

**Supplemental Watershed Plan-Environmental Assessment
for the
Pohick Creek Watershed**

Supplement No. 3 to the original watershed plan for the rehabilitation
of Pohick Creek Watershed Dam No. 4 (Royal Lake)

Fairfax County, Virginia

September 2006



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Fairfax County, Virginia

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Abstract

Pohick Creek Watershed Dam No. 4, Royal Lake, does not presently meet NRCS or Virginia safety standards for the stability and integrity of the auxiliary spillway. The recommended plan will rehabilitate the Royal Lake dam to meet current safety and performance standards. The plan provides for realignment of the auxiliary spillway, armoring the auxiliary spillway with articulated concrete blocks, and raising the training dikes using earthen embankments. There will be no change in the permanent pool elevation and no change in the current levels of flood protection downstream as a result of project activity.

Authority

The original work plan was prepared, and the works of improvement have been installed, under the authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566), as amended. The rehabilitation of Pohick Creek Watershed Dam No. 4 is authorized by the Watershed Protection and Flood Prevention Act (Public Law 83-566) as amended by the Small Watershed Rehabilitation Amendments of 2000 (Section 313 of Public Law 106-472).

Sponsors

Northern Virginia Soil and Water Conservation District
Fairfax County Board of Supervisors

Prepared By:

USDA – Natural Resources Conservation Service

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SUMMARY OF DRAFT SUPPLEMENTAL WATERSHED PLAN

Project Name: Pohick Creek Watershed Dam No. 4 (Royal Lake)

County: Fairfax **State:** Virginia

Sponsors: Fairfax County Board of Supervisors
Northern Virginia Soil and Water Conservation District

Description of Recommended Plan: The recommended plan is to rehabilitate the Royal Lake dam to meet current NRCS and State safety and performance standards. The plan provides for realignment of the auxiliary spillway, armoring of the auxiliary spillway with articulated concrete blocks, and raising the training dikes using earthen embankments. There will be no change in the permanent pool elevation and no change in the current levels of flood protection downstream as a result of project activity.

Resource Information:

Size of the entire Pohick Creek Watershed = 23,595 acres
Drainage Area of Royal Lake = 2,477 acres

Land Use:

Urban and Miscellaneous = 2,477 acres
Floodpool of Royal Lake = 99 acres

Land Ownership:

Upstream of dam: 59% private, 41% public
Downstream of dam; 10% private, 90% public

Project Beneficiary Profile: The population for Fairfax County in 2000 was 969,749. The population diversity was 70% White, 13% Asian, 11% Hispanic, 8.6% Black or African American, and 4.5% others.

In 1999, per capita personal income for Fairfax County was \$36,888. That makes the County income 54% higher than the State level and 71% higher than the national figure.

Cultural Resources: The area of potential effect was surveyed and a probable Archaic Site was identified during a Phase I Cultural Resources survey. The goals of a Phase I survey are to locate and identify all archaeological sites in the survey area, to estimate site size and boundaries, and to assess the site's potential for further (Phase II) investigation.

A Phase II survey will be completed for this area prior to construction. A Phase II survey is an evaluation of a resource's significance. It involves assessing the characteristics of a property against a defined historic context and the criteria of the Virginia Landmarks Register and the National Register of Historic Places. A major goal of a Phase II survey is to provide recommendations for future treatment of the site.

Threatened and Endangered Species: There is one federally threatened (FT), state threatened (ST) animal species listed in the project area, the Bald Eagle, Haliaeetus leucocephalus, which is likely to occur in the watershed. There are no confirmed occurrences of the Bald Eagle in the project area.

There is one listed state endangered (SE) animal species, the Brook Floater, Alasmidonta varicosa, a freshwater mussel likely to occur within a two mile radius of the project dam, although there have been no confirmed sightings of this species. Six state threatened (ST) animal species, the Henslow's Sparrow, Ammodramus henslowii; the Appalachian Grizzled Skipper, Pyrgus wyandot, a butterfly; the migrant Loggerhead Shrike, Lanius ludovicianus migrans; the Loggerhead Shrike, Lanius ludovicianus; the Wood turtle, Clemmys insculpta, and the Upland Sandpiper, Bartramia longicauda, are likely to occur within two miles of the dam. There are no confirmed sightings of these species. There are no federal or state listed threatened or endangered plant species in the project area.

Problem Identification: Royal Lake does not meet current dam design and safety criteria. During the planning process, there were three primary problems identified by the NRCS Planning Team, the local Sponsors and the public. These are the primary issues addressed by the rehabilitation plan.

- The vegetated earth auxiliary spillway does not have the stability or integrity to carry the design flow without breaching.
- The training dike along the auxiliary spillway outlet is too low to contain the design flow.
- The current auxiliary spillway alignment is a potential hazard to the townhouses which are located near the outlet of the auxiliary spillway.

The breach inundation zone includes Guinea Road (16,000 vehicles per day), the Norfolk Southern / Virginia Railway Express and Amtrak rail lines (9,000 passengers per day), Burke Lake Road (35,000 vehicles per day), 5 fiber optic lines, and a major gas line. There are 168 single family homes and townhouses, 35 businesses and two public buildings located in the breach inundation zone.

Alternative Plans Considered: Several alternatives were considered during the planning process with the following two being evaluated in detail:

1. No Federal Action (Sponsors' Rehabilitation) – Rehabilitate the dam to meet current dam safety and design criteria without Federal assistance.
2. Rehabilitate the Dam – Rehabilitate the dam to meet current dam safety and design criteria using Federal assistance.

Project Purpose: This project will bring Royal Lake into compliance with the current dam design and safety criteria for NRCS and the Commonwealth of Virginia. It also provides for the continuation of existing flood control for another 70 years after completion. The rehabilitation project will address all needs identified during the planning process.

Principal Project Measures: The rehabilitation of the dam involves three primary actions:

- Realign the auxiliary spillway about 45 degrees toward the dam.
- Armor the auxiliary spillway and training dikes with Articulated Concrete Blocks.
- Build elevated earthen training dikes to control flow direction.

Project Costs (Dollars):	<u>PL-106-472 Funds</u> 65%	<u>Other Funds</u> 35%	<u>Total</u> 100%
Structural Measures:	\$2,052,000	\$1,037,000	\$3,089,000

Project Benefits: Reduces potential for loss of life and maintains protection of existing infrastructure downstream of the dam and property values around the lake. Net average annual equivalent benefits between the Future with Federal Project (FWFP) and the Future without Federal Project (FWOFP) = \$0

Non-monetary Benefits:

- Minimizes the threat to loss of life to approximately 710 people that live and work in the 168 single family homes and townhouses, 35 businesses, and two public buildings within the breach inundation zone.
- Satisfactorily meet the dam design and safety criteria established by the Virginia Division of Dam Safety and Floodplain Management and NRCS.
- Eliminates the liability associated with continuing to operate an unsafe dam.
- Provide protection for Guinea Road, located immediately downstream of the dam, which has an average daily traffic count of 16,000 vehicles.
- Provide protection for Burke Lake Road which has an average daily traffic count of 35,000 vehicles.
- Provide protection for the Norfolk Southern / VRE and Amtrak railroad tracks downstream that transport approximately 9,000 passengers daily.
- Provide protection for 5 communications lines located in the railroad right-of-way.
- Provide protection for a gas line suspended beneath the Burke Lake Road bridge.
- Provide flood protection for the scores of people living in the area, as well as those working, recreating, or traversing within the downstream floodplains.
- Traps 2.73 acre feet of sediment annually, thereby improving downstream water quality.
- Maintain existing stream habitat downstream of the dam.
- Maintain the existing fish and wildlife habitat in and around the lake.
- Preserve recreational opportunities for area residents.

Environmental Values Changed or Lost:

<u>Resource</u>	<u>Impact</u>
Air Quality	Short term impacts during construction.
Land Use Changes	Cut 3.4 acres of hardwood trees. Replant 0.9 acres of trees. Convert 2.5 acres of trees to grass.
Floodplains	Positive impact - Current floodplain would be maintained.
Fisheries	Positive impact - Fish habitats would be maintained and/or protected.
Wildlife Habitat	Positive impact – Habitat will be maintained and protected in the watershed.
Wetlands	No effect.
Prime Farmland	N/A
Cultural Resources	Potential Archaic site has been identified. A Phase II investigation will be completed prior to construction.
Threatened and Endangered Species	No effect.
Compensatory Mitigation	None anticipated, although there is some potential, depending on the outcome of the Phase II Cultural Resources investigation.

POHICK CREEK WATERSHED AGREEMENT

Supplemental Watershed Plan Agreement
(Supplement No. 3)

between the

Fairfax County Board of Supervisors
Northern Virginia Soil and Water Conservation District
(herein referred to collectively as “Sponsors”)

and the

Natural Resources Conservation Service
United States Department of Agriculture
(herein referred to as “NRCS”)

Whereas, the Watershed Work Plan Agreement for the Pohick Creek Watershed, Commonwealth of Virginia, authorized under the Watershed Protection and Flood Prevention Act (Public Law 83-566, 16 U.S.C. 1001 et seq.) and executed by the Sponsors named therein and the Soil Conservation Service (which is now NRCS, pursuant to section 246 of the Department of Agriculture Reorganization Act of 1994, 7 U.S.C. 6862), became effective the 1st day of April 1969; and

Whereas, Supplement No. 1, which modified the Watershed Plan Agreement, was developed through cooperative efforts of the Sponsors and the Soil Conservation Service and became effective on the 25th day of September 1970; and

Whereas, Supplement No. 2, which modified the Watershed Plan Agreement, was developed through cooperative efforts of the Sponsors and the Soil Conservation Service and became effective on the 18th day of October 1971; and

Whereas, application has been made to the Secretary of Agriculture by the Sponsors for assistance in preparing a plan for rehabilitation of the works of improvement for the Pohick Creek Dam Site No. 4 located in Fairfax County, Commonwealth of Virginia, under the authority of section 14 of the Watershed Protection and Flood Prevention Act (16 U.S.C. 1012); and

Whereas, through the cooperative efforts of the Sponsors and NRCS, a Supplemental Watershed Plan has been developed to rehabilitate the Pohick Creek Dam Site No. 4, which Plan is annexed to and made a part of this Supplemental Watershed Plan Agreement; and

Whereas, in order to provide for rehabilitation of Pohick Creek Dam Site No. 4, it has become necessary to modify the Supplemental Watershed Plan Agreement;

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS, and the Sponsors, hereby agree on this Supplemental Watershed Plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this Agreement and including the following:

1. The name of the Soil Conservation Service is changed to Natural Resources Conservation Service (NRCS). All references to the Soil Conservation Service, SCS, or Service, now refer to the NRCS.
2. The Fairfax County Board of Supervisors agree to continue to participate in and comply with applicable federal and state floodplain management and flood insurance programs before construction starts.
3. The Sponsors will acquire all necessary land rights, easements, or right-of-ways in connection with the planned works of improvement.
4. No relocations are planned with this rehabilitation project. However, should it be determined later that relocation is needed, relocation costs will be cost-shared at following rate:

Sponsors	NRCS	Total Relocation Costs
35%	65%	100%

5. The Sponsors hereby agree that they will comply with all the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. 4601 et. seq., as implemented by 7 C.F.R. Part 21 and 49 C.F.R. Part 24) when acquiring real property interests for this federally assisted project. If the Sponsors are legally unable to comply with the real property acquisition requirements of the Act, they agree that, before any federal financial assistance is furnished, they will provide a statement to that effect, supported by an opinion of the chief legal officer of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance. In any event, the Sponsors agree that they will reimburse owners for necessary expenses as specified in 49 C.F.R. Part 24.
6. The Sponsors will obtain all necessary federal, state, and local permits required by law, ordinance, or regulation for installation of the planned works of improvement. The costs of such permitting is not eligible as part of the Sponsors' cost-share requirement.
7. The Sponsors will be responsible for the costs of water, mineral and other resource rights, and will acquire or provide assurance that landowners or resource users have acquired such rights pursuant to state law as may be needed in the installation and operation of the works of improvement. The costs associated with the subject rights are not eligible as a part of the Sponsors' cost-share requirement.

8. NRCS will assist the Sponsors with the installation of planned works of improvement. The percentages of total rehabilitation project costs to be paid by the Sponsors and by NRCS are as follows:

**Project Costs
(Dollars)**

Works of Improvement	NRCS PL-106-472 Funds	Other Funds - Fairfax County's Responsibility	Total Estimated Cost
Cost Sharable Items (per PL-106-472 and NRCS policy)	---	---	---
Rehabilitation of the dam (construction costs):	\$1,925,000	\$500,000	\$2,425,000
Sponsor's Planning Costs:	n/a	\$30,000	\$30,000
Sponsor's Engineering Costs:	n/a	\$461,000	\$461,000
Sponsor's Project Administration Costs:	n/a	\$46,000	\$46,000
Land Rights Acquisition Costs:	n/a	\$0	\$0
Subtotals: Cost-Sharable Costs: Cost-Share Percentages:^{a/}	\$1,925,000 (65%)	\$1,037,000 (35%)	\$2,962,000 (100%)
Non Cost Sharable Items (per PL-106-472 and NRCS policy)^{b/}	---	---	---
NRCS Engineering and Project Administration Costs:	\$127,000	n/a	\$127,000
Federal, State and Local Permits:	n/a	\$0	\$0
Subtotals: Non Cost-Sharable Costs:	\$127,000	\$0	\$127,000
Total Estimated Costs:	\$2,052,000	\$1,037,000	\$3,089,000

a/ The maximum NRCS cost-share is 65% of the cost-sharable items not to exceed 100% of the construction cost. Total eligible project costs include construction, land rights, relocation, project administration, and planning services provided by the Sponsors. Not included are NRCS engineering technical assistance costs of \$115,000; NRCS project administration costs of \$12,000; and the local cost of permitting and ordinances.

b/ If actual non-cost-sharable item expenditures vary from these estimates, the responsible party will bear the change in costs.

9. The Sponsors will obtain agreements with landowners or operators of not less than 50 percent of the drainage area above Royal Lake. These agreements state that the owners will carry out conservation plans on their land and ensure that 50 percent of the land is adequately protected before rehabilitation of the floodwater retarding structure.
10. The Sponsors will be responsible for the operation, maintenance, and replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with a new operation and maintenance agreement that will be entered into before issuing invitations to bid for construction work. The term of the operation and maintenance

agreement will be for the 71-year evaluated life of the project (70 years plus 1 year of installation). The Operation and Maintenance Agreement shall be prepared in accordance with the NRCS National Operation and Maintenance Manual.

11. An Emergency Action Plan (EAP) currently exists for the Floodwater Retarding Structure included in this plan. The Sponsors will provide leadership in developing a new EAP that is appropriate for the rehabilitated condition of this structure and will update the EAP annually with assistance from the local emergency response officials. NRCS will provide technical assistance in preparation and updating of the EAP. The purpose of the EAP is to outline appropriate actions and to designate parties responsible for those actions in the event of a potential failure of a floodwater retarding structure. The NRCS State Conservationist will ensure that a current EAP has been prepared prior to the initiation of construction.
12. The costs shown in this plan are preliminary estimates. Final costs to be borne by the parties hereto will be based on the actual costs incurred in the installation of works of improvement and the cost-share percentages stated in this agreement.
13. This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out the rehabilitation plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.
14. This agreement does not commit the NRCS to assistance of any kind beyond the 71-year project life.
15. A separate agreement will be entered into between NRCS and Fairfax County before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
16. This rehabilitation plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may de-authorize or terminate funding at any time it determines that the Sponsors have failed to comply with the conditions of this agreement. In this case, NRCS shall promptly notify the Sponsors in writing of the determination and the reasons for de-authorization of project funding, together with the effective date. Payments made to the Sponsors or recoveries by NRCS shall be in accord with the legal rights and liabilities of the parties when project funding has been de-authorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the Sponsors having specific responsibilities for the measure involved.
17. No member of, or delegate to, Congress, or resident commissioner, shall be admitted to any share or part of this Plan, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to the agreement if made with a corporation for its general benefit.
18. By signing this agreement, the recipient assures the U.S. Department of Agriculture that the program or activities provided for under this agreement will be conducted in compliance with all applicable Federal civil rights laws, rules, regulations, and policies.

19. Certification Regarding Drug-Free Workplace Requirements (7 CFR 3021).

By signing this watershed agreement, the Sponsors are providing the certification set out below. If it is later determined that the Sponsors knowingly rendered a false certification, or otherwise violated the requirements of the Drug Free Workplace Act, the NRCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

Controlled Substance means a controlled substance in Schedules I through V of the Controlled Substances Act (21 U.S.C. 812) and as further defined by regulation (21 CFR 1308.11 through 1308.15);

Conviction means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes;

Criminal drug statute means a Federal or non-Federal criminal statute involving the manufacturing, distribution, dispensing, use, or possession of any controlled substance;

Employee means the employee of a grantee directly engaged in the performance of work under a grant, including: (i) all direct charge employees; (ii) all indirect charge employees unless their impact or involvement is insignificant to the performance of the grant; and, (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the grantee's payroll. This definition does not include workers not on the payroll of the grantee (e.g., volunteers, even if used to meet a matching requirement; consultants or independent contractors not on the grantees' payroll; or employees of sub-recipients or subcontractors in covered workplaces).

A. The Sponsors certify that they will or will continue to provide a drug-free workplace by:

(1) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(2) Establishing an ongoing drug-free awareness program to inform employees about—

(a) The danger of drug abuse in the workplace;

(b) The grantee's policy of maintaining a drug-free workplace;

(c) Any available drug counseling, rehabilitation, and employee assistance programs; and

(d) The penalties that may be imposed upon employees for drug abuse violation occurring in the workplace;

(3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1);

(4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee will--

(a) Abide by the terms of the statement; and

(b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;

(5) Notifying the NRCS in writing, within ten calendar days after receiving notice under paragraph (4)(b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice shall include the identification number(s) of each affected grant;

(6) Taking on of the following actions, within 30 calendar days of receiving notice under paragraph (4) (b), with respect to any employees who is so convicted--

(a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(b) Requiring such employee to participate satisfactorily in drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1),(2),(3),(4),(5),and (6)

B. The Sponsors may provide a list of the site(s) for the performance of work done in connection with a specific project or other agreement.

C. Agencies shall keep the original of all disclosure reports in the official files of the agency.

20. Certification Regarding Lobbying (7 CFR 3018).

(1) The Sponsors certify to the best of their knowledge and belief, that:

(a) No Federal appropriated funds have been paid or will be paid, by or on behalf of the Sponsors, to any person for influencing or attempting to influence an officer or employee of an agency, Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(b) If any funds other than Federal appropriated funds have been paid or will be paid to

any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form – LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

- (c) The Sponsors shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

(2) This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

21. Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions (7 CFR 3017).

- (1) The Sponsors certify to the best of their knowledge and belief, that they and their principals:
 - (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.
 - (b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
 - (c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and
 - (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.
- (2) Where the primary Sponsors are unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this agreement.

Fairfax County Board of Supervisors

12000 Government Center Parkway, Suite 552
Fairfax, Virginia 22035-2531

By: /s/ Anthony H. Griffin
ANTHONY H. GRIFFIN

Title: County Executive

Date: September 25, 2006

The signing of this supplemental watershed agreement was authorized by a resolution of the governing body of the Fairfax County Board of Supervisors adopted at a meeting held on September 11, 2006.

/s/ Nancy Vehrs
County Clerk

12000 Government Center Parkway,
Suite 533
Fairfax, Virginia 22035-0072

Date: September 25, 2006

**Northern Virginia Soil and Water
Conservation District**

12055 Government Center Parkway, Suite 905
Fairfax, Virginia 22035-5512

By: /s/ Jean R. Packard
JEAN R. PACKARD

Title: Chairperson

Date: September 25, 2006

The signing of this supplemental watershed agreement was authorized by a resolution of the governing body of the Northern Virginia Soil and Water Conservation District adopted at a meeting held on August 22, 2006.

/s/ Nancy Vehrs
Notary

12000 Government Center Parkway,
Suite 533
Fairfax, Virginia 22035-0072

Date: September 25, 2006

**Natural Resources Conservation Service
United States Department of Agriculture**

Approved by:

/s/ M. Denise Doetzer
M. DENISE DOETZER

Date: September 25, 2006

INTRODUCTION

NEED AND PURPOSE

This supplement only addresses the Pohick Creek Watershed Dam #4, known locally as Royal Lake. This dam was built in 1977. A supplement to the watershed plan is needed because this dam does not meet current NRCS or Virginia Department of Conservation and Recreation, Division of Dam Safety and Floodplain Management (referred to herein as the Division of Dam Safety) dam design, safety, and performance standards for auxiliary spillway integrity and stability. For this reason, the dam does not meet the objectives of the Fairfax County Board of Supervisors, and the Northern Virginia Soil and Water Conservation District (herein referred to as Sponsors), which are to continue to provide flood protection and to reduce the risk of loss of human life. This supplemental plan documents the planning process by which the USDA Natural Resources Conservation Service (NRCS) provided technical assistance to local Sponsors, technical advisors, and the public in addressing resource issues and concerns within the Royal Lake Watershed.

With this need and purpose in mind, it should be noted that the local sponsors have done an exceptional job of maintaining the Pohick Creek dam sites, and Royal Lake is no exception. The Royal Lake dam site, and associated recreational lands and facilities, have been taken care of very well since the dam was constructed. Indeed, in 1993, the Pohick Creek Watershed was recognized as the “Watershed Project of the Year” by the National Watershed Coalition. An aerial photograph of Lake Royal was featured on the cover of their national meeting brochure and the proceedings from their Jackson, Mississippi convention.

In addition, Fairfax County should be praised for the overall high quality job that has been done to prevent development within the 100-year floodplain. Through local zoning and effective enforcement of the zoning rules, the County has effectively kept development out of the 100-year floodplain. This has allowed the floodplain to function as it should during storm events and has prevented untold amounts of damages from occurring.

PROJECT SETTING

ORIGINAL PROJECT

A plan for flood prevention and watershed protection was authorized in 1969 under the authority of Public Law 83-566, the Watershed Protection and Flood Prevention Act of 1954. The original work plan included the construction of seven single-purpose dams and one multi-purpose dam that were all high hazard dams designed for a 100-year life, an accelerated land treatment program for watershed protection, and 6.28 miles of stream channel improvement. Of the structures proposed in the plan, five of the single purpose dams and one multi-purpose dam were built from 1970 to 1985. Planned sites #6 and #10 and the channel work were deleted from the planned works of improvement. The project was closed out in January 1994.

PHYSICAL FEATURES

Project Location: The watershed for Royal Lake is located in Fairfax County, Virginia. Royal Lake drains to Pohick Creek, which empties into the Potomac River at Pohick Bay. The Royal Lake watershed is 2,477 acres (3.9 square miles). Appendix D shows the location map for this watershed.

Topography: Royal Lake is located in the Piedmont physiographic province. The topography of the Piedmont is relatively flat and topographically featureless. The elevation in the watershed ranges from about 275 feet at the dam to 375 feet at the watershed divide.

Soils: The soils present in the vicinity of Royal Lake are primarily mapped in the Manor series, and are associated with Glenelg, Elioak, Meadowville, Glenville and Worsham soils. The Manor series consists of shallow, highly micaceous, somewhat excessively drained soils of the uplands. These soils have formed from quartz sericite schist, and are found on narrow, rolling ridgetops and steeper ridge slopes. The surface layer is yellowish brown and is directly over micaceous residuum. Some areas of the Manor soils have a very thin, weakly developed subsoil similar to that of the Glenelg soils.

The predominant map unit in the vicinity of the dam is Manor silt loam, hilly phase, 14-25% slope. This soil has a shallower depth to bedrock than the Manor silt loam, rolling phase, 7-14% slope. It has steeper slopes and is more susceptible to erosion, and has a slightly lower water-holding capacity.

Geology: According to The Geologic Map of Virginia, 1993, compiled by the Commonwealth of Virginia Department of Mines, Minerals, and Energy, the reservoir is surrounded by two distinct rock formations. The very eastern end of the embankment is located in the Cambrian Sykesville Formation which consists of metasedimentary rocks. The remainder of the embankment and the impoundment are underlain by the Old Mill Branch metasiltstone member of the Ordovician-Cambrian Popes Head Formation. The Old Mill Branch Metasiltstone Member of the Popes Head Formation is described as a very mature, micaceous metasiltstone which contains interbedded pelitic phyllite (The Manassas Quadrangle, Fairfax and Prince William Counties, VA, 1994, USGS).

It should be pointed out that the geologic formation names applied to the formations at the site have changed since the dam was originally constructed. The original USDA/SCS Geologic Investigation of the dam site listed the underlying formation for the entire site as the Wissahickon Formation. That agrees with the U.S. Department of the Interior, Geological Survey Water-Supply Paper 1539-L, Geology and Groundwater Resources of the Fairfax Quadrangle, Virginia. In the original SCS geologic investigation, the Wissahickon Formation under the impoundment was described as a “deeply weathered, fine-grained quartz-muscovite schist, sometimes bordering on phyllite.”

Climate: The watershed lies mainly in the Piedmont physiographic province. This province has a continental, humid, temperate climate, and is characterized by warm to hot summers and rather cold winters. The average annual temperature is 58.2 degrees Fahrenheit, with an average minimum temperature in winter of 28.2 degrees Fahrenheit, and an average maximum temperature of 88.5 degrees Fahrenheit in the summer. The last frost of spring normally occurs

in late April and the first frost in the fall occurs around late October. This provides a growing season of approximately 204 days.

The average annual precipitation is 39.34 inches, varying from about 33.65 inches in the driest years to about 44.5 inches in the wettest years. This precipitation is well distributed throughout the year, with the highest monthly precipitation occurring in May, July and August. Snowfall averages about 14.8 inches annually, with appreciable snow cover on the ground an average of 12 days per year.

LAND USE

The drainage area upstream of Royal Lake is 2,477 acres. This area was digitized using 2002 USGS Imagery and 2005 NAIP imagery for base maps. Table A lists the land use upstream of the dam. This table also lists the land use in the breach inundation zone below the dam. Appendix D contains the aerial photograph of the watershed.

Table A - Land Use In Acres

Land Cover Type	Drainage Area of Royal Lake (ac.)	Percent Of Total	Breach Inundation Zone (ac.)	Percent of Total
Residential/ Business	1,814	73.3%	64.1	21.1%
Woodland	424	17.1%	223.9	73.5%
Transportation	195	7.8%	14.6	4.8%
Water	44	1.8%	0	0
Grassland	0	0	1.7	0.6%
Totals	2,477	100.0%	304.3	100.0%

THREATENED AND ENDANGERED SPECIES

According to the Virginia Fish and Wildlife Information Service, there is one federally threatened (FT), state threatened (ST) animal species listed in the project area, the Bald Eagle, Haliaeetus leucocephalus, which is likely to occur within a two mile radius of the project dam site. There are, however, no confirmed occurrences of the Bald Eagle in the project area.

There is one listed state endangered (SE) animal species, the Brook Floater, Alasmidonta varicosa, a freshwater mussel likely to occur within a two mile radius of the project dam, although there have been no confirmed sightings of this species. Six state threatened (ST) animal species, the Henslow's Sparrow, Ammodramus henslowii; the Appalachian Grizzled Skipper, Pyrgus wyandot, a butterfly; the migrant Loggerhead Shrike, Lanius ludovicianus migrans; the Loggerhead Shrike, Lanius ludovicianus; the Wood turtle, Clemmys insculpta, and the Upland Sandpiper, Bartramia longicauda, are likely to occur within two miles of the dam. However, there are no confirmed sightings of these species. There are no federal or state listed threatened or endangered plant species in the project area.

Confirmed occurrence of a listed species in a project area requires consultation with the appropriate State or Federal agency. Since there were no confirmed occurrences of Federal or State listed threatened or endangered species, consultation with these agencies is not required. However, the U.S. Fish & Wildlife Service, Virginia Department of Game and Inland Fisheries, and the Natural Heritage Division of the Virginia Department of Conservation and Recreation were invited to the preliminary scoping meeting on November 15, 2005. None of the three agencies attended, but submitted comments by letters and email.

The DCR Natural Heritage Division responded in a November 15, 2005 letter that their “Biotics Data System does not document the presence of natural heritage resources in the project area.The current activity will not affect any documented state-listed plants or insects.”

The Virginia Department of Game and Inland Fisheries (VDGIF) responded by email on November 14, 2005. VDGIF stated “We do not anticipate a significant adverse impact upon threatened or endangered species under our jurisdiction to occur due to this project.”

The U.S. Fish & Wildlife Service (USFWS) provided comments in an October 27, 2005 letter. The USFWS stated that “We have reviewed the information you have provided and believe that the proposed action will not adversely affect federally listed species or federally designated critical habitat because no federally listed species are known to occur in the project area. Should project plans change or if additional information on listed and proposed species becomes available, this determination may be reconsidered.” Table B summarizes the potential occurrence of threatened and endangered species in the project area. The letters of comment received on this topic are located in Appendix A.

Table B - Threatened & Endangered Animal Species Likely to Occur Within 2 Miles of the Project Dam

Animal or Plant Species	Scientific Name	Status*	Confirmed
Bald Eagle	<u>Haliaeetus</u> <u>Leucocephalus</u>	FT,ST	No
Brook Floater	<u>Alasmidonta varicosa</u>	FS,SE	No
Henslow’s Sparrow	<u>Ammodramus</u> <u>henslowii</u>	FS,ST	No
Appalachian Grizzled Skipper	<u>Pyrgus wyandot</u>	FS,ST	No
Migrant Loggerhead Shrike	<u>Lanius ludovicianus</u> <u>migrans</u>	FS,ST	No
Loggerhead Shrike	<u>Lanius ludovicianus</u>	ST	No
Upland Sandpiper	<u>Bartramia longicauda</u>	ST	No
Wood Turtle	<u>Clemmys insculpta</u>	ST	No

*- Species Legal Status: FT = Federally Threatened; FE = Federally Endangered; ST = State Threatened; SE = State Endangered; .FS = Federal Species of Concern

CULTURAL RESOURCES, NATURAL AND SCENIC AREAS, AND VISUAL RESOURCES

The National Register of Historic Places lists fifty-three sites in Fairfax County. Fifteen archaeological sites within one mile of the project area are listed in the State archaeological files; none will be affected by the proposed work. There are no architectural sites listed in the State architectural files within one mile of the project area.

The National Historic Landmarks Program lists 118 sites, buildings or structures in Virginia, eight of which are found in Fairfax County. None of the eight buildings, objects or districts is within one mile of the project area, nor will be affected by the project activities.

There are no designated State Natural and Scenic Area Preserves nor visual resources in the project vicinity that will be affected by the proposed changes to the dam.

The Virginia Department of Historic Resources (VADHR) was notified of the November 15, 2005 Scoping Meeting and submitted comments by letter. They state that although the dam was constructed in 1977 and is therefore "...not eligible for listing on the National Register of Historic Places, ...there is moderate potential for archaeological resources in the vicinity of the dam and impound area. Any rehabilitative option involving ground disturbance of previously undisturbed earth has the potential to impact archaeological resources. As such, we request that NRCS continue to consult with our office regarding the project, and present, when available, a set of alternatives to which we can comment directly."

In March of 2006, an NRCS Cultural Resources Specialist visited the Royal Lake watershed to conduct an inventory of the watershed and associated downstream impacted area. A Phase I methodology for evaluating cultural resources was developed and followed in this planning process. An archaeological site is located immediately below the dam. The Virginia DHR was informed of the results of the Phase I survey and recommended a Phase II investigation. A Phase II archaeological investigation will be completed prior to construction of any project activities.

WATER QUALITY

The rehabilitation project includes Royal Lake Dam which is approximately two (2) air miles below the head of the drainage. The streams on which this dam is located, Rabbit Branch forming the east arm of the lake and an unnamed tributary forming the west arm of the lake, all drain into Pohick Creek, which then flows into the Potomac River at Pohick Bay. Pohick Creek has a total stream length of 35.61 miles from the headwaters of Rabbit Branch to Pohick Bay.

The 2004 305(b)/303(d) Integrated Water Quality Assessment and Impaired Waters Report does not list any waters in the project area as "impaired". Citizen monitoring has been conducted on Pohick Creek just below the dam where the Rabbit Branch forms the main stem of Pohick Creek above the Norfolk Southern / VRE railroad tracks and downstream to the confluence with Sideburn Branch. A bioassessment of benthic macroinvertebrates was performed in three surveys from 2002 to 2004. All revealed poor stream conditions for stream biota.

The Pohick Creek watershed is not considered a Public Drinking Water Source or Supply, and is ranked low for nonpoint source impaired lakes. The watershed is, however, rated high for urban nitrogen, phosphorus and sediment contribution.

WETLANDS

The inlets to Royal Lake on the Rabbit Branch and the unnamed tributary were visually surveyed for wetlands on January 19, 2006 by NRCS staff. These inlets were found to lack developed wetlands, possibly due to past dredging activities. On March 17, 2006, the U.S. Army Corps of Engineers concurred by letter with the NRCS opinion that the area lacks jurisdictional wetlands. See Appendix A.

FOREST RESOURCES

The surrounding watershed is a typical Appalachian oak-hickory forest with yellow-poplar and green ash as associated species. Sugar maple and hemlock-mixed hardwoods dominate on the wetter bottomlands. An additional forest type is the coniferous pine forest.

WILDLIFE RESOURCES

Wildlife species inhabiting these forests include ruffed grouse, woodcock, various thrushes, and vireos, the scarlet tanager, several species of woodpeckers, gray and red squirrels, rabbits, gray fox, white-tailed deer, and raccoon. Ducks, geese, herons, birds, mink, turtles, muskrat and beaver may be found along the shoreline of the reservoir.

CHESAPEAKE BAY AND/OR COASTAL ZONE MANAGEMENT AREAS

The Pohick Creek Watershed drains into the Potomac River, a major tributary to the Chesapeake Bay. As such, the dam rehabilitation efforts must consider impacts as required by the Chesapeake Bay Preservation Act. The Bay Act is an element of Virginia's multifaceted response to the Chesapeake Bay Agreement. The Bay Act established a cooperative relationship between the Commonwealth and local governments aimed at reducing and preventing nonpoint source pollution. The Bay Act Program is designed to improve water quality in the Chesapeake Bay and its tributaries by requiring the use of effective conservation planning and pollution prevention practices when using and developing environmentally sensitive lands.

Fairfax County has adopted local land use plans and ordinances which incorporate water quality protection measures consistent with the Chesapeake Bay Act Regulations. The Regulations address non-point source pollution by identifying and protecting certain lands called Chesapeake Bay Preservation Areas. The lands that make up Chesapeake Bay Preservation Areas are those that have the potential to impact water quality most directly. Generally, there are two types of land features: those that protect and benefit water quality (Resource Protection Areas) and those that, without proper management, have the potential to damage water quality (Resource Management Areas). By carefully managing land uses within these areas, local governments

help reduce the water quality impacts of nonpoint source pollution and improve the health of the Chesapeake Bay.

Fairfax County is also included in Virginia's Coastal Zone Management Program, and is one of eight Planning District Commissions in the Coastal Zone Area. The Northern Virginia Regional Commission is responsible for review of federal, state and local activities in its geographic area for consistency with the provisions of the Coastal Zone Management Act. Any dam rehabilitation efforts must consider these regulations and comply with them during the planning, design, and construction phases of the project.

SOCIAL AND ECONOMIC CONDITIONS

Royal Lake has a watershed of 2,477 acres with approximately 2,312 acres lying within Fairfax County. The remaining 165 acres are within Fairfax City. A majority of the population within the watershed resides within Fairfax County.

Population and Race: According to the 2000 Census, Fairfax County had a total population of almost 1 million (969,749). Of the total population, about 70% (677,904) are white, 13% are Asian (126,038), and 8.6% (83,098) are Black or African American. Together these three groups make up 91.6% of the county's entire population. Hispanics of any race are the third largest minority group with 11%, or 106,958. "Other races" constitute 4.5% of the Fairfax County population with 44,019. Native Americans have a very small presence with only 0.3% of the population (2,561).

Fairfax City had a total population in 2000 of 21,498 with whites comprising almost 73%. Asians and blacks made up 12.2% and 5.1% of the population, respectively. Hispanics of any racial background made up 13.6% of total population. Native Americans also had a very small presence within Fairfax City at only 0.3% of the population (73).

Language Spoken at Home: Seventy percent of the Fairfax County population, 5 years of age and over, speak only English at home. This means that 30% of this same age group spoke languages other than only English at home. The single largest of this group, at 10.6%, speak Spanish at home. The next largest group, at 9.2%, speaks Asian and Pacific Island languages at home and 7.5% speak Indo-European languages other than Spanish at home. Over 13% speak English "less than very well." About 18% of Fairfax City residents speak a language other than English at home.

Age: The 2000 Census of the U.S. population indicates that the median age (middle point with ½ above and ½ below) of the population of Fairfax County was 35.9 (37 for Fairfax City). The median age for the state of Virginia was somewhat lower at 35.7 years while it was 35.3 for the entire nation. Residents in Fairfax County that were 65 years old or older totaled 7.9% (76,818), while the same statistic for Fairfax City was 12.8%. These compare to 11.2% for the State and 12.4% of the nation. About 75% of the County population, and 79.5% for the City, were over the age of 18. The same statistic for the state as a whole in 2000 was 75.4%. Both the local and the state numbers are close to the national average reported for 2000 at 74.3%.

Education: Almost 91% of the residents in the County, and 88.6% in Fairfax City had a high school education or higher while the state-wide and national percentages for this were 81.5% and

80.4% respectively. Approximately 14% of the residents in the county, and 19.5% of the City, have only a high school diploma or have passed an equivalency test. Almost 77% of the County residents, and 69% of the City, have some education beyond high school, including 30.4% with a bachelor's degree for the county (24.8% for the City) and 24.4% with graduate or professional degrees (20.8% for the City). Thus 54.8% of County residents, and 45.6% of the City, have a bachelor's degree or higher. An additional 16.9% in the County and 17.2% in the City have completed at least some college level work with 5.2% in the County and 6.2% in the City, having obtained an associate degree. All of these numbers are well above the state-wide and national averages.

Employment/Unemployment, Class of Worker and Commuter Status: Seventy-three percent (750,436) of the population of Fairfax County (548,812), and almost 70% of the City population (12,361), are 16 years of age or older and are considered in the labor force pool. About 97.4% of the civilian labor force in the County and 97.6% of the City were employed. About 2.6% of the civilian labor force in the County, and 2.4% in the City, were unemployed according to the 2000 Census. These figures are lower than the unemployment rate in 2000 for the state of Virginia as a whole which was 4.2%.

Both Fairfax County and Fairfax City have diverse and productive economies. According to the 2000 Census, three sub-sectors of the local economy employ about 90% of the workforce: management and related professional occupations (55.7%); sales and office occupations (22.9%); and service occupations (11.3%). Occupations in the construction, extraction and maintenance make up 5.4% and production, transportation and related occupations make up only 4.6% of area jobs. The same statistics for Fairfax City are very comparable to the County data.

According to the 2003 American Community Survey of the U.S. Census, private employment constitutes 76.5% of all employment in Fairfax County with 57.5% working in private for-profit businesses, 10% being self-employed and 9% working for private nonprofit organizations. Government workers constitute 23.2% of the workforce with 13% employed by the federal government, 1.5% employed by state government and 8.7% employed by local government. The same statistics for Fairfax City are comparable to the County data.

Of all Fairfax County residents employed in 2000, 52.7% worked within Fairfax County and 23.9% commuted to another locale and 23.4% commuted outside of the county and state (presumably to Washington, D.C. and Maryland). The same statistics for Fairfax City are somewhat different. Almost 23% of Fairfax City workers worked locally, while 77.1% worked outside of their City of residence and presumably mainly within Fairfax County and Washington, D.C. About 48.2% of all workers in Virginia reside and work within the same county while 51.8% commute to another county.

Housing: The 2000 Census indicates that there were 359,411 housing units within Fairfax County with 97.6% occupied, with 70.9% owner-occupied. Fairfax City had 8,204 housing units and an occupancy rate of 97.9% with 69.1% owner-occupied. The state-wide occupancy rate for Virginia as a whole in 2000 was 92.9% and the national figure was 91%. The local and state-wide rates for owner-occupancy are slightly higher than the national figure of 66.2% in 2000.

There are approximately 35 lots, mostly single family homes, that adjoin the frontage around the reservoir. Immediately upstream, there are 30 lots that adjoin the upper watershed reaches along the wooded drainage-ways that feed water into the reservoir. An additional 168 homes and 35

businesses and 2 public buildings are located in the projected breach inundation zone below the dam. Residential property values downstream of the dam range between \$238,000 and \$580,000 with an average of \$351,000. The total value of residential property (structures and contents only, excluding land values) at risk below the dam is an estimated \$60,824,000. An added \$24,500,000 of commercial property and \$19,174,000 worth of infrastructure (roads, bridges, rail lines, etc.) are below the dam within the breach inundation zone.

Income: The 2000 Census indicates that there were 351,279 households in Fairfax County, and an additional 8,013 within Fairfax City, in 1999. Median annual household income (householder and all others, related or not) for the county in the same year was \$81,050. This compares to \$67,642 per year for the median household income calculated for Fairfax City and \$46,677 for the state of Virginia. The national figure for median household income per year for 1999 was \$41,994. The median household income in 1999 for Fairfax County was 174% of the state median, 120% of the City's and 193% of the national median household income.

Median family income (householder and all others that are related) in Fairfax County for 1999 was \$92,146 per year. For Fairfax City, median family income in 1999 was \$78,921 per year. These figures are significantly more, approximately 70% and 46% higher respectively, than the \$54,169 in median family income for Virginia as a whole and almost 84% and 58% higher respectively than the \$50,046 reported for the entire United States in 2000.

With respect to per capita incomes, Fairfax County residents reported per capita income of \$36,888 in 1999. Fairfax City had per capita income of \$31,247 in 1999. Virginia reported per capita income of \$23,975 in 1999, while the same figure for the entire United States was \$21,587. That makes the county figure 54% higher than the State level and 71% above the national figure. Fairfax City's per capita income figure for 1999 was 30% higher than the Virginia figure and 45% above the national figure for per capita income.

From a gender-specific perspective, males earn far more than females in the workplace at all levels. Full-time, year-round male workers in Fairfax County had a median income in 1999 of \$60,503, while the same category of female workers in the county earned \$41,802/year. Full-time, year-round male workers within the city of Fairfax had median income in 1999 of \$50,348, while the same category of females in the city earned \$38,351/year. Full-time, year-round male workers had a median income in 1999 of \$37,764 in Virginia, while the same category of females in Virginia earned \$28,035/year. The Virginia figures are very close to the national statistics of \$37,057 and \$27,194 for male and female full-time, year-round workers, respectively.

Poverty: According to the 2000 Census, Fairfax County had 7,507 families (2.9%) living below the poverty level. The City of Fairfax had 131 families, or 2.4% of the total number of families, that live below the poverty level. State-wide, 7% of Virginia's families had incomes below the poverty level in 2000. At the national level, 9.2% of our families live below the poverty level.

Recreation: Royal Lake provides recreation to homeowners and landowners in the area and is highly valued by the local community. Lake-based recreation and other activities associated with the recreational facilities developed around the lake include boating, fishing, picnicking/barbequing, outdoor concerts, environmental education activities, cycling, walking and jogging, skate-boarding and roller-blading, youth sports (baseball, basketball, cross-country training, soccer and tennis), swimming at the Lakeview Swim Club, and some bird watching.

Currently, there are an estimated 15,321 recreation user days enjoyed on and around the lake annually with a total estimated value to the community of \$292,000 (net willingness to pay). Recreation directly and indirectly associated with the impoundment is summarized in Table C.

Table C - Royal Lake Recreation and Associated Park Recreation User Days and Value to the Community*

Recreation Category	Estimated Annual User Days	Estimated Annual Value
Aerobic Exercise:		
Walking:	227	\$1,544
Jogging:	65	\$448
Robinson H.S. Cross-Country Training (boys and girls Teams):	73	\$498
Baseball practice and games:	2,735	\$52,596
Basketball (exercise and pick-up games):	143	\$2,742
Boating:	23	\$437
Cycling, roller-blading and skate-boarding:	66	\$448
Environmental Education:	102	\$1,953
Fishing:	115	\$3,098
Outdoor Concerts (Braddock Nights):	525	\$11,147
Picnicking:	107	\$2,062
Playground and Tot-lot use:	188	\$3,994
Soccer practice and games:	3,906	\$75,105
Swimming (Lakeview Swim Club):	6,825	\$131,242
Tennis:	221	\$4,265
Totals:	15,321	\$291,580

* Based on interviews with Mr. Robert Stevenson, Royal Lake Park Manager, Fairfax County Parks and Recreation Department; Mr. John P. McAnaw, Chairman of the Parks and Lake Committee of King's Park West Civic Association; and Mr. Robert Duval, President of the Lakeview Swim Club, Inc.

PLANNING ACTIVITIES

As part of the planning process, several engineering surveys were conducted. Valley cross-sections were developed from aerial topographic surveys and USGS topographic maps. The Guinea Road stream crossing and Norfolk Southern Railroad / VRE bridge were surveyed with a total station survey instrument. Data for the Burke Lake Road bridge was taken from VDOT file information. The hydraulic modeling programs HEC-RAS (Hydrologic Engineering Center – River Analysis System) and TR-66 (NRCS Technical Release 66, Simplified Dam-Breach Routing Procedure) were used to determine the breach inundation zone and the water surface elevations at each cross-section. The first floor elevation and point-of-water-entry elevation for houses and businesses within the breach zone were identified from the construction plan

information provided by the county and from the 1-foot contour map where other data was not available. This information was used to identify the economic damages associated with different flood frequencies and water surface elevations. The SITES (Water Resources Site Analysis) computer program was used with information from the geologic investigations to model the stability and integrity of the vegetated earthen auxiliary spillway.

Other planning activities included a land use inventory, natural resources inventories, wetland assessments, and the identification of threatened and endangered species and fish and wildlife resources. Cultural and historic resources were researched and a Phase I survey completed. Social and economic effects of the potential alternatives were evaluated for cost-effectiveness and for local acceptability. Both the benefits and the costs of the alternatives were computed and analyzed.

Figure 1 – Sediment Survey of Royal Lake.



WATERSHED PROBLEMS AND OPPORTUNITIES

WATERSHED PROBLEMS

The Division of Dam Safety has issued a conditional certificate for Royal Lake because the vegetated earthen auxiliary spillway cannot pass the Probable Maximum Flood (PMF) storm flows without breaching the structure. The earthen training dike is also too low to prevent water flowing in the spillway from eroding the embankment of the dam.

Sponsor Concerns: The first conditional certificate was issued to Fairfax County for Royal Lake in May 2003. The Division of Dam Safety had been discussing the existing problems with this structure for many years prior to issuing the conditional certificate. The most recent conditional certificate was issued in September 2005. The conditional permit requires the Sponsors to address the potential for severe head-cutting and erosion in the auxiliary spillway. It also requires an increase in the height of the training dike. The local Sponsors are very interested in resolving the issues raised by the Division of Dam Safety and complying with the Dam Safety regulations.

A conditional certificate serves as notification to the Sponsors that the dam no longer meets State requirements and must be modified as soon as possible to meet State law. The presence of an unresolved conditional certificate leaves the Sponsors vulnerable to liability suits should the dam breach and downstream damages result. In order to address these concerns, the Sponsors requested the assistance of NRCS to do the watershed planning and to identify the improvements necessary to obtain full dam safety certification.

In addition to the two issues mentioned in the conditional certificate, NRCS identified a third issue that must be addressed in the rehabilitation of the dam. After the dam was built, there were several townhouses built downstream of the auxiliary spillway outlet. At the present time, flows in the auxiliary spillway will move directly toward these buildings. Under the conditions of the rehabilitation program, any solution proposed by NRCS must include a way to protect the townhouses from harm.

Soil Erodibility: According to Gannett Fleming's June 1999 report entitled, *Emergency Spillway Erodibility Study, Pohick Creek Damsite No. 4, Project PC0104*, in July 9, 1998, two test pits were excavated in Royal Lake's auxiliary spillway. The purpose of the test pits was to expose and evaluate the subsurface conditions within the spillway. Test Pit Nos. 1 and 2 were excavated to depths of 10.8 ft and 14 ft from the surface of the spillway, respectively. The test pit logs in the report identified the soil encountered at site ranging from silty sand (SM) to sandy silt (ML), overlying a weathered rock. At Test Pit No. 1, weathered rock was encountered at a depth of 9 ft. The weathered rock was not encountered in Test Pit No. 2.

From the results of the test pit investigation and information from a previous subsurface investigation performed by SCS prior to the construction of Pohick No. 4, Gannett Fleming developed a generalized subsurface profile within the emergency spillway. Gannett Fleming's report states that "Based on information from Drill Hole No. 25 and Test Pit Nos. 1 and 2, a generalized geologic profile was constructed consisting of six different layers of material." The report further states that, "a generalized geologic profile was developed that represents

conditions near the toe of the left slope of the emergency spillway (the side closest to the dam). At this location the profile has the deepest zone of erodible material.”

The subsurface profiles as well as the engineering properties of the soil/rock were utilized as input parameters for the SITES model. Gannett Fleming performed SITES analyses utilizing the lowest and highest estimates of erosion resistance properties of layers indicated above, for both the PMF and ½ PMF outflow hydrographs. The results of Gannett Fleming’s SITES analysis of the auxiliary spillway at Royal Lake, “indicate that remedial measures are required to preclude a catastrophic dam failure during passage of severe flood events.”

Floodplain Management: The Sponsors have identified flooding in the floodplain downstream as a primary concern. Fairfax County has participated in the National Flood Insurance Program since 1972, and realizes the value that Royal Lake provides in flood protection benefits, particularly for the roads. As such, they have expressed concerns about returning to the pre-project flood exposure. Specifically, they are concerned that removing the dam would have negative impacts associated with flood frequency and intensity downstream, including decreased property values, increased flood insurance premiums, and disruptions to utilities and the transportation network. Royal Lake controls about 3.9 square miles (2,477 acres) of the watershed above the affected properties.

Fairfax County has been very proactive in the protection of the Pohick Creek floodplain. In the early 1970s, USGS identified the 100-year floodplain within the watershed. The entire area was then zoned to prevent development. The six NRCS flood control dams were installed after the zoning was complete. The post-construction 100-year floodplain is substantially smaller than the zoned area. Removal of the Royal Lake dam would raise the 100-year floodplain from its current levels but would not exceed the existing zoned area.

Erosion and Sedimentation : As of 2006, Royal Lake had reached about 29% of its planned service life. According to the 2006 sediment survey conducted of the lake, the volume of sediment (both submerged and aerated) in the Royal Lake reservoir and its tributaries was about 23% of the original amount planned in the design. As expected, most of the sediment observed is present in the inlet channel areas of the structure. This material is primarily deposited sediments plus leaf and other organic debris. Note that another 7.5% of the sediment material was dredged from the impoundment from 1985 to 1990 by Fairfax County. Samples of the sediment have been taken and will be tested in case Fairfax County decides to conduct any dredging operations on their own. Federal funds will not be provided for dredging as part of the dam rehabilitation project because the reservoir has more than the minimum storage capacity of 50 years that is mandated by the rehabilitation program.

In the original design, 2,019 acres were classified as ‘subject to construction.’ Currently, 2,009 acres of the watershed are either classified as having a land use of ‘Residential/Business’ or ‘Transportation’, with the majority being Residential/Business. The watershed area is predominantly “built-out.” The increase in impervious surface area has increased the volume of runoff into the streams feeding the lake. As a result, the stream banks have eroded, contributing sediment to the lake. Stormwater management, stream bank erosion control, and general watershed erosion control in the watershed are the responsibility of the sponsors and will not be addressed under the dam rehabilitation program.

Local Concerns: Royal Lake and the local park are used extensively by the local residents. The potential for the lake to be drained for rehabilitation work, the impacts to the walking trails and other facilities during construction, and the increased traffic and parking problems along adjacent streets have sparked a number of concerns among local residents. Sediment accumulation in the lake is also an issue of concern. An additional issue centers on the possible loss of trees near the outlet of the auxiliary spillway. The aesthetic appearance of the proposed solution is a critical issue.

WATERSHED OPPORTUNITIES

The following is a general list of opportunities that will be recognized through the implementation of this dam rehabilitation plan. Some quantification of these opportunities will be provided in other sections of the report, as appropriate.

- Comply with dam design and safety criteria established by NRCS and the Division of Dam Safety.
- Minimize the potential for loss of life associated with a failure of this dam, particularly around the townhouses.
- Eliminate the sponsor liability associated with operation of an unsafe dam.
- Maintain the existing level of flood protection for downstream houses, businesses, and infrastructure.
- Protect real estate values around the lakes and downstream from the dam.
- Maintain existing fish and wildlife habitats around the dam.
- Preserve existing recreation opportunities.
- Protect water quality (the lake has trapped 79.22 acre-feet of sediment and attached nutrients in 29 years).

SCOPE OF THE ENVIRONMENTAL ASSESSMENT

A scoping process was used to identify issues of economic, environmental, cultural, and social importance in the watershed. Watershed concerns of Sponsors, technical agencies, and local citizens were expressed in the scoping meeting and other planning and public meetings. Factors that would affect soil, water, air, plant, animals, and human resources were identified by an interdisciplinary planning team composed of the following areas of expertise: engineering, biology, economics, resource conservation, water quality, soils, archaeology, and geology.

Specific concerns and their degree of significance to the decision making process were identified. On November 15, 2005, a Scoping Meeting was held at Braddock Hall in Burke, Virginia. Input was provided by Fairfax County, the Northern Virginia SWCD, the Virginia Department of Game and Inland Fisheries, the Virginia Department of Historic Resources, the Virginia Department of Conservation and Recreation – Division of Natural Heritage, and the U.S. Fish and Wildlife Service. Table D shows the degree of concern and degree of importance in decision making based on the scoping meeting .

Table D – Scoping Results For Rehabilitation of Royal Lake – November 15, 2005

Resource Concern	Degree of Concern ¹	Significance to Decision making ²	Remarks
Air Quality *	Low	Low	No open burning Emissions control on equipment Dust control during construction Loss of trees may affect air quality ** Stopped traffic impacts
Coastal Zone Management*	High	Low	RPA-100 foot buffer minimum and floodplains, wetlands, etc. RMA-All the rest of Fairfax County
Erosion & Sedimentation - Dredge Material	High	High	Dredge material ** - Aesthetics - Materials tested for disposal - Truck traffic for hauling
Fish & Wildlife Habitat; Fisheries *	Low	Low	Consider multiple gates
Floodplain Management;* Flooding	High	High	Increase flood pool upstream
Forestry and Parks	High	High	Realignment of Auxiliary Spillway
Historic Resources *	Med	Med	
Prime & Unique Farmlands *	Low	Low	None Present
Property Values around lake	High	High	Negative for decommissioning Positive for rehabilitation
Public Recreation	High	High	Impacts to trails and recreation fields
Public Safety	High	High	Transportation - Passenger rail - Freight rail - Public roads Homes/Businesses
Sewer Utilities	High	High	Sewer lines near lake
Stormwater Management	High	High	
Threatened & Endangered Species *	Low	Low	
Transportation	High	High	Local parking in cul-de-sacs Staging area
Water Quality *	High	Low	Benefits to environment Follow E&S ordinances/laws during construction
Wetlands *	Med	Med	
Wild & Scenic Rivers *	Low	Low	
Noise Pollution	High	High	During construction **
Aesthetics	High	High	Must look pleasing after rehab May need supplemental landscaping and reforestation

* Required by Law

** Consider during Design and Construction

¹ Low, Medium or High

² High- must be considered in the analysis of alternatives; Medium - may be affected by some alternatives solutions;
Low- consider, but not identified as important to decision making.

DESCRIPTION OF EXISTING DAM

EXISTING CONDITIONS

The Royal Lake principal spillway has a standard 3' x 9' rectangular one-stage riser with a height of 15 feet. The principal spillway conduit is a concrete pipe that is 36 inches in diameter and 208 feet long. The auxiliary spillway is vegetated earth and is 100 feet wide. The crest elevation is 300 feet above mean sea level (MSL). The vegetative cover of grass for the auxiliary spillway is very good. The as-built top of the dam was planned to be 310.75 feet (MSL) after soil settlement. However, the top of dam elevation identified in the Gannett-Fleming study was 311.5 feet (MSL). This is due in part to the asphalt path constructed on top of the dam and in part to the fact that the dam was built to the designed pre-settlement elevation. Since most of the settlement actually occurs during the construction period, the extra elevation just provides an increased margin of safety against overtopping.

At the time of design, the auxiliary spillway crest elevation met the NRCS criteria of detaining the entire volume of the 100-year, 10-day storm, for release through the principal spillway. This storage volume was and is still required for vegetated earth auxiliary spillways. Since that time, the precipitation amounts have been updated for the 100-year, 24-hour rainfall event and the 100-year, 10-day rainfall event. In addition, hydrologic and hydraulic computation methods have become more refined. When these precipitation values were input into the SITES model, the auxiliary spillway crest elevation was computed to be 301.77 feet (MSL). If the rehabilitation of the auxiliary spillway could be accomplished by continuing in the use of vegetated earth, then the crest would have to be raised to this elevation. This would cause an increase in the water storage behind the dam, possibly backing water into areas that have not previously experienced flooding during storm events. No residences would be flooded. It could also necessitate an increase in the height of the dam or an increase in the width of the auxiliary spillway.

The SITES model also was used to evaluate the capacity, stability, and integrity of the soils in the auxiliary spillway. The existing capacity of the auxiliary spillway is adequate to pass the Probable Maximum Precipitation (PMP) storm event without overtopping the dam at the existing auxiliary spillway size and crest elevation.

However, the soils in the auxiliary spillway are susceptible to surface erosion and are not able to withstand the flow velocities that will occur in the auxiliary spillway during a major storm. This is the stability part of the evaluation. According to the Gannett Fleming test pits and the NRCS drill holes, the soils can be described as silty sands and sandy silts to a depth of about 13 feet in the level section. Below that depth, the material is described as weathered mica schist.

The integrity of the site is related to the strength of the underlying soil materials. Since there is no hard bedrock under the auxiliary spillway, the underlying materials are also vulnerable to erosion. The auxiliary spillway at Royal Lake was built with the best information available at that time. The use of the SITES model allows a more in-depth evaluation of that same information. Since public safety is of utmost importance to NRCS, the Sponsors, and the Division of Dam Safety, the use of the SITES model should be viewed as an opportunity to identify and correct these potential safety issues in a timely manner.

There is a single training dike between the edge of the auxiliary spillway and the embankment of the dam. The purpose of the training dike is to direct water flowing through the auxiliary spillway away from the dam in order to prevent erosion of the dam itself. At the present time, the training dike is not high enough to do this.

Another issue of concern is the existing alignment of the auxiliary spillway. At the present time, the water exiting the spillway is directed toward a group of townhouses that were built after the dam was completed. The results from the SITES computer model indicate that the townhouses potentially could be impacted. The model does not predict the width of an earthen auxiliary spillway breach; it only indicates that a breach will occur for a given event. Therefore, it is possible that the townhouses would be damaged from flooding, from undermining of the foundation, or both.

In 2006, a remote controlled mobile video camera was used to inspect the inside of the riser and principal spillway pipe. The concrete riser and principal spillway pipe appeared to be in satisfactory condition. The embankment drains and the sewer pipe running through the dam were not surveyed. The sewer pipe is a 15" pipe encased in a 48" pipe. These pipes were in place prior to construction of the dam and the design includes accommodation for their presence within the embankment. These camera surveys will have to be completed prior to the start of design. Any problems with the embankment drains discovered prior to or during construction will have to be repaired as part of the rehabilitation project. It is likely that the embankment drain adjacent to the auxiliary spillway will need to be replaced concurrent to the changes in the training dike. Any problems identified with the sewer pipes would be the responsibility of Fairfax County and would not be funded through the rehabilitation program.

SEDIMENTATION

Royal Lake was designed with an original sediment storage capacity of 258 acre-feet for 100 years of life. Fairfax County hydraulically dredged 8.52 acre-feet from 1985 to 1989. The county also conventionally dredged 10.83 acre-feet from 1989 to 1990. The total amount of sediment dredged from 1985 to 1990 was 19.35 acre-feet. As part of the rehabilitation planning process, a reservoir sediment survey was conducted in late April and early May 2006. The 2006 sediment survey revealed 59.87 acre-feet of sediment deposited in the reservoir and its tributaries. When the dredged sediment volumes are added to the existing amount, the total volume of sediment accumulated since construction in 1977 is equal to 79.22 acre-feet. This equates to a sediment deposition rate of 2.73 acre-feet per year. Only 23.2 % of the available sediment storage capacity is currently filled. The remaining sediment storage capacity of the structure totals 198.13 acre-feet. This is 76.8% of the original capacity of the reservoir. At the 2.73 acre-feet per year historic rate of sediment deposition, there is enough sediment storage for another 72.5 years of sediment in the reservoir.

STATUS OF OPERATION AND MAINTENANCE

Operation and maintenance of the structure is the responsibility of Fairfax County. Recent records indicate that the operation and maintenance of the structure has been kept current for the site. This has been verified through site assessments. Fairfax County has done an excellent job of operating and maintaining this structure.

STRUCTURAL DATA

The as-built structural data for the dam and watershed is described in Table E.

Table E - Existing Structural Data for Royal Lake

Local Name	Royal Lake
Site Number	4
Year Completed	1977
Cost	\$323,007
Purpose	Flood control
Drainage Area, mi ²	3.9
Dam Height, feet	42.75
Dam Type	Earthen
Dam Volume, yds ³	121,200
Dam Crest Length, ft	1,092
Storage Capacity, ac-ft	
Submerged Sediment, ac-ft	244
Aerated Sediment, ac-ft	14
Flood Storage, ac-ft	826*
Surcharge, ac-ft	1,327
Total, ac-ft	2,425*
Principal Spillway	
Type	Concrete
Riser Height, ft	15
Conduit Size, inches	36
Stages, no.	1
Capacity, cfs	169
Energy Dissipater	None
Auxiliary Spillway	
Type	Earthen
Width, ft	100
Capacity, % of PMF	50**
Normal Pool Elev.	287
Flood Pool Elev.	300
Top of Dam Elev.	311.5*

* Based on Gannett Fleming report.

** Based on SITES model showing a breach during the 6-hour PMP event.

BREACH ANALYSIS AND HAZARD CLASSIFICATION

Breach Analysis: As part of the planning process, NRCS evaluated this dam for its current breach inundation zone. NRCS performed a breach analysis using a sunny day breach with the water level at the top of the dam and the existing earthen auxiliary spillway blocked. The dam height used in the breach analysis was 42.75 feet.

The analysis was conducted using the HEC-RAS and TR-66 computer models. The cross sections were developed from contour maps, including the maps used by USGS in the original floodplain study and the 5-foot and 1-foot contour maps provided by Fairfax County. The maximum discharge for the breach was computed using the criteria in Technical Release No. 60, Earth Dam and Reservoirs. The results of the breach analysis are shown in Table F and on the Breach Inundation Map in Appendix C.

The breach inundation zone analysis will be used by the Sponsors to update the Emergency Action Plan (EAP) that currently exists for the dam. The purpose of an EAP is to outline appropriate actions and to designate parties responsible for those actions in the event of a potential failure of the dam. The Sponsors will update the EAP annually with assistance from local emergency response officials. As resources allow, NRCS will provide technical assistance with updating the EAP. The NRCS State Conservationist is to ensure that a current EAP is prepared prior to initiation of construction.

Table F - Results of a Dam Breach Routing for Royal Lake

Cross Section Number	Distance from Dam to Downstream Cross-section (feet)	Maximum Water Surface Elevation (ft MSL)	Maximum Flow (cfs)	Approximate Location of Cross-section
Dam	0	292.4	60,700	Immediately below dam
209.3	400	289.0	56,400	Above Guinea Road
209.2	495	286.1	55,200	Below Guinea Road
206.9	1,180	283.8	43,900	Above Railroad
209.6	1,215	283.5	42,400	Below Railroad
199	2,427	280.0	37,200	Before Mason Bluff Rd.
189	4,721	267.6	29,300	Above confluence with Lake Braddock and unnamed tributary
188	4,871	267.2	27,900	Below confluence with Lake Braddock and unnamed tributary
181.3	6,591	262.3	24,100	Above Burke Lake Road
181.2	6,711	257.1	23,700	Below Burke Lake Road
170	8,341	251.6	22,000	Downstream of Parakeet Dr.
165	9,341	244.6	17,700	Downstream of Heritage Square .
155	11,141	237.2	15,600	End of Breach Zone

Hazard Classification: Royal Lake was originally constructed in 1977 for the purpose of protecting downstream lands from flooding. It was built as a SCS class (c) (high hazard) structure with a 100-year design life. The hazard class of the structure remains high because failure may cause loss of life and serious infrastructure damage.

In Virginia, State dam safety regulations require that a high hazard dam must be able to safely pass the volume of water associated with the Probable Maximum Flood (PMF) without overtopping. The Virginia Division of Dam Safety definition of the PMF is “the flood that might be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. NRCS is required to use the criteria established in NRCS Technical Release 60 (TR-60) to prepare rehabilitation designs. Under these criteria, the Probable Maximum Precipitation (PMP) is used to define the design requirements rather than the Probable Maximum Flood used by the State of Virginia. Since the Probable Maximum Flood is the result of the Probable Maximum Precipitation, the NRCS criteria meet the State criteria.

Current NRCS policy in TR-60 requires an evaluation of both the short duration (6-hour) and the long duration (24-hour) PMP storms to assess the capacity and integrity of the earthen auxiliary spillway. Only the short duration storm is used to check the stability of the spillway. Based on the results of these analyses, NRCS designs for the storm that has the potential to cause the most damage.

According to the most recent State Dam Safety conditional operation and maintenance certificate issued in September 2005, the auxiliary spillway of Royal Lake can only safely pass 50% of the runoff associated with the 6-hour PMF without breaching. The 6-hour PMP storm is 27.6 inches of water. The 6-hour storm event that would cause a failure of the auxiliary spillway is a storm with a frequency greater than once in a thousand years (less than 0.1% chance of occurring in a given year). This precipitation is about 13 inches. For the 24-hour storm event, this same amount of precipitation would occur once in about 800 years (about 0.13% chance of occurring in a given year). Storms with flood volumes exceeding these percentages of the PMF are likely to result in a breach of the structure.

EVALUATION OF POTENTIAL FAILURE MODES

Since both NRCS and the State of Virginia recognize that Royal Lake is a high hazard structure, several potential modes of failure were examined.

Sedimentation: The reservoir is designed to store sediment in the area below the elevation of the principal spillway inlet and to detain floodwater in the area between the principal spillway inlet and the crest of the auxiliary spillway. In many cases, water accumulates below the crest of the principal spillway riser to create a lake. As the lake fills with sediment, the amount of water in the lake decreases. When the sediment pool has filled to the elevation of the principal spillway inlet, the pool no longer has permanent water storage, but the designed flood detention storage is still intact. If the actual sedimentation rate is greater than the designed sedimentation rate, the sediment storage area will be filled before the design life of the structure has been reached. The additional sediment would begin to fill the floodwater detention area above the principal spillway and reduce the available flood storage. As the detention pool loses storage due to sediment deposition, the auxiliary spillway operates, or has flowage, more often. For a vegetated earthen auxiliary spillway, repeated flows would erode the soil material and eventually cause the spillway to breach. For a structural auxiliary spillway, only the topsoil material would erode, leaving the underlying armor intact but exposed. There would be no potential for a breach. The repair and re-vegetation of the spillway would be conducted under the Operation and Maintenance agreement.

The land use in the watershed above the dam is 73% Residential/Business, 17% Woodland, 8% Transportation (roads), and 2% Water. These uses are not expected to change significantly. The future sediment accumulation rates in Lake Royal are expected to be the same as the historic rate over time. It is expected that in some years, the sediment accumulation rate will be higher than the historic average, and in some years, the sediment accumulation rate will be less than the historic average. Based upon the historic sediment deposition rate of 2.73 acre-feet per year, the remaining sediment storage life of Royal Lake is 72 years and the potential for failure due to inadequate capacity is minimal.

Hydrologic Capacity: Hydrologic failure of a dam can occur by breaching the auxiliary spillway or by overtopping and breaching the dam. The integrity and stability of the auxiliary spillway and dam embankment are dependent on the depth, velocity, and duration of the flow, the vegetative cover, and the resistance of the soil in the auxiliary spillway and dam embankment to erosion. Under the present Virginia criteria for high hazard dams, the auxiliary spillway must have sufficient capacity to pass the full PMF event without breaching the spillway or overtopping the dam. At the present time, Royal Lake can pass about 50% of the 6-hour PMF before the auxiliary spillway breach would occur. The overall potential for hydrologic failure of Royal Lake is considered to be high because it cannot pass the PMF without breaching the auxiliary spillway.

Seepage: Embankment and foundation seepage can contribute to failure of an embankment by removing (piping) soil material through the embankment or foundation. As the soil material is removed, the voids created allow even more water flow through the embankment or foundation, until the dam collapses due to the internal erosion. Seepage that increases with a rise in pool elevation is an indication of a potential problem, as is stained or muddy water or “sand boils” (the up-welling of sediment transported by water through voided areas). Foundation and embankment drainage systems can alleviate the seepage problem by removing the water without allowing soil particles to be transported away from the dam.

The principal spillway pipe for Royal Lake does not exhibit signs of seepage. Seepage from the principal spillway pipe provides a low potential for failure. However, it should be noted that the location of the embankment drains at Royal Lake have not been identified and the camera survey of the sewer pipe under the embankment is not yet complete. Both of these potential sources of piping will have to be evaluated by Fairfax County before the design process is started.

Seismic: The integrity and stability of an earthen embankment are dependent upon the presence of a stable foundation. Foundation movement through consolidation, compression, or lateral movement can cause the creation of voids within an embankment, separation of the principal spillway conduit joints, or in extreme cases, complete collapse of the embankment. The Pohick Creek watershed is not located within an area of significant seismic risk; therefore, there is low potential for seismic activity to cause failure of the dam.

Material Deterioration: The materials used in the principal spillway system, the foundation and embankment drains, and the pool drainage system are subject to weathering and chemical reactions due to natural elements within the soil, water, and atmosphere. Concrete risers and conduits can deteriorate and crack, metal components can rust and corrode, and leaks can develop. Embankment failure can occur from internal erosion caused by these leaks. The

camera survey of the riser and principal spillway pipe show no material deterioration. Failure of the dam is not likely to occur through material failure.

Conclusion: The failure mechanism is most likely to be a lack of hydrologic capacity since the soils in the auxiliary spillway do not have the structural integrity necessary to pass the design storm event. The sediment capacity is adequate, there are no signs of seepage, the site is not in a seismic activity area, and the material components are in satisfactory condition.

CONSEQUENCES OF DAM FAILURE FOR THE EXISTING AUXILIARY SPILLWAY CONDITION

NRCS and the State of Virginia consider this dam to be an “unsafe” structure because it does not meet the criteria established for a high hazard dam and is at risk for catastrophic failure under extreme rainfall event conditions. This dam is “unsafe”, not because of imminent danger, but because the soil materials in the auxiliary spillway do not have the structural integrity necessary to resist the flows of the PMF. Until rehabilitation is complete, storm events with anticipated precipitation amounts greater than 10 inches should be monitored closely in order to be able to implement the Emergency Action Plan in a timely manner.

Under the existing conditions, water that flows in the auxiliary spillway will move directly toward the townhouses located on the north and west sides of Wood Wren Court. Storage in the reservoir will be about 1,568 acre-feet with a depth in the auxiliary spillway of approximately 4.1 feet when the breach is modeled to occur. Guinea Road, the Norfolk Southern / VRE railroad line, and Burke Lake Road will be affected along with their associated utilities. Some businesses and residences downstream of Burke Lake Road could experience some flood damages due to their proximity to the creek. Some residents may have loss of access to emergency services due to flooding on residential roads.

CONSEQUENCES OF DAM FAILURE BY OVERTOPPING

For the purposes of preparing the Emergency Action Plan, a worst-case scenario is assumed in the analysis of a possible dam failure. This scenario assumes a sunny day breach of the dam with no advance warning. Dam failure is assumed to occur when water begins to overtop the structure due to the unresolved blockage of the principal and auxiliary spillways. It is assumed that structural collapse would occur quickly and result in a release of water and sediment, beginning with a wall of water equal to the dam height. For Royal Lake, 2,524 acre-feet of water and sediment would be released at an initial water height of 42.75 feet.

Resource inventories performed during the planning process indicate that a sunny day failure of the Royal Lake dam would jeopardize 168 homes with water depths from a few inches to well over 12 feet. The average flood depth would be about 4.3 feet and would place about 505 residents at some degree of fatal risk. Thirty five local businesses would be exposed to water depths from a few inches to well over 10 feet. The average flood depth for affected businesses would be about 2.3 feet and would expose about 205 workers (and an undetermined number of clients) to some degree of fatal risk. The breach zone for Royal Lake extends from the dam for a distance of about a mile upstream along Sideburn Branch and about two miles downstream along Pohick Creek. This is a total distance of about three miles. Access to emergency services would

be limited for the 168 residences directly impacted by a sunny day breach, as well as the occupants of an additional 394 residences and about 50 businesses that would have access temporarily cut-off during a breach event.

Traffic counts from VDOT indicate that an additional exposure to loss of life could occur as a result of the 16,000 vehicles that use Guinea Road and the 35,000 vehicles that cross Pohick Creek at Burke Lake Road daily. Coffer Woods Road and Burke Road, with daily traffic counts of 6,700 and 7,900, respectively, would have restricted access. Commonwealth Boulevard, with 5,800 vehicles per day, would be blocked if the water level in the reservoir reached the top of dam. Additionally, an average of 9,000 passengers use the rail system each day and their access to commute would be disrupted for an estimated 9-10 months. Freight traffic would also be disrupted. The utilities associated with the transportation routes could also be destroyed.

The economic damages would include the damages to the homes, businesses, roads, rail lines, and utilities, the loss of business activity, and the loss of the lake and corresponding decreases in property values and recreational opportunities. The residences and business properties at risk in the area of the floodplain subject to a breach of Royal Lake have structure and content values estimated at over \$90.8 million. In addition, potentially impacted infrastructure is valued at over \$19.2 million. Infrastructure damage caused by a catastrophic breach would include the loss of Guinea Road, the Norfolk Southern / VRE railroad, Burke Lake Road, several communication lines, and a gas pipeline. Economic damages resulting from these losses would be approximately \$17.2 million. Long-term costs of the loss of these infrastructure components would also be incurred due to the need for alternate routes during the replacement period. Other economic damages from a catastrophic breach would be: a) lost recreation opportunities with the lake gone; b) changes in real property values and the tax base associated with increased flooding in the future; and c) increased flood damages in the future for remaining properties due to the absence of the dam and its flood protection effects. A catastrophic breach of the Royal Lake dam would result in a total estimated \$46.5 million in damages.

In addition to the damage caused by the water, a significant volume of sediment would initially be flushed downstream in the event of a catastrophic breach. At its full capacity, Royal Lake has a sediment storage volume of 258 acre-feet. Highly erodible sediment remaining in the sediment pool would continue to cause persistent sediment deposition problems for the downstream channel and floodplain. It is unlikely that a catastrophic breach would remove all of the fill material used to build the dam. The embankment material remaining after a breach would also eventually erode into the stream, contributing to the downstream sediment deposition. Sediment would be deposited in the stream channels and on the floodplain. This would constrict the floodplain and cause additional flooding in subsequent flood events. Deposition in the floodplain would also restrict the normal use of the land. The nutrients in the sediment could cause water quality problems in the future. At a minimum, sediment would initially be transported for the entire length of the breach inundation zone. Over time, the sediment would migrate downstream into the Potomac River, and eventually to the Chesapeake Bay.

There is also the potential for stream degradation upstream from the dam site. The abrupt removal of the water and sediment would cause instability in the streams feeding the reservoir. These streams could develop headcuts that would migrate upstream through the watershed, eroding the banks and channel bottoms and adding more sediment into the stream system.

FORMULATION AND COMPARISON OF ALTERNATIVES

The stated objectives of the Royal Lake Rehabilitation Plan for the Sponsors are: 1) to bring the Royal Lake dam into compliance with current dam safety and design criteria; 2) to maintain the current level of flood protection provided by Royal Lake; and 3) to address the local residents' concerns rated as high. These objectives can be met by installing measures which will bring the dam into compliance with State and Federal regulations. Under the Watershed Rehabilitation Provisions of the Watershed Protection and Flood Prevention Act, NRCS is required to consider the technical, social, and economic feasibility of both the locally preferred solution and other alternatives identified through the planning process.

FORMULATION PROCESS

Formulation of alternative rehabilitation plans for Royal Lake followed procedures outlined in the NRCS *National Watershed Manual, Part 508*. Other guidance incorporated into the formulation process included the NRCS *National Planning Procedures Handbook, Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, and other NRCS watershed planning policies. Each alternative evaluated in detail used a 71-year period of analysis, which includes a one year installation period and 70 years of expected useful life. This period of analysis was chosen because it is the life associated with the most limiting factor, the sediment storage capacity of the reservoir. It is anticipated that the dam will continue to be in service after that time with proper maintenance.

The formulation process began with formal discussions between the Sponsors, the Division of Dam Safety, and NRCS. The Division of Dam Safety conveyed state law and policy associated with a high hazard dam. NRCS explained agency policy associated with the Small Watershed Dam Rehabilitation Program and related alternative plans of action. As a result, alternative plans of action were developed based on NRCS planning requirements and the ability of the alternatives to address the initial objective of bringing the Royal Lake into compliance with current dam safety criteria. See Table G.

Table G - Alternative Plans of Action

1. No Federal Action (Sponsors' Rehabilitation)
2. Decommission the Dam
3. Non-Structural – Relocate or Floodproof Structures in the Breach Zone
4. Rehabilitate the Dam

Alternative plans of action were presented to the public at a public meeting on June 20, 2006. Public meeting participants identified no additional viable alternative plans of actions to be considered during the planning process.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Some of the alternatives considered in the planning process were eliminated from detailed consideration because they did not meet the needs of the Sponsors.

Decommission Dam: Decommissioning is an alternative which includes a plan to remove the flood detention capacity of the dam by removing a portion (or all) of the existing embankment down to the valley floor and restoring the function and stability of the stream channel and the 100-year floodplain. Decommissioning may require grading of the sediment pool to remove accumulated sediment. The removal of the principal spillway riser and pipe is also necessary. These unneeded materials may be buried or hauled to an appropriate disposal site.

Decommissioning is a mandatory rehabilitation alternative under NRCS policy. However, since this alternative did not meet the identified purpose and need of the plan which was to provide continued flood protection, it was not considered as a viable option for detailed development. In addition, the costs for decommissioning would be more expensive than other alternatives studied in detail. Overall costs would include the necessary upgrades to downstream bridges affected by the increased volume of water. Table H lists some of the components of decommissioning.

Table H – Individual Components of Dam Decommissioning

	ROYAL LAKE
Fill Removed, CY	121,000
Channel Restoration, mi.	1.42
Accumulated Sediment to be removed, CY	101,000
Forested Riparian Buffer to be created, acres	47.2
Critical Area Treatment, acres	2
Off-Site Disposal, tons	300
Cost of structure removal only*	\$7,632,500

* Other costs would include mitigation for induced damages, loss of recreation, and reduced property values.

This alternative would induce flooding downstream once the structure was removed. Federal policy requires that induced damages be mitigated. Since the floodplain boundaries were delineated prior to construction of the Pohick Creek dams, the present 100-year floodplain enforced by the county is slightly larger than the actual post-construction 100-year floodplain. Even with the existence of some residential structures and businesses located along the perimeter of the delineated 100-year floodplain in the lower third of the dam breach zone, there would probably be no need for mitigation associated with the removal of Royal Lake Dam. However, there would still be the need to mitigate for damage to the roads, bridges, and utilities in the watershed. None of the roads, railroads, or utilities are currently damaged in the 100-year event because the presence of the dam regulates the release of the water. An unregulated 100-year storm flow could create a need for mitigation.

Non-Structural - Relocation or Floodproof Structures in 100-year Floodplain: There are no homes, businesses, or public buildings located in the 100-year floodplain of Royal Lake. It is not feasible to relocate or floodproof the roads, bridges, and utilities that are at risk in the 100-year floodplain. Since the homes, businesses, and public buildings located in the breach inundation zone are only around the perimeter of the zone, it is not economically practical to relocate or floodproof these structures given the unlikely event of a dam breach. Although the existing

condition breach was not calculated, it would occur at an elevation significantly lower than the sunny-day breach and is not likely to affect the properties around the edges of the breach zone.

DESCRIPTION OF ALTERNATIVE PLANS CONSIDERED

No Federal Action (Sponsors' Rehabilitation): With this alternative, no federal funds would be expended. Since the Royal Lake does not meet current safety and performance standards, it is considered to be "unsafe." The Division of Dam Safety has issued a conditional certificate of operation for the dam. It is reasonable and prudent to expect that the Division of Dam Safety will soon issue an Administrative Order requiring the Sponsors to bring the dam up to State standards by rehabilitation of the dam or remove the hazard by removing the storage function of the reservoir. The Sponsors would be totally responsible for the cost of rehabilitation of the dam. NRCS would still have the technical responsibility of approving the Sponsors' solution.

At the present time, the potential for an uncontrolled breach is present and the Sponsors would be liable for the resulting damages until such time as the existing dam safety issues were addressed and resolved.

Without NRCS assistance, the Sponsors would have the following options:

- Hire a consultant, prepare plans to meet the State of Virginia and NRCS standards, and rehabilitate the dam using their own resources.
- Do nothing. In this case, the Division of Dam Safety may choose to breach the dam and send the Sponsors the bill. This option is likely to be more expensive than if the Sponsors performed the breach. The end results would be the same as those for the next option. This option would not meet the Sponsors' goal of maintaining the existing level of flood protection.
- The Sponsors could remove the flood storage capacity of the dam by breaching the dam using a least cost method. This breach would be a minimum size hole in the dam from the top of the dam to the valley floor, which would eliminate the structure's ability to store water. Downstream flooding conditions would be similar to those that existed prior to the construction of the dam. The sediment would not be stabilized and would migrate downstream. This course of action would minimize the Sponsors' dam safety liability but would not eliminate all liability as it would induce flooding downstream. This option would not meet the Sponsors' goal of maintaining existing levels of flood control.

For the purposes of this evaluation, the Sponsors' Rehabilitation will be used as the No Federal Action alternative.

Rehabilitate dam: There were several solutions considered under the Rehabilitation alternative. The options had to address the following issues:

- 1) Reduce threat to loss of life and damage to the townhouses located directly in the path of the existing spillway flows.
- 2) Prevent a breach of the auxiliary spillway.
- 3) Protect the dam embankment by raising the training dike.

Issue 1. Reduce Threat to Loss of Life and Damage to Townhouses: All of the solutions considered assumed a realignment of the existing auxiliary spillway. It will be rotated about 45 degrees toward the dam to prevent this problem.

Issue 2. Prevent a Breach of the Auxiliary Spillway: The only type of material that will withstand the velocities that will occur in the auxiliary spillway during the PMP storm event is concrete.

Option 1. Roller-compacted concrete (RCC) is a non-reinforced concrete that is durable and easy to install. It would be placed along the floor of the spillway from the level section to the valley floor. It is not practical for use at Lake Royal for several reasons. The primary reason is that RCC has a very limited window of installation time. Each batch of concrete must be installed within a time window of less than a hour. This would necessitate installation of a portable concrete mixing plant on site. Since the available working space on site is less than two acres, this is not feasible.

A second reason for not choosing RCC is the aesthetic appearance of RCC. Although the concrete could be tinted to make it less conspicuous, it would not be practical to cover the RCC with soil and grass. Both would be eroded away every time there was flow in the auxiliary spillway. This would have to be replaced after each flow event under the Operation and Maintenance plan. There would also be the added complication of polluting the downstream watershed with the eroded sediment.

Safety is the third concern. The relatively smooth surface of the concrete on the spillway floor could be attractive to skateboarders, roller skaters, bikers, etc. There is potential liability associated with these activities. There would also be the potential to attract vandalism in the form of graffiti.

Roller-compacted concrete is also the more expensive of the two options for armoring. It would cost about \$3,732,000 for design and installation.

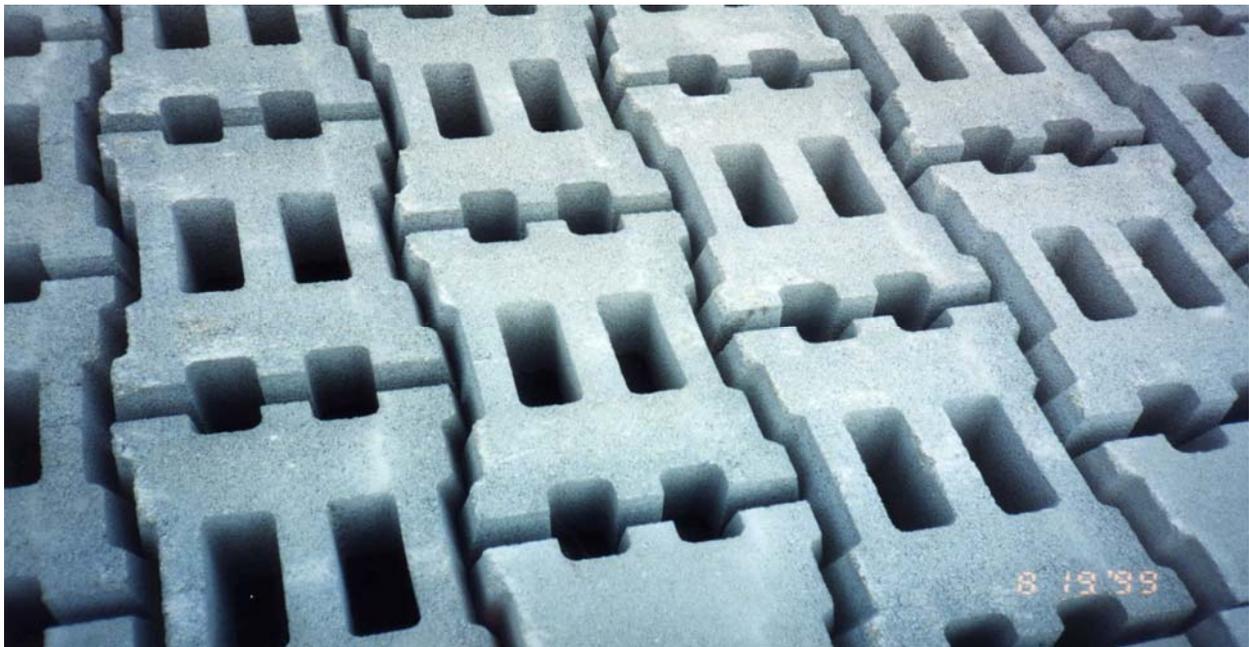
Option 2. Articulated Concrete Blocks (ACBs) are individually constructed concrete blocks that are cabled together to form a continuous erosion-resistant mattress (see Figures 2, 3 and 4). This mattress would extend from the level section of the spillway to the valley floor. The proposed blocks are “open cell” which provides about 20% open space within and around the block. Six inches of gravel and a geotextile fabric would be placed on the prepared subgrade to provide permeability and filtration while providing soil retention. The concrete mat would then be set over the geotextile fabric. Topsoil would be placed in the cells of the blocks and around the blocks. For the purpose of this plan, it is assumed that all of the ACBs will be covered with a foot of topsoil to allow more extensive vegetation of the site and to conceal the armoring. Small flows in the auxiliary spillway will do little damage to the site. Larger flows could erode the soil and grass downstream. Any necessary repairs would be addressed as part of the routine operation and maintenance of the site. Damage to the auxiliary spillway would be limited to just the topsoil and grass removal since the ACBs underneath the soil would provide the structural integrity necessary to prevent a breach. The vegetated surface would not be harmed by foot or bicycle traffic or by the vehicles used for maintenance around the lake, although care should be taken to avoid establishing ruts in the topsoil. The footpath to the top of the dam will need to be located in the inlet section or sufficiently downstream of the auxiliary spillway to avoid causing a discontinuity in the auxiliary spillway surface.

The auxiliary spillway crest would remain at the existing elevation of 300 feet MSL. The ACBs would be placed at an elevation of 299 feet. This would maintain the existing level of flood storage behind the dam. If flows in the auxiliary spillway cause the soils to be removed to the level of the ACBs, then the overall water storage below the crest will be reduced by a foot. Due to the high level of floodplain protection established by Fairfax County, there will be minimal effects downstream due to the slight increase in flow volume and frequency.

The ACBs can be manufactured off-site and trucked in for installation which reduces the amount of space needed for a staging area.

Design and installation of Articulated Concrete Blocks would cost about \$3,059,000. This includes the realignment of the spillway and building the training dikes.

Figure 2 - Open-Cell Articulated Concrete Blocks



For a structural auxiliary spillway such as those in Options 1 and 2, it will not be necessary to raise the crest from its existing elevation. However, for the existing crest elevation, flow in the auxiliary spillway will occur with a statistical frequency of about once in 70 years (a 1.4% chance of occurring in any given year) instead of once in 100 years (a 1% chance of occurring in any given year).

Figure 3 – Articulated Concrete Block Mattress Installation



Figure 4 - View of Completed Articulated Concrete Block Installation.



Option 3. Another option for preventing a breach of the auxiliary spillway would be to install a concrete cutoff wall in the auxiliary spillway. A cutoff wall is an L-shaped wall that is installed below ground, slightly downstream of the auxiliary spillway crest, with its top at the existing spillway crest elevation. The base of the wall is seated into the underlying bedrock. The wall would extend across the width of the spillway and run perpendicular to the training dikes.

When flow occurs in the auxiliary spillway, the wall holds the spillway crest at the design elevation and prevents the spillway from being breached. The flood storage of the dam is thus maintained. However, the cutoff wall only protects the storage capacity of the reservoir. It cannot prevent erosion from occurring on the downstream sections of the auxiliary spillway.

The use of a concrete cutoff wall is not considered to be a structural solution in that it does not protect the auxiliary spillway from excessive erosion. For this reason, the crest of the auxiliary spillway would have to be raised 1.8 feet to the elevation required for a vegetated earthen spillway. This will necessitate an increase in the width of the auxiliary spillway as a minimum, and may require an increase in the height of the dam.

This cost of this alternative would be close to \$4 million dollars because of the added excavation that would be required. In addition, the price for installation of the wall does not include the maintenance costs that may arise due to damage in the spillway from flow. Since the crest elevation of the spillway will be raised, flow will occur at the original flow frequency of about once in a hundred years (1% chance of occurrence). The continued risk of erosion and the greater level of maintenance required for a cutoff wall makes this alternative unacceptable to the Sponsors.

Issue 3. Protect the Dam Embankment by Raising the Training Dike: The purpose of a training dike is to keep the water that is flowing in the auxiliary spillway from eroding the embankment of the dam. Since the spillway alignment will be changed dramatically, it will also be necessary to put a training dike on the outside edge of the spillway to direct the water away from the foundations of the downstream townhouses. Both training dikes will be about 12 feet high at the crest of the auxiliary spillway and will taper to a height of 5.5 feet at the lower end. The dikes would be about 320 feet long on both sides.

Option 1: Earthen training dikes would look a lot like the training dike that is presently on site but would be longer. The inside and outside side slopes would be graded on a 3:1 slope with a 12 foot wide top. Both the outside slope and the top would be vegetated earth. The inside slope of each training dike would be armored with the same material used to armor the spillway floor. If the ACBs are used, the inside slopes will be covered with a foot of topsoil. Because there is an embankment on both sides of the auxiliary spillway, the footprint on the ground would range from about 270 feet wide at the upstream end to about 190 feet wide at the downstream end.

Option 2: The training dikes could also be made with a vertical concrete wall. This wall would be about one foot wide and would take up very little space along the spillway. However, it is visually unappealing, would be difficult to keep people off of, and would be vulnerable to vandalism by graffiti. The Royal Lake Task Force determined that this option was undesirable. See Figure 5.

Figure 5 – Projected Appearance of a Concrete Training Dike



Selected Rehabilitation Alternative

The potential solutions were evaluated for cost and engineering feasibility. This information was presented to the Sponsors at meetings on May 24, 2006 and June 7, 2006 and to the public at a meeting on June 20, 2006. The selected alternative for Royal Lake is to realign the auxiliary spillway, install earthen training dikes to control the flow direction of the water, and armor the spillway and interior slopes of the training dikes with ACBs. The design and construction cost for this solution would be \$3,059,000. Figure 6 shows the existing alignment of the auxiliary spillway. Figures 7 and 8 show two different views of the recommended alternative.

Figure 6 - Plan View Showing Existing Alignment of Auxiliary Spillway.

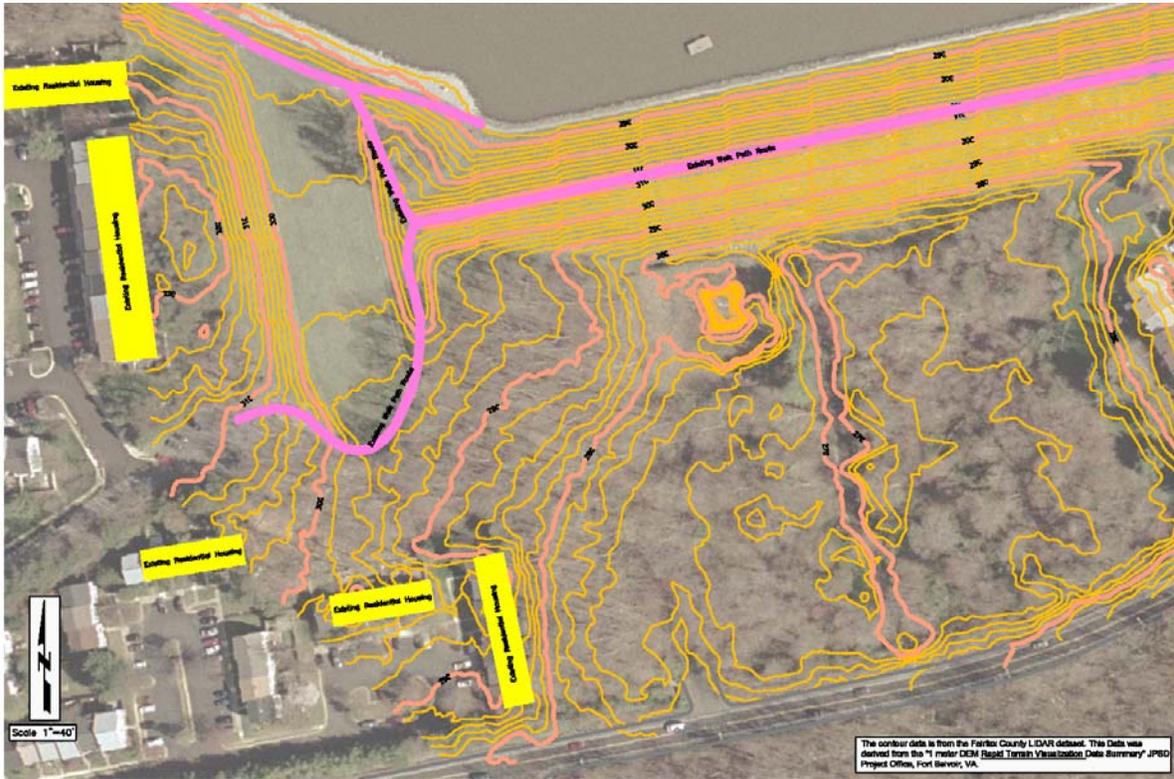


Figure 7 - Proposed Alignment of Auxiliary Spillway With Earthen Training Dikes.

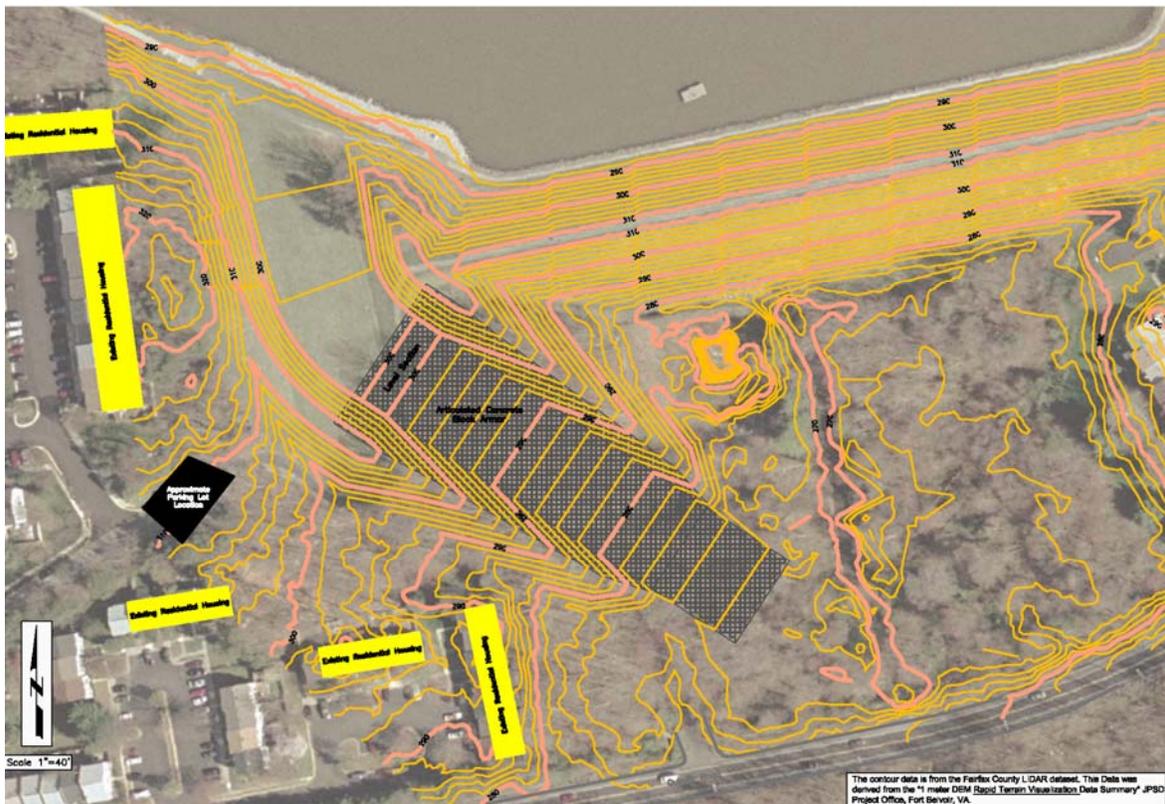


Figure 8 - Perspective View of Recommended Alternative. The ACBs are shown as they will appear before the topsoil is installed and seeded. Once the site is vegetated, the ACBs will not be seen at all.



EFFECTS OF ALTERNATIVE PLANS

Alternative plans of action can result in a multitude of effects on resources upstream and downstream of Royal Lake. This section describes anticipated effects on resource concerns identified by the Sponsors, the public, and agency personnel. Effects of alternative plans of action on resource concerns of national importance are also included.

There are two plans that will be considered and evaluated in detail: 1) No Federal Action (Sponsors' Rehabilitation) and 2) Rehabilitation of the dam by realigning and armoring the auxiliary spillway and raising the training dikes with earthen embankments. The Sponsors have indicated that they will use the plan developed by NRCS to complete the rehabilitation of the dam in the event that Federal funding is not available. Therefore, the Sponsors' Rehabilitation is the same as the Federal rehabilitation and the effects of the rehabilitation will be the same.

Public Safety

Existing Conditions: The soil material in the existing earth auxiliary spillway does not have the strength necessary to withstand the PMP event. It is projected that the auxiliary spillway would breach at a 6-hour precipitation event of approximately 13 inches. In addition to the amount of water flowing through the auxiliary spillway, this event has the potential to release the entire amount of water and sediment stored upstream of the dam. This is a volume of approximately 1570 acre-feet. The townhouses at the end of the auxiliary spillway could be flooded or undermined, or both. Some businesses near Guinea Road and Burke Lake Road could be affected. There may be one or two residential properties affected. Guinea Road, the Norfolk Southern/VRE railroad tracks, Burke Lake Road, and all the associated utilities will be damaged. There is the potential for loss of life in the event of a dam breach.

At the present time, there are no houses upstream of the dam that have a first floor elevation that is between the elevation of the crest of the auxiliary spillway and the top of the dam. However, there is one road that will be inundated for a length of 400 feet should the water reach the top of the dam. Recreational activity around the lake are limited during the drawdown of the floodwater pool.

No Federal Action (Sponsors' Rehabilitation): Under this alternative, the dam would be structurally rehabilitated using current design and safety criteria in order to provide continued flood protection for 70 years after the one year rehabilitation period is complete. The downstream flooding levels would be the same as they are presently. The threat to loss of life from failure of the dam would be greatly reduced.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Floodplain Management and Flooding

Existing Conditions: In the early 1970s, Fairfax County zoned the floodplain of Pohick Creek to restrict development in the 100-year floodplain. Since this work was done prior to construction of the six flood control dams built by NRCS, the zoned floodplain is more extensive than the post-construction floodplain. There will be little or no damage to the homes, businesses, or infrastructure from the 100-year storm event.

No Federal Action (Sponsors' Rehabilitation): The planned rehabilitation of the Royal Lake auxiliary spillway will replace the vegetated earth auxiliary spillway with a structural spillway armored with ACBs. Therefore, it is not necessary to increase the elevation of the auxiliary spillway crest or increase its capacity. The auxiliary spillway may flow more often than it does at present but it will be protected by the ACBs and little or no damage is anticipated from these small flows.

The flood reduction benefits currently provided by Royal Lake would be extended for a projected 70 years after construction. The rehabilitation of Royal Lake would result in the continuation of the present level of flood protection, but at a higher level of safety/reduced risk for catastrophic breach. The potential for failure of the dam would be reduced significantly.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Erosion and Sedimentation

Existing Conditions: The Royal Lake dam has trapped 79.22 acre-feet (90,950 tons) of sediment in its reservoir and tributaries since its construction in 1977. Parts of the lake have been dredged twice since 1985. Approximately 19.35 acre-feet of sediment were removed. Based on the 2006 sediment survey, there are 59.87 acre-feet of sediment in the reservoir and its tributaries. The sediment accumulation rate is 2.73 acre-feet per year. At this rate of sediment accumulation, there is enough storage available for an additional 72 years.

No Federal Action (Sponsors' Rehabilitation): The dam will provide flood control for 70 years after rehabilitation. At its present sedimentation rate, Royal Lake will trap about 2.73 acre-feet per year of sediment, which is sediment that would not be deposited in Pohick Creek, the Potomac River, or the Chesapeake Bay.

As part of the Sponsors' Rehabilitation, Fairfax County may choose to dredge the lake to improve the aesthetic appearance and increase the sediment storage capacity. This would be the sole responsibility of the County and be funded and permitted as such.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation). Since adequate sediment storage is available to meet the minimum 50-year life established by the Dam Rehabilitation legislation, no federal funds would be used to remove sediment from this reservoir.

Coastal Zone Management and Chesapeake Bay Act

Existing Conditions: Royal Lake is located in the Chesapeake Bay drainage area. As such, it is subject to the requirements of the Chesapeake Bay Preservation Act and the Virginia Coastal Zone Management Program.

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of the auxiliary spillway of Royal Lake will be done in accordance with all of the requirements and restrictions that are necessary. The Sponsor is responsible for assuring compliance and for obtaining any necessary permits and certificates.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Economic and Social Effects

Existing Conditions: Royal Lake has provided flood protection since 1977. Under the existing conditions, there is the potential for loss of life because the dam does not meet current dam safety and design criteria. According to the SITES model, an uncontrolled breach of the Royal Lake auxiliary spillway would occur with approximately 4.1 feet of water flowing through it. This could release 1,568 acre-feet of water and sediment in a wall up to 35 feet high. This would cause substantial damages to the downstream properties and infrastructure. Guinea Road, the Norfolk Southern/VRE railroad, Burke Lake Road, and the associated utilities would all be at risk. This dam is estimated to provide \$16,000 in average annual flood damage reduction benefits.

No Federal Action (Sponsors' Rehabilitation): Structural rehabilitation of the Royal Lake dam would provide continued flood protection to the residents of the watershed for 70 additional years. Property values around the lakes and downstream of the dam would be maintained. The existing opportunities for recreation would remain for the evaluated lives of the dam. Protection of the roads, bridges, and public utilities would be maintained at the present levels, as would the access to emergency services. In addition to the long-term economic benefits provided by the dam, there would also be short-term economic benefits from the construction activities. Average annual flood damages for this alternative are estimated to be \$16,900/year.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Archaeological and Historical Resources

Existing Conditions: The location of an archaeological site was identified immediately below the dam. A Phase II archaeological investigation will be completed prior to construction of any project activities.

No Federal Action (Sponsors' Rehabilitation): The presence of an archaeological site does not change the plans for the rehabilitation of the dam. If the Phase II archaeological investigation indicates that the site contains significant cultural resources, then a Phase III investigation and site mitigation will be required.

The sediment buildup in the pool area will continue to protect any sites that were not discovered before the structure was built. Undiscovered sites downstream from the structure will not be subject to the scouring produced by flood conditions.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Threatened and Endangered Species

Existing Conditions: There are no threatened or endangered plant or animal species located in the project area.

Streams, Lakes, and Wetlands

Existing Conditions: The tributaries of Royal Lake have stable outlets but are transporting some sediment into the lake. Despite the visible sediment deposition, there are no developed wetlands associated with these depositional areas, possibly because of the history of dredging at the lake.

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of the dam would have no adverse effect on the lake or the streams.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Fish and Wildlife Resources

Existing Conditions: The two headwater streams forming Royal Lake, Rabbit Branch and an unnamed tributary, are not considered trout waters. The lake was formerly managed by the Virginia Department of Game and Inland Fisheries as a recreational fishery in the past, but is no longer maintained due to periodic dredging of the lake. Some limited fishing opportunity exists. The lake continues to provide habitat for a number of cool and warm water fish species such as large and smallmouth bass, bluegills, sunfish, bullheads and a number of species of forage fish including shiners, minnows, dace and killifish.

The terrestrial species in the watershed are well-adapted to the urban environment around the dam.

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of the dam would result in no major changes in wildlife habitat around the lake. Terrestrial habitats below the dam would be affected by a loss of trees and disturbance of grasses on the embankment and auxiliary spillway

areas of the dam. Approximately 3.4 acres of trees would be removed to allow installation of the structural auxiliary spillway. The spillway and associated earth embankments would be vegetated to fescue. Approximately 0.9 acres of trees would be planted in the areas away from the spillway. The pool area would not change.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Water Quality

Existing Conditions: There are no noted water quality impairments to the lake or its tributaries.

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of the dam would not significantly change the present water quality in the watershed.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Transportation

Existing Conditions: There are two main roads which cross Pohick Creek below the dam, Guinea Road and Burke Lake Road. There are several streets in residential areas and one railroad bridge in the breach inundation zone. All of this infrastructure would be negatively affected by flood waters during a breach.

No Federal Action (Sponsors' Rehabilitation): The continuation of flood control for another 70 years after rehabilitation would provide continued access to transportation routes in the watershed that currently exist. Access to towns, shopping, schools, work places, medical services, and emergency services would be the same as under present conditions.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Land Use and Management

Existing Conditions: At the present time, the land use in the watershed above the dam is highly urbanized with mostly residential properties and scattered businesses throughout. The 100-year floodplain has been protected from development. Some "fill-in" development is occurring.

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of the Royal Lake dam would not significantly change the existing land use above or below the dam. Future development in the watershed above the dam could affect the service life of the dam if the erosion and sediment from any development is not adequately controlled.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Prime and Unique Farmlands

Existing Conditions: There are no prime or unique farmlands within the watershed.

Forestry and Parks

Existing Conditions: The land around the lake is forested and much of it is in a designated park. The present good health of this lake is due in no small part to the presence of these wooded parks. These mature forests buffer the lake from the effects of nutrients used in the watershed by taking them up before the nutrients can enter the lake. They also trap sediment from overland flow sources.

The walking trail around the lake passes around the downstream end of the auxiliary spillway and traverses up the training dike before crossing the dam. The area between the dam and Guinea Road is presently forested but is not a park. Most, if not all, is owned by Fairfax County. There are a number of trees between the end of the existing auxiliary spillway and the downstream townhouses that screen the auxiliary spillway and dam from the view of the townhouses. There is also a small grove of trees located on the upstream side of the dam between the dam and the auxiliary spillway entrance.

No Federal Action (Sponsors' Rehabilitation): Reorientation of the auxiliary spillway to protect the townhouses will result in the removal of approximately 3.4 acres of trees downstream of the existing auxiliary spillway. Upon completion of the project, approximately 0.9 acres will be replanted with a mixture of tree species. The majority of these trees will be between the townhouses and the auxiliary spillway. The remainder of the disturbed area will be vegetated to grass. Any trees that are presently located within 25 feet of the dam will be removed in accordance with Virginia Dam Safety Regulations and the area will be planted to grass. This will include the small grove of trees upstream of the dam, near the embankment and the entrance to the auxiliary spillway. The walking trail will be relocated once the rehabilitation measures have been installed.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Public Recreation

Existing Condition: There are multiple opportunities for recreation associated with Royal Lake. In addition to the lake-based activities such as boating and fishing, there are opportunities for picnicking/barbequing, outdoor concerts, cycling, rollerblading, jogging, walking, environmental education, and youth sports. Bird watching is a popular activity. There are also tennis and swimming facilities located in the parks around the lake.

No Federal Action (Sponsors' Rehabilitation): There are no anticipated changes to the existing recreational opportunities as a result of the planned rehabilitation activities.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Sewer Utilities

Existing Condition: There is a 15 inch sewer pipe encased within a 48 inch pipe that passes through the embankment of the dam. This pipe was installed before the dam was constructed.

No Federal Action (Sponsors' Rehabilitation): There are no anticipated changes to the existing sewer pipe as a result of the planned rehabilitation activities. However, an evaluation of the

condition of this pipe is necessary as part of the overall determination of the condition of the dam. Any needed repairs would be the responsibility of Fairfax County and would be independent of the rehabilitation effort.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Stormwater Management

Existing Condition: Royal Lake contributes to the management of stormwater in Fairfax County by providing detention of floodwater and its controlled release. It was designed to detain the volume of water that would run off the land in a 100-year frequency (1% chance of occurrence) storm event. Due to increases in the rainfall for the area, the storm that will cause flow in the auxiliary spillway at its present elevation will occur with a statistical frequency of once in about 70 years (a 1.4% chance of occurrence in a given year).

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of Royal Lake will continue to provide stormwater management control within the watershed at the existing level of floodwater detention. Should flow occur in the auxiliary spillway and remove the one foot of topsoil over the articulated concrete blocks, there will be slightly less detention capacity until the site is repaired.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Noise Pollution

Existing Condition: There is no noise pollution currently associated with the presence of the lake.

No Federal Action (Sponsors' Rehabilitation): During the rehabilitation of the auxiliary spillway, there will be some noise from the construction activities. Since this will be temporary in nature, practical remedies might consist of things like setting daily starting and stopping time requirements. There may be some additional costs associated this noise reduction practice.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Air Quality

Existing Condition: There are no air quality problems currently associated with the presence of the lake.

No Federal Action (Sponsors' Rehabilitation): During the rehabilitation of the auxiliary spillway, there will be some dust from the construction activities. Since this will be temporary in nature, air pollution abatement requirements will be included in the design.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Aesthetics

Existing Condition: At the present time, the auxiliary spillway and training dike are grassed with trees located in the exit area and in the area immediately upstream of the dam.

No Federal Action (Sponsors' Rehabilitation): When the rehabilitation of the auxiliary spillway is complete, the part of the auxiliary spillway that is presently in grass will still be mostly in grass and there will be approximately 2.5 acres of grass in the exit channel where there used to be trees. By covering the articulated concrete blocks with soil and vegetation, there will be no visible armor. The two earthen training dikes will be larger than the single one that is there presently but will be grass-covered. The areas that are disturbed during construction but that are located outside of the rehabilitated spillway, will be planted to trees.

Rehabilitate Dam: Same as the No Federal Action (Sponsors' Rehabilitation).

Cumulative Effects

The No Federal Action alternative calls for the Sponsors to rehabilitate the dam. The recommended alternative is to rehabilitate the dam with federal assistance. The effects of these two alternatives on the principle resources of concern, along with the social and economic effects, have been addressed in the previous pages and are essentially identical. The cumulative effects of the recommended alternative are to maintain the existing social, economic, and environmental conditions of the community. The cumulative effects of the Sponsors' rehabilitation would be the same but with additional local costs. The rehabilitation of this dam would result in a significant reduction in the threat to loss of life for area residents.

COMPARISON OF ALTERNATIVE PLANS

Table I summarizes the effects of each alternative considered. Refer to the Effects of Alternative Plans section for additional information.

Table I - Summary and Comparison of Candidate Plans

Effects	Future Without Federal Project No Federal Action - Sponsors' Rehabilitation (NED Plan)	Future With Federal Project Structural Rehabilitation with Federal Assistance (Recommended Plan) (NED Plan)
Sponsor Goals	Continue to provide flood protection, reduces liability	Continue to provide flood protection, reduces liability
Structural	Upgrade dam to meet dam safety criteria	Upgrade dam to meet dam safety criteria
Total Project Investment - Royal Lake	\$3,059,000	\$3,059,000
National Economic Development Account		
Total Beneficial Annualized (AAEs*)	---	\$155,000
Total Adverse Annualized (AAEs*)	---	\$155,000
Net Beneficial	---	\$0
Benefit/Cost Ratios	---	1.0 to 1.0
Estimated OM&R**	---	\$1,250
Environmental Quality Account		
Erosion & Sedimentation	Trap 2.73 ac-ft of sediment annually	Trap 2.73 ac-ft of sediment annually
Threatened and Endangered Species	No effect	No effect
Stream, Lakes and Wetlands	No Effect	No Effect
Fish & Wildlife Resources	No Effect	No Effect
Water Quality	No Effect	No Effect
Other Social Effects Account		
Public Safety	Decrease potential for loss of life from dam breach	Decrease potential for loss of life from dam breach
Floodwater Damage	Maintains present level of flood protection; no induced damages downstream	Maintains present level of flood protection; no induced damages downstream
Property Values	Values protected	Values protected
Recreation	Opportunities maintained	Opportunities maintained

Effects	Future Without Federal Project No Federal Action - Sponsors' Rehabilitation (NED Plan)	Future With Federal Project Structural Rehabilitation with Federal Assistance (Recommended Plan) (NED Plan)
Transportation	Access to emergency services maintained at present level; road maintenance continues at present level	Access to emergency services maintained at present level; road maintenance continues at present level
Land Use and Management	Cut 3.4 acres of trees; Replant 0.9 acres of trees and convert 2.5 acres to grass	Cut 3.4 acres of trees; Replant 0.9 acres of trees and convert 2.5 acres to grass
Enhanced protection from future flood events	No added protection beyond that provided under the existing conditions except to realign auxiliary spillway to reduce threat to townhouses	No added protection beyond that provided under the existing conditions except to realign auxiliary spillway to reduce threat to townhouses
Exposure/Risk of a catastrophic breach as proxy for associated mental duress	Very low	Very low
Civil Rights Impacts:	Positive across all groups	Positive across all groups
Environmental Justice Impacts:	No disparate treatment	No disparate treatment
Anxiety, frustration and mental duress:	Decreased across all groups with flood storage retained	Decreased across all groups with flood storage retained

* Per 1.7.2 (a) (4) (ii) of the “Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies” (P&G), U.S. Water Resources Council, March, 1983, allowing for abbreviated procedures, damage reduction and recreation benefits have not been displayed because they are the same for both alternatives and no net change in benefits occurs when comparing the two candidate plans to each other. Regional Economic Development account (RED) concerns were not identified during the scoping process. Therefore, the RED account information is not included in the above display. “AAEs” stands for Average Annual Equivalents which are based on a 5.125% discount rate and a 71 year period of analysis.

** OM&R – Operation, Maintenance and Replacement Costs include replacement of topsoil and vegetation over part of the Articulated Concrete Block lined auxiliary spillway once in the anticipated useful life of the structure.

IDENTIFICATION OF NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

Detailed evaluation of the candidate plans to rehabilitate Royal Lake indicate that they have identical scope, costs and effects. Therefore, both candidate plans are considered as NED plans. However, the rehabilitation alternative with federal assistance is the most locally acceptable alternative and best serves the local sponsors in achieving the needs and purpose of this rehabilitation and therefore is selected as the recommended plan. The federally assisted alternative is displayed within a zero-based accounting context that credits local costs avoided as adverse beneficial effects (benefits). Net benefits are zero because the total project cost is equal to the claimed benefits and the resulting B/C ratio is 1:1.

RISK AND UNCERTAINTY

Assessments, considerations, and calculations in this plan are based on a 71 year period of analysis. Associated monetary flooding impacts of downstream houses and businesses were based on the National Flood Insurance Program's Actuarial Rate Review. National averages were used to identify the value of potential damages. Actual damages occurring from each storm event could realistically be higher or lower, depending on soil moisture conditions at the time of a given event, associated debris flows, future development, and other factors such as changes in precipitation from various storm events. Although potential climatic changes are not expected to alter calculation of the PMP events, they could increase the occurrence of low frequency, high intensity storm events and associated flood damages.

Actual precipitation data for the 100-year, 24-hour storm event collected by the National Oceanic and Atmospheric Administration (NOAA) was revised upward in 2004. Their precipitation frequency estimates released as part of NOAA Atlas 14, Volume 2, in 2004 resulted in the 100-year, 24-hour storm event in Fairfax County going from 8.0 inches (as estimated when the design for the dam was completed in 1972) to 8.33 inches. This change had the effect of revising downward the frequency of storm event that the existing dam can store before water will flow through the auxiliary spillway. NRCS dams are designed with the crest of the auxiliary spillways set based on the elevation that will allow high hazard dams to store the 100-year storm before water will flow through the auxiliary spillway. The NOAA Atlas 14 data from 2004 indicates that the existing dam, floodpool and auxiliary spillway are projected to be able to only store about a 70 year frequency of return storm event. This means that the existing elevation of the crest of the auxiliary spillway is 1.8 ft. lower than needed to store the 100-year, 24-hour storm. In summary, as more storm data has been collected, NOAA has had to redefine what constitutes specific storm frequencies which directly affects NRCS dam design requirements. Periodic changes in the empirical data provided by NOAA make it essential, and in the interest of all involved (the local sponsors, the NRCS and state dam safety officials) to make sure that adequate storage and flow capacity are designed into the dams we jointly install and/or rehabilitate.

Property rights were procured to the crest of the auxiliary spillway at the time of construction. This meets current NRCS policy. Since no additional development is anticipated in the upstream watershed and there will be no changes made to the crest elevation of the auxiliary spillway, it is not necessary to obtain additional property rights.

The objective of this project is to meet applicable NRCS and Virginia public health and safety standards associated with this watershed dam. From a financing and administrative standpoint, the Sponsors have committed to NRCS that they are able to fund 35 percent of the costs to complete installation of the selected alternative and to perform the required maintenance on the upgraded structure for 70 years after construction. Statistically, the auxiliary spillway should flow only one time during the anticipated life of the rehabilitated structure. However, it is possible for several events to occur during this time period. If the flow in the auxiliary spillway for a single event is assumed to remove all the topsoil and vegetation from the articulated concrete blocks with no damage to the blocks themselves or to any other component of the auxiliary spillway, the estimated repair cost would be about \$110,000. This includes transportation and installation of about 3,000 cubic yards of topsoil and revegetation of about 1.7 acres. It does not include any costs for off-site damages incurred. Lesser events will have smaller costs. Routine maintenance is not included in these amounts.

RATIONALE FOR PLAN SELECTION

The recommended plan is to rehabilitate the dam to meet current NRCS and the Commonwealth of Virginia safety and performance standards. The recommended plan meets the identified purposes and needs for the project and significantly reduces the potential risk to human life. The project Sponsors, local residents, and state and local government agencies all prefer the Recommended Plan because it:

- Minimizes the threat to loss of life to approximately 710 people that live and work in the 168 single family homes and townhouses, 35 businesses, and 2 public buildings (a post office and a fire department) within the breach inundation zone.
- Provides protection for Guinea Road which is immediately downstream of the dam that has an average daily traffic count of 16,000 vehicles.
- Provides protection for Burke Lake Road which has an average daily traffic count of 35,000 vehicles.
- Provides protection for the Norfolk Southern / VRE and AMTRAK railroads downstream. They have an average daily count of more than 9,000 persons.
- Provide protection for 5 fiber optic lines located in the railroad right-of-way.
- Provide protection for a gas line connected under the Burke Lake Road bridge.
- Provides downstream flood protection for the scores of people living in the area, as well as those working, recreating, or traversing within the downstream floodplains for an additional 70 years.
- Eliminates the liability associated with continuing to operate an unsafe dam.
- Traps 2.73 acre feet of sediment annually, thereby improving downstream water quality.
- Maintains existing stream habitat downstream of the dam.
- Retains the existing fish and wildlife habitat around the lake.
- Leverages federal resources to install the planned works of improvement.

When compared to the No Federal Action Alternative (Sponsors' Rehabilitation), the Recommended Alternative (Rehabilitation) better meets the public and technical advisory groups' identified purposes and needs and was subsequently recommended to the Sponsors. The structural alternative meets the Sponsors' objectives of bringing this dam into compliance with current dam design and safety criteria, maintaining the current 100-year floodplain, and addressing resource concerns identified by the public. Finally, the Selected Plan will utilize more federal funds and require less local funds than the No Federal Action alternative. The plan reasonably meets the following four criteria: completeness, effectiveness, efficiency, and acceptability. NRCS and the Sponsors are in agreement and are comfortable with the recommended plan.

CONSULTATION AND PUBLIC PARTICIPATION

Original sponsoring organizations include the Northern Virginia Soil and Water Conservation District and the Fairfax County Board of Supervisors. Fairfax County has been responsible for the operation and maintenance of the Royal Lake Dam since it was built. Interest and support for rehabilitating the dam began in the late 1990s when a study completed by a private engineering firm identified some potential problems with the soils in the auxiliary spillway. This was followed in May 2003 with the first issuance of a Conditional Certificate by the Division of Dam Safety. Following the passage of Public Law 106-472 in November of 2000, federal funds became available to eligible applicants. NRCS received an application for dam rehabilitation assistance on May 20, 2002.

Local, State and Federal support for the rehabilitation of the Royal Lake Dam has been strong. Input and involvement of the public has been solicited throughout the planning of the project. At the initiation of the planning process, many meetings were held with representatives of the Northern Virginia SWCD and Fairfax County to ascertain their interest and concerns regarding the dam. The Sponsors have worked closely with the local landowners and residents to provide information on the planning activities and solicit their input on the pertinent issues being considered during planning.

A pre-public meeting was held at Braddock Hall between NRCS, DCR, Fairfax County, the Northern Virginia SWCD, and the community leaders of the watershed on September 8, 2005. This work session provided feedback from the local officials on what was important to share with the public at the upcoming meeting.

The first public meeting was held at Bonnie Brae Elementary School on September 29, 2005. Local, state and federal perspectives on the rehabilitation needs of the Royal Lake dam were provided to the approximately 50 meeting attendees. The public were informed of the dam rehabilitation program and potential alternative solutions to bring the dam into compliance with current dam safety criteria. Meeting participants provided input on their issues and concerns to be considered during the planning process. A fact sheet was developed and distributed which addressed frequently asked questions regarding rehabilitation of the dam.

The NRCS National Water Management Center Staff from Little Rock, Arkansas, toured the watershed on October 18, 2005 and provided input and support to the ongoing planning efforts. A follow-up teleconference was held with NRCS and Sponsors the next day. Feedback was provided regarding the federal dam rehabilitation program and the completion of a supplemental plan and environmental assessment for the rehabilitation of the dam.

An on-site visit of the Lake Royal dam was conducted for interested residents by NRCS and the Sponsors on October 28, 2005. The group walked over the dam and spillway and discussed how the potential alternatives could affect the various resources of the area.

A scoping meeting was held on November 15, 2005 at Braddock Hall to identify issues of economic, environmental, cultural, and social concerns in the watershed. Input was provided by local, regional, state and federal agencies at the meeting or through letters and emails to NRCS.

Consultation has been made with the Virginia Department of Historic Resources on project measures contained in this rehabilitation plan. Following the completion of the Phase I

archaeological survey where a middle archaic site was discovered, VDHR concurred with NRCS that a Phase II survey was necessary.

Consultation with the U.S. Fish and Wildlife Service, in accordance with Section 7 of the Endangered Species Act of 1973, was also conducted. They agreed that the rehabilitation of Royal Lake would not have significant negative impacts on the environment.

Two Royal Lake Task Force meetings were held on May 24 and June 7, 2006. The planning information gathered and analyzed to date was shared with the community leaders and Sponsors. The recommended alternative was presented and accepted by the Task Force.

A second public meeting was held on June 20, 2006, at the Bonnie Brae Elementary School. Information provided to meeting attendees included a summary of the current situation of the dam, planning efforts to date, the various alternatives considered during planning, and a detailed explanation of the recommended alternative for dam rehabilitation. There was favorable support and acceptance of the recommended alternative from those in attendance. The meeting attendance totaled about 35 people and included elected officials, representatives from county and federal agencies and watershed residents.

A Draft Plan was distributed for interagency and public review on July 14, 2006. Copies of the document were placed in local libraries and news articles placed in local newspapers which solicited comments from the public during the comment period. After a 45-day review period, comments received on the draft were incorporated into the Final Plan. Letters of comment received on the draft plan and NRCS responses to the comments are included in Appendix A.

RECOMMENDED PLAN

SUMMARY AND PURPOSE

This supplemental plan documents the planning process by which the NRCS provided technical assistance to local Sponsors, technical advisors, and the public in addressing resource issues and concerns relative to the rehabilitation of Royal Lake.

The recommended plan is to rehabilitate the dam. By doing this, the present level of flood protection is maintained, property values are protected, and the threat to loss of life is reduced. The recommended plan of action for the dam is outlined below:

- Realign the auxiliary spillway to reduce the threat to loss of life or damage to the townhouses located in the path of the existing spillway outlet. This will necessitate the construction of a new training dike to keep the water directed away from the townhouses.
- Armor the auxiliary spillway surface with articulated concrete blocks to prevent a breach of the auxiliary spillway.
- Raise and lengthen the existing training dike to protect the dam embankment.

These are the major structural components. There are a number of smaller improvements that will also be incorporated into the design of the rehabilitated dam such as the replacement of the embankment drain adjacent to the auxiliary spillway. The cost of these additional elements is included in the cost estimate.

After the implementation of these planned works of improvement, Royal Lake will meet all current NRCS and State of Virginia dam safety and performance standards.

Detailed structural data for the proposed rehabilitated dam can be found in Table 3.

EASEMENTS AND LANDRIGHTS

The Sponsors are responsible for obtaining any needed landrights and easements associated with the rehabilitation project. It is projected that no additional landrights will be needed in order to complete the rehabilitation project. NRCS currently does not require additional flood easements because the flood storage of the structure will not change. There are no relocations planned as a result of the installation of the project measures.

MITIGATION

There are no expected mitigation requirements for this project. However, if mitigation is required as a result of the pending Phase II Cultural Resources investigation, the necessary mitigation will be performed and cost-shared by NRCS and the Sponsors on a 65% Federal and 35% local cost-share basis.

PERMITS AND COMPLIANCE

Installation of the recommended plan will bring the dam into compliance with current NRCS and Virginia dam safety criteria. Prior to construction, the Sponsors will be responsible for obtaining an alteration permit from the Virginia Soil and Water Conservation Board, a 404 permit from the Army Corps of Engineers, any needed subaqueous lands permits from the Virginia Marine Resources Commission, and any other required permits. During construction, the successful contractor is required to develop a Stormwater Pollution Prevention Plan which includes applicable erosion and sediment control measures.

Royal Lake lies entirely within the Resource Protection Area of Pohick Creek, and thus falls under the Coastal Zone Management Act regulations. Therefore, prior to beginning any construction activities, Fairfax County must determine the extent of construction activities affecting Virginia's coastal resources or coastal uses with the Virginia Coastal Resources Management Program. Fairfax County must submit a consistency certification to the Virginia Department of Environmental regarding their coordinated review and compliance with these regulations. The Sponsors will be responsible for obtaining the certification of compliance from the Division of Dam Safety upon completion of the project

Based on the results of the Phase I Cultural Resources Survey of the Pohick Creek Dam No. 4, a Phase II investigation was recommended by the NRCS Cultural Resource Specialist. The Virginia Department of Historic Resources concurred with this recommendation. The Phase II investigation will be conducted prior to construction activities and will result in a determination of the site's significance in relation to historic benchmarks and determination of eligibility for the National Register of Historic Places and the Virginia Landmarks Register.

COSTS

As indicated in Table 1, the total project cost of the recommended plan is \$3,059,000. Of this amount, PL-106-472 funds will bear \$2,052,000 and nonfederal funds will bear \$1,007,000. Given that certain costs are excluded from calculation of the Sponsors' contribution (see the watershed agreement for complete details), the actual cash cost to the local Sponsors required for construction costs is an estimated \$500,000. Table 2 shows details of the costs and cost-share amounts by category. Total annualized costs are shown in Table 4 along with the estimated costs for operation and maintenance. Table 5 displays the average annual flood damage reduction benefits by flood damage categories, and Table 6 displays a comparison of annual costs and benefits. A 2006 price base was used and amortized at 5.125 percent interest for the 71 year period of analysis (including a design and installation period of 1 year and an expected useful life of 70 years).

The planning costs for the proposed rehabilitation measures are estimated costs only. The fact that these costs are included in this plan does not infer that they are final costs. Detailed structural designs and construction cost estimates will be prepared prior to contracting for the work to be performed. Final construction costs will be those costs actually incurred by the contractor performing the work, including the cost of any necessary contract modifications.

INSTALLATION AND FINANCING

The project is planned for installation in one construction season. During construction, equipment will not be allowed to operate when conditions are such that soil erosion, and water, air, and noise pollution cannot be satisfactorily controlled.

The NRCS will provide assistance to the Sponsors with the Royal Lake Dam rehabilitation project. NRCS will be responsible for the following:

- Execute a project agreement with the Sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
- Execute a Memorandum of Understanding with the Sponsors to provide a framework within which cost-share funds are accredited.
- Provide financial assistance equal to 65% of total eligible project costs, not to exceed 100% of actual construction costs.
- Verify that a current Emergency Action Plan is developed before construction is initiated.
- Provide consultative engineering support, technical assistance, and approval during the design and construction of the project.
- Certify completion of all installed measures.

Fairfax County will be responsible for the following:

- Secure all needed environmental permits, easements, and rights for installation, operation and maintenance of the rehabilitated structure.
- Prepare an updated Emergency Action Plan for the dam prior to the initiation of construction.
- Execute an updated Operation and Maintenance Agreement with NRCS for the dam. This agreement will be based on the NRCS National Operation and Maintenance Manual.
- Execute a Memorandum of Understanding with NRCS to provide a framework within which cost-share funds are accredited.
- Execute a project agreement with NRCS before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
- Provide nonfederal funds for cost-sharing of the project at a rate equal to, or greater than, 35% of the total eligible project costs.
- Provide engineering services for the design, construction, and certification of the project.
- Provide local administrative and contract services necessary for installation of the project.
- Acquire a Safe Dam Permit from the State of Virginia upon completion of the planned measures.
- Participate in and comply with applicable Federal floodplain management and flood insurance programs.
- Enforce all associated project easements and rights-of-way.

OPERATION, MAINTENANCE, AND REPLACEMENT

Measures installed as part of this plan, and previously installed measures, will be operated and maintained by Fairfax County with technical assistance from federal, state, and local agencies in accordance with their delegated authority. A new operation and maintenance agreement will be developed for Royal Lake utilizing the NRCS National Operation and Maintenance Manual, and will be executed prior to signing a project agreement for the construction of the project. The term of the new O&M agreement will be for the projected life of the rehabilitated structure, plus one year of project installation, for a total of 71 years¹. The agreement will specify responsibilities of the Sponsors and include detailed provisions for retention, use, and disposal of property acquired or improved with PL-106-472 cost sharing. Provisions will be made for free access of district, state, and federal representatives to inspect all structural measures and their appurtenances at any time.

CIVIL RIGHTS AND ENVIRONMENTAL JUSTICE IMPACT ANALYSIS

Rehabilitation of the dam will have positive economic and social effects across all residents within the floodplain and above the dam. Since vehicle operators also are significant beneficiaries of the proposed rehabilitation, it is reasonable to conclude that protection of the roads and bridges will benefit all racial, ethnic, and socio-economic groups within the watershed. Avoiding a dam breach will directly benefit all residents within the watershed and taxpayers in general within Fairfax County and the Commonwealth of Virginia.

There are no known disparate impacts that the rehabilitation project could possibly have. It was explained to local residents that rehabilitation of the dam would not enhance their flood protection, but simply re-establish the designed level of protection while reducing the risk to life and property that might occur from a dam breach.

EFFECTS OF RECOMMENDED PLAN ON RESOURCES

Table J lists the effects of the recommended plan on Resources of Principal National Recognition.

¹ The key determinant of the expected useful life was annual sediment delivery to the sediment-pool and flood-pool areas behind the dam. Sediment delivery projections were based on experience to date. In order to assure a 70 year useful life, and potentially extend the useful life significantly longer, the sponsors may choose to take additional erosion and sediment control measures above the impoundment in the upper watershed to slow sediment delivery to Royal Lake.

Table J - Effects of the Recommended Plan on Resources of Principal National Recognition

Types of Resources	Principal Sources of National Recognition	Measurement of Effects
Air Quality	Clean Air Act, as amended (42 U.S.C. 1857h-7 et seq.)	No change except during the construction period.
Areas of particular concern within the coastal zone	Coastal Zone Management Act of 1972, as amended, (16 U.S.C. 1451, et seq.)	The project area is located in a coastal zone. Erosion and sediment control practices will minimize project impacts.
Endangered and Threatened Species Critical Habitat	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)	None present in the project area.
Fish and Wildlife Habitat	Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661 et seq.)	Minimal effect from conversion of 2.5 acres of trees to grass.
Floodplains	Executive Order 11988, Floodplain Management	Maintain current flood protection.
Historic and Cultural Properties	National Historic Preservation Act of 1966, as amended, (16 U.S.C. Sec. 470, et seq.)	A Phase II Cultural Resources Investigation will be completed prior to design and construction. Mitigation will be performed if necessary.
Prime and Unique Farmland	CEQ Memorandum of August 1, 1980: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act. Farmland Protection Policy Act of 1981, (7 U.S.C. 4201 et seq.)	None present in the project area.
Water Quality	Clean Water Act of 1977 (33 U.S.C. 1251 et seq.)	No effect.

Table J - Effects of the Recommended Plan on Resources of Principal National Recognition (Con't)

Types of Resources	Principal Sources of National Recognition	Measurement of Effects
Wetlands	Executive Order 11990, Protection of Wetlands; Clean Water Act of 1977 (42 U.S.C. 1857H-7, et seq.)	None present in the project area.
Wild and Scenic Rivers	Wild and Scenic Rivers Act, as amended, (16 U.S.C. U.S.C. 1271 et seq.)	None present in the project area.
Economic	NA	Maintain existing flood protection for downstream residents for another 70 years. Maintain existing recreation and property values.
Fisheries	Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661 et seq.)	No effect.
Forestry	NA	Net loss of 2.5 acres of trees.
Recreation	NA	Existing benefits will be maintained.
Riparian Zone	NA	Riparian vegetation impacts will be minimal below existing dam.

Table 1 - Estimated Installation Cost
Pohick Creek Watershed Dam No. 4, Virginia
(Dollars)¹

Installation Cost Items	Estimated Costs		
	PL-106-472 Funds ²	Other Funds	Total
Structural measures to rehabilitate floodwater retarding dam: Royal Lake - Site 4:	\$2,052,000	\$1,007,000	\$3,059,000
Total Project:	\$2,052,000	\$1,007,000	\$3,059,000

Price base: July 2006

Note: \$30,000 in local sponsor planning costs have been excluded from Table 1 and Table 2 per NRCS policy to exclude non-federal technical assistance for planning from the estimated installation cost. These costs are included in the watershed agreement for calculating cost-share between the NRCS and the local sponsors.

Table 2 - Estimated Cost Distribution – Structural Measures
Pohick Creek Watershed Dam No. 4, Virginia
(Dollars)

Installation Cost Items	Installation Cost: PL-106-472 Funds ³				Installation Cost: Other Funds ⁴				Total Project Cost
	Construction Costs	Engineering Technical Assistance Costs	Project Admin. Costs	Total PL-106-472 Cost	Construction Costs	Engineering Costs	Project Admin. Costs	Total Other Funds	
Pohick Creek Site 4	\$1,925,000	\$115,000	\$12,000	\$2,052,000	\$500,000	\$461,000	\$46,000	\$1,007,000	\$3,059,000
Totals:	\$1,925,000	\$115,000	\$12,000	\$2,052,000	\$500,000	\$461,000	\$46,000	\$1,007,000	\$3,059,000

Price base: July 2006

¹ All tables have a price base of 2006;

² Paid by the USDA/NRCS – the Federal agency responsible for assisting in installation of improvements;

³ 65% of total project cost (the actual federal cost/share excludes technical assistance and permit costs and cannot exceed 100% of the estimated construction cost);

⁴ 35% of total project cost;

Table 3 – Structural Data for Rehabilitated Dam
Pohick Creek Watershed Dam No. 4, Virginia

ITEM	UNIT	AMOUNT
Hazard Class of Structure	-	C
Seismic Zone	-	1
Total Drainage Area	Sq. Mi.	3.87
Time of Concentration	Hours	1.2
Antecedent Moisture Condition II Runoff Curve Number	-	79
Elevation, Top of Dam	Feet, MSL	311.50 ¹
Elevation, Auxiliary Spillway Crest	Feet, MSL	300.0
Elevation, Principal Spillway Crest	Feet, MSL	287.0
Auxiliary Spillway Type	-	Structural ²
Auxiliary Spillway Bottom Width	Feet	100
Auxiliary Spillway Exit Slope	%	7.88
Maximum Height of Dam	Feet	42.75 ¹
Volume of Fill (Rehabilitation)	Cu. Yd.	16,000 ³
Total Capacity	Ac.-Ft.	2524
Sediment Submerged	Ac.-Ft.	244
Sediment Aerated	Ac.-Ft.	14
Floodwater Retarding Pool	Ac.-Ft.	840
Surface Area		
Sediment Pool	Acres	37.5
Floodwater Retarding Pool	Acres	99.3
Principal Spillway Design		
Rainfall Volume (1 day)	Inches	8.33
Rainfall Volume (10 day)	Inches	12.21
Runoff Volume (10 day)	Inches	5 ⁴
Capacity at Crest of Auxiliary Spillway	CFS	169
Conduit Size	Inches	36
Conduit Type	-	Concrete
Frequency of Operation, Auxiliary Spillway	Annual % chance	1.6
Auxiliary Spillway Hydrograph		
Rainfall Volume	Inches	11.1
Runoff Volume	Inches	8.44
Storm Duration	Hours	6
Velocity of flow (V _c)	Ft/s	15.08
Maximum Surface Elevation	Feet, MSL	303.81
Freeboard Hydrograph (6-hr PMP)		
Rainfall Volume	Inches	27.6
Runoff Volume	Inches	24.65
Storm Duration	Hours	6
Maximum Surface Elevation	Feet, MSL	311.3
Capacity Equivalents		
Sediment	Inches	1.25
Floodwater Retarding	Inches	4.06
¹ From Gannett Fleming report, 1999		
² ACB = Articulated Concrete Block system		
³ No fill associated with raising the dam, only with lengthening and raising the training dikes		
⁴ From TR-60 Figure 2-1		
Note: 6-hr and 24-hr PMP storms were evaluated. The 6-hr was the most critical condition in this case.		

Table 4 - Average Annual National Economic Development (NED) Costs
Pohick Creek Watershed Dam No. 4, Virginia
(Dollars)

	Average Annual Equivalent Cost	Annual Operation and Maintenance Costs	Total Average Annual Equivalent Cost
Rehabilitation of Pohick Creek Site 4	\$154,000	\$1,250	\$155,250
Totals:	\$154,000	\$1,250	\$155,250

Price base: July 2006

Note: The average annual equivalents are based on a 5.125% discount rate and a 71 year period of analysis (1 year for project installation and 70 years of expected useful life).

Table 5 - Estimated Average Annual Flood Damage Reduction Benefits
Pohick Creek Watershed Dam No. 4, Virginia
(Dollars)

Flood Damage Category	Estimated Average Annual Equivalent Damages		Damage Reduction Benefits
	Without Federal Project	With Federal Project	Average Annual Equivalents
Structure Damages:	\$5,500	\$5,500	\$0
Content Damages:	\$3,900	\$3,900	\$0
Private Clean-up Costs:	\$100	\$100	\$0
Public Clean-up Costs:	\$60	\$60	\$0
Private Business Income Losses:	\$50	\$50	\$0
Traffic and Emergency Services Disruption Costs:	\$1,000	\$1,000	\$0
Infrastructure Damages:	\$6,270	\$6,270	\$0
Public Admin. Costs:	\$20	\$20	\$0
Lost Recreation Value:	\$0	\$0	\$0
Lost Property Value:	\$0	\$0	\$0
Totals (rounded):	\$16,900	\$16,900	\$0

Price base: July 2006

Note: Damage reduction benefits resulting from the recommended plan equal zero as compared to the no federal action alternative because they are the same in scope, cost and effects, and therefore yield equivalent benefits. Positive benefits will accrue as a result of this project as compared to the existing conditions.

Table 6 - Comparison of NED Benefits and Costs
Pohick Creek Watershed Dam No. 4, Virginia
(Dollars)

Evaluation Unit	Benefits			Costs	Net Change	Benefit/ Cost Ratios
	Average Annual Equivalent Benefits		Total Average Annual Equivalent Benefits	Average Annual Equivalent Costs	Net Average Annual Equivalent Benefits	
	Damage Reduction Benefits	Other Benefits ¹				
Pohick Creek # 4	\$0	\$155,000	\$155,000	\$155,000	\$0	1.0 to 1.0
Totals:	\$0	\$155,000	\$155,000	\$155,000	\$0	1.0 to 1.0

Price base: July 2006

Note: The average annual equivalents are based on a 5.125% discount rate and a 71 year period of analysis (1 year for project installation and 70 years of expected minimum useful life).

¹ The costs and benefits of the Future With Project Plan are the same as those for the Future Without Project Plan. To maintain consistency with the display in Table 4, the costs associated with the No Action Alternative are tracked as a benefit of the Preferred Alternative.

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Water Resources Site Analysis Computer Program (SITES).

REPORT PREPARERS

The Pohick Creek Watershed Supplemental Plan and Environmental Assessment was prepared primarily by the NRCS Planning Team located in Richmond, Virginia. The document was reviewed and concurred in by state staff specialists having responsibility for engineering, resource conservation, soils, agronomy, biology, economics, geology, and contract administration. The in-house review was followed by a review by the NRCS National Water Management Center and then an interagency and public review.

The following table identifies and lists the experience and qualifications of those individuals who were directly responsible for providing significant input to the preparation of the Supplemental Plan/EA. Appreciation is extended to many other individuals, agencies and organizations for their input, assistance and consultation, without which this document would not have been possible.

NRCS NATURAL RESOURCES PLANNING TEAM

Name	Present Title and Years in Current Position	Education	Previous Experience	Other
R. Wade Biddix	Assistant State Conservationist for Water Resources – 3.5	M.S. Public Administration B.S. Agriculture	Supervisory District Cons. – 2 yrs. Planning Coordinator – 11 yrs. Area Resource Cons. - 2 yrs. District Conservationist - 4 yrs. Soil Conservationist - 4 yrs.	
Edward J. Fanning	Resource Conservationist – 2.5	B.S. Wildlife & Fisheries Management B.S. Range Management Graduate Course Work in Range Management	District Conservationist – 1.25 yrs. Soil Conservationist - 5 yrs. Sr. Environmental Analyst – 13 yrs.	
David L. Faulkner	Natural Resource Economist – 16.5	M.S. Ag. Economics B.S. Ag. Education	Ag. Economist (SCS) - 2.5 yrs. Ag. Economist (U.S.A.I.D.) - 4.5 yrs.	
Fred M. Garst	GIS Specialist – 9	B.S. Geology	GIS/Soil Scientist - 7 yrs. Soil Cons. Tech. - 7 yrs. Geologist (Private) – 4 yrs.	

NRCS NATURAL RESOURCES PLANNING TEAM (cont.)

Name	Present Title and Years in Current Position	Education	Previous Experience	Other
Alica J. Ketchem	Plng./Environmental Engineer – 12	M.S. Ag. Engineering B.S. Civil Engineering	Civil Engineer – 10 yrs.	PE
Bryan Lee	Cultural Resource Specialist – 3	M.A. Anthropology B.A. Anthropology	Archaeologist (Private) 10 years	
Mathew J. Lyons	State Conservation Engineer- 5	B.S. Civil Engineering	Civil Engineer – 12 yrs.	PE
Jeffrey D. McClure	Geologist –1.5	B.A. Geology B.A. Biology B.S. Geology	NRCS Geologist – total 2.5 yrs. Geologist (WV Dept. of Env. Prot.) - 11 yrs. Geologist (Private) – 8.5 yrs. CPG in KY and PA	
Kelly A. Ramsey	Hydraulic Engineer-0.5	B.S. Biological Sys. Eng.	Civil Engineer – 7 yrs.	PE
Phillip T. Rippé	Design Engineer - 2	M.S. Environmental Eng. B.S. Civil Engineering	Professional Engineer – 5 yrs. Civil Engineer – 9 yrs.	PE

Special acknowledgment goes to the following people who spent many hours in the Pohick Creek Watershed surveying, collecting data, meeting with landowners, and attending public meetings, or providing technical support.

- Fairfax County Staff: Carl Bouchard (retired), Don Lacquement, and Dipmani Kumar.
- NRCS Project Engineering Staff: John M. Cooke, Civil Engineering Technician; Josh Edwards, Engineering Aide, and Simon Mkrtychyan, Civil Engineer (Career Intern).
- NRCS Hydrology Team Leader William Merkel, NRCS Hydraulic Engineer Larry Goertz (retired), NRCS Design Engineer Morris Lobrecht, and NRCS Civil Engineer James N. Moore.

APPENDIX A

**LETTERS OF COMMENT AND NRCS RESPONSES TO COMMENTS
RECEIVED ON DRAFT SUPPLEMENTAL PLAN – EA**

Comments were requested on the Draft Supplemental Plan – EA from the following agencies and organizations.

<u>Federal Agencies</u>	<u>Response Received on Draft Supplemental Plan/EA</u>
Environmental Protection Agency Region III, Philadelphia	No
U.S. Army Corps of Engineers, Norfolk District Baltimore District	No No
U.S. Department of the Interior Fish and Wildlife Service Annapolis, Maryland Office Gloucester, Virginia Office	No No
Federal Emergency Management Agency, Philadelphia	No
U.S. Department of Agriculture Forest Service Farm Service Agency Rural Development	No No No
<u>Virginia State Agencies</u>	
Virginia Department of Environmental Quality Office of Environmental Impact Review (State Clearinghouse) Division of Waste Division of Air Program Coordination Northern Virginia Regional Office	Yes Yes Yes Yes
Virginia Soil and Water Conservation Board (Governor’s Designated Agency)	No
Virginia Department of Emergency Management	No
Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation Division of Dam Safety and Floodplain Management Division of Natural Heritage Division of Planning and Recreation Resources	No No Yes Yes

<u>Virginia State Agencies</u>	<u>Response Received on Draft Supplemental Plan/EA</u>
Virginia Department of Agriculture and Consumer Services	No
Virginia Department of Game and Inland Fisheries	Yes
Virginia Marine Resources Commission	Yes
Virginia Department of Historic Resources	Yes
Virginia Department of Transportation	Yes
Virginia Department of Mines, Minerals and Energy Division of Mineral Resources	Yes
<u>Other</u>	
Virginia Association of Soil and Water Conservation Districts	No
Northern Virginia Soil and Water Conservation District	Yes
Fairfax County Board of Supervisors	No
Northern Virginia Planning District Commission	No
Norfolk Southern Railroad	No

APPENDIX B

RECORD OF INVESTIGATION AND ANALYSIS

Appendix B. Investigation and Analysis Used in the Planning for the Rehabilitation of Pohick Creek Dam Site No. 4.

Threatened and Endangered Species: Identification of Federal and State listed threatened and endangered plant and animal species within a two mile radius of the project area was determined using the Virginia Fish & Wildlife Information Service computer program, a publication of the Virginia Department of Game and Inland Fisheries.

Cultural Resources, Natural and Scenic Areas, and Visual Resources: As a result of Phase I testing, one site was located and recommended for Phase II testing. The Virginia Department of Historic Resources concurred with the findings. This site is a moderate density – lithic scatter with diagnostic projectile points, tools, and over 60 pieces of debitage. The site area is approximately 0.75 acres in size, and its boundaries were clearly delineated. This area is currently wooded and is located immediately below.

The absence of Natural Heritage Resources, including Scenic Areas and Visual Resources, was determined by review of the Virginia Department of Conservation & Recreation Natural Heritage Resource Map for Fairfax County.

Water Quality: Impaired water listings and supporting information was taken from the Virginia DEQ 2004 305(b)/303(d) Integrated Water Quality Assessment and Impaired Waters Report.

Wetlands: Presence or absence of jurisdictional wetlands was determined by a site visit; the finding of a lack of jurisdictional wetlands was concurred with by the Northern Virginia Regulatory Section of the Army Corps of Engineers.

Forest and Wildlife Resources: Information on the potential natural vegetation of northern Virginia and associated wildlife resources was obtained from a Kuchler Type Description of the Appalachian oak – northern hardwood transition zone, and the Draft Natural Resource Management Plan for the Pohick Bay Regional Park.

Chesapeake Bay and /or Coastal Zone Management Areas: Information on the Chesapeake Bay Act and Coastal Zone Management Areas was taken from DEQ program literature.

Geology: As noted in plan, formations present at the site changed in nomenclature from the original plan to the current plan.

- Reference for original plan: U.S. Department of the Interior, Geological Survey Water-Supply Paper 1539-L, Geology and Groundwater Resources of the Fairfax Quadrangle, Virginia.
- Reference for this plan: The Geologic Map of Virginia, 1993, compiled by the Commonwealth of Virginia Department of Mines, Minerals, and Energy.

Sediment: In 2001, Fairfax County conducted a sediment survey of Royal Lake. The results of that survey and dredging showed that 13.4% of the sediment originally predicted to flow into Royal Lake had done so in the period from dam construction in 1977 to 2001 (24 years).

Although the final sediment numbers are available from the 2001 sediment survey, the raw data from the survey is no longer available. Since the survey could not be re-constructed, these sediment survey results were not used in the final analysis of the sediment pool.

For this project, Fairfax County again had a sediment survey completed in late April 2005. That survey and dredging showed that 30.7% of the sediment originally predicted to flow into Royal Lake had done so in the period from dam construction in 1977 to 2005 (28 years).

HYDRAULICS AND HYDROLOGY

Background: In 1999 and 2000, Fairfax County commissioned the engineering firm of Gannett Fleming, Inc., to conduct an investigation of the auxiliary spillway of Royal Lake. These studies used the SITES program to show that the stability and integrity of the auxiliary spillway soils were not sufficient to allow the PMP flow event to pass through the spillway without a breach of the dam. These studies also showed that the existing auxiliary spillway capacity would be adequate to pass both the 6-hour and 24-hour storms, as required in TR-60, if the stability and integrity criteria could be met.

Precipitation Data and Hydrologic Data: Since the project was originally designed, the precipitation data has changed. In the table below, the precipitation data used in the original design was compared to the NOAA-14 data from 2004.

Year	100-year, 6-hour event, inches	100-year, 24-hour event, inches	100-year, 10-day event, inches	6-hour PMP, inches	24-hour PMP, inches
1972	7.62	8	14	27.3	36
2004	5.36	8.33	12.21	27.6	36

SITES Analysis – Existing Conditions: As part of the planning process, NRCS ran the SITES program to verify Gannett Fleming’s assessment. The 2004 NOAA-14 precipitation data was used. Geotechnical information was taken from the Gannett-Fleming study and from the original SCS drill hole data as shown on the as-built drawings. This data was reviewed by Phillip Rippe’, State Design Engineer. Results from the independent SITES run showed that the auxiliary spillway would breach in an event larger than the 500-year frequency storm but less than the 1000-year frequency storm, thus confirming the Gannett Fleming results. The NRCS Standard rainfall distribution was used for the 6-hour PMP and the 24-hour PMP events. This is the dimensionless storm distribution from TR-60, Figure 2-4. The 5-point distribution was also used for evaluation of the 24-hour PMP event.

SITES Analysis for Rehabilitation of the Dam: Armoring the auxiliary spillway will provide the necessary stability and integrity to meet NRCS and State dam safety criteria. The SITES program is meant to be used on vegetated earth spillways. By giving artificially high numbers for the erodibility and hardness of the auxiliary spillway soil and rock materials, SITES can be

used to estimate the effects of armoring the spillway. During the design process, other techniques will be used.

In cooperation with the NRCS National Design, Construction, and Soil Mechanics Center, a preliminary design for the Articulated Concrete Blocks was prepared. Nine inch tapered open-cell blocks were selected.

When the new rainfall data was routed through the SITES program, it was determined that flow through the armored spillway at the existing crest elevation will occur with a statistical frequency of approximately once in 70 years. There is no change in the storage capacity of the reservoir. The level of downstream flood protection will not change. Based on the analysis, flow will occur more frequently in the auxiliary spillway than the original design. The armor in the spillway will protect it from structural damage in these events but there may be a need to replace the topsoil and vegetation. This will be the responsibility of the Sponsor under the Operation and Maintenance Agreement.

Water Surface Elevation Modeling: The HEC-RAS model was used to identify the water surface elevations within the downstream floodplain. The geometry and flow data from the 1972, pre-dam USGS floodplain study were used to calibrate the model. The Manning's "n" value was the primary value that was modified. The final "n" values for the channel and overbank flow were 0.033 and 0.08, respectively. The calibration model was particularly important in identifying the water surface elevations around the Norfolk Southern/VRE railroad bridge. Once the calibration model was complete, Guinea Road and the dam were added to the geometry file. Several of the original USGS cross-sections were extended using data from the LIDAR survey provided by Fairfax County. Some cross-sections were modified to more accurately depict the capacity of the floodplain below the railroad bridge.

Breach Modeling: In accordance with the National Engineering Manual and instructions from the State Conservation Engineer, the breach zone is determined by a breach that could occur if both the principal and auxiliary spillways were blocked, the reservoir was full, and the dam failed under "sunny day" conditions. The criteria defined in TR-60, Earth Dams and Reservoirs, was used to determine the peak discharge for the breach hydrograph.

The SCS TR-66, Simplified Dam-Breach Routing Procedure was used to route the breach flows. A required input for this model is the Elevation-Discharge-End Area relationship for each cross-section. The HEC-RAS steady flow model was used to develop this data for ten discharge values. The known 200-, 500-, and 1000-year flows were used as was the calculated discharge for the breach as computed by TR-60. The remaining mid-range values were arbitrarily selected but evenly distributed between the known values. This information is used by TR-66 to build the rating curve.

The TR-66 model does not account for the effect of bridges or other obstructions on the water surface elevations. Therefore, flow data from the TR-66 model was input back into the HEC-RAS model to evaluate the effect of the flow on Guinea Road and the Norfolk Southern/VRE bridges. Per guidance from Bill Merkel, NRCS Hydrologist, the Manning's "n" value for overbank flow was increased to 0.16 for breach flows.

The water surfaces generated by both TR-66 and HEC-RAS at the most downstream cross-section originally used were about 10 feet higher than the 100-year floodplain elevation for that section. This was about one mile downstream of Royal Lake and was the end of the breach inundation zone identified by the County. Since the breach zone must be continued until the water surface is within one foot of the designated 100-year floodplain elevation, the cross-sections were extended downstream for an additional mile. TR-66 and HEC-RAS were again used. This extended the breach inundation zone below Burke Lake Road.

Realignment of the Auxiliary Spillway: The auxiliary spillway was realigned to direct the flow away from the townhouses located at the end of the existing auxiliary spillway. All of the changes to the alignment were made in the inlet section. This allowed the level section and the exit channel to be straight.

SOCIAL AND ECONOMIC CONDITIONS

Sources for the data included in the social and economic conditions section of this supplement include the U.S. Census Bureau, Department of Commerce, 2000 Census, and interviews conducted with local contacts who are knowledgeable about recreational activities on and around Royal Lake.

Economic Analysis: The NRCS National Watershed Manual was used as a reference for the economic analysis along with two economic analysis guidance documents: “Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies” (P&G), U.S. Water Resources Council, March, 1983, and the “Economics Handbook, Part II for Water Resources”, USDA/Natural Resources Conservation Service, July, 1998. These guidance documents were used to evaluate potential flood damages, and estimate recreational use, project benefits and associated costs. P&G was developed to define a consistent set of project formulation and evaluation instructions for all federal agencies that carry out water and related land resource implementation studies. The basic objective P&G is to determine whether or not benefits from project actions exceed project costs. P&G also requires that the “National Economic Development” or NED alternative, which maximizes monetary net benefits, be selected for implementation unless there is an overriding reason for selecting another alternative based on federal, state, local or international concerns related to the social and environmental accounts. The allowance for exceptions to the NED plan recognizes the fact that not all project considerations nor benefits can be quantified and monetized when it comes to some ecological system and social effects.

Basic data were obtained from field surveys, interviews with residents, businesses and local government officials within the watershed. Detailed data on the homes and other structures within the floodplain, breach inundation zone, and breach flood pool of the Royal Lake watershed were obtained either from field surveys or from the Fairfax County Department of Public Works and Environmental Services, Stormwater Planning Division, Watershed Project Evaluation and Implementation Branch.

Flood damages were based on the results of the hydrology and hydraulics (H&H) simulation modeling carried out by the NRCS Planning/Environmental Engineer. The H&H data routed water for the storm events modeled establishing the extent of the floodplain as well as flood depths. This data was then used with water depth to damage functions developed by the Federal Emergency Management Agency (FEMA) to estimate damages by storm event for both the future without federal project (FWOFP) and future with federal project (FWFP) candidate plans.

These estimated damages formed the basis needed to construct damage frequency curves relating percent chance of storm occurrence with specific event damage estimates. The resulting functional relationships permit the prediction of damages for lesser and greater events than the storms of record and the simulated storm events. Annualized estimates of storm damages from all storm events for the FWOFP and FWFP scenarios is the end result of this analysis. Loss of recreation and property values, if applicable are added to the predicted annual damages to establish total average annual damages for both the FWOFP and FWFP alternatives.

All costs of installation, operation and maintenance were based on 2006 prices. The costs of all structural measures were assumed to be implemented over a one-year installation period and to have a 70-year useful life. Thus, a 71 year period of analysis was used along with the mandated 5.125% discount rate for all federal water resource projects for FY06 to discount and amortize the anticipated streams of costs and benefits.

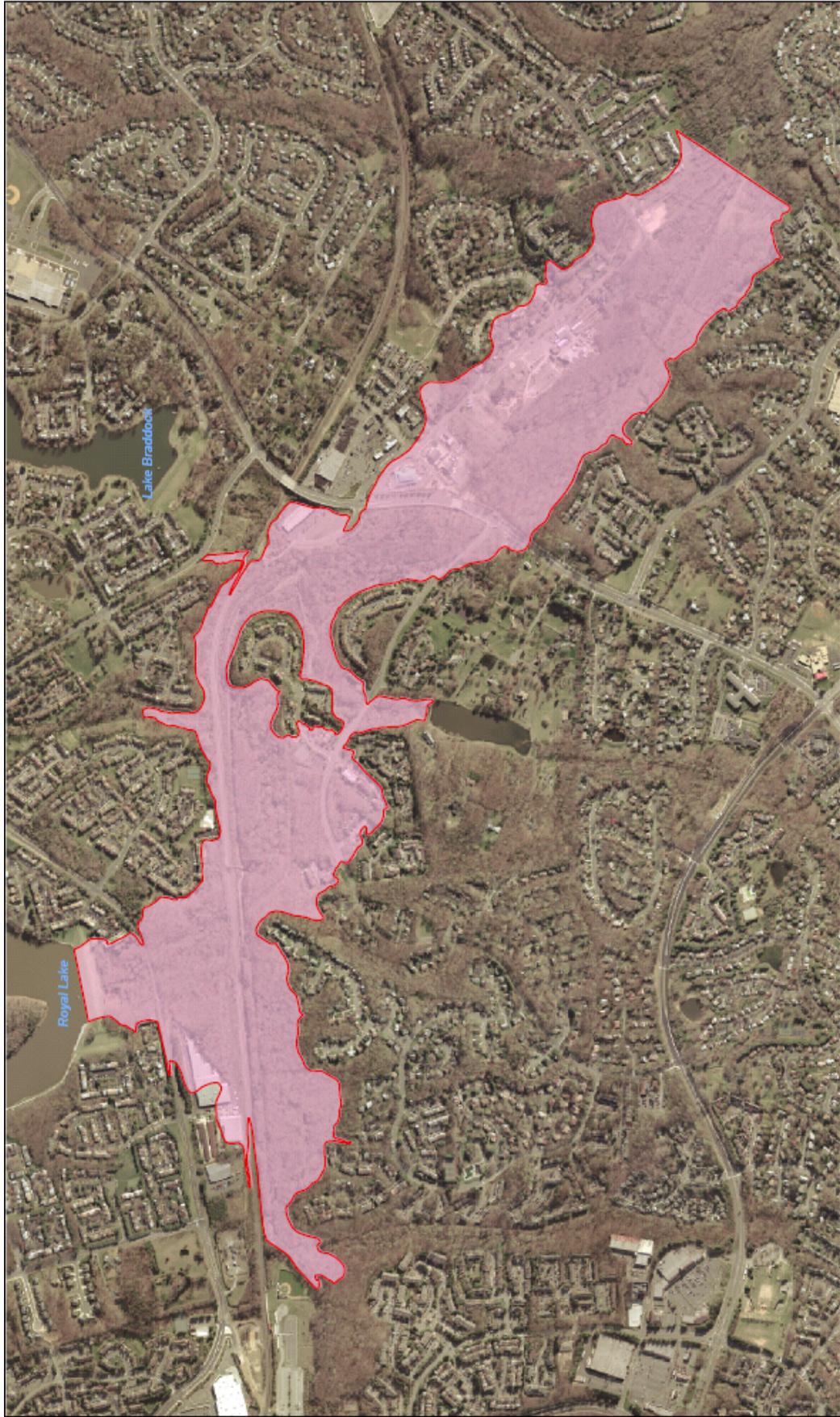
Damage reduction benefits were determined by computing the difference in damages for the FWOFP condition and the damages expected with each alternative in place. The basis for the assumptions concerning FWOFP and FWFP conditions are covered in the plan under “Effects of Alternative Plans” and “Comparison of Candidate Plans”.

APPENDIX C

BREACH INUNDATION ZONE MAP

AND

WATER SURFACE ELEVATION DATA



ROYAL LAKE BREACH INUNDATION ZONE

This map was produced at the Virginia Natural Resources Information Center – The USDA Natural Resources Conservation Service in Harrisonburg, Virginia on 6/28/06. The imagery was derived from USGS High resolution imagery for Northern Virginia. This is one foot ground resolution and is from April 2002 photography. The inundation zone was based on calculations made by the USDA-NRCS planning team. This map is projected in VA- State Plane Coordinates – VA north Zone, NAD83 Datum and US feet. This is a "Draft" copy, and is subject to change.

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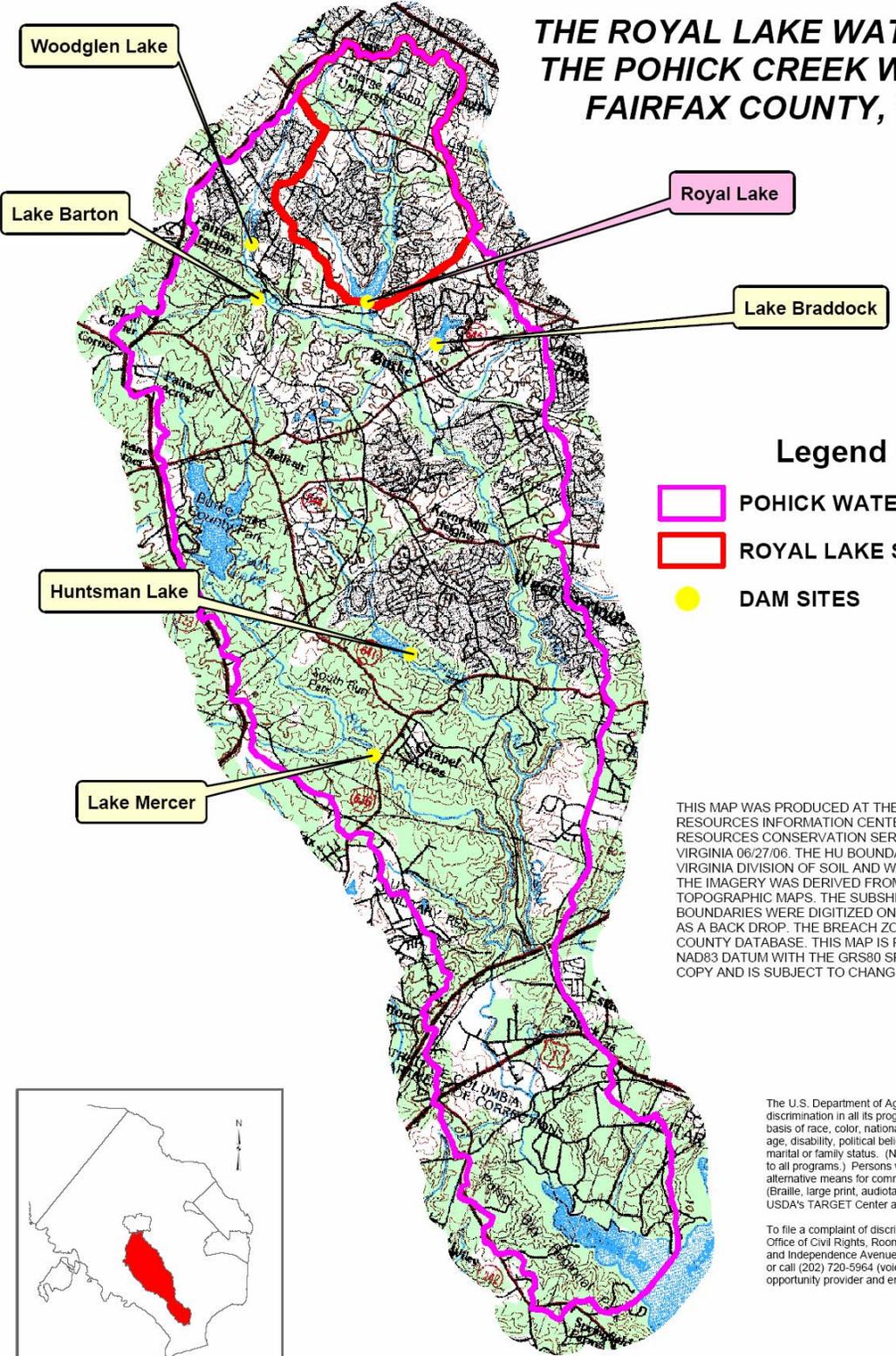
Table C1 - Depth of Water Flow over Bridges during Flooding Events (feet)

Stream Crossing	100-year	200-year	500-year	Sunny Day Breach
Guinea Road	n/a	4.6	5.2	11.6
Norfolk Southern / VRE Railroad	n/a	1.7	2.0	8.8
Burke Lake Road	n/a	2.0	2.5	4.9

APPENDIX D

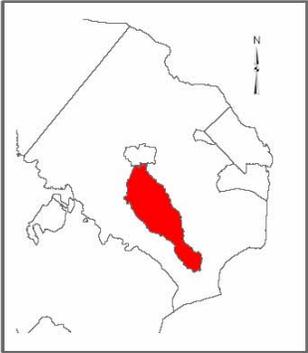
ROYAL LAKE WATERSHED PROJECT MAPS

THE ROYAL LAKE WATERSHED IN THE POHICK CREEK WATERSHED FAIRFAX COUNTY, VIRGINIA



- Legend**
- POHICK WATERSHED
 - ROYAL LAKE SUB WATERSHED
 - DAM SITES

THIS MAP WAS PRODUCED AT THE VIRGINIA NATURAL RESOURCES INFORMATION CENTER - THE USDA NATURAL RESOURCES CONSERVATION SERVICE IN HARRISONBURG, VIRGINIA 06/27/06. THE HU BOUNDARIES ARE FROM THE VIRGINIA DIVISION OF SOIL AND WATER CONSERVATION. THE IMAGERY WAS DERIVED FROM USGS 30x60 100K TOPOGRAPHIC MAPS. THE SUBSHEDS AND WATERSHED BOUNDARIES WERE DIGITIZED ONSCREEN WITH THE DRG AS A BACK DROP. THE BREACH ZONE IS FROM THE FAIRFAX COUNTY DATABASE. THIS MAP IS PROJECTED IN UTM-ZONE 18, NAD83 DATUM WITH THE GRS80 SPHERIOD. THIS IS A "DRAFT" COPY AND IS SUBJECT TO CHANGE.



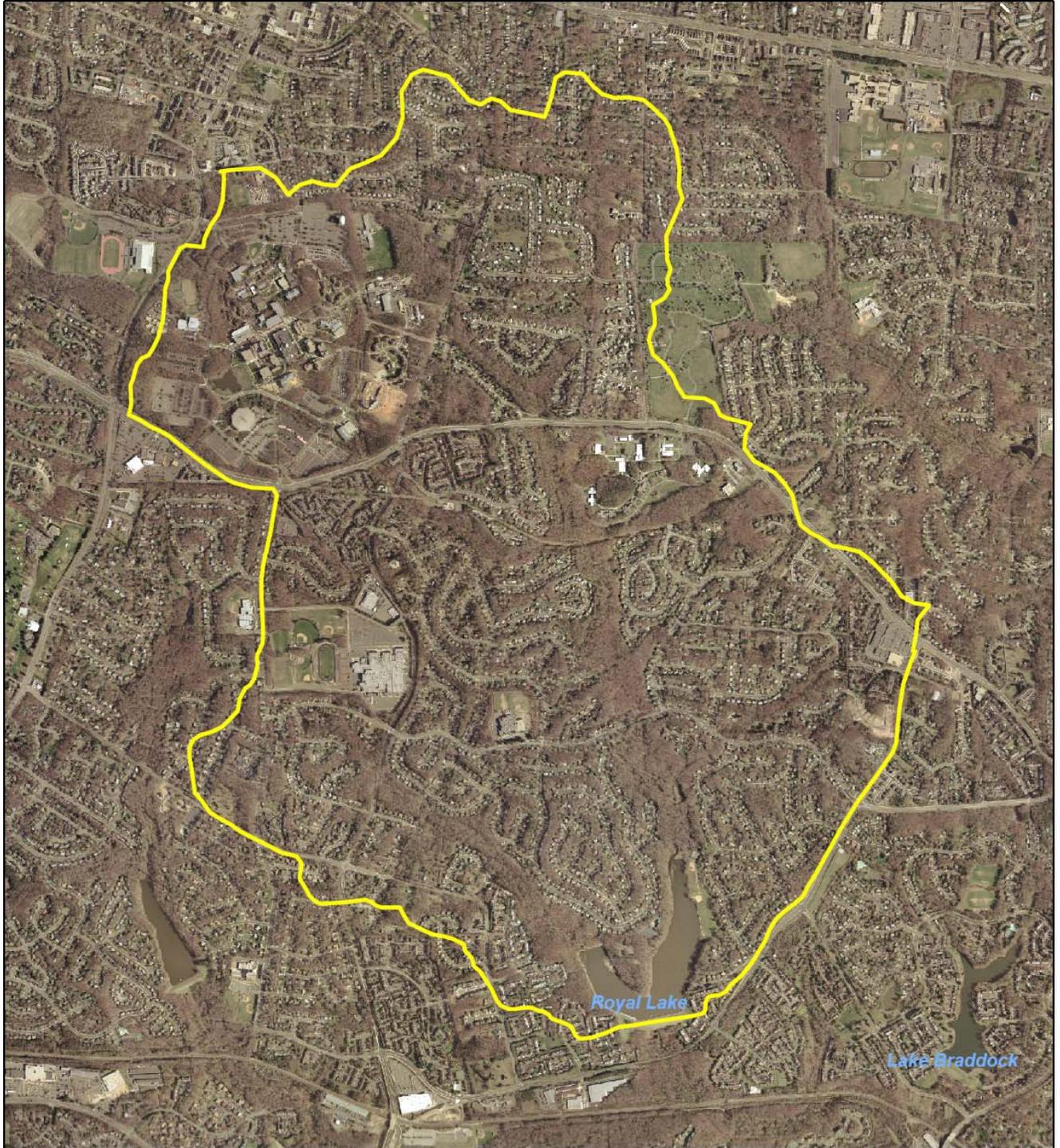
THE POHICK WATERSHED IN FAIRFAX COUNTY, VA

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**ROYAL LAKE SUB WATERSHED
IN FAIRFAX COUNTY, VIRGINIA**



This map was produced at the Virginia Natural Resources Information Center – The USDA Natural Resources Conservation Service in Harrisonburg, Virginia on 6/28/06. The imagery was derived from USGS High resolution imagery for Northern Virginia. This is one foot ground resolution and is from April 2002 photography. The sub watershed was digitized with a 1:24,000 back drop, on screen. This map is projected in VA- State Plane Coordinates – VA north Zone, NAD83 Datum and US feet. This is a "Draft" copy, and is subject to change.

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