EXECUTIVE SUMMARY

Goshen Dam is an intermediate sized earthen dam located in Rockbridge County, Virginia, approximately 3 miles southeast of the town of Goshen, Virginia. The dam was constructed in 1966 by the Boy Scouts of America (BSA) to create Lake Merriweather, a 425-acre impoundment that is part of the Goshen Scout Camps owned by the BSA. The lake empties into the Little Calfpasture River, just north of its confluence with the Calfpasture River and then becomes the Maury River just north of Goshen Pass. Goshen Dam is classified as a "High" hazard dam, in accordance with the Federal Dam Safety Guidelines, because failure of the dam potentially threatens the downstream communities of Wilson Springs and Rockbridge Baths.

The potential for failure of Goshen Dam is primarily associated with inadequate existing spillway capacity to pass the Base Safety Condition (BSC), defined by Engineer Regulation (ER) 1110-2-1155, "Dam Safety Assurance Program," dated 12 September 1997 as "when a dam failure related to hydrologic capacity will result in no increase in downstream hazard over the hazard that would have existed if the dam had not failed." The BSA is restricted in its operation of the low level outlet and spillway crest gates of the dam, due to water quality concerns of the Virginia Department of Environmental Quality (VDEQ). Historically, during the winter months, the BSA has kept the spillway crest gates in their lowered position, elevation 1359.5 mean sea level (MSL) (spill crest elevation), which maximized existing spillway capacity (all elevations in this report refer to MSL, except where otherwise indicated). However, the VDEQ concluded that this seasonal practice is detrimental to water quality downstream of Goshen Dam due to the sediment-laden discharges that occur during the winter months. Because of this reason, the BSA currently operates and maintains the dam according the "Operation Procedures for Gated Spillway at Goshen Dam," dated 9 April 1998 and developed by a private engineering consultant hired by the BSA. These procedures maintain a year-round pool elevation of 1369.5 MSL. Operation of the dam according to these procedures reduces the negative water quality effects that would occur during operation over the winter months but reduces the existing spillway capacity.

Failure of Goshen Dam would result in an estimated $25.4 million in flood damages for the BSC, which has been determined to be one-half of the Probable Maximum Flood (PMF). The PMF is the most severe flood that is considered reasonably possible at a site as a result of hydrologic and meteorologic conditions without overtopping the existing earthen dam. The probable threatened Population at Risk from dam failure at the one-half PMF is estimated at about 265, and there is potential for loss of life of up to 28 people. In addition, without repair and upgrade of the dam, the recreational use of the lake by the BSA, estimated at 24,000 average annual visitor days per activity, could be decreased to approximately 2,400 average annual visitor days per activity, according to a recreation benefit analysis conducted by the Assistant Secretary for the Army (Civil Works).

Six alternative plans, in addition to the no action plan, were formulated and evaluated in accordance with the guidelines of the Dam Safety Assurance Program (ER-1110-2-1155, dated 12 September 1997). Initial evaluation narrowed the alternatives down to three alternatives, as well as the no action plan, that were part of the final evaluation.

The recommended plan is Alternative I, roller compacted concrete armor of the dam embankment. Alternative I provides for safe passage of the one-half PMF, the determined base safety condition; minimizes disruption of vehicular access across the dam during construction; allows access across the dam for floods having exceedance frequencies less than 1.0 percent (floods occurring less than once every 100 years, on average); minimizes the magnitude of potential lake level drawdown required for construction; minimizes potential safety concerns associated with flooding during construction; eliminates the need to mechanically operate the spillway gates under emergency conditions; eliminates the need for future lake drawdowns for dam safety purposes, thereby reducing the potential release of sediment; and eliminates the need for increasing the size of the existing stilling basin.

The recommended alternative, with an estimated cost of $5,062,000, has the highest benefit-to-cost ratio of the evaluated alternatives, 0.33. While the cost of repairing and upgrading Goshen Dam is not economically feasible, the analysis shows the project is feasible under the Dam Safety Assurance Program based on the loss of life. As mentioned previously, if the dam is not repaired, it would potentially threaten the downstream PAR of up to 265 people, and there is potential for loss of life of up to 28 if the dam were to fail at the one-half PMF. It should be noted, there have been no significant changes to the environmental, hydrologic, cultural and economic conditions as described in this report.

GOSHEN DAM, LAKE MERRIWEATHER, VIRGINIA
DAM SAFETY EVALUATION REPORT
DECISION DOCUMENT

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INTRODUCTION

This study was undertaken for the purpose of determining the Federal interest in and the need for repair and upgrade of Goshen Dam, Rockbridge County, Virginia. The investigation and justification for modification for dam safety assurance are made in accordance with Engineer Regulation (ER) 1110-2-1155, "Dam Safety Assurance Program," dated 12 September 1997.

PROJECT AUTHORIZATION

The study was authorized by Section 507 of the Water Resources Development Act (WRDA) of 1996 (Public Law [P.L.] 104-303), as amended. This authority tasked the Federal Government (U.S. Army Corps of Engineers [USACE]) with design and construction assistance to the non-Federal interest (Boy Scouts of America [BSA]). The following information is excerpted from P.L. 104-303:

> "SEC. 507. DESIGN AND CONSTRUCTION ASSISTANCE.
> The Secretary shall provide design and construction assistance to the non-Federal interests for each of the following projects if the Secretary determines that the project is feasible:...(3) Repair and upgrade of the dam and appurtenant features at Lake Merriweather, Little Calfpasture River, Virginia, at an estimated cost of $6,000,000."

The existing dam and appurtenant features at Lake Merriweather were constructed by the BSA and were neither originally authorized nor constructed by the USACE.

PROJECT DESCRIPTION

Goshen Dam is an intermediate sized dam, constructed in 1966 by the BSA, to create Lake Merriweather, a 425-acre impoundment that is part of the Goshen Scout Camps owned by the BSA. Goshen Dam and Lake Merriweather are located approximately 3 miles southeast of the town of Goshen, Virginia (see Plate 1). Its

location in Rockbridge County is about 30 miles southwest of the city of Staunton in west-central Virginia. The lake empties into the Little Calfpasture River, just north of its confluence with the Calfpasture River and then becomes the Maury River, just north of Goshen Pass. Goshen Pass is a narrow pass that constricts the Maury River, providing significant backwater effects for large flood events.

Goshen Dam was originally identified as a "High" hazard dam, in accordance with Federal dam safety guidelines, in a Phase I dam inspection conducted in 1979 by a consultant for USACE. The Phase I program was administered by USACE prior to turning the dam safety program over to the state. Since 1990, the BSA has contracted a private engineering firm to perform dam inspections every two years, as required by Virginia dam safety regulations. The last inspection received by Virginia, in 2004, still identifies the dam as "High" hazard. Failure of the dam potentially threatens the communities of Wilson Springs, approximately 4 miles south of the dam, and Rockbridge Baths, about 6 miles south of the dam. Data specific to the population of Wilson Springs and Rockbridge Baths are not reported in the U.S. Census due to the small size of these communities.

Goshen Dam is a zoned earth-fill structure approximately 1,300 feet long and 38 feet high (see Plates 2 and 3). A gravel surfaced road traverses the crest of the dam, which is approximately 24 feet wide and at elevation 1380. The upstream and downstream slopes of the dam are 3 horizontal to 1 vertical (3H:1V), and 2.5H:1V, respectively. A reinforced concrete spillway, approximately 158 feet wide, cuts through the dam near its western end.

Spillway control is carried out through 10 motorized steel slide gates (14 feet wide by 9.5 feet high) located at the crest of the spillway structure. The spillway gates are operated from a control building at the dam crest along the western edge of the spillway. The elevations of the top of the sluice gates in their highest (closed) position and lowest (open) position are 1369 (normal pool elevation) and 1359.5 (spillway crest elevation), respectively. The lake can be drained via a 3-foot by 4-foot sluice gate,

located in the bottom of the control building. The sluice gate connects to a 3-foot by 4-foot channel, discharging through the west abutment below the spillway. Concrete retaining walls, located on either side of the spillway, extend down the downstream dam slope and terminate beyond the toe of the dam. Outflow from the spillway empties into a stone riprap lined channel.

The BSA is restricted in its operation of the low level outlet and spillway crest gates of the dam, due to water quality concerns of the Virginia Department of Environmental Quality (VDEQ). These restrictions on the operations of the dam, due to the possibility of discharging sediment, increase the risk for dam failure since the water level of the lake cannot be adjusted as needed. Historically, during the winter months, the BSA kept the spillway crest gates in their opened position, elevation 1359.5 (spill crest elevation). The primary reason for this practice was to ensure maximum spillway capacity, should the gates become damaged or otherwise inoperable due to ice or winter debris. There have been reported instances where debris lodged against spillway crest gates while in their closed positions, resulting in their becoming inoperable. Ancillary reasons for keeping the gates in their opened position included controlling aquatic vegetation, facilitating maintenance of docks and other lakeside structures, and facilitating minor repairs of the spillway crest gates. However, the VDEQ concluded that this seasonal practice is detrimental to water quality downstream of Goshen Dam due to the sediment-laden discharges that occur during the winter months. Because of this, the BSA currently operates and maintains the dam according to the "Operation Procedures for Gated Spillway at Goshen Dam," dated 9 April 1998 and developed by a private engineering consultant hired by the BSA. Operation of the dam according to these procedures reduces the negative water quality effects that would occur during operation over the winter months.

Lake Merriweather was created for recreational use by the BSA and is currently used for this purpose. The lake is located at Camp Goshen, the National Capital Area Council's long-term resident summer camp for the BSA. There are six separate camps on the shores of the lake. Recreational activities available at the camp include camping,

swimming, hiking, and boating. While the lake is not open to the public, there is considerable recreational use of Lake Merriweather by the BSA. However, since the lake is private, USACE policy does not allow for this recreational use to be included in the calculation of benefits for this project (See ER 1105-2-100, Planning Guidance Notebook, Paragraph 2-2, The Federal Objective).

CURRENT CONDITION

The potential for failure of Goshen Dam is primarily associated with inadequate existing spillway capacity to pass the Spillway Design Flood (SDF), without overtopping the existing earthen dam. The SDF is the flood the spillway of a given project is designed to pass safely without overtopping the structure. This potential overtopping could result in the dam's being eroded and breached during major flood events potentially threatening the communities of Wilson Springs, approximately 4 miles south of the dam, and Rockbridge Baths, about 6 miles south of the dam.

The existing spillway gates are operated in accordance with the "Operation Procedures for Gated Spillway at Goshen Dam," dated 9 April 1998 and developed by a private engineering consultant hired by the BSA. These procedures do allow for some operation of the gates during flood conditions. However, this capacity falls far short of passing the SDF and, according to the BSA, should not be counted on for the SDF. The existing dam face is earthen and susceptible to erosion and breaching during overtopping events. Any plans to address the dam safety deficiency for Goshen Dam must either increase the spillway capacity to eliminate overtopping, armor the dam to prevent erosion during overtopping, or remove the dam completely.

HISTORY OF MAINTENANCE AND REHABILITATION OR MODIFICATION

Construction of Goshen Dam was completed in 1966. Since then, there have been no modifications or rehabilitations on the dam. Detailed information regarding the amount spent on maintenance on the dam is not available since the dam is neither owned

nor operated by USACE. It is known that approximately $29,000 is spent on annual maintenance and includes, but is not limited to, grass cutting, gate testing, and debris cleanup in the lake and around the dam.

PROJECT USE

As discussed previously in this report, Lake Merriweather was created for recreational use by the BSA and is currently used for this purpose. Since construction of the dam was not authorized through USACE, there are no authorized project purposes to be impacted by modification of the dam. There are no expected annual flood damages that would be incurred without the dam in place. However, since the dam is in place, it is at risk of failure for 200-Year or greater storm events, potentially threatening downstream residents.

The annual number of Boy Scouts visiting Camp Goshen, Lake Merriweather, is estimated to be approximately 10,820. Of these visitors, about 8,000 are week-long camping visitors, 200 are consistent weekend and holiday campers (about 56 days a year), about 1,500 visit approximately one weekend per year, and about 1,000 visit the camp once a year. This adds up to approximately 72,400 visitor days per year, with 2 to 3 activities per visit, or approximately 24,000 average annual visits (per activity), according to an analysis conducted by the Assistant Secretary of the Army for Civil Works (ASA[CW]) (see Economics Analysis Appendix, Attachment 1). As stated previously, USACE policy does not allow for these recreation benefits to be included in the calculation of the benefit-to-cost ratio (BCR) for this project. However, it should be noted that without repair and upgrade of this dam, a large portion of the recreational benefits of the lake could potentially be lost.

CONSEQUENCES OF NO DAM SAFETY MODIFICATIONS

The dam safety problem at Goshen Dam, as discussed previously in this report, is associated with the inability of the earthen dam to safely pass the Base Safety Condition

(BSC). Accordingly, this problem requires attention under the Dam Safety Assurance Program, which provides for modification of completed USACE dams and related facilities when deemed necessary for safety purposes due to new hydrologic data or changes in design or construction criteria.

HYDROLOGIC ANALYSIS

Spillway Design Flood

The Norfolk District completed a comprehensive hydrologic and hydraulic modeling effort that evaluated the Probable Maximum Flood (PMF) and other storm event conditions applicable to Goshen Dam. Four relatively recent historic flood events (November 1985, April 1992, June 1995, and September 1996) were used to calibrate the model. Varying one-half PMF scenarios (centering, orientation, and size) were developed to assure the most extreme inflows and tail-water conditions.

The SDF for Goshen Dam, in accordance with the National Dam Safety Inventory classification of "High" hazard, is the PMF. However, the resulting backwater effects created by the constriction of the Maury River as it enters Goshen Pass provide a backwater cushion against the effects of dam failure of Goshen Dam during one-half PMF events. For the one-half PMF events analyzed, the backwater will equal the level of the dam, elevation 1380, at values ranging from 50 to 57 percent of PMF runoff. This significant backwater effect negates any increase in flow from a possible failure of Goshen Dam. At 50 percent of the PMF runoff, the difference in elevation between the backwater from Goshen Pass and the crest of Goshen Dam ranges from 3.4 to 0.0 feet. This small difference demonstrates that failure of Goshen Dam for flood events larger than 50 percent of the PMF would not significantly increase the downstream hazard existing just prior to dam failure. Therefore, it is recommended that 50 percent runoff from PMF event 1 (one-half for Little Calfpasture River Basin, Q_{out} = 85,600 cubic feet per second [cfs]) be adopted as the SDF for any design improvements for Goshen Dam. This PMF event produces the greatest inflow and the largest difference in lake and tailwater elevations.

The results of the hydrologic and hydraulic modeling effort indicate the existing spillway system is incapable of passing the BSC, the one-half PMF, without serious overtopping of the dam. As a result of the comprehensive modeling effort, using the HEC-1 hydrologic model developed for the Technical Alternatives Report, the Norfolk District concludes that the appropriate one-half PMF inflow to Lake Merriweather is 93,200 cfs, with a resulting outflow of 90,700 cfs. The calculated one-half PMF values are approximately 30 percent greater than the highest values calculated during previous studies. The difference is attributed to the more comprehensive modeling effort conducted during this study, and inclusion of recent historic flood conditions in the model calibration. The analyses and hydrologic modeling supporting this conclusion are contained in Appendix A of the Technical Alternatives Report (see Appendix 1 of this report).

Dam Failure Analyses

The potential for failure of Goshen Dam is primarily associated with the inadequate existing spillway capacity to pass the BSC, the one-half PMF, without overtopping the existing earthen dam. The existing spillway, with the gates at 1369, can pass less than one-third of the SDF without overtopping. This potential overtopping could result in the dam's being eroded and breached during major flood events, potentially threatening the communities of Wilson Springs, approximately 4 miles south of the dam, and Rockbridge Baths, about 6 miles south of the dam.

In order to fully assess the potential dam failure impacts, a level of 1378.5 feet was selected as a point when overtopping and subsequent breaching of the dam would begin. This elevation was selected to account for wave action and the potential for debris further reducing the existing spillway capacity. The failure was accomplished in a single hydrologic modeling time-step (30 minutes) again to fully assess the potential dam failure impacts. The ultimate breach size was an approximation of the existing earthen embankment excluding the concrete spillway.

The HEC-1 hydrologic model developed for the Technical Alternatives Report was used with the Dam Breach input. One additional uniform rainfall frequency event was developed for this analysis (0.5 percent, 200-Year, 20 percent PMF) since that is approximately equal to the event that is required to reach the selected elevation of 1378.5 feet. The following table lists the results of the breach analysis for the existing condition at various flood events and compares it to the results for a non-breaching condition. The location of these values is the Rockbridge Baths U.S. Geological Survey streamgaging station just upstream of Route 39 where it crosses the Maury River in Rockbridge Baths. Based on the hydrologic modeling, the flood wave associated with the Dam Breach conditions would arrive in Rockbridge Baths in less than 90 minutes.

The results of this analysis were used to determine the threshold flood. The threshold flood, as defined by ER 1110-2-1155, Dam Safety Assurance Program, dated 12 September 1997, is the flood that fully utilizes the existing dam or the flood that just exceeds the design maximum water surface elevation at the dam. The threshold flood for Goshen Dam was determined to be the 200-Year event, or approximately 20 percent of the PMF.

Table 1. COMPARISON OF DAM BREACH AND NON-DAM BREACH AT ROCKBRIDGE BATHS

Rockbridge Baths, Virginia Peak flow and stage			
Precipitation scenarios	No dam break (cfs/feet)	Dam break at 1378.5 (cfs/feet)	Difference (cfs/feet)
½ PMF run #1 (50%)	145,600	148,100	2,500
no tailwater	1125.1	1125.3	0.2
500-Year	75,200	135,100	59,900
no tailwater	1118.0	1124.0	6.0
200-Year	63,800	131,600	67,800
no tailwater	1116.8	1123.5	6.7
100-Year	53,600	53,600	0
no tailwater	1115.5	1115.5	0.0

ECONOMIC ANALYSIS

The economic consequences of no dam safety modifications and dam failure were analyzed in terms of economic losses, Population at Risk (PAR), flood warning system, and potential loss of life. Details of the economic analysis can be found in the Economic Analysis Appendix to this report.

Economic Losses

There is minimal development in the area of the stream below Goshen Dam, consisting of a total of 165 structures and approximately 330 vehicles in the flood plain south of Lake Merriweather down to Rockbridge Baths on the Maury River. Without the project in place, it is assumed the dam will fail for a 200-Year event or greater. While every flood greater than a 200-Year event would not necessarily cause the dam to fail, due to the difficulty in estimating this probability of failure, a 100-percent failure is assumed for events greater than 200-Year without a project. Structural flood damages

were estimated based on the value of the structures and contents, as well as the flood frequency and associated average water depth over the first floor of a structure, using standard value-depth-damage relationship tables. Flood damages to vehicles were estimated based on the average value of vehicles and the same flood stage frequencies used to estimate structural damages. Without the project in place, the average annual flood damages to structures and vehicles are estimated at $134,000.

The main infrastructure located near the Maury River is Virginia State Highway 39, which runs through much of the affected stream area. There is one bridge on this highway that crosses the Maury River just north of Rockbridge Baths. Parts of Highway 39 may be inundated during a severe storm event. However, the flooding due to one-half PMF event with a dam failure is not expected to be significantly different from that of a similar event without a dam failure. In terms of the effect of a dam failure on retention structures, there are no other flood damage reduction structures in proximity on the Maury River that would be affected by failure of Goshen Dam.

Population at Risk

The Institute for Water Resources Report #86-R-7, Guidelines for Evaluating Modification of Existing Dams Related to Hydrologic Deficiencies, dated September 1986, defines the PAR as those persons that would be exposed to flood waters if they took no measures to evacuate. The probable threatened PAR is the maximum number of people that could be affected if dam failure occurred at a given pool elevation and includes both permanent and transient populations. The PAR will vary depending on the time of day at which dam failure occurs, the general flooding conditions before failure occurs, and the pool level at the time of dam failure. For this analysis, the probable threatened PAR was estimated for each of the four conditions analyzed for determination of the BSC, 20 percent PMF Without Failure, 20 percent PMF With Failure, one-half PMF Without Failure, and one-half PMF With Failure.

The permanent PAR, the total number of inhabitants in the threatened area year-round, was estimated using the number of structures in the affected stream area perpendicular to the Maury River surrounding the gauging station and the average number of persons per unit in the area. The occupancy rate for a single family dwelling in Rockbridge County is 2.4 persons per structure (U.S. Census, 2000).

The temporary flood plain occupants may include those who work or travel through the area but do not reside in the area on a permanent basis. Since there are no major employers in the area, the population is not expected to increase due to workers temporarily entering the area. However, it would be expected that the permanent population would decrease during the day due to work outside the affected stream area. The change in PAR due to this temporary decrease in population was based on 49 percent of the population's working away from home (U.S. Census, 2000) an average of 9.5 hours per day (8.5-hour work day and average commute time of 30 minutes each way [U.S. Census, 2000], 5 days per week).

Flood Warning System and Evacuation Plans

A National Weather Service flood-warning system, Integrated Flood Observing and Warning System (IFLOWS), is currently in place for the western portions of the Commonwealth of Virginia. The main purpose of IFLOWS is to provide rainfall and stream stage information to help local and state emergency management personnel contend with the threat of flash floods. Due to various factors, including the position of satellites, an IFLOWS stream gauge is not able to be located at Goshen Dam. There are, however, currently two gauging stations in proximity to the dam, one northwest of Lake Merriweather at Goshen and another just north of Rockbridge Baths. Neither station would provide ample warning to the residents of Wilson Springs or Rockbridge Baths due to the locations of the stations.

The main evacuation route that runs through both Wilson Springs and Rockbridge Baths is Virginia Route 39. This route runs southeast parallel to the Maury River and provides access to Interstate 64. As discussed previously, parts of this highway may be

inundated during severe storm events. However, various secondary roads in the area allow for a quick increase in elevation. It is most likely that this would be the means of evacuation for the majority of people in the area. It is assumed that 75 percent of the probable threatened PAR would evacuate to higher ground in a storm event producing approximately 1 foot or less of water above the average first floor elevation of the structures in the affected stream area, based on the rate at which flood waters would rise for these types of events. The probable threatened PAR, including both the permanent and transient population, less those that would be able to evacuate, for the four scenarios analyzed is shown in the following table.

Table 2. PROBABLE THREATENED POPULATION AT RISK NOT EVACUATED

Scenario	Without failure	With failure	Incremental PAR
20% PMF (200-Year)	36	231	195
½ PMF	265	265	0

Warning Time

It was estimated for the purpose of this analysis that there would be no time between the time it was determined that dam failure was imminent and the time of actual failure, due to the lack of personnel monitoring Goshen Dam. The time from when the warnings were received to when the flood waters arrived would, therefore, be approximately equal to the time from dam failure to when flood waters arrived. Due to the location of the dam, staffing, and safety considerations, there may be no warning of dam failure. In order to compute the loss of life potential, some warning time must be assumed. The time that would elapse from the start of breach formation to the time the

populated areas of Wilson Springs and Rockbridge Baths would be flooded was estimated through the dam-breach analysis to be approximately one hour on average. For this analysis, the warning times of a dam failure starting with a pool level of elevation 1378.5 feet National Geodetic Vertical Datum were used. The actual warning times would depend on when personnel decided the dam was likely to fail, when failure began, breach time, how long it took to notify emergency personnel, and how long it took to disseminate the warning to the occupants of the flood area.

Loss of Life

The potential loss of life under the four scenarios examined in this study is analyzed by combining the PAR for each scenario with the likely warning time and other factors. It should be noted that it is extremely difficult to predict the potential for loss of life under any scenario. USACE analyses typically do not attempt to quantify loss of life due to the difficulties and uncertainties inherent in such an analysis. In reality, any loss of life would depend on a complex combination of many factors, including the flooding conditions, the time of day, the amount of warning time, and the effectiveness of evacuation measures.

The potential loss of life with and without dam failure was estimated using formulas contained in a research paper written by Wayne Graham of the U.S. Bureau of Reclamation, A Procedure for Estimating Loss of Life Caused by Dam Failure, September 1999, that combine the PAR with the expected warning time to estimate the potential loss of life. More detailed information on these formulas can be found in the Economic Analysis Appendix.

The PAR for each scenario was put into the Bureau of Reclamation loss of life equation based on the warning time of 1 hour determined in the dam-breach analysis (Loss of Life = $[PAR]^{.6}$). The results for each of the scenarios can be seen in the following table. It should be noted that any loss of life estimate is very uncertain. There is no way to predict the actual impact to human life that would occur under severe flooding events, with or without dam failure. In addition, every human life has an

immeasurable value, and this analysis is not meant to imply any specific value. These numbers are presented only to provide support to the justification of improving the dam and preventing any such losses.

Table 3. SUMMARY OF LOSS OF LIFE

Scenario	Without failure	With failure	Incremental loss of life
20% PMF (200-Year)	9	26	17
½ PMF	28	28	0

Base Safety Condition

ER 1110-2-1155 states that dam safety modifications related to hydrologic deficiencies should be recommended to meet or exceed the BSC. Section 7.a defines the BSC as "when a dam failure related to hydrologic capacity will result in no increase in downstream hazard over the hazard that would have existed if the dam had not failed." Section 7.b.3.a states, "The BSC is determined by comparing the loss of life for various floods, expressed as percentages of the PMF, with and without dam failure." In order to determine the BSC, the downstream hazard, including economic damages and potential loss of life, is compared between the without and with failure conditions for the Threshold Flood and for the one-half PMF. The Threshold Flood is the flood that the dam can currently safely pass, which in this case was determined to be approximately the 20 percent PMF (200-Year) event. The incremental damages and loss of life between the with and without dam failure for the Threshold Flood (20 percent PMF) and the one-half PMF can be seen in the following table.

Table 4. INCREMENTAL ECONOMIC DAMAGES AND LOSS OF LIFE

Scenario	Incremental economic damages	Incremental loss of life
20% PMF (200-Year)	19,700,000	17
½ PMF	1,000,000	0

In comparing the incremental economic damages for the 20 percent PMF and one-half PMF events, it can be seen that the incremental damages for the one-half PMF approach zero. In comparing the incremental loss of life for the 20 percent PMF and one-half PMF events, the incremental difference in the estimated loss of life decreases as the storm event gets larger. The incremental difference in the estimated loss of life for the one-half PMF is zero. Since the analysis shows both incremental economic damages and incremental loss of life decreasing and approaching zero in moving from the 20 percent PMF to the one-half PMF events, it was determined that the BSC is likely to be the one-half PMF.

ENVIRONMENTAL RESOURCES

Goshen Dam is located on the Little Calfpasture River, which drains approximately 82 square miles of the slopes of Little North Mountain, Great North Mountain, and the Estaline Valley near the Rockbridge and Augusta County lines. The stream drains elevations from over 4,400 feet above sea level. Lake Merriweather itself has a maximum depth of 38 feet and an average depth of about 10 feet. About 4,000 feet downstream of Goshen Dam the Little Calfpasture flows into the Calfpasture River, forming the Maury River.

Lake Merriweather is located in the ridge and valley region of the state just north of the Goshen Pass. The ridges running to the north and south of the pass are part of the

Clinton Formation and are composed of siltstone, sandstone, and quartzite. These materials are more resistant to erosion than the limestone and shale that underlie the valleys and other nearby ridges. Elevations within the vicinity of the dam vary from just over 3,000 feet to just under 1,100 feet along the Maury River. Elevations in the area of the BSA camp tend to be in the 1,400-foot range. The steepest section of the study area is Goshen Pass. Areas with a much gentler slope can be found along the flood plain of the Maury River in the vicinity and northwest of Rockbridge Baths. Both the Little Calfpasture and the Maury have numerous riffles typical of mountainous streams.

Adjacent to the BSA property on the southeast is the Little North Mountain Wildlife Management Area, which abuts the Goshen Pass Natural Area Preserve. The Preserve, which consists of 937 acres, abuts the Maury River. On the southwestern side of the river is the Goshen Wildlife Management Area. These two wildlife management areas, which are state-owned, cover 33,697 acres.

Much of the area surrounding Lake Merriweather, as well as the two Wildlife Management Areas, are dominated by the chestnut oak forest, pine-oak-heath woodland, and rocky, riverside scrub communities. The chestnut oak is the predominant oak species in the oak forests, although there are also areas of mixed oak forests that include white oak, black oak, scarlet oak, and hickories. The pine forests contain the Table Mountain pine, pitch pine, and a variety of heaths, such as mountain laurel, huckleberry, and blueberry.

Vegetation along the banks of the Little Calfpasture River consists primarily of hardwoods with grasses and vines in the more open areas. The downstream face of the dam is currently vegetated with grasses while the upstream side is rip-rapped. Much of the scout camp area, which is adjacent to the lake, is forested.

Common wildlife in the area consists of deer, raccoons, opossums, foxes, rabbits, squirrels, and other small rodents. Numerous salamanders, turtles, and snakes can be found. Birds include herons, ducks, hawks, grouse, turkey, warblers, sparrows, and owls.

Fish that have been found in the area streams include trout, smallmouth bass, rock bass, river chub, redbreast sunfish, and mottled sculpin. The Maury River at Goshen Pass is included in the state's "put-n-take" trout program and provides opportunities for recreational trout fishing.

CULTURAL RESOURCES

A review of the site files at the Virginia Department of Historic Resources revealed numerous potential sites within the area from Goshen Dam to Rockbridge Baths, and all but two were architectural sites. The closest site to the dam was approximately 1,200 feet away and was first discovered in 1877 and reported in 1898. This site consisted of a Woodland-era burial mound reported to contain pottery, copper, and gorgets as well as the burials. Although the mound remnants were no longer visible when the area was visited in 1985, further investigation of the area was recommended. The next closest site, which is near the confluence of the Little Calfpasture and the Calfpasture Rivers, is the location of the remnants of a 19th century forge.

From Goshen Pass through the Rockbridge Baths area along the Maury River there are 41 architectural sites recorded. Only one of these sites, the Route 39 bridge over Laurel Run, has been evaluated as eligible for listing on the National Register of Historic Places. No evaluations have been done for the remaining sites, which consist of 34 dwellings and 1 each of the following: store, church, cemetery, camp, barn, and artist's studio. These structures are located primarily in the communities of Wilson Springs and Rockbridge Baths along the flood plain of the Maury River.

EVALUATION PROCESS

NATURE OF DAM SAFETY PROBLEM

The nature of the dam safety problem, as described previously, is primarily inadequate existing spillway capacity to pass the BSC, which has been determined to be one-half of the PMF, without overtopping the existing earthen dam. Goshen Dam is at risk of failing for 200-Year and greater storm events.

POTENTIAL DAMAGES AND POTENTIAL LOSS OF LIFE ASSOCIATED WITH DAM FAILURE

As discussed previously, the potential economic losses for a failure of Goshen Dam for a one-half PMF event are estimated to be $25.4 million. The PAR associated with dam failure for this type of storm event is estimated to be approximately 265, while the potential loss of life is estimated to be up to 28 people. It is estimated that there are not significant flood damages prevented due to the dam's being in place. However, with the dam in place, there is a risk of failure for 200-Year and greater storm events, which account for average annual benefits of approximately $94,000 due to the upgrade and repair of the dam. There are also considerable recreation benefits, approximately 72,000 user days (24,000 average annual visits per activity), that are not included in calculation of the BCR since the dam/lake is located on private property with no public access.

SCREENING OF MEASURES

Measures were given a preliminary screening based on practicality, technical merits, costs, environmental impacts, potential risk factors, and local issues (real estate, access, and lake level). Any measures obviously not meeting the previously stated criteria were eliminated from further analyses. Preliminary measures that did meet the criteria were evaluated further and prioritized.

Nine measures were initially considered in the evaluation process. The preliminary measures studied involved three categories: retrofit of the existing spillway, construction of a new remote or auxiliary spillway, and modification of the dam. The following is a list of measures considered:

- Construction of a Vegetated Overland Emergency Spillway: The width of the spillway necessary to safely pass the one-half PMF, with spillway crest gates in their up position, is in excess of 1,000 feet, assuming a spillway elevation of approximately 1371.5 feet. The quantity of excavation and land required and the obvious negative environmental impacts, combined with anticipated

frequent use, make this an unacceptable measure. Therefore, it was eliminated from further consideration.

- Retrofit of Existing Spillway Structure: Use of this alternative would also require construction of an auxiliary overflow spillway to safely pass the one-half PMF. In order to allow the pool elevation to be maintained at 1,369 feet, the existing spillway gates would be retrofitted with an inflatable rubber dam controlled by the dam operator. The retrofit would require removal of all bridge piers except the middle pier, which would result in two clear openings, each with an approximate width of 70 feet (reduces the potential for debris blockage), and placement of an inflatable rubber dam. The increased clear span between piers (70.0 feet verses 8.0 feet) would require removal, redesign, and reconstruction of the existing bridge. The auxiliary concrete overflow spillway would need to be quite extensive in order for the combination to safely pass the one-half PMF. Estimated order of magnitude construction costs for the retrofit/auxiliary overflow spillway combination alternative would be in the range of $4.5 million to $5.5 million. The inflatable dam would require operation by a dam operator, which conflicts with the stated desire of the BSA to implement a system that does not require spillway gate operation during flood conditions. In addition, given the remote location of the dam, the rubber dam would be very susceptible to vandalism. Also, the bridge demolition and reconstruction required for the retrofit alternative would prevent access across the dam for an extended period of time. The reasons stated herein make this an unacceptable measure, and, therefore, it was eliminated from further consideration.

- Construct a Drop Inlet (Morning Glory Spillway): This alternative would involve construction of a drop inlet, or shaft spillway, in the lake connected to a conveyance system to convey the water to the downstream side of the dam. The conveyance system would consist of three components: an overflow control weir, a vertical transition, and a closed discharge channel (tunnel).

Construction of this alternative would involve completely draining Lake Merriweather for an extended period of time and requires extensive excavation upstream, through, and downstream of the dam, with associated negative environmental impacts. Also, the inlet of the spillway could prove a safety hazard to Boy Scouts or other visitors to the dam site. These factors and the prohibitive order of magnitude construction costs (>$6 million) make this an unacceptable measure, and, therefore, it was eliminated from further consideration.

- Auxiliary Concrete Side Channel Overflow Spillway: In order for the spillway system to safely pass the calculated one-half PMF with spillway crest gates in their up position (1,369 feet) with no overtopping of the dam, the auxiliary overflow spillway would have to be approximately 700 feet wide. Auxiliary spillways with smaller widths could also be utilized but with dam overtopping rates occurring at a statistically higher probability level. Overtopping of the dam would require measures to protect the dam embankment from damage during overtopping. Estimated order of magnitude construction costs for the auxiliary concrete side channel overflow spillway would range from $5 million to $7 million, depending on the type of construction used. This measure was included in the list of alternatives requiring further evaluation.

- Raising the Elevation of the Dam Embankment: This alternative would involve raising the elevation of the dam embankment to the level necessary to prevent overtopping during the one-half PMF. The elevation of the dam would have to be raised in excess of 10 feet to safely store the one-half PMF. Raising the elevation of the dam embankment would require extensive modification to the dam and spillway system and be cost prohibitive. In addition, such a large project would likely have adverse environmental impacts. Also, the raised dam would cause severe flooding around the perimeter of Lake Merriweather, especially at its upstream end, and extend the

flood zone beyond the BSA property lines. The reasons stated herein make this an unacceptable measure, and, therefore, it was eliminated from further consideration.

- Armor of the Dam Embankment: This alternative would involve armoring the dam embankment with erosion resistant materials to enable the dam to weather floods resulting in overtopping of the dam. Numerous erosion protection materials, including stone riprap, articulated concrete block (ACB), and roller compacted concrete (RCC) were analyzed. With the exception of RCC and ACB, the erosion protection materials were eliminated on technical merit as the primary erosion protection material. Given the hydraulic turbulence associated with overtopping events and the potential for large debris to be carried over the dam, there was concern that erosion protection materials, other than RCC or ACB, would be susceptible to dislodgment, undermining, or other serious damage during overtopping events. Preliminary cost estimates indicate the costs for ACB systems would be less than that for RCC. However, the hydraulic conditions associated with overtopping of Goshen Dam would be at the upper end of the conditions where ACB can be safely used. The performance characteristics of RCC would far exceed that of ACB, and the extra costs for RCC would be considered worth the increase in safety. Therefore, RCC is recommended as the armor material of choice. RCC is a no-slump concrete, hauled and spread by earthmoving equipment and compacted with vibratory rollers. It has properties equal to that of conventional non-reinforced concrete but is more economical. Through 2002, armoring of dams using RCC has been used to rehabilitate more than 70 dams in 25 states, including 3 dams in Virginia. Armoring the dam with RCC can provide the necessary protection against overtopping, facilitate debris removal from the dam face, and eliminate other maintenance concerns, such as burrowing animal control and brush/tree control on the dam face. Estimated order of magnitude construction costs for RCC armor of the dam embankment

range from $4.5 million to $5 million. The RCC armor measure was included in the list of alternatives requiring further evaluation.

ALTERNATIVE PLANS TO BE CONSIDERED

As a result of the screening process used to evaluate the measures, a list of alternatives involving either construction of auxiliary spillways or modifications to the dam embankment was developed to remediate the dam safety problem. Preliminary designs were created within the conceptual framework of each final alternative and combinations of the alternatives. Comprehensive hydrologic modeling of each alternative was undertaken to determine the effects of each on the dam/spillway system's ability to safely pass the one-half PMF. The following are the alternatives evaluated in this study.

Alternative I - RCC Armor of the Dam Embankment: This alternative would allow for the pool elevation to be maintained at 1369 feet and would armor the downstream face, crest, and portion of the upstream face of dam with RCC placed on the downstream slope, crest, and a portion of the upstream slope. A 1-foot thick sand/crushed stone filter drainage layer would underlie all RCC placed in horizontal, 12-inch layers starting at the downstream 20-foot-wide erosion apron and extend up the embankment in 1-foot-high by 2.5-foot-wide steps on the 2.5H to 1.0V slope. The stepped RCC face would facilitate access for inspection purposes and help dissipate the energy of the water during overtopping. A flexible scour apron of riprap stone would be constructed contiguously with the downstream RCC edges to help prevent undermining of the relatively rigid RCC. The RCC protection would extend over the crest of the dam (1380 feet) and down the 3.0H:1.0V upstream slope. In order to protect the abutment areas, the RCC armor would extend to the elevation 1382 contour. Asphalt pavement would cover the RCC on the crest of the dam to the 1382 contour. At completion, the existing upstream riprap would tie into the RCC armor.

Alternative II – 740-foot Auxiliary Spillway (Concrete Box Culverts) with RCC Armor of the Dam Embankment: This alternative would allow for the pool elevation to

be maintained at 1369 feet, provides an auxiliary spillway, and armors the remaining downstream face, crest, and portion of the upstream face of dam with RCC. The auxiliary spillway would be built into the dam embankment, to the east of the existing spillway. The auxiliary spillway would consist of 74 concrete box culverts, 9.5 feet high and 10 feet wide with an invert elevation of 1370 feet. The box culverts would be founded on a monolithic, reinforced concrete mat foundation. The crest of the dam would be raised to elevation 1380.5 feet to accommodate the box culverts. The RCC immediately downstream of the spillway boxes would be covered with a conventional concrete topping/facing to protect the RCC from the frequent and relatively high velocity flows. The remaining RCC would not have any topping/facing over the RCC.

Alternative III – 640-foot Auxiliary Spillway (Concrete Arches) with RCC Armor of the Dam Embankment: This alternative is similar to Alternative II; however, in lieu of conventional concrete box culverts, precast concrete arches would be used. This alternative would allow for the pool elevation to be maintained at 1369 feet, provide an auxiliary spillway, and armor the remaining downstream face, crest, and portion of the upstream face of dam with RCC. The auxiliary spillway would be built into the dam embankment to the east of the existing spillway and would have a crest elevation of 1369 feet. The auxiliary spillway would consist of 20 precast concrete bridge arches similar to ConSpan of Dayton, Ohio. The precast arches would have base openings of 32 feet with 11 foot rises. The larger base openings, associated with the arches, would provide additional clear span between supports, optimize spillway flow, and minimize the potential for debris blockage. The arches would be founded on a monolithic, reinforced concrete mat foundation and would be cast prior to placement, then transported to the site and placed, effectively cutting down on the length of time required to construct the bridge/spillway. The crest of the dam would be raised to 1382 feet to accommodate the precast units. The RCC downstream of the spillway boxes would be covered with a conventional concrete topping/facing to protect the RCC from the frequent and relatively high velocity flows. The remaining RCC would not have any topping/facing over the RCC.

Alternative IIIA – 160-foot Auxiliary Spillway (Concrete Arches) with RCC Armor of the Dam Embankment: This alternative is similar to Alternative III; however, in lieu of 20 precast concrete arches, 5 would be used. This alternative would allow for the pool elevation to be maintained at 1369 feet, provide an auxiliary spillway, and armor the remaining downstream face, crest, and portion of the upstream face of dam with RCC. The auxiliary spillway would be built into the dam embankment to the east of the existing spillway and would consist of five precast concrete bridge arches similar to ConSpan of Dayton, Ohio. The precast arches would have base openings of 32 feet with 11-foot rises, and invert elevations of 1369 feet. The arches could be cast prior to placement, then transported to the site and placed, effectively cutting down on the length of time required to construct the bridge. The crest of the dam would be raised to 1382 feet to accommodate the precast units. The RCC downstream of the spillway arches would be covered with a conventional concrete topping/facing to protect the RCC from the frequent and relatively high velocity flows. The remaining RCC would not have any topping/facing over the RCC.

Alternative IV – Remove Dam: The alternative of breaching the dam is not an acceptable solution to resolve the dam safety problem. There would be high costs for breaching the dam attributed to the need for reconstruction of the existing access across the stream and for removal of sediment before the dam would be able to be breached. The removal of this sediment would be of considerable environmental concern, since the sediment could potentially threaten the water quality of the stream below if it were not removed before the dam were to be breached. If the dam were breached and the lake were drained, the risks associated with failure and deficiencies of the dam would be eliminated. However, the purpose of the project, as specified by the study authority, is to repair and upgrade the existing dam and features at Lake Merriweather. If the dam were breached, the lake would no longer be of use, and the recreational benefits received by the BSA would no longer be available. For all of the above reasons, this alternative was eliminated from consideration.

Alternative V - Replace Dam: The alternative of replacing the dam would involve removal of the dam, as described in Alternative IV, and construction of a new dam. This alternative would provide the same result as Alternatives I, II, III, and IIIA, but would have considerably higher costs. Completely replacing the dam would have the same environmental concern requiring removal of sediment prior to the dam's being breached. However, this could be addressed by constructing a dam lower than the existing dam prior to removal of the existing dam. This alternative would also have greater environmental impacts than any of the previously mention alternatives due to the increased amount of construction required for a new dam as compared to repairing the existing dam. Due to the high costs and environmental impacts of replacing the dam, this alternative was eliminated from consideration.

Alternative VI – No Action: The alternative of no action is not considered an acceptable option because it does not meet the stated purpose of upgrading the dam/spillway system to allow safe passage of the one-half PMF. Therefore, it was eliminated from further consideration. However, it is carried forward as a basis of comparison for all other plans of improvement.

Alternative I would provide RCC protection to the crest and downstream face of the earthen dam so that it could safely pass the one-half PMF. Alternatives II and III would allow for the one-half PMF to be passed without overtopping the earthen dam. Alternatives II and III are similar, except that Alternative III would use concrete arches in lieu of conventional concrete box culverts for the auxiliary spillway structures. Concrete arches cost less and allow more area in a shorter space than concrete box culverts. Because of the advantages of the wider clear spans associated with concrete arches, only concrete arch units would be evaluated further. Alternative IIIA was developed as a mid-range alternative between Alternatives I and III. Alternative IIIA would increase the spillway capacity, thereby lessening the frequency and risk of overtopping but would RCC the crest and downstream face to allow the safe passage of the one-half PMF. Alternatives I, III, and IIIA were carried through to the final screening. The common design feature among all of the final alternatives is maintaining a pool elevation of

1369 feet. Each alternative meets the BSA and VDEQ desire of maintaining the lake level at 1369 feet, year-round.

EVALUATION OF ALTERNATIVE PLANS

Hydrologic Comparison

The following is a hydrologic comparison of the performance of the three alternative plans under final consideration. These plans allow for maintenance of the lake at elevation 1369. The first alternative, Alternative I, would RCC the remainder of Goshen Dam with a crest elevation of 1380. The second alternative, Alternative III, would include 20 ConSpan Units with base openings of 32 feet and an 11-foot rise, which would be installed in the dam to the east of the existing spillway. The invert elevation of these units would be 1369. The crest of the dam would be raised to accommodate the units to elevation 1382. The remaining downstream face of the dam would have RCC placed over it. The third alternative, Alternative IIIA, would be similar to the second alternative but would have 5 ConSpan Units, rather than 20.

Table 5. COMPARISON OF HYDROLOGIC MODEL RESULTS FOR FINAL ALTERNATIVES

	½ PMF Event 1			½ PMF Event 1 (50%)		
Item	Alt I	Alt III	Alt IIIA	Alt I	Alt III	Alt IIIA
Initial pool elevation (feet)	1369.0	1369.0	1369.0	1369.0	1369.0	1369.0
Peak Flow (cfs)						
Inflow	186,400	186,400	186,400	93,200	93,200	93,200
Outflow	177,700	168,300	177,700	90,700	89,300	89,100
Peak elevation (feet)	1396.8	1395.7	1396.8	1386.5	1379.9	1386.3
Existing spillway/culverts						
Depth of flow (feet)	27.6	26.7	27.8	17.5	10.9	17.3
Average flow velocity through existing spillway (f.p.s.)	22.7	16.3	22.1	27.0	21.0	27.8
Average flow velocity through auxiliary spillway (f.p.s.)		9.6	12.9		10.0	16.2
Crest of dam						
Elevation (feet)	1380.0	1382.0	1382.0	1380.0	1382.0	1382.0
Depth of flow (feet)	16.6	13.7	14.8	6.5	N.A.	4.3
Duration of overtopping (hrs)	13.0	8.0	10.0	9.5	N.A.	6.0
Average velocity (f.p.s.)	7.0	5.0	6.7	6.7	N.A.	5.2
Tailwater elevation (feet)	1396.4	1395.6	1396.3	1376.9	1377.0	1376.7

Table 5. COMPARISON OF HYDROLOGIC MODEL RESULTS FOR FINAL ALTERNATIVES
(cont'd)

Item	0.2% Exceedance Frequency uniform rainfall			1.0% Exceedance Frequency uniform rainfall		
	Alt I	Alt III	Alt IIIA	Alt I	Alt III	Alt IIIA
Initial pool elevation (feet)	1369.0	1369.0	1369.0	1369.0	1369.0	1369.0
Peak Flow (c.f.s.)						
Inflow	38,300	38,300	38,300	28,100	28,100	28,100
Outflow	31,500	36,600	37,800	24,900	26,500	22,400
Peak elevation (feet)	1380.8	1375.2	1378.4	1378.5	1374.0	1377.4
Existing spillway/culverts depth of flow (feet)	11.8	6.2	9.4	9.5	5.0	8.4
Average flow velocity through existing spillway (f.p.s.)	23.0	8.1	19.8	19.8	7.1	9.3
Average flow velocity through auxiliary spillway (f.p.s.)		8.5	9.7		7.7	9.7
Crest of Dam						
Elevation (feet)	1380.0	1382.0	1382.0	1380.0	1382.0	1382.0
Depth of Flow (feet)	0.8	N.A.	N.A	N.A.	N.A.	N.A.
Duration of Overtopping (hrs)	3.0	N.A.	N.A	N.A.	N.A.	N.A.
Average Velocity (f.p.s.)	2.4	N.A.	N.A	N.A.	N.A.	N.A.
Tailwater Elevation (feet)	1364.1	1364.4	1364.2	1359.5	1360.0	1359.5

f.p.s. – feet per second.

Alternative III accomplishes some fairly significant objectives but would more than quadruple the existing spillway width. Alternative III would significantly reduce the maximum pool levels for the events modeled and eliminate overtopping for the one-half PMF. Flow velocities would also be reduced for events less than the one-half PMF.

A comparison of plans I and IIIA was made. Both plans involve RCC of both the crest and the downstream dam face. The RCC-only plans increase the peak lake elevation from 0.2 to 0.9 foot for various one-half PMF scenarios. Overtopping durations would be greater with the RCC-only alternative but would still be less than 10 hours. Velocities for the RCC-only alternative would be slightly higher than the RCC with five Con-Span alternative. There would be a slight increase in overtopping with the RCC-only plan but would still require an event greater than a 100-Year event. All of the plans have been extensively modeled for a wide range of storm events and have demonstrated acceptable performance.

Economic Considerations

An economic analysis was completed on the final alternatives under consideration (see the Economic Analysis Appendix for more details on this analysis). Given the minimal development in the area of the stream below the dam, the dam provides minimal flood protection. There is no difference in the flood protection provided by the dam with the project if the dam does not fail. With the project in place, the dam is not expected to fail for any storm event. The risk of the dam's failing without the project is estimated for a 200-Year storm event. Given this, the project would provide flood protection from failure of the dam during a storm greater than a 200-Year event. Structural flood damages were estimated based on the value of the structures and contents, as well as the flood frequency and associated average water depth over the first floor of a structure, using standard value-depth-damage relationship tables. Flood damages to vehicles were estimated based on the average value of vehicles and the same flood stage frequencies used to estimate structural damages. The average annual damages with the project in place are estimated at $40,000, while the average annual damages without repair and

upgrade of the dam is estimated at $134,000. Therefore, the average annual benefits attributable to a project in place would be $94,000 as shown in the following table.

Table 6. AVERAGE ANNUAL BENEFITS

Item	Average annual amount ($)
Without project damages	134,000
With project damages	- 40,000
Average annual benefits	94,000

The costs for constructing the three final alternatives under consideration, as discussed previously, were developed using the Micro-Computer Aided Cost Estimating System. These costs represent total or fixed fee cost estimates, as detailed in Appendix C of the Technical Alternatives Report, and are a conceptual representation of the approximate order-of-magnitude costs associated with the design concepts described. The estimates are based upon representative unit costs for similar construction projects in the area. There are no maintenance costs attributable any of the alternatives under evaluation. The total construction costs for each of the alternatives, updated to October 2006, Fiscal Year (FY) 2007, price levels, are presented in the following table.

Table 7. TOTAL CONSTRUCTION COSTS (1)

Plan	Total cost ($)
Alternative I	5,062,000
Alternative III	7,378,000
Alternative IIIA	6,116,000

(1) Total construction costs are in October 2006 (FY 2007) price levels.

Since the benefits for each of the alternatives are equivalent, the least cost alternative would have the most net benefits and is the preferred plan. As shown in the previous table, the preferred plan, with the least cost, is Alternative I. The total cost to repair the dam using Alternative I was updated to reflect the specific details that have been developed through design of this alternative (see Appendix 3).

Environmental Considerations

The effect on water quality, related to the operation of Goshen Dam during the winter months, was a pertinent concern at the onset of this study. Historically, during the winter months, the BSA kept the spillway crest gates in their opened position, elevation 1359.5 (spill crest elevation). However, the VDEQ concluded that this seasonal practice is detrimental to water quality downstream of Goshen Dam due to the sediment-laden discharges that occur during the winter months. As a result, the operation of the dam has since changed, and the BSA currently operates and maintains the dam according to the "Operation Procedures for Gated Spillway at Goshen Dam," dated 9 April 1998 and developed by a private engineering consultant hired by the BSA. Operation of the dam according to these procedures reduces the negative water quality effects that would occur during the winter months. It is assumed the BSA will continue to operate and maintain the dam according to these guidelines after construction of the proposed project. Given this, there will be no change to the effect on the water quality downstream from Goshen

Dam, and there are no significant water quality benefits that will result due to the construction of the alternatives under consideration.

A more specific discussion of the potential environmental impacts from each alternative in the initial screening can be found in the "Recommended Plan" section. As explained in that portion of the report, Alternative I would have the fewest adverse environmental impacts, and almost all of these would be temporary impacts associated with construction. The other structural alternatives would require additional construction that would result in more adverse impacts.

Although no there are no significant water quality benefits anticipated from project construction, the project would reduce the likelihood of dam failure, which, if it were to occur, would have significant adverse effects on the downstream water quality, aquatic resources, and stream/river habitat. A dam failure would result in massive amounts of sediment, rock, and other debris' being washed downstream of the dam with the worst effects in the Little Calfpasture. Much of the aquatic life in the stream would be killed or severely stressed through direct smothering and indirect trauma. All the benthic life in the stream where sediment would be deposited would likely be lost. Much of the aquatic life in the lake would also die as the lake was drained. The unvegetated and exposed shoreline along the dry lake would be susceptible to erosion with the resulting additional sedimentation downstream.

Summary of Evaluation

The following table shows the decision matrix used in evaluation of the final alternatives.

Table 8. GOSHEN DAM ALTERNATIVE DECISION MATRIX

Alternative	BCR (1)	Adverse environmental impacts	Risks during construction	Dam access during construction	Dam access during flood
I	0.33	Low	Low	Yes	>100-Year flood
III	0.22	High	High	No	>500-Year flood
IIIA	0.27	High	High	No	>500-Year flood

(1) BCR's are calculated based on costs in October 2006 (FY 2007) price levels annualized at 5-1/8 percent over 50 years.

RECOMMENDED PLAN

Evaluation of the alternatives indicates that the best plan to repair and upgrade Goshen Dam at Lake Merriweather is Alternative I, RCC armor of the dam embankment. This alternative has the highest BCR of the evaluated alternatives, 0.33. While the cost of repairing and upgrading Goshen Dam is not economically feasible, the analysis shows the project is feasible under the Dam Safety Assurance Program based on the loss of life. ER 1110-2-1155 states, "where there is a significant question of safety, a benefit-to-cost ratio will not be calculated." A significant question of safety has been determined through the potential loss of life in this case; however, a benefit-to-cost ratio was calculated to indicate the flood damage reduction benefits that would be attained as well. If the dam is not repaired, a dam failure would potentially threaten the downstream PAR of up to 265 people, and there is potential for loss of life of up to 28 people if the dam were to fail at the one-half PMF.

Traditional USACE regulations do not allow for any quantifiable recreation and water quality benefits in this case. However, it should be noted that without repair and upgrade of the dam, the recreational use of the lake by the BSA, estimated at over

24,000 average annual visits (per activity), could potentially be decreased to 2,400 if the dam failed. Also, there is an imperative water quality concern in the stream below Goshen Dam, as identified by the VDEQ. Both the recreational opportunities and environmental issues need to be considered in addition to the dam safety issues at Goshen Dam.

PLAN DESCRIPTION AND COMPONENTS

The recommended plan, Alternative I - RCC Armor of the Dam Embankment, maintains the pool at an elevation of 1369 feet, and armors the downstream face, crest, and portion of the upstream face of dam with RCC (see Plate 4). RCC would be placed on the downstream slope, crest, and portion of the upstream slope. The RCC would be placed in horizontal, 12-inch layers starting at the downstream 20-foot wide erosion apron, and extend up the embankment in 1-foot high by 2.5-foot wide steps on the 2.5H to 1.0V slope. The stepped RCC face would facilitate access for inspection purposes and help dissipate the energy of the water during overtopping. A flexible scour apron of riprap stone would be constructed contiguously with the downstream RCC edges to help prevent undermining of the relatively rigid RCC. The RCC protection would extend over the crest of the dam (1380 feet) and down the 3.0H:1.0V upstream slope. In order to protect the abutment areas, the RCC armor would extend to the elevation 1382 contour. Soil and seed will be placed over the RCC on the downstream face of the dam. Asphalt pavement would cover the RCC on the crest of the dam to the 1382 contour. At completion the existing upstream riprap would tie into the RCC armor.

It is anticipated that the RCC will not change the seepage pathway of the dam. In order to collect seepage and to prevent uplift pressures on the RCC face, a 1.5 foot thick sand/crushed stone filter drainage layer will underlie all the RCC. A 4-inch diameter drain pipes on 50 foot centers will be installed in the middle of the dam that drain to daylight, and two 8-inch perforated pipes at the toe of the dam will be installed that will drain to the spillway. It was determined that settlement should not be an issue since the additional load of the RCC is considered insignificant and the overburden soils and weathered shale along the dam cutoff were excavated to bedrock and the remainder of the

dam area was proofrolled with a 50-ton pneumatic tired roller prior to placement of any fill. A slope stability analyses was conducted for the following three conditions (a) existing conditions, (b) proposed improvements to include RCC and topsoil on downstream face and (c) upstream rapid drawdown during construction. It was determined that the proposed RCC improvements would not significantly change the overall stability of the dam and that all factors of safety were above those required in EM 1110-2-1902, Stability of Earth and Rockfill Dams. These determinations regarding seepage, settlement, and stability were made based on information from the Feasibility Report for Proposed Dam & Lake, Goshen, Rockbridge County, Virginia, March 1965 (see Appendix 7).

A Value Engineering (VE) Workshop provided three proposals for consideration; maintain gate operations for added safety, encourage compliance and enforcement of environmental regulations, and consider an alternative of grouted riprap. Of the three proposals from the VE report, only maintenance of gate operations for added safety was incorporated in the final design for the recommended alternative. The final design for the project allows for operation of 8 of the 10 gates. The dam was not built by USACE, so enforcement of environmental regulations is not applicable in this case. Compliance and enforcement of environmental regulations can be done during construction of this project. However, operation of the dam will be conducted by the Boy Scouts. Rip rap armoring of the dam embankment was originally considered. However, this alternative was eliminated from consideration based on the technical issue of erosion. The plans and specifications have already been completed for this project. Therefore, there are no future VE efforts planned for this project.

The estimated project cost and economics of Alternative I can be seen in the following table. The average annual costs are in October 2006 (FY 2007) price levels, with a 5-1/8-percent discount rate used in the present value and annualized over a 50-year period of analysis.

Table 9. ALTERNATIVE I - PROJECT COST AND ECONOMICS (1)

Cost	Total cost ($)
First costs (2)	
Preconstruction Engineering and Design	636,000
Construction	4,165,000
Construction management	261,000
Total first costs	5,062,000
Annual costs	
Interest and amortization	289,000
Average annual OMRR&R	0
Total average annual costs	289,000
Average annual benefits	94,000
BCR	0.33

(1) Project costs are in October 2006 (FY 2007) price levels.
(2) Preconstruction Engineering and Design, construction, and construction management costs include a contingency of 5 percent, 10 percent, and 15 percent, respectively.
OMRR&R -- operation, maintenance, repair, rehabilitation, and replacement.

RATIONALE FOR RECOMMENDATION

Alternative I would have the fewest environmental effects, since it involves the least amount of new construction and does not involve draining the lake. The only permanent loss of habitat would be a small loss of aquatic habitat with the extension of the toe of the dam about 30 feet downstream of its current location. There would be a temporary loss of approximately 110,000 square feet of low grade habitat along both faces of the dam as these areas are cleared and covered with the RCC. Most of this loss would occur on the downstream face, which is covered in grass, compared to the upstream face, which is covered with riprap. The replacement of dirt and reseeding over the RCC would reduce this impact. Other temporary adverse effects include increased sedimentation downstream, noise levels, and traffic. The increased sedimentation would be associated with the removal of the vegetation on the dam face in order to install the

RCC. In addition, unlike Alternatives III and IIIA, Alternative I would not require construction of a stilling basin, which could destroy terrestrial habitat and increase the probability of encountering archaeological resources.

Alternative I allows for access across the dam during construction and has less risks associated with it because it does not require excavation of a deep cut through the existing dam embankment. During construction, if a flood event occurs and the lake level overtops the unprotected spillway excavation, a catastrophic breach of the dam could The plan also allows for access across the dam during a 1 percent flood event after the project is complete. result. Assuming the existing spillway remains fully operational, overtopping would not occur for flood events having a statistical chance of occurring less than once every 100 years on the average. Alternatives III and IIIA would prevent overtopping for flood events having a statistical chance of occurring less than once every 500 years on the average after project completion. However, this benefit is outweighed by the higher costs and adverse factors (environmental, risk, construction access, etc.) associated with Alternatives III and IIIA.

SCHEDULE OF FUNDING REQUIREMENTS

A schedule of funding requirements by FY for the recommended upgrade and repair of Goshen Dam can be seen in the following table. In order to accomplish the recommended modifications to the project as scheduled, funding from the Construction General appropriation is required in accordance with the following table. The study and design phases for this project have already been completed and, thus, are not included in the funding requirements.

Table 10. SCHEDULE OF FUNDING REQUIREMENTS

Task	Fiscal year	Begin date	End date	Total cost ($)
PCA Execution	2007	15-Oct 2006	15-Oct 2006	10,000
Contracting process	2007	16-Oct 2006	15-Jan 2007	25,000
Actual construction period	2007	15-Feb 2007	30 Sept 2007	5,568,000

PCA – Project Cooperation Agreement.

SUMMARY OF ENVIRONMENTAL IMPACTS

The following is a summary of the environmental impacts resulting from each of the final alternatives analyzed. More details regarding the environmental impacts to the recommended plan can be found in the Environmental Assessment, attached as an appendix to this document. Pertinent correspondence regarding coordination of the Environmental Assessment, including the U.S. Fish & Wildlife Service Coordination Act Report, can be found in this appendix as well. This Environmental Assessment remains accurate in terms of the impacts expected from the selected alternative. Specifically, there has not been any change in the status of compliance with the Clean Air Act since the original document was written. Similarly, there are no changes to the data on Federal and state listed threatened and endangered species. An updated Clean Water Act 401 certification obtained in 2003 will be valid through June 2008.

Alternative I - RCC Armor of the Dam Embankment: Alternative I, the recommended plan, would have the least environmental effect, since it would involve a minimal amount of new construction and would not involve draining the lake. The only permanent loss of habitat would be a small loss of aquatic habitat, with the extension of the toe of the dam about 30 feet downstream of its current location. There would be a temporary loss of approximately 110,000 square feet of low grade habitat along both

faces of the dam as these areas are cleared and covered with the RCC. Most of this loss would occur on the downstream face, which is covered in grass, compared to the upstream face, which is covered with riprap. Other temporary adverse effects include increased sedimentation downstream, noise levels, and traffic. The increased sedimentation would be associated with the removal of the vegetation on the dam face in order to install the RCC.

Alternative III – 640-foot Auxiliary Spillway (Concrete Arches) with RCC Armor of the Dam Embankment: The environmental effects of this alternative would be similar to those of Alternative I, with the addition of the adverse effects associated with the construction of the auxiliary spillway. Construction of the auxiliary spillway would require draining of the lake to facilitate construction and provide additional flood water storage capacity to prevent flooding of the construction/excavation area. If the lake level is allowed to overtop the spillway excavation during construction, a catastrophic breach of the dam would be a likely possibility. Overtopping protective measures such as sheetpile cofferdams were evaluated and disregarded because of their prohibitive costs and associated installation methods which could damage the existing dam embankment.

Draining of the lake would have significant impacts on the Little Calfpasture River and possibly adversely affect the Maury River in the vicinity of its confluence with the Calfpasture River. A significant portion of the sediment that has accumulated behind the dam would be released to flow downstream, smothering or severely stressing the benthic life in the stream. This sediment would also stress the fish and all other aquatic forms of life in the stream, further impeding the recovery of the stream. Depending on the method used to drain the lake and the time of year, it is possible water with colder temperatures (from the deeper sections) could adversely affect the life in the Little Calfpasture, a warm water stream. Draining the lake would also remove the lake itself as aquatic habitat and would result in the death of much of the aquatic life existing in the lake. The unvegetated and exposed shoreline along the dry lake would be susceptible to erosion with the resulting additional sedimentation downstream.

In addition to the environmental effects discussed above, there would be several other areas of impact. Included in these impacts would be negative effects on recreation during the construction process. There would be a temporary loss of approximately 110,000 square feet of low grade habitat along both faces of the dam as these areas are cleared and covered with the RCC. This plan would involve the loss of the additional terrestrial habitat in the location of the stilling basin. The excavation associated with spillway construction would involve the removal of 5-10 feet of silty sand and clay in this area down to the weathered shale. There is a possibility of archaeological resources in the area proposed for the stilling basin. Additional investigations would be required to determine if such resources exist. There would also be an increased likelihood of temporary downstream sedimentation from the removal of a section of the dam to install the culverts and the construction of the stilling basin and connection channel to the river. The placement of the excavated material near the auxiliary spillway could lead to an additional temporary increase in downstream sedimentation. In addition, a small amount of habitat would be affected by the regrading around the stilling basin.

Alternative IIIA – 160-foot Auxiliary Spillway (Concrete Arches) with RCC Armor of the Dam Embankment: The environmental effects of this alternative would be the similar to those of Alternative III. However, the width of the stilling basin required for Alternative IIIA would be considerably narrower than that required under Alternatives III. Therefore, the adverse environmental impacts associated with the stilling basin would be commensurably less.

COST SHARING

In accordance with Section 506 of the WRDA 1996 (P.L. 104-303), as amended, the Federal Government shall assist in an estimated total cost of $6 million for design and construction of the repair and upgrade of Goshen Dam. The non-Federal sponsor, the Virginia Department of Conservation and Recreation (VDCR), Division of Dam Safety, shall be responsible for all costs in excess of this amount. The non-Federal sponsor shall also be responsible for 100 percent of the OMRR&R costs. The estimated costs and cost sharing requirements can be seen in the following table.

Table 11. COST SHARING REQUIREMENTS

Item	Percent share (%)	Amount ($)
Study and Design Phase		750,000
LERRD		0
Construction Phase		4,426,000
Total cost through the end of the construction phase		
Federal (1)	100	5,176,000
Non-Federal	0	0
Total	100	5,176,000

(1) The total Federal share is limited to $6 million, and all costs exceeding this amount are to be paid by the non-Federal sponsor.
LERRD -- Lands, easements, rights-of-way, relocation, and disposal areas.

LOCAL COOPERATION AND INTEREST

The non-Federal sponsor, the Commonwealth of Virginia, is a public body that is legally and financially capable of furnishing the required project cooperation for the recommended project. Prior to project implementation, a final PCA will be coordinated and executed between the non-Federal sponsor and the Federal Government. State officials have reviewed the draft PCA and have indicated, in a letter dated 8 March 2004, their intent to sign the final version of the PCA prior to the implementation of the recommended plan. As indicated by a letter from the VDCR, Division of Dam Safety, dated 10 March 1999, the non-Federal sponsor is in agreement with the conclusions and recommendations of the Technical Alternatives Report, dated 1999, which are the same as those of this report this report. After review of this Dam Safety Evaluation Report, VDCR reaffirmed their support of the project in an electronic-mail, dated August 1, 2006. Local interest and support of the project was also expressed by Rockbridge County in an

electronic mail, dated July 26, 2006. All of the letters referenced here can be found in the Pertinent Correspondence Appendix of this report.

CONCLUSIONS

The dam safety problems associated with Goshen Dam, Rockbridge County, Virginia, as identified by this study have been reviewed and evaluated with regard to the overall public interest and with consideration to engineering, economic, environmental, social, and cultural concerns. The conclusions drawn by this evaluation are as follows:

a. A potential for failure at Goshen dam has been identified, and is associated with the inability of the earthen dam to safely pass the BSC, which has been determined to be the one-half PMF. Repair and upgrade of the dam is necessary since it has been estimated that the dam is at risk of failure for 200-year and greater storm events.

b. Failure of Goshen Dam would result in an estimated $25.4 million in flood damages for the one-half PMF. The probable threatened Population at Risk (PAR) from dam failure at the one-half PMF is estimated at about 265 and there is potential for loss of life of up to 28 people. Without repair and upgrade of the dam, the recreational use of the lake by the BSA, estimated at 24,000 average annual visitor days per activity, could be decreased to approximately 2,400 average annual visitor days per activity if the dam failed. Also, there is an imperative water quality concern in the stream below Goshen Dam, as identified by the VDEQ. Both the recreational opportunities and environmental concerns need to be taken into account in addition to the dam safety issues at Goshen Dam.

c. The recommended plan for repair and upgrade of Goshen Dam at Lake Merriweather is Alternative I, RCC armor of the dam embankment. This alternative, with an estimated cost of $5,062,000, has the highest BCR of the evaluated alternatives, 0.33. While the cost of repairing and upgrading Goshen Dam is not economically feasible, the analysis shows the project is feasible under the Dam Safety Assurance

Program based on the loss of life (see ER 1110-2-1155, Appendix C, paragraph C-7). If the dam is not repaired, the dam would potentially threaten the downstream PAR of up to 265 people and there is potential for loss of life of up to 28 if the dam were to fail at the one-half PMF.

d. Implementation of the selected plan would provide for safe passage of the one-half PMF, the determined BSC, minimizes disruption of vehicular access across dam during construction; allows access across the dam for floods having exceedance frequencies less than 1.0 percent (floods occurring less than once every 100 years, on the average); minimizes the magnitude of potential lake level drawdown required for construction; minimizes potential safety concerns associated with flooding during construction; eliminates the need to mechanically operate the spillway under emergency conditions; eliminates the need for future lake drawdowns for dam safety purposes, thereby reducing the potential release of sediment; and eliminates the need for increasing the size of the existing stilling basin.

e. The selected plan is supported by the non-Federal sponsor, the VDCR, Division of Dam Safety, which has the capability to provide the necessary non-Federal requirements presented in the "Recommendations" section of this report.

f. Since there is no OMRR&R attributable to the selected plan for repair and upgrade of the dam, and, thus, no need for inspections of maintenance, the Federal Government will not have any involvement with the project after construction is complete.

RECOMMENDATIONS

I have considered all potential impacts and effects in terms of the overall public interest, which includes environmental, social, and economic effects, as well as the overall engineering feasibility of the selected plan. ER 1110-2-1155 states, "where there is a significant question of safety, a benefit-to-cost ratio will not be calculated." A

significant question of safety has been determined through the potential loss of life in this case; however, a benefit-to-cost ratio was calculated to indicate the flood damage reduction benefits that would be attained as well. Bearing these considerations in mind, I recommend that, under the authority of Section 507 of the WRDA of 1996 (P.L. 104-303), as amended, USACE will repair and upgrade the dam and appurtenant features at Lake Merriweather, Little Calfpasture River, Virginia, in accordance with the recommended plan, with such modification as in the discretion of the commander, Headquarters USACE, may be advisable, at total implementation costs currently estimated at $5,176,000. This recommendation is subject to the cost sharing policies as outlined in this report and is endorsed, provided that, prior to construction, the non-Federal sponsor enters into a written PCA as required by Section 221 of the Flood Control Act of 1970 (P.L. 91-161), as amended, to provide local cooperation satisfactory to the Secretary of the Army. All cost sharing requirements, as stated in law and regulation, will be satisfied prior to initiating project construction. It is important to note that, since the property is privately-owned by the BSA, the Commonwealth would be required to obtain any and all rights from the BSA required to satisfy the items of local cooperation. Such local cooperation would include the following non-Federal responsibilities in addition to the responsibility for fulfilling the requirements of law for the selected project:

a. Provide a contribution equal to 0 percent of the implementation costs that include the cost of preparing this report, the costs of plans and specifications, and the costs of construction. As per Section 506 of the WRDA 1996 (P.L. 104-303), as amended, the Federal Government may expend up to $6 million on design and construction of repair and upgrade of Goshen Dam. The non-Federal sponsor shall be responsible for all costs in excess of this amount. The total implementation costs are currently estimated at $5,176,000, of which $5,176,000 would be the Federal share, and $0 the non-Federal share.

b. Assume responsibility for the OMRR&R, currently estimated at $0 annually, of the project or completed functional portions of the project, including mitigation

features, without cost to the Government, in a manner compatible with the project's authorized purpose, and in accordance with applicable Federal and state laws and specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

c. Provide all lands, easements, and rights-of-way, and perform, or ensure the performance of, any relocations determined by the Federal Government to be necessary for the initial construction, operation, and maintenance of the project.

d. Give the Government a right to enter at reasonable times and in a reasonable manner upon land that the non-Federal sponsor owns or controls for access to the project for the purpose of inspection, and if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

e. Hold and save the United States free from all damage arising from initial construction and OMRR&R of the project elements and any project-related betterments, except for damages due the fault or negligence of the United States or its contractors.

f. Perform, or cause to be performed, any investigations determined to be necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), P.L. 96-510, amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for initial construction, operation, and maintenance of the project elements. However, for lands that the Federal Government determines to be subject to the navigation servitude, the non-Federal Sponsor must obtain prior written instruction from the District Engineer regarding the method of testing and must perform such investigations only in accordance with those instructions. The Government shall have no obligation under the PCA for the costs of any investigations performed under this paragraph.

g. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor, for all necessary cleanup and response cost of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-ways that the Federal Government determines to be necessary for the initial construction, operation, or maintenance of the project elements.

h. Agree that the non-Federal sponsor shall be considered the operator of the project elements for the purpose of CERCLA liability. To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project elements in a manner that will not cause liability to arise under CERCLA.

i. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, P.L. 91-646, as amended by the Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987, P.L. 100-17, and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, operation, and maintenance of the project elements, including those necessary for relocations, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

j. Comply with all applicable Federal and state laws and regulations, including but not limited to, Section 601 of the Civil Rights Act of 1964, P.L. 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

k. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost-sharing provisions of the agreement.

l. All lands, easements, rights-of-way, and relocations necessary for the project must be provided by the non-Federal sponsor free and clear of all environmental hazards.

NOTE ON INFORMATION PRESENTED IN THIS DOCUMENT

The recommendations contained herein reflect the information now available and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels. Consequently, the recommendations may be modified before they are transmitted to higher authority as proposals for authorization and implementation funding. The non-Federal sponsor, interested Federal and state agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Dionysios Anninos
Colonel, Corps of Engineers
Commanding