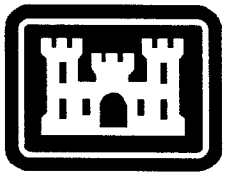
Section 905(b) (WRDA'86) Analysis

BLACKSTONE RIVER
FLOOD DAMAGE REDUCTION
RHODE ISLAND

December 2008



US Army Corps
of Engineers

New England District

SECTION 905(b) RECONNAISSANCE STUDY

BLACKSTONE RIVER, RHODE ISLAND

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SECTION 905(b) RECONNAISSANCE STUDY
BLACKSTONE RIVER, RHODE ISLAND

1. STUDY AUTHORITY

a. This Section 905(b) (WRDA 1986) Analysis was prepared under the authority provided in a resolution by the Committee on Public Works of the United States Senate, dated September 12, 1969, and also known as the Southeastern New England (SENE) resolution.

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE,
>
> That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report on the Land and Water Resources of the New England-New York Region, transmitted to the President of the United States by the Secretary of the Army on April 27, 1956, and subsequently published as Senate Document Numbered 14, Eighty-fifth Congress, with a view to determining the feasibility of providing water resource improvements for flood control, navigation and related purposes in Southeastern New England for those watersheds, streams and estuaries which drain into the Atlantic Ocean and its bays and sounds in the reach of the coastline of Massachusetts, Rhode Island and Connecticut southerly of, and not including, the Merrimac River in Massachusetts, to, and including, the Pawcatuck River in Rhode Island and Connecticut, with due consideration for enhancing the economic growth and quality of the environment."

b. Funds in the amount of $99,000 were appropriated in Fiscal Year 2008 and were specifically designated to conduct a flooding related Reconnaissance study in Rhode Island.

2. STUDY PURPOSE

The purpose of the Reconnaissance Study is to determine whether there is a Federal (Corps) interest in participating in a cost shared Feasibility Study to provide flood damage reduction improvements along the Blackstone River in Rhode Island. In response to appropriation language, the Reconnaissance Study was initiated in May 2008. The Reconnaissance Study has resulted in the finding that there is a Federal interest in continuing the study into the Feasibility phase. The purpose of this Section 905(b) Analysis is to document the basis for this finding and establish the scope of the Feasibility phase. As the document that establishes the scope of the Feasibility study, the Section 905(b) Analysis is used as the chapter of the Project Management Plan that presents the reconnaissance overview and formulation rationale.

3. LOCATION OF STUDY, NON-FEDERAL SPONSOR AND CONGRESSIONAL DISTRICTS

a. The study area is located Providence County, Rhode Island and includes all of the Blackstone River effecting the state (See Figure 1). The study area is about 140 square miles in size. Primary sub-basins in the study area are the Branch River and Abbott Run Brook. The cities and towns of concern are also shown in Figure 1.

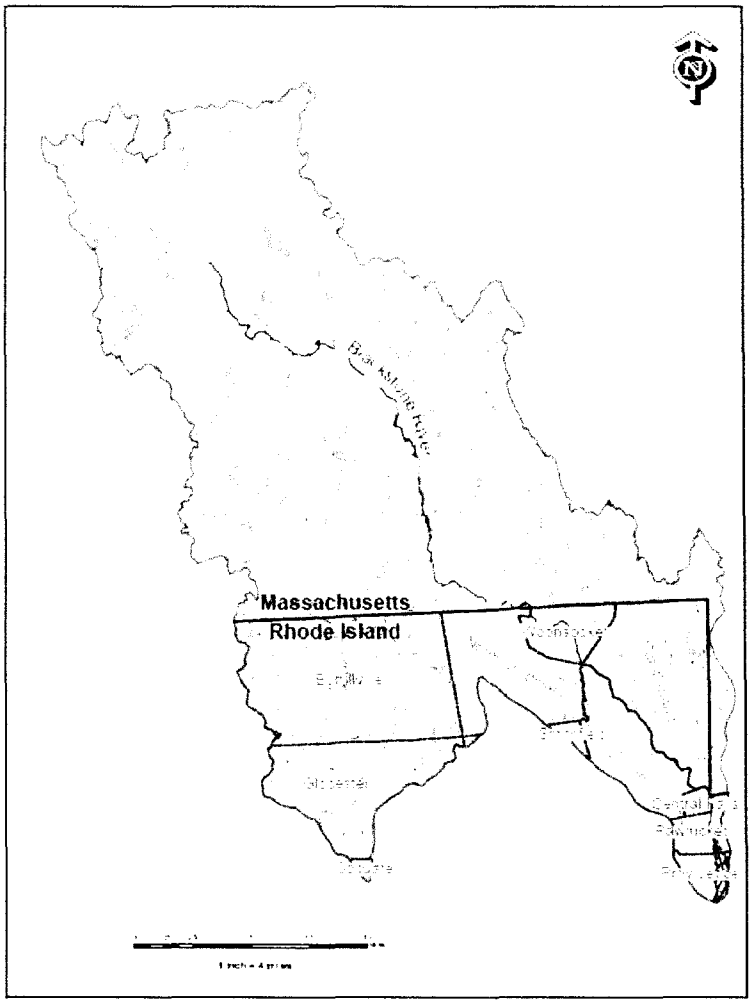

Figure 1: Map of Blackstone River Watershed.

b. Potential non-Federal sponsors for the Feasibility phase of the study are: the Rhode Island Department of Environmental Protection, the towns of Lincoln and Cumberland, the cities of Central Falls and Pawtucket, and the Rhode Island Emergency Management Agency.

c. The study area lies within the jurisdiction of the following Congressional Districts:

1) 1st Congressional District – Patrick J. Kennedy

2) 2nd Congressional District – James R. Langevin

4. PRIOR REPORTS AND EXISTING PROJECTS

a. A total of 10 prior investigations regarding flood damage reduction within the study area were reviewed as part of this Reconnaissance report. A summary of these efforts is listed below:

1) Section 205 investigation (1968) along the Clear, Pascoag, and Branch rivers. The study determined that there is a need for flood protection but the areas needing it were scattered widely; making it difficult to develop a solution. Upstream reservoirs were probably the best solution but the cost of these and any wall/dike system far exceeded the 205 authority. The report speaks of doing further study under the larger Pawcatuck River and Narragansett Bay Drainage Basins Study (PNB) authority.

2) Memorandum for the Record (1970) on Pawtucket flooding in the Pleasant View area and states no Federal interest in flood damage reduction measures. There is steep gradient flooding with no real flood damages found.

3) Section 205 Reconnaissance Study (1971) of flooding along the Blackstone River in Cumberland. No economically justified solutions were found. Removal of either the Sayles or Pratt dams would offer little flood relief, nor does the Blackstone Canal offer a viable flow diversion solution.

4) Section 205 Reconnaissance Study (1972) of the 3,500' stretch (Old Bernon Dam to Court Street) between the 2 existing Local Protection Projects in Woonsocket. The study determined that it was mostly basement flooding of an industrial building, some riverbank erosion, and some flooded property of the Blackstone Valley Gas & Electric. They reexamined channel widening (125') between Bernon Street and Court Street, which would involve several building demolitions and some wall removal. Nothing examined was found to be economically justified.

5) Section 208 investigation (1978) of the Peters River in Woonsocket. No solution found to be economically justified.

6) Soil Conservation Service conducted a flooding study (1979) of the Ten Mile River in Pawtucket. They determined that there was no economic justification for Federal participation.

7) PNB study and report (1981). This was a large feasibility study of flooding in the Narragansett Basin. Identified the following locations as flooding sites:

• Cumberland – Lincoln - Lonsdale section (industrial/commercial damages); Ashton section of Cumberland south to Martin Street; potential sewer, rail, and water supply damages;

• Central Falls - right bank damages, urban/industrial;

• Pawtucket – right bank flooding (commercial, Roosevelt and Main Streets)

The only reservoir site that was recommended for further study was the Nipmuc Reservoir in Burrillville. It also determined that further investigation was warranted for flood walls in the Berkley-Ashton sections of Cumberland.

Dam removals in Pawtucket and Central Falls were found to have a limited effect on reducing flooding, though further analysis was warranted at Slater Mill and Sayles Finishing Dam.

Water diversion in Central Falls and Pawtucket was not economically justified.

The only alternative found to be economically justified was the Berkley site (industrial) in Cumberland. This included both structural and non-structural plans.

8) Section 205 reconnaissance study (1983) of Moshassuk River in Pawtucket. No economic justification for protecting St. Francis Cemetery.

9) Section 205 reconnaissance study (1983) of Central Falls flooding, specifically, flooding of an industrial plant and residential properties in two different areas. Flooding problem determined to be an interior drainage issue, not over-bank flooding. The 1981 PNB study confirmed a lack of economic justification for Federal involvement in these areas.

10) Section 14 investigation (1984) along the Clear River in Burrillville. The investigation eventually led to a stream bank protection project.

b. Outstanding Requests ?

1) Burrillville, Section 205 flood damage reduction study request, August 2004.

2) Cumberland, meeting regarding flooding in Berkley section, March 2006.

c. There is currently an ongoing feasibility study of ecosystem restoration opportunities in the Blackstone River watershed in Massachusetts. That investigation was initiated in 1998.

d. Constructed Projects

1. Woonsocket Flood Control Project. Authorized by the Flood Control Act of 1944. Constructed between July 1956 and April 1960. Consists of: new Woonsocket Falls Dam with 4 taintor gates; widening, deepening, and straightening the river channel for 8,300 feet upstream of the dam; a pumping station; 1,115 feet of earth dike; and 316 feet of concrete flood wall.

2. Lower Woonsocket Flood Control Project. Authorized by the Flood Control Act of 1960. Constructed between December 1963 and April 1967. Consists of: 10,090 feet of earth dike and concrete floodwall; 4,700 feet of channel improvements; 2,330 feet of pressure conduit; 2 pumping stations; the removal of Bernon Dam.

3. Clear River Stream Bank Protection Project. Authorized by Section 14 of the Flood Control Act of 1946. Constructed between September and October 1986. Bank protection consists of replacing 60 feet of failed wall with a 15-foot high stone retaining wall and removing a wooden footbridge and its abutment that was restricting river flow and causing the erosion.

This review of prior reports and existing projects shows that the study area has been the subject of intense scrutiny over the past half century and more. Flooding problems continue to occur in certain areas of the watershed.

5. PLAN FORMULATION

As part of any Corps study, six planning steps that are set forth in the Water Resource Council's Principles and Guidelines are undertaken to focus the planning effort and eventually to select and recommend a plan for authorization. The six planning steps are: 1) specify problems and opportunities, 2) inventory and forecast conditions, 3) formulate alternative plans, 4) evaluate effects of alternative plans, 5) compare alternative plans, and 6) select recommended plan. The iterations of the planning steps typically differ in the emphasis that is placed on each of the steps. As part of the reconnaissance phase, the step of specifying problems and opportunities is emphasized. That is not to say, however, that the other steps are ignored because the initial screening of preliminary plans that results from the other steps is very important to the scoping of the subsequent Feasibility phase studies. The sub-paragraphs that follow present the results of the initial iterations of the planning steps that were conducted during the reconnaissance phase. This information will be refined and expanded in future iterations of the planning steps that will be accomplished during the Feasibility phase.

a. National Objectives

1) The national or Federal objective of water and related land resources planning is to contribute to National Economic Development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to National Economic Development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the study area and the rest of the nation.

2) The Corps has added a second national objective for National Ecosystem Restoration (NER) in response to legislation and administration policy. This objective is to contribute to the nation's ecosystems through ecosystem restoration, with contributions measured by changes in the amounts and values of habitat.

b. Public Concerns: A number of concerns have been identified during the course of the reconnaissance study, including those identified through coordination with the Rhode Island Emergency Management Agency, the Blackstone River National Heritage

Corridor Commission, the Northern Rhode Island Chamber of Commerce, the Blackstone Valley Tourism Council, and other local entities. Public concerns that are related to the establishment of planning objectives and planning constraints consist of:

1) The need for an examination of a full array of structural and non-structural alternatives to solving the problem of flood damages.

2) The perception that the Corps is only interested in building large, expensive flood damage reduction projects without giving adequate consideration to non-structural approaches.

3) A general concern with the time and cost involved in the Corps civil works process.

c. Problems and Opportunities: This section describes problems and opportunities that can be addressed through water and related land resource management:

1) General Problem Identification. The water resources problem to be solved is that the current hydrologic and hydraulic conditions of the lower Blackstone River cause flood damages to public and private property, to infrastructure, and constitute threats to human life. The causes of this problem can be ascribed to the following suite of factors:

a) Reduced stream capacity due to channel constrictions. Development over the years has led to the reductions in the width of river channels and floodplains, as land has been claimed for commercial or residential use. Sedimentation in the system has also reduced the carrying capacity of many of these watercourses.

b) Development throughout the watershed has resulted in a decrease in the amount of permeable land surface and as a result increases the amount and timing of flood flows. Natural attenuation of the runoff becomes less likely and the potential for damaging floods downstream increases. The most recent FIS flood profiles appear to show that the higher frequency events (up to 25 year event) have increased by as much as a foot in the last twenty years, which is probably the result of increased development in the upper portions of the watershed.

c) Obstructions (culverts and bridges). Culverts and bridges may become obstructions to the water flow either because their openings are not large enough to accommodate heavy flow, or because debris accumulates around them, effectively creating a dam. In some cases, accumulation of silt and debris may be attributed to lack of maintenance. Lack of maintenance may be due to jurisdictional issues or lack of awareness about the effects of these obstructions.

2) Watershed-Specific Problem Identification. This reconnaissance study is being conducted as a result of flooding that occurred along the Blackstone River in

October 2005. The flooding was the result of heavy rainfall (7 to 9 inches) which began on October 14th. River levels rose quickly; giving very little time for residents and businesses along the river much time to react. By October 16th, flood levels in Woonsocket had crested at 15.3 feet. Flood stage for the Blackstone River in Woonsocket is listed as 9.0 feet. Though not considered an historic event (the August 1955 flood, ~ 1% chance return period, crested at 21.8 feet), this was still a considerable event (~ 10 year event). Specific flooding areas are discussed below, starting upper part of the watershed and ending at the lowest.

a) Woonsocket:

- Temporary docks damaged ($5,000).
- Assisted living facility evacuated and damaged.
- Hyman Brickle & Son suffers losses of $700,000.
- Staples incur $5,000 in flood damage.

b) North Smithfield:

- Damages to public facilities (roads, fire, and police) of $37,000.
- Flood damage to many residential structures.

c) Smithfield:

- Some public and residential damage.
- Audubon Society flood losses of $7,000.

d) Lincoln:

- Ryco Trimming Company suffers $1,200,000 in damage.
- Lance Industries building damage (~ $500,000).
- Several other businesses suffer flood damages to property and inventory.
- Several areas where newly constructed bike path and roadways are damaged.
- Evacuations of 200 people to temporary shelter.

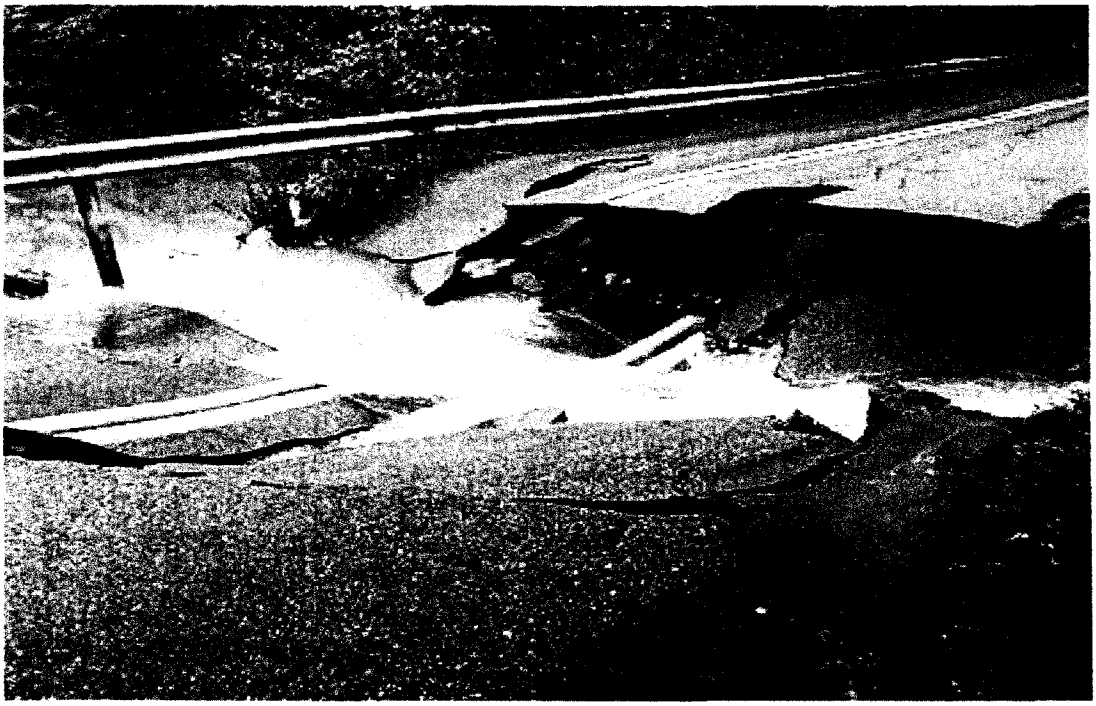

Figure 2: Road washout in Lincoln, RI.

e) Cumberland:

- Hope Global (light industrial) suffers $5,000,000 in damages.
- Dean Warehouse and Okonite properties also damaged.
- Apartments, homes, and businesses evacuated (< 1,000 people).
- Several roads and bridges damaged.
- Two public schools suffer water damage.

State of emergency

Animals left homeless

By JO C. GOODE

Health Dept. urges boiling

FLOODWATERS COMPLETELY ENGULF the yard at 35 Wildwood Road in Cumberland Monday. The house was submerged in water over 36 hours after the peak of the flooding of the Blackstone River. This photo was taken from a boat on Wildwood Road.

Figure 3: Flooding of neighborhood in Cumberland, RI.

f) Central Falls:

- City docks and landing damaged ($250,000).
- River tour (BVTC) boat damaged ($20,000).
- Samoset Plat (residential area) single family homes basements flooded.

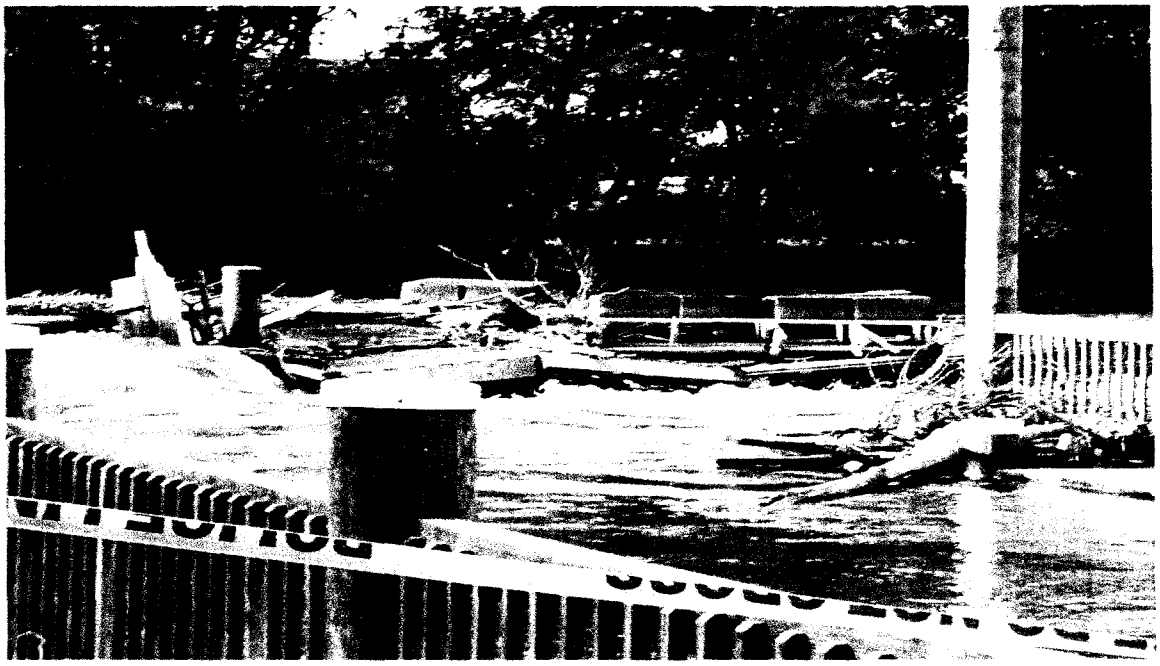

Figure 4: Boat dock damage in Central Falls, RI.

g) Pawtucket:

- Flooding of 16 businesses.
- Product, equipment, and lost production (> $3,000,000).
- City boat landing 100% loss ($250,000).
- American Heritage River building 100% loss ($200,000).
- Fatima & St. Joseph hospitals experienced water damage.

Figure 5: Flooding at business in Pawtucket, RI.

3) Flooding has been a serious and chronic problem within the Blackstone River watershed. There have been over 20 major floods since 1926. Some of the more notable floods that have occurred are the March 1936, July 1938, August 1955, March 1968, and October 2005 events. The flood of 1955 is considered the flood of record. The most recent flooding in 2005 was not as significant as that event and resulted in flood elevations several feet less than that reported in 1955. Records indicate that flooding is not limited to any one season and that there is a fairly even distribution between winter/spring and summer/fall events.

In the absence of Federal action, it is likely the flood damages will occur again, possibly increasing in frequency and intensity, endangering the lives of residents and impairing the function of municipalities within the study area.

4) Opportunities exist throughout the lower Blackstone River basin study area to address the problem of flood damages. State and municipal level authorities as well as businesses and homeowners have expressed the urgency of working

together to find long-term comprehensive solutions. Where possible, opportunities to improve habitats will also be examined.

d. Planning Objectives: The national objectives of National Economic Development and National Ecosystem Restoration are general statements and are not specific enough for direct use in plan formulation. The water and related land resource problems and opportunities identified in this study are stated as specific planning objectives to provide focus for the formulation of alternatives. These planning objectives reflect the problems and opportunities and represent desired positive changes in the without project conditions. The planning objectives are specified as follows:

1) To reduce the flood hazards and associated urban flood damages in the lower Blackstone River watershed;

2) To provide protection to buildings, emergency response facilities, and transportation corridors, thus improving public health and safety during future flooding;

3) To provide a plan that is compatible with future flood damage reduction and economic development opportunities; and

4) To contribute to national ecosystem restoration by providing more natural habitat, where possible.

e. Planning Constraints: Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that should not be violated. The planning constraints identified in this study are as follows:

1) Compliance with local land use plans and regulations;

2) Avoid negative effects on habitat of Federal and State threatened and endangered species within the study area;

3) Flood damage reduction measures must not induce flooding to other unprotected areas either upstream or downstream.

f. Measures to Address Identified Planning Objectives. A management measure is a feature or activity at a site, which address one or more of the planning objectives. A wide variety of measures will be considered in the future feasibility study. A description of the measures considered in this study is presented below:

1) No Action. The Corps is required to consider "No Action" as one of the alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA). "No Action" assumes that no project would be implemented by the Federal government or by local interests. "No Action", which is synonymous with the Without Project Condition, forms the basis from which all other alternative plans are measured.

2) Non-Structural. Various non-structural alternatives, including buy-outs, elevating structures, flood-proofing, and flood warning will be considered.

3) Structural. Measures such as road raising, snagging and clearing, floodwalls and levees, and re-channelization may be examined. Construction of a structural feature such as a levee or floodwall will serve to prevent waters from reaching people, businesses and roads. Analysis of a levee or floodwall system will be focused on those areas with a population density or commercial activity level sufficient to allow economic justification.

4) Additional Measures for Complete Alternatives. The Feasibility-level analysis may identify measures that might be required to generate a "complete" alternative. These may also include elements of an overall project in which the Corps does not presently have authority to become a cost-sharing participant. Stormwater management efforts within local municipalities may be included in several alternatives for which there is no existing Corps authority, but their inclusion may be required to generate a "complete" plan. Additionally, ecosystem restoration opportunities will be examined where the dual purposes of flood damage reduction and ecosystem restoration may be served.

g. Preliminary Evaluation of Alternatives.

For this 905(b) analysis two alternative plans were examined for reducing flood damages in the Berkley area of Cumberland.

1. Plan A. The first alternative, Plan A, is a structural flood damage reduction plan that was examined in 1981 by the Corps and found to be economically justified. It consists of 3,600 feet of earthen dike, 1,500 feet of concrete floodwall, two 10-foot wide railroad gates, and a 40-foot wide road gate. This planned structure segregates the industrial area from river flows by providing a semi-circular protection system that tie into the high ground provided by the railroad embankment to the east. A pumping station, located at the downstream side of the Martin Street bridge, will ensure interior drainage and seepage is adequately removed. A flood warning system will be included in the plan to alert the industrial area of impending floods and provide enough time to close the flood gates. The plan was designed to protect against the Standard Project Flood therefore the dike and wall heights are almost 20 feet in some places. The design height was chosen to protect against the 0.2% chance flood and includes 3 feet of freeboard.

For this reconnaissance study, the 1981 construction cost of Plan A was adjusted to account for inflation by applying a Construction Cost Index factor. The annual cost was determined by multiplying this updated project cost by the capital recovery factor for the current federal interest rate of 4 5/8%.

Annual benefits were also updated to account for present day conditions. The benefits were found by combining the current stage damage function and stage frequency curve to obtain today's expected annual damages for each structure. The annual benefits were found by taking the difference between expected annual damages for the without and with project conditions. The three industrial properties analyzed were found to avoid

$78,700 in annual structural and $800,300 in annual contents damage with this plan. The resulting cost analysis shows that the alternative is still economically justified.

Project Total Cost	$15,450,560
Annual Cost	$ 797,712
Annual Benefits	$ 879,000
Benefit/Cost Ratio	1.1

2. Plan B. The second alternative, Plan B, is a non structural flood damage reduction plan that was examined in 1981 by the Corps and found to be economically justified. It consists of a combination of "I" or "T" walls, gravity walls, stop log gates, and flood proofing shields that will provide surrounding protection for each individual industrial building in the project area. Each building will be provided with a pump to remove interior drainage from the parking lots and loading areas. A flood warning system will be included in the plan to alert the industrial area of impending floods and provide enough time to implement the flood proofing measures. The plan was designed to protect against the 1955 flood. The design height was chosen to protect against the 1% chance flood.

Again, for this reconnaissance study, the 1981 construction cost was adjusted to account for inflation and the benefits were updated to account for present day conditions. The three industrial properties analyzed were found to avoid $63,900 in annual structural and $636,000 in annual contents damage with this plan. The resulting cost analysis shows that the alternative is also still economically justified.

Project Total Cost	$2,933,111
Annual Cost	$ 151,437
Annual Benefit	$ 699,900
Benefit/Cost Ratio	4.6

h. Conclusions. The discussion above indicates that alternatives to address flood damage reduction within the lower Blackstone River basin appear to be in the Federal interest and may be implementable. Additional alternatives will be examined and compared during the feasibility study to determine a recommended plan. The magnitude and types of benefits from the proposed actions would include National Economic Development (NED), Regional Economic Development (RED), Other Social Effects (OSE), and Environmental Quality (EQ), including prevention or reduction of: flood damages, emergency costs, transportation impacts and delays, loss of income, loss of commerce; quality of life impacts, loss of life, and loss of habitat and open space impacts. Detailed benefits and costs of the alternatives will be developed during the next phase of the study. Recurring flood events appear to justify Federal participation for flood damage reduction studies in the lower Blackstone River basin study area. Therefore, alternatives to address the planning objectives appear viable.

6. FEDERAL INTEREST

Since flood damage risk reduction is an output with high budget priority and is the primary output of the alternatives to be evaluated in the Feasibility phase, there is a

strong Federal interest in conducting the Feasibility study. There is also a Federal interest in other related outputs of the alternatives including environmental restoration, watershed management, water supply, and other allied purposes that could be developed within existing policy. Based on the preliminary screening of alternatives, there appears to be an array of project alternatives that have the potential to be economically justified, environmentally acceptable, addressable through engineering solutions, and consistent with USACE policies.

7. PRELIMINARY FINANCIAL ANALYSIS

There are several potential non-Federal sponsors for the feasibility study recommended in this 905(b) analysis. These five are the Rhode Island Department of Environmental Protection, the towns of Lincoln and Cumberland, the cities of Central Falls and Pawtucket, and the Rhode Island Emergency Management Agency. As the local sponsors they would be required to provide 50 percent of the cost of the Feasibility phase. The New England District continues to work with these potential sponsors to develop an acceptable Project Management Plan for the Feasibility Study with which to move forward with.

8. ASSUMPTIONS AND EXCEPTIONS

a. Feasibility Phase Assumptions: The following critical assumptions will provide a basis for the Feasibility study:

1) In the absence of Federal action, the flood damages will likely occur again, possibly increasing in frequency and intensity, endangering the lives of people, damaging or destroying real and personal property, and impairing the function of municipalities within the study area.

2) Local interests will undertake initiatives for better stormwater management, which will complement Federal actions to reduce the risk of fluvial flood damages.

b. Collaborative Planning. As per EC 1105-2-409 § 4(c)(3), dated April 22, 2000, any alternative plan may be selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse, in the four *Principles and Guidelines* evaluation accounts:

1. National Economic Development (NED): displays changes in the economic value of the national output of goods and services;
2. Environmental Quality: displays non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of ecosystem restoration plans;
3. Regional Economic Development: displays changes in the distribution of regional economic activity (e.g., income and employment); and
4. Other Social Effects: displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others.

9. FEASIBILITY PHASE MILESTONES

Completion of Feasibility phase milestones will be conducted in accordance with ER 1105-2-100, Appendix H, Amendment 1, dated November 20, 2007.

10. FEASIBILITY PHASE COST ESTIMATE

Based on previous flood damage reduction feasibility studies conducted by the Corps, the cost estimate to complete the investigation of the site described above is $600,000.

11. VIEWS OF OTHER RESOURCE AGENCIES

Due to the funding and time constraints of the reconnaissance phase, only limited and informal coordination has been conducted with other resource agencies. Views that have been expressed are as follows:

a. Negative impacts to wetlands, fish and wildlife resources should be avoided and minimized wherever practicable.

b. Alternatives with unavoidable impacts should include mitigation measures that replace the function of the impacted area.

12. POTENTIAL ISSUES AFFECTING INITIATION OF FEASIBILITY PHASE

Continuation of this study into the cost-shared Feasibility phase is contingent upon an executed Feasibility Cost Sharing Agreement (FCSA). All efforts should be made to execute a FCSA within 18 months of the approval date of the Section 905(b) Analysis.

13. PROJECT AREA MAP

A map of the study area is provided as Figure 1.

14. RECOMMENDATIONS

Based on the foregoing information, I recommend that this Section 905(b) Analysis be approved and that the Lower Blackstone River Flood Damage Reduction Feasibility Study be initiated.

DATE: 22 Dec 08

Philip T. Feir
Colonel, U.S. Army
District Commander