

CHAPTER 1¹ ANALYSIS OF PHYSICAL AND ENVIRONMENTAL CONDITIONS

INTRODUCTION

A Comprehensive Plan for Northumberland County should have two broad objectives. First, it should identify long-range and strategic community needs of the County's growing population and second, it should provide a planning framework designed to guiding physical change which comes in response to such growth.

The Virginia Code (starting at 15.1-427) authorizes all local governments to prepare and administer comprehensive plans and related regulatory functions. Comprehensive Plans are mandated for all of Virginia's local governments by these statutes; and it is also a requirement that they be reviewed every five years. Tools for implementing the comprehensive plan include a subdivision ordinance, and a zoning ordinance. The subdivision ordinance is mandated by the general planning statutes. Zoning was first mandated by the Chesapeake Bay Preservation Act (1989) but the County has had a zoning ordinance (authorized by the general planning statutes) since the mid-1970s. Regulations adopted pursuant to the Chesapeake Bay Act establish the following planning requirements for comprehensive plans of communities under their jurisdiction.

- **Physical Constraints to Development:** which addresses those natural geographic qualities which seriously limit the potential for development.
- **Protection of Potable Water Supply:** which is concerned about protecting the existing and potential supply of drinkable water within the community.
- **Shoreline Erosion Control:** which focuses on the loss or potential loss of shorelines due to wind and wave erosion.
- **Access to Waterfront Areas:** which deals with access and potential access to areas for private as well as public use.
- **Redevelopment of Intensely-developed Areas and Other Areas Targeted for Redevelopment:** which focuses on opportunities to reduce pollution through conversions of existing development.

This chapter of the Comprehensive Plan focuses on current physical and environmental conditions that may influence or limit the future use of land. The conditions examined include both natural and man-made conditions which for purposes of analysis are grouped into the categories as listed above.

They reflect the planning emphasis of the Chesapeake Bay program, with the exception of the category "redevelopment of intensely developed areas." No areas in Northumberland County meet the Chesapeake Bay criteria for intensely developed.

These analyses will be used in later chapters as follows: In Chapter 2, environmental issues and strategies will be organized around these four topics; in Chapter 3, the structural framework of the future land use plan and land use policies will flow from the analysis plus the issues of Chapter 2;

¹Filename = Chapter1.3rd

and in Chapter 5, the "Water Quality Preservation Plan", a strategy for meeting the requirements of the Chesapeake Bay preservation laws and regulations, will be organized around the same topics. Also included as an Appendix to the Plan Report will be a study of the Economy and Demographics of the County which provides the basis for growth projections upon which the plan is based.

The format used throughout the Comprehensive Plan will follow the same five criteria of the Chesapeake Bay Program. Another important factor in selecting the format for this Chapter is the requirements of the Virginia Statutes concerning comprehensive plans for local communities. In this regard, the analyses should provide a thoroughly-researched basis for determining need and formulating the substance of the comprehensive plan.

Supporting PMA's work in preparing this Chapter is the prior work on these subjects performed by the County, which is hereby acknowledged. The County provided certain maps of physical conditions that were originally established in the Virginia Geographic Information System (VIRGIS).² Through a series of electronic steps, these maps were converted to the form in which they appear in this Chapter. The County also provided PMA with a computer file of a previous draft of the physical analysis section of the Comprehensive Plan.³ Where applicable, that text is used here.

Maps displayed in this Chapter were produced by PMA using MAPINFO.⁴ They include a combination of maps prepared from VIRGIS sources and original maps prepared for this study by PMA.

²Northumberland County uses the Virginia Geographic Information System (VIRGIS) developed by Virginia Tech and maintained by the Northern Neck Planning District Commission. Notes are included on individual maps to indicate which data came from VIRGIS sources; in general, they are the colored maps except for Figure 1.1 which was prepared from field work by PMA.

³File name of County's work is: "environ.pln" In an early draft, the text used from the "environ.pln" file was identified by italics and page number references. Those references have been removed from the current version.

⁴MAPINFO is proprietary desktop mapping software used by PMA to create maps displayed in this and other chapters of the Comprehensive Plan. Where VIRGIS maps data are used, the graphic data are added to the MAPINFO maps as one of several layers of information as appropriate.

A. PHYSICAL FACTORS THAT INFLUENCE OR CONSTRAIN DEVELOPMENT

Many factors can influence the type as well as the timing of development and most of these have to do with markets and economic conditions. Early in the life of this Nation, most of the population relied on agriculture of one type or another for both employment and to meet their needs for foods and services. After the beginning of the industrial revolution, towns and urban places became more important as jobs and trade centers. As jobs were generated by industries, markets for housing, trade and services were generated as people moved from rural areas to urban places in order to be close to their work. This pattern resulted in mass migration to towns, cities and metropolitan areas during the last century. As a result the rural areas lost population for most of the first three-fourths of the 20th century.

But certain areas appear to have a capacity to attract people based on the natural resources of the community itself. Some such communities have become great centers of tourism which, in and of themselves, function as job centers. Although still very much a rural community, Northumberland County has some qualities of the latter situation as evidenced by the large amount of building that has been taking place along the County shorelines. It went through a long period of declining population, but for a decade or more the County is again experiencing growth, this time from the attraction of the County itself. With more miles of buildable shoreline than any other county in Virginia, Northumberland has an asset that has become a growth generator. Waterfront development accounts for three out of four residential lots in the County and most of the new residential structures built in the past decade. A demographic and economic study (Appendix A) conducted as part of the research for the comprehensive plan suggests that the County will see more of this type of development during the next decade. But building can be overdone and that is one of the possibilities that County leaders need to keep in mind as they develop plans for the future.

During the next rounds of building, many factors will influence what happens. Certain parts of the County have already proved to be desirable as building sites, and since "success builds upon success" one might expect these areas to attract more development. Yet there are some conditions that will restrain development and these must be avoided. Data presented below will demonstrate much of the most desirable land in terms of location has some of the most serious problems. In the following pages some of the most significant conditions that will influence or constrain development are dealt with in detail. They include:

1. Existing development
2. Topography and physiography
3. Soil suitability for on-site sewage treatment
4. Shrink-swell soil factors
5. Flood-prone areas
6. Wetlands and natural habitat areas
7. Historic resources
8. Chesapeake Bay protected areas

Each of these topics is discussed briefly below. Where information is available, major physical features that would affect potential development are shown on a map. The narrative provides related descriptive information and significant observations as to how the conditions may influence planning policies.

1. Existing Development

Existing development has a powerful influence on future land use patterns because future development in rural communities almost always comes either as an extension of existing development or on new land but rarely as a replacement of existing buildings. So for purposes of planning for one or two decades, one might consider the existing development pattern as a fixed feature. This section reports on existing land use and existing subdivisions with a special analysis of shoreline subdivisions included.

a. Land Use

Figure 1.1 gives a graphic picture of existing development in Northumberland County in 1995. This map was developed from data obtained in a field survey conducted by PMA during the summer of 1995. The survey identified the use of existing major buildings.⁵ Buildings which have been abandoned were not included.

- Residential unit/Conventional single-family: This category includes two types of dwellings: (1) conventional single-family houses and (2) manufactured housing units customarily referred to as "doublewides" which are established on a permanent foundation as a single-family unit. This use is illustrated by a round yellow dot on the land use map. There is a total of 5,347 housing units in this category shown in this illustration.⁶
- Mobile home/Trailer: This category included "singlewide" mobile homes or manufactured homes whether located in a mobile home park or freestanding on a lot or acreage. The mobile home count was 365 units.⁷ The symbol used on the map is a small black square dot.
- Commercial: All commercial-type uses are included such as retail stores, offices, convenience stores, personal and business service shops and other similar uses. They are shown on the map as a round red dot. There are a total of 149 commercial uses indicated on the map.
- Industrial/Marine uses: This category includes industries of all types, warehouses, lumberyards and commercial marinas. The uses are identified by a red triangle on the map. There are a total of 20 such uses shown on the map.
- Public/Semi-public: This is a mixed category which includes mostly county buildings or facilities, schools and churches. The 76 uses in this category are

⁵The survey included all existing buildings that were visible from public (VDOT) roads. In many cases where waterfront residences were served by private driveways used by several houses, an active mailbox was considered to represent a residence and counted as such. In the latter cases, the maps may show the residences as being located on the public road rather than at its actual location.

⁶In 1990 the census reported 5,066 year-round units and 1,775 seasonal units. PMA did not count campers, motor homes and the like as dwelling units in this survey.

⁷The 1990 census reported 890 mobile homes, but with the narrow definition of a mobile home used by PMA, many units that would formerly have been called "mobile" were classified as regular residential units.

indicated by a green dot.

Land Use Map, Figure 1.1

This map illustrates the primary characteristics of development in Northumberland County. It is concentrated along existing roads and along the waterfront. Residential development appears along all roads while most of the commercial development is located along the primary highways. A concentration of commercial development within several villages is especially visible from this map. Industrial development, which is a combination of marine and other industrial uses, occurs mostly along waterfronts with a major concentration in the vicinity of Reedville.

The largest single category of land use is for agriculture and forestry as illustrated by the large amount of white area on the map. Farming and forest uses have remained fairly untouched by development at this stage, except for conversions of land to development along the various waterfronts.

b. Subdivisions

New subdivisions are important in evaluating development potential because once subdivision lots are recorded and streets developed to serve them, as a practical matter, the landscape of that land is changed forever. This may account for the fact that subdivision ordinances were one of the first planning tools mandated by state legislation. Subdivisions have played an important part in the development of Northumberland County during the last two decades, particularly development along the waterfront as the analysis presented below illustrates. Overall the number of lots in recorded subdivisions in Northumberland County totals 8,574 in 255 subdivisions.⁸ Of these, 87 subdivisions containing 6,527 lots have been identified as "waterfront subdivisions".

	No of Subdivisions	Total No. of Lots	Average Lots per Subdivision	Percent of Total Subs.
All Subdivisions	255	8574	33	100%
Shoreline Subs	87	6527	75	76%
Non-shoreline Subs	168	2047	12	24%

With more than three-fourths of all subdivision lots occurring in waterfront developments, this group warrants examination in more detail. Figure 1.2 provides a graphic representation of the location and size of each of the 87 waterfront subdivisions located within the County. In this chart, the diameter of the circle indicates the relative size of the subdivision in number of lots. There is no one specific concentration of subdivisions on any of the rivers or creeks; they are dispersed along the shorelines throughout the County.

⁸Source: listing of subdivisions provided by the County Office of Building and Zoning. Note: The number of lots were not known for a small number of subdivisions on this list, so the actual number of subdivision lots is a little higher than the number given in the text.

Existing Shoreline Subdivision, 1994 map, Figure 1.2

DISTRIBUTION OF WATERFRONT SUBDIVISIONS

No. of Lots (Range)	Number of Subdivisions	Percent of Subdivisions	Number of Lots	Percent of Total Lots in Subdivisions
More than 200 lots	7	8%	2930	45%
100 to 199 lots	8	9%	1161	18%
50 to 99 lots	16	18%	1151	18%
25 to 49 lots	24	28%	870	13%
Less than 25 lots	32	38%	350	6%
TOTAL	87		6527	

There is a large number of lots concentrated in just a few very large subdivisions. Forty-five percent of all waterfront lots within the County are found in only seven subdivisions in the highest (200 and up) category above. If the next category is added, nearly two-thirds of the lots are in subdivisions containing at least 100 lots.

It was observed that in many of the larger subdivisions, only a small share of the lots is actually on the waterfront; the remaining are inland lots. And while the majority of the waterfront lots have been developed with homes, most of the inland lots are still vacant.

2. Topography and Physiography

The topography and physiography of lands can greatly influence surrounding natural resources. The amount and rate of runoff which ultimately reaches water bodies are influenced by the size, shape, and topographic and physiographic characteristics of a watershed. Typically, runoff rates and the potential for erosion increase as slopes increase.

Elevation levels within Northumberland County range from sea level to approximately 170 feet. Although Northumberland County lies within the Coastal Plain region, the County contains three physiographic subregions which vary from flat coastal lands to hillier areas. The fluvial river terrace subregion includes tidal marsh areas along major rivers and creeks and some adjacent lands which range from 10 to 50 feet above sea level. The low marine terrace subregion ranges from 10 to 15 feet above sea level and typically lies between the fluvial river terrace and the upland. The fluvial river terrace and low marine terrace physiographic subregions comprise a band of level terraces along most of the Chesapeake Bay and the lower portion of the Potomac River. The coastal plain upland subregion includes the inland plateaus as well as the cliffs along the two major rivers in the County, with elevations ranging from 90 to 170 feet above sea level.

Elevation Map, 20-Foot Contours Figure 1.3

A conspicuous feature of Northumberland County's topography is an escarpment known as the "Suffolk Scarp". This feature which runs along the entire eastern coast of Virginia is located approximately two to three miles inland and is marked by a sharp drop in elevation at about 50 feet above sea level.

Figure 1.3 illustrates the principal topographic characteristics of the County. In particular, this map delineates clearly the Suffolk Scarp. The area between the "drop-off" and the shoreline of the Potomac River and Chesapeake Bay occupies nearly half of the County's total area and almost all of the area in demand for new development. Other maps and/or data appearing later in this Chapter will show that much of the area that lies seaward from the Suffolk Scarp is disadvantaged by poor percolation. In addition to the difficulty finding soils that are suitable for septic tanks, much of the land along the internal rivers and streams have slopes in excess of 15 percent. There is the problem of increased soil erosion in cases where slopes are both "steep" and "highly erodible". Careful attention should be given to ensure that new development is adjusted to these sensitive features of the soil and topography.

3. Soil Suitability for On-Site Sewage Treatment

One of the most important factors to consider in determining soil suitability for development in rural areas is the suitability of the soil for sewage disposal through the use of septic drainfields. Because Northumberland County is not serviced by a public sewage system (except for Reedville), careful consideration must be given to the design, construction, and maintenance of septic tank systems or other on-site sewage disposal systems located on questionable sites such as those in flood prone areas, on steep slopes, or with poorly-drained soils.

Figure 1.4 illustrates those areas within the County that have characteristics which are generally unsuited for establishing septic tank drain fields. This map is a composite of factors which limit the soil's capacity to accept septic tanks. Locations of high water tables, steep slopes, flood prone areas, and soils with inappropriate permeability rates were overlaid to determine areas in the County where soils are suitable to support septic systems.

Most of the problem areas are in the low lying area spanning a two to three mile band that roughly parallels the Chesapeake Bay and the Potomac River shorelines. This area is characterized by elevations lower than 50 feet above sea level. In addition, there is large number of smaller problem areas that run throughout the County. These are mostly located along streams and include stream banks and other steep slopes. The latter is a problem not only for septic tanks but as a source of soil erosion. Erosion can result when unstable soil is disturbed particularly if the slope is steep.

Despite the conditions noted above, it can be observed from Figure 1.4 that most of the land area within the shelf area between the Suffolk Scarp and the shorelines may have acceptable soils for septic tanks. Nevertheless this is an area where caution should be used in selecting sites where on-site sewage disposal is necessary.

Soil Suitability for Septic Tanks map Figure 1.4

Some clay and silt soils in the County are poorly suited for sewage disposal because their low permeability characteristics limit the rate which water moves down through the soil. An example of this situation occurs in Callao, where Beltsville soils contain fragipan, a dense soil layer beneath the surface which contributes to water quality impacts and presents a risk to human health. Soils with extremely low permeability may cause septage to rise to the surface. The state standard is that a permeability of less than 0.6 (0.6 inches of percolation per hour) is unacceptable for septic tank fields.

At the other end of the range, highly permeable soils are also unsuitable for installation of septic systems, because the effluent moves through it too fast to provide adequate treatment, having the potential to contaminate groundwater. State standards establish "6.0 inches per hour" as the maximum permeability acceptable for septic tank installation.

In summary, most of the development that is likely to occur within the County in the near future, given the large number of subdivision lots in scattered subdivisions, will require septic tanks - the only viable option for sewage disposal in these areas. The ability to install septic tanks will depend entirely upon the suitability of the soil for drain fields. The determination of whether the soil is acceptable for drain fields is to be made by the Health Department on a case-by-case basis. "Percolation", as the process for the ground accepting the outflow from septic tanks, refers to the rate that the water will pass through the soil while it is saturated. If percolation occurs too fast, then the septic tank fails because the drainage passes through the soil too quickly. If it occurs too slowly then the drainage may pass through the soil untreated and contaminate the underground water supply. Because soils in many of the preferred development areas do not meet Health Departments requirements for septic tank systems the County should encourage the Health Department to explore new strategies and technologies for sewage disposal systems for rural areas.

Every effort should be taken to minimize threats to groundwater in the County, particularly because the County relies entirely on groundwater for its potable water. Increased vertical separation between a drainfield and the water table provides adequate biological treatment, minimizing contamination of surface and ground water. Percolation and depth to groundwater testing should be completed prior to subdividing or platting land to ensure that purchased lots have primary and reserve sewage disposal areas on site. Homeowners should be encouraged to use water conservation devices to ease the load on septic systems.

4. Shrink-swell Factors

Shrink-swell is the potential for volume change in a soil with a loss or gain in moisture. Volume changes occur mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of change in soil moisture content influence the amount of swelling of soils in place.

Shrink-swell Soil Characteristics map, Figure 1.5

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special engineering must be used to compensate in such conditions.

Figure 1.5 illustrates the general shrink-swell qualities of Northumberland County's soils using a four-step classification.

- Moderate to high shrink-swell soils (the lowest quality) are present within the area between the shoreline and the Suffolk Scarf, but this type of soil is not the dominant class even in this area which otherwise has some soil qualities that are adverse to development.
- Low shrink-swell soils are present throughout the County but more dominant in the lower-lying areas of the high lands south and west of Routes 360 and 200. Low shrink-swell soils are more common in the drainage and stream basins of this portion of the County.
- Moderate to low shrink-swell is also found throughout the County and most commonly along the ridges between creeks and swales. Several points should be observed: (i) that most of the roads built by the Virginia Department of Transportation are located along the ridges where the better classes of soil are found; (ii) that almost all existing development occurs adjacent to existing roads which also have the advantages of the good soils; (iii) because of the distance between the tops of the ridges and the creeks and drainage ways that follow the valleys, development of this type has the least detrimental impact on water quality; and (iv) despite these advantages, the areas most in demand are in the lowlands where few of these conditions are present.
- The last category, none, is not significant because very little of the land area of the County is classified in this manner.

Overall, the county soils are within an acceptable range as to shrink-swell qualities, and this condition should not present any barrier to development that cannot be compensated for by engineering design.

5. Flood-prone Areas

Floodplains are low-lying land areas adjacent to rivers, streams, creeks, and other water bodies which are subject to periodic flooding when precipitation causes the volume of water to exceed the capacity of the waterway. Left in an unaltered, undeveloped state, floodplains can serve important natural, recreational, and historical functions.

There are a multitude of factors, such as topography, geographic orientation of the shoreline, depth and duration of flooding, and rate of water rise, which affect damages caused by a flood. The amount of flood damage is also affected by the extent of development within a floodplain since development can interfere with many of the natural functions floodplains serve.

According to Northumberland County's Flood Insurance Study, the coastal areas of the County are vulnerable to tidal flooding from major storms such as hurricanes and northeasters. These types of storms produce large amounts of precipitation and high winds which push large volumes of water against the shore. The topography of the area flooded, rate of rise of floodwaters, depth and duration of flooding, exposure to wave action, and extent to which structures have been placed in the floodplain determine the amount and extent of damage caused by any tidal flood. Northumberland County has experienced major storms and flooding since early settlement of the

area. The most recent severe storm occurred in November of 1985 when northeast winds in excess of 65 miles per hour pushed tides five feet above normal levels and destroyed bulkheads, boathouses, and other waterfront structures in the Northern Neck and other areas along the Chesapeake Bay and Potomac River.

Congress established the National Flood Insurance Program in 1968. This program enables property owners to purchase federally-backed flood insurance within communities which implement floodplain management measures to reduce flood risks to new development. Regulations of the National Flood Insurance Program specify requirements which must be included in local ordinances if a community wishes to participate in the program. Requirements of the program include regulation of buildings and other development in floodplain areas. The Federal Emergency Management Agency (FEMA) establishes flood risk data for insurance rating and floodplain management in addition to conducting Flood Insurance Studies and Maps for localities. The Flood Insurance Rate maps define flood hazard areas, or areas subject to inundation at 100-year and 500-year intervals. A 100-year flood zone has a one percent (1.0%) chance of being inundated in any given one-year period, whereas the 500-year flood zone has a two-tenths of one percent (0.2%) chance of being flooded in the same one-year period.

FEMA has completed Flood Insurance Rate Maps for Northumberland County, which are on file in the County Administrator's office. Figure 1.6 depicts generalized areas in the County that are located in flood-prone areas.

FEMA's Flood Insurance Study determined that all development in the County's floodplains is subject to water damage. Some flood-prone areas are subject to high velocity wave action which may cause structural damage and severe erosion along the shoreline. Due to the vast exposure afforded by the Chesapeake Bay and the Potomac River, the northern and eastern sections of the County are subject to wave damage.

There is considerable development in Northumberland County that is located within the 100-year floodplain shown on the Floodplain Map. It includes full-time dwellings, seasonal cottages, businesses and industries. This is understandable, given that most of the existing development within the County occurred before the floodzone maps were first prepared pursuant to a 1968 federal law. Even today an owner still has the option of building within a floodplain; however, most dwellings that are financed with insured loans are required by the mortgage insuring agency to purchase flood insurance.

Pressure for future development in the County's floodplains is expected to continue as long as an abundant supply of lots along the shorelines is available. The planning issue that arises is how far should the County try to go in regulating development in these vulnerable areas?

Floodplain Map, Figure 1.6

Structural and natural elements that afford some protection against flooding include bulkheads, seawalls, jetties, and sand dunes. The regulatory flood protection measures are included in various codes and ordinances which regulate some aspect of development within floodplains, including: State Uniform Building Code, County's Floodplain Management Ordinance, Subdivision Ordinance, and Chesapeake Bay Preservation Ordinance.

The County's Floodplain Management Ordinance was enacted in May, 1989. The general provisions of the ordinance include regulation of uses, activities, and development which will cause unacceptable increases in flood heights, velocities, and frequencies; restriction or prohibition of certain uses, activities and development within areas subject to flooding; requirement of protection or floodproofing for all uses, activities, and development in flood prone areas; and protection for individuals buying lands and structures unsuited for intended purposes because of flood hazards.

The County's Subdivision Ordinance requires subdividers to provide information needed to determine if improvements such as drainage plans and flood control devices are necessary to develop the property. If improvements are necessary, the subdivider must provide plans with a surveyor's or engineer's statement that such improvements will be adequate for property development when properly installed.

6. Wetlands and Natural Habitat Areas

a. Wetlands

Wetlands are transitional areas between dry uplands and wet downland areas such as streams, rivers, bays, and other bodies of water. Often referred to as swamps, bogs, pocosins, and marshes, wetlands serve as a natural water filter for wastes and sediments, a barrier and an absorber of floodwaters, a buffer and stabilizer of the shoreline from coastal erosion, a recharge area for groundwater, and an important breeding and nesting ground for many important species of fish, bird, and plant life. Wetlands also serve as valuable sites for recreation, open space, and education.

Wetlands are classified as either tidal or nontidal. Tidal wetlands are vegetated marshes, nonvegetated beaches, sandflats, and mudflats which receive regular tidal flooding by salt or brackish water. Tidal wetlands in the County are generally located along the bottomlands of major drainage streams subject to tidal action. Saltwater and freshwater marshes are typified by anaerobic mineral soils vegetated primarily by grasses, while mudflats and beaches do not support aquatic or terrestrial vegetation.

Nontidal wetlands, which may be adjacent to tidal marshes as well as farther inland, are beyond tidal influences, and are either continually or seasonally saturated by fresh water. Due to seasonal and yearly variations, these types of wetlands are not as easily recognized, since there may not be any surface evidence of the presence of water during certain times of the year.

According to the National Wetland Inventory, there are 1,560 acres of tidal wetlands in Northumberland County. Some of the larger marsh areas include approximately 157 acres in Dameron Marsh, 125 acres in Barnes Creek, and 85 acres on Hughlett Point.

For years, wetlands were considered undesirable wastelands and breeding grounds for mosquitoes which should be filled, drained, or altered. Consequently, millions of acres of wetlands were lost to a number of drainage and land-filling projects in order to convert them

to agricultural lands or development sites. Wetlands are extremely vulnerable to physical and hydrologic changes such as dredging, filling, and water pollution, and lose their ability to perform natural functions when they are filled or drained. It has been estimated that between the mid 1950s and late 1970s, 11 million acres of wetlands were lost nationwide. During this period, Virginia lost approximately 57,000 acres of freshwater vegetated wetlands to agricultural conversion, channelization, forestry, pond, lake, and reservoir construction and other development. During the early 1970s, the science community began to realize the significant functions and importance of wetlands and as a result, a number of federal, state, and local regulations evolved to manage and protect both tidal and nontidal wetlands.

- Federal Regulations: Sections 401 and 404 of the Clean Water Act are the primary federal regulations which affect development on wetlands. Before a wetland can be filled or disturbed, a 404 permit must be obtained from the U.S. Army Corps of Engineers.
- State Regulations: The Commonwealth of Virginia began to regulate wetlands in the early 1970s, with the passage of the Virginia Wetlands Act of 1972. The purpose of this act was to ensure that wetlands of primary ecological significance shall not be altered or unreasonably disturbed. The following areas were exempted from this Act: agricultural, silvicultural, and horticultural activities; cultivation and harvest of shellfish and worms for bait; maintenance and repair of roads and railways; outdoor recreational activities that do not disturb wetlands; construction and maintenance of noncommercial piers, boat houses, and fences constructed so as to preserve tidal flow, construction of navigational aids; maintenance of man-made drainage ditches; governmental activities; and activities undertaken pursuant to emergency decrees.
- Local Regulations: The Virginia Wetlands Act gave local governments authorization to establish local wetlands boards to exercise jurisdiction and review and issue permits for development on wetlands. In addition to establishing wetland regulations and wetlands board pursuant to the Virginia Act, Northumberland County adopted a Chesapeake Bay Preservation Area Ordinance which establishes a Resource Protection Area consisting of any wetlands plus a 100-foot vegetated buffer strip located landward from wetlands. Other regulations in Northumberland County which protect wetlands include the Floodplain Ordinance, Erosion and Sediment Control Ordinance, and Subdivision Ordinance.

Tidal Wetlands and Natural Habitat Areas map, Figure 1.7

Figure 1.7 illustrates significant wetland locations within the County, although this map is intended as a graphic rather than an exact portrayal of wetland locations. The County has on file a copy of the National Wetland Inventory and that source should be used for specific wetland locations and configurations.

The predominant locations for wetlands are at the terminus of the many streams which flow into the rivers that comprise its more than 450 miles of shoreline. According to data in the Shoreline Inventory conducted by the Northern Neck Planning District Commission for the County in 1994, almost 20 percent (88.6 miles) of the shoreline is in wetlands, either forested or open.

b. Natural Habitat Areas

In addition to showing the general locations of tidal wetlands, Figure 1.7 identifies areas designated as natural habitat areas, those sites which are known to be a natural habitat resource for rare, threatened or endangered species which have been inventoried as part of a state or federal natural heritage program. Information for locating these sites came from the Chesapeake Bay Area Public Access Plan. That plan did not identify precise locations of each area or the species protected. If development should occur within the vicinity of these areas, the County should examine each project so that development does no harm to the protected natural habitat site. The publication noted above provides a sketch of the area involved but even these sketches will not suffice in planning for a specific site. Persons proposing development should be required to identify the protected areas in detail on the site plans submitted for review by the County.

7. Historic Resources

The Virginia Department of Historic Resources is responsible for identifying and mapping known resources of historical and archaeological significance. In many communities throughout Virginia, this agency has sponsored the performance of in-depth surveys to identify both the location and historical context of buildings and sites of historic importance. VDHR has not completed an in-depth study of sites for Northumberland County, although it maintains an incomplete record of about 120 possible historic sites and buildings that have been identified over a period of time. New projects, such as highway widenings, now require a survey of possible historic sites that are likely to be affected by the project. Should a county-wide survey of possible historic sites be undertaken by VDHR, it is likely that 500 or more sites would be identified. In these surveys VDHR locates every building or site that is more than 50 years old.

Figure 1.8 depicts the general locations of sites that have been placed on the National Register of Historic Places. The list includes the following sites:

St. Stephen's Church	Springfield	Shalango
Reedville Historic District	Wheatland	Holly Graded School
Howland School	Shiloh School	Heathsville Historic District
Kirkland Campground	Ditchley	Hurtsville
Rice's Hotel; Hughlett's Tavern		

Figure 1.8, Map of Historic Resources in Northumberland Co

Historic landmarks and districts may be protected by the County through zoning regulations authorized in Section 15.1-503.2 of the Code of Virginia. This legislation authorizes the local governing body to adopt an ordinance setting forth the historic landmarks within the County as established by the Virginia Landmarks Commission, and any other buildings or structures within the County having an important historic, architectural or cultural interest. The Code also enables the County to establish "*Historic Areas*", which are defined as follows:

"An historic area (district) is an area containing buildings or places in which historic events occurred or having special public value because of notable architectural or other features relating to the cultural or artistic heritage of the community, of such significance as to warrant conservation and preservation."

An historic district has been established in the Reedville Community and one is pending in Heathville. Designation as an "historic district" may include an entire community or in such a district may be as small as a single building or site. When areas or sites are placed on the National Register of Historic Places, that status signifies that the sites are historically and architecturally important collections of resources. Rehabilitation work performed on income-producing properties in historic districts may be eligible for Federal tax credits.

The County may wish to continue the development of its historic resources through a comprehensive survey available through VDHR although the local government is usually required to provide matching funds for the survey. With a complete survey of historic sites, Northumberland would be in a position to prepare a Historic Preservation Plan as a future addendum to the Comprehensive Plan.

8. Chesapeake Bay Protected Areas

The Chesapeake Bay Preservation Act was adopted by the Commonwealth of Virginia to improve the quality of the water which enters the Chesapeake Bay. The Act established a cooperative state and local government program to protect water quality of the Bay and its tributaries and requires localities in Tidewater Virginia to incorporate general water quality protection measures into their comprehensive plan, zoning ordinance, subdivision ordinance, and erosion and sediment control ordinance. The Act also established the Chesapeake Bay Local Assistance Board and Chesapeake Bay Local Assistance Department.

The Chesapeake Bay Local Assistance Board serves all local governments located within the Tidewater region of Virginia. The Board is comprised of nine citizens appointed by the Governor to oversee implementation of the Act and develop regulations for the designation of Chesapeake Bay Preservation Areas and for land use management in these areas.

The Chesapeake Bay Local Assistance Department is the state agency which provides administrative staff to the Board in carrying out the requirements of the Act. In addition, the Department provides technical advise and financial assistance to local governments.

Subsequent to the adoption of the Act, the Chesapeake Bay Local Assistance Board adopted the Chesapeake Bay Preservation Area Designation Management Regulations on September 20, 1989, to improve water quality of the Bay through proper land use management strategies. The Regulations require Tidewater localities to define and protect Chesapeake Bay Preservation Areas, lands which if improperly developed may result in substantial damage to the Bay and its tributaries. These

localities were required to adopt zoning regulations and establish a zoning district map delineating Chesapeake Bay Preservation Areas. Northumberland County's Chesapeake Bay Preservation Area Ordinance, patterned after a model ordinance provided by CBLAD, became effective September 20, 1990. Chesapeake Bay Preservation Areas are classified into two categories: Resource Protection Areas (RPAs) and Resource Management Areas (RMAs).

- RPAs consist of lands at or near the shoreline which possess intrinsic water quality. The regulations define RPAs as tidal wetlands, nontidal wetlands connected by surface flow and contiguous to tidal wetlands, tributary streams, tidal shores, and other lands which provide for the removal, reduction, or assimilation of sediments, nutrients, and potentially-harmful or toxic substances in runoff entering the Bay and its tributaries. A buffer area not less than 100 feet in width must be located adjacent to and landward of RPAs and along both sides of any tributary stream. The only permitted uses in RPAs are redevelopment of existing uses, water dependent uses such as piers, public utilities, railways and roadways, water wells, passive recreation uses, and historic preservation or archaeological activities.
- RMAs, as established by Northumberland County, contain all areas of the County that are not classified as Resource Protection Areas. The RMA includes lands which have the potential to cause significant water quality degradation if improperly used or developed. Any use permitted under the County's zoning ordinance is permitted in the RMA, provided, all development meets performance criteria set forth in the Bay Act Regulations.
- Intensely Developed Areas (IDAs) are areas of concentrated development within the RPA where development has severely altered the natural state of the area such that it has more than 50 percent impervious surfaces, public sewer and water is constructed and currently serves the area, and housing density is equal to or greater than four dwelling units per acre. Although some of the designation criteria may exist in certain areas of the County, there are no areas of concentrated development which meet all IDA criteria; therefore, Northumberland County has not designated any areas as IDAs.⁹

In addition to defining Chesapeake Bay Preservation Areas, the Chesapeake Bay Preservation Area Designation and Management Regulations established Land Use and Development Performance Criteria to minimize nonpoint source pollution from stormwater runoff, minimize erosion and sedimentation, and maximize rainwater infiltration to reduce the introduction of nutrients and toxics entering state waters affecting the Chesapeake Bay. Any use, development, or redevelopment of land in Chesapeake Bay Preservation Areas must meet several performance criteria to the satisfaction of the reviewing local government. The criteria include the following:

- preservation of indigenous vegetation
- minimization of land disturbance

⁹Reedville is the only area that was considered, but it fails to meet the density requirement of four dwellings per acre which is part of the criteria for an IDA. See also Chapter 5 under "Policies relative to Intensely-Developed Areas.

- use and maintenance of best management practices (BMPs)
- minimization of impervious cover
- a plan of development review process and erosion and sediment control measures for development exceeding 2,500 square feet
- control of stormwater runoff and its quality
- requirement of a soil and water quality conservation plan for lands upon which agricultural activities are being conducted
- requirement of all wetland permits prior to any land disturbance
- the pump-out of on site sewage treatment systems at least once every five years
- requirement of a reserve sewage disposal site equivalent to the waste treatment capacity of the primary drainfield for new development

B. ANALYSIS OF CONDITIONS RELATED TO POTABLE WATER SUPPLY

1. Groundwater

a. The Hydrologic Cycle

Water resources are often described in the context of a hydrologic cycle, which is the cyclical movement of water within the environment from atmosphere to land to sea to atmosphere again. Precipitation, infiltration, evaporation, and transpiration are the main mechanisms which move water from one location to another. Precipitation in the form of rain, snow, or hail can be intercepted by vegetation, infiltrate into the ground, or runoff into surface waters. Plants which intercept precipitation absorb moisture and transpire water molecules back into the air. Infiltrated water is stored underground in storage areas between underground layers of rock or sediment, known as aquifers. Water not infiltrated eventually runs into depression areas, such as puddles, streams, lakes, rivers, and oceans. As exposed surface waters evaporate into the atmosphere, the hydrologic cycle continues.

b. Groundwater Aquifers

Groundwater occurs during the hydrologic cycle when water moves into and through the earth's surface. Groundwater is stored between layers of sand, gravel, and rocks called aquifers. Three aquifers comprise the underground water supply for Northumberland County: the water table aquifer; the principal artesian aquifer; and the upper artesian aquifer. All of the aquifers slope downward from west to east.

- The water table aquifer: the uppermost aquifer system is close to the surface and is accessed by shallow wells. It is the most vulnerable of all the aquifers to contamination. The water table aquifer consists generally of fine sand and shells to a depth of 30 feet and yields approximately 5 to 20 gallons per minute of moderately soft water that is generally satisfactory for domestic use. This aquifer is a significant source for minor supplies of domestic groundwater in Northumberland County, supplying groundwater to farms, institutions, and other small users in the region.
- The upper artesian aquifer occurs next. It is located 225 to 375 feet below ground level, is consistently about 60-foot thick and yields 20 to 110 gallons per minute of moderately soft water with acceptable fluoride and sodium concentrations. It is a good source of potable water for moderate suppliers.
- The principal artesian aquifer: extends from 300 to nearly 600 feet below the ground surface and provides a yield from 40 to 840 gallons per minute of soft, sodium-bicarbonated water, with slightly higher than normal chloride values in the southeastern most tip of the County. High sodium contents of greater than 200 parts per million have been found in the aquifer's eastern zone.

In a report prepared in the late 1970s by the then Water Control Board (now the Department of Environmental Quality), it was concluded that under (then) current and projected rates of utilization, studies project that groundwater should adequately meet the needs of Northumberland County through the year 2020. Although groundwater levels have declined

in recent years, groundwater in the Northern Neck thus far has not been overdeveloped.¹⁰

c. Potable Water Supply (Wells)

Almost all developed sources of potable water in Northumberland County are supplied by wells. According to the 1990 Census, individual wells supplied potable water to 5037 households in the County and public or private systems supplied an additional 1754 households. Generally, three types of wells are found in the County: dug wells, drilled wells, and driven wells.

- Dug wells: range in depth from 8 to 60 feet and the yield and quality of water from them varies considerably. At low elevations, some dug wells yield brackish water when pumped heavily. Dug wells tap into the upper water table aquifer which is vulnerable to contamination from surface and sub-surface contamination sources. Health officials suggest that these wells be monitored carefully and when necessary replaced with wells meeting current standards. In 1990, Northumberland County was one of the top ten localities in the Commonwealth having the most dug wells (2,211).
- Drilled wells: tap artesian (pressurized) water and range in depth from 300 to 900 feet. Deep drilled wells supply almost all of the water used by moderately heavy users including residential communities and industries. They are favored by homeowners, industries, and farmers since they provide a substantial supply of good quality water although wells located near tidal waters that draw from the deep aquifers may experience elevated salt levels.
- Driven wells: range in depth from 10 to 20 feet and are located primarily at lower elevations. Driven wells are not considered important water sources, since they generally yield low quality or brackish water.

Although many residents and businesses in Northumberland County have their own wells, a number of relatively-developed areas are served by privately-owned central water systems, which generally obtain water from the deepest aquifers. Blundon and Hinton Water Company operates a community water system in Reedville, serving more than 400 residents with current withdrawals of about 30,000 gallons per day. The Virginia Department of Health rates the system's capacity at 200,000 gallons per day. The system consists of three deep wells and two elevated storage tanks; however, only two wells are presently in service. Only about five percent of the water from the Blundon and Hinton system is used for residential purposes - Reedsville.

¹⁰State Water Control Board, Groundwater of the Northern Neck, Planning Bulletin 307, circa 1978.

There are other industrial and residential users which pump relatively large quantities of water; however, records are not available for systems that: do not pump at least 10,000 gallons per day; are not metered; or the Department of Environmental Quality does not keep records on them. The Virginia Department of Health, Office of Water Programs, regulates public water supply systems that serve 25 or more people, or which have more than 15 connections for 60 days or more a year. Public water supply systems consist of:

- 27 Community systems, which serve towns, and subdivisions
- 7 Non-transient non-community systems which serve schools, municipal buildings, factories, and offices
- 17 Transient non-community systems which serve hotels, restaurants, and recreational areas

According to recent figures, total groundwater withdrawals from the Northern Neck region approximate two million gallons per day. Withdrawals are divided fairly evenly between domestic and industrial use, with most industrial uses devoted to washing seafood at processing plants. Presently, Reedville and the Town of Kilmarnock in Lancaster County are the major water-demand centers affecting Northumberland County's water supply although most of Kilmarnock's demand is in Lancaster County.

The County's available water supply may also be affected by large users located outside the County. Aquifers serving Northumberland County are recharged "upstream" from the County, consequently, any major water consumer that accesses this supply may alter the pressure within the aquifer and therefore the quantity and possibly the quality of water. For this reason, it is within the County's interest to monitor potential large withdrawals within the recharge areas.

d. Potential Contamination Sources

Potential groundwater contamination sources include landfills, lagoons, and other waste facilities. When their locations are known these sources are generally monitored but some groundwater pollutants such as pesticides, fertilizers, and road de-icing chemicals are more difficult to monitor. The State's Groundwater Protection Steering Committee has assigned top priority to the following sources of groundwater contamination. Northumberland County is susceptible to contamination of its groundwater from most of these sources.

Underground Storage Tanks: Contamination of groundwater from underground storage tanks has increased steadily in recent years. Reports indicate that there are thousands of such tanks in use in the State, as well as a substantial amount of unused and abandoned tanks. Recent Environmental Protection Agency studies indicate that as many as 35 percent of underground storage tanks eventually leak. Many contain petroleum products or other substances which have the potential to contaminate groundwater if leakage should occur. Groundwater pollution by petroleum products stored in underground tanks is a very serious problem that is relatively common and often occurs in the vicinity of gasoline service stations.

In Virginia, the Underground Storage Tank Program requires newly installed underground storage tanks to meet design, construction, and monitoring standards to prevent leaks and overflows and have corrective action plans with a detailed mitigation strategy in the event of a spill. The Department of Environmental Quality operates a Pollution Response Program (PREP), which investigates reported cases of groundwater contamination resulting from leaking underground tanks.

Landfills: Various types of substances found in landfills have the potential to contaminate groundwater. Contaminants such as chemicals and fertilizers, hazardous waste, paint, varnish, and other materials may move through the ground and pollute the water table and deeper aquifers. The Virginia Department of Waste Management's regulations contain specific landfill design requirements and standards to prevent groundwater contamination.

Lagoons and Holding Ponds: Lagoons and holding ponds often contain liquid waste produced by coal-fired power plants, rendering plants, fertilizer production operations, sewage treatment facilities, and other commercial activities which produce wastes that can infiltrate into the ground and contaminate groundwater.

Septic Systems: Septic systems are considered a major threat to groundwater resources and are the leading contributor to the total volume of waste discharged directly into the ground. Nitrate contamination, household chemicals, septic cleaners, and wastes disposed of in underground absorption systems may pollute groundwater. Although many large mass drainfield systems serve clusters of houses, schools, and commercial facilities in Northumberland County, the most common problem associated with on site septic systems is contamination of individual wells.

Groundwater contamination problems can arise when septic systems are installed in soils that are too thin, or where the soil is so permeable that wastewater moves through it rapidly and little waste is assimilated. Problems can also arise if systems are installed in areas where underlying rock conditions allow untreated waste to travel long distances through channels or fractures to surface or groundwater. The extent of potential contamination is determined by construction and maintenance procedures as well as the density of septic systems in an area. Consequences of failing septic systems in highly concentrated areas can be far more serious than individual failures.

The Virginia Department of Health is the agency responsible for regulating household septic systems and mass drainfields in the Commonwealth. The Department's primary concern has been protection of public health from surface ponding of sewage caused by soils which do not percolate and contamination of private wells from adjacent septic systems. The Virginia Department of Environmental Quality is responsible for the approval of commercial and industrial septic systems. While these systems are governed by the general requirements of a No-Discharge Program, no separate criteria or program exists for permitting these facilities.

Pesticides and fertilizers: Groundwater contamination from pesticides and fertilizers is a complex problem. Although these chemicals are widely used and offer numerous benefits in farming, forestry, and lawn maintenance, their use is difficult to monitor and regulate. Contamination from pesticides and fertilizers in groundwater is dependent upon the rate of application, decomposition rate, water solubility of the substance, nature of the soil, and depth to groundwater. Although contamination from pesticides and fertilizers generally extends over a wide area at very low concentrations, increases may build up over years of use.

The problem of groundwater contamination by pesticides and fertilizers has been addressed by a number of federal and state regulations. Maximum contaminant levels for approximately a dozen pesticides were adopted by the Environmental Protection Agency under the Safe Drinking Water Act. Both the Federal Insecticide, Fungicide, and Rodenticide Act and the Toxic Substances Act contain provisions which authorize the EPA and the Commonwealth to protect groundwater from pesticide contamination.

In 1989, Virginia passed the Pesticide Control Act which established a Pesticide Control Board with broad regulatory powers and authorized the Virginia Department of Agriculture and Consumer Services to regulate the registration, labeling, handling, and use of pesticides for certification of private and commercial applicators classified for restricted use. Although there are no specifications for application rates of fertilizer and lime sold in Virginia, these materials are required to be registered.

Hazardous Waste: The disposal or spilling of toxic and hazardous materials is another potential source of groundwater contamination. The federal legislation which regulates the identification and clean up of sites containing hazardous wastes is the Comprehensive Environmental Response, Compensation, and Liability Act. Presently, no sites have been identified in Northumberland County. Virginia's Department of Waste Management is the agency responsible for maintaining the State's Comprehensive Response Compensation and Liability Information System list.

e. Programs Addressing Point and Non-point Pollution Sources

(1) Pollution Discharge Elimination System Permits

Any "point source" of pollution discharging into waters of the United States requires a National Pollution Discharge Elimination System (NPDES) permit. Industries and waste water treatment plants which discharge pollutants into State waters are required to hold a Virginia Pollution Discharge Elimination System (VPDES) permit.

Point sources of pollution are pollution sources which are traceable to a single point, such as an industrial waste or municipal sewage discharge pipe. The Virginia Department of Environmental Quality (DEQ) regulates point source pollution dischargers by regularly monitoring the effluent of permit holders. A list of current point source dischargers in Northumberland County include the following:

POINT SOURCE DISCHARGERS, 1995 - NORTHUMBERLAND COUNTY

VPDES Discharger	Receiving Stream
Public	
Callao Elementary School	Lodge Creek
Northumberland High School	Crabbe Mill Stream
Reedville Sanitary District	Cockrell Creek
Industrial	
Ampro Fisheries, Inc.	Cockrell Creek
Cowart Seafood Corporation	Coan River
J.L. Sisson Seafood	Great Wicomico River
Keyser Brothers, Inc.	Coan River
Little River Seafood, Inc.	Little Wicomico River
Neale's Oyster Company	Wilkins Creek
Pride of VA Seafood Products, Inc.	Cockrell Creek
Purcell Seafood, Inc.	Little Wicomico River
T/A Rappahannock Oyster Co., Inc.	Indian Creek
Turner's Oyster House	Yeocomico River
Zapata Protein Corporation	Cockrell Creek
Smith Point Seafood Co. Inc.	Cockrell Creek
Lewisetta Seafood	Potomac River
Kelly Seafood	Dividing Creek
Mike E. Croxton	Indian Creek
Sea Products, Inc.	Cockrell Creek
Thomas Edwin Lewis	Little Wicomico River
C.W. O'Bier and Sons, Inc.	Yeocomico River
Lake Packing Co.	Coan River

(2) Pollution Abatement Permit Program

Many other land uses activities which do not discharge directly into State waters have the potential to contaminate both surface water and groundwater through indirect discharges. Among such activities are the following types of uses:

- Storage of materials in pits
- Ponds and lagoons
- Sewage treatment plants
- Large commercial animal raising activities
- Application or disposal of sludge (human, animal or industrial waste)
- Recycling of wastewater

Virginia's Pollution Abatement (VPA) Permit Program regulates and monitors

activities in this class to ensure that groundwater sources are protected. Active Pollution Abatement Permits (December, 1993) within Northumberland County included the following activities: Lake Packing Co., Hughlett Point Spray Irrigation, Dameron Seafood, James Everett Headley and Callao Glass and Tire.

(3) Mining Permits

Activities associated with industrial, manufacturing, and mining water use can contaminate groundwater and surface water. Declining groundwater levels, reduced surface water recharge, diminished water quality and instream flow, extensive cones of depression, and saltwater intrusion may result from heavy groundwater and surface water usage and pumpage. Mining practices have the potential to affect the movement and recharge of groundwater, lower the water table, and disrupt aquifers.

As of April 1994, there were fourteen sites in Northumberland County with mining permits. Eleven sites mine sand, one site mines gravel, and the other two sites mine sand and gravel. A total of 105 acres in the County are permitted for mining activities, while 56 acres are presently disturbed due to current or previous mining activity. Almost five acres in the County have been reclaimed.

(4) Non-point Sources of Pollution

Non-point sources of pollution exist in every community. This category includes any pollutant whose point of generation cannot be traced to any identifiable facility and whose exact point of entry into the water course cannot be defined. Origins of non-point sources as classified by the Department of Environmental Quality identifies the following classes: agriculture, forestry, construction, urban development, resource extraction, land treatment, disposal and hydrologic modifications.

f. Major Planning Issue Concerning Water Supply

The major planning issue regarding potable water supply is to protect the groundwater sources from contamination. The most vulnerable aquifer is the water table which is closest to the surface and the first to become affected if contaminants pass through the soil. Areas of considerable concern are where the soil is less acceptable for septic tanks and where the elevations are lowest. The areas where most of these conditions are found are the lowlands along the shorelines which is also the area most in demand for development. Future development should be encouraged to make greater use of the lower aquifers, particularly the upper artesian aquifer for water supply. The protection of these aquifers against excessive usage is a matter that should be given high priority in future planning. It would help also to encourage periodic testing of individual wells to ensure that a satisfactory quality of water is maintained. This could be done through increased awareness of the water testing program that is presently available to county residents.

2. Principal Watersheds

The drainage of Northumberland County flows either to the Potomac River or directly into the Chesapeake Bay through the many rivers, streams and creeks that penetrate into the County and form its impressive long shoreline. Figure 1.9 shows the principal watershed areas as established by the Virginia Health Department in a shoreline study conducted in 1989. Watersheds are identified by significant rivers or creeks but include the lesser rivers and streams that flow into those named.

The table opposite Figure 1.9 provides a brief summary of each of the watershed areas, giving the approximate land area occupied by each and highlights of events in each watershed. Some factors are common throughout the County and may not be mentioned in the summaries. For example, septic tank and underground tank failures constitute an on-going threat of pollution.

Planning issues related to watersheds should focus on the runoff of drainage water which eventually finds its way into the underground water system or into one of the rivers and eventually into the Chesapeake Bay. The focus of strategy should be on ways of reducing pollutants in the runoff water as well as minimizing the amount of such water that actually reaches the Bay.

These are the same issues that are addressed by the Chesapeake Bay Preservation Zoning Regulations of the Resource Protection and Resource Management Areas. Drainage issues are also addressed by the Best Management Practices Handbook, Planning Bulletin 522, Va. Water Control Board, 1981.¹¹

¹¹Now the Department of Environmental Quality.

PRINCIPAL WATERSHEDS NORTHUMBERLAND COUNTY		
WATERSHED IDENTITY(KEYED TO MAP)	APPROXIMATE AREA (SQ MI)	PRINCIPAL FEATURES & ISSUES
A. Yeocomico River	25	Watershed shared with Westmoreland County; includes West and South Yeocomico Rivers, and their tributaries; significant activities: agriculture, seafood industries, business activities in and near Callao, shoreline residential development. Potential pollution sources: sewage treatment facility at Callao Elementary School ¹² , several seafood processing plants, recreational areas and marinas, commercial uses handling oil products.
B. Coan River/The Glebe and Kingscote Creek	28	Watershed includes named bodies of water and tributaries; significant activities: agriculture, seafood industries, shoreline residential development, commercial marinas, and development in and near Lottsburg, Heathsville and Lewisetta. Potential pollution sources: industrial waste sites, sewage treatment facility, commercial marina, seafood processing plants. Two sites have active VPDES permits ¹³ .
C. Potomac River: Coan River to Ginny Beach	29	Watershed drains all streams within named area directly into the Potomac River. Significant activities include: agriculture, shoreline residential development, seasonal dwellings and/or campsites, and shoreline residential development. Existing or potential pollution sources: activities around boat ramps and docking areas.
D. Little Wicomico River	15	Watershed includes Little Wicomico River and all tributaries. Significant activities: seafood industries and sports boating and fishing; part of Burgess commercial area; shoreline residential development; campgrounds; some agriculture. Potential pollution sources: industrial waste, private and commercial boat facilities, seafood processing.
E. Cockrell Creek	3	Watershed contains all of Cockrell Creek and tributaries. Significant activities: Town of Reedville-residential development; two large seafood industries; commercial marine facilities. Potential pollution sources: seafood industries, town's sewage treatment plant, public boat landings.
F. Chesapeake Bay: Gaskins Pond to Cockrell Creek	3	Watershed includes several ponds and streams which drain directly into the Chesapeake Bay. Significant activities: Chesapeake Beach and Fleeton Beach developments - seasonal dwellings; shoreline residential development. Potential pollution sources: failed septic tanks, boat facilities and usage.
G. Great Wicomico River	58	Watershed includes Great Wicomico River basin and all tributaries. Significant activities: business areas at Burgess, Wicomico Church and Heathsville; extensive shoreline residential development; agriculture; campgrounds and agriculture. Potential pollution sources: Tri-county landfill, sewage treatment plants at schools, campgrounds, marine and boat activities.
H. Chesapeake Bay: Mill Creek to Dividing Creek	16	Watershed includes several creeks and streams within named area flowing into the Chesapeake Bay. Significant activities: Wicomico Church business area; agriculture; shoreline residential development (Mill Creek). The least developed of the watershed areas with no major pollution threats.
I. Dividing Creek	10	Watershed includes Dividing Creek and tributaries. Significant activities: agriculture, seafood, moderate shoreline residential development. No major pollution threats.
J. Indian Creek	6	Watershed includes all tributaries of Indian Creek plus Henrys and Barnes Creeks. Significant activities: Kilmarnock, shoreline residential development, marinas, some agriculture. Potential pollution from Kilmarnock (Lancaster County)

¹²School to be closed in 1996. The reuse may change the threat.

¹³Pollution Discharge Elimination System (VPDES) permit, issued by the Department of Environmental Quality for wastewater or industrial waste discharges.

page for figure 1.9

3. Soil Conditions

This section discusses various qualities of the soil with emphasis on soil conditions that may affect the quality of water in the aquifers, creeks, rivers and eventually the Chesapeake Bay.

a. Water Table

Figure 1.10 maps the water table patterns in Northumberland County in terms of its depth below the surface. Twenty-four inches is taken as the dividing point; therefore, the water table is shown either as being 24 inches or more from the surface or 24 inches or less. The results are not surprising in that the predominant areas of high water table are in the lowest parts of the County near the shorelines.

The high-water pattern is quite pronounced within the area between the line previously described as the "Suffolk Scarp" (Refer to Topographic Conditions) and the shorelines of the Potomac River and Chesapeake Bay. That pattern runs from the County line at Kilmarnock then generally parallels Route 200 until it passes Route 360 near Burgess. From there, the escarpment runs approximately parallel to the Potomac River shoreline about two to three miles inland of that river.

One observation that can be made from this pattern is that, even though most of the high water table may be found in these low areas, some areas nearest the shorelines appear to have a lower water table than the general pattern of the high water table area. This has made it possible for more development to occur immediately adjacent to the shorelines while much of the higher ground nearby is unsuitable for septic tanks (Figure 1.4).

The high water table is also present to a lesser degree in the portion of the County south and west of the "Suffolk Scarp" line, but in the areas south and west of Routes 360 and 200 the high water tables are found mostly along the bottom lands and stream basins that penetrate into these otherwise higher elevations.

b. Highly Erodible Soils

Soils that are classified as "highly erodible" present a particular concern in the protection of water supply. Erodibility refers to the capacity of soils to be carried from the surface to streams with storm runoff. When this happens, surface impurities are carried into state waters increasing pollution and presenting dangers to marine life.

Areas that are particularly vulnerable to erosion may be found around construction sites, tilled fields and other places where the soil may be exposed to water or wind.

The State has determined that an erosion index of 8.0 or more is high enough to warrant precautions. When such areas are combined with steep slopes, the threat of severe erosion is increased considerably. Since most of the steep slopes in Northumberland County are along streams, there is always a threat of erosion in these areas if the slopes are disturbed. In addition, erosion from cultivated farm areas and intensely-developed residential areas can carry large amounts of chemicals into public waters.

Water Table map, Figure 1.10

Part of the State's strategy for establishing RPAs and RMAs in the Chesapeake Bay regulation in the Zoning Ordinance is to reduce the impact of erosion on state waters. The RPA and its associated buffer strip functions as a strainer for waters draining into public waters. The RMA extends protection further by requiring performance standards to be maintained.

c. Steep Slopes

Topographic landforms and corresponding slopes are environmental features that have always required careful consideration in determining appropriate types of land development and use. This was demonstrated earlier in this Chapter by the topographic representation shown on Figure 1.3, which found that nearly all of the state highway roads are located along the tops of ridges. And for reasons of access, all development is likewise located along the roads or very close to them. Other maps illustrated that the level ridge tops also contain the best drained soil. In a cursory examination of the road pattern, one might conclude that they were located randomly, but on closer examination the rationale of their locations relative to topography is obvious. For one thing, excessive slopes seem to have been avoided.

Slopes are also a major consideration in land use planning for several reasons. The first is evident in the pattern of highways. Steep slopes present more engineering problems than moderately sloped or nearly flat land and consequently increase the cost of development. Historically, developers like highway engineers, have sought out land with the fewest construction problems for establishing subdivisions except in cases where amenities offered such significant market advantages that the higher development costs were acceptable. In Northumberland County, both types of development are present but perhaps the more dominant type is the latter. The advantages of prime waterfront property is taking priority over immediate development costs.

Development on slopes can also present environmental liabilities contributing to excessive soil erosion and resulting in stream pollution. Where certain types of sandy soil which is located on a steep slope is disturbed during construction, the remaining soil can become very unstable, and start to erode. Because many such conditions exist along streams and shorelines, the preferred sites for building homes, these sites are extremely vulnerable to erosion during construction. The erosion problem has been reduced considerably, with the establishment of the Chesapeake Bay RPA which in many cases includes steep slopes when they are adjacent to shorelines and adjacent wetlands. The County's erosion and sedimentation control ordinance also establishes another layer of protection by requiring erosion control mechanisms around construction sites.

Figure 1.11 illustrates the slope situation throughout the County. Three classes of slopes are included: less than six percent; between six and 15 percent; and greater than 15 percent. The steeper slopes can be seen to form a pattern along the stream beds in the upland parts of the County. Within that area there is very little development in the areas of steep slopes; it is lined along existing roads.

In the lowland part of the County, slopes become a secondary issue because in these low lying areas other physical conditions such as poor soils and high water table present a greater constraint to development.

Slope Map, Figure 1.11

As a planning issue, land with slopes greater than 15 percent (15 feet fall per 100 feet) should be avoided wherever possible and if developed at all, extensive care should be taken to ensure that the site work does not leave unstable banks. Land with slopes greater than 20 percent should be avoided altogether.

d. Soil Permeability

Figure 1.4 (see Section A.4.) displays areas of the County that are unsuitable for septic tanks. That map is based on several factors that affect the soil's ability to be used for sewage disposal. Among these are wetness, slope, and texture of soil particles. One of the soil's principal determinants of acceptability is its permeability, an index that describes the rate at which water passes from the surface to lower layers when the soil is thoroughly wet. Soils which have a very high infiltration rate such as sandy or gravelly soils are said to have high permeability whereas those with a low infiltration rate are said to have low permeability.

The scale established by the State measures infiltration in terms of how many inches per hour will pass through the soil under thoroughly wet conditions. A permeability factor of 0.6 inches per hour or less is regarded as inadequate for septic tank drain fields. In addition, because these soils have a low percolation rate, more of the surface water that falls during precipitation is carried off the site, a condition that also promotes erosion.

High permeability presents another type of problem for septic tanks and the underground water supply. In order for septic tanks to function properly, the effluent must remain in the upper soil long enough for the bacteria to perform its neutralizing function. When it passes through too quickly impurities can enter and pollute the underground water supply. The state standards establish six inches per hour as the maximum acceptable permeability rate for septic tank function.

Therefore, soils with ratings outside the 0.6 through 6.0 range should normally not be used for septic tank fields.

C. ANALYSIS OF SHORELINE CONDITIONS

1. General Shoreline Conditions

A comprehensive Shoreline Inventory for Northumberland County was published in 1994 by the Northern Neck Planning District Commission. This inventory contains a wealth of detailed information on a tax map parcel basis for all 451 miles of shorelines within the County. PMA examined the data from the Shoreline Inventory according to eight sub areas. These are identified by major bodies of water. In all cases where a major river or creek is named, it includes all of its branches and tidal tributaries. Each area is identified below according to its principal river or creek and Figure 1.12 identifies the location of each area identified.

Area A Yeocomico River

Area B Coan River and The Glebe

Area C Cod Creek, Presley Creek, Hull Creek

Area D Cubitt Creek, Vir-mar Beach, Ginny Beach

Area E Little Wicomico River

Area F Great Wicomico River, Cockrell Creek, Harveys and Mill Creeks

Area G Dividing Creek

Area H Indian Creek

These areas are defined using tax map numbers to achieve the closest fit between tax map and shoreline sub area. Some of the major river basins overlap tax maps; however, for such overlapping or split areas the data are unadjusted in this analysis.

The Shoreline Inventory reports that the shorelines of Northumberland County extend for 451 miles.¹⁴ The study identified 10 separate conditions that existed at the time of the survey. PMA combined these into the following five classes for analysis:

- 228 miles (50.7 percent) of the area along shorelines overall is still in forests
- 53 miles were in beach (11.7%)
- 89 miles in wetland (19.7%)
- 25 miles altered with seawalls, riprap or similar material (5.5%)
- 56 miles open (12.4%)

¹⁴This figure comes from summing individual page totals of the Shoreline Inventory report.

Shoreline Situation map, Figure 1.12

These uses are distributed among the eight shoreline sub areas. Some of the more noticeable characteristics of each area are summarized.

- The dominant shoreline use in all of the sub areas is forest comprising overall 228 miles of shoreline and amounting to almost half of the total mileage in every sub area.
- Next, is wetlands occupying 88 miles of shoreline. This includes both open and forested wetlands.
- Open land and beach are next occupying 56 and 53 miles respectively.
- Altered land (construction, bulkheads, etc.) occupies 25 miles of shoreline or about 5.5 percent of the total shoreline.

It is significant that 94.5 percent of shoreline is still unaltered. One gets an image of much more development by a visual inspection made only from the roads. There is much yet to be preserved and protected.

The inventory also reported on the number of structures along the shorelines. These included boat houses, piers, residential buildings and farm buildings. There are 3,668 residential units along the shoreline which represents about 53 percent of the dwellings in all of Northumberland County using the 1990 census. There are 2,036 boat piers and 264 boat houses according to the survey, which amounts to almost two boat facilities for about every three houses. On average, there are five boat facilities per mile of total shoreline countywide.

The data reported above are shown graphically in the Chart below.

Reduce and insert chart here

Several issues arise from this analysis. First, since most of the shoreline still remains undeveloped, there is a significant opportunity for the County to establish development policies for the shoreline which promote conservation and protection against erosion. Second, more than half of the residential units of the County are on waterfront locations. This suggests an ever-increasing demand for such properties, as both open land and forests are subject to conversion to residential development. The most serious shoreline erosion threats come from the actions of strong winds and high surf produced by "noreasters" and hurricanes. The primary targets of these winds and waves are the exposed banks of the Potomac River and the Chesapeake Bay. The next topic addresses this issue in more detail.

2. Shoreline Erosion

Figure 1.12 also shows areas that have been identified by the Virginia Institute of Marine Science with erosion problems. The dotted line on this map indicates areas where erosion rates are two feet or more per year. Not much of the County's shoreline, particularly that exposed directly to the Potomac River and Chesapeake Bay, has escaped erosion to some extent. The protected inlets and rivers, not a small amount of the total, are relatively safe from direct erosion from northeaster storms and wave action in the Potomac River and Chesapeake Bay. It is within these protected areas that maximum results can be achieved through planning to reduce potential shoreline erosion. In 1977, Northumberland County ranked second among Tidewater counties in loss of acres of shoreline for the past one hundred years. Net loss was 3,270 acres, or an average erosion rate of 1.1 feet per year.

Average shoreline erosion rates can be misleading since erosion occurs sporadically in response to storm events.

Shoreline erosion rates are determined by four principal factors: storm frequency; storm type and direction; resulting wind tides, current, and waves; and storm intensity and duration. Other forces which cause increased levels of stormwater runoff and shoreline erosion are human activity, grading, upland runoff and vegetation removal. Shoreline erosion has a significant impact on water quality and natural resources. Recent studies have indicated that shoreline erosion is responsible for millions of pounds of nitrogen and phosphorus entering the Chesapeake Bay each year and is also responsible for an estimated 15 to 20 percent of sediment entering the Bay.

In 1989, Northumberland County contained approximately 25 miles of artificially stabilized shoreline to combat erosion. Many shoreline landowners have installed structures such as groins used in conjunction with bulkheads or riprap to reduce or prevent erosion. This technique has met with some success in combatting erosion on the shorelines that are exposed to heavy wave and wind action. A shoreline protection program should also contain a variety of techniques controlling erosion in addition to structures. Alternatives that have been used include:

- Protection of low energy shorelines by planting grasses, shrubs and vines to stabilize beaches, banks, and shorelines
- Replacement of sand on recreational beaches although this does not control shoreline erosion and at best is a temporary solution
- Development of off-shore erosion control structures such as breakwaters and artificial islands to modify wave action, reduce deep water wave energy, and promote beach nourishment.

3. Marshlands

Marshlands provide a considerable defense of the shoreline against erosion in addition to their function as a nursery ground for aquatic life. VIMS classifies marshes into three categories: fringe, extensive and embayed.

Fringe marsh is that which is less than 400 feet in width and which runs in a band parallel to the shore.

Extensive marsh is that which has extensive acreage projecting into an estuary or river.

Embayed marsh is a marsh which occupies a reentrant or drowned creek valley.

The following sketch illustrates these three types of marshlands. The fringe marshes have maximum values as a buffer to wave erosion of the fastland.

Insert sketch of three types of marsh.

D. Access to State Waters

Many objectives of the Chesapeake Bay Protection Program focus on improving the quality of potable water and preserving habitats for marine life within the Bay and its tributaries. In addition, the program also emphasizes a desire to improve public access for recreational and commercial purposes. Therefore, it may be stated that there is a dual focus of the Chesapeake Bay program relative to access: to increase recreational opportunities while protecting the water quality and natural resources of the Bay. This section examines factors that may influence the establishment of new public or private access points to the Bay or its tributary tidal streams.

1. The Chesapeake Bay Area Public Access Plan

In 1990, the Chesapeake Executive Council published its report titled The Chesapeake Bay Area Public Access Plan which included a report for every county within Virginia and in the adjoining states that were covered by the program. That study identified major existing access facilities ranging from state-operated boat ramps to commercial marinas. Figure 1.13 depicts the general locations of the waterfront access facilities that were identified in Northumberland County by the "Access Plan". They are grouped on this map into four categories:

- Fishing facilities, including both pier and bank fishing. These are also found in the other types of use but some of the facilities within the County only provide for fishing, no boat access. The inventory included six places where public access is provided for fishing.
- Boat launching ramps, including state as well as private ramps. There are eight launching ramps included in the inventory, but in addition many, if not most, of the facilities labeled as "Marinas" also have boat launching ramps in addition to boat slips.
- Marinas included here provide boat slips and in most cases sell fuel, food, and other products used by boaters. The facilities labeled as marinas on the map include commercial marinas as well as smaller marinas operated by community associations. The inventory reported 679 boat slips in 14 marinas.
- Beaches: There is one public (free) beach (Vir-Mar Beach) identified in the inventory. At Kohk Island a beach is available. Also, many of the member-only community organizations have private recreational areas that include beaches.

There are also 18 natural habitat areas (Figure 1.7) some of which provide limited access for purposes of observation and nature study. In addition, the State has two large tracts, one upstream on the Great Wicomico River and the other at the mouth of Dividing Creek (Figure 4.3). Each of these sites has some potential for public access.

The Public Access Plan cites a need to increase access to public beaches and to upgrade public boat ramps. Marshes and wetlands are also suggested as resources to extend opportunities for the public to enjoy the shoreline and waterfront for both recreational and educational purposes. The concern for more and improved public access to public waters also came from community workshops. It was observed in the workshops that the present level of facilities is inadequate to serve county residents as well as summer visitors.

Figure 1.13 Access

2. Shoreline Land Use

In the discussion on shoreline conditions it was observed that more than half of the residential units in Northumberland County in the early 1990s were located on waterfront lots. Most of these had their own access to the water, either directly or through a community organization. Shoreline data indicated that there were approximately two boat facilities for every three houses. The average frequency of boat facilities countywide is approximately five per mile.

If the water-related industries¹⁵ and marinas (Figure 1.13), are added to the residential development discussed above, one may observe that considerable development exists along the shoreline of Northumberland County. Despite this seemingly abundance of access, there is little opportunity for citizens who do not have access to waterfront property or a trailered boat to access the recreational opportunities offered by the Bay and its tributaries.

3. Effects of Underwater Grasses

These grasses found mostly in the shallow waters of protected coves and creeks may hold the secret to preserving the Chesapeake Bay. They are usually found in "low energy zones" of coves and creeks which are not subject to the severe tidal and wind action more prevalent in areas such as the southern shore of the Potomac River. Areas of submerged vegetation as identified by VIMS are shown in Figure 1.13. Underwater grasses grow prodigiously in shallow protected waters where they become nurseries for fin and shellfish as well as habitats and refuges for waterfowl. Underwater grasses - called submerged aquatic vegetation - not only filters surface water as it enters the streams but it also acts as a buffer against tidal action. For shorelines in low energy locations, underwater grasses have been found to form a quite adequate defense against shoreline erosion.

4. Channel Depths

Figure 1.13 also identifies major channels with depths of five feet or more from data on Navigational Charts published by NOAA¹⁶. Specific depths are indicated by the numbers along the channel. Channel flow is indicated by the arrows. The effects of tidal flow helps flush channels thereby protecting the integrity of their waters. This promotes a good environment for aquatic vegetation and resulting marine life habitats.

5. Factors Influencing the Establishment of New Access Points.

The Virginia Marine Resources Commission has established criteria for establishing new Marinas. Some of the more "desirable" of these are summarized below:¹⁷

- Water depth must be greater than three feet from mean low water.

¹⁵List is located in section entitled: Analysis of Conditions Related to Potable Water Supply, Item 1.e (1).

¹⁶National Oceanographic and Atmospheric Administration.

¹⁷See page VI-82, Local Assistance Manual for complete list of criteria.

- Site must not interfere with shellfish production.
- Wave height and current to be very low.
- Channel does not require frequent dredging; when dredging is required, a suitable disposal site is available; marina must be within 50 feet of navigable water depth.
- The tidal exchange shall be adequate to maintain water quality.
- No encroachment upon wetlands; habitat areas (endangered species); submerged aquatic vegetation; or existing recreational use.
- Shoreline stabilization is required without use of artificial structures.

Figure 1.14 provides information of shellfish grounds. The grounds are shown here as either "active" or "condemned". Active grounds included both Public Oyster Grounds and leased grounds. The County contains over 23,000 acres of public oyster areas and over 6,600 acres of private oyster areas in 1,183 leases.

Condemned shellfish areas are shown in the darker pattern. It will be observed that the condemned areas are located mostly in the upper reaches of the rivers or tributaries. These are usually shallower waters and less flushing from tidal action. One recent figure places the amount of condemned shellfish areas in the area of 4,500 acres.

The Virginia Department of Health, Division of Shellfish Sanitation, is the agency responsible for approving or condemning certain water bodies for the taking of shellfish. Condemnation of oyster grounds due to unsatisfactory pollutant levels continues to render more and more of the available oyster grounds in the County off limits. Shellfish may be harvested from most condemned areas; however, they must first be relayed to approved waters for 15 days before marketing. Relaying is only allowed when the water temperature is above 50 degrees.

In summary, there is a need to provide more public access to the Chesapeake Bay and its tributaries but there is also an equally important need to do so in a way that does no harm to the quality of the Chesapeake Bay.

fig 1:14