

FINAL

SUPPLEMENTAL WATERSHED WORK PLAN NO. 8  
AND ENVIRONMENTAL EVALUATION  
FOR  
BEAVER CREEK DAM (PA-433)  
OF THE BRANDYWINE CREEK WATERSHED  
(CHESTER, DELAWARE, LANCASTER COUNTIES, PENNSYLVANIA AND  
NEW CASTLE COUNTY, DELAWARE)



PREPARED BY  
USDA NATURAL RESOURCES CONSERVATION SERVICE

IN COOPERATION WITH  
CHESTER COUNTY BOARD OF COMMISSIONERS

&

CHESTER COUNTY WATER RESOURCES AUTHORITY

JANUARY 2014

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AND ENVIRONMENTAL EVALUATION  
FOR BEAVER CREEK DAM (PA-433) OF THE BRANDYWINE CREEK WATERSHED  
(CHESTER, DELAWARE, AND LANCASTER COUNTIES, PENNSYLVANIA AND NEW CASTLE  
COUNTY, DELAWARE)

**PREPARED BY:**

United State Department of Agriculture,  
Natural Resources Conservation Service

**PROJECT LOCATION:**

Chester County, Pennsylvania

**IN COOPERATION WITH:**

Chester County Board of Commissioners  
Chester County Water Resources Authority

**FOR MORE INFORMATION:**

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**ABSTRACT:**

Supplemental Watershed Work Plan No. 8 and Environmental Evaluation (EE) describes a plan to meet all applicable USDA-Natural Resources Conservation Service (NRCS) and Commonwealth of Pennsylvania dam safety and performance standards for Beaver Creek Dam (PA-433). The Service life of the dam will be 50 years. The dam was designed and constructed as a NRCS High Hazard Class dam. The new life expectancy is 50 years. The project is located in East Brandywine Township, Chester County, Pennsylvania. Beaver Creek Dam (PA-433) is located on Beaver Creek, approximately 2 miles north of Route 30 By-Pass and 1 mile west of US Route 322, and about 1 mile west of Guthriesville, PA.

The purpose of the project is to maintain or improve the current level of flood damage reduction for public safety, bridges, roads, agricultural and other lands, buildings, structures, infrastructure, and other features; and comply with applicable design, performance and safety criteria for High Hazard Class dams.

The need for this project is to continue providing and improving flood damage reduction downstream from the dam and address applicable NRCS and Commonwealth of Pennsylvania standards and design criteria for public health and safety to reduce the risk of loss of human life and property damage.

The Sponsors primary objectives for this project are to meet or exceed state and federal dam safety criteria and to maintain or enhance the current level of flood protection.

Alternative plans include no action and rehabilitation of the existing dam. Other alternatives were considered but were not evaluated in detail due to a variety of shortcomings described in the plan. The recommended plan is to rehabilitate the existing dam. This is also the National Economic Development Plan which is the plan that reasonably maximizes net national economic development benefits consistent with protecting the Nation's environment.

Dam rehabilitation will include: (1) maintaining the axis of the dam at its present location and elevation, (2) lowering the auxiliary spillway crest, (3) armoring the auxiliary spillway exit channel and side slopes with roller compacted concrete, (4) installing a sand diaphragm around the principal spillway conduit, (5) replacing the principal spillway riser structure, (6) installing access to the existing toe drains through the impact basin headwall, (7) installing riprap wave protection on the upstream face of the dam and (8) regrading an area adjacent to the downstream toe and installing a drain trench.

Economic benefits will exceed costs. Sponsors will incur at least 35% of the total rehabilitation project cost. The planned action will bring the Beaver Creek Dam (PA-433) into compliance with current, applicable NRCS and Commonwealth of Pennsylvania dam safety and performance standards for High Hazard Class dams.

There are no significant adverse environmental impacts from this project. This plan is intended to document the requirements of the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, and other applicable environmental laws for this federal action. The plan also documents the applicability of NRCS Categorical Exclusions for purposes of the National Environmental Policy Act of 1969.

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Persons with disabilities who require alternative means for communication of program information (e.g., Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD)."

SUPPLEMENTAL WATERSHED WORK PLAN AGREEMENT NO. 8

between the

CHESTER COUNTY BOARD OF COMMISSIONERS  
and  
CHESTER COUNTY WATER RESOURCES AUTHORITY

(Referred to herein as Sponsors)

and the

UNITED STATES DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE

Formerly the Soil Conservation Service (SCS)

(Referred to herein as NRCS)

Whereas, the Watershed Plan Agreement for the Brandywine Creek Watershed, Commonwealth of Pennsylvania and the State of Delaware, executed by the Sponsors named therein and NRCS, became effective on the second day of October 1962; and

Whereas, a Supplemental Watershed Plan Agreement No.1 for the Brandywine Creek Watershed, Commonwealth of Pennsylvania and the State of Delaware, executed by the Sponsors named therein and NRCS, became effective on the twentieth day of October 1966; and

Whereas, a Supplemental Watershed Plan Agreement No.2 for the Brandywine Creek Watershed, Commonwealth of Pennsylvania and the State of Delaware, executed by the Sponsors named therein and NRCS, became effective on the fifteenth day of February 1974; and

Whereas, a Supplemental Watershed Plan Agreement No.3 for the Brandywine Creek Watershed, Commonwealth of Pennsylvania and the State of Delaware, executed by the Sponsors named therein and NRCS, became effective on the fourteen day of October 1977; and

Whereas, a Supplemental Watershed Plan Agreement No.4 for the Brandywine Creek Watershed, Commonwealth of Pennsylvania and the State of Delaware, executed by the Sponsors named therein and NRCS, became effective on the third day of June 1987; and

Whereas, a Supplemental Watershed Plan Agreement No.5 for the Brandywine Creek Watershed, Commonwealth of Pennsylvania and the State of Delaware, executed by the Sponsors named therein and NRCS, became effective on the twenty-second day of May 1991; and

Whereas, a Supplemental Watershed Plan Agreement No.6 for the Brandywine Creek Watershed, Commonwealth of Pennsylvania and the State of Delaware, executed by the Sponsors named therein and NRCS, became effective on the twentieth day of January 1995; and

Whereas, a Supplemental Watershed Plan Agreement No. 7 for the Brandywine Creek Watershed, Commonwealth of Pennsylvania and the State of Delaware, is expected to be executed by Sponsors named therein and NRCS, in January 2014; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, has been assigned by the Secretary of Agriculture to NRCS; and

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsors for assistance in preparing a plan for works of improvement for the Beaver Creek Dam (PA-433) in the Brandywine Creek Watershed, Commonwealth of Pennsylvania, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Sections 1001 to 1008, 1010, and 1012); and

Whereas, there has been developed through the cooperative efforts of the Sponsors and NRCS a Watershed Work Plan No.8 - Environmental Evaluation for works of improvement for the rehabilitation of Beaver Creek Dam (PA-433), Commonwealth of Pennsylvania, hereinafter referred to as the Plan-EE or plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS, and the Sponsors hereby agree upon the following additional terms, conditions, and stipulations of said Watershed Plan Agreement, as supplemented.

**The following terms, conditions, and stipulations are specifically related to the rehabilitation works of improvement for Beaver Creek Dam and do not change the term, conditions, and stipulations of said Watershed Work Plan Agreement, as supplemented, not modified herein.**

**Beaver Creek Dam (PA-433)** - The works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this Plan-EE and including the following:

- 1. Term.** The term of this agreement is for the installation period and evaluated life of the project (50 years) and does not commit NRCS to assistance of any kind beyond the end of the evaluated life.
- 2. Costs.** The costs shown in this plan are preliminary estimates. Final costs to be borne by the parties hereto will be the actual costs incurred in the installation of works of improvement.
- 3. Real property.** The sponsors will acquire such real property as will be needed in connection with the works of improvement. The amounts and percentages of the real property acquisition costs to be borne by the Sponsors and NRCS are as shown in the Cost-share table in item 5 hereof.

The Sponsor holds a flood easement over the entire flood detention basin for the temporary detention, conveyance and storage of flood waters that are impounded, stored or detained by the Beaver Creek Dam at capacity to an Elevation of 510.8 feet MSL.

The sponsors agrees that all land acquired for measures, other than land treatment practices, with financial or credit assistance under this agreement will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

- 4. Uniform Relocation Assistance and Real Property Acquisition Policies Act.** The sponsors hereby agree to comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. Section 4601 et seq. as further implemented through regulations in 49 CFR Part 24 and 7 CFR Part 21) when acquiring real property interests for this federally assisted project. If the sponsors are legally unable to comply with the real property acquisition requirements, it agrees that, before any federal financial assistance is furnished; it will provide a statement to that effect, supported by an opinion of the chief legal officer of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance.
- 5. Cost-share for Watershed Work Plan.** The following table shows cost-share percentages and amounts for Watershed Work Plan implementation.

Works of Improvement	NRCS	Sponsors	Total
<b>Cost-Sharable Items</b> <sup>1</sup>			
Rehabilitation of dam (Construction Costs)	\$ 2,288,000	\$ 907,000	\$ 3,195,000
Relocation <sup>2</sup>	\$ -	\$ -	\$ -
Sponsors' Planning Costs	\$ -	\$ 275,000	\$ 275,000
Sponsors' Engineering Costs	NA	\$ 25,000	\$ 25,000
Sponsors' Project Administration	NA	\$ 25,000	\$ 25,000
Land Rights Acquisition Cost <sup>3</sup>	NA	\$ -	\$ -
<b>Subtotal: Cost-Share Costs</b>	<b>\$ 2,288,000</b>	<b>\$ 1,232,000</b>	<b>\$ 3,520,000</b>
<b>Cost-Share Percentages</b>	<b>65.0%</b>	<b>35.0%</b>	<b>100.0%</b>
<b>Non Cost-Sharable Items</b>			
NRCS Engineering & Project Administration	\$ 1,118,000	NA	\$ 1,118,000
Natural Resource Rights	NA	\$ -	\$ -
Federal, State and Local Permits	NA	\$ 1,000	\$ 1,000
<b>Subtotal: Non Cost-Share Costs</b>	<b>\$ 1,118,000</b>	<b>\$ 1,000</b>	<b>\$ 1,119,000</b>

6. **Land treatment agreements.** The Sponsors will encourage landowners and operators to continue to operate and maintain needed land treatment conservation measures for the protection and improvement of the watershed upstream of the dam.
7. **Floodplain Management.** Before construction of any project for flood prevention, the sponsors shall agree to participate in and comply with applicable federal floodplain management and flood insurance programs.
8. **Water and mineral rights.** The sponsors will acquire or provide assurance that landowners or resource users have acquired such water, mineral, or other natural resources rights pursuant to State law as may be needed in the installation and operation of the works of improvement. Any costs incurred shall be borne by the sponsors and these costs are not eligible as part of the sponsor's cost-share.

9. **Permits.** The sponsors will obtain and bear the cost for all necessary federal, state, and local permits required by law, ordinance, or regulation for installation of the works of improvement. These costs are not eligible as part of the sponsors' cost-share.
10. **NRCS assistance.** This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out the plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.
11. **Additional agreements.** A separate agreement will be entered into between NRCS and the sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
12. **Amendments.** This plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may deauthorize or terminate funding at any time it determines that the sponsors have failed to comply with the conditions of this agreement or when the program funding or authority expires. In this case, NRCS shall promptly notify the sponsors in writing of the determination and the reasons for the deauthorization of project funding, together with the effective date. Payments made to the sponsors or recoveries by NRCS shall be in accord with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the sponsors having specific responsibilities for the measure involved.
13. **Prohibitions.** No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
14. **Operation and Maintenance (O&M).** The sponsors will be responsible for the operation, maintenance, and any needed replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with an O&M Agreement. An O&M agreement will be entered into before federal funds are obligated and will continue for the project life (50 years). Although the sponsors' responsibility to the Federal Government for O&M ends when the O&M agreement expires upon completion of the evaluated life of measures covered by the agreement, the sponsors acknowledge that continued liabilities and responsibilities associated with works of improvement may exist beyond the evaluated life.
15. **Emergency Action Plan.** Prior to construction, the sponsors shall prepare an Emergency Action Plan (EAP) for each dam or similar structure where failure may cause loss of life or as required by state and local regulations. The EAP shall be reviewed and updated by the sponsors as required by Pennsylvania Department of Environment Protection. The EAP shall meet the minimum content specified in the NRCS Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart F, Section 500.52, and meet applicable State agency dam safety requirements. The NRCS will determine that an EAP is prepared prior to the execution of fund obligating documents for construction of the structure.
16. **Nondiscrimination Provisions.** "The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers. If you believe you experienced discrimination when obtaining services from USDA, participating in a USDA program, or participating in a program that receives financial assistance from USDA, you may file a complaint with USDA. Information about how to file a discrimination complaint is available from the Office of the Assistant Secretary for Civil Rights. USDA prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex (including gender identity and expression), marital status, familial status, parental status, religion, sexual orientation, political beliefs, genetic information, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.)"

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Office of the Assistant Secretary for Civil Rights  
1400 Independence Avenue, SW.  
Washington, DC 20250-9410

Or call toll free at (866) 632-9992 (voice) to obtain additional information, the appropriate office or to request documents. Individuals who are deaf, hard of hearing, or have speech disabilities may contact USDA through the Federal Relay service at (800) 877-8339 or (800) 845-6136 (in Spanish). USDA is an equal opportunity provider, employer, and lender.

Persons with disabilities who require alternative means for communication of program information (e.g., Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD)."

- 17. By signing this agreement** the recipient assures the Department of Agriculture that the program or activities provided for under this agreement will be conducted in compliance with all applicable federal civil rights laws, rules, regulations, and policies.
- 18. Certification Regarding Drug-Free Workplace Requirements** (7 CFR Part 3021). By signing this Watershed Agreement, the sponsors are providing the certification set out below. If it is later determined that the sponsors knowingly rendered a false certification, or otherwise violated the requirements of the Drug-Free Workplace Act, the NRCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

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

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

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

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

Certification:

- A. The sponsors certify that they will or will continue to provide a drug-free workplace by—
- (1) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition.
  - (2) Establishing an ongoing drug-free awareness program to inform employees about—
    - (a) The danger of drug abuse in the workplace;
    - (b) The grantee's policy of maintaining a drug-free workplace;
    - (c) Any available drug counseling, rehabilitation, and employee assistance programs; and

- (d) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace
- (3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1).
- (4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee will—
  - (a) Abide by the terms of the statement; and
  - (b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction.
- (5) Notifying the NRCS in writing, within 10 calendar days after receiving notice under paragraph (4)(b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees shall provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the federal agency has designated a central point for the receipt of such notices. Notice shall include the identification numbers of each affected grant.
- (6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4) (b), with respect to any employee who is so convicted—
  - (a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
  - (b) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a federal, state, or local health, law enforcement, or other appropriate agency.
- (7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6).
- B. The sponsors may provide a list of the sites for the performance of work done in connection with a specific project or other agreement.
- C. Agencies shall keep the original of all disclosure reports in the official files of the agency.

**19. Certification Regarding Lobbying** (7 CFR Part 3018) (for projects > \$100,000)

- A. The sponsors certify to the best of their knowledge and belief, that:
  - (1) No federal appropriated funds have been paid or will be paid, by or on behalf of the sponsors, to any person for influencing or attempting to influence an officer or employee of an agency, Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.
  - (2) If any funds other than federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
  - (3) The sponsors shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under

grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

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

**20. Certification Regarding Debarment, Suspension, and Other Responsibility Matters—Primary Covered Transactions (7 CFR Part 3017).**

- A. The sponsors certify to the best of their knowledge and belief, that they and their principals:
  - (1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any federal department or agency;
  - (2) Have not within a 3-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state, or local) transaction or contract under a public transaction; violation of federal or state antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
  - (3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state, or local) with commission of any of the offenses enumerated in paragraph A(2) of this certification; and
  - (4) Have not within a 3-year period preceding this application/proposal had one or more public transactions (federal, state, or local) terminated for cause or default.
- B. Where the primary sponsors is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this agreement.

**21. Clean Air and Water Certification.**

- A. The project sponsoring organizations signatory to this agreement certify as follows:
  - (1) Any facility to be utilized in the performance of this proposed agreement is (\_\_\_\_), is not (X) listed on the Environmental Protection Agency List of Violating Facilities.
  - (2) To promptly notify the NRCS-State administrative officer prior to the signing of this agreement by NRCS, of the receipt of any communication from the Director, Office of Federal Activities, U.S. Environmental Protection Agency, indicating that any facility which is proposed for use under this agreement is under consideration to be listed on the Environmental Protection Agency List of Violating Facilities.
  - (3) To include substantially this certification, including this subparagraph, in every nonexempt sub-agreement.
- B. The project sponsoring organizations signatory to this agreement agrees as follows:
  - (1) To comply with all the requirements of section 114 of the Clean Air Act as amended (42 U.S.C. Section 7414) and section 308 of the Federal Water Pollution Control Act (33 U.S.C. Section 1318), respectively, relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, issued there under before the signing of this agreement by NRCS.
  - (2) That no portion of the work required by this agreement will be performed in facilities listed on the EPA List of Violating Facilities on the date when this agreement was signed by NRCS unless and until the EPA eliminates the name of such facility or facilities from such listing.

- (3) To use their best efforts to comply with clean air standards and clean water standards at the facilities in which the agreement is being performed.
  - (4) To insert the substance of the provisions of this clause in any nonexempt subagreement.
- C. The terms used in this clause have the following meanings:
- (1) The term "Air Act" means the Clean Air Act, as amended (42 U.S.C. Section 7401 et seq.).
  - (2) The term "Water Act" means Federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et seq.).
  - (3) The term "clean air standards" means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted pursuant to the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110 of the Air Act (42 U.S.C. Section 7414) or an approved implementation procedure under section 112 of the Air Act (42 U.S.C. Section 7412).
  - (4) The term "clean water standards" means any enforceable limitation, control, condition, prohibition, standards, or other requirement which is promulgated pursuant to the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. Section 1342), or by a local government to assure compliance with pretreatment regulations as required by section 307 of the Water Act (33 U.S.C. Section 1317).
  - (5) The term "facility" means any building, plant, installation, structure, mine, vessel, or other floating craft, location or site of operations, owned, leased, or supervised by a sponsor, to be utilized in the performance of an agreement or subagreement. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location shall be deemed to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are collocated in one geographical area.

**22. Assurances and Compliance.** As a condition of the grant or cooperative agreement, the sponsors assures and certifies that it is in compliance with and will comply in the course of the agreement with all applicable laws, regulations, Executive orders and other generally applicable requirements, including those set out below which are hereby incorporated in this agreement by reference, and such other statutory provisions as a specifically set forth herein.

State, Local, and Indian Tribal Governments: OMB Circular Nos. A-87, A-102, A-129, and A-133; and 7 CFR Parts 3015, 3016, 3017, 3018, 3021, and 3052.

Nonprofit Organizations, Hospitals, Institutions of Higher Learning: OMB Circular Nos. A-110, A-122, A-129, and A-133; and 7 CFR Parts 3015, 3017, 3018, 3019, 3021 and 3052.

**23. Examination of Records.** The sponsors shall give the NRCS or the Comptroller General, through any authorized representative, access to, and the right to examine all records, books, papers, or documents related to this agreement, and retain all records related to this agreement for a period of three years after completion of the terms of this agreement in accordance with the applicable OMB Circular.

**24. Signatures.** The signing of this Public Law 83-566 Watershed Agreement by an authorized representative of the Sponsors indicates that the Sponsors has reviewed this Agreement and the Beaver Creek Dam (PA-433) Supplemental Watershed Work Plan No. 8-Environmental Evaluation and concur with the intent and contents of each.

**CHESTER COUNTY BOARD OF COMMISSIONERS**

The signing of this plan was authorized by a resolution by the Chester County Board of Commissioners governing body and adopted at an official meeting held on

\_\_\_\_\_, 2014 at \_\_\_\_\_, Pennsylvania.

By:

\_\_\_\_\_

Date: \_\_\_\_\_

Ryan Costello  
Commissioner

By:

\_\_\_\_\_

Date: \_\_\_\_\_

Kathi Cozzone  
Commissioner

By:

\_\_\_\_\_

Date: \_\_\_\_\_

Terence Farrell  
Commissioner

**CHESTER COUNTY WATER RESOURCES AUTHORITY**

The signing of this plan was authorized by a resolution by the Chester County Water Resources Authority governing body and adopted at a meeting held on

\_\_\_\_\_, 2014 at \_\_\_\_\_, Pennsylvania.

By:

\_\_\_\_\_

Date: \_\_\_\_\_

Chairperson

**USDA-NATURAL RESOURCES CONSERVATION SERVICE**

Approved by:

\_\_\_\_\_

Date: \_\_\_\_\_

Denise Coleman, State Conservationist  
Natural Resources Conservation Service  
U.S. Department of Agriculture  
One Credit Union Place, Suite 340  
Harrisburg, PA 17110-2993

SUMMARY OF SUPPLEMENTAL WATERSHED WORK PLAN NO. 8  
AND ENVIRONMENTAL EVALUATION  
FOR THE  
BEAVER CREEK DAM (PA-433) OF THE  
BRANDYWINE CREEK WATERSHED

(CHESTER, DELAWARE, LANCASTER COUNTIES, PENNSYLVANIA  
AND NEW CASTLE COUNTY, DELAWARE)

CONGRESSIONAL DISTRICTS – PA: 6<sup>TH</sup>, 7<sup>TH</sup>, 16<sup>TH</sup> AND DE: 0<sup>TH</sup>

(OFFICE OF MANAGEMENT AND BUDGET FACT SHEET)

**SPONSORS OF BEAVER CREEK DAM PROJECT**

Chester County Board of Commissioners  
Chester County Water Resources Authority

**ADDITIONAL SPONSORS OF BRANDYWINE CREEK WATERSHED PROJECT**

Chester County Conservation District  
New Castle Conservation District  
Pennsylvania Department of Environmental Protection  
Pennsylvania Fish and Boat Commission  
Pennsylvania Department of General Services

**AUTHORITIES**

Brandywine Creek Watershed Work Plan was completed and approved July 23, 1962, executed by the Sponsors and the USDA Soil Conservation Service (now USDA Natural Resources Conservation Service [NRCS]) and became effective in October 2, 1962 under the authority of Public Law (PL) 83-566, Watershed Protection and Flood Prevention Act (16 U.S.C.1001-1008).

Rehabilitation of PL 83-566 assisted dams has been authorized under the authority of Section 14 of Public Law 83-566, the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Parts 1001-1008, 1010, and 1012). The responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to NRCS.

**PROPOSED ACTION**

The proposed action is the rehabilitation of the Beaver Creek Dam (PA-433) to current design, performance, and safety criteria with a service life of 50 years.

## PROJECT PURPOSE AND NEED

The purpose of the project includes the following:

- Maintain or improve the current level of flood damage reduction provided by the Beaver Creek Dam (PA-433) for public safety, bridges, roads, agricultural and other lands, buildings, structures, infrastructure, and other features.
- Comply with applicable design, performance and safety criteria for High Hazard Class dams.

The need for this project includes the following:

- Continue providing and flood damage reduction downstream from the dam and address applicable NRCS and Commonwealth of Pennsylvania standards and design criteria for public health and safety to reduce the risk of loss of human life and property damage.

## PREFERRED ALTERNATIVE

The Preferred Alternative is the National Economic Development (NED) Alternative, which is to rehabilitate the Beaver Creek Dam. This will:

- Rehabilitate the dam to current NRCS High Hazard Class dam design criteria.
- Extend the service life for 50 years.
- Comply with Commonwealth of Pennsylvania Department of Environmental Protection (PADEP) dam safety regulations.

The Preferred Alternative results in the following:

- Maintaining the axis of the dam at its present location and elevation.
- Lowering the auxiliary spillway crest.
- Armoring the auxiliary spillway exit channel and side slopes with roller compacted concrete.
- Installing a sand diaphragm around the principal spillway conduit.
- Replacing the principal spillway riser structure.
- Installing access to the existing toe drains through the impact basin headwall.
- Installing riprap wave protection on the upstream face of the dam.
- Grading an area adjacent to the downstream toe and installing a drain trench.

## PROJECT BENEFITS

The Preferred Alternative includes these benefits:

- Flood control
- Minimized risk of loss of human life
- Minimized risk of extensive damages
- Sediment storage
- Improved downstream water quality
- Maintained land values

## ALTERNATIVE PLANS CONSIDERED

Several alternatives and variations of alternatives were considered. The National Economic Development (NED) Alternative is the alternative that reasonably maximizes net economic benefits consistent with protecting the Nation's environment.

Alternatives included structural and non-structural measures. All alternatives are based on a 50-year service life so they could be consistently compared. Table S-3 summarizes the primary alternatives considered for the project.

## RESOURCE INFORMATION

Beaver Creek Dam (PA-433) is located on Beaver Creek in East Brandywine Township, Chester County, Pennsylvania, approximately 4.5 miles northwest of Downingtown and one mile west of State Route 322. Beaver Creek flows into the East Branch of the Brandywine Creek downstream from the dam.

Figure S-2 shows the location of the Beaver Creek Dam (PA-433).

The dam is owned and operated by Chester County Water Resources Authority (CCWRA). Beaver Creek Dam (PA-433) is a zoned-earth embankment flood control structure. The dam is currently classified by the Pennsylvania Department of Environmental Protection – Division of Dam Safety as Size Category B, Hazard Potential Category 1 and an NRCS High Hazard Class dam.

The following resource information was obtained from the Chester County Soil Survey (USDA 1963).

### ***Climate***

- *Temperature*  
High temperatures average between 38°F in January and 86°F in July. Low temperatures average between 21°F in January and 63°F in July, with the record high being 107°F, and record low being -19°F.
- *Precipitation*  
The average annual precipitation is 45.8 inches. Precipitation is well distributed throughout the year. Monthly precipitation average between 3.3 inches in February, October and November to 4.5 inches in June. The heaviest 1-day rainfall during the period of record was 5.6 inches. Precipitation amounts of greater than 0.2 inches occur on about 80 days each year.
- *Snowfall*  
The average seasonal snowfall is 27 inches. The most snow reported in a month was 70 inches.
- *Topography and Drainage*  
The topography of Chester County is characterized by gently rolling uplands, with occasional low hills and ridges. Elevations range from 10 feet above mean sea level at the Delaware River to 1,056 feet above mean sea level in the northern part of the County. The Beaver Creek Dam is situated on Beaver Creek, which is a tributary of Brandywine Creek, which is subsequently a tributary of the Delaware River.

Table S-1 provides relevant resource information and the planned land use conditions upstream from the Beaver Creek Dam.

**Table S-1  
 Resource Information**

<b>Resource</b>	<b>Beaver Creek Dam (PA-433) Contributing Watershed</b>
Location of Structure <sup>1</sup>	
Longitude	75° 47' 00" W
Latitude	40° 01' 48" N
Hydrologic Unit Code <sup>2</sup>	02040205
HUC Watershed Name <sup>2</sup>	Brandywine - Christina
Congressional District <sup>3</sup>	Pennsylvania U.S. Congressional District 6
Drainage Area above dam (square miles) <sup>4</sup>	2.98
Land Use above dam (acres) <sup>5</sup>	Total – 1,907
Residential	925
Commercial	47
Cropland	244
Farmstead	115
Pasture and Rangeland	126
Forest	237
Water	55
Wetlands	11
Transportation	44
Other	103

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<sup>1</sup> Beaver Creek Dam Emergency Action Plan

<sup>2</sup> CCWRA – Hydrologic Unit Codes in Chester County

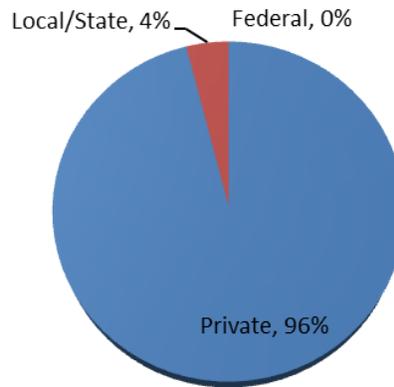
<sup>3</sup> <http://gerlach.house.gov/district/interactivemap.htm>

<sup>4</sup> AMEC - SITES Model Parameters - Existing Land Use Conditions

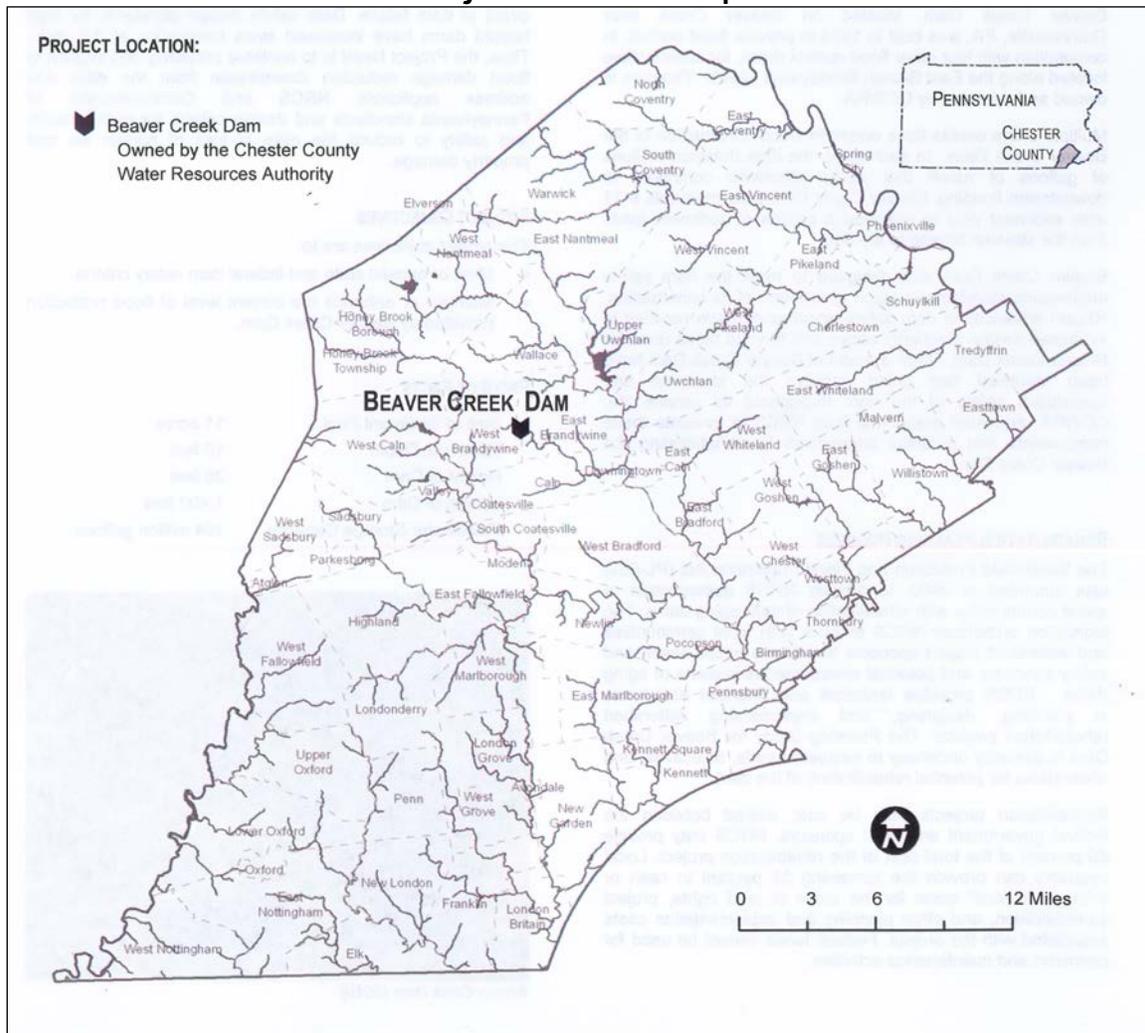
<sup>5</sup> AMEC - Runoff Curve Number Calculations - USGS Landsat Cover Grid

Figure S-1 provides relevant information regarding the percentages of private, state/local and federal land ownership upstream from the Hibernia Dam.

### Figure S-1 Land Ownership in Watershed



### Figure S-2 Project Location Map



## PROJECT BENEFICIARY PROFILE

Table S-2 provides relevant information regarding the project beneficiary profile.

**Table S-2**  
**Project Beneficiary Profile**

<b>Beneficiary</b>	<b>East Brandywine Township<sup>1</sup></b>	<b>Downingtown<sup>1</sup></b>	<b>Chester County<sup>1</sup></b>	<b>Pennsylvania<sup>1</sup></b>	<b>U.S.<sup>1</sup></b>
Population	6,742	7,891	498,886	12,702,379	308,745,538
Median Age	41.6 years	35.8 years	39.3 years	40.1 years	37.2 years
Per Capita Income	\$41,275	\$27,944	\$42,042	\$27,824	\$27,915
Median Household Income	\$107,944	\$51,524	\$86,264	\$51,651	\$52,762
Total Number of Households	2,331	3,430	182,732	4,952,566	114,761,359
Median Value of Housing Units	\$286,200	\$223,000	\$333,400	\$163,200	\$186,200
Percent of Families Living Below Poverty Level	0.8%	4.9%	3.7%	8.8%	10.5%

<sup>1</sup> Source: United States Census Bureau, Census 2010

The proposed action directly benefits 2,331 households in East Brandywine Township and 3,430 households in Downingtown, downstream from the dam. Additionally the proposed action indirectly benefits approximately 498,886 people which includes the population of Chester County.

**Table S-3  
 Primary Alternative Plans Considered**

Alternative	Summary of Alternative	Screening Method			Carried Forward for Detailed Study?
		Estimated Cost	Project Purpose Met	Project Need Met	
<b>No Action/Future Without Federal Project</b>	<ul style="list-style-type: none"> <li>Minimum constructed breach of the embankment to remove the storage function of the dam and restore the stream to a free-flowing state through the impoundment area and the footprint area of the dam.</li> </ul>	\$1,272,000			Yes
<b>Dam Rehabilitation (NED Alternative)</b>	<ul style="list-style-type: none"> <li>Federally assisted rehabilitation of dam to NRCS and Commonwealth of Pennsylvania High Hazard Class dam design criteria by lowering and armoring the auxiliary spillway, and installing a replacement riser, shoreline protection, sand diaphragm, accessible toe drains and a drain trench in the area past the left downstream toe of the dam.</li> </ul>	\$4,364,000	✓	✓	Yes
<b>Dam Decommissioning</b>	<ul style="list-style-type: none"> <li>Federally assisted removal of the entire embankment and restore the stream and 100-year floodplain to a free-flowing state through the impoundment area and the footprint area of the dam.</li> </ul>	\$1,462,000			No
<b>Dam Decommissioning with Nonstructural measures</b>	<ul style="list-style-type: none"> <li>Federally assisted removal of the entire embankment and restore the stream and 100-year floodplain to a free-flowing state through the impoundment area and the footprint area of the dam.</li> <li>Acquire and demolish existing residential and public structures in the downstream 100-year floodplain.</li> </ul>	>\$77,000,000	✓	✓	No

Alternative	Summary of Alternative	Screening Method			Carried Forward for Detailed Study?
		Estimated Cost	Project Purpose Met	Project Need Met	
<p><b>Other Nonstructural Measures (Floodproofing)</b></p>	<ul style="list-style-type: none"> <li>▪ Maintain dam at current configuration.</li> <li>▪ Construct a levee or floodwall to protect 1,725 residences, 20 businesses, 8 schools, and 2 child care centers.</li> <li>▪ Elevate 125 residences and 10 businesses above the breach inundation elevation.</li> <li>▪ Prevent development in breach inundation area.</li> </ul>	>\$48,000,000	✓	✓	No
<p><b>Acquisition or Relocation of At-Risk Structures</b></p>	<ul style="list-style-type: none"> <li>▪ Maintain dam at current configuration.</li> <li>▪ Acquire &amp; demolish or relocate 1,850 residences, 30 businesses, 8 schools, and 2 child care centers.</li> <li>▪ Prevent development in breach inundation area.</li> </ul>	>\$449,000,000	✓	✓	No

## PROJECT COSTS

Table S-4 summarizes the allocation of project costs for the Preferred Alternative. Funding will be requested annually until the project is funded.

**Table S-4**  
**Estimated Project Costs<sup>1</sup>**

Rehabilitate to NRCS High Hazard Class Dam	Source				Total Costs
	PL 83-566 Funds <sup>2</sup>		Other Funds		
	\$	%	\$	%	
Construction	\$ 2,288,000	72%	\$ 907,000	28%	\$ 3,195,000
Engineering	\$ 958,000	97%	\$ 25,000	3%	\$ 983,000
Relocation	\$ -	0%	\$ -	0%	\$ -
Real Property Rights	\$ -	0%	\$ -	0%	\$ -
Natural Resource Rights	\$ -	0%	\$ -	0%	\$ -
Project Administration	\$ 160,000	86%	\$ 25,000	14%	\$ 185,000
Permits	\$ -	0%	\$ 1,000	100%	\$ 1,000
<b>Total Costs</b>	<b>\$ 3,406,000</b>	<b>78%</b>	<b>\$ 958,000</b>	<b>22%</b>	<b>\$ 4,364,000</b>
Annual O & M Costs	\$ -	0%	\$ 24,000	100%	\$ 24,000

January-2014

<sup>1</sup> Price base 2013

<sup>2</sup> Maximum PL-83-566 cost-share is 65% of eligible cost-sharable items, not to exceed 100% of total construction costs. Not all cost-sharable items are included in the table, such as non-NRCS technical and engineering assistance for initial project planning.

Source: NRCS Rehab Cost Comp Est Worksheet

**Table S-5  
 Estimated Project Benefits<sup>1</sup>**

<b>Rehabilitate to NRCS High Hazard Class Dam</b>	<b>Estimated Average Annual Monetary Benefits</b>
<b>Flood Damage Reduction</b>	
Residential, Commercial and Transportation	\$ 263,700
<b>Other Benefits</b>	
Avoided Cost <sup>2</sup>	\$ 54,200
<b>Total Monetary Benefits</b>	<b>\$ 317,900</b>

January-2014

<sup>1</sup> Price base 2013

<sup>2</sup> Per Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, 1.7.2 (b) (3) - the avoided cost of the most likely alternative to the planned action.

**Table S-6  
 Estimated Project Benefits and Costs**

<b>Item</b>	<b>Value</b>
Average Annual Benefits <sup>2</sup>	\$ 317,900
Average Annual Costs <sup>2</sup>	\$ 210,000
Net Economic Benefits	\$ 107,900
Benefit Cost Ratio	1.5:1
Period of Analysis	50 years
Project Life	50 years

January-2014

<sup>1</sup> Price base 2013

<sup>2</sup> Amortized over 50 years at 3.5%, includes Operation and Maintenance.

## ENVIRONMENTAL CONSIDERATIONS AND EFFECTS

Table S-7 describes the resource concerns identified during project scoping and summarizes the potential impacts related to the Preferred Alternative.

**Table S-7**  
**Summary of Relevant Resource Concerns and Effects of Rehabilitation**

Relevant Resource Concern	Summary of Effects of Preferred Alternative
Air Quality/Clean Air Act	<ul style="list-style-type: none"> <li>• There will be some temporary affects during construction (dust and exhaust). Measures will be implemented to minimize effects.</li> </ul>
Aquatic Resources	<ul style="list-style-type: none"> <li>• No effect.</li> </ul>
Cultural Resources	<ul style="list-style-type: none"> <li>• No effect.</li> </ul>
Endangered and Threatened Species	<ul style="list-style-type: none"> <li>• No effect. Construction will be coordinated to avoid noise and activity disturbance to nearby Bald Eagle nesting site.</li> </ul>
Environmental Justice	<ul style="list-style-type: none"> <li>• The Beaver Creek Dam provides flood protection for the Borough of Downingtown, which has a higher percentage of residents who are Black or Hispanic than the statewide percentage. 4.9% of households are living below the poverty level.</li> <li>• No disproportionate adverse effects are anticipated to any ethnic, racial, or socioeconomically disadvantaged families or groups downstream of the dam.</li> </ul>
Erosion and Sedimentation	<ul style="list-style-type: none"> <li>• Sediment retention capacity maintained. Temporary increase during construction. Measures will be implemented to minimize effects.</li> </ul>
Fish and Wildlife	<ul style="list-style-type: none"> <li>• Habitat for numerous aquatic and terrestrial species maintained.</li> </ul>
Floodplain Management	<ul style="list-style-type: none"> <li>• Floodplain protection maintained.</li> </ul>
Floodwater Damage	<ul style="list-style-type: none"> <li>• Threat of loss of life or unsafe conditions from the dam failing minimized.</li> </ul>
Forest Resources	<ul style="list-style-type: none"> <li>• Forest resources maintained.</li> </ul>
Invasive Species	<ul style="list-style-type: none"> <li>• Construction could potentially introduce invasive plant species. Measures will be taken to minimize effects.</li> </ul>
Land Use	<ul style="list-style-type: none"> <li>• Land use in the benefit area will be maintained.</li> </ul>
Migratory Birds/Bald and Golden Eagle Protection Act	<ul style="list-style-type: none"> <li>• Temporary effects possible during construction. Present and potential habitat sites will be maintained.</li> </ul>
Prime and Unique Farmlands	<ul style="list-style-type: none"> <li>• Maintain existing level of flood protection for Prime Farmland or Farmland of Statewide Importance.</li> </ul>
Public Health and Safety	<ul style="list-style-type: none"> <li>• Continue to provide flood protection to agricultural land, rural transportation facilities, and rural residential structures in a manner that minimizes the risk of loss of human life.</li> </ul>
Regional Water Resources Plans	<ul style="list-style-type: none"> <li>• Continue to support Regional Water Resources Plans.</li> </ul>
Riparian Areas	<ul style="list-style-type: none"> <li>• Maintain existing impoundment &amp; stream riparian areas.</li> </ul>
Scenic Beauty	<ul style="list-style-type: none"> <li>• Maintain scenic quality of the general landscape.</li> </ul>

Relevant Resource Concern	Summary of Effects of Preferred Alternative
Social Issues	<ul style="list-style-type: none"> <li>• Promote public health and safety; continue flood protection; and support local labor and management requirements.</li> </ul>
Water Quality	<ul style="list-style-type: none"> <li>• No effect.</li> </ul>
Water Resources	<ul style="list-style-type: none"> <li>• No effect.</li> </ul>
Waters of the United States/Clean Water Act	<ul style="list-style-type: none"> <li>• No effect.</li> </ul>
Wetlands	<ul style="list-style-type: none"> <li>• No effect.</li> </ul>

**MITIGATION**

No compensatory mitigation activities are required. All needed measures will be taken to mitigate (avoid, minimize, and compensate) any adverse impacts during construction and may include timing of work, sediment controls such as seeding, mulching and silt fences and wetting construction areas to reduce dust.

**MAJOR CONCLUSIONS**

The Preferred Alternative is to rehabilitate Beaver Creek Dam (PA-433) to current Commonwealth of Pennsylvania and NRCS High Hazard Class dam design criteria for a service life of 50 years. This is also the National Economic Development Alternative.

**AREAS OF CONTROVERSY**

No areas of controversy were identified.

**ISSUES TO BE RESOLVED**

None identified.

**EVIDENCE OF UNUSUAL CONGRESSIONAL OR LOCAL INTEREST**

No evidence of unusual congressional or local interests was identified.

**COMPLIANCE CERTIFICATION**

Is this report in compliance with executive orders, public laws, and other statutes governing the formulation of water resource projects? Yes X No     .

## 1.0 PURPOSE AND NEED FOR ACTION

### 1.1 CHANGES REQUIRING PREPARATION OF A SUPPLEMENT

Beaver Creek Dam (PA-433), designed and constructed as a High Hazard Class dam, does not meet current NRCS and PADEP dam design and safety criteria.

### 1.2 INTRODUCTION

This Supplemental Watershed Work Plan No.8 and Environmental Evaluation formulate, evaluate, and resolve alternatives for the rehabilitation of Beaver Creek Dam (PA-433).

The Brandywine Creek Watershed Work Plan was completed and approved July 23, 1962. It has subsequently been supplemented seven times.

In addition, a previous Supplemental Watershed Work Plan No. 7 was developed in August 1996. The purpose of the supplemental plan was to remove two proposed flood water retarding structures from the Watershed Work Plan. This plan was completed, but is on hold. It was not approved or signed by the Sponsors and NRCS.

The Sponsors and NRCS recently drafted a Draft Watershed Work Plan No.7- Environmental Evaluation for works of improvement for the rehabilitation of Hibernia Dam (PA-436F), Commonwealth of Pennsylvania. To maintain sequence, the Hibernia Dam rehabilitation supplement is designated as Supplement No. 7 and this Beaver Creek rehabilitation supplement is designated as Supplement No. 8.

NRCS completed a Rehabilitation Assessment Report which included an evaluation and estimated risk based profile of the dam in June 2011. The evaluation indicated that the Beaver Creek Dam (PA-433) Risk Index was 3,686. NRCS reviewed the breach inundation zone downstream from the dam and determined that developments immediately downstream were subject to flooding during a breach of the dam.

### 1.3 PROJECT PURPOSE

The purpose of the project includes the following:

- Maintain or improve the current level of flood damage reduction provided by the Beaver Creek Dam (PA-433) for public safety, bridges, roads, agricultural and other lands, buildings, structures, infrastructure, and other features.
- Comply with applicable design, performance and safety criteria for High Hazard Class dams.

### 1.4 PROJECT NEED

The need for the proposed federal action (Project Need) arises from the fact that Beaver Creek Dam, designed and constructed as a High Hazard Class dam, does not meet current dam design and safety criteria. The dam was originally constructed in 1974 with a 50-year service life. Both NRCS and the Pennsylvania Department of Environmental Protection (PA DEP), Bureau of Waterways Engineering, have classified Beaver Creek Dam, as a High Hazard Class dam. The hazard classification is based on the potential for loss of life due to the prevalence of bridges, roads and buildings existing in the downstream dam breach inundation zone. The Project Need is to continue providing flood damage reduction downstream from the dam and address applicable NRCS and Commonwealth of Pennsylvania standards and design criteria for public health and safety to reduce the risk of loss of human life.

## 1.5 OPPORTUNITIES

The following opportunities will be recognized by implementing an alternative that addresses the project purpose and need. Quantification of these opportunities will be provided in other sections of this report as necessary.

- Comply with dam design and safety criteria established by NRCS and PADEP.
- Minimize the potential for loss of life associated with a failure of the dam.
- Reduce Sponsor liability associated with operation of noncompliant dam.
- Sustain the existing level of flood protection for downstream agricultural land, houses, businesses, and infrastructure.
- Protect real estate values by providing 100-year, 24-hour flood protection.
- Protect water quality.

## 2.0 SCOPE OF THE PLAN

### 2.1 SCOPING PROCESS

A scoping process identified issues of economic, environmental, cultural, and social concerns related to the project. Concerns of Sponsors and local citizens were expressed at planning and at public meetings of the Chester County Water Resources Authority. Factors that affect soil, water, air, plant and animal resources were identified by engineers, biologists, economists, resource conservationists, water quality specialists and others. The scoping process of the Environmental Evaluation for the dam involved site investigations, public meetings, and consultations with jurisdictional agencies.

The scoping process identified the (1) objectives, needs, and primary concerns for the Sponsor, (2) the relevant issues, and (3) the environmental concerns associated with the project.

### 2.2 IDENTIFIED RESOURCE CONCERNS

Table 2-1 identifies the primary Resource Concerns based on the National Watershed Program Manual, Part 501.24 and the additional Resource Concerns included in the Project Scope-of-Work. Relevancy to the proposed action was determined when sufficient rationale was provided. Irrelevant concerns are eliminated from further consideration. Relevant resource concerns were reviewed in detail for the alternatives comparison.

**Table 2-1  
 Summary of Scoping**

Resource Concern	Relevant to Proposed Action?	Rationale
National Economic Development (NED)	Yes	<ul style="list-style-type: none"> <li>The proposed action reduces the offsite or public problem and maximizes net national economic development benefits.</li> </ul>
Air Quality/Clean Air Act	Yes	<ul style="list-style-type: none"> <li>The proposed action or alternatives are located in a nonattainment area.</li> <li>There will be some temporary affects during construction (dust and exhaust).</li> </ul>
Aquatic Resources	Yes	<ul style="list-style-type: none"> <li>The Beaver Creek Dam impoundment and the surrounding areas provide limited aquatic resources.</li> </ul>
Coastal Zone Management Area	No	<ul style="list-style-type: none"> <li>The Beaver Creek Dam is not located in an area subject to Coastal Zone Management regulations.</li> </ul>
Coral Reefs	No	<ul style="list-style-type: none"> <li>No coral reefs or associated water bodies (e.g. embayment areas) are present in or near the planning area.</li> </ul>
Cultural Resources	Yes	<ul style="list-style-type: none"> <li>No cultural resources are known to exist within the project area.</li> <li>Cultural resources may be affected by some alternatives.</li> </ul>
Ecological Critical Areas	No	<ul style="list-style-type: none"> <li>There are no critical habitat areas in or near the project area.</li> </ul>

Resource Concern	Relevant to Proposed Action?	Rationale
Endangered and Threatened Species	Yes	<ul style="list-style-type: none"> <li>Some alternatives have potential to affect federal- or state-listed threatened or endangered species.</li> </ul>
Environmental Justice	Yes	<ul style="list-style-type: none"> <li>The Beaver Creek Dam provides flood protection for the Borough of Downingtown, which has a higher percentage of Black and Hispanic residents than the statewide average and has a 4.9 percentage of households living below the poverty level.</li> </ul>
Erosion and Sedimentation	Yes	<ul style="list-style-type: none"> <li>The Brandywine Creek watershed has USEPA-approved TMDLs for sediment, bacteria and nutrients.</li> <li>Significant sediment accumulations have been observed in the reservoir.</li> </ul>
Essential Fish Habitat	No	<ul style="list-style-type: none"> <li>There are no essential fish habitats in or near the project area.</li> </ul>
Fish and Wildlife	Yes	<ul style="list-style-type: none"> <li>The Beaver Creek Dam impoundment provides limited habitat for aquatic and terrestrial species.</li> </ul>
Floodplain Management	Yes	<ul style="list-style-type: none"> <li>The breach inundation area includes portions of the Brandywine Creek 100-year floodplain.</li> <li>The purpose of the Beaver Creek Dam is to reduce flooding losses in downstream communities.</li> </ul>
Floodwater Damage	Yes	<ul style="list-style-type: none"> <li>Project Purpose is to provide flood protection for residents, motorists, and other persons using downstream facilities, and minimize threat of loss of life or unsafe conditions from the dam failing.</li> </ul>
Forest Resources	Yes	<ul style="list-style-type: none"> <li>Forest resources may be impacted by implementation of some project alternatives.</li> </ul>
Invasive Species	Yes	<ul style="list-style-type: none"> <li>There are several species of invasive vegetation around Beaver Creek Dam that are common in southeastern Pennsylvania.</li> <li>Construction could potentially introduce invasive species.</li> </ul>
Land Use	Yes	<ul style="list-style-type: none"> <li>Land use has been planned in the benefit area under the premise that the dam would be retained.</li> <li>Loss of the dam would significantly impact land use in the benefit area.</li> </ul>
Migratory Birds/Bald and Golden Eagle Protection Act	Yes	<ul style="list-style-type: none"> <li>Bald eagles have been observed numerous times near the Beaver Creek dam. A bald eagle nesting site is present near the dam.</li> <li>The site is along the east coast migratory path.</li> <li>It is confirmed that a bald eagle nesting site was present near the dam in 2013.</li> </ul>
Natural Areas	No	<ul style="list-style-type: none"> <li>No designated Natural Areas will be affected by the project.</li> </ul>
Parklands	No	<ul style="list-style-type: none"> <li>The Beaver Creek Dam impoundment and the surrounding area are not designated as a Park.</li> </ul>
Prime and Unique Farmlands	Yes	<ul style="list-style-type: none"> <li>Soils surrounding the Beaver Creek Dam are classified as either Prime Farmland or Farmland of Statewide Importance.</li> </ul>

Resource Concern	Relevant to Proposed Action?	Rationale
Public Health and Safety	Yes	<ul style="list-style-type: none"> <li>Project Purpose is to continue to provide flood protection to agricultural land, rural transportation facilities, and rural residential and commercial structures in a manner that minimizes the risk of loss of human life.</li> </ul>
Regional Water Resources Plans	Yes	<ul style="list-style-type: none"> <li>The proposed project may affect Regional Water Resources Plans.</li> </ul>
Riparian Areas	Yes	<ul style="list-style-type: none"> <li>Riparian areas may be impacted by the project alternatives.</li> </ul>
Scenic Beauty	Yes	<ul style="list-style-type: none"> <li>Scenic quality of the general landscape may be affected by some alternatives.</li> </ul>
Scientific Resources	No	<ul style="list-style-type: none"> <li>No scientific resources known in or near project area.</li> </ul>
Sole Source Aquifer	No	<ul style="list-style-type: none"> <li>Chester County is not identified as a county that is at risk of contaminating sole source aquifers.</li> <li>The project is not included in a stream flow source zone within two miles of the Delaware River.</li> </ul>
Social Issues	Yes	<ul style="list-style-type: none"> <li>Numerous social issues, including, public health and safety, flood damages, and local labor and management requirements.</li> </ul>
Water-Based Recreation	No	<ul style="list-style-type: none"> <li>Water-based recreation is not allowed at the project site and alternatives will not affect other water-based recreation in the area.</li> </ul>
Water Quality	Yes	<ul style="list-style-type: none"> <li>Surface water quality may be affected by some alternatives.</li> <li>There are no identified ground water issues.</li> </ul>
Water Resources	Yes	<ul style="list-style-type: none"> <li>The Beaver Creek Dam impoundment and the surrounding areas provide water resources.</li> </ul>
Waters of the United States/Clean Water Act	Yes	<ul style="list-style-type: none"> <li>Alternatives may have impacts to surface waters and wetlands.</li> <li>The Brandywine Creek watershed has USEPA-approved TMDLs for sediment, bacteria and nutrients.</li> </ul>
Wetlands	Yes	<ul style="list-style-type: none"> <li>Wetlands are present in the vicinity of the project area and could be disturbed by project alternatives.</li> </ul>
Wild and Scenic Rivers	No	<ul style="list-style-type: none"> <li>Beaver Creek is neither a Federally-listed nor a State-Listed Wild and Scenic River.</li> </ul>

## 3.0 AFFECTED ENVIRONMENT

Unless otherwise noted in the following sections, future conditions are projected to remain unchanged.

Additional information regarding the affected environment of the Brandywine Watershed can be found in the Brandywine Work Plan. Conditions that have changed specific to Beaver Creek Dam are provided below.

### 3.1 PROJECT SETTING

Beaver Creek Dam is located in East Brandywine Township, Chester County, Pennsylvania. Its geographic coordinates are 40° 01' 48" North Latitude and 75° 47' 00" West Longitude (see Project Location Map in Appendix B). The dam is situated at approximately 500 feet above mean sea level. The rolling topography of the area is characteristic of the Piedmont Uplands Section of the Piedmont Physiographic Province. Although Beaver Creek Dam is located in East Brandywine Township, the majority of the 2.98 square mile watershed that drains into the Beaver Creek Dam impoundment is located in West Brandywine Township. The dam is located approximately 2 miles north of Route 30 By-Pass and 1 mile west of US Route 322, and about 1 mile west of Guthriesville, PA.

Beaver Creek Dam was designed and constructed under the supervision of the USDA Natural Resources Conservation Service (NRCS, formerly USDA Soil Conservation Service, SCS) in 1974. The Beaver Creek Dam watershed encompasses 2.98 square miles. Beaver Creek Dam has a length of 1,400 feet and is 35-foot high and has created an 11-acre impoundment. The maximum depth of the impoundment is 10 feet. Beaver Creek Dam has a flood water storage capacity of 184 million gallons. The dam discharges in to Beaver Creek which subsequently flows into the East Branch Brandywine Creek downstream from the dam. The purpose and objective for the construction of Beaver Creek Dam was to provide flood control for the East Branch Brandywine Creek and the main stem of the Brandywine Creek. Beaver Creek is not listed as an impaired water body (USEPA NEPAssist Report 2012).

### 3.2 SOILS

A current soil survey report obtained from the USDA NRCS Web Soil Survey indicates that there are five (5) soil map units within the defined study area. For the purposes of this resource (e.g. soils) the defined study area encompasses the perimeter around the Beaver Creek Dam impoundment and downstream along Beaver Creek approximately 1/4 mile to where Beaver Creek passes under Reeceville Road. Approximately 1/3 of the soil types identified within the project area and depicted on the Web Soil Survey are presently under water (e.g. the Beaver Creek Dam impoundment). For the portion of the study area not presently under water; the predominant soils group is the Gladstone gravelly loam. The second most predominant soils group is the Cokesbury silt loam. Table 3-1 below summarizes the soil units present within the defined study area.

**Table 3-1  
 Summary of Soil Units within Project Study Area**

<b>Soil Map Unit Name</b>	<b>Soil Map Unit Symbol</b>	<b>K Factor Erosion Potential**</b>	<b>Prime Farmland***</b>	<b>Hydric Soil</b>
Califon loam, 3 to 8 percent slope	CaB	.28	PFL	Partial
Cokesbury silt loam, 0 to 3 percent slope	CpA	.32	No	Yes
Cokesbury silt loam 3 to 8 percent slope	CpB	.32	No	Yes
Gladstone gravelly loam, 3 to 8 percent slope*	GdB	.28	PFL	Partial
Gladstone gravelly silt loam, 8 to 15 percent slope*	GdC	.28	FSI	Partial

Notes: \* Indicates that this soil unit is mapped within the project study area, but a majority of it has been flooded by the Beaver Creek impoundment.  
 \*\* K Factor Erosion Potential indicates the soil unit's susceptibility to sheet and rill erosion, K Factor < .39 = Not Susceptible to Erosion; K Factor > .39 = Susceptible to Erosion.  
 \*\*\* PFL Indicates Prime Farm Land; FSI Indicates Farmland of Statewide Importance

### 3.3 SOIL EROSION AND SEDIMENTATION

A sediment survey was completed in November 2011. The sedimentation study concluded that approximately 21 acre-feet of sediment has accumulated in the sediment pool at Beaver Creek Dam. This is 49% of the original 42.8 acre-feet sediment volume documented in the Final Design Report (1972).

The reservoir sedimentation rate and available sediment storage in the pool was evaluated for the 50-year period of 2018 to 2068, in accordance with NEH Section 3, Chapter 8 and SCS-ENG-309. The evaluation was performed using current and projected future land use conditions provided by CCWRA in the Beaver Creek Dam - Agriculture Land Cover Analysis, dated November 20, 2011. The agricultural soil loss rate was obtained from the RUSLE2 Erosion Calculation Record for Chester County, Pennsylvania. The estimated annual sedimentation rate is 0.262 acre-ft.

Given the agricultural nature of the watershed it is assumed that a substantial portion of the sedimentation is a result of sheet and rill erosion, although there may be stream bank erosion within the watershed that is also a source of sediment. There are no current on-site sheet or rill erosion issues, and no current ephemeral gully erosion issues identified. Erosion along the upstream face of the dam at the pool water level was observed. The presence of Beaver Creek Dam reduces the amount of sediment loadings downstream and the cost of removal of sediment from downstream bridges and culverts.

### 3.4 WATER RESOURCES

**Excessive Subsurface Water.** Beaver Creek Dam includes twelve piezometers, six with sensing tips in the embankment and six with sensing tips in the foundation, as well as toe drains. CCWRA has noted that review of the piezometer records indicate the one piezometer, BP-6S, has periods when the measured water level is higher than the adjacent toe drain. It is thought that this condition may be due to natural high groundwater in the vicinity of this piezometer and is not indicative of a dam safety problem at this time. According to the 2011 Gannett Fleming Piezometer Monitoring & Evaluation Report, the east toe drain measured flow between August 2009 and November 2010 fluctuated between just under 8 gpm and just under 18 gpm. The

report concluded that neither the toe drain nor the piezometer collected data are considered to be indicative of any dam safety issues.

**Excessive Seepage.** The Project Team reviewed previously completed subsurface exploration studies and conducted test pit evaluations at wet areas adjacent to the project. The previous subsurface exploration studies included borings taken throughout the dam and auxiliary spillway areas, installation and monitoring of twelve piezometers, evaluation of the drain flows, and excavation and observation of five (5) test pits. There was no evidence of excessive seepage that would affect the normal pool elevation or pose a risk to the downstream community.

**Excessive Runoff, Flooding or Ponding.** Beaver Creek Dam was constructed in 1974 as a flood control dam to reduce flooding losses in the downstream communities. Currently, the dam controls runoff from a 2.98 square mile area up to the 100-year storm, and mitigates flood flows greater than that return period.

The peak inflow to the dam from the Beaver Creek Watershed during the 100 year storm is 2,515 cfs. According to the July 1972 NRCS Design Report, the peak flow from the Beaver Creek Dam principal spillway during the 100-year storm is 120 cfs. This means the presence of Beaver Creek Dam reduces the peak flow rate by 2,394 cfs, a 95% reduction.

Chester County Water Resources Authority (CCWRA) has documented standing water in one area located downstream of the dam in past years. The Project Team observed five (5) test pit excavations in December 2011 to assess the source of excess moisture, concluding that the excess moisture at the toe of the dam is primarily due to poor surface drainage combined with a largely shaded area that inhibits drying/evaporation, as well as minimal infiltration through the topsoil layer.

A dam breach analysis was completed in 2000, and evaluated the Probable Maximum Flood. A breach would impact several communities, including the Borough of Downingtown located 7 miles downstream from the dam site. PADEP and NRCS have classified Beaver Creek Dam as a High Hazard Class dam, which is based on the potential for loss of life due to the prevalence of bridges, roads, and buildings existing in the downstream dam breach inundation zone.

Chester County recently completed a County-wide Act 167 - Stormwater Management Plan (approved July 2, 2013). This plan was reviewed for information relevant to future condition runoff.

**Surface Water Quality.** The watershed surrounding Beaver Creek Dam consists of a mix of agricultural, residential, and forested land use. In recent years a golf course and additional residential development have been constructed immediately adjacent to Beaver Creek Dam. The golf course is under agreement with the CCWRA to control chemical applications and is not presently considered a potential source of pesticide or nutrient contamination. However, fertilizers and pesticides were previously applied to agricultural lands and sediment in overland runoff could contain excessive levels of nutrients and pesticides.

The Brandywine Creek watershed has USEPA-approved TMDLs for sediment, bacteria and nutrients. Beaver Creek is not listed as impaired and has not been assigned a waste load for sediment. Past and current adjacent and upstream farming activities and upstream stream bank erosion of Beaver Creek are potential contributing sedimentation sources. Neither Beaver Creek nor the Beaver Creek Dam impoundment is listed as impaired water bodies.

Beaver Creek (downstream of the Beaver Creek Dam) is designated as a Cold Water, Migratory Fishery (CWF-MF), but does experience periods where temperatures approach the upper tolerances for trout. Temperatures and fisheries data can be found in the water quality standards review stream redesignation evaluation report for Beaver Creek dated October 2006.

In recent site visits to Beaver Creek Dam resident Canada geese were observed. Pathogens from their fecal matter could contaminate the dam impoundment. While there are many geese at Beaver Creek Dam throughout the year; it is difficult to quantify how many are resident geese. However, it is possible that at certain times, the number of geese exceed 1,000.

The USGS sampling of five (5) sites on Beaver Creek and a tributary up-gradient of Beaver Creek Dam indicate fair to excellent water quality. A USGS study conducted in 2001 confirms loading of bacteria in the watershed. Beaver Creek was identified as contributing to elevated bacterial levels to the East Brandywine Creek. Note, however, that the sampling location for this study was several miles downstream of the Beaver Creek Dam.

Land use in the Beaver Creek Dam watershed is currently changing from agriculture to residential. This will reduce future sediment loading and reduce potential agriculture related bacteria and nutrient loading.

**Groundwater.** The geology of Chester County includes fractured-rock aquifers, where weathered bedrock (saprolite) and soil overlie the competent bedrock. Water-bearing properties differ by geologic unit. Thickness of the saprolite varies but commonly is from 10 to 40 feet. Soils in much of the county are moderately deep and well-drained, although the soils are thin and (or) poorly drained in some areas. Drilled wells generally are completed as open holes in the bedrock, with casing extending through the saprolite to the top of competent bedrock. Hand-dug wells dating from the period before drilled wells were common (by the early 20th century) generally are completed in the saprolite. Unconsolidated deposits in the county generally are not used as aquifers.

The fractured-rock aquifers are recharged locally by precipitation infiltrating through soils and saprolite to the bedrock. Groundwater flows through fracture openings in the bedrock and also in the saturated part of the saprolite. Under natural conditions, groundwater discharges to streams and springs. The water table generally is a subdued replica of the land surface, as shown by 27 maps of groundwater levels in the county; such that groundwater flow paths commonly follow topography. Base flow (supplied by groundwater discharge to streams) comprises about 60 percent of total annual stream flow on average, as estimated from water budgets for several streams in Chester County, and may be as high as about 80 percent of stream flow.

Depth to water typically varies by topography; depths to water are greater under hilltops than on slopes or in valleys. Groundwater levels fluctuate seasonally because of changes in net recharge rates; depth to water is greatest in the fall and least in the spring. Although precipitation is distributed nearly evenly throughout the year, net recharge generally is greater in the cooler months (October–April), when evapotranspiration is reduced, than in the warmer months (May–September). Long-term average groundwater levels and base flow are highest in spring and lowest in fall in Chester County, Pennsylvania.

**Groundwater Quality.** This section is based on the review of the Chester County Groundwater Atlas, USGS Report 03-442, dated 2004.

Adjacent long-term agricultural land use is a potential source of groundwater impact as it relates to pesticides. However, there is no known pesticide contamination documented or identified impacting the groundwater quality in the vicinity of Beaver Creek Dam. There were no wells sampled by the USGS for pesticides in the vicinity of Beaver Creek Dam according to the Chester County Groundwater Atlas, Chester County, Pennsylvania 2004. In recent years a golf course and residential development has been constructed immediately adjacent to Beaver Creek Dam. The golf course is under agreement with the CCWRA to control chemical applications and is not presently considered a potential source of pesticide contamination.

There are documented elevated levels of nutrients (Nitrate, Nitrite, and Phosphorus) in groundwater wells throughout Chester County. Although there is no available groundwater nutrient data specific to Beaver Creek Dam and its immediate vicinity, the 2004 Chester County Groundwater Atlas indicates wells nearby to Beaver Creek exhibit elevated phosphorus levels, but not nitrate or nitrite levels.

There are no known sources of pathogens that pose a risk to the groundwater.

### 3.5 AIR QUALITY

Chester County is in the Philadelphia-Wilmington Nonattainment area for 24-hour particulate matter less than 2.5 micrometers diameter (PM<sub>2.5</sub>) and is in a moderate excessive eight (8) hour ozone zone according to the USEPA. There are no known chemical plants or sources within the watershed that would cause any chemical drift issues. There are no known permitted air emission sources or sources of objectionable odors from Beaver Creek Dam.

### 3.6 BIOLOGICAL RESOURCES

**Vegetation.** Vegetation present in and around Beaver Creek Dam is typical of the Chester County and Southeastern, Pennsylvania. Habitats include: deciduous hardwood forest, meadows, and mowed/maintained fields. The deciduous hardwood forests in the region are classified as Mixed Oak Forest, dominated by white, red and black oaks, often mixed with tulip poplar, and red maple, with lesser amounts of hickory, black cherry and beech. Stands of eastern hemlock (and occasionally sugar maple) are less frequent in the county, limited primarily to the cool north-facing slopes along streams. Understory plants typically include mountain laurel, blueberry, and huckleberry and a sparse herb layer containing plants such as partridgeberry and frostweed.

**Noxious and Invasive Plants.** There are several species of invasive vegetation around Beaver Creek Dam that are common in southeastern Pennsylvania. Multi-flora rose, Canada thistle, duckweed and watermeal have been identified around or on the impoundment. Invasive plants currently exist but are not causing a problem for the management of the dam or impoundment.

**Fish and Wildlife.** Beaver Creek is a Cold Water Migratory Trout Stocking Fisheries stream (CWF-MF, TSF). A reach of Beaver Creek, well downstream of Beaver Creek Dam, is listed by the PA Fish and Boat Commission as a Wild Trout Waters (Naturally Reproducing) as of June 2011.

Beaver Creek impoundment was stocked with fish for many years by a previous land owner; however the impoundment does not have any special designation as a warm water or cold water fishery.

Wildlife in the vicinity of Beaver Creek Dam and the impoundment can be described as typical for southeastern Pennsylvania. It is common to see deer, fox, beaver, squirrel, heron and other water fowl on or near the dam and sediment pool. In addition, a bald eagle nesting site was active in 2013 in a wooded area adjacent to the sediment pool.

### 3.7 HUMAN, ECONOMIC, AND SOCIAL CONSIDERATIONS

**Social Conditions.** The project site is located in a rural area of Chester County, Pennsylvania. The population of the area around the project shows steady growth due to rural residential development in Chester County. The land use in the project drainage area is primarily rural residential and agriculture. Table 3-2 provides relevant information regarding the social and economic conditions in the study area.

Table 3-2  
Social and Economic Profile<sup>1</sup>

Beneficiary	East Brandywine Township <sup>1</sup>	Downingtown <sup>1</sup>	Chester County <sup>1</sup>	Pennsylvania <sup>1</sup>	U.S. <sup>1</sup>
Population	6,742	7,891	498,886	12,702,379	308,745,538
Median Age	41.6 years	35.8 years	39.3 years	40.1 years	37.2 years
Per Capita Income	\$41,275	\$27,944	\$42,042	\$27,824	\$27,915
Median Household Income	\$107,944	\$51,524	\$86,264	\$51,651	\$52,762
Total Number of Households	2,331	3,430	182,732	4,952,566	114,761,359
Median Value of Housing Units	\$286,200	\$223,000	\$333,400	\$163,200	\$186,200
Percent of Families Living Below Poverty Level	0.8%	4.9%	3.7%	8.8%	10.5%

<sup>1</sup> Source: United States Census Bureau, Census 2010

**Land Use and Land Cover.** Beaver Creek Dam is located within an area zoned as R-2 Residential. The Beaver Creek Dam impoundment is approximately 11 acres in size and has a maximum depth of 10 feet. The majority of the contributing watershed is in West Brandywine Township, and is zoned R-1 Agricultural/Residential and R-2 Rural Residential.

Of the 1,907 acres in Beaver Creek Dam watershed, 1,224 (62%) had agricultural land cover (including rangeland) as of the 2005 Land Cover dataset. Since 2005, 437 (22%) acres have already been developed or are in the process of development. Thus, as of 2012 approximately 787 acres (40%) of agricultural land cover are present in the watershed. Another 401 acres (20.5%) have been proposed for development of some kind, and thus present potential lands that could be converted from agriculture at some point within the project lifetime. These development projects, if constructed, will reduce the agricultural land cover within the watershed to approximately 386 acres (20%) of the 1,907 acres in the drainage area. Only three agricultural parcels (138 acres in agriculture, 7%) have not had a development proposal since 1999.

A small portion of the current (2012) agricultural land in the Beaver Creek reservoir drainage area is enrolled in the state 319 program (68 acres of agriculture) or established as an Agricultural Security Area (ASA) (222 acres in agriculture). However, it is our understanding that neither of these programs prohibits agricultural lands from being developed. Of the total ASA agricultural lands, 50 acres are proposed for development and 172 acres (8.8%) would remain as agricultural land cover after completion of proposed developments.

As indicated by the proposed development activity, since 1999 development pressures have been extremely high in this area and those pressures are likely going to persist, continuing the conversion of agricultural land to residential and commercial uses. According to the Delaware Valley Regional Planning Commission (DVRPC), West Brandywine Township is expected to experience nearly 70% population growth between 2010 and 2040, which is the second highest municipal growth projection in Chester County. East Brandywine Township is expected to experience population growth of about 45% in the same timeframe.

As of 2005 approximately 370 acres (19%) within the Beaver Creek reservoir drainage area were considered urban or built-up land. When the 437 acres of additional development that has occurred since 2005 is included, approximately 807 acres (41%) are developed to support the 2010 population of approximately 1,082 in the watershed. Assuming population distribution remains constant, based on the DVRPC growth projections it could be estimated that by 2068 an additional 807 acres would need to be built-up to accommodate the projected population growth. This scenario would result in approximately 1,614 acres of future developed lands; if the new

development occurred entirely on agricultural lands, then all agricultural lands would be converted and 0 acres (0%) of the drainage area would be agricultural lands in 2068.

With all of the above factors and uncertainties taken together, it appears reasonable to assume that approximately 20 to 30% of the Beaver Creek drainage area may remain as agricultural land cover by 2068. This equates to about 392 to 582 acres. The pace at which this growth may occur is uncertain.

**Public Health and Safety.** Beaver Creek Dam is a High Hazard Class dam. The Borough of Downingtown is downstream from Beaver Creek Dam with a total population of 7,891 people.

The dam owner estimates that there are 4,400 residents within the dam breach inundation zone, as well as 8 schools with a population of 3,200 people and 30 businesses. The dam reduces flows for high frequency events up to an including the 100-year storm. The dam also affords flood protection from extreme events (greater than the 100-year storm) downstream and allows for more time for the evacuation of the population downstream.

1850 residents, 30 businesses, 8 schools, and 2 child care centers are within the dam breach inundation zone. These businesses include the Downingtown Municipal Water Treatment Plant. The dam owner has an approved Emergency Action Plan in place for monitoring and response during conditions that could result in a dam breach.

**Labor.** The labor needed to maintain the dam and reservoir is estimated as the equivalent of 1 full time staff, which includes support from multiple firms to provide grounds maintenance and other miscellaneous maintenance services.

**Management Level.** The dam owner has sufficient education and experience to manage and maintain the dam and reservoir; in addition, a consulting firm has been engaged for professional engineering services. The effort to provide management is estimated at 0.5 full time staff.

### 3.8 SPECIAL ENVIRONMENTAL CONCERNS

**Clean Air Act.** Chester County is designated as being in non-attainment for the 24-hour PM 2.5 Standards and 8-hour Ozone standards.

There are no known permitted air emissions or objectionable odors generated at Beaver Creek Dam. Beaver Creek Dam is currently meeting full compliance of the Clean Air Act.

**Clean Water Act/Waters of the US.** The Brandywine Creek watershed has USEPA-approved TMDLs for sediment, bacteria and nutrients. Beaver Creek is not listed as impaired and does not have a waste load allocation.

**Coastal Zone Management.** The Beaver Creek Dam is not located in an area subject to Coastal Zone Management regulations.

**Coral Reefs.** The Beaver Creek Dam is not located in an area subject to coral reef protection regulations.

**Cultural Resources / Historic Properties.** There are three locations downstream of Beaver Creek Dam that are listed in the National Register of Historic places database: County Bridge No. 124 (NPS Ref #:88000760), Roger Hunt Mill (NPS Ref # 8003457), and Downingtown Log House (NPS Ref. # 79002195). All three sites are located downstream in the dam breach inundation zone; not within the footprint of the dam. On March 29, 2013 the Pennsylvania State Historic Preservation Office confirmed there were no historic properties in the Area of Potential Effect.

**Endangered and Threatened Species.** A Pennsylvania Natural Diversity Inventory (PNDI) review for Beaver Creek Dam and impoundment area was conducted. Results indicate that no known threatened or endangered species and/or special concern species and resources are within the project area.

The U.S. Fish and Wildlife Service issued a No Effect determination for the project on February 28, 2013. Except for occasional transient species, no federally listed or proposed species under U.S. Fish and Wildlife Service jurisdiction was known to exist in the project area. Therefore, no biological assessment or further consultation under the Endangered Species Act were required with the Service. Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered. Additionally, the U.S. Fish and Wildlife Service comments stated that no potential bog turtle habitat was identified at the project site. Chester County Water Resources Authority has received guidance about the Bald Eagle nest from the PA Game Commission and is following the US Fish & Wildlife Service National Bald Eagle Management Guidelines. Eagles build multiple nests and if the nest is active at the time of dam rehabilitation work, review and approval of planned work activities within 1000 feet will be needed from Pennsylvania Game Commission and from the US Fish & Wildlife if the work activities are within 660 feet.

**Environmental Justice.** The Borough of Downingtown is located approximately 7 miles downstream of the Beaver Creek Dam and a portion of the community is in the Beaver Creek Watershed. Downingtown has the highest population density in the affected area. According to the 2010 census, Downingtown has a higher percentage of residents who are Black or Hispanic than the statewide percentage. Downingtown has almost double the statewide percentage of persons who are of two or more races. The Borough of Downingtown also has 4.9 % of households are living below the poverty level. Beaver Creek Dam provides flood relief to this area by reducing the flood elevations from high frequency events. In the event of a rare extreme event that could overtop or cause a dam failure; the dam provides storage and allows for more time to evacuate anyone who may be at risk from the dam breaching.

**Essential Fish Habitat.** There are no Essential Fish Habitats in the Beaver Creek Dam watershed.

**Floodplain Management.** Based on the review of EPA NEPAassist and FEMA's Flood Insurance Rate maps of the project study area, the project study area contains areas that are situated within Zone AE Special Flood Hazard Areas (SFHAs) subject to inundation by the 1 percent annual flood chance. The 1 percent annual chance flood (e.g. 100-year flood), also known as the base flood, is the flood that has a 1 percent chance of being equaled or exceeded in any given year. The SFHA is the area subject to flooding by the 1 percent chance of flood. Zone AE indicates that the base flood elevation has been determined. The Beaver Creek Dam and the immediate periphery of the impoundment have a base flood elevation of 504 feet above mean sea level. The Flood Zone AE extends downstream of Beaver Creek Dam along Beaver Creek and is classified as a Floodway Area in Zone AE. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance of flood can be carried without substantial increases in flood heights. (FEMA 2006) The communities downstream of Beaver Creek Dam participate in the National Flood Insurance Program.

**Forest Resources.** 237 acres (12%) of the 1,907 acres in the contributing watershed for Beaver Creek Dam is woodland.

**Invasive Species.** Multi-flora rose, Canada thistle, duckweed and watermeal have been identified around or on the pool. At this time, these and other potential invasive plants exist but are not causing a problem for the management of the dam.

**Migratory Birds / Bald Eagle and Golden Eagle Protection Act.** All native wild birds found in the United States, with the exception of the house sparrow, starling, feral pigeons and resident game birds (e.g. pheasant, grouse, wild turkey) are protected under the Migratory Birds/Bald and Golden Eagle Protection Acts. Habitat for native birds, including nesting sites, exists in and around the Beaver Creek Dam impoundment. Bald eagle, herons, geese, and other waterfowl have been observed at or near the Beaver Creek Dam impoundment. A bald eagle nesting site was active in 2013. PA Game Commission and US Fish & Wildlife protection protocols are discussed under Endangered and Threatened Species.

**Prime and Unique Farmlands.** According to the NRCS Web Soil Survey soils surrounding the Beaver Creek Dam impoundment are classified as either Prime Farmland or Farmland of Statewide Importance. However, the soils immediately adjacent to the Beaver Creek streambed downstream of the dam are not classified as Prime Farmland or Farmland of Statewide Importance.

**Riparian Areas.** The riparian areas adjacent to Beaver Creek Dam and sediment pool are primarily forested and wetlands except for a small meadow area at the west shoreline of the impoundment.

**Scenic Beauty.** Scenic quality of the general landscape may be affected by some alternatives. The project is located within view of residential properties and immediately adjacent to Applecross Country Club.

**Sole Source Aquifers.** Chester County is not identified as a county that is at risk of contaminating sole source aquifers.

**Wetlands.** Based on the review of National Wetland Inventory (NWI) maps using the US EPA NEPAAssist tool, three wetlands are present within the project area. All three wetland areas are identified as freshwater emergent wetlands. However, these wetland areas have subsequently been inundated with water with the construction of Beaver Creek Dam and could now be classified as open water. No NWI wetlands are identified along the immediate periphery of the Beaver Creek Dam impoundment; however based on visual observations and review of aerial photographs, wetlands are present along the periphery of the impoundment.

An estimated 19 acres of wetlands are present above the Beaver Creek Dam based on review of wetland delineations prepared by Pulte Homes as part of their subdivision and land development plans for the Applecross Country Club, specifically sheet 89 of 801. In addition, a new wetland has formed along the south edge of the impoundment as a result of excavation related to construction of the adjacent residential development.

**Wild and Scenic Rivers.** Beaver Creek is neither a Federally-listed nor a State-Listed Wild and Scenic River.

### 3.9 OTHER CONCERNS

**Recreation.** Beaver Creek Dam and its impoundment are not utilized for recreational purposes. Beaver Creek Dam is located immediately adjacent to Applecross Country Club. Beaver Creek, downstream of Beaver Creek Dam, is designated as a Cold Water Migratory Fishery and is used by anglers for recreational fishing.

The following resource concerns were determined to be not relevant to the proposed action:

- Ecological Critical Areas
- Natural Areas
- Scientific Resources
- Parklands

### 3.10 BACKGROUND AND STATUS OF DAM

Beaver Creek Dam was built in 1974 to provide flood control, in conjunction with three other flood control dams, for communities located along the East Branch Brandywine Creek. The dam is owned and operated by the Chester County Water Resources Authority (CCWRA). The Beaver Creek Dam impoundment is 11 acres in size and has a maximum depth of 10 feet. The dam height is 35 feet and its length is 1,400 feet. The Impoundment has a floodwater storage capacity of 184 million gallons.

The dam was originally designed with a 100-year service life and to meet the design standards in place at that time. Both NRCS and the Pennsylvania Department of Environmental Protection,

Bureau of Waterways Engineering, have classified Beaver Creek Dam as a High Hazard Class dam. This hazard classification is based on the prevalence of population, bridges, roads and buildings located within the downstream dam breach inundation zone that would be exposed to flood loss and potential loss of life in the unlikely event of dam failure. Dam safety design standards for high hazard dams have increased since completion of this dam.

The Chester County Water Resources Authority (CCWRA) has requested and is receiving watershed rehabilitation assistance from the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) for the Beaver Creek Dam through the NRCS Watershed Rehabilitation Program. This Planning Study began in November 2011 and is anticipated to be completed by November 2013.

Table 3-3 contains as-built data about Beaver Creek Dam (PA-433).

**Table 3-3  
 As-Built Project Features**

<b>Resource</b>	<b>Beaver Creek Dam (PA-433) <sup>1</sup></b>
<b>Statistics</b>	
Year Completed	1974
Actual Construction Cost	\$479,000
Purposes	Flood Control
NRCS Hazard Class	High
Drainage Area Controlled	3.06 Square Miles
AMC II Runoff Curve Number	72
<b>Key design elevations</b>	
Crest of dam	510.8 feet
Crest of auxiliary spillway	504.8 feet
Crest of the principal spillway	486.6 feet
<b>Structure components</b>	
Dam height	35 feet
Dam length	1400 feet
Embankment volume	77,000 cubic yards
<b>Auxiliary spillway</b>	
Type	Vegetated earth
Bottom width	225 feet
Design capacity	1,557 cfs
<b>Principal spillway</b>	
Type	Reinforced Concrete Pipe
Diameter	30-inch
Capacity	120 cfs
<b>Structure capacities</b>	
Sediment storage	42.8 acre-feet
Detention storage	800.0 acre-feet

January 2014

<sup>1</sup> Source: Beaver Creek Dam (PA-433) As-Built Plans.

### 3.11 CURRENT CONDITION OF DAM

The Project Team conducted a site visit to document the current conditions of Beaver Creek Dam, located in Chester County, Pennsylvania on December 2, 2011 to provide observations and photographs documenting the current conditions of the dam embankment and auxiliary spillway.

Beaver Creek Dam is an approximately 1,400-foot long earthen embankment with a maximum height of 35 feet, and 3H:1V upstream and downstream side slopes. The dam embankment is vegetated with sod and consists of a zoned earth fill with a cutoff trench extending to relatively impervious material. There are two toe drains that drain seepage to the principal spillway outlet impact basin. Both toe drains consist of a perforated 12-inch diameter coated corrugated metal pipe encased in coarse and fine drain fill. The northern toe drain is approximately 325 feet long and the southern toe drain is approximately 26 feet long. The principal spillway, which is located toward the south abutment, consists of a single stage concrete riser and a 30-inch diameter reinforced concrete pipe discharging into a concrete impact basin. The auxiliary spillway, which is located along the north abutment, is a 225-foot wide grassed-lined channel that discharges to the adjacent golf course approximately 270 feet downstream of the dam embankment.

Notable observations during the site walk of Beaver Creek Dam include:

- Wet areas along south abutment – A water bar along the downstream side of the south abutment reduces erosion from runoff; however, it has created an area where runoff is collected. Standing water was observed in this area during the site walk.
- Wet area adjacent to downstream side of dam – A wet area adjacent to the downstream side of the dam and north of the impact basin, where standing water/ saturated soil was observed. Isolated areas of standing water up to 2 inches deep were observed at several locations during the site walk. The wet area extended from the downstream toe of the dam toward the edge of the adjacent woods, and approximately 180 feet along the dam. The Project Team performed further evaluation of the adjacent wet area, which was provided to NRCS for review.
- Locations of poor vegetative cover - The upstream face of the dam was poorly vegetated and there was evidence of rutting from mowing activities. The northern side slope of the auxiliary spillway had areas of poor sod cover and dead vegetation.
- Evidence of settlement/subsidence – There was no evidence of uneven subsidence/settlement along the top of dam or along either abutment.
- Animal burrow/minor depression- A shallow depression, which may be from animal burrowing, was observed on the upstream embankment, resulting in the stripping of the vegetation. A small deep animal burrow was observed on the downstream embankment. In each case there was no standing water. Corrective actions to repair these burrows should be taken.
- Erosion along the upstream face of the dam – Erosion along the upstream face of the dam at the pool water level was observed. The toe erosion begins at a point just to the north of the principal spillway and extends approximately 350 feet to the north along the dam. The height of the escarpment varies from 4 inches to 2 feet with the maximum heights in the middle of the escarpment. Stabilization such as riprap toe armoring along this area to prevent further erosion should be considered.
- The condition of principal and auxiliary spillways - The principal spillway was in good condition with the exception of debris, which was observed on the side and top of the principal spillway riser. The riser structure had a noticeable lean toward the west. Flow was observed coming from the northern toe drain and discharging into the impact basin. No flow was observed from the southern toe drain at the time of the site visit. The Project Team performed TV inspections of the principal spillway, outlet pipe, and toe drains. The results of the TV inspections are discussed in a memorandum submitted to NRCS for concurrent review.
- The auxiliary spillway inlet and exit channels and the level control section were in good condition. There were no erosion, poor sod coverage, or depressions observed during the site walk.

A sediment survey and flood pool storage evaluation were conducted for the reservoir to determine the current condition. The analysis indicated that the total volume of accumulated sediments in the reservoir below normal water pool surface at elevation 486.6 feet is approximately 21 acre-feet. This is within the 50-year design sediment storage capacity of 42.8 acre-feet, per the 1972 design report.

The results of the Principal Spillway Hydrograph analysis indicate that the principal spillway has an adequate capacity to empty the detention storage in 5.67 days, which meets the TR-60 10-day limit. Per TR-60, the initial starting elevation for the Spillway Design Hydrograph and Freeboard Hydrograph analyses was set at the base flow water surface elevation of 487.18 feet. Peak pool elevation for the Principal Spillway Hydrograph analysis was 503.35 feet, resulting in no flow over the auxiliary spillway at its current configuration and crest elevation of 504.8 feet.

The results of the stability analysis indicate that the maximum peak flow in the auxiliary spillway during the Spillway Design Hydrograph event is 1,557 cfs with maximum velocities of 7.7 feet/sec. The maximum total stress (1.80 lb/ft<sup>2</sup>) and maximum effective stress (0.6 lb/ft<sup>2</sup>) will likely cause sod stripping in the exit channel.

The results of the integrity analysis indicate that the integrity of the spillway is compromised during the 6-Hour Freeboard Hydrograph Storm and all 24-Hour Freeboard Hydrograph Storm events. The 24-hour Freeboard Hydrograph Storm event results in head cut erosion and breaching of the auxiliary spillway. Based on the results of the SITES integrity analysis, the breach occurs approximately 10.3 hours after the beginning of the storm event and the potential head cut height at the upstream edge of the control section is approximately 5.7 feet.

The results of the discharge capacity analysis show, that the 24-hour Freeboard Hydrograph Storm event based on the USACE distribution governs and results in the highest maximum water surface elevation of the impoundment (511.75 feet). This is above the lowest surveyed point along the dam centerline (510.88 feet), as well as the designed settled top of dam elevation (510.8 feet). In fact, the 6-hr Freeboard Hydrograph Storm event also results in overtopping of the dam.

For the Probable Maximum Precipitation events based on the remaining 24-hour storm distributions (NRCS Standard Design Storm and 5-point curve), the auxiliary spillway has sufficient capacity to convey the flows without overtopping the dam. It should be also pointed out that the USACE distribution results in a significantly higher peak flow occurring at later stages of the storm compared to both the 5-point curve distribution and the NRCS dimensionless design storm distribution. The total runoff volume appears to be comparable between each of the 24-hour storm distribution analyses. However, the USACE distribution analysis, which has a higher peak flow occurring later during the storm, results in lower attenuation of flows and a higher maximum water surface elevation.

### 3.12 DOWNSTREAM SURFACE DRAINAGE ASSESSMENT

The Project Team visited the project site on December 15, 2011 to observe test pit excavation along the immediate adjacent area just downstream of the embankment of Beaver Creek Dam. This area, located along the valley floor to the north of the principal spillway, remains wet with standing water for much of the time. This area does only occasional dry out in the driest months, typically late summer. The purpose of the test pit exploration was to investigate the persistent wet surface conditions and subgrade soil at the dam's toe and to assess the source of the excess moisture.

The excess moisture at the toe of the dam is primarily due to poor surface drainage combined with restricted location that inhibits drying/evaporation, as well as restriction to infiltration through the topsoil layer. The woods to the southeast along with the dam to the northwest seem to protect the area from sun and wind exposure from drying the area, while the slight bowl shape of the area tends to collect and maintain surface runoff in the area. The Project Team anticipates that the currently wet conditions will continue if untreated. Negative impacts due the wet conditions will likely include continued difficulty in mowing and ground cover maintenance and potential

expansion of the saturated area. Long term degradation of the dam could occur, but is not expected due to this condition.

### 3.13 PRINCIPAL SPILLWAY ASSESSMENT

The Project Team conducted a video (TV) inspection of the principal spillway as part of the documentation of the current conditions of Beaver Creek Dam on December 13 - 14, 2011.

Based on the visual inspection, the inlet and outlet of the principal spillway pipe are functioning. There were about 2 inches of flow in the outlet pipe at the time of inspection due to a leak in the drawdown sluice gate. The leaked water flowed freely from the riser structure to the impact basin with no observable backup or loss through the pipe.

Notable observations during the TV inspection include:

- Surficial cracks - There were surficial cracks in the outlet pipe toward the riser structure at the crawler measured distance of 200.33 feet from the downstream edge of the intake riser structure.
- Debris in riser – A small log was observed in the principal spillway riser at the entrance to the 30-inch diameter outlet pipe. No other debris was observed in the riser.

Using the on-board laser measurement device on the TV crawler, the Project Team measured the joint gaps of each of the 11 joints where visible. Overall, the joint measurements ranged from 0 mm (0") to 2.03 mm (~1/12"), which is less than the maximum allowable tolerance gap of 3/4".

### 3.14 TOE DRAIN OBSERVATIONS

The Project Team performed a video inspection on each toe drain documenting the condition up to the fourth bend of the north toe drain and up to the second bend of the south toe drain. Both toe drains were flowing at the time of inspection with about 2 inches of flow. The discharge was constant and clear with no visible turbidity. The observable toe drain pipe segments appeared clear with no observed blockages, pipe deformation, or deterioration. Some rust was observed along the bottom of the pipes; however, the rust appeared surficial and there was no observable deterioration. Very fine silt, likely dust, has settled in the bottom of the pipe in between the corrugations. No significant sediment or larger particulates were observed. Due to limited accessibility to navigate around the bends, the conditions of the toe drain beyond the bends could not be observed at the time of the inspection.

### 3.15 STATUS OF OPERATION AND MAINTENANCE

The NRCS State Conservationist must verify that operation and maintenance is current prior to construction of the planned rehabilitation measures. The Sponsor is responsible for keeping the structure free of brush and trees, burrowing animals and recreational vehicle traffic.

CCWRA employs a routine monitoring protocol. Observations of the dam embankment, piezometers, abutments and areas down gradient of the toe of the dam are conducted monthly or on an as needed basis based on evaluation of piezometer conditions. A cursory review of site conditions is done when taking monthly piezometer measurements.

Staff also measures the impoundment water surface elevation using the staff plate on the riser. The pool elevations are monitored by a pressure transducer and data logger.

Piezometers are installed at Beaver Creek Dam, and CCWRA collects piezometer data on at least a monthly basis. The data are collected more frequently under certain circumstances, however, the frequency is subject to change based on evaluation of subsurface conditions as additional data are collected and reviewed.

These observations and piezometer data are sent to the Sponsor's engineer, Gannett Fleming, Inc., for review on a bi-monthly basis, or immediately if any unusual condition is observed. Recent readings at all the piezometers indicated phreatic levels within expected ranges.

There were no post construction changes to the structure that influence the safety of the dam. No road cuts, quarries or mining activities were observed in the vicinity of the dam or reservoir.

At the time of the site walk, the dam and associated structures were found to be functional and operation and maintenance is current.

### 3.16 BREACH ANALYSIS AND HAZARD CLASSIFICATION

A breach analysis of the existing dam was not conducted as part of this study. CCWRA has an approved breach analysis for the dam, as well as an Emergency Action Plan approved by Pennsylvania Department of Environmental Protection from 2011. The dam is currently classified by the PADEP – Division of Dam Safety as Size Class B, Hazard Category 1. The dam is classified as a High Hazard Class dam by the NRCS. The Breach Inundation Map is included in Figure C-1.

### 3.17 POTENTIAL DAM FAILURE MODES

The Project Team examined five potential modes of dam failure during the planning study. These include failure due to sedimentation, insufficient hydrologic capacity, seepage, seismic activity, and material deterioration, which are described below.

**Sedimentation – No Risk.** Sedimentation can fill the designed sediment pool, but will not encroach on the detention capacity. The analyses of sediment accumulation indicate that approximately 50 years of functional life remains for the sediment pool. Consequently sedimentation presents a no risk failure mode for the dam.

**Insufficient Hydrologic Capacity – Moderate Risk.** An auxiliary spillway breach or overtopping of the existing dam during a storm event can cause hydrologic failure. The integrity and stability of the auxiliary spillway is dependent upon depth, velocity, and duration of flow, the vegetative cover, and the embankment's resistance to erosion.

The dam was designed as High Hazard Class dam; however, the auxiliary spillway may only have moderate resistance to erosion. The principal spillways and auxiliary spillways may be considered inadequate according to current High Hazard Class dam design criteria. This deficiency, resulting from the upgraded design criteria, poses a moderate risk for hydrologic failure of the dam during extreme runoff events.

**Seepage and Slope Stability – Low Risk.** The Project Team performed a review reports provided by Chester Country Water Resources Authority, written by Gannett Fleming, Inc. to evaluate the slope stability and seepage of Beaver Creek Dam:

#### Piezometer Installation and Beaver Creek Dam

- Piezometer Installation and Subsurface Investigations at Emergency Spillway, dated February 5, 2009;
- Stability Analyses, dated April 8, 2009; and
- Beaver Creek Dam, Piezometer Monitoring and Evaluation, dated August 2010 and to August 2011.

The February 2009 Gannett Fleming, Inc. (GF) report addressed exploration of the emergency spillway and installation of piezometers in the dam. The initial piezometer readings show that water levels indicated by the deeper foundation soil piezometers are within the foundation soils. Likewise, the shallow embankment soil piezometers were either dry or indicate very low water levels at mid-slope and at the toe and slightly below the pool elevation at the crest. The readings at all the piezometers were within ranges expected by Gannett Fleming, Inc.

The April 2009 GF report provided information regarding slope stability analysis of Beaver Creek Dam. The report indicates that the soil strength parameters for the stability and seepage analyses were developed based upon correlations with published references. The report concluded that, based upon the estimated soil parameters, the dam is stable and the drainage system functions properly. The slope stability factor of safety was calculated for a range of pool elevations (486.8 feet to 496.8 feet) to estimate apparent threshold piezometric levels. For this range of pool elevations, the safety factors were well above the required 1.5 criteria, with safety factors ranging between 2.02 and 2.04 for Station 14+50; and 2.28 for Station 17+00. GF determined that a maximum pool elevation that meets the minimum factor of safety criteria of 1.5 is 510.2 feet. The stability analyses are based upon the US Army Corp of Engineers (USACE) EM 1110-2-1902, SLOPE STABILITY criteria rather than the NRCS TR-60 slope stability criteria. In general, the USACE slope stability criteria are slightly more rigorous relative to seepage conditions and include maximum surcharge pool consideration while the TR60 criteria include more clearly defined seismic slope stability criteria. In most parts of the country, the seepage and maximum pool surcharge criteria are the more critical aspects of dam stability.

GF analyzed the dam for slope stability using soil seepage and strength parameters developed from correlations with laboratory and field tests. Based upon those correlations, the slope stability and seepage analyses appear to indicate that the drainage system is operating properly. Based on the review of the available data, seepage and slope stability pose a low risk for failure of the dam.

**Seismic Activity – Very Low Risk.** The integrity and stability of an earthen embankment during seismic activity are dependent on the magnitude of the activity and the presence of unstable embankment or foundation material. Foundation movement through consolidation, compression, or lateral movement can create weak zones within the embankment where voids can form. This can cause conduit joint failure or collapse of the embankment.

Basic seismic indicators were checked and no seismic concerns were discovered. This will be confirmed during project design. The dam is located in an area designated as Seismic Zone 1. Seismic Zones indicate the effects of an earthquake at a particular place based on geological observations from the affected areas. Zone 1 represents areas with little to no historical seismic activity. Because Seismic Zone 1 is considered an area of low risk for seismic activity, seismic activity poses a very low risk for dam failure.

**Material Deterioration – Low Risk.** Based on the visual inspection, the inlet and outlet of the principal spillway pipe are functioning. As previously discussed, there were about 2 inches of flow in the outlet pipe at the time of inspection due to a leak in the drawdown sluice gate. The leaked water flowed freely from the riser structure to the impact basin with no observable backup or loss through the pipe.

Notable observations during the TV inspection of Beaver Creek Dam include:

- Surficial cracks - There were surficial cracks in the outlet pipe toward the riser structure near J2 and toward the impact basin near J11.
- Debris in riser – A small log was observed in the principal spillway riser at the entrance to the 30-inch diameter outlet pipe. No other debris was observed in the riser.
- Joint Displacement - Joint gap measurements ranged from 0 mm (0") to 2.03 mm (~1/12"), which is less than the maximum tolerable gap of 3/4".

The May 15, 2002 Gannett Fleming, Inc. report included the following description of the principal spillway for Beaver Creek Dam:

"The principal spillway includes a standard baffle type reinforced concrete riser about 15 feet high, a 30-inch diameter reinforced concrete pressure pipe conduit about 208-foot long constructed through the embankment, and a reinforced concrete impact basin. A 24-inch diameter opening is located through the base of the north wall of the riser for impoundment drawdown. Flow through the opening is controlled by the positioning of a

24-inch diameter sluice gate installed on the exterior face of the north wall, and manually operated from the top of the riser.

Review of recent annual dam safety inspection reports indicates the 24-inch diameter sluice gate is non-operational, and, that the riser structure is observed to be non-uniform in alignment, that is, the northeast side appears higher than the southwest side."

Based upon the February 2010 Gannett Fleming, Inc. report, the structure is stable and functioning within acceptable limits. Based on the biannual (two per year) reading for the monitoring period reported (about eight years), the riser seems to be stable, except for normal temperature fluctuations and the anomalous reading from January 2004, which may have been due to ice buildup.

The 24-inch diameter sluice gate was repaired in April 2005. The crank mechanism for the sluice gate was lubricated and successfully exercised on September 11, 2013 as per the 2012 Dam Inspection Report prepared by Gannett Fleming. Based on the noted inspections and no reported observation of cracking or deterioration of the conduits, material deterioration poses a low risk of dam failure.

### 3.18 CONSEQUENCES OF DAM FAILURE

Inundation due to dam failure potentially has the following consequences.

**Loss of Life.** The breach inundation study indicates that a dam failure may result in inundation of agricultural land, public utilities, homes, 1850 residents, 30 businesses, 8 schools, and 2 child care centers. The businesses include the Downingtown Municipal Water Treatment Plant.

**Release of Harmful Materials.** Large volumes of sediment and eroded embankment material released to the stream would harm water quality, degrade aquatic habitat and reduce downstream channel capacity. Further, the inundation area includes industrial land uses that may store hazardous materials, and a wastewater treatment plant that could result in the release of untreated sewage.

**Agricultural Damage.** Sedimentation may cause reduced productivity of agricultural land downstream from the structure.

**Infrastructure Destruction.** Residential dwellings, public buildings, fences, roads, bridges, public utilities including two regional water supply intakes and a wastewater treatment plant, and farm equipment may be damaged or destroyed.

The hazard classification was based on results of a breach routing completed by NRCS separate from this study. Due to potential impacted habitable structures downstream, the Beaver Creek Dam is classified as a High Hazard Class dam. Detailed discussions on the analyses, a presentation of results, and the inundation maps can be found in the stand-alone Breach Inundation Study report.

## 4.0 ALTERNATIVES

### 4.1 FORMULATION PROCESS

The following alternatives were considered in the development of this plan:

- **No Action/Future Without Federal Project (FWOP)**  
The FWOP alternative describes the most likely future condition that could be expected if NRCS takes no action. It describes what is most likely to happen in the absence of any developed federal alternative or changes in law or public policy.  
  
The FWOP is used to compare other alternatives to determine the magnitude of benefits and adverse effects. Clearly describing the FWOP condition provides the reference necessary to evaluate changes caused by the alternatives. The FWOP alternative may contain flaws, violate a law, or fail to meet the Project Purpose and Need; but it must still be developed as a comparison.
- **Rehabilitation to High Hazard Class Dam**  
Rehabilitation alternative includes federally assisted upgrading of the existing dam to current applicable standards. Rehabilitation alternatives were evaluated to extend sediment storage life for an additional 100 years with a minimum of 50 years of storage being provided.
- **Decommissioning of Dam**  
The Decommissioning alternative includes federally assisted removal of the entire dam and stabilizing the site.
- **Decommissioning of Dam with Nonstructural Measures**  
In addition to the federally assisted removal of the entire dam and stabilizing the site, this alternative includes acquisition and demolition of existing residential and public structures in the downstream 100-year floodplain.
- **Relocation or Floodproofing of At-Risk Dwellings in the Breach Inundation Area**  
This alternative includes acquisition and demolition, relocation and/or flood protection of structures in the breach inundation area so that the hazard class can be lowered and less stringent dam safety standards can be evaluated.
- **Other nonstructural measures**  
This alternative includes floodproofing, floodplain regulations, and other nonstructural measures so the hazard class can be lowered and less stringent dam safety standards can be evaluated.
- **All other reasonable alternatives**  
Other alternatives that meet the purpose and need.
- **National Economic Development (NED) Alternative**  
The National Economic Development (NED) alternative is not an independent option. It is the alternative, or combination of alternatives, that reduces the offsite or public problem and maximizes net national economic development benefits.

Alternative plans, including the NED plan, were formulated with consideration to completeness, effectiveness, efficiency, and acceptability (as required by the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, March 10, 1983.) These criteria are described below.

- **Completeness.** Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to the realization of the contributions to the objective.
- **Effectiveness.** Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

- **Efficiency.** Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.
- **Acceptability.** Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and public and to compatibility with existing laws, regulations, and public policies.

Table 4-1 summarizes the alternatives considered and the results of the screening process.

**Table 4-1  
Range of Alternatives and Determination for Detailed Study**

Alternative	Screening Criteria <sup>1</sup>				Carried Forward for Detailed Study
	Completeness	Effectiveness	Efficiency	Acceptability	
<b>No Action/Future Without Federal Project (FWOP)</b>	<ul style="list-style-type: none"> <li>Does not meet Project Purpose and Need.</li> </ul>	<ul style="list-style-type: none"> <li>Does not meet Project Purpose of providing flood protection to agricultural land, rural transportation facilities, and rural residential structures.</li> <li>Addresses current risk of loss of human life resulting from dam failure through compliance with State regulations.</li> </ul>	<ul style="list-style-type: none"> <li>Benefit/Costs of the FWOP were evaluated only for comparison of federal alternatives.</li> <li>Sponsor financial resources may limit timely implementation of FWOP alternative.</li> </ul>	<ul style="list-style-type: none"> <li>Consistent with state and local laws, regulations, and policies.</li> </ul>	Yes
<b>Rehabilitation to a High Hazard Dam/NED Alternative</b>	<ul style="list-style-type: none"> <li>Technically reliable.</li> <li>Meets Project Purpose and Need.</li> <li>Accounts for planned effects including NED, EQ, and OSE.</li> </ul>	<ul style="list-style-type: none"> <li>Meets Project Purpose by providing flood protection.</li> <li>Minimizes risk of loss of human life resulting from dam failure.</li> </ul>	<ul style="list-style-type: none"> <li>Most cost-effective federal alternative.</li> </ul>	<ul style="list-style-type: none"> <li>Consistent with state and local laws, regulations, and policies.</li> </ul>	Yes
<b>Federal Decommissioning of the Beaver Creek Dam</b>	<ul style="list-style-type: none"> <li>Does not meet Project Purpose and Need because removing the dam eliminates benefits of flood control.</li> <li>Does not account for all EQ effects due to reduced water quality from loss of existing sedimentation trapping and storage capacity.</li> <li>NED Account was not evaluated.</li> </ul>	<ul style="list-style-type: none"> <li>Does not provide flood protection to agricultural land, rural transportation facilities, and rural residential structures.</li> <li>Results in increased flooding and sedimentation.</li> <li>Addresses current risk of loss of human life resulting from dam failure.</li> <li>Reconnects the stream.</li> <li>Reduces future operation and maintenance costs.</li> </ul>	<ul style="list-style-type: none"> <li>Detailed planning was not conducted because alternative does not meet the purpose and need for flood protection.</li> </ul>	<ul style="list-style-type: none"> <li>Consistent with state and local laws, regulations, and policies.</li> </ul>	No
<b>Federal Decommissioning of Beaver Creek Dam with Nonstructural Measures</b>	<ul style="list-style-type: none"> <li>Meets Project Purpose and Need.</li> <li>Does not account for all EQ effects due to reduced water quality from loss of existing sedimentation trapping and storage capacity.</li> <li>NED Account was not evaluated.</li> </ul>	<ul style="list-style-type: none"> <li>Meets Project Purpose.</li> <li>Results in increased flooding and sedimentation.</li> <li>Addresses current risk of loss of human life resulting from dam failure.</li> <li>Reconnects the stream.</li> <li>Reduces future operation and maintenance costs.</li> </ul>	<ul style="list-style-type: none"> <li>Detailed planning was not conducted due to the exorbitant cost of the alternative.</li> </ul>	<ul style="list-style-type: none"> <li>Consistent with state and local laws, regulations, and policies.</li> </ul>	No
<b>Acquisition or Relocation of At-Risk Structures</b>	<ul style="list-style-type: none"> <li>Technically reliable and provides for all accounts.</li> <li>NED, EQ, and OSE Accounts were not evaluated.</li> </ul>	<ul style="list-style-type: none"> <li>Meets Project Purpose.</li> <li>Minimizes risk of loss of human life resulting from dam failure.</li> </ul>	<ul style="list-style-type: none"> <li>Detailed planning was not conducted due to the exorbitant cost of the alternative.</li> </ul>	<ul style="list-style-type: none"> <li>Consistent with local laws, regulations, and policies.</li> <li>Requires special restrictions on future development in breach inundation area.</li> </ul>	No
<b>Other Nonstructural Measures (floodproofing)</b>	<ul style="list-style-type: none"> <li>Technically reliable and provides for all accounts.</li> <li>NED, EQ, and OSE Accounts were not evaluated.</li> </ul>	<ul style="list-style-type: none"> <li>Meets Project Purpose.</li> </ul>	<ul style="list-style-type: none"> <li>Detailed planning was not conducted due to the exorbitant cost of the alternative.</li> </ul>	<ul style="list-style-type: none"> <li>Consistent with local laws, regulations, and policies.</li> <li>Requires special restrictions on future development in breach inundation area</li> </ul>	No

<sup>1</sup> Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, Section V. — Alternative Plans - 1.6.1 (c)

## 4.2 SPONSOR'S RATIONALE FOR CONDITIONS OF FUTURE WITHOUT PROJECT

Beaver Creek Dam, designed and constructed as a High Hazard Class dam, does not meet current dam design and safety criteria for High Hazard Class dams.

Pennsylvania Department of Environmental Protection, Bureau of Waterways Engineering (PADEP) will likely issue an administrative order requiring that the Sponsor upgrade the dam to current state standards; remove and/or relocate the hazards; or remove the hazard by removing the storage function of the reservoir. If the Sponsor does not comply with the administrative order, PADEP would likely breach the structure to remove the storage functions and bill the Sponsor for the work.

An evaluation of the Sponsor's options for meeting a potential PADEP administrative order, in the absence of NRCS technical and financial assistance, indicated that the likely Sponsor response would be to remove the storage function of the reservoir by constructing a breach, as directed by PADEP.

## 4.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

***Decommissioning of Beaver Creek Dam.*** The Decommissioning Alternative was evaluated to include the removal of the entire Beaver Creek Dam, removal of the principal spillway structure, release of the impoundment, and stabilization/restoration of stream and 100-year floodplain functions.

Approximately 1,590 linear feet of the stream channel and floodplain restoration could be required. The stream channel would be approximately 22 feet wide, to reflect the natural channel width just upstream of the existing impoundment. The associated floodplain would be approximately 360 feet wide, and would merge upstream with the existing Zone AE 100-year floodplain. Based on the Virginia Stream Restoration & Stabilization Best Management Practices Guide, a rural watershed requiring priority one or two relocation (construct new floodplain and channel) would incur construction costs up to \$130 per linear foot of stream restoration. This assumes no constraints to constructing the new channel, and readily available materials are nearby. The areas of the impoundment outside of the floodplain would also require additional stabilization against erosion from runoff.

The decommissioning alternative would eliminate flood storage and protection provided by the dam, which would expose downstream properties to an increased risk of flooding, property damage, and loss of life. As a result, the decommissioning alternative alone would not meet the objective to maintain the downstream flood damage reductions provided by the existing project. To meet this objective, the decommissioning alternative would have to be supplemented by other measures such as floodproofing or relocation of structures located within the 100-year floodplain.

After decommissioning, there is no impounded water or sediment storage provided by the dam. The principal spillway system would be removed and disposed of in a suitable manner. If the dam was decommissioned, it would cause the following impacts:

- ***Periodic Flooding, Sedimentation, and Other Damage***  
The existing dam provides sediment storage capacity, flood protection and flood-damage reduction to landowners, residents, motorists, and others using the project benefit area. Without the dam, periodic flood events would result in flood damages, sedimentation damage and other associated damages at or in excess of pre-project levels.

- **Increased Flood Zone**

The existing downstream structures are currently protected from damage resulting from the 100-year storm events because the presence of the dam regulates the release of the water. Decommissioning induces flooding downstream. NRCS requires that induced damages be mitigated.

The total estimated cost of dam decommissioning, including the construction of a restored main channel and removal of the dam is \$1,462,000. The Decommissioning Alternative was eliminated from the detailed study because it does not meet the Project Purpose and Need of maintaining flood damage reduction.

**Decommissioning with Nonstructural Measures.** To meet the Project Purpose and Need, the Decommissioning Alternative would have to be supplemented by other measures such as acquisition or relocation of structures located within the 100-year floodplain. Based on the evaluations of flood proofing and relocation/acquisition of residential structures an additional estimated cost of \$75,816,000 is included in the decommissioning cost estimate for relocation of 312 structures which are subject to flooding during the 100-year, 24-hour storm event without the dam in place.

The cost associated with Decommissioning along with the necessary costs of nonstructural flood damage reduction measures is estimated to be \$77,278,000 or nearly eighteen (18) times the cost of rehabilitating the dam to meet NRCS High Hazard Class dam standards. Decommissioning with Nonstructural Measures was eliminated from detailed study due to exorbitant costs and social disruptions caused by this alternative.

**Acquisition or Relocation of At-Risk Structures.** This alternative removes the downstream hazard and allows the Beaver Creek Dam to be reclassified as a Low Hazard Class dam. Land use restrictions would need to be implemented to prevent future upgrades to High Hazard Class dam due to downstream development within the breach inundation area. The threat to human life from sudden dam failure would be reduced by relocating the residential and commercial structures and raising and/or relocating the roadways within the potential breach inundation.

The cost for acquisition or relocation of at risk structures within the dam breach inundation zone of Beaver Creek Dam was evaluated. Per the 2010 Emergency Action Plan (EAP) provided by CCWRA, there are 1850 residences, 30 businesses, 8 schools, and 2 child care centers within the dam breach inundation zone of Beaver Creek Dam.

The estimated cost to purchase the 1,850 residences at risk in the downstream breach inundation zone is \$412,550,000. Additional cost would be incurred for demolition of existing houses and restoration of the site (i.e., filling in a basement, grading, landscaping, and disconnection and capping of utility lines). The costs for demolition vary greatly; however, using an estimate of \$20,000 per house based on average demolition prices in Bucks County (NRCS Pennsylvania State Office email communication), the total estimated cost for acquisition and demolition of at risk structures is approximately \$449,550,000. This cost is tens of millions of dollars higher than other alternatives under consideration even without including costs for purchasing and relocating 30 businesses, 8 schools, and 2 child care centers also located in the breach inundation zone.

The cost of acquisition of residential structures alone is not economically feasible and, therefore, costs for acquisition of other structures were not provided due to the complexity associated with estimation of these costs. The excessive cost of this alternative and social disruption caused by this approach is considered unreasonable and, therefore, Acquisition or Relocation of At-Risk Structures was eliminated from detailed study.

**Other Non-Structural Measures (Floodproofing of At-Risk Structures).** The Project Team considered installation of a levee and floodwall system downstream from the dam. The cost of floodproofing of at risk structures within the breach inundation zone of Beaver Creek Dam was evaluated. The dam breach inundation zone and affected structures were based on the

2010 EAP. For this planning study, it was estimated that approximately 1,725 residences, 20 businesses, 8 schools, and 2 child care centers would be protected by a levee system. The remaining 125 residences and 10 businesses would likely require individual floodproofing. The total estimated cost of this alternative is \$48,275,000. Additionally, implementation of this floodproofing alternative would include the cost of closure structures, land acquisition, permitting/wetland mitigation, and long-term operation and maintenance costs.

The excessive cost of this alternative and social disruption caused by this approach is considered unreasonable. Therefore, the Floodproofing of At-Risk Structures Alternative was eliminated from detailed study.

**Variations of Rehabilitation Alternative.** The following rehabilitation alternatives were considered and eliminated from detailed evaluation in consultation with CCWRA and based on effectiveness, efficiency, constructability and compatibility with the purpose and need for the project and in consideration of identifying the National Economic Development alternative:

- Increase the height of the embankment by installing additional fill, PVC sheet piling or a parapet wall to provide additional freeboard and prevent dam overtopping during the Probable Maximum Precipitation event.
- Increase the width of the auxiliary spillway.
- Armor the auxiliary spillway with articulated concrete block.
- Install a labyrinth weir to increase the effective width of the auxiliary spillway.
- Implement various methods for gaining an additional 100 years of sediment storage, including dredging, excavation, and raising the top of dam.

All of the variations of the Rehabilitation Alternative noted failed to meet the “Efficiency” screening criteria.

#### 4.4 DESCRIPTION OF ALTERNATIVE PLANS

**Future without Project.** The Future without Project condition is the baseline from which all other alternatives are measured. It reflects the most likely future conditions expected to exist over the life of the project without the potential federal funding identified in this plan.

The Sponsors have indicated that a minimum level breach of the dam, such as the removal of a portion of the earthen embankment, as directed by PADEP, would be the Future Without Project approach conducted by CCWRA. See Figure C-6 – Future Without Project Alternative in Appendix C.

PADEP has implemented a simplified approval process for dam removals; however, the proposed breach plan “must essentially restore the stream to its natural, free-flowing state through the impoundment area and the footprint area of the dam.” In addition, PADEP requires the breached dam to pass the 100-year flood without increasing flood elevations more than one foot behind the remaining structure. For the purposes of this planning study, pre-construction drawings of existing conditions were used to determine the pre-construction bank-to-bank stream width of approximately 22 feet. The existing embankment would be partially removed. However, due to the height of the dam and the need for a stable slope the final breach width at top of dam would be approximately 500 feet. Additional hydraulic modeling would be required to determine the increase in flood elevations behind the remaining structure. The total installation cost of the Future Without Project condition is estimated to be \$1,272,000. The average value of the lost flood damage reduction benefits resulting from implementing the Future Without Project condition would be \$263,700 annually.

If Beaver Creek Dam was breached by the sponsors, it would cause the following impacts:

- *Periodic Flooding, Sedimentation, and Other Damage*  
The existing dam provides sediment storage capacity, flood protection and flood-damage reduction to landowners, residents, motorists, and others using the project benefit area.

Without the dam, periodic flood events would result in increased flood damages, sedimentation damage and other associated damages at or in excess of pre-project levels.

- *Increased Flood Zone*

The existing downstream structures are currently protected from damage resulting from the 100-year storm events because the presence of the dam regulates the release of the water. The Future Without Project condition induces flooding downstream.

**Rehabilitation to High Hazard Class Dam.** The Beaver Creek Dam would be rehabilitated to meet current NRCS and PADEP High Hazard Class dam design and safety criteria. The service life would be 50 years. See the Project Site Map in Appendix B.

The control section of the auxiliary spillway will be lowered from elevation 504.8 feet to elevation 503.5 feet. The overtopping protection of the auxiliary spillway will be accomplished by use of roller compacted concrete (RCC). Existing vegetation will be stripped from the auxiliary spillway. The auxiliary spillway will be excavated and the subgrade prepared per the construction plans. During this process any unsuitable soil or material will be removed and replaced with acceptable material. Soft or yielding subgrade areas encountered during construction would be stabilized prior to installation of the RCC. A stepped slope of RCC will be installed along the exit channel. The RCC will be proportioned, mixed, placed, compacted and cured in accordance with the design specifications; and will be installed to conform to the grades, thickness, and typical cross sections of the construction plans. The RCC will be covered with compacted earthfill, which will be vegetated with grasses similar to those used on the original dam. Borrow for the earthfill will be obtained on-site.

Construction techniques of the filter diaphragm under the principal spillway will be evaluated in the design phase. Potential techniques can include a weighted filter placed upon the existing slope or a filter installed within an excavation at the toe. The filter diaphragm construction will consist of excavation, subgrade preparation, installation of aggregate material and geotextile, and backfill with suitable material.

Installation of toe drain access will include excavation adjacent to the impact basin, cutting the 90-degree bend of the toe drain pipe, and installation of a Y-fitting. The pipe will be backfilled with suitable material to existing grade and an end cap will be installed at the access.

A trench drain and regrading of the existing wet area adjacent to the downstream embankment toe will be installed to maintain a positive drainage. Construction will include trench excavation; installation of drainage stone, perforated pipe, and geotextile; and backfill with suitable material. The adjacent area will be graded per the construction drawings to provide positive drainage.

Replacement of the riser structure will first require drawdown of the impoundment area, construction of a coffer dam, and installation of a water diversion to dewater the construction area adjacent to the riser structure. The dewatering plan will be developed during the construction phase. Options for the coffer dam that may be considered include sand bags or sheet piling. Dewatering methods that may be considered include pumping, installation of a siphon, or installation of pipe extending upstream to divert flow directly through the principal spillway conduit and around the riser structure. Replacement of the riser structure will include demolition of the old structure, replacement of unsuitable material, installation of the foundation, and installation of the new riser structure.

Drawdowns will be conducted on a defined schedule to be determined in the design phase to allow a proper progress of the construction activities. The drawdowns will be required during the installation of RCC, replacement of the riser structure, and installation of the filter diaphragm.

The construction will be conducted to minimize erosion and sedimentation, including the development of an erosion and sediment control plan as part of the permitting process. The construction site will be seeded and mulched immediately as phases of work are complete to

establish vegetation immediately following construction on all land disturbed by construction activities. Appropriate plants for erosion control and wildlife habitat will be selected based upon the installation season, soils, surrounding vegetation, and Sponsors' preference. The rehabilitated dam will meet all current NRCS and Commonwealth of Pennsylvania dam safety and performance standards.

A bald eagle nest was observed in the vicinity of the Beaver Creek Dam and activities related to the Rehabilitation will be restricted based on the established protocols.

The restrictions due to the bald eagle nest vary depending on time of year, distance from the nest, and whether or not the nest is "active" (an egg or chick present). The following is a summary of the restrictions:

- Most restrictions take effect only when the nest is active and last only for the nesting season.
- Nesting season is from January 15 to August 2.
- If the nest is active, then within this timeframe all activities (even just walking around) within 1,000 feet of the nest need to be reviewed and approved by PA Game Commission and all activities within 660 feet need to be reviewed and approved by US Fish and Wildlife Service.
- The restrictions are mainly about limiting actions that could potentially harm or disturb the eagles (i.e. loud noises, changing the landscape, getting too close to the nest etc.)

If any planned activities at Beaver Creek Dam are scheduled to take place during an active nesting season, CCWRA will coordinate with NRCS to obtain any necessary approvals from Pennsylvania Game Commission and US Fish & Wildlife Service.

The top of dam elevation and the normal pool elevation remain unchanged and no compensatory mitigation is required.

The total estimated cost of this alternative is \$4,364,000 resulting in an average annual cost of \$210,000. The average annual benefit of this alternative is \$317,900. Rehabilitation is a feasible alternative due to its low cost compared to the other alternatives and limited disturbance to surrounding land and communities.

Rehabilitation to High Hazard Class dam is the National Economic Development (NED) Alternative and is also the Preferred Alternative for the following reasons:

- It fulfills the Project Purpose and Need, which were defined by the Sponsors and public.
- It has positive impacts on human resources and minimal impacts on natural resources.
- It has the highest benefit to cost ratio of the federally-assisted alternatives considered.
- It maximizes net economic benefits consistent with protecting the nation's environment.

Detailed information for the Rehabilitation to a High Hazard Class Dam alternative is provided in Table 4-2.

**Table 4-2**  
**Rehabilitation of Beaver Creek Dam to**  
**Current High Hazard Class Dam Criteria**

Project Feature	Original As-Built Conditions	Rehabilitation to Current High Hazard Dam
Principal Spillway Crest Elevation	586.6 feet	586.6 feet
Principal Spillway Conduit	30-inch diameter RCP	30-inch diameter RCP
Auxiliary Spillway Crest Elevation	504.8 feet	503.5 feet
Auxiliary Spillway Bottom Width	225 feet	225 feet
Top of Dam Elevation	510.8 feet	510.8 feet

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#### 4.5 SUMMARY AND COMPARISON OF ALTERNATIVE PLANS

Table 2-1 identifies the relevant resource concerns for the project. Table 4-3 summarizes the project measures. Table 4-4 compares project alternative costs. The NRCS-CPA-52 in Figure 5-1 compares the alternatives with respect to the relevant resource concerns and NRCS planning requirements.

**Table 4-3**  
**Summary of Alternative Plans Considered for Detailed Study**

	<b>Rehabilitate to NRCS High Hazard Class Dam</b>
<ul style="list-style-type: none"> <li>• Controlled breach of dam by Sponsor.</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain the axis of the dam at the present location.</li> </ul>
<ul style="list-style-type: none"> <li>• Excavate through the main embankment.</li> </ul>	<ul style="list-style-type: none"> <li>• Lower the auxiliary spillway control section.</li> </ul>
<ul style="list-style-type: none"> <li>• Remove existing inlet structure.</li> </ul>	<ul style="list-style-type: none"> <li>• Install roller compacted concrete armoring in auxiliary spillway crest, exit channel and adjacent side slopes.</li> </ul>
<ul style="list-style-type: none"> <li>• Abandon conduit in-place using grout or manufactured plugs at inlet and outlet.</li> </ul>	<ul style="list-style-type: none"> <li>• Install access to toe drains through impact basin headwall.</li> </ul>
<ul style="list-style-type: none"> <li>• Construct gutter berms to reduce slope length on excavated embankment notch.</li> </ul>	<ul style="list-style-type: none"> <li>• Install sand diaphragm along principal spillway conduit.</li> </ul>
<ul style="list-style-type: none"> <li>• Provide riprap slope protection and stream bed erosion control.</li> </ul>	<ul style="list-style-type: none"> <li>• Replace principal spillway intake riser.</li> </ul>
<ul style="list-style-type: none"> <li>• Use existing auxiliary spillway for onsite disposal area for excess excavated material.</li> </ul>	<ul style="list-style-type: none"> <li>• Install rock riprap wave protect along upstream face of dam.</li> <li>• Regrade area at downstream toe of dam to provide positive drainage and install a drain trench.</li> </ul>

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#### 4.6 NATIONAL ECONOMIC DEVELOPMENT (NED) ALTERNATIVE

The NED Alternative is the federally-assisted alternative with the greatest net benefits for an existing dam that (a) does not meet the current safety and performance standards, and (b) would put human life at risk if it catastrophically failed.

**Table 4-4**  
**National Economic Development Account Comparison of Alternative Plans**

Item	Alternative <sup>1</sup>	
	No Action/Future Without Project (Sponsor Breach)	Rehabilitate to NRCS High Hazard Class Dam
Total Investment	\$ 1,272,200	\$ 4,364,000
P.L. 83-566 Funds	\$ -	\$ 3,406,000
Other Funds	\$ 1,272,200	\$ 958,000
Average Annual Benefits <sup>2</sup>	\$ -	\$ 317,900
Average Annual Costs <sup>2</sup>	\$ 54,200	\$ 210,000
Net Beneficial	\$ (54,200)	\$ 107,900
Average Annual O&M Costs	\$ -	\$ 24,000

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<sup>1</sup> Price base 2013.

<sup>2</sup> Amortized over 50 years at a discount rate of 3.5 percent. Based on total economic benefits and costs of alternatives as compared to existing conditions.

## 5.0 ENVIRONMENTAL CONSEQUENCES

### 5.1 NRCS-CPA-52

The NRCS-CPA-52 displayed in Figure 5-1 documents the benchmark conditions and environmental consequences of the project alternatives considered for detailed study.

### 5.2 CATEGORICAL EXCLUSION

Consistent with Environmental Evaluation Worksheet (NRCS-CPA-52), Pennsylvania Supplemental Instructions, the planned activities are categorically excluded actions. CEQ regulations at 40 CFR § 1508.4, defines “categorical exclusion” to mean “a category of actions that does not individually or cumulatively have a significant effect on the human environment...” NRCS’ regulation that supplements and further implements NEPA requires that the Responsible Federal Official (RFO) must determine whether the proposed action fits within a categorical exclusion listed in the agency’s implementing NEPA regulations (see 7 CFR § 650.6(a)), and the proposed action does not involve any extraordinary circumstances (see 7 CFR § 650.6(b)).

If the entire planned action is listed as one or more of the NRCS categorically excluded activities and there are no Extraordinary Circumstances identified in the NRCS-CPA-52, Section O, then the activity is categorically excluded. The following categorically excluded activities Number 14, 15, and 16 apply to the actions described in this Plan:

14. Repairing or maintaining principal spillways and appurtenances associated with existing serviceable dams, originally constructed to NRCS standards, in order to meet current safety standards. Work will be confined to the existing footprint of the dam, and no major change in reservoir or downstream operations will result;
15. Repairing or improving (deepening/widening/armoring) existing auxiliary/emergency spillways associated with dams, originally constructed to NRCS standards, in order to meet current safety standards. Work will be confined to the dam or abutment areas, and no major change in reservoir or downstream operation will result;
16. Repairing embankment slope failures on structures, originally built to NRCS standards, where the work is confined to the embankment or abutment areas;

For the categorical exclusions to apply, the proposed action must:

- Be designed to mitigate soil erosion, sedimentation, and downstream flooding;
- Require disturbed areas to be vegetated with adapted species that are neither invasive nor noxious;
- Be based on current federal principals of natural stream dynamics and processes, such as those presented in the Federal Interagency Stream Corridor Restoration Working Group document, “Stream Corridor Restoration, Principles, Processes, and Practices”;
- Incorporate the applicable NRCS conservation practice standards as found in the Field Office Technical Guide;
- Not require substantial dredging, excavation, or placement of fill; and
- Not involve a significant risk of exposure to toxic or hazardous substances.

## Figure 5-1 NRCS-CPA-52

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U.S. Department of Agriculture Natural Resources Conservation Service  <b>ENVIRONMENTAL EVALUATION WORKSHEET</b>		NRCS-CPA 52 6/2010	<b>A. Client Name:</b> Chester County Water Resources Authority (CCWRA)		
		<b>B. Conservation Plan ID # (as applicable):</b> Program Authority (optional): Section 14 of PL 83-566, the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Parts 1001-1008, 1010, 1012).			
<b>D. Client's Objective(s) (purpose):</b> The purpose of the project is to maintain or improve the current level of flood damage reduction for public safety, bridges, roads, agricultural and other lands, buildings, structures, infrastructure, and other features, and comply with applicable design, performance and safety criteria for High Hazard Class dams.		<b>C. Identification # (farm, tract, field #, etc as required):</b>  Beaver Creek Dam (PA-433)			
<b>E. Need for Action:</b> The need for this project is to continue providing and improving flood damage reduction downstream from the dam and address applicable NRCS and Commonwealth of Pennsylvania standards and design criteria for public health and safety to reduce the risk of loss of human life and property damage.		<b>G. Alternatives</b>			
		<b>No Action</b> <input type="checkbox"/> if RMS	<b>Alternative 1</b> <input type="checkbox"/> if RMS	<b>Alternative 2</b> <input type="checkbox"/> if RMS	
		No Federal Action/Future Without Project (FWOP) - A Sponsor controlled breach of the dam, such as the removal of a portion of the earthen embankment, as directed by the Pennsylvania Department of Environmental Protection (PADEP).	Rehabilitate the Dam to current NRCS High Hazard Class Dam design criteria, and extend the design life an additional 50 years.		
<b>Resource Concerns</b>					
In Section "F" below, analyze, record, and address concerns identified through the Resources Inventory process. (See FDTG Section III - Resource Quality Criteria for guidance).					
<b>F. Resource Concerns and Existing / Benchmark Conditions</b> (Analyze and record the existing/benchmark conditions for each identified concern)		<b>H. Effects of Alternatives</b>			
		<b>No Action</b>	<b>Alternative 1</b>	<b>Alternative 2</b>	
		Amount, Status, Description (short and long term)	Amount, Status, Description (short and long term)	Amount, Status, Description (short and long term)	
		<input type="checkbox"/> if does NOT meet QC	<input type="checkbox"/> if does NOT meet QC	<input type="checkbox"/> if does NOT meet QC	
<b>SOIL</b>					
Erosion (Sheet and Rill)  An AMEC sedimentation study concluded that there is approximately 21 acre-feet of sediment accumulated. This is 49% of the sediment volume estimated in the Final Design Report (1972). An AMEC sediment survey study of Beaver Creek dam estimated an annual sedimentation rate of 0.262 acre-ft/year in the dam impoundment. Given the Agricultural nature of the watershed it is assumed to be due to Sheet and Rill Erosion. The presence of Beaver Creek dam prevents an estimated 0.262 acre-ft/yr of sedimentation downstream of the dam.		No change upstream. Short-term increase in suspended sediment and turbidity downstream during construction, but proper controls will minimize erosion. With the dam removed, sediment loading will increase downstream at a rate of 0.262 acre-feet/year.	No change upstream. Short-term increase in suspended sediment and turbidity downstream during construction, but proper controls will minimize erosion. Sediment pool will continue to trap 0.262 acre-feet/year of sediment.		
		NOT meet <input type="checkbox"/> QC	NOT meet <input type="checkbox"/> QC	NOT meet <input type="checkbox"/> QC	
Erosion (Ephemeral Gully)  There is no current evidence of ephemeral gulying issues on-site.		N/A  NOT meet <input type="checkbox"/> QC	N/A  NOT meet <input type="checkbox"/> QC	NOT meet <input type="checkbox"/> QC	

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<p>Erosion (Streambank)                  The final Design Report dated 1972 estimated the average annual streambank erosion to be 294 tons/year, or 0.22 acre-ft/year. A 2012 AMEC sediment survey study of Beaver Creek dam estimated an annual sedimentation rate from all sources was estimated to be of 0.262 acre-ft/year. A substantial portion of the sedimentation is a result of Sheet and Rill Erosion, although there may be stream bank erosion within the watershed that is also a source of sediment.</p>	<p>No change to upstream streambank erosion, downstream will increase due to increased flow volumes and velocities. Shoreline erosion problem will be eliminated.</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>	<p>No change upstream or downstream. Shoreline erosion will be eliminated.</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>
<p>Condition (Organic Matter)                  Not Applicable.                  This applicability was determined as part of a scoping process including, NRCS, Sponsor, KLA and others.</p>	<p>N/A</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>	<p>N/A</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>
<p>Condition (Compaction)                  Not Applicable                  This applicability was determined as part of a scoping process including, NRCS, Sponsor, KLA and others.</p>	<p>N/A</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>	<p>N/A</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>
<p><b>F. Resource Concerns and Existing / Benchmark Conditions</b>                  (Analyze and record the existing/benchmark conditions for each identified concern)</p>	<p><b>H. Effects of Alternatives</b></p>				
	<p><b>No Action</b></p>		<p><b>Alternative 1</b></p>		<p><b>Alternative 2</b></p>
<p><b>WATER</b></p>	<p>Amount, Status, Description (short and long term)</p>	<p>√ if does NOT meet QC</p>	<p>Amount, Status, Description (short and long term)</p>	<p>√ if does NOT meet QC</p>	<p>Amount, Status, Description (short and long term)</p>
<p>Quantity (Excessive Subsurface Water)                  Per previous subsurface exploration studies that included borings taken throughout the dam and auxiliary spillway areas, there was no evidence of excessive subsurface water that would affect the normal pool elevation and pose a risk to the downstream community. The 2011 Gannett Flerring Peizometer Monitoring &amp; Evaluation Report, the east toe drain measured flow between August 2009 and November 2010 fluctuates between just under 8 gpm and just under 18 gpm. The report concluded that the peizometer data collected are not considered to be indicative of any dam safety issues.</p>	<p>Embankment removed</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>	<p>No Effect</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>	<p>NOT meet  <input type="checkbox"/>                  QC</p>

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<p>Quantity (Excessive Seepage)</p> <p>Per previous subsurface exploration studies that included borings taken throughout the dam and auxiliary spillway areas, there was no evidence of excessive seepage that would affect the normal pool elevation and pose a risk to the downstream community</p>	<p>Embankment removed</p>	<p>NOT meet</p> <p><input type="checkbox"/></p>	<p>No Effect</p>	<p>NOT meet</p> <p><input type="checkbox"/></p>	<p>NOT meet</p> <p><input type="checkbox"/></p> <p>QC</p>
<p>Quantity (Excessive Runoff, Flooding, or Ponding)</p> <p>Beaver Creek Dam was constructed in 1974 as a flood control dam to reduce flooding losses in the downstream communities. Currently, the dam controls runoff from a 2.9 square mile area up to the 100-year storm, and mitigates flood flows greater than that return period.</p> <p>Recent residential development in the immediate vicinity may be contributing to excessive runoff into the impoundment.</p> <p>A Dam Breach analysis was completed in 2000, and evaluated the Probable Maximum Flood. A breach would impact the Borough of Downingtown located 7 miles downstream from the dam site. PADEP and NRCS have classified Beaver Creek Dam as a High Hazard Dam, which is based on the potential for loss of life due to the prevalence of bridges, roads, and buildings existing in the downstream dam breach inundation zone.</p> <p>Chester County has completed the "County-wide Act 167 Stormwater Management Plan for Chester County, PA" (July 2, 2013) and was reviewed for information relevant to flooding and runoff.</p>	<p>Residential, commercial and transportation resources will be a greater risk of flood damage. Average annual flood damage reduction benefits of \$263,700 will be lost.</p>	<p>NOT meet</p> <p><input type="checkbox"/></p> <p>QC</p>	<p>Maintain flood damage reduction downstream from the Beaver Creek Dam (PA-433) with an average annual value estimated at \$263,700.</p>	<p>NOT meet</p> <p><input type="checkbox"/></p> <p>QC</p>	<p>NOT meet</p> <p><input type="checkbox"/></p> <p>QC</p>
<p>Quality (Groundwater: Harmful Levels of Pesticides)</p> <p>Adjacent long-term agricultural land use is a potential source of groundwater impact as it relates to pesticides. However, there is no known pesticide contamination documented or identified impacting the groundwater quality in the vicinity of Beaver Creek Dam. There were no wells sampled by the USGS for pesticides in the vicinity of Beaver Creek Dam according to the Chester County Groundwater Atlas, Chester County, Pennsylvania 2004. In recent years a golf course and residential development has been constructed immediately adjacent to Beaver Creek Dam. The golf course is under agreement with the COWRA to control chemical applications and is not presently considered a potential source of pesticide contamination.</p>	<p>No Effect</p>	<p>NOT meet</p> <p><input type="checkbox"/></p> <p>QC</p>	<p>No Effect</p>	<p>NOT meet</p> <p><input type="checkbox"/></p> <p>QC</p>	<p>NOT meet</p> <p><input type="checkbox"/></p> <p>QC</p>

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<p>Quality (Surface Water: Harmful Levels of Pesticides)</p> <p>There are no identified problems associated with pesticides in the surface waters of the watershed. In recent years a golf course and residential development has been constructed immediately adjacent to Beaver Creek Dam. The golf course is under agreement with the COWRA to control chemical applications and is not presently considered a potential source of pesticide contamination.</p>	<p>No Effect</p>	<p>NOT meet</p> <p><input type="checkbox"/></p>	<p>No Effect</p>	<p>NOT meet</p> <p><input type="checkbox"/></p>	<p>NOT meet</p> <p><input type="checkbox"/></p>
<p>Quality (Groundwater: Excessive Nutrients and Organics)</p> <p>There are documented elevations of nutrients (Nitrate, Nitrite, and Phosphorus) in groundwater wells throughout Chester County. Although there is no available groundwater nutrient data specific to Beaver Creek Dam and its immediate vicinity, the 2004 Chester County Groundwater Atlas indicates wells nearby to Beaver Creek exhibit elevated phosphorus levels, but not nitrate or nitrite levels.</p>	<p>No Effect</p>	<p>NOT meet</p> <p>QC <input type="checkbox"/></p>	<p>No Effect</p>	<p>NOT meet</p> <p>QC <input type="checkbox"/></p>	<p>NOT meet</p> <p>QC <input type="checkbox"/></p>
<p>Quality (Surface Water: Excessive Nutrients and Organics)</p> <p>The Brandywine Creek watershed has USEPA-approved TMDLs for sediment, bacteria and nutrients. Beaver Creek is not listed as impaired and has not been assigned a waste load allocation for sediment. A USGS study conducted in 2001 confirms loading of bacteria in the watershed. Beaver Creek was identified as contributing to elevated bacterial levels to the East Brandywine Creek. The pool experiences severe algae blooms each year.</p>	<p>Increased downstream impacts to water quality by reducing the detention time for runoff upstream from Beaver Creek Dam (PA-433). Increased transport of nutrients adsorbed to suspended sediments.</p>	<p>NOT meet</p> <p>QC <input type="checkbox"/></p>	<p>Maintain current level of surface water quality downstream from Beaver Creek Dam (PA-433).</p>	<p>NOT meet</p> <p>QC <input type="checkbox"/></p>	<p>NOT meet</p> <p>QC <input type="checkbox"/></p>
<p>Quality (Surface Water: Excessive Susp. Sedmt &amp; Turbidity)</p> <p>The Brandywine Creek watershed has USEPA-approved TMDLs for sediment, bacteria and nutrients. Beaver Creek is not listed as impaired and has not been assigned a waste load for sediment. Past and current adjacent and upstream farming activities and upstream stream bank erosion of Beaver Creek are potential contributing sedimentation sources.</p>	<p>The 0.262 acre-feet/year of sediment will be delivered downstream.</p>	<p>NOT meet</p> <p>QC <input type="checkbox"/></p>	<p>Temporary increases during rehabilitation. After reconstruction is completed, sediment pool will continue to trap 0.262 acre-feet/year.</p>	<p>NOT meet</p> <p>QC <input type="checkbox"/></p>	<p>NOT meet</p> <p>QC <input type="checkbox"/></p>

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Quality (Surface Water: Harmful Temperatures) Beaver Creek is designated a Cold Water, Migratory Fishery (CWF-MF), but does experience periods where temperatures approach the upper tolerances for trout. Temperatures and fisheries data can be found in the water quality standards review stream redesignation evaluation report for Beaver Creek dated October 2006.	There will be a slight decrease in warm weather stream temperatures immediately downstream due to elimination of the pool discharge.	NOT meet QC	No Effect	NOT meet QC	NOT meet QC
Quality (Surface Water: Harmful Levels of Pathogens) In recent site visits to Beaver Creek Dam resident Canada Geese were observed. Pathogens from their fecal matter could contaminate the dam impoundment. While there are many geese at Beaver Creek Dam throughout the year – it is difficult to quantify how many are resident geese. However, it is very true that at certain times, the number of geese exceed 1,000.	Improved water quality.	NOT meet QC	No Effect	NOT meet QC	NOT meet QC
Quality (Groundwater Water: Harmful Levels of Pathogens) There are no known sources pathogens that pose a risk to the groundwater.	No Effect	NOT meet QC	No Effect	NOT meet QC	NOT meet QC
<b>F. Resource Concerns and Existing / Benchmark Conditions</b> (Analyze and record the existing/benchmark conditions for each identified concern)	<b>H. (continued)</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>No Action</b>	<b>Alternative 1</b>	<b>Alternative 2</b>		
	Amount, Status, Description (short and long term)	✓ if does NOT meet QC	Amount, Status, Description (short and long term)	✓ if does NOT meet QC	Amount, Status, Description (short and long term) ✓ if does NOT meet QC
<b>AIR</b>					
Pennsylvania air quality nonattainment counties can be found at: PM 2.5: <a href="http://www.epa.gov/region3/airquality/virm75nonattainment.html">http://www.epa.gov/region3/airquality/virm75nonattainment.html</a> Ozone: <a href="http://www.epa.gov/region3/airquality/virozone.htm#ctareas_2.htm">http://www.epa.gov/region3/airquality/virozone.htm#ctareas_2.htm</a>					
Quality (Particulate Matter < 2.5µm diameter ("PM 2.5")) Chester County is in the Philadelphia- Wilmington Nonattainment area for PM2.5	Minimal, short term, highly localized emissions of PM 2.5 may result from the use of diesel equipment and earth disturbances may cause localized increased in dust and coarse, airborne particulate matter that will be controlled using dust and erosion control BMPs.	NOT meet QC <input type="checkbox"/>	Minimal, short term, highly localized emissions of PM 2.5 may result from the use of diesel equipment and earth disturbances may cause localized increased in dust and coarse, airborne particulate matter that will be controlled using dust and erosion control BMPs.	NOT meet QC <input type="checkbox"/>	NOT meet QC <input type="checkbox"/>
Quality (Excessive Ozone) Chester County is in a moderate excessive ozone zone according to the EPA	No Effect	NOT meet QC	No Effect	NOT meet QC	NOT meet QC
Quality (Chemical Dnt) Not Applicable. There are no known chemical plants or sources within the watershed.	No Effect	<input type="checkbox"/> T meet QC	No Effect	<input type="checkbox"/> T meet QC	<input type="checkbox"/> T meet QC
Quality (Objectionable Odors) There are no known sources of objectionable odors from Beaver Creek Dam.	No Effect	<input type="checkbox"/> T meet QC	No Effect	<input type="checkbox"/> T meet QC	<input type="checkbox"/> T meet QC

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F. Resource Concerns and Existing / Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	H. (continued)					
	No Action		Alternative 1		Alternative 2	
	Amount, Status, Description (short and long term)	if it does NOT meet QC	Amount, Status, Description (short and long term)	if it does NOT meet QC	Amount, Status, Description (short and long term)	if it does NOT meet QC
<b>PLANTS</b>						
Condition (Noxious and Invasive Plants)  Multi-flora rose, Canada Thistle, Duckweed and Watermeal have been identified around or on the sediment pool. At this time, this and other potential invasive plants exist but are not causing a problem for the management of the dam or lake.	Minor occurrences following construction.	NOT meet  QC  <input type="checkbox"/>	Will be minimized with replanting of adapted species and management of noxious plants.	NOT meet  QC  <input type="checkbox"/>		NOT meet  QC  <input type="checkbox"/>
F. Resource Concerns and Existing / Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	H. (continued)					
	No Action		Alternative 1		Alternative 2	
	Amount, Status, Description (short and long term)	if it does NOT meet QC	Amount, Status, Description (short and long term)	if it does NOT meet QC	Amount, Status, Description (short and long term)	if it does NOT meet QC
<b>ANIMALS</b>						
Fish and wildlife (Inadequate Cover/Shelter)  Beaver Creek is a Cold Water Migratory Trout Stocking Fisheries stream (CWF-MF, TSF). Beaver Creek sediment pool was stocked with fish for many years by a previous land owner. It is not uncommon to see deer, fox, beaver, heron and other water fowl on or near the dam and sediment pool. A reach of Beaver Creek, well downstream of Beaver Creek Dam, is listed by the PA Fish and Boat Commission as a Wild Trout Waters (Naturally Reproducing) as of June 2011.	Improved temperatures for trout immediately downstream, increased sedimentation and nutrient loading downstream which could adversely impact trout reproduction and habitat, loss of warm water fishery in dam pool, eliminates stream obstruction for migratory fish passage, reduced habitat value for waterfowl, slight improvement in wildlife habitat with removed embankment.	NOT meet  QC  <input type="checkbox"/>	Fish and waterfowl may be impacted during construction due to the temporary drawdown of the sediment pool. The fish and wildlife impacts will be managed consistent with PA Fish and Boat Commission requirements.	NOT meet  QC  <input type="checkbox"/>		NOT meet  QC  <input type="checkbox"/>
Domestic animals (Inadequate Quantities and Qual. of Feed & Forage)	N/A	NOT meet	N/A	NOT meet		NOT meet
Not Applicable		QC		QC		QC
Domestic animals (Inadequate Stock Water)	N/A	<input type="checkbox"/> meet	N/A	<input type="checkbox"/> meet		<input type="checkbox"/> meet
Not Applicable		QC		QC		QC

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HUMAN - Economic and Social Considerations			
<p><b>Land Use</b>                      The contributing watershed consists of an estimated 55% agricultural, 14% forested landuse and 31 percent suburban development. In recent years the land directly adjacent to the Beaver Creek Dam impoundment has been developed with a golf course and residential community. Several upstream tracts of land may also be converted to residential developments.</p>	<p>The breach area will change from introduced grass species to native riparian woodland, slightly increasing the woodland habitat. <input type="checkbox"/></p>	<p>No Effect <input type="checkbox"/></p>	<input type="checkbox"/>
<p><b>Public Health and Safety</b>                      Beaver Creek Dam is a High Hazard Dam. The dam owner estimates that there are 4,400 residents within the dam breach inundation zone, as well as 8 schools with a population of 3,200 people and 30 businesses. The dam reduces flows for high frequency events up to an including the 100-year storm. The dam also affords flood protection from extreme events (greater than the 100-year storm).</p>	<p>Increased flooding of residential commercial and transportation facilities downstream from Beaver Creek Dam (PA-433). Average annual flood damage reduction benefits of \$263,700 will be lost.</p>	<p>Maintain flood damage reduction downstream from the Beaver Creek Dam (PA-433) with an average annual value estimated at \$263,700. Reduced risk to 4,400 residents, 8 schools, and 30 businesses.</p>	
<p><b>Labor</b>                      The labor needed to maintain the dam and reservoir is estimated as the equivalent of 1 full time staff, which includes support from multiple firms to provide grounds maintenance and other miscellaneous maintenance services.</p>	<p>No staff needed.</p>	<p>Maintain 1 full time staff.</p>	
<p><b>Management Level</b>                      The dam owner has sufficient education and experience to manage and maintain the dam and reservoir; in addition, a consulting firm has been engaged for professional engineering services. The effort to provide management is estimated at 0.5 full time staff.</p>	<p>No future dam management needs</p>	<p>Maintain experienced and educated staff with assistance for hired consulting firm.</p>	

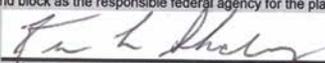
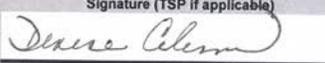
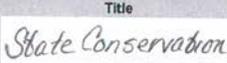
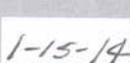
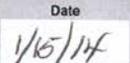
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<b>Special Environmental Concerns: Environmental Laws, Executive Orders, policies, etc.</b>					
In Section "I" complete and attach applicable Environmental Procedures Guide Sheets for documentation. Items with a "•" may require a federal permit or consultation/coordination between the lead agency and another government agency. In these cases, effects may need to be determined in consultation with another agency. Planning and practice implementation may proceed for practices not involved in consultation.					
<b>I. Special Environmental Concerns</b> (Document compliance with Environmental Laws, Executive Orders, policies, etc.)	<b>J. Impacts to Special Environmental Concerns</b>				
	<b>No Action</b>		<b>Alternative 1</b>		<b>Alternative 2</b>
	Status and progress of compliance. (Complete and attach Guide Sheets as applicable)	√ if needs further action	Status and progress of compliance. (Complete and attach Guide Sheets as applicable)	√ if needs further action	Status and progress of compliance. (Complete and attach Guide Sheets as applicable)
<b>•Clean Air Act</b> There are no emissions from the dam. Beaver Creek is currently meeting the full compliance of the Clean Air Act	Dust controls will be implemented during construction to minimize airborne Particulate Matter. Construction equipment will conform to requirements of the Pennsylvania State Implementation Plan for Clean Air Act compliance.	<input type="checkbox"/>	Dust controls will be implemented during construction to minimize airborne Particulate Matter. Construction equipment will conform to requirements of the Pennsylvania State Implementation Plan for Clean Air Act compliance.	<input type="checkbox"/>	<input type="checkbox"/>
<b>•Clean Water Act / Waters of the U.S.</b> The Brandywine Creek watershed has USEPA-approved TMDLs for sediment, bacteria and nutrients. Beaver Creek is not listed as impaired and does not have a waste load allocation.	No material will be filled or dredged within the bed and bank of a jurisdictional stream.	<input type="checkbox"/>	CCWRA will obtain necessary permits from PA DEP. NPDES permit will be needed, no section 404 permit needed.	<input type="checkbox"/>	<input type="checkbox"/>
<b>•Coastal Zone Management Areas</b> Not Applicable	N/A		N/A		
<b>•Coral Reefs</b> Not Applicable	N/A		N/A		
<b>•Cultural Resources / Historic Properties</b> There are three location downstream of Beaver Creek Dam that are listed in the National Register of Historic places database: County Bridge No. 124 (NPS Ref # 88000760), Roger Hunt Mill (NPS Ref # 8003457), and Downingtown Log House (NPS Ref # 79002195). All three sites are located downstream in the dam breach inundation zone; not within the footprint of the dam.  On March 29, 2013 the Pennsylvania State Historic Preservation Office confirmed there were no historic properties in the Area of Potential Effect.	No Effect	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	No Effect	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<b>•Endangered and Threatened Species</b> Potential bog turtle habitat identified by USFWS on 1/23/13 however, due to distance to a known site, size, and depth of muck, it was determined to be not bog turtle habitat. The bald eagle is Pennsylvania Threatened and Protected Species. An active bald eagle nesting site was observed in the vicinity in 2013.	No effect or adverse effects to bald eagle nesting site. Comply with nest protection protocols developed by USF&WS and PA Game Commission during construction.	<input type="checkbox"/>	No effect or adverse effects to bald eagle nesting site. Comply with nest protection protocols developed by USF&WS and PA Game Commission during construction.	<input type="checkbox"/>	<input type="checkbox"/>
<b>•Environmental Justice</b> The Borough of Downingtown is located downstream of Beaver Creek Dam and has the highest population density in the watershed. According to the 2010 census the population of Downingtown has a lower percentage of persons living below the poverty level when compared to the percentage of the state of Pennsylvania. Beaver Creek Dam does provide flood relief to this area by reducing the flood elevations from high frequency events. In the event of a rare extreme event that could overtop or cause a dam failure, the dam provides storage and allows for more time to evacuate anyone who may be at risk from the dam breaching.	Loss of flood protection for the Borough of Downingtown, which has a higher percentage of residents who are racial minorities than the statewide percentage.	<input type="checkbox"/>	No disproportionate adverse effects are anticipated to any ethnic, racial, or socioeconomically disadvantaged families or groups downstream of the dam.	<input type="checkbox"/>	<input type="checkbox"/>

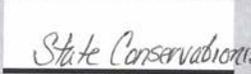
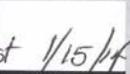
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<u>Essential Fish Habitat</u>						
Not Applicable	N/A		N/A			
<u>Floodplain Management</u>						
The 2-Year through 500-Year floodplains were estimated in the Beaver Creek watershed using FEMA Detailed methodology. The water surface elevations and flows are documented in the Chester County FEMA Flood Investigation Study (FIS) effective September 29, 2006.	Residential, commercial and transportation resources will be at greater risk of flood damage. Average annual flood damage reduction benefits of \$263,700 will be lost.	<input type="checkbox"/> <input type="checkbox"/>	Maintain flood damage reduction benefits downstream from the Beaver Creek Dam (PA-433) with an average annual value estimated at \$263,700.	<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/>
<u>Invasive Species</u>						
Multi-flora rose, Canada Thistle, Duckweed and Watermeal have been identified around or on the sediment pool. At this time, this and other potential invasive plants exist but are not causing a problem for the management of the dam or lake.	Construction could potentially introduce invasive plant species. Will be minimized by planting adapted species.	<input type="checkbox"/> <input type="checkbox"/>	Construction could potentially introduce invasive plant species. Will be minimized by planting adapted species.	<input type="checkbox"/>		<input type="checkbox"/>
<u>Migratory Birds/Bald and Golden Eagle Protection Act</u>						
All native wild birds found in the United States, with the exception of the house sparrow, starling, feral pigeons and resident game birds (e.g. pheasant, grouse, wild turkey) are protected under the Migratory Birds/Bald and Golden Eagle protection Acts. Habitat for native birds, including nesting sites, exists in and around the Beaver Creek Dam impoundment. No specific bird survey has been conducted for the project area, as such no specific bird information is presently available for the project area. Bald eagle, herons, geese, and other waterfowl have been observed at the Beaver Creek Dam impoundment.	Migratory birds and nesting activities could be temporarily disturbed during construction.	<input type="checkbox"/>	Migratory birds and nesting activities could be temporarily disturbed during construction.	<input type="checkbox"/>		<input type="checkbox"/>
<u>Prime and Unique Farmlands</u>						
According to the NRCS Web Soil Survey soils surrounding the Beaver Creek Dam impoundment are classified as either Prime Farmland or Farmland of Statewide importance. However, the soils immediately adjacent to the Beaver Creek streambed downstream of the dam are not classified as Prime Farmland or Farmland of Statewide importance.	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>		<input type="checkbox"/>
<u>Riparian Area</u>						
The riparian areas adjacent to Beaver Creek Dam and sediment pool are primarily forested except for a small meadow area at the west shoreline of the impoundment.	Decrease in shoreline riparian area with removal of storage function of dam.	<input type="checkbox"/>	No Effect	<input type="checkbox"/>		<input type="checkbox"/>
<u>Sole Source Aquifers</u>						
Chester County is not identified as a county that is at risk of contaminating sole source aquifers.	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>		<input type="checkbox"/>
<u>Scenic Beauty</u>						
Scenic quality of the general landscape may be affected by some alternatives. The project is located within view of residential properties and immediately adjacent to Applecross Country Club.	Loss of aesthetic appeal of lake, replaced by stream and riparian scene.	<input type="checkbox"/>	Temporary impacts while lake is drawn down and unsightly construction equipment. Long-term scenic beauty will be maintained.	<input type="checkbox"/>		<input type="checkbox"/>
<u>Wetlands</u>						
The wetland area above the Beaver Creek Dam was estimated using sheet 89 of 801 of the Sanitary Sewer and Water Plans. The estimated wetland area was 19 acres.	There may be a change in site hydrology and change in the character of the 19 acres of wetlands created by the lake.	<input type="checkbox"/>	No long-term effects. Temporary disturbance of wetlands created by the sediment pool may occur during construction due to the drawdown required.	<input type="checkbox"/>		<input type="checkbox"/>
<u>Wild and Scenic Rivers</u>						
The Beaver Creek Dam Watershed does not contain any wild and scenic rivers.	No Effect	<input type="checkbox"/>	No Effect	<input type="checkbox"/>		<input type="checkbox"/>

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<b>K. Other Agencies and Broad Public Concerns</b>		<b>No Action</b>	<b>Alternative 1</b>	<b>Alternative 2</b>																											
Easements, Permits, Public Review, or Permits Required and Agencies Consulted.		CCWRA will obtain necessary permits from PA DEP. NPDES permit will be needed; no section 404 permit needed.	CCWRA will obtain necessary permits from PA DEP. NPDES permit will be needed; no section 404 permit needed.																												
<b>K. (continued) Other Agencies and Broad Public Concerns</b>		<b>No Action</b>	<b>Alternative 1</b>	<b>Alternative 2</b>																											
Cumulative Effects Narrative (Describe the cumulative impacts considered, including past, present and known future actions regardless of who performed the actions)		Residential, commercial and transportation resources will be a greater risk of flood damage. Average annual flood damage reduction benefits of \$263,700 will be lost. Increased downstream delivery of sediment, bacteria, loss of habitat, reduced shoreline riparian areas, and other effects listed previously in CPA-52.	No adverse cumulative environmental, socioeconomic, or infrastructural impacts are anticipated for the dam rehabilitation alternative.																												
<b>L. Mitigation</b>		E&S and dust control measures will be utilized to minimize temporary effects.	E&S and dust control measures will be utilized to minimize temporary effects.																												
<b>M. Preferred Alternative</b>	<input type="checkbox"/> preferred alternative		Rehabilitation Alternative will meet Purpose and Need for Project and Maintain flood damage reduction downstream from the Beaver Creek Dam (PA-433) with an average annual value estimated at \$263,700. This is the National Economic Development (NED) Alternative with net benefits of \$107,900 and a B:C ratio of 1.5 to 1. On 5/15/2013 the CCWRA Board approved this alternative.																												
		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>																											
<b>N. Context (Record context of alternatives analysis)</b>																															
The significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality.																															
<input type="checkbox"/> local <input type="checkbox"/> regional <input type="checkbox"/> national																															
<b>O. Determination of Significance or Extraordinary Circumstances</b>																															
<b>Intensity:</b> Refers to the severity of impact. Impacts may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts. If you answer ANY of the below questions "yes" then contact the State Environmental Liaison as there may be extraordinary circumstances and significance issues to consider and a site specific NEPA analysis may be required.																															
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<b>P. The information recorded above is based on the best available information:</b>																															
In the case where a non-NRCS person (i.e. a TSP) assists with planning they are to sign the first signature block and then NRCS is to sign the second block as the responsible federal agency for the planning action.																															
 Signature (TSP if applicable)		 Signature (NRCS)		 Title	 Title																										
				 Date	 Date																										

National Environmental Compliance Handbook

The following sections are to be completed by the Responsible Federal Official (RFO)		
<b>Q. NEPA Compliance Finding (check one)</b>		
The preferred alternative:		Action required
<input type="checkbox"/>	1) is not a federal action where the agency has control or responsibility.	Document in "R.1" below. No additional analysis is required
<input checked="" type="checkbox"/>	2) is a federal action that is <b>category</b> excluded from further environmental analysis <b>and</b> there are no <b>extraordinary circumstances</b> .	Document in "R.2" below. No additional analysis is required
<input type="checkbox"/>	3) is a federal action that has been <b>sufficiently analyzed</b> in an existing Agency state, regional, or national NEPA document <b>and</b> there are no predicted <b>significant adverse environmental effects or extraordinary circumstances</b> .	Document in "R.1" below. No additional analysis is required.
<input type="checkbox"/>	4) is a federal action that has been sufficiently analyzed in another Federal agency's NEPA document (EA or EIS) that addresses the proposed NRCS action and its' effects <b>and has been formally adopted by NRCS</b> . NRCS is required to prepare and publish the agency's own Finding of No Significant Impact for an EA or Record of Decision for an EIS when adopting another agency's EA or EIS document. <b>Note: This box is not applicable to FSA.</b>	Contact the State Environmental Liaison for list of NEPA documents formally adopted and available for tiering. Document in "R.1" below. No additional analysis is required
<input type="checkbox"/>	5) is a federal action that has <b>NOT</b> been sufficiently analyzed or may involve predicted significant adverse environmental effects or extraordinary circumstances and may require an EA or EIS.	Contact the State Environmental Liaison. Further NEPA analysis required.
<b>R. Rationale Supporting the Finding</b>		
R.1 Findings Documentation		
R.2 Applicable Categorical Exclusion(s) (more than one may apply)	14. Repairing or maintaining principal spillways and appurtenances associated with existing serviceable dams, originally constructed to NRCS standards, in order to meet current safety standards. Work will be confined to the existing footprint of the dam, and no major change in reservoir or downstream operations will result. 15. Repairing or improving (deepening/widening/armoring) existing auxiliary/emergency spillways associated with dams, originally constructed to NRCS standards, in order to meet current safety standards. Work will be confined to the dam or abutment areas, and no major change in reservoir or downstream operation will result. 16. Repairing embankment slope failures on structures, originally built to NRCS standards, where the work is confined to the embankment or abutment areas.	
I have considered the effects of the alternatives on the Resource Concerns, Economic and Social Considerations, Special Environmental Concerns, and Extraordinary Circumstances as defined by Agency regulation and policy.		
<b>S. Signature of Responsible Federal Official:</b>		
		
Signature	Title	Date
<b>Additional notes</b>		

## 6.0 CONSULTATION, COORDINATION AND PUBLIC PARTICIPATION

### 6.1 PUBLIC PARTICIPATION

NRCS completed a Rehabilitation Assessment Report and estimated risk based profile of the Beaver Creek Dam in June 2011. The evaluation indicated the Risk Index was 3,686. NRCS reviewed the breach inundation zone downstream from the dam and determined that developments immediately downstream were subject to flooding during a breach of the dam. The evaluations indicated that the dam did not meet NRCS and Commonwealth of Pennsylvania Dam Safety requirements with respect to the current hazard classification and recommended modifications to meet current design criteria.

The Sponsor submitted a formal request for assistance to NRCS on September 15, 2010. The request for assistance listed concerns about compliance with current dam safety standards, including the function of the auxiliary spillway, principal spillway, foundation and embankment.

NRCS, CCWRA and members of the Project Team (listed in Table 9-1) conducted a project kickoff meeting at Chester County Water Resources Authority, 601 Westtown Road, Suite 260, West Chester, PA on November 14, 2011. Shortly after this meeting a Public Participation Plan was prepared to serve as a guide for carrying out the activities related to consultation, coordination and public participation. The planning effort was conducted with close coordination with the Pennsylvania Department of Environmental Protection's Bureau of Waterways Engineering Division of Dam Safety.

Public scoping open forums were conducted by CCWRA at monthly meetings. CCWRA received input, discussed problems and opportunities, and issued updates on progress. All CCWRA monthly meetings are open forums conducted in compliance with Commonwealth of Pennsylvania Sunshine Act which requires public agencies to hold certain meetings and hearings open to the public.

**April 17, 2013 – Project Team/NRCS.** The Project Team and NRCS held a meeting at the NRCS Field Office in West Chester, Pennsylvania. This meeting provided instruction and guidance on the project scope and the extent of activities required for developing the Supplemental Watershed Plan and Environmental Evaluation.

**April 17, 2013 – Public Forum.** Members of the Project Team and NRCS attended the CCWRA monthly meeting and conducted an open forum to discuss the project. The monthly meetings are advertised with public notice published in Chester County, Pennsylvania. The following topics were discussed:

- Problems and opportunities identified
- Sponsor objectives
- Alternatives considered
- Alternatives evaluated and comparison of effects

The Sponsor allowed public input at all monthly meetings prior to and during the planning process. The Draft Supplemental Watershed Work Plan No. 8 and Environmental Evaluation for Beaver Creek Dam (PA-433) of the Brandywine Creek Watershed was available upon request.

## 6.2 AGENCY CONSULTATION

The following agencies and elected officials received the Project Fact Sheet and later the Abstract of the Supplemental Watershed Plan No. 8 and Environmental Evaluation for Beaver Creek Dam of the Brandywine Creek Watershed.

- Chester County Conservation District
- PADEP, Bureau of Waterways Engineering,
- PA Fish and Boat Commission, Bureau of Fisheries
- Pennsylvania Department of General Services
- New Castle Conservation District
- East Brandywine Township
- West Brandywine Township
- Chester County Planning Commission
- Chester County Department of Emergency Services
- Delaware River Basin Commission
- Pennsylvania Governor's Policy Office
- Honorable Patrick Toomey
- Honorable James Gerlach
- Honorable Curt Schroder
- Honorable Chris Ross
- Honorable John C. Rafferty, Jr.
- Honorable Andrew Dinniman
- Honorable Robert P. Casey
- KLA Environmental Services
- Pulte Group, Northeast Corridor Division
- Applecross County Club Master Association
- Applecross Club Operations

Prior to construction of the dam, consultation with the State Historic Program Office (SHPO) and Chester County Historical Society determined that no archeological, historic, or cultural resources would be disturbed by the proposed dam construction. Since the dam was built in the footprint previously cleared for such resources, none of the proposed project alternatives pose a risk of impact to archeological or historic resources. A recent follow-up review of The National Register of Historic Places website reconfirmed that while several historical sites are nationally listed for Chester County, none occur in the area of potential effect for the project. On March 29, 2013 the Pennsylvania Historical and Museum Commission confirmed there are no known archeological or historical sites in the area of potential effect.

The U.S. Fish & Wildlife Service was consulted and they responded on February 28, 2013 that no federally listed species under their jurisdiction is known or likely to occur in the project area. In light of the observance of a bald eagle nest in the vicinity of Beaver Creek Dam, CCWRA in consultation with US Fish and Wildlife Service and Pennsylvania Game Commission, implemented restrictions and protocols to prevent disturbance during the nesting season.

According to correspondence received from Mr. John J. Kraeuter, Chief, Environmental and Geological Services Section, PA DEP, dated October 16, 2013, the project is considered a Category I Activity because the direct and indirect impacts to "waters" at the site fall below the impact thresholds of the permit: less than one acre of impacts to water and less than 250 feet linear impacts to streams' therefore, no further Section 404 permit coordination with USACE is required.

As per the Pennsylvania State Programmatic General Permit (PASPGP-4) issued by the USACE, PA DEP has been given the authority to review projects such as the Beaver Creek Dam (PA-433) for the Section 404 Clean Water Act requirements. CCWRA will be responsible for obtaining the necessary permits from PA DEP.

The Pennsylvania Natural Diversity Inventory (PNDI) online database was queried to determine if protected species or species proposed for protection ranged within the watershed). As documented in the NRCS-CPA-52 form, this review of the natural heritage data indicates that none of the project alternatives pose a risk of adverse impact to individuals, populations or threatened flora or fauna.

A bald eagle nest was observed in the vicinity of Beaver Creek Dam and as noted, CCWRA in consultation with US Fish and Wildlife Service and Pennsylvania Game Commission, implemented restrictions and protocols to prevent disturbance during the nesting season. None of the project alternatives pose a risk of adverse impact to other habitats of federal- or state-listed species of endangered or threatened species.

## 7.0 PREFERRED ALTERNATIVE: REHABILITATE TO HIGH HAZARD CLASS DAM

### 7.1 RATIONALE FOR PREFERRED ALTERNATIVE

The following alternatives were developed and presented to the Chester County Water Resources Authority on April 17, 2013:

- No Action/Future Without Federal Project (FWOP)
- Rehabilitation to a High Hazard Class dam
- Decommissioning of Beaver Creek Dam
- Decommissioning with Nonstructural Measures (Flood-Proofing in the Inundation Areas)
- Variations of Dam Rehabilitation Alternative

Two of these alternatives (FWOP and Rehabilitation to a High Hazard Class Dam) merited detailed evaluation. The Chester County Water Resources Authority selected on May 15, 2013 their preferred alternative to be the rehabilitation of the dam as identified by NRCS; with the understanding that the rehabilitation items will be developed during the design phase to minimize disturbance, construction cost, and operation and maintenance costs. Thus the Rehabilitation to High Hazard Class Dam Alternative is the Preferred Alternative of both NRCS and the Sponsor.

The Beaver Creek Dam (PA-433) Supplemental Watershed Work Plan No. 8 - Environmental Evaluation meets all applicable USDA-Natural Resources Conservation Service and Commonwealth of Pennsylvania dam safety and performance standards for the Beaver Creek Dam. The service life for the rehabilitated dam will be 50 years.

The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council, 1983) require the evaluation of a National Economic Development Alternative. This alternative is defined as that which maximizes the net economic benefits, consistent with protecting the Nation's environment. The Rehabilitation to a High Hazard Class Dam Alternative meets the tests of completeness, effectiveness, efficiency and acceptability. The Preferred Alternative is the NED Alternative with net annual economic benefits of \$107,900 and a Benefit/Cost ratio of 1.5 to 1.0.

### 7.2 MEASURES TO BE INSTALLED

Based on review of the Project Purpose and Project Need, the overall impacts on human and natural environmental resources, and consideration of the NED Alternative, the Preferred Alternative is to rehabilitate Beaver Creek Dam (PA-433) to NRCS and Commonwealth of Pennsylvania High Hazard Class dam design criteria with a service life of 50 years. The Preferred Alternative will sustain the present level of flood protection and reduce the threat to public health and safety. The Preferred Alternative (See Figure B-4 - Project Site Map in Appendix B) includes the following modifications to the dam:

- Maintain the axis of the dam at the present location.
- Lower the auxiliary spillway control section.
- Install roller compacted concrete armoring in auxiliary spillway crest, exit channel and adjacent side slopes.
- Install access to toe drains through impact basin headwall.
- Install sand diaphragm along principal spillway conduit.
- Replace principal spillway intake riser.
- Install rock riprap wave protect along upstream face of dam.
- Regrade area at downstream toe of dam to provide positive drainage and install a trench drain.

The alternative to rehabilitate Beaver Creek Dam to meet NRCS and Commonwealth of Pennsylvania High Hazard Class dam criteria would require construction and modification in three locations of the dam: the auxiliary spillway, the downstream toe, the upstream face of the dam.

**Auxiliary Spillway** - The control section of the auxiliary spillway will be lowered from elevation 504.8 feet to elevation 503.5 feet. The overtopping protection of the auxiliary spillway will be accomplished by use of roller compacted concrete (RCC). Existing vegetation will be stripped from the auxiliary spillway. The auxiliary spillway will be excavated and the subgrade prepared per the construction plans. During this process any unsuitable soil or material will be removed and replaced with acceptable material. Soft or yielding subgrade areas encountered during construction would be stabilized prior to installation of the RCC. A stepped slope of RCC will be installed along the exit channel. The RCC will be proportioned, mixed, placed, compacted and cured in accordance with the design specifications; and will be installed to conform to the grades, thickness, and typical cross sections of the construction plans. The RCC will be covered with compacted earthfill, which will be vegetated with grasses similar to those used on the original dam. Borrow for the earthfill will be obtained on-site.

**Downstream Toe** - Construction techniques of the filter diaphragm under the principal spillway will be evaluated in the design phase. Potential techniques can include a weighted filter placed upon the existing slope or a filter installed within an excavation at the toe. The filter diaphragm construction will consist of excavation, subgrade preparation, installation of aggregate material and geotextile, and backfill with suitable material.

Installation of toe drain access will include excavation adjacent to the impact basin, cutting the 90 degree bend of the toe drain pipe, and installation of a Y-fitting. The pipe will be backfilled with suitable material to existing grade and an end cap will be installed at the access.

A trench drain and regrading of the existing wet area adjacent to the downstream embankment toe will be installed to maintain a positive drainage. Construction will include trench excavation; installation of drainage stone, perforated pipe, and geotextile; and backfill with suitable material. The adjacent area will be graded per the construction drawings to provide positive drainage.

**Upstream Face** - Replacement of the riser structure will first require drawdown of the impoundment area, construction of a coffer dam, and installation of a water diversion to dewater the construction area adjacent to the riser structure. The dewatering plan will be developed during the construction phase. Options for the coffer dam that may be considered include sand bags or sheet piling. Dewatering methods that may be considered include pumping, installation of a siphon, or installation of pipe extending upstream to divert flow directly through the principal spillway conduit and around the riser structure. Replacement of the riser structure will include demolition of the old structure, replacement of unsuitable material, installation of the foundation, and installation of the new riser structure.

Drawdowns will be conducted on a defined schedule to be determined in the design phase to allow a proper progress of the construction activities. The drawdowns will be required during the installation of RCC, replacement of the riser structure, and installation of the filter diaphragm.

The construction will be conducted to minimize erosion and sedimentation, including the development of an erosion and sediment control plan as part of the permitting process. The construction site will be seeded and mulched immediately as phases of work are complete to establish vegetation immediately following construction on all land disturbed by construction activities. Appropriate plants for erosion control and wildlife habitat will be selected based upon the installation season, soils, surrounding vegetation, and Sponsors' preference. The rehabilitated dam will meet all current NRCS and Commonwealth of Pennsylvania dam safety and performance standards.

Detailed information for Preferred Alternative is provided in Table 7-1.

**Table 7-1  
 Preferred Alternative Design Features<sup>1</sup>**

Resource	Unit	Existing Condition	Rehabilitate To NRCS High Hazard Class Dam
Elevation, Crest of dam	MSL <sup>2</sup>	510.80 feet	510.80 feet
Elevation Crest of auxiliary spillway	MSL <sup>2</sup>	504.80 feet	503.50 feet
Elevation, Principal spillway inlet	MSL <sup>2</sup>	486.60 feet	486.60 feet
Dam crest length	Feet	1400 feet	1400 feet
Auxiliary spillway type	Type	Vegetated Earth	Roller Compacted Concrete
Auxiliary spillway bottom width	Feet	225 feet	225 feet
Principal spillway type	Type	Reinforced Concrete Pipe	Reinforced Concrete Pipe
Sediment storage	Acre-Feet	21.8	21.8
Total storage capacity - top of dam	Acre-Feet	1351.24	1351.24

January-2014

<sup>1</sup> Information in this table is based on the results of the planning study and may vary from the General Work Plan and As-Built Drawings.

<sup>2</sup> Mean Sea Level, NGVD29

After implementation of the Preferred Alternative, the Beaver Creek Dam will meet all current NRCS and PADEP dam safety and performance standards.

### 7.3 MITIGATION

No compensatory mitigation is required. All construction will be conducted to minimize erosion and sedimentation, including the development of an erosion and sediment control plan as part of the permitting process. Vegetation will be established immediately following construction on all land disturbed by construction activities. Appropriate plants for erosion control and wildlife habitat will be selected based upon the installation season, soils, surrounding vegetation, and the Sponsor's preference.

CCWRA will implement restrictions to avoid impacts to bald eagles observed nesting in the vicinity of Beaver Creek Dam. The restrictions vary depending on time of year, distance from the nest, and whether or not the nest is "active" (an egg or chick present). The following is a summary of the restrictions:

- Most restrictions take effect only when the nest is active and last only for the nesting season.
- Nesting season is from January 15 to August 2.
- If the nest is active, then within this timeframe all activities (even just walking around) within 1,000 feet of the nest need to be reviewed and approved by PA Game Commission and all activities within 660 feet need to be reviewed and approved by US Fish and Wildlife Service.
- The restrictions are mainly about limiting actions that could potentially harm or disturb the eagles (i.e. loud noises, changing the landscape, getting too close to the nest etc.)

If any planned activities at Beaver Creek Dam are scheduled to take place during an active nesting season, CCWRA will coordinate with NRCS to obtain any necessary approvals from Pennsylvania Game Commission and US Fish & Wildlife Service.

In order to take precautions regarding introduction of invasive species as disturbed areas are being re-vegetated, the construction contract will include standards and specifications drawn from the NRCS Field Office Technical Guide requiring mechanical and/or chemical means of control.

All needed measures will be taken to mitigate (avoid, minimize, and compensate) any adverse impacts during construction and may include timing of the work, sediment controls such as seeding, mulching and silt fences and wetting construction areas to reduce dust.

## 7.4 COMPLIANCE WITH FEDERAL, STATE, AND LOCAL LAWS

All applicable local, state, and federal laws will be complied with in the installation of this project.

### ***Commonwealth and Federal Regulations, Permits, and Compliance***

#### ▪ *Dam Permit and General Permits*

The Dam Owner, Chester County Water Resources Authority, will be responsible for obtaining a Dam Permit, or other appropriate authorization from Pennsylvania Department of Environmental Protection, Bureau of Waterways Engineering, prior to commencing construction. At this time no work is planned downstream of the principal spillway plunge pool, therefore no General Permit 3 (GP3) will be required. There will likely be no fee or minimal fees for these permits based on a possible exemption for local government.

#### ▪ *Section 402 of the Clean Water Act – National Pollutant Discharge Elimination System (NPDES) Permit*

The Phase I NPDES discharge program requires all operators of large construction activities which will disturb five or more acres of land to obtain permit coverage. More recently, NPDES Phase II regulations added permit coverage for small construction activities that disturb one to less than five acres. Effective December 7, 2002, PADEP integrated the federal Phase II NPDES requirements into the existing Pennsylvania Phase I NPDES permit for stormwater discharges associated with construction activities (NPDES Construction Permit). An important distinction between Phase I and II is that the small construction activities only require permit coverage when the activity disturbs one to less than five acres and will result in a point source discharge to surface waters of the Commonwealth. CCWRA will be responsible for obtaining a NPDES permit from PADEP.

#### ▪ *Other Federal Statutes and Interagency Coordination*

As per the Pennsylvania State Programmatic General Permit (PASPGP-4) issued by the USACE, PA DEP has been given the authority to review projects such as the Beaver Creek Dam (PA-433) for the Section 404 Clean Water Act requirements. CCWRA will be responsible for obtaining the necessary permits from PA DEP.

#### ▪ *Pennsylvania Clean Streams Law*

CCWRA will be responsible for preparing and submitting an Erosion & Sediment Control Plan to the Chester County Conservation District to comply with Title 25 Chapter 102, the Clean Streams Law of Pennsylvania.

### ***Local Permits and Compliance Actions***

- The project may be subject to local permits and compliance actions. East Brandywine Township regulates development and construction activities.

## 7.5 COSTS AND COST SHARING

Estimated installation costs for the Preferred Alternative are shown in Table 1 and Table 2. Total annualized costs are shown in Table 4. The costs shown in Tables 1, 2 and 4 and throughout the document are based on standard cost accounting practices required of federal watershed planning agencies, such as NRCS. The cost accounting guidance is Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council, 1983). The basis for cost sharing between NRCS and the Sponsor is different and is based on the provisions of the dam rehabilitation amendments (PL-106-472) of the Watershed Protection and Flood Prevention program. Cost-sharing for authorized projects under the dam rehabilitation amendments is based on the following (USDA-NRCS, National Watershed Program Manual, December 2009):

Total eligible rehabilitation project costs for the purpose of cost sharing includes: all costs associated with construction, acquisition of property rights, easements or rights-of-way, non-federal project administration and contracting, and non-federal technical and engineering assistance for project planning, design, and installation. Technical engineering and project administration assistance provided by NRCS shall not be considered as part of the total cost. Sponsor shall be responsible for the cost of all water, mineral and other resource rights and all required permits. These costs shall not be considered part of the total cost. Federal funds will be 65% of the above defined costs, not to exceed 100% of the construction costs. The Sponsor shall be responsible for 35% of the calculated total cost of the rehabilitation project based on the above definitions using non-federal funds. In-kind contributions and the value of property rights acquired may be counted as agreed to under a separate Memorandum of Understanding (MOU) between the Sponsors and NRCS dated October 14, 2010.

The estimated cost sharing allocation for the planned project is shown below.

Cost-sharing: Dam Rehabilitation	PL-566 Funds (65%) \$2,288,000	Other Funds (35%) \$1,232,000	Total (100%) \$ 3,520,000
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(See Watershed Agreement Item 5 for additional details)

## 7.6 INSTALLATION AND FINANCING

The works of improvement for rehabilitation of the dam are planned for installation in year one of the evaluation period. The actual installation period is contingent on the availability of funds for design and installation.

If possible, installation should be completed in one construction season in order to minimize the disturbance to plant, wildlife, and human communities. During construction, equipment will not be allowed to operate when conditions are such that soil erosion and water, air, and noise pollution cannot be satisfactorily controlled. NRCS will provide assistance to the Sponsor. The Sponsor has the needed authorities to carry out the Plan and intends to use them as appropriate.

**NRCS Responsibilities.** NRCS is responsible for the following implementation components of the Preferred Alternative:

- Design of the dam rehabilitation and preparation of construction drawings and construction specifications.
- Execute a Project Agreement with the Sponsor before either party initiates work. This Agreement sets forth detailed financial and working arrangements and other applicable conditions.
- Verify the Memorandum of Understanding with the Sponsor that allocates cost-share funding is up to date.
- Execute an updated O&M Agreement for the dam. This Agreement is based on the NRCS National Operation and Maintenance Manual.

- Determine that an Emergency Action Plan is prepared prior to the execution of fund obligating documents for construction of the structure.
- Provide contract administration technical assistance.
- Provide construction management technical assistance (Inspector and Contracting Officer Technical Representative).
- Provide engineering support, technical assistance, and approval during the design and construction of the project.
- Provide financial assistance equal to 65 percent of eligible project costs, not to exceed 100 percent of actual construction costs, as appropriations become available under the Watershed Rehabilitation component of the Watershed Protection and Flood Prevention Act (PL 83-566).
- Certify, in conjunction with DEP, Bureau of Waterways Engineering, completion of all installed measures.

**Sponsor Responsibilities.** CCWRA is responsible for the following implementation components of the Preferred Alternative:

- Provide written assurance that they have the legal authority and sufficient funding; that they are willing and able to obtain all necessary land rights, easements, permits and that they will be responsible for ensuring the operation, maintenance and replacement of installed measures.
- Participate in and comply with applicable federal floodplain management and flood insurance programs.
- Update/complete an Emergency Action Plan based on the planned changes for Beaver Creek Dam (PA-433).
- Secure all needed permits, easements, and rights for installation, operation, and maintenance.
- Execute any needed updates to the Memorandum of Understanding with NRCS which provides a framework within which cost-share funds are credited.
- Execute an Operation and Maintenance Agreement for Beaver Creek Dam (PA-433) with NRCS.
- Execute a Project Agreement or similar implementation agreement with NRCS to obligate funds for cost-share payments.
- Be responsible for all buried waste found during construction activities, if any, and all associated costs, although such costs could be included for in-kind credit at the Sponsor's request.
- Provide financial assistance or qualifying in-kind services at a rate equal to, or greater than, 35 percent of project costs using non-federal funds.
- Provide local administrative services necessary for installation of the project.

**Other Organizations Responsibilities.** No organizations other than the CCWRA and NRCS have any responsibilities in implementation of this plan.

## 7.7 EMERGENCY ACTION PLAN

Prior to construction, the sponsors shall prepare an updated Emergency Action Plan (EAP) for the dam or similar structure where failure may cause loss of life or as required by state and local regulations. The EAP shall meet the minimum content specified in the NRCS Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart F, Section 500.52, and meet applicable State agency dam safety requirements. The NRCS will determine that an EAP is prepared prior to the execution of fund obligating documents for construction of the structure. EAPs shall be reviewed and updated by the sponsors as required by the Pennsylvania Department of Environmental Protection.

## 7.8 CONTRACTING

The project will be installed by means of a federal contract administered by NRCS, as requested by the Sponsor. Other contracting arrangements will be agreed to between NRCS and the Sponsor before either party commences work activities. A project or other implementation agreement between NRCS and the Sponsor will detail the work activities and financial responsibilities for both parties.

## 7.9 REAL PROPERTY

CCWRA will be responsible for all needed land rights to implement the project. The Sponsor currently holds a flood easement upstream from the dam to Elevation 510.8 NAVD 1988, which is the existing and planned top of dam elevation. Additionally, CCWRA provided a land rights exhibit, dated January 28, 2013, which includes a statement (No. 23.), "The property is encumbered by the CCWRA Flood Easement over the entire flood detention basin for the temporary detention, conveyance and storage of flood waters that are impounded, stored or detained by the Beaver Creek Dam at capacity to an Elevation of 510.8 FT (NAVD88)."

## 7.10 SOLID AND HAZARDOUS WASTES

There are no known solid or hazardous wastes identified in the project area. If such wastes are discovered during construction, the Sponsor will ensure that such wastes are identified and disposed of in accordance with all applicable federal, state and local rules and regulations. The Sponsor will be responsible for waste identification and disposal, and if warranted, testing of soil and ground water and remediation plans. These activities will generally require the services of a hazardous waste consultant certified by the Pennsylvania Department of Environmental Protection, Bureau of Waste Management.

## 7.11 CULTURAL RESOURCES

In April 2013, the Pennsylvania State Historical Preservation Office (SHPO) confirmed there are no known cultural resources located in the construction, borrow, and spoils areas for the rehabilitation of Beaver Creek Dam. If during the design phase it is determined that other areas will be impacted during construction, consultation with PHMC will be done prior to completion of design. If cultural resources are discovered during installation, NRCS will require construction to stop and follow policy contained in NRCS General Manual, 420 Part 401 and will take action in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and the regulations (36 CFR 800) of the Advisory Council on Historic Preservation. In the case of a discovery during construction, NRCS will work closely with the PHMC, State Historical Preservation Office (SHPO) to reduce project effects on cultural resources.

## 7.12 FINANCING

The NRCS share of installation costs will be provided from funds appropriated under the Watershed Protection and Flood Prevention Act (PL 83-566), Watershed Rehabilitation. This is not a fund-obligating document, and federal assistance is subject to the availability of Congressional appropriations. The Sponsor has analyzed their financial requirements for carrying out the plan, including components that are not eligible for federal assistance as part of this plan. The Sponsor will arrange for funds to be available, when needed, from donations, non-federal grants, cash reserves, tax revenues and other non-federal sources. Credit for in-kind contributions will be as specified in the Memorandum of Understanding.

The cost, if any, of all water, mineral and other resource rights and all required permits are not eligible for federal financial assistance. These costs shall be borne, in full, by the Sponsor. The Sponsor also understands that they will be fully responsible for costs incurred for the operation, maintenance and replacement of installed measures.

### 7.13 OPERATION, MAINTENANCE, AND REPLACEMENT

Measures installed in this plan, and previously installed measures, will be operated and maintained by the Sponsor with technical assistance from federal, state, and local agencies in accordance with their delegated authority. A new O&M agreement will be developed for Beaver Creek Dam (PA-433) utilizing the NRCS-National Operation and Maintenance Manual, and will be executed when the implementation agreement is executed. The new O&M agreement will be for the evaluated life of the rehabilitation project, which is 50 years. CCWRA will be fully responsible for all operation, maintenance, repair and replacement of installed measures until such time that the structure is formally decommissioned in accordance with applicable laws and regulations.

The O&M agreement will specify responsibilities of the Sponsor and include detailed provisions for retention, use, and disposal of property acquired or improved with PL 83-566 cost sharing, requirements for operation and inspection, financial plan for conducting O&M activities, consultation requirements for modifications to works of improvement, notification requirements for emergency situations, policy related to violations of the agreement, recurring review and update of the agreement, preparation and review requirements for an Emergency Action Plan, recordkeeping requirements, and other such requirements. Provisions will be made for free access of Sponsor, state, and federal representatives to inspect all structural measure and their appurtenances at any time.

The operation and maintenance costs for the Preferred Alternative are based on Table 7-2.

**Table 7-2  
 Annual Operation and Maintenance Costs<sup>1</sup>**

Item	Cost	Amortization Rate <sup>3</sup> (%)	Return Period (Years)	Annual Cost
Routine Annual O&M Costs (Every year)	\$ 17,800			\$ 17,800
<b>Non-Routine Engineering Costs<sup>2</sup></b>				
Operation, Insp. & Maint. Manual	\$ 3,625	3.50%	15	\$ 315
Repairs to joint sealant at impact basin	\$ 4,300	3.50%	15	\$ 373
Review Piezometric Data <sup>4</sup>	\$ -	3.50%	1	\$ -
<b>Non-Routine O&amp;M Costs</b>				
Emergency Action Plan (Every 5 years)	\$ 14,500	3.50%	5	\$ 3,211
Riser Interior Inspection (Every 5 years)	\$ 3,500	3.50%	5	\$ 775
Principal Spillway Insp. (Every 10 years)	\$ 5,000	3.50%	10	\$ 601
Gate Conduit Inspection (Every 20 years)	\$ 12,500	3.50%	20	\$ 880
<b>Total Annual Operation and Maintenance Cost</b>				<b>\$ 23,955</b>

January 2014

<sup>1</sup> Price base 2013.

<sup>2</sup> Return Periods are based on 1-year installation time and 50-year operational life.

<sup>3</sup> Amortized O&M costs over return period at 3.5% interest rate based on Water Resources Discount Rate: [ftp://ftp-fc.sc.egov.usda.gov/Economics/priceindexes/Data/PPPI\\_CPI\\_CCI.xls](ftp://ftp-fc.sc.egov.usda.gov/Economics/priceindexes/Data/PPPI_CPI_CCI.xls)

<sup>4</sup> The cost to review the Piezometric data will not be incurred after rehabilitation, so the cost is not included.

**Table 1**  
**Total Estimated Project Installation Cost<sup>1</sup>**

<b>Preferred Alternative</b>	<b>Source</b>		<b>Total Estimated Installation Costs</b>
	<b>PL 83-566 Funds</b>	<b>Other Funds</b>	
Rehabilitate to NRCS High Hazard Class Dam	\$3,406,000	\$958,000	\$4,364,000

January-2014

<sup>1</sup> Price base 2013

**Table 2**  
**Estimated Cost Distribution**

Works of Improvement	Installation Cost - Public Law 83-566 <sup>1</sup>				Installation Cost - Other Funds <sup>1</sup>								Total Installation Costs
	Construction	Engineering	Project Administration	P.L. 83-566 Funds	Construction	Engineering	Real Property	Natural Resource Rights	Relocation Payments	Permits	Administration	Total Other	
Rehabilitate to NRCS High Hazard Class Dam	\$2,288,000	\$958,000	\$160,000	\$3,406,000	\$907,000	\$25,000				\$1,000	\$25,000	\$958,000	\$4,364,000

January-2014

<sup>1</sup> Price base 2013.

**Table 3  
 Structure Data<sup>1</sup>**

Item	Unit	Beaver Creek Dam (PA-433)
NRCS Hazard Class		High
Seismic zone		1
Uncontrolled drainage area <sup>3</sup>	Square mile	2.98
Controlled drainage area <sup>3</sup>	Square mile	0
Total drainage area <sup>3</sup>	Square mile	2.98
Runoff curve number (1-day) (AMC II) <sup>3</sup>		76
Time of concentration (Tc) <sup>3</sup>	Hours	2.06
Elevation Top of Dam	Feet <sup>2</sup>	510.80
Elevation crest auxiliary spillway	Feet <sup>2</sup>	503.50
Elevation crest principal spillway	Feet <sup>2</sup>	486.60
Auxiliary spillway type	Type	Roller Compacted Concrete
Auxiliary spillway bottom width	Feet	225
Auxiliary spillway exit slope	Percent	3.0 to 1.0
Maximum height of dam	Feet	36.3
Total capacity <sup>4</sup>		
Sediment	Acre feet	21.8
Floodwater retarding	Acre feet	656.8
Surface Area <sup>4</sup>		
Sediment Pool	Acres	11.52
Floodwater Retarding Pool	Acres	81.02
Principal spillway design		
Rainfall volume ( 1-day) <sup>3</sup>	Inches	7.41
Rainfall volume ( 10-day) <sup>3</sup>	Inches	11.20
Runoff volume ( 1-day) <sup>3</sup>	Inches	2.50
Runoff volume ( 10-day) <sup>3</sup>	Inches	5.00
Capacity of Principal Spillway	cfs	120
Dimensions of conduit	Inches	30
Type of conduit	Type	Reinforced Concrete Pipe
Auxiliary spillway hydrograph		
Percent Chance of Use	Percent	<1
Rainfall volume	Inches	10.67
Runoff volume	Inches	7.37
Storm duration	Hours	6
Velocity of flow (Ve)	Feet/second	8.00
Maximum reservoir water surface elevation	Feet	505.90
Freeboard hydrograph <sup>5</sup>		
Rainfall volume	Inches	34.58
Runoff volume	Inches	30.69
Storm duration	Hours	24
Maximum reservoir water surface elevation	Feet	510.72
Capacity equivalents		
Sediment volume	Inches	0.14
Floodwater retarding volume	Inches	4.13

January-2014

<sup>1</sup> Information in this table is based on the results of the planning study and may vary from the General Work Plan and As-Built Drawings for structures.

<sup>2</sup> Mean Sea Level, NGVD29.

<sup>3</sup> Hydrologic data taken from Beaver Creek Existing SITES Inputs 7-30-2012.xls (8/7/2012).

<sup>4</sup> Measured at crest of the auxiliary spillway.

<sup>5</sup> The 6-hour and 24-hour storms were evaluated and the 24-hour storm duration controlled.

**Table 4**  
**Estimated Average Annual NED Costs<sup>1</sup>**

<b>Item</b>	<b>Rehabilitate to High Hazard Class Dam</b>
<b>Annual Costs<sup>2</sup></b>	
Amortized Installation Costs	\$ 186,000
O&M and Replacement Costs	\$ 24,000
<b>Total Average Annual Costs</b>	<b>\$ 210,000</b>

January-2014

<sup>1</sup> Price base 2013

<sup>2</sup> Amortized over 50 years at 3.50% interest rate.

**Table 5**  
**Average Annual Flood Damage Reduction Benefits<sup>1</sup>**

Flood Damage			

January-2014

<sup>1</sup> Price base 2013.

<sup>2</sup> Agriculture-related damage includes damage to rural communities.

**Table 6**  
**Comparison of NED Benefits and Costs<sup>1</sup>**

<b>Works of Improvement</b>	<b>Direct Benefits<sup>2</sup></b>	<b>Other Benefits<sup>3</sup></b>	<b>Average Annual Benefits</b>	<b>Average Annual Costs<sup>4</sup></b>	<b>Benefit/Cost Ratio</b>
Rehabilitate to NRCS High Hazard Class Dam	\$ 263,700	\$ 54,200	\$ 317,900	\$ 210,000	1.5 to 1.0

January-2014

<sup>1</sup> Price base 2013.

<sup>2</sup> From Table 5.

<sup>3</sup> Per Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, 1.7.2 (b) (3) - the avoided cost of the most likely alternative to the planned action.

<sup>4</sup> From Table 4.

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## 9.0 LIST OF PREPARERS

Table 9-1 List of Preparers

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<b>Capital RC&amp;D Council</b>			
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Phil Perhamus, PWS	Wetland Scientist	BS Ecology	24
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Charles Richardson	CADD/Surveyor	ASS Applied Science	15
Mohamed Agnaou, EIT	Civil Engineering Professional	BS Civil and Environmental Engineering	13
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## 10.0

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*riparian areas*, S-11, 14

*riser*, v, S-2, S-7, 17, 19, 21, 22, 29, 32, 49, 50, D-7, D-8

*risk*, v, S-2, S-3, S-11, 1, 5, 8, 9, 13, 14, 20, 21, 22, 25, 26, 27, 33, 34, 46, 47, 48, D-8

*runoff*, 8, 17, 18, 20, 26, D-5

*scientific resources*, 5

*scoping*, S-10, 3, 46, D-2

*scour*, D-5

*screening*, 24

*sediment*, S-12, 4, 5, 7, 8, 9, 10, 12, 14, 18, 19, 20, 22, 23, 26, 28, 29, 50, 51, 52, D-2, D-5, D-6, D-7, D-8

*sedimentation*, 7, 8, 20, 25, 26, 29, 34, 50, 51

*seepage*, 8, 17, 20, 21

*seismic*, 20, 21

*service life*, S-1, S-2, S-3, S-12, 1, 14, 29, 49

*SHPO*, 47, 55

*slope stability*, 20, 21

*snowfall*, S-3

*social*, 3, 5, 10, 27, 28

*social issues*, 5

*soil types*, 6, D-4

*sole source aquifer*, 5, 14

*sponsor*, viii, xiii, D-8

*storage capacity*, 6, 14, 18, 25, 26, 28, D-4

*storage pool*, D-2

*subsurface*, 8, 19, D-6, D-7

*surficial*, 19, 21, D-7

*temperature*, 22

*topography*, S-3, 6, 9

*trees*, 19

*vegetation*, 4, 10, 17, 29, 30, 50, 51

*video*, 19, D-7

*water*, viii, xiii, S-3, S-12, 2, 3, 5, 6, 7, 8, 9, 10, 14, 17, 18, 19, 20, 21, 22, 25, 26, 27, 29, 50, 53, 55, 63, 65, D-5, D-6, D-7

*water quality*, S-3, 2, 3, 5, 8, 9, 22, 25

*water resources*, 5

*wetlands*, 5, 14, D-2

*wildlife, 30, 50, 51, 53*

*works of improvement, vi, vii, viii, ix, 1, 53,  
56*

## Appendix A

### COMMENTS AND RESPONSES

This activity is Categorically Excluded under the provisions of NEPA. Public and interagency input was received during project planning as described in Consultation, Coordination, and Public Participation. No comments were received on the draft document.

# Appendix B

## MAPS

### Figure B-1 Project Location Map

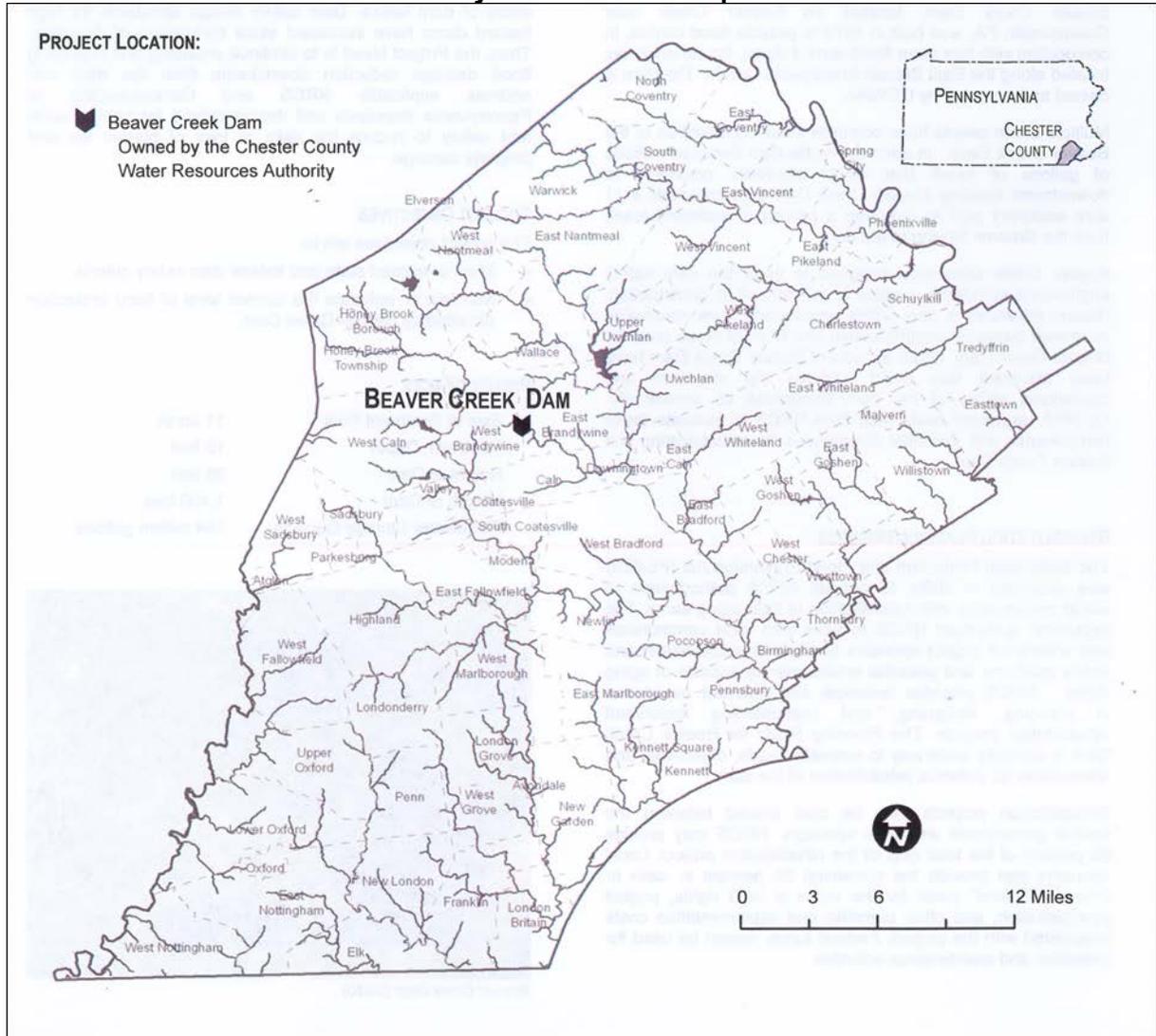
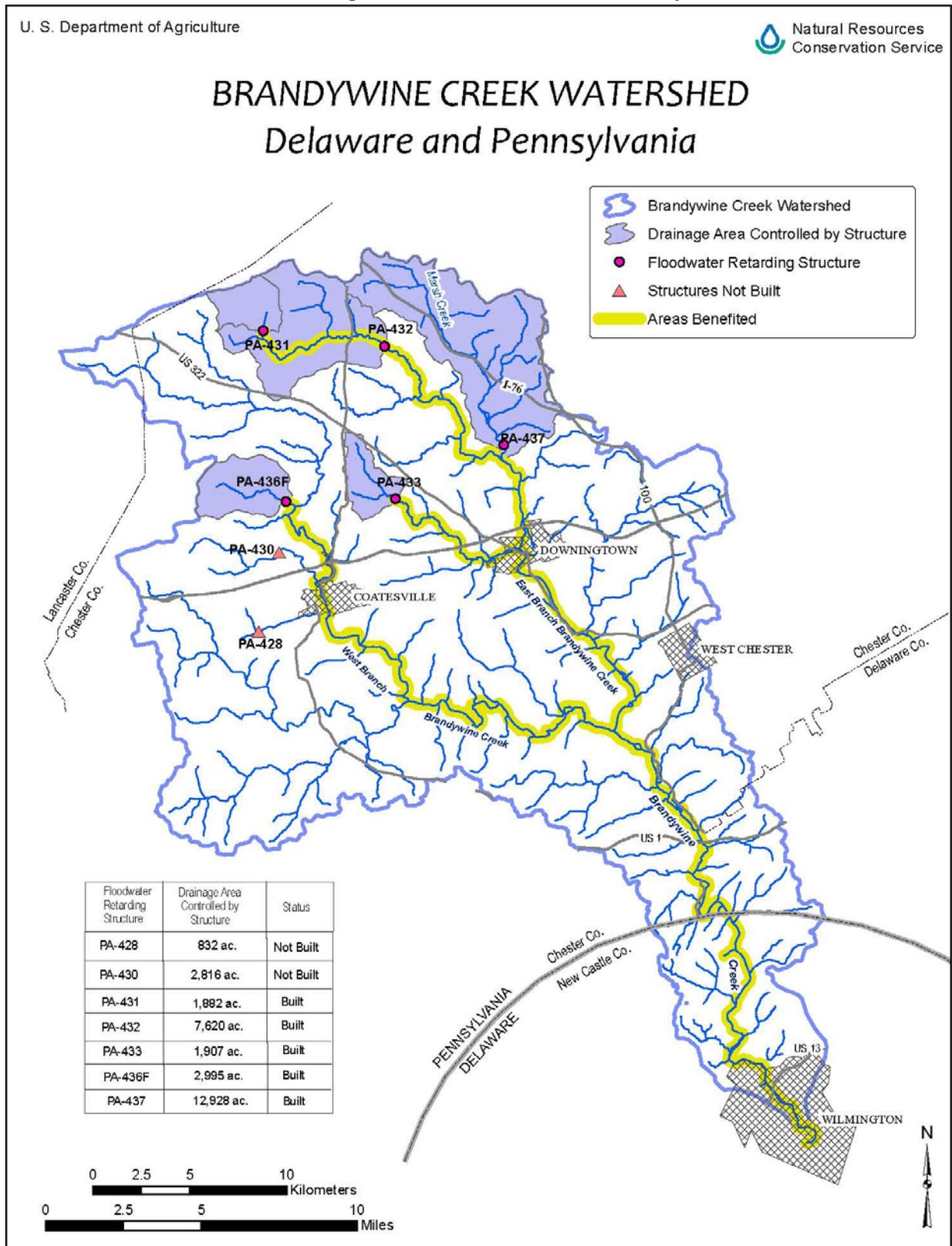


Figure B-2  
 Brandywine Creek Watershed Map



### Figure B-3 Project Watershed Map

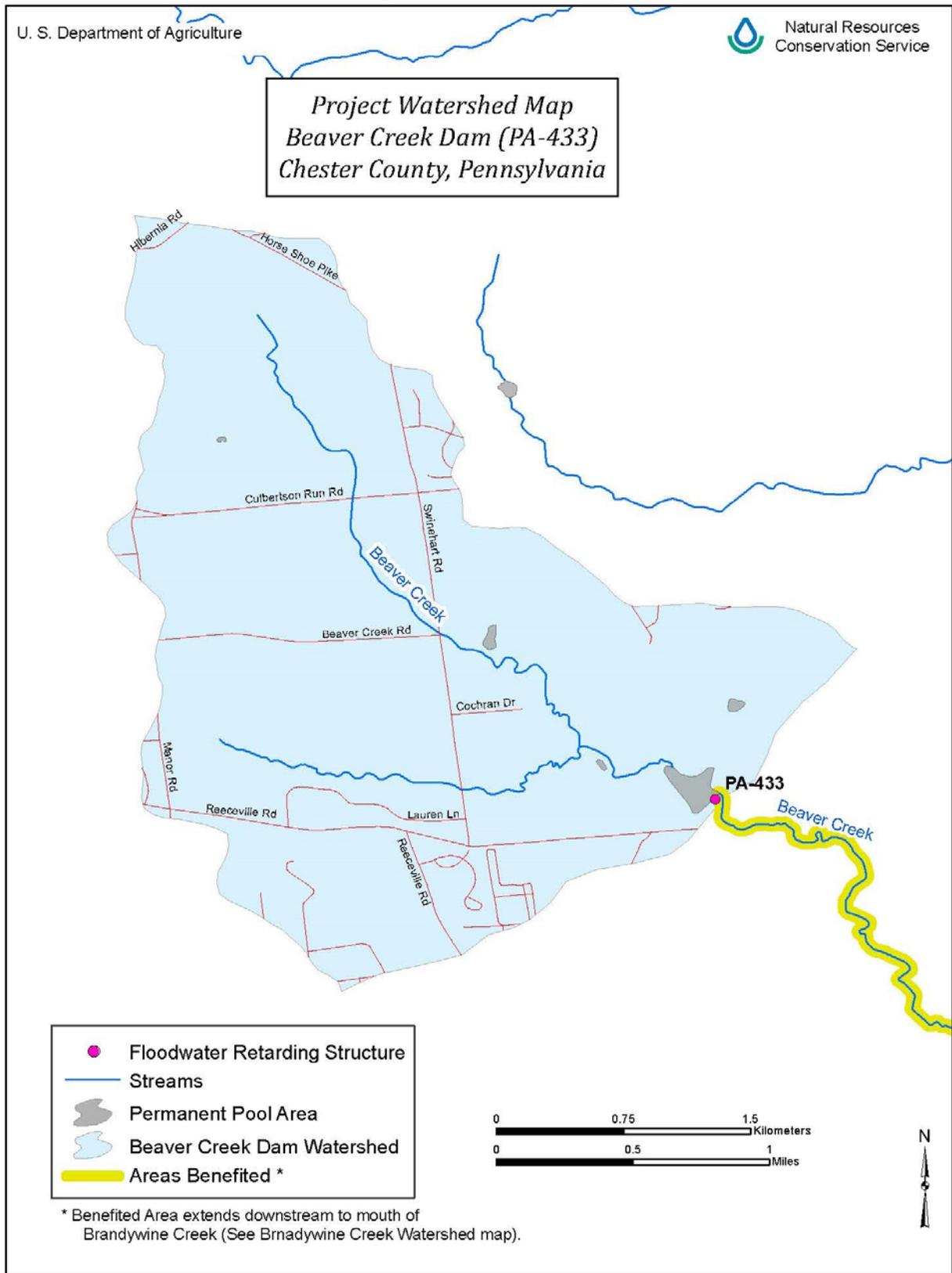
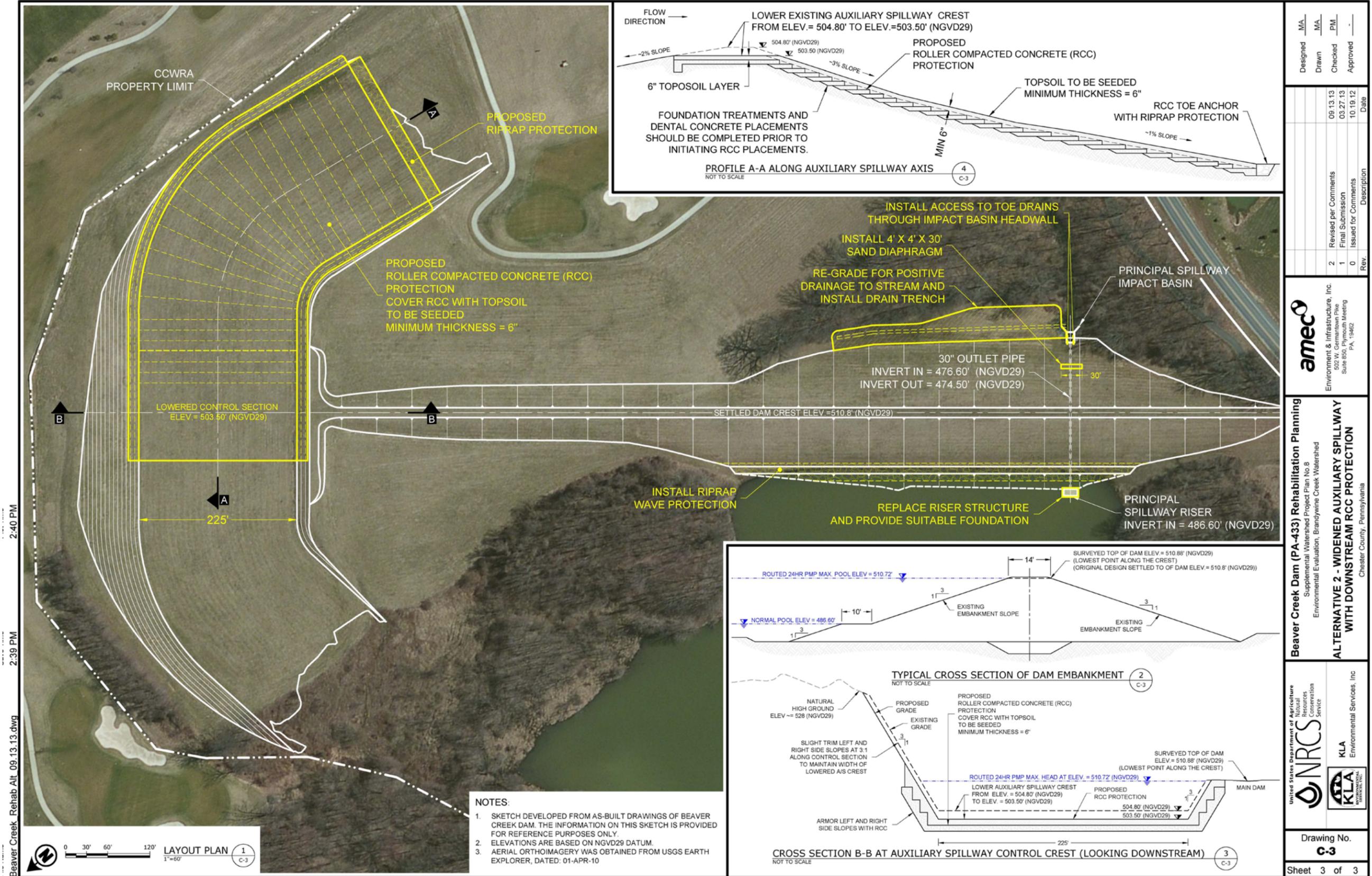


Figure B-4 – Project Site Map



# Appendix C

## SUPPORT MAPS

Figure C-1 – Approximate Breach Inundation Map

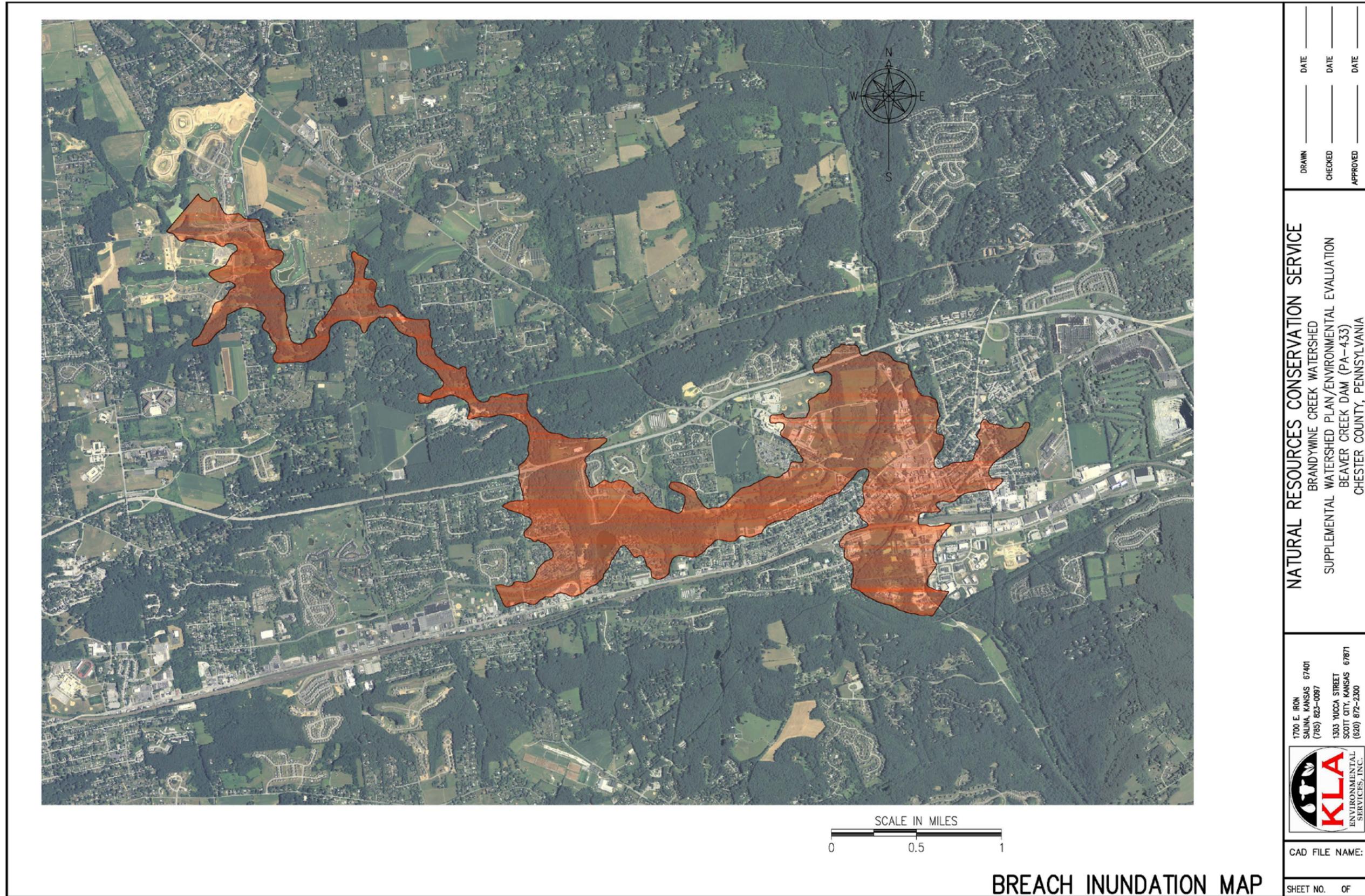


Figure C-2 – FEMA Map – 100-year and 500-year Floodplain

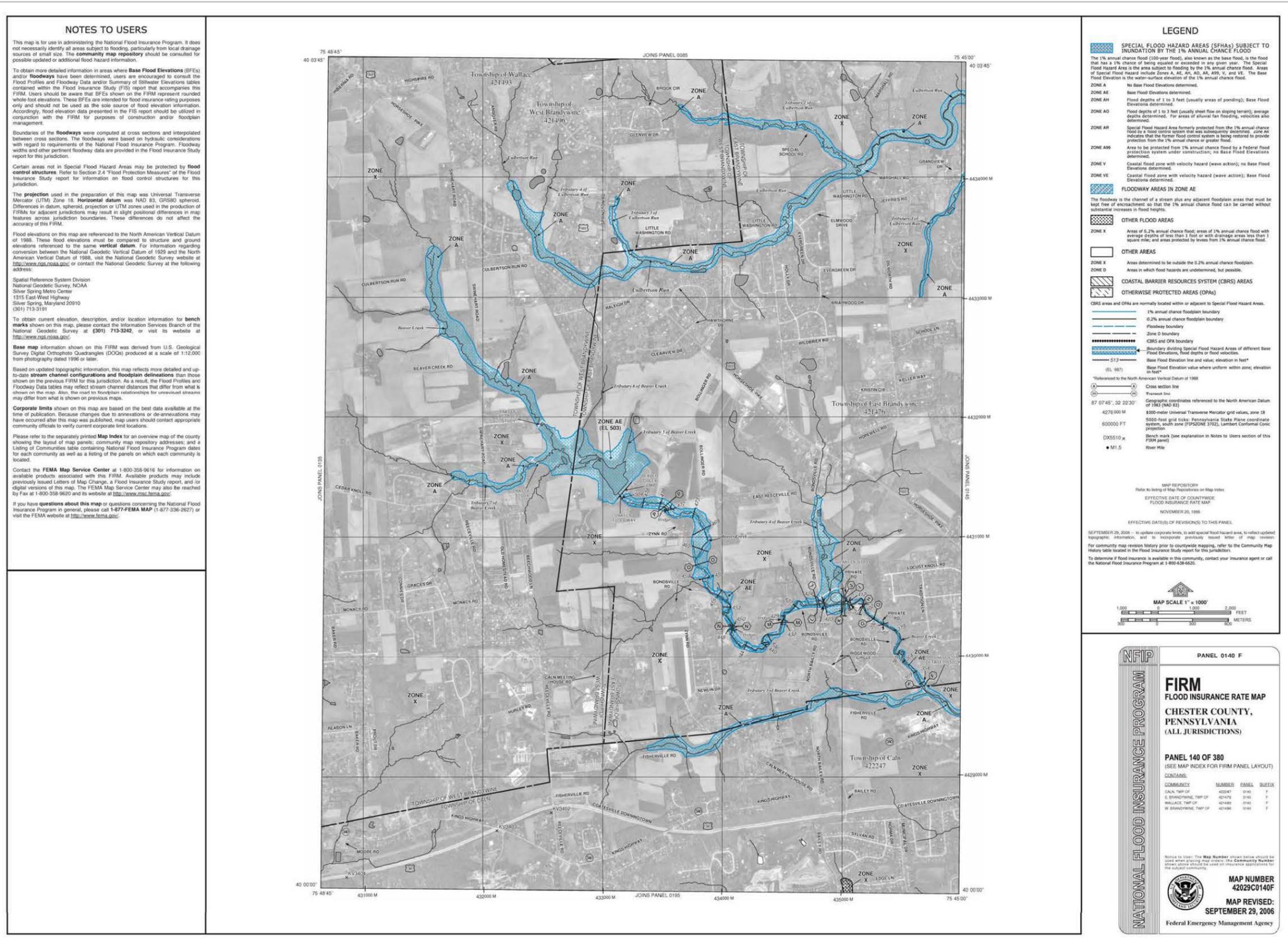


Figure C-3 – FEMA Map – 100-year and 500-year Floodplain

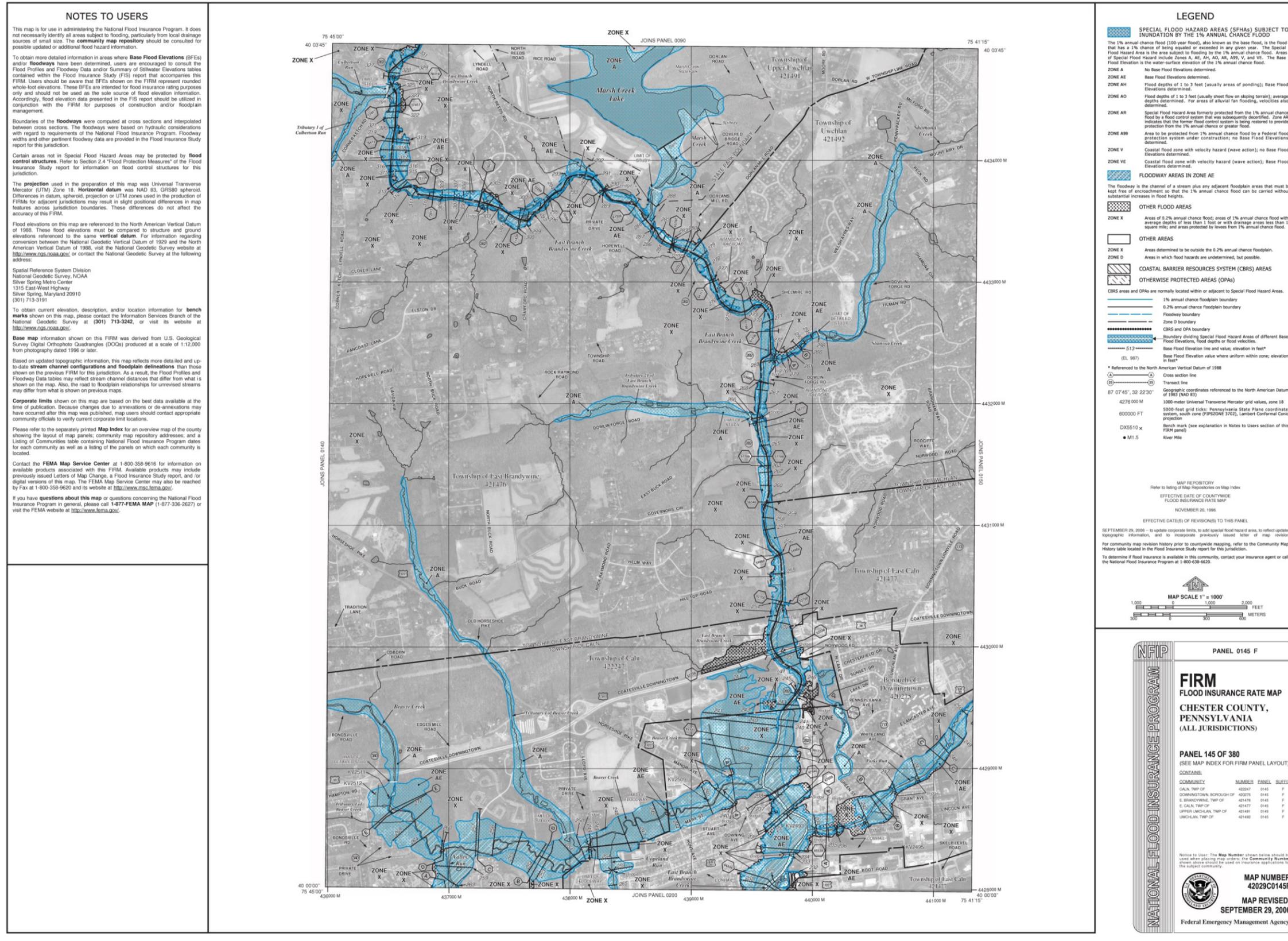


Figure C-4 – FEMA Map – 100-year and 500-year Floodplain

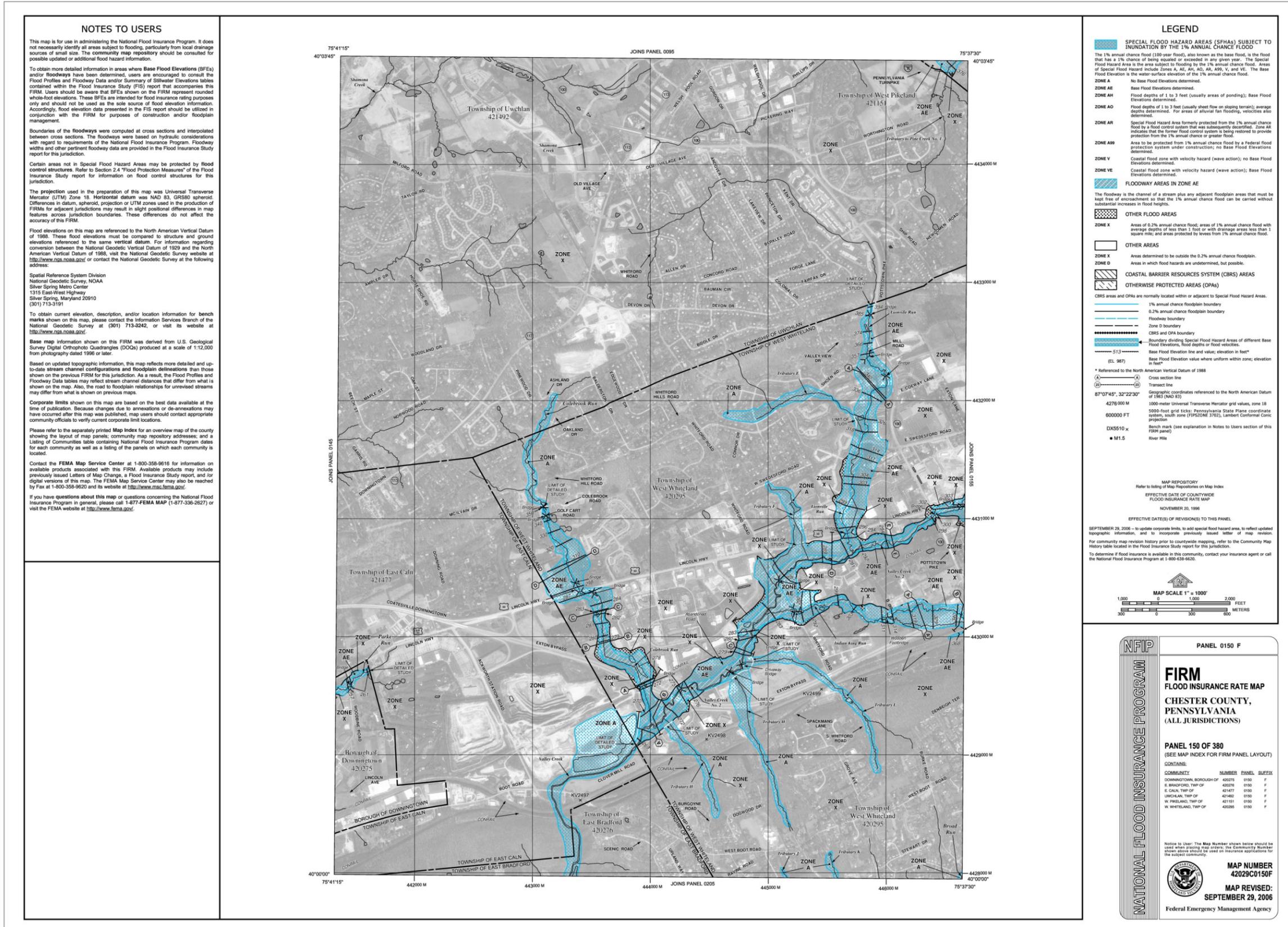


Figure C-5 - Existing Conditions

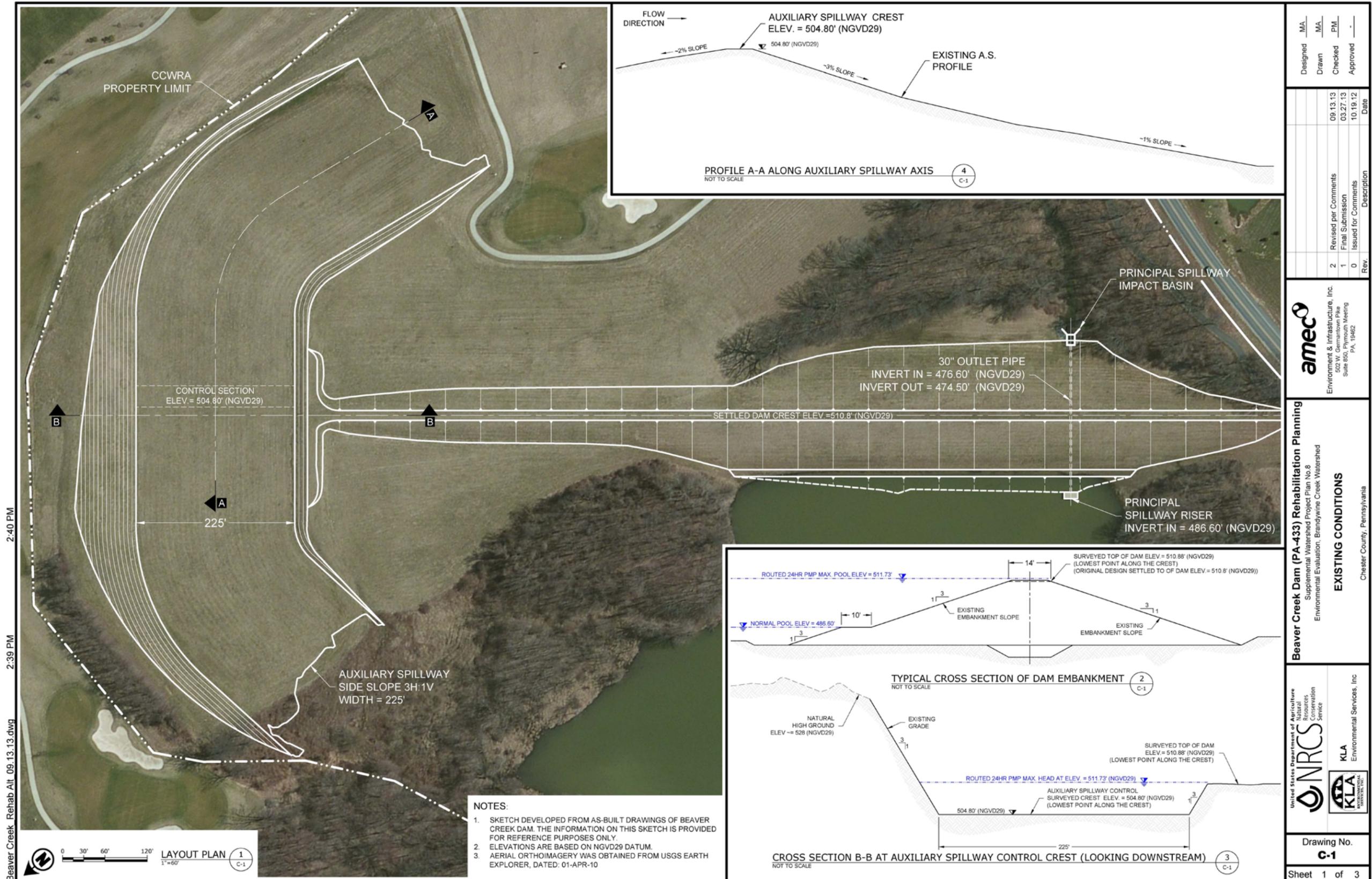
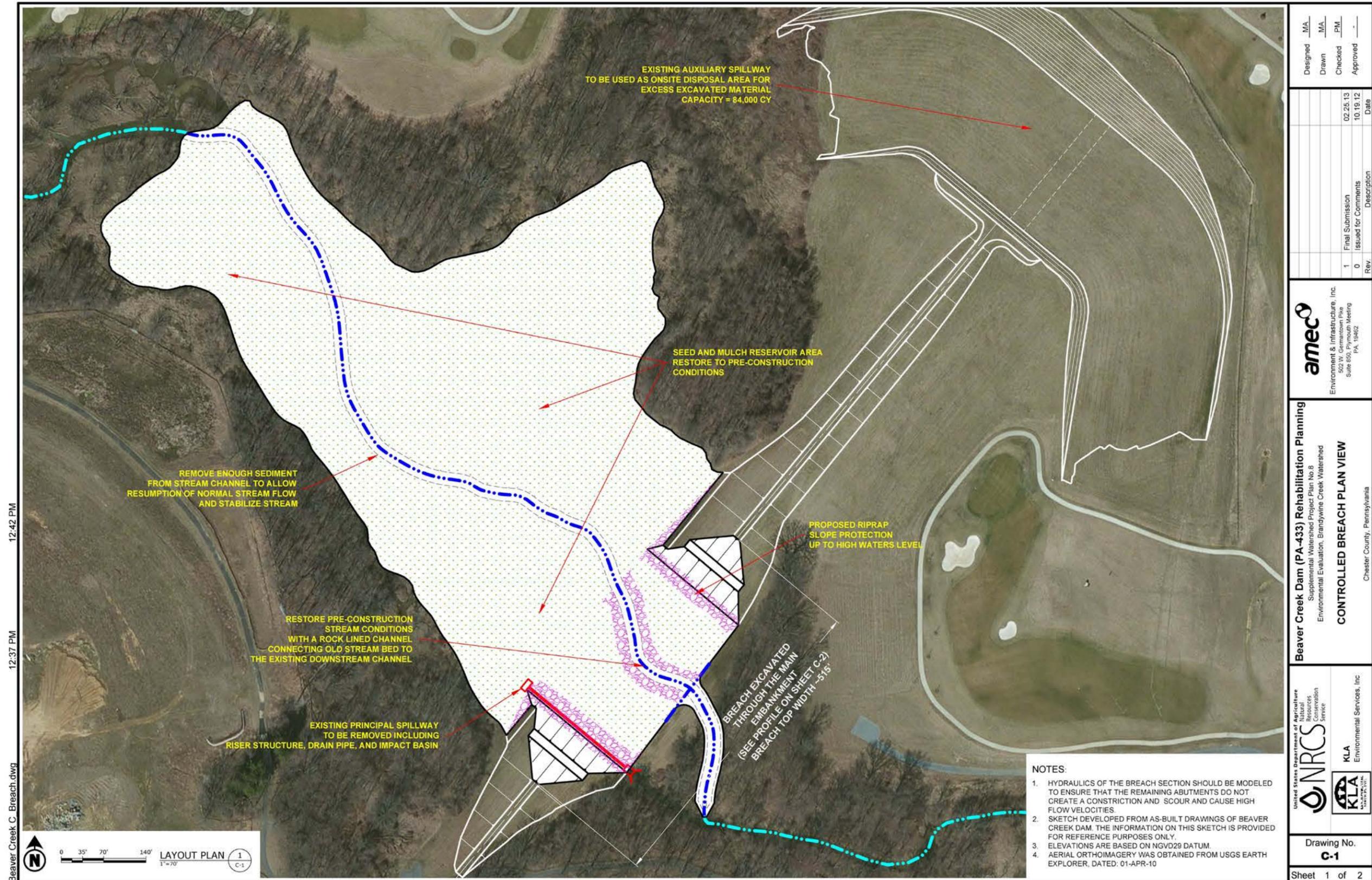


Figure C-6 – Future Without Project Alternative



- NOTES:**
1. HYDRAULICS OF THE BREACH SECTION SHOULD BE MODELED TO ENSURE THAT THE REMAINING ABUTMENTS DO NOT CREATE A CONSTRUCTION AND SCOUR AND CAUSE HIGH FLOW VELOCITIES.
  2. SKETCH DEVELOPED FROM AS-BUILT DRAWINGS OF BEAVER CREEK DAM. THE INFORMATION ON THIS SKETCH IS PROVIDED FOR REFERENCE PURPOSES ONLY.
  3. ELEVATIONS ARE BASED ON NGVD29 DATUM.
  4. AERIAL ORTHOIMAGERY WAS OBTAINED FROM USGS EARTH EXPLORER, DATED: 01-APR-10

Designed	MA	MA	PM	
Drawn	MA	MA	PM	
Checked				
Approved				

Rev	Description	Date
1	Final Submission	02.25.13
0	Issued for Comments	10.19.12

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 Environment & Infrastructure, Inc.  
 8523 W. Germantown Pike  
 Suite 850, Pymatun Meeting  
 PA, 19402

**Beaver Creek Dam (PA-433) Rehabilitation Planning**  
 Supplemental Watershed Project Plan No. 8  
 Environmental Evaluation, Brandywine Creek Watershed

**CONTROLLED BREACH PLAN VIEW**

Chester County, Pennsylvania

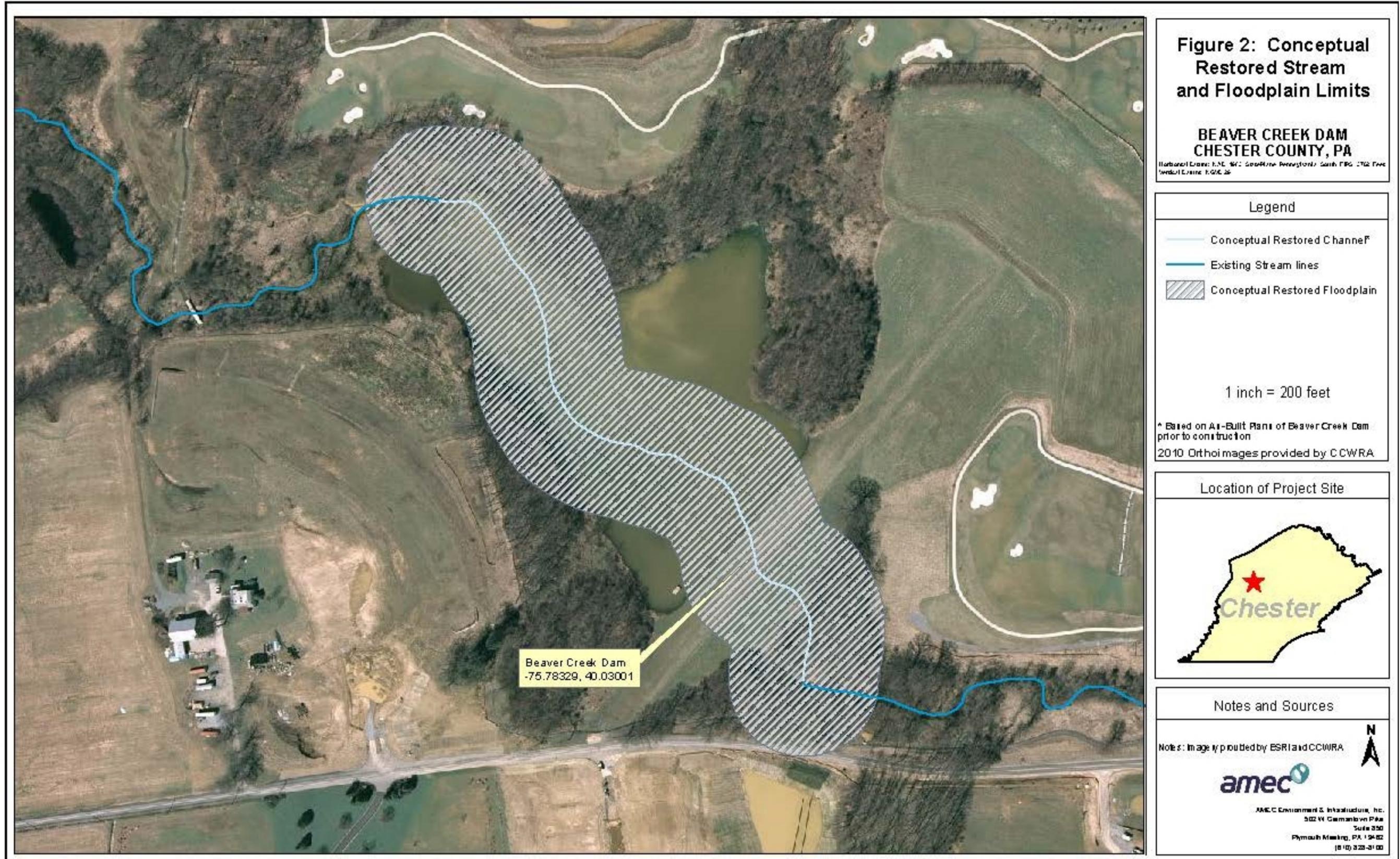
United States Department of Agriculture  
 Natural Resources Conservation Service  
**NRCS**

**KLA**  
 Environmental Services, Inc.

Drawing No.  
**C-1**

Sheet 1 of 2

Figure C-7 – Decommissioning Alternative



# Appendix D

## INVESTIGATIONS AND ANALYSES REPORT

## D.1 INTRODUCTION

This Appendix provides supplementary information regarding the investigations and analyses conducted for the project. The administrative record contains additional information relevant to each of the sections in this Appendix.

## D.2 EXISTING DATA

NRCS provided the following existing data from its archived files to the Project Team:

- As-Built Plans
- Detailed Report of Geology Investigations
- Soil Mechanics Reports
- Breach Inundation Studies
- Stream Hydrology Studies
- Design Documentation
- General Work Plan & Supplements
- Watershed Work Plans
- Supporting Documentation
- Environmental Studies

## D.3 EFFECTS ANALYSIS

Ecological, cultural and socio-economic effects of alternatives were evaluated using the NRCS-CPA-52 - Environmental Evaluation form. This analysis was conducted with consideration to the public participation scoping requirements set forth in the National Watershed Program Manual (NWPM) by considering the potential occurrences of and/or project impacts/risks to the list of 31 natural resources and other issues of concern presented in Section 501.24 Part B of the NWPM. The information presented in the Plan-EE is an overview of the relevant watershed characteristics compiled from existing information. In addition various websites, as referenced, were used to provide information on natural resource conditions at the site. Onsite observations were made to ground truth and supplement the compiled site information presented in this report.

Once alternatives were formulated, the Project Team evaluated the effect of each alternative on relevant resource concerns and special environmental concerns. The Dam Rehabilitation alternative involves minimal changes to the existing features and functions of the dam and the construction will be confined to the existing dam and auxiliary spillway.

The No Action/Future Without Federal Project (FWOP) includes removal of a portion of the existing embankment to allow flood flows to pass unimpeded and consequently would impact the hydrology upstream and downstream from the dam resulting in transport of sediment downstream of the dam. The hydrologic changes would have some effect on wetlands located in the existing reservoir storage pool, by changing the depth and duration of floodwater. The change would also increase flood flow depth and duration downstream, including increased streambank erosion and increased flood damages. The portion of the dam removed with the FWOP has little or no habitat value, so the primary on-site effects will be small improvements in habitat value at the site of the embankment.

## D.4 ECONOMIC AND SOCIAL EFFECTS

**Benefit Analysis Summary.** This analysis was completed to represent current conditions according to Attachment 3, Resource and Economic Evaluation in the Project Statement of Work. Changes to the land use composition of the benefit area since the last supplement were incorporated and evaluated by prorating the original benefits to the revised land use composition based on a ratio of areas for each land use. After updating based on land use changes, the original benefits for the project were indexed to current dollars (2013) and prorated for the study area based on the ratio of controlled area of each flood damage reach.

The Project Team observed the dam site, the contributing drainage areas above the dam, and the flood impact zones below the dam. The predominant land uses in the benefit area were qualitatively inventoried and the changes observed from the original plan and supplements were

noted. The previously formulated flood damage benefits were adjusted consistent with the increase in flood plain development observed since the original evaluation. After adjusting the flood damage reduction benefits based on the changes in land use, all benefits were indexed to reflect current values. Indexing was completed using procedures consistent with National Watershed Program Handbook 604.1 (B).

After allocating the original benefits, adjusting flood damage benefits based on the observed land use changes, and updating all benefits to current values, the relative benefit/cost ratio were determined for each project alternative by comparing the average annual benefit with the amortized rehabilitation costs.

The following is brief outline of the project benefit analysis:

1. Inventory the previous Supplemental Watershed Plans and determine the most recently calculated benefits.
2. Evaluate substantial changes in number of houses and businesses with reduced flood damages.
3. Allocate the Watershed Work Plan benefits to the appropriate project (Beaver Creek Dam).
4. Determine the appropriate economic index for each benefit purpose.
5. Calculate all economic indexes for each price base.
6. Update the flood damage reduction benefits allocated to the Beaver Creek Dam to current values.

The flood damage reduction benefits were allocated based on the flood control contribution noted in the previously developed (August 1996) but unapproved Supplemental Watershed Work Plan No. 7 for Brandywine Creek Watershed.

Although the benefit analysis described results in a large amount of uncertainty in the potential NED benefits and costs of the respective alternatives, the potential variation will not affect the NED plan selection thus an abbreviated analysis can be used per P&G.

**Population-At-Risk.** The population-at-risk was estimated based on the dam breach inundation zone and affected structures from the 2010 Emergency Action Plan (EAP) provided by CCWRA and the Evaluation of Potential Rehabilitation Projects worksheet completed by NRCS.

**Flood Damage Benefit Area Review.** The amended Watershed Work Plan for Brandywine Creek Watershed considered three dams in the Brandywine East Branch. All of the three dams planned, were constructed in the Brandywine East Branch.

The Project Team reviewed land use changes within the floodplain beginning with the area delineated by the Downingtown Frequency Map found in Figure 2 on page 70 of the Brandywine Creek Watershed Work Plan (April 1962). The analysis included a review of historical aerial photography of all stream reaches downstream from the Beaver Creek Dam (PA-433). The FEMA Zone A regions were overlaid on 1958 and 2010 historical aerial photography of the downstream flood damage reduction benefit areas for each stream reach. Developed areas were delineated and measured for both years. The flood damage benefits formulated with the unapproved Supplemental Watershed Work Plan Agreement No. 7 for Brandywine Creek Watershed were adjusted consistent with the increase in flood plain development observed during the evaluation period.

**Economic Index.** Principles & Guidelines (P&G) section 1.7.2(a)(4)(ii) and 2.1.1(b)(2) allows abbreviated procedures to evaluate project benefits. Consequently, indexing was used instead of hydrologic and economic evaluation for updating the benefits for those areas where no substantial land use changes have occurred. The original and supplemented project benefits were indexed to Price Base 2013 consistent with the tools provided at the NRCS Economics Web Site:

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/tools>

The project benefits were last updated in 1996 (Price Base 1995) via the unapproved Supplemental Watershed Work Plan No. 7 for Brandywine Creek Watershed.

**NED Analysis.** The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council, 1983) were used to determine the National Economic Development Alternative (NED). This alternative is defined as that which maximizes the net benefits consistent with protecting the Nation's environment. The economic evaluation was performed in accordance with Chapter 2, Section 4 of the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies and the NRCS National Watershed Program Manual (Parts 501.11 A(2); 501.12 C; 505.35 B (1) (iii)-(1V); 505.35 E-F).

## D.5 ENGINEERING

**Surveys.** The topographic survey included one profile along the axis of the dam crest, one profile of the auxiliary spillway (inlet channel, control section, and exit channel) and one profile through the dam embankment at the principal spillway. Survey point elevations were obtained using a survey grade GPS receiver with an OPUS solution. The horizontal datum was based on the North American Datum of 1983 (NAD83) using the Pennsylvania State Plane coordinate system, South Zone. The vertical datum was based on the National Geodetic Vertical Datum of 1929 (NGVD29) and a benchmark as depicted on as-built drawings ("Brandywine Creek Watershed", sheet 5-71).

A Bathymetric survey was conducted at the reservoir area on November 15, 2011. The Project Team performed the bathymetric survey using a boat equipped with a fathometer, and a survey grade GPS. Horizontal and vertical positions along with the fathometer readings (depth of reservoir) were recorded at various locations on the lake surface, shore to shore. A dropped 100-foot tape method was used at various locations to verify the fathometer readings. The positions were laid out on the reservoir surface in a grid pattern and were spaced less than 200 feet apart from each other. The bathymetric survey included a total of 50 depth measurements, which included 25 fathometer readings and 25 depth measurements using a rod. Sediment depths were also measured at these 25 rod measurement locations. This survey provided information on the current storage capacity below the normal pool elevation at 486.60 feet. In order to derive the total storage values above the pool elevation (from 486.6 feet to 511.71 feet), LiDAR survey data from PASDA, dated 2008, was combined with the bathymetric survey. Drawing of the reservoir area showing contours used to calculate storage was prepared.

**Flood Storage Capacity.** The flood storage capacity was determined by evaluating the cumulative storage capacity above the normal pool elevation. The Project Team compared the flood storage capacity based on the current bathymetric survey and the flood storage capacity based on the design drawings.

**Runoff Curve Number.** The Runoff Curve Number (RCN) development for the Beaver Creek Dam watershed followed TR-55 methodology. Arc Hydro tools, in conjunction with the USACE HEC-GeoHMS software, were used to combine land use data with corresponding soil types and develop a weighted RCN for the entire watershed.

Future Buildout Landuse conditions were evaluated using ArcGIS by modifying the 2005 Landuse shapefile for Beaver Creek provided by the CCWRA. Modifications to this data were based on the November 20, 2012 memo from CCWRA describing the future land use changes.

A detailed summary of the RCN calculations is provided in the "Beaver Creek Dam RCN" spreadsheet.

**Time of Concentration.** The Time of Concentration ( $T_c$ ) was developed using the segmental/velocity approach, described in TR-55, and the USACE HEC-GeoHMS software. An automated tool in HEC-GeoHMS uses the terrain to determine the paths with minimal slope for shallow concentrated flow, sheet flow, and open channel flow. The HEC-GeoHMS tool develops a preliminary Longest Flow Path using the DEM, which can then be manually edited by the user.

The edits include identifying the locations of flow-type transitions from sheet flow to shallow concentrated flow, and from shallow concentrated flow to channel flow. The Project Team conducted field verification of the location where shallow concentrated flow transitions to channel flow on January 27, 2012.

**Precipitation Data.** Precipitation data for the Beaver Creek Dam watershed was derived using the following sources:

- Hydrometeorological Report 51 – Probable Maximum Precipitation (PMP) Estimates, United States East of the 105th Meridian, which provides PMP values for various storm durations.
- NOAA Atlas 14, Volume 2 (Ohio River Basin and Surrounding States) – Provides rainfall depth-duration-frequency data for 13 Mid-Atlantic and central states.

These rainfall depths were used to develop design hydrographs and evaluate the principal spillway capacity; stability and integrity of auxiliary spillway; and dam capacity (top of dam elevation).

TR-60 design criteria require that the principal spillway capacity be evaluated by routing the Principal Spillway Hydrograph (PSH) with a combined 1-day/10-day 100-year return period rainfall. Two methods for estimating runoff volumes were used: (1) the runoff curve number procedure and (2) runoff volumes based on stream gage studies (TR-60, Figures 2-1(a) and 2-1(b)). The procedure that results in the higher auxiliary spillway crest elevation, when the PSH is routed through the structure, was used. The top of dam elevation and integrity of the auxiliary spillway (i.e. head-cutting and breaching) was evaluated by routing the Freeboard Hydrograph (FBH). For High Hazard Class dams, such as the Beaver Creek Dam, the FBH is generated by a PMP storm. Because of the relatively short  $T_c$ , both a short duration (6-hour) and a long duration (24-hour) storm were analyzed and the most critical result used. The stability of the auxiliary spillway (i.e. erosion and scour along the exit channel) was evaluated by routing the Stability Design Hydrograph (SDH), which is generated by using rainfall depth computed from the following equation:

$$SDH = P_{100} + 0.26(PMP - P_{100})$$

Per TR-60, the rainfall depths are temporally distributed using the standard NRCS 6-hour storm distribution (for the SDH and 6-hour FBH), the NRCS 5-point rainfall curve (for the 24 hour FBH), and the NRCS 1-day/10-day distribution (for the PSH). The 1-day/10-day and 6-hour distributions are applied by SITES directly. The 5-point rainfall curve is a critically stacked distribution, which is developed using PMP data for 6-, 12-, and 24-hour PMP storms. The 6-hour PMP is applied uniformly in the second increment of the stacked distribution. Each of the remaining incremental rainfalls is applied uniformly in adjoining 6-hour increments. A site-specific 5-point rainfall curve for Beaver Creek Dam was developed using a guidance document/spreadsheet (“5-point 24-hour NRCS Dimensionless Rainfall Distribution & TR-60 SDH/FBH Hydrologic Criteria”) provided by the NRCS.

The results of the discharge capacity analysis show, that the 24-hour FBH event based on the USACE distribution governs and results in the highest maximum water surface elevation of the impoundment (511.75 feet MSL). This is above the designed settled top of dam elevation (510.8 feet MSL). In fact, the 6-hour FBH event also results in overtopping of the dam.

**Sediment Volume.** Sediment volume currently deposited was calculated using the sampled sediment depths taken at the time of the bathymetric survey.

**Site Walk.** The Project Team conducted a site visit to document the current conditions of Beaver Creek Dam, located in Chester County, Pennsylvania on December 2, 2011. The site visit included a visual review and photographic documentation of the exposed areas of the dam and associated structures. At the time of the site visit, the dam and associated structures were found to be in functional condition.

**Embankment and Foundation Geology.** No detailed geologic investigation of the existing dam embankment was conducted. The geology of the dam and foundation are based on the investigations and analyses conducted during the original design of the dam, and subsequent investigations and analyses commissioned by CCWRA.

**Auxiliary Spillway Geology.** Connelly Drilling (Connelly) of Frederick, Maryland performed the subsurface exploration between December 1, 2011 and December 6, 2011. All work was observed by the Project Team's onsite representative. A representative from Chester County Water Resources Authority (CCWRA) was periodically onsite to observe the work. The borings were conducted at locations surveyed and staked prior to mobilization. Boring locations BB-2, BB-3 and BB-4 were adjusted in the field and were located by measuring distances from known site reference points. Boring locations and elevations should only be considered accurate to the degree implied by the method of measurement used.

The borings were advanced with 3 ¼" augers to refusal. Each boring was sampled in accordance with ASTM D1586 (Penetration Testing and Split Spoon Sampling of Soil) at five foot intervals to auger refusal at bedrock. The final 10-feet of each boring were cored into bedrock. The split-spoon soil samples and rock samples were visually examined and logged by the Project Team's onsite representative.

Each completed boring was covered with a traffic cone to mark and protect it until the end of drilling operations. All borings were tremie-grouted using the grout mixture (4 pounds of 200-mesh dry powdered bentonite for 94 pounds of cement) requested by CCWRA. Connelly removed all excess soil cuttings from the Site and disposed of the cuttings as requested by CCWRA to meet Chester County Health Department regulations. Drilling water was controlled with a combination of temporary hay bale diversions, level spreaders, and sediment traps. Areas impacted by drilling activities and egress were restored to as close to pre-existing conditions as practical by Connelly, AMEC, and CCWRA. Restoration efforts included raking disturbed areas to restore pre-existing grades and covering the areas with leaves/straw. Disturbed grass areas were additionally seeded and strawed.

The soil samples were delivered to Geostructures in King of Prussia, Pennsylvania for visual classification and testing. The laboratory testing for this project included soil classification (ASTM D2487), specific gravity (ASTM D854), sieve/gradation (ASTM D422), percent clay (ASTM D422), plasticity index (ASTM D4318), and dry density (ASTM D4531). The laboratory test data was provided and the results are summarized. The field classifications were confirmed or modified, as necessary. The soil samples were disposed of in an appropriate manner. All rock core samples were provided to CCWRA for their use and storage.

Groundwater was allowed to equilibrate within the borings and depth to groundwater was measured once in each boring in one round of groundwater measurements performed on December 6, 2011, 9:01 am, one day after drilling completion. Ground water was measured by the Project Team at 1.7 to 7.1 feet below the existing ground surface. Depth to groundwater measurements for each boring are included in the boring logs and are summarized in Table D-1.

**Table D-1**  
**Summary of Groundwater Measurements**

<b>Boring</b>	<b>Depth to Water (feet)</b>
BB-1	3.8
BB-2	7.1
BB-3	3.6
BB-4	1.7
BB-5	1.7

**Area Adjacent to Downstream Toe.** Five test pits were excavated in the wet area adjacent to the downstream left toe of the dam to assess the subsurface conditions. The test pit locations were chosen to bracket the area along the toe of the dam, along the tree line, and at the limits of the wet area along the dam. Test Pits 1 and 5 were placed to bracket the extents of the wet area along the dam. Test Pits 2, and 4 were placed along the wet area toward the tree line, and Test Pit 3 was placed toward the center of the wet area near the toe of the dam. Each test pit (TP) was excavated with a mini-track-hoe to depths ranging from four to six feet beneath the existing ground surface. Test Pits 1, 2, 4, and 5 were terminated after water was encountered during excavation. Test Pit 3 was terminated when a dense interval of cobbles was encountered that was difficult to excavate (e.g., practical refusal).

**Principal Spillway Video Inspection.** The Project Team conducted a televideo (TV) inspection of the principal spillway as part of the documentation of the current conditions of Beaver Creek Dam, located in Chester County, Pennsylvania on December 13-14, 2011. A memorandum provided observations, joint gap measurements, and videos to document the current conditions of the principal spillway.

The objectives of the inspection were to document the current condition of the principal spillway outlet pipe and riser structure, measure the joint gap at each pipe segment, and identify any potential issues. The Project Team used the T76 Camera Tractor and Orpheus Camera to perform the inspection. This equipment provided video by crawling through the outlet pipe. Measurements were obtained within the pipe by utilizing the integrated laser measurement tool with an accuracy of 0.01 mm.

Prior to beginning of the inspection, the lake was drawn down by CCWRA to obtain a no-flow condition. However, due to a leak in the drawdown sluice gate, there were about 2 inches of flow in the outlet pipe at the time of inspection. The pipe was accessed from the outlet in the impact basin and inspected to identify for any deformities, sags, cracks, or other items of note.

Measurements of the gap spacing were taken at each joint in the outlet pipe at four points (looking upstream): the 12 o'clock, 3 o'clock, 6 o'clock, and 9 o'clock positions; or as close to these positions as is possible. Due to the low flow in the pipe, the 6 o'clock position measurement was taken closer to the 5 o'clock and 7 o'clock positions, as noted. The low flow in the pipe limited the video inspection and measurements at and near the concrete riser due to splashing on the camera and lasers. The video was then evaluated to document notable observations.

Using the on-board laser measurement device on the TV crawler, the Project Team measured the joint gaps of each of the 11 joints where visible. Overall, the joint measurements ranged from 0 mm (0") to 2.03 mm (~1/12"), which is less than the maximum gap of 3/4".

**Toe Drain Video Inspection.** The Project Team performed several attempts to push through the four sharp bends on each toe drain to be able to observe the straight run sections along the toe of the dam. The Project Team performed several attempts with various camera configurations and was successful in obtaining observations up to the fourth bend of the north toe drain and up to the second bend of the south toe drain.

Both toe drains were flowing at the time of inspection with about 2 inches of flow. The discharge was constant and clear with no visible turbidity. The observable toe drain pipe segments appeared clear with no observed blockages, pipe deformation, or deterioration. Some rust was observed along the bottom of the pipes; however, the rust appeared surficial and there was no observable deterioration. Very fine silt, likely dust, has settled in the bottom of the pipe in between the corrugations. No significant sediment or larger particulates were observed.

As previously discussed, due to accessibility to navigate around the bends, the conditions of the toe drain beyond the bends could not be observed at the time of the inspection.

**Alternative Formulation.** The Project Team completed a conceptual/preliminary engineering analysis to determine the alternatives to be evaluated in detail. The alternatives considered included the following:

Future Without Project (FWOP) (no action) – The FWOP alternative was identified in coordination with NRCS and the Sponsors and is also known as the no action alternative. The FWOP alternative is a minimum level Sponsor breach of the dam, as directed by Pennsylvania Department of Environmental Protection. According to the National Watershed Program Handbook, FWOP is based on the course of action that the Sponsor is most likely to take in the event that no federally financed rehabilitation work were to be undertaken. The sponsor requested the following FWOP statement: “The Sponsor has indicated that a minimum level breach of the dam, such as the removal of a portion of the earthen embankment, as directed by the Pennsylvania Department of Environmental Protection, would be the FWOP approach conducted by Chester County Water Resources Authority.”

Rehabilitation to a High Hazard Class dam – The alternative to rehabilitate Beaver Creek Dam would require construction and modification in three locations of the dam: the auxiliary spillway, the downstream toe, and the upstream face of the dam.

Auxiliary Spillway - One of the rehabilitation efforts would lower the control section of the auxiliary spillway from elevation 504.8 to elevation 503.5 feet and armor the control section and exit channel with roller compacted concrete.

Downstream Toe - Another rehabilitation effort would include the installation of a 30-foot long and 4-foot wide filter diaphragm under the principal spillway conduit. Design considerations of the filter configuration, construction technique, extent, and height should be evaluated in the design phase. Design considerations of the filter diaphragm should include filter configuration, extent into foundation soils, and height. The construction technique should also be evaluated as potential options include, but are not limited to, a weighted filter placed upon the existing slope or a filter installed within an excavation at the toe, and construction aspects to consider include excavation dewatering and wetland impacts. Other rehabilitation effort at the downstream toe include installation of access with an end cap to the toe drains through the existing impact basin headwall and installation of a trench drain that permits manual measurement of flow rates, and regrading of the existing wet area adjacent to the downstream embankment toe to maintain a positive drainage.

Upstream Face - The final rehabilitation effort needed is to replace the existing riser structure and installation of a suitable foundation along with installation of a riprap layer along the upstream face of dam to protect against erosion resulting from wind waves in the pool area.

The Project Team formulated a matrix of dam features, deficiencies and potential solutions to explore alternatives for dam rehabilitation. Alternatives were evaluated in consultation with CCWRA and based on effectiveness, efficiency, constructability and compatibility with the purpose and need for the project. Rehabilitation alternatives considered but dismissed from further evaluation included the following:

- Increase the height of the embankment by installing additional fill, PVC sheet piling or a parapet wall to provide additional freeboard and prevent dam overtopping during the Probable Maximum Precipitation event.
- Increase the width of the auxiliary spillway.
- Armoring auxiliary spillway with articulated concrete block.
- Install a labyrinth weir to increase the effective width of the auxiliary spillway.

Dam Decommissioning – The Decommissioning alternative was formulated to restore the stream by reconnecting the upstream and downstream channel in a non-erosive manner and restoring the stream/river. The entire dam embankment would be excavated to allow normal flows and up to 100-year flood flows through the site in a non-erosive manner. Accumulated sediment would not be removed. The decommission alternative was developed in consideration of guidance in NRCS National Engineering Handbook, Part 653, Stream Corridor Restoration: Principles, Processes, and Practices. The decommissioning alternative would eliminate flood storage and protection provided by the dam, which could possibly expose downstream properties to an increased risk of flooding, property damage, and loss of life. As a result, the decommissioning

alternative alone would not meet the objective to maintain the downstream flood damage reductions provided by the existing project. To meet this objective, the decommissioning alternative would have to be supplemented by other measures such as flood proofing or relocation of structures located within the 100-year floodplain.

Dam Decommissioning with Nonstructural and Other Measures - This alternative includes Decommissioning as noted above and removing all structures within the 100-year floodplain. Estimated costs include relocation, property acquisition, demolition, and site stabilization/restoration along with decommissioning utilities, septic structures, wells and similar facilities.

Acquisition/Relocation of At-Risk Structures and Other Non-Structural Measures (Flood-Proofing in the Inundation Areas) - These alternatives were formulated to remove the downstream hazard and allows the Beaver Creek Dam to be reclassified as a Low Hazard Class dam. Land use restrictions were considered to prevent future upgrades to High Hazard Class dam due to downstream development within the breach inundation area. The threat to human life from sudden dam failure would be reduced by relocating the residential and commercial structures and raising and/or relocating the roadways within the potential breach inundation.

**Cost Estimates.** The Project Team prepared predictions of probable costs for all alternatives. The predictions of probable costs are intended for comparing the alternatives. Unless otherwise noted predictions of probable costs were prepared using the RS Means method for engineering cost estimation.

# Appendix E

## PROJECT DATA

<b>PL-83-566 Project Information</b> <b>Brandywine Creek Watershed Supplemental Watershed Plan/EE</b> <b>Beaver Creek Dam (PA-433)</b> <b>East Brandywine Township, Chester County, PA</b>	
<b>Rehab General Description Data</b>	
Project Number	2012
Hydrologic Unit Area:	02040205
Longitude (decimal format):	75.783333
Latitude (decimal format):	-40.030000
Area of Project (acres):	1,907
Project Evaluation Life:	50 Years
Project Discount Rate:	3.50%
Price Base:	2013
B/C Ratio:	1.5 to 1.0
Total Cost (Table 1):	\$4,364,000
Total PL 83-566 Cost:	\$3,406,000
Dam Number	PA-433
National Inventory of Dams (NID):	PA00903
Congressional District of dam:	06-PA
FIPS Code of dam:	029
# Single-Purpose Floodwater Retarding Structures Planned:	1
# Multi-Purpose Structures Planned:	0
Rehab Project Purposes:	Flood Control

<b>PL-83-566 Project Information</b> <b>Brandywine Creek Watershed Supplemental Watershed Plan/EE</b> <b>Beaver Creek Dam (PA-433)</b> <b>East Brandywine Township, Chester County, PA</b>	
Sponsor Data	
Organization:	Chester County Water Resources Authority and Chester County Board of Commissioners
Sponsor Representative (optional):	Janet Bowers
Sponsor Title:	Executive Director
Sponsor Type:	County
Address:	801 Westtown Road P.O. Box 2747
City:	West Chester
State:	Pennsylvania
Zip:	19380-0990
Phone:	610.344.5400
Email:	<a href="mailto:jbowers@chesco.org">jbowers@chesco.org</a>
Fax:	610.344.5401
O&M Responsibility (Yes/No):	Yes

<b>PL-83-566 Project Information</b>	
<b>Brandywine Creek Watershed Supplemental Watershed Plan/EE</b>	
<b>Beaver Creek Dam (PA-433)</b>	
<b>East Brandywine Township, Chester County, PA</b>	
<b>Rehab Budget Request Data</b>	
Failure Index:	127
Population at Risk:	5,000
Price Base:	2013
Estimated Installation Cost (Watershed Agreement):	\$3,520,000
Priority - State Dam Safety Agency:	Medium
Number of Municipal Water Supply Users:	0

<b>PL-83-566 Project Information</b> <b>Brandywine Creek Watershed Supplemental Watershed Plan/EE</b> <b>Beaver Creek Dam (PA-433)</b> <b>East Brandywine Township, Chester County, PA</b>	
<b>Rehab Subset of Benefits Data</b>	
Price Base:	2013
Total Funds Needed (FA/TA) (Table 1): PL-83-566 NRCS	\$2,288,000/\$1,118,000
Other Than PL-83-566:	\$958,000
Agricultural Related Flood Damage Reduction Benefits (Average Annual):	\$263,700
Non-Agricultural Related Flood Damage Reduction Benefits (Average Annual):	\$ -
Agricultural Related Non-Flood Damage Reduction Benefits (Average Annual):	\$ -
Non-Agricultural Related Non-Flood Damage Reduction Benefits (Average Annual):	\$ -
Beneficiaries (No.):	499,000
Visitor Days (Optional):	0
Farms and Ranches Benefited (No.):	Not Evaluated
Bridges Benefited (No.):	12
Public Facilities Benefited (No.):	20
Businesses Benefited (No.):	30
Homes Benefited (No.):	315
Reduced Erosion (Tons/Yr.):	0
Reduced Sedimentation (Tons/Yr.):	1,485
Streams/Corridors Enhanced/Protected (Miles):	42
Lakes/Reservoirs Enhanced/Projected (Surface Acres):	11
Domestic Water Supplies Benefited (No.):	0
Incidental Recreation Benefited (No. of Water Bodies/Stream Segments):	2
Groundwater Recharge (Acre-Feet):	0
Wetlands Created, Enhanced, or Restored (Acres):	0
Upland/Riparian Habitat Created/Enhanced (Acres):	0
Threatened and Endangered Species Benefited:	0
Population with Reduced Risk:	5,000