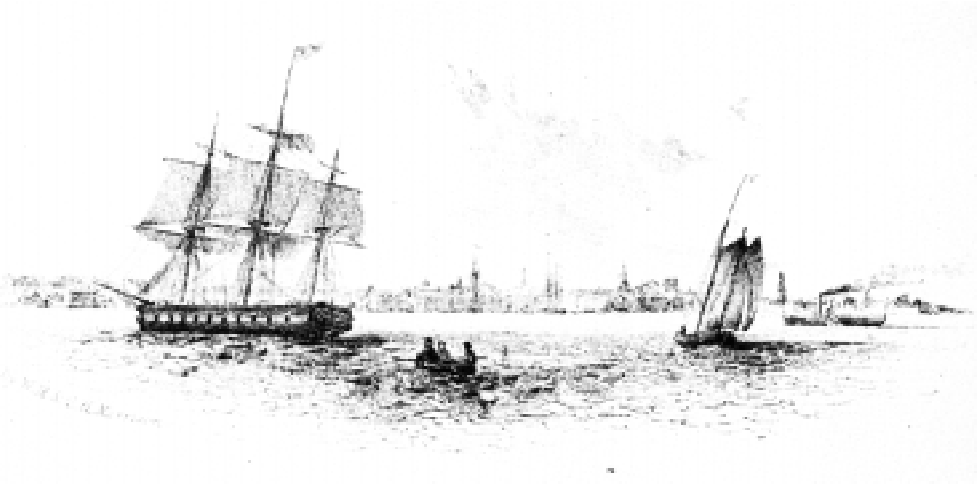
CITY OF ALEXANDRIA MASTER PLAN

Water Quality Management Supplement



Adopted January 13, 2001

Water Quality Management

CITY OF ALEXANDRIA MASTER PLAN

Executive Summary and Highlights

The Chesapeake Bay – Alexandria's downstream neighbor – is among the nation's largest and most productive estuaries. However, carried along with the huge volumes of fresh water from the Bay's 64,000 square mile watershed are sediments, fertilizers, pesticides, motor oil, and other pollutants generated by various land uses and human activities.

In 1988, the Virginia General Assembly, recognizing that action had to be taken to preserve the Bay for future generations, enacted the Chesapeake Bay Preservation Act. In 1992, the City of Alexandria adopted a Chesapeake Bay Preservation Ordinance (CBPO) to manage land development in a way that was more harmonious with the environment.

However, this was only a first step. While the City's CBPO is the backbone of Alexandria's water protection efforts, the Act also requires localities to incorporate water quality protection into their comprehensive plans. This planning process is the "vision phase" of the Bay Act program and there are no predisposed outcomes. While the City's CBPO sets out specific water quality protection criteria, the planning process provides City officials and residents with an opportunity to think strategically about the kind of environment they want to call home.

The ***Water Quality Management Supplement to the City of Alexandria Master Plan*** is the result of this strategic planning effort. To assist the City in its effort, the Chesapeake Bay Local Assistance Department provided the Northern Virginia Regional Commission with funding to serve as a technical resource.

The seal of the City of Alexandria highlights the City's historical and present day reliance on the Potomac River.

CHAPTER CONTENTS

- **Introduction**
- **Alexandria's Water Environment**
- **Pollution and Other Sources of Water Quality Decline**
- **Water Quality Management Today**
- **Policy Analysis and Recommendations**

While the outcomes are flexible, under the Chesapeake Bay Preservation Area Designation and Management Regulations, the City is required to investigate the following areas:

(1) Constraints to Development
(2) Protection of Water Quality
(3) Shoreline Protection and Erosion Control
(4) Public and Private Access to Waterfront Areas and
(5) Redevelopment of Intensely Developed Areas

A major effort in the planning process is to gather background information to ensure that adequate data is available for making environmentally sound decisions. As a result, the bulk of this Chapter is devoted to pulling together information from diverse sources in order to paint a complete picture of the City's environment. Sections include:

(1) Introduction
(2) Alexandria's Water Environment
(3) Pollution and Other Sources of Water Quality Decline
(4) Water Quality Management Today

This information then serves as the basis for Section V, "Policy Analysis and Action Plan." Section V takes a strategic look at how Alexandria's water quality programs and regulations meet the challenges laid out in Sections I through IV.

Although urban, Alexandria is still an important part of the Chesapeake Bay ecosystem.

SIGNIFICANT FINDINGS

The following is a summary of the important findings which are explained in more detail in Section V "Policy Analysis and Action Plan." Section V also includes a table identifying time frame for completion, cost, and the City agency responsible for implementation. New actions, or those which are not ongoing City programs, are shown in bold.

- **SMALL AREA PLANS.** Most detailed land use planning is accomplished through the City's fourteen Small Area Plans.

  To provide a stronger link between each SAP and this Supplement, the City will incorporate into each SAP: a discussion of the City's long-range water quality protection strategies; SAP-specific Chesapeake Bay Preservation Area maps; and, SAP-specific analyses of opportunities to protect and improve water quality and the environment through planned development and redevelopment opportunities.

- **EXISTING CITY ORDINANCES.** The City's Chesapeake Bay Preservation Ordinance, Erosion and Sediment Control Ordinance, and Floodplain Overlay District and the Virginia Uniform Building Code already provide a sound foundation for water quality management in Alexandria.

  The City will consider incorporating civil penalties into its CBPO as a way to strengthen local enforcement.

- **TARGETS OF OPPORTUNITY URBAN RETROFIT PROGRAM.** The Department of Transportation and Environmental Service's Targets of Opportunity Urban Retrofit Program is an important public-private partnership which has resulted in significant water quality benefits by controlling pollution from already developed areas of the City. This program will continue

to be used to improve water quality and help the State to meet its nutrient pollution reduction obligations under the federal Chesapeake Bay Program.

- **WETLANDS.** Wetlands are an important, but disappearing, resource in the City.

  The City will support efforts, similar to the Targets of Opportunity Urban Retrofit Program, that promote the restoration of degraded wetlands and streams. In addition, while healthy wetlands should generally be left alone, **when impacts do occur the City will try to mitigate the impacts through wetland creation or enhancement, improvements to riparian areas, or through the use of creative Best Management Practices to treat stormwater. The City will investigate opportunities to use wetlands as an educational tool for both students and adults.**

- **HABITAT PROTECTION.** Wildlife habitat protection is a major challenge in Alexandria. **The City will better identify, characterize, and map remaining significant natural habitat areas that will assist the City with its effort to preserve and protect these areas.** When possible, existing stream valleys need to remain in a natural condition.

  Remaining wildlife habitat areas are fragmented and ways to connect remaining habitat areas need to be explored. If current efforts by VDOT to reduce the impact of streets on wildlife corridors are successful, **the City will pursue developing similar standards for new or reconstructed City roads.**

- **WASTEWATER TREATMENT.** The Alexandria Sanitation Authority's effort to upgrade Alexandria's Wastewater Treatment Facility is probably the single most important, and costly, environmental protection effort in Alexandria. **The City will support this effort and ensure that citizens understand the important role that the upgrade plays in the protection of Chesapeake Bay water quality.** The City will continue to meet and exceed the requirements of its permit to operate a combined sewer system. The City will continue its efforts to minimize the number and volume of combined sewer overflows. The City will continue its sanitary sewer inspection and maintenance program in an effort to eliminate sanitary sewer overflows.

- **WATER QUALITY MONITORING.** The four primary pollutants of concern in the City include fecal coliform bacteria, nutrients, petroleum products (oil), and thermal (heat) pollution. **Current efforts by the City to control these pollutants need to be expanded and there is a need to better characterize City water quality.**

  Specifically, current water quality monitoring efforts are not adequate to detect pollution pulses associated with dumping and stormwater runoff. **The City will initiate a program to expand the scope of existing water quality monitoring efforts. The City will also pursue public-private partnerships and volunteers to assist in monitoring water quality in the City.**

- **POLLUTION PREVENTION.** Pollution prevention is the most cost-effective way to protect water quality. Existing City programs include its street sweeping program, leaf collection program, hazardous waste and used oil collection program, sanitary sewer line inspection and maintenance program, school-age water and environmental education programs, and best management practices manual for automotive related industries.

  While the City has undertaken important pollution prevention efforts, an expanded and comprehensive approach to pollution prevention is needed. Before the year 2007, the City will need to demonstrate,

under new federal Clean Water Act requirements, that it is minimizing pollution through public education and outreach programs.

Areas specifically identified as requiring attention and public outreach by the City include the following.

- **The City will coordinate with fuel oil companies to increase public awareness of the threat of aging above ground and underground storage tanks.**
- **The City will continue to work with the Virginia Department of Environmental Quality to prevent underground storage tank releases.**
- **The Health Department will continue to require that homes with failing septic systems connect to the sanitary sewer.**
- **The City will develop a strategic plan for reducing fecal coliform bacteria levels in Alexandria's streams based upon recent DNA test findings.**
- **The City will invite the Virginia Marine Resources Commission to address City officials and local marina operators about ways to prevent pollution.**
- **The City will encourage methods to reduce the impacts of thermal pollution on streams. Options include working with businesses to promote alternatives to dark impervious surfaces (light colored roofing materials and asphalt or using "green" roof technologies) and the more effective use of parking lot trees to cool impervious surfaces. The City will invite the Virginia Cooperative Extension to assist the City in putting together a strategic plan for reducing pollution from lawn and garden care practices while maximizing the use of existing resources.**

The City's web page will be used as a means of advertising environmental programs and for exchanging environmental information.

- **USED OIL AND ANTIFREEZE RECYCLING.** There is a need for additional participation in used oil and antifreeze programs. **The City will increase advertising of collection sites as a way to entice businesses to join the program.**

- **OPEN SPACE AND VEGETATION.** An important way to reduce nonpoint source pollution is to increase the amount of open space left in vegetation. The City's open space requirements do not currently contain a requirement that a percentage of open space must be vegetation. **The City will investigate setting guidelines for establishing a minimum percentage of vegetated open space to satisfy City open space requirements.**

- **FLOOD CONTROL AND STREAMBANK EROSION.** Most of Alexandria's waterways have been hardened or channelized to stabilize eroding stream banks and to increase carrying capacity. Balancing the need to provide flood control with a desire to promote wildlife habitat is among the most difficult problems faced by the City.

  The City will address erosion problems on a site-specific basis in recognition of the need for flexibility. A wide range of options will be explored by the City in addressing a particular erosion problem with the goal balance the need to minimize flooding, reduce erosion, and protect wildlife habitat. Options include, but are not limited to:

  - bioengineering
  - stream bypass
  - natural stream adjustment and
  - stream hardening

Management of already hardened streams is also a difficult issue for the City. Flood control channels must be kept clear in order to prevent flood damage to downstream businesses and residents.

The City will, on a site specific basis, consider planting high-canopy vegetation above the 100-year flood level in order to provide wildlife habitat and screening while not impacting on the physical integrity of the flood channel.

- **STREAM CORRIDOR MANAGEMENT.** Most of Alexandria's streams serve multiple functions, including flood control, buffering between land uses, and wildlife habitat. Many of these streams are also designated Resource Protection Areas. Unfortunately, these functions often come in conflict with each other.

  The City will develop an evaluation procedure for dealing with stream corridor management issues when they conflict with Chesapeake Bay preservation and wildlife habitat goals. The Chesapeake Bay Local Assistance Department will be consulted to ensure that it is compatible with the Chesapeake Bay Preservation Area Designation and Management Regulations.

  Most of Alexandria's tributaries lack a vegetative buffer that helps to protect water quality. Because of limited opportunities for revegetation of denuded stream buffers, **the City will identify, characterize, and map streams that have limited or no vegetation but have the potential to be restored by public or private means.**

- **POTOMAC RIVER SHORELINE.** A large majority of the Alexandria Potomac waterfront is hardened with rip rap and bulkheads. Some bulkhead areas have been identified as being in poor condition. **Dilapidated bulkheads must be addressed by a developer during any waterfront redevelopment project.** It is anticipated that planned redevelopment along the shoreline will result in the rehabilitation of most of the City's dilapidated bulkheads.

- **POTOMAC RIVER PUBLIC ACCESS.** The City recognizes the value of ensuring that there is adequate public access to the Potomac River shoreline. A subcommittee of the Waterfront Committee and the Parks and Recreation Commission continue to make specific recommendations for the few remaining undeveloped or nonconforming waterfront parcels.

  Planning efforts will continue to take into consideration the need to properly manage and protect sensitive natural resources with the goal of achieving increased opportunities for public access.

- **ENVIRONMENTAL COORDINATION AND PUBLIC OUTREACH AND EDUCATION.** New federal Clean Water Act mandates will require the City to demonstrate that it is develop outreach programs to inform individuals and households about steps that can be taken to reduce stormwater pollution. In addition, while many of the City's departments have taken on outreach programs to address specific, acute problems, there is a need for overall coordination of City efforts.

  To reduce redundancy, and to focus City outreach efforts in a cohesive manner, **the City will establish an Environmental Coordination Group (ECG) with representation from the departments of Transportation and Environmental Services, Planning and Zoning, and Recreation, Parks and Cultural Activities. Other departments or organizations will participate as needed.** The Environmental Coordination Group will facilitate the co-

ordination of environmental and public education and outreach programs, including the use of the City's web page to share environmental information with the public. This group will also facilitate the review of environmental impacts of significant projects in the City.

- **FUNDING OPPORTUNITIES.** While pollution prevention is more cost-effective than cleaning up pollution after the fact, it costs more in the short-term. There are a number of funding mechanisms available that can be used to raise revenue to implement State and federal mandates as well as locally identified stormwater management projects and programs. **The City will:**

  - **investigate for adoption a pro rata share stormwater program**
  - **monitor the continued implementation of stormwater utility programs in other jurisdictions and**
  - **continue to pursue grant funding for specific environmental projects**

Water Quality Management

CITY OF ALEXANDRIA MASTER PLAN

Table of Contents

I Introduction 1
- I.1 Purpose and Enabling Authority 2
- I.2 Opportunities to Make a Difference 3
- I.3 Approach and Organization 4

II Alexandria's Water Environment 5
- II.1 A Brief Water History 6
- II.2 Watersheds and Water Resources 7
  - Surface Water Quality 7
  - Stream Bank Erosion and Stream Buffers 12
  - Potomac River Shoreline 15
  - Wetlands 17
  - Groundwater 17
  - Potable Water Supply and Water Supply Protection 18
- II.3 The Land and Land Forms 19
  - Topography 19
  - Geology and Soils 19
- II.4 Wildlife and Natural Habitats 20
  - Habitat Fragmentation 24
- II.5 Public and Private Access to Waterfront Areas 24

III Pollution and Other Sources of Water Quality Decline 29
  - The Role of Redevelopment in Water Quality Improvement 30
- III.1 Point Source Pollution 31
  - NPDES Discharges 31
  - Wastewater Treatment 31
  - Combined Sewer System 32
  - Leaking Sanitary Sewer Lines 33
  - Above Ground and Underground Storage Tanks 34
  - Septic Systems 36
- III.2 Nonpoint Source Pollution 36
  - Wildlife, Non-Migratory Waterfowl, and Pet Waste 39
- III.3 Erosion of the Land 39

III.4 Air Pollution 39
III.5 Waterfront and Dock Activities 39
III.6 Areas of Special Concern 40
Potomac Yard 40
Cameron Station 41
Alexandria Gas Works/Oronoco Site 42
Bogle Chemical Company Site 43
Municipal Land Fill Sites 44
Other Hazardous Contamination Sites 44

IV Water Quality Management Today 45
IV.1 City Master Plan 46
Future Land Use Plan and Map 46
IV.2 City Ordinances and Regulations 46
Chesapeake Bay Preservation Ordinance 47
Erosion and Sediment Control Ordinance 48
Flood Control and Floodplain Overlay District 48
Regulation of Trees, Shrubs, Plants, and Vegetation 49
Regulation of Dog Waste and the Prohibition of Disposal of Refuse and Debris into Storm Sewers 49
Prohibition of Dumping Hazardous Wastes Including Use Oil 50
Prohibition of Automobile Maintenance on City Streets 50
Zoning Ordinance Development Approval Procedures 50
Procedures for the Control of Contaminated Land 51
IV.3 City Programs 51
Street Sweeping/Flushing and Catch Basin Cleaning Program 51
Targets of Opportunity Stormwater Retrofit Program 52
Best Management Practices Manual for Automobile Related Industries 53
Hazardous Waste and Used Oil Collection Programs 54
Leaf Collection Program 54
Sanitary Sewer Line Inspection and Maintenance Program 55
School-Age Water and Environmental Education Programs 55
IV.4 Alexandria Sanitation Authority 55
IV.5 State, Federal, and Regional Programs 56
IV.6 Community Programs 57
Alexandria Earth Day 57

V Policy Analysis and Action Plan 59
Role of Small Area Plans 59
V.1 Constraints to Development 60
Wetlands 60
Topography 60
Geology and Soils 60
Wildlife Habitat Corridors 62
Stream-Side Vegetation 62

	Floodplains	62
	Groundwater Recharge Areas	62
V.2	Protection of Water Quality	63
	Need for Regional Coordination	63
	Point Source Pollution	63
	Nonpoint Source Pollution	64
	Thermal Pollution	66
	Water Conservation	66
	Erosion of the Land	67
	Air Pollution	67
	Waterfront and Dock Activities	67
	Areas of Special Concern	67
V.3	Shoreline Protection and Erosion Control	67
	Stream Bank Erosion Control and Stabilization	67
	Stream Corridor Management	68
	Potomac River Shoreline and Bulkhead Management	68
V.4	Public and Private Access to Waterfront Areas	69
V.5	Redevelopment Areas	69
V.6	Overall Outreach and Coordination	69
V.7	Potential Funding and Enforcement Mechanisms	70
	Pro Rata Share Off-Site Drainage Facility Program	70
	Stormwater Utility	71
	Grant Opportunities	71
	Chesapeake Bay Preservation Act Civil Penalties	72
V.8	Implementation Summary and Time-Line	72

VI Acronyms 81

FIGURES

I.1	Location of the City of Alexandria with Respect to the Chesapeake Bay and Tidewater Virginia	3
II.1	View of Hunting Creek from Shuter's Hill – 1864	6
II.2	Major Streams and Watersheds of Alexandria	8
II.3	Watersheds at a Regional Perspective	9
II.4	Fecal Coliform Trends in Cameron Run and Four Mile Run	10
II.5	Sources of Fecal Coliform Contamination in Four Mile Run	10
II.6	Natural, Artificially Hardened, and Severely Eroding Stream Reaches	13
II.7	Inventory and Condition of Potomac River Shoreline Stabilization Structures	16
II.8	Generalized Alexandria Soils Map	21
II.9	Alexandria's Own Threatened Species – The Wood Turtle	22
II.10	Wild Celery – A Common Species of Aquatic Vegetation on Alexandria's Waterfront	23
II.11	Map of Existing and Potential Marina and Boat Docking Areas and Public and Private Waterfront Access Points	27

III.1 Location of Alexandria's Combined Sanitary Sewer System .. 32
III.2 Point Source Pollution Map and Special Areas of Concern 35
III.3 Alexandria's Industrial Heritage – 1877 Map Showing City Gas Works and Other Industrial Uses 40

IV.1 "No Dumping" Signs Along a Residential Street 50
IV.2 Alexandria Street Sweeper 52
IV.3 Targets of Opportunity Stormwater Retrofit Program Sites 53
IV.4 Public Education Materials Help to Provide Information on Alternatives to Dumping 54
IV.5 Chesapeake Bay Education Plaque at Oronoco Park 56

V.1 Generalized Constraints to Development Map 61

TABLES

II.1 Options for Addressing Impaired Streams 14
II.2 Alexandria's Soils and Suitability for Development 20
II.3 Existing and Potential Marina and Boat Docking Areas and Public and Private Waterfront Access Points..... 26

III.1 City Land Uses and Associated Imperviousness..... 37
III.2 Common Urban Pollutants and Their Sources 37

MAPS

City Wetland Map
Marine Clays and Steep Slopes
Potential Development Sites
Chesapeake Bay Preservation Areas
Floodplain Overlay District

All maps located at the back of the document.

Water Quality Management

CITY OF ALEXANDRIA MASTER PLAN

Introduction

I

Colonial Alexandria was founded as a link between the land and the water. Today, the linkage between the City and the water has never been stronger as citizens and visitors alike enjoy the natural and man-made beauty of Alexandria's waterfront. Forested stream valley parks located throughout the City provide passive recreational opportunities for residents and habitat for wildlife. All of Alexandria's waterways, including its creeks, streams, drainage ditches, and culverts, are part of the larger Chesapeake Bay ecosystem. However, Alexandria's two and a half centuries of residential, commercial, and industrial development and activity has not occurred without cost. Urban development and associated human activities have contributed to the steady decline of local and regional water resources – including the Potomac River and the Chesapeake Bay.

Because of Alexandria's historic and continuing reliance on the water for trade, food, and recreation, it is a particular point of pride that Alexandria has committed itself to the stewardship of its water and other natural resources. The purpose of this Master Plan supplement is to recognize the interdependency between people and their environment and to guide the City as it seeks to protect and restore its own numerous local tributaries as well as the natural habitats of the Chesapeake Bay and the Potomac River that are dependent on the water quality in these tributaries.

Citizens and Visitors Enjoy Alexandria's Waterfront

CONTENTS

- **Purpose and Enabling Authority**
- **Opportunities to Make a Difference**
- **Approach and Organization**

It is the intention of the City, using this supplement as a tool, to:

- restore impaired streams that are capable of supporting diverse aquatic habitats
- protect streams that currently support aquatic life from the effects of improper development and pollution and
- provide residents with a wide-range of opportunities to interact with and become stewards of their natural environment

Through these efforts, the City anticipates being able to continue to make a substantive contribution to the restoration of the Chesapeake Bay and to the improvement of the overall quality of life for the residents of the City of Alexandria.

PURPOSE AND ENABLING AUTHORITY

I.1

The Chesapeake Bay – Alexandria's downstream neighbor – is among the nation's largest and most productive estuaries. However, carried along with the huge volumes of fresh water from the Bay's 64,000 square mile watershed are sediments, fertilizers, pesticides, motor oil and other pollutants generated by various land uses and human activities. As the population of the Chesapeake Bay watershed has grown (from 6,353,800 in 1950 to 13,591,150 in 1990, a 113% increase), so too have the impacts of these pollutants on the health of the Bay.

Today, many once-plentiful aquatic species, including sturgeon, striped bass, oyster, blue crab, and many species of waterfowl, have reached critically low numbers. According to the Chesapeake Bay Program, American shad, once the most commercially valuable species of the Chesapeake Bay, declined from Bay-wide landings averaging more than 5 million pounds per year for most of the twentieth century to only 47,000 pounds in 1993 and 129,482 pounds in 1994. The 1993 oyster harvest of 592,000 pounds was only one percent of the peak harvests at the end of the 19th century. In addition to the decline of these commercially valuable species, submerged aquatic vegetation (SAV), which provide food and habitat for many aquatic species, also declined sharply during the 1960s and 1970s as a result of increased nutrient and sediment pollution from development of the surrounding watershed.

Population within the Chesapeake Bay watershed is expected to grow by an additional 931,950 people to 14,532,100 from 1990 to 2000.

In 1983, Virginia, Pennsylvania, Maryland, the District of Columbia, and the U.S. Environmental Protection Agency signed the Chesapeake Bay Agreement and created the Chesapeake Bay Program to help find ways to restore the Bay. In Virginia, the most widely recognized result of this agreement is the Chesapeake Bay Preservation Act of 1988 (Sections 10.1-2100, *et seq*., of the Code of Virginia (1950)). The City of Alexandria implemented the Act in 1992 in the form of its Chesapeake Bay Preservation Ordinance which requires developers to meet pollution reduction and minimization through performance criteria during the development and redevelopment processes.

In addition to requiring the development of a Chesapeake Bay Ordinance, the Act (Section 10.1-2109.B) also states that "Counties, cities, and towns in Tidewater Virginia shall incorporate protection of the quality of State waters into each locality's comprehensive plan consistent with the provisions of this chapter." The purpose of incorporating water quality protection into local comprehensive plans is to account for what is already being done to help protect water quality and to provide a framework for expanding these efforts in a way that helps all Virginians to meet environmental, social, and economic goals.

This "Water Quality Management" supplement to the City's Master Plan constitutes Alexandria's long-range vision for a cleaner water environment and sets forth policies, strategies, and time-lines to achieve its identified water quality protection goals.

OPPORTUNITIES TO MAKE A DIFFERENCE

I.2

Urban areas such as Alexandria contribute significantly to water quality problems. Not only does urbanization introduce a myriad of new pollutants into the environment, it significantly alters the land's ability to assimilate these pollutants. As forests and meadows are converted to parking lots, driveways, roads, roof tops and sidewalks, the surface of the land becomes increasingly impervious. This means that any pollutants that collect on these surfaces as a result of human activities are flushed directly into local streams without the cleansing benefit of infiltration into the soil or filtration by vegetation.

In general terms, urban pollution can be reduced through the application of four principles.

- Impervious surface area necessary to accommodate desired land uses should be minimized.
- Existing vegetation should be preserved and restored to the maximum extent practicable.
- Human behavior that results in pollution should be challenged and changed through public education.
- Pollution that cannot be reduced through changes in human behavior should be controlled by employing technology or by installing stormwater management pollution reduction facilities (also known as best management practices, or BMPs).

While Alexandria has been urbanized for some time, there are still many opportunities for the City to actively reduce pollution. In fact, continued growth and economic prosperity provides the principle means for improving water quality and habitat conditions in the City. Between 1990 and 2000, the City is estimated to have grown by 10% from 111,183 to 123,200 residents. Office space grew from 13,563,581 to 14,067,111 square feet from 1995 through 1998. Most future residential and

FIGURE I.1
Location of the City of Alexandria with Respect to the Chesapeake Bay and Tidewater Virginia

commercial development, with the exception of a few significant parcels, is expected to come in the form of redevelopment. From a resources management perspective, this is particularly significant because a majority of the City's residential and commercial areas were developed prior to the implementation of stringent water quality regulations (over 43% of housing units were built prior to 1960 and over 89% were built prior to 1980).

Through a combination of creating new development that is sensitive to water quality and natural habitats, retrofitting existing development with water quality controls when possible, and providing the tools for residents and businesses to become better stewards of the environment, Alexandria can and is already making real contributions to the protection of local water resources and the Chesapeake Bay.

APPROACH AND ORGANIZATION

I.3

This supplement takes the approach that to arrive at achievable water quality goals, strategies, and action plans, it is necessary to have a detailed understanding of the City's natural environment and existing City, State, and federal regulations and programs intended to help protect water quality and the environment. By comparing identified constraints to development, sensitive natural resources, and existing and potential sources of pollution with existing programs, it is possible to visualize areas of the City's water quality protection programs that may require further study and analysis.

To help foster this approach, this supplement is divided into the following sections:

I. Introduction
II. Alexandria's Water Environment
III. Existing and Potential Sources of Water Pollution
IV. Water Quality Management Today
V. Policy Analysis and Action Plan

Alexandria's Water Environment

II

Located on the tidal Potomac River approximately six miles south of downtown Washington D.C., Alexandria's natural and man-made environments are undeniably intertwined. Having experienced numerous waves of urbanization since its founding in 1749, the City contains very few natural resources that have not been affected by human activities. Remarkably, however, Alexandria is home to a hardy, if limited, natural ecosystem. Pockets of wildlife can be found in back yards, stream valleys, and even Alexandria's street trees and utility line rights-of-ways. More importantly, Alexandria serves as part of the larger Chesapeake Bay ecosystem. Alexandria's efforts to promote conservation and environmental stewardship within its boundaries serves as an integral part of larger Chesapeake Bay preservation efforts.

To promote future development and redevelopment that complements the remaining natural resources of the City, improves habitat conditions where possible, and enhances the overall quality of life for City residents, it is first necessary to identify and understand existing natural environment and the potential constraints to human activities that they represent. The following section provides a summary of natural resources and environmental features affecting water quality that are unique to Alexandria as well as those which are shared with its neighbors – Fairfax County and Arlington County.

Alexandria's Resilient Wildlife Habitat at Route One Interchange

CONTENTS

- **A Brief Water History**
- **Watersheds and Water Resources**
- **The Land and Land Forms**
- **Wildlife and Natural Habitats**
- **Public and Private Access to Waterfront Areas**

A BRIEF WATER HISTORY

II.1

The Cameron Run and Four Mile Run watersheds that drain Alexandria have been developed longer and more extensively than almost any others in Virginia. Human alteration of the natural environment began with the arrival of the American Indians who cleared forests for corn planting and hunted what one early colonial explorer, Henry Fleet, described in 1631 as "swarms" of deer, bear, buffalo, and turkey. Fish, including sturgeon, were trapped and speared extensively, and fresh water mussels were collected in great numbers (Hunting Creek was called Mussel Creek until 1695). Nonetheless, evidence suggests that wildlife populations easily supported these American Indians.

With the arrival of Europeans, the stress on the environment increased dramatically. Demand for meat and hides, in addition to extensive clearing for agriculture, led to the early disappearance of many larger animals. Tobacco farming soon became an economic mainstay in the region and a major tobacco warehouse was constructed on the north bank of Hunting Creek in 1732. By about 1800, the soil of Northern Virginia was described as completely exhausted. Erosion caused by poor farming practices claimed Alexandria's early commercial rival, Dumfries, whose port completely silted in by 1805.

In 1850, the first of several railroad tracks was constructed up the valley of Hunting Creek, Cameron Run, and Backlick Run. During the Civil War, the landscape between Alexandria and Fairfax was stripped bare of vegetation for heat and battlements. Barcroft Dam was built across Holmes Run in the early part of the century by the City to provide a clean water supply. Finally, beginning after World War I, the expansion of Washington D.C. as an employment center led to the boom in residential development and infrastructure that continues today.

As the Cameron Run and Four Mile Run watersheds developed, natural stream channels were replaced by an intricate network of storm sewers and culverts. By the middle part of the twentieth century, the lower portions of each watershed could no longer handle the increased volume and velocity of contributing stormwater runoff. Four Mile Run was especially affected. During the late 1960s and early 1970s, frequent flash flooding of residential and commercial areas located between the Potomac River and Shirley Highway resulted in over $40 million in damage (in 1968 dollars). In March of 1974, Congress authorized the U.S. Army Corps of Engineers to design and construct a flood control channel for Four Mile Run. The project was completed and dedicated in August, 1980. In order to protect the new channel's ability to control flooding, Alexandria, Arlington,

FIGURE II.1
View of Hunting Creek from Shuter's Hill (Site of Today's Masonic Temple) – 1864

The Civil War witnessed the clear-cutting of large areas of forest for heat and battlements. This resulted in large quantities of sediment entering the Potomac River and its tributaries. Above, the Forty-Fourth New York Infantry.

Fairfax, Falls Church, and the Northern Virginia Planning District Commission (now the Northern Virginia Regional Commission) signed the Four Mile Run Agreement in 1977. The Agreement, which is considered to be a model of regional stormwater cooperation, established a process to ensure that future land uses would not result in an increase in flood levels. Cameron Run, Lower Backlick Run, and Lower Holmes Run, which experienced similar flooding problems, are also channelized and maintained as flood control struc-

tures. Lower Backlick Run (from Indian Run east) was first channelized around 1850. The Cameron Run channel was completely reconstructed during the early 1980s, in conjunction with the widening of the Capital Beltway.

A 1974 report entitled *The Fauna of the Cameron Run Watershed, Fairfax County Virginia* describes an extensively altered watershed in which most open space and forest was confined to floodplain areas. While deer, fox, beavers, and otters had largely disappeared, some muskrat still called the watershed home and raccoon could be found in abundance. A survey of aquatic species found that many of the more pollution intolerant species had disappeared, especially when compared to the then relatively undeveloped Pohick Creek watershed to the west. However, even in 1974, none of the twenty Cameron Run watershed sampling sites was so polluted as to have a complete absence of pollution intolerant aquatic species. Pollution observed in 1974 included large quantities of trash and junk (including beer cans, tires, and even automobiles), pipe cement, and an unknown black liquid in lower Backlick Run.

Since the mid-1970s, the City's water quality protection efforts have included a vigorous stormwater detention program, the adoption of a Chesapeake Bay Preservation Ordinance in 1992, the implementation of a number of pollution prevention programs, and the development of an innovative pollution control and urban stormwater management retrofit program that has attracted national attention.

WATERSHEDS AND WATER RESOURCES

II.2

To set the stage for discussing modern water and environmental resources protection efforts, it makes sense to think in terms of watersheds rather than neighborhoods or political jurisdictions. Watersheds provide a natural division for resource management. Water pollution is dynamic, as rivers, streams, and groundwater transport pollution from higher to lower elevations. As a result, water pollution becomes a shared problem – and ultimately, a shared responsibility. This fact highlights the need for local, regional, and State coordination in the water quality planning process.

Alexandria is divided by three watersheds as defined by the Virginia Division of Soil and Water Conservation. These are the Four Mile Run (#A12), the Cameron Run (#A13), and the Potomac River (#A14). In practical terms, Four Mile Run drains the northern and eastern portions of the City while Cameron Run drains the remainder of the City except for areas of Old Town which drain directly to the Potomac River.

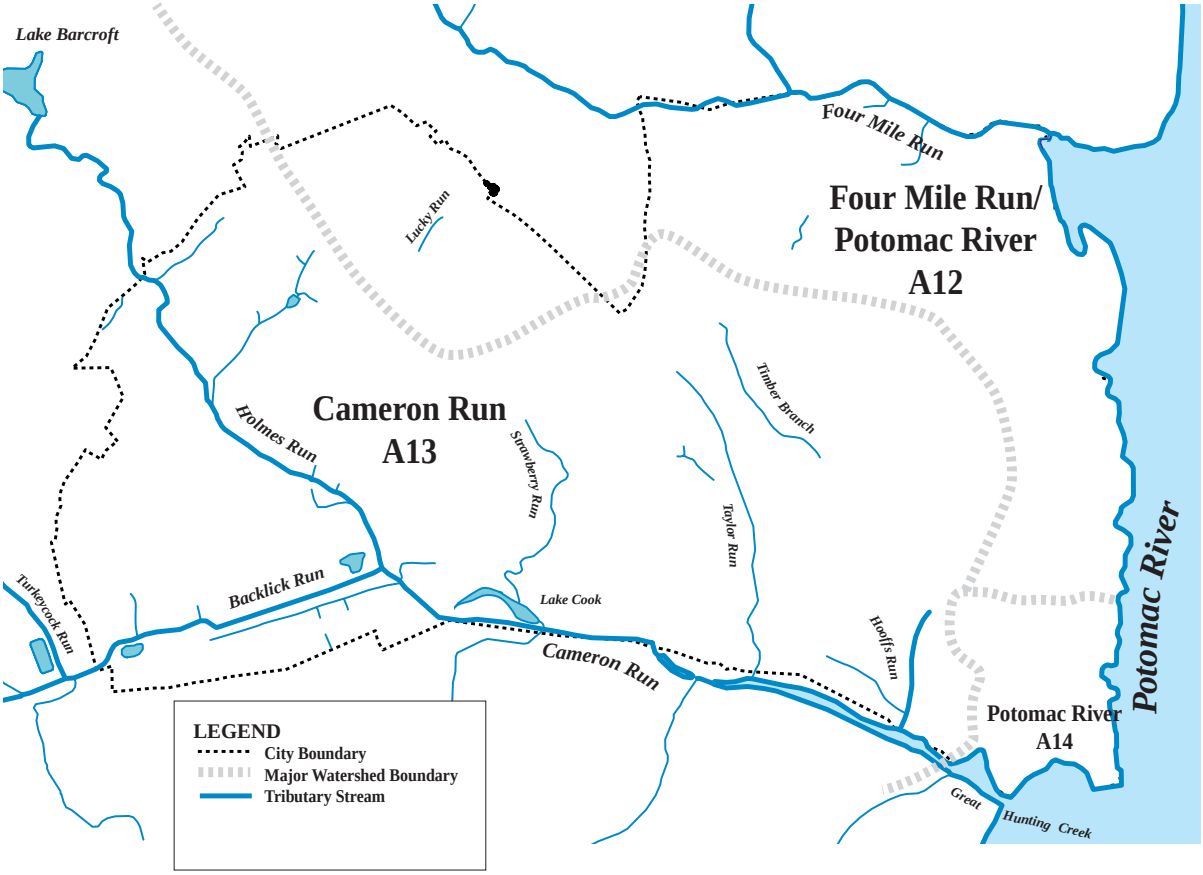
In addition to these larger streams, a myriad of smaller tributaries, some of which are still largely natural and some of which have been significantly altered or undergrounded (piped), drain the City's landscape. Significant named tributaries include Holmes Run, Backlick Run, Hooffs Run, Taylor Run, Timber Branch, Strawberry Run, and Lucky Run. Figure II.2 provides a map of the major watersheds and the location of creeks, branches, runs, and licks of Alexandria. Figure II.3 provides a map of Alexandria's watersheds from a regional perspective.

For the purpose of analysis, this section is divided into relatively distinct components that together provide an overall picture of the health of Alexandria's watersheds. These include surface water quality, streambank erosion and stream buffers, Potomac River shoreline, wetlands, and groundwater resources. In addition, this section includes a discussion of the source and protection of Alexandria's potable water supply.

Surface Water Quality

Among the most important indicators of the health of a watershed is the quality of the water running in local rivers and streams. Protecting the quality of surface water is a major challenge for many urban jurisdictions, including Alexandria. In addition to dumping and other overtly illegal acts, pollution that collects on parking lots, roof tops, and driveways, is often flushed directly to local streams during storm events. This is particularly true for Alexandria, which was largely built-out before regulations affecting water quality became adopted.

FIGURE II.2
Major Streams and Watersheds of Alexandria



Source: NVPDC. 1998.

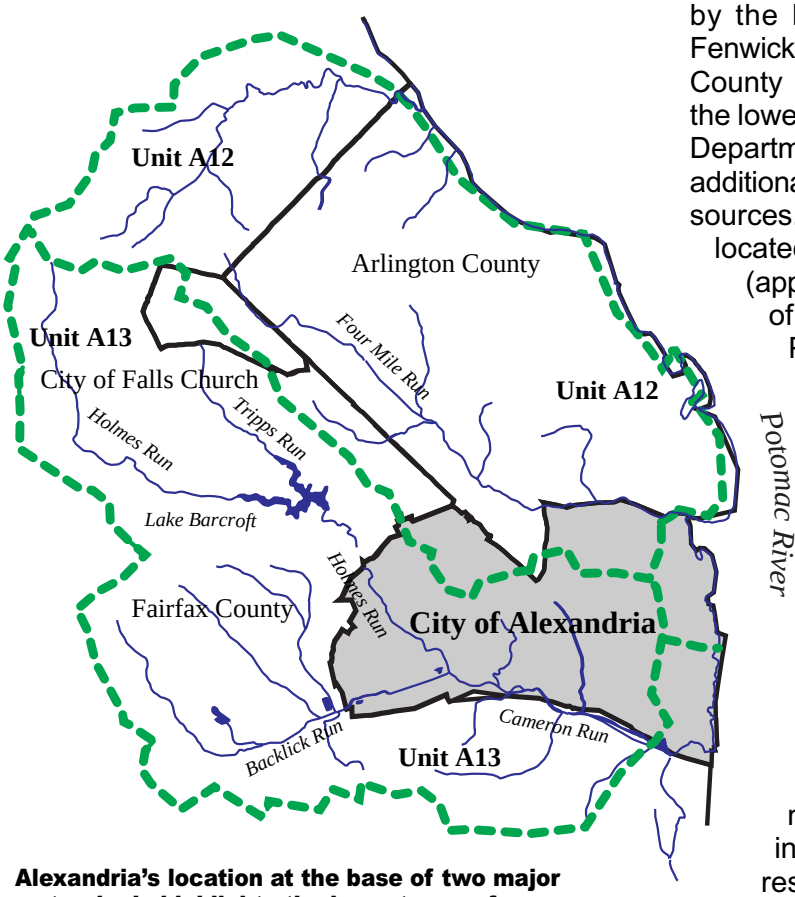
Water quality standards are set under the federal Clean Water Act (CWA), which is administered by the Virginia Department of Environmental Quality (VADEQ). All State waters are expected to be maintained to support recreational use and the propagation and growth of all aquatic life reasonably expected to inhabit them. These are known as the CWA "swimmable and fishable goals." The parameters used to measure these goals include dissolved oxygen content (DO), pH (alkalinity/acidity), maximum temperature, and fecal coliform bacteria count. Standards for these parameters are different for the tidal portions of Cameron Run and Four Mile Run (classified as Class II, tidal Coastal zone) and the remaining non-tidal tributaries within the City (Class III, non-tidal Coastal and Piedmont zones). The only difference between the two standards is that there is no established maximum temperature for Class II waters.

Fecal coliform levels are the most important from a human health standpoint. These indicator organisms, while not necessarily harmful in themselves, are found in the intestinal tracts of warm-blooded animals, including humans, and therefore can be indicative of fecal contamination and the possible presence of pathogenic organisms.

Temperature, DO, and pH are the primary indicators of the health of the aquatic ecosystem. The

presence of DO in water is essential for aquatic life and the type of aquatic community is dependent to a large extent on the concentration of DO present. Strongly related to pH are biological productivity, stream diversity, and the toxicity of certain chemicals, as well as important chemical and biological activity. Temperature affects feeding, reproduction, and the metabolism of aquatic animals. A week of high temperatures each year may make a stream unsuitable for sensitive aquatic organisms, even though temperatures are tolerable throughout the rest of the year.

FIGURE II.3
Watersheds at a Regional Perspective



Alexandria's location at the base of two major watersheds highlights the importance of interjurisdictional cooperation on water quality.

In addition to the CWA swimmable and fishable goals, many of the City's water quality programs are driven by the interstate Chesapeake Bay Agreement and the resultant Virginia Chesapeake Bay Preservation Act and the Potomac Tributary Strategy program. The primary focus of these efforts are to reduce the flow of nutrients entering the Potomac River and the Chesapeake Bay. While essential to healthy plant and animal growth, an overabundance of nutrients results in algae blooms which block sunlight and consume oxygen when they decay. Phosphorus is the primary nutrient of concern for fresh water systems such as the Potomac River while nitrogen is the nutrient of concern for brackish water systems such as the Chesapeake Bay.

Systematic water quality monitoring data for City streams is limited, and consistent data is available only for Four Mile Run and Cameron Run. Water quality in the lower Cameron Run is tested by the Fairfax County Health Department at Fenwick Drive where Cameron Run enters Fairfax County near Telegraph Road. Water quality in the lower Four Mile Run is tested primarily by the Department of Environmental Quality – although additional water quality data is available from other sources. Four Mile Run monitoring stations are located at its intersection with Columbia Pike (approximately one and a half miles upstream of the City limits) and George Washington Parkway. This provides a good means of assessing how the City may impact water quality in Four Mile Run.

Water quality in Cameron Run and Four Mile Run generally meet the CWA fishable and swimmable goals with the notable exception of fecal coliform counts. While DO levels in Four Mile Run drop markedly from Columbia Pike to the George Washington Parkway (10.9 mg/l to 7.7 mg/l), they are still well within acceptable limits and consistently test above the minimum standard of 4.0 mg/l. The primary reason for this decline in DO is the slowing down of water as a result of tidal influences and reductions in topography.

While temperature measurements are within CWA goals, this information should be interpreted with caution. During the summer months, stormwater runoff may become significantly warmer as it absorbs heat from impervious surfaces such as parking lots, streets, and roof tops. The resultant pulse

FIGURE II.4
Fecal Coliform Trends in Cameron Run

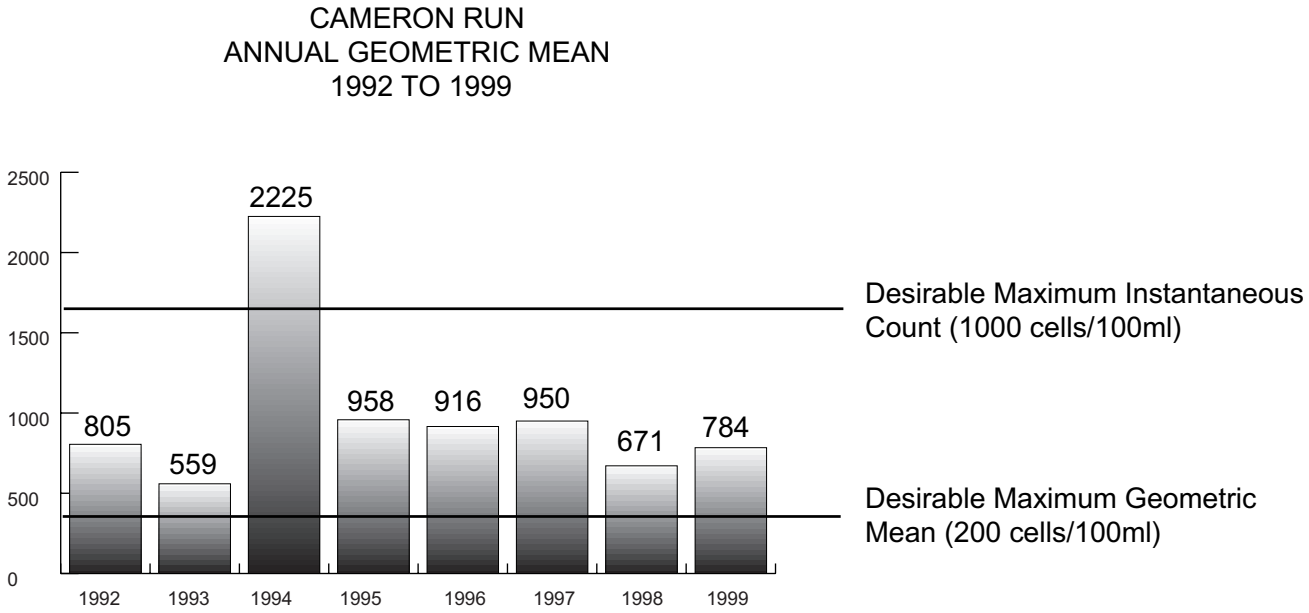
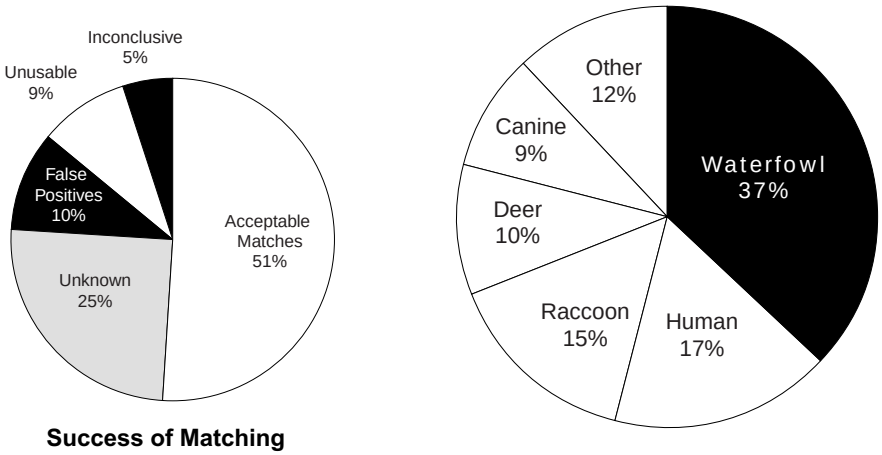


FIGURE II.5
Sources of Fecal Coliform Contamination in Four Mile Run



Success of Matching Bacteria With Potential Sources (N=539)

Distribution of Acceptable Matches by Animal Group (N=278)

Source: Simmons, et al., Septamber, 2000, Estimating Nonpoint Fecal Coliform Sources in Northern Virginia's Four Mile Run Watershed.

of warm water can cause thermal shock to many aquatic species. Because these pulses are typically short in duration, they are often not detected during monitoring. However, their impacts can be devastating. Volunteer monitoring in Four Mile Run has measured temperatures to rise as quickly as 10°F in an hour. Thermal shock can occur with changes of 3 or 4° in an hour.

Fecal coliform contamination continues to be a problem for Four Mile Run and Cameron Run. Alexandria's situation is by no means unique, as most of Northern Virginia's streams show elevated levels of these contaminants. At the Cameron Run monitoring site, 57% of samples tested in the "unhealthful" range (greater than 1,000 fc/100ml) for fecal coliform in 1999. Monitoring in the Four Mile Run reveals similarly high levels of fecal coliform contamination. Results of testing at Columbia Pike for the period from 1995 to 1999 show that 21% of samples tested above the "unhealthful" level. Fecal contamination was slightly worse at the George Washington Parkway monitoring site where 28% of samples tested in the "unhealthful" range.

Long term monitoring results (see Figure II.4) show that levels are consistently elevated but fluctuate according to year and rainfall.

The sources of bacteria contamination have been debated for a number of years. In 2000, a joint effort between the Northern Virginia Regional Commission and Virginia Tech shed light on the subject by applying DNA analysis to bacteria strains in Four Mile Run. The study revealed that waterfowl account for over a third of all bacteria matches (37%), followed by humans (17%), raccoon (15%), and canine (9%) (see Figure II.5). Equally of significance, the study found that the bacteria appears to regrow, through cloning, within storm drains and stream sediments – therefore perpetuating the problem. Having such information is critical to eventually managing the problem of bacteria in Alexandria's streams.

The Fairfax County Health Department also tests for nitrate nitrogen, total phosphorus, and a variety of heavy metals. The log average for Cameron Run for arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver is consistently below EPA contamination standards. The average nitrate nitrogen level in Cameron Run for 1996 was 0.8 mg/l, which is well below the maximum unhealthful level of 10 mg/l. However, levels have been rising, albeit slowly, from 0.6 mg/l in 1992. Average total phosphorus levels have remained stable at an acceptable 0.1 mg/l.

The "1998 Virginia Water Quality Assessment," which reports monitoring by VADEQ on a watershed-wide basis, found that all samples in that year for Cameron Run were "good" for total phosphorus. In the Four Mile Run, 94% of samples were found to be in the good range, 4% in the fair range, and 2% in the severe range. Four Mile Run is the only watershed in the middle Potomac River basin to report severe conditions. VADEQ's findings for nitrogen were less positive. Cameron Run had 36% of samples in the good range and 64% in the fair range. Four Mile Run reported 24% of samples in the fair range, 61% in the poor range, and 15% in the severe range, which is the second worse in the entire Virginia portion of the Potomac River watershed. Overall, both watersheds are considered high priorities by the Commonwealth for nonpoint source pollution.

Current water quality monitoring efforts, because they only occur at certain intervals and test for a few specific parameters, often leave undetected acute toxic pulses that occur when an uninformed or uncaring individual dumps a toxic substance down a stormdrain or directly into a stream. It is these incidences of dumping that most often result in fish kills and can devastate an otherwise healthy ecosystem in moments. Actual examples reported to the City Fire Marshall include draining oil from an automobile directly into a stormdrain and washing paint brushes, cans, and solvent containers into a stormdrain culvert.

In Alexandria, responding to these incidences is a cooperative effort among the VADEQ, the Alexandria Department of Transportation and Environmental Services, and the Fire Department, depending on the nature of the problem. According to VADEQ records for the Alexandria area (including portions of Fairfax County in the Alexandria zip code), there were four reported incidences in 1996, 29 reported incidences in 1995, 33 reported incidences in 1994, 14 reported incidences in

1993, 14 reported incidences in 1992, seven reported incidences in 1991, and nine reported incidences in 1990. Many incidences likely are not reported and go unmitigated.

The most common contaminants include fuel oil, gasoline, foam, diesel fuel, and antifreeze. Other toxic substances found in City streams include paint, trichloroethylene, car wash waste, salt runoff from roads, transmission fluid, floor cleaner, chlorinated pool water, freon, soap, creosote, mineral oil, mineral spirits, hydrazine, and various unidentifiable white, black, green, and yellow substances. Few waterbodies have been untouched by these incidences since most of them are connected to streets, parking lots, and yards through culverts and stormdrains.

Despite the obvious challenges, watershed-wide management efforts to date have resulted in cleaner water, and Alexandria, through its public education, street sweeping, and urban retrofit programs, as well as upgrades to the Alexandria Wastewater Treatment Facility, has contributed significantly to this success. Trend data collected by the VADEQ indicates that the Potomac River continues to improve in many areas, although in some areas past gains are being slowly eroded as a result of population pressures. Nitrogen levels in the Potomac River are fair but improving. Dissolved oxygen levels are good and improving. However, chlorophyll levels (high levels of which indicate excessive algae growth as a result of an oversaturation of nutrients) are good but degrading. The VADEQ also measures whether the Potomac River is meeting certain aquatic habitat objectives including available light, the health of phytoplankton communities (the more the better), suspended solids (the fewer the better), and phosphorus. The upper Potomac River (including Alexandria's waterfront), fails the test for available light and suspended solids and is borderline for phytoplankton communities and phosphorus.

As noted earlier, Virginia has embarked on an extensive and vigorous effort to reduce nutrients in the Potomac River and the Chesapeake Bay known as the Tributary Strategy program. Future planned improvements in Alexandria that will help Virginia meet and maintain its Tributary Strategy goal (a 40% reduction in nutrients from a 1985 baseline) include upgrades to the Alexandria Wastewater Treatment Facility and continued retrofit of urban areas with water quality management facilities.

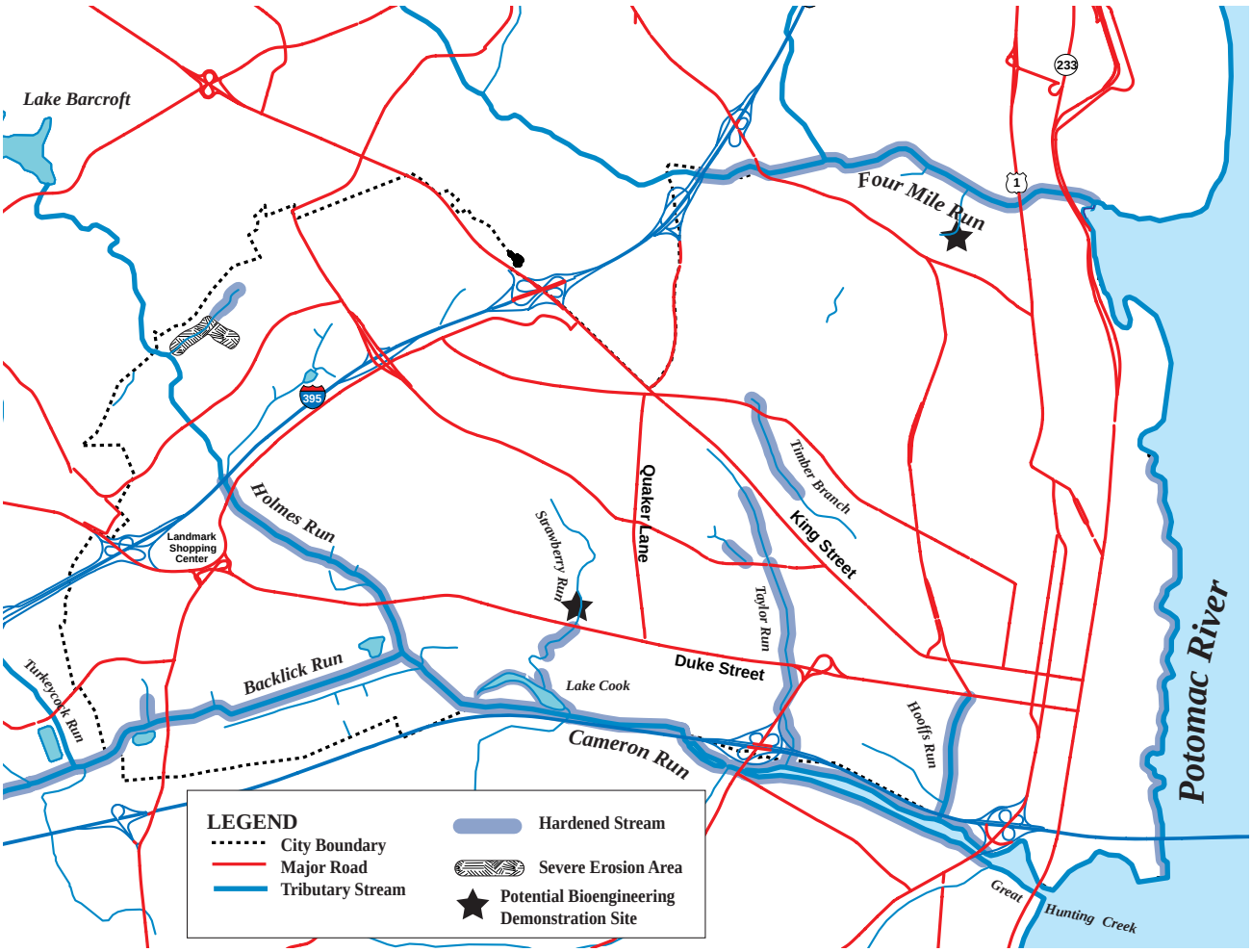
Stream Bank Erosion and Stream Buffers

The physical integrity of a stream – including its banks and areas buffering the stream – has a direct impact on stream habitat and water quality. Degraded physical integrity of a stream is typically a symptom of too much water volume for a stream's capacity. As impervious surface area increases, stormwater tends to enter local streams all at once, rather than infiltrate slowly into the soil where it enters a stream at a much reduced volume and rate. Urban streams seek to find new equilibrium by expanding their capacity, resulting in undercutting and widening of banks, deepening of channels, and gullying. The impact on water quality and habitat can be devastating. Soil sediments, which also contain nutrients, are washed downstream where they eventually settle and smother aquatic communities. In addition, aquatic habitats are destroyed because water levels in streams fluctuate from torrential, during storm events, to a trickle during periods of extended dryness.

While the impacts on water and habitat quality can be devastating, flooding as a result of a stream's inability to handle increased stormwater volume and velocity can seriously impact the welfare of local residents and businesses.

Most of Alexandria's major waterways have been hardened and/or channelized over time to stabilize eroding stream banks and to increase stormwater volume carrying capacity. The largest of these projects is the lower Four Mile Run flood control channel from Shirley Highway to its confluence with the Potomac River. By the middle part of the twentieth century, the cumulative impacts of development in the Four Mile Run watershed resulted in frequent flash flooding of the Arlandria section of Alexandria and Arlington. In 1974, Congress authorized the U.S. Army Corps of Engineers to design and construct a flood control channel for Four Mile Run that would contain

FIGURE II.6
Natural, Artificially Hardened, and Severely Eroding Stream Reaches



Source: Alexandria Department of Transportation and Environmental Services. 1997.

the increased surface water flow. The total expense of this channelization and bridge replacement project was $63 million. The project was completed and dedicated in August, 1980. In order to protect the new channel's ability to control flooding, Alexandria, Arlington, Fairfax, Falls Church, and the Northern Virginia Planning District Commission signed the Four Mile Run Agreement in 1977. The Agreement, which is considered to be a model of regional stormwater cooperation, established a Technical Review Committee to ensure that future land uses would not result in an increase in flood levels.

Cameron Run and Backlick Run, which have experienced similar flooding problems, are also channelized and maintained as flood control structures. The Cameron Run channel was completely reconstructed during the early 1980s, in conjunction with the widening of I-495. Portions of Strawberry Run, Taylor Run, Timber Branch, and Lucky Run have also been hardened or channelized.

Because these channels are designed to contain the 100-year flood without spill-over, they must be managed to prevent any decrease in carrying capacity.

TABLE II.1
Options for Addressing Impaired Streams

Stream is Already Channelized – Most of Alexandria's channelized streams are designed to control a specific flood volume. In the case of Four Mile Run, Alexandria is legally bound to clear of any vegetation and silt that may reduce the channel's capacity. Likewise, allowing extensive growth of vegetation or silt build-up in stormwater conveyance channels, in many cases, will result in flooding and possibly property and environmental damage. The vegetation that typically grows on the banks or silts of these channels are fast growing, hardy, low lying edge-of-the-forest species. Due to their low lying nature and vigorous growth, these types of vegetation are precisely what needs to be avoided in these areas.

An option, in these cases, includes the purposeful planting of high-canopy native vegetation far enough back from the channel to protect its physical integrity. The high-canopy will provide shade and some habitat. Native, moisture-loving vegetation that may be appropriate include sycamore, beech, etc. Areas immediately around the channel may be maintained as a native wildflower meadow, low-lying native vegetation, or as a grassy area (if a manicured look is desired).

A Natural Stream is Experiencing Erosion Problem – If the stream channel is in natural condition, but experiencing moderate or sever erosion problems, the following options may be considered.

- **Bioengineering.** Bioengineering refers to a host of techniques that utilize fast growing, hardy plants and other natural materials to stabilize a streambank. When performed correctly, and in the right context, bioengineering can increase habitat value, stabilize stream banks, and add nutrient uptake by riparian buffer vegetation. Bioengineering is usually accompanied with the regrading or grading back of the affected banks. Otherwise, vegetation may be lost or damaged through additional undercutting. Therefore, bioengineering is only feasible in situations where erosive volumes are moderate, where stream banks can be regraded, and where the maintenance of bioengineering once in place is possible. It is very important that sites are properly screened to ensure the maximum probability of success. Stream reaches that have been field identified as potential bioengineering demonstration sites include a small tributary traversing Four Mile Run Park, lower Strawberry Branch along Fort Williams Drive, and a small tributary of Holmes Run located in Dora Kelly Park. The locations of these sites are provided in Figure II.6.

- **Stream By-Pass.** An innovative means of protecting a stream from erosion, or as an alternative to hardening, is to construct a floodwater bypass system. While normal flows stay within the natural stream bed, floodwaters above a set level are directed to an adjacent, underground storm sewer which can relay the extra volume downstream. The benefit of this alternative is that the stream can be maintained in a natural state and that future damage can be avoided. This technique may not work well in areas that have already experienced severe erosion problems or where limited space is available. A further consideration is that an area adjacent to the stream must be disturbed in order for the construction of the diversion, which may require easements or limited removal of trees.

- **Let the Stream Adjust.** In some cases, where erosion is not severe and the floodplain adjacent to the stream is wide enough, it is best to let the stream adjust naturally to its new carrying capacity. Eventually, the new channel will widen or deepen, or form meanders, to handle increased stormwater flows.

- **Window Dressing.** There are times when stream hardening is the only solution to an erosion problem. Even so, stream channelization projects can often be designed in a manner that is more aesthetically pleasing. While not always fiscally feasible, areas with the most visibility can be constructed in this manner. A vegetation management plan that promotes the use of native vegetation that does not interfere with flood capacity may also be a part of the channelization effort.

An important outgrowth of the flooding problems of the 1960s and 1970s, and as a requirement of federal funding of the Four Mile Run flood control project, was the implementation of on-site stormwater detention requirements for development and redevelopment in the City. Instead of allowing stormwater to enter the local stream network all at once, the City requires that it be detained and released slowly to mimic the land's ability to hold large volumes of water over time. Since the 1970s, Alexandria has invested heavily in its system of stormwater conveyance and detention. As of 1992, there were over 135 stormwater control structures located within Alexandria. As a result, the need for future channelization and hardening projects has been reduced, although by no means eliminated, and the opportunity to stabilize remaining natural stream segments by other means has been increased.

While stream hardening will continue to be necessary under some circumstances, depending on the specific problem, a number of additional habitat-friendly stabilization options now exist. How to address remaining natural, but physically degraded streams should be viewed in the context of the options presented in Table II.1.

Figure II.6 shows major natural and man-made stream channels in Alexandria. Areas identified by the Department of Transportation and Environmental Services as experiencing moderate to severe streambank erosion and areas identified as possible bioengineering demonstration sites are also shown.

A natural, undisturbed, mature vegetated forest buffer is among the most effective means of protecting water quality and aquatic habitats from the impacts of land use development. Not only does a vegetative buffer protect streams from runoff and activities from adjacent land uses, the tree canopy also serves to cool and moderate stream temperatures. The City's Chesapeake Bay Preservation Ordinance requires the preservation of a 100-foot buffer area landward and adjacent to all Resource Protection Area components and tributary streams during development.

Many of Alexandria's tributaries lack stream-side vegetation, and specifically, mature tree canopy. In some highly urbanized areas of the City, or where streams have been hardened for flood control purposes, establishment of an area of stream-side vegetation may not be practical or feasible. To compensate, the City has and must continue to be proactive in identifying denuded buffer areas and habitat that can be restored.

Potomac River Shoreline

Alexandria's Potomac River shoreline stretches for 7.8 miles from Hunting Creek on the south to Four Mile Run on the north. As with the City's smaller streams, the physical integrity of the Potomac River shoreline is important to minimize erosion and to protect wildlife habitats. Most of the Potomac River shoreline from Daingerfield Island south is hardened with various combinations of rip rap and concrete, and wood and steel bulkheads. In some areas, hardening has allowed public access to the Potomac River, while in others it has been necessary to prevent harmful erosion. Overall, approximately 58% of the shoreline is artificially stabilized, of which 75% is rip rap, 20% is bulkhead, and 5% is channel gabion. Daingerfield Island, which is maintained by the National Park Service, represents the largest natural area along the Alexandria waterfront.

The vast majority of the bulkheads and hardened areas along the Potomac range from fair to good condition – although pockets of debilitated structures dot the shoreline. As development has continued along the Alexandria waterfront, remaining less stable bulkheads are slowly disappearing. Figure II.7 provides an inventory of Potomac River shoreline stabilization efforts, based on an October, 1998 field survey, and highlights the condition of bulkhead and stabilization structures.

While the Daingerfield Island shoreline has been left in a largely natural condition, other pockets of "natural" shoreline can be found along the Alexandria waterfront. Cobbles, washed from Alexandria's colonial streets and natural land forms, and banks with high clay content have prevented the development of significant areas of shoreline erosion.

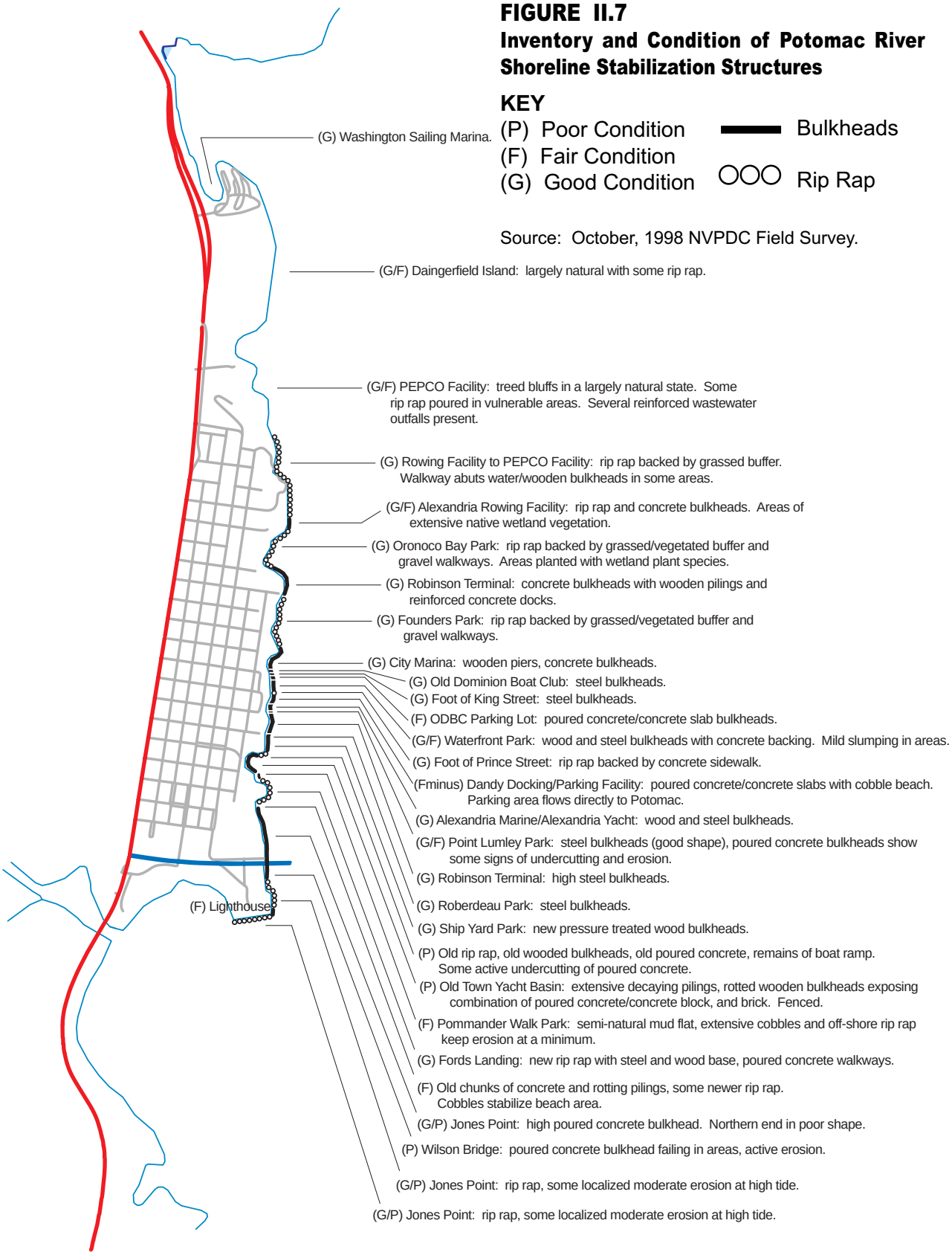
FIGURE II.7
Inventory and Condition of Potomac River Shoreline Stabilization Structures

KEY

(P) Poor Condition
(F) Fair Condition
(G) Good Condition

Bulkheads
Rip Rap

Source: October, 1998 NVPDC Field Survey.



Wetlands

Wetlands serve as habitat for a wide range of plants and animals and are important as a means of buffering and protecting local streams from the adverse impacts of development. Wetlands are especially important areas for nutrient uptake by vegetation and for pollutants and other materials to be filtered and settled out before reaching local streams and rivers. While Alexandria has for most of its history treated wetlands as areas to be reclaimed (lower King Street from Lee Street east was once open water) there still remains significant wetland areas within the City.

The City has delineated and mapped its wetlands in accordance with the federal "Manual for Delineating Jurisdictional Wetlands." Most of the City's wetlands are located adjacent to the Potomac River, Four Mile Run, Cameron Run, and other major tributaries. City wetlands are generally classified as palustrine (tidal wetlands along the Potomac River and the lower Four Mile Run and Cameron Run), riverine (adjacent to free flowing tributaries), and lacustrine (open water, usually a pond or lake). Map II.1 shows the City's delineated wetlands.

Wetlands must be identified for individual development sites according to all applicable federal, State, and City wetlands regulations, including the City's Chesapeake Bay Preservation Ordinance. Wetlands are protected under section 404 of the federal Clean Water Act, which is administered by the U.S. Army Corps of Engineers.

While remaining healthy wetlands should generally remain undisturbed, it is possible to use wetlands as open space and for education purposes. An example of this is Huntley Meadows Park in Fairfax County. A specially engineered raised boardwalk through part of the park allows residents to see first hand how a wetland functions, resulting in a greater appreciation for these resources. Smaller-scale, local examples include wetland areas of Dora Kelly Nature Park, the Wildlife Sanctuary in Four Mile Run Park and the privately owned Winkler Botanical Preserve.

In addition, opportunities to restore degraded wetlands or to create new wetlands should continue to be explored. If wetlands are impacted by development or projects, to the extent possible the impact or loss should be mitigated through wetland creation or enhancement, improvements to riparian areas, or through the use of creative Best Management Practices to treat stormwater.

Groundwater

During its earlier years, the City relied heavily on groundwater for its supply of potable water - as is evidenced by the multitude of wells, most of which are now closed, that dot the older parts of the City. While no longer relying on groundwater for drinking water, groundwater protection is still important. Many streams are fed by groundwater, especially during periods of extended dryness. Groundwater is extremely dynamic, and groundwater contamination can spread rapidly. Once contamination has occurred, mitigation is very expensive and time consuming.

The groundwater aquifer of the City consists primarily of the unconsolidated sediments of the Coastal Plain. Baring the introduction of manmade contaminants, natural groundwater characteristics are fairly stable over time because they are largely dictated by the chemical and structural characteristics of the local aquifer. An analysis of the City's aquifer performed in 1985 indicates that groundwater in Alexandria is generally suitable for a variety of domestic, commercial, and industrial purposes.

Well yield potential in the City ranges from low in the northwestern portions of the City (less than 100 gal./min.), to moderate in the central portions of the City (100 to 200 gal./min.), to moderately high in the eastern portions of the City (200 to 800 gal./min.). Groundwater quality is generally excellent in the eastern portions of the City and good in the remainder of the City. The exception is an area of naturally occurring poor groundwater quality located in portions of the City west of I-395. Groundwater in this area may locally contain high concentrations of sodium chloride, iron, and total dissolved solids. Groundwater within the City is generally soft (hardness < 60 mg/l) and total dissolved solids (ranging from 91 mg/l to 174 mg/l) are far below the recommended maximum of 500 mg/l.

Limiting factors associated with groundwater that should be considered during the development and redevelopment processes include the presence of two groundwater recharge areas. While most Coastal Plain areas serve as local recharge areas, regional recharge areas have been identified as the area near Cameron Station north to I-395 and west to the City limits and the larger North Ridge area (including Beverly Hills and Park Fairfax). These areas are depicted in Figure V.1. Since these areas are already developed, the most appropriate means of protecting these recharge areas is to minimize impervious surface area during the redevelopment process to allow for infiltration of rainwater into the soil.

Large areas of eastern and central Alexandria have also been identified by the U.S. Geological Survey as having high potential for groundwater contamination due to a combination of natural and man-made factors. The remaining portions of the City are considered to have moderate potential for groundwater contamination. Protecting these areas from contamination requires the prevention or mitigation of common sources of groundwater pollution. While these sources of pollution are discussed in further detail in Section III, they may include leaking underground storage tanks, failed septic fields, leaking sanitary sewer lines, and abandoned industrial/landfill sites. Of these sources, the VADEQ has sited underground storage tanks as the greatest threat to groundwater supplies.

Potable Water Supply and Water Supply Protection

Alexandria relies on surface water withdrawals outside its boundaries for its municipal water supply. While there are currently a small number of operational wells within the City that are maintained for industrial purposes, all existing development is connected to the municipal water system. All new development is required to be connected to the municipal water system.

The City's supplier/distributor of potable water is the Virginia-American Water Company (VAWC). Virginia-American, in turn, purchases treated water from the Fairfax County Water Authority (FCWA). The FCWA maintains two water intakes, one on the Potomac River in Loudoun County (Corbalis intake) and one on the Occoquan Reservoir. The VAWC is set up to conduct chlorine and ammonia treatment as needed, and from time-to-time, may post-treat water from the FCWA if chlorine levels drop appreciably.

Alexandria's water supply is among the best protected in the Commonwealth. By cooperative agreement under the Occoquan Basin Nonpoint Pollution Management Program (established in 1978), the entire Occoquan Reservoir watershed has been subject to Best Management Practices to control nonpoint source pollution since the early 1980s. Alexandria is an active participant in this program through the Virginia-American Water Company and City staff. In addition, large areas of the Occoquan Reservoir watershed have been downzoned to protect the watershed from large areas of impervious surfaces. Water quality monitoring for a wide array of parameters is conducted on a routine basis by the Occoquan Watershed Monitoring Lab to ensure that the water remains safe as a drinking water supply.

The City's potable water supply is more than adequate to meet future needs. However, the City also recognizes the importance of water conservation as a way to protect the environment and to protect the region's natural resources in the long term. The City currently uses 15.38 million gallons per day (MGD). The Virginia-American Water Company has conducted an extensive analysis of anticipated water needs for the City within a 15-year projection. The VAWC projects that by the year 2010, average use will rise to 17 MGD and peak use will rise to 25.4 MGD. The approximate allotment from the Fairfax County Water Authority is 25 MGD, which is sufficient to meet expected growth demands.

The VAWC's program for maintaining its drinking water lines includes regular analysis of water, comprehensive plan studies, and annual system-wide flushing. The VAWC does not have a formal water conservation program, and instead, relies on public service announcements calling for reduced usage (i.e., watering lawns or washing cars) during exceedingly long dry spells. According to the VAWC, the public is usually responsive, and there has been no need for additional conservation efforts.

THE LAND AND LAND FORMS

II.3

Land is the foundation of most human activities. Local geology and soil features, and the resultant topography, more than any other features will often dictate what type of activity is appropriate or feasible for a particular site. For instance, improper development on sensitive soils or steep slopes can easily result in soil erosion which contributes to downstream nutrient problems and creates long-term difficulties for structures built upon these soils.

The following is a description of the topography, geology, and soils of the City and the potential constraints that these features represent. Map II.2 illustrates the extent of these constraints, including marine clay soils and steep slopes.

Topography

The City of Alexandria has an exceptionally diverse topography. Elevations range from almost sea level along the Potomac River shoreline and lower Four Mile Run and Cameron Run to 280 feet above sea level near Alexandria Hospital. Physiographically, the area of Alexandria can be described as a plain that has been dissected by numerous streams which have cut narrow, shallow valleys into the landscape. While most of the terrain is gently rolling, numerous tributaries have cut steeper valleys. In general, Four Mile Run and Cameron Run form two well defined valleys which frame the City while a series of hills divide the spine. Most of the steepest slopes in the City are associated with the smaller tributaries that have cut through the central plain. In general, the further west into the City, the higher and more rolling the terrain.

Slopes greater than 15% require particular consideration during the development or redevelopment processes due to the risk of erosion and slump. While most of the City is considered rolling terrain, there are significant areas where slopes are greater than 15%, particularly adjacent to dissecting stream channels.

Geology and Soils

While topography is a manifestation of underlying characteristics, the characteristics of the geology and soil also have an important impact on development.

The City is situated almost entirely within the Coastal Plain physiographic province of Virginia. The Coastal Plain consists of intermixed layers of sands, pebbles, mud, and silts that were deposited as a result of erosion from areas to the west when water levels were higher than they are now. Geologically speaking, the City is fairly simple. The dominant geologic feature is the Potomac Formation, deposited in a deltaic-type environment (much like the present day Mississippi Delta) during the Cretaceous Period (144 to 65 million years ago, or mya). The Potomac Formation occupies the western two-thirds of the City and is characterized by light-gray to pinkish and greenish-gray sand and pebbles. The remaining eastern third of the City is underlain by the Shirley Formation, which was deposited much later, during the middle Pleistocene Epoch (1.8 to 0.1 mya). The Shirley formation consists of light to dark gray, bluish gray, and brown sand, gravel, silt, clay, and peat and is the result of surficial deposits of the Potomac River and relict baymouth barriers and bay-floor plains. A small outcrop of the Bacons Castle Formation (deposited during the upper Pliocene Epoch, 5.8 to 1.8 mya) is found in the Beverly Hills area and is characterized by gray, yellowish-orange, and reddish brown sand, gravel, silt and clay. Centered around T.C. Williams H.S. and the Northern Virginia Community College are two outcrops of the Yorktown Formation which consists of bluish-gray, and brownish yellow fine to course grained sands with interbedded sandy and silty blue-gray clays. These beds are commonly very shelly. The oldest rocks in the City, which are part of the Occoquan Formation, occur near where Holmes Run enters the City. The Occoquan Formation, which consists of light gray, medium to coarse grained granites, is actually part of the Piedmont Province and was formed over 560 million years ago.

Differences in erosion rates between underlying rock formations have shaped modern drainage patterns and the contours of the landscape.

Soils serve as the lifeblood of the ecology as well as the most basic of building material for roadways, embankments, and building foundations. As a result, they are very important to take into consideration during the development process. Not surprisingly, because Alexandria has long been an urban rather than an agricultural center, the last soil survey was conducted in 1915 by the U.S. Department of Agriculture, Bureau of Soils. Because most soils in the City have been developed and redeveloped since that time, therefore permanently altering soil structure, the study, entitled *Soil Survey of Fairfax and Alexandria Counties, Virginia* is useful only to demonstrate general soil characteristics. For most development purposes, an onsite soil test should be conducted to determine exact soil properties.

TABLE II.2
Alexandria's Soils and Suitability for Development

Soil Name	General Occurrence	Topography	Drainage	Development Limitations
Ochlocknee	Occupies a few strips along small streams. In Alexandria, associated with Cameron Run, Holmes Run, and Backlick Run.	Relatively flat, typically 4 to 6 feet above normal flood stage.	Poorly drained and subject to occasional overflows and wetness.	Unsuitable for most development.
Huntington Loam	Occupies narrow strips along the Potomac. In Alexandria, limited to Jones Point and Daingerfield Island.	Relatively flat. Typically 4 to 10 feet above sea level.	Good drainage. Subject to periodic wetness from flooding.	Unsuitable for most, but not all, development.
Keyport Silt Loam [Matapeake/Mattapex]	Occurs on the low, smooth terraces along the Potomac River. All of Old Town and much of the surrounding area is underlain by this soil.	Gently undulating to level, and in places slight depressions occur. A few of the slopes are rather steep, and the margins are often distinguished by bluffs. Typically 20 to 30 feet above sea level.	Drainage is fairly well established except for small depressions.	Few unfavorable features, some areas may experience high water table, therefore limiting the use of basements. Clay material of the substratum is well suited for the manufacture of brick and tile.
Susquehanna Loam	Occurs upland of Ochlocknee and occupies large areas of Alexandria including Eisenhower Valley and the Duke Street corridor.	Gently rolling to undulating, although there are occasional steep slopes.	Fair.	Few unfavorable features.
Sassafras Gravely Loam	Occurs in narrow strips along the slopes of the plateau like areas of Leonardtown loam and silt loam, in West Alexandria is the largest area.	Steep to gently sloping	Drainage is good.	Few unfavorable features. Some areas of marine clay and steep slopes. Contains large areas of heavy, waxy clay.
Leonardtown Silt Loam [Beltsville Silt Loam]	Occupies the highest areas of the City from Shuters Hill extending northwest.	Surface is gently undulating to nearly level, with occasional depressions.	Surface drainage is generally poor. Internal drainage is also slow in areas, causing periodic wetness after rain.	Few unfavorable features.

Because the underlaying parent materials are relatively flat, soils in Alexandria generally change in accordance with elevation and relation to streams and rivers. The soils of Alexandria include, from lowest to highest elevation: Ochlockonee (Oi), Huntington Loam (H), Keyport Silt Loam (K); Susquehanna Loam (So); Sassafrass Gravelly Loam (Sf); and Leonardtown Silt Loam (L) and Loam (Lo).

Figure II.8 provides a map of major soil groups while Table II.2 provides a brief description of each of these soils. The only soils of genuine concern in the City are those which contain marine clay (or shrink-swell) soils, those which are located on steep slopes, and those which experience prolonged wetness or inundation due to flooding or low depth to groundwater. While areas experiencing flooding or prolonged wetness should not be developed, areas with marine clays may be built upon (and to a large extent, have been built upon) if proper precautions are taken. Risks associated with marine clay include excessive shrinking and swelling, which can crack building foundations, and land slides and slumping during periods of prolonged wetness. Marine clay layers that are only a few inches to a few feet thick may be overcome if building footings are extended to the next layer. Thicker occurrences have been documented and may require additional precautions or preclude some types of development.

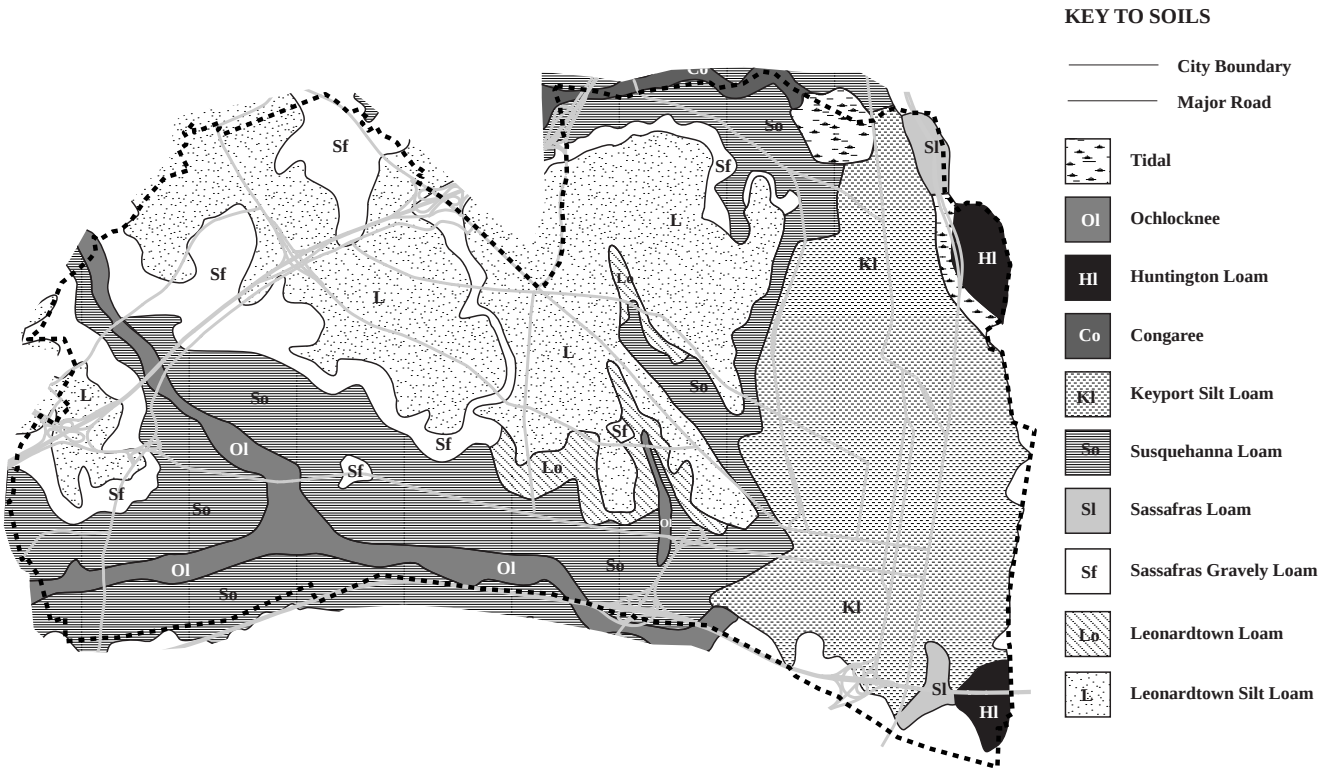
It is difficult to predict marine clay presence by soil type since most soils in Alexandria have areas of marine clay. However, Susquehanna loam, Sassafrass gravelly loam, and Keyport are particularly prone to areas of marine clay. Map II.2 shows areas which are underlain by marine clays.

WILDLIFE AND NATURAL HABITATS

II.4

A healthy and diverse habitat is the end goal of an effective watershed management plan. A periodic inventory of Alexandria's existing natural habitats is useful, if not necessary, to bench mark the success of water quality management efforts

FIGURE II.8
Generalized Alexandria Soils Map



Source: Digitized by NVPDC from U.S. Department of Agriculture. Soil Survey of Fairfax and Alexandria Counties, Virginia. 1915.

over time. Much of Alexandria's natural landscape has experienced radical change since the first European settlers took root in the area during the early 18th century. Even before Alexandria began to experience its most recent surge in growth after World War II, areas outside of Alexandria's urban core were subject to clearing for agricultural and industrial purposes. During the Civil War, the area between Alexandria and Fairfax was described as "totally denuded by trees" as forests were cut down to build defenses and to provide fuel for heat.

Despite the odds, regrowth of vegetation, scattered parcels of open and undeveloped land, utility rights-of-ways, and stream valleys, in combination with suitable forms of development, have resulted in a limited, yet remarkably resilient wildlife habitat known to ecologists as "typical suburban." While many species have taken up residence in lawn trees or wooded back yards, the bulk of the City's wildlife habitat can be found along natural areas of the Potomac River and the City's stream valley parks.

Wildlife habitat in Alexandria is diverse, but can be roughly divided into tidal and nontidal. Nontidal habitats include free flowing streams and forests of Alexandria's uplands while tidal habitats include the estuarine portions of Four Mile Run and Hunting Creek as well as their associated wetlands and marshes. Differences in vegetation that occupies these two areas should be considered when restoring or reforesting habitat areas.

Records maintained by the Virginia Department of Conservation and Recreation, Division of Natural Heritage (DNH), reveal the extent to which many species still call Alexandria's stream valleys home. In the Cameron Run watershed are thirty-seven different species of fish, seventeen types of frogs, salamanders, and toads, five species of turtle, and over twenty species and subspecies of snake (including the poisonous copperhead). In the Four Mile Run watershed are over fifty-seven different species of fish, eighteen types of frogs, salamanders, and toads, five species of turtle, and over twenty-two species and subspecies of snake. Over 110 birds have been confirmed as breeding or courting within both watersheds. "Edge" species of mammals such as squirrel, beaver, and muskrat also inhabit the area.

The DNH also maintains for planning purposes records on the general location and occurrence of endangered species of wildlife or vegetation in the Northern Virginia region. According to the DNH, only one State threatened species, the Wood Turtle (clemmys insculpta) is officially listed as likely located within the City. The wood turtle is terrestrial during warm weather and hibernates, typically under mud, sand, or submerged roots, during cool weather. Wood Turtles can be found near clear brooks and streams in deciduous woodlands, although they have also been found in woodland bogs and marshy fields. Contributing factors to the species' decline in Alexandria include degraded habitats as a result of loss of wetlands, fragmentation of habitats, urbanization, and vehicular traffic.

Other significant natural heritage resources exist on the Potomac shoreline to the immediate south of the City and within the larger Cameron Run and Four Mile Run watersheds. Some threatened and endangered species in the watersheds surrounding Alexandria include the Bald Eagle (federally endangered), Cerulean Warbler (federal species of concern), Bridle Shiner (State species of concern), Brown Creeper (State species of concern), Great Egret (State species of concern), Little Blue Heron (State species of concern), and Common Moorhen (State species of concern).

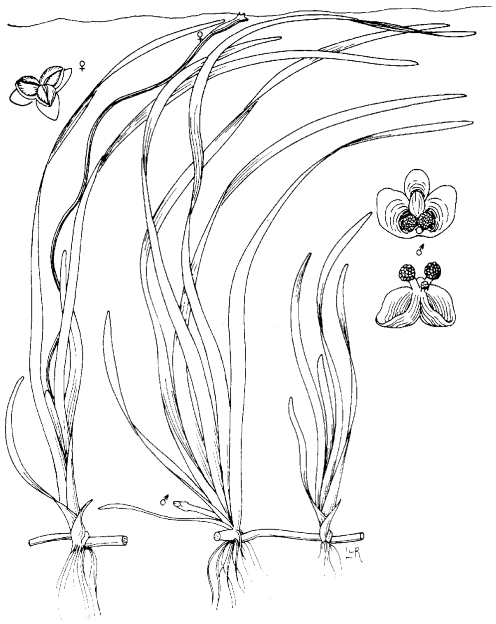
Vegetation that is native to the City includes associations of poplar, elm, sycamore, beech, red and water oak, and ironwood near major streams, white, red, and water oak, pin oak, pine, hickory, poplar, sweetgum on side slopes, and pine, chestnut, white, red, and black oak, and hickory throughout the higher elevations on terraces. Throughout the years, many species have been introduced to Alexandria's landscape, some of which have assimilated well and others which have become nuisances.

FIGURE II.9
Alexandria's Own Threatened Species – The Wood Turtle

While most people recognize the benefits of vegetation on the land to help prevent erosion, reduce surface temperatures, provide habitat for wildlife, and beautify the landscape, few recognize the equal importance of water-based vegetation to the environment. Submerged aquatic vegetation, or SAV, serves as a primary food source and habitat for aquatic life in the Potomac River and the Chesapeake Bay, filters pollutants from the water, and stores nutrients until the winter when there is a relative scarcity. The presence of healthy SAV beds is considered a valuable, although not definitive, overall indicator of water quality conditions.

The dramatic Bay-wide decline of all SAV species in the late 1960s and early 1970s was correlated with increasing nutrient and sediment inputs from development of the surrounding watershed. This situation galvanized diverse groups into formulating a policy and implementation plan that would ensure the future of SAV in the Chesapeake Bay and eventually lead to the establishment of the interstate Chesapeake Bay Program.

FIGURE II.10
Wild Celery – A Common Species of Aquatic Vegetation on Alexandria's Waterfront



SAV coverage in the Potomac River off of Alexandria's waterfront is monitored by the Metropolitan Washington Council of Governments, the U.S. Geological Survey, and the Virginia Institute of Marine Science.

SAV cover in the upper Potomac River (from Quantico to Great Falls) rose appreciably from 1984 to 1991, but then slowly declined until 1995. 1996 witnessed a slight increase in SAV coverage, which was measured at 1,834 acres. Overall, the upper Potomac has only achieved 25% of its SAV coverage goal. However, the trends in the upper Potomac are mirrored across the Chesapeake Bay and recent declines can be attributed to, in part, by higher than normal river flows.

A 1996 survey of Alexandria's waterfront placed major SAV beds at mouth of Four Mile Run and areas north and south of Daingerfield Island. Although not within Alexandria's corporate limits, there is a large SAV bed under the Woodrow Wilson Bridge that extends up the middle of the Potomac River to just north of Oronoco Bay Park. SAV has at times been plentiful at the mouth of Hunting Creek (a 1990 survey revealed a large, but sparse, 295 acre SAV bed); however, there was no SAV reported in 1996. Surveys of Jones Point, Founders Park, the Torpedo Factory, and Oronoco Bay Park reveal only sparse amounts of SAV, most of which was the often troublesome Hydrilla (*Hydrilla verticillata*).

Hydrilla, which was accidentally introduced to this area in the early 1980s, is the dominant SAV in the upper Potomac. Hydrilla is considered a nuisance because of its rapid growth and tendency to form thick mats that are impenetrable by watercraft. The Metropolitan Washington Council of Governments maintains a hydrilla harvesting program; however, Alexandria has not found recent problems to be persistent enough to participate in this program.

Other common SAV found in the upper Potomac River near Alexandria include wild celery (*Vallisneria americana*), Eurasian watermilfoil (*Myriophyllum spicatum*), and coontail (*Ceratophyllum demersum*). Wild celery is a preferred food for many waterfowl including mallards, canvasbacks, and goldeneyes. Wild celery is also excellent habitat for fish and invertebrates. Eurasian watermilfoil, which is also an introduced species, provides cover and spawning habitat for fish and invertebrates and is consumed by waterfowl. However, this species has a tendency to crowd out other species. Coontail provides good habitat for fish and small invertebrates and its foliage is consumed by waterfowl and other animals.

Habitat Fragmentation

One of the greatest challenges facing wildlife in Alexandria is not so much a lack of space, but habitat fragmentation. Roads and urban land uses fragment and isolate wildlife habitats, cutting wildlife off from food sources and traditional migrating patterns.

Stream crossings at roadways are often the greatest physical hinderance to the successful establishment and propagation of aquatic and terrestrial life. Most crossings consist of no more than an earthen embankment with a corrugated metal pipe allowing water to flow through. This configuration forms a physical barrier to the travel of fish and animal wildlife up and down a stream corridor. According to the Virginia Department of Game and Inland Fisheries, this type of habitat dissection is among the greatest threats to wildlife as they are cut off from outside populations and food sources.

Recognizing the need for these stream crossings to facilitate transportation in the City, crossings can be constructed to better allow for the free travel of aquatic and terrestrial species. The Virginia Department of Transportation is currently exploring opportunities for improving stream valley corridors for wildlife. Recently, VDOT has modified culverts to include a raised concrete area for small animals to traverse the culvert. In addition, a fence is added to channel the animals into the culvert and away from the road. This option, according to VDOT, is practical, has merit from a wildlife standpoint, and can be easily incorporated. The City should identify major stream crossings and identify areas that, when reconstructed in the future, may incorporate these or other practices.

PUBLIC AND PRIVATE ACCESS TO WATERFRONT AREAS

II.5

The City recognizes the value and importance of its waterfront and ensuring that there is adequate public and private access to these areas has long been a high priority of the City. Similarly, the City recognizes that waterfront access and use can affect water quality and that sensitive shoreline features may constrain where access is appropriate. The City's public access and design implementation plan for the waterfront is outlined in its 1983 "Alexandria Waterfront Design Plan." The Design Plan provides a generalized plan of development for the City's waterfront and includes policy guidance for improved pedestrian access to the waterfront and the design of public and private spaces. The Design Plan is purposely open-ended in nature in order to allow flexibility and creatively during waterfront development. While specific elements of the Design Plan have been updated as development has taken place or as design components have been implemented, the general schema of the plan remains the same.

One of the most important actions called for in the Design Plan is a continuous Waterfront Promenade along the Potomac River's edge to provide pedestrians with a variety of experiences reflecting the current and historical diversity of the City's Potomac shoreline. The Design Plan includes an "Urban Waterfront Core" comprising the Torpedo Factory and the waterfront plaza at the end of King Street that serves as a link to the King Street urban experience. To the north and south, the pedestrian passes through the green open space of parks, formally designed by less urban than the Waterfront Core, interspersed with commercial development. Daingerfield Island to the north and Jones Point to the south form natural "book ends" for the Alexandria waterfront.

Since 1983, significant progress has been made towards the establishment of the Waterfront Promenade. Much of this progress has resulted from joint planning efforts between the City and the National Park Service. These joint planning efforts were sparked in 1973 when the U.S. Department of Justice asserted that the United States had claim to all waterfront land east of the 1791 high water mark. At that time, the U.S. National Park Service was concerned with protecting Alexandria's Potomac shoreline as a gateway to the Nation's Capitol, as part of the National Historic Landmark (the Old and Historic Alexandria District), and as a segment of the Potomac Heritage Trail proposed by the Secretary of Interior in 1965. The Justice Department and the City

reached a settlement on the issue in October, 1981.

The settlement deeded to the City five parks of almost 12 acres and set land use criteria for these areas. Perhaps even more significantly, the Justice Department approved major settlements for several private property owners including the Marina Towers, PEPCO, Bryant, Andrew, Norton, Robinson Terminal, Kiriakow, and VEPCO properties. Each of these settlements included provisions for public open space and pedestrian access where none would have been required otherwise. The Justice Department's settlement with Marina Towers and PEPCO allowed the construction of a 3,000 foot-long bike trail linking Daingerfield Island with the rest of the Alexandria waterfront.

In 1996, the City's Waterfront Committee established a subcommittee composed of members from the Waterfront Committee and the Parks and Recreation Commission to evaluate current uses and needs along Alexandria's waterfront – including additional access and the need for boating and docking facilities. Using the 1983 plan as a reference, the goals of the subcommittee are to update the Plan to reflect development which has occurred since 1983 and to make specific recommendations for the few remaining undeveloped waterfront parcels. As part of its deliberations, the subcommittee investigates the presence of sensitive natural resources, the disturbance of which may exacerbate erosion or cause harm to wildlife or water quality. Constraints to access and the development of boating facilities identified in the 1983 plan include areas that experience heavy siltation and/or debris collection, unstable edge conditions, and the fact that much of the waterfront is within the 100 year floodplain (which dictates certain aspects of building design).

Major projects that have been identified by the City as having the potential to increase Potomac River access and/or to improve water quality include the following.

- Ford's Landing – This development project is nearing completion and includes new bulkheads and enhanced public access.
- Woodrow Wilson Bridge Replacement – The proposed replacement of the Woodrow Wilson Bridge includes funding for the restoration of the historic bulkheads and for increased community access to the waterfront. The project also includes the natural and artificial stabilization of shoreline areas from the Jones Point lighthouse to the historic bulkhead.
- Old Town Yacht Basin (now part of Windmill Hill Park) – Planning for the rehabilitation of this area is underway. Title to fastlands is being transferred to Alexandria from the District of Columbia. Old pilings will be removed and the dilapidated bulkhead will be restored and extended to link pedestrian access to the north and the south.

The City is also developing, or is planning to develop, reuse plans for the Old Dominion Boat Club and waterfront properties located along The Strand as well as the Robinson Terminal North property. Table II.3 contains information on existing and potential public and private boat docking areas and marinas as well as public and private access points on Alexandria's waterfront. Figure II.11 provides a map of the information presented in Table II.3.

Additional policies regarding future land uses on Alexandria's waterfront are contained in the Old Town Small Area Plan. These include provisions for open space and public access, encouragement of water-oriented activities and mixed-use development, and architectural design.

TABLE II.3
Existing and Potential Marina and Boat Docking Areas and Public and Private Waterfront Access Points

FACILITY NAME	LOCATION	Public/ Private	# Slips	Pumpout	Boat Ramp	Picnic	Restrooms	NOTES	Map Reference #
Existing Marina and Boat Docking Facilities									
Harborside at Old Town	400 S. Union Street	PR						Private docking facility (condominium slips) with public access to river.	1
Strand Properties	200 Strand	PR						Includes Alexandria Yacht Company and Potomac Party Cruises, Inc.	2
Old Dominion Boat Club	Strand and King Street	PR	65		X			Private facility and boat launch. Some public uses allowed by agreement (i.e., police boats, etc.).	3
Torpedo Factory Docks	1 Cameron Street	PU	28			X	X		4
Alexandria City Marina	End of Cameron Street	PU	36	X			X	Public monthly/transient docking facilities.	5
Alexandria Rowing Facility	End of Madison Street	PU						For use by Alexandria Public Schools. Limited use of boat launch (canoes, kayaks, etc.).	6
Washington Sailing Marina	Daingerfield Island	PU	685	X	X	X	X	Public docking facility and public boat launch.	7
Potential Marina and Boat Docking Facilities									
Ford's Landing (Old Ford Plant)	700 S. Union Street	PR						Proposed private docking facility (condominium slips) in addition to existing public access.	8
Additional Public and Private Waterfront Access Points									
Old Town Yacht Basin*	500 S. Union Street	PU							9
Jones Point Park	1 South Lee Street	PU				X		Upgrades scheduled as part of Wilson Bridge reconstruction.	10
Windmill Hill Park**	600 S. Union Street	PU	P			X		Athletic courts and fields.	11
Roberdeau Park	End of Wolfe Street	PU				X			12
Point Lumley Park	End of Duke Street	PU				X			13
Waterfront Park	1 Prince Street	PU				X			14
King Street	End of King Street	PU							15
Founders Park	300 N. Union Street	PU				X			16
Oronoco Bay Park	N. Lee Street from Madison to Pendleton	PU				X		Special activities by permit.	17
West's Point	End of Oronoco Street	PU				X			18

*Part of Windmill Hill Park.
**Consolidated Old Town Yacht Basin Site/Pomander Walk Park/Wilkes Street and Gibbon Street Ends.

FIGURE II.11
Map of Existing and Potential Marina and Boat Docking Areas and Public and Private Waterfront Access Points

Pollution and Other Sources of Water Quality Decline

III

Understanding what and where pollution is generated is the first step towards preventing and controlling pollution before it damages water quality and the environment. This section outlines existing and potential sources of pollution faced by the City.

Pollution problems faced by Alexandria are far more complicated than most Northern Virginia localities. Alexandria is one of the few localities in the region that has experienced a degree of heavy industrialization. As a result, long forgotten contaminated industrial sites are often rediscovered as they are converted to residential and commercial uses. Since its founding, industry in Alexandria has included glass making, iron works, ship building, railroad yards, lumber, power (coal and gas works), petroleum storage (including the entire block bounded by Lee, Gibbon, Wolfe, and Union streets), shoes (Potomac Shoe Company, 1880), munitions production, and other ventures including mills (flour and cotton) and breweries. In addition, Alexandria has some of the largest concentrations of commercial activity, which are associated with large areas of impervious surfaces, in Virginia.

Alexandria is also among the few remaining urban localities in which portions of the citizenry are served by a combined sewer system (CSS). In most localities, stormwater and wastewater are carried separately – with the stormwater being channeled to a local stream and the wastewater being piped to a local wastewater treatment facility. A CSS combines both stormwater and wastewater in one system for treatment. The disadvantage to this arrangement, which only affects portions of Old Town, is that during very wet weather, the system becomes overwhelmed and

Storm Drains Often Serve as a Direct Conduit for Pollution to Enter Local Streams

CONTENTS

- **Point Source Pollution**
- **Nonpoint Source Pollution**
- **Erosion of the Land**
- **Air Pollution**
- **Waterfront and Dock Activities**
- **Areas of Special Concern**

minimally treated wastewater is discharged directly to the Potomac River. The advantage to the system, however, is that during normal periods of rain, polluted runoff is treated to a high degree, resulting in significant water quality benefits. Alexandria has developed a program to minimize the negative aspects of the CSS while maximizing its positive aspects.

Some level of pollution resulting from human activities is almost inevitable. However, it is within the power of human beings to manage pollution in a way that can be assimilated into the environment. Unmanaged pollution can result in surface and groundwater contamination, poor air quality, aesthetic degradation of the landscape, and the destruction of important ecological habitats, all of which detract from the City's basic character.

The most cost-effective approach to the problem of pollution is to prevent it at its source. A number of tools are available to the City to aid in pollution prevention including public education and awareness programs, water conservation programs, lawn care programs, and recycling efforts, to name a few. The cost to the City once environmental damage has been done includes not only short term clean-up costs, but long term costs including decreased property values and loss of tax base.

The City also recognizes that the best way to protect local and regional water quality is through the use of an integrated watershed management plan. An integrated watershed management plan involves strategic use of structural and nonstructural BMPs to address all sources and types of pollutants in order to optimize water quality and resource protection.

The following section describes the City's existing sources of pollution as well as potential sources of pollution that the City may face. This inventory, along with various tools afforded by the State and the federal governments, should be used by the City to minimize and eliminate the impacts of pollution on the environment of Alexandria.

The Role of Redevelopment in Water Quality Improvement

With only a few exceptions, Alexandria is considered to be "built-out." That is, additional growth in the City will largely come as a result of the redevelopment of previously developed land. While redevelopment has its own challenges, it is also the City's best opportunity to systematically improve local and regional water quality. Most residential, commercial, and industrial development within the City built before the early 1990s did not take water quality protection into consideration. Sources of pollution range from nonpoint source pollution from uncontrolled residential and commercial parking areas to long forgotten contaminated industrial sites. Sources of pollution are detailed in Section III.1 through Section III.6. As these areas are redeveloped, it is the City's conviction that the opportunity should be used to improve water quality and to restore damaged habitats, including stream-side buffer areas. The fact that almost all developed land is directly connected to natural streams via the stormdrain system makes this a City-wide issue. Because Alexandria is situated along the banks of the Potomac River, redevelopment along the City's major streams and waterfronts deserves special consideration.

There are several ways to improve water quality during redevelopment including, but not limited to, the installation of on-site stormwater quality management practices, the reclamation and revegetation of unnecessary impervious surfaces, the use of pervious materials in place of impervious materials, the removal of substandard above and underground storage tanks, and the clean-up of industrial contamination. The City's primary regulatory tool for improving water quality during redevelopment is its Chesapeake Bay Preservation Ordinance, discussed in detail in Section IV.2. However, the City also provides incentives for developers to voluntarily improve water quality from surrounding development as part of its Targets of Opportunity Urban Retrofit Program. This program, discussed in Section IV.3, has resulted in over 1,000 acres of urban development served by regional stormwater management facilities.

To help promote potential redevelopment areas in the City, the Alexandria Economic Development Program and the Alexandria Department of Planning and Community Development have published an "Alexandria Build to Suit Opportunities" map (Map III.1). Areas identified on the map represent major targeted redevelopment (and a few new development) opportunities in the City. The primary intent of this map is to promote economic development in the City by highlighting major redevelopment opportunities and by providing specific information on site potential, including size, zoning, and maximum build-out. However, because the City has adopted a jurisdiction-wide Resource Management Area under its Chesapeake Bay Preservation Ordinance, and because many of these areas are former industrial sites located near the City's major waterways, a significant secondary benefit to the redevelopment of these areas is water quality improvement.

Information on specific redevelopment opportunities is also found in the City's Small Area Plans. In order to link these Small Area Plans to the goals and policies contained within this Supplement, the City has established as a goal to include in each SAP an analysis of opportunities to protect and improve water quality during redevelopment.

POINT SOURCE POLLUTION

III.1

Point sources of pollution are those that can be tracked to a specific point or outfall. While pollution from point sources is often in large volume, point sources are the easiest to manage because they are confined and often there is a single person responsible for clean-up. Point sources of pollution within the City include National Pollutant Discharge Elimination System (NPDES) discharge points, combined sewer overflow (CSO) points, underground and above ground storage tanks, and septic systems. In each case, there is a specific person/organization responsible for maintenance, and, with the exception of above ground storage tanks, all are monitored by the City, State, and/or federal government.

NPDES Discharges

Industries and municipalities, under the Clean Water Act (CWA), National Pollutant Discharge Elimination System (NPDES), are required to report wastewater discharges to State waters, and to the maximum extent practicable, mitigate the effects of the pollution on the environment. The Virginia Department of Environmental Quality, (VADEQ) administers Virginia's program and is charged with ensuring that environmental regulations are enforced. VADEQ issues VPDES permits (Virginia Pollution Discharge Elimination System) to control point source discharges within the state.

According to State records, there are five VPDES permits in Alexandria. However, since Cameron Station has closed, only four of these are presently active. There are eight additional VPDES permits operating within the Four Mile Run and Cameron Run watersheds in neighboring Arlington and Fairfax counties. VPDES permits in Alexandria include the Alexandria Sanitation Authority's discharge to Cameron Run (located immediately upstream from Route I), the City's Combined Sewer System Permit (discussed in greater detail in the following section), Potomac Electric and Power Company's holding tanks on the Potomac River, and Virginia Concrete's discharge to Hooffs Run. Discharges from these sources are strictly controlled and currently meet all State and federal environmental standards.

Wastewater Treatment

Wastewater from the City is treated by the Alexandria Sanitation Authority (Authority). The Authority is a special purpose body created by the City and chartered by the State. The Authority owns and operates an advanced wastewater treatment facility located on South Payne Street. In addition to the City's wastewater, the Authority treats wastewater from a part of Fairfax County. Wastewater from Fairfax County is treated under an agreement established when the Authority was originally created. The treatment plant has an annual average design capacity of 54 million gallons per day (mgd) and 60 percent of that capacity (32.4 mgd) is allocated to the County with the

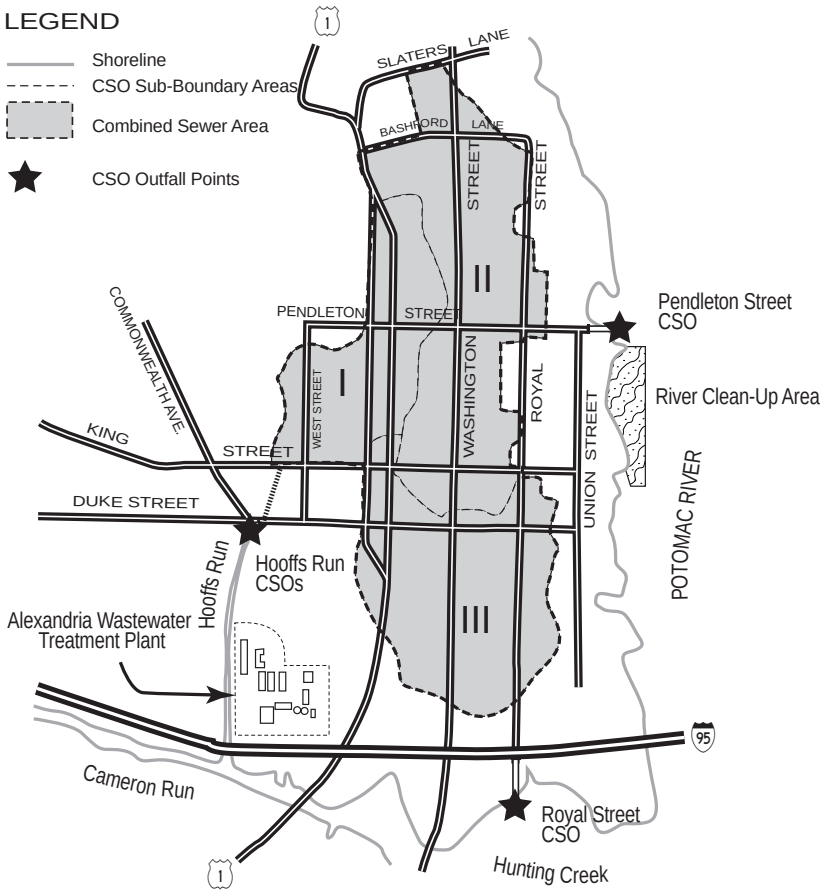
remaining 40 percent (21.5 mgd) allocated to the City.

The Authority also owns and operates the principal intercepting services pumping stations in the City. One sewer, the Holmes Run Trunk Sewer is used jointly by the City and the County.

Treated effluent from the Authority's plant is regulated by a VPDES permit and is discharged to Hunting Creek, an embayment of the Potomac River. Currently the plant is undergoing a significant upgrade to meet new Virginia water quality standards for Potomac River embayments. Additionally, the plant is being equipped to remove nitrogen under Virginia's strategy for meeting Chesapeake Bay goals for nutrient control.

The treatment plant discharge is the largest of the City's point sources. When the upgrade is completed, the treatment process will comprise primary treatment biological nutrient removal (BNR) and advanced treatment. The treatment effluent is disinfected to kill any leftover bacteria prior to discharge to Hunting Creek. Disinfection is accomplished by ultraviolet radiation and effluent testing is performed daily to assure that the treatment process is performing to VPDES permit limits. Bio-solids removed from the process are treated to EPA and State standards for pathogen removal and the resulting product is land applied on farms in Virginia where it makes an excellent fertilizer.

FIGURE III.1
Location of Alexandria's Combined Sanitary Sewer System



In 1987, the Clean Water Act was expanded to include not only point source pollution coming from industrial and wastewater treatment sources, but also to include discharges from storm sewer systems that drain urban areas. These requirements are discussed further under Section III.2.

Combined Sewer System

Most urban areas are served by separate stormwater and wastewater conveyance systems. The primary purpose of this separation is to ensure that the local wastewater treatment facility is not overwhelmed by large volumes of water during periods of heavy or prolonged rainfall. However, many older urban areas, including Alexandria, have areas where wastewater and

stormwater are combined in one system. This is known as a Combined Sewer System (CSS). In a combined sewer system, dry weather flow is conveyed to treatment plants. However, during rainfall events the capacity of the conveyance and treatment facilities can be exceeded because of the large stormwater flow. When this occurs, the excess flow is discharged directly to a waterbody. The excess flow, a mixture of stormwater and wastewater, is called a combined sewer overflow (CSO).

The City's CSO includes areas east of the railroad corridor (mostly Old Town) and comprises about 560 acres. CSO outfalls (emergency discharge points) are located at the foot of Pendleton Street and Royal Street and under Duke Street at Hooffs Run (see Figure 111.1).

The City initially proceeded to control overflows from the combined sewer systems by separating the sewers. This control approach became increasingly expensive and the last separation project was completed in 1990. Estimates to complete separation exceed $90 million. The City began studies in the early 1990's to seek alternative approaches to control combined sewer overflows and in 1995 submitted a long term control plan (LTCP) to the Virginia Department of Environmental Quality. The VADEQ issued the City a VPDES Permit for the CSS in 1995 and based on the City's studies, the permit calls for the City to operate and maintain the CSS according to the USEPA's technology-based best management practices. The practices are known as the Nine Minimum Controls and from part of EPA's national CSO control policy. However, the VPDES permit also requires the City to continue to monitor the CSS and report annually. The monitoring includes metering overflows and sampling the overflows and receiving waters. Additionally, the City may be required to improve solids and floatables control in the discharges from the four CSO outfalls. Based on the results of the monitoring and reporting, VADEQ will determine the need and extent of additional control As new end of pipe technology becomes available for solids and floatables control, VADEQ is expected to impose and require that the existing controls be upgraded.

The nine minimum controls which the City has implemented for controlling CSO discharges comprise the following:

- Proper operation and regular maintenance programs for the sewer system and the combined sewer overflows.
- Maximum use of the collection system for storage.
- Review and modification of the pretreatment program to assure CSO impacts are minimized.
- Maximization of flow to the POTW for treatment.
- Prohibition of CSOs during dry weather.
- Control of solid and floatable materials in CSOs.
- Pollution prevention programs that focus on contaminant reduction activities.
- Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts.
- Monitoring and reporting to effectively characterize CSO impacts and the efficacy of CSO controls.

The City's program uses a host of measures to meet these requirements. The CSS is administered by the City's Department of Transportation and Environmental Services.

Leaking Sanitary Sewer Lines

In many urban areas, and particularly in well established areas such as Alexandria, a significant potential source of pollution is leaking sanitary sewer lines. Leaking sanitary sewer lines may cause elevated fecal coliform bacteria levels in local streams as well as number of other health and odor problems.

The City's sanitary sewer system dates back to the early 1930s. The materials first used were terra cotta and cement. Today, the City's system is composed of PVC, concrete, and ductile iron pipe. The system contains over 200 miles of sanitary sewer, 137 miles of storm sewer, and 6.2 miles of combined sewer. The system is maintained by the City's Department of Transportation and Environmental Services, Maintenance

and Solid Waste Divisions, with the use of sewer jet cleaners, catch-basin cleaners, and rodders.

The sewer system is monitored by the use of TV equipment to determine when repair or replacement of sanitary sewer is required. Today, the City installs liners through the existing sewer pipe rather than open cut and install new sewer mains. Actual replacement of sewer main is seldom required.

The City of Alexandria contracts out stormsewer and sanitary sewer cleaning. The contract consists of one combination batch-basin cleaner and one sewer jet. The City's fleet consists of one rodder truck, two sewer jet trucks, and one TV van. The rodder truck and sewer jets are used on a daily basis for cleaning the sanitary sewers while the combination catch-basin cleaner and sewer jet is primarily used for cleaning storm sewers and storm sewer structures. The City currently has the sewer system set up in a preventative maintenance program and surveys the entire system on daily, weekly, and monthly programs.

The separate sanitary sewer systems in the Four Mile Run, Commonwealth and Holmes Run Sewer Service areas are experiencing excessive flows during wet weather conditions. The excessive flows are caused by stormwater entering the sanitary sewers. The stormwater reduces the capacity of the sewers to carry sewage and results in sanitary sewer oveflows (SSOs) and basement backups. The overflows are prohibited by Federal law and new rules being promulgated by USEPA will bring basement backups under the law.

The City has initiated field surveys and inspection to determine the degree and source of the stormwater infiltration and inflow (I&I). Based on the results of the field work and engineering studies, a remediation program will be developed. Remediation includes such measures are relining old sewers, jointly sealing, rerouting connections and manhole repairs.

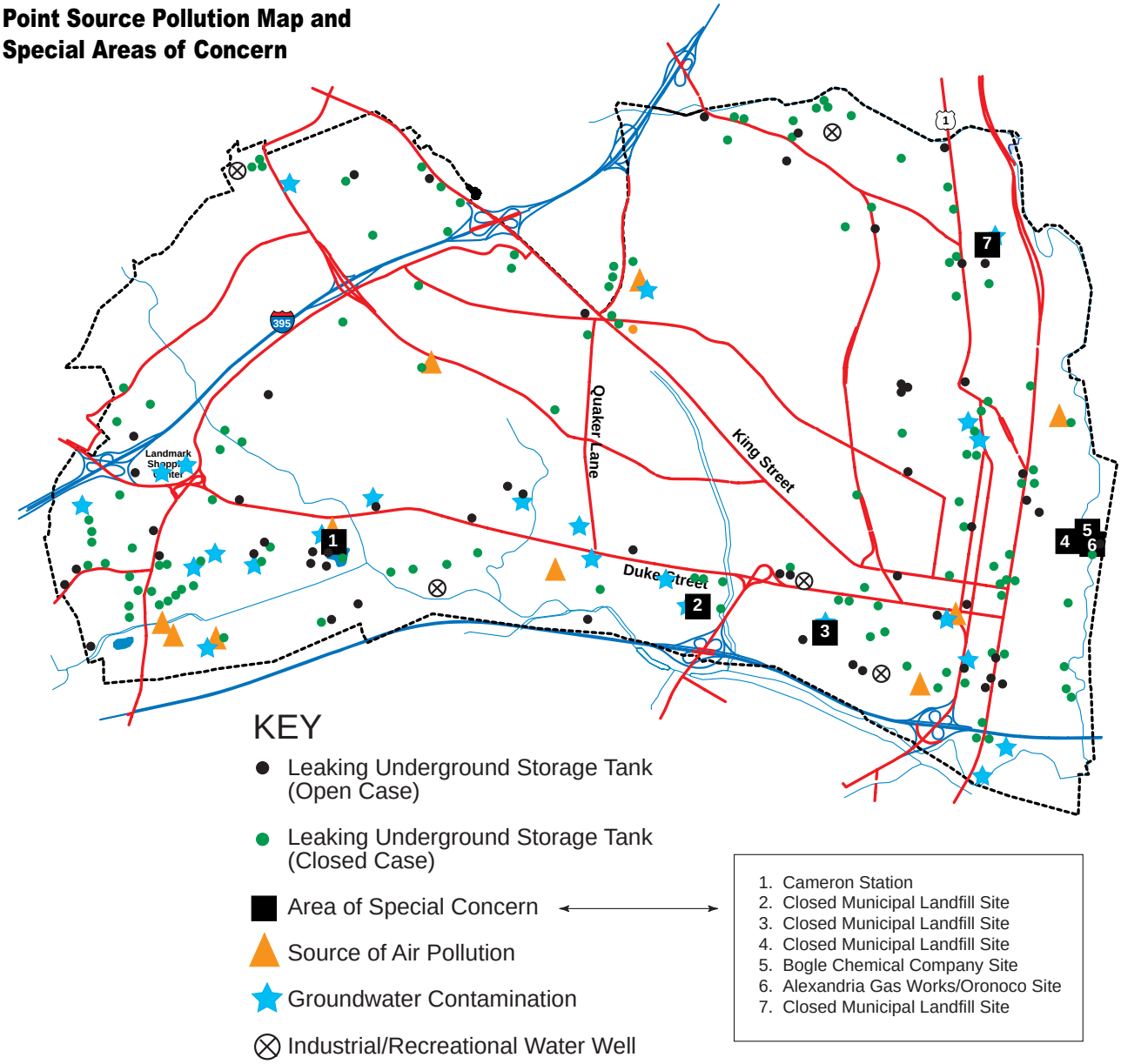
Above Ground and Underground Storage Tanks

Above ground and underground storage tanks can contribute to water quality problems as a result of spillage, leakage, and in the case of above ground storage tanks, toppling. The Virginia Department of Environmental Quality is responsible for permitting and tracking both above ground and underground storage tanks. The installation and removal of above ground and underground tanks is regulated by local building and fire codes and requires that permits also be issued by Alexandria Code Enforcement.

Above ground storage tanks are regulated by the federal government through the Clean Water Act. 40 CFR Part 112 requires owners of single tanks with a capacity greater than 660 gallons or multiple tanks with an aggregate capacity greater than 1,320 galls to register and formulate a "Spill Prevention Control and Countermeasure Plan." Virginia has adopted requirements for tank owners to present an "Oil Discharge Contingency Plan" (ODCP) before a storage tank may be registered. The purpose of an ODCP is to have a plan of action in the event of a catastrophic release of oil from the largest tank. The plan must also identify what the impact of such a discharge will be on the environmental receptors and what will be done to mitigate those impacts in the event of a spill.

However, individual tanks with a capacity of less than 660 gallons or multiple tanks with an aggregate capacity of less than 1,320 gallons are not currently regulated by the State or the federal government. Most home fuel oil tanks are typically only 200 to 660 gallons and are not regulated. According to 1990 federal census data 4,580 households (8.6%) rely on fuel oil or kerosene for their primary source of heat. This is slightly more than Fairfax County (7.8%) and less than Arlington County (12.6%). While the percentage is relatively low, the aggregate of tanks may pose a serious threat if small problems are not taken seriously. It is therefore the responsibility of the individual owner to ensure that leaks and spills do not occur. According to the VADEQ, approximately 90 percent of releases from individual tanks are a result of overfill or the tipping

FIGURE III.2
Point Source Pollution Map and Special Areas of Concern



over of the tank. Overfill can occur if the driver/filler is not paying attention or if the capacity of the tank is not known. To reduce the risk of an accidental spill, the homeowner or fuel oil company should inspect a tank before filling to ensure that it is sturdy and does not exhibit signs of corrosion. An owner should also have the capacity of the tank clearly marked on the tank and specifically indicate the filling cap location.

Underground storage facilities pose a much greater risk to water resources in Alexandria, in part because spillage is often not detected until long after it begins. According to the VADEQ, underground storage tanks are the primary source of groundwater contamination in Virginia. In addition, many streams are fed by groundwater and therefore a spill may also adversely impact surface water quality. In addition to gasoline, underground tanks are used for storing benzene, kerosene, diesel fuel, used motor oil, and fuel oil.

As of December 12, 1997, there were 301 registered underground storage tanks within the City limits, some of which have been removed. All regulated underground tanks still in use were required to be upgraded or replaced by December 1998. Residential underground tanks were exempted by the state.
There were also 219 recorded leaking underground storage tanks (LUSTs) since 1981. Of those, 164 have been mitigated and closed, while there are currently 55 open cases. Other open cases exist immediately outside the City in neighboring Fairfax and Arlington counties. Because groundwater movement follows topography and geology rather than jurisdictional boundaries, the issue of leaking underground storage tanks is a regional one requiring regional communication and coordination.

The City's Division of Environmental Quality (T&ES Department) and the Fire Department's Code Enforcement Bureau and Fire Marshall work with the VADEQ-Water Division (WD) to prevent leakage and to ensure that any leakage into the environment is remedied. Figure III.2 provides information on the location of underground storage tanks in the City and the location of underground storage tank spills currently under remediation.

In many instances, the presence of contaminated groundwater as a result of leaking underground storage tanks does not present itself until vacant commercial and industrial properties are redeveloped. Sometimes these contaminants surface near residential areas in the storm sewer system or in natural streams, causing public health and safety problems and producing undesirable odors. These issues are addressed by the City's Department of Transportation and Environmental Services and Fire Department.

Septic Systems

Improperly maintained septic systems can fail, therefore posing a local health and water quality risk. With the exception of a handful of properties, all households, commercial establishments, and industrial sites are connected to the City's sanitary sewer system. All new development and significant redevelopment is required by Code to hook into the City's system.

The locations of remaining septic systems within the City are not well documented, and many are within areas of the City that have been annexed. As a result, the existence of septic systems generally is only found out when a homeowner or business reports a problem to the City Health Department. The Health Department works with these individuals to either correct the problem, or in most instances, to hook into the City system.

NONPOINT SOURCE POLLUTION

III.2

Nonpoint source pollution is pollution which originates from small, diverse sources. Nonpoint source pollution may originate as atmospheric deposition, leaking automobiles, pet waste, and misapplied lawn fertilizers and pesticides as well as a host of other sources. When these pollutants get swept up into stormwater runoff, their exact source is lost and they become nonpoint source pollution.

Most commonly, nonpoint source pollution is a result of pollutants accumulating on impervious surfaces which are subsequently flushed into local waterways by stormwater runoff. However, direct dumping of pollution into stormdrains or creeks is also a very common, and documented, way for nonpoint source pollution to enter the water. On a per acre basis, urban land use in general, including residential development, produces higher annual nonpoint source pollutant loadings of nutrients, heavy metals, and oxygen depleting substances than do rural agricultural uses. Oil contamination, sediments, pesticides, metals, and other toxic substances found in urban runoff are often found at sufficient levels to kill and destroy aquatic life. Among the most destructive, yet inconspicuous pollutants are excess nutrients. Excess nutrients can result in a phenomenon known as eutrophication. Eutrophication results in algal blooms, which block sunlight and deplete dissolved oxygen content during decay. Eutrophication also destroys the recreational

use of the water resource and results in strong odor and undesirable taste.

As noted previously, the greater the level of impervious surface area, the greater the risk that water resources will be impacted by nonpoint source pollution. Because Alexandria is heavily developed and largely built-out, the City has an impervious surface area of approximately 41%, which is among the highest in Virginia. As a result, the City recognizes that the control of nonpoint source pollution must be a key component of water quality management efforts.

Land uses in the City are associated with different degrees of impervious surface area. This means that each land use will also affect water quality differently. This is discussed later in this section. Table III.1 shows impervious surface area by land use type and percent impervious cover. These figures were tabulated from City zoning records in 1991 to provide baseline imperviousness data for use in complying with the provisions of the City's Chesapeake Bay Preservation Ordinance. The percent imperviousness is extrapolated for each land use category from information provided in the Chesapeake Bay Local Assistance Manual.

TABLE III.1
City Land Uses and Associated Imperviousness

Land Use	Acreage	Percent Impervious
Residential	3,752.4	25% (low density) 37.5% (medium) 52.5% (high)
Commercial	727.0	70%
Industrial	1,143.8	70%
Institutional	867.8	70% (Metro) 10% (waterfront) Varied (other)
Parks	537.5	<10% (variable)
Vacant	466.9	0%

These land uses are drained to the City's natural streams via culverts and stormdrains. As of 1992, the City identified over 302 known municipal stormwater outfalls in Alexandria. Of these, 123 major outfalls were identified. A 1992 survey of each of these major outfalls provides a clear picture of the City's nonpoint source pollution problem. At numerous sites, field observations revealed cloudy water, colored water (gray, brown, and yellow), various stains on concrete (brown

TABLE III.2
Common Urban Pollutants and Their Sources

POLLUTANTS	SOURCES
Nutrients	■ Soil particles from erosion.
	■ Overapplication or misapplication of fertilizers.
	■ Fecal matter from pets.
	■ Vegetative matter (e.g., dumping clippings into streams).
	■ Power plant and automobile emissions.
Sediments	■ Construction activities.
	■ Urban streambank erosion.
	■ Poor landscape management techniques (including building on poor soils and steep slopes).
Bacteria	■ Antiquated sanitary sewer lines.
	■ Fecal matter from domestic animals.
	■ Malfunctioning septic systems.
Heavy Metals	■ Soil particles from erosion.
	■ Wear of vehicle parts including brake, clutch, and tires.
	■ Leakage of vehicular fluids.
	■ Atmospheric deposition of automobile emissions.
Toxic Chemicals	■ Overapplication or misapplication of home/lawn pesticides.
	■ Dumping household/industrial chemicals including paints.
	■ Abandoned industrial sites.
	■ Illegal dumping or flushing of automotive fluids such as antifreeze.
Petroleum Hydrocarbons	■ Leakage from automobile crank cases on impervious surfaces.
	■ Illegal dumping of used oil by home auto maintenance.
	■ Underground and above ground storage tank malfunction.
Litter	■ Dumping and littering.
Chlorides	■ Roadway deicing chemicals.
Thermal	■ Heated impervious surfaces.
	■ Lack of stream-side tree canopy cover.

and black), and the presence of many floatables including oily sheen, soapy subs, garbage, paper cups, etc. Odors ranged from none to musty, sewage, disinfectant, asphaltic, rotten egg, and petroleum.

While it is true that nonpoint source pollution *potential* increases as impervious surface area increases, one must not conclude from the above table that residential areas are not significant sources of nonpoint source pollution. Indeed, industrial areas tend to be the most stringently managed areas while residential areas are often the worse offenders because of the vast number of amateurs performing car repairs or applying fertilizers and pesticides.

In general, nonpoint source pollution from urban areas can be reduced by minimizing the amount of impervious surface area as a result of development, utilizing open space and preserving indigenous vegetation, restoring denuded vegetative stream buffers, preventing pollution through public education, and by employing the use of structural stormwater management facilities which operate by trapping runoff and detaining it until unwanted pollutants settle out.

However, different land uses and activities are associated with different types of pollution. In order to facilitate the efficient and effective targeting of nonpoint source management efforts, the City should be viewed in terms of four management areas.

High Density Commercial and Mixed Use Corridors – Impervious surface area within commercial and mixed use corridors generally constitutes upwards of 70% of the landscape. Nonpoint source pollution in these areas is best managed through the use of structural BMPs, measures that reduce impervious surface coverage, and measures that reduce the introduction of litter and other pollutants such as automobile leakage onto impervious surfaces. While public education may be effective in some instances, consumer transiency makes these efforts difficult to sustain. Rather, the City should work with businesses to identify cost-effective ways to control pollution while benefiting the business owner. One example is parking lot sweeping, which reduces pollution and results in a more aesthetic landscape.

Industrial Uses – Industrial uses are characterized by highly imperious surface areas and may be subject to the use or storage of heavy equipment or chemicals. Management of nonpoint source pollution in these areas includes the use of structural BMPs, measures to reduce impervious surface coverage, and measures to ensure that industrial effluent or waste is minimized and disposed of properly. The Virginia Office of Pollution Prevention is the lead agency that provides guidance to industries on waste minimization.

Public and Private Institutional and Recreational Uses – This category includes public uses such as schools, libraries, and playing fields, and private uses such as golf courses and marinas that may have extensive grounds that require maintenance. In addition to structural BMPs and minimizing impervious surfaces, techniques such as managed fertilizer applications, water-wise landscape management, and the wise use of chemical pesticides (known as Integrated Pest Management) can be used to minimize the introduction of pollution into the environment. The City should take every opportunity to serve as a positive example to City residents.

Residential Uses – In addition to structural BMPs and minimizing impervious surface areas during development, public education plays an important role in the control of residentially generated nonpoint source pollution. Yards and automobiles are major sources of nonpoint source pollution. Nonpoint source pollution enters the environment through dumping in stormdrains, runoff from the yard, or erosion of bare spots. Public education is most effective in these areas; however, differences between high density (condominium and apartment) and medium/low density residential uses should be considered. For instance, those living in high density areas will not benefit from public education on lawn care techniques. However, directing this information at the management company or landscape management contractor may have significant benefits.

A number of resources are available that provide guidance on the prevention of nonpoint source pollution through sensitive site design and through public education. The City should promote nonpoint source pollution reduction through its own public education programs and by encouraging the use of sensitive site design during the plan review process.

Wildlife, Non-Migratory Waterfowl, and Pet Waste

Non-migratory waterfowl, wildlife, and pet waste take on particular significance as sources of nonpoint pollution because they are primary sources of fecal coliform bacteria (see Figure II.5). Fecal coliform contamination is the single reason why most Alexandria streams are unsafe for recreation. While some sources of fecal coliform pollution are preventable through public education (pet waste, for instance), other sources will require significantly more effort and planning in order to achieve significant reductions.

EROSION OF THE LAND

III.3

Soil erosion is one of the most pressing pollution problems faced by the City. Suspended sediments choke and muddy local waterways making them uninhabitable by desirable species of aquatic life. In addition, nutrients and other pollutants attach themselves to sediment particles and contribute to eutrophic conditions in the Potomac River and the Chesapeake Bay.

Soil erosion is most often the result of streambank erosion, improperly managed land uses, and land development. The City has identified several areas which are experiencing erosion problems (see Figure II.6). The City's Erosion and Sediment Control Ordinance addresses soil erosion problems during the site development process.

AIR POLLUTION

III.4

What goes up must come down. What is air pollution today will be water pollution tomorrow. The federal Chesapeake Bay Program estimates that 27% of nitrogen reaching the Bay originates from air pollution. The difficulty in managing air pollution is that 60% comes from sources beyond the Bay region, mostly from the industrial states to the west. The federal Clean Air Act, last amended in 1990, is the primary regulation governing air quality. The Washington metropolitan area is in noncompliance for ozone standards and therefore has had to implement a host of new emissions standards to ensure that automobiles and stationary sources (such as power plants or other large boilers) are operating within their design limits. Because air quality is a regional issue, the Washington area's program is coordinated by the Metropolitan Washington Air Quality Committee (MWAQC), of which Alexandria is a member. Alexandria maintains an air quality monitoring station at the Health Department on North St. Asaph Street.

Air pollution point sources in the City include the Alexandria-Arlington Waste-To-Energy Facility (located at 5301 Eisenhower Avenue), the Potomac River Station (coal fired power plant operated by Potomac Electric and Power Company), and the Newton Asphalt plant. These facilities meet or exceed all U.S. EPA emission standards. Other significant air pollution sources include mobile sources, such as automobiles and trucks and area sources, such as lawn and garden equipment,

WATERFRONT AND DOCK ACTIVITIES

III.5

Because of their proximity to the water, waterfront and dock activities have a very high potential to degrade water quality if they are not properly managed. Dock related pollution may result from improper use of cleaning agents on boats, improper disposal of toilet waste, improper disposal

of hazardous materials (including gasoline and used oil), leakage from engines, improper disposal of fish wastes (gutting or cleaning), improper use of mollusk repellant copper paints, etc. Waterfront activities may also contribute litter and trash to the water.

Waterfront activities within the City are varied but include docking and pedestrian activities along the Old Town waterfront and at the Washington Sailing Marina, commercial activities along Waterfront Plaza, and recreational activities at Founders Park and Oronoco Bay Park. The City's public access and design implementation plan for the waterfront is outlined in its 1982 "Alexandria Waterfront Design Plan."

Management of marinas and docking facilities for water quality purposes is a joint responsibility of the Virginia Department of Environmental Quality, the Virginia Marine Resources Commission, and the U.S. Army Corps of Engineers. The Virginia Marine Resources Commission (VMRC) has established Criteria for the Siting of Marinas or Community Facilities for Boat Mooring (VR 450-01-0047) which outlines proper best management practices to ensure a marina's compatibility with the environment.

While all spills or accidental discharges to State waters must be reported to the VADEQ for remediation, most marinas, including Alexandria's, are not required to monitor water quality as part of their ongoing operations. Although the VADEQ has the authority to require such monitoring, according to the VADEQ, permits are very rarely required. Components of a marina permit, if required, would include:

- Periodic water quality monitoring for oil and grease, pH, temperature, organic carbon, and dissolved oxygen.
- Bottom sediment monitoring including arsenic, cadmium, chromium, copper, mercury, nickel, zinc, lead, selenium, organic carbon, and tributylin.
- An action plan to identify and remediate the source of any violation of water quality standards.
- The housing of proper spill containment equipment onsite.
- The posting of signs in conspicuous locations which state that discharge of any material, including sewerage, directly into State waters is strictly prohibited. The signs should also indicate where the nearest pump out station is located.

AREAS OF SPECIAL CONCERN

III.6

Other areas of special concern are due to past industrial activities and contamination and include Potomac Yard, Cameron Station, the Alexandria Gas Works/Oronoco Site, and the Bogle Chemical Company Site. The locations of these sites are found in Figure III.2. While Potomac Yard and Cameron Station are for the most part closed issues, the Alexandria Gas Works/Oronoco Site and the Bogle Chemical Company Site are ongoing issues. In addition to these areas, special areas of concern include closed landfill sites and other industrially contaminated sites.

Potomac Yard

The Potomac Yard is a recently decommissioned, 342-acre railyard straddling the City of Alexandria and Arlington County. Because of its redevelopment potential (approximately 25% of the site has already been redeveloped for commercial uses) the site has been the subject of intense investigations to determine the nature of chemical contamination and risk to human health and the environment. This caution has been warranted for both human health and environmental reasons since some proposed redevelopment will be residential in nature and because stormwater runoff from the site enters lower Four Mile Run and the Potomac River. Stormwater enters Four Mile Run and the Potomac River via open ditches and underground culverts. The Potomac River discharge from the Yard is mixed with piped stormwater from the City at its eastern boundary.

In 1997, the owners of the property, Commonwealth Atlantic Land Inc., submitted an "Off-Site

Ecological Assessment for the Potomac Yard Site" to the U.S. EPA to determine the extent that contamination has and will continue to impact on the ecology of Four Mile Run and the Potomac River. The report, while acknowledging the extent of contamination that has existed at the site, found that "Sediments in the Four Mile Run and the Potomac River contain chemicals at levels that are unlikely to be toxic to the species that are currently resident in the Potomac River and its tributaries in the vicinity of the site." Further, the report found that "Regional data and data collected near the site indicate that any contribution from the site is indistinguishable from regional background concentrations."

The principal chemical sources at the Potomac Yard site are believed to be the coal cinder-based ballast that was used as fill across most of the site, and past chemical releases that occurred during rail yard operations. Cinder-based ballast is a potential source of metals and possibly a trace source of certain organic compounds that are natural constituents of coal. Past surface releases as a result of tank car spills or leaks, and day-to-day yard activities (e.g. fueling locomotives, oil changes) are additional sources of organic and inorganic compounds. Extensive sampling conducted on the site prior to remedial activity verified that metals (in particular arsenic) and polyaromatic hydrocarbons (PAHs) were the principal chemicals of concern at the site. These chemicals were relatively widespread across the site and were present at elevated concentrations in certain localized areas. These chemicals also were detected in Four Mile Run and Potomac River drainages at concentrations excess of ecotoxicological screening guidance values. It was this finding that resulted in the publication of the off-site ecological risk assessment. Chemicals and metals detected in drainage ditches on the site (at varying levels) include aluminum, arsenic, chromium, copper, iron, lead, mercury, chlordane, endosulphan sulfate, endrin, endrin ketone, heptachlor, heptachlor epoxide, PCB (1260), anthracene, benzanthracene, dibenzanthracene, and flourene. The report found that at least some of the pesticides found in these drainage ditches was not from the site, but from stormwater runoff coming from neighboring communities and commercial areas. This indicates a need to better educate local residents on the proper use of pesticides in the home landscape. The drainage ditches were cleaned up and contaminated materials were disposed of off-site.

The U.S. EPA considers the status of Potomac Yard to be closed. Ongoing oversight of the contaminated sites, such as Potomac Yard is the responsibility of the Department of Transportation and Environmental Services, Division of Environmental Quality which is also responsible for ensuring that stormwater runoff from the site is treated to meet requirements of the City's Chesapeake Bay Preservation Ordinance.

Cameron Station

Cameron Station is a former 164-acre military installation, which is bordered on the south and east by Backlick Run and Holmes Run. While some contamination of the site resulted from day-to-day operations (Cameron Station was not used for weapons manufacture or heavy industrial activity), the contamination has been remediated and redevelopment of the site is underway.

Most contamination on the site, which was vacated in 1995, resulted from day-to-day activities and were identified in six of twelve operational units. Sources of contamination included the use, storage, and past spill of PCB transformers, a small landfill, pesticide use and storage areas, sludge and grease traps associated with the site's sewer system, petroleum contamination of acid pits, and leaking underground storage tanks. Remedial actions taken include excavation and disposal of soils in an off-site hazardous materials landfill, soil capping and monitoring of the onsite landfill, groundwater collection followed by air-stripping and in-situ bioremediation, and excavation of contaminated soils and off-site disposal.

This site is currently undergoing redevelopment which will include commercial and residential uses.

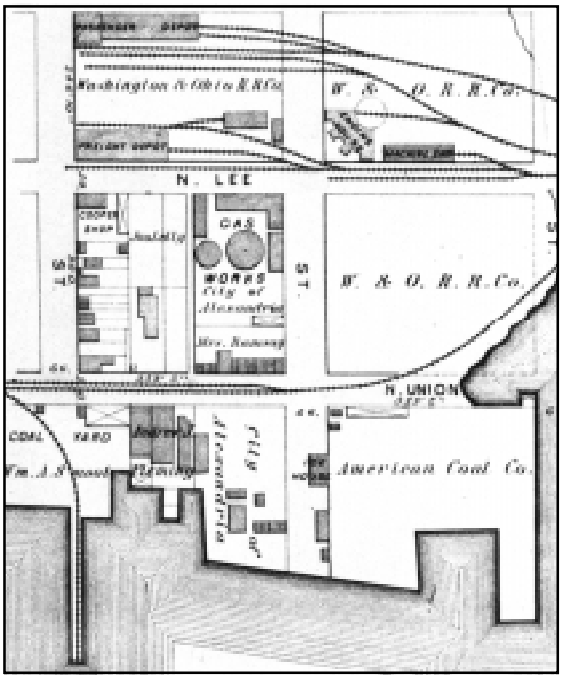
Alexandria Gas Works/Oronoco Site

A long-standing and difficult to address industrial contamination problem faced by the City is the presence of a creosote discharge and contamination at the foot of Oronoco Street at Founders Park. Creosote is a mixture of over 200 chemical compounds and is obtained by fractional distillation of coal tar, which is a by-product of high temperature coking of bituminous coal. Creosote has been commercially used as a wood preservative on railroad ties, utility poles, lumber and timber, and posts and pilings for docks and foundations. In September, 1975, an oil-like discharge was first observed at the storm sewer outfall at the east end of Oronoco Street. Upon investigation, the City found that a strong solvent had dissolved the asphalt paving in the sewer pipeline between Lee Street and Union Street, and that the oil-like material was leaching into the pipeline. The pipeline, which was installed in 1974, was repaired with gunite, which prevented further infiltration of the material. However, in the fall of 1975, a discharge was again observed, this time from beneath the pipe. In November, 1975, the end wall and outfall were made water tight, and again, the discharge stopped. In September 1976, the problem reoccurred and the City constructed a grout curtain perpendicular to the pipeline and pumped grout around the pile and into the gravel bed. However, the discharge resumed in March, 1977. At this time, a pollution boom was installed at the outfall in order to capture creosote discharges. Creosote was then skimmed off the water on a daily basis.

In June, 1977, exploratory holes were drilled in the area of the former Alexandria Gas Works, at Lee Street and Oronoco Street and the soil was found to be saturated with a coal-tar derivative. As was discovered, the source of the discharge was the creosote saturated soils of the old gas works, which operated on that site for 60 or 70 years prior to being closed in the 1930s. At the time, it was determined that there was nothing in the City Code that would allow the City to compel the property owner to correct the source and that action (legal or otherwise) would be required on the part of State or federal agencies. By this time, much of the riverbank near the outfall became saturated with the creosote material and the soil became discolored.

Since that time, the City has attempted a number of other remedial actions and has worked with the Department of Environmental Quality/Waste Management and the U.S. EPA on how to best address the problem. A preliminary assessment of the site was conducted by the Department of Environmental Quality/Waste Management in 1992 which included extensive sampling of local

FIGURE III.3
Alexandria's Industrial Heritage – 1877 Map Showing City Gas Works and Other Industrial Uses



soils, water, and sediments. The report found that creosote continues to seep from shoreline soils around the stormwater outfall. In addition, hydrologic pressure from nearby docking and undocking activities results in the resuspension of contaminated bottom sediments. In summary, the 1992 report found that "… contamination from the coal gasification plant by-products has been observed seeping into the Potomac River via Oronoco Outfall. The major pathways of concern include the surface water migration pathway, soil exposure pathway, and the air migration pathway. Migration of contaminants through the surface

water pathway has been observed. Contamination of the actual soil/sediment has also been observed. A noticeable odor of creosote is present at the site. As the site is located on a large river where recreational fishing and sports are likely to occur, further source and surface water/sediment sampling is warranted."

In an effort to address the contamination at the Oronoco Outfall, the City applied and was accepted in the spring of 2000 into the Virginia Voluntary Remediation Program administered by the Virginia Department of Environmental Quality. The City's objective is to determine the location and source of the contamination, how to prevent further discharges to the Potomac River and to protect the public and the local environment.

Bogle Chemical Company Site

The R.H. Bogle Company site, although not an immediate threat to water quality, represents an ongoing and long term management obligation. The R.H. Bogle Company was an herbicide formulating facility located on approximately 5 acres in the area roughly bounded by Oronoco Street, Union Street, Pendleton Street, and Lee Street. The facility handled several types of herbicides between the years 1924 and 1976. Arsenic trioxide and sodium arsenite were handled during the period of 1924 to 1969. 2,4,5-T and Silvex were handled from the 1950s to the 1970s. These herbicides arrived by rail, were stored in tanks on-site, formulated, and were loaded into railroad spray cars for application to railroad right-of-ways.

In 1974, the Virginia State Water Control Board (VSWCB) discovered high concentrations of arsenic in the soil at the Bogle site. Soil samples taken by the VSWCB showed arsenic concentrations ranging from 25 parts per million (ppm) up to 29,000 ppm over the 5 acre area. Arsenic concentrations in some of the sediment samples from Oronoco Bay, adjacent to the site, were greater than 1,000 ppm. Samples taken during the VSWCB investigation were analyzed for only a few pesticides other than arsenic; however, several herbicides including 2,4,5-T and Silvex were present in some samples. Site contamination, according to the VSWCB, may have been caused by spillage or by an alleged daily practice of washing pesticide residues from railroad cars and draining the rinsate onto the ground.

Arsenic is a naturally occurring element that exists in many forms and is commonly used as a pesticide. Arsenic is widely distributed in low concentrations in water as a result of natural sources and as a result of contamination through its manufacture and application. In large amounts, Arsenic can cause skin cancer, and if inhaled, lung cancer. It can also affect the gastrointestinal tract and liver. Acute poisoning (ala murder-mystery style) causes death through heart failure.

In 1975, the Bogle Company was issued an order to develop a short and long term solution to contaminated surface water runoff problems. The Bogle Company hired a contractor to perform a groundwater study of the area and to develop a plan to control the potential harmful effects of the contamination. The contractor concluded that:

- The majority of the arsenic contamination occurs within 15 feet of the surface.
- Artesian pressure in a deeper aquifer will preclude downward movement of contaminants.
- The only significant movement of arsenic from the site is due to soil erosion and surface water runoff.
- Most of the arsenic remaining in the soil has probably become insoluble due to chemical reactions with soil constituents.
- The problem could be alleviated by developing the property using strict guidelines for architectural design and disturbance of soil during construction.

These recommendations were accepted by both City and State authorities and in 1978 the site was sold to Development Resources, Inc. The most heavily contaminated areas of the site was capped with 18 inches of iron-rich clay to prevent arsenic migration. The clay cap extends from the south curb of Pendleton Street to the north curb

of Oronoco Street. In the east-west direction, the cap extends from the western side of the Robinson Terminal facility to the Dalton's Warf Townhouses. Dalton's Warf was constructed in 1980 and an office building and parking lot were constructed 1981. Restrictions placed on development of the site (and incorporated into property titles) included no basements or swimming pools, strict dust control during construction, and placement of polyethylene around buried utility lines.

The site is currently subject to a Consent Agreement from the U.S. EPA arising out of the investigation of arsenic contamination. The Consent Agreement states that "no construction of ground disturbance shall be undertaken on the property prior to receipt by the Company (Development Resources, Inc.) or its successor interest of a written authorization from the City Manager… and … shall be conducted in accordance with any lawful procedures established by the City Manager…" The Consent Agreement also regulates the disposal of waste materials resulting from construction or ground disturbance on the property.

In November, 1989, staff from the Virginia Department of Waste Management's Pre-remedial Superfund Program conducted a Screening Site Inspection (SSI) to determine whether the site had the potential for off-site releases of compounds regulated by the Comprehensive Response Compensation and Liability Act (CERCLA). The results of inorganic analyses of samples indicated significant levels (greater than or equal to five times background levels) primarily in the areas near the intersection of Pendleton Street and Union Street. No significant levels of inorganics were detected in any of the surface water samples. As a result, it was determined that current management practices were sufficient to protect health and the environment.

Municipal Land Fill Sites

Closed municipal landfill sites are areas of potential concern only if improperly disturbed. Four abandoned municipal landfill sites are located within the City boundaries. One site, located on the west side of Hooffs Run near the Beltway, has been partially remediated as a result of the Carlyle development project. Other landfills are located on the east side of Hooffs Run at the Alexandria Wastewater Treatment Facility, in North Old Town (centered around Montgomery Street, First Street, Pitt Street, and Royal Street) and the northeast corner of the City bordered by Commonwealth Avenue, Four Mile Run and Route 1. These sites are protected by a 1,000-foot potentially hazardous area management area and are monitored by the Department of Transportation and Environmental Services.

Other Hazardous Contamination Sites

As Alexandria continues to develop and redevelop, it is likely that vestiges of Alexandria's industrial past will continue to be discovered. The Department of Transportation and Environmental Services has the primary responsibility for addressing problem sites through the development process.

Water Quality Management Today

IV

Alexandria has adopted a sophisticated array of ordinances, regulations, and programs to address constraints to development, the preservation and management of water and natural resources, and the prevention and control of pollution. The City has worked diligently with State and federal agencies to bring its environmental and water quality protection programs into compliance with State and federal laws and regulations and has worked to implement its own programs to address locally identified environmental and water quality needs and concerns.

Responsibility for environmental protection in the City is a cooperative effort among four agencies including the Department of Transportation and Environmental Services, the Department of Planning and Zoning, , the Department of Parks, Recreation, and Cultural Activities, and the Code Enforcement Bureau of the Fire Department. In addition, the City's Environmental Policy Commission provides citizen input and guidance into the development of Alexandria's environmental policies, programs, and regulations. Many City residents and staff have gone above and beyond compliance with regulations or participation in City programs and have taken active roles in promoting environmental stewardship.

The following is an overview of existing plans, regulations, ordinances, and programs related to water quality protection and management in the City. The purpose of this exercise is to provide a foundation on which to assess the effectiveness of the City's overall environmental efforts in light of the needs identified in previous sections. Section V will compare identified needs with existing programs as a means of identifying areas where

Alexandria has Spearheaded Innovative Ways to Reduce Water Pollution Such as this Rain Garden in West End

CONTENTS

- **City Master Plan**
- **City Ordinances and Regulations**
- **City Programs**
- **State and Regional Programs**
- **Community Based Programs**

the City may need to increase or modify its protection efforts.

CITY MASTER PLAN

IV.1

The Master Plan is the principal guiding document that identifies the City's priorities and provides a vision of how the City will grow both physically and as a community. The Master Plan contains background information, guidance, and policy in the areas of land use, housing, transportation, community facilities, economics and finance, and urban design. In addition to these general policies, the Master Plan consists of several specific "Area Plans" that provide for the detailed on-the-ground implementation of goals and policies.

Goals and objectives relating to the protection of the environment and water quality are found throughout the City's Master Plan. This supplement serves to wrap these goals and objectives into a cohesive water quality management and protection plan.

Future Land Use Plan and Map

Because what happens on the land directly affects water quality, the City's Land Use Plan and Future Land Use Maps are integral components of Alexandria's water quality protection efforts. The goal of the Land Use Plan is to guide development in the City in a way that balances economic and community needs while protecting natural resources. The City has chosen to use Small Area Plans (SAPs) as an integral part of the planning process to guide the City's future development. The fourteen SAPs provide the analytical base for detailed land use recommendations affecting each of the City's neighborhoods and development areas.

The City intends that redevelopment in each of the City's SAPs will result in an incremental improvement in water quality. Furthermore, new development must be designed in a way that is sensitive to potential impacts on water quality and natural resources and steps must be taken to avoid and minimize these impacts to the maximum extent practicable. For these reasons, the City chose to implement a jurisdiction-wide Resource Management Area (RMA) under its Chesapeake Bay Preservation Ordinance (see discussion in Section IV.2). It is also the intent of the City that designated future land uses are compatible with an area's natural constraints (see Section II).

The Land Use Plan contains general policy statements regarding the need to balance growth and development with water quality and environmental protection. However, it is also a goal of the City that each SAP is analyzed for opportunities to protect and restore water quality during development and redevelopment.

CITY ORDINANCES AND REGULATIONS

IV.2

The City has enacted a number of ordinances and regulations to protect the environment and water quality from the impacts of development and human activity. In many instances, these ordinances and regulations implement State and/or federal requirements and mandates. For instance, the City's Chesapeake Bay Preservation Ordinance implements the State's Chesapeake Bay Preservation Act while the City's Erosion and Sediment Control Ordinance implements the State's Sediment and Erosion Control Law. The Floodplain Overlay District of the City's Zoning Ordinance is required by the Federal Emergency Management Agency (FEMA) in order for City residents to quality for flood insurance. Other City ordinances relating to water quality and the environment include regulations affecting the preservation and maintenance of trees, shrubs, plants, and vegetation, regulations prohibiting the improper disposal of pet waste, used oil, automotive fluids, and other hazardous materials that may find their way to a local stream through a storm drain, and pertinent sections of the Zoning Ordinance relating to development approvals and procedures. Additional procedures relating to the water quality and the environment include Procedures for the Control of Contaminated Land.

Collectively, these ordinances and regulations provide the means by which the City protects its water quality and, in some unfortunate situations, prosecute those who persist in abusing the City's natural resources.

Chesapeake Bay Preservation Ordinance

Alexandria's Chesapeake Bay Preservation Ordinance (Section 13-100 of the City Code) is one of the City's most visible and comprehensive water quality protection tools. This Ordinance implements the Virginia Chesapeake Bay Preservation Act (Chapter 25, Title 10.1 of the Code of Virginia) which was enacted in recognition that the Chesapeake Bay was on the verge of becoming an ecological disaster area in part because of uncontrolled nonpoint source pollution from urban and agricultural areas. However, the Chesapeake Bay was only the most visible manifestation of a larger problem. In addition to the Chesapeake Bay, local streams and watersheds were also suffering the effects of pollution and many could no longer support aquatic life.

The primary purpose of the Chesapeake Bay Preservation Ordinance is to prevent any increase in nonpoint source pollution from new development and to reduce nonpoint source pollution by at least 10% as a result of redevelopment. In addition, the City of Alexandria has committed to:

- Protect existing high quality state waters and restore all other State waters to a condition or quality that will permit all reasonable public uses, and will support the propagation and growth of all aquatic life which might reasonably be expected to inhabit them;
- Safeguard the clean waters of the Commonwealth from pollution;
- Prevent any increase in pollution;
- Reduce existing pollution; and
- Conserve water resources in order to provide for the health, safety, and welfare of the present and future citizens of the Commonwealth.

To accomplish these goals, the Ordinance establishes a program to protect environmentally sensitive features which, when disturbed or developed incorrectly, lead to reductions in water quality in the Chesapeake Bay and local streams, lakes, and rivers. In accordance with the guidelines established by the Chesapeake Bay Preservation Area Designation and Management Regulations, the City mapped Chesapeake Bay Preservation Areas (CBPAs) and Alexandria adopted a Chesapeake Bay Preservation Area Overlay District in 1992. The mapping of these areas, which include Resource Protection Areas (RPAs) and Resource Management Areas (RMAs), was based on a survey of existing natural resources documentation and field surveys.

Resource Protection Areas – RPAs are lands at or near the shoreline containing components which are especially sensitive because of (1) the intrinsic value of the ecological and biological processes they perform which benefit water quality, or (2) the potential for impacts that may cause significant degradation to the quality of State waters.

The RPA designation within the City includes tidal wetlands, nontidal wetlands connected by surface flow and contiguous to tidal wetlands or tributary streams, tidal shores, tributary streambeds not owned by the Commonwealth of Virginia, and a 100-foot vegetated buffer area located adjacent to and landward of all previously listed components and all tributary streams. The only uses permitted by right in the RPA are redevelopment and water dependent facilities. As a result, these lands are excluded from new development in most instances.

Resource Management Areas – RMAs include land types that, if improperly developed, have the potential for causing significant water quality degradation or for diminishing the functional value of the RPA. All lands in the City, not included in an RPA, constitute the RMA since all such land drains through natural or man-made channels to the Potomac River.

Development and redevelopment within the RMA must meet several performance criteria to minimize impacts on water quality. Performance criteria include preventing an increase in nonpoint source pollution as a result of new development based on a City-wide average, decreasing

nonpoint source pollution by 10% during redevelopment, minimizing land disturbance during development, maximizing the preservation of native vegetative cover, and minimizing impervious surfaces for the desired land use. In addition, the Ordinance requires that a 100 foot vegetated buffer area must be preserved along all RPA features and tributary streams and in some cases, reestablished if one does not presently exist or is in poor condition.

The criteria are intended to establish rules that local governments can use in granting, denying or modifying requests to rezone, subdivide, or to use and develop land in the RMAs and RPAs. Implementation of the criteria is achieved through use of performance standards, structural pollution management facilities (also known as BMPs, or best management practices), and various planning and zoning concepts.

Map IV.1 presents the City's Chesapeake Bay Preservation Area Map. It should be noted that it is the designation criteria identified in the Chesapeake Bay Preservation Ordinance which is binding, and when conflicts between the Chesapeake Bay Preservation Area Map and the designation criteria arise, the designation criteria prevail.

Erosion and Sediment Control Ordinance

The purpose of the City's Erosion and Sediment Control Ordinance (Section 5-4-1 *et seq*) is to prevent the degradation of local soil and water resources as a result of land-disturbing activities by ensuring that the owner of the property on which land disturbing activities are being carried out provides adequate controls of erosion and sedimentation. The City's E&SC Ordinance also requires the land owner to take necessary measures to preserve and protect trees and other vegetation during all phases of any land-disturbing activity. The E&SC Ordinance implements the Virginia Erosion and Sediment Control Law (§§ 21-89.1 *et seq*., Code of Virginia (1950)) as well as the Chesapeake Bay Preservation Act.

Under the E&S Ordinance, land owners proposing a nonexempt regulated land disturbing activity of greater than 2,500 square feet (reduced from 10,000 square feet under the City's Chesapeake Bay Preservation Ordinance) must first submit an erosion and sediment control plan to the City Department of Transportation and Environmental Services.

The following is an abbreviated list of the basic principles of the City's E&S Ordinance. The developer must refer to the City Code for a complete description of requirements.

- Measures must be taken to stabilize denuded areas and soil stockpiles.
- Permanent vegetative cover must be established on denuded areas not otherwise permanently stabilized.
- Adjacent properties must be protected from sediment deposition.
- Measures intended to trap sediment on-site must be constructed as a first step in grading and be made functional before upslope land disturbance takes place.
- Stormwater runoff from drainage areas greater than three acres must be controlled by a sediment basin.
- Cut and fill slopes must be designed and constructed in a manner than minimizes erosion.
- Downstream properties and waterways must be protected from sediment deposition, erosion and damage due to increases in the volume and velocity of stormwater runoff as a result of site disturbance.
- Onsite waterways must be designed and constructed to withstand expected velocity and volume of flow.
- Disturbance of natural waterways be construction vehicles and activities must be minimized.
- Conservation practices for erosion and sediment control must be equal to or exceed the specifications of those contained in the most recent edition of the *Virginia Erosion and Sediment Control Handbook*.

Flood Control and Floodplain Overlay District

The purpose of the City's Floodplain Overlay District (Section 6-300 of the City Code) is to prevent the loss of life and property, the creation of health

and safety hazards, the disruption of commerce and governmental services, and unnecessary expenditure of public funds for flood protection as a result of improper development within the floodplain. The floodplain districts throughout the City are shown on Map IV.2 entitled "Floodplain Map, The City of Alexandria, Virginia" adopted May 15, 1991. The City's floodplain management regulations are in compliance with the floodplain management criteria set forth in regulations promulgated by the Federal Insurance Administration of the Federal Emergency Management Administration.

The floodplain within the City is defined as the 100-year flood level. In general, buildings or structures and their extension and accessory buildings may be constructed or substantially improved only in accordance with specific requirements. Among these requirements is that new structures or additions must be appropriately flood proofed and any alteration (including development or fill) may not increase flood levels by more than one-half foot.

Floodprone areas of the City are associated with Four Mile Run, Cameron Run, Holmes Run, Backlick Run, Lucky Run, Strawberry Branch, Hooffs Run, Timber Branch, Taylor Run, and low lying areas along the Potomac River.

Although primarily meant as a means to protect life and property from the devastating effects of flooding, the Floodplain Overlay District, in combination with designated Chesapeake Bay Preservation Areas, serves to protect wildlife habitat corridors and sensitive soils in the City's remaining natural stream reaches from improper or intensive development.

In addition to floodplain regulations, the City manages several stream channelization projects which help to minimize the potential for flooding in existing neighborhoods and commercial areas. The City has invested considerable resources into these projects to prevent the type of flooding that devastated Arlandria and other areas of Alexandria during the 1960s and 1970s. Major channelization projects are located in the following receiving bodies: Four Mile Run, Cameron Run, Backlick Run, Holmes Run, and Hooffs Run. The largest channel, Four Mile Run, is inspected by City personnel at least quarterly, and before periods of expected heavy rainfall. As needed the City removes silt and debris from ditches, swales, and open channels in the City. On average, the City removes over 1,750 cubic yards of silt a year from the Four Mile Run channel alone.

Since the early 1970s, the City has also required new development to provide on-site stormwater detention in order to prevent downstream flooding, protect remaining natural stream channels, and in some cases, to reduce the need for further channelization. As of 1992, there were 135 stormwater control structures located within the City.

Regulation of Trees, Shrubs, Plants, and Vegetation

In order to protect and maintain vegetation planted on private property as a result of the site plan or subdivision processes, and in order to promote and protect trees and vegetation on public spaces, the City has adopted regulations governing the removal and maintenance of trees, shrubs, plants, and vegetation (Section 6-2-1 et seq). Implementation of these regulations is the responsibility of the Department of Parks, Recreation, and Cultural Activities and the City Arborist. In general, the regulations restrict the removal or destruction of trees on properties subject to site plans or approval of a subdivision plat.

Regulation of Dog Waste and the Prohibition of Disposal of Refuse and Debris into Storm Sewers

Storm sewers serve as direct conduits from streets and parking lots to neighborhood streams and eventually the Potomac River and Chesapeake Bay. The Alexandria City Code (Section 5-6-31) prohibits the placement of any kind of material in catchbasins or manholes of any public sewer, including but not limited to common pollutants such as trash, paint, antifreeze, and used oil. Specifically relating to the control of animal feces, which is a primary source of fecal coliform bacteria in City streams, Section 5-7-42(3) prohibits know-

ingly or willingly allowing an animal to defecate on public property unless the owner of the dog immediately removes the material and disposes of it in a safe manner. A civil penalty of $50 can be assessed for violating this provision.

Prohibition of Dumping Hazardous Wastes Including Used Oil

Hazardous wastes, including used motor oil, present an immediate risk not only to the environment, but to human health as well. In addition to Section 5-6-31 of the City Code (discussed above), the dumping of hazardous and flammable materials is regulated under the Virginia Statewide Fire Prevention Code. The Fire Prevention Code is incorporated by reference into the City Code under Section 4-2-12. In instances where used oil or other hazardous materials have been dumped, the City's Fire Department may issue citations and impose a fine of up to $2,500 or one year imprisonment. Significant violators may also be charged under the state code with fines of up to one million dollars.

FIGURE IV.1
"No Dumping" Signs Along a Residential Street

"No Dumping" Signs Alert Residents to the Legal and Environmental Ramifications of Dumping Oil

Prohibition of Automobile Maintenance on City Streets

Even in the absence of malice, maintenance of automobiles is one of the primary sources of toxic pulses in urban streams and creeks. Even for those who exercise caution, it is difficult to prevent some spillage of used oil, antifreeze, or other automobile fluid during major repairs or maintenance. Frequently, individuals will choose to maintain vehicles on a City street because it represents a convenient way to dispose of used fluids or so that small "drips" do not mar the owner's driveway or garage. Section 10-4-13 "Stopping for Purpose of Sale, Repairs, etc." specifically prohibits any vehicular repair in any public park, wildlife sanctuary, or public parking lot. The provision also prohibits any activity that results in the drainage of a any fluid other than water from a motor vehicle. Violators are subject to a traffic infraction punished by a fine not to exceed $100.

Zoning Ordinance Development Approval Procedures

The City's development approval procedures under its Zoning Ordinance (Section 11-100) provide for a number of actions that must be observed during the development process in order to minimize environmental impacts, ensure compliance with environmental regulations, and remedy environmental problems. Pertinent sections of the development approval procedures include, but may not be limited to the following.

- Preliminary site plans must show the general location of slopes, terraces, and retaining walls, major trees and shrubs, natural and artificial watercourses and bodies of water and wetlands, limit of floodplain, limit of designated Resource Protection Areas, significant geological features, areas that can reasonable be expected to or which do contain soils or materials contaminated with but not limited to heavy metals, petroleum products, PCBs, pesticides, flyash, or other toxic or

hazardous materials, underground storage tanks, areas located within 1,000 feet of a former sanitary landfill, dump, or disposal area, areas with the potential of generating combustible gasses.

- Plans for collecting and depositing stormwater and the method used of treatment of natural and artificial watercourses, including a delineation of proposed limits of floodplains.
- Plans to remediate, remove, or control any contaminated soils, materials, underground storage tanks, combustible cases, or old landfills, dumps, or disposal areas.
- Plans for minimizing the impact on existing or developing wetland or for the creation of new wetlands.

Responsibility for ensuring compliance with these procedures rests with the Planing Commission, the Department of Planning and Zoning, the Health Department, and the Department of Transportation and Environmental Services.

Procedures for the Control of Contaminated Land

During the 1970s, it became apparent that many areas of Alexandria had become contaminated to a point where development and redevelopment would pose a safety hazard without proper remediation. As a result, the City has set out public actions regarding the use, development, and control of land which has become contaminated with substances posing a danger to public health or to marine life. Contaminants of specific concern include levels of methane gas that may be considered unsafe for conventional construction and levels of arsenic and/or creosote that warrant special precautionary measures or controls. Other contaminants may include petroleum hydrocarbons, heavy metals, PCBs, etc.

The City acknowledges that each situation is unique and requires individual attention through appropriate technical reviews depending on the type of contaminant, the degree and extent of contamination, and location. In general, the following offices and departments are responsible for procedures for the control of contaminated land.

- The Office of the City manager has overall responsibility for the effective implementation of procedures.
- The Department of Transportation and Environmental Services, in cooperation with the Department of Planning and Zoning, is responsible for identification of contaminated areas and technical coordination with other City departments and the Planning Commission regarding any proposed land use control measures.
- The Department of Transportation and Environmental Services in consultation with the Health Department, is responsible for formulating the necessary public health and safety requirements needed in each particular case and for coordinating with appropriate federal and State agencies.
- The Department of Transportation and Environmental Services is also responsible for ensuring that all public works in the area conform to public health and safety requirements.
- The Code Enforcement Bureau is responsible for informing all appropriate departments of all applications for construction permits of any type and for demolition permits related to a contaminated site and assure that buildings are designed and constructed in a manner that contamination will not affect health or safety.

CITY PROGRAMS

IV.3

In addition to City regulations and ordinances, Alexandria has implemented several programs that are aimed at reducing environmental and water pollution. These programs have been adopted to meet specific needs that have been identified by the City, and collectively, address a wide range of pollutants and provide significant benefits to the environment.

Street Sweeping/Flushing and Catch Basin Cleaning Program

A significant portion of pollutants entering local streams come from runoff from street surfaces.

Many of these pollutants, in addition to affecting water quality, are also an aesthetic nuisance. Alexandria has a long tradition of using street sweepers for aesthetic purposes and first established its program in the 1900s. More recently, street sweeping has been recognized for its water quality benefits. Although less effective at trapping fine particles (which often have nutrients attached), sweeping is very effective at removing litter, larger sediments, and sands. According to various sources, street sweepers can remove up to 50% of all street surface pollutants. Today, water quality is a primary reason for the continuance of the City's street sweeping program.

FIGURE IV.2
Alexandria Street Sweeper

Street Sweeping Results in Significant Water Quality and Aesthetic Benefits

Alexandria's mechanical and vacuum street sweepers, which are operated by the Department of Transportation and Environmental Services, serve over 600 lane miles at a frequency of once a week to once a month, depending on need.

In addition to sweeping, the City runs a "street flushing" program in areas served by the City's combined sewer system (CSS). In these areas (primarily Old Town), a street flusher follows the sweeper and flushes remaining pollutants that are not picked up by the sweeper into stormdrains with a high powered hose. Because the CSS area drains to the Alexandria Wastewater Treatment Facility, the flushed water is treated to a very high degree – resulting in significant water quality benefits. It should be noted that this program can only work in the CSS area since other areas of the City do not drain to a treatment facility.

Catch basins, which often trap litter and other large debris, are also cleaned with a frequency of once per week to three times per year, depending on the observed rate of accumulation.

Targets of Opportunity Stormwater Retrofit Program

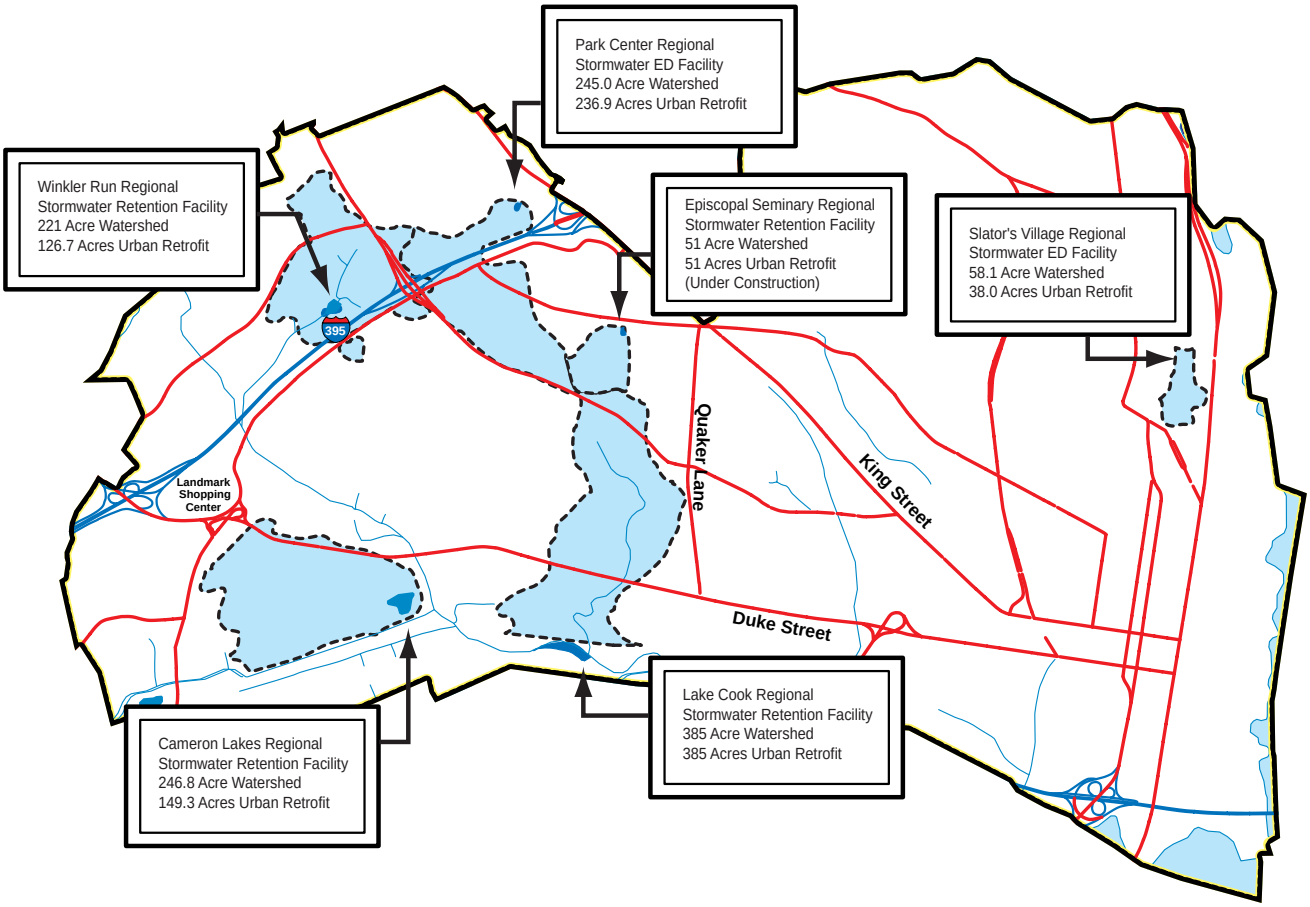
One of the most effective ways to reduce pollutants in urban areas is to retrofit existing development with stormwater quality facilities (or best management practices, BMPs). Since the City of Alexandria adopted a stormwater quality management program in 1992 as part of its Chesapeake Bay Preservation Ordinance, over 1,000 acres of urban BMP retrofits have been installed within the City under its Targets of Opportunity Stormwater Retrofit Program.

The objective of this program is to enhance the mandatory requirements of the Chesapeake Bay Program with additional treatment of stormwater runoff from built up areas that would otherwise not be required to implement water quality protection measures.

Upon adoption of the Chesapeake Bay Preservation Ordinance, Alexandria staff made a survey of the City to identify opportunities for future urban BMP retrofitting. Staff members who review development proposals were directed to discuss with developers the possibility for including the retrofit of neighboring preexisting development. Particular attention was paid to already existing ponds and basins, which might be adapted in the future for service as regional stormwater detention basins.

A substantial part of Alexandria's retrofit program has been fully and voluntarily paid for by devel-

FIGURE IV.3
Targets of Opportunity Stormwater Retrofit Program Sites



Source: Department of Transportation and Environmental Services, 1998.

opers of adjacent downhill properties. Specific projects include Winkler Run Pond, Lake Cook Retrofit, Cameron Lakes Retrofit, Park Center Basin Retrofit, and Potomac Yards South Retrofit. Figure IV.3 provides a map of areas of the City retrofitted as a result of the program.

The result is that Alexandria has been able to retrofit a total of 1,007 acres since 1992 (23% of State goals under Virginia's Tributary Strategy nutrient reduction program). Total annual phosphorus removal from these projects is estimated at 2,832 pound a year while total annual total nitrogen removal is estimated at 11,514 pounds. Alexandria continues to seek partnerships with developers in order to accomplish even more retrofit within the City.

This program won a Community Innovation Award from the Chesapeake Bay Program in 1997 out of recognition of the City's efforts.

Best Management Practices Manual for Automotive Related Industries

Service stations and other automotive related industries present a specific risk to water quality because hazardous fluids are handled in an open area by many different people. To help these businesses understand the implications of their actions and determine preventative measures, the City of Alexandria has produced a "Best Management Practices Manual for Automotive Related Industries."

The practices described in the manual help an automotive shop to keep heavy metals, oil, grease, and other pollutants out of local streams. The practices are outlined to help assist businesses in complying with the environmental requirements of the City, as well as State and federal agencies.

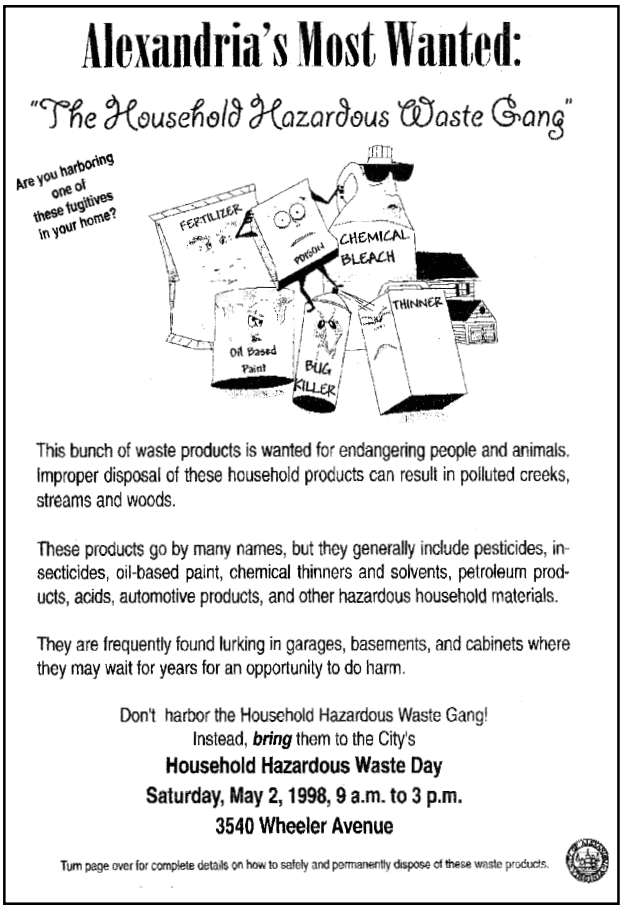
Fourteen recommended practices are keyed to specific shop activities and four advanced management practices are suggested to control pollution from more severe problems. Many of the practices are straightforward and should already be in place at the shop. Key components of the manual include running a dry shop, being a zero discharger, closing of the loop (that is, reusing or recycling hazardous materials), properly training employees, and keeping customers informed. Over 35 manuals have been distributed to automotive businesses in the City as of 1998.

Hazardous Waste and Used Oil Collection Programs

In order to encourage City residents to dispose of hazardous waste and used oil in an environmentally sound manner, and to provide an alternative to dumping, the Recycling Division hosts a Household Waste Collection Day for City residents twice a year. A flyer (see Figure IV.4) is distributed to all residents announcing the date and location of hazardous waste pick ups. By making it easy to dispose of these substances, it is more likely that residents will not be tempted to dump these substances into stormdrains or wooded areas. The highly successful program, which is free of charge to City residents, has been in existence since 1987.

In addition to Hazardous Household Waste Days, the Recycling Division works with City service stations to collect used oil on a day-to-day basis as a public service. Participation by City service stations in this program is voluntary. As of 1998, four stations accepted used motor oil. The number of stations accepting motor oil has decreased significantly from prior years. While the Department of Recreation, Parks, and Cultural Activities has created and distributed a pamphlet to address dumping "hot spots," which includes the locations of recycling stations, there is currently no means of informing the general public of their locations.

FIGURE IV.4
Public Education Materials Help to Provide Information on Alternatives to Dumping


Alexandria's Most Wanted:

"The Household Hazardous Waste Gang"

Are you harboring one of these fugitives in your home?

This bunch of waste products is wanted for endangering people and animals. Improper disposal of these household products can result in polluted creeks, streams and woods.

These products go by many names, but they generally include pesticides, insecticides, oil-based paint, chemical thinners and solvents, petroleum products, acids, automotive products, and other hazardous household materials.

They are frequently found lurking in garages, basements, and cabinets where they may wait for years for an opportunity to do harm.

Don't harbor the Household Hazardous Waste Gang!
Instead, ***bring*** them to the City's
Household Hazardous Waste Day
Saturday, May 2, 1998, 9 a.m. to 3 p.m.
3540 Wheeler Avenue

Turn page over for complete details on how to safely and permanently dispose of these waste products.

Leaf Collection Program

Although leaf particles (called detritus) provide excellent food for aquatic species, an overabundance of detritus can represent a significant source of local nutrient pollution. Since 1965, the City has run a leaf vacuuming program to ensure that the City's streams are not overwhelmed and choked by large quantities of leaf debris.

Every spring, the City hires a contractor to grind the leaves that were collected the previous fall and turn them into mulch. This mulch is an effec-

tive natural substitute for commercial fertilizers and is available free for self-hauling at the City's mulching site.

Sanitary Sewer Line Inspection and Maintenance Program

Although the City performs routine maintenance and inspection of its sewer lines, Alexandria has embarked on a multi-year effort to detect elicit connections to sewer lines and to locate areas of groundwater inflow (into the system) and sewage infiltration (into the surrounding soils) in the Four Mile Run sewershed. Inflow of surface water and groundwater during wet weather can overwhelm the system. At the same time, leakage from sanitary sewer lines into the environment can pollute local streams. The Department of Transportation and Environmental Services is the lead agency for this effort. The results of the initial study, will be used to develop a plan for mitigating significant problems.

School-Age Water and Environmental Education Programs

Educating the City's youth to respect their natural environment is the most effective way to protect water quality in the future. The Park Planning Division of the City's Department of Parks, Recreation, and Cultural Activities has developed several programs aimed at increasing environmental awareness among the City's elementary, junior, and high school students. One such program, called the "Stream Team" involved students from Hammond Junior High School who adopted and monitored a stretch of Holmes Run from the Dora Kelly Nature Park to Shirley Highway. The project not only inspired many students to recognize Holmes Run as more than a ribbon of dirty water, but also resulted in the collection of valuable information on the health of the stream and sources of pollutants. The Park Planning Division also routinely works with Boy Scouts and other groups on small erosion control and litter clean up projects.

ALEXANDRIA SANITATION AUTHORITY

IV.4

One of the most significant, yet least celebrated of Alexandria's contributions to the health of the Chesapeake Bay and the Potomac River is the planned upgrade of the Alexandria Wastewater Treatment Facility (AWTF) by the Alexandria Sanitation Authority (ASA). The ASA is a public body organized under the provisions of the Virginia Water and Sewer Authorities Act that was chartered in 1953 for the purpose of "acquiring, constructing, improving, extending, operating, and maintaining a sewage disposal system." The ASA serves almost all of Alexandria as well as the Fairfax County portion of the Cameron Run watershed. Located on South Payne Street, the AWTF was upgraded in 1984 to treat 54 million gallons a day, or approximately 5 billion gallons of waste water per year.

During 1997, two events resulted in a decision by the ASA to upgrade its facilities to meet more stringent water quality requirements as well as voluntary water quality goals. First, Virginia began to aggressively pursue its nutrient reduction commitments (a 40% reduction in phosphorus and nitrogen from a 1985 baseline) under the interstate Chesapeake Bay Agreements. Since much of the reduction would require upgrades to the region's wastewater treatment facilities, the ASA staff assisted the Virginia Association of Municipal Wastewater Agencies (VAMWA) in preparing workable nutrient control legislation that was adopted by the State legislature and signed by the Governor. This legislation is significant in its voluntary approach to water quality improvements, as opposed to the traditional command and control approach. Significantly, the resultant legislation, named the Water Quality Improvement Act, included a funding mechanism to help pay up to 50% of the capital costs of upgrades.

Second, the State Water Control Board approved the Potomac Embayment Policy in April, 1997, which changed the level of overall treatment needed by the ASA plant and other plants which discharge into the Potomac River. With the adop-

tion of the Potomac Embayment Policy, and in consideration of the Water Quality Improvement Act and the *Shenandoah and Potomac Rivers Basins Tributary Nutrient Reduction Strategy*, the ASA is now required to design and install upgraded facilities to meet more stringent water quality requirements. In May of 1997, the ASA Board authorized a notice to proceed to its engineering consulting firm to begin the design work necessary to upgrade the ASA's facilities. The primary upgrade is a process known as biological nutrient removal, or BNR. The BNR upgrade is expected to become operational in April of 2002 and construction is anticipated to be completed by the end 2005. Estimates place the total costs of the upgrade at $200-to 240 million, much of which will be paid by Alexandria and Fairfax County citizens who use the facility.

Despite the cost, the environmental benefits of the AWTF upgrade will be far reaching. Total nitrogen flow to the Potomac River will be reduced by 53% from 1985 base-year levels (1,994,000 lbs/yr to 920,500 lbs/yr) while total phosphorus flow to the Potomac will be reduced by 59% (16,300 lbs/yr to 6,600 lbs/yr).

STATE, FEDERAL, AND REGIONAL PROGRAMS

IV.5

Many water quality management and environmental programs and regulations are implemented at the State, federal, and regional levels. The City works together with these agencies in order to reduce duplication of efforts and to pool collective resources.

The Virginia Department of Environmental Quality (VADEQ) monitors and enforces State regulations concerning underground storage tanks, industrial and wastewater treatment facility outfalls, wetlands protection, and air quality. Alexandria participates in the Northern Virginia Regional Commission's Four Mile Run flood control program which requires new development and redevelopment to provide onsite detention. The program, with Alexandria's support, has recently been expanded to allow for watershed-wide water quality programs.

With regard to already contaminated sites in the City, Alexandria is working with property owners and the VADEQ under the relatively new Virginia Voluntary Remediation Program (VRP). The City has entered into the VRP for the Alexandria Gas Works / Oronoco Outfall site. The VRP provides a mechanism for willing owners of contaminated land to clean up their sites under minimal government oversight in exchange for State approval of the clean up. Under the VRP, parties negotiate a Site Characterization/Remedial Action Workplan with the VADEQ. Upon successful completion of the plan, the State issues a Certification of Satisfactory Completion which provides that the VADEQ cannot pursue further enforcement action against past, present, or future owners of the property for the contamination. This State "seal of approval" is likely to be important to potential purchasers, lenders, and developers
Alexandria is an active participant in the Metropolitan Washington Air Quality Committee (MWAQC). Airborne deposition from automobiles and power plants is a major contributor to water

FIGURE IV.5
Chesapeake Bay Education Plaque at Oronoco Park

This Chesapeake Bay Education Plaque was presented to the City by the Chesapeake Bay Commission in recognition of Alexandria's contributions to urban water quality.

quality problems. MWAQC provides the framework for how the region will come into compliance with federal Clean Air Act standards for ozone. Alexandria maintains one ambient air quality monitoring station on North St. Asaph Street in Old Town.

Finally, City staff actively participate on the Metropolitan Washington Council of Government's Nonpoint Source Pollution Subcommittee and monitor the activities of the federal Chesapeake Bay Program. In 1997, Alexandria was presented with an "Award for Community Innovation" from the Chesapeake Bay Program for its Targets of Opportunity Urban Retrofit Program.

COMMUNITY PROGRAMS

IV.6

Alexandria Earth Day

Alexandria Earth Day is the premier community-based environmental awareness festival that offers a host of events and activities to further educate the citizens of Alexandria about the importance of protecting the City's natural heritage.

Alexandria Earth Day was first established in 1994, and the most recent event (1997) had over 65 exhibitors, two stages of entertainment, a 4-H Expo and talent show, a school project competition (with over 150 student entries), and a celebration of Arbor Day. The Alexandria Earth Day Committee also produces a widely distributed Alexandria Earth Day Environmental Almanac that features articles by Alexandrians about the environment and its affects on the quality of life in Alexandria.

Alexandria Earth Day is officially co-sponsored by the Alexandria Environmental Policy Commission, the Office of Special Events of the Department of Parks, Recreation and Cultural Activities, the Virginia Cooperative Extension, and the Alexandria Volunteer Bureau. The school project competition (remanded the Youth in Action Environmental Project Competition), the petting zoo, Arbor Day, the Archaeology dig, recycling, the bike tour, are all representative of the diversity of activities and opportunities.

Held each year in the spring at various parks within the City, Alexandria Earth Day is evidence of the power of public-private partnerships.

Policy Analysis and Action Plan

V

The purpose of this section is to examine the City's environmental and water quality protection ordinances described in Section IV in light of the City's desire to protect its sensitive natural resources, avoid improper land uses on areas with constraints to development, and reduce or eliminate existing and potential sources of pollution. The purpose of this analysis is to identify the strengths of the City's environmental and water quality protection programs and to develop a strategic water quality protection plan to address issues and concerns that are not adequately accounted for by existing City programs. The results of this analysis are used as the basis of specific goals and action statements.

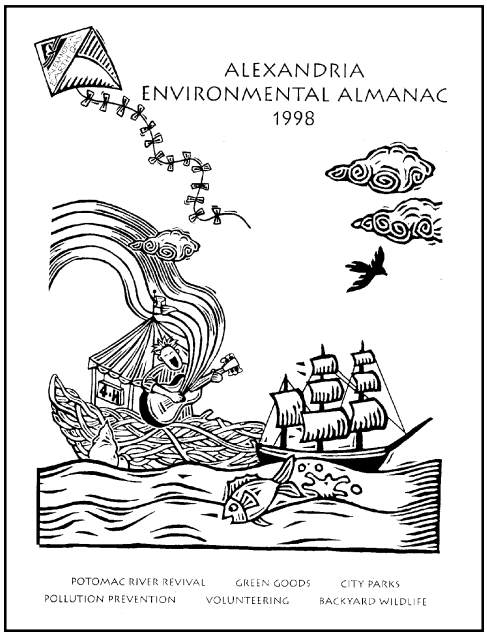
This section, much like the rest of the document, is organized along the lines of meeting the Chesapeake Bay Local Assistance Department's four critical areas including:

(1) Constraints to Development;
(2) Protection of Water Quality;
(3) Shoreline Protection and Erosion Control;
(4) Public and Private Access to Waterfront Areas; and,
(5) Redevelopment of Intensely Developed Areas.

In addition, this section addresses issues relating to the overall coordination of City environmental and water quality goals, policies and outreach programs as well as alternative financing strategies.

Role of Small Area Plans

Since most detailed land use planning is accomplished through the City's fourteen Small Area Plans (SAPs), it is the City's intent that this Water



1998 Earth Day Celebration
Alexandria Environmental Almanac

CONTENTS

- **Constraints to Development**
- **Protection of Water Quality**
- **Shoreline Protection and Erosion Control**
- **Public and Private Access to Waterfront Areas**
- **Redevelopment Areas**
- **Overall Outreach and Coordination**
- **Potential Funding Mechanisms**

Quality Management supplement serve as an overlay to the planning and development process and should be referenced accordingly. However, to provide a stronger link between each SAP and this supplement, as part of the five year review of the master plan, the City will work to incorporate into each SAP: a discussion of the City's long-range water quality protection policies and strategies, SAP-specific Chesapeake Bay Preservation Area maps, and an SAP-specific analysis of opportunities to protect and improve water quality and the environment through planned development and redevelopment opportunities.

CONSTRAINTS TO DEVELOPMENT

V.1

Constraints to development within the City include topography, geology and soils, wetlands, wildlife habitat corridors, and groundwater recharge areas (see Figure V.1 for a generalized constraints to development map). Many of these areas are well identified since Alexandria has been substantially built-out for a number of years. In addition, many sensitive areas have already been built upon, making constraints to development more of a reactive management issue except in the cases of large scale redevelopment.

Wetlands

(1) The City has mapped its wetlands according to the Federal Manual for Delineating Jurisdictional Wetlands. The U.S. Army Corps of Engineers (in cooperation with the U.S. EPA, the Virginia Department of Environmental Quality, and the City) has primary responsibility for enforcing wetland regulations. Developers must certify to the City, under its Chesapeake Bay Preservation Ordinance, that all wetland permits have been obtained prior to land disturbance.

(2) While remaining healthy wetlands should generally be left alone or protected , when impacts do occur the City will try to mitigate the impacts through wetland creation or enhancement, improvements to riparian areas, or through the use of creative Best Management Practices to treat stormwater. It may be possible to use some wetland areas as open space and for environmental education purposes. A local example includes wetland areas of Dora Kelly Nature Park and the privately owned Winkler Botanical Preserve. Additional opportunities for using wetlands as educational tools will be investigated.

(3) There are several degraded wetlands in Alexandria that may have the potential to be restored for wildlife habitat or stormwater quality management purposes. Opportunities to restore degraded wetlands or to create new wetlands will continue to be explored in conjunction with the City's Targets of Opportunity Stormwater Retrofit Program and should be explored as part of any large project, including the reconstruction of the Woodrow Wilson Bridge.

Topography

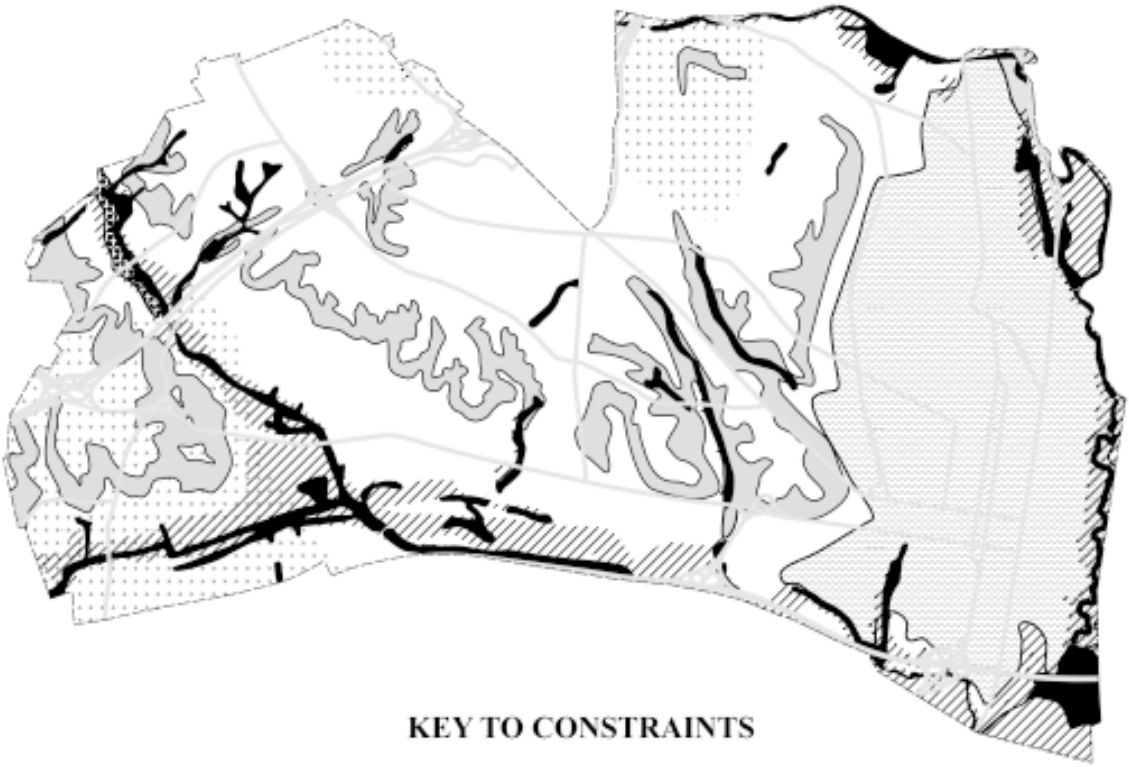
(1) Areas of steep topography outside of the City's stream valleys and designated Resource Protection Areas are limited. Steep slopes outside of these areas are managed by the Resource Management Area requirements of the City's Chesapeake Bay Preservation Ordinance and the City's Erosion and Sediment Control Ordinance.

Geology and Soils

(1) The primary constraints posed by geology and soils in the City are areas subject to flooding, high water table, and marine clays (shrink-swell). These areas have been identified and mapped by the City. The City will continue to protect these areas from inappropriate development to prevent loss of life and property and water quality degradation through the Virginia Uniform Building Code and the City's Floodplain Overlay District.

(2) The City recognizes the utility of having an up-to-date soils map for the purpose of identifying potential constraints to development. The last soil survey for the City was con-

FIGURE V.1
Generalized Constraints to Development Map



KEY TO CONSTRAINTS

- Generally Unsuitable for Development (Wetlands and Stream Buffer Areas)
- Limited Development Potential/ Development Requires Special Consideration (Floodplains and Floodplain Soils)
- Limited Development Potential/ Development Requires Special Consideration (Steep Slopes and Slide Prone Soils)
- Generally Suited for Development Development May Require Special Consideration (High Water Table)
- Generally Suited for Development (Few Unfavorable Features)
- Potential Groundwater Recharge Areas

ducted in 1915 by the U.S. Department of Agriculture, Bureau of Soils. Since that time, development and redevelopment, as well as changes in soil classifications, has reduced the usefulness of this survey. A long range goal of the City is to work with the National Resource Conservation Service to produce an updated soils map of Alexandria.

Wildlife Habitat Corridors

(1) Except for where flood control or utility maintenance is a consideration, existing publicly owned stream valley habitat corridors will remain in a natural state with provisions made for passive recreational opportunities. Likewise, stream valley corridors on private property will continue to be managed in accordance with the provisions of the Chesapeake Bay Preservation Ordinance.

(2) The City will identify, characterize, and map remaining significant natural habitat areas (including streams and stream valleys as well as isolated groves).

(3) Habitat fragmentation is a significant challenge to maintaining a healthy ecosystem in Alexandria. Streets that criss-cross the landscape cut off wildlife populations from food sources and result in a danger to drivers as animals attempt to cross roadways. In response to habitat fragmentation concerns, the Virginia Department of Transportation has recently approved a culvert design that includes a raised concrete area for small animals to traverse the culvert. This design alternative is significantly more cost-effective than other mitigation options. If current efforts by VDOT to improve stream valley corridors for wildlife are successful, Alexandria will examine the feasibility of developing similar standards for new or reconstructed City roads.

Stream-Side Vegetation

(1) Many of Alexandria's tributaries lack the stream-side vegetation that helps to filter pollutants and moderate water temperatures. Because of limited opportunities for revegetation of denuded stream buffers in the City, Alexandria must be proactive in identifying denuded buffer areas and habitat that can be restored. The City will identify, characterize, and map stream-side areas which have limited or no vegetation but have the potential to be restored (in conjunction with Action 2 under Wildlife Habitat Corridors). The City will identify areas which can be revegetated through the redevelopment process (see Action 2 under Redevelopment Areas) or through coordination with citizen volunteers and not-for-profit groups (primarily projects on publicly-owned land) and prioritize areas which will most benefit water quality and wildlife habitat.

Floodplains

(1) The City will protect residences and businesses from the potentially devastating effects of flooding by prohibiting inappropriate development within floodplains as designated by the Federal Emergency Management Agency. Floodplains are protected in the City through vigorous enforcement of the City's Floodplain Overlay District, which, among other requirements, states that new structures must be appropriately flood proofed and that new structures and/or alterations to existing structures may not increase flood levels by more than one-half foot. The City's floodplain map is up-to-date (last revised in 1991).

Groundwater Recharge Areas

(1) Since Alexandria's primary groundwater recharge areas are already built upon, the City's Chesapeake Bay Preservation Ordinance provision to minimize impervious surface area during development and redevelopment is the most effective means of promoting overall groundwater recharge. Groundwater recharge is also promoted by a provision in the CBPO that allows a developer to meet performance criteria requirements by reducing existing impervious surface cover by 20% during redevelopment.

(2) In many areas of the City, extensive groundwater recharge is not possible or desirable due to the prevalence of marine clays and shallow hardpans and the close proximity of foundations and basements. Where site-specific groundwater recharge is appropriate, the City will continue to encourage the use of infiltration BMPs for pollution mitigation, including infiltration trenches and bioretention facilities. The City is recognized as a leader in these BMP technologies.

PROTECTION OF WATER QUALITY

V.2

Pollution problems faced by the City are far more complex than most Northern Virginia localities. Alexandria is one of the few localities in the region that has experienced a degree of heavy industrialization. In addition, Alexandria has some of the largest concentrations of commercial activity, which are associated with large areas of impervious surfaces, in Virginia. Alexandria is also one of the few remaining urban localities in the nation in which portions of the citizenry are served by a combined sewer system (CSS).

The complexity of urban water quality issues in Alexandria requires that the City commit to an integrated approach to watershed management. Integrated watershed management involves the strategic use of structural (urban BMPs, etc.) and nonstructural (public education, reestablishment of stream buffers, etc.) water quality management techniques to address a range of sources and types of pollution. It also involves a recognition that water quality protection requires not only interdepartmental coordination, but planning among Alexandria's neighboring jurisdictions, specifically Arlington County, Fairfax County, and the City of Falls Church. By taking this approach, water quality protection and habitat restoration efforts can be maximized. Actions discussed in this section should be thought of in terms of this integrated approach and not as divorced or separated from one another.

Need for Regional Coordination

Because watersheds and airsheds very seldom match political boundaries, regional coordination of environmental and water quality protection efforts is essential. For instance, the airshed of the Chesapeake Bay is over nine times the size of its watershed – stretching to Ohio, Kentucky, and Indiana. Alexandria participates in a variety of regional efforts including the Metropolitan Washington Council of Governments and the Northern Virginia Regional Commission. An example includes Alexandria's funding of, and participation in, the Northern Virginia Regional Commission's Four Mile Run Program. This program, which had previously served to address interjurisdictional flooding issues, has recently been expanded to include water quality issues. In addition, the City participates in the activities of the federal Chesapeake Bay Program.

Point Source Pollution

(1) Of all of the City's programs, the Alexandria Sanitation Authority's upgrades to the Alexandria Wastewater Treatment Facility will have the most significant impact on water quality. The City will continue to support the ASA's efforts to meet new environmental goals and standards.

(2) The City's combined sewer system (CSS) currently operates under a Virginia Pollutant Discharge Elimination System (VPDES) permit granted by the Department of Environmental Quality. To maintain its VPDES permit, the City must meet, document, and report on "Nine Minimum CSO Controls." The City, through the Department of Transportation and Environmental Services, will continue to meet and exceed the requirements of the City's VPDES permit.

(3) An aging stock of above ground storage tanks is a significant potential threat to water quality. The City will work with the area's fuel oil companies (several of which are located within the City) to have them distribute above ground and underground storage tank safety educational materials to owners and fillers of above ground storage

tanks. The City will look to the Virginia Department of Environmental Quality for assistance.

(4) Underground storage tanks are a significant source of groundwater contamination in the City. Enforcement of UST regulations is the responsibility of the Virginia Department of Environmental Quality. The City, through the Department of Transportation & Environmental Services and Code Enforcement, will continue to work with the VADEQ to address the continuing problem of failing underground storage tanks. Chapter 795 of the Code of Virginia (enacted in 1998), now requires the VADEQ to compile a list of the locations of oil releases which are serious enough to have site characterizations performed and to send the list to local Health Departments (through the State Health Department). This new regulation should greatly enhance communication between VADEQ and Alexandria on the subject of UST remediation and management.

(5) Only a handful of septic systems remain within the City limits. Since the location of these septic systems in the City is for the most part unknown (records were lost in various boundary adjustments with Fairfax and Arlington counties), septic failures should be dealt with on a problem-specific basis. The City will continue its policy of converting homes with failed septic systems to public sewer.

(6) The City has initiated several short term and long term steps to minimize the Sanitary Sewer Overflows (SSO) to Four Mile Run from the Four Mile Run Pump Station which is owned and operated by Alexandria Sanitation Authority.

A 650,000 gallon storage tank was put in service in 1998 as a result of the proffer by the developer of Potomac Yard Retail Center. An additional tank is to be installed by the developer of Lincoln Properties that is scheduled to be completed by June 2001. This will increase the storage capacity to a total of 1 million gallons. These tanks are designed to intercept sanitary sewer overflows that would otherwise be released into Four Mile Run, significantly reducing the frequency and volume of sanitary sewer overflows into Four Mile Run.

As part of long term strategy, an Inflow and Infiltration (I&I) reduction program has been initiated by the City. The I&I sewer survey started in Four Mile Run Sewer Service area in November 2000 after an extensive public information effort. This will be a multi-phase, multi-year effort to identify sources of infiltration and inflow in the collection system and develop and implement a program to repair the deficiencies.

Also the developers of Potomac Yard are required to build Potomac Yard Trunk Sewer at their cost to convey the wastewater from the yard to treatment plant. This system will not only convey the wastewater from future developments in the yard, but additionally will provide for flexibility of pump over during wet weather from Four Mile Run Pump station to the new trunk sewer. It will also eliminate the River Road pump station and its service area will be served by the new trunk sewer. These measures give operational flexibility at the Four Mile Run Pump Station and relieves the Commonwealth Interceptor.

The combination of efforts listed above will result in a reduction of SSO incidents at Four Mile Run Pump Station in short term and eliminate the SSOs in the long term.

Nonpoint Source Pollution

(1) The City will protect its tributary streams and the Chesapeake Bay from nonpoint source pollution through the continued application of its Chesapeake Bay Preservation Ordinance and Erosion and Sediment Control Ordinance.

(2) The City will continue to be a leader in the field of innovative BMP technologies and will

continue to vigorously pursue its Targets of Opportunity Retrofit Program. BMPs used in the City of Alexandria include:

- Sand Filtration Systems
- Compound Aggregate Filters
- Bioretention and Bioretention Filters
- Rock-Plant Filters
- Stormwater Wet and Dry Ponds
- Infiltration Trenches/Basins

(3) The City will assure the long-term viability of private BMPs through regular site inspections and the continued enforcement of BMP maintenance provisions.

(4) A pollutant of great concern from a human health standpoint is fecal coliform bacteria which is generally attributed to over populations of certain wildlife, resident wildfowl, leaking sanitary sewer lines, and pet waste. Fecal coliforms, while not necessarily harmful in themselves, are indicative of fecal contamination and the possible presence of pathogenic organisms. Four Mile Run and Hunting Creek are both classified as "impaired" streams by the VADEQ because of fecal coliform contamination. A 2000 study conducted by the Northern Virginia Regional Commission and Virginia Tech in cooperation with affected localities used DNA fingerprinting to identify the primary sources of bacteria. The results show that bacteria come primarily from waterfowl, with significant contributions also coming from humans, raccoons, and dogs. The effort will allow Alexandria and its neighbors to target prevention efforts.

As a means of addressing the portion of bacteria from pet waste, the City adopted a Master Plan for Dog Exercise Areas in the fall of 2000 which includes requirements for providing plastic bags at dog runs or along major dog exercise areas and the strategic placement of waste receptacles to encourage the proper disposal of dog waste. The Plan also requires that new dog exercise areas be located more than 75 feet from bodies of water.

(5) The City will continue to reduce the threat of fecal contamination of local streams from sanitary sewer lines. Ongoing inspection and maintenance, coupled with recent efforts to reduce inflow and infiltration of stormwater and groundwater into sewer lines into the sewershed, will help minimize human sources of fecal contamination.

(6) Major City outreach programs aimed at helping businesses and residents to prevent pollution include its Household Hazardous Waste Collection Day program, the Alexandria Earth Day program, and the Best Management Practices Manual for Automotive Related Industries. There is a need for additional coordinated and ongoing programs to prevent pollution from a wider array of sources. This is particularly true of pollution resulting from the residential and commercial use of lawn and garden care products, including fertilizers and pesticides. Overall efforts by the City are hampered because there is no dedicated staff for these types of outreach efforts.

(7) The City will invite representatives from the Virginia Cooperative Extension to inform the City of available resources to help residents and businesses reduce pollution resulting from the use of lawn and garden care products and to help the City put together a pollution prevention strategic plan that maximizes the use of existing resources.

(8) Limited water quality monitoring within the City is insufficient to help staff locate and manage nonpoint sources of pollution. Existing stations are located at the lower reaches of the City's two major waterbodies. Pollution that is detected at these stations could have come from anywhere within the Four Mile Run or Cameron Run watersheds, which are 19.7 and 44.5 square miles, respectively. As a result, it is difficult to focus pollution prevention efforts in a timely and meaningful manner. The City has, and will continue to seek grant funding to implement a system of continuous monitoring stations that will enable the City to develop a strong and effective public outreach program based

on actual data and allow the City to reduce pollution by providing a tool to locate actual pollution sources. The City will also pursue public-private partnerships and volunteers to assist in water quality monitoring in the City. The City will work with the Alexandria Sanitation Authority that has a water quality testing laboratory and has expressed a willingness to participate in the City's pollution prevention efforts.

(9) The City will pursue adding to its web page a means of advertising environmental programs (including City manuals and publications) and exchanging environmental information.

(10) The City's Household Hazardous Waste Collection Days program and the Best Management Practices Manual for Automotive Related Industries program will be continued. However, there is a need to recruit more facilities to collect used antifreeze and used oil on a consistent basis. Voluntary participation and the City's special use permit system will be used to increase the number of service stations participating in the program. While the Department of Parks and Recreation has provided public information to pollution "hot spots" on recycling center locations, there is not a way to disseminate this information on a more consistent basis. The City will investigate ways to increase the advertising of collection sites as a way to entice businesses to join the program.

(11) The City will continue its street sweeping program and consider the purchase of Best Available Technology that will capture smaller pollution particles as older equipment is retired.

(12) The City will examine the feasibility of establishing a minimum percentage of vegetated space to satisfy the City's current open space requirements. This will help to promote infiltration of stormwater into the soil and reduce stormwater runoff.

Thermal Pollution

(1) While thermal pollution does not have the visual impact that most pollution has on the casual observer, the impact to aquatic species can be devastating. Thermal pollution is caused by the removal of tree canopy cover during development and its replacement with impervious surface area (and especially blacktop, which absorbs heat at very high rates). As a result, stormwater runoff from a typical summer storm causes a thermal pulse to occur in the local stream. Thermal shock to aquatic species can occur when the temperature of a stream changes more than 3 to 4° in 24 hours or less. In the Four Mile Run, stream temperatures have been measured to rise as quickly as 10°F in a single hour during the first flush of a summer squall. The City will continue to address the affects of thermal pollution through provisions of the Zoning Ordinance that require tree canopy for parking lots and other large areas of heat-generating impervious cover. It is important that parking lot trees are recognized as serving more than just an aesthetic function in the landscape. The City will consider ways of encouraging the use of other heat-reducing techniques – including the use of concrete, the mixing of light colored sands into asphalt, and the use of lighter colored roofing materials – especially where tree canopy is not a viable alternative. The City will also encourage the use of "green roof" techniques as an alternative to conventional roofs. The City will investigate incentives to retrofit existing parking areas with heat-reducing measures. The City will provide increased guidance on which trees are suited for harsh parking lot conditions and will continue to ensure that parking lot trees are adequately maintained.

Water Conservation

(1) The City will encourage the Virginia-American Water Company to distribute with local water bills a water conservation brochure that is currently under development by the Fairfax County Water Authority.

(2) The City will encourage the use of water from BMPs to be recycled as irrigation water, which will also reduce the requirement for fertilizers, since BMP water is typically nutrient rich. Any such efforts should be coordinated with the Health Department.

Erosion of the Land

(1) The primary means for controlling erosion of the land is the City's Erosion and Sediment Control Ordinance as well as its requirements to implement on-site stormwater detention for development and redevelopment in the City. There are now over 135 of these detention structures located in the City. This program will continue to be implemented vigorously in order to protect remaining natural streams from high volumes and velocities of stormwater runoff.

Air Pollution

(1) Airborne deposition of pollutants accounts for up to a quarter of pollution entering the Chesapeake Bay. The City has been at the forefront of air quality monitoring in the region and will continue to work through the Metropolitan Washington Air Quality Committee to reduce mobile and stationary sources of airborne pollution.

Waterfront and Dock Activities

(1) The City will work with the Department of Environmental Quality and the Virginia Marine Resources Commission to develop a pollution prevention program for the City's docks. The City will periodically invite the Virginia Marine Resources Commission to address local marina operators about how to prevent nonpoint source pollution.

(2) In lieu of a stringent water quality monitoring program, the City will work to implement signage at the City's public marinas and boardwalk areas informing users that polluting the water is a violation of federal Clean Water Act with a number to call to report suspected violations. Adequate provisions for the deposit of waste will continue to be made.

Areas of Special Concern

(1) The Department of Transportation and Environmental Services' Division of Environmental Quality will continue to work with the VADEQ' s Voluntary Remediation Program and federal authorities to identify and mitigate areas of special concern including the creosote problem at the Alexandria Gas Works/Oronoco site and continue to monitor the Potomac Yards site and the Bogle Chemical Company site for any signs of continuing contamination or adverse affects on human health, water quality, and aquatic resources.

SHORELINE PROTECTION AND EROSION CONTROL

V.3

Stream Bank Erosion Control and Stabilization

Most of Alexandria's waterways have been hardened or channelized to stabilize eroding stream banks and to increase carrying capacity. While stream hardening will continue to be necessary, depending on the specific problem, a number of alternative options may exist. The City will address erosion problems associated with remaining natural, but physically degraded streams on a site-specific basis and recognizes the need for flexibility in the remediation process.

(1) Channelized Streams: Most of Alexandria's channelized streams are designed to control a specific flood volume and in some cases the City is legally bound to clear vegetation and silt that may reduce a stream's carrying capacity. To help increase public understanding of the need for managing flood control channels, the City will develop a map identifying flood control channels that require periodic clearing. To mitigate the loss of vegetation, the City will investigate the purposeful planting and maintenance of high-canopy native vegetation above the 100-year flood level (or above any flood control structures which extend beyond the 100-year flood level).

The vegetation that typically grows on the banks or silts of flood control channels are fast growing, hardy, low-lying edge-of-the-forest species. Due to their low lying nature and vigorous growth, these types of vegetation are precisely what needs to be avoided. For areas where the clearing of low-lying vegetation has been determined to be necessary for flood control purposes, the City will minimize the use of herbicides for clearing vegetation.

Any replacement vegetation must be placed in a way that will not impact the physical integrity of the flood control channel. High-canopy vegetation will provide shade and some habitat while avoiding potential impacts to flood carrying capacity and the structural stability of the flood control structure. Native, high canopy, moisture loving vegetation that may be appropriate include sycamore and beech. Areas immediately around the channel may be maintained as a native wildflower meadow, low-lying native vegetation, or as a grassy area if a manicured look is desired.

(2) Natural Streams: Natural streams which are experiencing moderate to severe erosion problems will be addressed on a site-specific basis. Depending on specific site and fiscal constrains, the City may consider a range of techniques including, but not limited to, bioengineering, stream by-pass, natural stream adjustment, and stream hardening.

The City will actively seek to establish a bioengineering demonstration site as an example of the circumstances under which the technique is appropriate.

Stream Corridor Management

Management of the City's remaining stream corridors is made difficult by the fact that these streams can, and often do, serve multiple functions including natural open space, buffering between land uses, wildlife habitat, and flood control. Many of these stream corridors are also designated Resource Protection Areas under the City's Chesapeake Bay Preservation Ordinance. Unfortunately, these functions often come into conflict with one another. For instance, management for flood control purposes may require clearing of vegetation while management for wildlife habitat purposes would suggest that vegetation should be encouraged. Similarly, management for erosion control will require different approaches depending on site-specific goals and constraints.

In order to reduce the conflicts that arise over the management of the City's remaining stream corridors, and to provide increased communication on issues and options, the City will develop an evaluation procedure for dealing with stream erosion and flood control management issues when they conflict with Chesapeake Bay preservation and wildlife habitat goals. The City will develop stream specific maintenance plans that try to minimize the impact on the environment and wildlife habitat including minimizing the use of herbicides for clearing vegetation. The Chesapeake Bay Local Assistance Department will be consulted during the development of this procedure to ensure that it is compatible with the Chesapeake Bay preservation Area Designation and Management Regulations.

Potomac River Shoreline and Bulkhead Management

In addition to eroding streambanks, several bulkheads along the Potomac River shoreline have been identified as being in poor condition. In some cases, active undercutting and erosion are taking place (see Figure II.7). Examples include bulkheads near the Wilson Bridge, the Old Town Yacht Basin, areas along Jones Point, and the Dandy docking/parking facility. Dilapidated bulkheads must be addressed by the developer during any waterfront redevelopment project. It is anticipated that spot redevelopment along the Potomac River, planned redevelopment of the Old Town Yacht Basin, and the reconstruction of the Woodrow Wilson Bridge will result in the rehabilitation of a significant majority of the City's dilapidated bulkheads.

PUBLIC AND PRIVATE ACCESS TO WATERFRONT AREAS

V.4

The City recognizes the value and importance of its waterfront and ensuring that there is adequate public access to these areas has long been a high priority of the City. Conversely, the City recognizes that waterfront access and use can affect water quality and that sensitive shoreline features may constrain where access and development is appropriate. Constraints include floodplain areas, areas that experience siltation and debris accumulation, and unstable edge conditions.

The 1983 "Alexandria Waterfront Design Plan" and other joint planning efforts with the National Park Service serve as the basis for current efforts to increase public access to the Potomac River. While most of the elements of the Design Plan have already been implemented, the City's Waterfront Committee and Parks and Recreation Commission continue to make specific recommendations for the few remaining undeveloped or nonconforming waterfront parcels.

These planning efforts will take into consideration the need to properly manage and protect sensitive natural resources and to protect water quality while seeking to achieve increased opportunities for public access to the waterfront.

REDEVELOPMENT AREAS

V.5

Most development within the City, with the exception of a few remaining parcels, will take place in the form of redevelopment. The City of Alexandria will use the redevelopment process as an opportunity to improve water quality to its local tributaries and the Potomac River and the Chesapeake Bay. The City will achieve water quality improvement through the redevelopment process in the following manners.

(1) The City's Chesapeake Bay Preservation Ordinance will be used to reduce nonpoint source pollution from redevelopment by 10% from existing site conditions or to reduce the imperviousness of a site by 20%.

(2) The City's Chesapeake Bay Preservation Ordinance will be used to reestablish, when possible, Resource Protection Areas and buffers adjacent to water bodies, including vegetation within the RPA buffer areas. When impacts are unavoidable, the City will work to minimize the impacts and require mitigation either on site or offsite.

(3) The City will continue to promote its Targets of Opportunity Urban Retrofit Program by working with private developers to voluntarily retrofit existing urban development in addition to controlling runoff from the actual development/redevelopment site.

(4) The City will continue to use the redevelopment process as a catalyst for remediating areas which have experienced contamination as a result of industrial activity, leaking underground storage tanks, dumping, or waste disposal activities.

(5) When redevelopment of an area is large enough to consolidate significant parcels, the City will work with the developer to identify remaining sensitive natural resources and consider using cluster development to avoid or minimize further impact to these resources.

OVERALL COORDINATION AND OUTREACH

V.6

Water quality management is primarily the responsibility of the Department of Transportation and Environmental Services, with support from the Department of Planning and Zoning, the Department of Parks, Recreation, and Cultural Activities and the Code Enforcement Bureau.

There is a need to provide a more focused approach to water quality management and coordinate among the City departments on environmental issues that impact water quality within the City. There is also a need for increased coordinated

outreach to citizens and businesses on how to prevent pollution from entering the water in the first place. Many of the City's departments have taken on outreach programs to address specific, acute problems. While public outreach and coordination are largely voluntary components of the City's water quality protection efforts, new federal Clean Water Act regulations (40 CFR Parts 122 and 123) will require the City to demonstrate that it is taking actions to provide materials or develop outreach programs to inform individuals and households about steps that can be taken to reduce stormwater pollution. This new mandate will require that the City submit a National Pollution Discharge Elimination System (NPDES) Permit around the year 2002 and demonstrate full compliance by mid-2007.

In an effort to address these concerns the City will establish an Environmental Coordination Group (ECG) with representation from the departments of Transportation and Environmental Services, Planning and Zoning, and Parks, Recreation, and Cultural Activities. Other departments or organizations will participate as needed. The Environmental Coordination Group will facilitate the coordination of environmental issues with a focus on water quality management and public education and outreach programs for the City. Responsibilities will include using the City's web site as a means of sharing environmental information with the public and among City agencies. This group will also facilitate the review of environmental impacts of significant projects in the City.

In addition, the City consolidated many of its environmental programs under the Department of Transportation and Environmental Services and within that department created a new Division of Environmental Quality (AlexDEQ). AlexDEQ responsibilities include watershed management, including stormwater quality management and implementation of the Chesapeake Bay Preservation Ordinance, reviewing soil and erosion plans, coordinating contaminated land issues, and administering the air and noise pollution programs. The AlexDEQ will also work closely with other sections within T&ES such as Engineering and Maintenance whose responsibilities include sanitary and storm sewers and stream maintenance, which have significant impacts on water quality.

Finally, T&ES will continue to work with regional and State partners responsible for water quality programs, regulations, and initiatives including the Northern Virginia Regional Commission, the Metropolitan Washington Council of Governments, the Chesapeake Bay Local Assistance Department, the Virginia Department of Environmental Quality, and the Virginia Department of Conservation and Recreation.

POTENTIAL FUNDING AND ENFORCEMENT MECHANISMS

V.7

While water quality and environmental management can result in cost savings by reducing the need for cleaning up pollution, the upfront costs can be discouraging. There are, however, several means by which the City can raise the necessary revenue to implement State and federal mandates as well as locally identified stormwater management projects and programs. Funding for the programs, capital projects and activities discussed in this supplement will require a varying degree of continuing or new City funding. As is the case with all City funding, this funding is determined in the City's annual operating budget and capital improvement program development process (in competition with other City needs) and is subject to appropriation by City Council. Non-tax sources are one area to consider. Some of these options are discussed below.

Pro Rata Share Off-Site Drainage Facility Program

The purpose of a pro rata share program is to require land developers to pay their share of the cost of providing off-site drainage improvements made necessary, or required at least in part, by the development of land. The ultimate objective of the pro rata share program is to provide a supplemental funding source to implement adequate drainage facilities and to minimize damage to the drainage network. Section 15.2-2243

of the Code of Virginia allows a locality to "provide in its subdivision ordinance for the payment by a subdivider or developer of land of the pro rata share cost of providing reasonable and necessary sewerage, water, and drainage facilities, located outside of the land owned or controlled by the subdivider or developer…"

The maximum amount of revenue that can be collected through this program is limited to the increased cost of drainage facilities that are required to accommodate increased development from new development or redevelopment. Items that may be included are and acquisition, design, utility relocation, construction, and administrative costs. The proportionate share is calculated by determining the increase in imperviousness as a result of the development and comparing it to the difference between existing watershed imperviousness conditions and future build out conditions.

A hypothetical example of how to calculate pro rata share is as follows.

- The locality anticipates that future stormwater management efforts will cost $4,000,000.
- The current rate of watershed imperviousness is 41%, or 1,102 acres, and the anticipated build out rate of imperviousness is 50%, or 1,344 acres. This means an anticipated increase in imperviousness of 242 acres.
- The rate is determined by taking the cost of the proposed projects and multiplying it by the ratio of the increase in impervious area to the total impervious area at build out (242/1,344). The result, $720,238, is the maximum amount that can be assessed of developers in the watershed.
- For a dollar amount per acre, $720,238 is divided by the total increase in impervious area (242). The result is $2,976.19 per impervious acre.

Most other Northern Virginia localities have adopted a form of pro rata share program. The City's Department of Transportation and Environmental Services should investigate the benefits of implementing a pro rata share program.

Stormwater Utility

The purpose of a stormwater utility (or stormwater tax/service charge) is to provide an ongoing source of revenue to offset the costs of stormwater management. Under Section 15.2-2114 of the Code of Virginia, income derived from these charges may be used to pay or recover costs for the following:

- The acquisition of real and personal property, and interest therein, necessary to construct, operate, and maintain stormwater control facilities;
- The cost of administration of such programs;
- Engineering and design, debt retirement, construction costs for new facilities, and enlargement or improvement of existing facilities;
- Facility maintenance;
- Monitoring of stormwater control devices;
- Pollution control and abatement, consistent with State and federal regulations; and,
- Planning, design, land acquisition, construction, operation, and maintenance activities.

Charges may be assessed to property owners or occupants, including condominium unit owners or tenants, and should be based upon their contributions to stormwater runoff. Waivers are mandated for federal, State, and local agencies, roads and public rights-of-ways, and anyone who owns and maintains a private storm drainage facility.

Jurisdictions in Virginia which have implemented stormwater utility fee programs include Virginia Beach, Chesapeake, Newport News, Norfolk, Hampton, and Prince William County. After much consideration, Fairfax County tabled the idea of implementing a stormwater utility. Utility fees range from $1.50 per month per residential unit in Prince William County to $4.50 per month per residential unit in Norfolk.

The City should monitor the continued implementation of stormwater utility in other jurisdictions and, if fiscal need warrants, investigate the feasibility of an Alexandria stormwater utility.

Grant Opportunities

There are a number of federal and State grant programs that can help defray the costs of planning and implementing stormwater management programs. Common sources include:

- Chesapeake Bay Local Assistance Fund
- Virginia Coastal Resources Management Fund
- Virginia Water Quality Improvement Fund
- Watershed Restoration Grants
- Water Quality Management Planning Grants
- Small Watershed Grant Program
- Virginia Environmental Endowment
- Chesapeake Bay Restoration Fund

The City will continue to apply for these grants as a way of stretching public funding for water quality improvement measures.

Chesapeake Bay Preservation Act Civil Penalties

The 1998 General Assembly enacted legislation that provides localities with a new tool to enforce local Chesapeake Bay Preservation Ordinances. The revised Chesapeake Bay Preservation Act allows localities to amend their local ordinance to impose a penalty of $1,000 per day per penalty up to $10,000. Currently, to stop a violation of the CBPO a localities must obtain a stop-work order from a judge. Local incorporation is considered a minor program amendment and is subject to Chesapeake Bay Local Assistance Board review.

The City should investigate the benefits of incorporating language provided in Section 10.1-2109.E of the Code of Virginia. Timing should be coordinated with expected changes to the Chesapeake Bay Preservation Area Designation and Management Regulations.

IMPLEMENTATION SUMMARY AND TIME-LINE

V.8

This section outlines the responsibilities and timelines for implementing the actions identified in Section V. For each action item, information is provided on Time Frame, Potential Cost, and Implementing Agency. Each action statement is also cross-referenced with the action-item explanation in Section V.

To track progress and monitor the implementation and effectiveness of the proposed action items, City staff will provide regular updates to the City's Environmental Policy Commission (EPC). In addition, the EPC's annual report to City Council will include a water quality section that evaluates progress on implementation of the action items and makes recommendations on policy and priorities.

Each action item is scheduled to be achieved on an ongoing basis or within a time frame that is short – defined as within 24 months of adoption – or long – defined as within 5 to 6 years. Costs take into account only those required by new activities. Acronyms for Implementing Agency are:

- Transportation and Environmental Services (T&ES)
- Planning and Zoning (P&Z)
- Parks, Recreation, and Cultural Activities (PR&CA)

NEW INITIATIVES

ACTION STATEMENT	TIME FRAME	COST	AGENCY RESPONSIBILITY	REFERENCE
The City will incorporate into each Small Area Plan a discussion of long range water quality protection strategies, SAP-specific Chesapeake Bay Preservation Area maps, and an SAP-specific analysis of opportunities to protect and improve water quality through development and redevelopment opportunities.	Concurrent with Five Year Planning Cycle	No Additional Cost	P&Z, T&ES	Role of Small Area Plans
The City will work with the National Resource Conservation Service to produce an updated soils map of Alexandria.	Long Term	Yes/Variable	T&ES	Geology and Soils (2)
When redevelopment of an area is large enough to consolidate significant parcels, the City will work with the developer to identify remaining sensitive natural resources and consider a cluster development to avoid or minimize impacts to these resources.	Ongoing	No Additional Cost	T&ES/P&Z	Redevelopment Areas (5)
Opportunities to restore degraded wetlands will be explored, and should be explored as part of any large project, including the reconstruction of the Woodrow Wilson Bridge.	Ongoing	Yes/Variable	T&ES	Wetlands(3)
Additional opportunities for using wetlands as educational tools will be investigated.	Long Term	Yes/Low	T&ES/ /PR&CA	Wetlands(2)
The City will identify, characterize, and map remaining significant natural habitat areas including streams and stream valleys as well as isolated groves.	Short Term	Yes	PR&CA	Wildlife Habitat Corridors(2)

ACTION STATEMENT	TIME FRAME	COST	AGENCY RESPONSIBILITY	REFERENCE
The City will identify, characterize, and map stream-side areas which have limited or no vegetation but have the potential to be restored and prioritize areas for targeted revegetation efforts.	Long Term	Yes	PR&CA/T&ES	Stream-Side Vegetation (1)
If current VDOT efforts to improve stream valley corridors for wildlife are successful, the City will examine the feasibility of developing similar standards for new or reconstructed City roads.	Long Term	Yes/Mod.	T&ES	Wildlife Habitat Corridors(3)
The City will work with the area's fuel oil companies to distribute above ground and underground storage tank safety education materials.	Short Term	Yes/Low	T&ES/ Code Enforcement, Fire Marshall	Point Source Pollution(3)
The City will develop a strategic plan for reducing fecal coliform bacteria in Alexandria's streams based on the findings of the Northern Virginia Regional Commission's 2000 DNA fingerprinting study.	Short Term	Yes	T&ES	Nonpoint Source Pollution(4)
The City will develop ways to better enforce animal waste control laws and to encourage proper disposal of pet waste	Short Term	Yes/Low	T&ES/PR&CA	Nonpoint Source Pollution(4)
The City will continue its sanitary sewer system inspection and maintenance program to reduce the threat of fecal contamination of local streams from leaking sewer lines.	Ongoing	No Additional Cost	T&ES	Nonpoint Source Pollution(5)

ACTION STATEMENT	TIME FRAME	COST	AGENCY RESPONSIBILITY	REFERENCE
The City will invite the Virginia Cooperative Extension to help formulate a pollution prevention strategic plan that focuses on the use of lawn and garden care products and maximizes the use of existing resources.	Short Term	No Additional Cost	T&ES/Health	Nonpoint Source Pollution (7)
Continue to seek grant funding to implement a comprehensive water quality monitoring system.	Short Term	Yes/Low	T&ES/Health	Nonpoint Source Pollution(8)
Establish a multi-departmental Environmental Coordination Group (ECG) to coordinate the City's environmental policies and public outreach on environmental issues.	Short Term	Yes	T&ES/P&Z/PR&CA	Overall Outreach and Coordination
The City will add to its web page a means of advertising environmental programs (including City manuals and publications) and exchanging environmental information.	Short Term	Yes/Low		Nonpoint Source Pollution(9)
The City will increase the advertising of used oil collection sites as a way to entice business to join the program.	Short Term	Yes/Low	T&ES	Nonpoint Source Pollution(10)
The City will examine the feasibility of establishing a minimum percentage of vegetated space to satisfy the City's current open space requirements.	Short Term	No Additional Cost	T&ES/P&Z	Nonpoint Source Pollution(12)
The City will encourage heat reducing techniques including the use of street/parking lot trees, light colored asphalt/roofing materials, and the use of "green" building techniques such as "green" roofs.	Short Term	Yes/Low	T&ES/P&Z	Thermal Pollution(1)

ACTION STATEMENT	TIME FRAME	COST	AGENCY RESPONSIBILITY	REFERENCE
The City will investigate incentives to retrofit existing parking areas with heat-reducing measures.	Long Term	Yes/Low	T&ES/P&Z	Thermal Pollution(1)
The City will provide increased guidance on which trees are suited for harsh parking lot conditions and will continue to ensure that parking lot trees are adequately maintained.	Short Term	Yes/Low	T&ES/P&Z	Thermal Pollution(1)
Encourage the Virginia-American Water Company to distribute water conservation information with utility bills.	Short Term	No Additional Cost	T&ES	Water Conservation(1)
Work with the Virginia Marine Resources Commission to develop a pollution prevention program for the City's docks.	Short Term	Yes/Low	T&ES	Waterfront and Dock Activities(1)
Implement signage at public marinas that informs users that dumping is a violation of the Clean Water Act and a provides a number to call to report violations.	Short Term	Yes/Low	T&ES	Waterfront and Dock Activities(2)
Continue to work with Virginia DEQ to identify and mitigate areas of special concern including the creosote problem at the Alexandria Gas Works/Oronoco Site.	Ongoing	Yes	T&ES	Areas of Special Concern(1)
Develop a map of City flood control channels for public education purposes.	Short Term	Yes/Low	T&ES	Streambank Erosion Control and Stabilization (1)
Plant flood control channels with high-canopy vegetation to reduce the impacts of needing to remove low-lying vegetation.	Short Term	Yes/Mod.	T&ES/PR&CA	Streambank Erosion Control and Stabilization (1)

ACTION STATEMENT	TIME FRAME	COST	AGENCY RESPONSIBILITY	REFERENCE
Address natural streams that are experiencing erosion problems on a site specific basis. Consider a range of techniques including bioengineering, stream by-pass, natural stream adjustment, and stream hardening.	Ongoing	Yes/Variable	T&ES/PR&CA	Streambank Erosion Control and Stabilization (2)
Actively seek a location for a bioengineering demonstration site.	Long Term	Yes/Mod.	T&ES/PR&CA	Streambank Erosion Control and Stabilization (2)
The City will develop in consultation with CBLAD an evaluation procedure for dealing with conflicts between erosion and flood control management and Chesapeake Bay preservation and wildlife habitat management.	Short Term	No Additional Cost	T&ES/PR&CA	Stream Corridor Management
The City will use the redevelopment process to rehabilitate dilapidated Potomac River bulkheads.	Long Term	No Additional Cost	T&ES/P&Z/PR&CA	Potomac River Shoreline and Bulkhead Management
Investigate the benefits of implementing a pro rata share stormwater program to help offset the costs of stormwater management.	Short Term	Yes	T&ES	Potential Funding and Enforcement Mechanisms
Monitor continued implementation of stormwater utility in other jurisdictions for potential future implementation.	Long Term	No Additional Cost	T&ES	Potential Funding and Enforcement Mechanisms
Continue to pursue grant funding for water quality improvement projects.	Ongoing	Yes/Variable	T&ES/P&Z//PR&CA	Potential Funding and Enforcement Mechanisms
Investigate the benefits of incorporating civil penalties into the Chesapeake Bay Preservation Ordinance.	Short Term	No Additional Cost	T&ES/P&Z	Potential Funding and Enforcement Mechanisms

CONTINUED INITIATIVES

ACTION STATEMENT	TIME FRAME	COST	AGENCY RESPONSIBILITY	REFERENCE
The City will continue enforcement of its Chesapeake Bay Preservation Ordinance.	Ongoing	No Additional Cost	T&ES/P&Z	Wetlands(1), Nonpoint Source Pollution(1), Redevelopment Areas(1)(2)
The City will continue enforcement of its Erosion and Sediment Control Ordinance.	Ongoing	No Additional Cost	T&ES/P&Z	Topography(1), Nonpoint Source Pollution(1), Erosion of the Lane(1)
The City will continue enforcement of the Virginia Uniform Building Code.	Ongoing	No Additional Cost	T&ES	Geology and Soils(1)
The City will continue enforcement of its Floodplain Overlay District.	Ongoing	No Additional Cost	T&ES/P&Z	Geology and Soils(1), Floodplains(1)
The City will continue to coordinate regionally on water quality management issues.	Ongoing	No Additional Cost	T&ES/P&Z	Need for Regional Coordination(1)
Except for where flood control or utility maintenance is a consideration, existing stream valley habitat corridors will remain in a natural state with provisions made for passive recreational opportunities.	Ongoing	No Additional Cost	T&ES/P&Z	Wildlife Habitat Corridors(1)
Continue to use the redevelopment process as a catalyst for identifying and remediating contaminated sites.	Ongoing	No Additional Cost	T&ES/P&Z	Redevelopment Areas(4)
The City will continue to promote its Targets of Opportunity Urban Retrofit Program.	Ongoing	Yes/Variable	T&ES	Redevelopment Areas(3)

ACTION STATEMENT	TIME FRAME	COST	AGENCY RESPONSIBILITY	REFERENCE
The City will use its Chesapeake Bay Preservation Ordinance to protect and reestablish, where possible, vegetation within the buffer area of the City's Resource Protection Areas.	Ongoing	No Additional Cost	T&ES	Redevelopment Areas (2)
Where appropriate, the City will promote groundwater recharge through minimization of impervious surfaces and by encouraging the use of infiltration BMPs for pollution management.	Ongoing	No Additional Cost	T&ES/P&Z	Groundwater Recharge Areas(1)(2)
The City will continue to meet and exceed the requirements of its permit to operate a combined sewer system (CSS). The City will act to minimize the number and volume of CSO overflows and continue to work towards eliminating sanitary sewer overflows.	Ongoing	No Additional Cost	T&ES	Point Source Pollution(2)
The City will continue to support the Alexandria Sanitation Authority's efforts to upgrade the Alexandria Wastewater Treatment Facility.	Short Term	No Additional Cost	T&ES	Point Source Pollution(1)
The City will continue to work with the Department of Environmental Quality to minimize environmental threats from underground storage tanks.	Ongoing	No Additional Cost	Health	Point Source Pollution(4)
The City will continue its policy of converting homes with failed septic systems to public sewer.	Ongoing	No Additional Cost	Health/T&ES	Point Source Pollution(5)
The City will continue to be a leader in innovative BMP technologies.	Ongoing	No Additional Cost	T&ES	Nonpoint Source Pollution(2)

ACTION STATEMENT	TIME FRAME	COST	AGENCY RESPONSIBILITY	REFERENCE
The City will assure the long-term viability of private BMPs through regular site inspections and enforcement of BMP maintenance agreements.	Ongoing	No Additional Cost	T&ES	Nonpoint Source Pollution(3)
The City will continue its street sweeping program.	Ongoing	No Additional Cost	T&ES	Nonpoint Source Pollution(11)
Encourage the use of water from BMPs to be recycled as irrigation water.	Ongoing	No Additional Cost	T&ES/	Water Conservation(2)
Continue to protect streams from high volumes and velocities of stormwater runoff through the City's stormwater detention program.	Ongoing	No Additional Cost	T&ES	Erosion of the Land(1)
Continue to work with Metropolitan Washington Air Quality Committee to reduce mobile and stationary sources of airborne pollution.	Ongoing	No Additional Cost		Air Pollution(1)
Continue to monitor the Potomac Yard site and Bogle Chemical Company site for any signs of continuing contamination.	Ongoing	Yes	T&ES	Areas of Special Concern(2)

Water Quality Management
CITY OF ALEXANDRIA MASTER PLAN

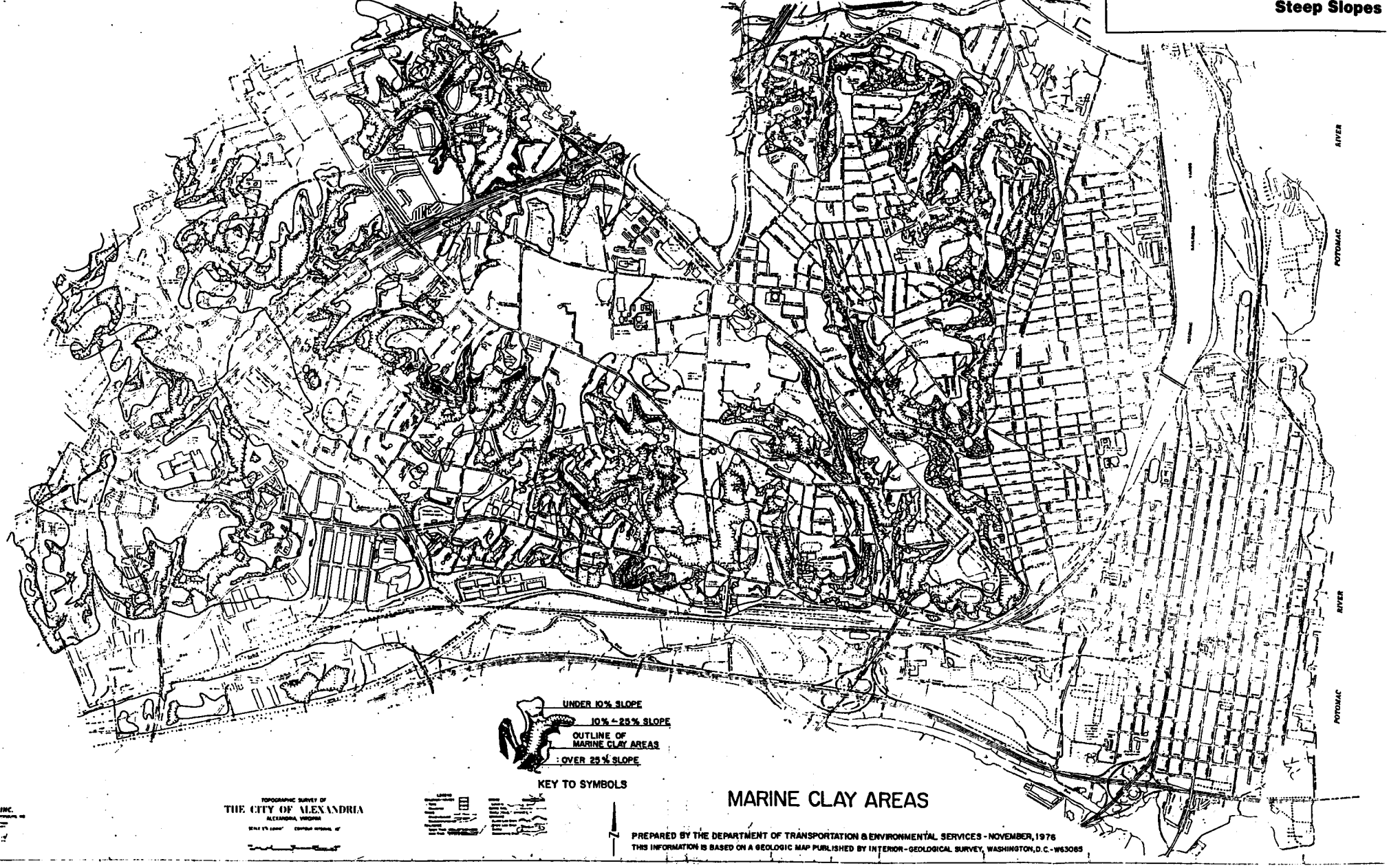
Acronyms

Acronyms used in the Water Quality Management Supplement, City of Alexandria Master Plan:

Alex DEQ	Division of Environmental Quality, Department of Transportation and Environmental Services
ASA	Alexandria Sanitation Authority – organized under Virginia Water & Sewer Authorities Act
AWTF	Alexandria Wastewater Treatment Facility
BMP	Best Management Practice
BNR	Biological Nutrient Removal
CBA	Chesapeake Bay Agreement – VA, PA, MD, DC & US EPA
CBLAD	Chesapeake Bay Local Assistance Department
CBP	Chesapeake Bay Program
CBPA	Chesapeake Bay Preservation Area – (under the act of 1988 Sect. 10.1-210 et seq VA Code of 2950 Chpt. 25)
CBPO	Chesapeake Bay Preservation Ordinance – City of Alexandria 1992 Article XIII Sec. 13-100 et seq.
CERCLA	Comprehensive Environmental Response Compensation and Liability Act (Superfund Law)
CSS	Combined Sewer System
CSO	Combined Sewer Overflow
CWA	Clean Water Act – regulations at 40 CFR parts 122-123
DNH	Division of Natural Heritage – VA Dept. of Conservation & Recreation
DO	Dissolved Oxygen Content
EI	Erodibility Index – RKLS/T [K=soils susceptibility to water erosion of surface layer. R=Rainfall & Runoff. LS=combined slope & Steepness./ T=Soil Loss Tolerence]
E&SCO	Erosion & Sediment Control Ordinance – {under VA Erosion & Sediment Control Law Section 21-89.1 et seq.}
FCWA	Fairfax County Water Authority
FMRPS	Four Mile Run Pumping Station
FOD	Floodplain Overlay District – [FEMA (Federal Emergency Management Agency) requirement. Sect. 6-300 city code]

II	Inflow & Infiltration (reduction)
LUST	Leaking Underground Storage Tank
MWAQC	Metropolitan Washington Air Quality Committee
NPDES	National Pollutant Discharge Elimination System
NVRC	Northern VA Regional Commission
NVPDC	Northern VA Planing District Commission (now the Northern VA Regional Commission)
ODCP	Oil Discharge Contingency Plan – Clean Water Act 40 CFR part 112
pH	Alkalinity / acidity
POTW	Publicly Owned Treatment Works
ppm	parts per million
PTS	Potomac Tributary Strategy
RMA	Resource Management Area – Alexandria less RPA's
RPA	Resource Protection Area – wetlands, tidal shores, streambeds 100 ft. buffer
SAP	Small Area Plan
SAV	Submerged Aquatic Vegetation
SSI	Screening Site Inspection
SSO	Sanitary Sewer Outflow
T&ES	Department of Transportation and Environmental Services
UST	Underground Storage Tank
VADEQ	Virginia Department of Environmental Quality
VADEQ-WD	Virginia Department of Environmental Quality – Water Division
VAMWA	VA Association of Municipal Wastewater Agencies
WQIA	Water Quality Improvement Act
VAWC	Virginia American Water Company
VMRC	Virginia Marine Resources Commission
VPDES	Virginia Pollutant Discharge Elimination System [permit]
VRP	Voluntary Remediation Program
VSWCB	Virginia State Water Control Board
VUBC	Virginia Uniform Building Code

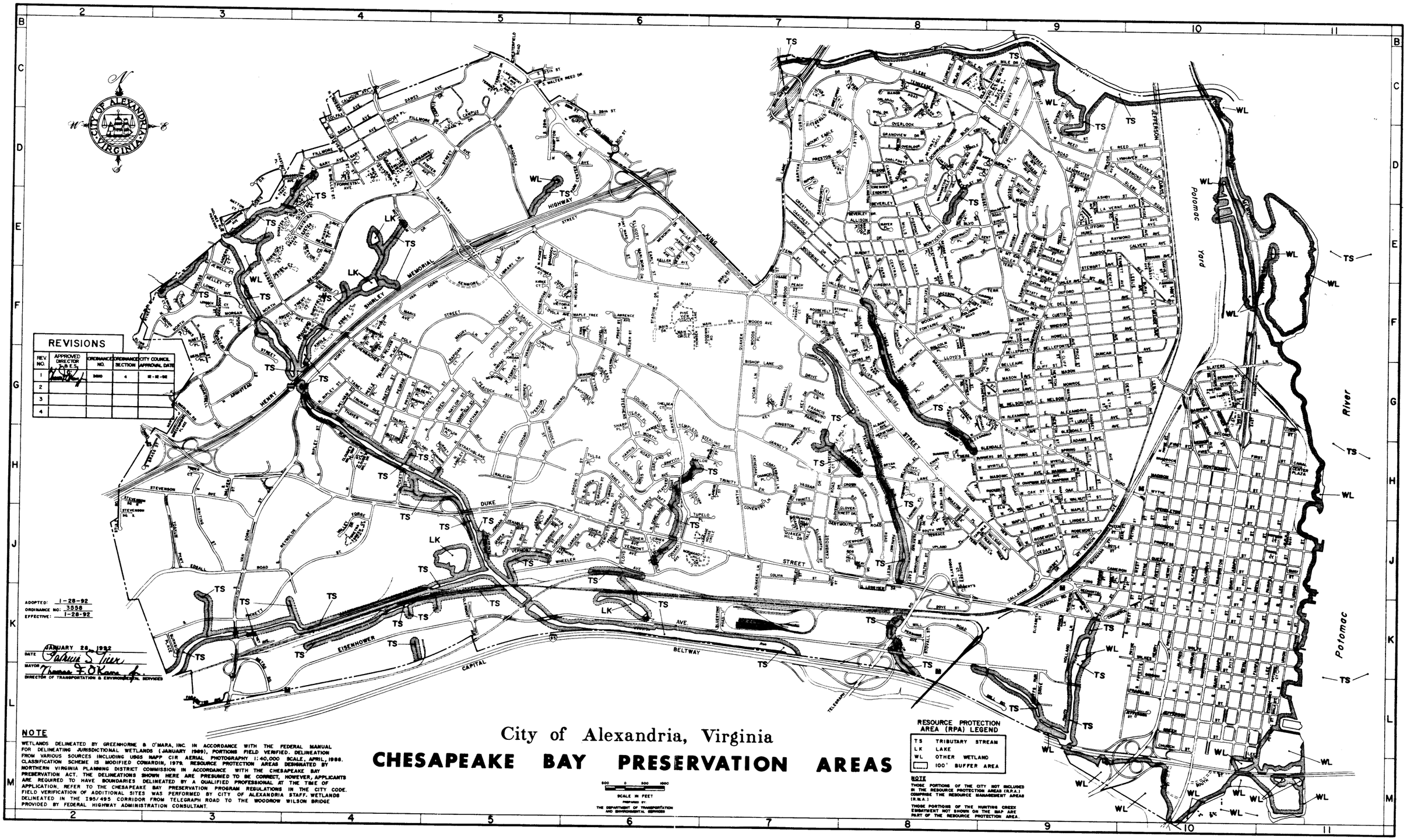
ARLINGTON
COUNTY
FAIRFAX
COUNTY
FOUR MILE RUN
HOLMES RUN
BACKLICK RUN
CAMERON RUN
CAMERON STATION
TAYLOR RUN
HOOFFS RUN
Potomac River
City of Alexandria, Virginia
WETLANDS



MARINE CLAY AREAS

PREPARED BY THE DEPARTMENT OF TRANSPORTATION & ENVIRONMENTAL SERVICES - NOVEMBER, 1976

THIS INFORMATION IS BASED ON A GEOLOGIC MAP PUBLISHED BY INTERIOR - GEOLOGICAL SURVEY, WASHINGTON, D.C. - W63085



NOTE

WETLANDS DELINEATED BY GREENHORNE & O'MARA, INC. IN ACCORDANCE WITH THE FEDERAL MANUAL FOR DELINEATING JURISDICTIONAL WETLANDS (JANUARY 1989), PORTIONS FIELD VERIFIED. DELINEATION FROM VARIOUS SOURCES INCLUDING USGS MAPP CIR AERIAL PHOTOGRAPHY 1:40,000 SCALE, APRIL, 1988. CLASSIFICATION SCHEME IS MODIFIED COWARDIN, 1979. RESOURCE PROTECTION AREAS DESIGNATED BY NORTHERN VIRGINIA PLANNING DISTRICT COMMISSION IN ACCORDANCE WITH THE CHESAPEAKE BAY PRESERVATION ACT. THE DELINEATIONS SHOWN HERE ARE PRESUMED TO BE CORRECT, HOWEVER, APPLICANTS ARE REQUIRED TO HAVE BOUNDARIES DELINEATED BY A QUALIFIED PROFESSIONAL AT THE TIME OF APPLICATION. REFER TO THE CHESAPEAKE BAY PRESERVATION PROGRAM REGULATIONS IN THE CITY CODE. FIELD VERIFICATION OF ADDITIONAL SITES WAS PERFORMED BY CITY OF ALEXANDRIA STAFF. WETLANDS DELINEATED IN THE I95/495 CORRIDOR FROM TELEGRAPH ROAD TO THE WOODROW WILSON BRIDGE PROVIDED BY FEDERAL HIGHWAY ADMINISTRATION CONSULTANT.

City of Alexandria, Virginia

CHESAPEAKE BAY PRESERVATION AREAS

NOTE

THOSE PORTIONS OF THE CITY NOT INCLUDED IN THE RESOURCE PROTECTION AREAS (R.P.A.) COMPRISE THE RESOURCE MANAGEMENT AREAS (R.M.A.).

THOSE PORTIONS OF THE HUNTING CREEK EMBAYMENT NOT SHOWN ON THE MAP ARE PART OF THE RESOURCE PROTECTION AREA.

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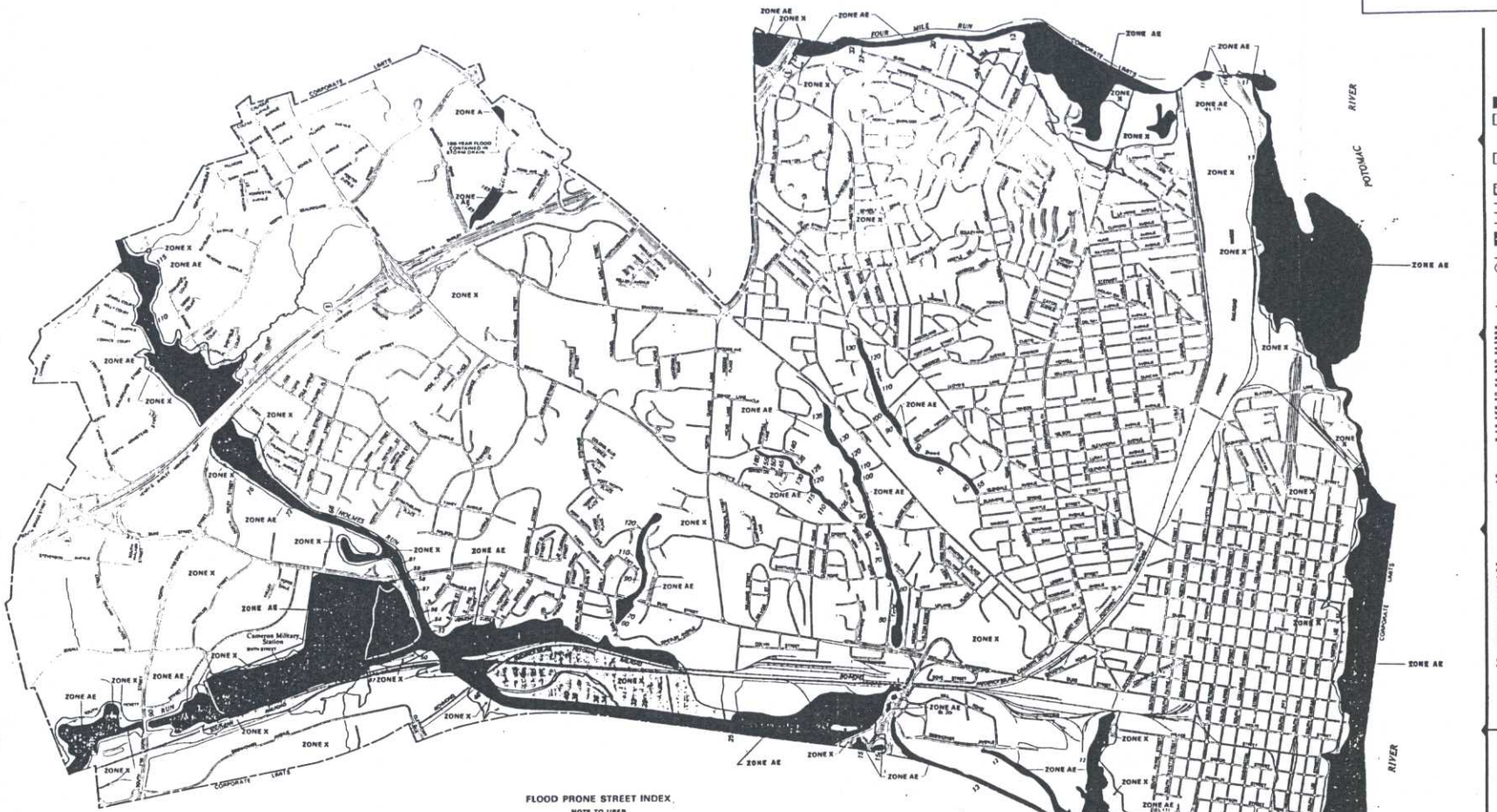

FLOOD PRONE STREET INDEX

NOTE TO USER

This index provides a list of all streets shown on the Flood Insurance Rate Map (FIRM) that are generally or locally within Special Flood Hazard Areas (SFHAs). This index should not be used as an authoritative source for determining whether specific streets, properties, or buildings are within an SFHA. This index is intended to be used only as a guide for determining the relative location of the street in question on the FIRM panel.

KEY

BAKER STREET ..... (A2)
street name ..... grid

NAMED STREETS

A STREET	(C-D)
ABCDT COURT	(F-G)
B STREET	(C-D)
BRADFORD COURT	(E-F)
BRYAN STREET	(F-G)
C STREET	(C-D)
CAMERON STREET	(B-C)
D STREET	(C-D)
DUKE STREET	(B-C)
E STREET	(B-C)
EXECUTIVE AVENUE	(E-F)
FIFTH STREET	(B-C)
FIRST STREET	(E-F)
FOUR MILE DRIVE	(E-F)
FOURTH STREET	(E-F)
FRANKLIN STREET	(F-G)
GARRISON STREET	(F-G)
GLEBE ROAD	(F-G)
GOODRICH AVENUE	(E-F)
GREEN STREET	(F-G)
INTERSTATE ROUTE 95	(F-G)
INTERSTATE ROUTE 395	(E-F)
JAMIE'S LANE	(E-F)
KING STREET	(B-C)
LINDEN STREET	(B-C)
MOUNT VERNON AVENUE	(E-F)
NORTH BEAUREGARD STREET	(F-G)
NORTH UNION STREET	(L-M)
NORTH VAN DORN STREET	(B-C)
PENDLETON STREET	(F-G)
PRINCESS STREET	(F-G)
QUEEN STREET	(F-G)
S. BISHOP STREET	(F-G)
SANGER AVENUE	(E-F)
SECOND STREET	(C-D)
SEVENTH STREET	(B-C)
SIXTH STREET	(B-C)
SK MILL ROAD	(F-G)
SOUTH EARL STREET	(F-G)
SOUTH FAIRFAX STREET	(F-G)
SOUTH LEE STREET	(F-G)
SOUTH PATRICK STREET	(F-G)
SOUTH PAYNE STREET	(F-G)
SOUTH PICKETT STREET	(F-G)
SOUTH ROYAL STREET	(F-G)
SOUTH VAN DORN STREET	(F-G)
SOUTH VIEW TERRACE	(F-G)
TELEGRAPH ROAD	(F-G)
THIRD STREET	(C-D)
WASHINGTON STREET	(F-G)

May 28, 1991
DATE

Patricia S. Ticer
MAYOR

Thomas F. O'Kane, Jr.
DIRECTOR OF TRANSPORTATION & ENVIRONMENTAL SERVICES

T. Edward Braswell, Jr.
CHAIRMAN, PLANNING COMMISSION

FLOOD PLAIN MAP

CITY OF ALEXANDRIA
ALEXANDRIA, VIRGINIA

ADOPTED : MAY 28, 1991
ORDINANCE NO. : 3517
EFFECTIVE : MAY 15, 1991

ZONE AE
ZONE AO
ZONE V
ZONE VE
FLOODWAY AREAS IN ZONE AE
OTHER FLOOD AREAS
ZONE X
OTHER AREAS
ZONE X
ZONE D
UNDEVELOPED COASTAL BARRIERS
Floodplain Boundary
Floodway Boundary
Zone D Boundary
Boundary Dividing Special Flood Hazard Areas of different Base Flood Elevations, Flood Hazards, or Flood Risk Zones
Base Flood Elevation Line (Elevation in Feet)*
Cross Section Line
Base Flood Elevation in Feet Where Uniform Within Zone*
Elevation Reference Mark
River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all areas upslope from areas subject to flooding or erosion. Users should consult community officials regarding flood hazards and should be satisfied that ground elevations shown on the map are consistent with the community's topographic data.

Coastal flood elevations apply only landward of MHW (NGVD) and include the effects of wave action. Wave elevations may also differ significantly from those developed for the National Weather Service for hurricane and other coastal planning.

Areas of special flood hazard (100-year flood) include Zones A, AE, AO, AH, V1-V30, V, and VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Flood profiles and floodway data and models are on file at the Department of Public Works, Alexandria, Virginia.

Flood elevations shown on this map are based on the Flood Insurance Study Report.

Elevation reference marks are described in the Flood Insurance Study Report.

MAP REPOSITORY

City Hall, Room 2300, 301 King Street, Alexandria, Virginia 22314. (Maps available for reference only, not for distribution)

EFFECTIVE DATE OF COUNTYWIDE
AUGUST 15, 1990

FLOOD HAZARD BOUNDARY MAP REVISIONS
NONE

FLOOD INSURANCE RATE MAP EFFECTIVE
AUGUST 15, 1990

FLOOD INSURANCE RATE MAP REVISIONS

May 5, 1978: to add special flood hazard area
May 26, 1981: to add special flood hazard area
June 1, 1984: to change zone designations
October 15, 1986: to reflect current flood boundary and to add zone of flood hazard area
April 26, 1988: to change special flood hazard areas, to change base flood elevations, to change zone designations, to add areas, to delete areas, to reflect Phase II flood survey, and to change to FIRM format
December 1, 1988: to change base flood elevations, and to change zone of flood hazard area
May 15, 1991: to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to change special flood hazard areas, to update map format, and to add streets and repair number

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 800-638-6620.

APPROXIMATE SCALE
0 1000 2000 3000 4000 5000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP and STREET INDEX

CITY OF ALEXANDRIA, VIRGINIA
INDEPENDENT CITY

ONLY PANEL PRINTED

COMMUNITY-PANEL NUMBER
515519 0005 B

MAP REVISED
MAY 15, 1991

Federal Emergency Management Agency