CRITICAL AREAS IN THE POTOMAC RIVER BASIN

A Review of Water Pollution Control in 1975

By

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Edited by

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4350 East West Highway
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December 1976

ICPRB Technical Publication 76-4

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ACKNOWLEDGEMENTS

Many sources were consulted in the preparation of this report, but by far the most information came from state water resources agencies in the Potomac River basin. They include:

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Pennsylvania:	Department of Environmental Resources P.O. Box 1467 Harrisburg, Pennsylvania 17120
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Some of these state agencies reviewed parts of the text and supplied water quality and effluent data, but the author is solely responsible for the report's findings and conclusions.

Staff members of the Interstate Commission on the Potomac River Basin who contributed to this report include Eva Delp, who edited the report, completed the tables and figures, and prepared the manuscript for printing; Kevin Flynn, who drew the maps and reviewed the report; ICPRB Executive Director Paul Eastman, who also reviewed the manuscript and made many helpful suggestions; and Deniece Long, who helped in the typing of the publication.

This publication has been prepared by the staff of the Interstate Commission on the Potomac River Basin. Funds for this publication are provided by the United States government, the United States Environmental Protection Agency, and the signatory bodies to the Interstate Commission on the Potomac River Basin: District of Columbia, Maryland, Pennsylvania, Virginia and West Virginia. The opinions expressed are those of the authors and should not be construed as representing the opinions or policy of the United States government or any of its agencies, the several states, or the Commissioners of the Interstate Commission on the Potomac River Basin.

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INTRODUCTION

This report examines 18 areas in the Potomac River basin which currently do not meet water quality standards or which have not met them in recent years (Figure 1). The term "critical" has been coined to describe them, not to imply that they are nearly dead or beyond the point of recovery, but rather to denote the importance of the abatement decisions that are to be made in these areas. The report is designed to serve as an overview of the areas most severely affected by water pollution in the Potomac basin as well as a source of information on dischargers and water quality at specific locations.

The general format of the report is the following: each section provides a description of the area of investigation, a brief summary of the recent water quality, a listing of the significant dischargers and a discussion of the steps being taken to eliminate the situations that are resulting in water quality violations. Variations in this format occur when a particular area does not lend itself to such an analysis.

Although water quality in the Potomac River and its tributaries can generally be termed "good," numerous areas of localized water pollution do exist. As Figure 1 indicates, the critical areas lie in each of the states of the basin, including parts of Maryland, West Virginia, Virginia and Pennsylvania, as well as in the District of Columbia. The water pollution problems in each of these areas are a result of a variety of causes, including acid mine drainage, municipal and industrial discharges, and non-point sources of pollution.

In the critical areas where the discharges of inadequately treated municipal and industrial wastes have created problems (Table I*), some significant improvements in water quality have occurred in recent years. More improvements are expected as the treatment facilities are upgraded to meet the requirements of Public Law 92-500. The treatment efficiency levels and compliance schedules issued to these dischargers by the state and federal governments should guarantee that low dissolved oxygen values will not be a water quality problem in most areas by 1977.

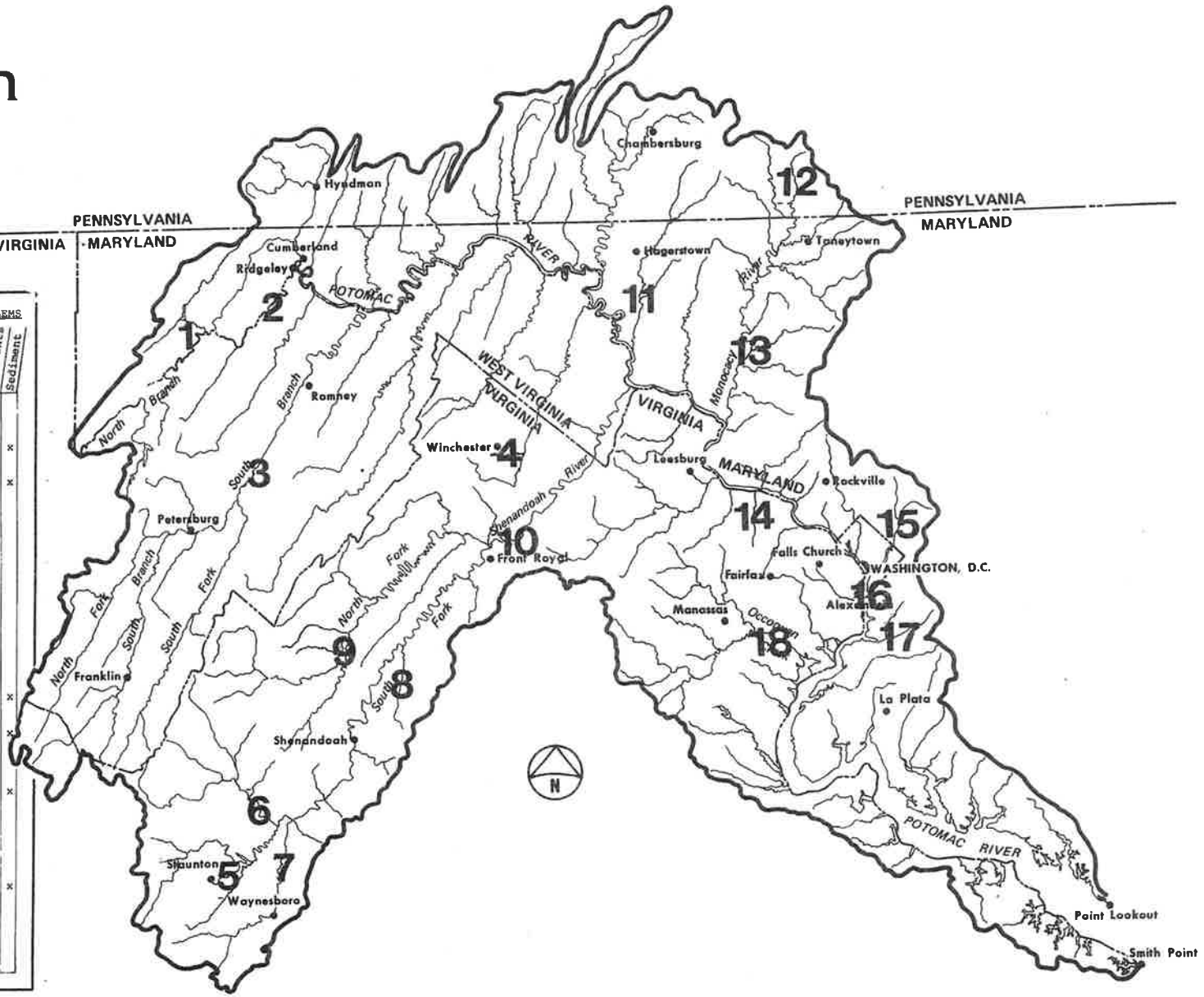
In areas where non-point sources of pollution are the cause of water degradation--such as the low pH of the acid mine drainage

*Editor's note: Table I, which is located at the end of the text beginning on page 66, lists major dischargers within the critical areas and gives more complete information on permit requirements and 1975 effluent data than is found in the text.

FIGURE 1

Potomac River Basin Critical Areas

STREAM NAME	LOCATION	WATER QUALITY PROBLEMS				
		Bacteria	Dissolved Oxygen	pH	Nutrients	Sediment
1 North Branch and Georges Creek	Headwater of each to their confluence		x	x		
2 North Branch	Georges Creek to South Branch	x	x	x		x
3 South Branch	Downstream of Moorefield				x	x
4 Abrams Creek	Entire length	x	x			
5 Lewis Creek	Entire length	x	x		x	
6 North River	Bridgewater and downstream	x	x			
7 South River	Waynesboro and downstream	x	x			
8 Hawksbill Creek	Luray and downstream	x	x			
9 North Fork Shenandoah River	Timberville, New Market and Broadway areas	x	x			
10 Shenandoah River	Front Royal and downstream		x			x
11 Antietam Creek	Entire length	x				x
12 Rock Creek	Gettysburg and downstream	x			x	
13 Monocacy River	Frederick and downstream	x			x	x
14 Sugarland Run	Herndon and downstream	x	x			
15 Anacostia River	Entire length	x	x		x	
16 Potomac Estuary and embayments	Washington, D.C. to Piscataway Creek	x	x		x	x
17 Piscataway Creek	Entire length	x	x		x	
18 Bull Run drainage basin and Occoquan Reservoir	Cub Run, Flat Branch, Bull Run and Lower Occoquan	x	x		x	



in the North Branch, sediment pollution in the Monocacy, or combined sewer overflows and storm water runoff in the Washington Metropolitan Area--improvements in recent years have not been so obvious and future improvements are expected to occur slowly. Non-point sources of pollution have proven difficult to identify and control, and their abatement has been given a secondary priority in terms of financial commitment. Water quality violations that are a result of non-point problems can not realistically be expected to improve significantly until well into the 1980's.

BASIN DESCRIPTION

The Potomac River has a drainage area of 14,670 square miles which includes portions of Maryland, West Virginia, Virginia, Pennsylvania and the District of Columbia. The river originates in the Allegheny plateau, flowing northeast then southeast, slowly changing from a small stream into a major estuary and flowing into the Chesapeake Bay. Despite the presence of several cities, the Potomac River basin remains essentially rural in nature. Land use is currently estimated to be 55% forest, 40% agricultural and 5% urban.

The only large metropolitan center in the basin is the region around Washington, D.C. Because of its unique distinction as the nation's capital, the major source of employment in this area is in the field of public administration and little industry has developed. The major industries in the Potomac basin are concentrated in the North Branch of the Potomac between Luke and Cumberland, Maryland and along the South Fork of the Shenandoah River in Virginia.

The Environmental Protection Agency estimates that there are 751 dischargers in the basin, 117 termed as major dischargers and 634 minor dischargers. Of the major dischargers, 48 are industrial and 69 are municipal. EPA estimates that the major dischargers contribute daily to the river basin approximately 128,000 pounds of BOD_5, 134,000 pounds of suspended solids, 7,500 pounds of phosphorus and 81,000 pounds of nitrogen. Approximately 95% of the BOD_5 load and 85% of the suspended solids load come from municipal dischargers.

WATER POLLUTION

Because of its complexities, measurement of water pollution is difficult. Pollution is not a single state, but rather the result of numerous conditions. Scientists most often measure pollution in terms of chemical and biological parameters--such as the concentration of BOD_5, suspended solids, nutrients, or fecal coliforms. People interested in water recreation often use less precise, but equally valid, parameters such as color, odor, general appearance and other aesthetic measures. Because of the wide range of measurements which are possible, and the frequent lack of sampling data, there has been no attempt to rank the

critical areas discussed in this report in any order of severity. Instead, the critical areas are listed from upstream to downstream.

The water pollution terminology most often used in this report include the following:*

BOD_5 (the five day biochemical oxygen demand) is a measure of the amount of dissolved oxygen which is required for the biological oxidation of carbonaceous materials. When waste containing BOD_5 is discharged into a stream, oxygen is removed from the stream as the material is oxidized. If enough of the waste is discharged, the oxygen demand of the material may be sufficient to cause an oxygen depletion which is detrimental to the receiving waters, particularly the fish and other aquatic life. The discharge of BOD_5 is usually reported in the metric system as milligrams per liter (mg/l) and the English system as pounds per day (pounds/day). It should be noted that the conversion between these two systems is simple. If one knows the flow of a discharger in million gallons per day (mgd) and the concentration of the discharge in mg/l, the number of pounds of BOD5 being discharged per day is equal to the concentration times the flow times 8.34. Likewise, if one knows the pounds per day of BOD5 being discharged and the flow of the discharger, the average concentration in mg/l is simply the pounds per day divided by the flow and 8.34.

Suspended solids are particles physically held in suspension in water by agitation or the flow of the water itself. After being discharged from a waste treatment facility, these particles often begin to settle, and accumulate on the bed of the stream into which they are discharged. If enough solids collect, they can adversely affect the biological activities that occur on the stream bed. As was the case with BOD5, suspended solids are often reported in mg/l and in pounds/day. The conversion between the two systems is the same as with BOD_5.

Fecal coliform is a type of bacteria found in large amounts in the gastrointestinal tract and feces of warm-blooded animals and man. Although these organisms are themselves not dangerous, they are used as an indicator of pathogenic organisms which are more difficult to detect. Fecal coliforms are reported as the most probable number per 100 milliliters (MPN/100 ml). This value represents the expected number of fecal coliform organisms one would find in a sample of 100 milligrams.

The two nutrients of most interest in water pollution are phosphorus and nitrogen. Both of these nutrients occur not only in their elemental form in the environment, but also in a variety of compounds. These two nutrients can join with other elements commonly found in streams to form algae and rooted aquatic plants. A certain level of nutrients is needed to promote a healthy environment in a stream, but an over-abundance of nutrients can result in a condition known as eutrophication--a condition characterized

*Terms relating to sewage treatment processes are defined in the glossary at the end of the text.

by a nuisance level of aquatic plants and wide daily fluctuations in the dissolved oxygen level of the stream due to plant photosynthesis. As with BOD_5 and suspended solids, nutrients are reported in mg/l and pounds/day.

pH is a measure of the degree of acidity in a stream. A pH value of 7 is considered neutral, any value less than 7 is considered acidic and any value above that is considered basic or alkaline. Both plant and fish populations are affected by pH levels, with a generally acceptable level ranging from 6 to 8.5.

NOD (the nitrogenous oxygen demand) is a measure of the amount of oxygen which is required for the biological oxidation of nitrogenous demand in a waste. When this value is added to the BOD of a waste, the "total oxygen demand" is obtained. The NOD of a waste is often exerted more slowly than the BOD and most often after the BOD. NOD is reported in mg/l and pounds/day.

COD (the chemical oxygen demand) is a measure of the amount of oxygen which is required for the chemical oxidation of a waste. Values of COD for a given waste are greater than the sum of that waste's BOD and NOD. This is because COD not only measures oxidation that would occur naturally, but measures all possible oxidation. COD is reported in mg/l or pounds/day.

Turbidity is a measure of the light transmitting properties of water--that is, how clear the water appears. Turbidity is reported in Jackson Turbidity Units (JTU), a numerical measure of the cloudiness of water. The greater the JTU of water, the more difficult it is for light to pass through it. Research suggests that in water with an average turbidity of over 130 JTU fish productivity will be reduced, and that very little aquatic life can exist in turbidities consistently above 200 JTU.

Effluent limited denotes a segment that will meet its required water quality standards by using the point source controls required by the U.S. Congress to be available by 1977. A water quality limited segment is one which will require more stringent controls than those required by Congress to be available by 1977 or where new sources might threaten to degrade water quality.

WATER QUALITY STANDARDS

Water quality standards are established to help insure that a given segment will be of a desired quality. In the Potomac basin each of the states has established different standards for their stream segments. Each of these particular standards will not be outlined here but instead an indication will be made of the range of values that have been established by the states. A detailed listing of all of the state standards was published by ICPRB in 1974 (Mason, et al., 1974).

Three parameters for which each of the states in the basin have set standards are dissolved oxygen, fecal coliforms and pH. The dissolved oxygen standard most often applied to the stream

segments discussed in this report requires that the level always be above 4 mg/l and that the daily average be above 5 mg/l. In some segments this standard is more stringent, requiring that the dissolved oxygen level always be above 5 mg/l and that the daily average be above 6 mg/l. The fecal coliform standards vary greatly throughout the basin. The most stringent standard requires that the most probable number of coliforms per 100 milliliters of sample (MPN/100 ml) be less than 70, while the most lenient standard requires that the geometric mean be less than 1,000 MPN/100 ml. In this report all yearly averages of fecal coliforms are given as geometric means. The pH standard also varies throughout the basin but generally the pH of a stream is considered acceptable if it lies in the range from 6 to 8.5.

ABATEMENT EFFORTS

This report comes four years after the passage of Public Law 92-500, the Federal Water Pollution Control Act Amendment of 1972. This law tremendously affected the emphasis and efforts of state governments to control water pollution. Although the law was passed with the intention to "restore and maintain the chemical, physical and biological integrity of the Nation's waters," it initially resulted in a decrease in the amount of money spent by municipalities and industries on pollution control devices. This slowdown came as a result of numerous anticipated and unforeseen difficulties that arose with the implementation of the act, including the removal of many of the enforcement and permit powers from the state governments and a series of early changes in the rules and regulations promulgated by EPA for the management of the law. But since its passage a portion of the billions of dollars that were allocated by the act has escaped the web of red tape and been spent for the planning of water quality management and the construction of sewage treatment facilities within the Potomac River basin.

It is necessary to be familiar with several provisions of PL 92-500 to understand the abatement programs under way in the basin. Section 402 prohibits the discharge of pollutants from any point source into the waters of the United States unless the discharger has applied for and received a National Pollutant Discharge Elimination System (NPDES) permit. NPDES permits are issued by EPA or by a state water pollution control agency whose permit program has been approved by EPA as meeting the intent of the law. Currently, the only states in the Potomac basin which have received EPA approval for issuance of NPDES permits are Virginia and Maryland.

Each permit sets a limit on the quantity of pollutants that can be discharged in the effluent from a point source. For municipal point sources, the law requires effluent limitations to be achieved by July 1, 1977 based on a minimum of secondary treatment, which is defined by EPA as a level of treatment producing no greater than 30 milligrams per liter (mg/l) of 5-day biochemical oxygen demand (BOD_5) and suspended solids as a monthly average. For industrial

point sources, effluent limitations based on best practicable control technology (BPT) must be achieved by July 1, 1977. BPT effluent limitations have been determined by EPA for each different industrial category. More stringent effluent limitations must be achieved by both municipal and industrial dischargers if required to avoid violations of federal and/or state quality standards established for the receiving waters.

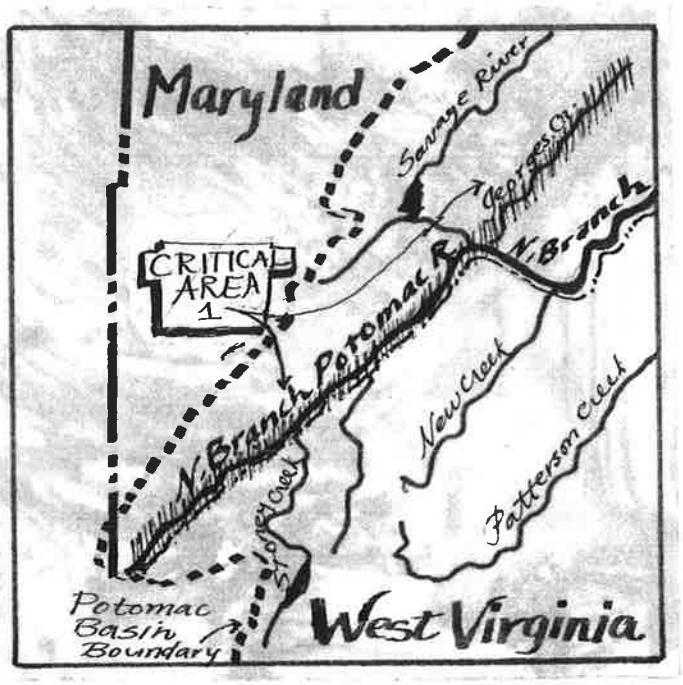
As a second step, PL 92-500 also requires industrial dischargers to achieve effluent limitations by July 1, 1983, based on best available technology economically achievable (BAT), which again have been determined by EPA individually for each different industrial category. Municipal dischargers must achieve best practicable waste treatment technology but this has been defined by EPA as secondary treatment plus whatever additional is required to comply with water quality standards. The law further requires that by 1983 such standards must protect all water uses, including swimming and propagation of fish and shellfish. Thus industries, as well as municipalities, may be required to limit pollutants even further to meet the more stringent water quality standards by 1983, although most Potomac basin waters already are subject to the "fishable and swimmable" standards.

Currently, all major dischargers in the critical areas have received NPDES permits. In the spirit of the law, permits have been written so that by 1977 all municipal dischargers should be at secondary treatment. Except for a few cases, the permits have also been written so that all treatment levels for industrial dischargers are BPT. Unfortunately, writing a permit for a discharger does not necessarily guarantee that the requirements will be met, and in several instances facilities will not meet the standards set for them in the time period prescribed. In the discussion of critical areas, care has been taken to note these situations, giving detailed explanations of when the standards will be met.

When a municipality finds that it is not performing as well as is required, it has the opportunity to apply for a series of grants from EPA provided in Section 201 for 75% of the cost of correcting its problems. The first of these grants is a Step I grant. This grant funds a general study of the problem in which several alternatives are investigated. After the investigation, one is selected as best. The municipality is then eligible for a Step II grant, in which a detailed engineering study is done for the one alternative found to be the most cost effective and environmentally sound in the Step I grant. Finally, the municipality is eligible for a Step III grant, which is the funding of the costruction of the project itself. Due to a lack of funds, however, in any one year not every municipality which faces a problem is likely to be granted funds. Instead, each state has established a priority system, as required by the law, in which the project deemed most necessary is funded first, and projects with lower priorities are often rescheduled for receiving funds and completion in later years.

CRITICAL AREA ONE

North Branch Potomac River and Georges Creek
Maryland and West Virginia



Critical Area One is located in the headwaters of the Potomac River and includes Georges Creek and the first 40 miles of the North Branch. Water quality problems in this area stem from two sources--the discharge of untreated sewage and acid mine drainage. Raw sewage discharges are common in this area and occur in many small communities that have not been sewered or that have failing septic systems. This problem would normally be considered significant except that in this area it is overwhelmed by the much more serious problem of acid mine drainage.

Acid mine drainage is the runoff of water from active and inactive coal mines. This discharge can be characterized by a high concentration of acidity and iron and sulfur compounds. When entering a stream, mine drainage lowers the pH and creates an environment which is deadly to all but the most resistant forms of plant and animal life. Mine drainage problems in this area result not only from active mines but also from abandoned mines, some of which have been inactive for over 150 years.

WATER QUALITY

The North Branch, Georges Creek and many of the minor tributaries have been devastated by the flow of acid mine drainage for as long as mining has been practiced in this area. Of the 140 miles of streams that have been adversely affected, most are devoid of fish. Virtually no natural biological communities exist upstream of Kitzmiller on the North Branch. Many of the streams have a ferric hydroxide slime (known as "yellow-boy") covering stream beds.

In 1974, a detailed study was published by the State of West Virginia concerning the extent of that state's acid drainage problem. The report indicated that the streams most adversely affected by acid drainage were Deakin Run (with a pH of 4.9),

Buffalo Run (3.2), Stony River (4.5), Abrams Creek (4) and Piney Swamp Run (3.1). In Maryland, acid mine drainage affects Laurel Run, Mill Run, Braddock Run and numerous unnamed tributaries in addition to Georges Creek and the North Branch. In 1975 the pH of the Potomac averaged 3.8 at Barnum, West Virginia, 4.1 at Kitzmiller, Maryland, and 4.3 at Bloomington, Maryland. The pH averaged 5.8 on Georges Creek just before its confluence with the Potomac. At all of these locations iron concentrations were high. Stream surveys in Maryland indicated pH's as low as 2.6 and iron concentrations as high as 500 mg/l.

MAJOR DISCHARGERS

The sources of acid mine drainage are active and inactive surface and deep coal mines. Studies during the late 1960's and early 1970's indicated that about two-thirds of the acid load entering the North Branch originated in West Virginia with the remaining one-third originating in Maryland. The studies also indicated that each state faces a different abatement problem--the majority of acid mine drainage in West Virginia came from active mines and the majority of acid mine drainage in Maryland came from inactive, abandoned mines. The West Virginia report, entitled West Virginia Acid Mine Drainage Study in North Branch Potomac River Basin (Department of Natural Resources, 1974), stated that the "Abatement of drainage from old abandoned mines would probably have a very minor effect on the water quality of the North Branch itself until quality standards are met on active mine discharges." The report also indicated that the largest polluters were two plants owned by Island Creek Coal Company--the Alpine mine and the North Branch mine. Other studies indicated that Maryland's problem, on the other hand, was how to contend with the approximately 400 inactive mines in the Potomac basin, of which about 175 had been found discharging acid loads.

DISCUSSION

In recent years both Maryland and West Virginia have taken steps to correct their particular problems concerning acid mine drainage. West Virginia has begun to enforce its NPDES permits more vigorously. Treatment systems have been put into place at the Alpine and North Branch mines and the quality of their discharges has been greatly improved. Over 30 samples have been taken from the treatment system of these two mines during the last two years and all have indicated that the plant was working properly. According to West Virginia officials, Deakin Run, Stony River and Buffalo Creek have all shown improvements in their water quality, and active mines can no longer be considered the major discharger of acid loads.

To correct pollution from their abandoned mines, the State of Maryland has enacted the "Abandoned Mine Drainage Control Act." This act authorizes the Secretary of Natural Resources to acquire and rehabilitate land occupied or degraded by any abandoned mine. The act also authorizes a $5 million state loan, known as the "Mine Reclamation and Water Quality Restoration Loan of 1970," exclusively for the purpose of financing the costs of

acquisition, improvements, or rehabilitation of land and facilities connected with acid mine drainage. Unfortunately, this $5 million loan will not be nearly enough to abate the acid mine drainage problem. Preliminary engineering estimates of the total costs of acid mine drainage abatement from abandoned mines for the State of Maryland alone are around $30 million.

Some improvements in water quality have been the result of increased surface mining, oddly enough. The reworking of a number of abandoned surface mines has resulted from the increased value of coal. Many of these abandoned surface mines had never been reclaimed and were discharging acid. Having been reworked, they must be reclaimed according to state law, and are left in much better condition than before the reworking.

In addition to the work done by Maryland and West Virginia, the Baltimore District of the Army Corps of Engineers is carrying out an extensive investigation of acid mine drainage in the North Branch. The Corps investigation will attempt to define the extent and magnitude of abandoned mine drainage pollution and develop detailed designs and cost estimates for the most cost effective alternative.

CRITICAL AREA TWO

North Branch Potomac River, Maryland

Critical Area Two is a 50 mile stretch of the North Branch, from Luke to Oldtown, Maryland. Waters entering this segment above Luke are already of poor quality, having been adversely affected by acid mine drainage farther upstream. In this segment the waters receive major discharges from Westvaco and the Upper Potomac River Commission (UPRC), which increase the temperature and add hundreds of pounds of organic wastes and solids. Farther downstream, before the river is able to completely recover, it receives the discharges of Celanese, Kelly Springfield, PPG Industries and the city of Cumberland. The impact of all of these discharges greatly reduces the quality of water in this segment and has led historically to numerous water quality violations each year.

WATER QUALITY

As with other portions of the North Branch, the water quality data in this area is incomplete at best. Only six months of sampling was done during 1975. During 1974 monthly samples were taken during nine months. Two monitoring stations are located so that they can measure the impact of Westvaco and UPRC, one just below UPRC and the other 13 miles farther downstream. The station located nearest UPRC had a dissolved oxygen concentration of 7 mg/l during 1974, with values as low as 1.8 mg/l. At this station total solids averaged 420 mg/l and turbidity averaged 73 JTU. Farther downstream the dissolved oxygen improved only slightly, with a yeraly average of 7.4 mg/l but with a low of 1.6 mg/l. Total solids averaged 406 mg/l and the turbidity averaged 90 JTU. Below Cumberland the quality was much improved with dissolved oxygen averaging 10 mg/l, total solids 335 mg/l and turbidity 32 JTU.

MAJOR DISCHARGERS

Westvaco Corporation and the Upper Potomac River Commission

Westvaco is located on the North Branch Potomac River at Luke, Maryland. This pulp and paper mill was founded in 1888 and has grown to be the single largest industry in the Potomac basin. Over 1,800 people are now employed by Westvaco and the plant produces daily some 750 tons of pulp and 1,000 tons of white paper. The paper produced here is used for everything from magazines to cigarette packages.

Westvaco has historically been known as one of the largest polluters on the Potomac. In its early years of operation, literally hundreds of pipes discharged raw wastes from Westvaco into the Potomac. Since 1960, however, the plant has embarked on a $30 million pollution abatement program designed to eliminate both its air and water pollutants. The plant currently withdraws almost 60 mgd of water from the river, making it also one of the largest water users in the Potomac basin. Thirty million gallons of this water is used for cooling, and returned to the Potomac without treatment. The other water is used as process water. Approximately 20.2 million gallons of this water is sent to the Upper Potomac River Commission facility for treatment. Of the remaining water, half is recycled and the other half evaporated.

The UPRC facility treats the wastes of Westvaco and the towns of Westernport, Luke and Piedmont. This facility was constructed in 1960 with Westvaco paying 96% of the construction and the operating costs of the facility at that time. The facility was designed to treat 21.6 mgd of which 20.8 was expected to flow from Westvaco. This facility was designed as a conventional activated sludge plant at a cost of approximately $4 million. In 1972 some renovation took place but a larger, $5 million renovation and expansion is currently under way to meet the 1977 standards. Improvement in the facility will include a new primary clarifier, major modifications in the municipal sewage handling system, replacement of an entire aerator system and a cooling tower. The current permit for UPRC allows the facility to discharge 14,261 pounds/day of BOD_5 and 51,341 pounds/day of suspended solids. In 1975 the facility averaged a flow of 20.1 mgd with 11,475 pounds/day of BOD_5 and 36,192 pounds/day of suspended solids. A new set of requirements will go into effect in 1977 which will limit the discharge of BOD_5 to 9,000 pounds/day and the discharge of suspended solids to 30,000 pounds/day.

Cumberland

The Cumberland sewage treatment facility was built in 1957 and designed to treat 10 mgd. Treatment consists of prechlorination, grit removal, primary sedimentation and final chlorination. The sludge produced is air dryed on drying beds and is collected by farmers and homeowners as a soil conditioner. This facility is the largest domestic water treatment facility in the upper portion of the basin, treating the wastes of Cumberland, La Vale, the Braddock Run area and the Bedford Road area. In 1973 it was reported that the plant treated the wastes of some 78,000

individuals. This facility is in the final stages of an improvement program which will include expanding the plant to 15 mgd and adding a new primary clarifier, activated sludge facilities, and secondary clarifiers.

In 1975 the Cumberland sewage treatment plant averaged a flow of 8.7 mgd containing 6,398 pounds/day of BOD_5 (88 mg/l) and 3,913 pounds/day of suspended solids (55 mg/l). The permit for the plant during this period allowed 9,100 pounds/day of BOD_5 and 4,250 pounds/day of suspended solids. The permit will be made more stringent beginning July 1, 1977, reducing the BOD_5 load to 2,500 pounds/day and the suspended solids load to 3,120 pounds/day.

PPG Industries

Pittsburgh Plate Glass Industries is a manufacturer of plate and flat glass. The facility is located near Cumberland, Maryland and discharges to the North Branch. At peak production the plant uses approximately 2 mgd of water and produces about 760 tons a day of glass. In 1973, however, PPG closed its grinding and polishing operations and its water use was greatly reduced. In 1975 the plant used only .135 mgd of which .125 mgd was process and cooling water and the remaining .01 mgd was sanitary sewage. PPG operated a .75 mgd treatment plant for its sanitary waste, a 40 acre lagoon for its process water and a cooling tower. During 1975 PPG met its NPDES permit requirements.

Celanese Fibers Company

Celanese Fibers Company is located near Cumberland, in Amcelle, Maryland and discharges to the North Branch of the Potomac. The plant produces cellulose acetate and tri-acetate fibers. In 1975 the plant used approximately 11.6 mgd for cooling water, which was returned to the river without treatment. The plant also used 1 mgd for process water, averaging 83 pounds/day of BOD_5 (10 mg/l) and 115 pounds/day of suspended solids (14 mg/l). Celanese's permit allows it to discharge 420 pounds/day of BOD_5 and 500 pounds/day of suspended solids. Celanese uses standard secondary treatment with activated sludge to treat its wastes.

Kelly-Springfield Tire Company

Kelly-Springfield has been producing truck and auto tires at its present location since 1921, although in recent years the plant's production has been reduced. The only treatment given to discharges from Kelly-Springfield is bar screening and settling. In 1975 Kelly-Springfield discharged over 1,500 pounds/day of suspended solids. Rather than treat its own discharge to levels acceptable for the 1977 standards, Kelly-Springfield has chosen to pretreat its waste and then to send it to the Cumberland plant for treatment.

DISCUSSION

Of the areas discussed in this report, Area Two can be

considered as one of the most critical. The impact of acid mine drainage from upstream sources and the discharge of oxygen demanding substances in this section have had a tremendously adverse effect on the river. Unfortunately, low pH and low dissolved oxygen values tend to occur during the same period of the year--the summer months.

To complicate pollution abatement efforts, it appears that the clean-up of the wastes of Westvaco at the UPRC facility has resulted in increased pH problems. In the past, the discharges from Westvaco-UPRC have had a large quantity of alkalinity in them. This alkalinity has tended to neutralize the acid water of the North Branch and cause the pH of the stream to increase. As these facilities have upgraded their treatment, less alkalinity has been discharged and the pH values of the stream have remained low. By 1977 UPRC is expected to decrease its discharge by 40% due to in-plant changes at Westvaco, so even less alkaline materials will be discharged.

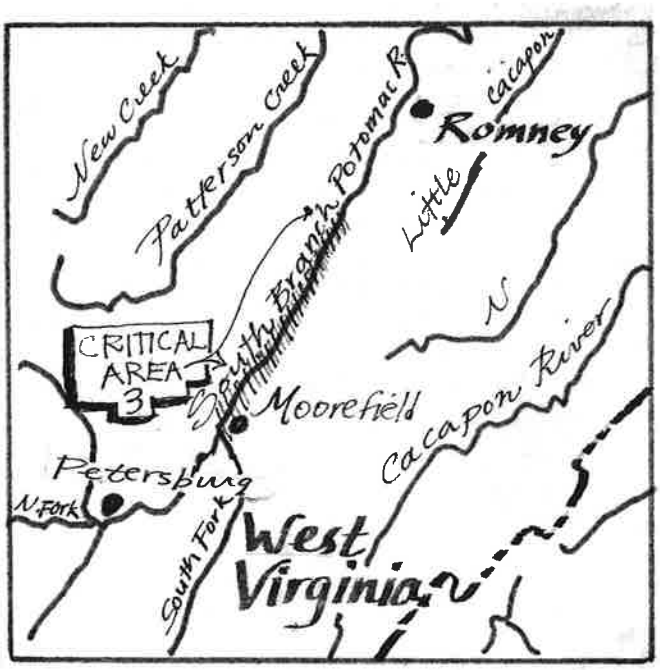
One positive development in the near future of this area is the construction of the Bloomington Dam. This dam will be located some 20 miles upstream of Westvaco and will increase the average low flow at Bloomington from 93 cubic feet per second (cfs) to 305 cfs. This dam should have the effect of raising the summer-time pH and dissolved oxygen levels.

Recent studies (Water Quality Analysis of the Potomac River, Hydroscience, 1976) have been conducted to determine the allowable load of oxygen demanding substances in this portion of the river. These studies indicate that the load discharged by Westvaco-UPRC after the construction of the Bloomington Dam should not exceed 9,200 pounds/day of BOD_5, a figure very close to the 1977 limit of 9,000 pounds/day established by Maryland's permit. This study also set limits for Cumberland and Celanese Fibers. The limit established for Cumberland by the State of Maryland is considerably higher than the limit suggested in the report even after the construction of Bloomington Dam. Further investigations are needed by Maryland to determine whether the limit established for Cumberland will result in water quality violations.

Water quality problems have been common in this area of the Potomac for years and change is not likely to occur rapidly. There is little hope that any real improvement in the problem of acid mine drainage will occur before 1985, and based on water quality models, one can expect dissolved oxygen violations to occur any time stream flow approaches the seven-day ten-year low flow levels. If not rapidly, one can hope improvements will come steadily as the acid mine drainage problem is corrected, the Bloomington Dam is completed, and improvements are made in the Cumberland, Westvaco-UPRC and Celanese treatment facilities.

CRITICAL AREA THREE

South Branch Potomac River, West Virginia



Critical Area Three is located near the confluence of the North and South Forks of the South Branch of the Potomac River. The area begins at Moorefield, West Virginia and extends several miles downstream. The two major dischargers in this area are the town of Moorefield and the Rockingham Poultry Marketing Co-op, Inc.

WATER QUALITY

Unfortunately there are no water quality monitoring stations located in this portion of the river. What is known about the water pollution in this area is a result of visual observations and has not been officially confirmed with chemical analysis. The type of water quality problem that is prevalent in this area is the growth of algae and other aquatic plants. The river below Moorefield is slow-moving, and there are numerous deep pools that serve as nutrient traps. Algae growth is quite noticeable in these pools during the summer months, and the algae growth is believed to cause water quality violations.

MAJOR DISCHARGERS

Rockingham Poultry Marketing Co-op, Inc.

Rockingham Poultry is the largest discharger to this portion of the river. Until 1973, the plant was a serious polluter. The effluent from this chicken rendering plant was discharged to the South Fork with only the slightest treatment. In 1973, however, the facility made major improvements to its treatment, adding a Griffith-style aerated lagoon and chlorinator designed to treat .427 mgd. The permit for this facility allows it to discharge 82 pounds/day of BOD_5, 124 pounds/day of suspended solids, fecal coliform concentrations of 400 MPN/100 ml and oil and grease concentrations of 10 mg/l. During 1975 the facility averaged a

flow of .331 mgd containing an average of 77.6 pounds/day of BOD_5. Five of the samples taken exceeded the effluent limitation for the BOD_5 load, but improved operation and maintenance will allow this facility to easily meet its NPDES permit.

Moorefield

The town of Moorefield has a population of approximately 2,000 people, of which 1,500 is sewered. Its treatment facility is a primary treatment plant designed to treat .2 mgd. The permit for the facility allows it to discharge .2 mgd containing 50 pounds/day (30 mg/l) of BOD_5 and suspended solids. The facility is not treating its wastes to that level currently, however. No data were taken for this facility in 1975, but data are available for a short time period in 1976. During the months of April, May and June, the facility averaged a flow of .125 mgd containing 307 mg/l of BOD_5, 112 mg/l of suspended solids and a fecal coliform concentration of 17,329 MPN/100 ml. The strength of the BOD_5 in the effluent indicated that there is probably some type of industrial discharge to the municipal facility. The town has completed a Step I planning grant for the improvement of its facility but has yet to receive funds for a Step II design grant.

DISCUSSION

It appears that the probable cause of the water quality problems below Moorefield currently is the minicipal sewage treatment plant. That facility is discharging three times as much BOD_5 per day as the Rockingham Poultry plant. It is diffucult to determine the impact that either of these dischargers has on the growth of algae, however, since neither of them monitor the concentration of nitrogen or phosphorus in their effluent. If excessive algae and aquatic plant growth continues to be a problem, both dischargers should be required to begin to monitor the nutrients in their discharges. A slight reduction in nutrient concentrations can be expected when the Moorefield facility is upgraded to secondary treatment. However, the upgrading of this facility has been given a rather low priority by the state and may not be completed for several years.

It is possible that requiring nutirent removal from the dischargers in this area may not solve the water quality problems. Another possible source of nutrient pollution to this stretch is the discharge from non-point sources along the banks of the river below Moorefield. This area is used for the grazing of cattle and it is believed that their wastes may have an impact on the quality of the river. This situation reinforces the need for more monitoring, both of the dischargers and the river itself, in this portion of the Potomac.

CRITICAL AREA FOUR

Abrams Creek, Virginia

Critical Area Four is located downstream from Winchester, Virginia on Abrams Creek and extends into Opequon Creek. The major treatment facilities in this area discharge into Abrams Creek, but their full effects are not felt until several miles after Abrams Creek flows into the Opequon Creek. Historically, the water quality violations in this area have been a result of low dissolved oxygen levels and high fecal coliform concentrations. The State of Virginia classifies this creek as water quality limited.

WATER QUALITY

In 1975 dissolved oxygen levels in Abrams Creek averaged 7.5 mg/l and did not go below water quality standards during the 12 periods when samples were taken. Fecal coliform standards were exceeded during all 12 sampling periods with the log mean average equaling 4,963 MPN/100 ml.

MAJOR DISCHARGERS

Winchester

The Winchester sewage treatment plant began operation in December of 1949. By 1973 the plant was serving some 21,000 individuals from the City of Winchester and Frederick County. During that year the plant treated an average of 4.5 mgd, of which .3 mgd was from industrial sources. Although the flow of the industrial dischargers was small compared to the municipal flow, it constituted up to 60% of the organic loading of the plant. The largest single contributor of industrial waste was National Fruit Product Company, Inc. which discharged daily .135 mg. Currently, treatment consists of primary sedimentation, chemical addition of a polymer, trickling filters and secondary sedimentation. The sludge produced is treated by anaerobic digestion, drying beds, elutriation and vacuum filtering. During periods of fruit processing, urea and lime are added to the waste flows. The urea serves as

a source of nitrogen to aid in the biological treatment of the waste and the lime is used to adjust the pH of the effluent. In 1975, this plant averaged a flow of 4.8 mgd, discharging 1,065 pounds/day of BOD_5 and 734 pounds/day of suspended solids.

The permit issued for this facility allows it to discharge 804 pounds/day of both suspended solids and BOD_5 at a concentration of 18 mg/l. The facility is not hydraulically overloaded but due to the strength of the industrial dischargers it is organically overloaded. This organic overload causes the plant to exceed its limit on the discharge of BOD_5. Winchester has applied for and received a Step I grant to determine what modifications will be necessary for it to meet its effluent requirements. The State of Virginia has suggested that advanced treatment in the form of nutrient removal may be required for compliance with water quality standards.

O'Sullivan Corporation

The O'Sullivan Corporation is involved in the mixing, milling and calendering (pressing to a glossy finish) of natural and synthetic polymers and rubber compounds in order of vulcanize and finish shoe products. The facility also fabricates various resins into calendered or extruded film and sheeting. Wastewater from this facility consists of boiler blowdown, in-plant oil sumps and spent cooling water. The current discharge permit for O'Sullivan requires it to provide treatment that will limit the levels of suspended solids, BOD_5, oil and grease to 10 mg/l and the concentration of total phosphorus to 15 mg/l. Currently, O'Sullivan is discharging approximately 2 mgd.

DISCUSSION

In 1975 Critical Area Four met water quality standards in all categories except fecal coliforms. The source of this pollution is undoubtedly the Winchester sewage treatment plant and possibly some non-point sources of pollution. The dissolved oxygen level was well above the water quality standard, however. Stream flow was much greater than usual in 1975 and no severe low flow situation occurred during the year. This area is a water quality limited segment and thus there is the possibly of water quality violations during low flow periods until final effluent standards are in effect.

The greatest problem facing this area is the growth of nuisance aquatic plants which grow as a result of excessive nutrients in the creek. Control of this problem will not occur until the Winchester sewage treatment plant removes nutrients from its discharge, which will not occur for several years. Even then the control of only point sources may prove to be inadequate and a strategy will have to be implemented to control non-point sources of pollution.

CRITICAL AREA FIVE

Christians and Lewis Creeks, Virginia

Critical Area Five includes two small creeks: Christians Creek and Lewis Creek, just prior to their discharge into the Middle River. Lewis Creek has long suffered water quality degradation, especially low dissolved oxygen, high nutrient values and high fecal coliform concentrations. The major discharger to Lewis Creek is the town of Staunton. Additional pollution is discharged by a number of smaller facilities. Non-point sources are also thought to have an impact on this stretch. Lewis Creek has an extremely small seven-day ten-year low flow and therefore any pollution that reaches the creek is significant during low flow periods. Christians Creek, unlike Lewis Creek, has been historically within water quality standards. Recently a new treatment facility, the Fisherville regional sewage treatment plant, began operation. The impact of this new plant has not been measured yet, however modeling efforts by the State of Virginia indicate that the discharge will cause no violations of water quality standards.

WATER QUALITY

The dissolved oxygen concentration in Lewis Creek during the 12 sampling periods it was monitored in 1975 averaged 9.7 mg/l, well above the water quality standard and approximately 1 mg/l greater than the previous year's average. None of the sampling periods indicated a violation in the dissolved oxygen with eight of the 12 samples exceeding water quality standards. Nutrient levels were exceedingly high with total nitrogen averaging 7.2 mg/l and total phosphate equaling 1.1 mg/l.

MAJOR DISCHARGERS

Staunton

The Staunton sewage treatment plant discharges into Lewis Creek

and currently serves nearly 25,000 individuals. The secondary treatment facility was designed for a flow of 4.5 mgd and includes an aerated degritter, a primary clarifier, two high rate trickling filters, a secondary clarifier and a chlorinator. The sludge produced is treated by digestion and drying lagoons. The permit issued for this facility which expired in September of 1976, allows it to discharge an average of 4.5 mgd containing 938 pounds/day of BOD_5 and 900 pounds/day of suspended solids. In 1975 the flow in the facility only averaged 2.3 mgd and the BOD_5 and suspended solids loads were 388 and 406 pounds/day, respectively. Although this plant is operated efficiently these discharges are great enough to cause severe water quality problems in Lewis Creek. The city of Staunton has completed a Step I grant to investigate this problem and begun a Step II grant for development of detailed engineering plans for the solution. The Step I study suggested that the town relocate its discharge from the water quality limited Lewis Creek to the effluent limited Middle River. This change in the location of discharge should greatly improve the quality of water in Lewis Creek without substantially affecting the water quality of the Middle River.

Fisherville

The Fisherville regional sewage treatment plant is a newly completed secondary plant which discharges into Christians Creek. The plant is designed to treat 2 mgd of flow to a 90% removal level for BOD_5 and suspended solids. The treatment consists of grit removal, aerobic digestion, aeration, final settling, micro-straining and chlorination. The plant is expected to serve some 12-14,000 individuals and will eliminate discharges of the DeJarnette Sanitarium, Western State Hospital, Woodrow Wilson Education Center, the Goose Creek sewage treatment plant, and the sewered area of Fisherville. The permit for this facility allows it to discharge an average of 2 mgd with a loading of 400 pounds/day of both BOD_5 and suspended solids.

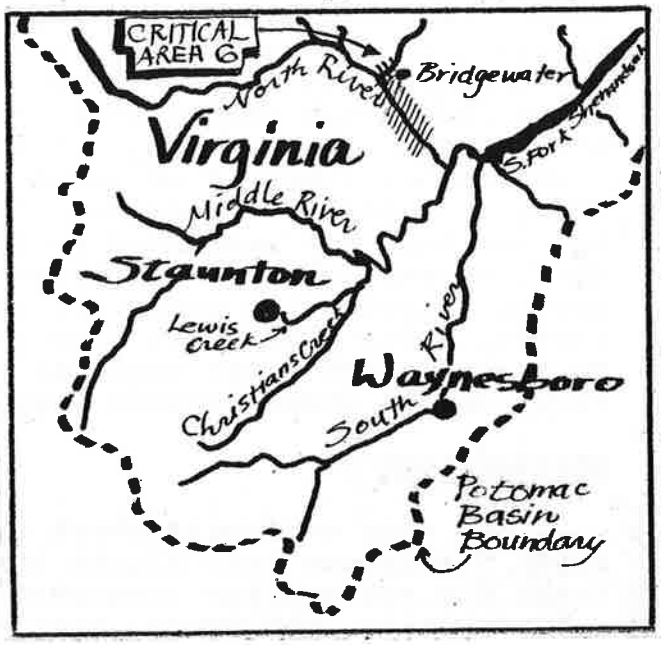
DISCUSSION

The low flows that are characteristic of Lewis Creek make it a poor choice as a receiver of wastewater from the Staunton sewage treatment facilities. When the effluent pipe for Staunton is relocated to the Middle River, a substantial improvement in the quality of Lewis Creek will occur.

With the completion of the Fisherville regional plant, and the elimination of a number of smaller, less sophisticated plants, Christians Creek should also improve in water quality.

CRITICAL AREA SIX

North River, Virginia



Critical Area Six includes the North River downstream of Bridgewater, and three of its tributaries: Blacks Run, Cooks Creek and Muddy Creek. The entire area suffers from low dissolved oxygen levels during low flow periods, and from high fecal coliform concentrations. In addition, Blacks Run and Cooks Creek suffer from high nutrient concentrations.

WATER QUALITY

Dissolved oxygen levels in Blacks Run averaged 7.14 mg/l in 1975 with one out of the 12 samples taken below water quality standards. Fecal coliform concentrations averaged 909 MPN/100 ml with six out of 12 samples above the water quality standards. Nutrient levels were high, with total nitrogen averaging 11.9 mg/l and total phosphorus averaging 2.4 mg/l.

Dissolved oxygen levels in Cooks Creek were slightly higher than in Blacks Run, with a yearly average of 7.8 mg/l. However, there was also one violation in dissolved oxygen in Cooks Creek in 1975. There were five violations of fecal coliform concentrations in Cooks Creek, and the creek had a yearly average of 600 MPN/100 ml. Total nitrogen averaged 7.5 mg/l and total phosphates averaged 1.23 mg/l.

MAJOR DISCHARGERS

Bridgewater

The town of Bridgewater operates a primary treatment facility designed to treat .35 mgd and discharge into the North River. The treatment includes grit removal, pre-chlorination, clarification, digestion and post chlorination. The facility has a permit to discharge an average of .425 mgd containing 156 mg/l of BOD_5 and 120 mg/l of suspended solids. In 1975 the plant's discharge averaged only .28 mgd, the suspended solids concentration averaged 72 mg/l but the plant greatly exceeded its permit by discharging an average of 218 mg/l of BOD_5. This facility is soon to be

abandoned. Its flow is to enter the North River regional sewage treatment plant which was constructed by the Harrisonburg-Rockingham Regional Authority. The change should occur sometime between July and December of 1976.

Dayton

The town of Dayton operates a facility designed to treat .244 mgd and discharges its effluent into Cooks Creek. The plant processes include a communitor, a .3 acre stabilization pond which is aerated with six surface aerators and a chlorinator. The facility is fed by a combined sewer and during periods of rainfall, raw sewage is by-passed around the plant. The facility has one large industrial contributor, Marval Industries, which processes over 15,000 turkeys a day. The permit for Dayton allows it to discharge .244 mgd of effluent containing 66 mg/l of BOD_5 and 50 mg/l of suspended solids. In 1975 the flow averaged .383 mgd and the BOD_5 and suspended solids concentrations were 164 and 166 mg/l, respectively. From these figures, it is obvious that Dayton exceeded its permit in all the categories which were monitored. This plant will also soon be abandoned and its flow directed to the North River regional plant. The change in the sewage flows should occur between July and December of 1976.

Harrisonburg

The city of Harrisonburg operates a secondary treatment plant which discharges into Blacks Run. The facility was designed to treat 1.4 mgd and its treatment includes grit removal, primary sedimentation, biological treatment using trickling filters, secondary clarification, and chlorination. The facility has a permit to discharge 2.75 mgd with a BOD_5 concentration of 60 mg/l and a suspended solids concentration of 40 mg/l. In 1975 the plant averaged a flow of 3.03 mgd with concentrations of 71 and 40 mg/l of BOD_5 and suspended solids, respectively. Like the other municipal dischargers in the area, Harrisonburg will join the North River regional plant. Its discharge into the regional plant should begin in July of 1976.

The plant which will replace these municipal dischargers is an 8 mgd enhanced secondary treatment plant that will use activated sludge with chemical flocculation. The facility will discharge into North River approximately four miles downstream of the current Bridgewater plant.

Wampler Foods, Inc.

Wampler Foods, Inc. began operation in the late 1940's. Its discharge flows into War Branch which then flows into Muddy Creek. The facility produces dressed turkey. At the facility over 169,000 pounds of product are produced a day. Wastes and by-products are treated using the following processes: screening, primary sedimentation, chemical coagulation, dissolved air floatation, trickling filter and supplemental aeration, clarification and chlorination. The plant has a permit to discharge 654 pounds/day of BOD_5 and 547 pounds/day of suspended solids. In 1975 the plant did not operate at its full capacity. Its flow averaged

.22 mgd with loads of 320 and 370 pounds/day of BOD_5 and suspended solids, respectively. The plant is currently not operating at BPT but should meet those standards soon by adding a biodisk as a polishing treatment for its organic load. This addition is expected before July 1977.

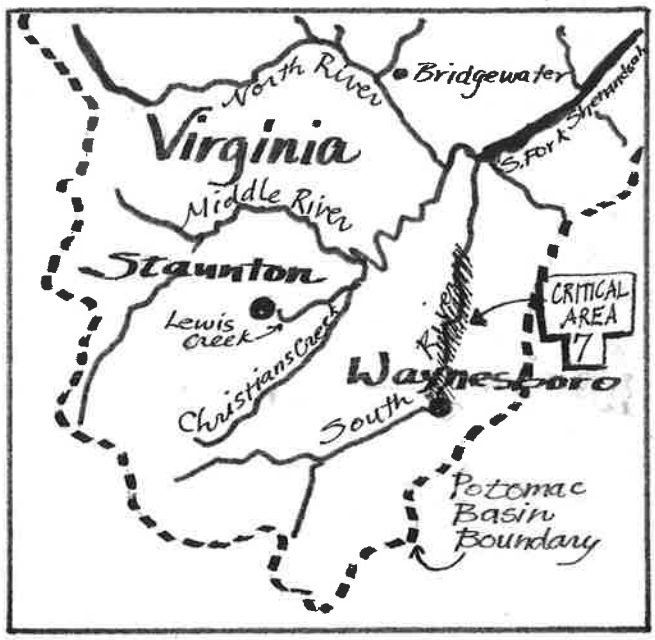
DISCUSSION

Critical Area Six faces the prospect of substantial improvements in water quality. The consolidation of the small, inefficient municipal treatment plants into one large, more sophisticated plant should result in a decrease in the total pounds of BOD_5 and suspended solids discharged daily. There should also be a beneficial impact from removing discharges from small streams, such as Cooks Creek and Blacks Run, and placing them into the larger North River. The polishing unit which is to be added to Wampler Foods, Inc. should also help the quality of War Branch and Muddy Creek. When this report is revised in the years to come, it is quite possible that these improvements will allow this segment to be removed from the list of critical areas.

CRITICAL AREA SEVEN

South River, Virginia

Critical Area Seven is located on the South River at and below Waynesboro, Virginia and extends to near Grottoes, Virginia. The South River is a tributary of the South Fork of the Shenandoah River. Water quality above this area has been historically of an extremely high standard. However, the area presently has high organic loadings and high levels of fecal coliforms. This is a water quality limited segment.



WATER QUALITY

Dissolved oxygen levels downstream of Waynesboro averaged 8.9 mg/l in 1975 with only one of the 12 monthly samples below water quality standards. This average was up nearly 1 mg/l from the previous year. Fecal coliform concentrations averaged only 317 MPN/100 ml and only one sample exceeded the water quality standard of 1,000 MPN/100 ml. Nutrient levels were average for this type of stream, with total nitrogen levels averaging 2.68 mg/l and total phosphates averaging .44 mg/l.

MAJOR DISCHARGERS

The most significant factor in the decrease in water quality between Waynesboro and Harriston is the discharge of wastewater from three large treatment facilities: the city of Waynesboro, Crompton-Shenandoah and E. I. du Pont de Nemours Company, Inc. Together they discharged in 1975 over 12.3 mgd of wastewater containing some 1,100 pounds/day of BOD_5, 13,200 pounds/day of suspended solids and 14,700 pounds/day of chemical oxygen demand.

Waynesboro

The Waynesboro sewage treatment plant began operation in 1955 and currently serves over 15,000 individuals. The plant was upgraded in 1968 and now has a design flow of 4 mgd with plant design removal efficiencies of 85-90% of BOD_5 and suspended solids.

Treatment currently consists of bar screening, degritting, biological treatment by trickling filters, final sedimentation and chlorination. Sludge is digested, vacuum filtered, dried on sand beds and then transported to final disposal. During the calendar year 1975, the flow to the plant averaged 3.3 mgd. The plant discharged an average of 511 pounds/day of BOD_5 (21 mg/l) and 675 pounds/day of suspended solids (25 mg/l). The permit under which this plant operates allows it to discharge 4.0 mgd of wastes containing 1,100 pounds/day of BOD_5 (33 mg/l) and 1,268 pounds/day of suspended solids (38 mg/l). It is obvious that the plant operated well within its permit in 1975. Further increase in this plant's efficiency will be necessary for the stream to meet water quality standards. The facility should complete its Step I grant to investigate the further needs in upgrading by July 1976 and should begin upgrading by July 1977.

Crompton-Shenandoah

Crompton-Shenandoah is located in Waynesboro, Virginia. It is a dryer and finisher of pile fabrics. This plant uses both natural and synthetic fibers in its production process. Wastes from this plant include waxes, dyes, bleaches and other closely related compounds. In a normal process year, approximately 2.5 mgd of water is used by the facility and nearly all of the water comes from local springs. Present wastewater treatment includes equalization, biological treatment using an aerated lagoon and final clarification. A trickling filter and another clarifier are also used when necessary. This treatment process has been installed in recent years. It should be noted that this plant was chosen by the EPA as a model facility on which BPT standards were set for this type of operation.

During the calendar year 1975 production was lower than in previous years with waste flows from the plant averaging only 1.54 mgd. Average daily BOD_5 loads discharged in 1975 were 58.7 pounds/day (4.6 mg/l), suspended solids loads were 388 pounds/day (30.2 mg/l), and COD averaged 2,312 pounds/day (180 mg/l). The current permit for this plant does not expire until 1979 and allows the discharge of an average BOD_5 load of 60 pounds/day, suspended solids load of 449 pounds/day and COD load of 2,000 pounds/day. During 1975 there was a biological upset at the treatment plant and for a few months neither the BOD_5 nor COD standards were met.

E. I. du Pont de Nemours

The Du Pont plant located in Waynesboro is engaged in the manufacturing of three synthetic fibers: cellulose acetate, orlon acrylic and lycra spandex. Process wastewaters currently receive secondary treatment consisting of neutralization, blending and pre-aeration, cooling, mixing with recycled sludge, aeration and final clarification. In addition to the process water discharge, Du Pont has two cooling water discharges. 1975 was not a typical year for the Du Pont facility. The plant's production was reduced markedly and personnel layoffs occurred. Du Pont does not expect this trend to continue, and a large addition to the plant is planned. The plant discharged only 7.46 mgd of effluent in 1975, containing 526 pounds/day of BOD_5 (10 mg/l), 2,543 pounds/day of

suspended solids (41 mg/l) and 4,293 pounds/day of COD (69 mg/l). The NPDES permit for Du Pont allows the plant to discharge an average load of 1,000 pounds/day of BOD_5, 12,170 pounds/day of suspended solids and 11,633 pounds/day of COD. These limits will be lowered to 600 pounds/day of BOD_5 and 6,085 pounds/day of suspended solids in July of 1976 and compliance by Du Pont is expected.

Du Pont is currently running its own stream surveys for more extensive information to use in water modeling. They are attempting to show that their permit should be relaxed to only those requirements prescribed by BPT.

DISCUSSION

As mentioned previously, water quality below Waynesboro has been of poor quality historically. This poor quality has been the result of the discharge of inadequately treated wastes. This situation has been exacerbated by the low flows that occur near Waynesboro on the South River during summer months. In recent years vast improvements have occurred in this portion of the river. Continued efforts by the city of Waynesboro, Crompton-Shenandoah and Du Pont have substantially improved water quality.

In the process of allocating waste loads among the three major dischargers, a water quality model was used to establish the assimilative capacity of the river. The assimilative capacity determined by this model, together with BPT guidelines used by EPA (used to set limits on parameters other than BOD_5), were then used to allocate all of the assimilative capacity of the river among the three major dischargers. Therefore, according to the model prediction, none of the assimilative capacity remains to be allocated later for the expansion of these facilities or for the use of new waste dischargers.

This situation has placed the dischargers along South River in a precarious position. If the dischargers wish to expand production--or in the case of the municipality, increase its service area--the treatment efficiencies of the facilities must increase proportionately. Otherwise, water quality standards will probably be violated during periods of low flow. Although there now exists the capacity for the city of Waynesboro and Du Pont to expand over their 1975 levels, this capacity, without increases in treatment efficiencies, could quickly disappear.

One important question concerning waste load allocations which will complicate the decision which must be made is the question of nitrogenous loads to the South River. The discharge from two of the facilities, Du Pont and Waynesboro, contain large amounts of nitrogenous oxygen demand (NOD). As of yet, no limit has been placed on their discharges. The State of Virginia feels that NOD dischargers should be limited, but Du Pont disagrees and contends that the NOD does not play as great a role in water quality in this segment as Virginia believes. Du Pont is concluding a study of this problem and their results, along with studies made by the State of Virginia and EPA, will be used to determine the allocation given dischargers in 1977.

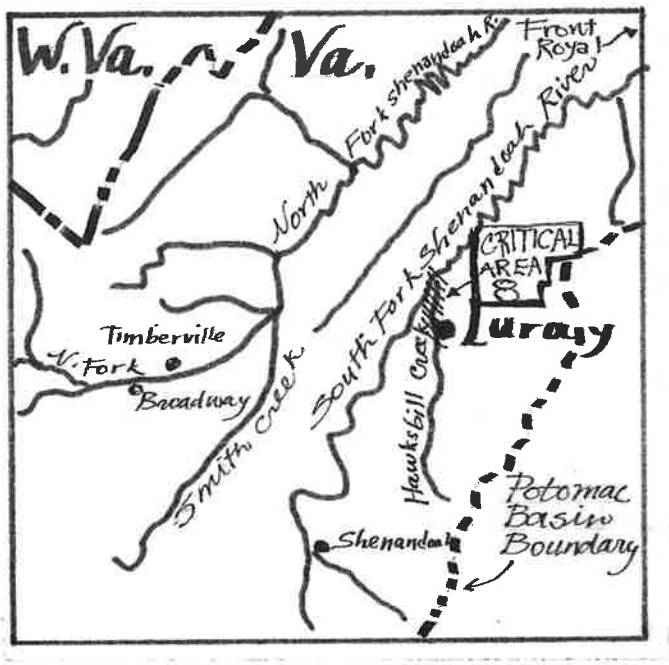
Water quality in the South River below Waynesboro has improved in recent years due to several reasons including: (1) the increased

treatment efficiencies of major dischargers, (2) the cutback in production of two of the major dischargers and (3) unusually high stream flow. However, the management of this stretch of river faces important decisions in the coming years. The pressures of increased industrial production and population expansion will be felt soon and higher levels of treatment, including nitrification (reduction of the nitrogenous oxygen demand) may be in requirements of all facilities discharging in this segment. More detailed water quality models could prove to be of value in making this management decision and continuing the water quality improvement observed in the past.

CRITICAL AREA EIGHT

Hawksbill Creek, Virginia

Critical Area Eight begins on Hawksbill Creek near the town of Luray and continues some five miles downstream until the creek merges with the South Fork of the Shenandoah River. The creek suffers from several water quality problems including low dissolved oxygen levels during the summer months, high fecal coliform counts, high total solids concentrations and high nutrient levels. The magnitude of these problems is affected by non-point sources of pollution, but the major source of the problem is thought to be the discharge from two point sources, the town of Luray and Virginia Oak Tannery.



WATER QUALITY

In 1975 the fecal coliform concentrations averaged 3,774 MPN/100 ml on Hawksbill Creek, below Luray. Ten of the 11 coliform samples taken exceeded the water quality standards. Farther downstream, the dissolved oxygen averaged 10.36 mg/l, with none of the 11 samples below water quality standards. At this same location total nitrogen averaged 3.34 mg/l and total phosphates averaged 1.2 mg/l. Although no data was available for turbidity, this segment of the creek often runs a deep brown in color.

MAJOR DISCHARGERS

Luray

The wastewater facility at Luray treats the discharge of approximately 5,000 residents and four small industries. The plant was initially designed as only a .335 mgd primary treatment plant and chlorination units have recently been added. In 1975 the plant treated over .602 million gallons on a daily average and thus could be considered extremely overloaded. Infiltration/ inflow has also been recognized as a problem in the proper

operation of the plant. Due to the industrial discharges, the wastes entering the Luray facility are at times very concentrated. In 1975 BOD_5 averaged 95 mg/l and suspended solids averaged 84 mg/l. The permit issued by the State Water Control Board allows for a flow of .335 mgd, and concentrations of BOD_5 and suspended solids of 156 and 120 mg/l, respectively.

This facility will not meet the secondary treatment requirement by the deadline of 1977. It is currently in the midst of preparing secondary treatment plans under a Step II grant but it appears unlikely that secondary treatment facilities will be constructed until 1979 or later.

As mentioned, chlorination units are being used at this facility. Their effectiveness in lowering fecal coliform concentrations can not be determined, however, since that parameter is not being measured currently in the plant's effluent.

Virginia Oak Tannery

Virginia Oak Tannery is a processor of purchased animal hides. Using both vegetable and chrome tanning procedures, the tannery produces leather which is used for shoe manufacturing and leather goods. The treatment process consists of equalization, settling, biological treatment in three aerated lagoons and final clarification. The plant employs about 250 individuals. The permit for Virginia Oak Tannery allows the industry to discharge 700 pounds/day of BOD_5, 3,400 pounds/day of suspended solids and requires fecal coliform concentrations to be less than 400 MPN/100 ml.

The discharges of Virginia Oak Tannery were generally within the limits issued by the state except for the fecal coliform standard. BOD_5 averaged 450 pounds/day and suspended solids averaged 2,838 pounds/day while the facility discharged .41 mgd. The facility did not meet the coliform requirement in 1975 with the yearly average near 500,000 MPN/100 ml.

Virginia Oak Tannery has applied for a change in its permit which should allow it to discharge a greater quantity of suspended solids. A final decision on this has not been made by the State Water Control Board.

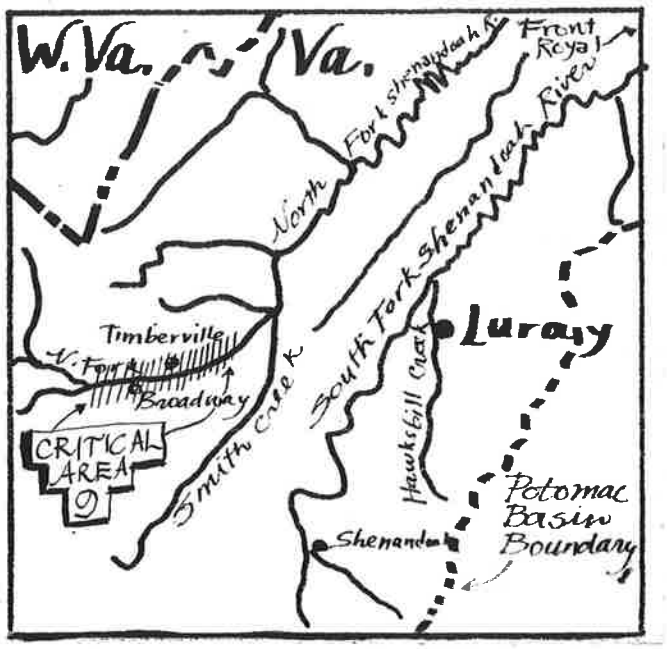
DISCUSSION

The dischargers to Hawksbill Creek face a problem mentioned many times throughout this report: facilities discharging into a stream that often is simply too small to assimilate their wastes. Until the Luray plant is upgraded from a primary plant to something more sophisticated, Hawksbill Creek will continue to suffer water quality violations during low flow periods.

CRITICAL AREA NINE

North Fork Shenandoah River, Virginia

Critical Area Nine lies on the North Fork of the Shenandoah, along a ten mile stretch downstream of the town of Broadway. In past years, municipal and industrial discharges in this area have resulted in severe water quality degradation: low dissolved oxygen levels, high fecal coliform counts and visible scum and debris floating along the stream. This area has for many years been noted as one of the most polluted in all of the Potomac River basin. Dischargers that contribute to this degradation are: the towns of New Market, Timberville and Broadway; and the industries of Shen-Valley Meat Packers, Rockingham Poultry and National Fruit Product Company.



WATER QUALITY

During 1975 the dissolved oxygen level in the North Fork downstream of Timberville and New Market averaged 10.1 mg/l and no samples taken were below the water quality standard. These values represent a marked improvement over the previous year when the dissolved oxygen levels averaged nearly 2 mg/l less and two of the 12 samples taken were below water quality standards. This improvement in dissolved oxygen can probably be attributed to the greater stream flow that occurred in 1975, rather than improvements in wastewater treatment, since no upgrading in treatment facilities was completed during that year.

Fecal coliform counts in 1975 averaged 1,104 MPN/100 ml, with six of the 12 samples exceeding water quality standards. Nutrient levels were normal for a stream receiving wastewater discharges, with total nitrogen averaging 1.98 mg/l and total phosphates .1 mg/l.

MAJOR DISCHARGERS

New Market

The town of New Market operates a .28 mgd sewage treatment

facility which serves approximately 1,500 individuals and treats wastes from a chicken processing plant run by Holly Farms. The treatment of the wastes includes contact stabilization and aeration. Unfortunately, the facility is extremely overloaded and its effluent is of a poor quality. In 1975 the flow from this plant averaged .293 mgd with a BOD_5 concentration of 199 mg/l and suspended solids concentration of 130 mg/l. This BOD_5 concentration is quite high due to the discharge of Holly Farms, and is the strength of normal domestic sewage before treatment.

The town is in the midst of planning expanded facilities under a Step I grant and is under mandate to quickly arrive at a solution acceptable to the State Water Control Board. New Market has required Holly Farms to determine a means of pre-treatment which will limit its discharge to the town's facility to 200 mg/l or less. A dialogue among Holly Farms, the town of New Market and the state has been established in the hope that the initial decision made will be acceptable to all involved.

Timberville

The town of Timberville installed a new treatment plant in 1966. The facility has bar screens, primary sedimentation and chlorination. The plant has a design flow of .1 mgd and it treats the wastes of around 1,000 individuals. There are no known industrial discharges to the plant. The permit written by the State of Virginia for the Timberville facility allows it to discharge .103 mgd, with a BOD_5 and suspended solids concentration of 24 mg/l. In the year 1975, the Timberville discharge averaged only .078 mgd but its BOD_5 and suspended solids concentrations averaged 27.8 and 26.3 mg/l, respectively. During 1975 there were occasional violations of these two standards. Timberville has applied for a Step I grant to determine what direction should be taken to meet its effluent requirement.

Broadway

The town of Broadway uses a series of two ponds for its treatment process. The ponds are designed to treat approximately .1 mgd. The effluent from these ponds does not meet effluent standards. The town's permit for 1975 allowed it to discharge .1 mgd with BOD_5 and suspended solids concentrations of 48 mg/l. In 1975 the facility averaged a flow of .183 mgd with BOD_5 and suspended solids concentrations of 61 and 90 mg/l, respectively. The town has applied for a Step I grant but will not be able to meet the secondary treatment standards by 1977. In the interim, the citizens of Broadway have taken it upon themselves, at their own expense, to upgrade their plant without state or federal assistance. An aeration system for the lagoons has been designed and should be installed when approved by the State Board of Health.

National Fruit Product Company, Inc.

National Fruit Product Company, Inc. produces canned fruit products including canned apples, peaches, applesauce, apple juice and sliced peaches. The plant discharges two types of waste from two effluent pipes, one containing waste heat and the

other containing process water. In 1974 the plant processed an average of 200 tons of fruit a day. Wastewater from the cannery is screened before being discharged into a series of lagoons with capacities ranging from 600,000 gallons to two million gallons. This plant has a permit to discharge 37 and 52 pounds/day of BOD_5 and suspended solids, respectively. In 1975 its effluent averaged .03 mgd with 28 pounds/day of BOD_5 and 42 pounds/day of suspended solids. This facility is considered to be exceeding BPT and will require no further upgrading.

Rockingham Poultry Marketing Cooperative

The Rockingham Poultry Marketing Cooperative is a poultry processing and rendering plant that has been in operation over 30 years. The treatment of process water currently consists of grease and solids separation, biological treatment using two anaerobic lagoons and one mechanically aerated lagoon. In the early 1970's this plant processed over 168,000 pounds of poultry a day. Until very recently Rockingham Poultry had occasionally exceeded several of its permit requirements. The poor discharge was a result of the facility being extremely overloaded hydraulically and the lack of either a disinfection facility or a final clarifier. This plant is currently on a compliance schedule to enhance its treatment. A new treatment plant, expected to be in operation by August of 1976, will allow Rockingham to meet BPT. In 1975 the plant averaged a flow of .91 mgd containing 220 mg/l of BOD_5 and 117 mg/l of suspended solids. This facility has been a major polluter of the North Fork for a number of years and its discharge has severely affected water quality. When this plant is upgraded, a significant increase in water quality can be expected.

Shen-Valley Meat Packers, Inc.

The Shen-Valley Meat Packers, Inc. is located in Timberville. The industry operates two facilities with the major plant processing hogs and beef livestock. The second facility operates a chicken frying process. Current treatment consists of fat and scum skimming, anaerobic digestion, aeration, final settling and polishing. The addition of flow meters and chlorination facilities is expected soon. The permit issued to Shen-Valley allows it to discharge 57 pounds/day of BOD_5, 91 pounds/day of suspended solids and a concentration of 400 MPN/100 ml of fecal coliform. Over a period for which data is available, the Shen-Valley plant met NPDES permit requirements for all except the fecal coliform. Virginia State Water Control Board considers the facility capable of operating at BPT and no more capital investment is expected to be made for pollution control devices. The increase in efficiency that is necessary will be made through improved operation and maintenance procedures.

DISCUSSION

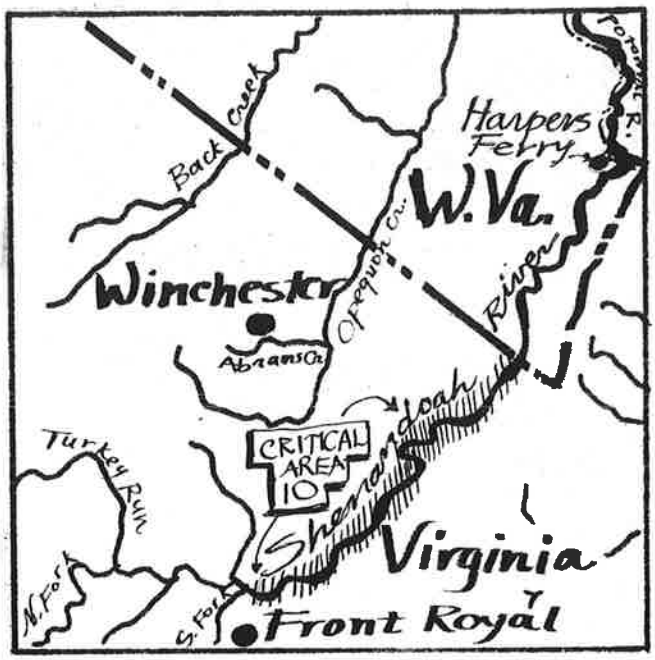
It is reasonable to expect water quality to begin to improve in the Shenandoah's North Fork in 1976. With the new Rockingham Poultry treatment facility in operation by late summer, a major

improvement can be expected. Further improvements in water quality will then depend upon the upgrading of the Broadway and New Market facilities, both of which are several years away and are to be completed after the 1977 requirement of secondary treatment for all municipal plants.

CRITICAL AREA TEN

Shenandoah River, Virginia

Critical Area Ten is located on the Shenandoah River downstream of Front Royal, Virginia. The area suffers from high organic loadings and occasional high fecal coliform concentrations. These problems are aggravated by a low water dam just downstream of Front Royal which lowers the re-aeration rate of the river during periods of low flows. The water quality problems around Front Royal appear to be seasonal in nature. During periods of high flows, the wastes discharged are diluted to the extent that they cause no water quality violations.



WATER QUALITY

The dissolved oxygen concentration in the Shenandoah River below Front Royal in 1975 averaged 10.9 mg/l with no value below the water quality standards. Fecal coliform concentrations averaged only 127 MPN/100 ml. Nutrient levels were also fairly low with total nitrogen averaging 1.4 mg/l and total phosphates at .09 mg/l. Water quality at this location was good during 1975, probably due to high river flow.

MAJOR DISCHARGERS

Front Royal

The town of Front Royal operates a 1.5 mgd primary treatment plant which was constructed in 1950. Treatment includes primary settling and chlorination. The permit issued to the facility allows it to discharge 1.5 mgd with 130 and 120 mg/l of BOD_5 and suspended solids, respectively. In 1975 the flow averaged 1.1 mgd with a concentration of 76 mg/l of BOD_5 and 60 mg/l of suspended solids. This facility will not meet secondary standards by 1977. Front Royal is involved in a Step II grant for developing the plans and specifications for a secondary plant, but the completion of construction is not expected until near 1980. This plant is

second only to Avtex in its quantity of pollutants discharged to the Shenandoah River.

Avtex, Inc. (formerly FMC Corp.)

Avtex produces rayon and polyester fibers. Process waters are treated in an activated sludge facility which includes zinc removal. The facility is designed for a flow of 12.4 mgd, producing an effluent with a BOD_5 concentration of 30 mg/l. This plant has three other outfalls; two for the discharge of flyash retention basins and another for storm and cooling water. The current permit for the process water limits the discharge to 337 pounds/day of zinc, 3,031 pounds/day of BOD_5, 5,556 pounds/day of suspended solids and 45,455 pounds/day of COD. These limits will be made more stringent beginning July 1, 1977 by allowing only 205 pounds/day of zinc to be discharged. In 1975, flow from process water averaged 8.5 mgd with a load of 894, 1,580 and 7,384 pounds/day of BOD_5, suspended solids and COD, respectively. By July of 1977 this plant is expected to be operating at BPT.

Old Virginia, Inc.

Old Virginia, Inc. began production in 1941. The company produces canned fruit preserves, jellies and butters. Peak production occurs during the months of October and November when BOD_5 loads may reach 700 pounds/day. Bar screening is the only treatment the effluent from Old Virginia receives before being discharged into the Shenandoah River. According to a permit application submitted by Old Virginia in 1971, an aerated lagoon was to be built by December 31, 1971. That system, however, was never put into operation and instead Old Virginia decided to join the Front Royal treatment plant when it is upgraded to secondary treatment. The permit issued to Old Virginia allowed the discharge of 386 pounds/day of BOD_5 and 108 pounds/day of suspended solids. With this permit, Old Virginia was allowed to discharge wastes with concentrations of up to 1,000 mg/l of BOD_5 (approximately five times the strength of raw municipal wastes) and still not violate the permit requirements.

Old Virginia has two alternatives for improving its treatment. One alternative is to pre-treat its wastes to a degree acceptable to the town of Front Royal, and then to allow Front Royal to treat the residual fruit wastes along with the municipal wastes. The second alternative is for Old Virginia to treat all of its wastes to a degree suitable for discharging directly in the river. As previously noted, the Front Royal secondary treatment facility is not expected to operating until 1980. A decision as to what alternative Old Virginia will choose should be made before July 1977.

Allied Chemical Corporation

Allied Chemical produces sulfuric acid from sulfur delivered by railroad tank cars. The effluent from the plant includes purge water from acid cooling systems. Wastewater is placed in a lagoon, neutralized, and settled before being discharged. The plant is meeting BPT and its waste is thought to have little impact upon the quality of the Shenandoah River.

DISCUSSION

Of the areas investigated in this report, this segment of the Shenandoah below Front Royal had the best water quality in 1975. Two of its major dischargers, Avtex and Allied Chemical, are already approaching BPT standards. Only two major problems remain. The first is to upgrade the Front Royal plant to secondary treatment as quickly as possible. During periods of low flow, the discharge from the current plant could result in water quality violations. The second step is to require Old Virginia, Inc. to take immediate action to discontinue its discharge of raw waste in accord with the law, even though the discharge from this plant is small, and its overall impact on the Shenandoah may be marginal.

CRITICAL AREA ELEVEN

Antietam Creek, Maryland

Critical Area Eleven is located on Antietam Creek at and below Hagerstown and extending to the main stream of the Potomac River. This 20 mile stretch of river is adversely affected by municipal effluents, agricultural and urban runoff, thermal pollution, and industrial dischargers.

WATER QUALITY

Maryland state water standards for fecal coliform concentrations are exceeded throughout the entire length of Antietam Creek. During 1974 monthly samples were taken at two locations in this stretch of river, at Funkstown and at Sharpsburg. The averages for these stations were 500 and 1,235 MPN/100 ml, respectively.

Antietam Creek also violated its water temperature standards. Water increased as much as 56°F in temperature as it flowed past Hagerstown, due in part to the discharge of the Hagerstown sewage treatment plant. Dissolved oxygen levels below Hagerstown were generally high, averaging 9.5 mg/l during 1975. Total solids concentrations were moderately high, averaging 291 mg/l. Nutrient levels below Hagerstown were also high, indicated by a .548 mg/l average of total phosphorus.

A good deal of controversy was aroused over Antietam Creek in June of 1976 when it was disclosed during Congressional hearings that the United States Geological Survey (USGS) had discovered polychlorinated biphenyls (PCB's) in the sediment of Antietam Creek in 1972. PCB's have been shown to be cancer-causing agents. Their concentrations in most sediments in the U.S. are extremely low, averaging approximately 50 parts per billion (ppb). In their survey of the Antietam, USGS found the levels of PCB's in the sediments to be 1,200 ppb--25 times the national average. A survey conducted in June of 1976 by Maryland and the Environmental Protection Agency, after the USGS disclosure, indicated that the high levels of PCB's no longer existed in the Antietam, and EPA speculated that the PCB-ladened sediment had been washed farther downstream by the high flows of previous years. However, during the survey DDT, another known carcinogen, was

discovered in the sediment. This chemical, which had been banned by EPA in 1972, was found in concentrations as high as 2,059 ppb. EPA stated after the survey that although the values of DDT were high, they were not considered a threat to public health. Identification of the specific sources of the DDT was not possible.

MAJOR DISCHARGERS

Hagerstown

By far the largest discharger to this segment of the Antietam is the Hagerstown sewage treatment plant. This plant was first constructed in 1924 and has gone through additions and improvements, the last coming in 1973. Treatment at the plant currently consists of bar screening, grit removal, secondary treatment using activated sludge, secondary clarification and chlorination. The sludge produced is treated by an anaerobic digester and then dried on sand drying beds. The sludge is then disposed of as a soil conditioner. The facility is designed to treat 8 mgd of waste and currently serves some 36,500 people. This facility suffers from an excessive amount of infiltration and inflow and during periods of heavy rainfall the plant is forced to bypass all flows greater than 10 mgd. During 1975, the Hagerstown facility treated an average of 8.08 mgd discharging 705 pounds/day of BOD_5 and 1,306 pounds/day of suspended solids. The permit for this facility allows it to discharge 8 mgd containing 1,201 pounds/day of BOD_5 and 3,603 pounds/day of suspended solids. In addition to exceeding its permitted flow requirements, the Hagerstown facility also exceeded its fecal coliform limits on several occasions.

Aside from its infiltration and inflow problems the city of Hagerstown suffers from another water quality management problem. Much of the area surrounding Hagerstown is not sewered and relies on septic systems to handle its wastes. The soils in this area do not lend themselves to absorption of the traditional septic tank effluent and they often fail. This failure has led to some minor surface water contamination but more importantly, it is believed that the situation could lead to ground water contamination.

Industrial Dischargers

The major industrial dischargers in this portion of the Antietam include Doubleday and Company, Metal Finishing, Inc., Mack Truck, Inc., Marine Electronics and Western Maryland Railroad. Mack Truck is the largest of these facilities, producing some 19 mgd of wastes. Each of these facilities has faced some difficulty in the past with properly disposing of their wastes. The State of Maryland, however, reports that each has either corrected its problems or will by July of 1976.

DISCUSSION

Non-point sources of pollution are believed to contribute

three types of contaminants to Antietam Creek--bacteria, sediment and nutrients. The contaminants are transported from various parts of the Antietam drainage basin, most significantly agricultural land and urban areas, and are deposited in the Antietam. Unfortunately, there have been few definitive studies in this basin and no data is available that can directly relate pollutant loads from non-point sources to various activities in the Antietam basin. The qualitative work that has been done occurred in the early and mid-sixties and covered the entire Potomac basin. It was not specific to this area, and is most probably out of date.

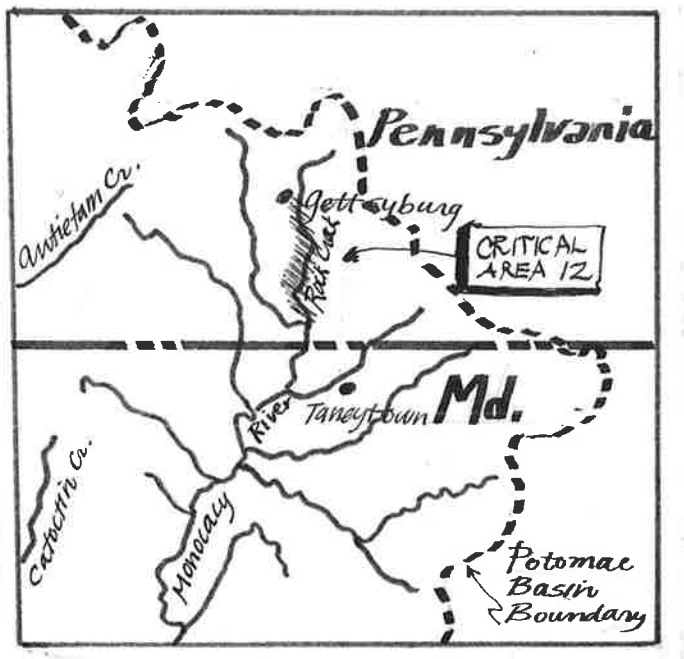
Beginning in 1976, however, detailed planning for non-point source pollution will begin by the State of Maryland under Phase II of the River Basin Planning Program. This program will investigate the sources of non-point pollution and easily implemented control mearures.

Although water quality problems in this area are essentially limited to bacterial pollution, future water quality needs are evident. The high bacterial, sediment and nutrient concentrations that are currently found in the waters of Antietam Creek are believed to originate from non-point sources rather than point sources and extensive steps will be necessary to correct them. A solution to the failing septic systems around Hagerstown will have to be found. In addition, any increases in wastes discharged from the Hagerstown area cuuld result in dissolved oxygen violations in the Antietam. Continual planning and foresight will have to be practiced to prevent the occurrence of water quality problems in the area.

CRITICAL AREA TWELVE

Rock Creek, Pennsylvania

Critical Area Twelve is located on Rock Creek below the city of Gettysburg. This creek originates in Pennsylvania then flows southward into Maryland, serving as a major tributary to the Monocacy River. The creek is affected little by the discharge of waste, with the exception of the Gettysburg sewage treatment facility. The discharge of this facility in the past has resulted in low dissolved oxygen values, high coliform concentrations and the excessive growth of aquatic plants downstream of Gettysburg.



WATER QUALITY

During 1975 only a limited amount of sampling was done on Rock Creek below Gettysburg, with only five samples taken during the year. Dissolved oxygen values averaged 7.8 mg/l, with a low value of 4.1 mg/l. BOD_5 values averaged 3 mg/l and ammonia, nitrate and nitrite nitrogen averaged 3.2 mg/l. These concentrations are fairly high and indicate the significant impact made by the Gettysburg plant. The fecal coliform concentration was measured only once during this period, so little can be assumed about its yearly average.

MAJOR DISCHARGERS

Gettysburg

The Gettysburg sewage treatment facility is a secondary plant designed to handle 1 mgd of waste. The plant uses primary settling, trickling filters, secondary settling and chlorination as its major treatment processes. Although the municipal and industrial flows to this plant are only approximately .95 mgd, the daily average flow is much greater due to excessive infiltration and inflow. This problem is extreme enough to cause the by-passing of sewage around the facility during periods of rainfall. From July to December of 1975, the daily flow to the facility averaged

1.5 mgd. The effluent from the facility during this time contained 475 pounds/day of BOD_5 (38 mg/l) and 288 pounds/day of suspended solids (23 mg/l). An interim permit was issued to Gettysburg by the EPA in 1974 which allowed the facility to discharge a waste of not more than 1 mgd containing 500 pounds/day of BOD_5 (60 mg/l) and suspended solids. At the time the permit was written, it was assumed that this facility would be upgraded in the future. The final permit written for this facility required it to discharge not more than 1 mgd containing 125 pounds/day of BOD_5 and suspended solids. Nutrient removal was also required with phosphorus to be removed continuously and ammonia to be removed on a seasonal basis.

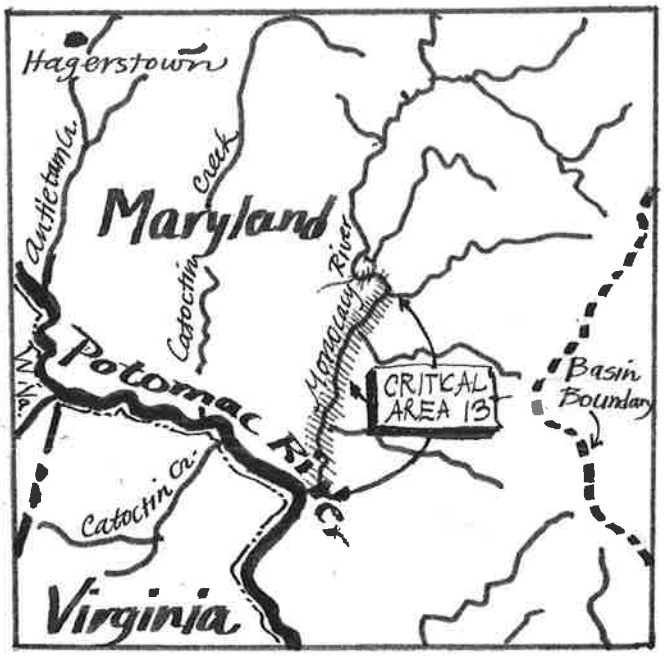
DISCUSSION

Although a final decision is yet to be made, it appears that the present Gettysburg facility will be abandoned in favor of a larger, regional sewage plant. As a result of a Step I grant and the development of a facilities plan, it has been concluded that advanced waste treatment is necessary for this discharge. A program which will include an extensive infiltration/inflow correction and a new treatment facility including ammonia and phosphorus removal has been suggested. Cost estimates are presently in the range of $16-18 million. If all goes well it is possible that the final planning for this regional plant could be completed in a little over a year and construction completed a year and a half later, putting the final completion date somewhere in 1979. The construction of this advanced waste treatment facility should assure a significant improvement in the water quality of Rock Creek and an end to water quality violations.

CRITICAL AREA THIRTEEN

Monocacy River, Maryland

Critical Area Thirteen lies on the Monocacy River below Frederick, Maryland. This river drains an area of rich farmland, including dairy and cattle farms. Unfortunately, the soils in this area are highly susceptible to erosion. Many tons of sediment are carried into the Monocacy each year and are eventually discharged to the Potomac River. In the past, dissolved oxygen levels have often violated stream standards below Frederick due to the city's discharge of sewage. Throughout the entire length of the Monocacy, fecal coliform standards are often exceeded, due to both point nnd non-point sources of pollution.



WATER QUALITY

Only six monthly samples were taken at the Maryland primary network station below Frederick during 1975. The samples were taken early in the year and did not include the late summer months. During this period dissolved oxygen levels averaged 8.2 mg/l, total nitrogen averaged 2.44 mg/l, total phosphates averaged .123 mg/l, chlorophyll a averaged 19 mg/l and total solids averaged .81 mg/l. The only parameter which consistently exceeded water quality standards was fecal coliforms, which averaged 610 MPN/100 ml. More intensive water quality surveys were taken from 1966-1970. They showed dissolved oxygen levels to be below water quality standards downstream of Frederick, with the lowest values of dissolved oxygen found 2.5 miles below the city's discharge.

MAJOR DISCHARGERS

Frederick

The largest discharger to the Monocacy is Frederick's sewage treatment plant. This plant began operation in 1936 and currently includes a grit chamber, communitor, primary and secondary clarifier,

trickling filters and chlorinator. The plant was designed to treat 7 mgd and currently serves about 30,000 people. This facility receives the discharges of a large number of industrial facilities including Jenkins Food Corp., Frederick Iron and Steel Corp., Clorox, W. W. Poultry, numerous laundromats and several electroplating companies. These dischargers contribute only about .5 mgd, but many contain very high concentrations of wastes. The sewage entering the Frederick facility has contained BOD_5 concentrations as great as 500 mg/l due to these industries.

To alleviate the problem of high concentrations of pollutants from industries in the sewage influent, a city ordinance was passed in 1971 to limit the strength of wastes that the city would accept from any industry. For any flow greater than .002 mgd, the concentration of BOD_5 and suspended solids is limited to 300 mg/l and 240 mg/l, respectively. For flows less than .002 mgd, the load of the discharger is limited to 5 pounds/day of both BOD_5 and suspended solids. Limits were also set for color, chlorine, grease and oil.

In 1975, the Frederick sewage treatment plant discharged an average of 4.42 mgd containing 2,761 pounds/day (75 mg/l) of BOD_5 and 1,252 pounds/day (34 mg/l) of suspended solids. The permit for this facility was not issued until March of 1976. The interim requirements for this plant, which are in effect until July 1, 1977, allow the plant to discharge 5,755 pounds/day (115 mg/l) of BOD_5 and 2,502 pounds/day (50 mg/l) of suspended solids. The final effluent requirements for this plant are quite stringent and require it to limit its discharge to 584 pounds/day (10 mg/l) of BOD_5 and suspended solids.

It is doubtful that this stringent final permit will ever go into effect. The permit issued requires treatment levels much in excess of those needed to maintain dissolved oxygen standards below Frederick and would require a great deal of upgrading of the Frederick treatment plant. The city and state will soon determine more realistic final effluent standards for Frederick.

Ballenger Creek

Within a few years, a major discharger will be located on the Monocacy River below Frederick: the Ballenger Creek sewage treatment plant. The plant is designed to be a 2 mgd enhanced activated sludge plant. When completed, the initial flow into the plant will be small since its service area has yet to be developed, being a southern suburb of Frederick. A permit has been issued for the plant which will allow it to discharge up to 2 mgd containing 250 pounds/day (15 mg/l) of BOD_5 and suspended solids and 8.3 pounds/day (5 mg/l) of ammonia.

DISCUSSION

Although the Monocacy receives the discharge of a major municipal discharger, the biggest pollution problem in this stream segment arises from non-point sources of pollution. As mentioned previously, the drainage area of this river is composed of highly erodible soils. These soils, along with

less than ideal farming practices and urban/suburban development, result in the erosion of tons of sediment a year into the Monocacy. During one sampling period, from October of 1970 to September of 1971, it was estimated that about 25% of the sediment load (356,260 tons) to the Potomac River was contributed by the Monocacy. One impact of this sediment load is high turbidity and heavy siltation. A second impact of the sediment load is the discharge of nutrients that are carried into the Monocacy along with the sediment. A study by Hydroscience, Inc., for ICPRB, mentioned earlier, indicated that the load of phosphorus which is discharged from the Monocacy to the Potomac from non-point sources (1,000 pounds/day) was almost twice that discharged from point sources (542 pounds/day). For the case of nitrogen, about 1,374 pounds/day could be attributed to point sources, whereas an estimated total of over 10,000 pounds/day was discharged into the Potomac. Both of these figures indicate that a huge quantity of nutrients are coming from non-point sources in this basin. The nutrients not only affect the concentration of algae and other aquatic plants in the Monocacy, but also contribute to the nutrients which reach the Potomac estuary and create nuisance conditions there.

Although some attention was given to it in the first phase, the exact extent of the non-point source problem will be investigated farther in the second phase of the Maryland River Basin plan for this basin. Currently, the agencies most closely involved in the control of sediment pollution in this area are the Soil Conservation Districts, which promote voluntary attempts to control erosion and sediment.

CRITICAL AREA FOURTEEN

Folly Lick and Sugarland Run, Virginia

Critical Area Fourteen is located downstream of the Herndon sewage treatment plant on Folly Lick and it extends into Sugarland Run. The flow of both of these streams is small and historically water quality has been good. An unfortunate set of events has resulted in a significant degradation of water quality in this area in 1975.

WATER QUALITY

No monthly water quality data was available for Folly Lick in 1975. However, a number of stream surveys were done by the State of Virginia. These surveys indicated a great deal of organic pollution had adversely affected aquatic organisms. In this stream segment, areas were found where only the most pollutant tolerant organisms remained. A total absence of benthic organisms was found in other areas of the stream. These studies also showed BOD_5 and fecal coliform concentrations to be high in Folly Lick.

Virginia maintained a monitoring station on Sugarland Run in 1975. Dissolved oxygen values at this station were high, averaging 9.5 mg/l. Also, the BOD_5 and fecal coliform concentrations were high, averaging 3.5 mg/l and 503 MPN/100 ml, respectively. Fecal coliform values exceeded water quality standards on three of the 12 monthly readings. Nutrient values were also above normal with total nitrogen averaging 1.8 mg/l and total phosphates averaging .26 mg/l.

MAJOR DISCHARGERS

Herndon

The Herndon sewage treatment plant was first constructed in 1937 and upgraded in 1957. Currently the plant has the following units: communitor, a "clarigester"--a unit in which primary clarification and digestion takes place in the same tank--a trickling filter, a secondary clarifier and a chlorinator. This

plant was scheduled to close in June of 1975 and have its flows directed to the Potomac Interceptor, a trunk sewer from the Dulles International Airport in Virginia to Washington, D.C. Its original permit, which expired in August 1975 allowed it to discharge a flow of .3 mgd containing 26 mg/l BOD_5 and 31 mg/l suspended solids. In early 1975 the facility was using chemical addition to enhance its treatment and was meeting its NPDES permit requirements.

The diversion that was planned for June 1975, did not take place, however, due to a moratorium imposed by Fairfax County on connections to the Potomac Interceptor. A new permit was then written for August 1975 until December 31, 1976. This permit imposed seasonal limits on the Herndon plant, allowing it to discharge a waste with concentrations of 60 mg/l of BOD_5 and suspended solids from October until March of each year and 36 mg/l of BOD_5 and suspended solids from April until September. The permit was made more lenient because the plant was scheduled to discontinue operation and increased capital investment in the plant seemed unwarranted. A tacit agreement was made between the Virginia State Water Control Board and Herndon that the permit would be issued with the understanding that the plant would soon be closed.

In April of 1975 Herndon dismissed its sewage treatment plant operator leaving employees to monitor and make minor repairs to the plant but no one qualified to operate it. State inspectors soon noticed the plant was operating very inefficiently, discharging a poor quality effluent. State personnel noted that the trickling filter was in especially bad condition and that there was little difference in appearance between the effluent from the primary clarifier and that of the secondary clarifier. This condition continued throughout the remaining months of 1975 with the plant often violating the interim standards given by the state. It was not until 1976 that a consulting firm was obtained by Herndon to make the necessary repairs and to see that the plant was operating properly.

DISCUSSION

The decrease in water quality in 1975 in Critical Area Fourteen can be attributed to one source: the poorly treated discharge of the Herndon plant. Poor management resulted in inefficient operation, violation of the interim permit and poor water quality conditions. This was corrected in 1976 but is only satisfactory for the interim period until the permanent solution of connection to the Potomac Interceptor for treatment at the Blue Plains regional plant is accomplished, presumably by December 31, 1976.

CRITICAL AREA FIFTEEN

Anacostia River, Maryland and Washington, D.C.

The Anacostia River and its tributaries are located in Montgomery and Prince George's Counties, Maryland and in the District of Columbia. This river drains some 120 square miles, of which 20% is heavily urbanized, 60% is suburban and the remaining 20% is a mixture of forests and farmlands. The upper portion of the Anacostia is free-flowing but the last four miles of its length are tidal and thus affected by the water quality of the Potomac River. Although there is one major discharger to the Anacostia, the most significant impact to water quality is believed to be caused by non-point sources of pollution. Combined sewer overflows and storm water runoff combine to contribute large quantities of pollutants to the Anacostia and adversely affect its water quality.

WATER QUALITY

Throughout the Anacostia fecal coliform concentrations violated water quality standards. In 1975 fecal coliform concentrations averaged 3,086 MPN/100 ml at the District of Columbia line. Farther downstream, at Pennsylvania Avenue, the concentrations were even greater, averaging 4,620 MPN/100 ml. Dissolved oxygen values measured at Pennsylvania Avenue were not of good quality, averaging 6.5 mg/l during the year with values as low as 2.0 mg/l. Over 10% of the samples taken at Pennsylvania Avenue were less than the 3 mg/l standard. Total phosphates at this station averaged .28 mg/l during 1975 and total nitrogen averaged 2.99 mg/l.

MAJOR DISCHARGERS

PEPCO

The one point source discharge which has a major impact on water quality in the Anacostia is the Potomac Electric Power

Company (PEPCO). Over a billion gallons of cooling water are discharged a day by PEPCO into the Anacostia from its Benning Road and Buzzard Point electric generating stations. These discharges help raise the temperature of the Anacostia to almost 86°F (30°C) during summer months. This elevated temperature has a profound effect on the type of aquatic ecosystem that can survive in the portion of the Anacostia under the influence of the PEPCO discharge.

In addition to PEPCO there are several much smaller industrial dischargers to the Anacostia including a number of sand and gravel operations, the Naval Ordinance Laboratory and the Mineral Pigment Corporation. None of these smaller facilities is believed to have a major impact on water quality in the Anacostia.

DISCUSSION

The most important source of pollution to the Anacostia is the discharge of raw sewage from the Anacostia sewage collection system which flows to the Blue Plains sewage treatment plant. Outside of the District of Columbia this sewage collection system serves approximately 475,000 individuals in a 147 square mile area. The overflows are a result of infiltration/inflow and an inadequate capacity in the service system. There are numerous points of overflow but the majority of the overflow occurs at the Anacostia junction chamber, which is located at the confluence of the Northwest and Northeast Branches of the Anacostia. Here four large trunk lines are joined into one sewer line that is too small to always handle the flow of the other four. The inadequacy of the sewer line is compounded by infiltration/inflow into the system. It has been estimated that during peak periods infiltration/inflow rates are as great as 63.5 mgd and overflow rates during those periods are about 50 mgd. In 1975 approximately 188 million gallons of sewage were discharged into the Anacostia, or a little over one-half million gallons a day on the average. Daily averages have little significance, however, since over 50% of the overflow in 1975 occurred during one month and the flows for a four month period accounted for well over 90% of the yearly total.

The Washington Suburban Sanitary Commission (WSSC) is taking steps to correct this overflow problem. A project to increase the capacity of the Anacostia sewer system, costing nearly $14 million, will soon begin. The project will include the construction of more sewer lines, a pumping station and a force main. The project is designed by WSSC to eliminate all of their sewer overflows to the Anacostia. It was deemed necessary after other studies indicated that correction of the inflow/infiltration problem alone was not sufficient to alleviate the overflow problem.

After the completion of this project, some improvements in the Anacostia can be expected. However, in the tidal portions the water quality will still be partially dependent on the quality of the Potomac. Therefore as water quality is improved in the Potomac, further improvements can be expected in the tidal portion of the Anacostia.

CRITICAL AREA SIXTEEN

Potomac Estuary
Washington, D.C. and Maryland

Critical Area Sixteen lies along a 15 mile stretch of the Potomac River from Washington, D.C. to Piscataway Creek. More than any other area in the basin, this segment of the river has felt the effects of a growing population along its shores. In this segment the treated wastes of slightly less than three million people are discharged, a quantity of waste which translates daily into some 400 million gallons of municipal sewage containing 105,000 pounds of BOD_5 and 108,000 pounds of suspended solids.

WATER QUALITY

This portion of the Potomac has long suffered from water pollution problems. The severity of the problem was recognized as long ago as 1925, when the U.S. Public Health Service concluded that no section of the river adjacent to the District of Columbia "could be considered free enough from pollution with sewage to permit its use for bathing without a potential danger to such bathers of contracting sewage borne diseases." In 1932 when the raw sewage of nearly 600,000 people was being discharged into the Potomac, the situation was termed critical. In 1937, 18 years after the Public Health Service first suggested treatment for sewage in the metropolitan area, the Blue Plains sewage treatment plant was constructed to supply the wastes with primary treatment. But within six years, because of continued population growth, the organic load reaching the Potomac was a third greater than that in 1932 before any treatment was available. Beginning in 1949 the primary plant was expanded to 175 mgd and serious planning for upgrading to secondary treatment was under way.

On August 22, 1957, the Surgeon General of the U.S. Public Health Service called an enforcement conference on the subject of pollution in the interstate waters of the Potomac River in the Washington Metropolitan Area. A second conference was held in February of 1958 during which expeditious completion of secondary treatment was recommended to improve a river that had become degraded by excessively low dissolved oxygen levels, foul odors,

noxious floating debris, and bacterial contamination that had closed the river to bathers from Three Sisters Island to Hallowing Point. Expanded and upgraded treatment facilities at Blue Plains, providing a low degree of secondary treatment (a capacity of 240 mgd with BOD_5 and suspended solids removal of 75% and chlorination), began operation in 1959.

However, prior to 1959, as well as subsequently, evidence of a trend toward eutrophication (nutrient enrichment and nuisance aquatic plant growths) in the estuary was noted. An invasion of water chestnut occurred, especially in the tributaries of the upper estuary, beginning in the 1930's. It was alleviated by a Corps of Engineers program of physically removing each and every plant. An extensive invasion of water milfoil followed in the 1940's and 50's, impairing both the surface usefulness of the water for small boats and creating oxygen depletion in creeks and embayments. These growths disappeared in the late 1950's by some unexplained natural means. Subsequently, during the 1960's, the estuary was characterized by massive persistent blue-green algae blooms in the tidal freshwater portions, which at times resulted in ugly, odorous algal mats and oxygen depletions as the algae died and decayed.

In April of 1969 a third conference was held to discuss what steps could be taken to prevent the continuing degradation of the Potomac in the metropolitan area. The topics of interest to the third conference differed considerably from the preceding two. Although concern over bacterial pollution and high organic loadings continued, one of the major concerns of the third conference was eutrophication. Visual observations by even the most casual passer-by indicated that excessive aquatic plants and algae were a problem in the Potomac and scientific research in the Potomac reinforced these casual observations. Studies performed before the third conference indicated that at least one of the nutrients being discharged to the Potomac which encouraged algal growth would have to be limited to stop the steady decline of the Potomac. The nutrient most often mentioned was phosphorus. After several days of meetings, involving the testimony of many technical experts on water pollution, the executive board of the conference made the recommendation that all sewage treatment facilities in the area be required to remove 96% of their BOD_5 and phosphorus load and 85% of their nitrogen load. These recommendations have since been used by the states and federal government as guidelines for the writing of NPDES permits in the Washington Metropolitan Area.

Since the early 1970's water quality in this area has remained stable or slightly improved, although this may have been due in part to higher than usual fresh water inflows in the estuary during these years. During 1975 water quality was fairly good. Dissolved oxygen values did not violate water quality standards and algal concentrations were low compared to years past. Fecal coliform concentrations continued to be a problem, however, and often exceeded the water quality standards. Since all dischargers in this area were chlorinating their effluents, the high coliform concentrations are thought to be due to storm water runoff and combined sewer overflows.

MAJOR DISCHARGERS

In the Washington Metropolitan Area there are 13 individual municipal dischargers with flows near 1 mgd or greater. Five of these dischargers have flows in excess of 15 mgd (Table II). It is beyond the scope of this report to discuss each of these dischargers in detail. (Those interested in more detail are referred to the reports prepared by Maryland, Virginia and the District of Columbia in compliance with the requirements of sections 305(b) and 303(e) of Public Law 92-500.)

It is expected that by the year 1979 that all of the major facilities in the Washington area will be operating at the levels recommended in the Potomac conferences, except as mentioned below. To reach this goal several of the older, less sophisticated facilities will be eliminated--including Westgate, Dogue Creek, Little Hunting Creek, and the Fort Belvoir plants--and their flows diverted into larger regional plants. The only major facility that may not reach this goal by 1979 is the Blue Plains regional treatment plant, where the EPA has postponed the requirement for the construction of the nitrogen removal portion of the plant, which was estimated to cost about $100 million. This postponement has been established so that the effects in the estuary of phosphorus removal, the reduction of nitrogenous oxygen demand and other advanced treatment at Blue Plains can be studied and a more informed decision can be made on the necessity of nitrogen removal.

Planning since 1970 for additional sewage treatment capacity for suburban Montgomery County, Maryland, has been focused on a new 60 mgd advanced waste treatment facility to be located at Dickerson in the western extreme of the county because the size of the Blue Plains regional facility has been limited to 309 mgd (Figure 2). It also was planned that the proposed Dickerson AWT plant would include future capacity for suburban Fairfax County, Virginia, and the District of Columbia. These jurisdictions would pay for capacity at Dickerson but would actually use an equivalent amount of the Montgomery County existing capacity at Blue Plains in trade. On August 20, 1976, however, the EPA returned the Dickerson AWT plant construction grant application, thereby suspending further processing of it. EPA rejected the application primarily because (1) the capacity of 60 mgd was not justified by population projections and sewage flow requirements or the existence of specific commitments from Fairfax County and the District of Columbia for use of part of the planned capacity and (2) the proposed plant's high capital and operating costs over the life of the project (estimated by EPA at $273 million and $108 million, respectively) were not cost-effective. Other factors also were mentioned as considerations including the location of the discharge about 20 miles above the District of Columbia water supply intake and about eight miles above the proposed intake for Leesburg, Virginia. Alternate courses of action suggested by EPA were (1) an up-to-60 mgd plant at Dickerson with 90% of the capacity committed to meet 20 year regional flow requirements, (2) a 60 mgd plant, or a 30-35 mgd plant at Dickerson or other location, following a full study of alternatives, and with the 90% capacity committments, or (3) a series of small, 1-5 mgd plants in areas impacted by sewer moratoria, possibly incorporating land treatment. Thus the implementation of the more than six years of planning for additional capacity at

TABLE II

AGGREGATE PRESENT AND PLANNED DISCHARGES FROM MAJOR SEWAGE TREATMENT PLANTS IN THE WASHINGTON METROPOLITAN STATISTICAL AREA

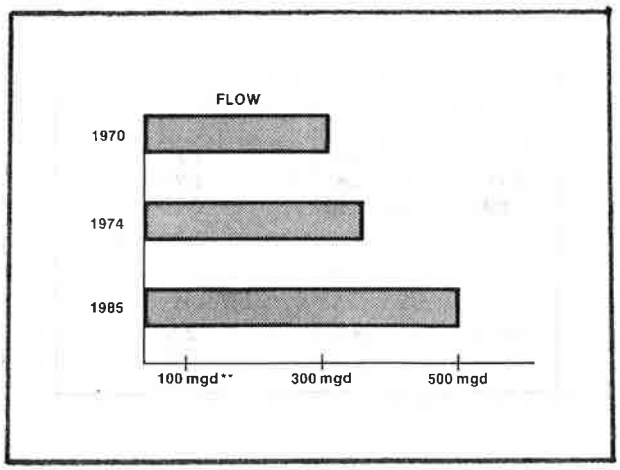
DATES	BLUE PLAINS FLOW/mgd*	PISCATAWAY	ALEXANDRIA	ARLINGTON	LOWER POT.	DICKERSON	TOTAL
1970	252	5.8	23	19	—	—	300
1974 (fiscal)	280	13.4	17	21	14	—	345
1985	309	36	49	30	36	37	497
	BOD_5 lbs/day x 10^3						
1970	103.8	.54	13.0	5.5	—	—	123
1974 (fiscal)	106	.56	4.5	3.0	1.5	—	116
1985	12.7	1.7	1.36	0.75	.6	.925	18.04
	Suspended Solids lbs/day x 10^3						
1970	102.	1.3	12.6	14.3	—	—	130
1974 (fiscal)	97	0.40	5.1	4.0	2.21	—	104
1985	18.1	1.7	1.36	0.75	.6	.31	22.8
	Phosphorus lbs/day x 10^3						
1970	17.3	0.32	2.3	1.7	—	—	21.6
1974 (fiscal)	13.1	0.13	1.4	1.7	1.2		17.6
1985	.56	.033	.091	0.050	.066	.061	.861
	Nitrogen lbs/day x 10^3						
1970	46.2	0.73	3.7	2.5	—	—	53
1974 (fiscal)	51.4	0.51	2.7	2.7	2.4	—	60
1985	6.1	.33	.907	0.25	1.12	.61	9.3

*Flow Figures from EPA, Region III
Source: Palmer (ICPRB)

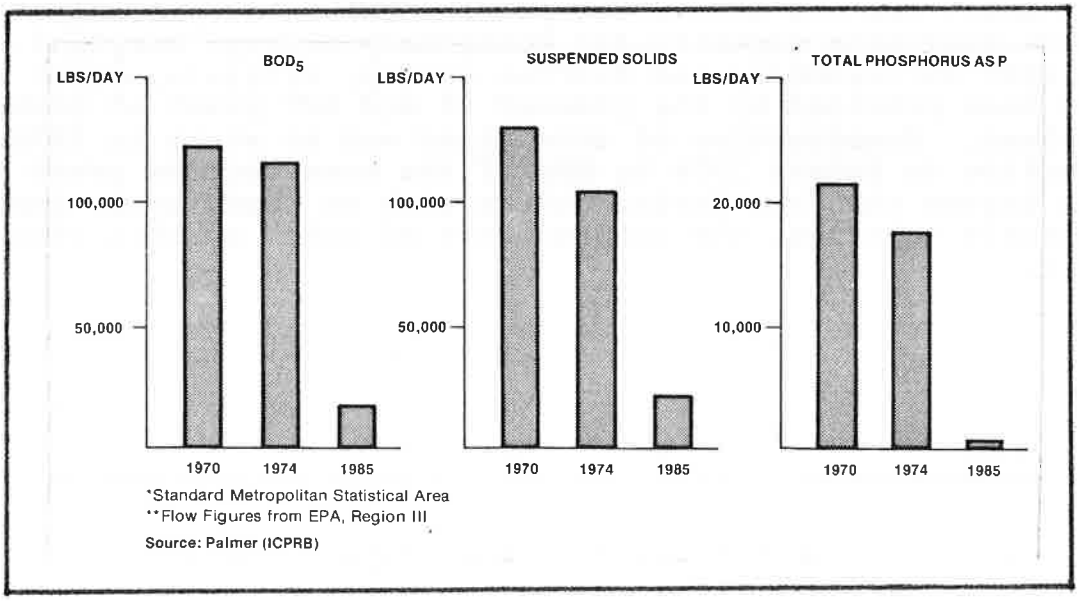
From Dollars and Sense, A Report on Water Quality Management in the Washington Metropolitan Area, ICPRB, 1975.

FIGURE 2

EVEN THOUGH SEWAGE FLOWS IN THE METROPOLITAN WASHINGTON AREA ARE EXPECTED TO RISE...



...ADVANCED WASTE TREATMENT PROCESSES WILL MARKEDLY REDUCE THE LEVELS OF MAJOR POLLUTANTS BEING DISCHARGED INTO THE UPPER POTOMAC ESTUARY.



Modified from Figure 2, "Discharges from Major Sewage Treatment Facilities in the Washington Standard Metropolitan Statistical Area," Dollars and Sense, ICPRB, 1975.

Dickerson, Montgomery County and other regional jurisdictions has been thwarted, at least for the immediate future, and a new course of action is yet to be determined.

DISCUSSION

The Washington Metropolitan Area, in meeting the current NPDES permit requirements based on the recommendations of the Potomac Enforcement Conferences, is completing a pollution abatement program of huge proportions. Advanced waste treatment processes will greatly reduce the levels of major pollutants being discharged into the upper Potomac estuary, regardless of the anticipated increased sewage flows in the area (Figure 2). The cost of increasing treatment efficiencies and increasing treatment capacity from 400 mgd to 525 mgd has been estimated at $587 million. The annual operating and maintenance cost of this program is estimated at $46.7 million. Such a program will decrease tremendously the current quantity of pollutants discharges in the metropolitan area and will be a great step toward a cleaner Potomac River near Washington.

Unfortunately, some problems will remain. The discharge of combined sewer overflows and storm water runoff will continue to keep the fecal coliform concentrations in excess of the water quality standards. Sediment, discharged both from tributaries upstream and in the metro area after storms, will continue to keep the river appearing muddy. Nutrients, which originate farther upstream but settle in the estuary, may result in occasional algae problems.

Last, but not least, the problem exists of providing additional sewage treatment capacity for Montgomery County, Maryland, the District of Columbia, and Fairfax County, Virginia, which was to have been provided by the planned 60 mgd AWT plant at Dickerson, Maryland. Construction of this plant was to start in 1976. The rejection in August 1976 by EPA of the construction grant application leaves the area jurisdictions with no immediately implementable alternate solution, the consequences of which at this time are not clear.

CRITICAL AREA SEVENTEEN

Piscataway Creek, Maryland

Critical Area Seventeen is located just a few miles south of the District of Columbia on Piscataway Creek. This creek originates in Prince George's County in a marshland and flows southwest to the Potomac mainstream. About three miles before reaching the Potomac, Piscataway Creek broadens significantly to about three-quarters of a mile in width. In this area the quality of the creek is affected by the quality of the Potomac River and local dischargers as well as by the quality of the upstream portion of the creek. Here the creek suffers from high concentrations of nutrients, which in turn cause the growth of nuisance aquatic plants.

WATER QUALITY

Samples were taken during only three months of 1975 by the State of Maryland at their primary network stations on Piscataway Creek. The most recent and extensive data taken before 1975 were gathered in 1970. That 1970 survey indicated that Piscataway had become extremely enriched with nutrients. Nitrogen in the form of nitrates and nitrites ranged from .32 mg/l to 4.48 mg/l. Chlorophyll a concentrations averaged 191 mg/l in November of that year. Bacteriological standards were occasionally exceeded in Piscataway Creek during 1970, most often after heavy rainfalls. Dissolved oxygen values fluctuated greatly, ranging from 2.9 mg/l to 18 mg/l. The high values that were observed for dissolved oxygen were believed to be due to the photosynthesis of algae during daylight hours.

MAJOR DISCHARGERS

Piscataway

By far the largest discharge to the creek comes from the Piscataway sewage treatment plant, which is located where the

creek begins to broaden. At this point the creek flows very slowly and there is little current to disperse the plant's effluent out of the creek and into the bay. This situation allows the concentration of nutrients and oxygen demanding substances to accumulate in this area and create the water quality problems previously mentioned.

The Piscataway plant presently has primary and secondary facilities capable of handling 30 mgd. Its permit allows it to discharge 17 mgd containing 1,418 pounds/day (10 mg/l) of both BOD_5 and suspended solids. During 1975 the flow averaged 15.7 mgd with BOD_5 loads of 502 pounds/day (4 mg/l) and suspended solids loads of 662 pounds/day (5.1 mg/l).

In November of 1975 a $27,255,000 contract was awarded to add advanced wastewater treatment at Piscataway. The addition will include phosphorus removal, biological nitrification, mixed-media filtration and post aeration. This project is expected to take two years to complete, and once completed it will allow the discharge from Piscataway to move up to 30 mgd. A second project under way at Piscataway is the relocation of the sewage outfall pipe from its current location to the main channel of the Potomac estuary.

Andrews Air Force Base

The second large facility discharging into Piscataway Creek is the Andrews Air Force Base--plant #1. This facility treats the wastes of about 8,000 individuals and the discharge from its air field. The plant is a secondary treatment facility designed to treat .93 mgd. In 1974 the plant averaged a flow of .85 mgd discharging 20 mg/l of BOD_5 and 22 mg/l of suspended solids. The permit issued to this plant in June of 1975 allows the facility to discharge .931 mgd containing 91 pounds/day (12 mg/l) of BOD_5 and 76 pounds/day (10 mg/l) of suspended solids.

DISCUSSION

The future of Piscataway Creek seems much brighter than its recent past. The relocation of the Piscataway outfall to the main channel of the Potomac will greatly decrease the annual nutrient load which reaches the creek and should lead to a decrease in the concentration of nuisance aquatic plants. There are few industrial dischargers into Piscataway Creek and currently the Piscataway sewage treatment plant represents more than 90% of the municipal flows. After the Piscataway outfall is removed, Andrews Air Force Base will be the only facility discharging over .2 mgd.

The future of the Piscataway facility itself is not so clear. The State of Maryland is faced with the difficult task of handling the wastewater produced in the Maryland portion of the Washington Metropolitan Area and these long-range plans have yet to be settled. One alternative that has been seriously considered is a 65 mgd expansion of the Piscataway plant beyond the current expansion to 30 mgd. This expansion would allow the flows to Piscataway to increase to 95 mgd, making it the second largest regional plant in the area, after Blue Plains. But this alternative also has received

criticism, particularly from citizens and officials of Prince George's County, who have no desire to have Montgomery County's wastes transported into their county.

CRITICAL AREA EIGHTEEN

Bull Run Drainage Basin and the Occoquan Reservoir Virginia

Critical Area Eighteen lies in the Bull Run drainage basin, including Cub Run, Flat Branch and Bull Run and extends into the Occoquan Reservoir. This area receives the discharges of 11 major municipal faciliites and various non-point sources of pollution. The Occoquan Reservoir serves as a major water supply source for Northern Virginia and its quality is of great importance. This area has been the topic of numerous major studies, and a great deal of time and money has been spent determining the best means of managing the Occoquan. A policy for wastewater management has been created for the Occoquan watershed and it will be discussed after the description of dischargers.

WATER QUALITY

Dissolved oxygen averaged 9.9 mg/l in Bull Run during 1975. BOD_5 values were high, averaging over 3 mg/l. Water quality surveys conducted in February of 1975 found very poor water quality with no benthic life and indications of sewage by-passes.

Dissolved oxygen values in Cub Run averaged 8.4 mg/l with three of the 12 readings below 5 mg/l. The BOD_5 concentration was high, averaging 4.1 mg/l. Total nitrogen averaged 1.6 mg/l and total phosphates averaged 2.6 mg/l.

Dissolved oxygen averaged 9 mg/l in Flat Branch in 1975 but BOD_5 values were very high, averaging 9.2 mg/l. Nitrogen and phosphate concentrations were also very high with total nitrogen averaging 7.3 mg/l and total phosphates 3.1 mg/l.

Water quality problems in the Occoquan usually occur in summer months, when the lower portion of the reservoir becomes anaerobic and algae blooms cause serious problems in the treatment of the water for drinking purposes.

MAJOR DISCHARGERS

Greenbriar

The Greenbriar plant discharges into the head of Big Rocky Run. The plant treats the wastes of some 7,000 individuals. The facility has a communitor and two holding ponds. Treatment is enhanced with chemical addition. The plant's permit allows it to discharge .8 mgd with concentrations of 20 mg/l of BOD_5 and suspended solids and a phosphorus concentration of 5 mg/l. In 1975 the flow averaged .7 mgd with BOD_5, suspended solids and total phosphates averaging 8 mg/l, 11 mg/l and 3.7 mg/l, respectively. The fecal coliform values for the year were also well within the prescribed limit of 200 MPN/100 ml.

Big Rocky Run

The Big Rocky Run sewage treatment plant also discharges into Big Rocky Run, treating the wastes of approximately 2,500 people. Treatment is performed with a package stabilization unit that includes a raw sewage communitor, an aerated grit chamber, chlorinator and a holding pond. The plant's permit allows it to discharge .25 mgd containing 14 mg/l of BOD_5 and suspended solids and 5 mg/l of total phosphorus. In 1975 the plant treated an average of .21 mgd and discharged an effluent averaging 9 mg/l of BOD_5, 11 mg/l of suspended solids and 2.4 mg/l of total phosphorus. Fecal coliform concentrations were also well within the standards for this facility.

Upper Cub Run

The Upper Cub Run sewage treatment plant discharges into Cub Run. This plant treats the wastes of about 2,000 individuals. Its treatment is performed using activated sludge with contact stabilization. Ferric chloride is added to enhance treatment and the effluent is chlorinated. The plant's permit allows it to discharge .124 mgd with concentrations of 15 mg/l of suspended solids and BOD_5 and 5 mg/l of phosphates. In 1975 the plant discharged an average of .19 mgd containing 5 mg/l of BOD_5, 7 mg/l of suspended solids and 1.2 mg/l of phosphorus.

Middle Cub Run

The Middle Cub Run sewage treatment plant discharges into Cub Run four miles downstream of the Upper Cub Run discharge. The plant treats the wastes of some 6,000 individuals using contact stabilization, ferric chloride addition, lagoons and chlorination. During 1975 the facility reported some difficulties with its chemical addition. These problems did not appear serious since the facility discharged an effluent containing only 7 mg/l of BOD_5, 12 mg/l of suspended solids and 2.3 mg/l of total phosphorus while averaging .58 mgd. The permit for this plant allows it to discharge .6 mgd containing 20 mg/l of BOD_5 and suspended solids and 5 mg/l of phosphorus.

Flatlick

The Flatlick sewage treatment plant discharges into Flatlick Branch some three miles before it joins Cub Run. Treatment includes the use of primary sedimentation tanks, activated sludge with alum addition, holding ponds and a chlorinator. The facility has a permit to discharge .5 mgd containing 15 mg/l of BOD_5 and suspended solids or 5 mgd while containing 6 mg/l of BOD_5, 5 mg/l of suspended solids and 3.1 mg/l of total phosphorus.

Manassas-Liberia

The Liberia sewage treatment plant is located on Flat Branch. The facility's treatment includes use of bar screens, primary clarifiers, two secondary aerators, secondary clarifiers, a pond with a 30 day detention time and a chlorinator. Alum is also added to the effluent before the bar screening process to enhance treatment. The plant's permit allows it to discharge .338 mgd with concentrations of 23 mg/l of BOD_5 and suspended solids and 5 mg/l of total phosphorus. In 1975 the plant averaged a flow of .327 mgd with an average concentration of 7.7 mg/l of BOD_5, 12.3 mg/l of suspended solids and .43 mg/l of total phosphorus.

Manassas-Northside

The Northside sewage treatment plant is also located on Flat Branch. This facility has chemical addition with primary settling, primary aerator, secondary settling, secondary aerator, final settling, chlorination and stabilization. The permit for this plant allows it to discharge .872 mgd containing concentrations of 22 mg/l of BOD_5, 23 mg/l of suspended solids and 5 mg/l of total phosphorus. In 1975 the flow of this plant exceeded its limit, averaging .894 mgd but its effluent averaged 8.3 mg/l of BOD_5, 12.3 mg/l of suspended solids and .71 mg/l of total phosphorus.

Greater Manassas Sanitary District

The Greater Manassas Sanitary District operates two sewage treatment plants, Westgate and Old Centreville, which discharge into Bull Run. Both facilities use chemical addition along with primary sedimentation, activated sludge, secondary sedimentation and chlorination. The permit for Westgate allows it to discharge .96 mgd containing 9.6 mg/l of BOD_5 and suspended solids and 2.5 mg/l of total phosphorus. In 1975 the plant discharged an average of .78 mgd containing 6.1 mg/l of BOD_5 and suspended solids, and 1.5 mg/l of total phosphorus.

The permit for the Old Centreville facility allows it to discharge 2.34 mgd containing 9 mg/l of BOD_5 and suspended solids and 2.5 mg/l of total phosphorus. In 1975 the plant averaged a flow of 2.2 mgd containing concentrations of 3.4 mg/l, 3.9 mg/l, and .6 mg/l of BOD_5, suspended solids and total phosphorus, respectively.

Manassas Park I and II

The town of Manassas Park operates two treatment facilities

which discharge into an unnamed tributary of Flat Branch. Both plants have permits which allow them to discharge .344 mgd containing 10 mg/l of BOD_5 and suspended soldis and 2.5 mg/l of total phosphorus. Both plants use the Griffith process for treatment. Manassas Park II also has a finishing pond. The flow of Manassas Park I averaged .26 mgd in 1975 with its BOD_5 averaging 7.9 mg/l and its suspended solids 8.8 mg/l. Manassas Park II averaged .2 mgd with a BOD_5 average of 4.2 mg/l and suspended solids of 8.8 mg/l.

Contrary to the spirit of the Occoquan agreement, neither of these plants attempted to remove phosphorus from their discharges in 1975. All other major dischargers in this drainage basin did. Also, these facilities did not monitor for fecal coliform or total phosphorus in their effluent during 1975.

DISCUSSION

As mentioned previously, the Occoquan is a major water supply source in Northern Virginia and as such it has received a great deal of attention. Extensive studies were performed in the late 1960's and early 1970's to determine the degree of degradation that had occurred and to determine ways to improve the situation. In 1971, the Virginia State Water Control Board published a paper, "Adoption of a Policy for Waste Treatment and Water Quality Management in the Occoquan Watershed." This position paper stated that as a long-term solution, a number of regional plants were to be built (the number not to exceed three) which would use very advanced waste treatment techniques to remove BOD_5, COD, suspended solids, phosphorus and possibly nitrogen. These plants would replace the existing plants. Until the new plants were constructed, the present plants were to remove the "maximum amounts of BOD, COD, suspended solids and phosphorus" possible. These old plants would be allowed to expand modestly provided that treatment would be upgraded so that there would be no increase in the loading to the stream. Finally, a detailed monitoring program would begin in the Occoquan watershed.

It was hoped that the regional plant could be constructed in 1974, however, completion has been delayed much beyond that date. It is now estimated that this plant will be completed in December of 1977 or early 1978. The plant will be designed to treat 10.9 mgd and will include the latest in treatment technology.

With the completion of the Occoquan treatment plant by early 1978, water quality should improve in Bull Run, Cub Run, Flat Branch and their tributaries. The total impact that the new plant will have on the Occoquan Reservoir itself is less obvious. The effect of non-point sources has yet to be studied in detail, although monitoring is under way that will make such an evaluation possible. It is conceivable that the nutrient load from non-point sources is great enough to cause problems even if the nutrients of from the municipal dischargers are removed. However, the completion of the new regional treatment facility will at least be a major first step in the improvement of the Occoquan Reservoir.

TABLE I

MAJOR DISCHARGERS IN THE
CRITICAL AREAS

AREA/DISCHARGER	DAILY FLOW (mgd) 1975	permit	DAILY LOADS OF BOD_5 (pounds/day) 1975	permit	DAILY LOADS OF SUSPENDED SOLIDS (pounds/day) 1975	permit	1975 CONCENTRATIONS (mg/l) BOD_5	SUSPENDED SOLIDS
2/UPRC	20.1	N/A[1]	11,475	14,261	36,192	51,341	68.5	216
2/Cumberland	8.7	8.95	6,398	9,100	3,913	4,250	88	55
2/Celanese Fibers Company	1.0	N/A[1]	83	420	115	500	10	14
2/Kelly Springfield Tire Company	12.19	N/A[1]	N/A[2]	N/A[2]	1,500	3,300	N/A[2]	14.75
3/Rockingham Poultry	.331	N/A[1]	77.6	82	N/A[3]	124	28.11	N/A[3]
3/Moorefield[4]	N/A	.2	N/A	50	N/A	50	N/A	N/A
4/ Winchester	4.8	5.35	1,065	804	734	804	26.6	18.3
4/O'Sullivan Corporation	2.6	(Va.)	158.5	N/A[5]	3,821.8	N/A[5]	7.31	176.25
5/Staunton	2.3	4.5	338	983	406	900	17.6	21.2
5/Fisherville[6]	N/A	2	N/A	400	N/A	400	N/A	N/A
6/Bridgewater	.28	.425	509	425	168.1	553	218	72

TABLE I (Continued)

AREA/DISCHARGER	DAILY FLOW (mgd) 1975	DAILY FLOW (mgd) permit	DAILY LOADS OF BOD_5 (pounds/day) 1975	DAILY LOADS OF BOD_5 (pounds/day) permit	DAILY LOADS OF SUSPENDED SOLIDS (pounds/day) 1975	DAILY LOADS OF SUSPENDED SOLIDS (pounds/day) permit	1975 CONCENTRATIONS (mg/l) BOD_5	1975 CONCENTRATIONS (mg/l) SUSPENDED SOLIDS
6/Dayton	.383	.244	523	134.3	530	101.7	164	166
6/Harrisonburg	3.03	2.75	1,794	1,376	1,010.8	917.4	71	40
6/Wampler Foods	.22	(Va.)	320	654	370	547	174.4	201.6
7/Waynesboro	3.3	4	511	1,100	675	1,268	21	25
7/Crompton-Shenandoah	1.54	(Va.)	58.7	60	338	449	4.6	30.2
7/E. I. du Pont de Nemours	7.46	(Va.)	526	600	2,543	6,085	10	41
8/Luray	.602	.335	477	435.8	421.7	335.3	95	84
8/Virginia Oak Tannery	.41	(Va.)	450	700	2,838	3,400	131.6	830
9/New Market	.293	.28	486.3	112	317.7	112	199	130
9/Timberville	.078	.103	18.1	20.6	17.1	20.6	27.8	26.3
9/Broadway	.183	.1	93.1	40	137.6	93.1	61	90
9/National Fruit Product Company	.03	(Va.)	28	37	42	52	112	207
9/Rockingham Poultry	91	(Va.)	1,670	315	888	210	220	117

TABLE I (Continued)

AREA/DISCHARGER	DAILY FLOW (mgd) 1975	permit	DAILY LOADS OF BOD_5 (pounds/day) 1975	permit	DAILY LOADS OF SUSPENDED SOLIDS (pounds/day) 1975	permit	1975 CONCENTRATIONS (mg/l) BOD_5	SUSPENDED SOLIDS
9/Shen-Valley Meat Packers	.13	(Va.)	36.1	57	24.4	91	33.27	22.52
10/Front Royal	1.1	1.5	697	1,626	550	1,501	76	60
10/Avtex	8.5	(Va.)	894	3,031	1,580	5,556	12.6	22.3
10/Old Virginia	.02	(Va.)	190	386	28	108	1,140	168
10/Allied Chemical (7)	.4	(Va.)	N/A	N/A	N/A	N/A	N/A	N/A
11/Hagerstown	8.08	8	705	1,201	1,306	3,603	10.5	19.4
12/Gettysburg	1.5	1	475	500	288	500	38	23
13/Frederick	4.42	N/A(1)	2,761	5,755	1,252	2,502	75	34
13/Ballenger Creek(8)	N/A	2	N/A	250	N/A	250	N/A	N/A
14/Herndon Expired 8-75(9)	N/A	.3	N/A	65.1	N/A	77.6	N/A	N/A
Effective Oct-March 8-75 April-Sept	N/A N/A	.3 .3	N/A N/A	150.1 90.1	N/A N/A	150.1 90.1	N/A N/A	N/A N/A
15/PEPCO(10)	1,138	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17/Piscataway	15.7	17	502	1,418	662	1,418	4	5.1

TABLE I (Continued)

AREA/DISCHARGER	DAILY FLOW (mgd) 1975	permit	DAILY LOADS OF BOD_5 (pounds/day) 1975	permit	DAILY LOADS OF SUSPENDED SOLIDS (pounds/day) 1975	permit	1975 CONCENTRATIONS (mg/l) BOD_5	SUSPENDED SOLIDS
17/Andrews Air Force Base	.85	.931	142	91	156	76	20	22
18/Greenbriar	.7	.8	46	133.4	642	133.4	8	11
18/Big Rocky Run	.211	.25	15.8	29.2	19.4	29.2	9	11
18/Upper Cub Run	.19	.125	8	31.3	11.1	31.3	5	7
18/Middle Cub Run	.58	.6	33.9	100	58	100	7	12
18/Flatlick	.357	.5	17.9	62.55	14.9	62.55	6.02	5.01
18/Manassas-Liberia	.327	.338	21	64.8	33.5	64.8	7.7	12.3
18/Manassas-Northside	.894	.872	618	160	91.7	167	8.3	12.3
18/Greater Manassas	.78	.96	39.7	77	39.7	77	6.1	6.1
18/Manassas Park I	.26	.344	17.13	28.7	19.08	28.7	7.9	8.8
18/Manassas Park II	.2	.344	7	28.7	14.67	28.7	4.2	8.8
16-18/Other Dischargers in the Washington Metropolitan Area								
Lower Potomac Fairfax County	15.36	18	1,832	3,450	1,896	3,450	14.3	14.4

TABLE I (Continued)

AREA/DISCHARGER	DAILY FLOW (mgd) 1975	permit	DAILY LOADS OF BOD_5 (pounds/day) 1975	permit	DAILY LOADS OF SUSPENDED SOLIDS (pounds/day) 1975	permit	1975 CONCENTRATIONS (mg/l) BOD_5	SUSPENDED SOLIDS
Fairfax County, Westgate	12.28	13.7	922	5,141.6	1,434	5,141.6	9	14
Little Hunting Ck. Fairfax County	4.42	6.6	405	1,100	553	1,100	11	15
Dogue Creek Fairfax County	2.87	5	263	834	311	834	11	13
Arlington County	21.5	24	3,036	5,404.3	3,659	6,004.8	16.8	20.3
Alexandria	17.58	27	4,840	6,930	5,600	7,600	33	38
Belmont	1.34	1.5	200	260	145	284	17.8	12.7
Neabsco	.852	1.6	66	322	126	322	9.2	17.7
Featherstone	.907	1.3	61	167	107	167	8	14.1
Dumfries	.969	1	62	322	100	322	8.2	13.5
Fort Belvior #2	1.32	2.5	303.4	625.5	368	625.5	27.6	33.4
Blue Plains	292	299	92,820	100,000	93,360	100,000	38.2	38.4

FOOTNOTES TO TABLE I

(Va.) The State of Virginia does not include limitations for flow in their National Pollutant Discharge Elimination System (NPDES) permits to industries.

(1) No limitation for flow is included in the permit granted to this discharger.

(2) No limitation for BOD_5 loads is included in Kelly-Springfield's permit. This industry produces no organic wastes.

(3) Data on suspended solids discharged by Rockingham Poultry Marketing Co-op, Inc. was not available for 1975.

(4) No data was taken at the Moorefield facility in 1975. Data was collected during April, May and June of 1976. The flow during that time averaged .125 mgd with BOD_5 and suspended solids concentrations of 307 mg/l (320 pounds/day) and 112 mg/l (116.8 pounds/day), respectively.

(5) O'Sullivan's permit requirements for BOD_5 and suspended solids were not written in pounds/day. The limit on both BOD_5 and suspended solids was 10 mg/l. Since Virginia does not include flow requirements for industrial dischargers in their permits, conversion to pounds/day for use in this table isnnot possible.

(6) The Fisherville facility was under construction in 1975. Reporting of data did not begin until January of 1976.

(7) The NPDES permit for Allied Chemical did not include parameters of flow, BOD_5 or suspended solids. Allied discharges only cooling water from this plant.

(8) Construction of the new Ballenger Creek facility was not completed in 1975.

(9) In violation of their permit, no data was reported by the Herndon treatment plant in 1975. After their permit expired in August a new permit was granted which imposed seasonal limits on the facility.

(10) Only data on flow was recorded by PEPCO. PEPCO uses only cooling water in its two plants located on the Anacostia.

Note on converting and rounding off data: NPDES permits vary widely in what they require and how data is reported. For purposes of comparison, where necessary, permit and effluent data have been converted to fit the categories listed in the table. The conversion formula is described in the introduction to the text on page Daily loads determined by the formula have been rounded to the nearest tenth.

GLOSSARY

Sewage Treatment Terminology

ACTIVATED SLUDGE--Sludge floc produced in raw or settled wastewater by the growth of zoological bacteria and other organisms in the presence of dissolved oxygen and accumulated in sufficient concentration by returning floc previously formed.

ACTIVATED SLUDGE PROCESS--A biological wastewater treatment process in which a mixture of wastewater and activated sludge is agitated and aerated. The activated sludge is subsequently separated from the treated wastewater (mixed liquor) by sedimentation and wasted or returned to the process as needed.

AERATION--The bringing about of intimate contact between air and a liquid by one or more of the following methods: (a) spraying the liquid in the air, (b) bubbling air through the liquid, (c) agitating the liquid to promote surface absorption of air.

AEROBIC DIGESTION--Digestion of suspended organic matter by means of aeration.

ANAEROBIC DIGESTION--The degradation of organic matter brought about through the action of microorganisms in the absence of elemental oxygen.

BAR SCREENING--A wastewater treatment process during which the largest particulate matter is separated from the sewage by passing the sewage through coarse screens. This often is the first treatment received by waste.

BIO DISK--A relatively new treatment process which employs a very large cylinder upon which sewage is continually collected and allowed to oxidize.

BIOLOGICAL WASTEWATER TREATMENT--Forms of wastewater treatment in which bacterial or biochemical action is intensified to stabilize, oxidize, and nitrify the unstable organic matter present. Biodisks, contact beds, trickling filters, and activated sludge processes are examples.

BLOWDOWN--The water discharged from a boiler or cooling tower to dispose of accumulated salts.

CHEMICAL COAGULATION--The destabilization and initial aggregation of colloidal and finely divided suspended matter by the addition of a floc-forming chemical.

CHLORINATION--The application of chlorine to water or wastewater, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results.

CHLOROPHYLL A--A primary plant pigment which functions in the process of photosynthesis, used as an indicator of plant biomass in water.

CLARIFICATION--Any process or combination of processes the primary purpose of which is to reduce the concentration of suspended matter in a liquid.

CLARIGESTER--A treatment process in which clarification and aerobic digestion occurs in the same tank.

COAGULATION--In water and wastewater treatment, the stabilization and initial aggregation of collidal and finely divided suspended matter by the addition of a floc-forming chemical or by biological processes.

COMMUNITOR--A device which is often used with, or in place of, bar screens. Instead of removing large particles, communitors are designed to grind them into smaller particles which are then removed by other processes.

CONTACT STABILIZATION PROCESS--A modification of the activated sludge process in which raw wastewater is aerated with a high concentration of activated sludge for a short period, usually less than 60 minutes, to obtain BOD removal by absorption. The solids are subsequently removed by sedimentation and transferred to a stabilization tank where aeration is continued further to oxidize and condition them before their reintroduction to the raw wastewater flow.

DIGESTER--A tank in which sludge is placed to permit digestion to occur. Also called sludge digestion tank.

DIGESTION--The biological decomposition of organic matter in sludge, resulting in partial gasification, liquefaction, and mineralization.

DISSOLVED AIR FLOATATION--A process designed to separate solids and liquids. This is accomplished by bubbling air through the liquid, which increases the buoyancy of the solids and lifts them to the surface of the liquid where they can be removed.

EFFLUENT--Wastewater or other liquid, partially or completely treated, or in its natural state, flowing out of a reservoir, basin, treatment plant, or industrial treatment plant, or part thereof.

ELUTRIATION--A process of sludge conditioning whereby the sludge is washed with either fresh water or plant effluent to reduce the demand for conditioning chemicals and to improve settling or filtering characteristics of the solids. Excessive alkalinity is removed in this process.

EQUALIZATION--The collection of sewage in a storage area to eliminate large fluctuations in either its strength or flow.

FILTRATION--The process of passing a liquid through a filtering medium (which may consist of granular material, such as sand, magnetite, or diatomaceous earth, finely woven cloth, unglazed porcelain, or specially prepared paper) for the removal of suspended or collodial matter.

FLOCCULATION--In water and wastewater treatment, the agglomeration of colloidal and finely divided suspended matter after coagulation by gentle stirring by either mechanical or hydraulic means. In biological wastewater treatment where coagulation is not used, agglomeration may be accomplished biologically.

GRIT--The heavy suspended mineral matter present in water or wastewater, such as sand, gravel, or cinders.

GRIT CHAMBER--A detention chamber or an enlargement of a sewer designed to reduce the velocity of flow of the liquid to permit the separation of mineral from organic solids by differential sedimentation.

HYDRAULICALLY OVERLOADED--A condition in which the quantity of flow through a treatment plant is greater than that for which it is designed, which often results in the decrease in operational efficiency of the plant.

INFILTRATION--The quantity of groundwater that leaks into a pipe through joints, porous walls, or breaks.

INTERCEPTOR--A sewer that receives dry-weather flow from a number of transverse sewers or outlets and frequently additional predetermined quantities of storm water (if from a combined system), and conducts such waters to a point for treatment or disposal.

LAGOON--A pond containing raw or partially treated wastewater in which aerobic or anerobic stabilization occurs.

MICROSTRAINING--The filtration of a fluid through a specially created media designed to remove essentially all of the fluid's suspended solids and colloidal material.

NEUTRALIZATION--The adjustment of the pH of a fluid.

NITRIFICATION--A treatment process which involves the conversion of ammonia nitrogen into nitrate and nitrite nitrogen.

ORGANICALLY OVERLOADED--A condition in which the quantity of organic wastes entering a sewage treatment plant is greater than that for which it is designed. As with hydraulic overloading, this often results with a decrease in the operational efficiency of the plant.

POLISHING--The final treatment stages, such as in a polishing pond, where the effluent receives a final treatment before being discharged.

PRIMARY TREATMENT--The first major (sometimes the only) treatment in a wastewater treatment works, usually sedimentation. The removal of a substantial amount of suspended matter but little or no collodial and dissolved matter.

SANITARY SEWER--A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with minor quantities of ground, storm and surface waters that are not admitted intentionally.

SECONDARY WASTEWATER TREATMENT--The treatment of wastewater by biological methods after primary treatment by sedimentation.

SEDIMENTATION--The process of subsidence and deposition of suspended matter carried by water, wastewater, or other liquids, by gravity. It is usually accomplished by reducing the velocity of the liquid below the point at which it can transport the suspended material. Also called settling.

SLUDGE--The accumulated solids separated from liquids, such as water or wastewater, during processing, or deposits on bottoms of streams or other bodies of water. The precipitate resulting from chemical treatment, coagulation, or sedimentation of water or wastewater.

STABILIZATION--A process used to equalize wastewater flow composition prior to regulated discharge.

TRICKLING FILTER--A filter consisting of an artificial bed of coarse material, such as broken stone, clinkers, slate, slats, brush, or plastic materials, over which wastewater is distributed or applied in drops, films, or spray from troughs, drippers, moving distributors, or fixed nozzles, and through which it trickles to the underdrains, giving opportunity for the formation of zoological slimes which clarify and oxidize the wastewater.

VACUUM FILTER--A filter consisting of a cylindrical drum mounted on a horizontal axis, covered with a filter cloth, and revolving with a partial submergence in liquid. A vacuum is maintained under the cloth for the larger part of a revolution to extract moisture. The cake is scraped off continuously.

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