REPORT OF THE JOINT
SUBCOMMITTEE STUDYING

The Problems Associated with Nutrient Enrichment and Related Water Quality Standards in the Waters of the Commonwealth

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

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Report of the
Joint Subcommittee Studying Nutrient Enrichment
in the Waters of the Commonwealth
To
The Governor and the General Assembly of Virginia
Richmond, Virginia
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To: Honorable Gerald L. Baliles, Governor of Virginia,
and
The General Assembly of Virginia

I. INTRODUCTION

The 1985 General Assembly adopted SJR 116 which created a joint subcommittee to study the problems associated with nutrient enrichment and related water quality standards in the waters of the Commonwealth. The subcommittee was charged with examining:

1. the reductions in phosphorus loads which should be achieved in each river;

2. the nutrient effluent standard or standards which should be established to accomplish such reductions;

3. short-term and long-term costs and benefits of various technologies available for meeting the applicable standards;

4. the responsibility of state and local governments to pay for capital, operation and maintenance costs of phosphorus removal or other treatment requirements in excess of federal standards; and

5. financing alternatives for water quality improvements necessary to meet effluent standards and correct other nutrient problems.

The study was initiated in recognition of the fact that the quality of Virginia's waters, especially those of the Chesapeake Bay system, are being affected by the presence of excessive amounts of nutrients, particularly phosphorus. At its first meeting, the subcommittee received detailed descriptions of the nature and scope of the nutrient problem in Virginia's waters. It became evident that any analysis of the problem should not be limited to phosphorus but should also consider the effects of other nutrients such as nitrogen on water quality.

The subcommittee was informed of present state efforts to control the flow of nutrients from both point sources (i.e. sewage treatment plants) and nonpoint sources (i.e. agricultural, urban, and forest runoff). The subcommittee felt it was essential that the Commonwealth begin to consider establishing some form of nutrient standard for all the Chesapeake Bay tributaries showing evidence of degradation attributable to the presence of excessive amounts of nutrients. The subcommittee considered two approaches to standard setting to obtain necessary reduction goals: establishing specific effluent standards versus establishing some form of in-stream water quality standard.

Various technologies are available to reduce the presence of phosphorus and nitrogen. The cost effectiveness of these technologies must be carefully evaluated before committing the Commonwealth to a long-term nutrient reduction strategy. The subcommittee was presented with a range of strategies and the advantages and disadvantages of each.

Financing must be provided for the advanced wastewater treatment technologies necessary to achieve nutrient reduction in Virginia's waters. The subcommittee's approach to the financing issue was to review the entire wastewater financing question rather than focus specifically on nutrient control. In taking this more general approach, the subcommittee sought answers to the following questions:

- What are the costs of having clean water in Virginia?

- What level of government should be responsible for those costs?

- What financial alternatives are available to meet these costs?

Although much of the study has focused on the control of nutrients from point sources, the subcommittee feels equal emphasis needs to be placed on the impact of nutrients originating from nonpoint sources. The subcommittee anticipates continuing its work during the upcoming year, concentrating on the role of nonpoint sources, and how best to integrate the various point and nonpoint nutrient control strategies into a comprehensive approach.

II. BACKGROUND

A. DESCRIPTION OF NUTRIENT PROBLEM

The demands of population growth have led to increased discharges from industrial and municipal sources. These point sources of pollution, combined with runoff from urban, agricultural, and forest land (nonpoint sources), have resulted in excessive amounts of certain nutrients in some of Virginia's waters. While nutrients such as phosphorus and nitrogen are needed for the growth of phytoplankton (algae), which is essential to the aquatic food chain, problems develop when an oversupply of these nutrients stimulates algae growth. Excessive amounts of algae diminish water clarity, and as this plant material begins to decay, dissolved oxygen is depleted from the water faster than it can be replaced. The oxygen content of the water then reaches levels too low to support the survival of fish or other living organisms important to the "health" of the water. The most apparent consequence of this excessive enrichment is the presence of an algal bloom.

In freshwater systems, phosphorus is generally the critical or limiting nutrient with respect to total algal production. Estuarine systems like the Bay and its tributaries, however, are more complex. In the tidal fresh segments of Bay tributaries, the potential for phosphorus limitation exists year round. In the more saline portions of the tributaries and in the middle and lower Bay either nitrogen or phosphorus may be limiting depending upon the location in the estuary and/or the time of year. It is important, therefore, that nutrient control strategies address both nitrogen and phosphorus.

B. NUTRIENT PROFILE OF RIVERS

In 1983, the EPA Chesapeake Bay Program published its findings on the Bay. Included was a review of the historical trends in nutrient enrichment in the various regions of the Bay. The areas most affected by nutrient enrichment in Virginia include the western shore tributaries: the Potomac River Embayments and the Rappahannock, York and James Rivers. The tidal fresh segments of these rivers are considered moderately to highly enriched while the lower portions of the tributaries exhibit moderate to low enrichment. The James River and Potomac Embayments are dominated by point source nutrient inputs (primarily sewage treatment plants) and the York and Rappahannock by non-point source loadings. The lower main Bay area appears to be relatively unaffected by nutrient enrichment at this time. It is apparent that in Virginia, nutrient control efforts should focus on the tributaries.

1. Potomac River (Virginia Portion)

Although the majority of the basin is largely rural, the Potomac River's nutrient problems are mainly due to municipal sources and a lesser degree upland and waste runoff. Sixteen major sewage treatment plants (STPs) with a total design flow of 190 million gallons per day, plus nine major industrial plants discharge into the river. Since the 1970s, efforts have been made to upgrade the nutrient removal capability by the STPs. Presently, nine of the STPs are equipped with phosphorus removal technology.

The point sources contribute 61% of the phosphorus load while nonpoint sources contribute a majority (64%) of the nitrogen load. High levels of nitrogen and moderate levels of phosphorus are found in the upper estuary, while in the lower estuary nutrient levels are relatively low. By the year 2000, if no additional nutrient control measures are put into place, it is estimated that nitrogen loads will increase by 7% and phosphorus by 10%. Thus, since many of the STPs in the basin already employ advanced treatment for phosphorus, the greatest potential for reduction seems to be in nonpoint sources.

The Potomac estuary has a long history of algae bloom during summer months. Chlorophyll levels in the tidal fresh portions of the estuary and Virginia embayments have reached 100 ug/l and during bloom conditions have exceeded 250 ug/l.

2. Rappahannock River

The Rappahannock River basin is almost entirely rural, with Fredericksburg being the only

major city. It is currently the least polluted of the Bay's major tributaries, but with increasing urbanization is subject to deterioration of water quality.

Nutrient loadings are primarily from nonpoint sources which contribute 61% of the phosphorus load and 87% of the nitrogen load. Trend analysis done by the State Water Control Board indicates that phosphorus concentrations are increasing and by the year 2000, phosphorus will have increased by 16% compared to 2% for nitrogen, if no additional nutrient control measures are undertaken. For the period 1977-1980, high levels of phosphorus and moderate levels of nitrogen were found in the tidal fresh region. Since this period, there appears to be a slight decrease in the phosphorus level with no change in the nitrogen level.

It should also be noted that chlorophyll levels are the highest in the tidal fresh area, approaching 30 ug/l in 1984-1985. The lower portion of the river is characterized by lower chlorophyll levels, less than 15 ug/l.

3. York River

Like the Rappahannock, the York has not been significantly affected by man-made sources. The addition of the Hampton Roads Sanitation District (HRSD)-York River Sewage Treatment Plant has resulted in an increase in the amount of nitrogen and phosphorus discharges over 1980 levels. Currently, nonpoint sources contribute 75% of the nitrogen load and 45% of the phosphorus load. By the year 2000, nitrogen is expected to increase 11% and phosphorus by 58% when compared to 1983 load levels if no additional control measures are instituted.

The tidal fresh portion above West Point in the recent past has experienced moderate levels of phosphorus and nitrogen. According to the State Water Control Board, for the period 1984-1985, there appears to be a reduction in the level of phosphorus and no change in nitrogen levels. The lower portion of the river has experienced a similar trend of somewhat lower levels of phosphorus with no change in nitrogen levels.

Chlorophyll levels in 1984-1985 were below 20 ug/l for the transition and lower estuary zones. No data is available for the tidal fresh zone.

4. James River

The James River basin drains about one quarter of Virginia's total land area. Although agricultural in some areas, the river is characterized by extensive urban development at the fall line and around Hampton Roads. A large number of major municipal treatment plants (20) with a total design flow of 325 million gallons per day, as well as 30 major industrial dischargers, are located within the river basin.

Above the fall line, nonpoint sources contribute 91% of the nitrogen load and 64% of the phosphorus load. In the estuary portion, point sources contribute 79% of the nitrogen and 93% of the phosphorus loads. High levels of both nitrogen and phosphorus are found in the James between Richmond and the mouth of the Chickahominy River. The lower portion of the river is characterized by moderate levels of nitrogen and low levels of phosphorus. If no additional nutrient initiatives or control strategies are implemented, phosphorus levels are expected to increase by 32% and nitrogen by 22% by the year 2000.

Chlorophyll levels are the highest in the tidal fresh portion near the confluence of the Appomattox and James Rivers and just below Hopewell. The highest measured value was 75 ug/l. The transition and lower estuary zones all are below 20 ug/l. The 1981 algae bloom above Richmond resulted in chlorophyll levels of 121 ug/l in the upper portions of the tidal fresh zone.

III. CURRENT EFFORTS TO CONTROL NUTRIENTS

A. POINT SOURCE

1. State Water Control Board (SWCB)

The State Water Control Board has the responsibility for issuing discharge permits for effluent originating from point sources of pollution such as sewage treatment plants and industrial discharges. While there are no statewide standards for controlling the level of nutrients in the water, there are effluent standards limiting the level of such nutrients as nitrogen and phosphorus in three specific areas. In June 1971, the Potomac Embayment Standards were adopted. These limit the amount of phosphorus in the effluent being discharged into the Potomac River embayments from Jones Point to the Route 301 bridge. In

July of the same year, a special standard was established as part of the Occoquan Reservoir Policy. This nutrient standard applies to plants discharging into the Occoquan Watershed. In the area of the Chickahominy Watershed above Walker's Dam, a special nutrient standard was established in July, 1966 for all discharges.

The Potomac Embayment Standard and the Occoquan Policy have had the greatest impact on discharges in their designated areas. The following facilities have each installed phosphorus removal technologies which are currently being operated. An asterisk indicates those facilities with nitrogen removal technologies installed, but none are in routine operation. In the case of the upper Occoquan Sanitation Authority plant, its nitrogen removal technology only becomes operational when the nitrate levels are above the safe level for drinking water purposes. For the two Potomac Embayment plants, operation of the nitrogen removal facilities has been deferred until the completion of the re-evaluation studies of the Embayment Standards.

NAME	SIZE (MGD)
Arlington Co.*	30.0
Alexandria Sanitation Authority	54.0
Fairfax Co. - Little Hunting Creek	6.6
Fairfax Co. - Lower Potomac*	36.0
Upper Occoquan Sanitation Authority*	15.0
Dale Service Corporation (Two)	4.0
	2.0
Prince William Co.	12.0
Quantico Marine Base	2.0
Stafford Co. - Aquia	3.0

2. Demonstration Projects for Nutrient Removal

The 1985 General Assembly appropriated $360,000 for the installation of pilot phosphorus removal technology. Current plans call for projects to be approved in December, 1985 with start-up of the projects in early 1986. The demonstrations will last at least one year.

3. Virginia Initiative Plant - Hampton Roads Sanitation District (HRSD) Program

The Hampton Roads Sanitation District has proposed an innovative concept for upgrading its Lamberts Point treatment plant in Norfolk with biological nutrient removal. The new facility, to be known as the Virginia Initiative Plant (VIP), would be sized initially at 40 MGD and provide for phosphorus and nitrogen removal by using an emerging technology, biological nutrient removal. Cost estimates for the facility are projected at slightly more than 2% higher than the cost to construct and operate a conventional secondary treatment plant which would provide minimal nutrient removal. HRSD is currently operating a pilot plant facility at its Lambert's Point site to develop design criteria and operating experience for the proposed VIP facility.

B. NONPOINT SOURCE

According to an EPA study,FN#1 67% of the nitrogen and 39% of the phosphorus loads in the tributaries are from nonpoint sources. In an effort to reduce agricultural and urban runoff, the Division of Soil and Water Conservation has developed the Chesapeake Bay Nonpoint Source Pollution Control Program. The Virginia General Assembly authorized $975,000 for the program's first year of operation. This, combined with the U.S. Environmental Protection Agency's contribution of $875,000, brought the total funding level for FY 1984-1985 to $1,850,000. This amount will be increased to $3,600,000 for FY 1985-1986 with $1,425,000 coming from state sources and $2,175,000 from EPA.

The program's goal is to "increase the implementation of BMPs by farmers and land developers within the Chesapeake Bay Drainage Basin, thereby reducing NPS pollution potential to the Bay." The greatest potential for reducing nutrient loadings from nonpoint sources lies with the agricultural Best Management Practices (BMPs) Cost Sharing Program. This program provides financial assistance to farmers who implement such practices as no-till farming, grassed filter strips, cover crops, contour farming, animal waste systems, etc. It is targeted specifically to those areas dominated by agricultural pollution sources where the greatest potential for water quality improvements exist. Since the program's inception, 1,100 farmers have participated benefitting 43,200 acres. As a result, 43,000 pounds of phosphorus are being contained on farm

land, some of which would otherwise surely enter the Bay and its tributaries.

The Division has also established education and research demonstration programs. The objective of these programs is to show farmers the economic and water quality benefits of various BMP practices.

In order to target the limited resources to areas where such practices would do the most good, the Division is presently documenting the areas of greatest potential pollution. During FY 1984-1985, a computerized geographic information system (VIRGIS) was developed which will provide analyses of these potential pollution areas.

Urban nonpoint pollution of the Bay is an area of growing concern. There are currently no state regulations dealing with the quality of urban storm water other than the Erosion and Sediment Control Program. One reason for the apparent lack of programs, according to the Division of Soil and Water Conservation's Annual Report , is the lack of data on the effectiveness of urban BMPs. One such demonstration program which will provide much needed data is located at a Prince William County parking lot. Porous pavement has been used to prevent run-off by allowing water to filter through to the ground below.

The subcommittee received testimony from the Division of Soil and Water Conservation that the BMP program is as cost effective as the point source programs. The cost of both these programs is approximately $5-$10 per pound of nitrogen and phosphorus removed.

C. RESEARCH

The Virginia Institute of Marine Science (VIMS) is undertaking a two-year, $100,000 study, financed by the Council on the Environment, to identify whether nutrients, phosphorus or nitrogen stimulate phytoplankton (algal) production in the lower Chesapeake Bay. The project involves pumping water from the York River into twelve tanks simulating conditions in the river with various combinations of phosphorus and nitrogen. Comparisons are being made of the algae growth in each sample tank while taking into account seasonal changes. The study is scheduled for completion in 1987.

IV. ESTABLISHING NUTRIENT STANDARDS

A. PRESENT STANDARDS

There are no national criteria for limiting those nutrients which contribute to excess aquatic growth (eutrophication). A majority of the states have developed some narrative or qualitative statement concerning nutrient enrichment. Virginia has adopted a general standard which, while not specifically referencing the problem of nutrient enrichment, does state that

> "All State waters shall be free from substances attributable to sewage, industrial waste, or other waste in concentrations, amounts, or combinations which contravene established standards or interfere directly or indirectly with reasonable, beneficial uses of such water or which are inimical or harmful to human, animal, plant, or aquatic life. Specific substances to be controlled include, but are not limited to: floating debris, oil, scum, and other floating materials; toxic substances, substances that produce color, tastes, turbidity, odors, or settle to form sludge deposits, and substances which nourish undesirable or nuisance aquatic plant life. Effluents which tend to raise the temperature of the receiving water will also be controlled."

According to a 1982 study by the Washington Metropolitan Council of Governments, approximately fifteen states have adopted numerical nutrient standards to deal with problems of eutrophication.[2] A majority of these states have established a standard for phosphorus while a minority have established a numerical standard for nitrogen.

B. EFFLUENT STANDARD V. INSTREAM WATER QUALITY STANDARD

Senate Joint Resolution 116 requests the subcommittee to examine what nutrient effluent standard(s) should be established in order to avoid the effects of excessive enrichment. In the subcommittee's discussion, it became evident that nutrient concentrations are important only in relation to the plant growth that is stimulated by these nutrients. Therefore, the subcommittee did not limit itself solely to an examination of nutrient effluent standards but also considered chlorophyll concentrations in the tributaries as an indicator of the degree of nutrient enrichment. Recent scientific studies support the linkage between the algal densities (chlorophyll concentrations) and the degree to which a system meets or does not meet the needs of the various users of the estuary. The subcommittee heard testimony on the merits of nutrient

effluent standards versus the development of an instream water quality indicator such as chlorophyll. The merits of basin by basin, regional or statewide standards were also presented to the subcommittee.

Mathematical modeling projects are underway to help predict water quality conditions which will exist for a given set of nutrient inputs in the tributaries and main stem and the Bay. The first of these may be completed within three years. These models can provide part of the basis for adopting specific standards. It should be noted that while predictive models are commonly used in water quality management, water quality modeling is an expensive, time consuming, and extremely complex process producing a usable but not 100% accurate management tool.

C. LEGAL CONSTRAINTS

During the joint subcommittee's deliberations this year, questions arose as to the legal authority necessary for establishing nutrient control standards.

Generally, the questions can be stated as follows:

1. What is the basis and extent of the General Assembly's authority to impose nutrient limitations in the waters of the Commonwealth?

2. Does the State Water Control Board (SWCB) have sufficient authority based upon current statutes and regulations to establish more specific nutrient control standards?

3. Assuming the SWCB has the authority to impose particular nutrient control standards, what are the limitations on their exercise of such authority?

1. Authority of General Assembly to Limit Nutrients

The power of the General Assembly is limited only by the state and federal constitutions. Commonwealth V. Henry, 110 Va. 879 (1909).

The Virginia Constitution contains Article XI entitled "Conservation," and that article states in part "....it shall be the Commonwealth's policy to protect its atmosphere, lands, and waters from pollution, impairment, or destruction, for the benefit, enjoyment, and general welfare of the people of the Commonwealth." Virginia Constitution Article XI, §1. Section 2 of the same article authorizes the General Assembly to take such actions as necessary to carry out this policy.

In light of this broad Constitutional authority, it would appear that the General Assembly could set a goal or a standard for nutrient reduction in Virginia's waters as a police power responsive to section 2 of Article XI.

The rationale for requiring such a standard by law is to further the public welfare of all citizens of the Commonwealth. The only limitation in this regard would be that the action undertaken by the General Assembly must have a real, substantial relation to the protection of water quality and that they not impose an unusual or unnecessary restriction on the lawful use of property. Bowman v. Virginia State Entomologist, 128 Va. 358,371 (1970).

There is little doubt that the General Assembly has the power to enact legislation which would set a reasonable nutrient limitation standard in state waters. However, the legislature has delegated the responsibility for managing the quality of Virginia's waters to the State Water Control Board.

2. Authority of State Water Control Board to Limit Nutrients

The State Water Control Law states in part, that it is the public policy to restore all state waters to "such conditions of quality that any such waters will permit all reasonable public uses..." and to "reduce existing pollution" (Va. Code, § 62.1-44.2).

To achieve this, the SWCB is given the power to adopt water quality standards in § 62.1-44.15(3) of the Code. The Board, however, is restricted in its assessment of potential standards in that it must consider, among other factors, "the economic and social costs and benefits which can reasonably be expected to obtain as a consequence of the standards..." Va. Code, § 62.1-44.15(3)(a). Because of this requirement, and due to the fact that the Board's authority comes entirely through legislative delegation, the standards set by the Board must be "reasonable, practicable of attainment, based on a fair weighing of the economic and social costs and benefits involved, and of uniform application to all affected parties similarly situated." Commonwealth v. County Utilities Corp.; 223 Va. 534,546 (1982).

The Board currently has nutrient removal requirements in specific areas such as the Potomac embayments.[3] However, there are no generally applicable water quality standards for nutrients and no general effluent limitations or other statewide requirements for nutrient removal.

Based on statutory language and the focus of the general standards set out by the Board, the Board clearly has the authority to establish nutrient control standards. However, once a standard is set, there may be challenges by individuals, industry, or localities as to the legality of those standards based on their reasonableness, how specific they are, and how and where they are applied.

3. Limitations on the Exercise of State Water Control Board Authority

Any nutrient standard adopted by the Board should be economically and technically and legally feasible. In order to justify the setting of the standard in the first place, the Board should have strong scientific evidence that the proposed standard will directly contribute to the solution of the problem.

However, in 1971, the General Assembly enacted legislation to limit the authority of the State Water Control Board as follows:

> "§ 62.1-44.15:1. Limitation on power to require construction of sewerage systems or sewage or other waste treatment works.—Nothing contained in this chapter shall be construed to empower the Board to require the State, or any political subdivision thereof, or any authority created under the provisions of § 15.1-1241, to construct any sewerage system, sewage treatment works, or water treatment plant waste treatment works or system necessary to (1) upgrade the present level of treatment in existing systems or works to abate existing pollution of state waters, or (2) expand a system or works to accommodate additional growth, unless the Board shall have previously committed itself to provide financial assistance from federal and state funds equal to the maximum amount provided for under § 8 or other applicable sections of the Federal Water Pollution Control Act (P.L. 84-660, as amended), or unless the State or political subdivision or authority voluntarily agrees, or is directed by the Board with the concurrence of the Governor, to proceed with such construction, subject to reimbursement under § 8, or other applicable sections of such federal act.
>
> The foregoing restriction shall not apply to those cases where existing sewerage systems or sewage or other waste treatment works cease to perform in accordance with their approved certificate requirements.
>
> Nothing contained in this chapter shall be construed to empower the Board to require the State, or any political subdivision thereof, to upgrade the level of treatment in any works to a level more stringent than that required by applicable provisions of the Federal Water Pollution Control Act, as amended."

The General Assembly may want to review the appropriateness of such a statute in relation to the Virginia Water Resources Revolving Fund.

V. NUTRIENT REMOVAL: COSTS/BENEFITS OF VARIOUS TECHNOLOGIES

Municipal wastewater treatment plants currently must meet a minimum level of treatment which is defined by the U.S. Environmental Protection Agency as "secondary treatment". Some removal of nutrients (phosphorus and nitrogen) also results from the conventional secondary treatment processes.

In areas where nutrient enrichment is a problem the levels of phosphorus and nitrogen may need to be further reduced. The subcommittee received testimony from staff of the State Water Control Board as to the alternative nutrient removal technologies available to municipal treatment plants and the advantages and disadvantages of each.

A. Phosphorus removal technologies

- simultaneous precipitation - In this process chemicals are added directly to the existing treatment units. Phosphorus is removed along with other wastewater pollutants.

Advantages: least costly of the chemical processes, quick implementation time (12-18 months), least construction needed.

disadvantages: sensitive to operational problems, the units might need expansion, increase in operation and maintenance cost, may restrict sludge processing and disposal options.

- post precipitation - In this process chemicals are added following the existing treatment.

Phosphorus is removed and separated from other wastewater pollutants.
advantages: reliably meets effluent limits, flexibility in operation, flexibility in sludge processing and disposal (two separate sludges).
disadvantages: longer implementation time (3-5 years), higher cost due to larger scale construction, increase in operation and maintenance cost (chemical sludge handling).
- biological phosphorus removal - In this process conventional biological treatment is modified so that phosphorus removal is increased from 15-20% to 70-85%. It does require special design for the treatment units.
advantages: no chemicals are used, less sludge is produced, potential for low operating costs.
disadvantages: relatively new and experimental technology, difficult process to operate under certain conditions.
B. Nitrogen Removal Techniques
- biological nitrification/denitrification - This process involves the use of conventional biological treatment followed by a nutrification and a denitrification stage
advantages: high percentage of nitrogen removed, relatively stable operation, each process can be separately optimized.
disadvantages: high capital and operation and maintenance costs, large number of unit processes to operate, chemicals such as methanol are required, temperature sensitive.
- breakpoint chlorination - this involves adding enough chlorine to oxidize the nitrogen in the wastewater to nitrogen gas.
advantages: high efficiency, disinfection achieved, relatively low capital cost, little space is required.
disadvantages: high operation and maintenance costs, potential for chlorine toxicity requiring dechlorination, used primarily in conjunction with other nitrogen removal processes, safety concern due to large amounts of chlorine.
- ion exchange - In this process highly treated effluent is passed through a bed of exchange material where nitrogen is removed from the wastewater.
advantages: high efficiency, insensitive to temperature fluctuations, can include nitrogen recovery for reuse as fertilizer.
disadvantages: complex operation, high capital and operation and maintenance cost
- biological nitrogen removal - Using this approach conventional biological treatment is modified so that nitrogen removal is increased from 10-20% to 75-80%. It requires a special design in order to combine removal processes into a single process.
advantages: no chemicals, potential for low operating cost.
disadvantages: relatively new technology, lower nitrogen removal than nitrification denitrification system, difficult process to operate.

The addition of phosphorus and/or nitrogen removal at a municipal wastewater treatment plant may require significant capital expenditures and increases in plant operating costs. The following tables (in Appendix A) are presented to provide a comparative analysis of the costs of installing and operating the nutrient removal technologies previously discussed. Table 1 presents costs estimates for adding nutrient removal technologies at a one million gallon per day (MGD) treatment facility which would serve approximately 8,300 persons.

Table 2 presents cost estimates of one alternative scenario to demonstrate the range of resources that would be needed in the Chesapeake Bay Basin if nutrient removal were required. Under this scheme phosphorus removal would be installed at nine facilities in the tidal fresh water portion of the Bay tributaries (where phosphorus is considered the limiting nutrient) and nitrogen removal would be installed at 25 facilities in the lower estuary higher salinity portions of the Bay tributaries (where nitrogen is considered the limiting nutrient.

The costs presented in these tables are considered preliminary planning figures. Actual final costs would vary based on local conditions at each treatment plant site. For comparison purposes, current average household monthly user fees in metropolitan areas of Virginia range from $10 to $14 per month.

Several conclusions can be drawn from an analysis of the costs and benefits of the various nutrient control technologies. First, there are a number of these technologies that are effective in limiting the level of nutrients being discharged from point sources. Second, the technology to be used at a specific plant is a case by case decision based upon plant size, type of existing treatment, effluent limits, and location. While some emerging technologies offer low cost alternatives which hold great potential for wider use in the future, the present cost of removing nitrogen is almost prohibitive.

VI. FINANCING ISSUES AND OPTIONS

Rather than concentrate on the specific issue of financial assistance for nutrient removal the

subcommittee chose to analyze the entire scope of wastewater financing. Senate Joint Resolution No. 116 directed the subcommittee to examine (i) the responsibility of state and local governments to pay for capital, operation and maintenance costs of phosphorus removal or other treatment requirements in excess of federal standards; and (ii) financing alternatives for water quality improvements necessary to meet effluent standards and correct other nutrient enrichment problems. The subcommittee felt that a comprehensive financial assistance mechanism would be the best approach to the problem. However, within this broad financial framework, it is important to incorporate a procedure for establishing priorities. The State Water Control Board could provide necessary funds for the removal of phosphorus and nitrogen as appropriate.

A. DESCRIPTION OF VIRGINIA'S WASTEWATER TREATMENT PROGRAM

Virginia's wastewater treatment program is designed to protect and enhance the quality of its water resources and improve the environment in general. The existing program, administered under both state and federal law, mandates the establishment of water quality standards and the issuance, monitoring and enforcement of National Pollutant Discharge Elmimination System (NPDES) permits for all discharges of waste into state waters. These permits contain conditions and limitations on the discharge of wastewater to meet minimum treatment levels imposed by the federal Clean Water Act.

A significant financial obligation is placed upon localities which must meet the various federal requirements. Financial assistance has been provided by the Commonwealth and the federal government. For the period 1958 to 1983, more than $1.4 billion was expended in Virginia for the construction of wastewater treatment facilities. Of this, 70% ($980 million) was provided by EPA under its Construction Grants Program. These funds, in the form of grants to localities, support a percentage of the projects eligible costs. The federally-supported percentage has varied over the years and has recently been reduced to 55%. It appears now that federal financial support will be terminated by 1994. Termination of financial assistance would leave Virginia localities faced with meeting 100% of the costs of their remaining needs.

The SWCB projects the need for $2 billion by the year 2000 for Virginia's comprehensive wastewater treatment program. Funds will be needed for five categories of treatment.

1. Secondary treatment, a minimum level which must be maintained by all treatment facilities, generally ensures that streams remain unpolluted in order to support aquatic life, recreation, and other beneficial uses.

2. Advanced treatment is a more stringent level requiring the reduction of additional pollutants, sometimes including nitrogen and phosphorus.

3. Infiltration/inflow deals with the repair or elimination of sources of water to a sewer line other than wastewater.

4. Collector systems and interceptor lines include the pipes used to collect and transport wastes to treatment plants.

5. Combined sewer overflow (CSO) is a problem which is addressed by the installation of separate sewer lines to collect stormwater in areas which currently have a single collection and conveyance system for both stormwater and wastewater.

B. FINANCING ALTERNATIVES

1. Grants to Localities

One approach to financing these wastewater treatment systems is through state grants to localities. This option allows the State to control the wastewater treatment facilities to be funded including: the establishment of priorities; the eligible costs; and the amount and type of state support. While a locality would need to finance less of the cost of its facility, the state would be faced with providing significant revenues to support the program. This approach requires a continued infusion of funds by the state because grant funds are not repaid. Grant programs cannot meet the test of a long-term financing mechanism, but in hardship situations, may be the only way for a locality to meet its needs. Maintenance of a hardship grant program would not require large appropriations, but could help needy localities provide adequate wastewater treatment.

2. Loans

Loan programs fall into two major categories: direct and indirect assistance. Under direct

assistance, one option is a state operated and funded loan program. The state would still have control over use of the funds which would eventually be repaid and made available for re-use. Operation of a loan program would increase administrative costs because of the additional project review and tracking necessary to protect the integrity of the program. The locality's acceptance of a loan program will vary depending on the cost to the locality. Direct loan programs are more attractive than most other financing sources since the interest rate can be set at less than that of the prevailing market rate. In order to establish a direct loan program the state must provide the initial capital. This can be done via a general obligation bond or a direct appropriation. In either case a significant start-up cost is entailed.

Another form of direct assistance is the establishment of a bond bank. Bond banks are an arrangement for pooling general obligations of localities and special districts within a state. A separate entity is established by the state. The entity sells bonds and relends the proceeds to localities. The obligations of the bond bank are payable in the first instance from the local participants. They provide a means for small issuers to reduce the risk associated with their issues, to attract more bidders due to the larger issue, and to reduce the cost of underwriting and marketing.

Bond insurance is also an example of a direct assistance. It provides additional security for the investor in case of default. This can be, for some localities, the only means of entering the bond market either independently or through a bond bank. Another form of credit enhancement is for the State to provide funds for the bank's capital reserve fund. The bond bank is required to maintain a fund sufficient to cover one year's principal and interest payments. By providing the capital reserve fund, a potential investor perceives less risk to his investment and allows for monies otherwise obligated to the capital reserve fund to be loaned to localities to meet additional needs.

All of the above credit enhancements provide security for investors allowing for lower borrowing costs. The bond bank expands this security by increasing the number of localities which could feasibly enter the bond market. Alone or combined, they increase financing capability with a relatively minor requirement for State outlay with the possible exception of financing the capital reserve fund.

A final example of direct assistance is also a variation of a grant program. Specifically, an interest subsidy grant could be financed by the State providing a direct payment to a locality to reduce the locality's cost of borrowing. While this can amount to a significant savings for a locality, the interest subsidy grant carries with it the same disadvantages as other grants: one-time use and continuing need for appropriations. In addition, its use assumes the marketability of a locality's issue.

Indirect assistance usually takes the form of state guarantees. A moral obligation pledge given by the Commonwealth will lower a locality's cost of borrowing, have no effect on limits of State borrowing, and have little potential for State outlay. It is, however, considered a contingent liability of the State and does not provide the reduced locality cost of borrowing as does the "full faith and credit" backing. The "full faith and credit" backing of the State lowers a locality's cost of borrowing more than the moral obligation since it is a firm obligation of the State to cover any default. Providing a moral obligation or "full faith and credit" obligation on a locality-by-locality basis would be administratively unfeasible. Many Virginia localities, even with one of the state guarantees, could not sell bonds at an affordable interest rate or sell bonds at all, due to their poor credit rating or the size of the bond issuance.

Combinations of direct and indirect assistance can be used to resolve the disadvantages of any of the individual forms of loan programs; e.g., establishment of a bond bank with a moral obligation pledge from the state.

C. PREFERRED FINANCING MODEL

The preferred financing model for meeting future water quality needs is a program called a State Revolving Fund (SRF). The fund is called revolving because the principal and interest payments are repaid to a specially enacted "fund" which in turn loans the funds out again. When such a fund loans money out at or near market rates the fund assets build quickly and significantly. Current congressional actions endorse the SRF concept for a fairly simple reason. Grant monies once given out are lost forever; whereas loaned monies are returned, often with interest, to further the objectives of the "revolving fund". Both Houses of the United States Congress have passed legislation introducing this concept as a transition from the current grant process to the era of no federal financial assistance.

Although a new concept to the federal government, the revolving fund concept has long been

utilized in Virginia. Since 1810 Virginia has maintained "a permanent and perpetual school fund" known commonly as the Literary Fund. Establishing a revolving fund to meet water quality financing needs has numerous advantages. A revolving fund would:

- become self-supporting after the initial capitalization takes place;

- provide a long-term financing mechanism for meeting Virginia's wastewater treatment needs;

- allow the State to pursue additional capitalization funds if proposed congressional legislation is enacted;

- allow Virginia to establish the policy for the loans according to its own priorities;

- expand to assist with other financial needs, such as water supply, as resources become available.

The Literary Fund could serve as a model for the creation of a Water Facilities Revolving Fund (WFRF). This would require the establishment of a permanent and perpetual fund adminsitered jointly by the State Water Control Board and the Virginia Resources Authority (VRA). Under this concept the State Water Control Board would administer the policy aspects of the Water Facilities Revolving Fund (WFRF) and the Virginia Resources Authority would serve as the financial manager. (See proposed legislation in Appendix C).

Utilization of this concept ensures that the state could direct wastewater construction policies through setting loan criteria. This would require minimal operational involvement in the financial administration of the programs but would still retain the ability on the part of the state to exercise financial control over the fund's assets. The SWCB would be in a position to decide which jurisdictions would receive Water Facilities Revolving Funds and for what types of construction as well as what percentage of the total project costs and at what interest rates.

The SWCB would have the flexibility to provide any combination of financial incentives to influence wastewater construction policy. For example the SWCB could establish a policy that all construction projects that incorporate phosphorous removal be granted WFRF loans of 75% of total project costs while those projects that only do secondary treatment receive only 50% of total project costs. Within this framework the SWCB could also state that "have" localities would pay higher interest rates than "have not" localities. These are only examples of methods the SWCB could utilize for influencing policy. Any project costs not covered by the WFRF could be covered by the Virginia Resources Authority bonding capability. By working together in the administration of the WFRF a financial package could be tailored for each locality at varying levels below market costs.

The Water Facilities Revolving Fund concept has the potential of generating $1.9 billion for meeting Virginia's wastewater construction needs between now and the year 2009. This analysis, conducted by Kidder Peabody and contained in Appendix B assumes the following:

- an initial capitalization of $10 million in state appropriation combined with $50 million of federal funds for each year of a five year period;

- All funds returned are renewed immediately; and

- All loans are made at 8% average interest cost.

Assuming a lower interest cost of 6% would produce $1.6 billion. At a 4.5% interest rate the fund would contain $1.3 billion by the year 2009.

VII. RECOMMENDATIONS

1. The work of the subcommittee should continue through 1986. The subcommittee was able to define the extent of the nutrient enrichment problem, the costs and types of control technologies available as well as various funding alternatives. Since most of the subcommittee effort has concentrated on point sources of pollution it is important that the subcommittee investigate how best to incorporate such nonpoint control measures as strengthening enforcement of erosion and sediment control laws and land use regulations into a comprehensive nutrient control policy.

2. The General Assembly should appropriate $10 million per year for the next five years into

a revolving loan fund. This amount combined with $50 million per year from the federal government, assuming federal funds continue to be available, should enable Virginia to meet its $2 billion in wastewater treatment needs by the year 2009. Under the recommended legislation, the Virginia Resources Authority would have the responsibility for managing the WFRF and the State Water Control Board would establish the funding priorities such as nutrient removal.

3. The State Water Control Board should develop water quality standards that address nutrient enrichment problems in the Chesapeake Bay tributaries. The Board should seek to begin implementation of these standards by 1988.

Respectfully Submitted,

Joseph V. Gartlan, Chairman
J. Paul Councill, Jr., Vice-Chairman
Charles J. Colgan
Elmo G. Cross, Jr.
V. Thomas Forehand, Jr.
Raymond R. Guest, Jr.
Richard J. Holland
J. W. O'Brien
S. Wallace Stieffen
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FOOTNOTES

1. Chesapeake Bay Programs: Findings and Recommendations, EPA. September, 1983, p. 30.

2. "A Review of State Water Quality Standards Which Pertain to Nutrient Enrichment." Department of Environmental Programs, Metropolitan Washington Council of Governments. August 1982, p. vi.

3. Commonwealth of Virginia Water Quality Standards, § 5.01(b) (1980).

NUTRIENT REMOVAL COSTS*
FOR 1 MGD TREATMENT PLANT

	PHOSPHORUS REMOVAL			NITROGEN REMOVAL			
	SP	PP	BPR	NIT/DENIT	BC	IE	BNR
CAPITAL (MILLIONS)	$0.43	$0.86	$0.44	$ 1.82	$ 0.66	$ 7.82	$1.04
O&M (MILLIONS)	$0.09	$0.16	$0.04	$ 0.26	$ 0.45	$ 0.28	$0.08
MONTHLY USER FEE	$4.08	$7.52	$2.57	$13.50	$15.65	$32.74	$5.65

TABLE 1

APPENDIX A

SP - SIMULTANEOUS PRECIPITATION
PP - POST PRECIPITATION
BPR - BIOLOGICAL PHOSPHORUS REMOVAL
*JANUARY, 1985 DOLLARS

NIT/DENIT - NITRIFICATION/DENITRIFICATION
BC - BREAKPOINT CHLORINATION
IE - ION EXCHANGE
BNR - BIOLOGICAL NITROGEN REMOVAL

NUTRIENT REMOVAL COSTS*
VIRGINIA TIDEWATER FACILITIES

	PHOSPHORUS REMOVAL — TIDAL FRESH WATERS (9 FACILITIES)			NITROGEN REMOVAL — LOWER ESTUARY (25 FACILITIES)			
	SP	PP	BPR	NIT/DENIT	BC	IE	BNR
CAPITAL (MILLIONS)	$23.94	$59.17	*	$157.10	$32.77	$420.56	*
O&M (MILLIONS)	$ 8.28	$12.64	*	$ 15.16	$60.10	$ 30.64	*
AVERAGE MONTHLY USER FEE	$ 2.05	$ 3.58	*	$ 5.07	$10.29	$ 11.98	*

TABLE 2

*FOR THESE NEW TECHNOLOGIES, COST ESTIMATES ARE NOT AVAILABLE FOR RANGE OF TREATMENT PLANT SIZES. HOWEVER, USER COSTS SHOULD BE LOWER THAN OTHER TECHNOLOGIES.

Impact of Five $60 Million Annual Appropriations from the Commonwealth of Virginia to the Virginia Resources Authority for Purposes of Funding a Revolving Loan Pool

prepared for the

JOINT SUBCOMMITTEE TO STUDY PROBLEMS ASSOCIATED WITH NUTRIENT ENRICHMENT AND RELATED WATER QUALITY STANDARDS

in response to the

SENATE JOINT RESOLUTION #116

October 17, 1985

VIRGINIA RESOURSES AUTHORITY
Revolving Loan Pool Analysis

The purpose of this analysis is to determine how many loans could be generated from a revolving loan pool funded by five $60 million annual appropiations from the Commonwealth of Virginia. The analysis presents three scenarios. All scenarios are assumed to originate new loans through July 1, 2009. The first scenario is based on an interest cost of 4.5%, the second on an interest cost of 6% and the third on an interest cost of 8%.

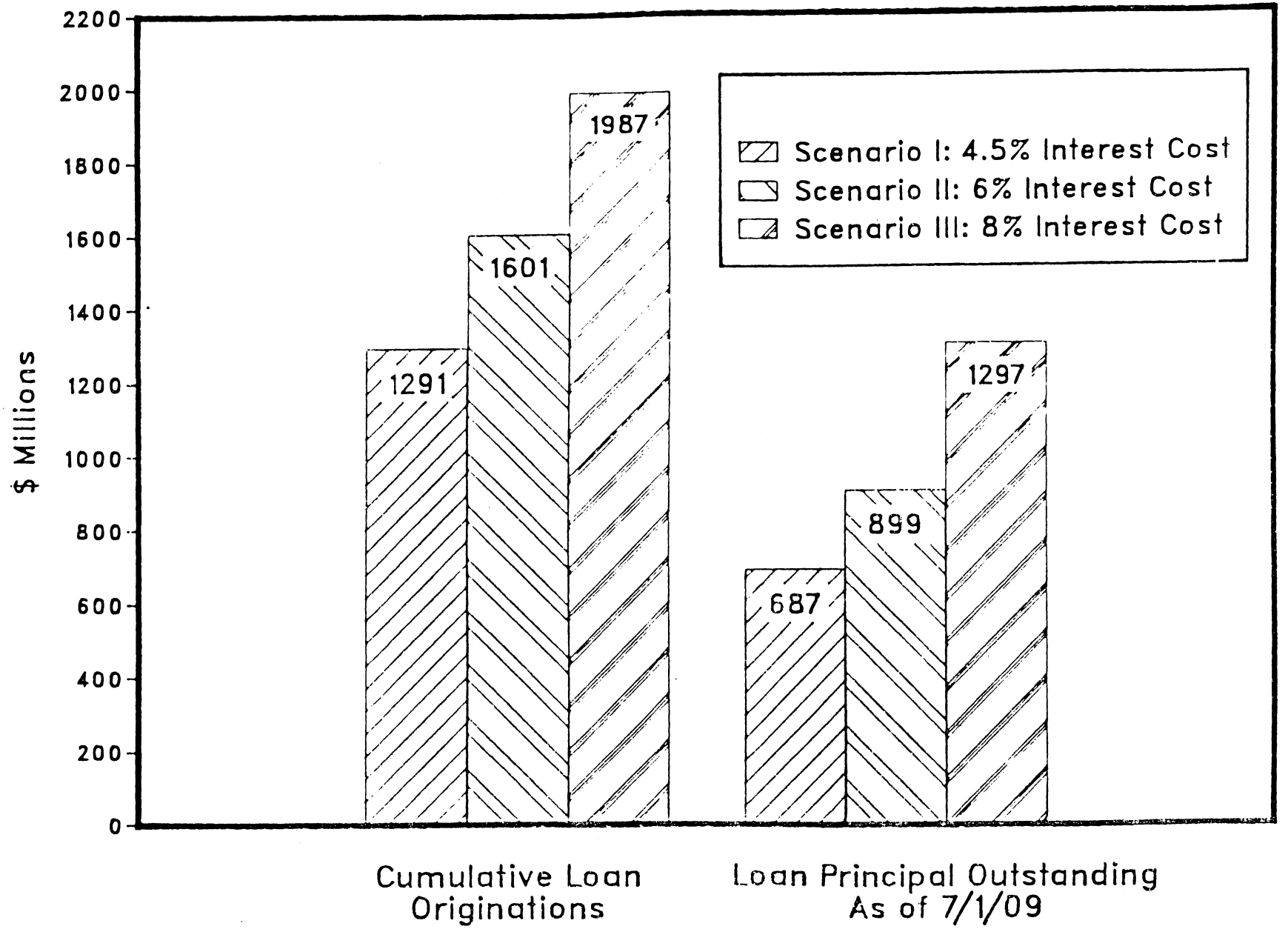
VIRGINIA RESOURCES AUTHORITY

Revolving Loan Pool

SUMMARY OF SCENARIOS

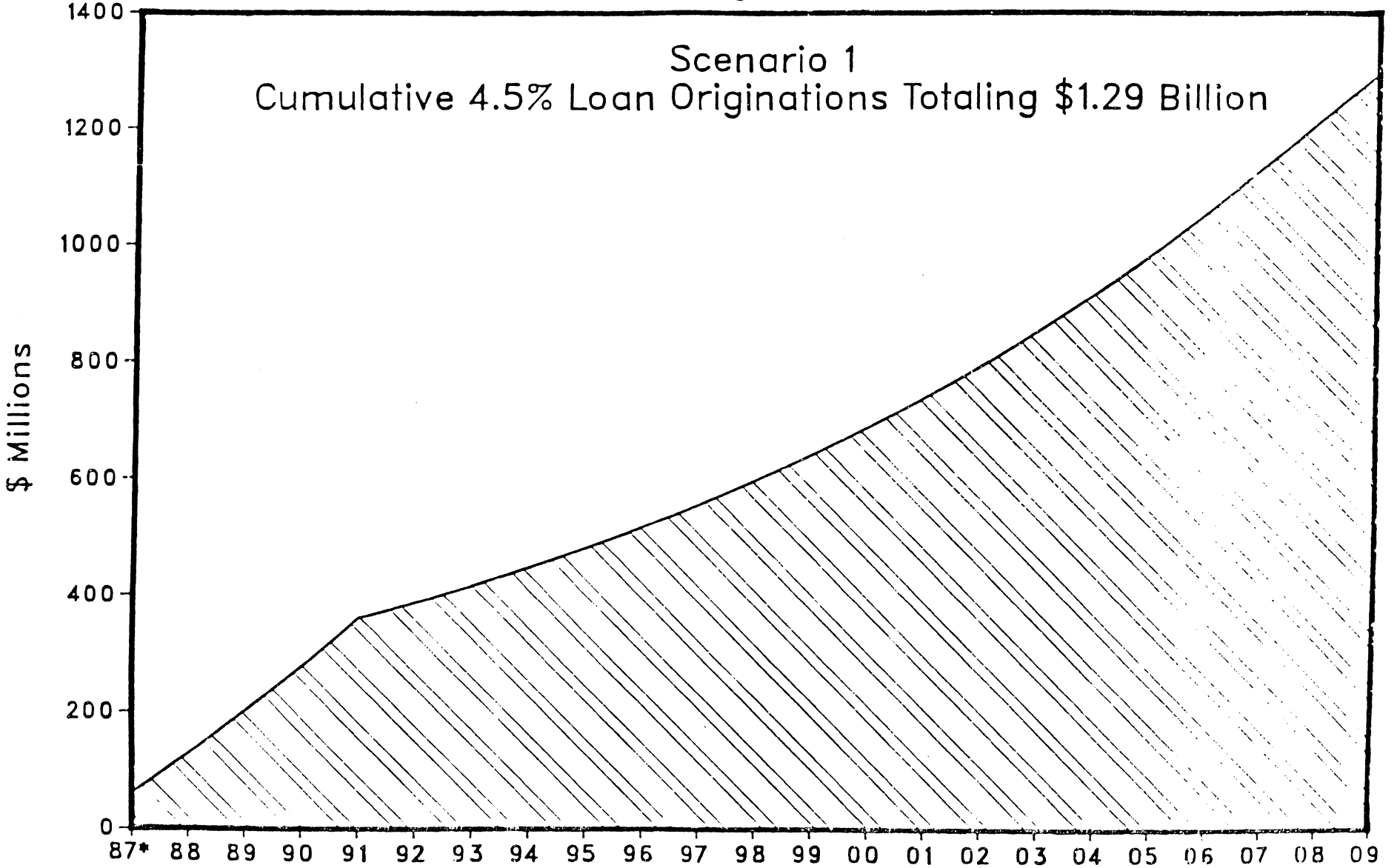
	4.5% Interest Cost	6% Interest Cost	8% Interest Cost
Total Loan Originations	$1,291,437,000	$1,600,980,320	$1,987,057,000
Total Loan Principal Outstanding as of July 1, 2009	687,001,099	899,602,606	1,297,020,201

VIRGINIA R[OURCES AUTHORITY
Revolving Loan Pool Alternatives



Scenario I: 4.5% Interest Cost

VIRGINIA R DURCES AUTHORITY
Revolving Loan Pool



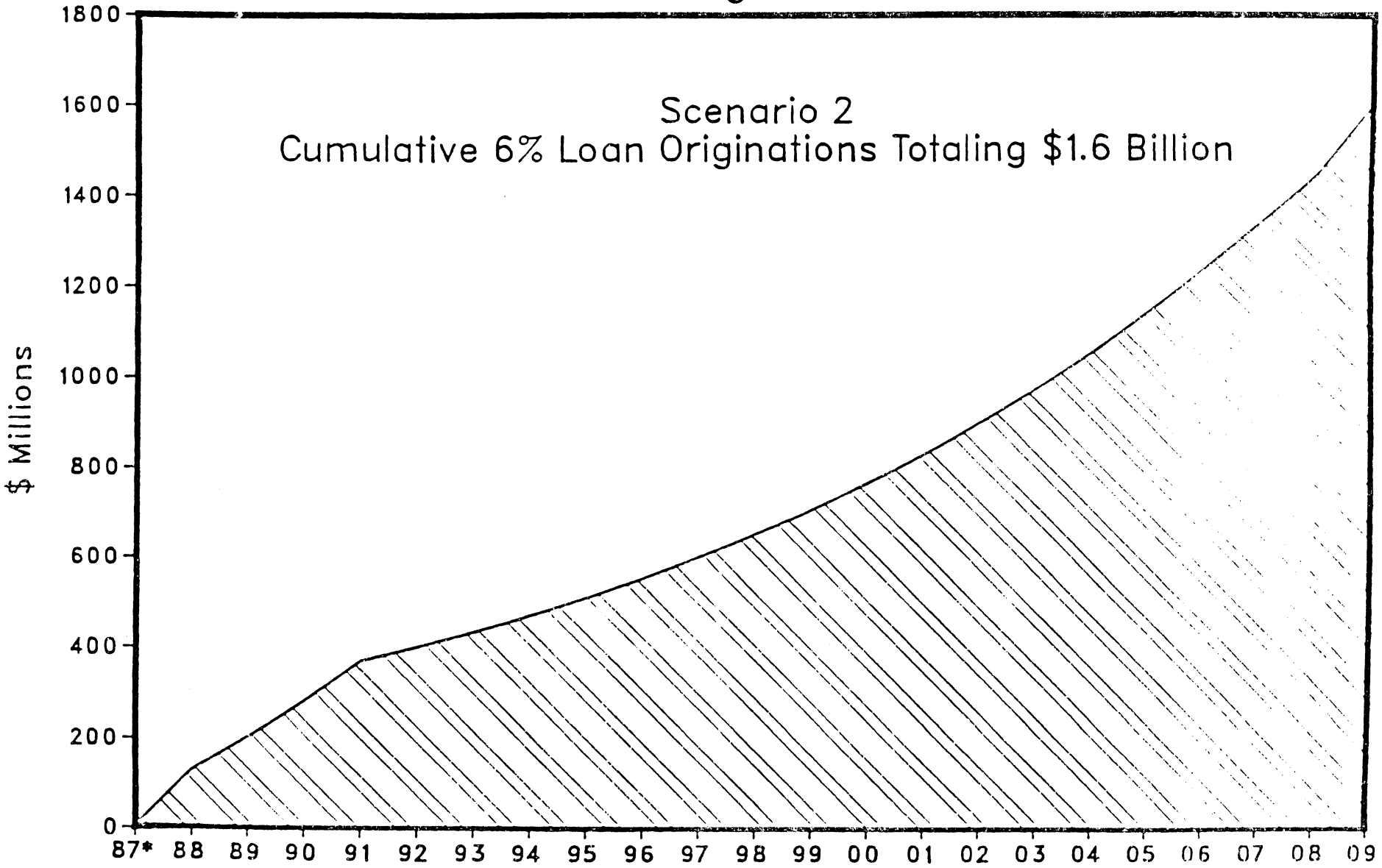
* All dates as of 7/1 (sum of annual originations).

Virginia Resources Authority
$300,000,000 Appropriation Loan Pool

PERIOD ENDING	MORTGAGE ORIGINATION	PRINCIPAL PAYMENTS	PRE-PAYMENTS	INTEREST PAYMENTS	PREPAYMENT PENALTIES	LESS: SERVICING	LESS: INSURANCE	NET MORT REVENUE (NOTE 1)	ENDING PRIN BALANCE	ORIG TO L
07/01/85										
01/01/86	41,050,000	157,886		228,347				386,232	40,892,114	
07/01/86	21,050,000	807,472		1,150,262				1,957,733	61,134,643	
01/01/87	40,583,333	1,357,737		1,894,818				3,252,556	100,360,238	
07/01/87	26,412,667	1,954,175		2,672,866				4,627,041	124,818,730	
01/01/88	40,583,333	2,478,404		3,317,250				5,795,655	162,923,659	
07/01/88	31,238,667	3,125,210		4,105,994				7,231,203	191,037,116	
01/01/89	40,583,333	3,726,429		4,795,515				8,521,943	227,894,020	
07/01/89	36,569,667	4,429,101		5,595,844				10,024,945	260,034,586	
01/01/90	40,583,333	5,115,600		6,334,991				11,450,591	295,502,319	
07/01/90	42,291,667	5,879,364		7,146,629				13,025,993	331,914,622	
01/01/91		6,291,785		7,409,351				13,701,136	325,622,837	
07/01/91	26,727,000	6,572,666		7,466,646				14,039,312	345,777,172	
01/01/92		7,001,027		7,714,638				14,715,665	338,776,145	
07/01/92	28,755,000	7,308,486		7,771,016				15,079,502	360,222,659	
01/01/93		7,774,735		8,032,440				15,807,175	352,447,924	
07/01/93	30,886,000	8,110,768		8,087,207				16,197,975	375,223,156	
01/01/94		8,617,491		8,362,085				16,979,575	366,605,665	
07/01/94	33,178,000	8,984,497		8,414,879				17,399,376	390,799,168	
01/01/95		9,534,997		8,703,981				18,238,978	381,264,171	
07/01/95	35,638,000	9,935,542		8,754,363				18,689,905	406,966,629	
01/01/96		10,533,329		9,058,430				19,591,759	396,433,300	
07/01/96	38,281,000	10,970,193		9,105,935				20,076,128	423,744,107	
01/01/97		11,619,077		9,425,789				21,044,866	412,125,030	
07/01/97	41,121,000	12,095,263		9,469,907				21,565,170	441,150,767	
01/01/98		12,799,355		9,806,422				22,605,777	428,351,412	
07/01/98	44,171,000	13,318,093		9,846,579				23,164,672	459,204,319	
01/01/99		14,081,805		10,200,657				24,282,462	445,122,514	
07/01/99	47,447,000	14,646,584		10,236,225				24,882,809	477,922,930	
01/01/00		15,474,677		10,606,824				26,083,501	462,448,254	
07/01/00	50,966,000	16,089,257		10,639,116				26,728,373	497,324,996	
01/01/01		16,986,862		11,031,256				28,018,118	480,338,135	
07/01/01	54,746,000	17,655,302		11,055,517				28,710,818	517,428,833	
01/01/02		18,627,945		11,468,274				30,096,219	498,800,889	
07/01/02	58,807,000	19,354,622		11,485,681				30,840,303	538,253,266	
01/01/03		20,408,265		11,920,206				32,328,472	517,845,001	
07/01/03	63,168,000	21,197,892		11,929,844				33,127,736	559,815,109	
01/01/04		22,338,936		12,387,327				34,726,263	537,476,173	
07/01/04	67,830,000	23,196,481		12,388,035				35,584,516	582,109,692	
01/01/05		24,431,598		12,869,422				37,301,020	557,678,094	
07/01/05	72,804,000	25,362,376		12,859,896				38,222,271	605,124,719	
01/01/06		26,310,992		13,367,549				39,678,542	578,813,726	
07/01/06	77,761,000	25,723,788		13,367,162				39,090,949	630,850,939	
01/01/07		25,813,877		13,950,068				39,763,945	605,037,061	
07/01/07	82,837,000	26,417,426		13,967,279				39,384,705	658,276,635	
01/01/08		26,637,795		14,568,790				40,206,584	632,638,840	
07/01/08	78,540,000	25,160,741		14,596,751				39,777,492	687,001,099	
01/01/09		26,231,248		15,218,418				40,499,666		
	1,291,437,000	624,717,149		434,788,481						

Scenario II: 6% Interest Cost

VIRGINIA RESOURCES AUTHORITY
Revolving Loan Pool



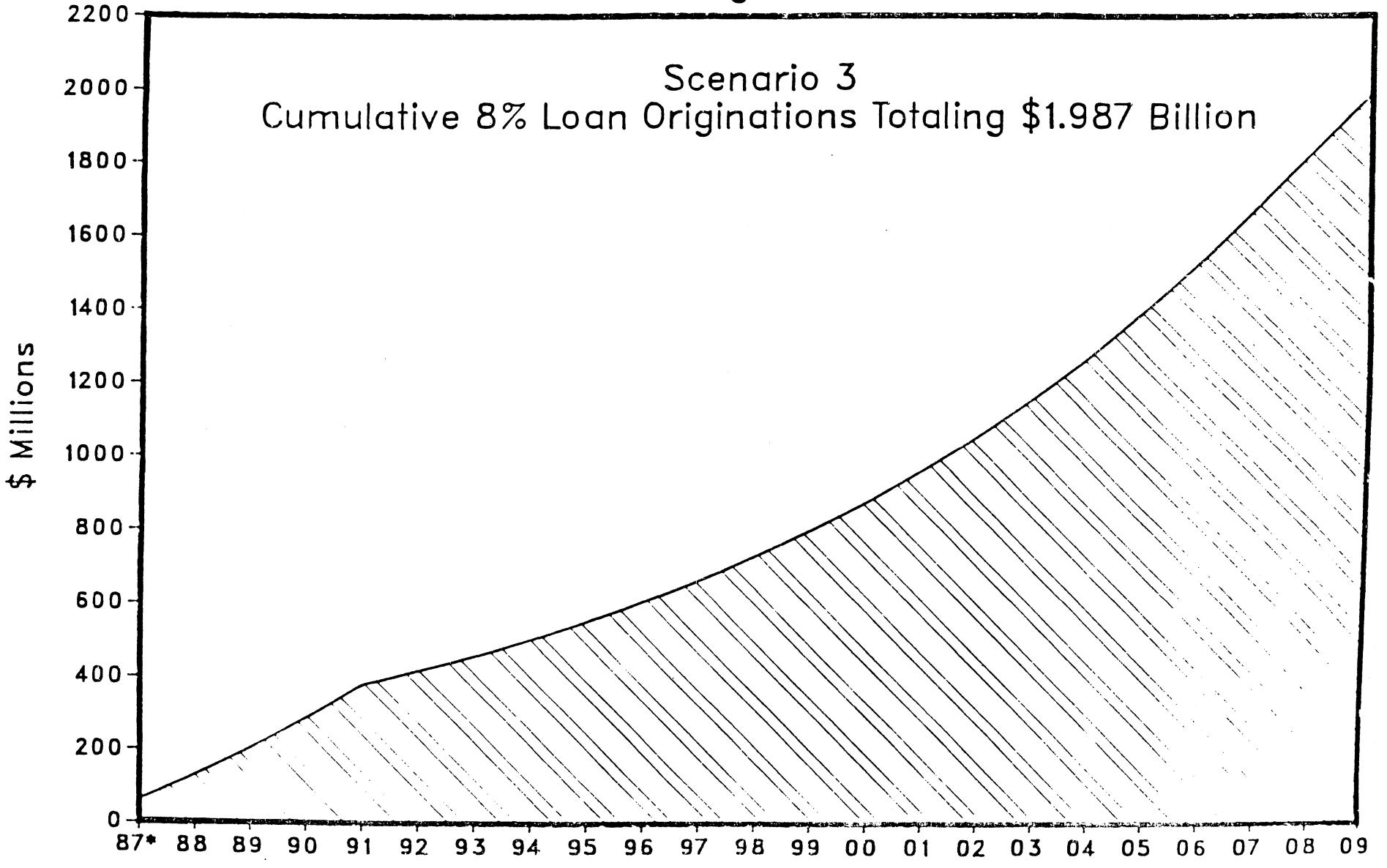
* All dates as of 7/1 (sum of annual originations).

Virginia Resources Authority
$60,000,000 Appropriation Loan Pool

PERIOD ENDING	MORTGAGE ORIGINATION	PRINCIPAL PAYMENTS	PRE-PAYMENTS	INTEREST PAYMENTS	PREPAYMENT PENALTIES	LESS: SERVICING	LESS: INSURANCE	NET MORT REVENUE (NOTE 1)	ENDING PRIN BALANCE	ORIG FEE TO LENDE
07/01/85										
01/01/86	41,050,000	132,793		304,588		10,131		427,250	40,917,207	
07/01/86	21,050,000	681,172		1,535,824		51,081		2,165,915	61,286,035	
01/01/87	40,583,333	1,149,991		2,533,300		84,252		3,599,040	100,719,377	
07/01/87	27,154,335	1,664,906		3,585,521		119,240		5,131,187	126,208,805	
01/01/88	40,583,333	2,126,202		4,468,852		148,607		6,446,446	164,665,937	
07/01/88	32,662,148	2,694,672		5,546,436		184,432		8,056,677	194,633,412	
01/01/89	40,583,333	3,235,773		6,507,801		216,387		9,527,186	231,980,972	
07/01/89	38,801,349	3,864,590		7,613,005		253,123		11,224,472	266,917,731	
01/01/90	40,583,333	4,495,315		8,660,678		287,940		12,868,053	303,005,749	
07/01/90	45,450,255	5,191,246		9,794,038		325,603		14,659,681	343,264,757	
01/01/91		5,612,153		10,228,199		340,005		15,500,347	337,652,605	
07/01/91	30,825,636	5,916,402		10,365,639		344,535		15,937,505	362,561,839	
01/01/92		6,367,696		10,797,722		358,863		16,806,555	356,194,143	
07/01/92	33,447,459	6,706,274		10,938,400		363,496		17,281,179	382,935,327	
01/01/93		7,204,661		11,398,526		378,750		18,224,436	375,730,667	
07/01/93	36,247,861	7,580,816		11,541,752		383,462		18,739,106	404,397,712	
01/01/94		8,130,440		12,030,892		399,675		19,761,657	396,267,272	
07/01/94	39,283,900	8,547,892		12,176,324		404,453		20,319,763	427,003,280	
01/01/95		9,153,640		12,696,344		421,686		21,428,298	417,849,640	
07/01/95	42,574,200	9,616,454		12,843,560		426,516		22,033,498	450,807,386	
01/01/96		10,283,649		13,396,424		444,834		23,235,239	440,523,737	
07/01/96	46,140,087	10,796,263		13,544,934		449,698		23,891,498	475,867,561	
01/01/97		11,530,713		14,132,732		469,169		25,194,275	464,336,848	
07/01/97	50,004,642	12,097,979		14,281,963		474,049		25,905,893	502,243,511	
01/01/98		12,906,018		14,906,919		494,746		27,318,191	489,337,493	
07/01/98	54,192,879	13,533,238		15,056,208		499,618		28,089,828	529,997,134	
01/01/99		14,421,774		15,720,691		521,619		29,620,845	515,575,360	
07/01/99	58,731,911	15,114,735		15,869,277		526,457		30,457,555	559,192,535	
01/01/00		16,091,302		16,575,805		549,845		32,117,262	543,101,234	
07/01/00	63,651,119	16,856,326		16,722,814		554,618		33,024,522	589,896,027	
01/01/01		17,929,134		17,474,071		579,481		34,823,724	571,966,893	
07/01/01	68,982,345	18,773,122		17,618,505		584,155		35,807,472	622,176,116	
01/01/02		19,951,125		18,417,346		610,586		37,757,884	602,224,991	
07/01/02	74,760,098	20,881,608		18,558,072		615,122		38,824,558	656,103,481	
01/01/03		22,174,563		19,407,535		643,222		40,938,876	633,928,918	
07/01/03	81,021,778	23,199,760		19,543,268		647,576		42,095,453	691,750,936	
01/01/04		24,613,299		20,446,590		677,450		44,387,439	667,132,637	
07/01/04	87,807,917	25,747,179		20,575,876		681,571		45,641,484	729,193,375	
01/01/05		27,302,887		21,536,501		713,333		48,126,055	701,890,487	
07/01/05	95,162,443	28,545,233		21,657,702		717,166		49,485,769	768,507,697	
01/01/06		29,811,159		22,681,488		751,081		51,741,566	738,696,538	
07/01/06	102,695,582	29,363,495		22,824,023		755,907		51,428,611	812,031,625	
01/01/07		29,673,733		23,987,462		794,636		52,866,558	782,357,892	
07/01/07	105,645,713	29,445,625		24,165,056		800,594		52,810,088	858,757,981	
01/01/08		29,913,023		25,366,279		841,224		54,458,078	828,844,958	
07/01/08	101,103,331	29,852,854		26,108,781		865,317		55,096,318	960,095,434	
01/01/09		30,656,813		28,417,134		942,128		58,133,820	929,436,621	
07/01/09		29,834,015		27,507,911		911,958		56,429,968	899,602,606	
01/01/10		29,041,075		26,622,454		882,575		54,780,954		
	1600,980,320	730,418,789		738,711,222		24,501,971				

Scenario III: 8% Interest Cost

VIRGINIA RESOURCES AUTHORITY
Revolving Loan Pool



* All dates as of 7/1 (sum of annual originations).

Virginia Resources Authority
$60,000,000 Appropriation Loan Pool

PERIOD ENDING	MORTGAGE ORIGINATION	PRINCIPAL PAYMENTS	PRE-PAYMENTS	INTEREST PAYMENTS	PREPAYMENT PENALTIES	LESS: SERVICING	LESS: INSURANCE	NET MORT REVENUE (NOTE 1)	ENDING PRIN BALANCE	ORIG TO LENDER
07/01/85										
01/01/86	41,050,000	104,339		406,307				510,647	40,945,661	
07/01/86	21,050,000	537,355		2,051,008				2,588,364	61,458,305	
01/01/87	40,583,333	912,094		3,388,184				4,300,278	101,129,545	
07/01/87	28,215,667	1,331,044		4,816,635				6,147,678	128,014,168	
01/01/88	40,583,333	1,715,927		6,037,125				7,753,052	166,881,575	
07/01/88	34,715,667	2,189,715		7,519,475				9,709,190	199,407,526	
01/01/89	40,583,333	2,654,704		8,877,335				11,532,038	237,336,156	
07/01/89	42,055,667	3,191,680		10,419,285				13,610,965	276,200,143	
01/01/90	40,583,333	3,748,441		11,930,952				15,679,393	313,035,035	
07/01/90	50,104,667	4,357,324		13,535,646				17,892,970	358,782,378	
01/01/91		4,774,661		14,272,334				19,046,995	354,007,717	
07/01/91	36,938,000	4,968,859		14,078,136				19,046,995	385,976,859	
01/01/92		5,553,548		15,347,233				20,900,780	380,423,311	
07/01/92	39,946,000	5,915,513		15,653,517				21,569,029	414,453,798	
01/01/93		6,433,773		16,471,754				22,905,527	408,020,025	
07/01/93	44,472,000	6,846,958		16,802,532				23,649,490	445,645,068	
01/01/94		7,434,562		17,702,854				25,137,416	438,210,505	
07/01/94	48,784,000	7,903,142		18,050,372				25,953,514	479,091,363	
01/01/95		8,563,677		19,022,033				27,585,710	470,527,686	
07/01/95	53,538,000	9,094,377		19,386,960				28,481,336	514,971,309	
01/01/96		9,836,406		20,436,183				30,272,590	505,134,903	
07/01/96	58,752,000	10,436,634		20,818,806				31,255,440	553,450,268	
01/01/97		11,269,499		21,951,642				33,221,141	542,180,769	
07/01/97	64,474,000	11,947,509		22,352,205				34,299,714	594,707,260	
01/01/98		12,881,598		23,575,261				36,456,859	581,825,662	
07/01/98	70,755,000	13,646,574		23,993,932				37,640,506	638,934,089	
01/01/99		14,693,427		25,314,371				40,007,798	624,240,662	
07/01/99	77,646,000	15,555,570		25,751,152				41,306,723	686,331,091	
01/01/00		16,727,967		27,176,605				43,904,572	669,603,125	
07/01/00	85,209,000	17,698,626		27,631,391				45,330,016	737,113,499	
01/01/01		19,010,755		29,170,150				48,180,905	718,102,744	
07/01/01	93,509,000	20,102,538		29,642,661				49,745,199	791,509,207	
01/01/02		21,570,133		31,303,653				52,873,786	769,939,074	
07/01/02	102,617,000	22,797,041		31,793,404				54,590,445	849,759,033	
01/01/03		24,437,538		33,586,226				58,023,764	825,321,495	
07/01/03	112,613,000	25,815,125		34,092,520				59,907,644	912,119,370	
01/01/04		27,647,856		36,027,549				63,675,405	884,471,514	
07/01/04	123,581,000	29,193,381		36,549,386				65,742,767	978,859,133	
01/01/05		31,239,753		38,637,739				69,877,491	947,619,380	
07/01/05	135,618,000	32,972,377		39,173,841				72,146,218	1050,265,003	
01/01/06		34,742,060		41,430,965				76,173,025	1015,522,944	
07/01/06	148,317,000	34,547,917		42,028,556				76,576,473	1129,292,026	
01/01/07		35,245,427		44,581,464				79,826,890	1094,046,599	
07/01/07	156,401,000	35,330,462		45,265,429				80,595,891	1215,117,138	
01/01/08		36,225,052		47,998,268				84,223,320	1178,892,086	
07/01/08	154,362,000	36,233,885		48,615,588				84,849,473	1297,020,201	
01/01/09		36,328,453		51,262,758				88,191,207		
	1967,057,000	726,965,249		1135,931,383						

APPENDIX C

LD1576118

D 1/15/86 M. Ward C 1/17/86 jrt

SENATE BILL NO. ..... HOUSE BILL NO. .....

A BILL to amend and reenact §§ 62.1-203, 62.1-206 and 62.1-209 of the Code of Virginia, and to amend the Code of Virginia by adding in Title 62.1 a chapter numbered 22, consisting of sections numbered 62.1-224 through 62.1-232, the amended and added sections relating to the Virginia Water Facilities Revolving Fund.

Be it enacted by the General Assembly of Virginia:

1. That §§ 62.1-203, 62.1-206 and 62.1-209 of the Code of Virginia are amended and reenacted and that the Code of Virginia is amended by adding in Title 62.1 a chapter numbered 22, consisting of sections numbered 62.1-224 through 62.1-232 as follows:

§ 62.1-203. Powers of Authority.—The Authority is granted all powers necessary or appropriate to carry out and to effectuate its purposes, including the following:

1. To have perpetual succession as a public body corporate and as a political subdivision of the Commonwealth;

2. To adopt, amend and repeal bylaws, and rules and regulations, not inconsistent with this chapter for the administration and regulation of its affairs and to carry into effect the powers and purposes of the Authority and the conduct of its business;

3. To sue and be sued in its own name;

4. To have an official seal and alter it at will although the failure to affix this seal shall not affect the validity of any instrument executed on behalf of the Authority;

5. To maintain an office at any place within the Commonwealth which it designates;

6. To make and execute contracts and all other instruments and agreements necessary or convenient for the performance of its duties and the exercise of its powers and functions under this chapter;

7. To sell, convey, mortgage, pledge, lease, exchange, transfer and otherwise dispose of all or any part of its properties and assets;

8. To employ officers, employees, agents, advisers and consultants, including without limitations, attorneys, financial advisers, engineers and other technical advisers and public accountants and, the provisions of any other law to the contrary notwithstanding, to determine their duties and compensation without the approval of any other agency or instrumentality;

9. To procure insurance, in amounts and from insurers of its choice, against any loss in connection with its property, assets or activities, including insurance against liability for its acts or the acts of its directors, employees or agents and for the indemnification of the members of its Board of Directors;

10. To procure insurance, guarantees, letters of credit and other forms of collateral or security from any public or private entities, including any department, agency or instrumentality of the United States of America or the Commonwealth, for the payment of any bonds issued by the Authority, including the power to pay premiums or fees on any such insurance, guarantees, letters of credit and other forms of collateral or security;

11. To receive and accept from any source aid, grants and contributions of money, property, labor or other things of value to be held, used and applied to carry out the purposes of this chapter subject to the conditions upon which the aid, grants or contributions are made;

12. To enter into agreements with any department, agency or instrumentality of the United States of America or the Commonwealth for the purpose of planning, regulating and providing

for the financing of any projects;

13. To collect, or to authorize the trustee under any trust indenture securing any bonds to collect, amounts due under any local obligations owned by the Authority, including taking the action required by § 15.1-225 to obtain payment of any sums in default;

14. To enter into contracts or agreements for the servicing and processing of local obligations owned by the Authority;

15. To invest or reinvest its funds as provided in this chapter or permitted by applicable law;

16. Unless restricted under any agreement with holders of bonds, to consent to any modification with respect to the rate of interest, time and payment of any installment of principal or interest, or any other term of any local obligations owned by the Authority;

17. To establish and revise, amend and repeal, and to charge and collect, fees and charges in connection with any activities or services of the Authority; ~~and~~

18. To do any act necessary or convenient to the exercise of the powers granted or reasonably implied by this chapter ~~.~~ *; and*

19. To pledge as security for the payment of any or all bonds of the Authority, all or any part of the Fund transferred to a trustee for such purpose from the Water Facilities Revolving Fund pursuant to § 62.1-231.

§ 62.1-206. Sources of payment and security for bonds.—The Authority shall have the power to pledge any revenue or funds of *or under the control of* the Authority to the payment of its bonds, subject only to any prior agreements with the holders of particular bonds pledging money or revenue. Bonds may be secured by a pledge of any local obligation owned by the Authority, any grant, contribution or guaranty from the United States of America, the Commonwealth or any corporation, association, institution or person, any other property or assets of *or under the control of* the Authority, or a pledge of any money, income or revenue of the Authority from any source.

§ 62.1-209. Provisions of resolution or trust indenture authorizing issuance of bonds.—A. Bonds may be secured by a trust indenture between the Authority and a corporate trustee, which may be any bank having the power of a trust company or any trust company within the Commonwealth. A trust indenture may contain provisions for protecting and enforcing the rights and remedies of the bondholders that are reasonable and proper and not in violation of law, including covenants setting forth the duties of the Authority in relation to the exercise of its powers and the custody, safekeeping and application of all money. The Authority may provide by the trust indenture for the payment of the proceeds of the bonds and all or any part of the revenues of the Authority to the trustee under the trust indenture or to some other depository, and for the method of their disbursement with whatever safeguards and restrictions as the Authority specifies. All expenses incurred in carrying out the trust indenture may be treated as part of the operating expenses of the Authority.

B. Any resolution or trust indenture pursuant to which bonds are issued may contain provisions, which shall be part of the contract or contracts with the holders of such bonds as to:

1. Pledging all or any part of the revenue of the Authority to secure the payment of the bonds, subject to any agreements with bondholders that then exist;

2. Pledging all or any part of the assets *of, or funds under control* of the Authority, including local obligations owned by the Authority, to secure the payment of the bonds, subject to any agreements with bondholders that then exist;

3. The use and disposition of the gross income from, and payment of the principal of and premium, if any, and interest on local obligations owned by the Authority;

4. The establishment of reserves, sinking funds and other funds and accounts and the regulation and disposition thereof;

5. Limitations on the purposes to which the proceeds from the sale of the bonds may be applied, and limitations pledging the proceeds to secure the payment of the bonds;

6. Limitations on the issuance of additional bonds, the terms on which additional bonds may

be issued and secured, and the refunding of outstanding or other bonds;

7. The procedure, if any, by which the terms of any contract with bondholders may be amended or abrogated, the amount of bonds, if any, the holders of which must consent thereto, and the manner in which any consent may be given;

8. Limitations on the amount of money to be expended by the Authority for operating expenses of the Authority;

9. Vesting in a trustee or trustees any property, rights, powers and duties in trust that the Authority may determine, and limiting or abrogating the right of bondholders to appoint a trustee or limit the rights, powers and duties of the trustees;

10. Defining the acts or omissions which shall constitute a default, the obligations or duties of the Authority to the holders of the bonds, and the rights and remedies of the holders of the bonds in the event of default, including as a matter of right the appointment of a receiver; these rights and remedies may include the general laws of the Commonwealth and other provisions of this chapter;

11. Requiring the Authority or the trustees under the trust indenture to file a petition with the Governor and to take any and all other actions required under § 15.1-225 of the Code of Virginia to obtain payment of all sums necessary to cover any default as to any principal of and premium, if any, and interest on local obligations owned by the Authority or held by a trustee to which § 15.1-225 shall be applicable; and

12. Any other matter, of like or different character, relating to the terms of the bonds or the security or protection of the holders of the bonds.

CHAPTER 22.

VIRGINIA WATER FACILITIES REVOLVING FUND.

§ 62.1-224. Definitions.—As used in this chapter, unless a different meaning clearly appears from the context:

"Authority" means the Virginia Resources Authority created in Chapter 21 of Title 62.1 (§ 62.1-197 et seq.).

"Board" means the State Water Control Board.

"Cost," as applied to any project financed under the provisions of this chapter, means the total of all costs incurred by the local government as reasonable and necessary for carrying out all works and undertakings necessary or incident to the accomplishment of any project. It includes, without limitation, all necessary developmental, planning and feasibility studies, surveys, plans and specifications, architectural, engineering, financial, legal or other special services, the cost of acquisition of land and any buildings and improvements thereon, including the discharge of any obligations of the sellers of such land, buildings or improvements, site preparation and development, including demolition or removal of existing structures, construction and reconstruction, labor, materials, machinery and equipment, the reasonable costs of financing incurred by the local government in the course of the development of the project, carrying charges incurred before placing the project in service, interest on funds borrowed to finance the project to a date subsequent to the estimated date the project is to be placed in service, necessary expenses incurred in connection with placing the project in service, the funding of accounts and reserves which the Authority may require and the cost of other items which the Authority determines to be reasonable and necessary.

"Fund" means the Virginia Water Facilities Revolving Fund created by this chapter.

"Local government" means any county, city, town, municipal corporation, authority, district, commission or political subdivision created by the General Assembly or pursuant to the Constitution or laws of the Commonwealth or any combination of any two or more of the foregoing.

"Project" means any wastewater treatment facility located or to be located in the Commonwealth by any local government. The term includes, without limitation, sewage and wastewater (including surface and groundwater) collection, treatment and disposal facilities;

drainage facilities and projects; related office, administrative, storage, maintenance and laboratory facilities; and interests in land related thereto.

§ 62.1-225. Creation and management of Fund.–There shall be set apart as a permanent and perpetual fund, to be known as the "Virginia Water Facilities Revolving Fund," sums appropriated to the Fund by the General Assembly, sums allocated to the Commonwealth expressly for the purposes of establishing a revolving fund concept through the Clean Water Act (33 U.S.C. § 1251, et seq.), as amended from time to time, all receipts by the Fund from loans made by it to local governments, all income from the investment of moneys held in the Fund, and any other sums designated for deposit to the Fund from any source public or private. The Fund shall be administered and managed by the Authority as prescribed in this chapter, subject to the right of the Board, following consultation with the Authority, to direct the distribution of loans or grants from the Fund to particular local governments and to establish the interest rates and repayment terms of such loans as provided in this chapter. In order to carry out the administration and management of the Fund, the Authority is granted the power to employ officers, employees, agents, advisers and consultants, including, without limitation, attorneys, financial advisers, engineers and other technical advisers and public accountants and, the provisions of any other law to the contrary notwithstanding, to determine their duties and compensation without the approval of any other agency or instrumentality. The Authority may disburse from the Fund its reasonable costs and expenses incurred in the administration and management of the Fund and a reasonable fee to be approved by the Board for its management services.

§ 62.1-226. Deposit of money; expenditures; investments.–All money belonging to the Fund shall be deposited in an account or accounts in banks or trust companies organized under the laws of the Commonwealth or in national banking associations located in Virginia or in savings and loan associations located in Virginia organized under the laws of the Commonwealth or the United States. The money in these accounts shall be paid by check signed by the Executive Director of the Authority or other officers or employees designated by the Board of Directors of the Authority. All deposits of money shall, if required by the Authority, be secured in a manner determined by the Authority to be prudent, and all banks, trust companies and savings and loan associations are authorized to give security for the deposits. Money in the Fund shall not be comingled with other money of the Authority. Money in the Fund not needed for immediate use or disbursement may be invested or reinvested by the Authority in obligations or securities which are considered lawful investments for public funds under the laws of the Commonwealth.

§ 62.1-227. Annual audit.–An independent certified public accountant selected by the Authority or the Auditor of Public Accounts shall perform at least once in each fiscal year, an audit of the books and accounts of the Authority with respect to the Fund in accordance with generally accepted auditing standards and, accordingly, include such tests of accounting records and such other auditing procedures as considered necessary under the circumstances. The Authority shall furnish copies of such audit to the Governor and to the Board.

§ 62.1-228. Collection of money due Fund.–The Authority is empowered to collect, or to authorize others to collect on its behalf, amounts due to the Fund under any loan to a local government, including, if appropriate, taking the action required by § 15.1-225 to obtain payment of any amounts in default. Proceedings to recover amounts due to the Fund may be instituted by the Authority in the name of the Fund in the appropriate circuit court.

§ 62.1-229. Loans to local governments.–Except as otherwise provided in this chapter, money in the Fund shall be used solely to make loans to local governments to finance or refinance the cost of any project. The local governments to which loans are to be made, the purposes of the loan, and the amount of each such loan, the interest rate thereon and the repayment terms thereof, which may vary between local governments, shall be designated in writing by the Board to the Authority following consultation with the Authority. No loan from the Fund shall exceed the total cost of the project to be financed or the outstanding principal amount of the indebtedness to be refinanced plus reasonable financing expenses.

Except as set forth above, the Authority shall determine the terms and conditions of any loan from the Fund, which may vary between local governments. Each loan shall be evidenced by appropriate bonds or notes of the local government payable to the Fund. The bonds or notes shall have been duly authorized by the local government and executed by its authorized legal representatives. The Authority is authorized to require in connection with any loan from the Fund such documents, instruments, certificates, legal opinions and other information as it may deem necessary or convenient. In addition to any other terms or conditions which the Authority may establish, the Authority may require, as a condition to making any loan from the Fund, that the local government receiving the loan convenant to perform any of the following:

A. Establish and collect rents, rates, fees and charges to produce revenue sufficient to pay all or a specified portion of (i) the costs of operation, maintenance, replacement, renewal and repairs of the project; (ii) any outstanding indebtedness incurred for the purposes of the project, including the principal of and premium, if any, and interest on the loan from the Fund to the local government; and (iii) any amounts necessary to create and maintain any required reserve, including any rate stabilization fund deemed necessary or appropriate by the Authority to offset the need, in whole or part, for future increases in rents, rates, fees or charges;

B. Levy and collect ad valorem taxes on all property within the jurisdiction of the local government subject to local taxation sufficient to pay the principal of and premium, if any, and interest on the loan from the Fund to the local government;

C. Create and maintain a special fund or funds for the payment of the principal of and premium, if any, and interest on the loan from the Fund to the local government and any other amounts becoming due under any agreement entered into in connection with the loan, or for the operation, maintenance, repair or replacement of the project or any portions thereof or other property of the local government, and deposit into any fund or funds amounts sufficient to make any payments on the loan as they become due and payable;

D. Create and maintain other special funds as required by the Authority; and

E. Perform other acts, including the conveyance of, or the granting of liens on or security interests in, real and personal property, together with all rights, title and interest therein, to the Fund, or take other actions as may be deemed necessary or desirable by the Authority to secure payment of the principal of and premium, if any, and interest on the loan from the Fund to the local government and to provide for the remedies of the Fund in the event of any default by the local government in the payment of the loan, including, without limitation, any of the following:

1. The procurement of insurance, guarantees, letters of credit and other forms of collateral, security, liquidity arrangements or credit supports for the loan from any source, public or private, and the payment therefor of premiums, fees or other charges;

2. The combination of one or more projects, or the combination of one or more projects with one or more other undertakings, facilities, utilities or systems, for the purpose of operations and financing, and the pledging of the revenues from such combined projects, undertakings, facilities, utilities and systems to secure the loan from the Fund to the local government made in connection with such combination or any part or parts thereof;

3. The maintenance, replacement, renewal and repair of the project; and

4. The procurement of casualty and liability insurance.

All local governments borrowing money from the Fund are authorized to perform any acts, take any action, adopt any proceedings and make and carry out any contracts that are contemplated by this chapter. Such contracts need not be identical among all local governments, but may be structured as determined by the Authority according to the needs of the contracting local governments and the Fund.

Subject to the rights, if any, of the registered owners of any of the bonds of the Authority, the Authority may consent to and approve any modification in the terms of any loan to any local government subject to guidelines adopted by the Board.

§ 62.1-230. Grants to local governments.—Subject to any restrictions which may apply to the use of money in the Fund, the Board in its discretion may approve the use of money in the Fund to make grants or appropriations to local governments to pay the cost of any project. The Board may establish such terms and conditions on any grant as it deems appropriate. Grants shall be disbursed from the Fund by the Authority in accordance with the written direction of the Board.

§ 62.1-231. Pledge of loans to secure bonds of Authority.—The Authority is empowered at any time and from time to time to transfer from the Fund to banks or trust companies designated by the Authority any or all of the assets of the Fund to be held in trust as security for the payment of the principal of and premium, if any, and interest on any or all of the bonds (as defined in § 62.1-199) of the Authority. The interests of the Fund in any obligations so transferred shall be subordinate to the rights of the trustee under the pledge. To the extent funds are not available from other sources pledged for such purpose, any payments of principal and interest received on the assets transferred or held in trust may be applied by the trustee

thereof to the payment of the principal of and premium, if any, and interest on such bonds of the Authority to which the obligations have been pledged, and, if such payments are insufficient for such purpose, the trustee is empowered to sell any or all of such assets and apply the net proceeds from the sale to the payment of the principal of and premium, if any, and interest on such bonds of the Authority. Any assets of the Fund transferred in trust as set forth above and any payments of principal, interest or earnings received thereon shall remain part of the Fund but shall be subject to the pledge to secure the bonds of the Authority and shall be held by the trustee to which they are pledged until no longer required for such purpose by the terms of the pledge. On or before the tenth day of January in each year, the Authority shall transfer, or shall cause the trustee to transfer, to the Fund any assets transferred or held in trust as set forth above which are no longer required to be held in trust pursuant to the terms of the pledge.

§ 62.1-232. Liberal construction of chapter.—The provisions of this chapter shall be liberally construed to the end that its beneficial purposes may be effectuated. Insofar as the provisions of this chapter are inconsistent with the provisions of any other law, general, special or local, the provisions of this chapter shall be controlling.

APPENDIX D

LD4096118

D 01/16/86 Farber C 01/17/86 owj

SENATE JOINT RESOLUTION NO.....

Continuing the study by the joint subcommittee examining the problems associated with nutrient enrichment and related water quality standards in the water of the Commonwealth.

WHEREAS, the U.S. Environmental Protection Agency's Chesapeake Bay Program determined that nutrient enrichment is a major reason for water quality degradation and the decline of living resources in the Chesapeake Bay and its tributaries; and

WHEREAS, the Chesapeake Bay Program recommended the development of a basin-wide plan that includes implementation schedules to control nutrients from various sources; and

WHEREAS, the nutrients phosphorus and nitrogen are present in excess in the Bay's tributaries and originate from industrial and sewage treatment plants as well as from agricultural, forestal and urban areas; and

WHEREAS, some tributaries have clearly demonstrable nutrient enrichment problems, while other tributaries contribute to nutrient problems through the transport of nutrients to the Chesapeake Bay; and

WHEREAS, the Chesapeake Executive Council, through its Chesapeake Bay Restoration and Protection Plan, established general goals and objectives pertaining to nutrient enrichment; and

WHEREAS, there are a number of strategies which can contribute to control of the problem of nutrient enrichment, including nutrient removal at sewage treatment plants, a phosphate detergent ban, and land management practices to reduce nutrient runoff; and

WHEREAS, the First Biennial Review of the Chesapeake Action Agenda recommended the establishment of specific nutrient load goals; and

WHEREAS, a subcommittee was formed in 1985 by Senate Joint Resolution No. 116 to examine the problem of nutrient enrichment, and that subcommittee has completed some, but not all of its assigned responsibilities; now, therefore, be it

RESOLVED by the Senate, the House of Delegates concurring, That the joint subcommittee studying the problems associated with nutrient enrichment and related water quality standards in the waters of the Commonwealth is hereby continued in order to complete its evaluation. The current membership of the joint subcommittee shall continue to serve; and, be it

RESOLVED FURTHER, That the joint subcommittee shall examine and make recommendations to the General Assembly concerning the following:

1. The establishment of specific numerical target loads, in terms of pounds of nitrogen and phosphorus entering the Chesapeake Bay and its each of its tributaries;

2. How best to coordinate point and nonpoint source control strategies in order to achieve such target loads and mitigate the effects of nutrient enrichment; and

3. Changes in existing laws, regulating and administrative programs necessary to achieve target nutrient loads; and, be it

RESOLVED FINALLY, That the State Water Control Board, Division of Soil and Water Conservation, and the Virginia Institute of Marine Science shall provide such assistance as is necessary for the work of the joint subcommittee, including but not limited to, development of a chlorophyll standard.

The joint subcommittee shall complete its work in time to submit its recommendations to the 1987 Session of the General Assembly.

The costs of the study, including direct and indirect costs, are estimated to the $21,355.