficult. The combined costs of monitoring and enforcement of a given performance standard could outweigh the lower costs of compliance. And without, the monitoring and enforcement activity, performance standards may provide even less reliability assurance that the goals of the rules are being met than would a set of technology standards.

There are a number of areas where these regulations could potentially be improved by making performance standards available as an alternative to the specific technology standards listed in the regulation even if CBLAD judges its own enforcement and monitoring costs to be too high for it to justify eliminating technology standards. This additional flexibility could be provided by giving localities and applicants the opportunity to provide for the monitoring and enforcement necessary to assure CBLAD that the alternative method will perform at least as well as the technology standard it replaces. The burden of demonstration would be on the locality or applicant. This way, a party would only choose an alternative strategy if, in its judgement, the costs of monitoring and enforcement could be kept low enough so that the benefits of the alternative strategy outweigh its costs.

For example, an applicant might choose to propose replacing the technology standard with a performance standard. Because of the enforcement problems associated with performance standards, the applicant would have the burden of proving that it had the mechanisms in place to both monitor and enforce the actual performance of the alternative. Those applicants that would find monitoring and enforcement difficult and expensive could fall back on the technology standards to ensure that they had satisfied the act. The performance alternative could stimulate innovation in alternative mechanisms for achieving the goals of the Act and lower compliance costs for a given level of water quality.

Before these performance-based alternatives would be useful, some development of assurance mechanisms would have to take place. CBLAD could assist in the development of

contract mechanisms, private land-use restrictions and other legal and financial tools that would be required for implementing performance-based alternatives.

In the discussion of the eleven land use and development standards found in §120, we will repeatedly make reference to areas where the regulatory flexibility offered by voluntary performance-based standards may result in lower compliance costs. These suggestions will be generally subject to the condition that the appropriate assurance mechanisms can be put in place to satisfy CBLAD that actual performance is at least as good as or better than what would be achieved under the technology standards. Since the development of these compliance mechanisms may take time, one possible strategy might be to allow in these rules for pilot programs to determine whether such alternatives can be reliably implemented. If such strategies do turn out to be cost effective, then the regulations could be modified to explicitly allow for them at some later date. The encouragement of innovation in this area would seem to be a natural extension of CBLAD's traditional consultative role.

a. Minimize the extent of disturbed land: CBLAD indicates that this section does not set arbitrary limits on the amount of land that can be disturbed. Rather, it is used in the plan-of-development review process to discourage "indiscriminate" land clearing. The benefit of this is to leave existing vegetation in place since existing vegetation is generally more effective at protecting water quality than are the reasonably available alternatives. Costs may arise due to any required changes in the development plan. CBLAD staff indicate that observing this standard often saves developers money. This claim cannot be independently evaluated given the lack of data. Without more information, it is not possible to determine the net economic impact of this standard.

b. Preserve indigenous vegetation: It is not at all clear that native vegetation is necessarily the best choice for achieving improvements in water quality. CBLAD does provide guidance in its *Local Assistance Manual* on what this standard intends to accomplish and what constitutes *indigenous*. There is, according to the agency, some opportunity for innovation in what is allowed as indigenous vegetation. That said, this requirement is somewhat vague and is simply not written in a way that can be adequately justified in terms of water quality improvements. This explicitly rules out innovations in vegetative management that could improve water quality over what can be achieved by indigenous vegetation. DPB would suggest that this requirement

be rephrased to make the language more consistent with the agency's actual stated intent of improving water quality.

c. Local governments must ensure appropriate BMP maintenance: CBLAD staff and a number of other sources[4] report that this requirement is more often honored in the breach. The need for periodic monitoring and maintenance is one of the key weaknesses of using both BMPs **and** riparian vegetative buffers. There is almost no data available to assess the effectiveness of this provision, but observations by people in the field give reason to believe that this provision is not effectively enforced. Should the resources become available, it would seem reasonable to suggest that CBLAD expand its program of evaluation and enforcement to determine whether these local government maintenance agreements are accomplishing what is intended. Some increased effort in this area would almost certainly produce positive net economic benefits.

d. New development of 2,500 feet or more must be reviewed: The "plan of development" review process is a procedural mechanism for ensuring that the other standards of this regulation are met. As such, it adds somewhat to the administrative costs that developers face in developing land in the preservation area. However, this procedure is familiar to developers and may be a relatively inexpensive way to enforce the terms of the regulation.

e. Minimizing impervious cover: The requirement that development minimize impervious cover is intended to reduce the numerous problems associated with stormwater runoff. According to CBLAD staff, one of the main affects of this provision is to require localities to make sure that their regulations do not require more impervious surface than is reasonably necessary for the intended purpose. For example, this provision has been used to change the standards for the minimum acceptable size of parking lots for developments. While there is a connection between stormwater runoff and reduced water quality, the connection between impervious surface and reduced water quality may be interrupted by numerous stormwater management practices. As applied to builders and developers, this seems like a promising area for allowing localities and applicants flexibility in return for sufficient assurances that actual performance will be as good as or better than the strategy of minimizing impervious surface.(Technical Note 5, 1994; Technical Note 95, 1997)

[4] This is based on conversations with planning staff in three localities in the Bay watershed. These staff indicated that budget constraints prevented significant monitoring and enforcement activity in this area.

f. Reduces the cut-off size of developments that must comply with local erosion and sediment control ordinance: This subsection is not being changed in any substantial way. It requires some applicants, who would not otherwise be covered by the Virginia Erosion and Sediment Control Law, to conform to its provisions. This will increase costs somewhat for those applicants whose proposed land disturbing activity falls between 2,500 and 10,000 square feet. The administrative costs for these applicants is not large since applicants need only fill out a form certifying that they will satisfy the requirements of the act. Enforcement is provided by local inspectors. CBLAD staff report informal observations indicating good overall levels of compliance with the rule. The added costs of erosion and sediment control at these smaller developments are not known but are expected to be balanced to some extent by benefits in water quality. CBLAD indicates that there is a substantial scientific literature supporting the effectiveness of the various erosion control techniques. However, there do not appear to have been any studies to measure the actual changes in erosion and sediment in the Chesapeake Bay watershed resulting from this rule. The data do not exist to determine whether this requirement results in cost effective reductions in sediment load.

g. On-site sewage treatment system standards: Septic systems provide sewage disposal services for many homes and businesses in the Preservation Area. These systems process large quantities of sewage and have the potential of contributing large quantities of biological nutrients to Bay waters. One of the key difficulties in assessing the impact of septic system regulations is the lack of reliable scientific evidence on important aspects of the problem. CBLAD staff have indicated that there is general scientific agreement that most of the nitrogen entering septic fields ends up entering the Bay watershed,[5] but the impact of homeowner behavior on septic system performance is very important, and yet little data exists on how homeowners make decisions about septic maintenance and repair. Nor is there agreement on the costs and benefits of a given period for mandatory pump-out. Due to the great potential contribution of septic systems to Bay water quality, it would be worth considering whether a greater investment should be made in identifying and resolving some of the key uncertainties surrounding the environmental impact of septic systems.

Subsection a: Pump-outs and solids filters

The previous regulation required pump-out of septic systems every five years regardless of need. The proposed rule relaxes this requirement by allowing, as an alternative to mandatory pump-out, the use of a plastic filter device that removes solid material from the effluent stream. The filter is designed in such a way that once it is full, the septic system will no longer accept waste. Having this option available may reduce the costs of preventing failures of septic systems, failures that would lead to contamination of ground and surface water.

However, CBLAD should consider whether it is possible to offer owners of septic systems even greater opportunities for cost reductions. The pump-out rule is designed to prevent septic tank failure and a subsequent increase in nitrogen loading. The mandatory pump-out rule is used because, on older systems, there is no easy way to determine the state of the septic system. To inspect the fill-state of the tank one needs to open the tank which is a large part of the pump-out costs. Thus, it would rarely make sense to inspect a tank without going ahead and pumping it out.[6] There is also the possibility that periodic inspection could destroy the integrity of tanks, hastening failure.

The Department of Health requires that all new septic tanks have an observation port installed. (Department of Planning and Budget, 1996) This port, a length of PVC pipe, allows the fill-state of the tank to be easily observed using a "dip stick." For tanks with an observation port, annual or biannual inspections along with the requirement that nearly full tanks be pumped-out could significantly reduce septic maintenance costs. Homeowners have strong economic incentive to have the tank pumped as it nears capacity. This avoids the significant costs of replacing a failed septic system. CBLAD could allow localities to offer, as an alternative to mandatory 5-year pump-out, demonstration of annual inspection by the owner of the septic field.

Because there is substantial evidence that many homeowners do not maintain their septic systems properly, resulting in failures,[7] CBLAD might require localities to implement a system whereby septic contractors certify that they have inspected homeowners' tanks. Chesterfield County has such a system in place for notification of pump-outs. The primary difficulty with implementing this alternative arrangement is that it shifts some of the costs of septic tank

[5] Not all nitrogen enters the ground-water because some of the nitrogen is vented to the atmosphere as gaseous nitrogen.
[6] CBLAD staff, personal conversations.
[7] Virginia Department of Health staff, personal conversations.

maintenance to the local government, which may not have the resources to implement a tracking and enforcement system as an alternative to automatic pump-out. Currently, all of the costs are paid by tank owners. It would be up to localities to determine whether it would be worth it to implement some arrangement for septic tank maintenance tracking, possibly paid for through a fee on tank owners, in order to save on the potentially much higher costs of mandatory pump-out.

The mandatory pump-out rule affects the various localities quite differently. Some localities already require almost all new development to provide hook-ups to municipal waste treatment while others rely almost exclusively on septic systems. The mandatory pump-out rule falls most heavily on these latter areas, and the benefits of increased flexibility would accrue primarily to these areas as well.

It is also important to ask whether the septic tank provisions are actually being implemented. CBLAD has indicated that many localities are not in compliance with these provisions. Thus, it is unclear what impact these regulations are having on water quality. The addition of the plastic filter as an alternative to pump-out will lower the cost of compliance and lower costs may improve compliance rates. Any further reductions in costs could improve compliance rates even further. The low rates of compliance may also indicate that an increase in the resources available for monitoring and enforcement could result in significant improvements in the performance of municipal regulation of septic systems.

Subsection b: Reserve site and alternating drainfields

Septic drainfields have an expected life of around 25 years. Once the field reaches the end of its useful life, it can no longer serve the nutrient removal functions for which it was designed. For this reason, CBLAD has, in the past, required a 100 percent reserve site, that is, enough land in reserve so that the owner could build a second drainfield when the first reaches the end of its useful life. CBLAD is proposing to allow an alternative to keeping a 100 percent reserve. This alternative allows owners the option of installing two, smaller drainfields which will be used in alternating years. The septic system will be fitted with a diversion valve that will allow effluent to be directed to one field or the other. Allowing drainfields to “rest” greatly increases their useful life and their ability to remove nitrogen from effluents.

The effect of this language is to allow landowners to choose two smaller drainfields, which will be subjected to intermittent use, for one main drainfield with an equal amount of reserve, the reserve to be used once the main drainfield fails.

Evidence indicates that alternating drainfields greatly improves the life expectancy of the combined system relative to the sequential use pattern previously allowed.[8] While this system is in use in Fairfax County, it is not clear whether many other jurisdictions have any interest in this alternative. The combined drainfield approach involves the substitution of much higher initial construction costs against some possible savings in land costs and a savings in the cost of constructing a new drainfield 25 years in the future.

The savings in future construction costs can be assumed to have little value to most homeowners and businesses. At any reasonable discount rate, the value of reducing costs at a date 25 years in the future is extremely small. The savings in the amount of land needed to support a development served by septic systems is much more likely to be a factor in this choice. However, where land prices are high enough to justify the increased construction costs, it is probably more likely that the land is served by municipal sewage service. Conversely, if land is not served by municipal sewage services, then it is somewhat less likely that land values are high enough to make the choice of the increased construction costs attractive to the applicant. Thus, while providing this flexibility may produce some benefits, it is unlikely that the savings will be large.

The rules specify that localities must require that owners alternate the drainfields annually and notify them of the requirement each year. Unfortunately, even in localities such as Fairfax, there is no data to indicate whether people do actually switch their drainfields in response to the notification. It is possible that low rates of compliance on switching could actually result in greater rates of drainfield failure than in the absence of the switching option. Such a perverse outcome is unlikely, in our view, because homeowners have substantial economic incentives to switch the drainfields annually in order to increase the expected life of the drainfields. under the assumption that landowners will switch fields appropriately, the dual drainfield option, by increasing the range of options, can only work in the direction of improved

[8] CBLAD staff, personal conversations.

economic efficiency. This option is not expected to have a large economic impact because it is likely to be more expensive than other options in most cases.

The proposed rule specifies, in some detail, the design of the diversion valve. Then, in subpart (7), the proposed language provides that:

> *In lieu of the aforementioned diversion valve, any device that can be designed and constructed to conveniently direct the flow of effluent from the tank into either one of the two distribution boxes may be approved if plans are submitted to the local health authority and found to be satisfactory.*

This language allows the locality to replace all of the technology standards covering the design of the diversion valve with a local approval standard that essentially says: if the locality finds the design to be satisfactory then it may be used. No monitoring of actual performance is required. It may be questioned whether local health authorities have the technical expertise to predict with accuracy the performance of novel field switching devices or designs based on submitted plans. However, CBLAD indicates that localities will generally seek the advice of technical specialists at the regional or state level. Even so, some provision for monitoring the actual performance of novel designs may be useful to ensure that the designs work as well as those specified in the regulations.

h. Stormwater management: CBLAD has worked with the Department of Conservation and Recreation and the Department of Environmental Quality to establish consistent stormwater management regulations for use by all state agencies with stormwater management responsibilities. DCR has already promulgated these new rules, and DPB analyzed the new stormwater rules at that time. (Department of Planning & Budget, 1996) These new CBLAD rules incorporate the rules already promulgated by DCR. The cost of compliance should fall somewhat, but it is not known with any certainty what net impact this will have on water quality due to change in the pattern of stormwater runoff.

i. Water quality assessments on agricultural land: The existing regulations require that all agricultural land have a water quality conservation plan. The proposed rule changes this provision to require that all agricultural land have an "assessment conducted regarding the effectiveness of existing practices pertaining to soil erosion and sediment control, nutrient management, and management of pesticides to ensure that water quality protection is being accomplished consistent with the Act and this chapter." Once the assessment is done, agricultural practices that are deficient in some way would be addressed resulting in

recommendations for additional conservation practices to correct only the deficiencies. This change reduces the likelihood that a farmer will have to have a management plan written that covers already adequate farm management practices.

The new regulations provide standards for what assessments must be done on lands where the assessment identifies weaknesses in the current management practices. In particular, soil tests will be explicitly required whenever the assessment indicates the need for a nutrient management plan. This is a new requirement that may impose some additional compliance costs. Soil tests cost $8 each including administrative costs. A test must be performed for each field and each soil type. A typical set of soil tests may require 5 tests per hundred acres. For a 1,000 acre farm, this would cost $400.[9] The farmer does not have to pay the full cost of soil tests done in support of a nutrient management plan. The farmer is entitled to a 25% tax credit for these tests. CBLAD argues that the soil tests produce a net economic benefit on average by boosting farm profits by an amount greater than the cost of the test although there is some reason to doubt this conclusion. (Dunn and Shortle, 1987) In fact, it is probably not true that soil test are generally profitable for farmers when all of the costs of gathering and using the information are taken into account. We certainly do not need to require that farmers use fertilizer to boost yields on their crops. It is rarely, if ever, true that a regulatory action can increase business profits by requiring business people to do something that they would choose not to do in the absence of the regulation.

Supposing that it were true that soil tests generate net increases in farm profits, as is asserted by CBLAD and others, then a regulation is not a necessary or appropriate response to the lack of soil tests. Rather, a program of providing farmers with information (that they have somehow failed to receive through farm publications, neighbors or the extension service) about their opportunities to increase their profits should be all that is necessary.

Even if the tests do not pay for themselves in terms of greater profits, they are probably essential for the development of appropriate and effective nutrient management plans. A number of studies do indicate that nutrient management is currently a cost effective method of reducing nutrient flows into the Chesapeake Bay. (Dunn and Shortle, 1987; Letson, Crutchfield and

[9] Per Dana Balis, Department of Conservation and Recreation, personal conversation.

Malik, 1993) This implies that the soil tests produce a net economic benefit. This conclusion does not depend on how the costs are allocated between farmers and others.

The rules do not require that farmers implement the provisions of any management plan. CBLAD argues that a regulatory requirement is not necessary since there is evidence that, in the past, persuasion has been effective in getting farmers to implement the needed changes. This assertion is at variance with the results of a number of economic studies, some of which were carried out in the Chesapeake Bay region. (Dunn and Shortle, 1987) Given the divergence between CBLAD's perceptions and the results of these studies, additional monitoring by CBLAD would be useful for assessing just how effective these voluntary provisions are in generating improvements in water quality.

j. Silvicultural activities: Silvicultural activities can have very significant effects on water quality. Although forestry activities are exempt from erosion control laws, the Department of Forestry (DOF) does have the legal authority to control deterioration of water quality due to silvicultural activities. CBLAD staff and a representative of the Chesapeake Bay Foundation[10] indicate that the record of compliance of silvicultural operations with the DOF's Best Management Practices manual has varied widely both over time and across firms resulting in sometimes substantial contributions to effluent loads moving into the Bay.

The regulation of forestry activities is not under CBLAD's jurisdiction because the Board has deferred to DOF in regulating silvicultural activities. This means that local governments cannot make the control of silvicultural runoff part of its overall strategy for controlling water quality although, as pointed out by CBLAD, localities can require a demonstration that a logging site is in compliance with the DOF best management practice guidelines. This gives rise to the possibility that the costs of control of pollution loadings may vary widely between forestry and non-forestry activities. If there is a large difference in control costs per unit of loadings removed, then there would be a loss of economic efficiency. If the costs of compliance are low relative to the costs facing other sources of pollutants in the Bay, then it might be worthwhile for CBLAD to work more closely with the Department of Forestry to ensure that forestry BMP compliance rates are maintained at high levels.

[10] Per Ms. Estie Thomas, Chesapeake Bay Foundation, personal conversation.

In the longer run, it may be worth exploring whether the control of water quality impacts from forestry activities in the Chesapeake Bay watershed might logically be placed under the control of localities as part of their comprehensive control of the water quality affects of land use practices. Whether this would be an efficiency enhancing move would depend on a number of factors that are beyond the scope of this study.

6) Use and development criteria for RPAs (§130)

This section contains the key substantive limits on the use of the lands designated to be in the resource protection area. As discussed earlier, the RPA includes areas in direct contact with waters and tributaries of the Bay and a 100 foot strip on the landward edge of those areas in contact with water. The land included in the RPA is generally the land where use and development are likely to have the greatest impact on water quality. The substantive restrictions on these areas are significantly greater than those for the resource management areas. These use and development criteria are **in addition to** the criteria that apply to RMAs.

This section generally restricts activities in the RPA to those activities that are logically connected to the type of land found in the RPA, that is, uses directly related to the proximity of the land to water, and to those activities that are "grandfathered" in due to nonconforming uses predating local adoption of land management regulations.

a) Permitted uses and exemptions

The permitted uses in the RPA are quite limited. They include:

1. Water dependent uses,
2. Continuance or redevelopment of existing use existing at the time of program adoption,
3. New use on non-conforming lots predating enactment,
4. Roads or driveways, or
5. Flood control or stormwater management facilities.

The regulations establish standards for when these uses are permissible and how they should be carried out. The substance of the requirements is that encroachments and adverse impacts on water quality should be minimized as far as practical.

Water wells, passive recreation facilities, and historic preservation and archeological activities are exempt from the restrictions as long as they are done in a way that minimizes their

water quality impact. They must be reviewed by local government, and any land disturbance over 2,500 square feet in extent must comply with erosion and sediment control rules.

b) Buffer area requirements

Subsection 3 of section 130 of the proposed regulation adds the following language:

> *The 100-foot wide buffer area shall be the landward component of the Resource Protection Area as set forth in subdivision 5 of subsection B of § 9VAC10-20-80 of this chapter. Notwithstanding permitted uses, encroachments and vegetation clearing, as set forth in this subsection, the 100-foot wide buffer area is never reduced in width.* ~~*Except as noted in this subsection, a combination of a buffer area not less than 50 feet in width and appropriate best management practices located landward of the buffer area which collectively achieve water quality protection, pollutant removal, and water resource conservation at least the equivalent of the 100-foot buffer area may be employed in lieu of the 100-foot buffer.*~~

The added language seems to be redundant given the language of §80-B.5. The perceived need for this language probably arose from the dual role of the "buffer" in this regulation: as a delineation of a regulated land area and as a description of a specific water quality control practice to be used on much of the designated land area. As discussed previously, a rewording of the regulation could eliminate this confusion along with the need to restate this language here.

Subsection 3 continues:

> *To minimize the adverse effects of human activities on the other components of the Resource Protection Area, state waters, and aquatic life, a 100-foot wide buffer area of vegetation that is effective in retarding runoff, preventing erosion, and filtering nonpoint source pollution from runoff shall be retained if present and established where it does not exist. The 100-foot wide buffer area shall be deemed to achieve a 75% reduction of sediments and a 40% reduction of nutrients.*

In our discussion of §80 we argued that the definition of "buffer area" should not automatically establish that the buffer area be fully vegetated. On agricultural lands, the regulations clearly envision the prospect of non-vegetated portions of the buffer area.[11] This is not the case with non-agricultural land. The proposed changes would greatly limit the ability of owners of non-agricultural lands to use alternatives to vegetated buffers even if they could show a net benefit to water quality.

It should be noted that the last sentence of the foregoing quote deems something to be true that is not true in general, and the data do not exist to determine with any certainty whether

[11] While, as CBLAD points out, agricultural buffer modifications generally maintain some vegetative cover such as crops, and farmers do have some economic incentive to control silt and nutrient runoff, it is obvious that this incentive is not strong enough to prevent the large contribution that agricultural uses make to non-point source pollution in the Bay. If these economic incentives were strong enough, little of this regulation would be needed.

it is even approximately true on average. What is known to be true is that the effectiveness of riparian vegetated buffers varies greatly across localities within the region subject to these regulations and, indeed, varies widely from place to place and from vegetation type to vegetation type. (Chesapeake Bay Program, 1995) Moreover, the performance of riparian buffers depends on how well the buffer is managed by the individual landowner. The performance of riparian buffers will be discussed at some length in the next section of this report.

Improved data on actual performance of riparian buffers may indeed show that they perform on average as well as or better than this language asserts, however no regulatory language can make something true that is not true or is not known. Even it this assertion were true on average, it is certainly not generally true of any given parcel of riparian land. This language is unnecessary, and since it is also counterfactual, it should be removed from the proposed regulation.

The last part of subsection 3 deletes a provision from the existing version of the regulation that allowed non-agricultural owners to substitute BMPs for vegetation on part of the buffer area:

> **[Deleted]** *Except as noted in this subsection, a combination of a buffer area not less than 50 feet in width and appropriate best management practices located landward of the buffer area which collectively achieve water quality protection, pollutant removal, and water resource conservation at least the equivalent of the 100-foot buffer area may be employed in lieu of the 100-foot buffer.*

This is a critically important deletion because it will almost certainly increase the cost of compliance with the regulations and it is not known with any degree of certainty that the increased costs will result in an improvement in water quality. In fact, given the wide variation in the performance of riparian buffers in removing nutrients from groundwater entering the watershed, it is possible that removing this flexibility could actually increase the amount of plant nutrients (nitrogen and phosphorus) entering the Bay.[12]

The deletion of this language removes a measure of flexibility in how localities may meet their requirements under these regulations. Since this change reduces options now available to localities and landowners, it cannot logically reduce costs of compliance, only increase them. Those localities using the flexibility to substitute more effective BMPs will now be prevented from using a management tool that they had determined was in their own interest to use. Thus,

[12] Conrad Heatwole and Leonard Shabman, Virginia Tech, personal conversations.

we conclude that this change can only act to increase the costs of complying with the regulation.[13] The extent to which these costs are balanced by benefits of having larger buffers is the subject of the next section of this analysis.

The confusion about the meaning of "buffer area" in the existing regulations may be one reason why CBLAD decided to delete this language. If the buffer area and the RPA are synonymous, then allowing localities to allow the substitution of BMPs for buffer might be seen as allowing localities to reduce the size of the 100 foot riparian border strip that is included in the RPA. According to CBLAD, the agency did not intend that the original language would allow a reduction in the size of the RPA, although it is clear that the rules did intend to allow reduction in the extent of the vegetative buffer that were already platted at the time the regulations were established. Separating the definition of "buffer area" from the definition of "vegetated buffer," as suggested earlier, would resolve this particular difficulty with the flexibility language that CBLAD is proposing to delete.

CBLAD staff has indicated that there is another reason for removing the language that allows the substitution of BMPs for vegetated buffers in non-agricultural lands. They argue that, while in theory BMPs can often perform at least as well as or even better than riparian vegetated buffers (RVBs), CBLAD's experience is that, in practice, the failure rate is higher for BMPs than it is for RVBs. Since the issue of allowing BMPs to substitute for RVBs depends critically on the characteristics of these buffers and the BMPs that might serve in their place, it is worth examining some of the properties of these two tools for protecting water quality in the Bay.

(i) Riparian vegetative buffers and non-agricultural riparian BMPs

It is well understood that land use in the riparian zone has the potential for influencing water quality in the adjacent streams. (Chesapeake Bay Program, 1995) Agriculture, residential yards and septic systems, commercial establishments, and, increasingly, golf courses contribute plant nutrients, sediment, and other pollutants to nearby waterways. One way to intercept these pollutants is to install a man-made system for treating runoff from the land. Such systems are

[13] CBLAD asserts in its supporting documents that this is not a change in the regulation but, rather, a clarification of the Board's existing intentions. Since some localities have used the flexibility implied by this language and will now be prevented from doing so, it is reasonable to conclude that this change will likely increase local compliance costs.

often referred to as best management practices.[14] Another way to control the pollution load in the receiving stream is to use vegetation to physically slow the flow of water. Then the soil and vegetation can absorb a number of contaminants that would otherwise enter the watershed.

The U.S. Department of Agriculture has developed a specification for a "Riparian Forest Buffer System" (RFBS) designed to control non-point source pollution and improve the stream environment. Not all buffers match the design of the RFBS, of course. This is merely a reference system to allow comparisons of function and effectiveness across different buffer designs. According to a report from the Chesapeake Bay Program, along with its function in removing non-point source pollutants from water entering streams, the buffer reduces sediment, modifies stream temperature, controls light quantity and quality, enhances habitat diversity, protects channel morphology, and enhances the food web and species richness. (Chesapeake Bay Program, 1995) This buffer system consists of three "zones". Zone 1, next to the stream, is an area of permanent forest vegetation. Zone 2 is an area of managed forest up-slope from zone 1. Zone 3 is a filter strip, planted in grass or some other herbaceous vegetation.

Each of the three zones provides a unique function that contributes to the overall effectiveness of the RFBS. Zone 3, the grassy strip, acts to slow runoff from adjacent land and to spread the flow out into a sheet rather than a gully. Water flowing through a gully bypasses the biological removal capabilities of the other 2 zones, whereas sheet flow is easily assimilated, and biological removal can be effective. This zone is responsible for the removal of a significant portion of the sediment load from nearby land.

Zone 2 is a forested area that is managed in a long-term rotation. Its function is to remove pollutants in both the subsurface and surface flow through biological and chemical transformations, storage in woody vegetation, infiltration, and sediment deposition. Tree and other plant roots can sometimes reach down into the underlying water table and extract nitrate and, to a lesser extent, dissolved phosphorus. The managed harvesting of woody biomass from zone 2 is encouraged both for permanent removal of nutrients from the riparian zone and to encourage greater uptake of nutrients by young, vigorously growing woody vegetation.

[14] This terminology may be confusing for some since there are cases where a vegetated or forest buffer is the best way to manage the riparian zone, thus a vegetated riparian buffer would seem to be the BMP. However, for the purposes of this analysis we will use BMP to refer to management options other than vegetated buffers.

Zone 1 is an area of permanent forest vegetation adjacent to the stream channel. It shades the stream thereby reducing water temperature, it contributes woody debris that enhances the biological function of the stream, and it controls stream-bank erosion by slowing water flow and holding soil particles in place. These functions of zone 1 have a larger impact on small streams, although they do affect shoreline conditions in larger streams. The forest in zone 1 also enhances the aesthetic qualities of the stream-bank, providing a wooded view from the water and land on the other side of the stream.

The effectiveness of a RFBS in removing pollutants varies widely depending on the geology and hydrology of the site. Based on the studies available, the report from the Chesapeake Bay Program on RFBS performance concluded that, depending on the circumstances, forested buffers can be expected to remove from 4 percent to 80 percent of nitrate pollution from ground and surface water before the water enters the nearby stream. For a number of regions, the potential for removing nitrates with vegetated buffers is extremely low. Even for areas where an RFBS can be expected to perform well, local variations and unknowns lead to estimates of nitrogen removal capacity that vary by factors of two and three. (Chesapeake Bay Program, 1995, 42) It is important to note that, according to available data, the effectiveness of buffer systems in removing pollutants is greatest in the coastal plain and the lower piedmont areas where these regulations are being implemented.

The RFBS report also points out that the performance of a RFBS depends an a number of factors under the control of the landowner. For example, the failure of zone 3 vegetation to transform runoff into a sheet flow can permanently compromise the performance of the buffer. Landowners must carefully maintain zone 3 characteristics to sustain RFBS pollutant removal properties. The type of vegetative management on zone 2 can have a significant effect on nutrient removal efficiencies, these include rotation period, type of plantings, cut for view, and forest litter management.

There is another source of uncertainty concerning the effectiveness of the riparian vegetated buffers required in the buffer area. The management requirements for vegetative buffers used in this regulation differ from the grassy strip and forest combination standard specified by the U.S. Department of Agriculture. Due to the lack of good scientific studies, we

cannot yet say how different vegetated buffer arrangements will perform in different regions of the Bay watershed.

For areas where RFBS are reasonably effective in removing pollutants, the width of the vegetated buffer is one of the factors that determines how much of the pollutants are filtered out by the vegetation. Up to a point, adding to the width of the vegetated area also adds to pollutant removal capacity. However, after a certain point, the marginal effectiveness of adding width to the vegetated buffer falls dramatically. In one study, a 19 percent increase in vegetated buffer width, from 23.6 meters to 28.3 meters, increased the percentage of nitrogen removed from 75.3 percent to 80.1 percent, a 6 percent improvement. (Chesapeake Bay Program, 1995, 30) Thus, the cost of removing the last 6 percent of nitrogen using a wider vegetative buffer has become quite expensive in terms of land used per amount of nitrogen removed. In fact, a 19 meter forest strip without a grassy strip produced all but 1 percent of the 75.3 percent reduction in nitrogen. This result could be due to many factors and should not be construed as proving that grassy strips are ineffective. However, it may well be that a somewhat narrower buffer would be more appropriate given the cost of the next best technology for removing nitrogen from Bay waters. The subject requires further study.

In areas where the RFBS is not particularly effective, the relative cost effectiveness of the buffer in removing nitrogen is probably extremely low. Varying the width of the buffer may have little or no effect on water quality. In these cases, buffer width must be justified on other grounds beside their impact on water quality. For example, since buffers offer other environmental services besides water quality protection, an analysis into the optimal width of the buffer would investigate the marginal contribution to aesthetics, habitat, diversity, etc. of the landward 25 feet of vegetation. CBLAD has provided substantial scientific evidence that some important functions of buffers such as flood control and wildlife habitat actually increase more rapidly with greater width up to widths often much greater than 100 feet. Thus, even though the marginal benefits of nitrogen removal begin to fall well before the 100 foot boundary, other services of buffers are still very substantial at this distance. In addition, it stands to reason that the probability of having a buffer compromised by a gully falls as buffer size increases. This issue deserves more study given the requirement in these rules that all 100 feet of the buffer area be vegetated in non-agricultural settings.

Given the wide range of performance of RVBs in controlling non-point source pollution of the Bay, it is reasonable to conclude that there are many cases where other BMPs could be more effective at protecting Bay waters. In theory this is correct. A number of designs for controlling the migration of nutrients from the surface of the land into the Bay are already in use. Their performance, when they are operating properly, can clearly outperform RVBs in areas where vegetated buffers have low effectiveness. (Technical Note 95, 1997) Thus, there is a potential for improved water quality by allowing the substitution of BMPs for vegetated buffers.

CBLAD staff have indicated that allowing the substitution of BMPs for vegetated buffers was not allowed in this proposal because the actual performance of BMPs has been disappointing relative to their theoretical potential. This opinion is supported by empirical analysis of BMP performance in the field. One 1992 study(Galli, 1993) found that less than half of the stormwater infiltration trenches surveyed were working as designed and that the performance of the trenches declined over time, with less than one third still functioning after five years. Studies of other BMP types give similarly disturbing results.(Metropolitan Washington Council of Governments, 1988)

These studies found that the primary reasons for failure of the BMPs were improper construction and improper maintenance. A number of BMPs studied were constructed in inappropriate soils, were placed too close to the water table, or were compacted by heavy machinery during construction. Others were contaminated by sediments during or shortly after construction or were clogged due to inadequate treatment of runoff. Grassy strips and sump pits, used for sediment filtration which needs to occur before the water enters infiltration trenches, were not maintained. The study on the performance of infiltration trenches concluded that "communities will need to carefully review their ability to provide or enforce regular maintenance activity if the longevity of infiltration practices is to be measurably improved." (Galli, 1993)

From the foregoing discussion, we conclude that, for a given location, the physical characteristics of the site will determine whether a RVB or a BMP would be most likely to produce the greatest improvements in water quality. In many areas, there may not be a significant difference between these two approaches, at least in their theoretical potential. Much depends on the expected actual performance given expected levels of care in construction and

maintenance. CBLAD has concluded that, given their experience with both of these approaches and given the available resources for monitoring and enforcement, RVBs are more likely, on average, to give better performance than BMPs. Thus, the agency has opted to require RVBs as the exclusive management option in non-agricultural settings.

If there were no reason to believe that the agency could have any impact on the levels of care in construction and maintenance, then such a policy might be justified.[15] However, the distinct advantage that BMPs have in some parts of the Bay watershed suggest two possible strategies. First, since much of the uncertainty over the performance of both of these practices is due to uncertainty over how they are constructed and maintained, it may be possible to achieve some savings if resources could be made available for increasing levels of enforcement in return for some added flexibility in the use of BMPs in lieu of RVBs. This alternative may be difficult to implement because, while the savings would accrue to riparian landowners, CBLAD and localities would face higher enforcement costs, which would involve raising revenues to support the increased enforcement activity.

One way to resolve this dilemma is to maintain the RVB requirement as the default management technique but to allow riparian landowners to use a BMP so long as they can provide CBLAD or the locality with sufficient assurance that the BMP will be properly designed, constructed and maintained so that the system would perform at least as well as a properly installed RVB. Since not all RVBs perform as well in practice as theory might suggest, it is important that the assurances provide for monitoring, maintenance and repair.

It is possible to think of a number of mechanisms that could be used to provide the needed assurances. These would probably involve some contractual obligation, recorded with title and running with the land, along with some financial assurance that the funds needed would be available. The contractual obligation would require that monitoring be carried out to demonstrate compliance. If these arrangements became common, it would be in the interest of the various industry associations to standardize this process so as to reduce the cost of this compliance alternative option. If there is some residual risk of BMP failure to perform as well as RVBs, the agency would be justified in requiring proposed alternatives to perform better than,

[15] The agency has also had to balance the many other costs and benefits of using vegetated buffers. These considerations are discussed elsewhere in this report.

rather than as well as, the RVB alternative. This would give the agency assurance that the expected improvement in water quality will actually be achieved. The development of alternative compliance assurance mechanisms would appear to be a worthwhile area for future research.

Given the lack of sufficiently detailed geophysical information about individual sites, the lack of appropriate contractual mechanisms, and the increased costs of enforcement that would be required, DPB has found no sufficient reason to dispute CBLAD's conclusion that redesigning these regulations to allow for routine exceptions to the requirement for vegetated buffers is not warranted at this time. However, the prospect for improved geophysical information and the potential for the development for efficient assurance mechanisms argue strongly for CBLAD to give consideration to whether such flexibility could be part of some future version of these regulations.

(ii) Some economic impacts of RVBs

Up to this point, we have only discussed the direct costs of RVBs and the associated water quality benefits. There are, however, other costs and other benefits associated with requiring vegetated buffers. These arise because RVBs change the characteristics of adjacent properties and because they induce a change in human settlement patterns.

The impact of the RVB requirement may be broken down into two components. First, it reduces the supply of housing units to some extent by taking land out of the housing market. Second, the RVB requirement increases the value of land by reducing density and providing better views for people living near the water and using the water.

While a 100 foot riparian buffer may not seem like much, when the total area included in the buffer area is considered, a substantial amount of land is made unavailable for development. For every 50 miles of undeveloped shoreline or riparian bank, approximately one square mile of land is removed from the development market. Since a stream has two banks, every 25 miles of stream will see one square mile of vegetated buffer. Not all land in the buffer would have been appropriate for development, so this estimate represents the upper bound, however, even after you take this into account, a large amount of land near the waterfront will have its potential for development eliminated.

In terms of standard supply and demand analysis, the RVB rule shifts the supply curve for coastal land to the left. For a given level of demand for coastal land, this shift can be expected to increase the price of coastal land by reducing the quantity of coastal land available for development. The shift of the supply curve to the left implies a reduction in the net economic value to consumers available from owning and using coastal properties. (This measure of net economic value to consumers is referred to as *consumer surplus*.) However, the affect on landowners' producer surplus (or net economic profit) is ambiguous because it depends on the elasticity of the demand curve.[16] Not including the effect on water quality, aggregate welfare of those in the market would go down, and there could be a gain or a loss of profits to those owning land in the coastal zone because the gain in price is offset to some extent by the loss of land that can be used for development.

The second impact of the RVB requirement is to increase the amenity value of living or visiting the coastal zone. This can be represented on the traditional supply and demand graph as a shift outward of the demand curve for the land still available for development. For a given supply curve, an outward shift in the demand curve can be expected to raise the price of the good and the quantity of land developed. There is an unambiguous increase in consumer surplus and in producer surplus.

It is critically important to understand where this gain comes from. The increase in the value of coastal properties due to the RVB requirement does not come from the benefit to a developer or landowner of putting such a buffer on his or her own land. That possibility already exists and is built into the shape and position of the current demand curve. The argument is sometimes made that developers will benefit from the RVB requirement because their own land will improve in value from having a vegetated buffer. This argument is almost certainly incorrect. Since developers already have the opportunity to put such buffers in place and a clear profit motive to do so when it does increase profits, then we must conclude that either it is not really profitable to them or that developers do not read the newspaper, watch TV, read their trade publications, or talk to each other because they are clearly passing up an opportunity to make themselves richer. Since this latter possibility does not seem likely, we conclude that those

[16] Elasticity is a measure of how quickly the quantity demanded changes as the price changes. For example, if a one percent increase in price leads to a greater than one percent change in the quantity of land demanded then

vegetated buffers that would be profitable for the owner of the property on which they are placed would be put in place in the absence of this regulation.

Thus, we cannot ascribe any shift in the demand curve to increased value from placing a vegetated buffer on one's own land. It must arise from the advantage that people gain from having a buffer on everyone else's land. To use the term of art from economic analysis, there is an *external* benefit to my putting a vegetated buffer on my land. Some of the benefits of my doing so accrue to other people, and in particular, to other landowners. These external benefits are only likely to be achieved if the RVB requirement applies generally to everyone.[17]

Returning to the supply and demand analysis, we conclude that the RVB requirement must raise the price of riparian land both because it limits supply and because it increases the average amenity value of the land. Some portion of that price increase represents the impact of the increased scarcity of land and the remainder of the price increase represents the increased amenity value of the land. It cannot be determined whether there is a net gain in society to this change without much more information. It is clear that there is a significant transfer of value toward the current landowners and toward those who make the most use of the amenities of riparian properties. Those people who do not make significant use of Bay recreational opportunities but do live in the area where property values increase will be made worse off by the change. While it would require more data to confirm this hypothesis, it would not be surprising to find that the costs of this regulation fall somewhat disproportionately on the less well-off while the benefits accrue disproportionately to the relatively well-off.[18]

However, this is not quite the end of the story. Most observers would probably agree that the impact of the increased demand is greater in magnitude than the impact of the reduced supply. If that is true, then we would expect the combination of these two effects to lead to a net increase in the equilibrium quantity demanded of riparian land. Such a result works to some extent at cross purposes with the intent of these regulations because it will tend to increase development along the riparian zone. Because the riparian zone is essentially linear, this increased demand for riparian property would not only increase the population in the riparian

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demand for land would be considered "elastic." If a one percent change in price led to less than a one percent change in quantity demanded, then demand would be "inelastic."

[17] It bears repeating that we do not know whether most of the aesthetic benefits of RVBs could be achieved by much narrower buffers. This is a subject worthy of study.

zone but could also contribute to a tendency already observed in the Bay watershed for development to "sprawl" along the lines of riparian zones.

Even with these regulations in place, the increased population will put increasing pressure on water quality in the Bay. Also, if these rules do increase the tendency for development to disperse along the riparian zone, then we would expect an increase in average vehicle miles traveled and in the number of septic systems used. Airborne nitrogen from automobiles and power plants are thought to be significant contributors to the nitrogen load in the Bay watershed. (Chesapeake Bay Program, 1997; Alliance for the Chesapeake Bay, 1993) Septic fields are suspected of contributing to the nitrogen load in the Bay, but clear scientific evidence is lacking as to the extent of this contribution. The uniform application of RVBs will have some tendency to produce effects that work against the outcome intended by the agency. This is not to say that the regulations will not produce benefits, they will. However, some of the benefits may be offset by regulation induced changes in development patterns.

c) Permitted modifications of buffer areas

On non-agricultural lands, the only allowed modifications involve routine management of a fully vegetated strip. There is a great deal of uncertainty about the impact on RVB function of such practices as sight-line management, removing fallen trees, and silvicultural thinning. Under some circumstances these activities can improve buffer performance in protecting water quality and in other circumstances water quality protection is reduced. CBLAD has a research program for resolving some of these issues, but much more needs to be known before the water quality effects of various practices can be predicted with any accuracy.

Farmers are given much greater flexibility than are commercial facilities, residential developers, or individual landowners. The proposed language continues to provide that agricultural activities may encroach into the landward 50 feet of the vegetated strip. The conditions for allowing this encroachment have been clarified:

> *when at least one agricultural best management practice which, in the opinion of the local Soil and Water Conservation District Board, addresses the more predominant water quality issue on the adjacent land ¥ erosion control or nutrient management ¥ is being implemented on the adjacent land, provided that the combination of the undisturbed buffer area and the best management practice achieves water quality protection, pollutant removal, and water resource conservation at least the equivalent of the 100-foot buffer area.*

[18] This assertion is based on the income distribution of property owners.

If nutrients are the "predominant water quality issue" then the farmer must develop and implement a nutrient management plan. No specific response is required for a sediment and erosion problem, only that the Soil and Water Conservation District Board (SWCDB) must approve whatever is implemented to control erosion. Also, if the SWCDB identifies a pollution problem then the farmer must correct these problems in a timely fashion in order to be allowed to encroach on the 100 foot RVB.

In addition to the 50 foot encroachment rule, the proposed language continues to allow farmers to encroach on 75 feet of the buffer area.

> *Agricultural activities may encroach within the landward 75 feet of the 100-foot wide buffer area when agricultural best management practices which address erosion control, nutrient management, and pest chemical control, are being implemented on the adjacent land. The erosion control practices must prevent erosion from exceeding the soil loss tolerance level, referred to as "T", as defined in the "National Soils Handbook: of 1996" in the "Field Office Technical Guide" of the U.S. Department of Agriculture Natural Resource Conservation Service. A full nutrient management plan, including soil tests, must be developed, consistent with the Virginia Nutrient Management Standards and Criteria (4VAC5-15-10 et seq. of the Virginia Administrative Code).* … *Such problems requiring correction shall be reported to the local government for the purposes of follow-up and, if necessary, enforcement. In conjunction with the remaining buffer area, this collection of best management practices shall be presumed to achieve water quality protection at least the equivalent of that provided by the 100-foot buffer area.*

The difference between what is allowed on agricultural lands and non-agricultural lands is very great indeed. For there to be such a difference in treatment, it may be expected that there should be a commensurate difference in performance of BMPs as between these two land uses. The evidence for such a dramatic difference is not strong.[19] CBLAD staff has indicated that, although it is difficult to monitor and enforce BMP performance at the level of individual lots, these problems are less severe at commercial facilities and larger developments. As discussed earlier, it may be possible to craft assurance arrangements that would allow applicants on non-agricultural lands some of the flexibility offered to agricultural users.

d) Buffer area requirements for Intensely Developed Areas (IDAs)

Subsection 7 of §130 provides that, in IDAs, reestablishing vegetation in the buffer area "may not be required". The regulations require only that localities "give consideration to" requiring reestablishment of vegetation over time. The rules do not specify any circumstances

[19] CBLAD staff note that one reason for this difference is that agricultural uses do not usually result in permanent impervious cover on the land. If, indeed, this is the major difference, then the regulations could be written in a way that addresses this concern rather than, as they are now written, treat the uses differently regardless of the amount of impervious cover.

where revegetation is required, so it must be concluded that revegetation is not required in buffer areas located in IDAs. This is essentially the same as the requirement in the existing regulations. In all probability, establishing vegetation in the buffer area in IDAs would be more expensive than establishing vegetation in buffers in most other areas, and CBLAD indicates that there is evidence that vegetated buffers are not as effective in IDAs as in less developed areas. Thus, not requiring vegetation in buffer areas in IDAs would appear to be an appropriate response to the higher costs involved; to do otherwise would not be expected to produce a net economic gain.

7) Non-conformities, exemptions, and exceptions (§150)

Subsection C of this section changes somewhat the standards for granting exceptions to the requirements of Part IV of these regulations. According to CBLAD, under the existing regulations, people were granted exceptions to the zoning rules by right. CBLAD argues that this is inconsistent with the Code of Virginia which requires that the applicant demonstrate hardship status in order for an exception from zoning rules to be granted. While the language of the regulation is being changed, CBLAD staff report that localities have been using the hardship demonstration rule for some years now. Thus, this change in the regulation merely makes the language comport with current practice.

This standard for granting exemptions probably has higher compliance costs than the earlier rule. First, it increases the cost of making a successful application for a variance due to the increased procedural requirements. Second, the hardship test almost certainly precludes some activities that would have been allowed by the existing language. No data exists with which one could estimate these increased costs.

The more stringent exemption rule will result in higher water quality and other economic values associated with more tightly regulated land-use near the Bay. Since it cannot be readily determined how many cases would be affected by this change or which development projects would be affected, it is not possible to estimate the benefits that would arise from use of the more stringent exception standard. Given the lack of data, it is not possible to reliably estimate the economic value of the move from the earlier rule to the current one.

8) Comprehensive Plan Criteria (§§ 170-171)

In all probability, the changes in this section do not greatly alter the costs localities will incur in complying with the rules. However, the fine-tuning of information requirements in comprehensive plans may provide better focus for local planning efforts and, hence, improve the benefits expected from the Chesapeake Bay Preservation Act (hereinafter, the Act).

9) Zoning and Subdivision Ordinances (§§ 181-201)

This part of the rules requires that local zoning and subdivision ordinances be revised to be consistent with the Act and with the rules. As already discussed in our examination of the proposed regulations, these requirements make substantial use of specific technology standards such as minimizing impervious cover and land disturbance, preserving existing vegetation, concentrating development and increasing its density. These technology standards should be considered suspect because they may unnecessarily increase the cost of achieving the goals of the regulation: protecting water quality and other valuable environmental services provided by the Bay. Where possible, localities should be offered the possibility of proving that they have provided equivalent or greater protection of Bay environmental services by using methods not specifically enumerated in the Act or the regulations.

Technology standards may be appropriate if monitoring and enforcement problems outweigh the benefits of improved flexibility. CBLAD has argued strongly that, under current circumstances, the increased flexibility is not a feasible option. However, it would seem appropriate to begin to investigate whether mechanisms may be developed to offer localities the option of making a demonstration that an alternative approach would work to meet the ends of the Act. Shifting the burden of proof in this way would allow flexibility where the additional monitoring and enforcement costs are not too high. Under these new arrangements, localities and landowners could make proposals that include arrangements that resolve any enforcement and monitoring concerns that CBLAD might have.

The proposed regulations add requirements that are designed to ensure that landowners receive constructive notice of all restrictions and requirements that control the uses and activities of parcels of land. The regulations require plat notation of a number of provisions of the rules. It is appropriate to provide an effective mechanism for informing current and future owners of land of the regulatory restrictions affecting their land. This ensures that market transactions

involving regulated property will be carried out with full information on the part of both buyer and seller about these important land-use rules that may have a significant impact on the value of the land to the parties to the transaction. One would expect that, on average, the seller would have better information about these restrictions but would not have incentive to disclose all of the restrictions to potential buyers. Recording the restrictions on land records goes a long way toward ensuring that buyers and sellers have equal access to information concerning regulatory restrictions on land use.

Overall economic impact of the proposed regulation

In order to evaluate the overall economic impact of this regulation we would have to know what water quality and other amenities would be with and without this rule and how people would value that difference. We would also need to know what costs would be incurred because of the rule. The foregoing discussion makes it quite clear that a numerical measure of the costs and benefits of this regulation would be quite speculative.

Each step in this analysis is subject to uncertainty. The behavioral, physical and biological systems that are affected by the terms of this regulation are highly complex and many of the interactions between the various components of the system are only partly understood. For example, the response of landowners and hence housing prices to land-use restrictions has been estimated, but the estimates are subject to considerable uncertainty. This is especially true since each time a regulation is changed, the responses expected of landowners is likely to change somewhat as well. Much depends on changes in the population, the level of economic activity, and consumers' perceptions of what alternatives are available to them.

In addition to uncertainty about behavioral responses, there is great uncertainty about the effectiveness of the various effluent control strategies required in these regulations, about the physical distribution of effluents, about the biological consequences of a given temporal and geographic distribution of effluents, and about how much people value the change in biological and physical attributes of the Bay. Many of these interactions have been measured with some degree of success, and each year, more is learned. However, while the direction of many responses is fairly certain, the magnitudes are still subject to very great uncertainty.

The proposed rule is **not likely** to lead to a significant **reduction** (from the current levels) in pollutants entering the Bay although some reductions may occur over time. The largest part of the gain from these regulations will be in reducing the growth in the contribution of land use practices to the pollution load in the Bay. CBLAD claims that this program places a cap on the amount of pollutants that will enter the Bay from the regulated area. It is hard to see how this could be true. An increased number of septic connections, more residential development, any increases in agriculture and forestry activities will give rise to the potential for more pollutants entering the Bay. Vegetated riparian buffers, even where they are the most effective can only remove a percentage of the nutrients, chemicals and sediment flowing into Bay waters. Once a system of vegetated buffers are in place, then any additional growth will almost certainly lead to some increase in pollutant loads.

However, if water quality in the Bay is better with the regulation than without it, then economic benefits will flow from the land use controls. In the one study that has made an attempt to add up all of the benefits of a net improvement in water quality in the Bay, the authors of the study concluded that, in 1984, Bay users in the Baltimore-Washington region would be willing to pay up to $100 million dollars per year for a moderate improvement in the recreational services derived from the Bay. (Bockstael, McConnell and Strand, 1989) In today's dollars, this would be approximately $150 million per year. This estimate did not associate any net economic value to the commercial fisheries in the Bay since most economists would agree that there is little net economic value in the commercial catch from the currently depleted fisheries. Most, if not all, of the value of the catch is consumed by the cost of harvest. If improved management of fisheries were to result in healthier fish stocks, then improved water quality may add net economic value to the commercial catch.

In many ways, the estimate given for the value of improvements in water quality were probably somewhat conservative. They did not include the value to people outside of the study area. Nor did they include the value that some people may place on improving Bay water quality even though they do not intend to use the Bay for recreation. The study did not attempt to estimate any increase in tourism that might occur due to the improvement. Also, if the attractiveness of Bay recreation increased, investments in greater public access to the Bay might increase willingness to pay for improvements above the amount measured by the study.

Naturally, the estimate given combines benefits that fall mostly to residents of Washington, D.C. and Maryland. They do give a range of values that indicates the general magnitude of economic gain that may be earned in Virginia from improvements in water quality in the Bay. To develop a Virginia-specific estimate would require a study of Virginia Bay users similar to the one used to develop the estimate just discussed.

Costs of compliance with this rule are likely to be considerable. These costs include: increased farm management costs, increased administration costs to localities,[20] increased scarcity of land near the Bay,[21] possible increased costs due to a greater tendency for development to "sprawl" along the riparian zone, higher costs to homeowners for septic services and other requirements, and reduced profits to developers due to explicit compliance costs and lost development opportunities. The economic costs of these regulations almost certainly add up to millions of dollars per year, although a precise estimate is not possible given the available data.

Another relatively intractable source of uncertainty in estimating the net economic impact of these rules is due to our limited knowledge about the physical affect of the rules on water quality. The performance of vegetated riparian buffers is not well understood and varies widely from site to site. BMP substitutes for buffers cannot be expected to perform well without significantly increased expenditures on enforcement and monitoring. The impact of septic fields on water quality is not clearly understood. The impact of a given reduction of nutrients on the growth of submerged aquatic vegetation is poorly understood. The list of physical and biological interactions about which we have limited understanding is quite long.

Since we do not know with any precision what physical and biological responses to expect from these rules, calculating the net economic impact of the proposal is not yet possible. The most we can say is that the services of the Bay are very valuable and that the land use controls specified in this rule, while quite expensive, will help preserve water quality in the Bay. In order to maximize any expected net gain from these regulations, CBLAD should be somewhat

[20] Some of these costs are shared by CBLAD through its grant program. This does not change the level of costs, but it does shift the costs away from the localities where most of the benefits accrue to the general taxpayer in the state. It is not within the scope of this report to assess the appropriateness of having taxpayers from western Virginia pick up the tab for part of the expense of managing land use in localities in the Bay watershed.

aggressive in finding ways to reduce compliance costs. This will give Virginians their best chance of achieving a positive economic outcome from land use controls in the Bay region.

Businesses and entities affected

Since land prices will rise due to these regulations, all businesses and economic entities in the regulated region will be affected by the rules. Those who owned (at the time this regulation was implemented) property in the area close to the amenities of the Bay will benefit from both increased scarcity of their land and increased amenity values because the value of their land will rise. People who do not make recreational use of the Bay and people who are renters will probably suffer a net loss because their costs will be higher but without much prospect of offsetting benefits.

Increases in land scarcity transfers wealth from future generations of landowners to present generations of landowners by increasing the current value of land in the Bay region. This occurs since much of the expected future gains in amenity values are capitalized into the value of property near the Bay. The price of land on the real estate market is equal to the present value of the risk adjusted stream of future benefits. If the expected amount of future benefits rises, the price of the land will respond very quickly. Thus, the current owner receives most of the economic gain from an increase in the future amenity value of a piece of land.

Localities particularly affected

The Counties of Accomack, Arlington, Caroline, Charles City, Chesterfield, Essex, Fairfax, Gloucester, Hanover, Henrico, Isle of Wight, James City, King George, King and Queen, King William, Lancaster, Mathews, Middlesex, New Kent, Northampton, Northumberland, Prince George, Prince William, Richmond, Spotsylvania, Stafford, Surry, Westmoreland, and York, and the Cities of Alexandria, Chesapeake, Colonial Heights, Fairfax, Falls Church, Fredericksburg, Hampton, Hopewell, Newport News, Norfolk, Petersburg, Poquoson, Portsmouth, Richmond, Suffolk, Virginia Beach, and Williamsburg are required to comply with the provisions of this regulation. Thus, most of the direct costs of the regulation will fall primarily on these localities.

[21] Keep in mind that the increase in property values due to improved amenities is already accounted for in the study of the benefits of improved water quality. The increased scarcity cost of land must be counted on the cost side of the

Other localities will also feel varying affects from this regulation. Areas near the Bay will see an increase in property values and possibly tourism revenues. Other regions of the state will be more likely to see a net loss from this regulation since people in these areas make less use of Bay amenities but pay for some of the improvements through their tax revenues.

The benefits of the regulation may be expected to accrue more to the regulated localities than to others, due to their proximity to the Bay. A substantial portion of this benefit will be capitalized into land values and will accrue mostly to the current generation of landowners. Thus, some of the immediate impact of the regulation may be seen as a transfer between current and future residents of these localities.

This last point may bear some explanation. Suppose that I currently own a piece of riparian land in the Bay region. If these regulations are expected to increase the quality of water in the Bay at some point in the future, then the rental price of the land at that future date will be higher than it would otherwise have been. As the current owner of the land, I can use this fact to charge a higher price for my property when I sell it. The overall impact of this market activity is that the current owner can extract in his or her sale price much of the increased value that would otherwise accrue to someone in the future.

Projected impact on employment

The net impact of this regulation on employment in Virginia is unknown. There will be losses due to the increased scarcity of land and gains from any increase in tourism resulting from improved water quality in the Bay. The net impact cannot be estimated at this time.

Effects on the use and value of private property

The value of many parcels near the Bay may increase in value as a result of this regulation due to increases in amenity values and due to increased scarcity of riparian land. Also, the revenues of commercial establishments serving the area near the Bay will tend to increase, but, in the long run, as profits from commercial establishments increase, land rents will rise and will absorb a substantial share of any increased profits in commercial establishments.

ledger.

Summary

This regulation comprises a set of comprehensive land use rules designed to reduce the water quality impact of development in the Chesapeake Bay watershed. The mechanism for protecting water quality is to regulate the use and development of certain lands in the Bay watershed where such use and development would be expected to result in deterioration of water quality in the Bay or its tributaries. Much of the regulation is accomplished by establishing specific standards for where certain types of development may take place and how that development should be carried out.

We have noted a number of areas where it may be possible for CBLAD to consider offering localities and applicants increased flexibility without placing water quality at risk. In the case of vegetated riparian buffers, there will almost certainly be cases where limiting the flexibility of riparian landowners in substituting BMPs for vegetation may come at the expense of water quality or economic efficiency or both.

CBLAD's justification for limiting flexibility is that CBLAD and the localities lack the resources to effectively enforce more flexible rules since those rules would entail significantly greater monitoring and enforcement costs. Due to the relatively limited funding available for monitoring and enforcement, it is difficult to make any definitive inferences about how effective the provisions of the regulation have been to date.

One way of granting increased flexibility in a situation where public monitoring and enforcement efforts are limited is to give localities and applicants the opportunity to provide for the monitoring and enforcement efforts themselves. DPB encourages CBLAD to consider the development of innovative compliance assurance mechanisms that would make it possible for the agency to allow increased flexibility at the local level. This may be done in such a way that the alternative compliance plan will provide the authorities with sufficient assurance that water quality will be as good as or better than what could be achieved by the methods specified in the regulation. This strategy has much to recommend it. Localities and applicants will only seek the flexibility if it will lower costs, so any use of alternative methods will be sure to lower compliance costs. Also, the flexibility gives all parties continuing incentives to seek out better and cheaper methods for protecting water quality. CBLAD could take the lead in helping localities generate innovations in the area of assurance mechanisms.

We are led to the conclusion that too little is known to estimate how much of a reduction in non-point source emissions will result from the implementation of this regulation. Nor do we have the data necessary to estimate the costs of compliance. Estimating benefits and costs is extremely difficult in this instance because the changes in land-use patterns are so large that significant transfers of wealth are taking place, and it is very difficult to disentangle the wealth transfers from changes in net economic value. Given this uncertainty, CBLAD should make every effort to minimize compliance costs and to encourage private interests to find ways of lowering the costs of protecting the Bay.

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