

Questions and Answers on Rehabilitation of Huntsman Lake Dam, Fairfax County, Virginia



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Background: In the early 1960s, the Pohick Creek watershed started to rapidly change from agricultural land use to residential and commercial land use. As this change occurred, residents began to see environmental damages from soil erosion and siltation. Several residential lakes were filled with sediment. As construction activities increased, the residents became concerned about potential flooding due both to proximity to the creek and the increased runoff from a growing amount of impervious surfaces.

In 1965, the Pohick Creek Watershed Protection and Flood Prevention Project was developed under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566). Six flood control dams were built in the watershed starting with Lake Braddock in 1970. Huntsman Lake was completed in 1973, Royal Lake in 1977, Lake Barton in 1978, Woodglen Lake in 1981, and Lake Mercer in 1985. All of these dams are regulated by the State of Virginia, Department of Conservation and Recreation (DCR), Division of Dam Safety and Floodplain Management. At the present time, four of them require upgrades in order to meet state regulations. Royal Lake, also known as Pohick #4, is the first one that was rehabilitated. Lake Barton (Pohick #2), Woodglen Lake (Pohick #3), and Huntsman Lake (Pohick #8) are the other three.

Q. How do flood control dams work?

A. In an uncontrolled watershed, a flood event can be caused any time that precipitation creates more runoff than can be safely carried in the stream network. A flood control dam does two things. The most important one is that it detains water behind the dam so that flood water can be released slowly, in amounts that match the capacity of the stream. The volume of water that can be detained is called flood storage. Flood storage is located between the crest of the principal spillway riser and the crest of

the auxiliary spillway. The **principal spillway** riser is the concrete structure that is located just off-shore from the dam. The **auxiliary spillway** for each of the Pohick dams is a wide, flat, grassed area located off to the side of the dam at an elevation that is below the top of the dam.

Secondly, the dam traps sediment that would otherwise be transported downstream. The crest of the principal spillway riser controls the elevation of the water that you see in the lake day-to-day. The storage capacity of the lake below this elevation is meant for sediment storage and it is designed to hold all the sediment that will be washed into the lake during its design life. The Pohick dams were planned for a design life of 100 years. At that time, without ongoing sediment removal efforts, all of the water in the lake would be replaced by sediment.



Daily base flow and stored flood waters are removed from the lake through the principal spillway. For the Pohick dams, the principal spillway is a 30-inch pipe that passes under the dam and outlets into the stream. Water drops into the riser and then flows through the pipe.

The auxiliary spillway is a safety feature to protect the integrity of the dam itself. The Pohick dams are designed to store all the water from the 100-year, 10-day storm. In storm events that are larger than the design storm, water passes through the auxiliary spillway rather than overtopping the dam.

Q. What is wrong with Huntsman Lake ?

A. Since the time of construction, the technology for evaluating dam safety has improved. One computer program that is used is called SITES. It uses site-specific soils, vegetation, and geology data to model the behavior of the principal and auxiliary spillways under flood conditions. Huntsman Lake has a vegetated earth auxiliary spillway. According to the SITES model, the auxiliary spillway of this lake will erode in a flood-flow event, causing the spillway to breach. A breach would cause a very quick release of all of the water impounded behind the dam. Little or no warning would be available to people downstream.

Under the State Dam Safety regulations, the auxiliary spillway at Huntsman Lake does not meet current safety standards.



The vegetated earth auxiliary spillway protects the dam from damage during extremely large storms. To meet state standards, armor (i.e. rock, concrete, etc.) will probably be placed under the vegetation.

Q. Who is responsible for the upkeep of this dam?

A. All of the Pohick Creek Watershed dams are operated and maintained by the Fairfax County. Fairfax County has done an outstanding job in protecting the dams that serve this watershed. Through the use of zoning, the county has limited development in the 100-year floodplain above the lakes and below them. This means that no houses are flooded upstream of the dam when it is full of floodwater. It also means that minimal property damage occurs in the areas immediately adjacent to the streams below the dams.

Q. Are the dams structurally safe?

A. Yes. The dams were designed to last 100 years. By all visual appearances, they are in good physical condition. The earth embankments are stable and the inlet and outlet pipes of the principal spillway are functioning appropriately. The auxiliary spillways are also well vegetated and stable. The internal integrity of the principal spillways and the gates that control the water level of the lakes and allow the lakes to be drained for repairs, if needed, appear to be in good condition. An assessment of the overall integrity of the structural components will be needed as we move forward with rehabilitation to assure that the dams continue to provide flood control for the next 50-100 years.

Q. Is the dam adequate to meet the requirements of the state?

A. No. A high-hazard dam must be able to handle the volume of water associated with an event that hydrologists call the “Probable Maximum Precipitation” or “PMP” (the PMP for this area is about 27½” rainfall in 6 hours – a storm comparable to a significant hurricane). There are three parts to this. The auxiliary spillway must have the **capacity** to contain the volume of water associated with the PMP without overtopping the dam, the surface of the auxiliary spillway must be able to resist the erosive velocity of the water as it passes through (**stability**), and the underlying soils must be strong enough to stay in place during a flow event (**integrity**).

The capacity of the spillway is adequate but the vegetated earth surface of the spillway is not strong enough to prevent erosion of the spillway during a PMP event and the underlying soils will erode, causing a breach of the dam.

Q. What has the State done about the dam?

A. Every dam regulated by the State is required to be certified as safe by the Division of Dam Safety and Floodplain Management. In light of the vulnerability of the auxiliary spillway, the State has issued a “conditional” certificate rather than a regular certificate to the owner of the dam, the Fairfax County Board of Supervisors.

Q. What does a “conditional certificate” from the State mean?

A. A conditional certificate means that the dam does not meet current State dam safety regulations and must be modified as soon as possible to meet State law.

Q. If water has never flowed through the auxiliary spillway, why are we concerned?

A. The easy answer is “because it is the law.” However, there is a more complex answer. As with many engineering practices, as the risk increases, the necessary factor of safety increases. The Probable Maximum Precipitation storm event is statistically unlikely to occur in any given year. The Pohick Dams were built as high hazard dams because there was a threat to loss of life at the time of construction. This threat to loss of life from a dam breach has multiplied many times as the human population of the Pohick watershed has increased from 4,767 in 1965 to well over 100,000 in 2005. By rehabilitating the dam to meet the necessary dam safety standards, we are reducing the risk associated with this dam to an acceptable level.

Q. What is the role of the federal government?

A. The role of the United States Department of Agriculture Natural Resources Conservation Service (NRCS) in rehabilitation of our nation’s aging watershed dam infrastructure is spelled out by Public Law (PL) 83-566, as supplemented by PL 106-472, otherwise known as “The Small Watershed Rehabilitation Amendments of 2000”. Congress recognized that the nation has a large number of small watershed dams, such as Huntsman Lake. Since 1948, federal assistance has been used to install more than 11,000 small dams across the country to provide public benefits such as flood protection, recreation, municipal and industrial water supplies, etc. These dams are part of our nation’s public infrastructure just as roads and bridges are, and like roads and bridges, they require annual maintenance and eventual replacement as they reach the end of their designed useful life.

Q. What actually does the federal dam rehabilitation legislation require for dams to be rehabilitated?

A. Anticipating a growing need to rehabilitate these dams, Congress passed legislation to allow the NRCS to work with local dam owners to determine the technical needs and feasibility of rehabilitating our aging dams. Scientific understanding of the functions and values of dams, and the associated environmental issues and concerns have increased substantially since the 1950's, 60's and 70's when most of the nation's small dams were constructed. These laws are designed to: 1) better protect public safety and the environment; 2) assure sound technology is used; 3) assure economic justification and 4) make sure that federal projects have public support. Specifically, Congress mandated that federal technical and financial assistance be provided only:

- Where there is local leadership and decision making, typically led by a local watershed steering committee with full public participation by all affected individuals and parties; and
- Within the context of the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA), and the Economic and Environmental Principles and Guidelines for Water Related Land Resources Implementation Studies (P&G).

NEPA requires that environmental considerations be central to any federal investment that alters the landscape and our natural resources. NHPA requires that historic preservation (cultural and historic resources) be considered, and appropriately dealt with, whenever federal funds result in physical changes on the landscape. P&G, like NEPA, addresses environmental evaluation procedures and also requires that the economic and social costs and benefits of any federal action be identified, accounted for, and used to contribute to the public investment decision making process.

Therefore, dam rehabilitation supported by the NRCS requires all parties involved to conduct planning and evaluation in view of identified social, economic, historic and environmental considerations. The end objective of this process is to only provide federal funds to projects that are technically and environmentally sound, socially acceptable, economically justified, and supported by grass-roots democratic processes.

Q. What does the NRCS planning process require?

A. The federal statute stipulates:

- that there must be local sponsors who support and lead the planning process;
- that NRCS technical expertise serve the locally-led planning process to arrive at any recommended works of improvement; and

- that the evaluation of alternatives includes:
 - 1) No action (termed the “future without federal project condition”, i.e., what happens if the federal government doesn’t do a thing?);
 - 2) Decommissioning (removal of the dam through a “controlled” breach followed by stabilization of the site);
 - 3) Rehabilitation of the existing dam to establish a minimum projected useful life of 50 years (this usually involves consideration of several technically feasible solutions); and
 - 4) Identification of an alternative that meets National Economic Development (NED) criteria (economic defensibility whereby an alternative is identified as maximizing net monetary benefits; this may be one of the other alternatives or a combination of several).

When applicable, the following alternatives will also be evaluated:

- 1) Non-structural alternatives such as relocation and/or flood proofing of “at-risk” inhabited dwellings and other properties in the downstream floodplain to prevent possible loss of life and property should the dam breach. (“Non-structural” is a term that refers to not repairing the dam, but instead taking actions, such as elevating buildings, homes, roads, etc. and building small floodwalls around buildings to reduce future damages); or
- 2) Rehabilitation of the existing dam with added purposes (Huntsman Lake is currently a single-purpose dam for flood control. Other purposes could include water supply, recreation, enhancement of threatened and endangered species, etc.).

Q. What does the planning process mean to the local people?

A. The planning process allows for public participation and input into the planning of the dam rehabilitation project. Local sponsors must initiate the process by applying for federal assistance. The Fairfax County Board of Supervisors and the Northern Virginia Soil and Water Conservation District completed this step on August 7, 2003. The sponsors must also commit to supporting, leading and guiding the planning process. The sponsors must then support the process in practical terms by facilitating communication with the local residents, including hosting public information, education and participation meetings; by hosting environmental scoping meetings¹; by providing guidance on what the local community desires to have happen; and by obtaining landowner permissions to allow access to private property for data gathering.

Q. How do local folks contribute to the planning process?

A. The establishment of a strong local watershed steering committee is the foundation of the partnership between local, State, and Federal agencies and the public. Local input into the planning

¹ Scoping is a federal planning term used to describe identification of relevant issues and concerns.

process is critical to the selection of the alternatives to be considered. The local watershed steering committee provides leadership and guidance throughout the overall planning process.

Q. Who serves on local watershed steering committees?

A. Typically, representatives of the local government form the core group of individuals who serve on this committee. They recruit other members of the community to help with getting the work done. Stakeholders, the individuals from the local community who would be affected by the rehabilitation, should also serve on the local committee. Representatives should be chosen from landowners living above the dam and in the floodplain below the dam. Individuals from the Northern Virginia SWCD should also serve on the steering committee to represent the individuals affected downstream.

Q. What activities will need to be conducted in the watershed to complete the plan?

A. Planning for dam rehabilitation will involve a number of different actions. The local sponsors, steering committee, and general public should be willing to facilitate all needed investigations and analyses. The following investigations and analyses will be needed:

- Surveys of the existing dam structure and its permanent (non-flooded) pool of water, the flood pool (area where floodwaters are stored), and the sediment volume within the lake to determine how much of the facility’s sediment storage has been lost over the intervening years since the dam was built;
- Analysis of the chemical contents of trapped sediments behind the dam to determine if any toxic materials are present (An urban watershed has the potential to have toxic material in the sediments because lawn care products and automobile byproducts, such as zinc and chromium, could be eroded into the lakes);
- Analysis of the stream’s hydrology (rainfall and runoff characteristics) and stream hydraulics (the mechanics of water moving through specific sections of its course relevant for analyzing flood risks and determining what would be expected to occur should a storm breach the dam);
- Investigations and analysis of the dam’s existing components, layout, and size for conformance to NRCS and State design criteria.
- Surveys of the downstream floodplain and the assets (homes, businesses, roads and bridges, and utilities that are in harm’s way);
- Analysis of the expected flooding damages that would likely occur in the future given specific storm events (For example, 10 inches of rainfall in a 24 hour period could happen

with a hurricane passing overland in the area. We would also need to understand the expected effects should the dam breach, including mapping of the inundation area.);

- An assessment of the in-stream and in-lake plants and animals, and water quality, as well as the associated wetlands and upland areas immediately adjacent to the lake and stream and below the dam;
- Analysis of all required alternatives as well as any other alternatives identified in the planning process;

Q. What is the planning and implementation process?

A. For a typical dam rehabilitation project, the process should generally proceed as follows:

The Water Resource Planning Process

- 1) A determination regarding dam safety is made by the State within a watershed (this has already occurred for the four Pohick Creek dams).
- 2) The agencies responsible for implementing State laws regarding dam safety begin a dialogue with local sponsors.
- 3) An application for federal assistance is made (also already completed for the four dams).
- 4) Upon authorization to act on the request, the NRCS initiates discussions on how to proceed (already underway).
- 5) Public meetings, as many as are needed to inform the public and listen to their concerns and suggestions, are held.
- 6) Contacts are made with local landowners to get their permission to conduct the needed surveys and investigations.
- 7) A scoping meeting is held early in the process to solicit the knowledge and ideas of other interested federal, state and local agencies, university scientists, etc. all with technical expertise related to natural resources and the contemplated works of improvement.
- 8) The needed inventories, investigations, and analyses are initiated and completed.
- 9) Additional public meetings are held, on an as needed basis, to inform the public of what has been learned and again solicit the ideas of the local leaders and members of the public.
- 10) A draft of a watershed supplement to the original Pohick Creek “Work Plan” is prepared. The supplement serves as the document that explains the technical alternatives along with their associated economic, social, and environmental implications.
- 11) An interagency and public review of the watershed supplement is carried-out. Comments are accepted and incorporated, as deemed appropriate.
- 12) The final watershed supplement is prepared.
- 13) The supplement is submitted to NRCS headquarters for authorization to implement the selected plan as soon as funds are available.

- 14) When Congress and/or the local sponsors provide the needed construction funds, a detailed project agreement is developed between the NRCS and the sponsors. The project agreement obligates the Federal and local funds necessary to implement the project. Preparation of a new Operation and Maintenance (O&M) Agreement and an Emergency Action Plan is required prior to signing the project agreement.
- 15) A design for the rehabilitation project is prepared.
- 16) All necessary State and/or Federal environmental and related permits are obtained by the local sponsors.
- 17) Based on the requirements of the design, additional conservation easements may be required. The local sponsors will obtain the required conservation easements prior to construction.
- 18) The competitive bidding process is used to select a contracting firm.
- 19) The contractor performs the work under a contract administered by the NRCS, or the State or local authority such as the county.
- 20) After completion of the rehabilitation, annual O&M is carried out by the local owners, and annual safety inspections are made by state and federal personnel.

Q. How long does the planning process usually take?

A. Typically 1-2 years.

Q. How long does the design phase usually take?

A. Typically 6-12 months are required from preparing a request for proposals to completion of the design.

Q. How long does the permitting phase take usually?

A. Getting the needed permits for a non-controversial action usually takes 2-4 months. Controversial actions can take much longer. Rehabilitation of the Pohick Creek dams is unlikely to be controversial.

Q. How long does it take to actually implement a recommended solution?

A. The length of time it actually takes to perform the work depends upon the amount and complexity of the work undertaken. For example, relocation of properties out of the floodplain is a vastly different process compared to repair of an existing dam. Each alternative can also have unforeseen obstacles pop up that must be resolved. Assuming construction is the selected alternative, then the entire implementation process from start to finish shouldn't take more than one year. This also assumes good weather conditions for construction.

Q. How does the federal cost/sharing work?

A. Federal funds for dam rehabilitation are authorized for up to 65% of the total costs of a project, but will not exceed 100% of the actual construction costs incurred for rehabilitation. The local sponsors are responsible for the remaining 35%. Any nonfederal funds can be used as part of the local cost-share. Credits towards the sponsor's 35% share of the total cost include acquisition of land rights and valuation of in-kind contributions such as services provided by local staff. The cost of environmental permits will solely be the responsibility of the local sponsors. Expenses for acquisition of permits may not be credited towards the sponsor's 35% of total project cost. NRCS pays 100% of the technical assistance costs for planning, design and/or installation provided by the agency.

Q. Will the trees downstream of the dam be removed?

A. Yes, but maybe not all of them. We don't know how many will need to be removed during the rehabilitation of the spillway. At this point, we also don't know how many could possibly be replaced after construction. From discussions with Fairfax County officials, NRCS is aware of the importance of the trees to the residents around the lake and will make an effort to salvage and/or replace as many as possible. However, please be aware that the long-term integrity of the dam and the safety of downstream residents are the primary reason for this rehabilitation effort. Aesthetics are secondary but not unimportant.

Q. If we draw down the lake before a storm, will that eliminate the need to rehabilitate the dam?

A. No. Drawing down the lake by opening the reservoir gate at the bottom of the riser is a tricky proposition. It is very difficult to get the correct timing. A rapid drawdown of the lake water could cause mudslides across the face of the dam. A correctly done drawdown of the lake is unlikely to occur quickly enough to provide more flood water storage. In addition, if a piece of debris gets caught in the gate, it may not be possible to reclose the gate and all of the water will drain out.

The storage volume of the permanent pool (sediment pool) for Huntsman Lake was designed to be 173 acre-feet, which includes both the water and the stored sediment. The flood pool storage volume was designed to be 531 acre-feet. If the lake were completely empty, the flood event storage would be increased by about 32%. However, it is unlikely that the lake would be completely empty when such storage was needed. It is more likely that the lake would be drained for nothing and everyone would be upset about the resulting mudhole.

Q. Will you have to dredge the lake?

A. We don't know yet. For the purpose of the rehabilitation program, NRCS must ensure that there is a future life of 50 – 100 years. (The amount of sediment in the pool area is just one of the components used to determine the usable life of the dam.) The County will conduct a survey of the

lake to ascertain the quantity of sediment currently in the lake. From that information, it will be possible to estimate the remaining life of the dam. As stated in the question about the purpose of a flood control dam, sediment accumulation is a normal and expected function of a dam.

There are several issues about dredging. As part of the rehabilitation process, the lake sediment may have to be removed to ensure adequate capacity for the rehabilitated life of the dam. NRCS would then design dredging as part of the rehabilitation. If the sediment storage capacity is adequate for NRCS's purposes, then NRCS will not include dredging in the rehabilitation design or funding.

Part of the appeal of having a lake in the neighborhood is the attraction of open water. In order to maintain this appearance, it will be necessary to periodically remove the accumulated sediment from the lake or to trap the sediment in some type of catch basin before it enters the lake. This would be a decision made by Fairfax County and funded accordingly.

The dredging process is often the subject of much concern. If it is necessary to remove sediment from the lake as part of the rehabilitation process, NRCS will take every care to minimize the environmental and aesthetic impacts of the work.

Q. Where is the sediment coming from?

A. In a developed watershed like Pohick Creek, the most likely source is the banks of the streams draining into the lake. The Northern Virginia SWCD has conducted stream surveys in other parts of the county and found eroding streams in areas similar to the Pohick watershed. It is likely that a stream survey done in the Pohick watershed would show similar results.



Soil eroded from streambanks and bare areas are deposited in the lake as sediment.

Stream bank erosion occurs when flows increase in the channel. As the amount of impervious surface increases in a watershed, the amount of water that is absorbed into the ground decreases and the amount that must be carried across the surface increases. This also increases the frequency and velocity of flows. Stabilization of eroding stream banks would be one way to reduce the amount of sediment entering the lake. This would not be part of the rehabilitation process.

Another potential source of sediment is development/redevelopment in the watershed. Fairfax County already has erosion and sediment control regulations in place to address this issue. Additional treatment of bare areas in the watershed would reduce sediment loading.

Q. Rehabilitation seems to be a foregone conclusion. Are there any other choices?

A. If the dam is not rehabilitated to meet the current safety standards, the only other choice would be to remove it in its entirety. This would reduce the threat to loss of life from a dam breach but would increase the flooding caused by fairly common rainfall events. Flooding would occur frequently and would occur at deeper depths than it did before most of the watershed was paved. Property values around the lake would decline and there would be a loss of recreational area.

Final Comments: At the end of the dam rehabilitation planning and implementation process:

- 1) The environmental, social and economic benefits of the end result should serve the public interests for the next 50 to 100 years.
- 2) The local sponsors, and public in general, should feel that the process worked effectively and responsibly to meet their needs; and
- 3) The entire process should have been conducted in a professional and open manner, supportive of our mutual values for fair and democratic public procedures.

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