

**FINAL Supplemental Watershed Plan No. 6 & Environmental Evaluation
for the
Rehabilitation of Floodwater Retarding Structure No. 8
of the Assunpink Creek Watershed
Hamilton Township, Mercer County, New Jersey**



PREPARED BY
USDA Natural Resources Conservation Service
IN COOPERATION WITH
Mercer County
Hamilton Township
New Jersey Department of Environmental Protection
July 2021

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**FINAL Supplemental Watershed Plan No. 6 & Environmental Evaluation
for the
Rehabilitation of Floodwater Retarding Structure No. 8
of the Assunpink Creek Watershed
Hamilton Township, Mercer County, New Jersey**

Prepared By:
USDA – Natural Resources Conservation Service

In Cooperation With:

Mercer County
Hamilton Township
New Jersey Department of Environmental Protection

Authority

The original watershed work plan was prepared, and the works of improvement were installed, under the authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566) as amended. The rehabilitation of Assunpink Creek Dam No. 8 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472.

Abstract

Assunpink Creek Dam 8 was designed as a high hazard dam but fails to comply with current dam safety and performance criteria. It does not presently meet Natural Resources Conservation Service (NRCS) or New Jersey Department of Environmental Protection Dam Safety standards for integrity and stability of an auxiliary spillway. The recommended plan is to rehabilitate Assunpink Creek Dam No. 8 to meet current New Jersey Department of Environmental Protection Dam Safety and NRCS criteria. The plan provides for the installation of a 110-foot-wide, 4-cycle labyrinth weir over the embankment, decommissioning the existing auxiliary spillway by installing a 200-foot-long earthen berm across the existing auxiliary spillway, constructing a pedestrian bridge with railing over the labyrinth weir, and installing a stilling basin and rip-rap outlet protection. A trash rack bar grate will be installed on the principal spillway riser to reduce the potential for the blockage of the orifice by trash and debris. There will be no change in the current levels of flood protection downstream due to project activity. Project installation cost is estimated to be \$6,240,500 of which \$4,591,000 will be paid from the Small Watershed Rehabilitation funds and \$1,649,500 from local funds.

Comments and Inquiries

For further information, please contact Julie Hawkins, State Conservationist, USDA - Natural Resources Conservation Service, 220 Davidson Avenue, 4th Floor, Somerset, New Jersey 08873.

Non-Discrimination Statement

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at <https://www.usda.gov/oascr/how-to-file-a-program-discrimination-complaint> and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

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ASSUNPINK CREEK WATERSHED AGREEMENT

Supplemental Watershed Plan Agreement
(Supplement No. 6)

between the

Mercer County
Hamilton Township
New Jersey Department of Environmental Protection
(herein referred to collectively as “Sponsors”)
State of New Jersey

and the

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

Whereas, the Watershed Work Plan Agreement for the Assunpink Creek Watershed, State of New Jersey, executed by the Sponsors named therein and the Soil Conservation Service (which is now NRCS, pursuant to section 246 of the Department of Agriculture Reorganization Act of 1994, 7 U.S.C. 6862), became effective on the 12th day of August 1965; and

Whereas, Supplement Watershed Work Plan Agreements for Assunpink Creek Watershed, State of New Jersey, executed by Sponsors named therein and NRCS, became effective on the 5th day of June 1968, the 8th day of October 1971, the 27th day of April 1972, the 21st day of February 1974, and the 19th day of June 2002; and

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsors for assistance in preparing a plan for rehabilitation of the works of improvement for the Assunpink Creek Dam No. 8 located in Hamilton Township of Mercer County, State of New Jersey, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Section 1001 to 1008, 1010, and 1012); 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, there has been developed through the cooperative efforts of the Sponsors and NRCS, a Supplemental Watershed Plan and Environmental Evaluation for works of improvement for the rehabilitation of Assunpink Creek Watershed Dam No. 8, State of New Jersey, hereinafter referred to as the Watershed Project Plan or Plan, which Plan is annexed to and made a part of this agreement; and

Whereas, in order to provide for rehabilitation of the Assunpink Creek Watershed Dam No. 8, it has become necessary to modify the Supplemental Watershed Plan Agreement;

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

1. The County of Monmouth is hereby deleted as a local sponsoring organization of said watershed project, per the request of the County of Monmouth.
2. The Mercer County Soil Conservation District is hereby deleted as a local sponsoring organization of said watershed project, per the request of the Mercer County Soil Conservation District.
3. The Freehold Soil Conservation District is hereby deleted as a local sponsoring organization of said watershed project, per the request of the Freehold Soil Conservation District.
4. **Term.** The term of this agreement is for the installation period and evaluated life of the project (53 years) and does not commit NRCS to assistance of any kind beyond the end of the evaluated life.
5. **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.
6. **Real property.** The Hamilton Township will acquire such real property as will be needed in connection with the works of improvement according to NRCS minimum land rights' policy, which is to the 100-year, 24-hour storm elevation of 73.99 feet, a level below top of dam elevation. The Township accepts this level of easement and its associated risk for potential damages. They also recognize that the land rights must include a prohibition on future construction of habitable dwellings upstream from the dam below the elevation of the top of the dam. 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 Section 5 hereof.

The sponsors agree 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 that will continue to maintain and operate the development in accordance with the operation and maintenance agreement.

7. **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, they agree that, before any Federal financial assistance is furnished, they will provide a statement to that effect, supported by an opinion of the chief legal officer of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance.

8. **Cost-share for Watershed Project Plans.** The following table will be used to show cost-share percentages and amounts for watershed project plan implementation.

Works of Improvement	%	NRCS	%	Sponsors	Total
Cost-Sharable Items ^{1/}					
Rehabilitation of dam (Construction Costs)	81%	\$2,979,000	19%	\$682,000	\$3,661,000
Mitigation		\$0		\$0	\$0
Sponsors' Project Administration ^{1/}	0%	\$0	100%	\$7,000	\$7,000
Sponsors' Engineering	0%	\$0	100%	\$18,000	\$18,000
Land Rights Acquisition	0%	\$0	100%	\$897,000	\$897,000
Subtotal: Cost-Share Costs	65%	\$2,979,000	35%	\$1,604,000	\$4,583,000
Non Cost-Sharable Items ^{2/}					
NRCS Engineering Technical Assistance Costs	100%	\$1,575,000	0%	\$0	\$1,575,000
Project Administration ^{1/}	100%	\$37,000	0%	\$0	\$37,000
Federal, State and Local Permits	0%	\$0	100%	\$45,500	\$45,500
Real Property Rights		\$0		\$0	\$0
Subtotal: Non Cost-Share Costs		\$1,612,000		\$45,500	\$1,657,500
TOTAL:		\$4,591,000		\$1,649,500	\$6,240,500

1/ The sponsors and NRCS will each bear the costs of project administration that each incurs.

2/ If actual non-cost-sharable item expenditures vary from these figures, the responsible party will bear the change.

9. **Land treatment agreements.** The Sponsors will obtain agreements from owners of not less than 50 percent of the land above each multiple-purpose and floodwater-retarding structure. These agreements must provide that the owners will carry out farm or ranch conservation plans on their land. The sponsors will ensure that 50 percent of the land upstream of any retention reservoir site is adequately protected before construction of the dam. The sponsors will provide assistance to landowners and operators to ensure the installation of the land treatment measures shown in the watershed project plan. The sponsors will encourage landowners and operators to continue to operate and maintain the land treatment measures after the long-term contracts expire, for the protection and improvement of the watershed.

10. **Floodplain management.** Before construction of any project for flood prevention, the sponsors must agree to participate in and comply with applicable Federal floodplain management and flood insurance programs. For plans approved as of the date of this revised manual, the sponsors are required to have development controls in place below low and significant hazard dams prior to NRCS or the sponsors entering into a construction contract.
11. **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 must be borne by the sponsors and these costs are not eligible as part of the sponsors' cost-share.
12. **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.
13. **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.
14. **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.
15. **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 must 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 must be in accordance 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.
16. **Prohibitions.** No member of or delegate to Congress, or resident commissioner, may be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but this provision may not be construed to extend to this agreement if made with a corporation for its general benefit.
17. **Operation and Maintenance (O&M).** The Hamilton Township 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 from completion of construction). 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.

18. **Emergency Action Plan.** Prior to construction, the sponsors must 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 must 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 must be reviewed and updated by the sponsors annually.
19. **Nondiscrimination Provisions.** In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

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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.

20. **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 must—
 - 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 must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice must 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 will keep the original of all disclosure reports in the official files of the agency.

21. 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 must complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
 3. The sponsors must 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 must 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.

22. 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:
- Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
 - 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;
 - 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

- 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 are unable to certify to any of the statements in this certification, such prospective participant must attach an explanation to this agreement.

23. 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 will 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.

24. 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.

25. Examination of Records.

The sponsors must 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.

26. Signatures.

The Sponsors and NRCS further agree to all other terms, conditions, and stipulations of said watershed agreement not modified herein.

County of Mercer
P.O. Box 8068
Trenton, NJ 08650

By: Brian M. Hughes
BRIAN M. HUGHES

Title: County Executive

Date: 10/6/21

The signing of this supplemental watershed agreement was authorized by the governing body of the County of Mercer at a meeting held on October 7, 2021.

Administrative Secretary or Notary

County of Mercer
P.O. Box 8068
Trenton, NJ 08650

Date: _____

By: Jerlene H. Worthy
Jerlene H. Worthy, Clerk
Board of Mercer County Commissioners

10/7/21
Date

-2-

WHEREAS, the recommended plan is to rehabilitate Dam No. 8 to meet current NJDEP Dam Safety and NRCS criteria, which plan provides for: 1) Installation of a 110 foot wide, 4 cycle labyrinth weir over the embankment, 2) Decommissioning the existing auxiliary spillway by installing a 200 foot long earthen berm across the existing auxiliary spillway, 3) Construction of a pedestrian bridge with railing over the labyrinth weir, 4) Installation of a stilling basin and rip-rap outlet protection, and 5) A trash rack bar grate installation on the principal spillway riser to decrease the potential for the blockage of the orifice by trash and debris; and,

WHEREAS, as part of this Project, the Township of Hamilton will be required to acquire land rights upstream including easements which prohibit the future construction of habitable dwellings from the dam below the elevation of the top of the dam; now, therefore,

BE IT RESOLVED, that the County Executive and Clerk to the Board be and are hereby authorized to execute the Assunpink Creek Watershed Agreement (Supplement No. 6) for the Rehabilitation of Floodwater Retarding Structure No. 8 of the Assunpink Creek Watershed, Township of Hamilton, County of Mercer, State of New Jersey, in a total amount of \$6,240,500.00 (\$4,591,000.00 - Small Watershed Rehabilitation Funds; \$1,649,500.00 - Non-Federal Funds; No County Funds); and,

BE IT FURTHER RESOLVED, that the Clerk to the Board shall forward eight (8) certified copies of this Resolution, along with eight (8) Agreements to the Office of the County Engineer for further processing and one (1) copy of the resolution and agreement to the Mercer County Director of the Department of Transportation.

I hereby certify this to be a true
copy of the original.

Abba Kene
Mercer County Board of Commissioners

Deputy Clerk to the Board

Signatures (cont.)

New Jersey Dept. of Environmental Protection
Division of Fish and Wildlife
P.O. Box 400
Trenton, NJ 08625

By: 
DAVE GOLDEN

Title: Director

Date: 8/4/21

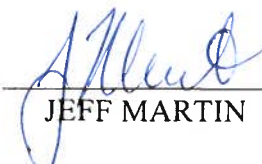
RECORD OF VOTE						
COUNCIL	AYE	NAY	N.V.	A.B.	RES.	SEC.
ANTHONY P. CARABELLI, JR.	✓			✓		
NANCY PHILLIPS	✓			✓	✓	
CHARLES F. WHALEN	✓				✓	
PASQUALE "PAT" PAPERIO, JR.	✓					✓
RICHARD L. TIGHE, JR.	✓					✓

X - Indicates Vote A.B. - Absent N.V. - Not Voting RES. - Moved SEC. - Seconded

Signatures (cont.)

Hamilton Township

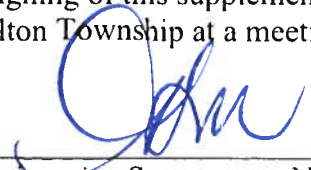
P.O. Box 00150
2090 Greenwood Avenue
Hamilton, NJ 08650

By: 
JEFF MARTIN

Title: Mayor

Date: 8/20/2021

The signing of this supplemental watershed agreement was authorized by the governing body of Hamilton Township at a meeting held on August 17, 2021 (Res. No. 21-301).


Administrative Secretary or Notary
ALISON J. SABO, DEPUTY MUNICIPAL CLERK

Hamilton Township
P.O. Box 00150
2090 Greenwood Avenue
Hamilton, NJ 08650

Date: 8/20/2021

USDA, Natural Resources Conservation Service

Approved by:


JULIE HAWKINS
New Jersey State Conservationist

Date: 11/3/2021

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Tab 1

EVALUATION OF POTENTIAL REHABILITATION PROJECTS

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EVALUATION OF POTENTIAL REHABILITATION PROJECTS										
STATE	NJ	DAM	Robert G. Martin Lake Dam Site 8		BY	ASJV	DATE	3/3/2021		
YEAR BUILT		1967		DESIGN HAZARD CLASS	H	DRAINAGE AREA		2.76	mi ²	
WORK PLAN DATE		3/1/1965		CURRENT HAZARD CLASS	H	DAM HEIGHT		18	ft	
sht 1 of 5		CONSEQUENCES OF DAM FAILURE (ver. 2021-01)					NID ID	NJ00543		
POTENTIAL DAM FAILURE:										
Total Failure Index								137	A	
POTENTIAL LOSS OF LIFE:										
Maximum Population-at-Risk [PAR]								(number)	935	B
Total Risk Index									507	C
POTENTIAL LOSS OF PROPERTY:										
Identify major community affected by breach and rate impact as High (H), Medium (M), Low (L) or None(blank)										
Community		Hamilton Township/City of Trenton				(H,M,L,-)	H		D	
Number of homes, businesses, major buildings						(number)	2,073		E	
POTENTIAL LIFELINE DISRUPTION:										
Water supply, identify community disrupted by dam failure, and estimate number/amount										
Municipal sole source				Users	(number)	0		F		
Supplemental source				Users	(number)	0		G		
Irrigation water				Storage	(Ac-Ft)	0		H		
POTENTIAL INFRASTRUCTURE DISRUPTION:										
Transportation system crossings, identify major crossing rendered unusable by dam failure, and estimate number										
Major/Interstate				Roads	(number)	0		I		
Secondary/County		Local streets, roadways		Roads	(number)	12		J		
POTENTIAL ADVERSE IMPACTS ON THE ENVIRONMENT:										
Describe impacts and rate each as High (H), Medium (M), Low (L), or None (blank)										
Threatened & endangered species				(H,M,L,-)				K		
Sensitive riparian areas				(H,M,L,-)				L		
Contaminated reservoir sediment				(H,M,L,-)				M		
Wetland and wildlife habitat				(H,M,L,-)				N		
Other				(H,M,L,-)				O		
POTENTIAL ADVERSE SOCIAL IMPACTS:										
Describe impacts and rate each as High (H), Medium (M), Low (L) or None(blank)										
Known cultural resources				(H,M,L,-)				P		
Historic preservation issues				(H,M,L,-)				Q		
Socially disadvantaged community				(H,M,L,-)	H			R		
POTENTIAL ADVERSE ECONOMIC IMPACTS:										
Average annual benefits attributed to this dam, updated workplan value						(\$)	376,900	S		
Changes in benefits since workplan; Increase(I), No change(NC), Decrease(D)						(I,NC,D)	I	T		
Low income families impacted						(number)	182	U		
INPUT BY STATE DAM SAFETY AGENCY:										
State dam safety order issued for repair, modification, removal issued, Yes(Y), No(N)						(Y,N)	Y	V		
State Dam Safety Agency Priority, High(H), Medium(M), Low(L), None(blank)						(H,M,L,-)	H	W		
OTHER CONSIDERATIONS:										
Identify any other considerations and rate as High(H), Medium(M), Low(L) or None(blank)										
						(H,M,L,-)		X		
						(H,M,L,-)		Y		

EVALUATION OF POTENTIAL REHABILITATION PROJECTS						
STATE	NJ	DAM	Robert G. Martin Lake Dam Site 8	BY	ASJV	DATE 3/3/2021
sht 2 of 5	FAILURE & RISK INDEXES					ver 2021-01
Adopted from Bureau of Reclamation "Risk Based Profile System" see attached worksheet tab.						
LIFE LOSS:						
Population-at-Risk [PAR], see NRCS dams inventory definition (number of people)						
Estimate PAR for static loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway						8 A
Estimate PAR for hydrologic loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway						935 B
Estimate PAR for seismic loading failure; typically assume water at or above invert of the lowest non-gated spillway (sunny day failure)						6 C
Fatality Rates [FR] from dam breach						
Adopted from BuRec "A Procedure for Estimating Loss of Life Caused by Dam Failure" DSO-99-06 see: http://www.usbr.gov/research/dam_safety/documents/dso-99-06.pdf						
Flood Severity/Lethality [DV] is the average depth [D] times velocity [V] across flood plain (ft2/sec)						
DV= (breach discharge - bank full discharge) / breach floodplain width						
Warning Time [T] between failure warning and flood wave at population (minutes)						
Flood Severity Understanding [U] of the warning issuer of the likely flooding magnitude						
Scenario	Breach Discharge (cfs)	Bankfull Discharge (cfs)	Breach Floodplain Width (ft)	DV (ft2/sec)	Warning Time, T (minutes)	Understanding, U (N/A or Vague)
Static	3,085	332	818	3	30	Vague
Hydrologic	13,096	332	3350	4	30	Vague
Seismic	2,219	332	731	3	30	Vague
For DV≥50	T≤60	U=vague	FR=0.04			
	T>60		FR=0.03			
For DV<50	T≤60	U=vague	FR=0.007			
	T>60		FR=0.0003			
Estimate FR for static loading failure scenario						0.007 D
Estimate FR for hydrologic loading failure scenario						0.007 E
Estimate FR for seismic loading failure scenario						0.007 F
Scenario	Load Factor	Response Factor	Failure Index	Fatality Rate	PAR	Risk Index
Static	1	58	58	0.007	8	3
Hydrologic	*	*	77	0.007	935	504
Seismic	0.15	13	2	0.007	6	0
TOTAL=			137	TOTAL= 507		

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	NJ	DAM	Robert G. Martin Lake Dam Site 8	BY	ASJV	DATE	3/3/2021
sht 3 of 5	STATIC FAILURE INDEX						ver 2021-01
PRINCIPAL SPILLWAY SYSTEM (60 points max):			(total points)	30			A
Downstream filter or filter zone around conduit (yes=0 or no=10)					10		B
Conduit trench deep (>2d) and narrow (<3d) and steep sideslope (<2:1) (no=0 or yes=10)					0		C
Principal spillway system (inlet, pipe, or outlet) in deteriorated condition (no=0 or yes=10)					0		D
Conduit has seepage cutoff collars or other compaction adverse features (no=0 or yes=10)					10		E
Conduit contains open joints, open cracks, steady seepage (no=0 or yes=10)					0		F
Conduit founded on competent bedrock (yes=0 or no=10)					10		G
Reservoir control gate located at outlet of conduit (no=0 or yes=10)					0		H
RESERVOIR FILLING HISTORY (75 points max):			(total points)	0			I
Reservoir has filled to x% of effective height (earth spillway crest minus original streambed)					109		J
(<50%=75 or 51-75%=50 or 76-90%=25 or 91-95%=10 or 96-100%=5 or >100%=0)					0		K
SEEPAGE AND DEFORMATION (85 points max):			(total points)	6			L
Seepage carrying fines, or seepage increases with reservoir elevation increases, or sinkholes/jugholes exist in embankment (no=0 or yes=80)					0		M
Large amounts of seepage (no=0 or yes=6)					0		N
Visible and significant slope movement or sloughing (no=0 or yes=6)					0		O
Longitudinal or transverse embankment cracking greater than one foot in depth (no=0 or yes=6)					0		P
Sinkholes/depressions within two times effective height of the dam, either face (no=0 or yes=6)					0		Q
Poor top of dam condition, eroded, trees, rodent holes, settlement (no=0 or yes=6)					0		R
Abnormally wet areas at downstream toe/groin of embankment (no=0 or yes=6)					0		S
Inadequate slope protection against erosion by rainfall or waves (no=0 or yes=6)					6		T
FOUNDATION GEOLOGY (41 points max):			(total points)	6			U
Highly fractures rock under core (no=0 or treated=3 or untreated=30)					0		V
Karst terrain and soluble rock (gypsum or limestone) (no=0 or treated=3 or untreated=30)					0		W
Collapsible soils (no=0 or treated=3 or untreated=30)					0		X
Significant stress relief fractures in abutments (no=0 or treated=3 or untreated=30)					0		Y
History of underground mining under embankment area (no=0 or treated=3 or untreated=30)					0		Z
Coarse grained and highly permeable soils (no=0 or yes=3)					3		AA
Presence of weak layers/conditions diminishing embankment stability (no=0 or yes=3)					0		AB
Erodible soils (sandy/silty materials) or weakly cemented rock (no=0 or yes=3)					3		AC
Reservoir area prone to landslides that could cause overtopping (no=0 or yes=3)					0		AD
EMBANKMENT DESIGN AND CONSTRUCTION (24 points max):			(total points)	4			AE
Filters for core or foundation or compatibility between zones (no=4 or yes=0)					0		AF
Embankment or foundation drainage system (yes=0 or no=4)					0		AG
Erodible core material (sands, silts, dispersive clays) (no=0 or yes=4)					4		AH
Incomplete or no foundation cutoff of shallow permeable layers (no=0 or yes=4)					0		AI
Poorly placed earthfill, inadequate density (no=0 or yes=4)					0		AJ
Gate features to drain reservoir (yes=0 or no=4)					0		AK
EMBANKMENT MONITORING (15 points max):			(total points)	12			AL
Instruments (except surficial survey points) installed at dam (yes=0 or no=4)					4		AM
Installed instruments routinely read and evaluated (yes=0 or no=4)					4		AN
Visual inspection of dam by engineer less often than yearly (no=0 or yes=4)					4		AO
Good physical/visual access to downstream groin/toe for inspection (yes=0 or no=4)					0		AP
STATIC FAILURE INDEX:			A+I+L+U+AE+AL		58		AQ

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	NJ	DAM	Robert G. Martin Lake Dam Site 8	BY	ASJ/V	DATE	3/3/2021
sht 4 of 5	HYDROLOGIC FAILURE INDEX					ver 2021-01	
HYDROLOGIC LOADING:							
Total Spillway Capacity (PS&ES) for 6hr storm [Pfb], Work Plan Tbl 3 (rainfall inches)						26.0	A
Obtained from Work Plan Tbl 3, or dams inventory data, or computer routings							
100 year, 6hr rainfall [P100] (inches)						5.6	B
Probable Maximum Precipitation [PMP] (inches)						26.3	C
if Pfb <= P100 = 5.60 enter 40							
if Pfb = P100+0.2(PMP-P100) = 9.74 enter 25							
if Pfb = P100+0.4(PMP-P100) = 13.88 enter 15							
if Pfb = P100+0.6(PMP-P100) = 18.02 enter 7							
if Pfb = P100+0.8(PMP-P100) = 22.16 enter 3							
if Pfb => PMP = 26.30 enter 1							
Enter interpolated value						1.1	D
HYDROLOGIC UNCERTAINTY:							
Drainage Area [DA] (square miles)						2.76	E
DA<10 enter 1.5 ; 10<DA<20 enter 1.4 ; 20<DA<50 enter 1.3 ; DA=>50 enter 1.2						1.5	F
PIPE SPILLWAY PLUGGING:							
Pipe Diameter [D] (inches)						36	G
D<12 enter 1.1; 12<=D<24 enter 1.0; 24<=D enter 0.9						0.9	H
Riser & trash rack type:							
Non-standardized inlet enter 1.1, Open Top riser enter 1.0; Covered or Baffle Top enter 0.9						0.9	I
EARTH SPILLWAY FLOW:							
Earth spillway flow depth [Des] from the spillway crest to top of dam (feet)(10' max)						6.8	J
DAM EROSION RESISTANCE:							
Non-plastic (PI<10) fill enter 2.0 ; Plastic core enter 1.7 ; Overtopping armoring enter 0.8						2.0	K
Vegetal Cover Factor [Cf], see NEH-Part 628-Chapter 51, Earth Spillway Erosion Model.						0.9	L
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8						0.9	M
EARTH SPILLWAY EROSION RESISTANCE:							
Low, can be excavated with hand tools, enter 2.0							
PI>10 and SPT blows<8, PI<10 and SPT blows>8, Kh<0.10, seismic velocity<2000fps							
Moderate, can be excavated with construction equipment, easy ripping, enter 1.2							
PI>10 and SPT blows>8, PI<10 and SPT blows>30, Kh<10, seismic velocity<7000fps							
High, very hard ripping, requires drilling and blasting, enter 0.2							
moderately hard rock, Kh>10, seismic velocity>7000fps						2	N
Vegetal Cover Factor [Cf], see NEH-Part 628-Chapter 51, Earth Spillway Erosion Model.						0.9	O
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8						0.9	P
HYDROLOGIC FAILURE INDEX:							
dam overtopping breach: (2)(D)(F)(H)(I)(K)(M)						5	Q
earth spillway breach: (D+5J)(F)(H)(I)(N)(P)						77	R
larger of (2)(D)(F)(H)(I)(K)(M) or (D+5J)(F)(H)(I)(N)(P) but less than 300						77	S

EVALUATION OF POTENTIAL REHABILITATION PROJECTS						
STATE	NJ	DAM	Robert G. Martin Lake Dam Site 8	BY	ASJV	DATE 3/3/2021
sht 5 of 5	SEISMIC FAILURE INDEX					ver 2021-01
SEISMIC LOADING:						
Latitude (degrees.decimal)			40.213	A		
Longitude (degrees.decimal)			-74.675	B		
See "http://https://earthquake.usgs.gov/hazards/interactive/index.php" (MAP LINK)						
PGA [peak ground acceleration] for 2% chance in 50 years, see NSHM maps (%g)			12.00	C		
if PGA is less than 10% g, enter 0						
if PGA is between 10% g and 19% g, enter 0.15						
if PGA is between 20% g and 39% g, enter 0.30						
if PGA is between 40% g and 59% g, enter 0.65						
if PGA is greater than 60% g, enter 1.0			0.15	D		
FOUNDATION LIQUEFACTION:						
Select the following foundation conditions which best represents the site						
Loose alluvium, lacustrine, loess materials, enter 10						
Bedrock, glacial till, highly clayey materials, enter 5			10	E		
EMBANKMENT FREEBOARD FOR FOUNDATION LIQUEFACTION:						
Dam height (ft)			18	F		
Freeboard - Elevation difference from top of dam to assumed pool surface (ft)			15.0	G		
Freeboard percent of dam height (%)			83	H		
if Freeboard is less than 25% of dam height, enter 10						
if Freeboard is 25% to 50% of dam height, enter 5						
if Freeboard is more than 50% of dam height, enter 1			1	I		
EMBANKMENT FREEBOARD FOR EMBANKMENT CRACKING:						
Freeboard is less than or equal to 15 feet (no=0 or yes=1)			1	J		
EMBANKMENT CRACKING:						
Embankment contains self-healing filter zones (no=4 or yes=0)			4	K		
SEISMIC FAILURE INDEX:						
IF E=10, L=(D)(E)(I) ; IF E=5, L=(D)(E)(J+1)(K+1) ; but less than 100			2	L		
BRANDON SAMSON State Conservation Engineer's Signature concurring with technical content of sheets 2 thru 5 Digitally signed by BRANDON SAMSON Date: 2021.03.10 06:44:09 -06'00'						

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Tab 2

PLAN-EE REHABILITATION TEMPLATE

(Word Version, dated 10/1/2016)

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U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Assunpink Creek	
Watershed Rehabilitation Worksheet		County(s): Mercer	State(s): New Jersey
Sponsoring Local Organization(s):		Hydrologic Unit Code: 020401050803	
Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number: NJ-2010	
		Watershed Site Number: Dam No. 8	
		NID Number: NJ00543	

A. Authority and Program Criteria

Original Program Authority:		Public Law 83-566				
Current Program Authority:		Section 14 of Public Law 83-566				
Current Hazard Classification:		High				
Design Hazard Classification:		High				
Status of Operation and Maintenance		The site has been well maintained with regular mowing and cleaning of debris from the principal spillway. The earth embankment and auxiliary spillway are well vegetated and stable. There are a few areas on the embankment with some bank erosion that requires topsoil and reseeding. No issues were noted with the concrete in the principal spillway and impact basin. The low-level outlet valve was exercised successfully in April 2016.				
Sedimentation (acre-feet/year) ^{1/}	Originally Planned	0.26 submerged; 0.05 aerated	Actual	0.63 submerged; 0.11 aerated	Future	0.30 submerged; 0.04 aerated
Evaluation of Potential Rehabilitation Projects			Updated:	No	9/19/2017	
Sponsor's Application Submission date		11/17/2017	NRCS acknowledges Valid Application:			11/27/2017
Will upstream land rights be obtained to top-of-dam elevation per NWPM 505.36G? ^{2/}						No
Are basic assumptions and decisions (Investigation and Analysis) included in the administrative record?						Yes
Is the Investigation and Analysis (I&A) attached to the Plan-EE?						Yes
Does planning and analyses comply with 1983 P&G?						Yes

^{1/} If future sediment storage is provided for less than 100 years, explain rationale in Section L Additional Notes and Comments.

^{2/} Provide rationale for selected land rights elevation if below top-of-dam in Section L Additional Notes and Comments.

B. Purpose and Need for Action

Purpose: Provide the current level of flood protection for the next 50-100 years while minimizing environmental, economic, and social impacts and comply with applicable dam safety and performance standards to reduce the potential for flood damages and loss of life from a catastrophic breach.

Need: The current structure does not presently meet NRCS or New Jersey Department of Environmental Protection dam safety standards for integrity and stability of an auxiliary spillway. The dam does not meet the criteria for flood storage and principal spillway capacity, which would require raising the ASW crest. Overall, it does not meet current safety and performance standards for a high hazard potential dam. To reduce the risk of flood damage to homes, commercial facilities, and an expanded infrastructure, as well as to reduce the risk of loss of life due to a flood event, action is necessary.

The dam is a single-purpose flood control structure that provides flood protection for Hamilton Township, Mercer County, New Jersey. However, the dam embankment and auxiliary spillway do not presently meet NRCS design standards for a high hazard dam.

There is a need to maintain flood protection downstream and to address dam safety and performance deficiencies of the existing high-hazard dam that are not in compliance with NRCS and State of New Jersey standards. There is a potential for loss of life due to the existence of 12 roadways downstream of this structure within the breach inundation zone. In addition, people living or working in 292 residences, 1 commercial building, and 6 public properties would be at risk from a catastrophic dam failure. The dam currently provides flood protection for flood events up to a magnitude of the 500-year flood for 853 residences, 4 apartment complexes, 49 businesses, 10 public buildings, 8 stream crossings, and 64 roadways.

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Assunpink Creek	
Watershed Rehabilitation Worksheet		County(s): Mercer	State(s): New Jersey
Sponsoring Local Organization(s):		Hydrologic Unit Code: 020401050803	
Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number: NJ-2010	
		Watershed Site Number: Dam No. 8	
		NID Number: NJ00543	

C. Watershed Rehabilitation Alternatives with Rationale for Level of Analysis

Alternative	Alternative Description and Major Feature	Cost	Carried Through Analysis	Rationale
No Action/Future Without Federal Project	The Sponsors will rehabilitate the dam to meet current safety and performance standards, maintain incidental recreational use, maintain the existing top of dam and auxiliary spillway crest elevations, and maintain existing flood control to downstream properties. They have decided to fully rehabilitate the dam the same way that the dam would be rehabilitated using Federal assistance (see dam rehabilitation Preferred Alternative below for further details).	\$6,240,500	Yes	No Action
Armoring of Existing Auxiliary Spillway with Roller Compacted Concrete	This alternative involves the installation of roller compacted concrete (RCC) on the floor and sides of the existing ASW. Topsoil would be placed on top on the finished RCC for aesthetics and the area would be seeded. A reinforced concrete weir wall would be constructed at the entrance to the RCC ASW as well as a reinforced concrete cutoff wall at the downstream end with riprap outlet protection. In addition, a filter diaphragm would be constructed at the downstream slope around the principal spillway conduit and the existing asbestos cement pipe toe drains will be replaced with plastic pipe and extended approximately 100 linear ft on each side of the principal spillway. There will be no change in the current normal pool elevation of the dam impoundment (Veterans Lake) and no change in the levels of flood protection downstream.	\$8,073,500	Yes	Meets purpose and need.
Decommissioning	This alternative removes the storage function of the dam and reconnects, restores, and stabilizes the stream and floodplain functions. Downstream flooding conditions would be similar to those that existed prior to construction of the dam. This would result in about \$366,200 in average annual damages. To alleviate these damages, a cost of \$220 - 230 million was estimated that would include the relocation of the affected properties (853 residences, 4 apartment buildings, 49 businesses, and 10 public properties). Since relocating so many buildings was not only very expensive but also impractical, another effort was made to estimate the cost of floodproofing the affected buildings. This, too, proved very expensive - estimated at \$20 - 30 million. Along with addressing the flooding of the buildings,	>\$30 million	No	Meets purpose and need but not reasonable due to exorbitant cost. Therefore, this alternative was not studied in detail.

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Assunpink Creek	
Watershed Rehabilitation Worksheet		County(s): Mercer	State(s): New Jersey
Sponsoring Local Organization(s):		Hydrologic Unit Code: 020401050803	
Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number: NJ-2010	
		Watershed Site Number: Dam No. 8	
		NID Number: NJ00543	

	this alternative would also require modifying 64 roadways and 8 stream crossings so that the current level of flood protection could be maintained and increased flooding would not impact vehicles as they traveled along these roads. And, at a minimum, partial removal of the dam's embankment would need to be completed so as to safely pass the 100-year, 24-hour frequency flood event, thus eliminating the structure's ability to store water. Due to the already excessive cost of floodproofing the buildings, no effort was made to estimate additional costs of road/crossing modifications and dam excavation. Also, according to New Jersey Dam Safety regulations, no increase in the downstream 100-year flood elevations will be allowed. An increase is defined, for this purpose, as 0.15 ft. or greater.			
Dam Rehabilitation - Construction of Straight Drop Spillway through Dam Embankment	This involves constructing a 160-foot-wide, reinforced concrete straight drop spillway over the embankment, constructing an earthen berm across the 200-ft wide existing auxiliary spillway (with a pedestrian pathway to maintain pedestrian access to the dam), and constructing a stilling basin with riprap outlet protection. The existing spillway conduit would outlet through the straight drop spillway headwall. Also, the existing asbestos cement pipe toe drains would be replaced with plastic pipe and extended approximately 100 LF on each side of the principal spillway beyond the current limits of the drain pipes. There will be no change in the current levels of flood protection downstream as a result of project activity. A pedestrian bridge would be constructed over the straight drop spillway to maintain pedestrian access along the dam crest. Flood storage easements of 5.86 acres would need to be procured by Hamilton Township.	\$7,429,500	Yes	Meets purpose and need.
Dam Rehabilitation - Construction of Labyrinth Weir through Dam Embankment	This alternative involves constructing a 110-ft wide, 4-cycle staged reinforced concrete labyrinth weir over the embankment (one cycle at EL 73 and three cycles at EL 73.7), constructing an earthen berm across the 200-ft wide existing auxiliary spillway (with a pedestrian pathway to maintain pedestrian access to the dam), and constructing a stilling basin with riprap outlet protection. A section of the existing principal spillway conduit would be removed and an outlet protection enclosure installed over the conduit as it projects from the labyrinth weir	\$6,240,500	Yes	Meets purpose and need.

U.S. Department Agriculture Natural Resources Conservation Service		May 2015		Watershed: Assunpink Creek	
Watershed Rehabilitation Worksheet		County(s): Mercer	State(s): New Jersey		
Sponsoring Local Organization(s):		Hydrologic Unit Code:		020401050803	
Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number:		NJ-2010	
		Watershed Site Number:		Dam No. 8	
		NID Number:		NJ00543	

	chute. Also, the existing asbestos cement pipe toe drains would be replaced with plastic pipe and extended approximately 100 LF on each side of the principal spillway beyond the current limits of the drain pipes. There will be no change in the current levels of flood protection downstream as a result of project activity. A pedestrian bridge would be constructed over the labyrinth spillway to maintain pedestrian access along the dam crest. Flood storage easements of 5.86 acres would need to be procured by Hamilton Township.			
Raise the Top of Dam and/or Crest of Auxiliary Spillway	This option didn't make sense because the auxiliary spillway has capacity to pass the freeboard hydrograph (6-hour Probable Maximum Flood), but it doesn't meet the stability/integrity criteria. Raising the ASW crest or TOD would also have negative effect on upstream properties.	N/A	No	Does not address dam deficiencies so it does not meet purpose and need.
Nonstructural Alternatives	This alternative leaves the dam as is while relocating and/or floodproofing properties downstream that would be at risk from a dam failure. Roadways and/or crossings would be modified so that motorists traveling on them would not be at risk in the event of a dam failure. Once properties are relocated/floodproofed and roadways/crossings are modified, the hazard classification of the dam would be changed from high to either low or significant. A cost of \$120 - 125 million was estimated that would include the relocation of the affected properties (292 residences, 1 business, and 6 public properties). Since relocating these buildings was not only very expensive but also impractical, another effort was made to estimate the cost of floodproofing the affected buildings. This, too, proved very expensive - estimated at \$15 - 20 million. Along with addressing the flooding of the buildings, this alternative would require modifying 12 roadways so that flooding from a dam failure would not impact vehicles as they traveled along these roads. Due to the already excessive cost of relocating and/or floodproofing the buildings, no effort was made to estimate additional costs of roadway modifications. Another part of this alternative that was not estimated was the cost of procuring restrictive easements in the area between the 100-year floodplain elevation and the breach elevation, ensuring that future development would not occur. It should be noted that the effect of a dam	>\$20M	No	Meets purpose and need but not reasonable due to exorbitant cost. Therefore, this alternative was not studied in detail.

U.S. Department Agriculture Natural Resources Conservation Service May 2015		Watershed: Assunpink Creek		
Watershed Rehabilitation Worksheet		County(s): Mercer	State(s): New Jersey	
Sponsoring Local Organization(s):		Hydrologic Unit Code: 020401050803		
Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number: NJ-2010		
		Watershed Site Number: Dam No. 8		
		NID Number: NJ00543		
	failure was measured as the net impact between a PMP storm event with no breach compared to a PMP storm event with a breach. Under the PMP without a breach scenario, many properties would be impacted by flooding. Thus, these properties were not accounted for under the PMP with a breach scenario. This is why the estimated cost of this alternative was so much less than the cost of the Decommissioning alternative and why so many fewer properties were impacted.			
Articulated Concrete Blocks (ACBs) in the existing auxiliary spillway	Dam doesn't meet the criteria for flood storage and principal spillway capacity, which would require raising the ASW crest. This requirement can be waived for structural spillways; however, ACBs cannot be considered a structural solution in this situation by NRCS policy.	N/A	No	Does not meet NRCS policy and therefore this alternative was not studied in detail.

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Assunpink Creek	
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Sponsoring Local Organization(s):	Hydrologic Unit Code: 020401050803		
Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection	Watershed Project Number: NJ-2010		
	Watershed Site Number: Dam No. 8		
	NID Number: NJ00543		

D. National Economic Development (NED) Account

	No Action	Dam Rehabilitation - Armoring of Existing Auxiliary Spillway with Roller Compacted Concrete	Dam Rehabilitation - Construction of Straight Drop Spillway through Dam Embankment	Dam Rehabilitation - Labyrinth Weir
NED Benefits and Costs	No Action	Alt 1	Alt 2	Alt 3
Project Investment	\$6,240,500	\$8,073,500	\$7,429,500	\$6,240,500
NRCS	\$4,591,000	\$5,683,000	\$5,336,500	\$4,591,000
Sponsors	\$1,649,500	\$2,390,500	\$2,093,000	\$1,649,500
NED Plan ^{3/}				
Beneficial Annual	\$366,200	\$305,500	\$278,200	\$236,600
Adverse Annual	\$236,600	\$305,500	\$278,200	\$236,600
Net Beneficial	\$129,600	\$0	\$0	\$0
Benefit to Cost Ratio		1.0	1.0	1.0
Comparison of NED Benefits and Costs (Table 6) ^{4/ 5/}	No Action	Alt 1	Alt 2	Alt 3
Agricultural Related		\$0	\$0	\$0
Non-Agricultural Related	\$366,200	\$0	\$0	\$0
Other - Cost Avoidance		\$305,500	\$278,200	\$236,600
Other Purpose -		\$0	\$0	\$0
Other Purpose -		\$0	\$0	\$0
Other Purpose -		\$0	\$0	\$0
Total Benefits	\$366,200	\$305,500	\$278,200	\$236,600
Average Annual NED Costs (Table 4)	No Action	Alt 1	Alt 2	Alt 3
Amortized Installation	\$221,400	\$284,600	\$263,000	\$221,400
Other Direct Costs-		\$0	\$0	\$0
Operation, Maintenance, and Replacement	\$15,200	\$20,900	\$15,200	\$15,200
Total Adverse ^{6/}	\$236,600	\$305,500	\$278,200	\$236,600
Average Annual Flood Damage Reduction (Table 5)	No Action	Alt 1	Alt 2	Alt 3
Agricultural				
Floodwater - Crop and Pasture				
Floodwater - Other Ag				
Sediment and Erosion - Sediment				
Sediment and Erosion - Channel				
Other				
Sub-total Ag Damages	\$0	\$0	\$0	\$0
Non-Agricultural				
Floodwater - Urban	\$2,829,200	\$2,829,200	\$2,829,200	\$2,829,200
Other				
Indirect - Damage reduction benefit				
Sub-total Non-Ag Damages	\$2,829,200	\$2,829,200	\$2,829,200	\$2,829,200
Total Damages	\$2,829,200	\$2,829,200	\$2,829,200	\$2,829,200

^{3/} The Sponsors have indicated that without federal assistance they would rehabilitate the dam according to NRCS standards. Therefore, damage reduction benefits resulting from each alternative equal zero as compared to the no action alternative because they are the same in scope, cost, and effects. Alternative 3 is the NED Plan because it is the least cost alternative.

^{4/} See Appendix C Investigation and Analysis Report, Social and Economic conditions for a thorough description of benefits, adverse effects, and B/C ratio.

^{5/} Price base: October, 2020; NED Plan is the Preferred Alternative.

^{6/} Price base: 2020, amortized over 53 years at a discount rate of 2.50%. Prepared October, 2020.

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Assunpink Creek	
Watershed Rehabilitation Worksheet		County(s): Mercer	State(s): New Jersey
Sponsoring Local Organization(s):		Hydrologic Unit Code: 020401050803	
Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number: NJ-2010	
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		NID Number: NJ00543	

E. Regional Economic Development (RED) Account

The RED account was not evaluated in the plan since it was not identified as an issue during plan development.

F. Other Social Effects (OSE) Account

Record additional social effects of the alternatives to the human environment not covered in the P&G National Economic Development Account or in the NRCS-CPA-52.			
Resource Concerns (describe existing conditions)	No Action	Rehabilitation – Armor Existing ASW with RCC	Rehabilitation – Straight Drop Spillway Through Embankment
	Amount, Status, Description (Document both short- and long-term impacts)	Amount, Status, Description (Document both short- and long-term impacts)	Amount, Status, Description (Document both short- and long-term impacts)
Public Health and Safety	May Effect	May Effect	May Effect
Dam currently fails to meet dam safety and performance criteria for a high hazard dam. The dam is located in a highly populated urban area of Mercer County. A dam failure would cause significant damage and potential loss of life.	Short- and long-term effects to the public health and safety include reduced threat to loss of life from a catastrophic breach.	Same as No-Action and Alternative 3 (Labyrinth Weir).	Same as No-Action and Alternative 3 (Labyrinth Weir).
Floodplain Management	No Effect	No Effect	No Effect
The dam currently serves as a flood control structure for the surrounding area. A dam breach would result in catastrophic flood damages and significant risk to loss of life.	There will be no change in the levels of flood protection downstream.	Same as No-Action and Alternative 3 (Labyrinth Weir).	Same as No-Action and Alternative 3 (Labyrinth Weir).
Parklands	May Effect	May Effect	May Effect
Hamilton Veterans Park, where the dam is located, is maintained by Hamilton Township and falls under the NJDEP Green Acres Program, which assists in maintenance of the park and helps to ensure conservation of the park.	Park lands will be temporarily affected by construction work; areas in the LOD may close to recreation during the construction period. A representative of the Green Acres Program indicated that the organization would only need to be consulted if permanent impacts to recreation or conservation were to occur. Project work is not anticipated to result	Same as No-Action and Alternative 3 (Labyrinth Weir).	Same as No-Action and Alternative 3 (Labyrinth Weir).

U.S. Department Agriculture Natural Resources Conservation Service		May 2015		Watershed: Assunpink Creek	
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Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number:		NJ-2010	
		Watershed Site Number:		Dam No. 8	
		NID Number:		NJ00543	

	in long-term effects to park lands or conservation lands, but Green Acres should be engaged throughout the process to ensure exemption.		
Regional Water Resource Plans	No Effect	No Effect	No Effect
N/A			
Recreation	May Effect	May Effect	May Effect
The dam is located within a highly utilized public park, used for walking, biking, and other recreational activities by local residents. Within the LOD, there are 7.71 acres classified as recreational land, which includes 0.79 miles of trails, both paved and unpaved, used for hiking, walking, and biking.	Portions of the park surrounding the dam will be temporarily closed to recreation during construction (under the discretion of Hamilton Township Division of Recreation). There are no anticipated long-term impacts to recreation.	Same as No-Action and Alternative 3 (Labyrinth Weir).	Same as No-Action and Alternative 3 (Labyrinth Weir).
Land Values	No Effect	No Effect	No Effect
Groundwater/Sole Source Aquifer	No Effect	No Effect	No Effect
The dam and adjacent areas are located within the New Jersey Coastal Plain Aquifer System.	There are no known drinking water or groundwater wells within or immediately adjacent to the project site. Additionally, there will be no action resulting from the project which will inhibit the infiltration or replenishment of groundwater.	Same as No-Action and Alternative 3 (Labyrinth Weir).	Same as No-Action and Alternative 3 (Labyrinth Weir).
Other: Scenic Beauty	May Effect	May Effect	May Effect
Hamilton Veterans Park, including its scenic beauty and recreational activities, is highly valued by local residents.	Temporary construction work on the dam will negatively impact the scenic beauty of the dam within Hamilton Veterans Park. There will be minor long-term effects on scenic beauty due to the alterations to the dam embankment	Temporary construction work on the dam will negatively impact the scenic beauty of the dam within Hamilton Veterans Park. There will be negligible long-term effects on scenic beauty due to the alterations of the dam and ASW. The RCC	Same as No-Action and Alternative 3 (Labyrinth Weir).

U.S. Department Agriculture Natural Resources Conservation Service		May 2015		Watershed: Assunpink Creek	
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Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number:		NJ-2010	
		Watershed Site Number:		Dam No. 8	
		NID Number:		NJ00543	
		area and installation of the berm on the ASW.	ASW will be reseeded and appear similar to preconstruction conditions.		

G. Potential Modes, Parameters and Consequences of Failure

Modes of Dam Failure	Non-storm Breach Reservoir Elev. (ft-NAVD88)	Peak Breach Discharge – (cfs)	Population at Risk	Potential
Stability				Low
Hydrologic				High
Seismic				Low
Seepage	-	-	-	Low
Material Deterioration	-	-	-	Low
Other:				Choose an item.
Consequences and Other Notes: Reasoning for Potential Failure: The auxiliary spillway does not meet TR 210-60 criteria for integrity. The results of the hydrologic and hydraulic analysis show that a headcut would form at the toe of the auxiliary spillway and would progress upstream past the control section, resulting in an uncontrolled release of water.				

H. Consultation, Coordination and Public Participation

Agency/Public Participation	Meeting/Contact	Date Complete	Site Visit	Date Complete
USFWS - ESA Sec 7/ Sec 12 PL -566	Letter	8/11/2020	No	8/12/2020
USACE	Letter	8/11/2020	No	8/12/2020
EPA Region 2	Public Meeting	6/26/2019	No	8/12/2020
National Marine Fisheries Service,	Letter	8/11/2020	No	8/12/2020
USDA - NRCS	Public Meeting	6/26/2019	Yes	8/12/2020
NJ Department of Agriculture	Public Meeting	6/26/2019	No	8/12/2020
NJDEP Green Acres*	Public Meeting	6/26/2019	No	8/12/2020
NJ Bureau of Dam Safety	Letter	8/11/2020	No	8/12/2020
Delaware River Keepers	Public Meeting	6/26/2019	Yes	8/12/2020
Mercer County	Public Meeting	6/26/2019	No	8/12/2020
Hamilton Township	Public Meeting	6/26/2019	Yes	8/12/2020
Hamilton Neighbors	Public Meeting	6/26/2019	No	8/12/2020
Hamilton Open Spaces	Public Meeting	6/26/2019	Yes	8/12/2020

U.S. Department Agriculture Natural Resources Conservation Service May 2015		Watershed: Assunpink Creek		
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Sponsoring Local Organization(s):		Hydrologic Unit Code: 020401050803		
Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number: NJ-2010		
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NJ Dept. of Environmental Protection – Land Use Regulation	Letter	8/11/2020	No	8/12/2020
Monmouth County	Public Meeting	6/26/2019	No	8/12/2020
Mercer County Soil Conservation District	Public Meeting	6/26/2019	No	8/12/2020
Freehold Soil Conservation District	Public Meeting	6/26/2019	No	8/12/2020
U.S. Congressman Smith’s Office	Public Meeting	6/26/2019	Yes	8/12/2020
FEMA	Public Meeting	6/26/2019	No	8/12/2020
USGS	Public Meeting	6/26/2019	No	8/12/2020
U.S. Forest Service	Public Meeting	6/26/2019	No	8/12/2020
NJ DEP – Historic Preservation Office	Letter	8/11/20220	Response	9/23/2020
NJDEP – Division of Fish and Wildlife	Letter	8/11/20220	No	8/12/2020
4 Federally Recognized Tribes in NJ	Letter	2/3/21	No	8/12/2020
Public Participation	Public Meeting	6/26/2019	Yes	8/12/2020

Explanations: A Public Scoping Meeting was held in Hamilton Township on June 26, 2019. Due to COVID-19 risks and restrictions for public gatherings, a virtual Public Meeting was held using Microsoft Teams on August 12, 2020 with 31 total participants. *The NJDEP - Green Acres did not attend the Virtual Public Meeting but sent an email that they had no concerns with the proposed project.

Cultural Resources

Cultural Resources ^{7/}

Date

Literature Review conducted	11/13/2019
Pedestrian Survey conducted	Click here to enter a date.
Consultation with State Historic Preservation Office	11/14/2019
Consultation with State Tribal Historic Preservation Office	Click here to enter a date.
Consultation with Tribes	2/3/2021
Tribes Contacted: NRCS sent consultation letters on 2/3/21 to the following four tribes with a Federally recognized interest in Mercer County, NJ: Absentee-Shawnee Tribe of Indians of Oklahoma, Delaware Nation, Oklahoma, Delaware Tribe of Indians; and Shawnee Tribe. None of the tribes responded to the letters.	

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Cultural Resources Identified: None identified – No effect.

NJHPO responded to the project consultation on 23 September 2020 and stated

“Upon review, HPO records do not identify any known historic or archaeological properties in or near the project site. The mid-twentieth century earthen dam does not appear to meet any of the criteria for inclusion on the National Register of Historic Places. The identified areas of ground disturbance appear to be within the earthen dam, previous quarry areas, or surrounding poorly drained soils. These areas possess a low sensitivity for any significant archaeological resources.”

The NJSHPO also concluded that “the HPO would not recommend the need for any additional consideration of project effects on historic or archaeological resources.”

^{7/} Consultation correspondence and agency letters reside in the administrative record file.

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Assunpink Creek	
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Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection	Watershed Project Number: NJ-2010		
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I. Land Use in Drainage Area

Land Use/Resource Types	Existing Condition	No Action	Alternative 1	Alternative 2
To use Rt click, select Worksheet Object, then Open to enter data in Excel	Affected Area - acres			
Cropland	77.4	77.4	77.4	77.4
Pasture and Rangeland	11.8	11.8	11.8	11.8
Forest	185	185	185	185
Farmstead	0	0	0	0
Residential	1122.4	1122.4	1122.4	1122.4
Commercial	214.2	214.2	214.2	214.2
Transportation				
Stream/channel *				
Lake/open water	18.4	18.4	18.4	18.4
Wetlands-herbaceous/fringe				
Wetlands-scrub/shrub				
Wetland - forested				
Wetlands Combined	129.5	129.5	129.5	129.5
Other:	10.0	10.0	10.0	10.0
Totals (Acres)**	1768.7	1768.7	1768.7	1768.7
* Also indicate lengths (feet) in notes below.				
** Totals will be red color until sum equals existing condition total.				
Notes: Land use is for future build out conditions and was developed using NLCD data and zoning restrictions for Hamilton Township.				

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Assunpink Creek	
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J. Risk and Uncertainty

Biological - The risk and uncertainty in the analysis of biological and environmental impacts could be reduced by more intensive data collection, including official on-site surveys of wetlands, vegetation, fish and wildlife species. The reasoning for work is to meet the purpose and need of the project. It was determined that increased investment in analysis was not necessary and any reduction in risk and uncertainty would not result in a different identification of the NED alternative.

Cultural Resources - If any cultural or archaeological resources are discovered during construction, the project will be stopped, the SHPO Office will be notified, and NRCS policy will be followed.

Economic - Because local tax appraisal district records were utilized to obtain the structural values of residences, commercial, and public properties that would be affected by project activities, there is the possibility of under- and/or over-estimated values as compared to fair market values, which could impose uncertainty into the economic analysis. Content values were estimated as a percentage of assessed property values, which also could result in values not reflective of actual values. Estimated floodwater depths for various storms (including the 500-year storm) for each structure were based on the results of the hydrology and hydraulics (H&H) simulation modeling. This could result in greater and/or less risk of flood events. Depth-to-damage functions provided by NRCS were utilized to estimate structural and content damage. Updated functions based on more recent flood events could also provide varying results – increased and/or decreased damages. The risk and uncertainty in the analysis for flood damage reduction could be reduced for the economic analysis, but that would require more intensive primary and secondary data collection. The reasoning for work is to meet the purpose and need of the project. The identification of the NED alternative is not distorted by the use of these procedures. Thus, it was determined that increased investment in analysis was not necessary and any reduction in risk and uncertainty would not result in a different identification of the NED alternative.

Engineering - Risk and uncertainty during construction can be reduced by conducting design-phase geotechnical explorations to provide additional characterization of subsurface conditions at locations based on the specific layout and features of the preferred alternative. Subsurface conditions between boring and test pit locations may vary, and the adequacy of the design should be confirmed if unanticipated conditions are encountered during construction. Professional opinions of future performance of concrete structures at the dam are based on visual observations and engineering analyses. While these structures, including the principal spillway riser, conduit, and stilling basin, are expected to perform as intended during design-level hydraulic and seismic loadings within the design life of the structures, risk and uncertainty can be reduced by regular inspection and maintenance, as well as monitoring major flood and seismic events, in accordance with NRCS and NJ Dam Safety requirements. There is uncertainty associated with H&H analyses due to the use of input parameters that are the best approximation of hydrologic conditions in the watershed. The uncertainty and risk could be limited by calibration of the watershed response to rainfall events of the same magnitude; however, the lack of stream gage data limits the applicability of calibration. 100-yr peak discharge from the previously developed FEMA Flood Insurance Study shows comparable peak discharge (FEMA peak discharge of 565 cfs vs. 492 cfs from this study). The WSE of 74 ft in the Veterans Lake from this study also matches the FEMA DFIRM BFE. The rainfall input used for the analysis was obtained from rainfall frequency studies revised in 2006 and from PMP studies developed in 1978, which have not been updated using the latest state-of-the-science tools and methods to incorporate data from storms that occurred since the studies were published. The uncertainty associated with rainfall data could be reduced if site-specific PMP rainfall data were available. New Jersey is currently developing a state-wide PMP study. If the study is completed before the project enters the design phase, the H&H analyses could be reassessed.

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	Watershed Site Number: Dam No. 8		
	NID Number: NJ00543		

K. List of Preparers

Name	Current Position - Years	Education	Experience (Years)	Applicable Certifications
NRCS				
Dave Lamm	State Conservation Engineer - 24	BS - Engineering	40	PE in NJ
Hilary Trotman	Project Engineer - 21	BS - Engineering	23	PE in NJ, COR
Jeff McClure	Geologist - 16	BS - Geology BA - Geology	37	CPG in PA and VA
Hamilton Township				
Richard Williams	Municipal Engineer - 12	BS - Construction Engineering	40	PE in NJ
A&E Consultants				
Petr Masopust, Aterra Solutions	Principal Water Resources Engineer - 5	MS - Civil and Environ. Engineering; MS - Water Technology and Environ. Engineering	17	PE in CT, MA, NH, and PA
Joe Bellini, Aterra Solutions	Vice President/Principal Engineer - 7	BS and MS - Civil Engineering	31	PE, PH, D. WRE, CFM
Wade Biddix, Aterra Solutions	Planning Coordinator - 5	MS - Public Administration BS - Agriculture	38	
Tim Sweeney, Aterra Solutions	Resource Conservationist - 2	BS - Natural Resources	37	
James Featherston, Contractor	Economist - 6	MS - Ag. Economics BS - Ag. Economics	36	
Paul Welle, Schnabel Engineering	Hydraulic Engineer - 22	BS - Ag. Engineering	52	PE in CT, KS, NJ, PA, VA, and WV
Brian Toombs, Schnabel Engineering	Senior Dam & Geotechnical Engineer - 3	MS - Geotechnical Engineering BS - Civil & Environmental Engineering	10	PE in MA and NY
Sal DeCarli, EA Engineering	Environmental Planner - 5	MS - Environmental Science and Policy	12	Certified Ecologist
Adam Nowicki, ERM	Environmental Scientist - 7	BS - Biology; BS - Environmental Science	14	

U.S. Department Agriculture Natural Resources Conservation Service May 2015		Watershed: Assunpink Creek	
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Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number: NJ-2010	
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		NID Number: NJ00543	

Mike Gansner, ERM	Senior Associate Partner - 30	BS - Marine Ecology	33	
Michael Schaffer, ERM	Principal Consultant - Air Quality - 6	BS - Meteorology	18	
Ed Schneider, ERM	Senior Archaeologist - 6	MA - Anthropology	35	Professional Archaeologist

L. Additional Notes and Comments

Section A, Footnote 1 - The design report documented an estimated reduced sedimentation rate after completion of urban development. Since urban development is complete, this rate estimated during design was used. It was confirmed by a similar rate recently computed using a sedimentation analysis of a nearby reservoir.

For more detailed rationale for future sediment storage, see the Period of Analysis Determination in the Social and Economic Conditions section of the Investigations and Analyses in Appendix C.

Section A, Footnote 2 - For the rational for landrights elevation below the top of dam, see the Floodpool Risk Analysis in the Social and Economic Conditions section of the Investigations and Analyses in Appendix C.

Mitigation - There may be up to 0.73 acres of wetlands disturbance which is unavoidable. NJ Freshwater Wetland General Permit 18 for Dam Repairs allows up to one acre of wetland disturbance without mitigation. If the wetland disturbance exceeds one acre, mitigation may be required.

The Sponsors have indicated that without federal assistance they would rehabilitate the dam according to NRCS standards. Therefore, damage reduction benefits resulting from each alternative equal zero as compared to the no action alternative because they are the same in scope, cost, and effects, and therefore, yield equivalent benefits. However, in order to reflect the monetary beneficial attributes of each alternative, costs and benefits for each alternative were evaluated. Project benefits are estimated to be \$366,200 annually. Benefits are derived from assuming the continued performance of Dam No. 8 by meeting safety and performance standards and continuing downstream flood protection (damage reduction benefits). Alternative 3 is the least cost alternative; hence it is the NED plan. See Appendix C Investigation and Analysis Report, Social and Economic Conditions for a more thorough description of benefits, adverse effects, and B/C ratio.

Price base: October 2020; NED Plan is the Preferred Alternative.

Price base: 2020, amortized over 53 years at a discount rate of 2.50%. Prepared October 2020.

U.S. Department Agriculture Natural Resources Conservation Service	May 2015	Watershed: Assunpink Creek	
Watershed Rehabilitation Worksheet		County(s): Mercer	State(s): New Jersey
Sponsoring Local Organization(s):		Hydrologic Unit Code: 020401050803	
Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection		Watershed Project Number: NJ-2010	
		Watershed Site Number: Dam No. 8	
		NID Number: NJ00543	

Table 2 - Estimated Cost Distribution															
Item Description	Installation Costs - Public Law 83-566 1/						Installation Costs - Other Funds 2/								Total Installation Cost 3/
	Construction	Engineering	Real Property Rights	Relocat. Payments	Project Admin.	Total Federal Cost	Construction	Engineering	Real Property Rights	Natural Resource Rights	Relocat. Payments	Required Permits	Project Admin.	Total Non-Federal Cost	
Rehab. of Dam No. 8	\$2,979,000	\$1,575,000	\$0	\$0	\$37,000	\$4,591,000	\$682,000	\$18,000	\$897,000	\$0	\$0	\$45,500	\$7,000	\$1,649,500	\$6,240,500
Price Base: 2020														Oct-2020	

- 1/ Federal Engineering Costs (Design - \$800,000; Surveying - \$20,000; Geo-Tech - \$85,000; Construction Inspection - \$650,000; and Quality Assurance Testing - \$20,000; Total - \$1,575,000) are not included when calculating federal cost share for the rehabilitation project. Hamilton Township permitting costs (\$45,500) are not eligible for cost share either. Therefore, federal cost share (65%) is based on total eligible project cost of \$4,583,000. The actual federal cost/share cannot exceed 100% of the construction cost.
- 2/ 35% of total eligible project cost, excluding cost of permits.
- 3/ As per the NRCS National Watershed Manual, Part 508.44, the actual federal cost/share amount will be calculated based on a total eligible project cost that excludes federal technical assistance costs, water, mineral and other resource rights, and all federal, state, and local permits. However, for the purpose of planning, all of these costs are included in the benefit/cost analysis and are displayed as part of the public record of this analysis.

U.S. Department Agriculture Natural Resources Conservation Service May 2015 Watershed Rehabilitation Worksheet Sponsoring Local Organization(s): Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection	Watershed:	Assunpink Creek		
	County(s):	Mercer	State(s):	New Jersey
	Hydrologic Unit Code:		020401050803	
	Watershed Project Number:		NJ-2010	
	Watershed Site Number:		Dam No. 8	
		NID Number:	NJ00543	

Table A – Comparison of Structural Options						
Item	Unit	Existing	Alt 3 No Fed Action	Alt. 1	Alt. 2	Alt. 3
Preferred Alternative	-	-				
Class of structure	-	High	High	High	High	High
Seismic zone	-	Moderate	Moderate	Moderate	Moderate	Moderate
Uncontrolled drainage area	mi ²	2.76	2.76	2.76	2.76	2.76
Controlled drainage area	mi ²	0.00	0.00	0.00	0.00	0.00
Total drainage area	mi ²	2.76	2.76	2.76	2.76	2.76
Runoff curve No. (1-day) (AMC II)	number	78	79	79	79	79
Time of concentration (T _c)	hrs.	2.68	2.68	2.68	2.68	2.68
Elevation top of dam ^{1/}	ft.	79.42	79.42	79.42	79.42	79.42
Elevation crest auxiliary spillway	ft.	73.0	73.0	73.0	73.0	73.0
Elevation crest high stage inlet	ft.	71.4	71.4	71.4	71.4	71.4
Elevation crest low stage inlet	ft.	64.9	64.9	64.9	64.9	64.9
Assumed hydrologic breach elevation	ft.	75.8	75.8	75.8	75.8	75.8
Assumed static breach elevation	ft.	73.0	73.0	73.0	73.0	73.0
Assumed seismic breach elevation	ft.	71.4	71.4	71.4	71.4	71.4
Auxiliary spillway type	type	Earth	Labyrinth	RCC	Straight Drop	Labyrinth
Auxiliary spillway bottom width	ft.	200	111	200	160	111
Auxiliary spillway exit slope	percent	3	N/A	2.5	N/A	N/A
Length of Dam	ft.	1,490	1,490	1,490	1,490	1,490
Maximum height of dam	ft.	18	18	18	18	18
Volume of fill	yd ³	41,900	41,900	41,900	41,900	41,900
Total capacity ^{2/}	acre ft.					
Sediment submerged	acre ft.	17.1	17.1	17.1	17.1	17.1
Sediment aerated	acre ft.	2	2.2	2.2	2.2	2.2
Sediment life remaining	years		52	52	52	52
Beneficial use (identify use)	acre ft.	N/A	N/A	N/A	N/A	N/A
Floodwater retarding	acre ft.	446	446	446	446	446
Between high and low stage	acre ft.	291	291	291	291	291
Surface area						
Sediment pool ^{2/}	acres	16	16	16	16	16
Beneficial use pool (identify use)	acres	N/A	N/A	N/A	N/A	N/A
Floodwater retarding pool ^{3/}	acres	106	106	106	106	106

U.S. Department Agriculture Natural Resources Conservation Service May 2015 Watershed Rehabilitation Worksheet Sponsoring Local Organization(s): Hamilton Township (Lead), Mercer County, New Jersey Department of Environmental Protection	Watershed:	Assunpink Creek			
	County(s):	Mercer	State(s):	New Jersey	
	Hydrologic Unit Code:		020401050803		
	Watershed Project Number:		NJ-2010		
	Watershed Site Number:		Dam No. 8		
		NID Number:		NJ00543	

Table A – Comparison of Structural Options (cont.)						
Principal spillway design						
Item	Unit	Existing	Alt 1 - No Fed Action	Alt. 1	Alt. 2	Alt. 3
Rainfall volume (1-day)	in	8.3	8.3	8.3	8.3	8.3
Rainfall volume (10-day)	in	12.0	12.0	12.0	12.0	12.0
Runoff volume (10-day)	in	5.4	5.40	5.40	5.40	5.40
Capacity of low stage (max.)	ft ³ /s	41	41	41	41	41
Capacity of high stage (max.)	ft ³ /s	114	114	114	114	114
Dimensions of conduit	in	36	36	36	36	36
Type of conduit	-	RCP	RCP	RCP	RCP	RCP
Frequency of operation of auxiliary spillway	%	4	4	4	4	4
Auxiliary spillway hydrograph						
Rainfall volume	in	11.12	11.12	11.12	11.12	11.12
Runoff volume	in	8.46	8.46	8.46	8.46	8.46
Storm duration	hrs.	6	6	6	6	6
Velocity of flow (Ve)	ft./s	N/A	N/A	9.2	N/A	N/A
Max. Reservoir water surface elev.	ft.	75.7	75.5	75.7	75.7	75.5
Freeboard hydrograph						
Rainfall volume	in	26.92	26.92	26.92	26.92	26.92
Runoff volume	in	23.97	23.97	23.97	23.97	23.97
Storm duration	hrs.	6	6	6	6	6
Max. Reservoir water surface elev.	ft.	78.7	78.7	78.7	78.9	78.7
Capacity equivalents (watershed inches)						
Sediment volume	in	0.13	0.13	0.13	0.13	0.13
Floodwater retarding volume	in	3.03	3.03	3.03	3.03	3.03
Beneficial volume (identify use)	in	N/A	N/A	N/A	N/A	N/A
^{1/} All elevations are to be recorded in North American Vertical Datum 1988 (NAVD88).						
^{2/} If reservoir contains beneficial storage or if sediment capacity will not store water, show area in parenthesis and footnote accordingly in Section L.						
^{3/} Crest of auxiliary spillway.						

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Tab 3

**ENVIRONMENTAL EVALUATION WORKSHEET
(NRCS-CPA-52)**

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U.S. Department of Agriculture Natural Resources Conservation Service 11/2019		NRCS-CPA-52 11/2019		A. Client Name: Hamilton Township, New Jersey (Lead Sponsor)																									
ENVIRONMENTAL EVALUATION WORKSHEET		B. Conservation Plan ID # (as applicable): Supplemental Watershed Plan Program Authority (optional): Watershed Rehabilitation		C. Identification # (farm, tract, field #, etc. as required): Assunpink Creek Dam No. 8 (the dam) is located in Mercer County and Hamilton Township, New Jersey.																									
D. Client's Objective(s) (purpose): The sponsors want to maintain existing flood damage reduction for downstream properties. Sponsors also want to comply with current safety and performance standards for a high hazard dam.																													
E. Need for Action: Assunpink Creek Dam No. 8 is a high hazard dam that does not meet current safety and performance standards. The risk of a breach is heightened due to its current condition. The effects of a breach are loss of life, and flood damage to homes, commercial facilities, and an expanded infrastructure. A total of 935 people downstream would be at risk of loss of life should the dam fail.		H. Alternatives <table border="1"> <thead> <tr> <th>No Action</th> <th>Alternative 1</th> <th>Alternative 2</th> <th>Alternative 3</th> </tr> </thead> <tbody> <tr> <td> This is the No Action - the Town will rehabilitate the dam to NRCS and NJ state standards at the least cost without federal assistance. Alternative 3 is the NED Plan. </td> <td> Roller Compacted Concrete (RCC) Auxiliary Spillway - Armor the existing 200-ft. wide auxiliary spillway (ASW) with RCC from the control section down to the valley floor. Install a reinforced concrete weir wall at entrance and reinforced concrete cutoff wall at downstream end of the ASW. Install a filter diaphragm in the embankment and replace the toe drains. Install a trash rack bar grate on the riser to reduce the potential for the blockage by trash and debris. </td> <td> Straight Drop Spillway over Embankment - Construct a 160-ft. wide reinforced concrete spillway over the dam embankment as well as a stilling basin with riprap outlet protection. Construct an earthen berm across the ASW. Replace the toe drains. Construct a pedestrian bridge with railing over the straight drop spillway. Install a trash rack bar grate on the riser to reduce the potential for the blockage by trash and debris. </td> <td> Labyrinth Weir Spillway through Dam Embankment. Construct a 110-ft. wide, 4-cycle labyrinth weir over the embankment as well as a stilling basin with riprap protection. An earthen berm will be constructed across the ASW. Replace the toe drains. Construct a pedestrian bridge with railing over the labyrinth weir. Install a trash rack bar grate on the riser to reduce the potential for the blockage by trash and debris. </td> </tr> </tbody> </table>				No Action	Alternative 1	Alternative 2	Alternative 3	This is the No Action - the Town will rehabilitate the dam to NRCS and NJ state standards at the least cost without federal assistance. Alternative 3 is the NED Plan.	Roller Compacted Concrete (RCC) Auxiliary Spillway - Armor the existing 200-ft. wide auxiliary spillway (ASW) with RCC from the control section down to the valley floor. Install a reinforced concrete weir wall at entrance and reinforced concrete cutoff wall at downstream end of the ASW. Install a filter diaphragm in the embankment and replace the toe drains. Install a trash rack bar grate on the riser to reduce the potential for the blockage by trash and debris.	Straight Drop Spillway over Embankment - Construct a 160-ft. wide reinforced concrete spillway over the dam embankment as well as a stilling basin with riprap outlet protection. Construct an earthen berm across the ASW. Replace the toe drains. Construct a pedestrian bridge with railing over the straight drop spillway. Install a trash rack bar grate on the riser to reduce the potential for the blockage by trash and debris.	Labyrinth Weir Spillway through Dam Embankment. Construct a 110-ft. wide, 4-cycle labyrinth weir over the embankment as well as a stilling basin with riprap protection. An earthen berm will be constructed across the ASW. Replace the toe drains. Construct a pedestrian bridge with railing over the labyrinth weir. Install a trash rack bar grate on the riser to reduce the potential for the blockage by trash and debris.																
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Resource Concerns																													
In Section "F" below, analyze, record, and address concerns identified through the Resources Inventory process. (See FOTG Section III - Resource Planning Criteria for guidance).																													
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SOIL: EROSION																													
Sheet and Rill Erosion No known current issues with erosion at dam site or areas within the immediate vicinity of the dam. The outlet channel of the dam was lined with riprap stone during construction of the original dam to mitigate erosion.		Same as Alternative 3. ☐ NOT meet PC																											
Bank erosion from streams, shorelines or water conveyance channels There are a few areas on the embankment with some bank erosion that requires topsoil and reseeded.		Same as Alternative 3. ☐ NOT meet PC																											
SOIL: SOIL QUALITY DEGRADATION - Compaction The dam structure and adjacent spillway consist of compacted soils. These areas were compacted during the original dam construction.		Same as Alternative 3. ☐ NOT meet PC																											
WATER																													
Flooding The dam currently serves as a flood control structure for the surrounding area. A dam breach would result in catastrophic flood damages and significant risk to loss of life.		Same as Alternative 1. ☐ NOT meet PC																											
Quality (Nutrients, pesticides, or sediments transported to surface water) Veterans Lake and Pond Run are both classified as impaired waters or 303(d) waters by the state of New Jersey and the EPA. Both water bodies are impaired by total suspended solids and turbidity.		Same as Alternative 1. ☐ NOT meet PC																											

F. Resource Concerns and Existing/ Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	I. (continued)							
	No Action		Alternative 1		Alternative 2		Alternative 3	
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AIR: AIR QUALITY IMPACTS								
Emissions of Particulate Matter (PM) and PM Precursors Routine maintenance activities at dam, including mowing, generate small amounts of localized dust.	Same as Alternative 1.	☐ NOT meet PC	Construction work and the trucking of materials will cause a temporary increase in emissions of particulate matter (i.e. dust). BMPs, such as surface watering, will be implemented to minimize dust emissions. No long-term effects are anticipated. The future under this alternative does not include any temporary or permanent emissions sources.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC
Emissions of Greenhouse Gases (GHGs) Routine maintenance activities at dam involve usage of petroleum-powered engines which generates CO2 and N2O from combustion engines.	Same as Alternative 1.	☐ NOT meet PC	The use of heavy diesel and gasoline machinery, as well as trucking materials/equipment onsite, will cause a temporary increase in GHG emissions. No long-term effects are anticipated.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC
PLANTS								
Plant productivity and health There are approximately 7 acres of land within the LOD that are classified as vegetated, including forests, fields, and wetlands (based on NLCD data). There are no known current issues with plant productivity and health.	Same as Alternative 1.	☐ NOT meet PC	The temporary drawdown of the Assumpink Dam impoundment may temporarily negatively impact wetland plant productivity and health along the edges of the impoundment. These impacts are anticipated to be short-term and conditions will return to normal after the impoundment is re-filled after construction. Long-term impacts will be minor or negligible.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC
Plant structure and composition There are approximately 7 acres of land within the LOD that are classified as vegetated, including forests, fields, and wetlands (based on NLCD data). There are no known current issues with plant structure and composition.	Same as Alternative 1.	☐ NOT meet PC	Approximately 1.5 acres of trees within the LOD may be removed to facilitate construction activities (0.75 acres west of dam embankment and 0.75 acres along ASW). Only trees necessary to facilitate construction activities will be removed. Areas disturbed for vehicle and equipment staging or compacted by heavy equipment will be regraded and revegetated with an appropriate native (and climate change adaptable) seed mix or plantings. These effects may be long-term and minor or negligible.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC
ANIMALS								
Terrestrial habitat for wildlife and invertebrates The dam and surrounding areas provide habitat for various wildlife species, including migratory birds, mammals, and amphibians and reptiles.	Same as Alternative 1.	☐ NOT meet PC	Wildlife species who use the LOD for habitat and foraging may be temporarily displaced. Wildlife may also be disturbed by construction noise. Area immediately surrounding the LOD provide similar habitat for these species. Long-term effects which include the negligible loss of nesting and foraging area from the removal of trees within the LOD.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC
Aquatic habitat for fish and other organisms The dam impoundment (Veterans Lake) provides habitat for various common freshwater fish species.	Same as Alternative 1.	☐ NOT meet PC	The drawdown of the dam impoundment during construction work may temporarily displace fish species who inhabit the impoundment. No long-term changes to the population or diversity of fish species within the impoundment or Pond Run is expected.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC
ENERGY								
Energy efficiency of equipment and facilities The structure is not used to generate electricity. No significant energy outlay is currently used in the routine operation and maintenance of the site.	Same as Alternative 3.	☐ NOT meet PC	No additional electrical loading is anticipated for the alternative.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC	Same as Alternative 1.	☐ NOT meet PC
Human Economic and Social Considerations								
Public Health and Safety Dam currently fails to meet dam safety and performance criteria for a high hazard dam. The dam is located in a highly populated urban area of Mercer County. A dam failure would cause significant damage and loss of life.	Same as Alternative 3.		Same as Alternative 3.		Same as Alternative 3.		Short-term: Reduced threat to loss of life from a catastrophic breach. Downstream flood protection continued. Long-term: Reduced threat to loss of life from a catastrophic breach. Downstream flood protection continued.	

Land Use The dam is located in a public park in Hamilton Township. Landuse in the project area, downstream, and upstream of the dam is parklands, industrial, residential, general developed areas.	Same as Alternative 3.	Same as Alternative 3.	Same as Alternative 3.	An additional 5.86 acres of easements upstream of the dam will be secured by Hamilton Township for the project. Short-term: No change in upstream or downstream land use. Long-term: No change in upstream land use or downstream land use. There are no projected social and/or political factors affecting land use within the APE due to project activity.
Operation and Maintenance and Capital For O&M - the funds are 100% local funds. At present, there are no appropriated state or federal funds for construction. It is anticipated that funds for construction will be 65% federal and 35% local funds.	Nonfederal funds - probably Hamilton Township funds.	Same as Alternative 3.	Same as Alternative 3.	Short-term: If funded for implementation - a combination of 65% federal and 35% nonfederal funds for eligible costs. NRCS technical assistance (engineering services and project administration costs) are not a part of the cost-share determination. Long-term: Funds for annual O&M would be required.
Floodwater Storage Dam is currently a floodwater retarding structure with 500 acre-feet of flood storage to crest of auxiliary spillway.	Same as Alternative 3.	Same as Alternative 3.	Same as Alternative 3.	Short-term: 500 acre-feet of flood storage would be maintained. Long-term: Eventually sediment pool would be reduced but floodwater storage would remain constant.

Special Environmental Concerns: Environmental Laws, Executive Orders, policies, etc.

In Section "G" complete and attach Environmental Procedures Guide Sheets for documentation as applicable. 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.

G. Special Environmental Concerns (Document existing/ benchmark conditions)	J. Impacts to Special Environmental Concerns							
	No Action		Alternative 1		Alternative 2		Alternative 3	
	Document all impacts (Attach Guide Sheets as applicable)	✓ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	✓ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	✓ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	✓ if needs further action
•Clean Air Act Guide Sheet The dam is located in an area that violates EPA's standard for ozone and thus is considered a nonattainment area.	May Effect Same as Alternative 1.	☐	May Effect Effects of PM, dust, and GHG from construction work and trucks may temporarily affect air quality. BMPs will be implemented to minimize emissions. May require consultation with EPA and NJDEP based on nonattainment status.	☐	May Effect Same as Alternative 1.		May Effect Same as Alternative 1.	
•Clean Water Act / Waters of the U.S. Guide Sheet Pond Run and Veterans Lake are considered to be Waters of the United States. Both Veterans Lake and Pond Run are impaired water bodies, also known as 303(d) waters, and are impaired for total suspended solids and turbidity.	May Effect Same as Alternative 3.	☐	May Effect This alternative does not involve the construction of a stilling basin and therefore there are no anticipated impacts to the stream channel. Other impacts are anticipated to be the same as Alternative 3.	☐	May Effect Same as Alternative 3.		May Effect The construction of the stilling basin associated with this alternative is anticipated to impact the stream channel (WOTUS) west of the dam embankment. Construction work may temporarily increase TSS loads and turbidity in Veterans Lake and Pond Run. Effects are not expected to be long term. BMPs will be implemented to minimize effects.	
•Coastal Zone Management Guide Sheet New Jersey has several "coastal areas" and although the project is in a tidally influenced municipality, it is not part of an area defined under the Coastal Area Facility Review Act, which defines the inland limit of "coastal areas" requiring Federal Coastal Consistency Determinations. NJDEP was consulted for this project and had no questions, comments or concerns relating to the projects adherence to coastal consistency.	No Effect Same as Alternative 1.	☐	No Effect No impacts to coastal zones are expected.	☐	No Effect Same as Alternative 1.		No Effect Same as Alternative 1.	
Coral Reefs Guide Sheet There are no coral reefs near Assunpink Dam.	No Effect Not applicable.	☐	No Effect Not applicable.	☐	No Effect Not applicable.		No Effect Not applicable.	
•Cultural Resources / Historic Properties Guide Sheet There are no historic properties within the project area. There are 5 historic properties within 2 miles of the project area.	No Effect Same as Alternative 1.	☐	No Effect No anticipated impacts, as there are no historic properties within the LOD.	☐	No Effect Same as Alternative 1.		No Effect Same as Alternative 1.	
•Endangered and Threatened Species Guide Sheet Based on the USFWS IPaC for the area, the northern long-eared bat (NLEB; <i>Myotis septentrionalis</i>), a federally threatened mammal species, is listed by USFWS as potentially present in the LOD. Based on consultation with NJDEP Natural Heritage Program, the fowler's toad and the eastern box turtle, which are New Jersey state species of concern, and the wood turtle, which is endangered, are also potentially present within the LOD.	May Effect Same as Alternative 1.	☐	May Effect To minimize potential impacts on NLEB, tree cutting will occur between 1 October and 31 March, outside of NLEB time-of-year restrictions typically requested by the USFWS. There are no known or documented NLEB hibernacula within close proximity to the project site. It is anticipated that NLEB could be adversely affected due to tree cutting, but not likely. Additionally, there are NJDEP ranked species-based habitats within the LOD. Rank 1, 2, and 3 habitat covers 10.96 acres within the LOD. Initial consultation with NJDEP NHP indicated that habitat for species of special concern existed within the AIA but no official surveys have been	☐	May Effect Same as Alternative 1.		May Effect Same as Alternative 1.	

Environmental Justice Guide Sheet The project area population exhibits the following diversity: 28.0% non-white and 27.7% hispanic. The area within the breach zone (compared to Hamilton Township, Mercer County and the State of New Jersey) exhibits the following: lower per capita income, higher level of poverty, and lower median household income. There are no federally recognized Indian Tribes in New Jersey. There are five state recognized Indian tribes that have expressed interest in Mercer County but none are located in the APE of the project.	No Effect Same as Alternative 3.	☐	No Effect Same as Alternative 3.	☐	No Effect Same as Alternative 3.	No Effect No impacts are anticipated. The project site is not located within a designated EJ community. Refer to Environmental Justice fact sheet for more information.	
•Essential Fish Habitat Guide Sheet There is no essential fish habitat in the project area.	No Effect Not applicable.	☐	No Effect Not applicable.	☐	No Effect Not applicable	No Effect Not applicable	
Floodplain Management Guide Sheet The downstream 100-yr. floodplain is currently benefitted by Assunpink Dam No. 8.	May Effect Same as Alternative 1.	☐	May Effect No changes to the downstream floodplain are expected. The floodplain will continue to be benefitted by Assunpink Dam. Areas in the downstream floodplain fall within the LOD and will be temporarily impacted by construction activities. No long-term impacts are anticipated.	☐	May Effect Same as Alternative 1.	May Effect Same as Alternative 1.	
Invasive Species Guide Sheet Common reed (<i>Phragmites australis</i>) a federally listed invasive plant species, is present within the AIA. No confirmed occurrences of invasive species within the LOD.	No Effect Same as Alternative 3.	☐	No Effect No confirmed occurrence of invasive species within the LOD. Project action will utilize BMPs to prevent spread of invasive species in the project area if encountered.	☐	No Effect Same as Alternative 1.	No Effect Same as Alternative 1.	
•Migratory Birds/Bald and Golden Eagle Protection Act Guide Sheet There is no evidence that the impoundment provides any special or unique features that are not generally found at other impoundments within the region. There are no known occurrences of bald or golden eagle nesting areas within 1 mile of the dam.	May Effect Same as Alternative 1.	☐	May Effect Actions associated with the dam may have temporary negative effects on migratory birds during the construction phase. Migratory bird species may be temporarily displaced in the immediate vicinity of the dam as a consequence of construction vehicle movement, worker activities and noise generated by associated equipment, however other similar impoundments in the region are anticipated to provide similar services to migratory birds. Negligible long-term effects are anticipated due to the possible removal of trees used by migratory birds.	☐	May Effect Same as Alternative 1.	May Effect Same as Alternative 1.	
Natural Areas Guide Sheet The dam is located in a park that is maintained by Hamilton Township, but is not a designated natural area.	No Effect Not applicable.	☐	No Effect Not applicable.	☐	No Effect Not applicable.	No Effect Not applicable.	
Prime and Unique Farmlands Guide Sheet Prime farmland soils are found in the LOD where Glassboro and Woodstown sandy loam is present, covering 2.4 acres. Farmland soils of statewide importance are found in the LOD where Othello silt loam, Sassafra sandy loam (5-10%), and Galloway variant soils are present, covering 76 acres. However, none of these soils are currently used for farming and are unlikely to be farmed in the future. In addition, all soils within the expected limits of disturbance were previously disturbed in construction of the dam.	May Effect Same as Alternative 2.	☐	May Effect Short-term: construction of the RCC ASW and improvements to the dam embankment area will temporarily disturb/compact prime farmland and farmland soils of statewide importance. Short-term impacts will be minor. Long-term: negligible adverse impacts. Only approximately 1 acre of prime farmland will be impacted by this alternative, since few alterations will be made to the western side of the ASW. Prime farmland along the access road will likely be disturbed and compacted from the movement of vehicles and equipment.	☐	May Effect Same impacts as Alternative 1. However, a smaller portion of the ASW will be impacted by this Alternative 2 and therefore fewer effects on prime farmland and farmland soils of statewide importance are expected. During construction of the RCC ASW, 2.4 acres of Prime Farmland soil may be impacted. This includes soil on the western side of the ASW and the site access road. Short-term impacts, such as disturbance and compaction via equipment and staging/stockpiling of materials, and will be minor. Long-term impacts will be negligible.	May Effect Same as Alternative 2.	

Riparian Area <i>Guide Sheet</i> Riparian habitat exists in areas buffering Pond Run.	May Effect Same as Alternative 1.	☐	May Effect Drawdown of the impoundment associated with construction may have short-term adverse effects to riparian areas, but it is anticipated that a slow drawdown rate will not result in long-term adverse effects.	☐	May Effect Same as Alternative 1.	May Effect Same as Alternative 1.
Scenic Beauty <i>Guide Sheet</i> Hamilton Veterans Park, including its scenic beauty and recreational activities, is highly valued by local residents.	May Effect Same as Alternative 2.	☐	May Effect Temporary construction work on the dam will negatively impact the scenic beauty of the dam within Hamilton Veterans Park. There will be negligible long-term effects on scenic beauty due to the alterations of the dam and ASW.	☐	May Effect Temporary construction work on the dam will negatively impact the scenic beauty of the dam within Hamilton Veterans Park. There will be minor long-term effects on scenic beauty due to the alterations to the dam embankment area and installation of the berm on the ASW.	May Effect Same as Alternative 2.
Wetlands <i>Guide Sheet</i> Using the USFWS National Wetlands Inventory data, there are wetlands present within the LOD. Those wetlands include freshwater forested wetlands (0.38 acres), lake wetlands (0.19 acres), and riverine wetlands (0.16 acres). There are no vernal pools within the LOD. Within the AIA, there are 5 potential vernal pools locations and one verified vernal pool.	May Effect Same as Alternative 3.	☐	May Effect This alternative does not involve the construction of a stilling basin and therefore there are no anticipated effects to freshwater wetlands to the west of dam embankment.	☐	May Effect Wetland impacts from the construction of the stilling basin with this alternative are anticipated to be approximately the same as Alternative 3.	May Effect This alternative is anticipated to impact <1 acre of freshwater wetlands from the construction of the stilling basin. Long-term impacts to wetlands are anticipated to be minor or negligible. Short-term minor adverse impacts to wetlands are anticipated due to the drawdown of the impoundment. No impacts to vernal pools are anticipated.
Wild and Scenic Rivers <i>Guide Sheet</i> There are no wild or scenic rivers in the LOD.	No Effect Not applicable.	☐	No Effect Not applicable.	☐	No Effect Not applicable.	No Effect Not applicable.
K. Other Agencies and Broad Public Concerns	No Action		Alternative 1		Alternative 2	Alternative 3
Easements, Permissions, Public Review, or Permits Required and Agencies Consulted.	Same as Alternative 1		Additional easements required up to the 100-year, 24-hour storm (this is the minimum to meet NRCS policy). Clean Water Act regulation has been delegated to the State of New Jersey. NJDEP regulates and permits freshwater wetland activities, if required. Agency consultation letters were sent on 8/11/2020 to Army Corps of Engineers, USFWS, National Marine Fisheries Service, NJDEP - Historic Preservation Office, NJDEP - Land Use Regulation, NJDEP - Division of Fish and Wildlife, and NJ Bureau of Dam Safety.		Same as Alternative 1.	Same as Alternative 1.
Cumulative Effects Narrative (Describe the cumulative impacts considered, including past, present and known future actions regardless of who performed the actions)	Same as Alternative 1.		The cumulative effects of this project are very positive for protection of downstream loss of life and property. There are no significant negative short-term or long-term environmental or human impacts associated with the implementation of this alternative.		Same as Alternative 1.	Same as Alternative 1.
L. Mitigation (Record actions to avoid, minimize, and compensate)	Same as Alternative 1.		Mitigation of wetland and watercourse impacts will be achieved through minimization and avoidance of these resources to the maximum extent practical. Based on USFWS NW1 data, there is the potential to impact up to 0.73 acres of wetlands. NJ Freshwater Wetland General Permit 18 for Dam Repairs allows up to one acre of wetland disturbance without mitigation.		Same as Alternative 1.	Same as Alternative 1.
M. Preferred Alternative	☒ preferred alternative					☒ preferred alternative
	Supporting reason					This is the alternative that maximizes net economic benefits - the NED Plan.
N. Context (Record context of alternatives analysis) ☐ local ☐ regional						
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.						
O. To the best of my knowledge, the data shown on this form is accurate and complete:						
In the case where a non-NRCS person (e.g. a TSP) assists with planning they are to sign the first signature block and then NRCS is to sign the second block to verify the information's accuracy.						
 Signature (TSP if applicable) EVAN MADLINGER Digitally signed by EVAN MADLINGER Date: 2021.03.23 16:15:07 -04'00'		Environmental Planner Title Acting State Resource Conservationist		3/21/2021 Date 3/23/21		
Signature (NRCS)		Title		Date		
If preferred alternative is not a federal action where NRCS has control or responsibility and this NRCS-CPA-52 is shared with someone other than the client then indicate to whom this is being provided.						

The following sections are to be completed by the Responsible Federal Official (RFO)

NRCS is the RFO if the action is subject to NRCS control and responsibility (e.g., actions financed, funded, assisted, conducted, regulated, or approved by NRCS). These actions do not include situations in which NRCS is only providing technical assistance because NRCS cannot control what the client ultimately does with that assistance and situations where NRCS is making a technical determination (such as Farm Bill HEL or wetland determinations) not associated with the planning process.

P. Determination of Significance or Extraordinary Circumstances

To answer the questions below, consider the severity (intensity) of impacts in the contexts identified above. 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.

Yes	No	
☐	☒	Is the preferred alternative expected to cause significant effects on public health or safety?
☐	☒	Is the preferred alternative expected to significantly affect unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?
☐	☒	Are the effects of the preferred alternative on the quality of the human environment likely to be highly controversial?
☐	☒	Does the preferred alternative have highly uncertain effects or involve unique or unknown risks on the human environment?
☐	☒	Does the preferred alternative establish a precedent for future actions with significant impacts or represent a decision in principle about a future consideration?
☐	☒	Is the preferred alternative known or reasonably expected to have potentially significant environment impacts to the quality of the human environment either individually or cumulatively over time?
☐	☒	Will the preferred alternative likely have a significant adverse effect on ANY of the special environmental concerns? Use the Evaluation Procedure Guide Sheets to assist in this determination. This includes, but is not limited to, concerns such as cultural or historical resources, endangered and threatened species, environmental justice, wetlands, floodplains, coastal zones, coral reefs, essential fish habitat, wild and scenic rivers, clean air, riparian areas, natural areas, and invasive species.
☐	☒	Will the preferred alternative threaten a violation of Federal, State, or local law or requirements for the protection of the environment?

Q. NEPA Compliance Finding (check one)

The preferred alternative:

		Action required	Action required
☐	1) is not a federal action where the agency has control or responsibility.	Document in "R.1" below. No additional analysis is required	Document in "R.1" below. No additional analysis is required
☒	2) is a federal action ALL of which is categorically excluded from further environmental analysis AND there are no extraordinary circumstances as identified in Section "O" .	Document in "R.2" below. No additional analysis is required	Document in "R.2" below. No additional analysis is required
☐	3) is a federal action that has been sufficiently analyzed in an existing Agency state, regional, or national NEPA document and there are no predicted <u>significant adverse environmental effects or extraordinary circumstances</u> .	Document in "R.1" below. No additional analysis is required.	Document in "R.1" below. No additional analysis is required.
☐	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 and has been formally adopted by NRCS . NRCS is required to prepare and publish its 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. (Note: This box is not applicable to FSA)	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	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
☐	5) is a federal action that has NOT 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.	Contact the State Environmental Liaison. Further NEPA analysis required.

R. Rationale Supporting the Finding

R.1	
Findings Documentation	
R.2	(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.
Applicable Categorical Exclusion(s) (more than one may apply)	
7 CFR Part 650 Compliance With NEPA, subpart 650.6 Categorical Exclusions states prior to determining that a proposed action is categorically excluded under paragraph (d) of this section, the proposed action must meet six sidebar criteria. See NECH 610.116.	

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 and based on that made the finding indicated above.

S. Signature of Responsible Federal Official:

JULIE HAWKINS Digital signed by JULIE HAWKINS DN: cn=JULIE HAWKINS, o=Department of Agriculture, ou=USDA, email=julie.hawkins@aphis.usda.gov, c=US	State Conservationist	March 30, 2021
Signature	Title	Date

Additional notes

Alternative 3 (Labyrinth Weir) meets the purpose and need for the project and addresses the safety and performance issues associated with the potential breach of the dam. It does not cause significant impacts to the natural or human environment. The rehabilitation of this dam will reduce the threat to loss of life and property from a catastrophic breach of the dam and bring the dam up to current NRCS and NJ dam safety criteria. This is the alternative that maximizes net economic benefits and is identified as the National Economic Development (NED) Plan.

Tab 4

STRUCTURAL TABLE 3

Dams with Planned Storage Capacity

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**Table 3 – Structural Data—Dams with Planned Storage Capacity
Assunpink Creek, New Jersey**

Item	Unit	Structure
Class of structure		High Hazard
Seismic zone		Moderate ^{4/}
Uncontrolled drainage area	mi ²	2.76
Controlled drainage area	mi ²	0.00
Total drainage area	mi ²	2.76
Runoff curve No. (1-day) (AMC II)		79
Time of concentration (Tc)	hrs	2.68
Elevation top dam ^{1/}	ft	79.42
Elevation crest auxiliary spillway	ft	73.00
Elevation crest high stage inlet	ft	71.43
Elevation crest low stage inlet	ft	64.89
Auxiliary spillway type		Labyrinth Weir
Auxiliary spillway bottom width	ft	111
Auxiliary spillway exit slope	percent	N/A
Maximum height of dam	ft	18
Volume of fill	yd ³	41,900
Total capacity ^{2/}		
Sediment submerged	acre ft	17.1
Sediment aerated	acre ft	2.2
Beneficial use	acre ft	N/A
Floodwater retarding	acre ft	446
Between high and low stage	acre ft	291
Surface area		
Sediment pool ^{3/}	acres	16
Beneficial use pool	acres	N/A
Floodwater retarding pool ^{2/}	acres	106
Principal spillway design		
Rainfall volume (1-day)	in	8.3
Rainfall volume (10-day)	in	12.0
Runoff volume (10-day)	in	5.40
Capacity of low stage (max.)	ft ³ /s	41
Capacity of high stage (max.)	ft ³ /s	114
Dimensions of conduit	ft/in	3/36
Type of conduit		RCP

Item	Unit	Structure
Frequency operation-auxiliary spillway	percent chance	4
Auxiliary spillway hydrograph		
Rainfall volume	in	11.12
Runoff volume	in	8.46
Storm duration	hrs	6
Velocity of flow (Ve)	ft/s	N/A
Max. reservoir water surface elevation	ft	75.5
Freeboard hydrograph		
Rainfall volume	in	26.92
Runoff volume	in	23.97
Storm duration	hrs	6
Max. reservoir water surface elevation	ft	78.7
Capacity equivalents		
Sediment volume	in	0.13
Floodwater retarding volume	in	3.03
Beneficial volume	in	N/A

^{1/} All elevations are to be recorded in North American Vertical Datum 1988 (NAVD88).

^{2/} Crest of auxiliary spillway.

^{3/} If reservoir contains beneficial storage or if sediment capacity will not store water, show area in parenthesis and footnote accordingly.

^{4/} USACE EM 1110-2-1806 (2016). See Appendix C for details on seismic analysis.

APPENDIX A

PROJECT MAP

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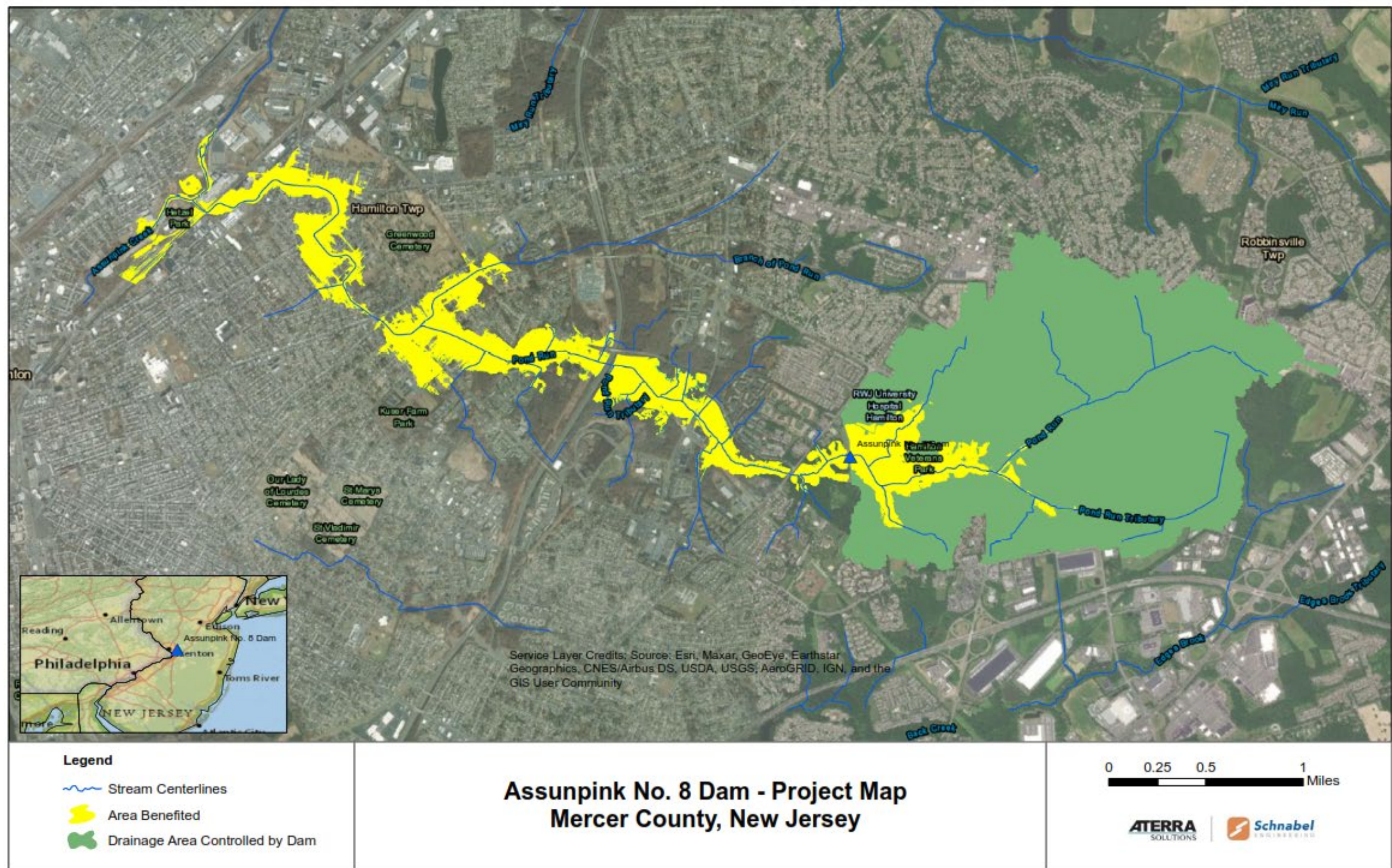


Figure A-1 – Project Map

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APPENDIX B

SUPPORT MAPS

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Figure B-1 – Limits of Disturbance Map

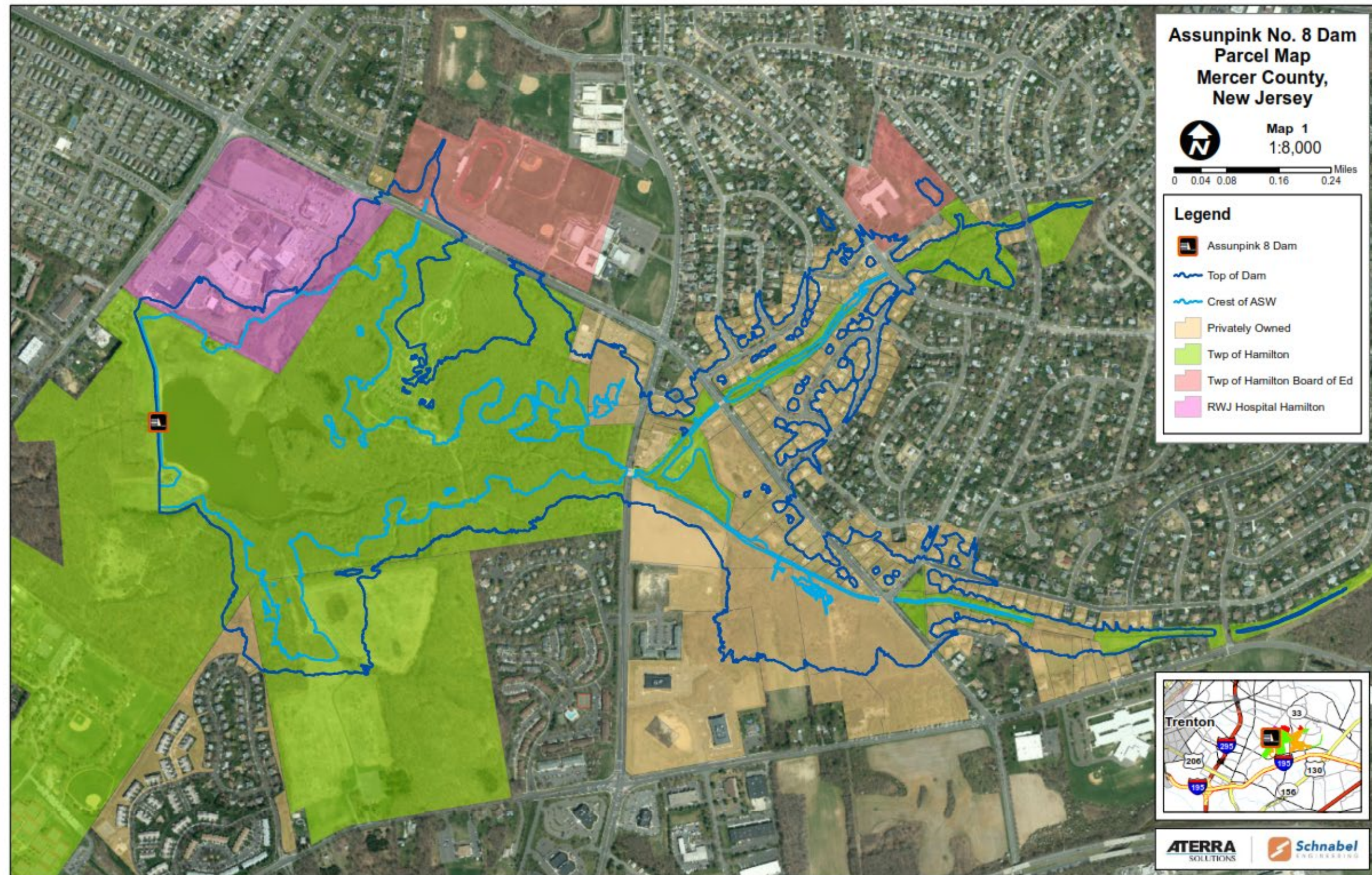


Figure B-2 – Parcel Map of Land Ownership

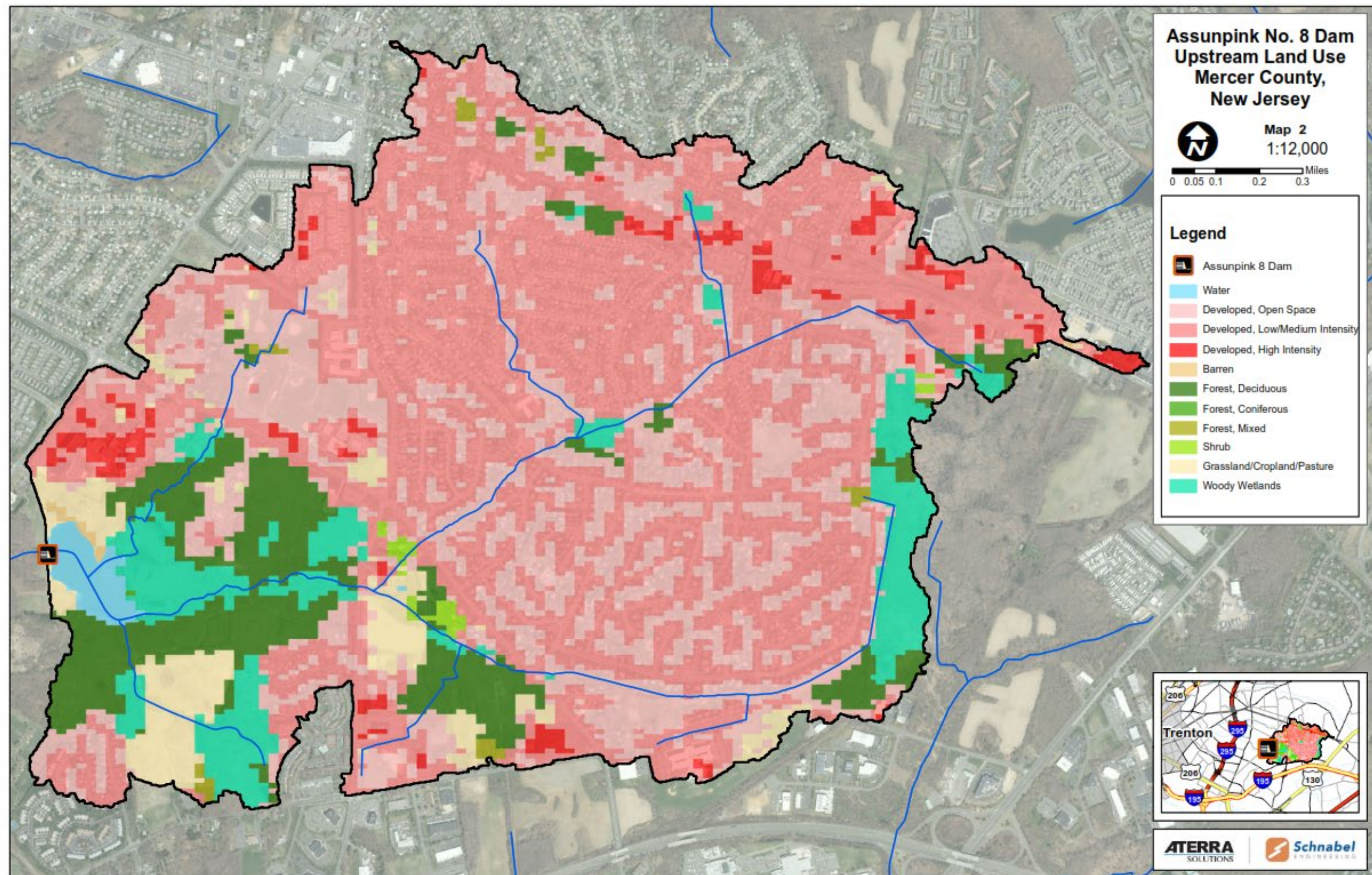


Figure B-3 – Upstream Land Use Map

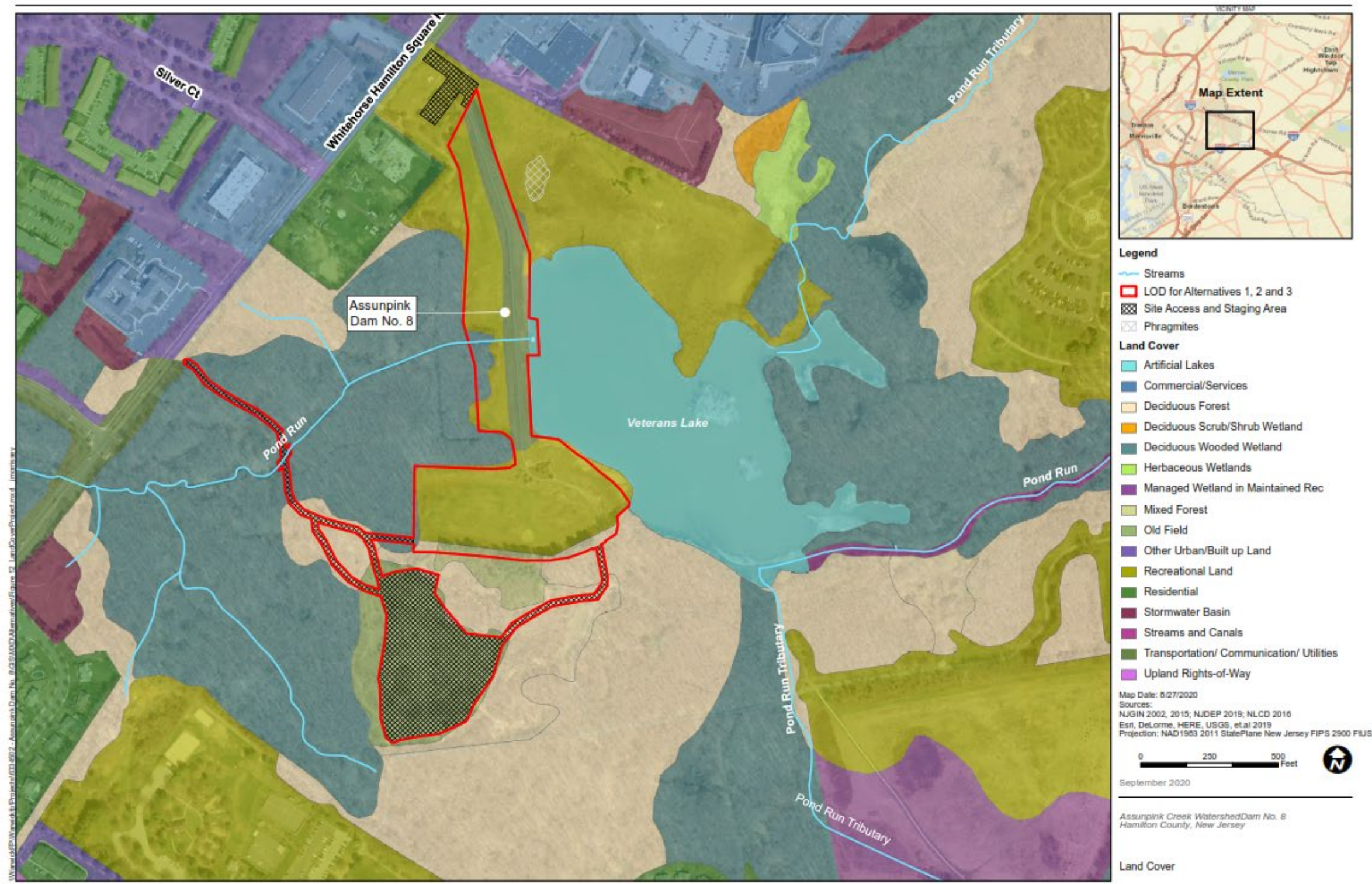


Figure B-4 – Land Cover Map

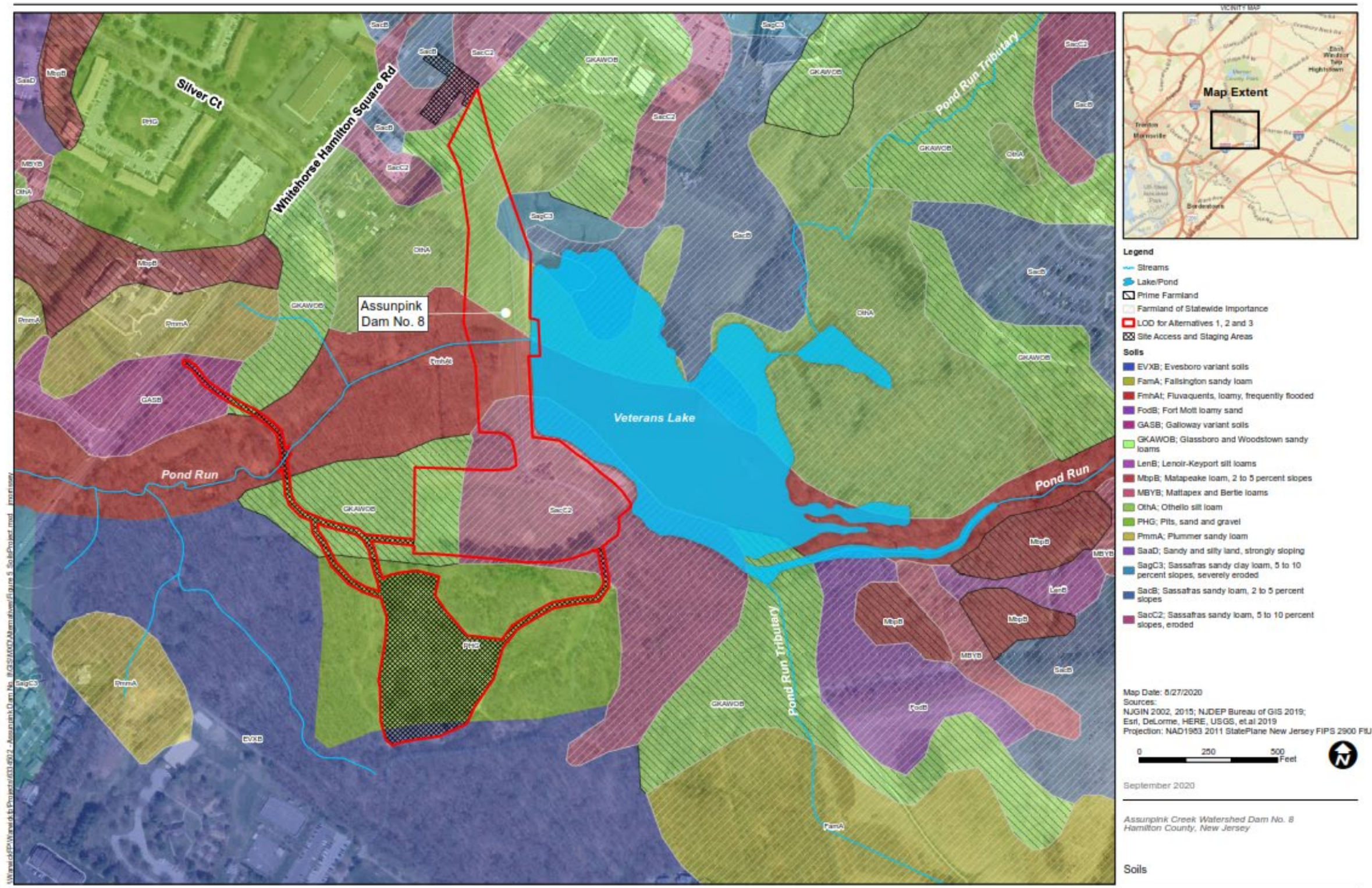


Figure B-5 – Soils Map



Figure B-6 – Hydrology Map

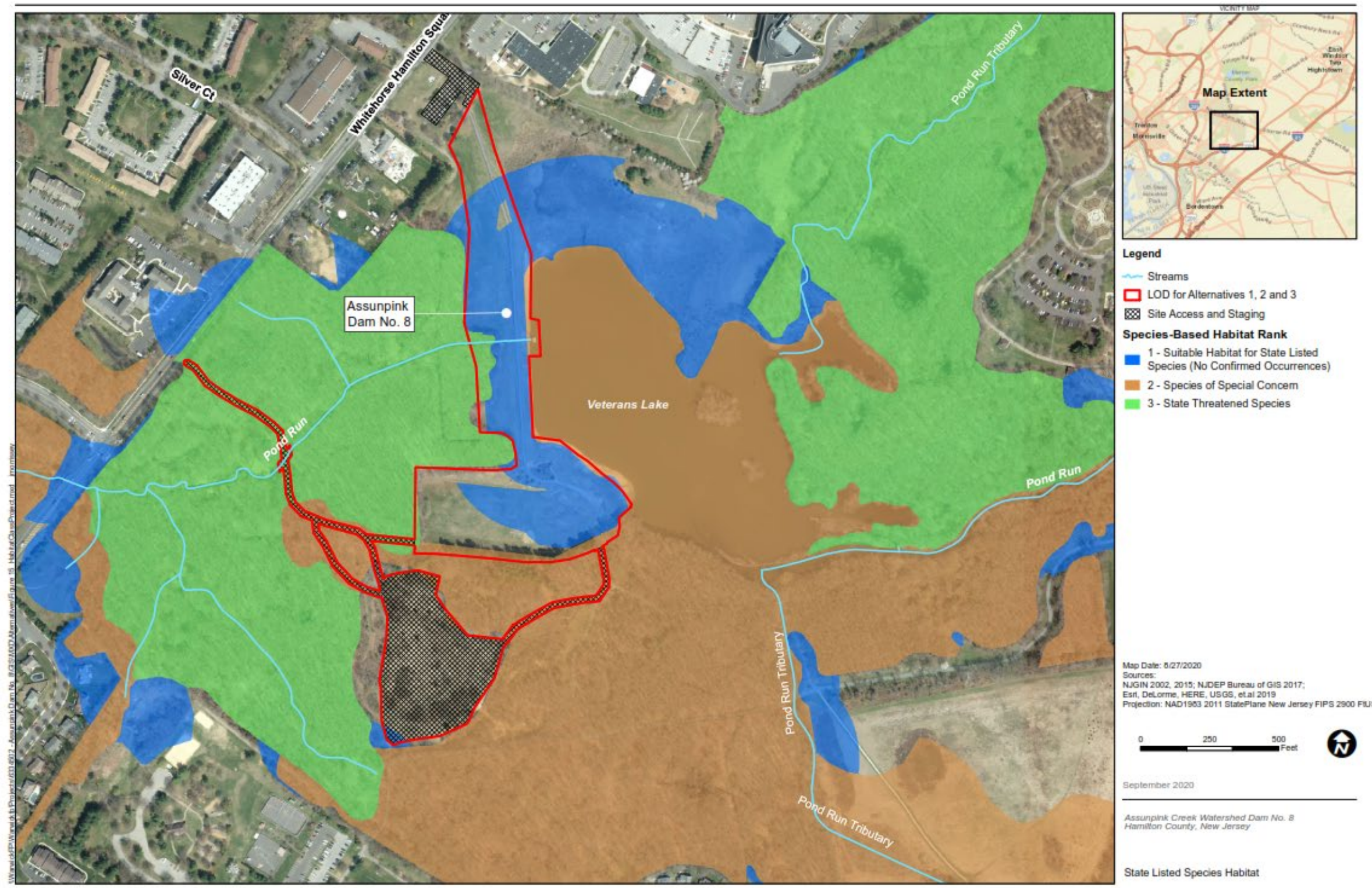


Figure B-7 – State Listed Species Habitat Map

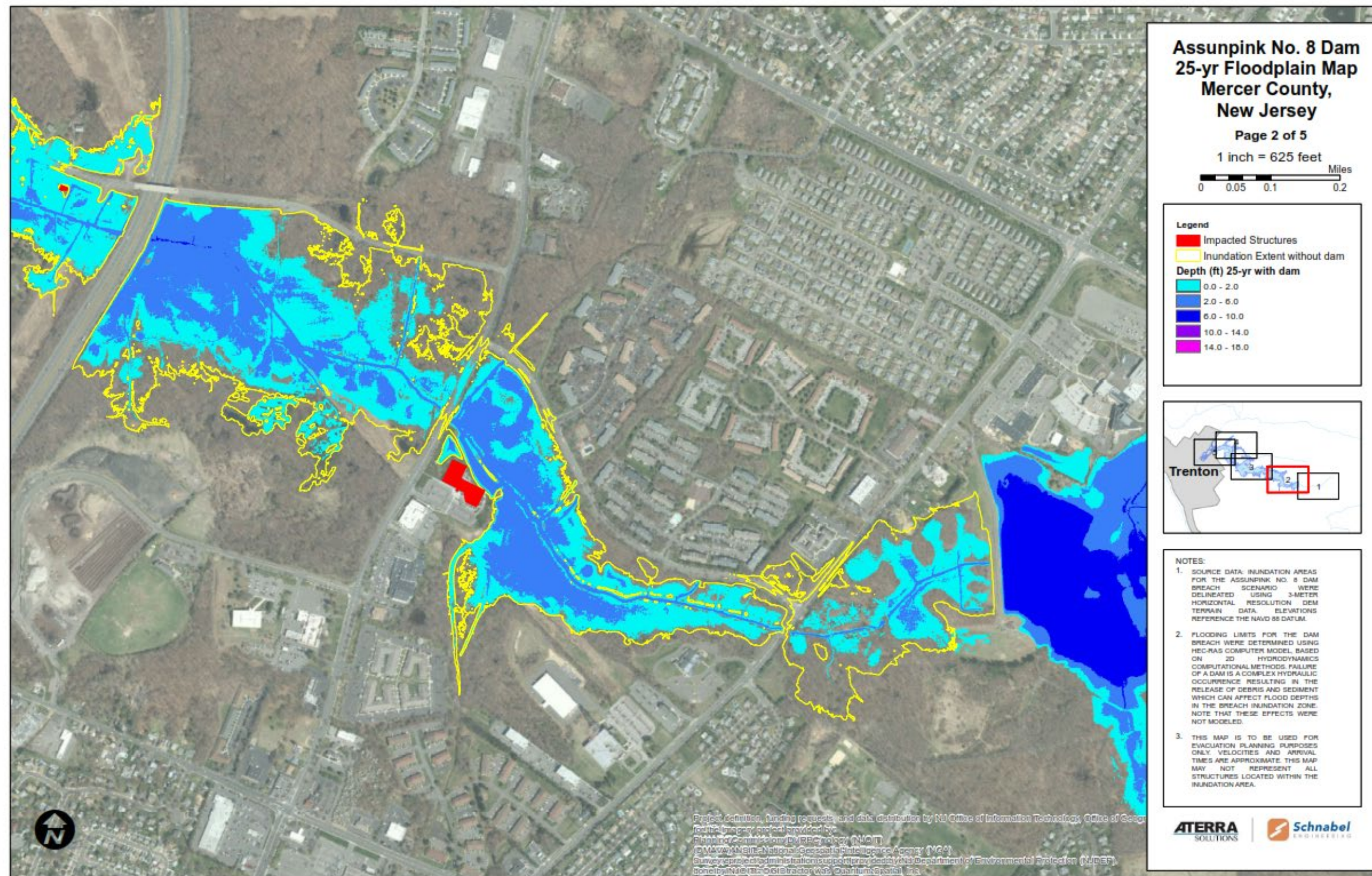


Figure B-9 – 25-Year Floodplain Map (Page 2 of 5)

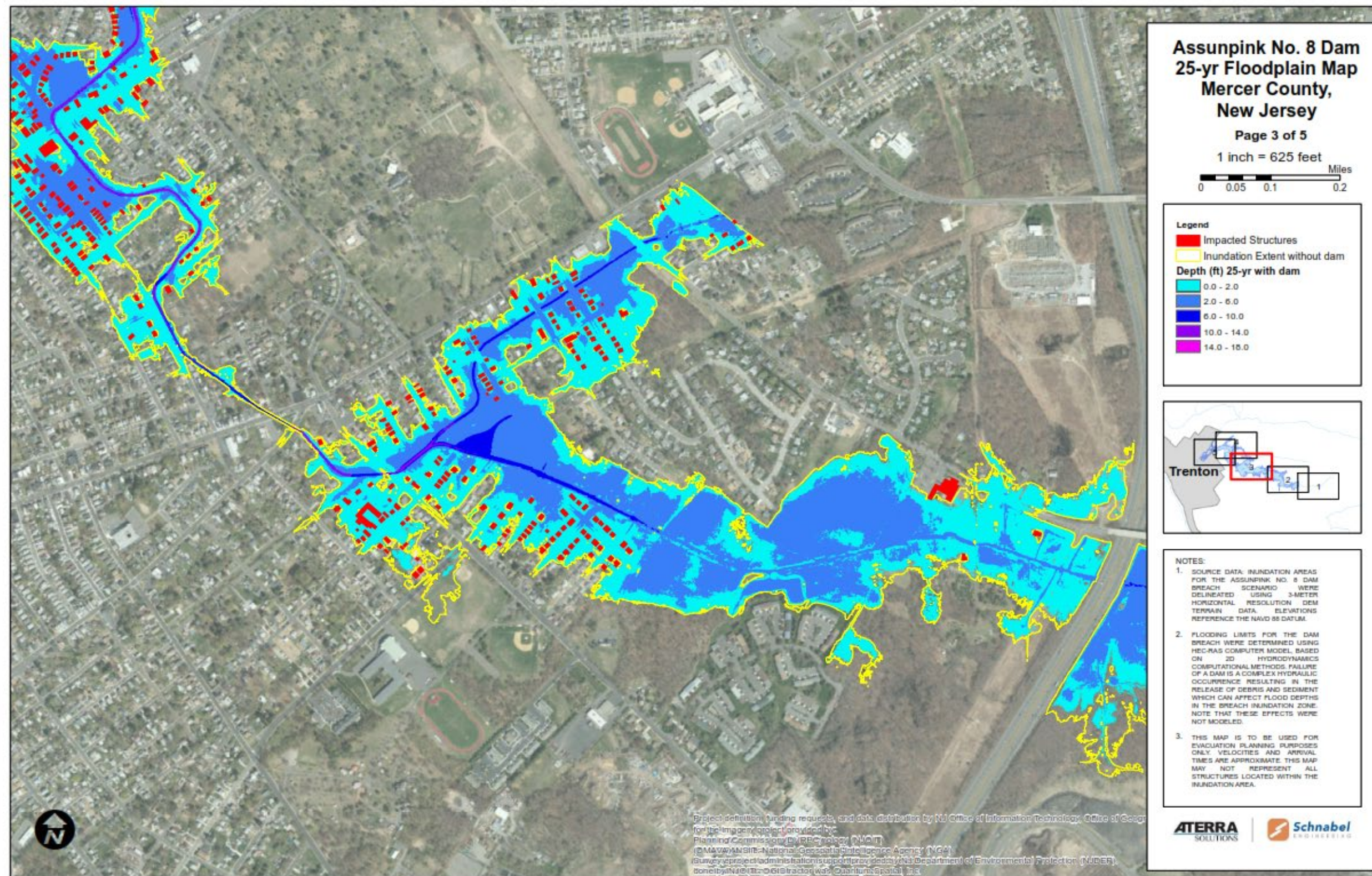


Figure B-10 – 25-Year Floodplain Map (Page 3 of 5)



Figure B-11 – 25-Year Floodplain Map (Page 4 of 5)

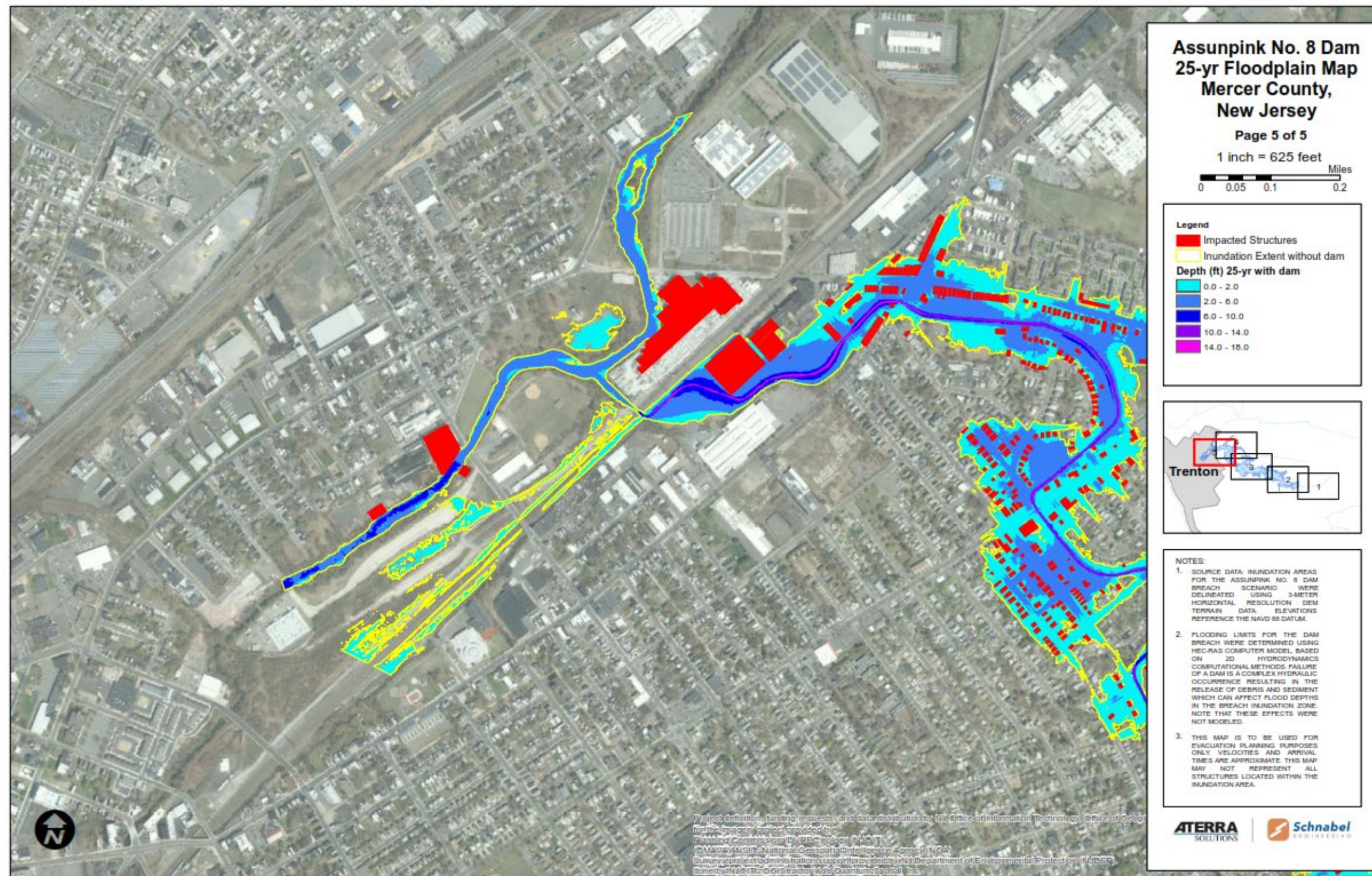


Figure B-12 – 25-Year Floodplain Map (Page 5 of 5)

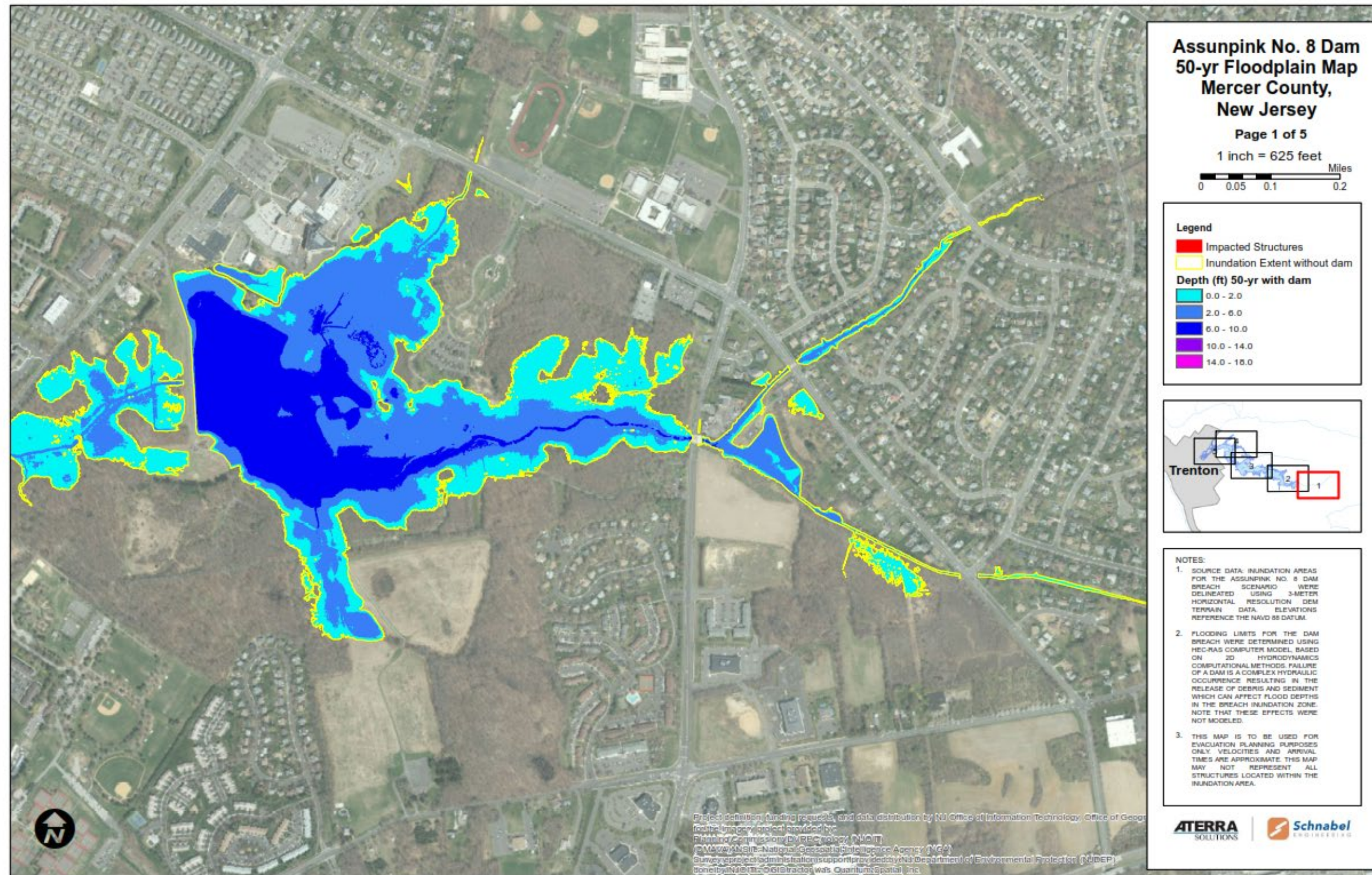


Figure B-13 – 50-Year Floodplain Map (Page 1 of 5)

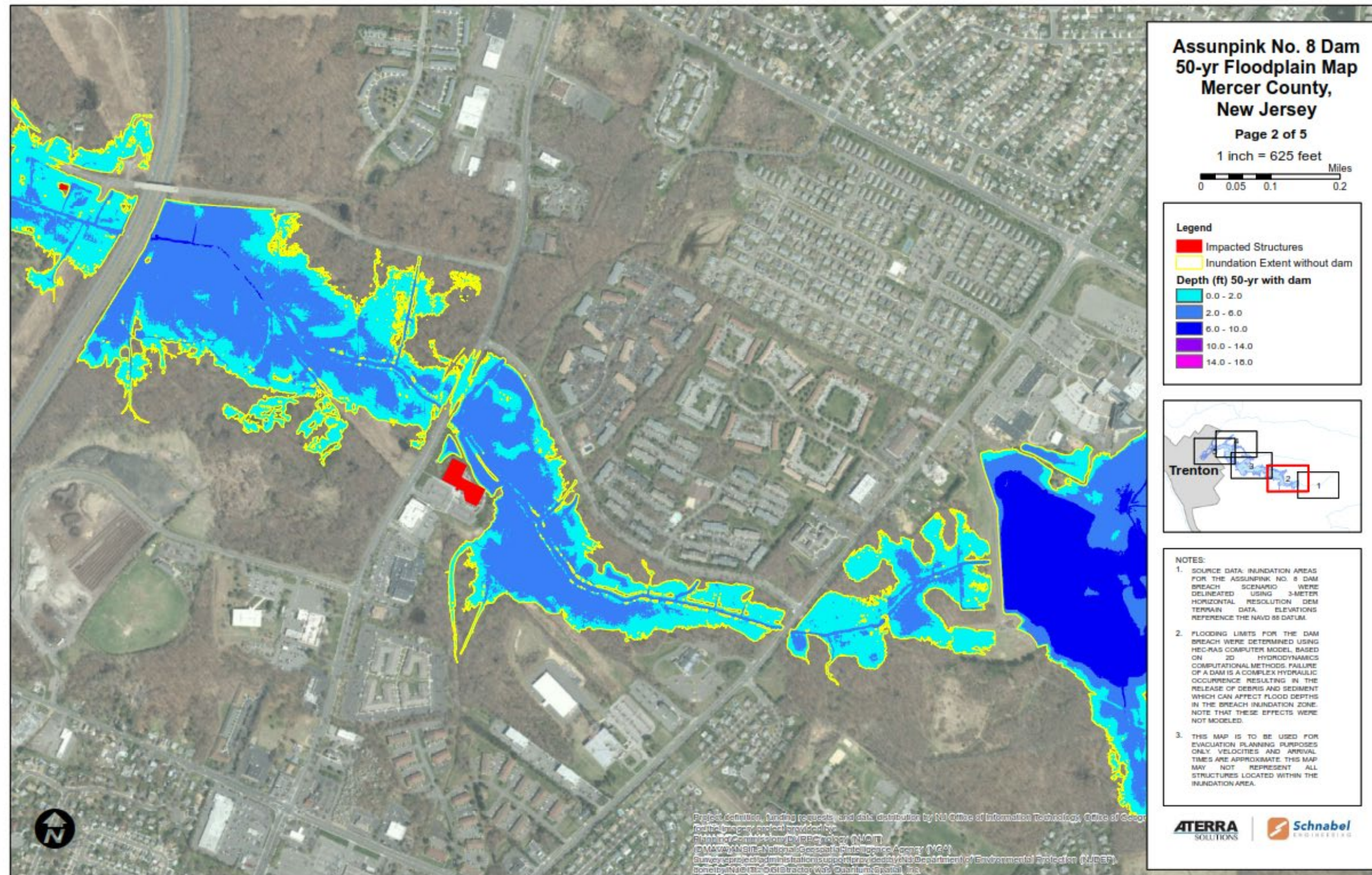
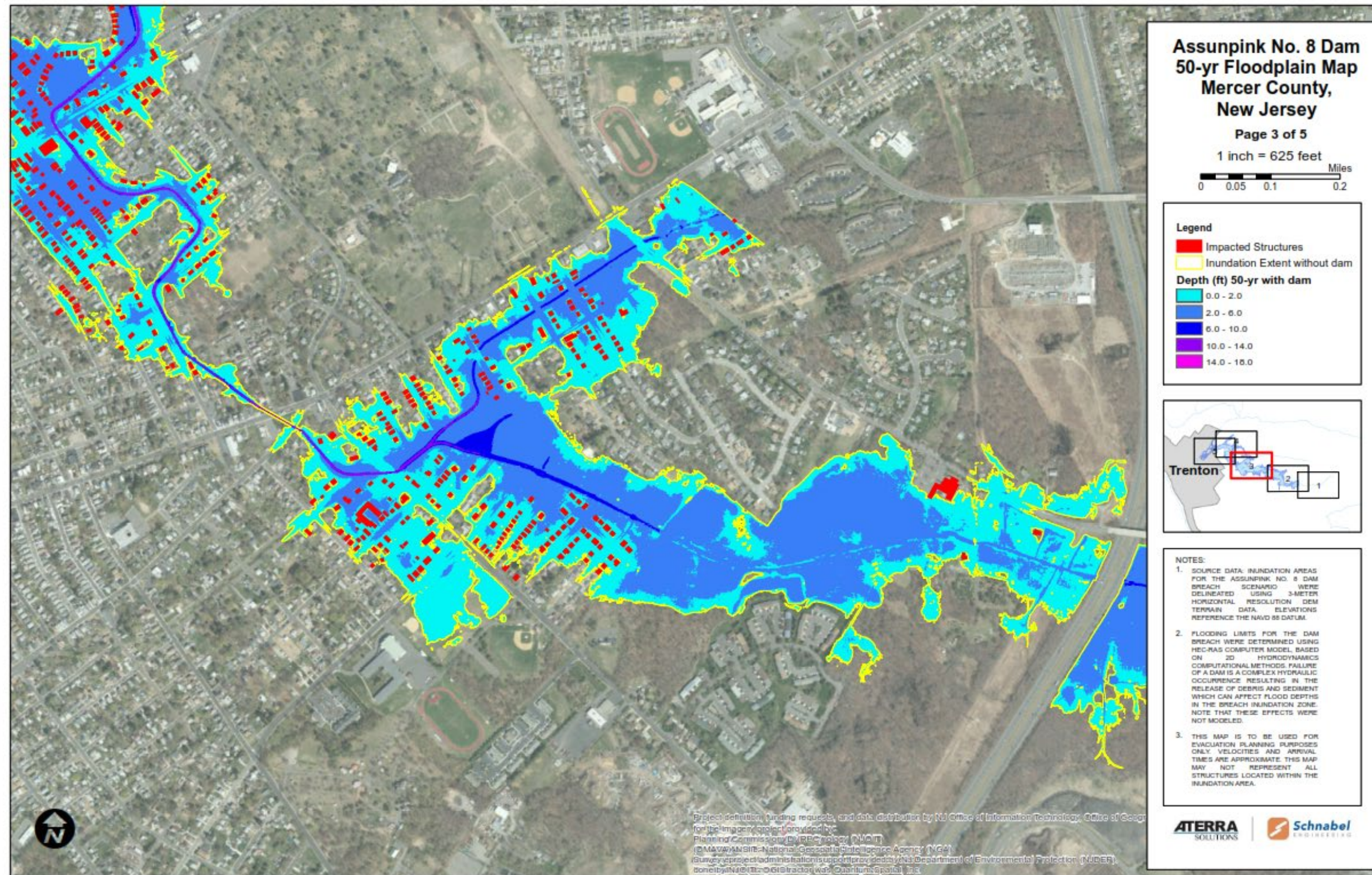


Figure B-14 – 50-Year Floodplain Map (Page 2 of 5)



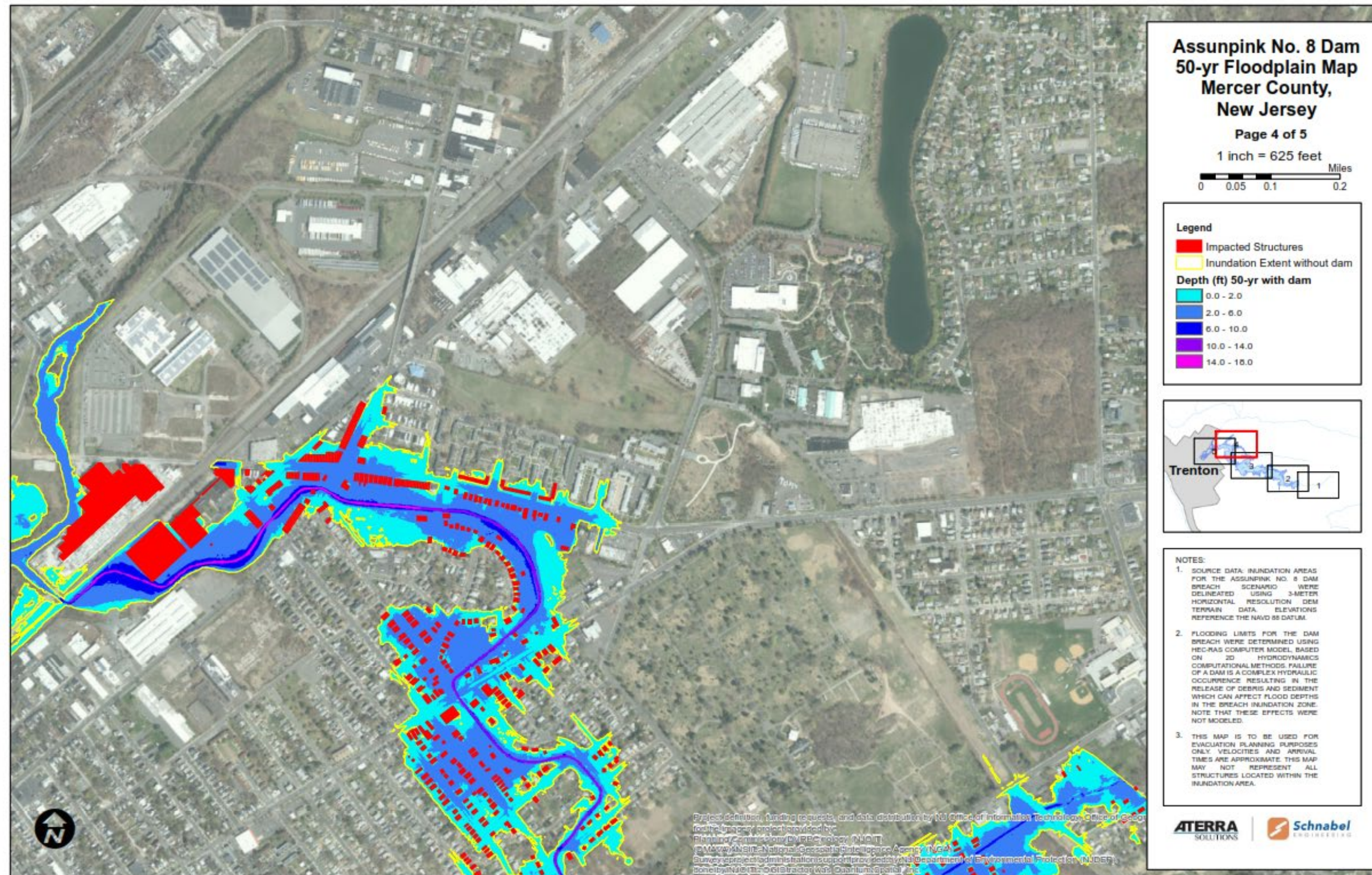


Figure B-16 – 50-Year Floodplain Map (Page 4 of 5)

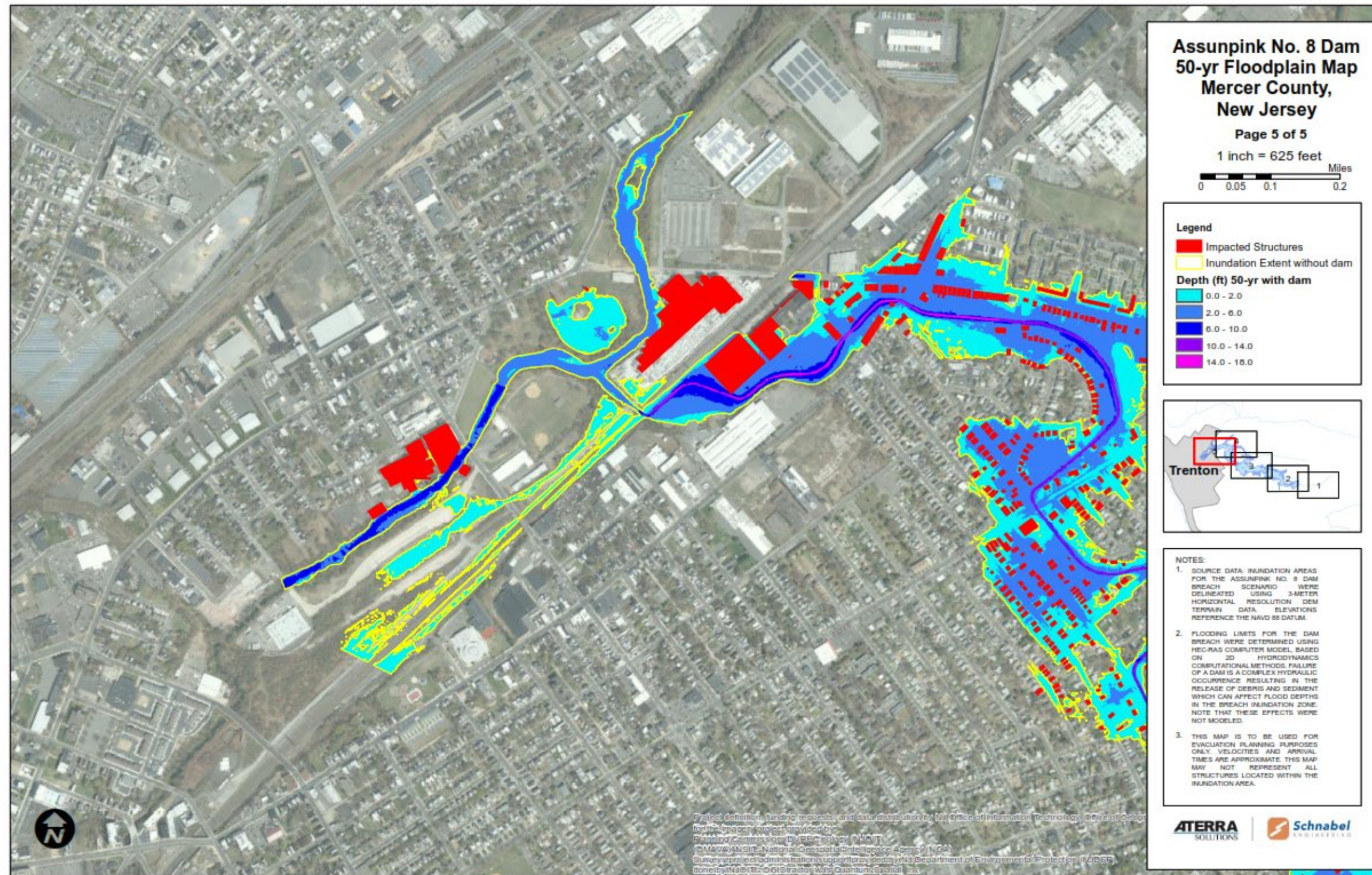


Figure B-17 – 50-Year Floodplain Map (Page 5 of 5)

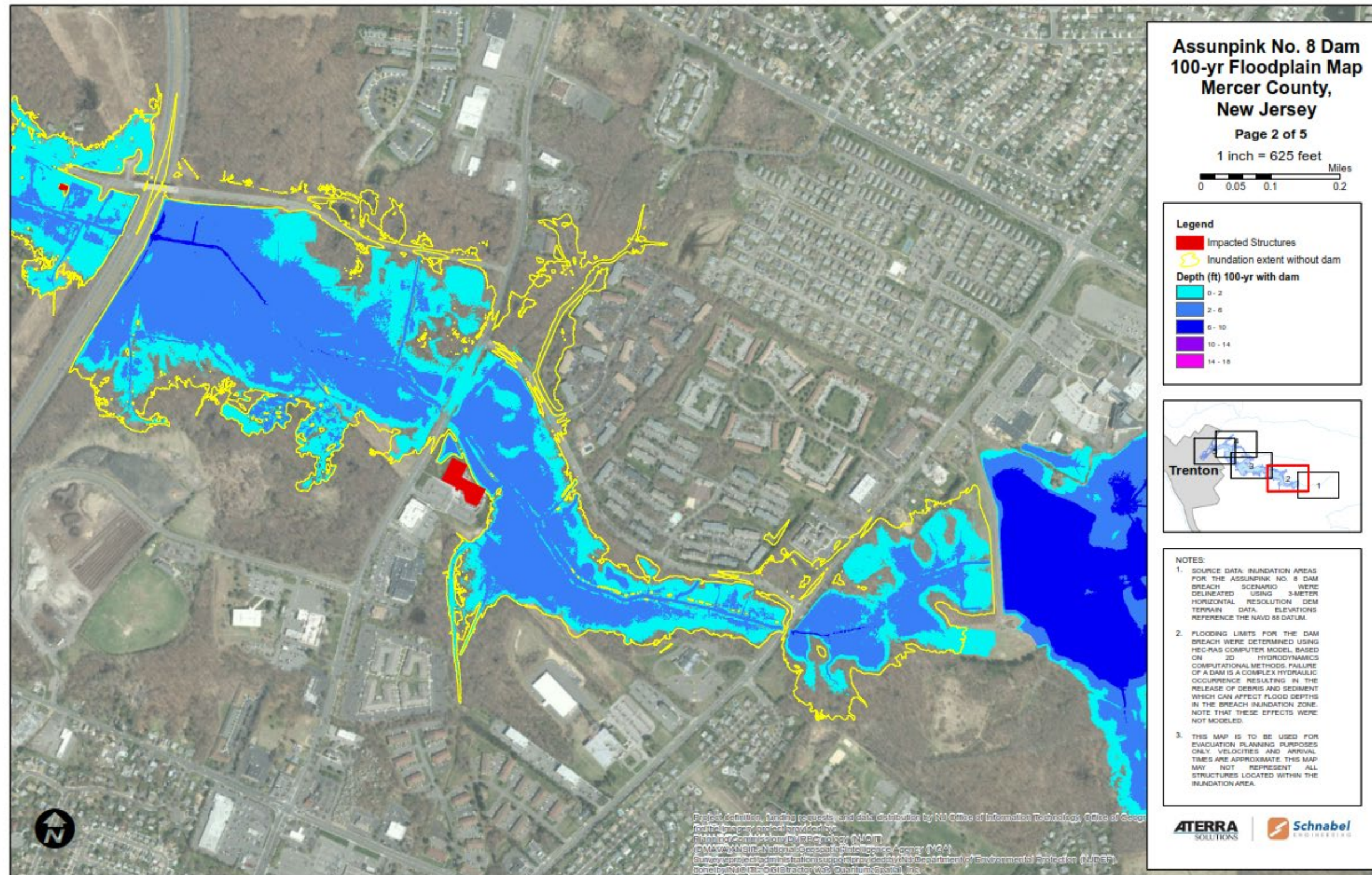


Figure B-19 – 100-Year Floodplain Map (Page 2 of 5)

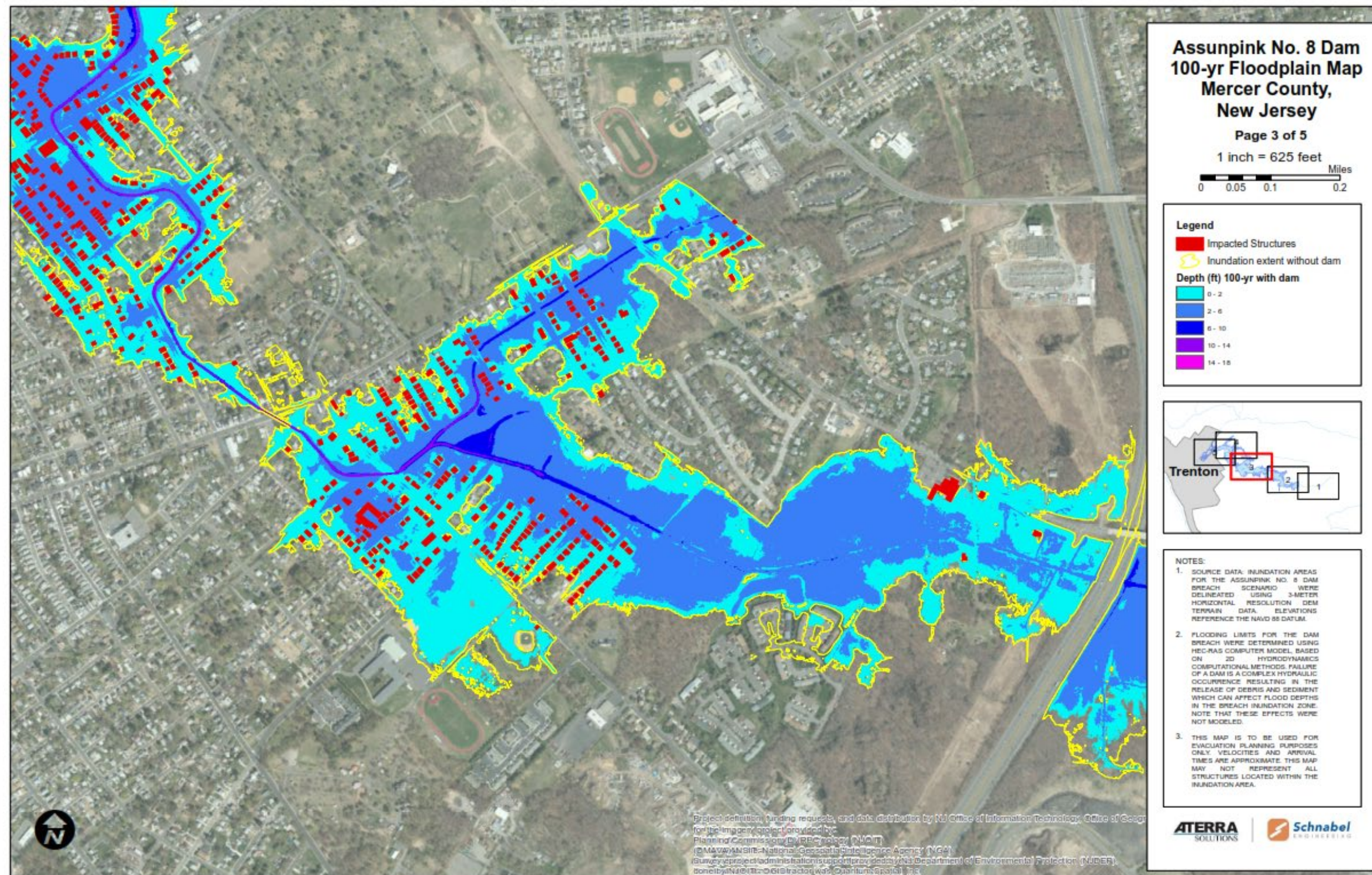


Figure B-20 – 100-year Floodplain Map (Page 3 of 5)

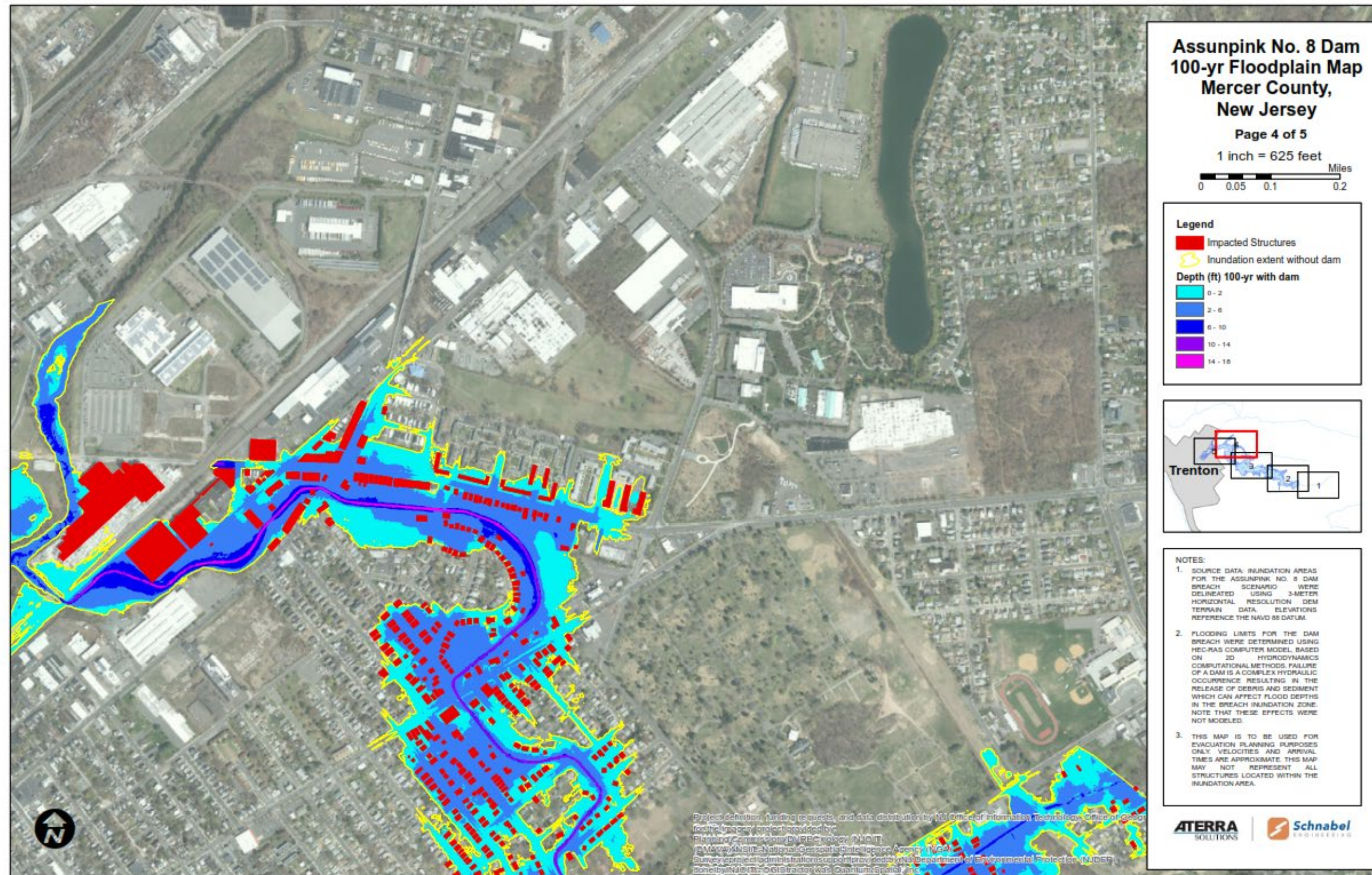


Figure B-21 – 100-year Floodplain Map (Page 4 of 5)

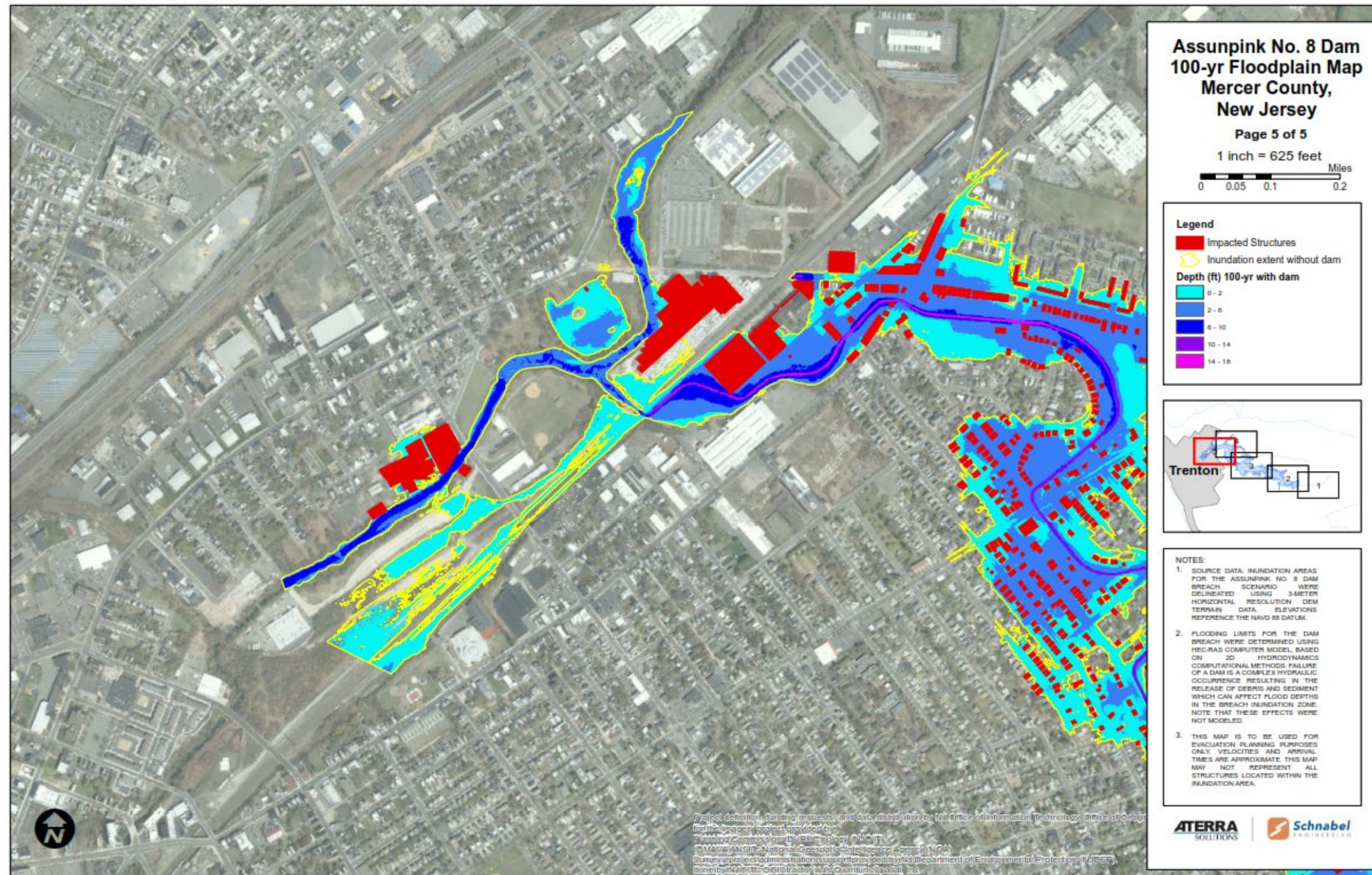


Figure B-22 – 100-year Floodplain Map (Page 5 of 5)

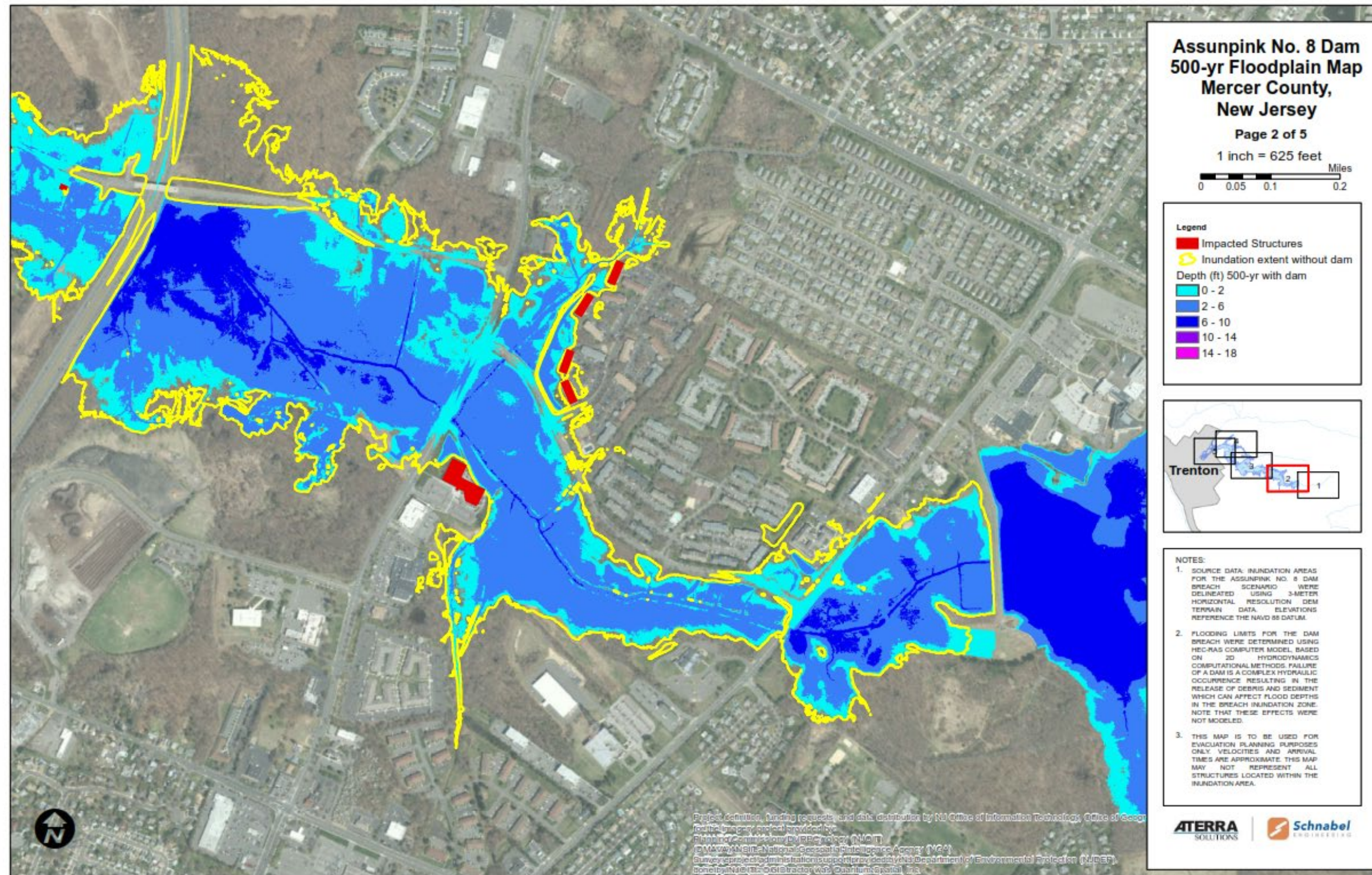


Figure B-24 – 500-Year Floodplain Map (Page 2 of 5)

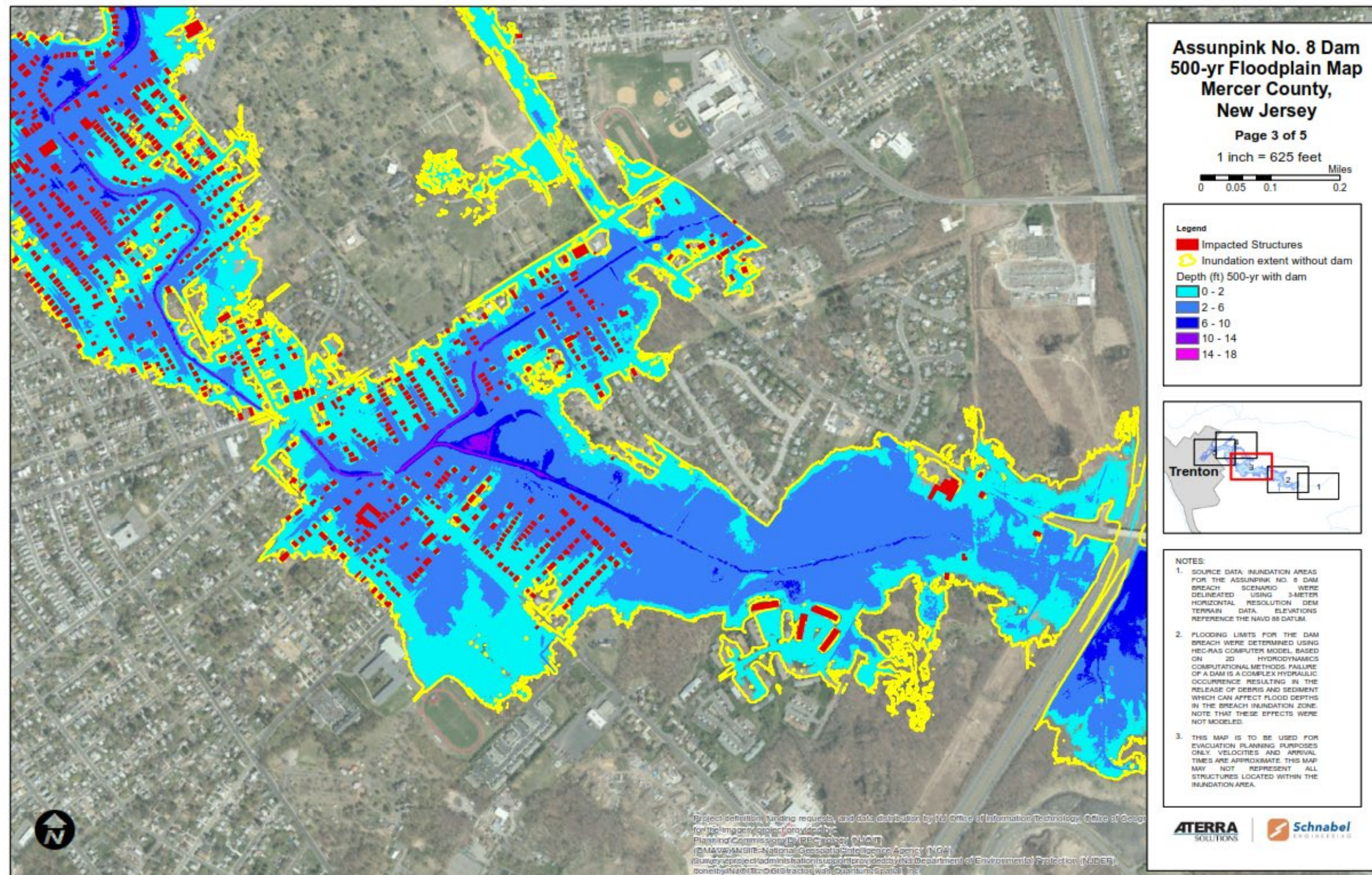


Figure B-25 – 500-Year Floodplain Map (Page 3 of 5)

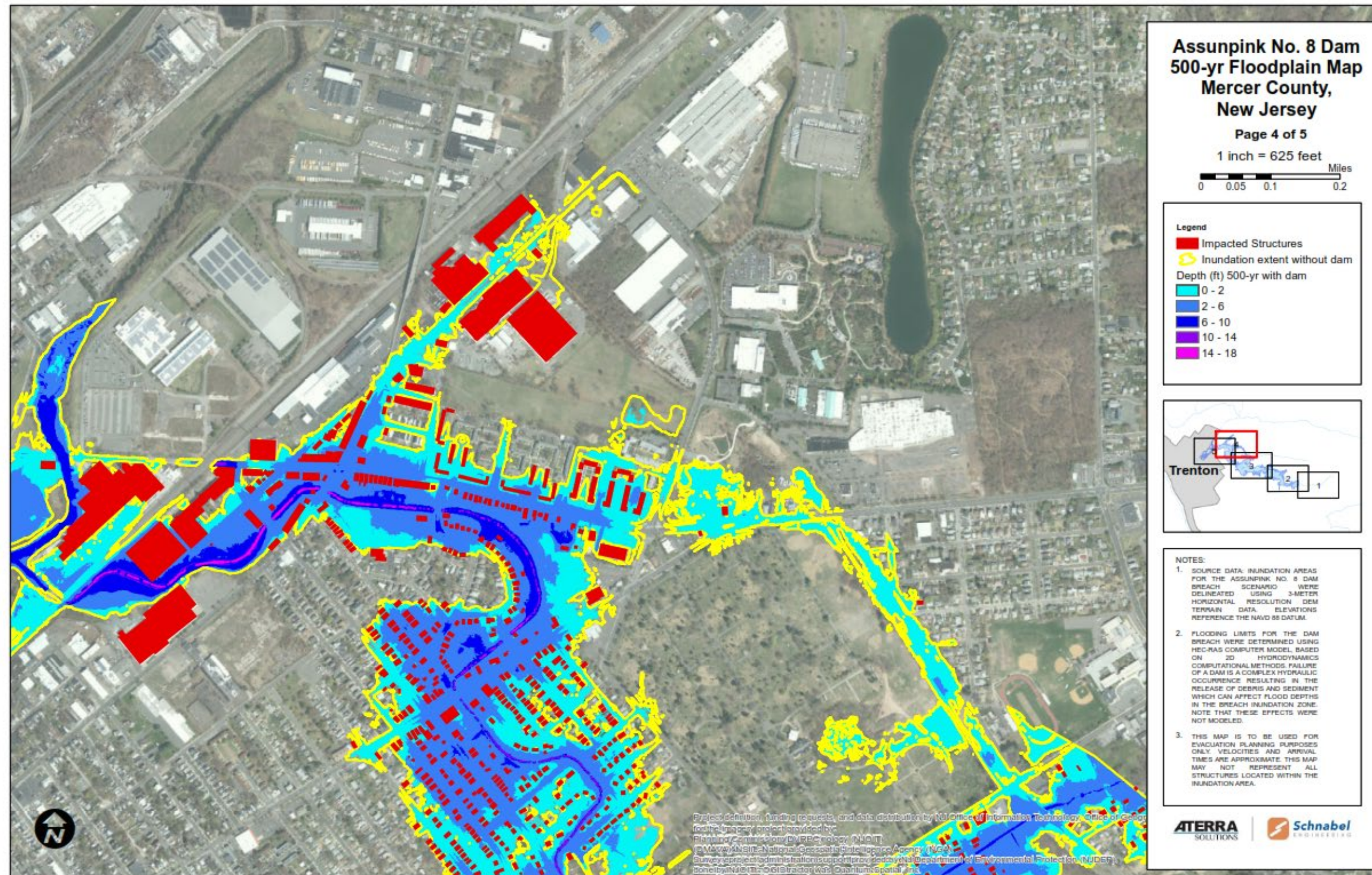


Figure B-26 – 500-Year Floodplain Map (Page 4 of 5)

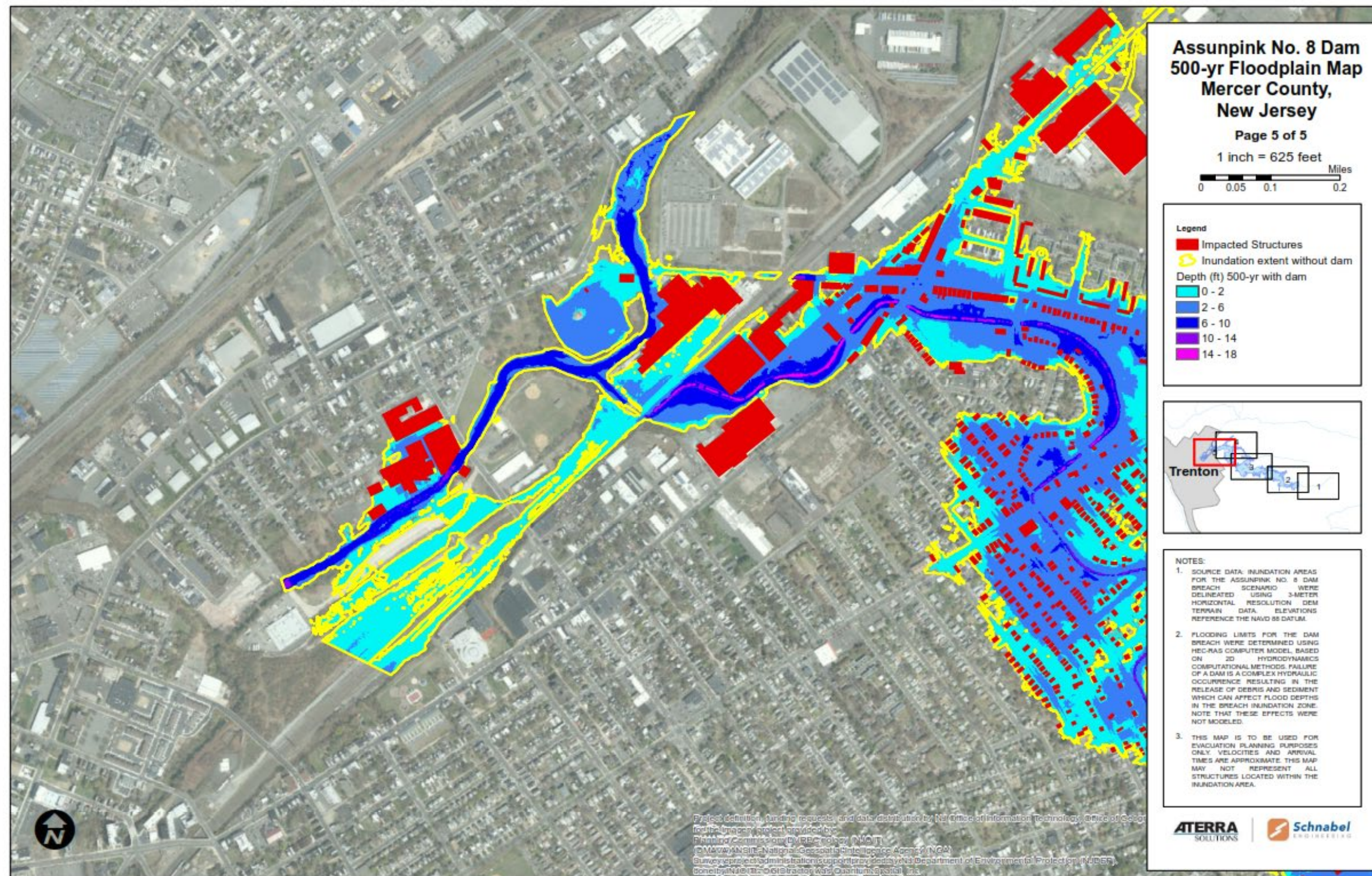


Figure B-27 – 500-Year Floodplain Map (Page 5 of 5)

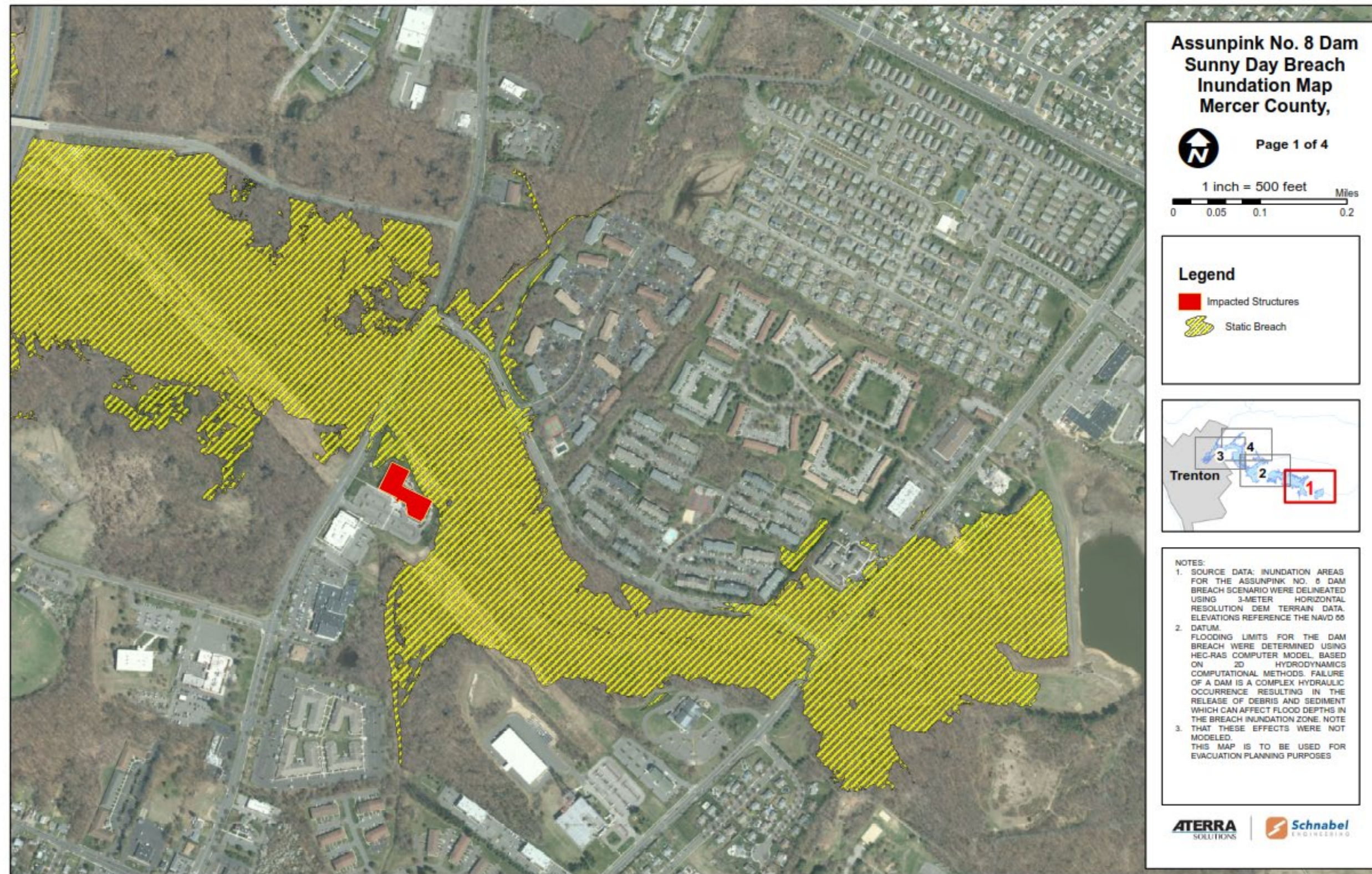


Figure B-28 – Sunny Day Breach Inundation Map (Page 1 of 4)

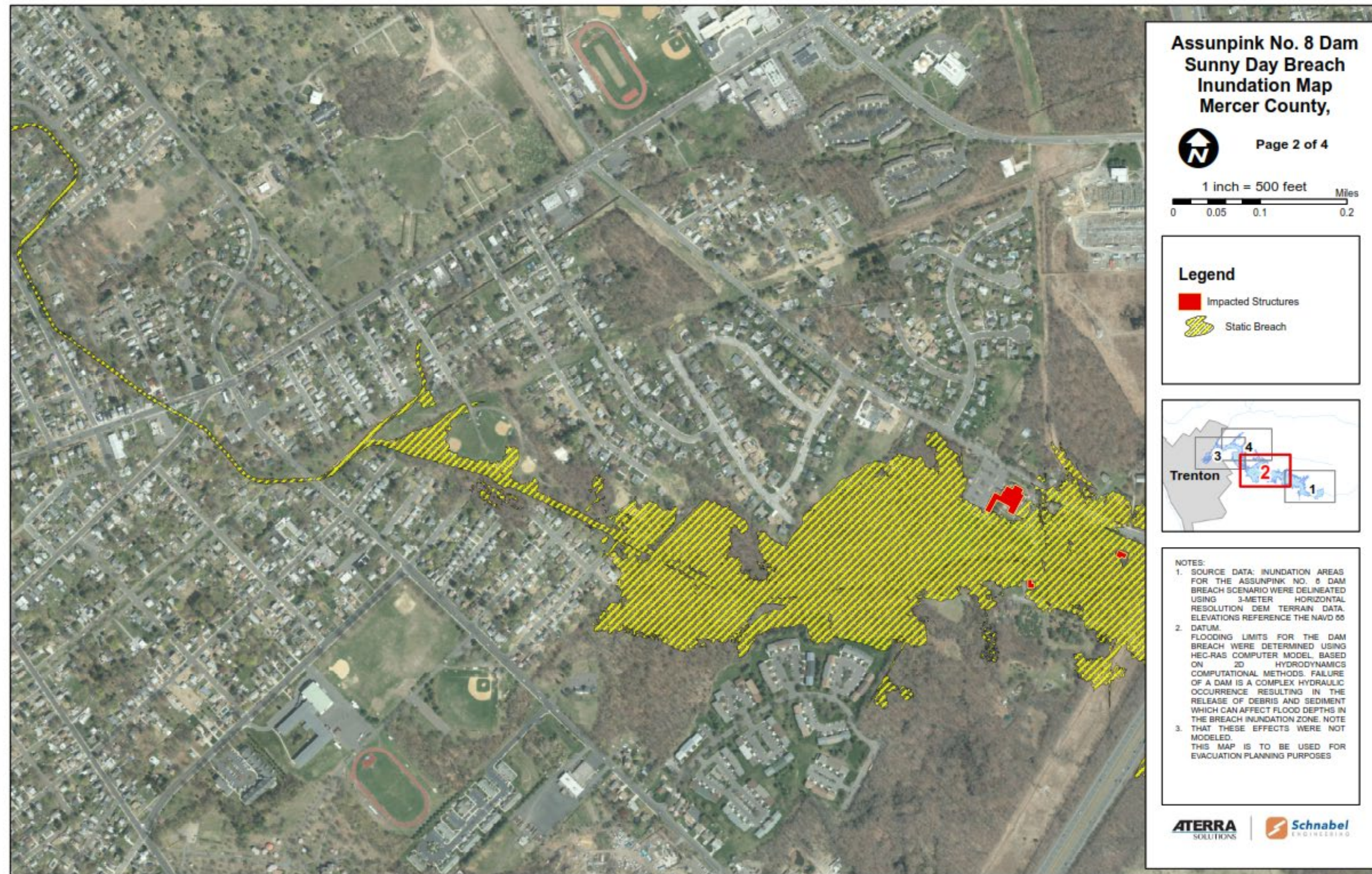


Figure B-29 – Sunny Day Breach Inundation Map (Page 2 of 4)



Figure B-30 – Sunny Day Breach Inundation Map (Page 3 of 4)



Figure B-31 – Sunny Day Breach Inundation Map (Page 4 of 4)



Figure B-32 – Probable Maximum Flood Breach Inundation Map (Page 1 of 4)

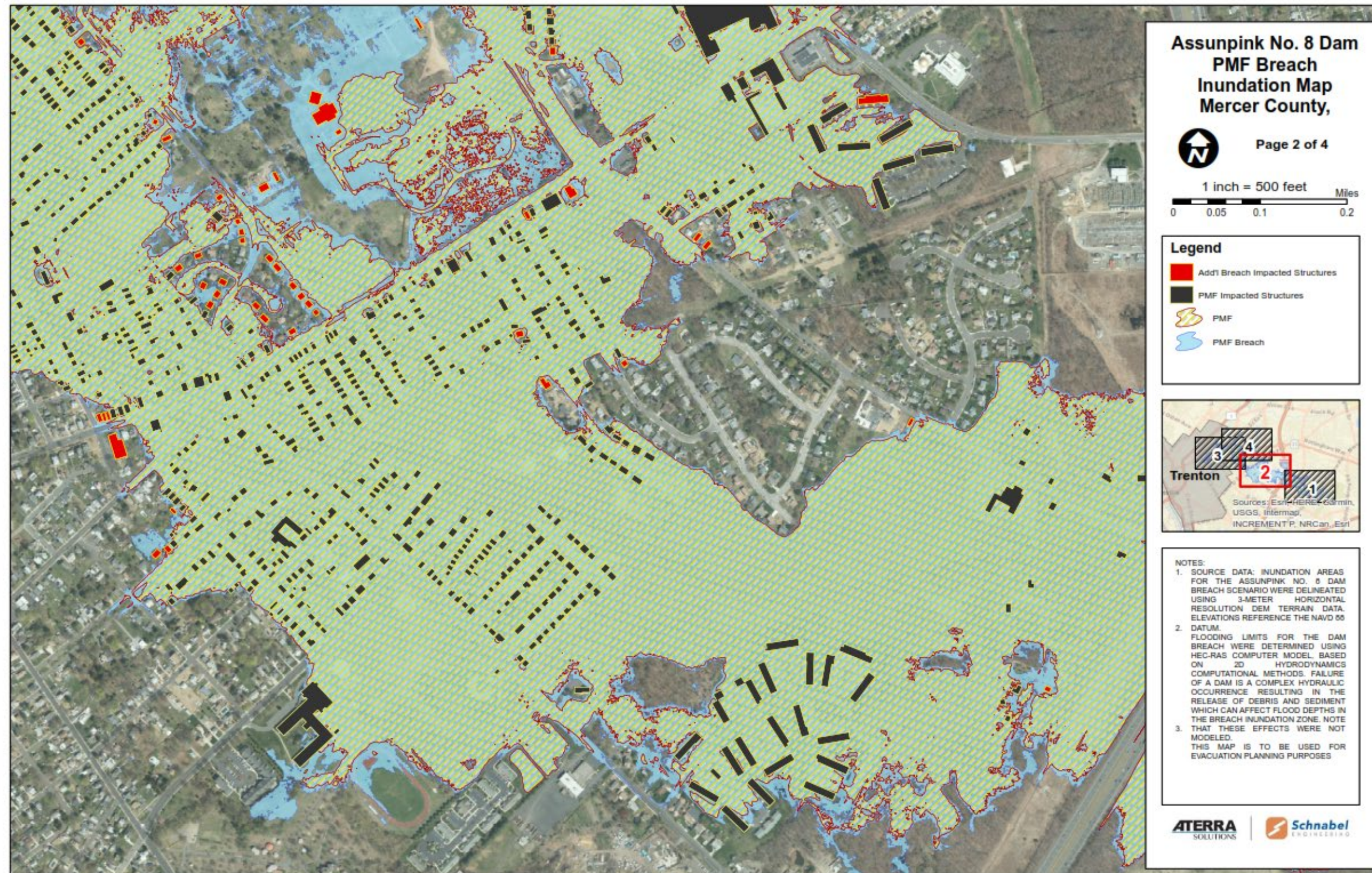


Figure B-33 – Probable Maximum Flood Breach Inundation Map (Page 2 of 4)



Figure B-34 – Probable Maximum Flood Breach Inundation Map (Page 3 of 4)

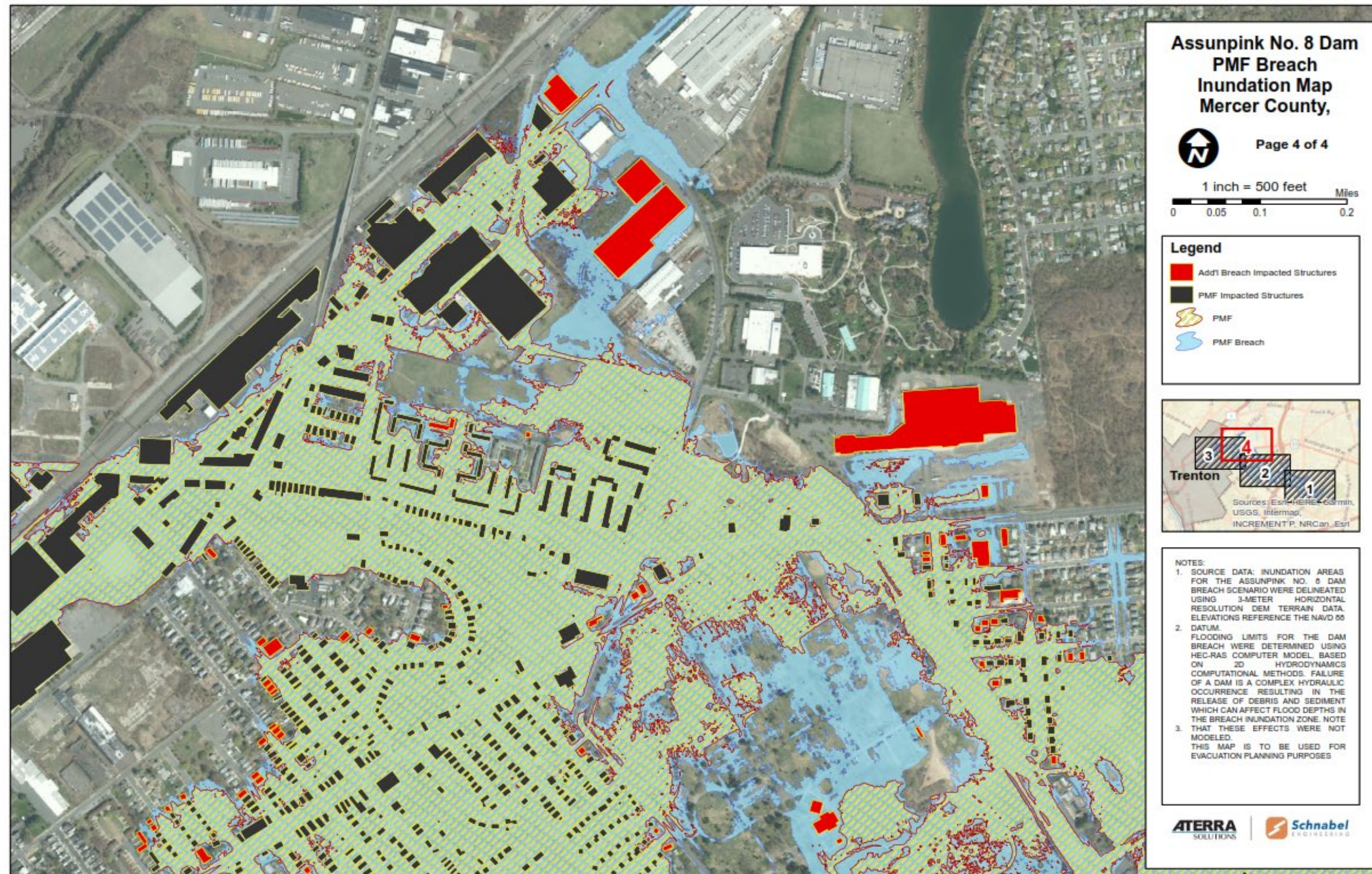


Figure B-35 – Probable Maximum Flood Breach Inundation Map (Page 4 of 4)



Figure B-36 – Alternative 1 – Aerial View of RCC Armoring Existing Auxiliary Spillway

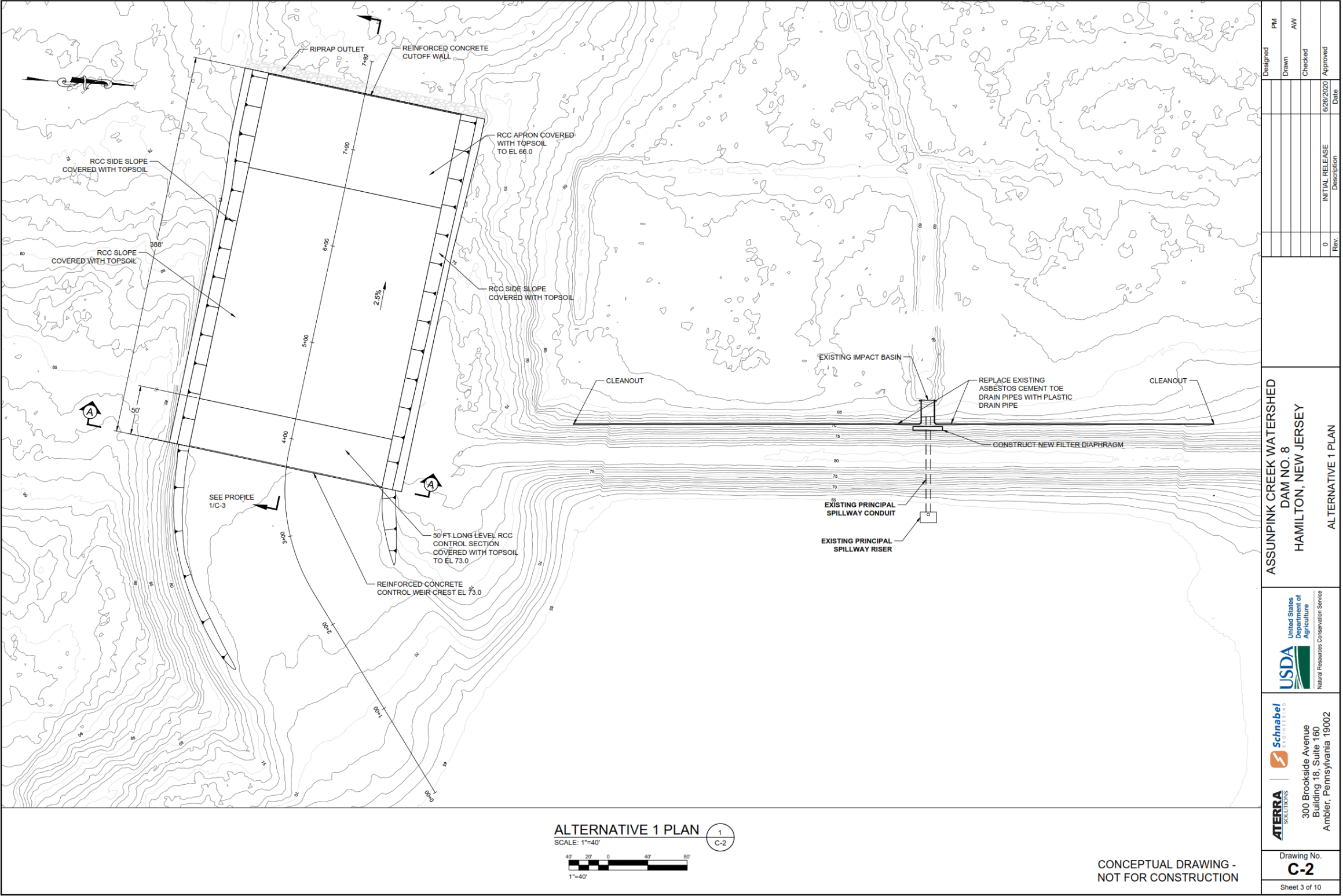


Figure B-37 – Alternative 1 – Plan View of RCC Armoring Existing Auxiliary Spillway

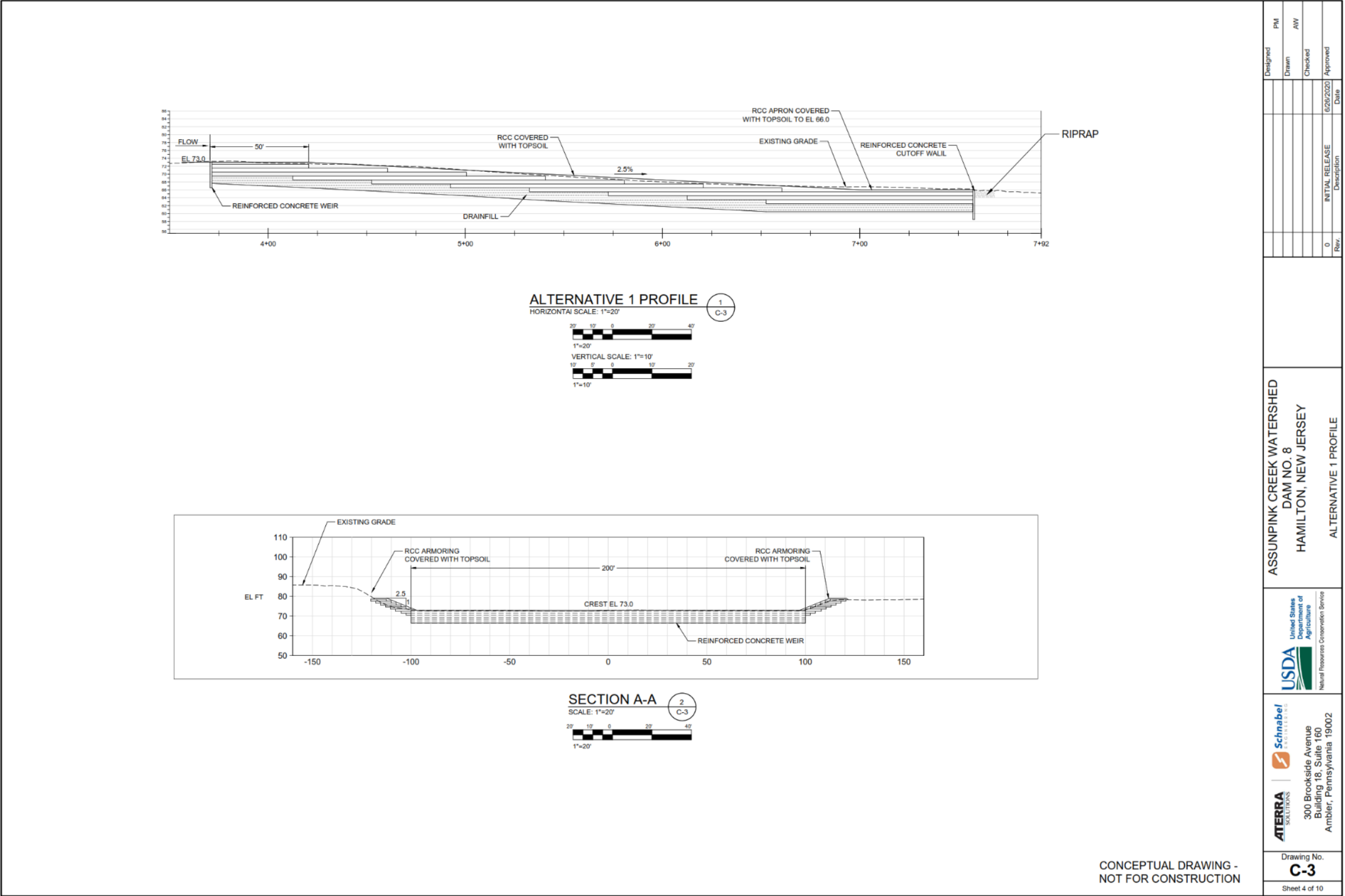


Figure B-38 – Alternative 1 – Profile View of RCC Armoring Existing Auxiliary Spillway



Figure B-39 – Alternative 2 – Aerial View of Straight Drop Concrete Auxiliary Spillway

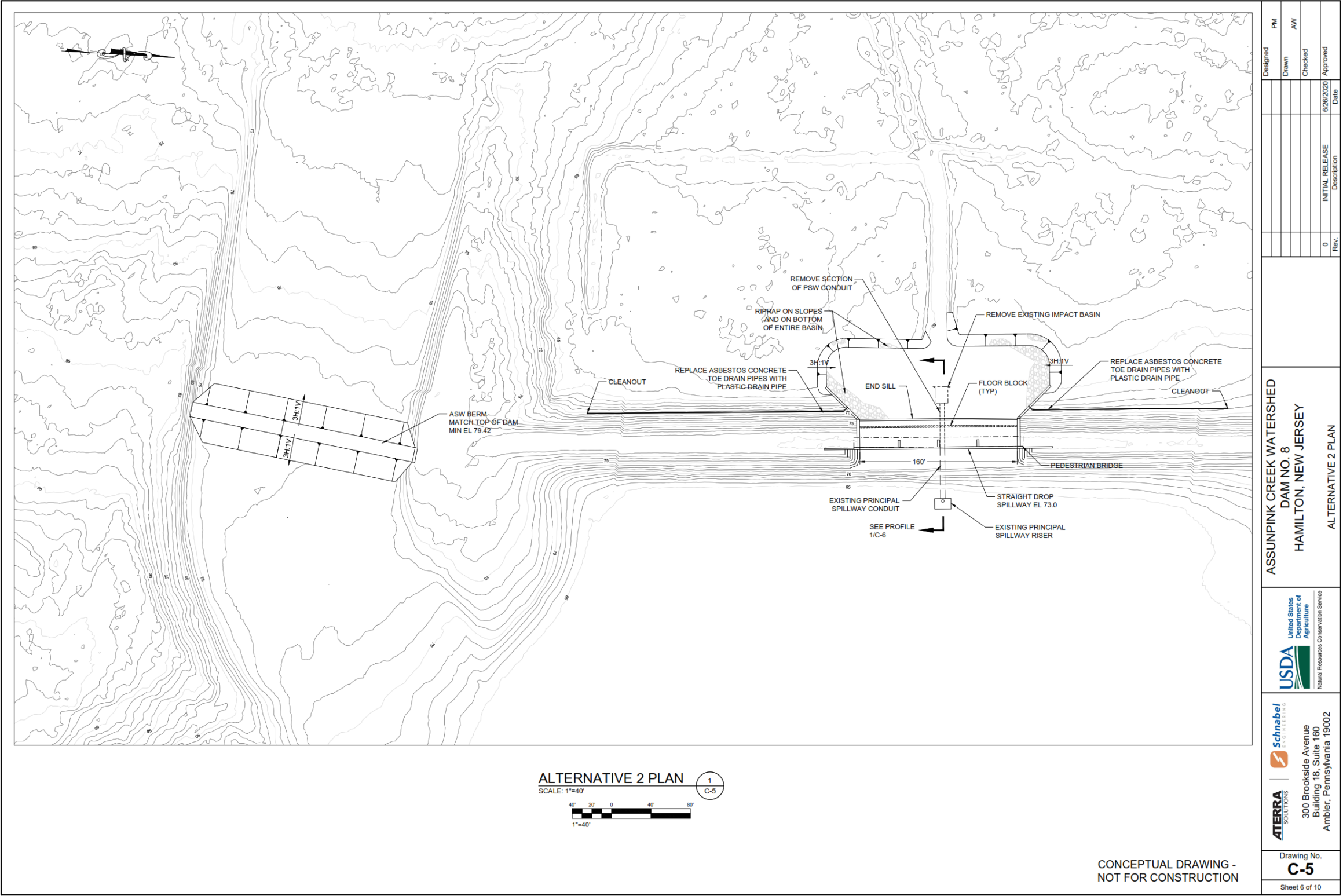


Figure B-40 – Alternative 2 – Plan View of Straight Drop Concrete Auxiliary Spillway



Figure B-42 – Alternative 3 – Aerial View of Labyrinth Weir Auxiliary Spillway

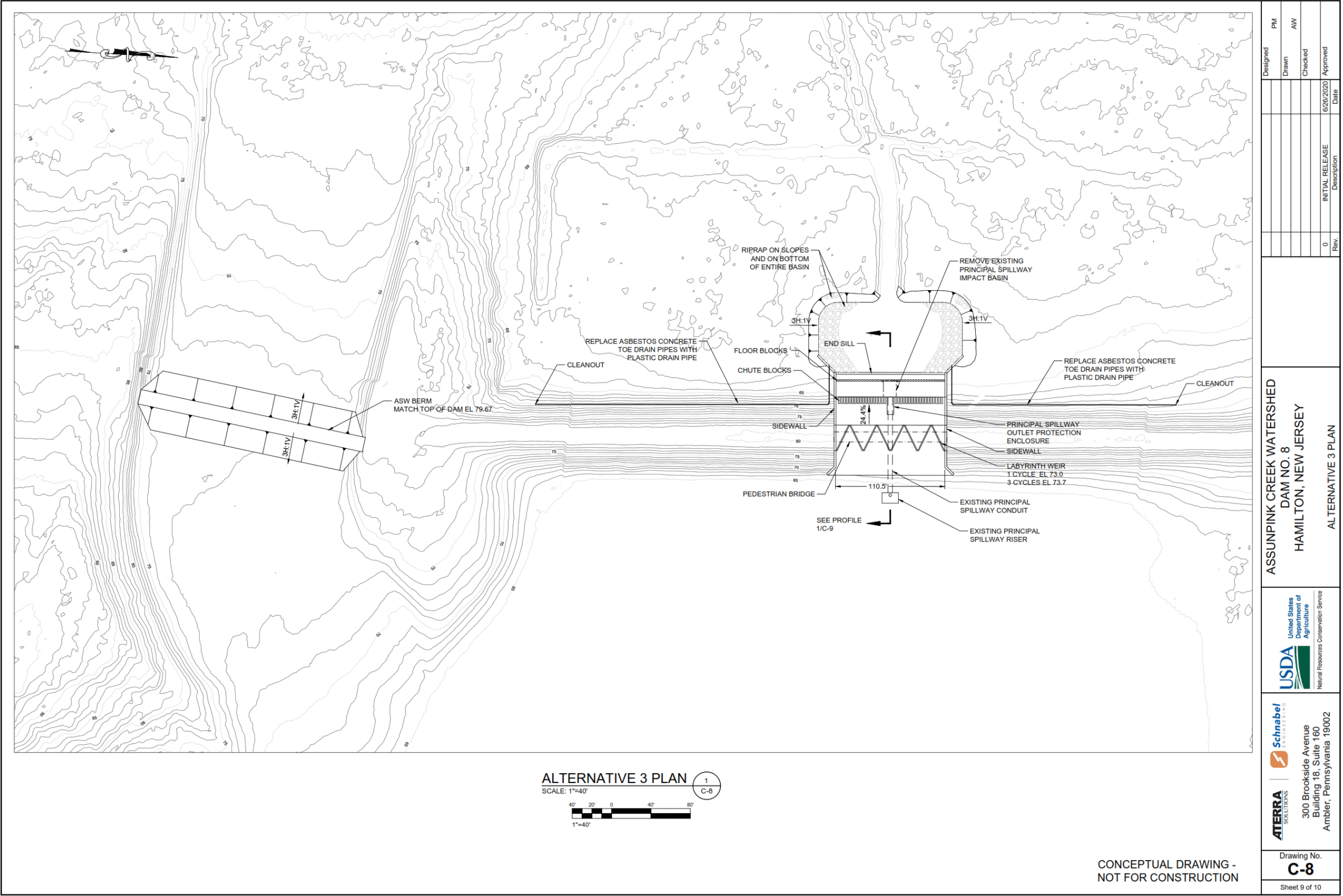


Figure B-43 – Alternative 3 – Plan View of Labyrinth Weir Auxiliary Spillway

APPENDIX C

INVESTIGATIONS AND ANALYSES REPORT

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Investigations and Analyses Used in the Planning for Rehabilitation of Assunpink Creek Dam No. 8

PLANNING ENGINEERING

Purpose

This document summarizes the investigations and analyses completed for the dam rehabilitation planning engineering of Assunpink Creek Dam No. 8. This includes a summary and reference for the existing conditions, breach, deficiencies, alternatives studied, and the selected rehabilitation alternative for this dam. The following documents state the assumptions, investigations, and analysis performed, and the conclusions developed:

- Assessment Report for Assunpink Dam No. 8, Mercer County Soil Conservation District in conjunction with NRCS, July 2017.
- DamBreak Modeling for Inundation Mapping of Pond Run #8 Dam (NJDEP File No. 28-83), Civil Dynamics, Inc., June 2015.

The basis for the planning engineering investigations and analyses is current NRCS and State of New Jersey criteria and standards, including the following:

- National Engineering Handbook, Part 630, Hydrology.
- National Engineering Handbook, Part 628, Dams.
- Technical Release 210-60, Earth Dams and Reservoirs, March 2019.
- NRCS Conservation Practice Standard Dam (Practice Code 402).
- State of New Jersey, Department of Environmental Protection, Bureau of Dam Safety, Dam Safety Standards (N.J.A.C. 7:20-1.9 Design Criteria)

Topographic Survey

A topographic survey performed by NRCS as part of the 2017 dam assessment was the basis for determination of the lowest crest elevation of the existing dam. The survey was performed using NGVD 29 datum and, therefore, the elevation was adjusted to NAVD 88 datum by subtracting 1.07 feet. Other critical elevations were obtained from the As-Built Drawings and adjusted to NAVD 88 datum as well.

Bathymetric and Sediment Survey

A one-day sonar survey for bathymetric and sub-bottom profiling to estimate the depth of water and accumulated sediment within the accessible areas of the reservoir was performed on November 13, 2019, using the Specialty Devices Inc. BSS+ Sub Bottom Profiler (BSS+) sonar system mounted off the side of a 14-foot Jon boat to measure the depth of water and depth to the bottom of sediment. Three acoustic frequencies were used simultaneously with the BSS+, 12, 50, and 200 KHz, to image differing depths and resolutions. The boat was guided over accessible areas of the reservoir using sub-meter GPS survey equipment. About 8½ acres of the 15.8-acre reservoir were open and accessible with the boat and sonar system. The other submerged areas of the reservoir

were too shallow to access with the boat and sonar, less than about 1 foot, and were also ice covered at the time of the survey. Probes were also used to check the depth of water and sediment at several locations.

Life Span

A bathymetric survey was conducted on November 13, 2019, using sonar to estimate available sediment storage in the reservoir. Previous geology reports and updated land cover data were used to estimate future sedimentation in the reservoir.

The 1966 Geology Report for the dam estimated a gross erosion rate of 6,200 tons/year and stated that “slight increases” are expected during urban development with an eventual decrease to 2,620 tons/year once major development has taken place. This reduced erosion rate would be due to conversion of agricultural land to residential, commercial, and industrial land uses with adherence to erosion and sediment control ordinances and good maintenance of lawns and other open areas. Since urban development is complete, this erosion rate was used. Sediment delivery to the reservoir would also be reduced due to maintenance of the streams. The delivery rate at that time was estimated at 20% and the trap efficiency at 94%. Using these rates and assuming that 85% of the sediment would be submerged and 15% would be aerated, there is adequate sediment storage for an additional 57 years. The estimated submerged sedimentation rate is 0.30 ac-ft/year.

In 1996, the NRCS performed a Watershed Sediment Analysis for Colonial Lake, located near Assunpink Dam No. 8. This report included estimated sheet and rill erosion rates for each land use within the watershed and estimated that gully and streambank erosion would equal 10% of sheet and rill erosion. Based on these erosion rates and land cover information developed for the current H&H analysis, there is adequate sediment storage capacity in Assunpink Dam No. 8 reservoir for 52 years of sediment accumulation. The estimated submerged sedimentation rate is 0.33 ac-ft/year. Thus the estimated submerged sedimentation rate of 0.30 ac-ft/year appears to be reasonable.

The full sediment survey report is part of the administrative record. Additional information on sediment is included in the “Period of Analysis Determination” section.

A visual inspection of the dam and structural components was conducted on January 10, 2020. The results were recorded on the NRCS Dam Field Inspection Checklist. The structural components are currently in good condition and are expected to last for another 55 years. The logic for determining the period of analysis is included in the Social and Economic Conditions section in Appendix C.

SUMMARY OF DATA SOURCES FOR PLANNING ENGINEERING

Land Cover – National Land Cover Database (NLCD) 2011 Land Cover (CONUS)

NLCD 2011 was the most up-to-date iteration of the National Land Cover Database, the definitive Landsat-based, 30-meter resolution land cover database for the U.S, when the hydrology was developed. The data in NLCD 2011 are completely integrated with NLCD 2001 (2011 Edition, amended 2014) and NLCD 2006 (2011 Edition, amended 2014). For NLCD 2011, there are 5 primary data products: (1) NLCD 2011 Land Cover; (2) NLCD 2006/2011 Land Cover Change

Pixels labeled with the 2011 land cover class; (3) NLCD 2011 Percent Developed Imperviousness; (4) NLCD 2006/2011 Percent Developed Imperviousness Change Pixels; and (5) NLCD 2011 Tree Canopy Cover provided by an MRLC partner – the USDA Forest Service Remote Sensing Applications Center. In addition, ancillary metadata include the NLCD 2011 Path/Row Index shapefile showing the footprint of Landsat scenes and change analysis pairs used to derive 2006/2011 spectral change. All Landsat scene acquisition dates are included in the shapefile's attribute table. As part of the NLCD 2011 project, NLCD 2001 and 2006 land cover and impervious data products were revised and reissued (2011 Edition, amended 2014) to provide full compatibility with the new NLCD 2011 products. The 2014 amended version corrects for the over-elimination of small areas of the four developed classes. NLCD Tree Canopy Cover was created using MRLC mapping zones from NLCD 2001 (see Tree Canopy Cover metadata for additional detail). All other NLCD 2011 products were created on a path/row basis and mosaicked to create a seamless national product.

Land Use Information

The existing land cover based on NLCD 2011 was used for development of the Runoff Curve Number (RCN). Future land use was evaluated based on zoning limitations in the watershed. The majority of the watershed is either already developed or the zoning restrictions are in place, resulting in a minimal increase of the RCN - from 78 to 79.

SSURGO Soils

SSURGO dataset was used to derive the Prime Farmland and Hydrologic Groups in the Pond Run Watershed. SSURGO datasets consist of map data, tabular data, and information about how the maps and tables were created. The extent of a SSURGO dataset is a soil survey area, which may consist of a single county, multiple counties, or parts of multiple counties. SSURGO map data can be viewed in the Web Soil Survey or downloaded in ESRI® Shapefile format. The coordinate systems are geographic. Attribute data can be downloaded in text format that can be imported into a Microsoft® Access® database.

Agricultural Land

The agricultural land within the breach inundation zone was estimated using the 2011 NLCD data. The land cover types associated with agricultural land were assumed to be cultivated crops and hay/pasture.

Hydrologic Soil Groups

Hydrologic Soil Groups were derived from the USDA NRCS – SSURGO data for New Jersey. The NRCS Soil Data Viewer version 6.2 was used, with ArcGIS 10.5. The attributes selected for this layer are under “Soil Qualities and Features” – Hydrologic Soil Groups. Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration, when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

Sub-Watershed Boundaries

Sub-watershed boundaries for evaluation of downstream hydrology were delineated using ArcGIS 10.5 Spatial Analyst tool and using the LiDAR terrain data.

USGS NED one-meter x 52y446 DE Delaware Valley HD 2015 IMG 2019 – Digital Elevation Model

USGS NED one-meter x 52y446 DE Delaware Valley HD 2015 IMG 2019 is a tile of the standard one-meter resolution digital elevation model (DEM) produced through the 3D Elevation Program (3DEP). The elevations in this DEM represent the topographic bare-earth surface. USGS standard one-meter DEMs are produced exclusively from high resolution light detection and ranging (LiDAR) source data of one-meter or higher resolution. One-meter DEM surfaces are seamless within collection projects, but not necessarily seamless across projects. The spatial reference used for tiles of the one-meter DEM within the conterminous United States (CONUS) is Universal Transverse Mercator (UTM) in units of meters, and in conformance with the North American Datum of 1983 (NAD83). All bare earth elevation values are in meters and are referenced to the North American Vertical Datum of 1988 (NAVD88). Each tile is distributed in the UTM Zone in which it lies. If a tile crosses two UTM zones, it is delivered in both zones. The one-meter DEM is the highest resolution standard DEM offered in the 3DEP product suite. Other 3DEP products are nationally seamless DEMs in resolutions of 1/3, 1, and 2 arc seconds. These seamless DEMs were referred to as the National Elevation Dataset (NED) from about 2000 through 2015 at which time they became the seamless DEM layers under the 3DEP program and lost the NED branding. Other 3DEP products include five-meter DEMs in Alaska as well as various source datasets including the LiDAR point cloud and interferometric synthetic aperture radar (IfSAR) digital surface models and intensity images. All 3DEP products are public domain.

The 3DEP data serves as the elevation layer of The National Map and provides basic elevation information for earth science studies and mapping applications in the United States. The data are utilized by the scientific and resource management communities for global change research, hydrologic modeling, resource monitoring, mapping and visualization, and many other applications.

This is a 10,000-meter by 10,000-meter tile. The geographic area of coverage is described below in the Bounding Coordinates. Additional information for the 3DEP may be found on <http://nationalmap.gov/elevation.html>. Data may be downloaded through The National Map Viewer: <http://nationalmap.gov/viewer.html>. Direct links for direct access by automated services are provided in the Distribution section of this metadata.

HYDROLOGY AND HYDRAULIC ENGINEERING

The purpose of this study was to perform the necessary hydrologic and hydraulic analysis in support of meeting the requirements of TR 210-60 and the State of New Jersey Dam Safety Standards (N.J.A.C. 7:20-1.9 Design Criteria). The analyses completed as part of the project included a hydrologic analysis of the watershed upstream of Assunpink Dam No. 8 using a SITES model, hydrologic analysis of the Pond Run Watershed using a HEC-HMS model, and hydraulic analysis for “with” and “without” dam scenarios for several recurrence intervals using a two-

dimensional HEC-RAS model of Pond Run. The “with” and “without” dam scenarios were modeled to evaluate the potential impacts on downstream properties. The results of the analysis were used as input for the economic analysis.

HYDROLOGIC ANALYSIS

The HEC-HMS software package was used to develop a rainfall-runoff model for Pond Run Watershed and to estimate inflow hydrographs for a two-dimensional HEC-RAS model. The Pond Run Watershed was divided into 7 sub-watersheds, represented by the schematic shown in Figure C-1.

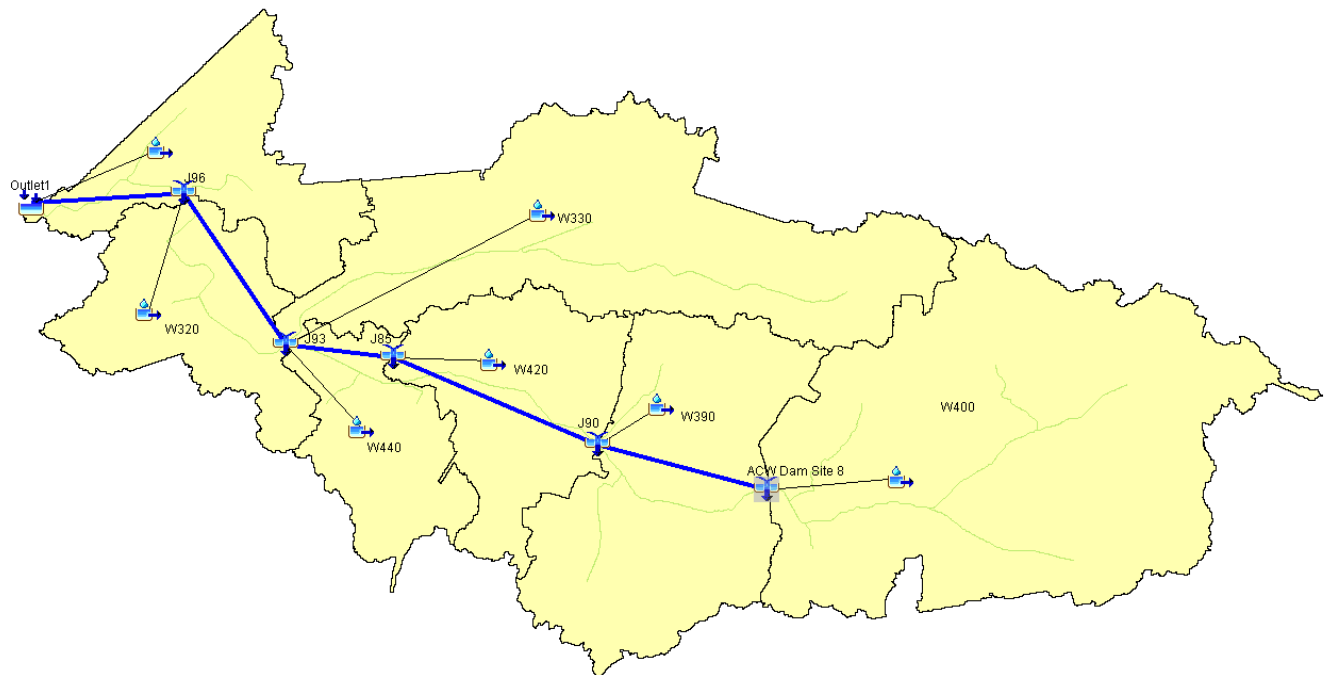


Figure C-1 – HEC-HMS Model Schematic

The components of the HEC-HMS model are described in the following sections.

Rainfall

Point precipitation data for the 10-year, 25-year, 50-year, 100-year, 200-year, and 500-year and 24-hour durations were obtained from NOAA Atlas 14.

Table C-1 – NOAA Atlas 14 Precipitation Data

Duration	Precipitation Data (inches), Average Recurrence Interval (Years)					
	10	25	50	100	200	500
5 minutes	0.542	0.611	0.662	0.713	0.761	0.821
10 minutes	0.866	0.974	1.06	1.13	1.21	1.3
15 minutes	1.1	1.24	1.34	1.43	1.52	1.63
30 minutes	1.59	1.83	2.01	2.2	2.37	2.6
1 hour	2.07	2.44	2.73	3.02	3.32	3.73
2 hours	2.54	3.03	3.42	3.83	4.24	4.82
3 hours	2.8	3.36	3.81	4.29	4.78	5.47
6 hours	3.53	4.28	4.9	5.57	6.29	7.33
12 hours	4.34	5.34	6.21	7.16	8.22	9.8
24 hours	5.03	6.2	7.21	8.32	9.56	11.4

Runoff Losses

The SCS curve number (CN) method was used to estimate runoff losses. CNs were developed using the National Engineering Handbook, Part 630, Chapter 9 based on cover type, hydrologic conditions, and hydrologic soil groups (HSGs) obtained from the following sources:

- NLCD land cover – <https://www.mrlc.gov/nlcd2011.php>
- Soil Survey Geographic (SSURGO) database

Table C-2 – Sub-Watershed Curve Numbers

Sub-Watershed ID	Drainage Area (mi ²)	Present Curve Number
W420	0.82	85
W400	2.76	78
W390	1.37	75
W330	1.87	82
W440	0.57	81
W320	0.74	81
W310	0.76	81

Runoff Transformation

The SCS Dimensionless Unit Hydrograph method was used to transform runoff volumes to flow hydrographs. This method consists of parameters such as rainfall duration (D), time-to-peak (T_p), time-of-recede (T_r), and peak flow (q_p). The dimensionless hydrograph is scaled by Lag Time (L) and the Peak Flow (q_p) to produce the basic shape of unit hydrograph. Lag time can be calculated using various approaches, including the SCS lag equation. The SCS lag equation is an empirical-

based approach that estimates lag time directly. This approach is recommended for homogeneous basins less than 2,000 acres in size.

The SCS lag time equation is given as:

$$L = \frac{l^{0.8}(S + 1)^{0.7}}{1900Y^{0.5}}$$

where:

- L = lag time [hrs.]
- l = length of the longest path [ft.]
- Y = average watershed land slope [%]
- S = maximum potential retention [inch]
- = (1,000/CN) – 10
- where:
- CN = curve number

Another approach to calculate the lag time is referred to as the segmental approach. In this approach, the parameter being estimated is essentially the time of concentration or longest travel time within the basin. The time of concentration is calculated individually for sheet flow, shallow concentrated flow, and channel flow. The sum of the individual travel times represents the time of concentration. USDA-NRCS relates lag time, L, and time of concentration, T_c , as:

$$L = 0.6T_c$$

The SCS lag equation was used to estimate lag times for the individual sub-basins in the HEC-HMS model. The SCS lag time equation's input parameters (flow length and average watershed land slope) were calculated for each sub watershed using HEC-GeoHMS. Since we did not have enough detailed information to apply the segmental approach to all sub-watersheds, this approach was used for developing hydrographs for various recurrence intervals used as input for hydraulic modeling and for evaluating flood damages for “with” and “without” dam scenarios.

Table C-3 – Lag Times (SCS Lag Equation)

Sub-Watershed ID	Lag Time (minutes)
W420	48.91
W400	136.86
W390	66.91
W330	117.17
W440	59.40
W320	81.98
W310	112.64

The more detailed segmental approach was utilized to develop time of concentration (and lag time) for the watershed contributing to the dam site (W400) to be used for evaluation of the existing dam structure and proposed rehabilitation alternatives. This approach is generally considered more precise when field verification of individual flow segments can be performed, and sufficient data

is available to describe the channel characteristics. The individual segments were analyzed using the best available topography (LiDAR), aerial photography, storm sewer network GIS data, and field verification of individual flow segments. The resulting time of concentration and lag time calculated using the segmental method are 2.68 hours and 96.11 minutes, respectively.

Routing

The HEC-HMS model was not set up to perform the stream/river (reach element) because routing was performed directly in the HEC-RAS model.

Stage-Storage Relationship

The stage-storage relationship for the reservoir was updated using the latest LiDAR data and bathymetric survey performed in December 2019 to account for sediment accumulation that had occurred since the construction of the dam. The updated stage-storage relationship is presented in Table C-4.

Table C-4 – Stage-Storage Relationship

Stage [ft]	Storage [ac-ft]
62.4	0
64.9	17.1
66	39.3
67	66.9
68	101.7
69	145.3
70	201.0
71	271.5
72	357.7
73	462.8
74	591.7
75	744.5
76	923.6
77	1128.7
78	1360.9
79	1624.2
80	1911.7
81	2197.5
82	2483.4

Hydraulic Analysis

A two-dimensional HEC-RAS hydraulic model was developed for hydraulic analysis of Pond Run. The model domain extended from the dam site to the confluence with Assunpink River. Unsteady flow modeling for several recurrence intervals was performed to simulate downstream flow conditions and estimate flood depth at impacted structures, roads, bridges, and culverts. For each

model scenario, inflow hydrographs developed in the HEC-HMS model were dynamically linked with the HEC-RAS model. For the “without” dam scenarios, the storage area and the inline structure representing the reservoir and the dam were removed and a new geometry file was created.

LiDAR-based topographic data was used to develop model geometry. Manual adjustments were made to the terrain model in areas where Pond Run is conveyed to a concrete channel. The terrain model was manually adjusted based on field measurements.

Hydraulic Analysis Results

The hydraulic analysis was performed to estimate inundation depths at downstream structures for a range of flood recurrence intervals, from the 10-year to the 500-year floods, in support of the economic analysis. Flood inundation rasters for each recurrence interval were developed in HEC-RAS. Spatial location of structures downstream of the dam was obtained from a Microsoft Building Footprints layer available for ArcGIS. Flood depths at each affected structure (with at least 10% of the building footprint inundated) were extracted from the respective inundation rasters using GIS tools.

Review of Hazard Classification

Breach inundation maps were developed to evaluate the current hazard classification and to estimate dam breach consequences for the Plan-EE. National Engineering Manual, Part 520, Subpart C – Dams (520.21), defines High Hazard Potential dams as structures where failure may cause loss of life or serious damage to homes, industrial or commercial buildings, important public utilities, main highways, or railroads. Furthermore, inundation maps showing discharge due to a sudden breach of the dam must be prepared. Unless otherwise determined by the State Conservation Engineer, the conditions at the time of breach may be water level in the reservoir at or above the crest elevation of the lowest open channel auxiliary spillway and “nonstorm” conditions downstream of the dam.

According to the New Jersey Department of Environmental Quality Dam Safety Standards, N.J.A.C. 7:20, a structure is defined as Class I – High Hazard Potential if its failure may cause the probable loss of life or extensive property damage. Furthermore, the existence of normally occupied homes in the area that are susceptible to significant damage in the event of a dam failure will be assumed to mean “probable loss of life.”

Dam breach modeling performed by Civil Dynamics in support of the Dambreak Modeling for Inundation Mapping for Pond Run #8 Dam report (2015) included both sunny-day (full-pool) breach and PMP breach scenarios. The study confirmed the high hazard classification of the dam.

Based on the Federal and State guidelines, the sunny-day failure at full-pool with non-storm conditions downstream can be considered the limiting case for determination of hazard classification. Therefore, the full-pool dam breach scenario was evaluated to confirm the dam hazard classification. The USDA-NRCS’s WinDAM C computer program was used to generate the breach hydrographs, which were manually entered into the HEC-RAS hydraulic model. Table C-5 describes the key inputs for WinDAM C, including soil parameters, which were based on the

geotechnical exploration performed as part of this project and Table C-6 provides a summary of peak discharges for each dam breach scenario.

Table C-5 – WinDAM C Parameters

Parameter	Unit	Value	Basis for Value Assigned/Reference
Erosion Model	N/A	N/A	Hanson/Robinson Stress Erosion Model
Total Unit Weight	lb/ft ³	120	Based on geotechnical exploration
Erodibility Index (K_d)	lb/ft ²	5	Based on geotechnical exploration
Undrained Shear Strength	lb/ft ²	20	Based on geotechnical exploration
Critical Shear Stress	lb/ft ²	0	Based on geotechnical exploration
<u>Upstream Embankment</u>			
Slope (H/V)	N/A	3	As-Built Drawings
Retardance Curve Index (or Manning n-value)	N/A	5.6	Used a Retardance Curve Index from Table 7-4, Part 650 Engineering Field Handbook, Chapter 7, Grassed Waterways, Retardance Class C; based on site visits (grass-legume mixture).
<u>Dam Crest</u>			
Width	feet	15	As-Built Drawings
Retardance Curve Index (or Manning n-value)	N/A	0.013	Used Manning's n-value corresponding to paved surface.
<u>Downstream Embankment</u>			
Slope (H/V)	N/A		As-Built Drawings
Retardance Curve Index (or Manning n-value)	N/A	5.6	Used Retardance Curve Index from Table 7-4, Part 650 Engineering Field Handbook, Chapter 7, Grassed Waterways, Retardance Class C; based on site visits (grass-legume mixture).
Plasticity Index	N/A		Based on geotechnical exploration
Particle Diameter	in	0.02	Based on geotechnical exploration
Vegetal Cover Factor (C_r)	N/A	0.75	Based on Table 7-3, Part 650 Engineering Field Handbook, Chapter 7, Grassed Waterways – grass mixture based on site visits.
Maintenance Code	N/A	2	Minor discontinuities in the cover (based on SITES reference manual)
Internal Erosion Conduit (width/height)	Feet	0.25/0.25	Assumed

Parameter	Unit	Value	Basis for Value Assigned/Reference
Invert elevation of Conduit	feet in NAVD88	59.31	Assumed
Station of Conduit	feet	450	Assumed
Elevation to Start Routing	feet in NAVD88	73	Based on full-pool elevation
Dam Base Elevation	feet in NAVD88	59	Based on as-builts (converted from NGVD29)

Table C-6 – Peak Dam Breach Discharges

Breach Scenario	Peak Discharge [cfs]	Maximum Pool Elevation [ft]
Seismic Dam Breach	2,219	71.4
Static (Sunny-Day) Dam Breach	3,085	73.0
Hydrologic Dam Breach	13,901	76.6

Based on the limiting sunny-day dam breach scenario, there are three roadways and one bridge that would be impacted by the full-pool (sunny-day) breach and would experience flood depths greater than one foot resulting in likely loss of life. Therefore, based on the Federal and State guidelines, there is no justification for lowering the hazard classification.

EVALUATION OF DAM PERFORMANCE

A SITES model was developed to evaluate the performance of the dam in accordance with TR 210-60 design criteria. The Principal Spillway Hydrograph (PSH), the Stability Design Hydrograph (SDH), and the Freeboard Hydrograph (FBH) provide basis for evaluating dam capacity and stability and integrity of the auxiliary spillway in accordance with TR 210-60 design criteria (see additional information below). A summary of TR 210-60 design hydrographs and the corresponding rainfall values are provided in Table C-7.

The Probable Maximum Precipitation data was obtained from the Hydrometeorological Report (HMR) 51 – Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, and the rainfall volume used in the analysis is presented in Table C-7. The precipitation values for the Principal Spillway Hydrograph and the Stability Design Hydrograph include a 100-year precipitation component and, therefore, they were updated using the NOAA Atlas 14 data. Runoff volume maps procedure described in the National Engineering Handbook, Part 630, Chapter 21 (USDA-NRCS, 2019) was also utilized for evaluation of the Principal Spillway Hydrograph. Runoff volumes were obtained from Figure 21-2 and Figure 21-3 in the above-referenced publication.

Table C-7 – TR 210-60 Design Hydrographs and Corresponding Rainfall/Runoff Volumes

Principal Spillway Hydrograph	100-year Return Period	Source
<i>Distribution</i>	<i>NRCS, 1-day/10-day</i>	
<i>1-day Rainfall , inches</i>	<i>8.32</i>	<i>NOAA Atlas 14</i>
<i>10-day Rainfall, inches</i>	<i>12.00</i>	
<i>1-day Runoff, inches</i>	<i>2.7</i>	<i>Figure 21-2 & 21-3, Part 630, Ch 21</i>
<i>10-day Runoff; inches</i>	<i>5.4</i>	<i>Figure 21-2, Part 630, Ch 21</i>
Stability Design Hydrograph	$P_{100} + 0.26 (PMP - P_{100})$	
<i>Distribution</i>	<i>NRCS, 6-hour</i>	
<i>Rainfall, inches</i>	<i>11.12</i>	<i>NOAA Atlas 14 & HMR51</i>
Freeboard Hydrograph	PMP	
<i>Distribution</i>	<i>NRCS, 6-hour; and NRCS, 24-hour 5-point PMP Distribution</i>	
<i>6-hour Rainfall inches</i>	<i>26.92</i>	<i>HMR51</i>
<i>24-hour Rainfall, inches</i>	<i>34.72</i>	<i>HMR51</i>

Soil parameters and material properties for stability and integrity analysis were developed based on data obtained as part of the geotechnical exploration. The auxiliary spillway was modeled with three soil layers: alluvial 3 (SM), alluvial 4 (SC-SM, ML), and coastal (SP-SM).

No rock was encountered in the auxiliary spillway. A summary of the soil parameters is provided in Table C-8. Figure C-2 shows the auxiliary spillway profile with the corresponding material stratification.

Table C-8 – SITES Soil Parameters

Material	Alluvial 3	Alluvial 4	Alluvial 3 (2)	Coastal
Description	SM	SC-SM, ML	SM	SP-SM
Plasticity Index	0	5	0	0
Dry Density (pcf)	100	90	100	100
Head Cut (Erodibility) Index, K_h	0.03	0.06	0.03	0.04
Percent Clay (%)	0	17	0	0
Rep. Dia, D_{50}(mm)	0.22	0.17	0.22	0.54

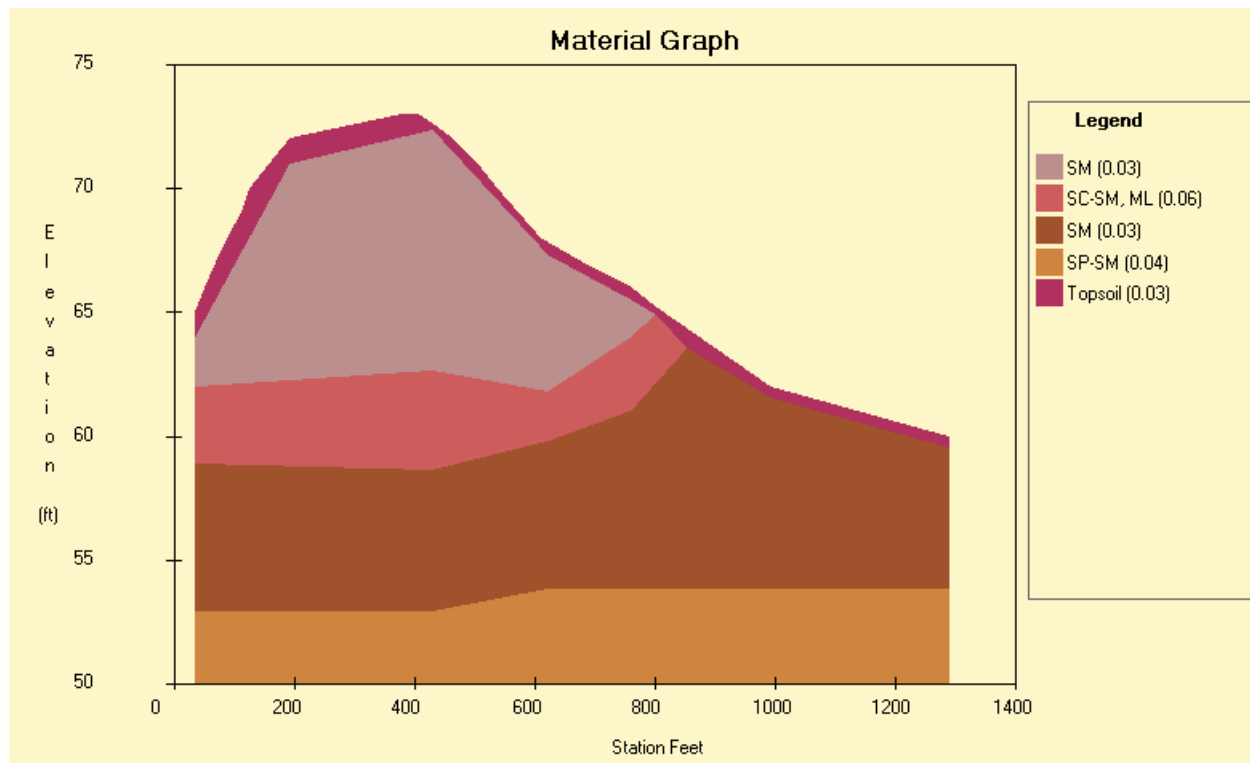


Figure C-2 – Auxiliary Spillway Profile

Principal Spillway Design Criteria

For the PSH, a combined 1-day/10-day 100-year rainfall is used to analyze the capacity of the principal spillway. Typically, the objective is to pass the PSH without overtopping the auxiliary spillway; however, the NRCS allows for some overtopping if the spillway is considered “structural” (not applicable to the existing spillway). The pool elevation should be drawn down in 10 days passage of the PSH. If more than 15% of the storage at the maximum stage attained when routing the PSH remains after 10 days, the minimum elevation of the vegetated auxiliary spillway is typically raised to accommodate the remaining storm volume. If more than 15% of the PSH volume remains, the minimum elevation of the auxiliary spillway is typically raised to accommodate the remaining storm volume. Further routing of the FBH or SDH is performed with the starting reservoir elevation set to the 10-day drawdown water surface elevation.

Auxiliary Spillway Stability Design Criteria

The 6-hour SDH is used to evaluate the stability of the auxiliary spillway. During the design storm event, the auxiliary spillway should not experience excessive stripping of vegetation. The stress limitations may be increased 20 percent when the anticipated average use is once in 50 years, or 50 percent when the anticipated average use is once in 100 years.

Auxiliary Spillway Integrity Design Criteria

The auxiliary spillway shall be evaluated for headcut development and advancement during the FBH event. The auxiliary spillway needs to pass the worst case of the 6-hour or the 24-hour FBH event without breaching.

Freeboard Design Criteria

The FBH is used to evaluate the total spillway flow and establish the minimum settled elevation of the top of the dam. In addition, the minimum elevation difference between the crest of the auxiliary spillway and the top of the dam must be 3 feet or higher. The auxiliary spillway should pass the worst case of the 6-hour or the 24-hour FBH event with the associated maximum water surface elevation at or below the crest of the top of the settled dam.

State of New Jersey, Department of Environmental Protection, Bureau of Dam Safety, Dam Safety Standards

According to N.J.A.C. 7:20-1.9 Design Criteria, the minimum design storm used to calculate required spillway capacity for Class I dams is the PMP. N.J.A.C. 7:20-1.9 Design Criteria does not specify the temporal distribution to be used; however, based on the feedback received from NJDEP, NRCS structural, hydraulic, and hydrologic design procedures may be used directly, including NRCS rainfall distributions. HMR51 is to be used for PMP values; however, it is expected that state-wide PMP study will be completed prior to the final design and the resulting values will be utilized in lieu of the HMR51 values. For existing dams, relaxation of the 1-ft freeboard requirement will be considered with reasonable rationale. No increase in the downstream 100-year flood elevations will be allowed per NJDEP criteria. An increase is defined, for this purpose, as 0.15 ft or greater. NJDEP would allow armoring of the auxiliary spillway with ACBs, as long as the manufacturer's specifications meet support safe operation under design flows.

Existing Conditions

Based on the SITES analysis results, the dam is not overtopped during the 6-hour or 24-hour FBH storms. However, the dam does not meet the TR 210-60 design criteria for the principal spillway capacity and the floodwater retarding storage because extensive time is required to draw down the reservoir and the spillway flows during the 1-day/10-day storm. As a result, the auxiliary spillway crest would have to be raised to elevation 76.83 feet unless the rehabilitation design includes a structural spillway. Furthermore, the vegetated auxiliary spillway does not meet the stability (erosion resistance) design criteria and the integrity design criteria. The integrity results are shown graphically in Figure C-3 and Figure C-4 for the 6- and 24-hour durations, respectively. The results indicate that headcut will occur along the length of the ASW and breach the control section during passage of both the 6-hour and 24-hour FBH. To meet the stability and integrity design criteria, rehabilitation options would require armoring of the auxiliary spillway. However, if the selected rehabilitation alternative does not include a structural spillway, the auxiliary spillway capacity would also have to be increased to accommodate the higher auxiliary spillway crest, or the dam crest would have to be raised to prevent overtopping of the dam.

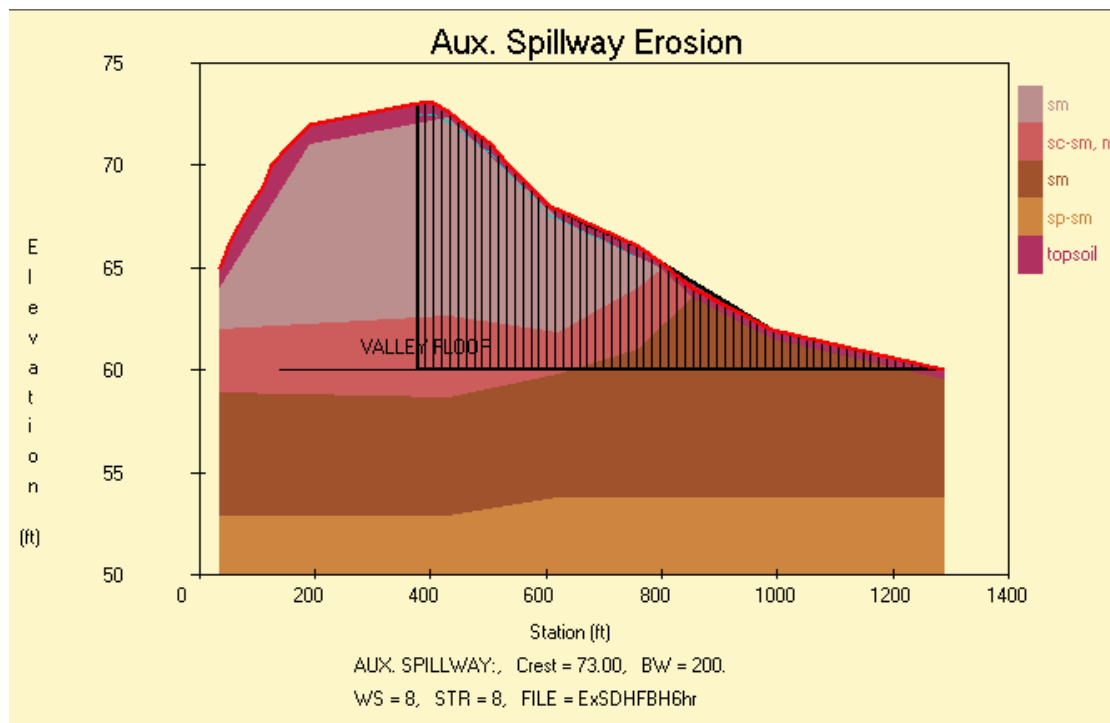


Figure C-3 – ASW Headcut Plot – 6-hour FBH

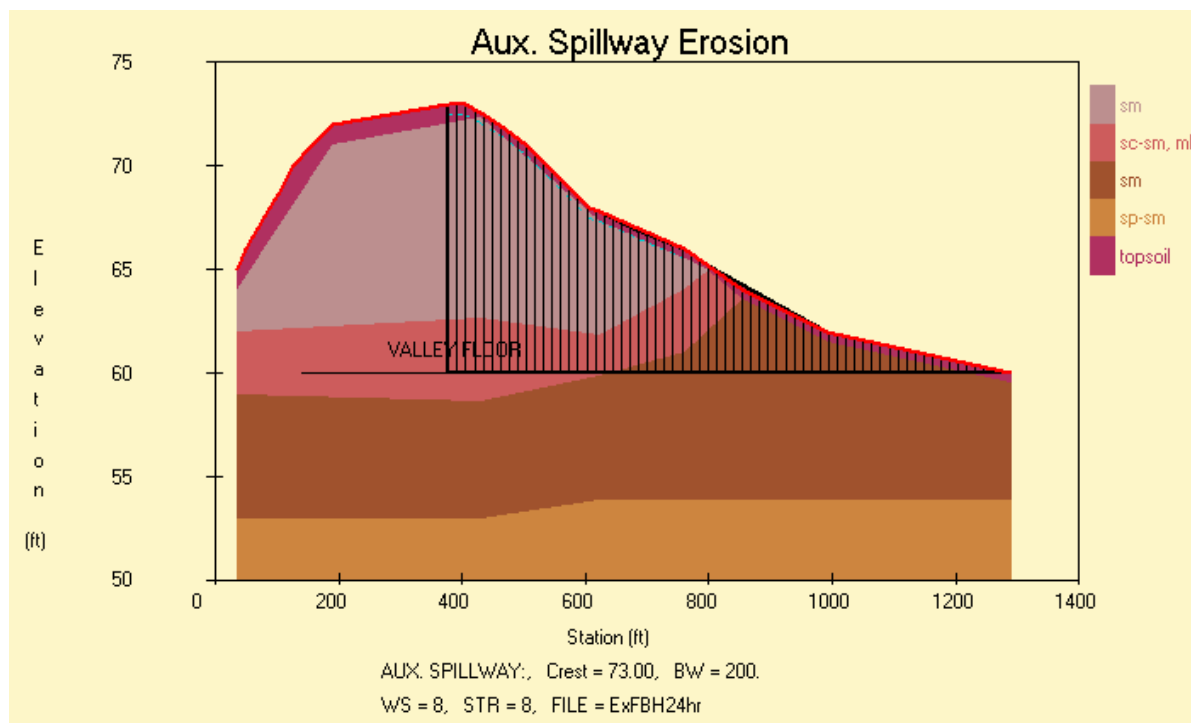


Figure C-4 – ASW Headcut Plot – 24-hour FBH

The results of the analysis also indicate that the auxiliary spillway would be engaged during the 24-hour, 50-year recurrence interval flood with peak discharge of 131 cfs and depth of flow of 0.6 ft. However, the dam continues to provide the same level of flood protection as designed. For

comparison, the 6-hour, 100-year recurrence interval that was used during the design to set the elevation of the auxiliary spillway crest does not engage the auxiliary spillway.

A summary of results for existing and future build-out conditions land use is presented in Table C-9 and Table C-10, respectively.

Table C-9 – Existing Conditions SITES Analysis Results (Existing Land Use)

Storm	6-hour Duration		24-hour Duration		10-day Duration*	
	Peak Outflow (cfs)	Peak Stage (ft.)	Peak Outflow (cfs)	Peak Stage (ft.)	Peak Outflow (cfs)	Peak Stage (ft.)
PSH (Runoff)	N/A	N/A	N/A	N/A	109.3	72.76
PSH (Rainfall)	N/A	N/A	N/A	N/A	137.9	75.32
SDH	2430	75.69	N/A	N/A	N/A	N/A
FBH	8184	78.70	7126	78.23	N/A	N/A

**Note that the 10-day results (PSH) reflect the ASW being raised to meet the PSH criteria.*

Table C-10 – Existing Conditions SITES Analysis Results (Future Build-out Land Use)

Storm	6-hour Duration		24-hour Duration		10-day Duration*	
	Peak Outflow (cfs)	Peak Stage (ft.)	Peak Outflow (cfs)	Peak Stage (ft.)	Peak Outflow (cfs)	Peak Stage (ft.)
PSH (Rainfall)	N/A	N/A	N/A	N/A	138.5	75.43
SDH	2478	75.72	N/A	N/A	N/A	N/A
FBH	8248	78.73	7152	78.24	N/A	N/A

**Note that the 10-day results (PSH) reflect the ASW being raised to meet the PSH criteria.*

Rehabilitation Alternatives

A number of alternatives were discussed at length between the Sponsors, NRCS-NJ, and the Aterra-Schnabel-JV. The objectives were to meet current safety and performance standards while maintaining recreational use of the dam and existing flood protection, both upstream and downstream. Due to significant development both upstream and downstream, alternatives that would increase top of dam or auxiliary spillway crest elevations would have a negative effect on numerous upstream properties that would have to be offset by other measures. Since the dam is not overtopped during the design event and the main dam safety issue is the integrity of the auxiliary spillway during the design event, it was agreed between the Sponsors, NRCS-NJ and Aterra-Schnabel JV that rehabilitation alternatives would focus on structural measures that would resolve the auxiliary spillway integrity issue while maintaining the existing level of flood protection. The most viable alternatives were studied in detailed and included: 1) armoring of the auxiliary spillway with roller compacted concrete; 2) construction of a straight drop spillway through the dam embankment, and 3) construction of labyrinth weir spillway through the dam

embankment. The crest of the auxiliary spillway would remain at EL 73 and there would be no increased downstream flooding and no upstream properties would be negatively impacted by the rehabilitation alternatives.

Table C-11 shows a summary of peak flows and stages for each of the rehabilitation alternatives studied in detail. Only the controlling 6-hr FBH event and the selected recurrence intervals are presented in Table C-11.

Table C-11 –Comparison of SITES Analysis Results

Alternative	FBH		25-yr		50-yr		100-yr		500-yr	
	Peak Outflow (cfs)	Peak Stage (feet)	Peak Outflow (cfs)	Peak Stage (feet)	Peak Outflow (cfs)	Peak Stage (feet)	Peak Outflow (cfs)	Peak Stage (feet)	Peak Outflow (cfs)	Peak Stage (feet)
Existing Conditions	8248	78.73	129	73.01	262	73.59	492	73.99	1265	74.79
RCC Armored ASW	8248	78.73	130	73.01	271	73.55	492	73.97	1225	74.82
Straight Drop Spillway	7972	78.85	132	73.01	340	73.40	553	73.80	1317	74.67
Labyrinth Weir	7898	78.70	131	73.01	316	73.44	506	73.89	1395	74.64

Preferred Alternative

In order to meet current safety and performance standards, maintain recreational use, maintain existing top of dam and auxiliary crest elevations, and maintain flood control to downstream properties, a structural spillway (labyrinth weir) was selected to rehabilitate the dam. This alternative consists of a 110-foot-wide, 4-cycle, 2-stage structural concrete labyrinth spillway over the embankment, a SAF stilling basin and rip-rap outlet protection, an earthen berm across the existing auxiliary spillway, a pedestrian bridge with railing over the labyrinth weir, and a trash rack bar grate on the riser to reduce the potential for the blockage by trash and debris. There will be no change in the current levels of flood protection downstream due to project activity and the 25-yr flood recurrence event will continue to be contained without overflowing the auxiliary spillway. The proposed alternative is contained within the area disturbed and filled in as part of the original dam construction. There no measures proposed for the downstream constructed channel since its dimensions are similar to those of the constructed channel downstream of the existing auxiliary spillway. Two-dimensional hydraulic modeling performed using HEC-RAS indicates that there will be no increases in flood depths downstream of the dam, including the area between the proposed labyrinth weir and the first downstream crossing. This area is already subject to flooding due to backwater conditions from the downstream crossing. The constructed channel

downstream of the proposed labyrinth weir will not be affected due to minimal increase in downstream velocities (less than 3 fps).

The proposed alternative calls for eliminating the vegetative earth auxiliary spillway from the project. To eliminate the function of the spillway, a berm will be constructed across the existing auxiliary spillway channel with an elevation the same as the crest of the dam. This berm would be about 200-feet long and have a minimum 12-foot crest width with 3H:1V side slopes. The height of the berm would be approximately 7 feet. This berm will be designed to meet the same NRCS standards for a typical dam. The footprint of this berm will remain within the original total project's footprint. Maps of the conceptual plan and profile are shown in Appendix B.

Based on the conceptual drawing developed as part of this planning effort, it is estimated that there will be 10,900 cubic yards of excavation required for the proposed labyrinth spillway and stilling basin. Of this quantity, it is expected that at least 3,600 cubic yards will be required for backfill during the construction of the labyrinth weir spillway and 1,700 cubic yards will be needed for the construction of the earthen berm across the auxiliary spillway. The remainder of the excavated soils will be wasted within the current limits of the existing auxiliary spillway.

GEOTECHNICAL INFORMATION

Regional and Site Geology: The Assunpink Creek Watershed Site 8 is located in the embayed section of the Atlantic Coastal Plain physiographic region, which extends from Maryland to Long Island. According to the USGS (Trapp, 1992), the region can be generalized as coastal marine deposits from the Upper Cretaceous period overlying Lower Cretaceous alluvial and deltaic deposits. These sedimentary deposits typically consist of quartz sands and clay lenses in near shore environments. The thickness of these deposits generally increases moving from the western boundary towards the Atlantic coast.

According to available surficial soil mapping (Stanford/NJDEP, 2014), the materials in the area comprise alluvium, consisting of gravel, sands, silts, and clays along the Assunpink stream channel, as well as Pennsauken Formation materials consisting of fluvial fine to coarse sands and clayey sands at the abutments and auxiliary spillway.

The surficial materials overlie deeper soil formations of the Coastal Plain region. According to geologic mapping (Stanford et al./NJDEP, 2018), the site is founded upon the Magothy Formation of the upper Cretaceous Epoch. The Magothy Formation can be described as very fine-to medium-grained quartz sands, and silts and clays. Underlying the Magothy Formation are the soils of the Potomac Formation. NJDEP bedrock mapping shows the deeply extending Magothy and Potomac soils rather than bedrock. Reportedly, these deep soil deposits are underlain by Mesozoic metamorphic bedrock, including schistic and gneissic materials.

Regional and Site Seismicity: The seismicity at the dam site is typical of the Central and Eastern United States (CEUS). The CEUS is a stable, intraplate region that is not nearly as active as the Western United States (WUS), which borders a plate boundary. However, CEUS earthquakes experience much less attenuation than the WUS given the thick, dense crust. Thus, earthquakes of similar magnitudes will impact a much larger region in the CEUS.

A literature review was performed of regional seismicity to identify seismogenic sources in the area and locations of significant past earthquakes. The review identified 14 Magnitude 4 (M4.0) or greater earthquakes within a 100-km radius of the dam site that are part of the CEUS Seismic Source Characterization Model earthquake catalog (CEUS-SSCn, 2012), and/or provided by New Jersey Geological Survey (NJGS). The earliest event occurred in 1737 (M5.2) and the most recent in 1964 (M4.2); magnitudes ranged from M4.0 to M5.8. Many of these earthquakes occurred before the creation of the modern-day seismic network; therefore, there is a great degree of uncertainty associated with their location and magnitude. Additionally, the reported body wave magnitude for the events was estimated from the intensity of shaking that was reported in the area.

No surficial faults that have been active during the Quaternary Period have been identified within the 100-km radius around the site. Source zones and areas of higher seismicity that may impact the site are largely concentrated in southern New York, northern New Jersey, and eastern Pennsylvania. The Ramapo Fault system consists of a series of northeast-striking, southeast-dipping faults that extend from eastern Pennsylvania to the Hudson Valley in New York. The Ramapo Fault system has not been active in the Quaternary Period. Based on the historical seismic record, and according to maps provided in USACE EM 1110-2-1806, the site is considered to be located in a moderate seismic hazard zone.

Previous Explorations

Original Design Phase Investigation

The original investigation was performed in 1965 to support the design and construction of the dam. The investigation included test borings and test pits conducted by the SCS along the proposed embankment centerline, along the centerlines of the principal and auxiliary spillways, and within the proposed borrow area located upstream of the embankment. In total, 3 borings were drilled along the dam centerline and 1 boring in the borrow area upstream of the dam. In addition, test pits were excavated including 12 test pits for the dam and abutments, 4 test pits for the principal and auxiliary spillway, and 13 test pits for the proposed borrow area.

The results of the 1965 investigation are presented in the 1966 Report titled *Detailed Geologic Investigation of Site 8* and the 1967 As-Built Drawings. The test borings and test pits primarily encountered silty alluvium material, organics, and poorly to well graded sands and gravels, underlain by Pleistocene and Cretaceous sands. The 1966 Soil Mechanics Memorandum notes that “extensive permeability tests were made in the field for three holes down into the older sediments” resulting in “low permeability to moderate in some sections (mostly 0 to 1.8 feet/day).” The results from one boring “up in the more recent open gravels showed rates of 200 to 500 feet/day. Seepage into test pits was very rapid in these recent gravels.”

Original Design and Construction Phase Laboratory Testing

The laboratory testing performed during the original design phase of the dam, with available documentation, included:

- Dry Unit Weight (Quantity and ASTM not specified)
- 3 Particle Size Distribution (ASTM D422)
- 3 Atterberg Limits (D4318)

- 3 Standard Proctor Compaction Tests (ASTM D698)

Details of the testing can be found in the 1966 Soil Mechanics Memorandum included in the documents provided to Schnabel Engineering by the NRCS.

2019 Geologic and Geotechnical Investigation

Borings and Test Pits

The 2019 geologic and geotechnical investigation was performed to explore and characterize the subsurface materials comprising the dam embankment, foundation, and auxiliary spillway. The investigation included 6 borings from the dam crest, upstream bench, and downstream toe, and 2 borings in the auxiliary spillway. The investigation also included 2 test pits at the dam downstream toe and 5 test pits in the auxiliary spillway. Open standpipe piezometers were located in two borings at the dam crest and two borings at the downstream toe; slug testing was performed in each of the piezometers.

Drilling, Sampling, and In Situ Testing Methods

Boreholes were advanced using a 4-inch inside diameter (I.D.) flush joint casing with fluid rotary (water) tricone “drive and wash” methods. The method consists of driving the casing with a hammer in advance of the boring and then drilling within the cased section using a tricone bit and fluid rotary technique. The tricone bit was not advanced beyond the tip of the driven casing, and circulation of drilling fluids (water) remained inside the casing.

The Standard Penetration Test (SPT) was performed continuously in the test borings until alternate sampling methods were used, the selected termination depth in soil was reached, and/or refusal occurred. SPTs were performed using a 24-inch long, split-spoon sampler lowered through the flush-joint casing to collect soil samples and measure the relative penetration resistance of the soils. The number of blows (blow count) of a 140-lb. hammer falling 30-inches required to drive the split-spoon sampler four consecutive 6-inch increments was recorded. The SPT N-value, recorded as blows-per-foot, is defined as the sum of the second and third 6-inch blow count intervals. The SPT samples were obtained using a 140-lb. automatic trip hammer in general accordance with ASTM D1586.

Undisturbed thin-wall Shelby tube (ST) sampling was not attempted during the investigation because fine-grained soils were not encountered.

Schnabel Engineering personnel described the collected soils in the field using visual-manual procedures as described in ASTM D2488. Final soil descriptions provided on the logs are based on the visual-manual procedures (ASTM D2488) and confirmed by laboratory testing of select samples in accordance with the Unified Soil Classification System (USCS) per ASTM D2487.

Water level measurements were taken in the borings for the presence and depth of groundwater prior to backfill or the installation of piezometers. Water levels were typically measured in each boring, both during drilling and after completion of drilling activities.

Four borings were completed with the installation of an open standpipe piezometer, with the slotted screen set at selected depths to target strata of interest based on the conditions encountered. The remaining borings were grouted from the bottom of the boring to the ground surface with cement-bentonite grout using a tremie pipe.

Test pits were excavated within the auxiliary spillway channel and on the downstream toe of the embankment using a small excavator. Soil samples were collected from the side walls of the excavation at 2-foot increments or in each distinct material encountered. Schnabel Engineering personnel described the collected soils in the field using visual-manual procedures as described in ASTM D2488 and confirmed by laboratory testing of select samples in accordance with the Unified Soil Classification System per ASTM D2487. Test pits were typically terminated at the extent of the excavator's reach, approximately 8 feet below ground surface (bgs). Test pits were backfilled and compacted in 1-foot lifts of excavated materials until restored to approximate original grade.

Laboratory Testing for 2019 Investigations

The laboratory testing performed for the 2019 geologic and geotechnical investigation included:

- D. 30 Moisture Content (ASTM D2216)
- E. 34 Particle-Size Distribution (ASTM D422)
- F. 2 Particle-Size Distribution with Hydrometer (ASTM D422)
- G. 2 Atterberg Limits (ASTM D4318)

The testing results aided in the classification of materials encountered during investigation and provided data for use with empirical correlations to support selection of material properties and engineering parameters.

Subsurface Conditions

Original Design Phase Investigation

Several geologic materials were identified at the site during the 1965 field investigation and described in the 1966 Geology Report and the logs on the 1967 As-Built Drawings. The 1965 borings within the floodplain are described as having encountered silty alluvium, overlying an organic soil along the proposed dam centerline. Below the alluvium and organic materials, encountered materials included Pleistocene silty sand, silt and clay, and poorly to well-graded gravels, underlain by sands of the Magothy Formation. The left and right abutments consisted of silty and clayey sand and silty sand or sandy silt, respectively. A portion of the steep left abutment was underlain by poorly-graded clean sand, while the right abutment was underlain by permeable gravel fill.

2019 Geologic and Geotechnical Investigation

Several different natural geologic and embankment construction material strata were encountered during the 2019 investigation. The following informal, project-specific strata names have distinct

characteristics that are identified based on visual descriptions, field testing, drilling observations, laboratory test results, and engineering properties. The soil classifications are visual-manual classifications, except at specific intervals where laboratory testing has been performed, using USCS classifications. Bedrock was not encountered during the investigation.

4. Topsoil/Surficial Soils
5. Stratum E: Embankment Fill Material
 - a. Stratum E1: Embankment Fill – Zone 1 (SP-SM, SM, ML)
 - b. Stratum E2: Embankment Fill – Zone 2 (SM)
6. Stratum A: Alluvial Material
 - a. Stratum A1: Alluvial Material – Upper Embankment Foundation (SM, MH)
 - b. Stratum A2: Alluvial Material – Lower Embankment Foundation (SW-SM, SP-SM, GW)
 - c. Stratum A3: Alluvial Material – Upper Auxiliary Spillway (SP-SM, SM)
 - d. Stratum A4: Alluvial Material – Lower Auxiliary Spillway (SC-SM, ML)
7. Stratum C: Coastal Foundation Material (SM, SP-SM, SP)
8. Toe Drain Materials (SP, GP)

Water Level Observations

Water levels were measured in the borings and piezometers during and after the subsurface investigation program to obtain information about groundwater and piezometric conditions within the dam embankment, foundation, and auxiliary spillway. When possible, initial water level readings in boreholes were generally obtained during or after drilling and prior to the installation of a piezometer or grouting; however, representative water levels could often not be accurately determined within the boreholes due to the water induced into the boring due to the drilling method and pervious nature of much of the soil materials encountered. Piezometers were installed in two borings along the dam crest and two borings at the downstream toe. The water levels recorded on the boring logs were measured before and after development of the piezometers. The four piezometers were read in February 2020 prior to performing the slug testing. At that time, all four piezometers indicated that phreatic levels within the embankment and foundation, as represented by the screened interval for each piezometer, are generally consistent at approximately EL 60 to EL 61. The pool level at the time of these readings was approximately EL 65.1.

Geotechnical Considerations

Dispersive Soils

There is no significant evidence of materials that are potentially susceptible to dispersion being present within the embankment, the embankment foundation, or the auxiliary spillway in amounts that could compromise the integrity of either structure. The majority of soils encountered during the exploration, and in particular in the Embankment E1 and E2 soils, were observed to be non-plastic to low-plasticity ($PI < 8$) and low clay content (fraction finer than 0.005mm $< 12\%$), both of which are indicative of non-dispersive soils, and therefore were not appropriate candidates for

dispersion testing. Atterberg limit testing was performed on SC-SM soil exhibiting low-plasticity within Stratum A4 and resulted in a PI of 5 and fraction finer than 0.005mm greater than 12%. In general, no significant zone or quantity of fine-grained, plastic soils was encountered that could be considered potentially problematic due to dispersive behavior. Therefore, based on the review of available data and geotechnical investigation results, dispersive soil was determined not to be a concern to the structures and further testing has not been performed.

Filter Compatibility

Schnabel Engineering performed an evaluation of filter compatibility on the toe drain materials encountered during the field investigation. The evaluation was performed using procedures outlined in NEH Part 633, Chapter 26, “Gradation Design of Sand and Gravel Filters” (August 2017). Sheet 6 of the As-Built Drawings provides two details for the constructed geometry of the two-stage filter drain: the first being where the drain is in contact only with the E2 embankment fill and A1 alluvial foundation materials, and the second where the base of the drain was constructed as a single-stage gravel filter because it is in contact with the more coarsely graded A2 alluvial foundation materials.

The function of the existing toe drain is to filter and drain seepage from the embankment and foundation materials; therefore, the analysis considered design criteria to evaluate filter only as well as combined filter and drain compatibility. The results of the analyses are summarized in Table C-12.

Table C-12 – Summary of Filter Compatibility Evaluations

Base Soil Material	Filter Material	NRCS Filter Material Compatibility	NRCS Filter and Drain Material Compatibility
E2 Embankment	Drain Sand	☐	☐
A1 Foundation	Drain Sand	☐	☐
A2 Foundation	Drain Gravel	X	X
Drain Sand	Drain Gravel	☐	X

The results indicate that the drain sand material is a compatible filter and drain for both the Embankment E2 materials and the A1 foundation soils.

The drain gravel does not meet the filter criteria as defined in the 2017 Edition of Chapter 26 of the National Engineering Handbook (NEH). For A1 foundation soil, the sand drain material is slightly too fine grained to meet the minimum D60 requirement; however, the difference is minor, and the material meets all other criteria.

The drain gravel is too fine grained to meet minimum D15 requirements to satisfy filter criteria for the drain sand material as a filter and drain; however, it does meet filter-only criteria.

The results for drain gravel indicate the gravel filter is finer than what would be designed with the 2017 version of NEH Chapter 26; however, it is Schnabel's opinion that it will adequately filter the surrounding materials and is considered acceptable as a drain for both the A2 and drain sand materials. It is worth noting that the pre-2017 version of Chapter 26 would allow the filter band to be adjusted to a finer limit such that the drain gravel would meet the pre-2017 Chapter 26 criteria.

Foundation Toe Drain System

The foundation toe drain seepage collection system consists of 6-inch diameter asbestos-cement pipes with perforated collector segments and solid outlet segments. The toe drain outlet pipes discharge through the principal spillway impact basin wing walls and are typically submerged under normal tailwater conditions. The outlets were dewatered by stopping flow through the principal spillway conduit, resulting in lowered tailwater to facilitate the visual and CCTV inspection on January 19, 2020. The video camera was advanced from the toe drain outlets, until the 90-degree turn in both pipes prevented further movement (approximately 27 feet upstream from the toe drain outlet). Observation of the inspection video indicates that the pipes had some accumulation of what appeared to be organic material in some locations, but the majority of the pipe interiors appeared to be open and no major obstructions were observed. In general, the asbestos cement outlet pipes appeared to be in good condition. Seepage flows exiting the pipe during the inspection were observed to be clear with an estimated flow rate of 1 gpm at the time of inspection.

TR 210-60 states that seepage collection and discharge systems must include access points. Due to the 90-degree bends restricting inspection of the perforated collector portions of the toe drain pipes, cleanout and inspection ports should be installed at the opposite ends of the collector pipes toward the right and left abutments, respectively.

Filter Diaphragm for Principal Spillway Conduit

TR 210-60 requires that a filter diaphragm be present around the principal spillway conduit. The As-Built Drawings do not clearly indicate whether a filter diaphragm was constructed around the principal spillway conduit. The provided As-Built Drawings are difficult to decipher, but the embankment elevation view on Sheet 4 appears to indicate that the toe drain filter trench may extend below and be at or above the spillway conduit at the location where the toe drain alignment crosses the conduit. At the spillway conduit location, the details on Sheet 6 of the As-Built Drawings indicate the bottom portion of the filter trench is likely constructed of the two-part filter such that the drain sand (Type 1 fine filter) is in contact with the foundation soils below the conduit, as well as the embankment fill beside and above the conduit. The filter compatibility calculations show that the drain sand is a compatible filter and drain for both the E2 embankment fill and the A1 foundation soils.

It is unclear whether the dimensions of the existing foundation filter drain at the conduit alignment meet requirements per NEH-628, Chapter 45, "Filter Diaphragms." However, based on a review of the As-Built Drawings, the relatively low seepage gradient from upstream to downstream, and the cohesionless, coarse-grained composition of the E2 embankment fill and the A1 foundation soils, it is Schnabel's opinion that the existing conditions at the downstream portion of the spillway

conduit appear to be adequately filtered and therefore the installation of a new filter diaphragm is not recommended.

If a new filter diaphragm is to be constructed, it would require excavating a significant portion of the downstream slope at the conduit alignment in order to achieve stable temporary excavation slopes because the embankment fill and foundation soils are predominantly cohesionless sands and silty sands. Because the excavation would create significant disturbance to the dam embankment, it is our opinion that this serves as further reason to avoid installing a new diaphragm, at least as a stand-alone rehabilitation measure.

Seepage and Static Slope Stability

Historical Concerns Regarding Seepage, Settlement, and Stability

The 1966 Geology Report notes that a permeable buried gravel channel was found underlying the extreme left side of the floodplain at a depth of 1 to 6.5 feet. The 1966 Geology Report states that rapid seepage occurred in five of six test pits dug into or adjacent to the buried gravel beneath the centerline of the dam and principal spillway. The 1966 Soil Mechanics Memorandum and 1966 Design Report recommend that this gravel layer be excavated along the centerline of the dam alignment to form a cutoff trench. It should be noted that in both original design borings (B19-01 and B19-301) performed from the crest, pervious sand and gravel materials were encountered below cutoff trench fill.

The Geology Report also identifies that the steep slope of the left abutment between the floodplain and normal pool level was underlain by poorly graded clean sand that extends for an unknown distance; seepage was noted in a test pit through that stratum. The report recommends, and the As-Built Drawings show, that a low-permeability blanket was placed to cover the exposed permeable sands below normal pool level along the left abutment upstream of the embankment.

The 1966 Soil Mechanics Memorandum states that due to stripping of the compressible, organic materials in the floodplain within the dam footprint, settlement due to dam construction was anticipated to be negligible: estimated to be a maximum of 0.2 to 0.3 feet. The 1966 Soil Mechanics Memorandum and 1966 Design Report both state that no numerical stability analyses were performed during the original design. The Memorandum states “the fill should be amply stable with the proposed 2.5:1 slopes and a 10-foot upstream berm.” The Design Report states that “no stability analysis was made due to the low fill height, but it should be amply stable with the proposed side slopes.”

Seepage Analysis

Aterra-Schnabel JV used the finite-element analysis program SEEP/W (GeoStudio, 2018 R2) to develop a steady-state seepage model for the selected cross-section located at the approximate maximum section of the dam embankment. The model was developed to evaluate piezometric and seepage conditions through the embankment and foundation and estimate pore water pressures for use in the slope stability analysis.

Preliminary seepage input parameters were selected for each stratum based on applicable published soil type correlations, soil classifications from the exploration and testing program, and the results of slug testing performed in the piezometers. The model was calibrated to obtain general agreement with the recent piezometer readings, boring moisture content profiles, sample moisture descriptions, and observed seepage flows from the toe drain pipes during the dam inspection in January 2020.

To evaluate potential changes in seepage and piezometric conditions during flood events, a transient seepage analysis was performed based on the 6-hour freeboard hydrograph (FBH) event developed as part of the SITES model for this project and as stated as the preferred procedure for flood surcharge conditions per Figure 5-3 in TR 210-60. For the transient analysis, the toe drain was modeled to mirror hydrostatic tailwater head to account for the potential for reverse flow through the outlet pipes.

Normal pool is low relative to the total height of the embankment and the reservoir is only expected to rise during flood events. The results of the steady state seepage analysis show that phreatic levels are low through the embankment upstream of the cutoff trench and generally remain within the foundation soils downstream of the cutoff trench and in the area of the toe drain. The transient FBH model indicates that during the 6-hour FBH storm, the migration of the saturated wetting front into the embankment materials is expected to be limited, and the majority of the embankment fill remains unsaturated. Based on the relatively short duration of elevated pool conditions per the results of the hydrologic and hydraulic analyses and the observed condition of the compacted embankment, it is Schnabel's opinion that internal erosion from seepage is not expected to be a dam safety issue.

Static Slope Stability

Aterra-Schnabel JV performed a two-dimensional, limit-equilibrium static slope stability analysis in accordance with Section 5 of TR 210-60, using SLOPE/W, a module within the GeoStudio 2018 R2 suite of software. The analysis considered the following load cases:

5. Steady Seepage: Normal pool EL 64.9, steady-state seepage conditions
 - a. Upstream and downstream slopes
6. Rapid Drawdown: Drawdown from normal pool level to the low-level outlet elevation
 - a. Upstream slope only
7. Flood Surcharge: Freeboard hydrograph (FBH) pool with transient headwater from EL 64.9 to EL 78.7 and transient tailwater levels from EL 60.0 to EL 69.0
 - a. Upstream and downstream slopes

The model utilizes the approximate maximum section of the dam. Embankment and foundation stratigraphy were modeled based on the data collected during the 2019 field investigation and laboratory testing program, as well as the review of historical records. The available data was used to select soil strength parameters based on a variety of applicable published empirical correlations for SPT N-values, material type, and anticipated shear behavior.

Given the cohesionless nature of the embankment materials, the slope stability models and analyses assessed both near surface failures and deeper global failures per requirements provided in TR 210-60, Figure 5-3.

For the rapid drawdown load case, a staged rapid drawdown analysis was performed, with a pre-drawdown normal pool set to EL 64.9 feet and a post-drawdown pool level at the invert elevation of the low-level outlet (EL 60.4). The drawdown analysis is based on the Duncan, Wright, and Wong (1990) method as presented in USACE EM 1110-2-1902. Undrained strengths for applicable soil materials was assigned based on anticipated permeability and shear behavior under drawdown conditions. The seepage analysis indicates migrating of the saturated wetting front into the embankment during flood conditions will be limited, and therefore stability during drawdown from flood pool conditions was not modeled.

The static stability analysis results, including minimum required factors of safety (FS) per TR 210-60 Figure 5-3, are presented in Table C-13.

Table C-13 – Static Slope Stability Analysis Results

Load Condition	Calculated Factor of Safety – Upstream Slope	Calculated Factor of Safety – Downstream Slope	NRCS TR 210-60 Minimum Required Factor of Safety
Normal Pool Steady Seepage	1.7 1.3 (Near Surface)	1.6 1.5 (Near Surface)	1.5 1.3 (Near Surface)
Normal Pool Rapid Drawdown	1.7 1.6 (Near Surface)	n/a	1.2 1.1 (Near Surface)
Flood Surge, FBH Event ¹	1.7 1.3 (Near Surface)	1.7 1.5 (Near Surface)	1.4 1.2 (Near Surface)

^{1/} Represents the critical (low) factor of safety slope stability calculated for transient FBH pool conditions based on the 6-hr FBH hydrograph for pool levels from EL 64.9 to EL 78.7. Factors of safety and location of the critical slope surface vary throughout the transient analysis as flood pool increases and recedes.

The slope stability results demonstrate that the dam satisfies minimum criteria for static slope stability for each load case considered. It is important to note that since the lower portion of the upstream slope is flatter than the upper portion of the slope, and the steeper upper portion is above the normal reservoir level, the lowest calculated factor of safety for the shallow rapid drawdown failure is higher than the lowest calculated factor of safety for shallow normal pool critical failure, which occurs above the normal pool elevation.

Embankment Seismic Performance

Peak Ground Acceleration and Earthquake Magnitude

The seismic hazard analysis presented herein consists of estimating the annual rate of exceedance of ground motion parameters of interest for design (e.g., peak ground acceleration, spectral ground accelerations, etc.) that may originate from the various earthquake sources existing around a site.

Peak ground accelerations (PGA) were obtained using the Dynamic: Conterminous US 2014 (v4.2.0) data from the online Unified Hazard Tool provided by the USGS as part of their Earthquake Hazards Program. The data indicate the horizontal PGA for boundary B/C “firm rock” (defined as having a shear wave velocity of 760 meters [2,500 feet] per second) for the dam site ranges from 0.017g to 0.320g for the 200 to 10,000-year recurrence interval earthquake events, respectively.

NRCS requires selection of a maximum design earthquake (MDE) and its corresponding PGA based on the anticipated consequence of seismic failure under normal pool conditions. Schnabel Engineering modeled a dam breach at normal pool conditions which indicates that breach flows are very small and downstream impacts are negligible such that the consequence of a seismically induced breach failure at normal pool is considered low. Per TR 210-60 Figure 4-1, the analyses consider a baseline PGA of 0.06g corresponding to a design seismic event with a 1,000-year return period.

The USGS Uniform Hazard Tool provides deaggregation of the data that was the basis of the 2014 seismic mapping. The deaggregation plot is a graphical representation of the relative contribution of various seismic sources based on magnitude and distance. The deaggregation data for the dam site indicates the mean value for the magnitude of the MDE is Mw 5.51.

Site Class and Factored Peak Ground Acceleration

The site is underlain by deep foundation soils which could result in amplification of seismic waves. Amplification factors were selected following the procedure outlined in Chapters 11 and 20 of ASCE 7-16, Minimum Design Loads for Buildings and Other Structures (ASCE 7-16). Although ASCE 7-16 is not typically applied to earthen embankments, the application of the site coefficients presented in this standard to account for soil amplification is appropriate since a site-specific seismic hazard analysis or site response analysis has not been performed. Table 20.3-1 of ASCE 7-16 provides guidance on selecting appropriate Site Class based on *in situ* testing of the subsurface materials. A Site Class D is considered appropriate for the Assunpink Dam No. 8 site based on the N-values from the SPTs performed in the foundation soils during the 2019 Investigation.

A Site Amplification Factor was applied as defined in Table 11.8-1 of ASCE 7-16. This coefficient represents the estimated site amplification within the foundation soils and is selected based on the baseline Site Class Boundary B/C PGA and specific Site Class D for the dam. The coefficient is multiplied by the Site Class Boundary B/C PGA to get the factored Class D Soil PGA. An amplification factor of 1.6 was applied, resulting in a factored PGA of 0.10g.

Liquefaction Potential

As required by TR 210-60 based on the factored PGA of 0.1g, the potential for the dam and foundation was evaluated to experience cyclic liquefaction using the methodology presented by Idriss and Boulanger in Soil Liquefaction during Earthquakes (2008). This methodology estimates a factor of safety against liquefaction for a given soil interval. A factor of safety of 1.0 or greater indicates the soil is not anticipated to experience liquefaction during the analyzed earthquake ground motions.

The borings performed during the Aterra-Schnabel field investigation were used for the evaluation. SPT N-values recorded during the field investigation were corrected to N1,60 for the liquefaction analysis to account for hammer energy, overburden, borehole diameter, rod length, and sampler type. The liquefaction potential was evaluated for the saturated embankment and foundation soils for ground motions corresponding to the factored PGA of 0.10g for an Mw 5.51 earthquake event. The results indicate that no soil zones within the embankment or foundation are anticipated to be susceptible to liquefaction under the design ground motions.

Seismic Yield Acceleration and Performance

A pseudo-static slope stability analysis was performed to estimate the seismic yield acceleration for the embankment upstream and downstream slopes. The yield acceleration is defined as the site ground accelerations at which the FS for slope stability is equal to 1.0, and above which deformation of the dam may begin to occur. Saturated soils in the bottom of the embankment fill and underlying foundation that are anticipated to experience undrained loading during seismic ground motions were modeled using estimated total stress strengths. Soils anticipated to be free-draining were modeled with effective stress strengths.

These results indicate that the yield acceleration of the upstream slope (0.24g) and downstream slope (0.22g) is greater than the minimum Class D PGA for the site (PGA=0.10g), suggesting that the slopes are unlikely to deform during a seismic event. Therefore, seismic performance is expected to be adequate.

Seismic Stability and Structural Condition of the Principal Spillway Riser

The principal spillway riser was evaluated for seismic stability in accordance with the NRCS Engineering Technical Release, TR 210-68, Seismic Analysis of Risers. This methodology uses the equivalent lateral force procedure and incorporates a spectral acceleration defined in a manner consistent with ASCE/SEI 7-16. The seismic parameters were obtained from the USGS/OSHPD seismic design maps.

The results indicate that the riser satisfies stability criteria for overturning and sliding for both loading scenarios: riser in air and riser in water. The resultant of force lies within the middle third of the foundation base for both scenarios. The factor of safety against sliding for both the conditions was observed to be greater than 1.125 as required by TR 210-68.

Structural analysis of the reinforced concrete indicates that the existing riser meets ACI 350 criteria for seismic loading, except with respect to the spacing of the shrinkage and temperature steel. The primary function of temperature and shrinkage reinforcing steel is to limit cracking during the early life of a structure. For the existing riser, concrete shrinkage has already occurred, and the structure has likely experienced numerous thermal cycles during its 54-year lifespan with no reported performance issues.

Calculated bearing pressures of the existing riser are expected to be approximately 1.30 ksf, which is within the allowable limit of 6 ksf based on NAVFAC DM 7.02, Chapter 4, Table 1, Presumptive Values of Allowable Bearing Pressures for Spread Foundations for “medium to compact coarse to medium sand with little gravel.”

Existing Conditions and Deficiencies

On January 10, 2020, Petr Masopust, PE, of Aterra Solutions, performed a visual inspection of the dam and appurtenant structures and was accompanied by representatives from Hamilton Township and NRCS. During the inspection, the low-level drain gate was successfully operated, and Pipe Data View Services performed a video inspection of the interior of the principal spillway riser and conduit using a remote-controlled rover. A summary of the site inspection observations is as follows:

- The embankment was in overall good condition with no apparent grass overgrowth. There was some minor vehicle rutting and exposed areas from the recent geotechnical exploration observed on the downstream slope of the dam and at the toe of the dam. The areas were re-seeded; however, given the time of the year, it is not expected that vegetation will be re-established before spring.
- Several animal burrows were observed along the upstream slope between the principal spillway riser and the right abutment. The diameter of the animal burrows was less than 1 foot.
- The auxiliary spillway is in generally good condition. There were areas without established vegetation, mostly where geotechnical exploration was performed in December 2019. Since the areas have been re-seeded, it is expected that vegetation will be re-established during spring. There are also some exposed areas and minor erosion at the entrance channel of the auxiliary spillway.
- The concrete principal spillway riser and trash racks were in good condition, although the trash rack for the orifice is missing. The slide gate pedestal and gate stem appeared to be in good condition. The gate was operated during the inspection and is fully functional.
- The condition of the principal spillway conduit was good without any cracks or apparent material deterioration. No apparent joint displacements or gaps were observed during the inspection. Both foundation drains had approximately an inch of sediment deposit at the bottom. The asbestos cement pipe appeared to be in good condition and there were no obstructions observed. The flow from the foundation drains was clear.
- The principal spillway conduit outlet and the impact basin were in good condition. The dam was constructed with embankment foundation drains that outlet at the end of the impact basin. Both drains were flowing. Animal guards are missing at the end of the pipes. The release channel is unobstructed.

A visual inspection of the exposed portions of the principal spillway riser was performed on February 4, 2020, by Ketan Ragalwar, PhD, EIT, who is a structural engineer from Schnabel Engineering. Visible portions of the principal spillway riser and downstream impact basin were observed to be in good condition with no visible signs of deterioration, cracking, or movement. At certain locations, concrete abrasion (exposed aggregate) was observed. However, the loss of cement paste was observed to be superficial and can be attributed to abrasion due to flowing water.

The findings of the visual inspections are as follows:

- The principal spillway riser exterior had no significant issues to report and is in generally good condition. A trash rack bar grate should be installed to the low flow orifice on the riser to reduce the potential for the accumulation of trash and debris, which could block the orifice.
- The principal spillway riser meets NRCS criteria for sliding and overturning stability.

The findings of the current geotechnical explorations indicate that dispersive soils are not considered a potential threat to the integrity of the dam or auxiliary spillway. Based on analyses by Schnabel Engineering, the embankment satisfies minimum NRCS criteria for seepage, static slope stability, liquefaction, and seismic performance.

The foundation toe drain appears to be functioning with no observed evidence of clogging or sediment migration. The filter compatibility analysis indicates the toe drain gravel materials are slightly too fine grained and do not meet the 2017 NRCS filter and drain criteria for the A2 foundation base soils and the drain sand base material. However, the drain gravels are considered to be an acceptable filter and drain when evaluated based on pre-2017 versions of NEH Part 633 Chapter 26. The current 2017 version of Chapter 26 is more restrictive, but, in Schnabel's opinion, the results do not warrant full replacement of the filter and toe drain at this time. In accordance with TR 210-60, Schnabel recommends that cleanout and inspection ports be installed at the opposite ends of the toe drain collector pipes toward the right and left abutments, respectively. During construction, the existing perforated collector segments should be video inspected to further evaluate the performance of the filter drain and the condition of the existing asbestos-cement pipes. If the condition and/or performance of the filter drain system is found to be worse than anticipated, additional consideration should be given regarding rehabilitation or replacement of the drain system.

Although it is unclear whether the dimensions of the existing foundation filter drain at the conduit alignment meet requirements per NEH-628, Chapter 45, "Filter Diaphragms," it is Schnabel's opinion that the existing conditions at the downstream portion of the principal spillway conduit appear to be adequately filtered. Installation of a new filter diaphragm as a stand-alone rehabilitation activity is not recommended. However, if rehabilitation alternatives to address other dam safety deficiencies require earthworks impacting the embankment downstream slope at the principal spillway alignment, consideration should be given to installation of a new filter diaphragm and replacement of the existing foundation toe drain, because impacts and modifications to this area of the dam embankment would already be required.

SOCIAL AND ECONOMIC CONDITIONS

Economic Analysis

The NRCS National Watershed Program Manual (NWPM) was used as a reference for the economic analysis along with two economic analysis guidance documents: Water Resources Council's "Principles and Guidelines for Water and Land Related Resources Implementation Studies (P&G)," December 1983; and the "National Resource Economics Handbook, Part 611 Water Resources Handbook for Economics," USDA/Natural Resources Conservation Service, July 1998.

In general, the National Economic Development (NED) benefits presented in this supplemental plan were developed based on P&G utilizing methods of updating rural community (urban area, road and bridge, other infrastructure) flood reduction benefits. In order to display annual benefits of Assunpink Creek Dam No. 8 for the structural scenario (rehabilitation of the dam), depicting average annual floodwater damages as the result of no dam in place was compared to average annual floodwater damages with the dam in place.

According to the P&G, the alternative that maximizes net economic benefits is referred to as the NED alternative and will be the preferred alternative. The Sponsors have indicated that without federal assistance, they would rehabilitate the dam according to NRCS standards.

In a letter dated July 6, 2020 the Township of Hamilton stated: “For purposes of establishing a “No Federal Action Alternative”, in the absence of federal funding, the Hamilton Township would implement the Federally preferred alternative according to NRCS standards and specifications.” P&G allows for abbreviated procedures commensurate with the planning and policy context to be used (P&G section 1.7.2 (a) (4) (ii)), when more detailed analysis will not alter identification of the recommended NED alternative. In this case, the future without federal project and the future with federal project involve the same least-cost alternative with comparable scope, effects, benefits, and costs. No net change in benefits occurs when comparing the two candidate plans to each other.

Per use of abbreviated procedures allowed by P&G and NRCS policy, avoidance of the local cost is claimed as the benefits of the federally led dam rehabilitation. The federally assisted alternative as displayed credits local costs avoided (Total Adverse Annualized for the Future Without Federal Project scenario) as adverse beneficial effects (Total Beneficial Annualized) consistent with P&G 1.7.2(b)(3). Thus, although the average annual benefits of rehabilitation are \$236,600, net benefits are zero because the total project cost is equal to the claimed benefits and the resulting B/C ratio is 1:1. However, an effort was made to estimate updated benefits of Dam No. 8. Discussions of updated benefits begin in the *Stream Crossings and Roadways Damages* section below.

In addition, one other overarching concern associated with dam rehabilitation analyses is the intent of the program to minimize threat to human life. Threat to human life is central to the dam rehabilitation program. Agency policy allows for use of the other social effects goal (account in P&G terms) to make the case for rehabilitating any given floodwater detention structure, even if the associated B/C ratio is less than 1:1. This is due to a priority placed on protecting lives. Also, trying to monetize the value of life, or in the case of dams, avoidance of loss of life, is fraught with subjective value judgments. Threat to human life can therefore be used to supersede purely economic considerations when deemed appropriate.

Stream Crossings and Roadways Damages

According to the New Jersey Department of Transportation, the 2016/17 average daily traffic counts for the downstream project area totaled 46,023 (daily traffic counts for some of the roads were not available). Flood damages were estimated by storm frequencies. Using current construction costs for the crossings and roadways, average annual floodwater damages were

calculated for the no dam and the with dam scenarios, the difference being damage reduction benefits.

For the breach analysis, NRCS policy, “Guidance for Completion of Evaluation of Potential Rehabilitation Projects” dated December 10, 2001, updated July 5, 2013, was utilized to estimate population at risk (PAR) for motorists and persons at risk in buildings downstream of the dam. The worksheet used to calculate PAR is separated into three sections: Structures (Elevated) Impacted by Potential Breach (i.e., mobile homes, etc.); Structures (with Foundations) Impacted by Potential Breach (homes, condos, commercial buildings, schools, etc.); and Highways and Railroads.

For the Highways and Railroads section, PAR is limited to road overflow depth (100-year storm) of 1.0 foot and greater. PAR where road overflow of less than 1.0 foot is not considered. Therefore, because the PAR estimation takes effect only at 1.0 foot of floodwaters’ depth and above, it was determined that PAR instructions would be utilized in the economic analysis, which meant that any crossing with impact of flooding of less than 1.0 foot would not be a part of the economic analysis. Eight stream crossings and 64 roadways were affected by flooding under the without dam scenario with floodwater depths greater than 1.0 foot. A customized Excel worksheet (which has been utilized in multiple water resource projects in the past) was used. As per the project statement of work, floods from the 10-year through the 500-year storms were included in the worksheet to estimate average annual damages to stream crossings and roadways. Damages were based on current construction and/or repair values associated with roadways and bridges. Results were used in the economic analysis. Table C-14 summarizes average annual floodwater damages and benefits for the crossings and roadways.

**Table C-14 – Summary of Stream Crossings/Roadways Floodwater
Average Annual Damages and Benefits**

Location of Stream Crossing/Roadway	ADT (#) ^{1/}	Average Annual Damages		Average Annual Benefits
		Without Dam	With Dam	
<i>Crossings</i>				
8 Crossings	31,986	\$11,800	\$11,300	\$500
<i>Roadways</i>				
64 Roadways	14,037	\$411,200	\$367,900	\$43,300
TOTALS	46,023	\$423,000	\$379,200	\$43,800

^{1/} Average Daily Traffic, New Jersey Department of Transportation.

Urban Damages

Current, local tax appraisal district records were utilized to obtain the structural values of about 870 residences and apartments (about \$81 million, which includes outbuildings), 65 commercial (about \$27 million), and 21 public properties (about \$1.4 million) that would be affected by project activities. Content values were estimated as a percentage (75%) of assessed property values. Estimated floodwater depths for various storms per the project statement of work (10-year storm through the 500-year storm) for each structure were based on the results of the hydrology and hydraulics (H&H) simulation modeling. Using photos taken during a field review in June 2019,

elevation where damage starts for each property was estimated (e.g., basement window elevation of first floor elevation). Floodwater data was then used with water depth-to-damage functions provided by NRCS to estimate structural and content damage. These depth-to-damage functions were specific for 1) different types of residences (i.e. one or two story homes with or without basements; split-level homes; mobile homes; apartments; etc.); and 2) over 180 different type of commercial and public properties. A similar analysis was conducted for vehicles located at residences and businesses within the floodplain area. It was estimated that each affected residence would have a minimum of two vehicles and two to six for the commercial and public properties. All estimated values and damages were assessed within a customized Excel template prepared for this purpose. NOTE: There were no critical facilities affected by the 500-year frequency storm event without the dam scenario.

Summary of Floodwater Damages and Benefits

As mentioned earlier, the Township of Hamilton would rehabilitate the dam with local funds if federal funds were not available. However, an effort was undertaken to update floodwater damage reduction benefits that the dam is currently providing. Table C-15 reflects floodwater damage reduction benefits of the project. Note: Since one of the purposes was to provide current level of flood protection, the with dam scenario also reflects conditions with the rehabilitated dam.

Table C-15 – Floodwater Reduction Damages/Benefits Summary

Item	Average Annual Values		
	Damages Without the Dam	Damages With the Dam	Benefits
Floodwater Reduction			
Urban Structures	\$2,044,800	\$1,758,600	\$286,200
Vehicles	\$361,400	\$314,500	\$46,900
Road and Bridges	\$423,000	\$379,200	\$43,800
Subtotal	\$2,829,200	\$2,452,300	\$376,900
Total Floodwater Reduction	\$2,829,200	\$2,452,300	\$376,900

As reflected in Table C-15, current average annual floodwater damages with the dam are \$2,452,300. Floodwater damages without the dam were estimated to be \$2,829,200. The difference of \$376,900 reflects the average annual benefits that the dam currently provides to downstream properties.

However, according to P&G 2.1.3, the benefit stream, deferred installation costs, and OM&R costs were discounted to the beginning of the period of analysis using the applicable project discount rate. Installation expenditures were brought forward to the end of the period of installation by charging compound interest at the project discount rate from the date the costs are incurred. Then, the project discount rate was used to convert the present worth values to average annual equivalent terms.

Since the installation period is three years, the benefits were discounted for three years, resulting in average annual benefits of \$366,200 for each alternative. The deferred installation costs and OM&R costs were also discounted for three years, and the installation costs were charged interest over the three-year period based on the year of implementation. Adhering to the guidance from P&G 2.1.3 resulted in the following:

Alternative	Average Annual Benefits	Average Annual Costs	Net Benefits	B/C
Alternative 1:	\$366,200	\$305,500	\$60,700	1.20
Alternative 2:	\$366,200	\$278,200	\$88,000	1.32
Alternative 3:	\$366,200	\$236,600	\$129,600	1.55

As reflected above, Alternative 3 maximizes net benefits and produces the greatest B/C ratio.

Incidental Recreation Benefits

There is a paved walking/jogging trail across the top of the dam. During the field review, it was evident that the trail is heavily used. However, according to Hamilton Township officials, no record of number of annual visitor-days was available, nor was any official willing to pose an estimate. The trail will be impacted during construction, but recreational activities are expected to return to before construction levels once the rehabilitation is completed. No new investments in recreational facilities are planned and recreation benefits are not claimed as a part of project benefits. Therefore, incidental recreation occurring as part of the site is expected to continue, but was not evaluated, and no recreation benefits/costs are included in the economics tables.

Population at Risk (PAR)

Due to the potential catastrophic nature of a breach of Dam No. 8, population at risk (PAR) was estimated. It should be noted that estimating a number for population at risk is based on professional judgment coupled with empirical data. However, conservative means were utilized to hopefully avoid misconceptions of the PAR leading to unwarranted fear. PAR estimates were provided for motorists, residents, and other people located downstream affected by the breach. These include people in cars (motorists) traveling on roads downstream of the dam and those living in homes and working in businesses and public properties.

Guidance for Completion of “Evaluation of Potential Rehabilitation Projects,” December 10, 2001, updated July 5, 2013, was utilized to estimate PAR for residences and motorists downstream of the dam. According to the guidance, 3 people per residence or business are estimated to be at risk where floodwaters are greater or equal to 1.0 foot inundation depth above natural ground elevation. For paved roads with predominantly local traffic, two PAR are estimated to be at risk where floodwaters are road overflow depth of greater or equal to 1.0 foot. For state and federal highways with predominant traffic including non-local vehicles, four PAR are estimated to be at risk.

An analysis of a PMP event with no breach scenario was compared to a PMP event with breach scenario. The difference would reflect the impact of a breach (dam failure) to downstream buildings and infrastructure during a PMP event. It was estimated that 2,073 buildings (1,777 residences, 156 apartment buildings, 99 businesses, and 41 public buildings) would be affected by a breach of Dam No. 8. However, it was determined that based on the afore-mentioned PAR

instructions, only 292 residences, 0 apartment buildings, 1 business, and 6 public buildings would have PAR associated with them, resulting in 911 PAR for the urban buildings.

Ninety-eight city streets and nine crossings with predominantly local traffic would be affected by impacts from a breach. However, only 12 streets and no crossings qualified for PAR based on the aforementioned PAR instructions. Two people per vehicle were used. Therefore, for the 12 local roads and using 1 vehicle per road, 24 motorists in 12 vehicles would be at risk. Based on the above-mentioned scenarios, total PAR was estimated to be 935.

According to the National Watershed Program Handbook (NWPH) part 601.12(13), an effort must be made to predict if there is a risk to loss of life from the 100-year and 500-year floods. In order to estimate this risk, PAR is multiplied by the fatality rate as calculated in the Evaluation of Potential Rehabilitation Projects Worksheet for each dam failure scenario.

Dam Failure Scenario	PAR	Fatality Rate	Loss of Life
Hydrologic	935	0.007	6.5
Static	8	0.007	0.06
Seismic	6	0.007	0.04

As reflected above, only the hydrologic dam failure scenario would result in risk to loss of life. This scenario is based on a flood event that far exceeds the 100-year or 500-year floods. Therefore, there is no threat to loss of life from the 100-year or 500-year floods.

Period of Analysis Determination

Schnabel personnel conducted a one-day sonar survey for bathymetric and sub-bottom profiling to estimate the depth of water and accumulated sediment within the accessible areas of the reservoir on November 13, 2019. The sediment survey report indicated that the current submerged sediment accumulated in the reservoir is 32.6 ac-ft. The top of the sediment is not level but ranges from EL 62.4 to 64.9 feet (the principal spillway crest). The report also indicates that the future sedimentation rate was estimated to be 0.30 ac-ft/year. Thus, here is adequate sediment capacity in the normal pool for 52 – 57 years. A mid-point of 55 years was assumed. After this 55-year period, there would be 49.6 ac-ft of submerged sediment in the reservoir at EL 64.9 feet. Since this is the elevation of the principal spillway crest, this is the maximum elevation of submerged sediment that would allow the dam to still provide adequate flood detention storage. Even though 55 years of sediment storage capacity is currently present, an analysis was conducted to determine the most economical period of analysis.

Fifty-, 75-, and 100-year expected useful lives were evaluated (53-, 78-, and 103-year periods of analysis including 2 years for design and 1 year for construction). A net present value analysis was conducted comparing the three alternative periods of analysis. Average annual values were also estimated. All costs of installation, operation, and maintenance were based on 2020 prices. The costs associated with designing and implementing all structural measures were assumed to be implemented over the three-year period. The federal action with a 53-year period of analysis yielded the highest net benefits using the mandated 2.50% discount rate for all federal water resource projects for FY-21 to discount and amortize the anticipated streams of costs and benefits.

In order to prolong the life of the sediment pool, an analysis was completed that involved dredging the sediment pool. Two scenarios were investigated: 75 years and 100 years. From Schnabel's report, the future sedimentation rate was estimated to be 0.30 ac-ft/year. This equates to 484 cubic yards/year of sediment. Using a baseline of 55 years, for a 75-year period of analysis, this would mean that for an additional 20 years, 9,680 additional cubic yards of sediment storage would be required at a cost of \$834,000. For the 100-year scenario, for an additional 45 years, 21,780 additional cubic yards of sediment storage would be required at a cost of \$1,877,000. Because there is currently greater than 50 years of sediment storage capacity remaining (minimum requirement for the Dam Rehabilitation Program) and due to the additional costs, dredging was not considered a valid addition to any alternative.

Floodpool Risk Analysis

Planning principles were used to conduct an analysis of the risk associated with induced flooding due to floodpool water levels above the elevation of the flowage easement and the potential cost of meeting top of dam (TOD) easement policy. There are a total of 62 buildings (55 houses, 5 public buildings, and 2 commercial properties) and either whole or parts of 214 parcels currently below the TOD elevation.

The Hamilton Township flowage easement is at EL 73.1 feet, which is the elevation of the crest of the auxiliary spillway (ASW). The impacted acreage at the elevation of the flowage easement is 119.6, and the impacted acreage at the elevation of the top of dam (EL 79.4 feet) is 298.0, a difference of 178.4 acres. For the existing structures below TOD, the elevation where damages begin was obtained, or point of water entry into the buildings. This information was used to estimate potential structure and content damages to the existing structures below TOD.

For the analysis, the following assumptions were made: (1) the cost of easements for the added 178.4 acres of land (easement encumbrance costs and legal fees for each parcel owner); (2) the value of structures and parcels for the 62 structures based on average tax assessor values; and (3) estimated damages from all storm events, as represented by the following specific modeled storms: 100-year, 200-year, 500-year, 1,000-year, and PMP event for the with rehabilitation conditions.

In order to determine the NED easement elevation, an economic analysis of the various flood events upstream of the dam was completed. Average annual costs for each storm event induced from floodpool damages (average annual value of floodpool damages avoided) was compared to average annual cost of each procured easement (cost to avoid possible damages). The results are presented in Table C-15. Based on the analysis, the current easement elevation of 73.1 NAVD 88 was the NED flood event. As the table reflects, none of the flood events produced positive net economic benefits, but the current easement elevation level resulted in zero net benefits; therefore, it is the NED elevation.

However, NRCS policy [National Watershed Program Manual, 504.3(C.)(1)(iii)] states "For watershed rehabilitation projects the minimum land rights area upstream from the dam must be for all areas below the elevation of the top of the dam, unless the plan allows a lower elevation (not lower than the elevation of the 100-year, 24-hour storm or auxiliary spillway elevation, whichever is higher).

- If the land rights elevation is lower than the top of the dam, the rationale for the selected elevation of required land rights must be discussed in the plan and a provision must be included in the watershed agreement that describes the potential risk and liability the sponsors and landowners may be assuming by not securing land rights to the top of dam elevation.

- The land rights must include a prohibition on future construction of inhabitable dwellings upstream from the dam below the elevation of the top of the dam. All land rights must be identified by metes and bounds surveys conducted by a professional land surveyor.”

For Assunpink Dam No. 8, the minimum NRCS easement elevation is the water surface passage of the 100-year, 24-hour storm through the dam. This equates to an elevation of 74.0 (Table C-16). Therefore, to meet minimum NRCS policy, Hamilton Township must procure 5.86 acres of flood storage easements upstream of the dam between EL 73.1 and 74.0.

As noted in Table C-16, the estimated cost of procuring 5.86 acres of additional land rights is about \$897,000. However, it should be noted that this estimate was from a Hamilton Township employee and not from a certified appraiser or the Township’s attorney. Efforts were made to obtain an opinion from the Township’s attorney but were unsuccessful. In order to procure the additional land rights, the Township will need to hire a certified appraiser to estimate the value of the land rights with a development restriction. Such value could be more or less of the estimated \$897,000.

Table C-16 – Economic Analysis of Various Floodpool Easement Elevations

Elevation Level	Elevation ^{1/}	Additional Residential Acres Needed	Additional Commercial Acres Needed	Additional Public Acres Needed ^{2/}	Total Additional Acres Needed	Cost of Additional Purchases ^{3/}	Average Annual Cost of Additional Purchases	Average Annual Benefits ^{4/}	Net Benefits
TOD	79.4	42.8	14.3	0.0	57.1	\$55,124,900	\$1,515,900	\$26,400	-\$1,489,500
1,000-year	75.2	10.4	2.6	0.0	13.0	\$5,350,700	\$147,100	\$11,000	-\$136,100
500-year	74.8	7.3	2.2	0.0	9.5	\$1,452,500	\$39,900	\$9,500	-\$30,400
200-year	74.3	5.1	1.6	0.0	6.6	\$1,014,200	\$27,900	\$6,700	-\$21,200
100-year	74.0	3.0	2.86	0.0	5.86	\$896,600	\$24,700	\$2,200	-\$22,500
Current Easement	73.1	0.0	0.0	0.0	0.0	\$0.0	\$0.0	\$0.0	\$0.0

^{1/} NAVD 88

^{2/} Land owned by Hamilton Township. Assumed Township would restrict development; thus no easement needed.

^{3/} Costs include acquisition of buildings, land, legal fees, deed search, title fees, and closing costs.

^{4/} Floodpool damages avoided due to easement acquisition.

This analysis, along with alternatives for managing floodpool risk, was presented to the Hamilton Township. The alternatives presented were: (1) procure the minimum land rights and accept the potential risk and possible associated implications (whatever they might be) of not procuring land rights to top of dam; (2) acquire easements to the top of the dam; (3) procure an insurance policy explicitly for the floodpool risk; (4) attempt to acquire a waiver of the risk from all property owners for the 62 existing buildings and landowners of affected parcels with property below the top of dam; and/or (5) pass a setback ordinance preventing future development below the top of dam.

Hamilton Township decided to procure additional flood storage easements of 5.86 acres according to minimum NRCS land rights' policy. They prefer to live with this level of easement and its associated risk for potential damages. They accepted and have lived for over 50 years with the existing easement and its associated potential for risk of flood damage. They also recognize that the land rights must include a prohibition on future construction of inhabitable dwellings upstream from the dam below the elevation of the top of the dam.

ENVIRONMENTAL INVESTIGATIONS AND ANALYSES

EA Engineering, Science, and Technology, Inc. (EA) provided the environmental information on this project to Aterra Solutions who compiled the input into the Assunpink Dam No. 8 Plan-EA. The principal objective of this project is to provide NRCS with a NEPA analysis and supporting written documentation, which comprehensively includes objective appraisals of the positive and negative effects of the proposed action and alternatives implementation methods and sites, including mitigation measures. The purpose is to describe the existing environmental conditions and resources on site, and specific resources that could be impacted by their presence in the defined project area. The resource areas covered by the Affected Environment Report include soils, water resources, air quality, terrestrial vegetation, animals, cultural resources, land use, recreation, and scenic beauty. The Affected Environment Report is in the administrative record for the project.

Soils

Soil information presented in this report was summarized from USDA NRCS Web Soil Survey (WSS) data (USDA NRCS 2019a). Online soil data from WSS was utilized in the analysis of project impacts and no field surveys were conducted as a part of this project.

Geology

Geologic units in the LOD were identified using the 1:250,000 U.S. Bedrock Geologic Map of New Jersey (New Jersey Department of Environmental Protection [NJDEP] Bureau of Geographic Information Systems, 2019a). Descriptions of the formations were obtained from the New Jersey Geological and Water Survey (2014).

Water Resources

Assunpink Dam is a flood control structure located on Pond Run, a tributary of Assunpink Creek, and is located approximately 4 miles upstream of the confluence of Pond Run with Assunpink Creek. The dam and the park area immediately surrounding the dam are located atop the New Jersey Coastal Plain Aquifer. The catchment of Assunpink Dam is an area of approximately 3 square miles. Based on the U.S. Environmental Protection Agency (EPA) definition, Veterans Lake and Pond Run are considered Waters of the United States (EPA 2019a; U.S. Army Corps of Engineers, 2012). Veterans Lake and Pond Run are considered impaired waters by EPA and NJDEP. EPA and NJDEP document that the 303(d) listed impairment for the impoundment and Pond Run is for aquatic life, and the listed cause of the impairment is total suspended solids and turbidity (EPA, 2017). The National Wild and Scenic Rivers System website indicated that there are no wild, scenic, or recreational rivers in or near Assunpink Dam. The dam is located within a tidally influenced municipality, however, it is not part of the area defined under the NJ Coastal Facility Review Act which defines the inland limits of areas requiring Federal Coastal Consistency Determinations. These Programs do not consider the river that the dam is located on, Pond Run, as being a tidally influenced river.

Wetlands

Wetlands information used in the plan was obtained from the USFWS National Wetlands Inventory (NWI) data. The NWI is a publicly available resource that provides detailed information on the abundance, characteristics, and distribution of U.S. wetlands. NWI data was used to determine wetlands impacts; an official wetlands delineation in the LOD was not conducted as a part of the assessment of project impacts.

Floodplains

Floodplain data was obtained from the Federal Emergency Management Agency (FEMA) flood insurance rate map for the study area (Panel 34021C0233F) effective 20 July 2016. According to the FEMA map, the dam and portions of the LOD are located in a special flood hazard area with base flood elevations between 65 and 74 feet along Pond Run.

Air Quality

According to the EPA Green Book for 8-Hour Ozone (2015), which provides information about designations, classifications, and nonattainment area status for the 8-Hour Ozone (2015) National Ambient Air Quality Standards (NAAQS), the entirety of Mercer County is located in a nonattainment area for ozone (EPA, 2019c).

Plants

Vegetation communities and land cover types present in the project area were mapped using the NJDEP Modified Anderson System (2015). Sixteen discrete communities or land cover types occur in the general area, including artificial lakes, commercial/services, deciduous forest, deciduous scrub/shrub wetland, deciduous wooded wetlands, herbaceous wetlands, managed wetland in maintained recreational area, mixed forest, old field, other urban/built-up land, recreational land, residential, stormwater basin, streams and canals, transportation/communication/utilities, and uplands right-of-way (NJDEP 2015). Additionally, information from USDA, New Jersey Trails Association, and NJDEP Division of Land Use Regulation was used to obtain a general sense of common trees, bushes, and plant species in the area, since official field surveys were not conducted for this project. No on-site surveys were conducted as part of this analysis to determine the presence or absence of plants, including State Status Plan Species and Noxious/Invasive Weeds.

Special Status Plant Species

A USFWS Information for Planning and Consultation (IPaC) report was generated for the project. The report did not list any threatened or endangered plant species in the project area. The New Jersey Natural Heritage Program (NHP) lists rare and endangered plant species by county and there are several species listed for Mercer County (NJDEP Division of Parks and Forestry, 2019). No endangered plant species have been identified near the dam using the data publicly available by the New Jersey NHP. Formal consultation with New Jersey NHP on 7 November 2019 confirmed that there are no rare plant species occurrences within 1 mile of the Assunpink Dam No. 8 site.

Noxious Weeds and Invasive Plants

There are 5 plant species classified by the New Jersey Department of Agriculture as prohibited weed seed, and 19 plant species that are classified as restricted weed seeds (New Jersey Department of Agriculture, 2016). During site reconnaissance on 25 June 2019, an approximately 0.2-acre stand of Phragmites (*Phragmites australis*), which is a federally listed invasive plant species, was observed in a depressed wet area directly upstream of the northern end of the dam embankment, approximately 50 ft east of the LOD.

Animals

Threatened and Endangered Species

A USFWS IPaC report along with official correspondence with USFWS has been completed for the project site, and one federally threatened species was found to be potentially present in the project area: the northern long-eared bat (NLEB) (*Myotis septentrionalis*). The species are not known to exist in the LOD. The IPaC also listed several migratory birds, including bald eagles, which have the potential to be present in the project area during portions of the year. The IPaC species list and correspondence with USFWS fulfill the requirements of Section 7 of the Endangered Species Act.

Formal consultation with NJDEP NHP indicated that the Area of Initial Analysis (AIA), (which includes the LOD) contains “occupied habitat” for the Threatened wood turtle (*Glyptemys insculpta*) and the species of Special Concern Eastern box turtle (*Terrapene carolina carolina*), which has been observed by local volunteers in the park. Additionally, the species of Special Concern Fowler’s toad (*Anaxyrus fowleri*) has been observed within Hamilton Veterans Park by local volunteers and was identified by residents during the scoping meeting as being potentially present in the AIA. However, NJDEP has not conducted any official surveys within the AIA, and the resident and volunteer observations have not been confirmed by NJDEP.

The NJDEP habitat ranking system was used to identify and rank habitats that have occurrences or potential occurrences of Special Concern, Threatened, or Endangered species in the LOD.

Cultural Resources

Initial research on the NJDEP open source database on November 14, 2019, indicated that no historical districts, properties, or archaeological resources were present in the LOD (NJDEP Bureau of GIS 2019a, 2019b). Additionally, the NJHPO responded to the project consultation on 23 September 2020 and stated:

“Upon review, HPO records do not identify and known historic or archaeological properties in or near the project site. The mid - twentieth century earthen dam does not appear to meet any of the criteria for inclusion on the National Register of Historic Places. The identified areas of ground disturbance appear to be within the earthen dam, previous quarry areas, or surrounding poorly drained soils. These areas possess a low sensitivity for any significant archaeological resources.”

The NJSHPO also concluded that “the HPO would not recommend the need for any additional consideration of project effects on historic or archaeological resources.”

According to the National Conference of State Legislature list of tribes, there are no federally recognized Indian tribes located in the State of New Jersey. However, there are four tribes with a Federally recognized interest in Mercer County, NJ: Absentee-Shawnee Tribe of Indians of Oklahoma, Delaware Nation, Oklahoma, Delaware Tribe of Indians; and Shawnee Tribe. NRCS sent consultation letters on 2/3/21 to these four tribes and none of the tribes responded to the consultation letters.

Natural Areas, Parklands, Recreation, and Scenic Beauty

According to the NJDEP Division of Parks and Forestry Natural Areas System Rules in N.J.A.C. 7:5A, Assunpink Dam is not located in an officially designated state natural area, as defined by USDA National Environmental Compliance Handbook Part 610.32.

A representative of the Hamilton Township NJDEP Green Acres Program was consulted regarding project impacts to Veterans Park.

Information regarding recreational land in the LOD was obtained from the New Jersey Trails Association (2014).

The definition of scenic beauty from USDA National Environmental Compliance Handbook Part 610.35 takes into consideration landforms, water, vegetation, and structures, which all exist around Assunpink Dam. Although a specific metric was not used to evaluate scenic beauty, it was assumed that the scenic beauty and the rural nature at the dam site (and in the LOD) are highly valued by local residents and are what draw visitors to the park.