

WRRDA 7001 Submissions Package
U.S. Army Corps of Engineers

Proposal Name: City of Hartford Flood Protection System Rehabilitation Feasibility Study

Submission Date: 09/19/2016

Proposal ID Number: 2b080b4d-bf53-49d6-81fa-6b281bac0087

Purpose of Proposal: Severe floods in 1936 and 1938 prompted the U.S. Army Corps of Engineers (USACE) to construct a comprehensive flood control system to protect the City of Hartford from Connecticut River flooding. Despite the initial protection, the effects of time and the elements have taken a toll on the system's integrity, and significant capital investment is needed. Recent ratings by the USACE placed the City of Hartford's system in the "unacceptable" category indicating the system is at a heightened risk of failing to meet the rated protection criteria of the original USACE flood control project.

In addition to the risk to human life, there is significant public and private infrastructure at risk in the event of a levee failure. Over 20% of Hartford's land area is in the levee protected zone, most of which is comprised of important commercial, institutional, and residential properties. Major public infrastructure throughout the municipality is also at risk, the most vulnerable of which is the MDC's regional sewage treatment system which is in the process of a \$3 Billion EPA mandated upgrade. The Interstate 84/91 interchange, regional airport, MDC water distribution system, military jet fuel supply pipeline, and numerous major employers are also at increased risk. To ensure that the flood protection systems can safely protect human life, public and private property, and regional utility infrastructure; federal assistance through WRDA is greatly needed.

1. Administrative Details

Proposal Name: City of Hartford Flood Protection System Rehabilitation Feasibility Study

by Agency: City of Hartford, Department of Public Works

Locations: CT

Date Submitted: 09/19/2016

Confirmation Number: 2b080b4d-bf53-49d6-81fa-6b281bac0087

Supporting Documents

File Name	Date Uploaded
Mayor Letter .pdf	09/19/2016
FloodControlSystemMap.pdf	09/19/2016
FeasibilityStudyProposal.pdf	09/19/2016
SWIF Approval Letter.pdf	09/19/2016
WRDA Hartford Study Request.pdf	09/19/2016

2. Provide the name of the primary sponsor and all non-Federal interests that have contributed or are expected to contribute toward the non-Federal share of the proposed feasibility study or modification.

Sponsor	Letter of Support
City of Hartford, Connecticut(Primary)	<p>The City of Hartford has attached a detailed letter of support for its request for WRDA funding for flood control improvements. Through significant local expense, Hartford went through a mandated levee accreditation process with the Federal Emergency Management Agency (FEMA) which resulted in accreditation for the 100 year flood in 2009. Hartford conducted a significant outreach program, receiving much public support, as part of meeting the FEMA requirements.</p> <p>Although FEMA 100 year requirements were met, the Hartford Flood Control system also falls under U.S. Army Corps of Engineers (USACE) regulations which require a much higher level of protection, exceeding the 500 year flood level. The City's system was recently determined by USACE to be deficient, and the City was forced to enter into the USACE System Wide Improvement Framework (SWIF) program. This is a remedial program which allows 2 year grace period for the City to evaluate all defects, develop a plan to correct the deficiencies, and commit to the funding that is required.</p> <p>Hartford has been struggling to fund the high cost of the flood control capital improvements needed to satisfy USACE. Although Hartford's levee system provides protection for many regional assets, Hartford has had to shoulder the financial burden alone. The City's USACE approved SWIF program includes a commitment for \$78 M in capital improvements. Hartford's financial condition is such that local funding alone will not be sufficient, and therefore outside assistance from WRDA is greatly needed.</p>

3. State if this proposal is for a feasibility study, a modification to an authorized USACE feasibility study or a modification to an authorized USACE project. If it is a proposal for a modification, provide the authorized water resources development feasibility study or project name.

[x] Feasibility Study

4. Clearly articulate the specific project purpose(s) of the proposed study or modification. Demonstrate that the proposal is related to USACE mission and authorities and specifically address why additional or new authorization is needed.

Severe floods in 1936 and 1938 prompted the U.S. Army Corps of Engineers (USACE) to construct a comprehensive flood control system to protect the City of Hartford from Connecticut River flooding. Despite the initial protection, the effects of time and the elements have taken a toll on the system's integrity, and significant capital investment is needed. Recent ratings by the USACE placed the City of Hartford's system in the "unacceptable" category indicating the system is at a heightened risk of failing to meet the rated protection criteria of the original USACE flood control project.

In addition to the risk to human life, there is significant public and private infrastructure at risk in the event of a levee failure. Over 20% of Hartford's land area is in the levee protected zone, most of which is comprised of important commercial, institutional, and residential properties. Major public infrastructure throughout the municipality is also at risk, the most vulnerable of which is the MDC's regional sewage treatment system which is in the process of a \$3 Billion EPA mandated upgrade. The Interstate 84/91 interchange, regional airport, MDC water distribution system, military jet fuel supply pipeline, and numerous major employers are also at increased risk. To ensure that the flood protection systems can safely protect human life, public and private property, and regional utility infrastructure; federal assistance through WRDA is greatly needed.

5. To the extent practicable, provide an estimate of the total cost, and the Federal and non-Federal share of those costs, of the proposed study and, separately, an estimate of the cost of construction or modification.

	Federal	Non-Federal	Total
Study	\$2,680,000	\$1,340,000	\$4,020,000
Construction	\$22,500,000	\$12,100,000	\$34,600,000

Explanation (if necessary)

Breakdown of Feasibility Study Components & Costs • Project #1 Underseepage Control (Bulkeley Bridge and S. Meadows) - \$500,000

• Project #2 Interior Drainage-Pump Station Rehab/Replacement - \$525,000 • Project #3 Interior Drainage-Conduit Rehab/Replacement - \$575,000

• Project #4 Levee Utility Penetration Abandonment/Modification - \$355,000 • Project #5 Levee Toe Drain Modifications - \$350,000 • Project #6 Concrete Floodwall Stability Rehab/Replacement - \$375,000

TOTAL WRDA FEASIBILITY STUDY FUNDING REQUEST \$2,680,000

Please see the attached: i) WRDA Funding Request Overview & Project Description; and ii) January 15, 2016 letter from USACE granting the Hartford a 2 year SWIF plan development period, each of which provide greater detail regarding the Hartford Flood Control System and the parameters of the proposed feasibility study.

6. To the extent practicable, describe the anticipated monetary and nonmonetary benefits of the proposal including benefits to the protection of human life and property; improvement to transportation; the national economy; the environment; or the national security interests of the United States.

Assured integrity of the flood control system is essential to re-establishing the City of Hartford as a center of prosperity in the region. As Connecticut's capital city, Hartford has been home to many large employers in the private and public sector. However, conditions of unemployment and poverty have recently become severe and pervasive. These socio-economic conditions cannot be remedied while anchor businesses and potential new investors remain weary of potential flooding.

Recent federal regulatory action has furthered the adverse impact of fiscal recession on the local economy by signalling that Hartford is extremely vulnerable to flood risk. The media has made reference to the massive floods that hit Hartford in the 1930s, conjuring images of The Great Flood of 1936 that submerged much of the city leaving 14,000 residents homeless and businesses boarded. These accounts hinder all attempts to reduce the dire citywide unemployment and poverty rates. Joblessness impacts as many as 49.35% of our citizens in some areas of the city. These economic conditions have been acknowledged by the federal government via designation of a North Hartford Promise Zone.

As Hartford strives to stabilize and rebuild its core downtown business and residential base, it must be able to show potential employers and developers their investments will stay above water both figuratively and literally. The proposed feasibility study will quantify the strength of the system and potentially show more cost effective resolutions to discovered deficiencies. This information will form the basis of a clear course of action to restore Hartford as a feasible location to live and do business in the future. Further, it may dispel current misunderstandings in the business and development community and open up opportunities in the near term.

7. Does local support exist? If ‘Yes’, describe the local support for the proposal.

Yes

Local Support Description

There exists intense local support for this program. The requested feasibility study pertains to a potentially undermined section of the Hartford Flood Control System. This critical infrastructure protects those properties comprising 20% of the City’s grand list. Were a flood to occur, affected areas would include the Downtown Hartford Commercial District, the North Hartford Promise Zone, the \$2 billion South Meadows Wastewater Treatment Facility (the largest such facility in the area and sole processing center for the regions sludge-based waste), and numerous historical and essential city and state government facilities. Such an event would cripple the region. Accordingly, this project is universally supported by local area residents and businesses.

8. Does the primary sponsor named in (2.) above have the financial ability to provide for the required cost share?

Yes

Primary Sponsor Letter of Support

(As uploaded)

Mayor Letter .pdf



Luke A. Bronin
Mayor

United States Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742

September 19, 2016

**RE: Report to Congress on Future Water Resources Development (WRDA)
Section 7001 Request for Funding Feasibility Studies
City of Hartford Flood Control System Improvements**

The City of Hartford thanks you for this invitation to submit a critical City water resources project for consideration of inclusion in pending federal legislation associated with Section 7001 of the Water Resources Development Act (the "WRDA"). In response, Hartford respectfully requests recognition of a current undertaking to remediate our aging flood control system as a project of the utmost importance and urges designation thereof as a federal priority.

Massive floods hit Hartford in the 1930s. The Great Flood of 1936 submerged much of the city leaving 14,000 residents homeless and businesses boarded. In response, the U.S. Army Corps of Engineers (USACE) constructed an intricate flood prevention system comprising 7 miles of earthen embankments and concrete flood-walls, 6 storm-water pump stations, 6 closure structures, and 5+ miles of tunnels. This collective flood protection assembly is regarded the largest and most complex in New England, and has capably provided protection from Connecticut River flooding since its construction. Although the flood control system was devised and built by the federal government, the responsibility for operation, maintenance, and repairs was transferred to the City of Hartford through a series of formal assurance agreements. USACE continues to maintain complete regulatory authority over the Hartford Flood Control System.

This system is now 75 years old and in urgent need of major repair. USACE Engineers notified Hartford in 2014 that the flood control system is no longer compliant with minimum standards and was being placed in "Inactive Status." This means that material deficiencies exist in the system which substantially reduce its capacity to provide flood protection as initially designed and constructed. The immediate impact of this determination was ineligibility for rehabilitation support; meaning, the city would be denied federal funds to rebuild flood prevention infrastructure if damaged by flooding. These deficiencies also put in jeopardy the City of Hartford's current FEMA Levee Accreditation under 44 CFR 65.10. Loss of accreditation will result in large sections of the City being designated as high-risk flood zones triggering extreme increases in flood insurance premiums and severe impediments to the deployment of state and federal funds therein.

Hartford applied for and obtained formal eligibility in January 2016 for participation in the USACE System Wide Improvement Framework ("SWIF") in order to avoid the deleterious impacts of being placed in Inactive Status. The SWIF requires a formal plan be developed within 2 years to bring the system back into compliance. The SWIF requires a schedule of corrective actions and demonstration of financial planning in support of all required repairs. The current cost projection for the improvements is in excess of 80 million dollars.

550 Main Street
Hartford, Connecticut 06103
Telephone (860) 757-9500
Facsimile (860) 722-6606



Luke A. Bronin
Mayor

The financial ramifications of an imminent project of this scale and expense will be severe for Hartford. This capital city is culturally rich and endowed with a great wealth of nationally significant history; however, it is facing a severe fiscal crisis, with limited ability to raise additional revenue. Unemployment and poverty are severe and pervasive in Hartford. The citywide unemployment rate is 16.4%, with some areas as high as 27%. While the statewide poverty rate is 10%, the city's is 33.9%, with some areas as high as 49.35%. Hartford households are disproportionately low-income with an average per capita income of only \$16, 286 annually versus \$37,726 statewide. These economic conditions have been acknowledged by the federal government via designation of a North Hartford Promise Zone.

While the costs of the flood control system are far beyond the fiscal capacity of the City of Hartford, deferral of these expenses is simply not an option. Infrastructure failure would be an environmental and civic catastrophe for the entire central-Connecticut region. A levee breach today would flood 25% of Hartford's land base. This would inundate approximately 3,000 acres of highly developed residential, commercial, and industrial areas and destroy 20% of the city's grand list. Affected areas would include Downtown Hartford's Commercial District, the North Hartford Promise Zone, the \$2 billion South Meadows Wastewater Treatment Facility (the largest such facility in the area and sole processing center for the region's sludge-based waste), and numerous historical and essential city and state government facilities.

For the foregoing reasons I hereby submit this critical city water resources project for inclusion in the forthcoming WRDA legislation. The program that we propose to undertake with WRDA funding is specifically described in Attachment A and is entitled Description of SWIF Capital Project Feasibility & Planning Program. Also included as Attachment B is a letter from USACE dated January 15, 2016 which formally accepts the City of Hartford into the SWIF program. Approval of the SWIF by USACE as per the attached letter is a recognition that the improvement projects included are considered viable projects by USACE, and also serves as verification that they are within USACE New England District scope of responsibilities.

I trust that you will find our application, comprised of this letter and the aforementioned attachments, to be both complete and compelling. Please do not hesitate to contact either myself or my staff if you have any questions or require further information. You will find David Tanner, City of Hartford Department of Public Works Deputy Director, to be immediately responsive and knowledgeable of all matters related to this project. He can be reached preferably by email at david.tanner@hartford.gov or by phone at (860) 757-9962. Again, thank you for your support through your exceptional and tireless representation of our interests from within the highest levels of the United States Government.

Respectfully,

A handwritten signature in black ink, appearing to read "Luke A. Bronin", is written over a horizontal line.

Luke A. Bronin
Mayor, City of Hartford

Attachments (uploaded separately):

Attachment #A WRDA Funding Request Overview & Project Description
Feasibility Studies for Future Capital Improvements

Attachment #B SWIF Verification Letter from USACE dated January 15, 2016

550 Main Street
Hartford, Connecticut 06103
Telephone (860) 757-9500
Facsimile (860) 722-6606

Map Document

(This is as uploaded, a blank page will show if nothing was submitted)

FloodControlSystemMap.pdf

SYSTEM MAP: MAJOR FEATURES

Hartford, Connecticut Flood Control System

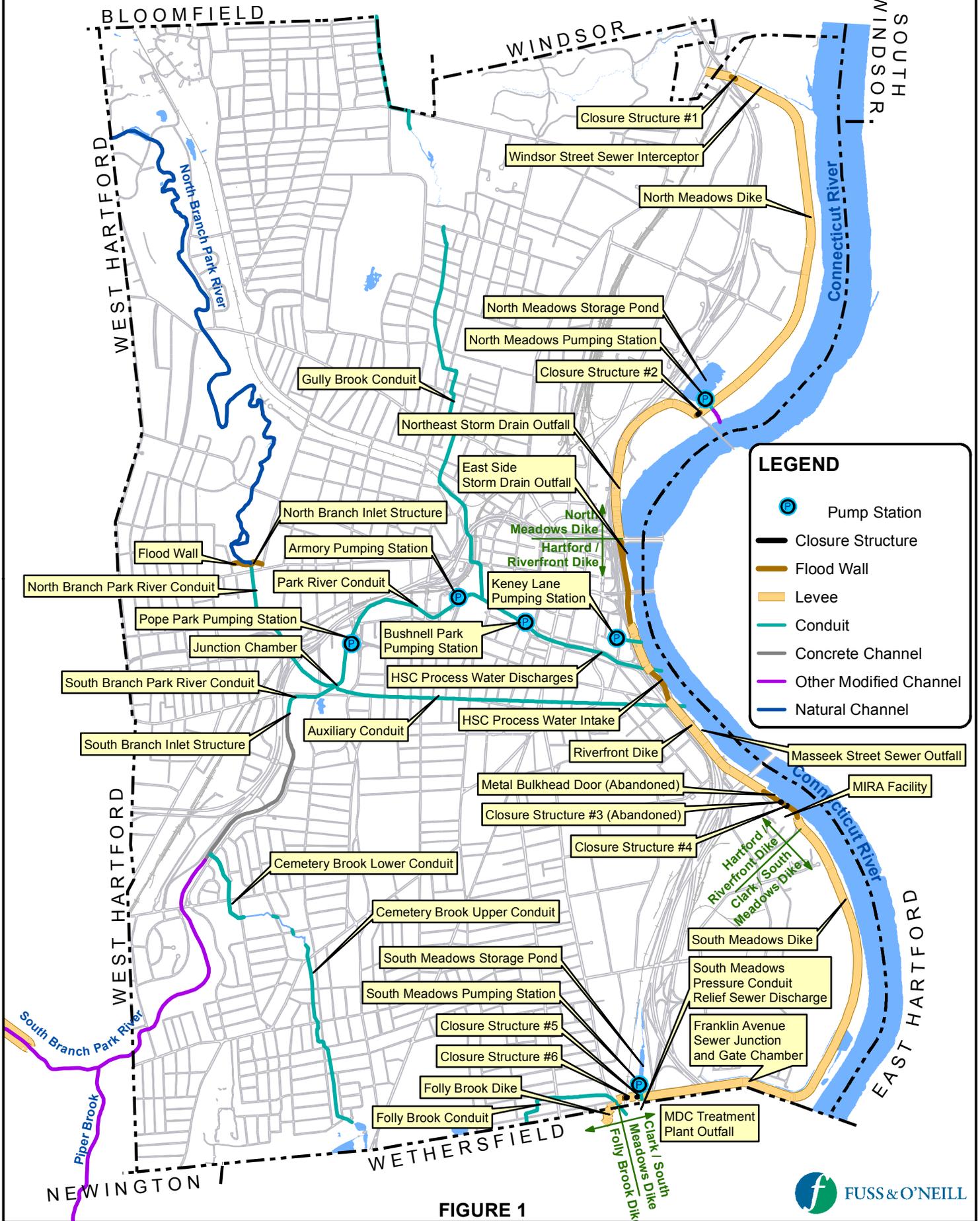


FIGURE 1

Additional Proposal Information

(This is as uploaded, a blank page will show if nothing was submitted)

FeasibilityStudyProposal.pdf

1. Administrative Details

Proposal Name: City of Hartford Flood Protection System Rehabilitation Feasibility Study

by Agency: City of Hartford, Department of Public Works

Locations: CT

POC Name: David Tanner

POC Phone: (860) 757-9962

POC Email: david.tanner@hartford.org

Date Submitted: 09/19/2016

Confirmation Number: 2b080b4d-bf53-49d6-81fa-6b281bac0087

Supporting Documents

File Name	Date Uploaded
Mayor Letter .pdf	09/19/2016
FloodControlSystemMap.pdf	09/19/2016

2. Provide the name of the primary sponsor and all non-Federal interests that have contributed or are expected to contribute toward the non-Federal share of the proposed feasibility study or modification.

Sponsor	Letter of Support
<p>City of Hartford, Connecticut(Primary)</p>	<p>The City of Hartford has attached a detailed letter of support for its request for WRDA funding for flood control improvements. Through significant local expense, Hartford went through a mandated levee accreditation process with the Federal Emergency Management Agency (FEMA) which resulted in accreditation for the 100 year flood in 2009. Hartford conducted a significant outreach program, receiving much public support, as part of meeting the FEMA requirements.</p> <p>Although FEMA 100 year requirements were met, the Hartford Flood Control system also falls under U.S. Army Corps of Engineers (USACE) regulations which require a much higher level of protection, exceeding the 500 year flood level. The City’s system was recently determined by USACE to be deficient, and the City was forced to enter into the USACE System Wide Improvement Framework (SWIF) program. This is a remedial program which allows 2 year grace period for the City to evaluate all defects, develop a plan to correct the deficiencies, and commit to the funding that is required.</p> <p>Hartford has been struggling to fund the high cost of the flood control capital improvements needed to satisfy USACE. Although Hartford’s levee system provides protection for many regional assets, Hartford has had to shoulder the financial burden alone. The City’s USACE approved SWIF program includes a commitment for \$78 M in capital improvements. Hartford’s financial condition is such that local funding alone will not be sufficient, and therefore outside assistance from WRDA is greatly needed.</p>

3. State if this proposal is for a feasibility study, a modification to an authorized USACE feasibility study or a modification to an authorized USACE project. If it is a proposal for a modification, provide the authorized water resources development feasibility study or project name.

[x] Feasibility Study

4. Clearly articulate the specific project purpose(s) of the proposed study or modification. Demonstrate that the proposal is related to USACE mission and authorities and specifically address why additional or new authorization is needed.

Severe floods in 1936 and 1938 prompted the U.S. Army Corps of Engineers (USACE) to construct a comprehensive flood control system to protect the City of Hartford from Connecticut River flooding. Despite the initial protection, the effects of time and the elements have taken a toll on the system's integrity, and significant capital investment is needed. Recent ratings by the USACE placed the City of Hartford's system in the "unacceptable" category indicating the system is at a heightened risk of failing to meet the rated protection criteria of the original USACE flood control project.

In addition to the risk to human life, there is significant public and private infrastructure at risk in the event of a levee failure. Over 20% of Hartford's land area is in the levee protected zone, most of which is comprised of important commercial, institutional, and residential properties. Major public infrastructure throughout the municipality is also at risk, the most vulnerable of which is the MDC's regional sewage treatment system which is in the process of a \$3 Billion EPA mandated upgrade. The Interstate 84/91 interchange, regional airport, MDC water distribution system, military jet fuel supply pipeline, and numerous major employers are also at increased risk. To ensure that the flood protection systems can safely protect human life, public and private property, and regional utility infrastructure; federal assistance through WRDA is greatly needed.

5. To the extent practicable, provide an estimate of the total cost, and the Federal and non-Federal share of those costs, of the proposed study and, separately, an estimate of the cost of construction or modification.

	Federal	Non-Federal	Total
Study	\$2,680,000	\$1,340,000	\$4,020,000
Construction	\$22,500,000	\$12,100,000	\$34,600,000

Explanation (if necessary)

Breakdown of Feasibility Study Components & Costs • Project #1 Underseepage Control (Bulkeley Bridge and S. Meadows) - \$500,000

• Project #2 Interior Drainage-Pump Station Rehab/Replacement - \$525,000 • Project #3 Interior Drainage-Conduit Rehab/Replacement - \$575,000

• Project #4 Levee Utility Penetration Abandonment/Modification - \$355,000 • Project #5 Levee Toe Drain Modifications - \$350,000 • Project #6 Concrete Floodwall Stability Rehab/Replacement - \$375,000

TOTAL WRDA FEASIBILITY STUDY FUNDING REQUEST \$2,680,000

Please see the attached: i) WRDA Funding Request Overview & Project Description; and ii) January 15, 2016 letter from USACE granting the Hartford a 2 year SWIF plan development period, each of which provide greater detail regarding the Hartford Flood Control System and the parameters of the proposed feasibility study.

6. To the extent practicable, describe the anticipated monetary and nonmonetary benefits of the proposal including benefits to the protection of human life and property; improvement to transportation; the national economy; the environment; or the national security interests of the United States.

Assured integrity of the flood control system is essential to re-establishing the City of Hartford as a center of prosperity in the region. As Connecticut's capital city, Hartford has been home to many large employers in the private and public sector. However, conditions of unemployment and poverty have recently become severe and pervasive. These socio-economic conditions cannot be remedied while anchor businesses and potential new investors remain weary of potential flooding.

Recent federal regulatory action has furthered the adverse impact of fiscal recession on the local economy by signalling that Hartford is extremely vulnerable to flood risk. The media has made reference to the massive floods that hit Hartford in the 1930s, conjuring images of The Great Flood of 1936 that submerged much of the city leaving 14,000 residents homeless and businesses boarded. These accounts hinder all attempts to reduce the dire citywide unemployment and poverty rates. Joblessness impacts as many as 49.35% of our citizens in some areas of the city. These economic conditions have been acknowledged by the federal government via designation of a North Hartford Promise Zone.

As Hartford strives to stabilize and rebuild its core downtown business and residential base, it must be able to show potential employers and developers their investments will stay above water both figuratively and literally. The proposed feasibility study will quantify the strength of the system and potentially show more cost effective resolutions to discovered deficiencies. This information will form the basis of a clear course of action to restore Hartford as a feasible location to live and do business in the future. Further, it may dispel current misunderstandings in the business and development community and open up opportunities in the near term.

7. Does local support exist? If ‘Yes’, describe the local support for the proposal.

Yes

Local Support Description

There exists intense local support for this program. The requested feasibility study pertains to a potentially undermined section of the Hartford Flood Control System. This critical infrastructure protects those properties comprising 20% of the City’s grand list. Were a flood to occur, affected areas would include the Downtown Hartford Commercial District, the North Hartford Promise Zone, the \$2 billion South Meadows Wastewater Treatment Facility (the largest such facility in the area and sole processing center for the regions sludge-based waste), and numerous historical and essential city and state government facilities. Such an event would cripple the region. Accordingly, this project is universally supported by local area residents and businesses.

8. Does the primary sponsor named in (2.) above have the financial ability to provide for the required cost share?

Yes

Additional Proposal Information

(This is as uploaded, a blank page will show if nothing was submitted)

SWIF Approval Letter.pdf



DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD MA 01742-2751

January 15, 2016

Honorable Luke Bronin
Mayor of Hartford
550 Main Street, Room 200
Hartford, CT 06103

Dear Mayor Bronin,

The US Army Corps of Engineers (USACE) has reviewed the City of Hartford's December 3, 2015 letter requesting approval of the Letter of Intent (LOI) for Hartford's two Flood Damage Reduction (FDR) Systems (System ID #4305000011 and #4305000032) located in Hartford, CT. The December 3, 2015 letter and attachment addressed USACE's comments as requested in our October 09, 2015 letter. Therefore, as of August 11, 2015 the LOI for the two Hartford FDR Systems (Connecticut River Right Bank and North and South Branch Park River Conduit) is approved and the systems are eligible in the Rehabilitation Program pursuant to Public Law (P.L.) 84-99.

The city of Hartford is granted a two-year period starting on August 11, 2015 to prepare a SWIF plan. During the development of the SWIF plan, the city is expected to (a) operate and maintain the system in accordance with the operation and maintenance manual, (b) implement interim risk reduction measures, and (c) perform risk communication activities with the population at risk. USACE will monitor the city's progress during the 2 year SWIF plan development period on an annual basis. During the review period, if progress is deemed unsatisfactory, the two Hartford FDR systems may be returned to an "ineligible" status within the Rehabilitation Program pursuant to P.L. 84-99.

If you have any questions concerning this project or this letter, please contact David Schafer, Chief, Emergency Management Office, at 978-318-8274 or email at david.w.schafer@usace.army.mil or Michael Bachand, Levee Safety Program Manager, at 978-318-8075 or email at michael.l.bachand@usace.army.mil.

Sincerely,

A handwritten signature in black ink, appearing to read "C. J. Barron", written over a horizontal line.

Christopher J. Barron
Colonel, Corps of Engineers
District Engineer

Copy Furnished:

Honorable Richard Blumenthal
702 Hart Senate Office Building
United States Senate
Washington, D.C. 20510

Honorable Chris Murphy
SD-B40A Dirksen Senate Office Building
United States Senate
Washington, D.C. 20510

Honorable John B. Larson
United States Representative
1501 Longworth House Office Building
Washington, DC 20515

Dean Savramis, P.E.
Director, Mitigation Division, FEMA Region 1
99 High Street, 6th Floor
Boston, MA 02110

Arthur P. Christian II P.E.
Inland Water Resources Division
Connecticut Department of Energy and Environmental Protection
79 Elm Street
Hartford, Connecticut 06106

Constantin Banciulescu, P.E.
Greater Hartford Flood Commission
City Engineer/Assistant Director of Public Works
50 Jennings Road
Hartford, CT 06210

Bob Umasnahker
Civil Engineer
Department of Public Works
50 Jennings Road
Hartford, Connecticut 06210

ROUTING SLIP		NEVER USE FOR APPROVALS, DISAPPROVAL, CONCURRENCES, OR SIMILAR ACTIONS	
For use of this form, see AR 25-50			
TO	INITIALS	DATE (YYYYMMDD)	
7	District Engineer		
6	Deputy District Engineer	<i>DA</i>	1-19
5	Deputy District Engineer PM		
4	Executive Assistant	<i>JA</i>	1-19
	Library		
	Security		
	ACE-IT		
	Contracting Division		
	Contracts Branch		
	Purchase Branch		
	Construction Division		
	Counsel		
3	Engineering/Planning Division	<i>Jan</i>	1/15/16
	A/E - Value Engineer		
	Design Branch		
	Evaluation Branch		
	Geo-Environmental Branch		
2	Geotechnical/Water Resources	<i>Jan</i>	1/15/16
	Planning Branch		
	Emergency Mgmt. Office		
	Equal Employ. & Opp. Office		
	Human Resources		
	Internal Review Office		
	Logistics/ULA Office		
	Operations Division		
	Technical Support Branch		
	Programs/Project Management		
	Env/Military Proj. Mgmt. Branch		
	Programs/Civil Proj. Mgmt. Br.		
	Navigation Section		
	Public Affairs Office		
	Real Estate Division		1
	Appraisal Branch		
	Conveyancing Branch		
	Planning & Control Branch		
	Regulatory Division		
	Resource Management Office		
	Budget Manpower Branch		
	Finance & Accounting Branch		
	Management Analysis Branch		
	Safety & Occup. Health Office		
	Small Business Prog. Office		
<i>Julie</i> CHECK ACTION DESIRED			
INFORMATION		NECESSARY ACTION	
SIGNATURE		SEE ME	
NOTE AND RETURN			
CIRCULATE			
FROM		DATE	
<i>Mike Bachand</i>		2016 01 15	
TELEPHONE		FAX	
E-MAIL			
ORGANIZATION			

Additional Proposal Information

(This is as uploaded, a blank page will show if nothing was submitted)

WRDA Hartford Study Request.pdf

**City of Hartford, CT Flood Control System
WRDA Funding Request Overview & Project Description
Feasibility Studies for Future Capital Improvements
September 19, 2016**

Index to Attachment Sections:

Section A: WRDA Funding Request Summary
Section B: Funding Request Background & Overview
Section C: Project Descriptions

**SECTION A: WRDA FUNDING REQUEST SUMMARY FOR FEASIBILITY
STUDIES FOR CAPITAL IMPROVEMENTS**

• Project #1 Underseepage Control (Bulkeley Bridge and S. Meadows)	\$500,000
• Project #2 Interior Drainage-Pump Station Rehab/Replacement	\$525,000
• Project #3 Interior Drainage-Conduit Rehab/Replacement	\$575,000
• Project #4 Levee Utility Penetration Abandonment/Modification	\$355,000
• Project #5 Levee Toe Drain Modifications	\$350,000
• Project #6 Concrete Floodwall Stability Rehab/Replacement	\$375,000
TOTAL WRDA FEASIBILITY STUDY FUNDING REQUEST	\$2.68 Million

SECTION B: FUNDING REQUEST BACKGROUND & OVERVIEW

1. Flood Control System Background

Following devastating floods in 1936 and 1938, U.S. Army Corps of Engineers began construction of a comprehensive flood control project to protect the City of Hartford from Connecticut River flooding. This system has become the largest of its kind in New England, and one of the largest on the East Coast.

This system has been effective at protecting both communities from flooding for greater than 70 years since its construction. Despite the protection afforded, the effects of time and the elements have taken a toll on the system's integrity. Significant capital investment is needed to continue the level of protection originally afforded. Significant development has occurred behind these levees in the ensuing years, much of which is at risk in the event of a levee failure. In Hartford, for example, approximately 20% of its land area is in the levee protected zone, most of which is comprised of prime commercial, institutional, and residential properties. Furthermore, major public safety related infrastructure is also vulnerable to flooding in the event of a levee failure. Some of the infrastructure that would be most adversely impacted include the Interstate 84/ 91 interchange, the MDC regional sewage treatment facility, the State of Connecticut's Brainerd Airport, and a critical aviation fuel supply line that serves Bradley Airport and Westover Air Force base.

Hartford has been struggling to fund the high cost of capital improvements needed to satisfy maintenance and improvement mandates from regulatory agencies including FEMA and the U.S. Army Corps of Engineers.

The City of Hartford's flood protection system consists of 7 miles of levees, 6 storm water pump stations, and over five miles of major underground conveyance conduits.

2. Federal Accreditation of Flood Control Systems

Hartford went through an exhaustive accreditation process with FEMA which resulted in receiving FEMA accreditation for the 100 year level of protection system in 2009. The significance of levee accreditation is that properties within the levee protected zone would otherwise be considered in a high risk flood zone which would necessitate flood insurance, and would require the application of flood plain development regulations. These requirements would deter growth and economic development in these areas. Furthermore, designation of the areas as high risk flood zones would severely inhibit the use of state and federal funding for many public infrastructure projects. Although accreditation was secured from FEMA, there were numerous caveats relating to future capital improvements that were included. The accreditations include commitments to continue with flood control system improvements and maintenance in order to maintain the 100 year protection level accreditation status.

3. Flood Control System Deficiencies Cited by USACE

In 2012, Hartford received Periodic Inspection (PI) letters from the U.S Army Corps of Engineers (USACE) which outline immediate repair and maintenance needs, in addition to long range capital improvement needs. The USACE requirements include efforts to maintain the basic 100 year protection status as mandated by FEMA, but also the added burden of ensuring that the levee systems meet the original design basis, which in this case exceeds the 500 year level of protection.

In 2014 USACE evaluated the system again under newly adopted criteria, and reported that the systems were not in compliance due to unfulfilled improvement needs to correct deficiencies previously cited, and that ongoing care and investment in the systems were severely lacking. USACE took the further and serious action of notifying the City of Hartford, by letter dated August 13, 2014, that its flood protection system was being placed in the USACE "Inactive Status" category. USACE placed the Hartford system in inactive status due to the number and magnitude of the deficiencies noted.

4. Consequences of USACE Inactive Rating

The consequences of the action by USACE to place the Hartford system in inactive status is significant. The immediate consequence is that Hartford is currently exposed to the full cost of any potential damage to the levee system caused by flooding that would otherwise be covered by federal funding. A second and, as yet unknown consequence, relates to FEMA's reaction to the USACE "Inactive Status" designation of the Hartford system.

Potentially, FEMA may rezone the levee protected zones as high risk flood zones, which would cause severe consequences for property owners within this zone. This would result in requirements for expensive flood insurance for property owners, limit use of State and Federal funding within these high risk flood zones, and generally hinder economic development once these areas are considered high risk flood zones.

In addition to the above regulatory problems, the actual condition of the flood control systems, as reported by USACE, present that there is significant risk to human life, property, public infrastructure within the levee protected zone. In essence, USACE has indicated that the Hartford Flood Control System is not capable of providing the flood protection it was designed to provide. In addition to human life, there is significant public and private infrastructure including public and private buildings, street and highway infrastructure, and public utility facilities.

One of the most vulnerable and expensive public facilities that would be impacted by a failure of flood control components is the regional sewer collection and treatment system, owned and operated by the Metropolitan District Commission. This facility is at the lowest elevation within the levee protected zone, and would be inundated under various levee failure scenarios.

5. USACE “SWIF” Program

Although the system currently has FEMA’s 100 year level accreditation, the more stringent requirements of USACE require the system to be maintained to its original design criteria which is greater than the 500 year flood. USACE has continued to enforce its standards which require a more compliant operation and maintenance program, and additional capital improvements to repair elements of the system which are suspected or have been shown to be substandard.

Routine levee inspections by USACE after the FEMA accreditation have resulted in Hartford’s flood control system’s rating being “Unacceptable”. The unacceptable items involve a range of deficiencies including physical defects, lack of maintenance, and lack of required ongoing inspections. This rating caused USACE to place the system in “Inactive Status”. In addition to possibly impacting the FEMA accreditation, Inactive Status systems are not eligible for federal assistance in the event of flood damage to the flood control system.

In order to avoid the deleterious effects of being placed in Inactive Status, the City entered into a program with USACE which allows for temporary active status designation by entering into a System-Wide Improvement Framework (SWIF) program. The SWIF allows the City 2 years (from August 2015) to develop a remedial plan, and to make demonstrable progress in correcting its deficient conditions. The SWIF plan must also provide a financial plan, identify funding sources, and make commitments necessary to satisfy the deficiencies identified in the USACE inspection reports. Also, until such time as the deficiencies are corrected, various “interim risk reduction measures” (IRRM’s) must be

implemented to minimize the impacts that could occur if the system failed in variety of manners. This includes such items as action plans, public outreach, and early warning systems.

In addition to the maintenance and inspection items included in the SWIF, approximately \$79 million in the long range capital improvements required to bring the system into compliance have been identified.

6. Financial Burden of Levee Compliance and Request for WRDA Funding Assistance

Although the Hartford flood control system is essentially a regional protection system, in that it protects many regional facilities, Hartford has had to shoulder the ongoing financial burden alone. The capital investment needs for these flood control systems is extreme, and Hartford has been able to meet the system's investment needs.

Hartford has relied primarily on local bonding and, to a lesser extent, state grants to perform the improvements needed. However, given the magnitude of the combined financial needs, this has proven inadequate. The investment needs have an order of magnitude estimate of \$78 Million, and federal assistance appears to be the only viable source for such an extensive investment.

In order to meet federal levee safety requirements, and to ensure that the systems are capable of protecting the human life, public and private property, and regional utility infrastructure that exists within the levee protected zone, federal assistance is severely needed.

7. WRDA Project Description Overview: Engineering Evaluation and Plan Development for Capital Improvement Alternatives

In order to begin the process of implementing the capital improvements needed for USACE to reinstate an "Active Status" for the Hartford Flood Control system, engineering and planning work must first occur on the identified projects. A comprehensive list of conceptual projects has previously been compiled, which results in the investment needs summarized above, however, important project details have yet to be resolved.

Examples of major capital projects include general levee surface repairs, rehabilitation and upgrades to the nine pump stations, repair of levee toe drains and associated collector drainage systems, repair and upgrade of levee penetrations for public utilities (pressurized and non-pressurized), repair and upgrade of railroad closure structures, and structural repairs to major underground conduit systems. Perhaps the most urgent project is the control of flood wall under-seepage between the Bulkeley Bridge and Founders Bridge,

which respectively carry Interstate I-84 and Route 2 over the Connecticut River.

The WRDA funding request is intended to be used to perform the following general tasks associated with the listing of conceptual projects needed to satisfy UACE requirements:

- Advance conceptual designs to a level that will allow for evaluation of feasibility and ability of each project to satisfy USACE criteria for noted deficiencies.
- Develop alternative designs to a level whereby risk assessment criteria can be evaluated, cost estimate can be prepared, and a value engineering process can be conducted.
- Identify and evaluate environmental impacts and permitting aspects of each alternative.
- Select a preferred alternative for each project along with a final cost estimate.
- Develop preferred alternatives to a level that will support rapid final plan and specification preparation to support expedited construction bidding.

Section C below entitled “Project Descriptions” contains details of five specific projects that are considered the highest priority, and therefore included in this request for WRDA funding for Engineering Evaluation and Plan Development.

SECTION C: PROJECT DESCRIPTIONS

Project #1 Hartford Bulkeley Bridge Floodwall and South Meadows Levee Under-Seepage Control

The City of Hartford is protected by a concrete floodwall in the vicinity of the central business district between the Bulkely Bridge on Interstate I-84, and the Founders Bridge which connects Route 2 to downtown Hartford. Interstate I-91 is located behind and parallel with the floodwall. When the flood control system construction in the late 1930's, a raised boulevard on the Hartford side existed where the current I-91 is situated. The raised boulevard provided a considerable mass of earth to resist underseepage and uplift caused by high Connecticut River levels. Although the design rationale remains unclear, shorter sheet pile underseepage control was used in the original construction of this section of the levee, which is the main source of the underseepage concern. With the construction of the interstate highway system (now Interstates 84 & 91) in the late 1950's and 1960's, and later improvements in the 1980's, the highways were grade-separated and I-91 was significantly depressed in elevation. Most of the fill upon which the raised boulevard was built has been removed, thereby creating a shorter seepage path and the potential for increased under-seepage.

Although the entire remainder of Hartford's levee system is protected from under-seepage

by a deep sheet pile cut-off wall, this is the only section where a short cut-off wall exists. Piezometers installed on the land side of the floodwall have shown that groundwater levels rise in direct relation to increases in Connecticut river elevation, which indicates that excessive under seepage is occurring. Depending on the severity and duration of the flooding, the consequences of underseepage problems could range from nuisance flooding of the highway and adjacent railroad to large scale failure of the levee system. The Levee Accreditation report performed by the City's consultant indicates that underseepage models, which have been confirmed by piezometer monitoring, indicate that the current configuration can control underseepage for up to approximately a 100 year flood event. At flood levels greater than this, the underseepage would significantly exceed allowable USACE standards for hydraulic gradient, thus indicating an unacceptable underseepage condition.

This is a potentially dangerous condition that could lead to flooding of the complete levee protected area in the City. The most vulnerable facilities at this location are the active rail lines and Interstate I-91, both of which are within less than 100 feet from the floodwall. In order to determine the specifics of the highway construction for I-91, a significant amount of CT DOT records research is required, supplemented by field exploration. The research and analysis is needed to determine the extent to which Interstate I-91 is currently resistant to uplift forces caused by levee underseepage.

Subsurface exploration to more specifically identify environmental contamination parameters and geotechnical conditions in this project location is also required. Conceptually, this project calls for installation of an underground cut-off wall system using either sheet piling, grout/slurry wall, installation of ground water relief wells and pumping equipment, highway ballast improvements, or other methods. Each option has various pros and cons, however, alternatives for completing this project need to be explored in greater detail and developed into a preferred alternative. The Preliminary Opinion of Cost is \$12.5 M based on conceptual information.

In another section of the levee, piezometer readings taken over the last several years indicate that interior groundwater levels are also reacting excessively to increased river levels at the South Meadows Dike. This project seeks to determine the specific causes of the under-seepage in this location as well. The effectiveness of the underseepage controls at this location is also a major concern for the MDC for its adjacent regional sewage treatment facility. Construction operations for upgrades to the MDC's facility need to be especially careful about excavation support systems to ensure that the levee's underseepage system is not further compromised. Also, permanent flood resistant design criteria for the MDC's upgrade projects may be needed if the risk of levee underseepage failure is not fully addressed. Preliminary Opinion of Cost is \$5.0 M based on conceptual level information.

Project #1 WRDA Request: The requested amount of WRDA funding for the Feasibility Studies, Engineering Evaluation, and Plan Development related to the **Underseepage**

Control task is \$500,000. This would include development of design alternatives, feasibility evaluation of alternatives, preliminary engineering design, cost estimating, value engineering, and selection of a preferred alternate.

Projects #2 and #3-Flood Control System Interior Drainage

Introduction

In addition to the levee system, Hartford and East Hartford flood control systems contain an extensive interior drainage system consisting of multiple pump stations, storm water collection pipes, gravity and pressure conduits, and associated valves, gates and control structures. The interior drainage system also has multiple interconnections with the regional sanitary sewer and combined sewer systems, owned and operated by the Metropolitan District Commission(MDC).

Aside from levee failure, the interior drainage system poses the most significant risk of inundation within the levee protected area. One of the main goals of the interior drainage project(s) is to perform a comprehensive inundation analysis to determine the extent to which inundation would occur as a result of various interior drainage component failures. This information is important for Hartford and East Hartford to understand, but is of also of great importance for the MDC since its collection and treatment facilities are greatly impacted by the performance of the flood control interior drainage system. The MDC may need to include additional costs for improvement to its existing or proposed facilities to protect against potential failures of the interior drainage system.

The regional sewage treatment facility, owned and operated by the Metropolitan District Commission (MDC), is also greatly affected by the performance of these facilities. Poor performance or failure of any of these interior drainage components could result in flooding that would inundate the regional sewage treatment facility. The MDC's regional sewage treatment facility is perhaps the most vulnerable public infrastructure within the levee protected zone due to its low elevation. Such flooding could cause significant damage to the plant, or could result in the plant's failure to fulfill its mission of treating the region's sewage. Such a failure could create a significant release of untreated waste water, which would have severe environmental and public health impacts. Thus, the performance of the flood control system's interior drainage components is of great importance to the integrity of the regional sewer system.

The City of Hartford system includes 6 flood control pump stations, while the East Hartford system contains 3 pump stations. The primary purpose of the pump stations is to evacuate storm water that falls within the protected areas and pump it to the Connecticut River. The levee system provide protection from the Connecticut River flowing into the protected areas, however the pump stations are needed during flood conditions since

gravity flow of stormwater is not possible when the Connecticut River is elevated.

Project #2 Flood Control Pump Stations

The South Meadows Pumping Station, constructed in 1929, is the oldest and most frequently used station within the Hartford Flood Control System. Although various repairs have been made to mechanical equipment, including replacement of pump bearings and seals, valve replacement, and pipe joint repairs, the station is outdated and deteriorated structurally. Failure of this pump station to perform at full capacity results in localized flooding outside of the station's holding pond. If the station fails to pump as per its design capacity, the resulting flooding could easily inundate the adjacent regional sewer facility which would could cause damage and have severe environmental impacts. Capital improvements currently being designed by the MDC may need to consider some degree of flood protection for their facilities to guard against the potential for inundation as noted above. Thus the MDC may incur increased construction costs to include such safeguards in their construction projects at the sewage treatment facility.

An evaluation needs to be made as to whether major rehabilitation or complete replacement is needed. The major rehabilitation alternate would include replacement of the original 1929 pumps with newer more efficient models capable of maintaining the base pumping capacity. New electrical service and panels would be installed along with various electrical and mechanical improvements.

As an alternate to the above rehabilitation, consideration of an alternate to completely replace this pumping station with a new station needs to be evaluated. The new station could be built alongside the existing station, and the old station decommissioned and demolished following completion of the new station.

Rehabilitation work is also needed on the City's remaining 5 pump stations, The North Meadows Pumping Station was constructed in 1939 and is the second oldest of the six Hartford Flood Control pumping stations. This station should also be evaluated for major rehabilitation or complete replacement.

The Keney Lane Pumping Station which was erected in 1943, and the Bushnell Park Pumping Station which was constructed in 1944, need to be evaluated for rehabilitation needs. The remaining two stations, Armory Station and Pope Park Station, are the newest stations and receive little usage. Therefore, minor rehabilitation is recommended for evaluation of these stations. The Town of East Hartford's three Pump Stations (Meadow Hill, Cherry Street, and Pitkin Street Stations) also need consideration for upgrade or replacement.

Project #2 WRDA Request: The requested amount of WRDA funding for the Feasibility

Studies, Engineering Evaluation, and Plan Development related to the **Interior Drainage-Pump Station Rehabilitation/Replacement** task is \$525,000. This would include development of design alternatives, feasibility evaluation of alternatives, preliminary engineering design, cost estimating, value engineering, and selection of a preferred alternate.

Project #3 Flood Control System Interior Drainage – Flood Control Conduits

There are 4 pressure conduits within the system which become pressurized due primarily to backflow of the Connecticut River into these conduits during periods of high river level. These systems also become surcharged due to high inflows, generally coincident with the high river levels.

The Park River Conduit is a twin barrel concrete box culvert, of varying cross section ranging from approximately 22' to 36' in width, and 20' to 28' in height. It conveys flow from the South and North Branches of the Park River through the City and discharges to the Connecticut River. It is one of the most important components in the flood protection system. There are various storm drain, combined sewer, and pump station inlets along the way, all of which have regulation devices to prevent backflow during periods of high river levels. The sections of the conduit in the vicinity of I-91 were built circa 1940 and are founded on wooden pilings. Several joints in this area have shown signs of settlement and lateral movement. Causes of the movement need to be investigated, and potentially the conduit may need to be shored up in places to prevent further movement. Also, construction/expansion joints need to be replaced due to failure to prevent infiltration and further deterioration. The Park River Auxiliary Conduit is a 22' diameter concrete relief conduit which takes excess flow from the Park River Conduit (PRC) during times of high flow. It is an inverted siphon approximately 140' feet in depth, and is prone to collecting sediments that diminish capacity. Due to its design as a siphon, it is full of water at all times. Preliminary Opinion of Cost for repairs to the Park River Conduit system is \$10.0M based on conceptual information.

The Gully Brook Conduit is a twin concrete box culvert which was constructed as a pressure conduit for its lower-most segment. The cross sections of each barrel vary from 9' wide by 7' high to 11' wide by 9'-6" wide. The Corps of Engineers built the pressure conduit section which is approximately 3,119 feet long measured from its intersection with the Park River Conduit within Bushnell Park. The pressure conduit connects with and accepts flow from the existing Gully Brook Conduit. This conduit needs to be evaluated for rehabilitation or replacement due to signs of deterioration. Preliminary Opinion of Cost for repairs to the Gully Brook Conduit is \$5M based on conceptual information.

The Folly Brook Conduit is a concrete conduit of varying cross section and construction type, with an average cross section measuring approximately 12' wide by 8' high. Its purpose is to accept the flow of the Folly Brook which enters from Wethersfield, convey the flow through a portion of the south end of Hartford, and discharge to the Wethersfield Cove. The Conduit flows in a west to east direction, roughly parallel with the Wethersfield Town line. The Folly Brook Conduit is completely open to the Wethersfield Cove at its outlet, and therefore is directly exposed to any fluctuations in the Connecticut River level. The total length is approximately 3,000 feet.

The Folly Brook Conduit was constructed in various phases using different construction techniques and has suffered significant deterioration due to age, substandard initial construction techniques, and the corrosive effects of combined sewer overflows which discharge into this conduit. This project calls for the construction of a new conduit, which would likely have to be constructed parallel to the existing conduit for logistical reasons. This upgrade is needed to allow for reliable future flows of storm and floodwaters, and the increased flows which may result from sewer separation. Preliminary Opinion of Cost is \$8.0 M, based on conceptual information.

Project #3 WRDA Request: The requested amount of WRDA funding for the Feasibility Studies, Engineering Evaluation, and Plan Development related to the **Interior Drainage-Conduit Rehabilitation/Replacement** task is \$575,000. This would include development of design alternatives, feasibility evaluation of alternatives, preliminary engineering design, cost estimating, value engineering, and selection of a preferred alternate.

Project #4 Levee Utility Penetration Abandonment & Modification

A large number of utilities pass through the levee and flood walls, introducing the potential for progressive seepage, backflow, or destabilization of the levee during a flood event. Planned improvements include properly abandoning utilities no longer in use, and repair or enhanced backflow prevention for those that remain in use. Utility owners include the City, the MDC, and others. Among them is a high pressure jet fuel line that transfers fuel through central Connecticut to points north including Bradley International Airport, and Westover Air Force Base.

Levee penetration investigation is needed, along with a program to permanently abandoning unused utility lines that penetrate through the dike. As Hartford transitioned from an industrial riverfront City to an insurance and financial center, many utility connections that passed through the earthen levees and concrete walls were no longer needed. Unfortunately, however, it is not clear in many cases how they were abandoned. Records for the abandoned utilities and inspection/confirmation of their integrity is

difficult to locate or is non-existent. Given the presence of these penetrations and the risk posed, efforts are needed to perform exploratory work to uncover the known penetrations, visually inspect, and then permanently seal with grout fill or other means where needed.

Project #4 WRDA Request: The requested amount of WRDA funding for the Feasibility Studies, Engineering Evaluation, and Plan Development related to the **Levee Utility Penetration Abandonment & Modification** task is \$355,000. This would include development of design alternatives, feasibility evaluation of alternatives, preliminary engineering design, cost estimating, value engineering, and selection of a preferred alternate.

Project #5 Levee Toe Drain Modifications

The toe drains along the landside toe of Hartford’s North Meadows Dike consist of drainage rock rather than perforated pipe, as is required by current design standards. As such the U.S. Army Corps of Engineers (USACE) has identified these toe drains as an “unacceptable” feature. Installation of perforated pipe toe drains is required along the North Meadows Dike to bring it into compliance with USACE criteria.

The toe drains along the landside toe of Hartford’s South Meadows Dike consist of gapped clay pipe segments rather than perforated pipe, as is required by current design standards. As such the USACE has classified these toe drains as “unacceptable.” Replacement of the existing clay pipe with toe drains made of perforated pipe is required along the South Meadows Dike to bring it into compliance with USACE criteria.

The Town of East Hartford also has documented problems with its toe drain system and improvements needs have been identified by USACE.

Project #5 WRDA Request: The requested amount of WRDA funding for the Feasibility Studies, Engineering Evaluation, and Plan Development related to the **Levee Toe Drain Modifications** task is \$350,000. This would include development of design alternatives, feasibility evaluation of alternatives, preliminary engineering design, cost estimating, value engineering, and selection of a preferred alternate.

Project #6 Concrete Floodwall Stability Rehab/Replacement

The City's concrete floodwalls and closure structures form an integral part of the Connecticut River Levee system. Portions of these components were noted by the U.S. Corps of Engineers (USACE) as deficient in its recent inspections, and the City has agreed to address these problems in the recently approved System-wide Improvement Framework (SWIF) Letter of Intent.

USACE has identified various floodwall sections that have visual signs of distress. Three specific sections of the concrete floodwalls were included in the O&M inspection guidelines as requiring periodic movement measurement, however, USACE has also identified several other concrete floodwall sections or closure structure components that have demonstrated signs of distress. Obvious signs of distress, such as differential settlement and movement, cracking, and fracturing of concrete were apparent at these locations.

Through the SWIF documents and other USACE inspection records, deficient floodwall locations have been identified as follows:

- Location #1 Closure Structure #1 and Closure #2 Cracking North Meadows Dike
- Location #2 Settlement/Tilting at Concrete Closure Structure #6-South Meadows Dike
- Location #3 Settlement/Movement Floodwall at Sta. 0+00 to 4+67 North Meadows Dike
- Location #4 Settlement/Tilting at Floodwall within the MIRA site
- Location #5 Floodwall East of Van Dyke Avenue at Sta. 36+00 to 45+00 (Hartford Dike)

Location #5 noted above is the most severely impacted floodwall section, showing signs of significant differential settlement. Under an (unfunded) riverfront enhancement project, an approximate 300 foot long section of floodwall which has been noted as having significant joint movements, settlements, and cracking at several of its joints would be removed and relocated. This modification would alleviate the need to physically address this floodwall problem, and the City fully supports the floodwall replacement project. Portions of the feasibility study

Project #6 WRDA Request: The requested amount of WRDA funding for the **Concrete Floodwall Stability Rehab/Replacement** is \$375,000. This would include development of design alternatives, feasibility evaluation of alternatives, preliminary engineering design, cost estimating, value engineering, and selection of a preferred alternate.