Project Name: Brandywine Creek Shad Restoration Project

Organization Name: The Nature Conservancy and University of Delaware Water Resources Center

Project Type (Place a check mark next to **one** category that best describes the project):
( ) Habitat Restoration* (✓) Fish Passage ( ) Shellfish Restoration ( ) Species Conservation ( ) Invasives Control
( ) Stewardship ( ) Watershed Planning ( ) Sustainable Watershed Assets

1. **Conservation Outcome(s):** Elaborate on the long-term conservation outcome(s) summarized previously in the application; discuss what makes the outcome(s) achievable and important.

The Nature Conservancy of Delaware (TNC) and University of Delaware Water Resources Center (UD) propose to collaborate with the City of Wilmington to conduct a feasibility study, prepare conceptual engineering drawings, and initiate permitting and regulatory approvals to restore fish passage, specifically American shad, hickory shad, river herring, striped bass and other anadromous species, to the Brandywine Creek through the City of Wilmington, Delaware. The long-term conservation outcome of this proposal is to restore fish passage and habitat to the 320 sq. mi. Brandywine Creek watershed by removing on-stream dams and/or installing fish ladders, fish notches, rock ramps or bypass channels. Map 1 depicts the 11 dams along the creek that will be the focus of this analysis. Currently there are 11 low head (2 ft to 10 ft high) dams along 7.2 miles of the Delaware portion of the Brandywine Creek that stretch from tidewater upstream into the Piedmont to 120 ft above sea level (Table 1). The known dams in Delaware include Dam 1 (West Street), Dam 2 (Brandywine Park City Dam), Dam 3 (Augustine Mill), Dam 4 (Bancroft Mills), Dam 5 (Brandywine Falls), Dam 6 (DuPont Research), Dam 7 (Breck's Mill), Dam 8 (Henry Clay Mill, Hagley), Dam 9 (Upper Hagley), Dam 10 (Eleutherian Mills), Dam 11 (Rockland Mills).

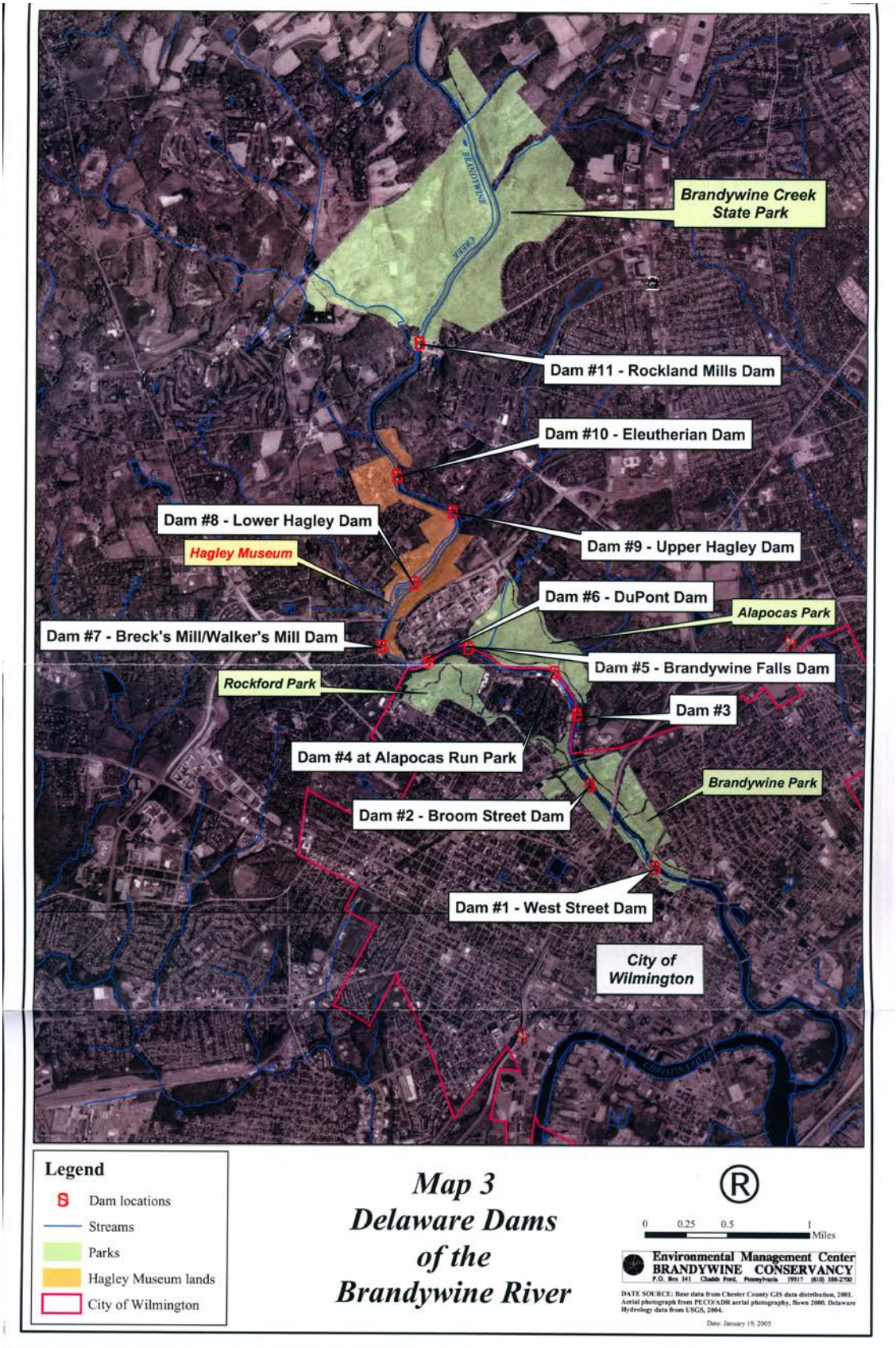
American shad {Alosa sapidisimmd) were once an abundant migratory fish found throughout East Coast rivers and streams of North America, including the Brandywine River in Delaware and Pennsylvania. Shad were an important part of Native American and early colonial diets, and later, were the basis of an important commercial fishery in larger rivers like the Susquehanna and Delaware. Spring runs of shad comprised a unique and dramatic natural phenomenon, now a lost part o f our cultural heritage.

Shad restoration efforts are underway in numerous rivers and streams along the East Coast. A 1985 study titled *A Review and Recommendations Relating to Fishways Within the Delaware Basin* commissioned by the Delaware Basin Fish and Wildlife Management Cooperative identified three tributaries historically used by shad for spawning which had "the greatest potential for restoration of the American shad." These include the Lehigh, the Schuylkill, and the Brandywine Rivers. The following is a report on the current state of dams along the Brandywine River. Restoring shad to the Brandywine River has important economic, ecological, and cultural benefits for the Brandywine Valley region generally and the Wilmington area specifically.

The following is a summary table on the 11 dams on the Brandywine River, a map highlighting the dams and relevant landmarks, a report detailing each dam, along with photographs of the dams in their current state during the fall of 2015. The description includes the dams location, river mile, owner (if known), parcel numberse and owners of land on east and west bank, historic and present function, approximate height (based on the 2005 survey by the Brandywine Conservancy), approximate width, if it has a mill race, and the estimated shad potential (cumulatively). The source for shad procudtion estimates is *A Review and Recommendations Relating to Fishways within the Delaware Basin* by the Delaware Basin Fish and Wildlife Management Cooperative (Delaware Division of Fish and Wildlife, et al. 1985). Additionally, the appendix includes flood profiles of the dams.

. Table 1. Dams in the Delaware portion of the Brandywine Creek

Dam No.	Dam Name	River Mile	Latitude/ Longitude	Function	Height/ Width (ft.)	East Bank Parcel # Owner	West Bank Parcel # Owner	Mill Race?	Shad Production Potential	Historic?
1	West Street	2.1	39.75142/ -75.54760	Protect water supply from tidal influence. Encloses sewer pipes	3 ft. 176 ft.	2601340075 City of Wilmington	2601340075 City of Wilmington	No	3,300	Wimington Historic District
2	Brandywine Park/ Broom Street	2.9	39.75868/ -75.55502	City water intake; aesthetic (waterfall and mill race supply)	7 ft. 154 ft.	2601410006 City of Wilmington	2601340075 City of Wilmington	Yes	3,600	Wilmington Historic District
3	None	3.35	39.76491/ -75.55695	None known; was for industrial water supply	3 ft. 135 ft.	0614300001 Augustine Mill Associates	2600640050 2/3 Mill Road LLC	No	4,600	No
4	Alapocas Run Park and Bancroft Mills	3.6	39.76861/ -75.55922	None known; was for water supply	4 ft. 150 ft.	0612700002 State of Delaware	2600620041 Rockford Falls Partners LLC	No	6,700	No
5	Brandywine Falls	4.2	39.77078/ -75.56919	Mill race supply; aesthetic; was for industrial water supply	8-10 ft. 200 ft.	0612700002 State of Delaware	2600230001 Brandy. Falls Condo Assoc.	Yes	7,700	No
6	DuPont	4.5	39.76959/ -75.57346	None known; possible backup water source	4-6 ft. 182 ft.	0612600002 E I DuPont Nemours & Co.	2600540002 City of Wilmington	No	9,000	No
7	Breck's Mill/Walker's Mill	4.8	39.77086/ -75.57903	Aesthetic; once fed two mill races	6 ft. 156 ft.	0612600001 Walkers Mill Associate LLC	703020017 Eleutherian Mills-Hagley	Yes (2)	10,700	Yes
8	Henry Clay Mill/ Lower Hagley	5.2	39.77636/ -75.57531	National Historic Landmark, Aesthetic (waterfall), mill race	6-8 ft. 215 ft.	061170001 Eleutherian Mills-Hagley	702700032 Eleutherian Mills-Hagley	Yes	12,100	Yes
9	Upper Hagley/ Birkenhead	5.7	39.78270/ -75.57107	National Historic Landmark, Aesthetic (waterfall), mill race	2 ft. 205 ft.	0610800002 Black Gates LLC	0702700032 Eleutherian Mills-Hagley	Yes	13,000	Yes
10	Eleutherian Mills	6.2	39.78556/ -75.57740	National Historic Landmark, Aesthetic (waterfall), mill race	3 ft. 126 ft.	0609800002 Black Gates LLC	0702700032 Eleutherian Mills-Hagley	Yes	16,400	Yes
11	Rockland Mills	7.2	39.79757/ -75.57497	Part of Historic District. Once fed mill race. Aesthetic	7-8 ft. 135 ft.	0607500002 State of Delaware	0701900007 State of Delaware	Yes	26,600	Yes


Brandywine Creek State Park
Dam #11 - Rockland Mills Dam
Dam #10 - Eleutherian Dam
Dam #8 - Lower Hagley Dam
Dam #9 - Upper Hagley Dam
Hagley Museum
Dam #6 - DuPont Dam
Alapocas Park
Dam #7 - Breck's Mill/Walker's Mill Dam
Dam #5 - Brandywine Falls Dam
Rockford Park
Dam #3
Dam #4 at Alapocas Run Park
Brandywine Park
Dam #2 - Broom Street Dam
Dam #1 - West Street Dam
City of Wilmington
Legend
Dam locations
Streams
Parks
Hagley Museum lands
City of Wilmington
Map 3
Delaware Dams
of the
Brandywine River
0 0.25 0.5 1 Miles
Environmental Management Center
BRANDYWINE CONSERVANCY
P.O. Box 141 Chadds Ford, Pennsylvania 19317 (610) 388-2700
DATE SOURCE: Base data from Chester County GIS data distribution, 2001. Aerial photograph from PECO/ADR aerial photography, flown 2000. Delaware Hydrology data from USGS, 2004.
Date: January 19, 2005

Outcomes Achievable and Important

Both the short and long-term goals of this project are achievable. Achieving the short term goal, assessing the feasibility of restoring fish runs to the Brandywine Creek watershed, will include participating with numerous partner organizations. Partner organizations include: Delaware Department of Natural Resources and Environmental Control (DNREC), the Brandywine Conservancy, the City of Wilmington, New Castle County, and numerous other government, private, and nonprofit organizations. Specifically, DNREC will be a key partner in this process because of their expertise in working on dam passage options on rivers in the state such as the Brandywine River. DNREC will also be involved in the activities related to permitting, sampling for toxic contaminants in the sediment behind the dams, and the fish population studies. The Brandywine Conservancy will also serve as a critical partner in this project.

This project will serve as an expansion of the Brandywine Shad Restoration effort and partnership to a Christina Basin-level effort, since the Brandywine is thelargest tributary in the Christina Basin. This is a 'natural' expansion of the project to the full watershed, and by bringing the effort before the full Brandywine-Christina Basin Clean Water Partnership, can solidify both shad restoration efforts at a new level of awareness in a broader community and bring new federal, state, and local partners and potentially new sources of funding into the mix. This approach will combine economic and staff resources and expenses in the areas of public outreach and agency staff support. For example, we'll work to: develop public information materials about the broader restoration effort that will apply to both waterways; enlarge the Brandywine Shad Partnership and work with DNREC and the Pennsylvania Fish and Boat Commission (PFBC) to establish an active shad-stocking program that will work for both efforts.

Threats and/or Opportunities: Elaborate on the relationship of threats and/or opportunities to the long-term conservation outcome(s) and describe which of these threats and/or opportunities will be addressed in the project. Specifically, describe the specific watershed management, water quality or living resource need or problem the project will address and its value to local communities. Include a description of the source of the problem, as appropriate.

Shad were once extremely abundant in the Delaware Estuary's watersheds. Shad numbers began to decline rapidly around 1910 and dammed spawning tributaries is one of several reasons (over fishing and water quality deterioration are the others) for the decline in the shad numbers. According to the *State of the Delaware Estuary 2008*, the Delaware River currently supports a viable commercial and sport shad fishery but harvests are small compared to historic benchmarks. The National Park Service's Wild and Scenic Rivers program states that the designated rivers, "shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations." Currently the Brandywine Creek watershed has 11 dams that block fish passage and prevent fish migration throughout the entire 320 square mile watershed. This project will identify the extent to which fish passage is blocked and will identify options to restore shad and diadromous fish migration so that the Brandywine Creek is restoring historic numbers of fish and meeting the intent of the Delaware Basin Fish and Wildlife Management Cooperative

There are several threats and opportunities related to the long-term conservation goal of restoring fish passage to the Brandywine Creek. The following threats and opportunities have been identified for this project:

Threats

- Eleven known dams impede fish passage.
- Several dams have no known owners.
- Dam owners may not be willing to remove or retrofit dams.
- Little is known about the abundance of diadromous fish species in the lower Brandywine Creek.
- Sediment quality behind dams is unknown.

Opportunities

- Potential to reopen 320 square miles of the Brandywine Creek watershed to shad and diadromous fish migration for the first time in centuries.
- Restore fish habitat to the Brandywine Creek.
- Increase the number of diadromous and resident fish species.
- Create a self-sustaining population of fish resilient to recreational fishing pressure.
- Make the Brandywine Creek watershed free flowing again.
- Restored shad runs could symbolize the resurgence in stream water quality after decades of legacy pollution.

The first threat is that 11 known dams impede fish passage on the Brandywine Creek. Research will be conducted to identify any additional dams in the Pennsylvania portion of the watershed. The characteristics of all of the dams will be researched and verified. The extent to which each dam blocks fish passage and the feasible options to remove or retrofit the barriers identified will be the crux of this project. Options for retrofitting these barriers may include fish ladders, notching, bypass channels, or additional fish passage techniques.

The second threat noted is that dam owners may not be willing to remove or retrofit dams. TNC and UD plans to work with all of the stakeholders in the Brandywine Creek watershed. We will also work closely with the Brandywine Conservancy and other partner organizations associated with the Brandywine River's American Shad restoration effort. Dam owners include partner organizations such as the City of Wilmington and USGS. This study will identify the dam's exact role in the City's water supply intake and identify the feasibility of maintaining the dams function for the City while providing fish passage. This study will research fish passage restoration efforts across the Mid-Atlantic and New England to determine how other groups have addressed this issue. Specifically, the Brandywine Conservancy and the Brandywine River partnership group will be consulted on these topics since the group has addressed both of these situations. The remaining dams on the Brandywine will be researched and surveyed and a partnership approach to work with the dam

owners will be a key component of the project. The expertise garnered from the Brandywine River effort will be used in this project with the expectation that it will bring additional partners to the efforts and will utilize the successful approaches of the Brandywine project. Key members of the group include: National Fish and Wildlife Foundation, American Rivers, DNREC, Delaware Trout Unlimited, U.S. Fish and Wildlife Service, USDA/NRCS, NOAA Restoration Center, and multiple stakeholders.

The third threat listed is that fish may not naturally return to the Brandywine Creek once fish passage is restored. TNC and UD plans to work with DNREC and the PFBC to develop a fish stocking plan as part of this project. This fish stocking plan will be applicable to the Brandywine River Shad Restoration effort.

Finally we plan to address the threat of contaminated sediment trapped behind the dams in question and work with DNREC to test the sediment and determine whether dam removal will release harmful sediment causing harm to the riverine system. And if so may conclude that dam removal may not be an option at that specific site and other fish passage alternatives like notching, fish ladders, or rock ramps will be the more feasible alternatives to restore the fish passage.

This project is extremely valuable to local and regional communities. Shad serve as a valuable indicator of environmental conditions in the Delaware Estuary and Basin. The long-term intent of this project is to increase the migration of shad and the success of this project will prove beneficial to the overall health of the estuary. This project will provide an opportunity to restore a historic fish population and increase recreational opportunities while sustaining a healthy shad population and improving the overall health of the estuary.

2. **Activities:** Elaborate on the primary activities that will be employed through the proposed grant. Explain how these activities address the threats, opportunities and/or conservation outcome(s) described above. Explain how this project specifically relates to the eligible activities described in the Request for Proposals. How do these activities relate to specific local or regional watershed initiative or plan (e.g., *Comprehensive Conservation and Management Plan for the Delaware Estuary, etc.)*

The project goal is to determine the feasibility of removing or retrofitting the fish passage barriers on the Brandywine Creek ultimately restoring shad and diadromous fish migration to the 320 sq. mi. watershed. The grant activities are listed in Table 3 below.

Table 3. Grant Activities

PROPOSED GRANT ACTIVITIES	
Task 1	Create shad restoration committee under the auspices of the Brandywine Christina Clean Water Partnership.
Task 2	Conduct literature review of successful fish restoration projects on the East Coast.
Task 3	Conduct field survey and inventory existing dams along the Brandywine Creek in Delaware and Pennsylvania.
Task 4	With DNREC conduct fish abundance surveys along the tidal and freshwater Brandywine Creek.
Task 5	Explore the feasibility of restoring fish passage utilizing techniques such as dam removal, dam notching, fish ladders, rock ramps, bypass channels, and lift and carry.
Task 6	Conduct an alternatives analysis of fish passage based on environmental, ownership, historic value, and cost criteria.
Task 7	Conduct public education and outreach program.
Task 8	Recommend the most feasible fish passage alternative and prepare conceptual engineering drawings for each dam along with a cost estimate.

TASK 1: Create Restoration Committee

- Utilize the Brandywine Christina Basin Task Force and create a Fish and Wildlife subcommittee to serve as an umbrella group for this project. Seek input from this group as well as keep members up to date on the research and activities. This group will also serve heavily in the implementation phase of this project.
- The Brandywine Conservancy is willing to help on the following partnership design and formation activities conducted in Task 1:
  - Meeting convening, agenda development, and chairing.

- Partnership management, which may include: answering questions, responding to concerns, and providing background information.

TASK 2: Literature Review

- Conduct a literature review of historic and current fish populations in the Brandywine Creek.
- Research records to determine if any of the dams are considered historic dams.
- Research dam ownership records.
- Conduct literature search of successful fish restoration projects along the East Coast of the USA.

TASK 3: Dam Survey

- Field survey and map the location of the existing dams.
  - Identify the function and historic value of each dam including dam identification and mapping.
  - Dam owner meetings, which may include building support for the project.
- Identify and apply for necessary dam permitting requirements and review information. For example: US EPA and US Army Corps of Engineers Section 404 of the Clean Water Act, Section 106 Cultural/Historic Resource Assessment with U.S. Department of the Interior, DNREC Subaqueous Lands Permit, and City of Wilmington and New Castle County Floodplain Permits.
- Work with DNREC to test the composition of the sediment behind the dams where dam notching and removal may be deemed the most feasible options.

TASK 4: Fishery Surveys

- Angler interviews will be conducted on the Brandywine Creekand its tributaries in partnership with DNREC following their protocol for fish population studies. The University of Delaware will update DNREC's fish population study protocol in Spring 2008 to collect data on the fish population and angler information on the Brandywine River in Delaware. The interviews for the Brandywine project will collect information such as the amount of time spent fishing, type of fishing employed, type of fish species caught, cost of fishing trip, and targeted fish species. Collecting this data from anglers will provide essential data on the current fish populations and angler information and will assist in the long-term goal of restoring fish passage to the Brandywine Creek.
- Work with DNREC Division of Fish and Wildlife to conduct electrofishing on the Brandywine Creek. The division has a backpack electrofishing unit for use in wadeable streams. According to the department many species of fish including stream fishes can be easily and safely collected through electrofishing. One of the last fish population studies on the creek was conducted in 1995.

TASK 5: Feasibility

- Determine cost estimates and identify potential funding sources for dam removal or retrofits.
- Identify all fish passage alternatives for each dam, for example: fish ladder, bypass channel, dam notch, rock ramp, or dam removal.
- Prepare conceptual fish passage restoration drawings for each dam.

TASK 6: Alternative Analysis

- Compile all of the feasibility information into a comparative matrix for each dam, using the following format:

Options for Dam #1	Environmental	Regulatory	Cost	Function	Constructability	Maintenance	Aesthetics
Fish Ladder							
Dam Notching							
Fish Ladder							
Rock Ramp							
Bypass Channel							
Lift and Carry							

- Create a work plan to prioritize implementation of the dam removal or retrofit alternatives for each dam with a specified timeline and identify potential partners and funding sources.
- Work with DNREC and PFBC to develop a fish stocking plan for Brandywine restoration efforts. Maryland's Department of Natural Resources will also be involved in this task due to their expertise and available resources in the Chesapeake Bay watershed.

TASK 7: Public Outreach and Education

- Conduct workshops to inform the community of the Brandywine Creek fish passage feasibility study and obtain the public's feedback.
- The Brandywine Conservancy will to help on the following education and outreach activities conducted in Task 7 and throughout the project as needed:
  - Public information materials.
  - Public meetings.
  - Outreach and support-building in Pennsylvania.
- Incorporate the public and the education community (at all levels) to participate in the implementation of the restoration effort.

TASK 8: Recommendations
- Create a final report recommending the most feasible fish passage alternative for each dam along with a cost estimate.
- Provide final recommendations to DNREC in order to begin implementation based on the recommendations provided in the report.

How this Project Relates to the Eligible Activities in the Request for Proposals

This project is in line with the Delaware Estuary Watershed grants program general funding priorities as well as its specific funding priorities. This project's long-term goal is in line with the grants general funding priority of removing fish passage barriers. This project specifically aims to restore diadromous fish and other aquatic species; restore fish migration; and enhance fish habitat. This project will heavily involve the expertise and input from local governments (city, county, and state), nonprofit groups, and private organizations, as well as anglers and the community.

This project will include work on the local level to protect and improve the Brandywine Creek watershed. The location of the project is in the designated project area, the Delaware Estuary. One component of this project is to incorporate public outreach and education into the project once the feasibility of the project is determined. The work with the community will emphasize the importance of human impact on the ecosystem. This project will also demonstrate the importance of restoring shad and diadromous fish migration and habitat in the Brandywine Creek in a strategic watershed management approach with multiple stakeholder participation and community involvement. The long-term goal of this project is to restore important habitat and historic fish migrations. This project will include coordination with numerous partnership groups as named in Question #5 below.

How this Project Specifically Relates to Local or Regional Watershed Initiatives or Plans

The tributaries of the Brandywine Creek have several state designations that garner protection and regional significance. DNREC classifies the Brandywine Creek from the Delaware/Pennsylvania state line downstream as Exceptional Recreational or Ecological Significance Waters (ERES).

In April 2005 the USEPA promulgated high flow total maximum daily loads (TMDLs) for the entire Christina River Basin which contains the Brandywine Creek watershed. The TMDLs are set for nitrogen, phosphorus, and bacteria in both Delaware and Pennsylvania. If implemented this project has the potential to improve the overall habitat in the Brandywine Creek and will have a positive impact on the water quality in the river thus making progress toward achieving the TMDLs.

The *Comprehensive Conservation and Management Plan for the Delaware Estuary (CCMP)*, dated September 1996, intends to provide a watershed approach to management, valuing interconnected habitats, preserved land, and planned efforts to protect and enhance the Estuary's natural resources while maintaining the economic viability of the region. Along the theme of restoring and maintaining healthy populations of finfishes, invertebrates, birds, amphibians, reptiles, and mammals, which is contained in the living resources objectives of the CCMP, it is specifically noted as a key area to identify, restore, and protect specific habitat areas or types. Action H5.7 specifically notes fish passage restoration as a specific action to address this key area. Although the Brandywine Creek is not mentioned as a priority area, there is survey data that has found the Brandywine Creek and its tributaries were once shad spawning grounds and the restoration of anadromous fish access to these spawning grounds in the Delaware River watershed is directly in line with the CCMP. This project also meets the recommendations issued in the fish passage and shad indicators in the *State of the Delaware Estuary 2008*. The report recommends the following actions that directly relate to this project:

- Explore new approaches to facilitate fish passage and to reconnect aquatic ecosystems and enhance fish passage improvements across the estuary.
- Maintain and monitor the shad habitat conditions in the spawning reaches of tributaries in order to increase the shad population.

3. **Outcomes and Indicators:** Describe the general monitoring approach that will be used to assess progress on one or more of the indicators presented previously in the application. Please note any challenges or limitations you anticipate in conducting this monitoring or the interpretation of anticipated results. If this project is a continuation or expansion of an existing project, describe the status and results/outcomes achieved to date.

The most important outcome of this project is the number of dams restored for fish passage along the Brandywine Creek and evidence of fish migration during the spawning period. The feasibility report will list the most feasible fish passage alternative of each dam from the mouth of the creek upstream into Pennsylvania. The long term outcome of this project will be achieved when all barriers to fish migration have been removed and fish abundance surveys indicate that diadromous fish are once again migrating up the Brandywine Creek from their tidal origins.

4. **Project Team:** List key individuals and describe their qualifications relevant for project implementation. Full-proposal Project Narrative other collaborating organizations. In addition, address how this project will involve local communities.

Names and contact information for project partners:

a. University of Delaware Water Resources Center
   Gerald Kauffman (*jerryk@udel.edu*), Director
   Martha Corrozi (*mcorrozi@udel.edu)*, Policy Scientist
b. The Nature Conservancy
c. Brandywine Conservancy:
d. City of Wilmington
e. New Castle County:
f. Delaware Department of Natural Resources and Environmental Control, Division of Fish and Wildlife:
   Robert Line, (*robert.line@state.de.us*), Natural Areas Program
   Mike Stangl, Fishery Biologist
g. Christina Basin Clean Water Partnership, including but not limited to the following organizations:
   - Brandywine Valley Association
   - City of Wilmington
   - Delaware Nature Society
   - United State Geological Survey (USGS)
   - Pennsylvania Department of Environmental Protection
   - Chester County Water Resources Authority
   - Chester County Conservation District

h. Citizens/Volunteers

Wide positive community-based support is provided for the shad restoration effort. Once the data is collected we plan to host public workshops and outreach activities to educate the community on the dams and the alternative options to remove or retrofit the fish passage barriers. There are also numerous opportunities for volunteers and University students to get involved in plantings, pre- and post-monitoring, and additional activities associated with the project once implementation begins.

5. **Additional Uploads:** You may use the Uploads page of the Easygrants system to upload documents other than this narrative that you feel are important to the review of your project. These separate uploads do not count toward the 12 page limit for this narrative. Examples may include:
   - A map or aerial photograph of the project site location and boundaries **(required for habitat restoration projects)**
   - Resumes or CVs for key staff

- Support letters (maximum of five)
- Conceptual or engineered project plans

Dam 1

Dam 1 in the Brandywine Creek is located on West Street in Wilmington. At 39.75142 latitude and -75.54760 longitude, the City of Wilmington is the owner. The land on the west bank of the dam is parcel number 2601340075 and the east bank is parcel number 2601340075. The dam is located at 2.1 river miles of the Brandywine and has a height of approximately 3 ft. Dam 1 protects water supply from tidal influencing and encloses two sewer pipes for the City of Wilmington. The estimated shad production potential is 3,300.

2. **Dam 1 Looking Upstream**

Dam 2

Dam 2 is located at Brandywine Park and Broom Street. At 39.75868 latitude and -75.55502 longitude the City of Wilmingont is the owner of the dam. The land on the west bank of the dam is parcel number 2601340075 and the land on the east bank is parcel number 2601410006. The dam is located at river mile 2.9 of the Brandywine and has a height of approximately 7 ft. Dam 2 is used for city water intake. While it is not a historic dam, it is a part of the Wilmington Historic District and does have a mill race. The estimated shad production of dam 2 is 3,600.

3.
4. **Dam 2 Looking at West Bank and Construction on Mill Race**

Dam 3

Dam 3 in the Brandywine Creek is located at latitude 39.76491 and longitude -75.55695. The land on the west bank of the dam is parcel number 2600640050 and the owner is 2/3 Mill Road LLC . The east bank is parcel number 0614300001 and the owner is Augustine Mill Associates. The dam is located at 3.35 river miles of the Brandywine and has a height of approximately 3 ft. Dam 3 was historically used for industiral water supply, however currently has no known use. There is no mill race with the dam and it is not a historical dam. Additionally, dam 3 is currently breached.

The estimated shad production potential is 4,600.

Dam 3 Breached Looking Upstream, Breeched

Dam 4

Dam 4 in the Brandywine Creek is located at Alapocas Run Park and Bancroft Mills at latitude 39.76861 and -75.55922 longitude; the Delaware Department of Natural Resources and Environmental Control own the dam. The land of the west bank of the dam is parcel number 2600620041 and the owner is Rockford Falls Partners LLC. The east bank is parcel number 0612700002 and the owner is the State of Delaware. The dam is located at 3.6 river miles of the Brandywine and has a height of approximately 3 to 4 ft. Dam 4 was historically used for water supply, however currently has no know use. There is no mill race with the dam and it is not a historical dam. The estimated shad production potential is 6,700.

Dam 4 Looking at East Bank

Dam 5

Dam 5 in the Brandywine Creek is located at Brandywine Falls at latitude 39.77078 and -75.56919 longitude. The land of the south bank of the dam is parcel number 2600230001 and the owner is Brandywine Falls Condo Association. The north bank is parcel number 0612700002 and the owner is the State of Delaware. The dam is located at 4.2 river miles of the Brandywine and has a height of approximately 8 to 10 ft. Dam 5 was historically used for water supply, however currently has no know use. There is a mill race but it is not a historical dam. The estimated shad production potential is 7,700.

Dam 5 Looking at East Bank

Dam 6

Dam 6 in the Brandywine Creek is located at the DuPont Experimental Station at latitude 39.76959 and -75.57346 longitude; DuPont Company owns the dam. The land of the south bank of the dam is parcel number 2600540002 and the owner is the City of Wilmington. The north bank is parcel number 0612600002 (N. Bank) and the owner is the E I DuPont Denemours & Co. The dam is located at 4.5 river miles of the Brandywine and has a height of approximately 4 to 6 ft. Dam 6 currently has no know use, but is a possible back-up water supply to the DuPont facility. There is no mill race with the dam and it is not a historical dam. The estimated shad production potential is 9,000.

Dam 6 Looking Downstream, Partially Breeched

Dam 7

Dam 7 in the Brandywine Creek is located at Breck's Mill and Walker's Mill at latitude 39.77086 and -75.57903 longitude; Hagley Museum owns the dam. The land of the west bank of the dam is parcel number 703020017 and the owner is Eleutherian Mills-Hagley Foundation. The east bank is parcel number 612600001 and the owner is the Walkers Mill Association LLC. The dam is located at 4.8 river miles of the Brandywine and has a height of approximately 6 ft. Dam 7 historically fed two mill races. There are two mill races with the dam currently and it is a historical dam in the Hagley Museum. The estimated shad production potential is 10,700.

5.

Dam 7 Looking Upstream

Dam 8

Dam 8 in the Brandywine Creek is located at Henry Clay Mil and Lower Hagley at latitude 39.77636 and -75.57531 longitude; Hagley Museum owns the dam. The land of the west bank of the dam is parcel number 702700032; the owner is Eleutherian Mills-Hagley Foundation. The east bank is parcel number 061170001; the owner is the Eleutherian Mills-Hagley Foundation. The dam is located at 5.2 river miles of the Brandywine and has a height of approximately 6 to 8 ft. Dam 8 historically fed a mill race. There is currently a mill race with the dam and it is a historical dam in the Hagley Museum. Additionally, the dam is a National Historic Landmark. The estimated shad production potential is 12,100.

6.
7. **Dam 8 Looking Upstream**

Dam 9

Dam 9 in the Brandywine Creek is located at Upper Hagely and Birkenhead at latitude 39.78270 and -75.57107 longitude; Hagley Museum owns the dam. The land of the west bank of the dam is parcel number 0702700032 and the owner is Black Gates LLC. The east bank is parcel number 0610800002 and the owner is the Black Gates LLC. The dam is located at 5.7 river miles of the Brandywine and has a height of approximately 2 ft. Dam 9 historically fed a mill race. There is currently a mill race with the dam and it is a historical dam in the Hagley Museum. Additionally, the dam is a National Historic Landmark. The estimated shad production potential is 13,000.

8.

Dam 9 Looking Upstream East Bank, Partially Breeched

Dam 10

Dam 10 in the Brandywine Creek is located at Eleutherian Mills at latitude 39.78556 and -75.57740 longitude; Hagley Museum owns the dam. The land of the west bank of the dam is parcel number 0702700032 and the owner is Black Gates LLC. The east bank is parcel number 0609800002 and the owner is the Black Gates LLC. The dam is located at 6.2 river miles of the Brandywine and has a height of approximately 3 ft. Dam 10 historically fed a mill race. There is currently a mill race with the dam and it is a historical dam in the Hagley Museum. Additionally, the dam is a National Historic Landmark. The estimated shad production potential is 16,400.

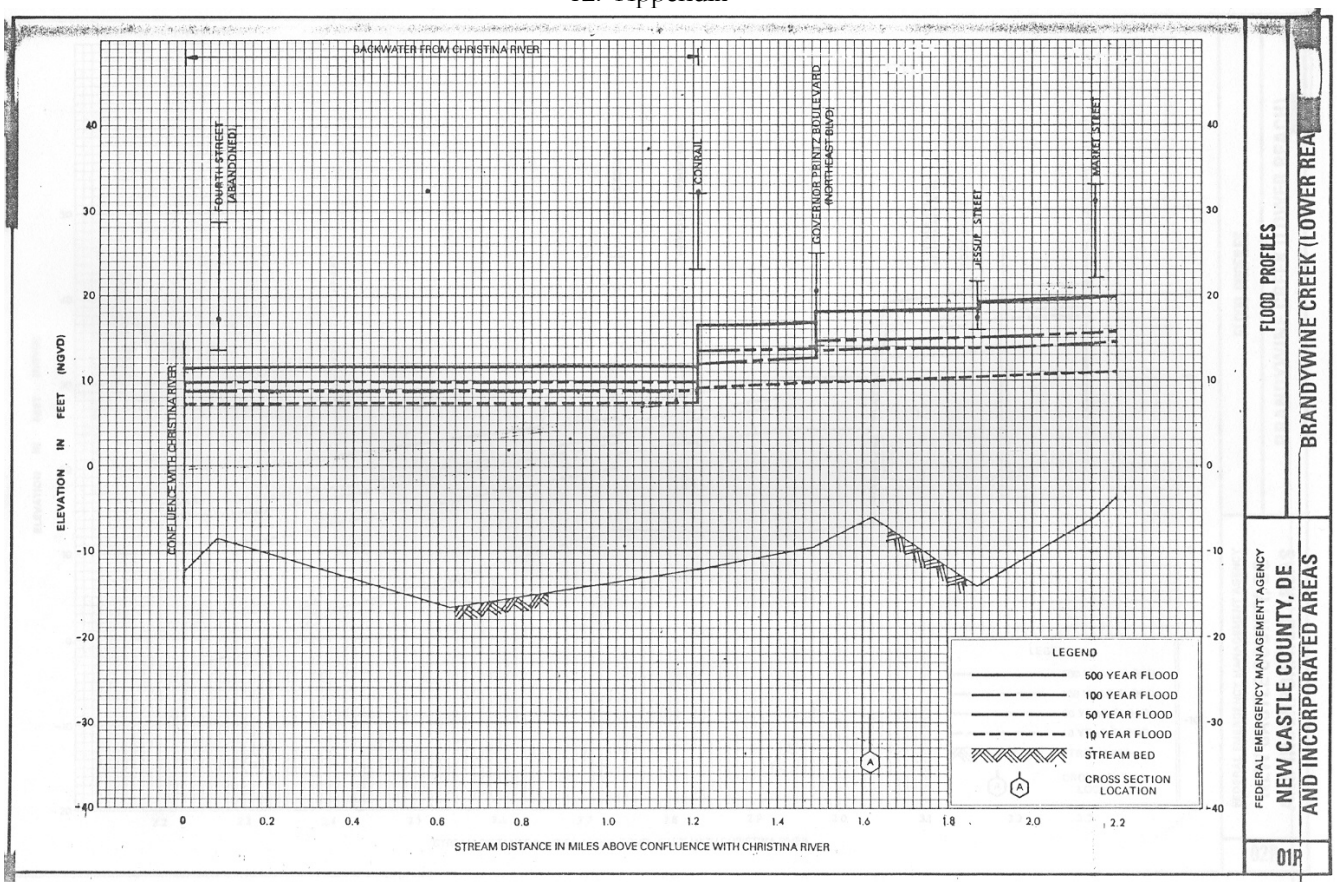
9.

10. Dam 10 Looking Upstream East Bank

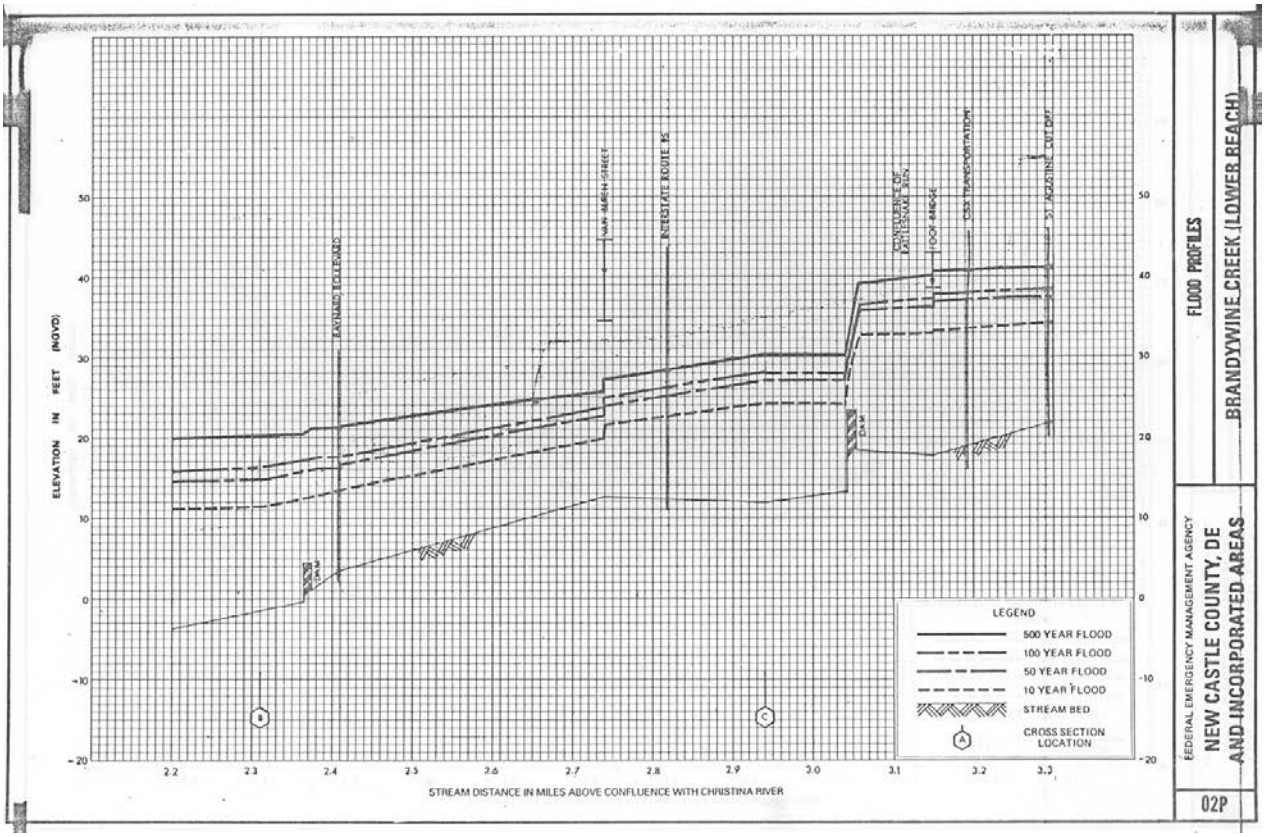
Dam 11

Dam 11 in the Brandywine Creek is located at Rockland Mills at latitude 39.79757 and -75.57497 longitude; the Delaware Division of Natural Resources and Environmental Control own the dam. The land of the west bank of the dam is parcel number 0701900007 and the owner is the State of Delaware. The east bank is parcel number 0607500002 and the owner is the State of Delaware. The dam is located at 7.2 river miles of the Brandywine and has a height of approximately 7 to 8 ft. Dam 11 historically fed a mill race. There is currently a mill race with the dam and it is a historical dam. Additionally, the dam is a part of the Wilmington Historic District. The estimated shad production potential is 26,600.

11. Dam 11 Looking Upstream West Bank, Partially Breeched

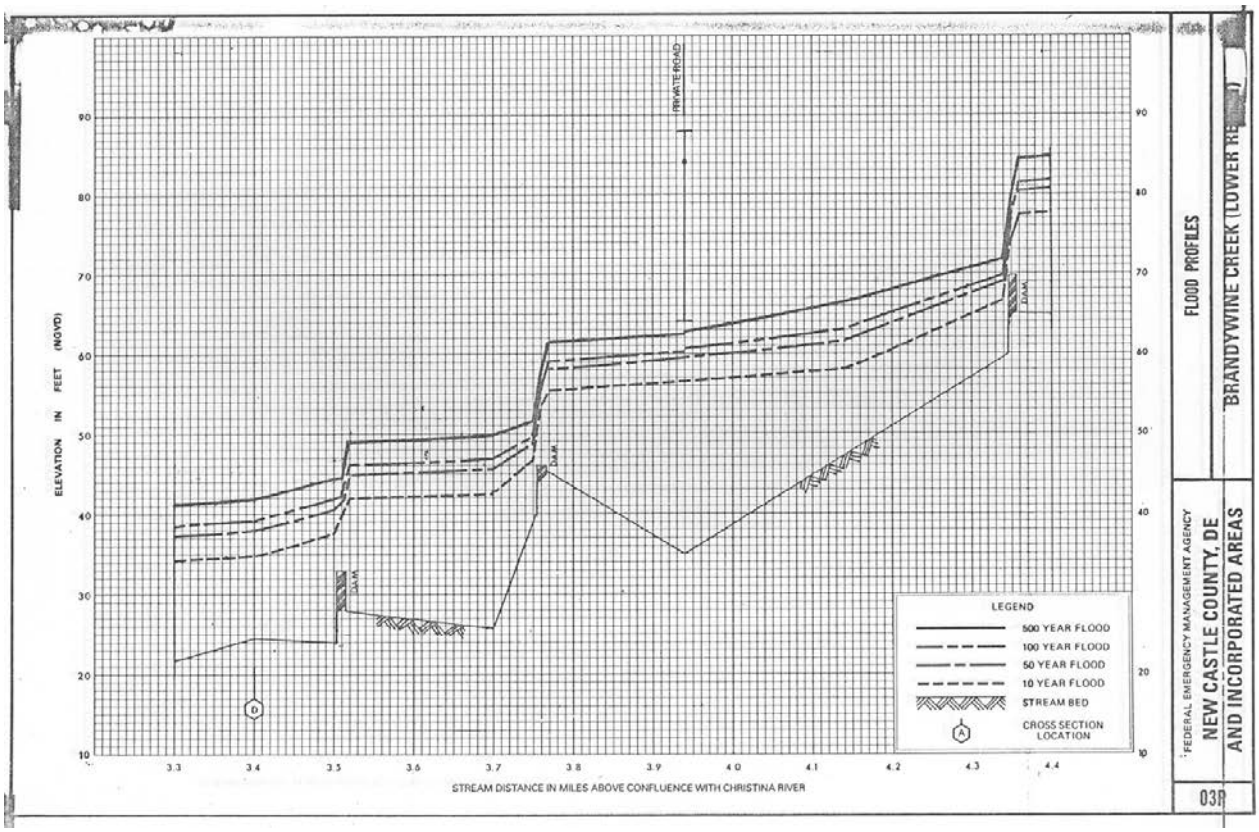

BACKWATER FROM CHRISTINA RIVER
FOURTH STREET (ABANDONED)
CONRAIL
CONFLUENCE WITH CHRISTINA RIVER
GOVERNOR PRINTZ BOULEVARD (NORTHEAST BLVD)
JESSUP STREET
MARKET STREET
ELEVATION IN FEET (NGVD)
STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH CHRISTINA RIVER
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
FLOOD PROFILES
BRANDYWINE CREEK (LOWER REA
FEDERAL EMERGENCY MANAGEMENT AGENCY
NEW CASTLE COUNTY, DE
AND INCORPORATED AREAS
01P

13.


LEONARD BOULEVARD
MAIN STREET
INTERSTATE ROUTE 95
CONFLUENCE OF EASTBURNE RUN
CSX TRANSPORTATION
ELEVATION IN FEET (NGVD)
STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH CHRISTINA RIVER
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
FLOOD PROFILES
BRANDYWINE CREEK (LOWER BEACH)
FEDERAL EMERGENCY MANAGEMENT AGENCY
NEW CASTLE COUNTY, DE
AND INCORPORATED AREAS
02P

14.

15.
16.


FLOOD PROFILES
BRANDYWINE CREEK (LOWER RE
FEDERAL EMERGENCY MANAGEMENT AGENCY
NEW CASTLE COUNTY, DE
AND INCORPORATED AREAS
03P
ELEVATION IN FEET (NGVD)
STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH CHRISTINA RIVER
PRIVATE ROAD
DAM
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION