North Branch Park River Watershed Management Plan

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Prepared for:

Connecticut Department of Environmental Protection

Prepared by:

FUSS & O'NEILL
Disciplines to Deliver

In Cooperation With:

Park River Watershed Revitalization Initiative
Farmington River Watershed Association

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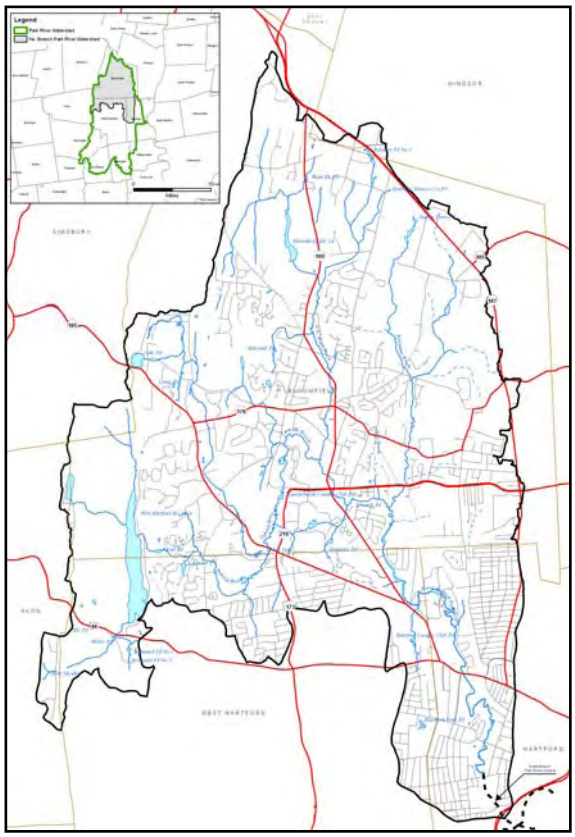
Executive Summary

E.1 The North Branch Park River – An Impaired Urban River



The North Branch Park River Watershed.

The North Branch Park River watershed is an approximately 29-square mile sub-regional basin within the larger Park River watershed and the Connecticut River basin. The majority of the watershed land area (97%) is located within Bloomfield, Hartford, and West Hartford. The North Branch Park River is formed by four major tributaries - Beamans Brook, Wash Brook, Filley Brook, and Tumbledown Brook - and flows in a southerly direction for approximately 6 miles through the northern sections of the City of Hartford before entering an underground conduit near Farmington Avenue and ultimately flowing to the Connecticut River.

The North Branch Park River and its watershed, as it exists today, reflect the rich cultural history of the Hartford metropolitan area as well as many dramatic changes that have altered the development patterns along the river and within its watershed, the physical characteristics of the river, and even the name of the river itself. The watershed is home to approximately 48,000 residents, numerous educational and corporate campuses, and sites of historical and cultural significance including the Harriet Beecher Stowe House, the Mark Twain House, and Elizabeth Park.

The water quality of the North Branch Park River also reflects several hundred years of urbanization within the Hartford area. Today, the poor water quality in portions of the North Branch Park River limits recreational uses and provides insufficient habitat for fish, other aquatic life, and wildlife due to physical alteration and elevated levels of bacteria. The river is considered "impaired" for these uses. Urban stormwater and combined sewer overflows (discharges of untreated wastewater directly to the river during larger storms when the combined storm and sanitary sewers become overwhelmed by stormwater runoff) are believed to be the primary sources of the bacteria contamination in the North Branch Park River.

The North Branch Park River conduit entrance near Farmington Avenue.

While the flood control projects of the last century have protected the City of Hartford from the type of catastrophic floods that occurred in the 1930s and 1950s, channelization and burial

of portions of the North Branch Park River dramatically altered the physical and habitat characteristics of the river and the land development patterns along the river and within its watershed. These changes have disconnected the river from the surrounding communities and have contributed to the river's deteriorated water quality and degraded habitat conditions that exist today.

In contrast to the more heavily developed, southern portion of the watershed, significant acreage of undeveloped land remains in the northern portion of the watershed. Much of this land is unprotected and could be developed in the future. Protection of these headwater areas from the potential water quality impacts of future land development is also a priority for the overall health of the river.

E.2 Why Local Water Quality Matters

Clean waterways can increase neighborhood prosperity by providing access to healthy natural resources and cultural landscapes within a vibrant urban context. Watershed planning can strengthen water conservation, stormwater management, and improve water quality. Rather than shunting surface water runoff directly into sewers, urban landscapes can be designed and modified to absorb and clean polluted runoff with green infrastructure. Stream buffers can improve water quality and aquatic life while restoring native habitat for wildlife and increasing the tree canopy, as well as potentially increasing urban property values. Watershed management planning identifies ways to balance high-density development with healthy natural environments through traditional and innovative approaches to stormwater and nonpoint source pollution control and sustainable development practices.

While there are many challenges associated with improving water quality in the North Branch Park River, the river also has the potential to serve as a tremendous asset and a focal point for urban/suburban community collaboration. It can be perceived as a natural feature that could help define the character of the urban/suburban nexus. Cities across the United States are beginning to rediscover their connections to rivers and waterways. The reconnection of Hartford to the Connecticut River is a local example of the benefits that can be reaped from re-connecting people with the river.

The North Branch Park River still retains sizeable natural areas along its banks as it flows from its headwaters into Hartford. The linear nature of rivers provides a tangible link and the potential for communities to collaborate on revitalization efforts. The potential exists for a regional vision to be developed where the upper watershed communities can offer substantial water quality and habitat protection benefits while the urban areas can provide the urban river experience with the river forming a physical and emotional connection to the community.

E.3 The Need for a Comprehensive Watershed Plan

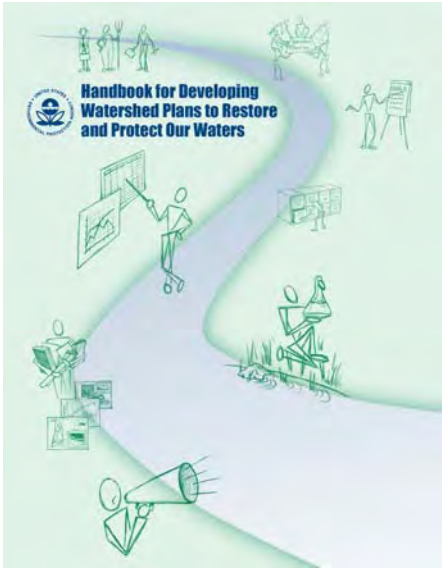
The Connecticut Department of Environmental Protection (CTDEP), working with local stakeholder groups, recognizes the need to address the water resource issues of the North Branch Park River and its tributaries using a watershed-based approach. A primary way to do

this is by developing and implementing a comprehensive watershed management plan to protect and restore water resource conditions throughout the watershed.

In 2007, the CTDEP retained a project team led by Fuss & O'Neill, Inc. and including the Farmington River Watershed Association, the Park River Watershed Revitalization Initiative, and New England Environmental, Inc. to prepare a watershed management plan for the North Branch Park River. The objective of the plan is to characterize the watershed conditions, identify, investigate, and address the current and emerging issues facing the watershed, and have the clear potential to affect on-the-ground change within the watershed. The watershed management plan for the North Branch Park River should address the unique challenges and needs of this and other similar urban rivers, recognizing the potential of urban waterways, their value as a natural resource, and their role in improving livability in a built-up environment. The process of developing the plan should be well documented to serve as a potential model for other urban watershed plans.

E.4 Plan Development Process

The North Branch Park River Watershed Management Plan is the culmination of desktop analyses and field assessments performed by the project team under the direction of the CTDEP and the project Steering Committee. The plan synthesizes information from earlier studies and reports on the watershed, Geographical Information System (GIS) mapping and analyses, review of land use regulations, and detailed field assessments to document baseline watershed conditions, the potential impacts of future development in the watershed, and recommended actions to protect and restore water resource conditions.



The management plan was developed to satisfy EPA and CTDEP criteria for watershed-based plans.

The watershed management plan has been developed consistent with the U.S. Environmental Protection Agency (EPA) and CTDEP guidance for the development of watershed-based plans. The guidance outline nine key elements that establish the structure of the plan, including specific goals, objectives, and strategies to protect and restore water quality; methods to build and strengthen working partnerships; a dual focus on addressing existing problems and preventing new ones; a strategy for implementing the plan; and a feedback loop to evaluate progress and revise the plan as necessary. Following this approach will enable implementation projects under this plan to be considered for funding under Section 319 of the Clean Water Act.

Development of the watershed management plan consisted of the following major tasks:

1. ***Project Steering Committee.*** A project Steering Committee was formed at the outset of the project to guide the development of the management plan. A series of four workshop meetings were held with the Steering Committee at key stages in the project. This plan therefore reflects the combined efforts of the CTDEP and the Fuss & O'Neill

project team, the project Steering Committee, state and local resource agencies, and other stakeholders.

2. ***Public Outreach and Project Website.*** A public education and outreach program was developed to enhance public understanding issues affecting the watershed and to encourage early and continued participation in the plan development. Numerous public outreach meetings and workshops were held throughout the watershed over the duration of the project. An interactive website was also developed that will serve as the long-term home of the management plan and future implementation efforts.

3. ***Baseline Watershed Assessment.*** A baseline assessment was performed to develop an understanding of the current water resource conditions in the North Branch Park River watershed. The project team reviewed existing watershed data, studies, and reports; compiled and analyzed GIS mapping of the watershed and various subwatersheds; and developed pollutant loading and impervious cover models to evaluate areas in the watershed that are most at-risk from future development.

   A comparative subwatershed analysis was also performed to identify the subwatersheds that 1) are more sensitive to future development and should be the focus of watershed conservation efforts to maintain existing high-quality resources and conditions and 2) are likely to have been impacted and have greater potential for restoration to improve or enhance existing conditions.

4. ***Watershed Field Inventories.*** The results of the comparative subwatershed analysis were used to target individual subwatersheds for detailed field inventories. Using screening-level assessment procedures developed by the Center for Watershed Protection and EPA, field crews assessed approximately 13 miles of stream corridors, potential hotspot land uses, and representative residential neighborhoods, streets, and storm drainage systems. The field inventories identified a number of common issues and problems, as well as potential candidate sites for stormwater retrofits, stream restoration, and other targeted projects.

5. ***Land Use Regulatory Review.*** The project team also reviewed the land use regulations and planning documents of the watershed municipalities, focusing on the communities of Bloomfield, Hartford, and West Hartford, which comprise the majority of the land area in the watershed. The land use regulatory review identified a number of recommendations to improve stormwater management, promote green infrastructure and Low Impact Development (LID), reduce the amount of impervious cover generated by future development, and better protect watercourses, wetlands, and riparian areas.

6. ***Goals, Objectives, and Management Plan Recommendations.*** The project team then developed a series of goals, objectives, and potential management strategies for the watershed based upon the results of the watershed inventory and evaluation phases of the project. Potential management strategies were further refined with input from the Steering Committee, culminating in the plan recommendations that are presented in this document.

E.5 Watershed Management Goals

The North Branch Park River Watershed Management Plan is intended to be an affordable and effective watershed management plan that can be implemented by the watershed municipalities, institutions, residents, and other stakeholders. Other broad goals of the plan are to:

- ***Water Quality.*** Improve water quality in the impaired segments of the North Branch Park River to meet state water quality standards such that it supports its designated uses, as well as maintain and enhance water quality of its tributaries. Water quality is essential to the economic well-being, environmental and public health, recreational opportunities, and quality of life for the residents, local governments, and visitors of the North Branch Park River watershed.

- ***Habitat Protection and Restoration.*** Protect and enhance habitat features, including terrestrial wildlife habitat, aquatic habitat, wetlands, and riparian vegetation, to increase the diversity of floral and faunal species in the watershed.

- ***Sustainable Growth and Land Use.*** Promote balanced, sustainable growth, economic development, and cultural vitality, without adversely impacting the watershed and by preserving and enhancing the watershed's natural resources for future generations.

- ***Public Education and Stewardship.*** Educate citizens about the North Branch Park River watershed and the human and economic benefits of a healthy watershed. Increase citizen stewardship by expanding community involvement in scientific research, history and arts cultural programming and urban ecological conservation. Connecting people to local landscapes inspires a sense of appreciation, which is needed to establish sustainable environmental stewardship practices.

E.6 Plan Recommendations

A set of specific objectives and recommended actions were developed to satisfy the management goals for the watershed. The plan recommendations include watershed-wide recommendations that can be implemented throughout the North Branch Park River watershed, targeted recommendations that are tailored to issues within specific subwatersheds or areas, and site-specific recommendations to address issues at selected sites that were identified during the watershed field inventories. Recommendations can be viewed as short-term, mid-term, and long-term according to their implementation priority.

- ***Short-Term Recommendations*** are initial actions to be accomplished within the first one to two years of plan implementation. These actions establish the framework for implementing subsequent plan recommendations. Such actions include formation of an urban watershed stewardship organization; development of local regulations, LID and green infrastructure planning recommendations; discharge investigations; education program planning; and field inventories within previously unassessed subwatersheds. Small demonstration restoration projects could be completed during this phase, with volunteer service events, however construction of larger retrofit practices and stream

restoration projects requiring extensive design, engineering, and permitting should be planned for later implementation. Project budgets for short-term recommendations could generally range from $5,000 to $100,000.

- ***Mid-Term Recommendations*** involve continued programmatic and operational measures, delivery of educational and outreach materials, and construction of several larger retrofit and/or stream restoration projects over the next two to five years. Progress on land conservation, especially the protection of headwaters and unique landscapes, LID and green infrastructure implementation, and discharge investigation follow-up activities should be completed during this period, as well as project monitoring and tracking. A sustainable funding and maintenance program should also be established for watershed green infrastructure through increased regional cooperation. Project budgets for mid-term recommendations could generally range from several thousand to several million dollars (for infrastructure-related projects).

- ***Long-Term Recommendations*** consist of continued implementation of any additional projects necessary to meet watershed objectives, as well as an evaluation of progress, accounting of successes and lessons learned, and an update of the watershed management plan. Long-term recommendations are intended to be completed during the next 5- to 10-year timeframe and beyond. The feasibility of long-term project recommendations, many of which involve significant infrastructure improvements, depends upon the availability of sustainable funding, such as stormwater utility fees.

Table ES-1 summarizes the management recommendations for the North Branch Park River watershed. The recommendations are organized by implementation priority (short-, mid-, and long-term) and scale/location (watershed, targeted, or site-specific). Successful implementation of this plan will require a cooperative effort and commitment from the key watershed stakeholders, including a watershed organization dedicated to the implementation of this plan, the watershed municipalities and citizens, state and federal agencies, and other groups. The table also identifies the watershed stakeholders who should be involved in implementing the plan recommendations in either a lead or support role.

Table ES-1. Watershed Management Plan Recommendations Summary

Action Items Priority Abbreviations S = short-term, M = mid-term, L = long-term Scale/Location Abbreviations W = watershed-wide, T = targeted, S = site-specific	Priority	Scale/Location	Who Should Be Involved (L = lead, A = assist)											
			Hartford	Bloomfield	West Hartford	MDC	Watershed Organization	CRCOG	Landowners	NCCD	FRWA/ PRWRI	CTDEP	NRCS	Citizens & Volunteers
Goal A - Plan Implementation														
Objective A-1. Establish Watershed Organization														
Establish independent Park River watershed organization	S	W									L	A		A
Secure funding and hire watershed coordinator	S	W					L							A
Establish NBPR advisory committee to guide plan implementation	S	W					L							A
Adopt watershed management plan through MOA	S	W	L	L	L									A
Identify potential funding sources and submit grant applications	S	W	L	L	L		L	A		A	A			
Objective A-2. Conduct Additional Field Assessments														
Perform additional stream and upland assessments	S	T					L						A	A
Goal B - Water Quality														
Objective B-1. Reduce or Eliminate CSO Discharges														
Implement CSO Long Term Control Plan (LTCP)	M/L	T				L								
Consider green infrastructure in combination with LTCP (see B-2)	M/L	T	A			L								
Objective B-2. Implement LID and Green Infrastructure														
Evaluate feasibility of incorporating green approaches in LTCP and City of Hartford stormwater management program	S	W	L			L	A							A
Implement LID/BMPs for Albany Avenue and Granby Street Outfalls	S	T	A			L	A							
Implement green infrastructure demonstration projects	S/M	W	L			L	A							
Require consideration of green approaches in MDC project design	S	W				L	A							
Modify municipal land use regulations to promote LID	S	W	L	L	L			A						A
Adopt green infrastructure and LID in municipal projects	M/L	W	L	L	L									
Implement priority stormwater retrofits	M/L	S/T	A	A	A	A	L			A				
Objective B-3. Identify and Eliminate Illicit Discharges														
Targeted illicit discharge investigations	S	T	L	L	L		A			A				
Implement municipal IDDE programs	M	W	L	L	L									
Implement priority stream cleanup efforts	S	S/T					L				A			A
Objective B-4. Protect and Restore Riparian Buffers														
Priority riparian buffer restoration projects	M/L	S/T	A	A	A		L		A				A	A
Adopt/strengthen stream buffer regulations	M	W	L	L	L									A
Incorporate minimum buffer widths into municipal wetland regulations	S	W	L	L	L			A						A
Adopt incentives for developers to restore degraded buffers	S	W	L	L	L			A						A
Amend Greater Hartford Flood Commission regulations	S	W	L											

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Objective B-5. Implement Water Quality Monitoring Program														
Develop and implement long-term monitoring program	S	W					L				A	A		A
Implement field monitoring study of LID effectiveness	M	W	A	A	A		L			A				
Goal C - Habitat Protection and Restoration														
Objective C-1. Enhance In-stream and Riparian Habitat														
Conduct fish passage assessments	S	T					L			A				
Fish passage feasibility assessment of University of Hartford dam	S	S							L[1]			A		
Revise local stream crossing & stormwater design standards	S	W	L	L	L									
Implement priority stream restoration projects	M/L	S	L	L			L						A	A
Implement stream daylighting projects	L	S	L	L			L		A				A	
Objective C-2. Protect and Enhance Forests and Urban Tree Canopy and Restore Understory Vegetation														
Conduct watershed-wide urban tree canopy analysis	S	W					L					A		
Develop Town-based UTC goals and plan	M	W	L	L	L		A							A
Amend municipal regulations	S	W	L	L	L			A						A
Implement priority reforestation projects	M/L	T	L	L	L		A		A			A		
Engage tree wardens in watershed municipalities	S/M	W	A	A	A		L					A		
Implement reforestation/tree canopy demonstration projects	S/M	T	A	A	A		L							A
Landowner education, stewardship and incentive programs	S	W	A	A	A		L			A		A		A
Adopt City of Hartford Tree Ordinance and develop master plan	S	W	L											A
Promote urban agriculture, community gardens	M	T	L	L	L		A		A					A
Objective C-3. Control Invasive Species														
Develop invasive species management plan	M	T	A	A	A		L		A		A			A
Implement priority invasive species management projects	M/L	T	L	L	L		L		L			A		A
Goal D - Sustainable Growth and Land Use														
Objective D-1. Promote Smart Growth														
Modify municipal land use codes, ordinances, and plans	S	W	L	L	L			A						A
Objective D-2. Protect Open Space														
Priority land acquisitions and conservation restrictions	S/M	T	L	L	L		A		A			A		A
Continue to implement municipal open space plans	S	T	L	L	L									
Seek alternative funding sources for open space acquisition	S/M	T	L	L	L		A							
Promote use of open space through trail maps and events	S/M	T					L							A
Identify and protect priority farmland	M	T		L			A							A

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Objective D-3. Promote Low-Impact, Context-Sensitive Greenways														
Develop a Greenway between Bloomfield & Hartford that protects the stream corridor and links to neighborhood cultural points of interest.	M/L	T	L	L				A	A					A
Incorporate LID and conservation design elements	M/L	T	L	L			A	A						
Objective D-4. Increase Public Access to the River														
Enhance river access on public lands	L	T	L	L	L		A							A
Develop public access inventory for the watershed	S	T	A	A	A		L			A				A
Implement signage, interpretive stations, and online resources	M	T	A	A	A		L			A				A
Provide linkages between the river and cultural institutions	M	T	L				A		A					A
Goal E - Public Education and Stewardship														
Objective E-1. Creation of Education & Stewardship Network														
Develop framework for watershed place-based K-12 education	S	W	A	A	A		L							A
Develop educational toolkit and school stewardship network	M	W	A	A	A		L							
Objective E-2. Campus Facility Managers Outreach														
Organize and host workshops to demonstrate best practices	S/M	W					L	A	A[2]					A
Encourage awareness and involvement by students and faculty	S/M	W					A		L[3]					A
Objective E-3. Residential Outreach														
Foster a "block-by-block" approach for the restoration and conservation of stream reaches and ponds.	S/M	W					L		L					L
Increase watershed stewardship signage in residential areas	M	W	L	L	L		A			A				A
Encourage and provide incentives for disconnection of roof runoff	M	W	L	L	L		A							A
Develop education/outreach materials	S	W					L	A						
Deliver education/outreach to the public	M	W	L	L	L									A
Objective E-4. Municipal and Business Outreach														
Review municipal facility compliance	S	W	L	L	L									
Improve municipal stormwater management programs	S/M	W	L	L	L									
Develop education/outreach materials	S	W					L	A						
Deliver education/outreach to the public	M	W	L	L	L									A
Increase watershed stewardship signage in commercial areas	M	W	L	L	L		A			A				A

PRWRI - Park River Watershed Revitalization Initiative
FRWA - Farmington River Watershed Association
NRCS - Natural Resource Conservation Service
CRCOG - Capitol Region Council of Governments
NCCD - North Central Conservation District
CTDEP - Connecticut Department of Environmental Protection
MDC - Metropolitan District Commission

[1]University of Hartford [2]Institutions including universities, schools, hospitals, golf courses, etc. [3]Universities and schools

1 Introduction

1.1 Background

The North Branch Park River – An Impaired Urban River

The North Branch Park River watershed (*Figure 1-1*) is an approximately 29-square mile sub-regional basin within the larger Park River watershed and the Connecticut River basin. Four major tributaries – Beamans Brook, Wash Brook, Filley Brook, and Tumbledown Brook – drain from Bloomfield and northern parts of West Hartford converging near the University of Hartford to form the North Branch of the Park River.

The majority of the watershed land area (97%) is located within Bloomfield, Hartford, and West Hartford. While only 11% of the North Branch Park River watershed is located within Hartford, upstream drainage from the entire watershed contributes to the North Branch Park River, which flows for approximately 6 miles between the West End, Blue Hills, and Asylum Hill neighborhoods of Hartford before entering an underground flood control conduit just north of Farmington Avenue and ultimately flowing to the Connecticut River.

The North Branch Park River conduit entrance near Farmington Avenue.

The North Branch Park River and its watershed, as it exists today, reflect the rich cultural history of the Hartford metropolitan area as well as many dramatic changes that have altered the development patterns along the river and within its watershed, the physical characteristics of the river, and even the name of the river itself. The watershed is home to approximately 48,000 residents, numerous educational and corporate campuses, and sites of historical and cultural significance including the Harriet Beecher Stowe House, the Mark Twain House, and Elizabeth Park.

The water quality of the North Branch Park River also reflects several hundred years of urbanization within the Hartford area. Today, the poor water quality in portions of the North Branch Park River limits recreational uses and provides insufficient habitat for fish, other aquatic life, and wildlife due to physical alteration and elevated levels of bacteria. The river is considered "impaired" for these uses. Urban stormwater and combined sewer overflows (discharges of untreated wastewater directly to the river during larger storms when the combined storm and sanitary sewers become overwhelmed by stormwater runoff) are believed to be the primary sources of the bacteria contamination in the North Branch Park River.

While the flood control projects of the last century have protected the City of Hartford from the type of catastrophic floods that occurred in the 1930s and 1950s, channelization and burial of portions of the North Branch Park River dramatically altered the physical and habitat characteristics of the river and the land development patterns along the river and within its watershed. These changes have disconnected the river from the surrounding communities and have contributed to the river's deteriorated water quality and degraded habitat conditions that exist today.

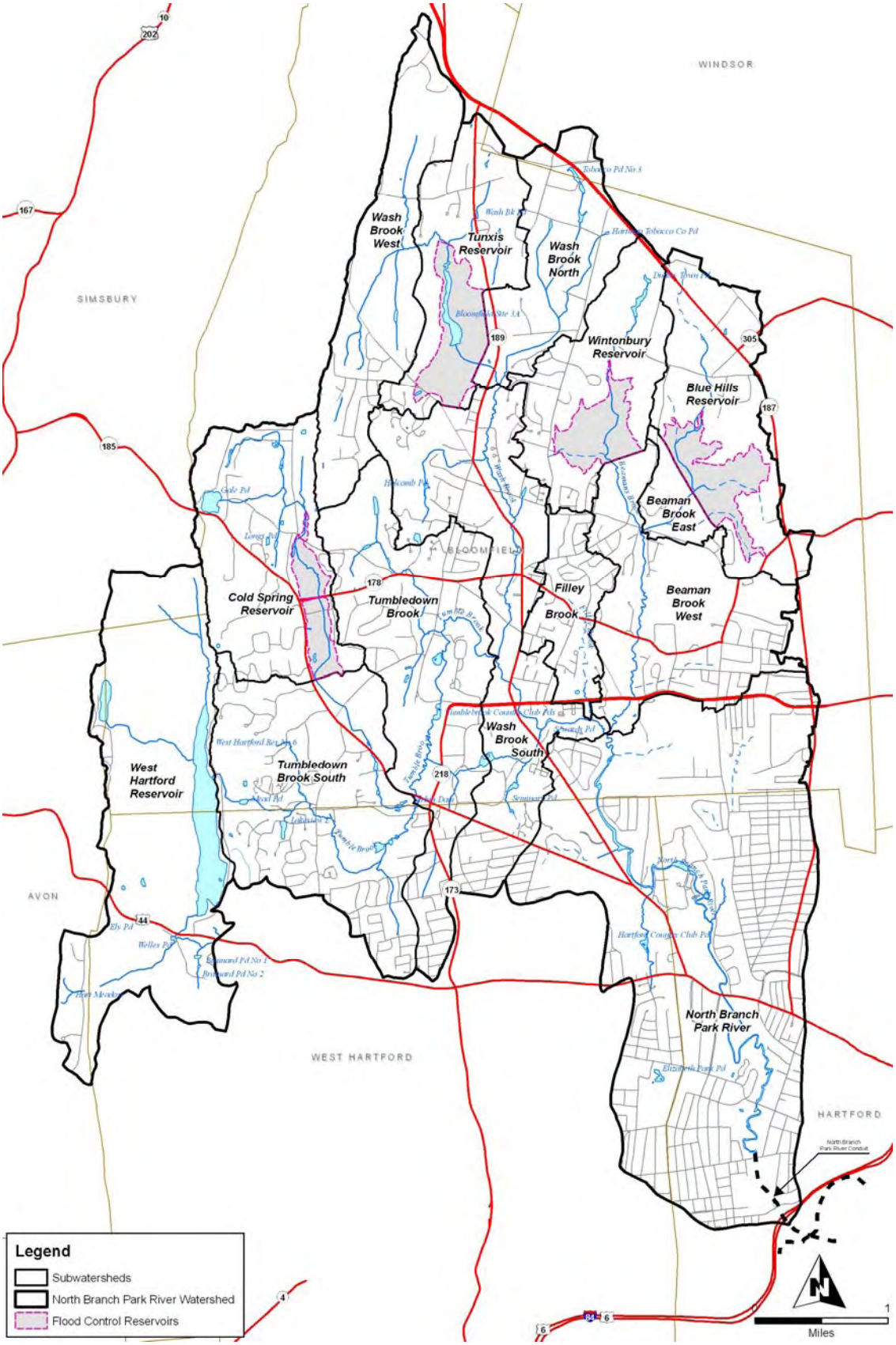


Figure 1-1. North Branch Park River Watershed

In contrast to the more heavily developed, southern portions of the watershed, significant acreage of undeveloped land remains in the northern portion of the watershed. Much of this land is unprotected and could be developed in the future. Protection of these headwater areas from the potential water quality impacts of future land development is also a priority for the overall health of the river.

Why Local Water Quality Matters

Clean waterways can increase neighborhood prosperity by providing access to healthy natural resources and cultural landscapes within a vibrant urban context. Watershed planning can strengthen water conservation, stormwater management, and improve water quality. Rather than shunting surface water runoff directly into sewers, urban landscapes can be designed and modified to absorb and clean polluted runoff with green infrastructure. Stream buffers can improve water quality and aquatic life while restoring native habitat for wildlife and increasing the tree canopy, as well as potentially increasing urban property values. Watershed management planning identifies ways to balance high-density development with healthy natural environments through traditional and innovative approaches to stormwater and nonpoint source pollution control and sustainable development practices.

The confluence of the Park River conduit with the Connecticut River in Hartford.

While there are many challenges associated with improving water quality in the North Branch Park River, the river also has the potential to serve as a tremendous asset and a focal point for urban/suburban community collaboration. It can be perceived as a natural feature that could help define the character of the urban/suburban nexus. Cities across the United States are beginning to rediscover their connections to rivers and waterways. The reconnection of Hartford to the Connecticut River is a local example of the benefits that can be reaped from re-connecting people with the river.

The North Branch Park River still retains sizeable natural areas along its banks as it flows from its headwaters into Hartford. The linear nature of rivers provides a tangible link and the potential for communities to collaborate on revitalization efforts. The potential exists for a regional vision to be developed where the upper watershed communities can offer substantial water quality and habitat protection benefits while the urban areas can provide the urban river experience with the river forming a physical and emotional connection to the community.

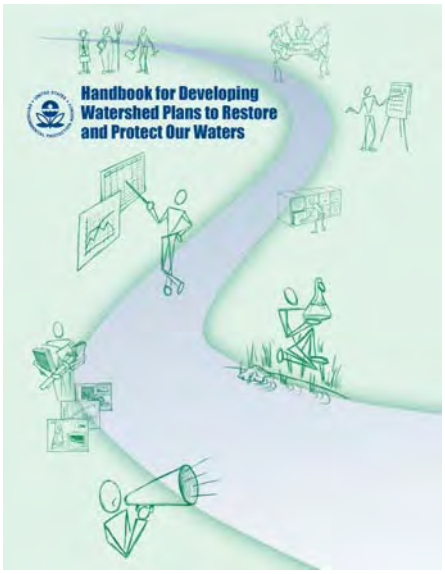
The Need for a Comprehensive Watershed Plan

The Connecticut Department of Environmental Protection (CTDEP), working with local stakeholder groups, recognizes the need to address the water resource issues of the North Branch Park River and its tributaries using a watershed-based approach. A primary way to do this is by developing and implementing a comprehensive watershed management plan to protect and restore water resource conditions throughout the watershed.

In 2007, the CTDEP retained a project team led by Fuss & O'Neill, Inc. and including the Farmington River Watershed Association, the Park River Watershed Revitalization Initiative, and New England Environmental, Inc. to prepare a watershed management plan for the North Branch Park River. The objective of the plan is to characterize the watershed conditions, identify, investigate, and address the current and emerging issues facing the watershed, and have the clear potential to affect on-the-ground change within the watershed. The watershed management plan for the North Branch Park River should address the unique challenges and needs of this and other similar urban rivers, recognizing the potential of urban waterways, their value as a natural resource, and their role in improving livability in a built-up environment. The process of developing the plan should be well documented to serve as a potential model for other urban watershed plans.

1.2 Plan Development Process

The North Branch Park River Watershed Management Plan is the culmination of desktop analyses and field assessments performed by the project team under the direction of the CTDEP and the project Steering Committee. The plan synthesizes information from earlier studies and reports on the watershed, Geographical Information System (GIS) mapping and analyses, review of land use regulations, and detailed field assessments to document baseline watershed conditions, the potential impacts of future development in the watershed, and recommended actions to protect and restore water resource conditions.



The management plan was developed to satisfy EPA and CTDEP criteria for watershed-based plans.

The watershed management plan has been developed consistent with the U.S. Environmental Protection Agency (EPA) and CTDEP guidance for the development of watershed-based plans. The guidance outline nine key elements that establish the structure of the plan, including specific goals, objectives, and strategies to protect and restore water quality; methods to build and strengthen working partnerships; a dual focus on addressing existing problems and preventing new ones; a strategy for implementing the plan; and a feedback loop to evaluate progress and revise the plan as necessary. Following this approach will enable implementation projects under this plan to be considered for funding under Section 319 of the Clean Water Act.

Development of the watershed management plan consisted of the following major tasks.

Project Steering Committee

A project Steering Committee was formed at the outset of the project to guide the development of the management plan. Four workshop meetings were held with the Steering Committee at key stages in the project. This plan therefore reflects the combined efforts of the CTDEP and the Fuss & O'Neill project team, the project Steering Committee, state and local resource agencies, and other stakeholders. Members of the Project Steering Committee, the CTDEP project team, and others involved in the plan development process are listed in the Acknowledgments section at the beginning of this document.

Baseline Watershed Assessment

A baseline assessment was performed to develop an understanding of the current water resource conditions in the North Branch Park River watershed. The project team reviewed existing watershed data, studies, and reports; compiled and analyzed GIS mapping of the watershed and various subwatersheds; and developed pollutant loading and impervious cover models to evaluate areas in the watershed that are at-risk from future development.

A comparative subwatershed analysis was also performed to identify the subwatersheds that 1) are more sensitive to future development and should be the focus of watershed conservation efforts to maintain existing high-quality resources and conditions and 2) are likely to have been impacted and have greater potential for restoration to improve or enhance existing conditions.

The baseline assessment serves as a basis for the watershed management plan recommendations. It also provides a background reference document to support future implementation activities within the watershed. A copy of the Baseline Watershed Assessment Report is provided on CD in *Appendix A* of this watershed management plan.

Watershed Field Inventories

The results of the comparative subwatershed analysis were used to target individual subwatersheds for detailed field inventories (*Figure 1-2*). Using screening-level assessment procedures developed by the Center for Watershed Protection and EPA, field crews assessed approximately 13 miles of stream corridors, potential hotspot land uses, and representative residential neighborhoods, streets, and storm drainage systems. The field inventories identified a number of common issues and problems, as well as potential candidate sites for stormwater retrofits, stream restoration, and other targeted projects.

Example of stream channel modifications identified during field inventories.

Along with the Baseline Watershed Assessment Report, the Watershed Field Assessment Report also serves as a basis for watershed plan recommendations, as well as a background reference document to support future plan implementation activities. A copy of the Watershed Field Assessment Report is provided on CD in *Appendix B* of this plan.

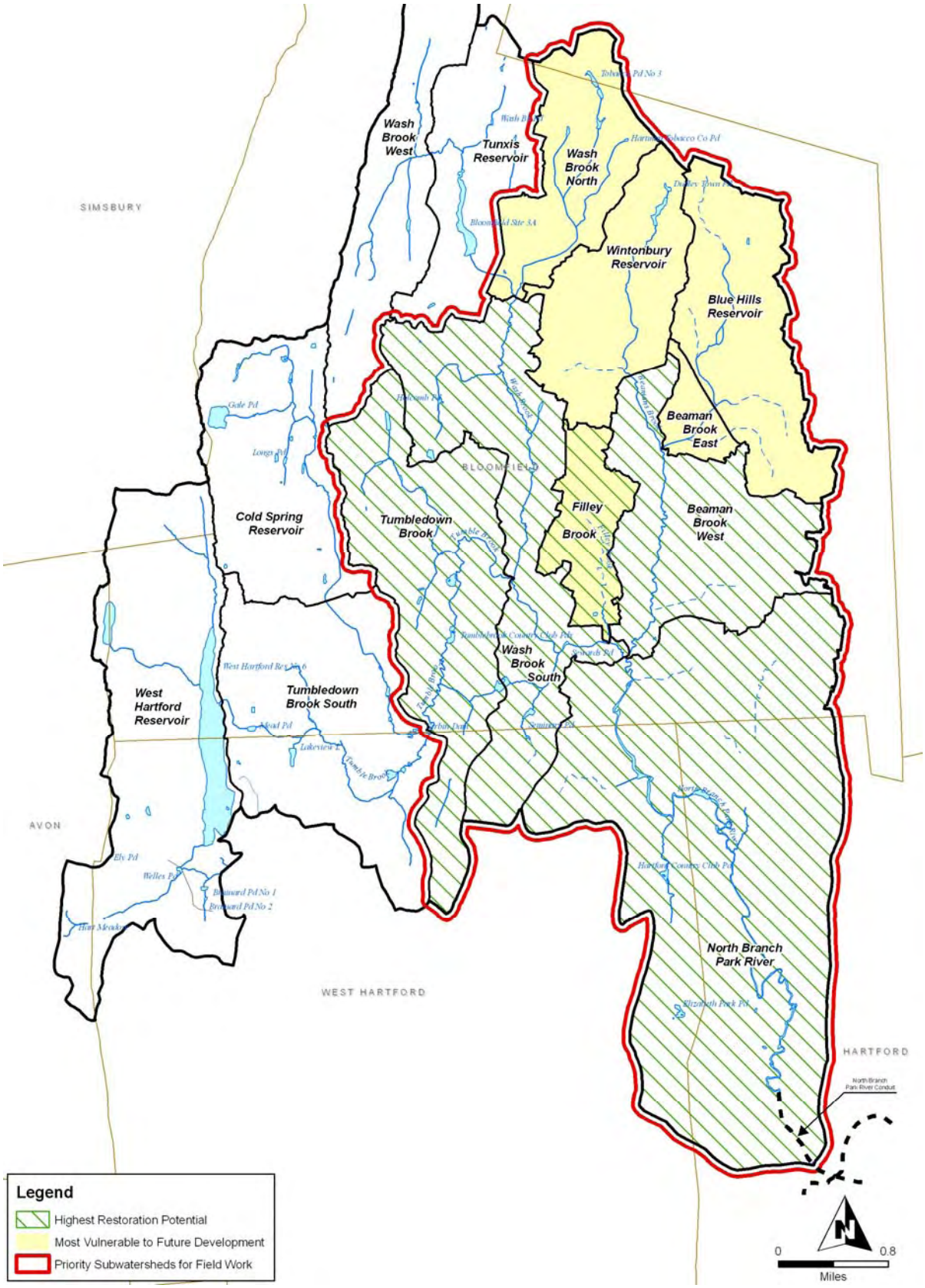


Figure 1-2. Priority Subwatersheds Targeted for Field Inventories

Land Use Regulatory Review

The project team also reviewed the land use regulations and planning documents of the watershed municipalities, focusing on the communities of Bloomfield, Hartford, and West Hartford, which comprise the majority of the land area in the watershed. The land use regulatory review identified a number of recommendations to improve stormwater management, promote green infrastructure and Low Impact Development (LID), reduce the amount of impervious cover generated by future development, and better protect watercourses, wetlands, and riparian areas. A copy of the Land Use Regulatory Review Report is provided on CD in *Appendix C* of this watershed management plan.

Goals, Objectives, and Management Plan Recommendations

The project team then developed a series of goals and objectives for the watershed based upon the results of the watershed inventory and evaluation phases of the project. The watershed management goals and objectives are described in *Section 2* of this plan. Potential management strategies were further refined with input from the Steering Committee, culminating in the plan recommendations that are presented in *Section 3* of this document.

1.3 Public Outreach

Significant public outreach was conducted during the watershed planning process to enhance public understanding of issues affecting the watershed and to encourage early and continued participation in the development and implementation of the watershed plan. Numerous public outreach meetings and workshops were held throughout the watershed over the duration of the project. An interactive website was also developed (www.northparkplan.net) that will serve as the long-term home of the management plan and future implementation efforts. The public outreach program included the following events and activities:

- August 29, 2008 – Meeting with Town of West Hartford planning to review watershed planning and the project purpose.
- December 11, 2008 – Evening meeting with Bloomfield Conservation Commission. The Commission recommended a presentation to Bloomfield Town Council and noted that the presentation would be broadcast on local public access television.
- March 9, 2009 – Evening presentation to Bloomfield Town Council meeting, which was broadcast on Bloomfield Public Access Television.
- April 22, 2009 – A description of the North Branch Watershed Management Plan was included as part of a centerfold Earth Day presentation on the Park Watershed in the front section of the Hartford Courant. Daily distribution of that The Hartford Courant run was 168,158 copies distributed. Research has shown that each copy has 2.4 readers, for a total reach of 403,579 people.
- July 9, 2009 – The watershed management plan was presented to a professional audience gathered for the US EPA workshop, "Managing Wet Weather with Green Infrastructure" at the Legislative Office Building in Hartford. Over 75 professionals attended this workshop, including staff from City of Hartford, West Hartford, and campus management for the University of Connecticut. This presentation was broadcast on Connecticut Network Television.

- September 14, 2009 – Evening presentation to the Asylum Hill Neighborhood Association, (AHNA). Over twenty persons attended this meeting, including residents of the neighborhood, and representatives from Habitat for Humanity, NINA, Asylum Hill Congregational Church, and City of Hartford. AHNA agreed to assemble a sub-committee to outline the neighborhood interest in the North Branch of the Park River (western boundary of the Asylum Hill neighborhood). See June 9th for follow-up action.
- September 18, 2009 – Presentation to the University Park group including persons from University of Hartford, Weaver High School, Watkinson School, Village for Family and Children, St. Thomas Seminary, Town of Bloomfield, Town of West Hartford, CIGNA, Sunrise Assisted Living, Hebrew Health Care, Mandell Jewish Community Center, and Blue Hills Civic Association, Greater Hartford Transit District, and Hebrew Health Care. Draft plan recommendations and a website links were sent to Chris Grant (administrative contact) with a request that she forward the information to the University Park group.
- September 23, 2009 – Evening presentation at the monthly Blue Hills NRZ, which was held at the Mt. Sinai Campus of St. Francis Hospital. Over twenty persons attended. Draft recommendations and website links were sent to Chair Keith Darby in June 2010, with a request that she forward the information to the neighborhood network.
- November 7, 2009 – Saturday morning public workshop: Residential Rain Gardens workshop held at Connecticut Historical Society, One Elizabeth Street, in Hartford. Twenty-six persons attended this workshop, which included presentations by CTDEP, a residential landscape designer, and project team representatives (Eileen Fielding and Mary Rickel Pelletier).
- November 2009 through February 2010 – West End Civic Association Hartford Plan of Conservation and Development working group (organized by David Barrett, President of the West End Civic Association). The sub-committee work (Nov 29th, Dec 17th and 29th and Jan 5th and 14th) included a meeting (Jan 21st) with Roger O'Brien, City of Hartford Planning Director and concluded with a presentation to the WECA Board on the evening of February 2, 2010.
- December 8, 2009 – Announcement and brief summary of North Branch Park River Watershed Management Plan at the West End Civic Association General meeting, which is held at the United Methodist Church (Farmington Avenue and South Whitney Street, Hartford).
- December 10, 2009 – Presentation to Woodside Circle Association residents (approximately 14 people were in attendance).
- January through March 2010 – Hartford Neighborhood Environmental Partnership (HNEP) Plan of Conservation and Development working group (Feb 9 and March 23). This effort was organized by CTDEP (Judith Prill/Mary Sherwin) with Linda Bayer of Hartford 2000.
- March 9, 2010 – Presentation to Allyn Estate residents, (approximately 12 people were in attendance). A follow-up walk to review landscape improvement options took place on Sunday afternoon, June 9, 2010.

- March 24, 2010 – Campus Managers Workshop held at Hartford Seminary. Persons in attendance included campus, residential rental property owners, and golf courses greens keepers.
- April 22, 2010 – Earth Day at Legislative Office Building; tabling organized by CTDEP.
- April and May 2010 – Email outreach with City of Hartford Planning and Zoning regarding refinement of language in City of Hartford Plan of Conservation and Development.
- June through July 2010 – Announcement of the North Branch Park River Watershed Management Plan draft recommendations and the project website were posted in the West End Civic Association newsletter, which is distributed to residents.
- June 9, 2010 – Follow-up meeting with Asylum Hill Neighborhood Association "Housing and Environment" sub-committee to encourage AHNA to review the information posted on the project website and read the draft plan recommendations. It was agreed to arrange a walk on Saturday morning July 17 to review areas of public access to the North Branch Park River between Farmington Avenue and Asylum Avenue.
- June 12, 2010 – Distributed flyers for July 13th public presentation with a watershed map during "Celebrate West Hartford" at Sustainable West Hartford booth.
- June 28 – Presentation to West Hartford Conservation Commission regarding draft plan recommendations. Conservation Commission and West Hartford residents who attended the meeting recommended outreach to Town Council John Philips, the Tree Warden, and to Kevin Presage, (former WHCC Chair) who is currently working on a sub-committee to update regulations based on POCD recommendations. Problems with pond sedimentation were noted during the discussion.
- July 13, 2010 – Final public presentation of the watershed management plan, hosted by the Watkinson School. Approximately 32 persons attended this evening event including representation from elected officials, institutional campus administration, City of Hartford Planning Director Roger O'Brien, and members of the Steering Committee as well as interested persons.
- July 17, 2010 – North Branch walk between Asylum Avenue and Farmington Avenue with Asylum Hill Neighborhood Association. This follow-up to the June 9 meeting included Bernie Michel, President of the Asylum Hill Neighborhood Association, and Jennifer Cassidy, resident of Asylum Hill and aide to City of Hartford Councilman Boucher.

2 Watershed Management Goals and Objectives

This section presents overall management goals for the watershed and specific objectives to achieve these goals. The goals and objectives presented in this section were developed in conjunction with the project Steering Committee based upon the results of the watershed inventory and evaluation phases of the project, as well as through discussions and workshop meetings with the Steering Committee members.

2.1 Watershed Management Goals

The watershed management goals for the North Branch Park River watershed are:

- **Goal A – Plan Implementation.** Develop an affordable and effective watershed management plan that can be implemented by the watershed municipalities, institutions, residents, and other stakeholders.

- **Goal B – Water Quality.** Improve water quality in the impaired segments of the North Branch Park River to meet state water quality standards such that it supports its designated uses, as well as maintain and enhance water quality of its tributaries. Water quality is essential to the economic well-being, environmental and public health, recreational opportunities, and quality of life for the residents, local governments, and visitors of the North Branch Park River watershed.

- **Goal C – Habitat Protection and Restoration.** Protect and enhance habitat features, including terrestrial wildlife habitat, aquatic habitat, wetlands, and riparian vegetation, to increase the diversity of floral and faunal species in the watershed.

- **Goal D – Sustainable Growth and Land Use.** Promote balanced, sustainable growth, economic development, and cultural vitality, without adversely impacting the watershed and by preserving and enhancing the watershed's natural resources for future generations.

- **Goal E – Public Education and Stewardship.** Educate citizens about the North Branch Park River watershed and the human and economic benefits of a healthy watershed. Increase citizen stewardship by expanding community involvement in scientific research, history and arts cultural programming and urban ecological conservation. Connecting people to local landscapes inspires a sense of appreciation, which is needed to establish sustainable environmental stewardship practices.

2.2 Watershed Management Objectives

Specific objectives associated with the watershed management goals are described below. Recommended management strategies to achieve the plan objectives, including implementation priority, schedule, costs, funding sources, and implementation responsibilities, are presented in *Section 3* of this plan.

2.2.1 Goal A – Plan Implementation

- **Objective A–1.** Establish a watershed organization to take a long-term leadership role in the implementation of the North Branch Park River Watershed Management Plan. An independent urban watershed organization can assist neighborhood groups with improvement projects, and encourage inter-municipal coordination.

- **Objective A–2.** Conduct additional field assessments in non-priority subwatersheds to identify future implementation activities and to guide plan updates.

2.2.2 Goal B – Water Quality

- **Objective B–1.** Reduce or eliminate existing CSO discharges to the North Branch Park River through the MDC Clean Water Project.

- **Objective B–2.** Mitigate the negative impacts of stormwater runoff on hydrology and water quality through the use of Low Impact Development (LID) practices and Green Infrastructure approaches.

- **Objective B–3.** Improve water quality by identifying and eliminating illicit discharges and encouraging stream cleanups.

- **Objective B–4.** Protect existing and restore degraded riparian buffers.

- **Objective B–5.** Implement an ongoing water quality and biological monitoring program to assess the effectiveness of implementation efforts and build upon the existing water quality database to guide future decision making.

2.2.3 Goal C – Habitat Protection and Restoration

- **Objective C–1.** Enhance in-stream and riparian habitat along the river and its tributaries to sustain a diversity of aquatic life.

- **Objective C–2.** Protect and enhance forested areas and urban tree canopy within the watershed and restore understory vegetation.

- **Objective C–3.** Control or diminish the prevalence of invasive species.

2.2.4 Goal D – Sustainable Growth and Land Use

- **Objective D–1.** Promote sustainable growth and economic development through smart growth principles.

- **Objective D–2.** Manage, maintain, and promote existing open space and continue to protect/acquire open space that meets resource protection and recreational goals.

- **Objective D–3.** Promote the development of a greenway network within the watershed and the region without adversely impacting water quality and natural resources.

- **Objective D–4.** Increase public access to the North Branch Park River and its tributaries to enhance public appreciation and stewardship of the river.

2.2.5 Goal E – Public Education and Stewardship

- **Objective E–1.** Creation of a formal comprehensive K-12/higher education and stewardship network along the North Branch Park River.

- **Objective E–2.** Conduct outreach to campus facility managers about the water quality and nonpoint impacts of campus management practices.

- **Objective E–3.** Build awareness of land stewardship and management practices and reduce nonpoint source impacts in residential areas.

- **Objective E–4.** Advance local government and community business awareness of the North Branch Park River through site-specific research that clarifies cost-effective ecosystem service benefits (through human health and real estate data), pollution prevention education, and watershed restoration outreach activities.

3 Watershed Management Recommendations

This section of the plan describes specific recommendations to meet the watershed management goals and objectives outlined in *Section 2*. The recommendations include watershed-wide recommendations that can be implemented throughout the North Branch Park River watershed, targeted recommendations that are tailored to issues within specific subwatersheds or areas, and site-specific recommendations to address issues at selected sites that were identified during the watershed field inventories.

The recommendations presented in this section are classified according to their implementation priority. Recommendations can be viewed as short-term, mid-term, and long-term, as summarized below:

- ***Short-Term Recommendations*** are initial actions to be accomplished within the first one to two years of plan implementation. These actions establish the framework for implementing subsequent plan recommendations. Such actions include formation of an urban watershed stewardship organization; development of local regulations, LID and green infrastructure planning recommendations; discharge investigations; education program planning; and field inventories within previously unassessed subwatersheds. Small demonstration restoration projects could be completed during this phase, with volunteer service events, however construction of larger retrofit practices and stream restoration projects requiring extensive design, engineering, and permitting should be planned for later implementation. Project budgets for short-term recommendations could generally range from $5,000 to $100,000.

- ***Mid-Term Recommendations*** involve continued programmatic and operational measures, delivery of educational and outreach materials, and construction of several larger retrofit and/or stream restoration projects over the next two to five years. Progress on land conservation, especially the protection of headwaters and unique landscapes, LID and green infrastructure implementation, and discharge investigation follow-up activities should be completed during this period, as well as project monitoring and tracking. A sustainable funding and maintenance program should also be established for watershed green infrastructure through increased regional cooperation. Project budgets for mid-term recommendations could generally range from several thousand to several million dollars (for infrastructure-related projects).

- ***Long-Term Recommendations*** consist of continued implementation of any additional projects necessary to meet watershed objectives, as well as an evaluation of progress, accounting of successes and lessons learned, and an update of the watershed management plan. Long-term recommendations are intended to be completed during the next 5- to 10-year timeframe and beyond. The feasibility of long-term project recommendations, many of which involve significant infrastructure improvements, depends upon the availability of sustainable funding, such as stormwater utility fees.

Table 3-1 summarizes the management recommendations for the North Branch Park River watershed based upon the management objectives identified in the previous section. The recommendations are organized by implementation priority (short-, mid-, and long-term),

scale and location (watershed, targeted, or site-specific), and the groups who are responsible for implementing the recommendations. The remainder of this section presents detailed plan recommendations, including implementation priority, schedule, anticipated benefits, potential costs, funding sources, implementation responsibilities, and an evaluation framework to measure the progress of plan implementation.

Table 3-1. Watershed Management Plan Recommendations Summary

Action Items Priority Abbreviations S = short-term, M = mid-term, L = long-term Scale/Location Abbreviations W = watershed-wide, T = targeted, S = site-specific	Priority	Scale/Location	Who Should Be Involved (L = lead, A = assist)											
			Hartford	Bloomfield	West Hartford	MDC	Watershed Organization	CRCOG	Landowners	NCCD	FRWA/ PRWRI	CTDEP	NRCS	Citizens & Volunteers
Goal A - Plan Implementation														
Objective A-1. Establish Watershed Organization														
Establish independent Park River watershed organization	S	W									L	A		A
Secure funding and hire watershed coordinator	S	W					L							A
Establish NBPR advisory committee to guide plan implementation	S	W					L							A
Adopt watershed management plan through MOA	S	W	L	L	L									A
Identify potential funding sources and submit grant applications	S	W	L	L	L		L	A		A	A			
Objective A-2. Conduct Additional Field Assessments														
Perform additional stream and upland assessments	S	T					L						A	A
Goal B - Water Quality														
Objective B-1. Reduce or Eliminate CSO Discharges														
Implement CSO Long Term Control Plan (LTCP)	M/L	T				L								
Consider green infrastructure in combination with LTCP (see B-2)	M/L	T	A			L								
Objective B-2. Implement LID and Green Infrastructure														
Evaluate feasibility of incorporating green approaches in LTCP and City of Hartford stormwater management program	S	W	L			L	A							A
Implement LID/BMPs for Albany Avenue and Granby Street Outfalls	S	T	A			L	A							
Implement green infrastructure demonstration projects	S/M	W	L			L	A							
Require consideration of green approaches in MDC project design	S	W				L	A							
Modify municipal land use regulations to promote LID	S	W	L	L	L			A						A
Adopt green infrastructure and LID in municipal projects	M/L	W	L	L	L									
Implement priority stormwater retrofits	M/L	S/T	A	A	A	A	L			A				
Objective B-3. Identify and Eliminate Illicit Discharges														
Targeted illicit discharge investigations	S	T	L	L	L		A			A				
Implement municipal IDDE programs	M	W	L	L	L									
Implement priority stream cleanup efforts	S	S/T					L				A			A
Objective B-4. Protect and Restore Riparian Buffers														
Priority riparian buffer restoration projects	M/L	S/T	A	A	A		L		A				A	A
Adopt/strengthen stream buffer regulations	M	W	L	L	L									A
Incorporate minimum buffer widths into municipal wetland regulations	S	W	L	L	L			A						A
Adopt incentives for developers to restore degraded buffers	S	W	L	L	L			A						A
Amend Greater Hartford Flood Commission regulations	S	W	L											

Table 3-1. Watershed Management Plan Recommendations Summary

Action Items Priority Abbreviations S = short-term, M = mid-term, L = long-term Scale/Location Abbreviations W = watershed-wide, T = targeted, S = site-specific	Priority	Scale/Location	Who Should Be Involved (L = lead, A = assist)											
			Hartford	Bloomfield	West Hartford	MDC	Watershed Organization	CRCOG	Landowners	NCCD	FRWA/ PRWRI	CTDEP	NRCS	Citizens & Volunteers
Objective B-5. Implement Water Quality Monitoring Program														
Develop and implement long-term monitoring program	S	W					L				A	A		A
Implement field monitoring study of LID effectiveness	M	W	A	A	A		L			A				
Goal C – Habitat Protection and Restoration														
Objective C-1. Enhance In-stream and Riparian Habitat														
Conduct fish passage assessments	S	T					L			A				
Fish passage feasibility assessment of University of Hartford dam	S	S							L[1]			A		
Revise local stream crossing & stormwater design standards	S	W	L	L	L									
Implement priority stream restoration projects	M/L	S	L	L			L						A	A
Implement stream daylighting projects	L	S	L	L			L		A				A	
Objective C-2. Protect and Enhance Forests and Urban Tree Canopy and Restore Understory Vegetation														
Conduct watershed-wide urban tree canopy analysis	S	W					L					A		
Develop Town-based UTC goals and plan	M	W	L	L	L		A							A
Amend municipal regulations	S	W	L	L	L			A						A
Implement priority reforestation projects	M/L	T	L	L	L		A		A			A		
Engage tree wardens in watershed municipalities	S/M	W	A	A	A		L					A		
Implement reforestation/tree canopy demonstration projects	S/M	T	A	A	A		L							A
Landowner education, stewardship and incentive programs	S	W	A	A	A		L			A		A		A
Adopt City of Hartford Tree Ordinance and develop master plan	S	W	L											A
Promote urban agriculture, community gardens	M	T	L	L	L		A		A					A
Objective C-3. Control Invasive Species														
Develop invasive species management plan	M	T	A	A	A		L		A		A			A
Implement priority invasive species management projects	M/L	T	L	L	L		L		L			A		A
Goal D – Sustainable Growth and Land Use														
Objective D-1. Promote Smart Growth														
Modify municipal land use codes, ordinances, and plans	S	W	L	L	L			A						A
Objective D-2. Protect Open Space														
Priority land acquisitions and conservation restrictions	S/M	T	L	L	L		A		A			A		A
Continue to implement municipal open space plans	S	T	L	L	L									
Seek alternative funding sources for open space acquisition	S/M	T	L	L	L		A							
Promote use of open space through trail maps and events	S/M	T					L							A
Identify and protect priority farmland	M	T		L			A							A

Table 3-1. Watershed Management Plan Recommendations Summary

Action Items Priority Abbreviations S = short-term, M = mid-term, L = long-term Scale/Location Abbreviations W = watershed-wide, T = targeted, S = site-specific	Priority	Scale/Location	Who Should Be Involved (L = lead, A = assist)											
			Hartford	Bloomfield	West Hartford	MDC	Watershed Organization	CRCOG	Landowners	NCCD	FRWA/ PRWRI	CTDEP	NRCS	Citizens & Volunteers
Objective D-3. Promote Low-Impact, Context-Sensitive Greenways														
Develop a Greenway between Bloomfield & Hartford that protects the stream corridor and links to neighborhood cultural points of interest.	M/L	T	L	L				A	A					A
Incorporate LID and conservation design elements	M/L	T	L	L			A	A						
Objective D-4. Increase Public Access to the River														
Enhance river access on public lands	L	T	L	L	L		A							A
Develop public access inventory for the watershed	S	T	A	A	A		L			A				A
Implement signage, interpretive stations, and online resources	M	T	A	A	A		L			A				A
Provide linkages between the river and cultural institutions	M	T	L				A		A					A
Goal E - Public Education and Stewardship														
Objective E-1. Creation of Education & Stewardship Network														
Develop framework for watershed place-based K-12 education	S	W	A	A	A		L							A
Develop educational toolkit and school stewardship network	M	W	A	A	A		L							
Objective E-2. Campus Facility Managers Outreach														
Organize and host workshops to demonstrate best practices	S/M	W					L	A	A[2]					A
Encourage awareness and involvement by students and faculty	S/M	W					A		L[3]					A
Objective E-3. Residential Outreach														
Foster a "block-by-block" approach for the restoration and conservation of stream reaches and ponds.	S/M	W					L		L					L
Increase watershed stewardship signage in residential areas	M	W	L	L	L		A			A				A
Encourage and provide incentives for disconnection of roof runoff	M	W	L	L	L		A							A
Develop education/outreach materials	S	W					L	A						
Deliver education/outreach to the public	M	W	L	L	L									A
Objective E-4. Municipal and Business Outreach														
Review municipal facility compliance	S	W	L	L	L									
Improve municipal stormwater management programs	S/M	W	L	L	L									
Develop education/outreach materials	S	W					L	A						
Deliver education/outreach to the public	M	W	L	L	L									A
Increase watershed stewardship signage in commercial areas	M	W	L	L	L		A			A				A

PRWRI - Park River Watershed Revitalization Initiative
FRWA - Farmington River Watershed Association
NRCS - Natural Resource Conservation Service
CRCOG - Capitol Region Council of Governments
NCCD - North Central Conservation District
CTDEP - Connecticut Department of Environmental Protection
MDC - Metropolitan District Commission

[1]University of Hartford [2]Institutions including universities, schools, hospitals, golf courses, etc. [3]Universities and schools

3.1 Watershed-Wide Recommendations

Watershed-wide recommendations are those recommendations that can be implemented throughout the North Branch Park River watershed. These basic measures can be implemented in each of the watershed municipalities, are applicable in most areas of the watershed, and are intended to address nonpoint source pollution through municipal land use regulations and planning, green infrastructure and smart growth, public education and outreach, urban watershed forestry, and watershed monitoring. The water quality and natural resource benefits of these measures are primarily long-term and cumulative in nature resulting from runoff reduction, source control, pollution prevention, and improved stormwater management for new development and redevelopment projects.

3.1.1 Build a Foundation for Implementing the Plan

During the planning process, the project Steering Committee provided direction and local knowledge of the watershed in guiding the watershed assessments, determining priorities, and developing the management plan. As the focus of the planning process moves towards implementation, the project Steering Committee should transition to a formal watershed organization that will take a leadership role in implementing the North Branch Park River Watershed Management Plan. Because the task of raising public awareness pertains to the greater Hartford metro area, an independent organization can represent the Park River regional watershed (both the North and South Branch subwatersheds). Such an organization could be established for the entire Park River watershed, with an initial focus on the North Branch Park River and implementation of this plan, as well as future development and implementation of a similar watershed-based management plan for the South Branch Park River.

Recommended actions include:

- Establish an independent watershed organization (i.e., 501(c)3 non-profit corporation, partnership, coalition, or similar entity) for the Park River regional watershed; secure funding for and hire a watershed coordinator.
- Under the Park River watershed organization, form an advisory committee to guide the implementation of the North Branch Park River Watershed Management Plan.
- Include representatives from each of the watershed municipalities, while focusing on Hartford, West Hartford, and Bloomfield where greater than 97% of the watershed is located, and representatives from regional, state, federal and local environmental organizations, businesses, and local institutions.
- Develop a purpose statement, responsibilities, and operating procedures for the advisory committee. Advisory committee functions to guide the implementation of the North Branch Park River Watershed Management Plan may include:
  - Attend regularly scheduled committee meetings.
  - Adopt policy statements and funding decisions.
  - Provide input, guidance and resources to implement the watershed plan, including review of goals and objectives, assigning priorities and responsibilities for plan recommendations and work tasks, and monitoring progress of work products.

- Chair or participate in subcommittee(s) that may be formed to further implementation of the plan.
- Final approval of reports and products.
- Assist in submitting grant applications and seeking funding opportunities.
- Report the status of the watershed plan activities with the represented organizations and groups.
- Providing input and guiding the activity of contracted services.
- Comment on federal, state and municipal permit applications for consistency with the management plan.
- Periodically review and update action items in the plan (at least every 5 years).
- Develop annual work plans (i.e., specific "to-do" lists).
- Plan and lead public outreach activities.
- Host annual public meetings to celebrate accomplishments, recognize participants, review lessons learned, and solicit feedback on plan updates and next steps.

- Encourage adoption of the watershed plan by the watershed municipalities through a Memorandum of Agreement (MOA), Intermunicipal Agreement, or similar mechanism to encourage inter-municipal coordination and accountability and to formalize the municipalities' agreement to support the watershed planning effort through funding, staff, or other resources.
- Review and prioritize potential funding sources that have been preliminarily identified in this plan (see *Section 3.5.2*), and prepare and submit grant applications for projects identified in the watershed plan.

3.1.2 Low Impact Development and Green Infrastructure

What is Low Impact Development and Green Infrastructure?

Low Impact Development (LID) and green infrastructure are the preferred approaches by EPA and CTDEP for stormwater management in urban and suburban areas. The two terms are often used interchangeably, but are generally used in different contexts.

LID is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product. The goal of LID is to mimic a site's pre-development hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Instead of conveying and managing/treating stormwater in large, costly end-of-pipe facilities located at the bottom of drainage areas, LID addresses stormwater through small, cost-effective landscape features located at the lot level. LID is a versatile approach that can be applied equally well to new development, urban retrofits, and redevelopment projects.

Figure 3-1. Examples of Low Impact Development Practices

a. Site Planning

b. Reduced Clearing Limits

c. Vegetated Swales

d. Increased Flow Travel Time

e. Parking Lot Bioretention

f. Stormwater Planters

g. Permeable Pavement

h. Green Roofs

Source: Larry Coffman, Low Impact Development Center (a through f), University of Connecticut (g and h).

Green infrastructure is a relatively new term and, similar to LID, refers to systems and practices that use or mimic natural processes to infiltrate, evapotranspire, or reuse stormwater. However, while LID is generally used to describe development approaches and practices at the site level, the term "green infrastructure" is typically used in a broader range of contexts and scales. LID hydrologic calculations are based on site-specific conditions within a watershed, while green infrastructure refers to features within a larger water resource management system. At the largest scale, the preservation and restoration of natural landscape features (such as forests, floodplains and wetlands) are components of green infrastructure. On a smaller scale, green infrastructure practices also include rain gardens, permeable pavement, green roofs, green streets, infiltration planters, trees and tree boxes, and rainwater harvesting for non-potable uses such as toilet flushing and landscape irrigation. These approaches reduce the amount of runoff discharging to surface waters and keep rainwater out of sewer systems so it does not contribute to sewer overflows (EPA Green Infrastructure Website, Accessed June 24, 2010).

Table 3-2 summarizes various types of green infrastructure practices approaches and the scales at which they are typically applied. Many of the site and neighborhood-scale practices are also considered LID techniques.

Table 3-2. Green Infrastructure Practices and Approaches

Scale	Green Infrastructure Practices and Approaches
Site	Green Roofs Rain Harvesting Downspout Disconnection Planter Boxes Rain Gardens/Bioretention Permeable Pavement Vegetated Swales Stormwater Wetlands Stormwater Infiltration Systems Brownfield Redevelopment Infill and Redevelopment
Neighborhood	Green Parking Green Streets & Highways Trees & Urban Forestry
Watershed	Wetland/Riparian Buffers Urban Forests

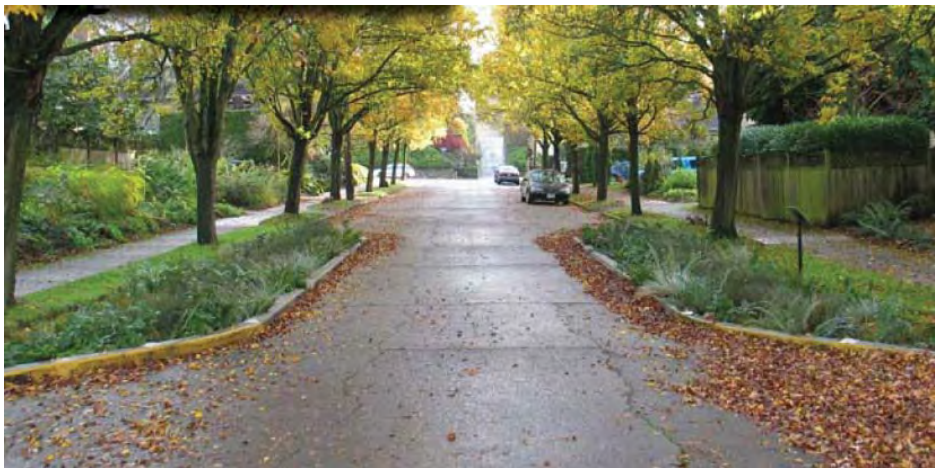
Source: Adapted from EPA Green Infrastructure Website, Accessed June 24, 2010.

Additional Benefits of LID and Green Infrastructure

In addition to reducing the overall volume of stormwater runoff, pollutant loads, and the frequency of sewer overflows, green infrastructure offers a number of other environmental, economic, and human health benefits, which are often accentuated in urban and suburban areas. These additional benefits include (Green Infrastructure Statement of Intent, EPA, April 19, 2007):

- *Cleaner Water* – Vegetation and green space reduce the amount of stormwater runoff and, in combined systems, the volume of combined sewer overflows.

Figure 3-2. Examples of Green Infrastructure Practices



a. Stormwater Curb Extensions

b. Stormwater Planters

c. Rain Harvesting

d. Urban Forestry

- Source: EPA, 2008.

- *Enhanced Watercourses, Waterbodies, and Water Supplies* – Most green infiltration approaches involve allowing stormwater to percolate through the soil where it recharges the groundwater and the base flow for streams, thus ensuring adequate water supplies for humans and more stable aquatic ecosystems.

- *Cleaner Air* – Trees and vegetation improve air quality by filtering many airborne pollutants and can help reduce the amount of respiratory illness.

- *Reduced Urban Temperatures* – Summer city temperatures can average 10ºF higher than nearby suburban temperatures. High temperatures are linked to higher ground level ozone concentrations. Vegetation creates shade, reduces the amount of heat absorbing materials and emits water vapor – all of which cool hot air.

- *Increased Energy Efficiency* – Green space helps lower ambient temperatures and, when incorporated on and around buildings, helps shade and insulate buildings from wide temperature swings, decreasing the energy needed for heating and cooling.

- *Community Benefits* – Trees and plants improve urban aesthetics and community livability by providing recreational and wildlife areas. Studies show that property values are higher when trees and other vegetation are present.

- *Cost Savings* - Green infrastructure may save capital costs associated with digging big tunnels and centralized stormwater ponds, operations and maintenance expenses for treatment plants, pumping stations, pipes, and other hard infrastructure; energy costs for pumping water around; cost of treatment during wet weather; and costs of repairing the damage caused by stormwater and sewage pollution, such as streambank restoration.

Green Infrastructure and CSO Control

Many urban areas, including the Hartford metropolitan area, utilize combined sewers to convey sewage and stormwater runoff to water pollution control facilities for treatment. Combined sewers are designed to convey sewage and a limited amount of stormwater runoff. When runoff exceeds available system capacity, combined sewer overflows (CSOs) occur as direct discharges of untreated sewage to water bodies, contributing to degraded water quality and habitat conditions such as exists in the North Branch Park River.

Conventional approaches to CSO abatement generally seek to increase storage or conveyance capacity within the sewer system. Two common designs are inline storage systems and CSO tanks. In-line storage systems add storage volume within the sewer system, while CSO tanks are large underground chambers situated at CSO discharge points. Both systems avert discharges by storing and, in some cases, also treating excess sewer flow before releasing it slowly back to the sewer system. These approaches can be effective but are often expensive and difficult to site, especially in urban areas where the availability of land is limited and land acquisition costs can be relatively high.

Green infrastructure can be both a cost effective and an environmentally beneficial approach to reduce stormwater and other excess flows entering combined or separate sewer systems in

combination with centralized hard infrastructure solutions. Other U.S. cities have incorporated green infrastructure approaches into their CSO control programs and are using green infrastructure to reduce stormwater pollution for compliance with municipal stormwater permit requirements (NRDC, 2006).

The preferred approach for CSO control within the North Branch Park River and other portions of the Hartford sewer system, as dictated by a federal consent decree and CTDEP consent order, consists primarily of separating the combined sewers and constructing new separate storm sewers to carry stormwater runoff. This aggressive approach is designed to eliminate CSOs during storms up to and including the typical one-year frequency event. However, it also presents an opportunity to augment sewer separation and other traditional CSO abatement efforts with green infrastructure approaches to reduce the volume of runoff and improve the quality of stormwater discharges from the new separated storm drainage outfalls to the North Branch Park River. Green infrastructure approaches can also be effective for addressing municipal stormwater permit requirements for existing and new stormwater discharges.

Obstacles to Green Infrastructure

Although many cities have begun to embrace green infrastructure for addressing sewer overflows and stormwater pollution, concerns still persist over the feasibility of green infrastructure in highly urbanized areas. This is in part because of a perception that insufficient land is available for green infrastructure implementation in cities. However, the major perceived obstacle is that green infrastructure is costly to retrofit or introduce into urban landscapes.

Although green infrastructure is in many cases less costly than traditional methods of stormwater and sewer overflow control, some municipalities persist in investing only in conventional controls rather than trying an alternative approach (NRDC, 2006). Additionally, public agencies generally do not pay for green infrastructure or LID retrofits on private property. Private property owners may marginally benefit from onsite green infrastructure in terms of increased real estate value, reduced risk of flooding, etc., but usually bear most of the cost of installation and maintenance of green infrastructure and LID practices (Montalto et al., 2007). Cities and towns that have developed successful green infrastructure programs have incentives (or perceived dis-incentives), such as stormwater utility fees. Comprehensive green infrastructure programs depend upon research to determine appropriate basin-specific water management objectives. Fortunately, such work is a meaningful evolution of green jobs.

Ongoing CSO Control and Green Infrastructure Efforts

As described in the baseline assessment report, the MDC is implementing a major infrastructure improvement program known as "The Clean Water Project" to achieve state and federal water quality goals by 2020. The Clean Water Project is a rare opportunity for systemic green infrastructure improvements to reduce stormwater run-off throughout the city. The objectives of the Clean Water Project include the reduction of combined and sanitary sewer overflows, as well as nitrogen reductions. The Long Term Control Plan would eliminate all discharge from CSOs during storms up to and including the typical one-year frequency event. The District plans to address the CSO issues by implementing one or more of the following traditional strategies:

- Separating the combined sewer systems
- Correcting illegal connections including roof drains and sump pumps and groundwater infiltration locations
- Installing new, larger sewer pipes
- Installing storage pipes to hold storm flows and prevent storm event related discharges
- Increasing sewer treatment plant capacities

The MDC and the City of Hartford are also evaluating the use of green infrastructure approaches and LID to further manage wet weather flows, including storm runoff volume and quality. Such practices include the installation of storage beneath athletic fields, rain gardens, open channels/bio-swales, and pervious pavements which promote the infiltration of runoff into the soil instead of directing it into the storm and/or combined sewer system. Green infrastructure concepts have also been proposed for in and around the State Capitol in Hartford including the removal of impervious cover (reduction of paved areas) and the installation of stormwater swales and rain gardens. Development of the MDC green infrastructure plan and the "Green Capitols" project are ongoing. Cooperation from the City of Hartford (and the community interest necessary to support political will) is essential because the MDC only owns/manages the below-grade sewer system.

Plan Recommendations

- Ultimately, the existing CSO discharges to the North Branch Park River must be significantly reduced or eliminated to realize improvements in water quality in the river. The MDC should continue to implement its CSO Long Term Control Plan, but also consider green infrastructure and LID alternatives in combination with traditional hard infrastructure solutions to further reduce runoff volume and stormwater pollution from existing outfalls and new outfalls that result from sewer separation efforts.

- The MDC, in partnership with CTDEP, the City of Hartford, and other member communities, should conduct a comprehensive study to evaluate the feasibility and benefits of incorporating green infrastructure approaches to augment the MDC's CSO Long Term Control Plan as well as municipal (MS4) stormwater management programs. Such a study could build upon the ongoing green infrastructure planning efforts of the MDC and City of Hartford One City, One Plan (POCD) progress, as well as information contained in this watershed plan and other ongoing planning initiatives. Elements of the study should include:
    - An inventory and mapping of existing and potential conditions that will support (or detract from) green infrastructure planning including natural resources, social and economic resources.
    - Demonstration of project types with clear water quality benefits that can be implemented throughout the city for fairly fixed costs, such as infiltration and storage beneath athletic fields, bio-swales at the edge of parking lots, and rain gardens around stormwater drains that have been placed in fields and parkland.
    - Hydrologic and hydraulic modeling to quantify the potential benefits of green infrastructure in terms of reductions in runoff volume, stormwater pollutant loads, and sewer overflow discharges. The modeling should incorporate a

cost-benefit analysis for comparison of the cost-effectiveness of green infrastructure with traditional stormwater management approaches.

- Identification of public land areas available for long-term green infrastructure management such as City of Hartford property, most notably Flood Commission properties, state-owned properties within the watershed, and other available municipal and state properties within the watershed.
- Identification of privately-owned land, such as institutional and corporate campuses, that could provide additional long-term green infrastructure system benefits within the watershed and residential neighborhoods.
- Evaluation of various types of green infrastructure practices, through demonstration projects that can be monitored in order to select the practices that are most feasible in the Hartford area such as:
  - Rain gardens
  - Green streets
  - Pervious pavement
  - Green roofs
  - Green walls/columns (integrating vertical city construction with a vertical watershed concept)
  - Downspout disconnection
  - Outfall retrofits
- Evaluation of the potential benefits of expanded stream buffers and restored urban forests, including identification of future high-density development locations within the watershed.
- Evaluation of various green build-out scenarios similar to approaches taken by other cities in the U.S.
- Evaluation of long-term program costs and financing alternatives, including incentive mechanisms for implementation of LID and green infrastructure on private property (stormwater fee discounts, development incentives, grants, and rebates and installation financing). The MDC and City of Hartford should explore the feasibility of a stormwater utility, borrowing from lessons learned from the recent CTDEP stormwater utility pilot projects and the ongoing work by the CTDEP to incorporate LID into state permits and policy.
- Identify selected pilot locations within problem areas to demonstrate the feasibility and effectiveness of green infrastructure approaches. The northwestern neighborhoods of Hartford located within the North Branch Park River watershed are a potential candidate given the existing combined sewer system in this area and proposed plans for sewer separation.
- As recommended in the City of Hartford's recently adopted Plan of Conservation and Development ("One City, One Plan"), resolve the issue of shared stormwater responsibility between the City and the MDC.

- The MDC should design and construct LID measures and/or end-of-pipe structural Best Management Practices (BMPs) for new stormwater discharges to the North Branch Park River and its tributaries as a result of sewer separation projects, including planned stormwater outfalls associated with the Upper Albany Avenue and Granby Street separation projects to ensure that stormwater runoff is not discharged directly into the river.

- The MDC recently included language in engineering design proposals requiring their design consultants to consider LID and green infrastructure approaches as alternatives to traditional hard infrastructure in all projects of the MDC Clean Water Project. Green infrastructure approaches should be given primary consideration and implemented whenever feasible to better manage stormwater runoff and reduce NPS pollution.

- Implement the MDC "Green Capitols" and similar green infrastructure downtown demonstration projects generated by the "iQuilt" initiative. In addition, the MDC can work with the City of Hartford on green infrastructure projects that will benefit residential neighborhoods, such as athletic fields, parklands, and green streets. However the neighborhood civic groups and the City of Hartford must provide leadership through the design process. Additional information on EPA's *Greening America's Capitals* project is available at http://www.epa.gov/smartgrowth/greencapitals.htm.

- Upstream watershed municipalities (Bloomfield and West Hartford) should incorporate LID and green infrastructure into municipal projects: 1) protect headwaters from development, 2) focus on areas where waters become impaired, and 3) implement green infrastructure projects to mitigate stormwater runoff, including roadway projects using "green streets" approaches. These watershed municipalities can take a leadership role by also incorporating LID green infrastructure into a high-profile demonstration project at a publicly-owned facility. All green infrastructure sites should be regularly monitored and actively used for educational purposes.

- Watershed municipalities should incorporate LID and green infrastructure stormwater requirements into their local land use regulations to: 1) satisfy existing and future Phase II Stormwater Program regulatory requirements, 2) provide incentives, for example funding or simply accelerated permitting, and require LID practices and green infrastructure approaches to be implemented for new development and redevelopment projects, and 3) address other local drainage and natural resource protection issues identified by the municipalities.

3.1.3 Land Use Regulations

The land use regulatory review that was performed as part of the plan development process identified areas for improvements in municipal local land use regulations and related land use planning documents to better protect water resources throughout the watershed. The following sections summarize recommendations for the three primary municipalities in the watershed – Bloomfield, Hartford, and West Hartford – as well as several other governmental entities in the watershed. A copy of the complete land use regulatory review is included on CD in *Appendix C* of this watershed management plan.

Bloomfield

Bloomfield adopted new Zoning Regulations in the summer of 2009, which strengthened provisions for innovative stormwater management design, erosion and sediment control, and protection of steep slopes and hillsides through the use of the Talcott Mountain Overlay District. Bloomfield also has progressive Inland Wetlands and Watercourses regulations,

including riparian buffer protection through minimum buffer widths (100 feet for the North Branch Park River) and the preservation of natural buffers, a progressive upland review area, defined as 200 feet from watercourses and 100 feet from wetlands, and provisions for protection of vernal pools.

The Bloomfield Subdivision Regulations, including standard specifications and details for the design and construction of subdivision improvements, were last modified in 1992 and are outdated with respect to stormwater quality management and storm drainage. Bloomfield is also in the process of revising its Plan of Conservation and Development, which presents an opportunity to incorporate a number of key planning initiatives and recommended regulatory revisions that will help protect water resources from potential impacts associated with future land development in Bloomfield.

Specific land use regulatory and planning recommendations for Bloomfield include:

- Promote watershed planning, smart growth, open space protection, green infrastructure, and LID principles in the revised Plan of Conservation and Development, including adoption of the North Branch Park River Watershed Management Plan.
- Modify the Stormwater Runoff section of its zoning regulations to include a set of stormwater management standards. Development of stormwater management standards would allow Bloomfield to establish clearer, specific performance standards that all projects must meet in order to obtain P&Z approval. At a minimum, the revised standards should reference the Connecticut Stormwater Quality Manual (as amended). The stormwater standards could include LID practices recommended for use in Bloomfield and could be tailored to protect specific water bodies or sensitive resources in the Town of Bloomfield.
- Explore the feasibility of a stormwater utility or other stormwater program financing options, borrowing from lessons learned from the recent CTDEP stormwater utility pilot projects and the ongoing work by the CTDEP to incorporate LID into state permits and policy.
- Consider establishing an administrative process or public funding to support open space planning and acquisition.
- Bloomfield may require that due regard be given to the preservation and enhancement of scenic points and vistas, ridgelines, and contours of the land but does not specifically regulate development along ridgelines. Bloomfield should consider modifications to its zoning regulations to regulate development along ridgelines.
- Adopt regulations or make specific recommendations concerning the use of pesticides on town property.
- Consider limits on net increase in stormwater runoff volume in addition to peak flow as a result of development.
- Strengthen the landscape provisions of the Zoning Regulations by requiring maximum tree preservation, replacement and diversity of tree species.
- Review current setbacks and lot dimensions in subdivisions for potential to relax side yard setbacks and allow narrower frontages to reduce road length and site imperviousness, and to relax front setback requirements to reduce driveway length and lot imperviousness.

- Review existing parking ratios to see if lower ratios are warranted and feasible. The required parking ratio for a particular land use (other than commercial retail) should be enforced as both a maximum and minimum to limit excess parking space construction and impervious cover. Consider allowing the Commission to approve parking lots with more spaces than the allowed maximum provided all of the spaces above the maximum number are composed of a pervious surface, and where adequate stormwater management is provided. Also consider parking spaces held in reserve for phased developments, thereby avoiding the situation where unnecessary parking is not constructed if future phases of development do not occur.
- Modify the parking area landscaped area requirements in the zoning regulations to promote parking lot bioretention and other LID practices.
- Modify the Subdivision Regulations (last revised in 1992) to reflect updated stormwater quality standards, LID and green infrastructure, drainage design, and street design (complete or green streets).
- Revise storm drainage design standards and regulations such that new or modified stream crossings are designed consistent with the Connecticut DEP Stream Crossing Guidelines.
- Consider modifying the zoning regulations to promote the use of and remove common barriers to implementing smart growth principles. General recommendations include:
  - Use urban dimensions in urban places to allow for more compact development
  - Revise/reduce parking requirements to reduce unnecessary impervious cover (see above)
  - Increase density and intensity in centers
  - Modernize street standards
  - Designate and support preferred growth areas and development sites
  - Use green infrastructure and LID to manage stormwater (see above)
- Consider unique species or communities in regulations for open space, alternative or traditional subdivision regulations.
- Consider habitat fragmentation in regulations for open space, or for alternative/traditional subdivisions.

Hartford

The City of Hartford adopted a new Plan of Conservation and Development ("One City, One Plan") in June 2010. Development of the Plan of Conservation and Development involved a comprehensive public discussion on measures to promote neighborhood revitalization. In the process, community interest groups requested adoption of the North Branch Park River Watershed Management Plan. Interest was also expressed by stakeholders in updating the city's Inland Wetlands and Watercourses Regulations and stormwater management requirements of the Zoning Regulations. Overall, the stated goals of the Plan of Conservation and Development include many of the goals and recommendations of this watershed management plan. The regulatory review also identified additional regulatory and planning recommendations for the City of Hartford.

Specific land use regulatory and planning recommendations for Hartford include:

- Consider updating and maintaining a comprehensive online map of existing City of Hartford Inland Wetlands and Watercourses.
- Add definitions for watershed, vernal pools, and riparian buffers to the Inland Wetlands and Watercourses Regulations.
- Embrace a watershed perspective in its land use planning and/or its regulations.
- Amend the Inland Wetlands and Watercourses Regulations to promote the preservation and restoration of vegetative buffers, including recommended minimum riparian buffer widths and the preservation of natural buffers. Ensure that new development occurs with respect to regulations that protect water quality, and outline conditions to address existing development that may be damaging to water quality, especially with respect to parking areas that are less than 25 feet from the stream corridor.
- Revise the zoning regulations to strengthen stormwater management requirements and require the inclusion of Best Management Practices and Low Impact Development Design techniques in stormwater management plans. Use regulatory site plan review as a tool to ensure stormwater quality measures are implemented in new developments.
- Explore the feasibility of a stormwater utility or other stormwater program financing options, borrowing from lessons learned from the recent CTDEP stormwater utility pilot projects and the ongoing work by the CTDEP to incorporate LID into state permits and policy.
- Promote "smart growth" principles that address stormwater management through LID and green infrastructure strategies.
- Revise storm drainage design standards and regulations such that new or modified stream crossings are designed consistent with the Connecticut DEP Stream Crossing Guidelines.
- Review the municipal code and regulations for potential regulatory barriers to implementing downspout disconnection and revise the ordinances/regulations accordingly.
- Consideration of habitat fragmentation in regulations for open space, or for alternative/traditional subdivisions.
- Conduct a comprehensive review of the "Soil Erosion, Sediment Control and Storm Water Runoff" sections of the zoning regulations.
- Adopt the proposed City of Hartford Tree Ordinance. Include a comprehensive urban forest master plan that distinguishes sites and woodland ecosystems variations within parks, open spaces, and stream corridors as well as trees for streetscapes and parking lots that enhance LID and green infrastructure urban design benefits.
- Consider increasing the fine for illegal dumping (currently $100) to include cost of clean-up and restoration of environmental disturbance, which may involve a cooperative effort to update the state fines for illegal dumping.
- Review parking regulations to ensure they are consistent with smart growth & sustainability, including opportunities to reduce parking ratios, parking space size, and other factors that would reduce impervious cover.
- Adopt a City-wide complete streets roadway design policy. Employ traffic calming techniques in residential areas where appropriate, and integrate stormwater management

through green streets concepts (stormwater curb extensions, roadside bioretention and water quality swales).

West Hartford

The Town of West Hartford also recently revised its Plan of Conservation and Development. West Hartford's Plan of Conservation and Development for 2009-2019 strongly emphasizes sustainability and quality of life, including preservation of remaining open space; accessible and welcoming streetscapes and public spaces; sound energy policies; and low impact development. The West Hartford Plan of Conservation and Development also contains good recommendations for improving land use practices and water quality protection, including review and revision of the Town's zoning, subdivision, and inland wetlands regulations.

Specific land use regulatory and planning recommendations for West Hartford include:

- Strengthen landscape provisions of the zoning ordinance and the subdivision regulations to require maximum tree preservation and replacement.
- Amend zoning ordinance to authorize Town Planner to refer site plan applications to the Design Review Advisory Committee and for TPZC to refer Special Use Permit applications at discretion to the Design Review Advisory Committee.
- Conduct a comprehensive review of the parking requirement standards of the zoning ordinance, in particular as it relates to number of parking spaces required by use and size of parking stalls.
- Review zoning ordinance to determine if additional ridgeline protection is necessary;
- Revise zoning ordinance to strengthen stormwater management requirements and require the inclusion of Best Management Practices and Low Impact Development Design techniques in stormwater management plans.
- Conduct a comprehensive review of the "Soil Erosion, Sediment Control and Storm Water Runoff" section of the zoning ordinance.
- Review Subdivision Regulations to determine if the street design standards effectively promote the "complete street network."
- Review Subdivision Regulations to determine if ridgelines and other natural resources are adequately protected.
- Review the Inland Wetlands and Watercourses Regulations to determine if the current regulations are adequate to continue to protect the Town's natural resources and implement the policies of the PCD, in particular as outlined in the Open Space/Conservation section. Measures such as the possible adoption of conservation overlay zones should be evaluated.
- Inclusion of a watershed-based approach in long-term planning, including adoption of the North Branch Park River Watershed Management Plan.
- Develop a "Metacomet Ridge Overlay District" to protect the natural character of the ridge, the National Historic Metacomet Monadnock Mattabesett (MMM) Trail, and to protect water quality within the MDC Reservoirs. Existing ridge protection overlay districts in Avon and Bloomfield can serve as a reference.
- Review Subdivision Regulations to determine if street design standards effectively promote best management practices for stormwater runoff and the principles of Low Impact Development.

- Consider limits on net increase in stormwater runoff volume in addition to peak flow as a result of development.
- Explore the feasibility of a stormwater utility or other stormwater program financing options, borrowing from lessons learned from the recent CTDEP stormwater utility pilot projects and the ongoing work by the CTDEP to incorporate LID into state permits and policy.
- Revise storm drainage design standards and regulations such that new or modified stream crossings are designed consistent with the Connecticut DEP Stream Crossing Guidelines.
- Review the municipal code and regulations for potential regulatory barriers to implementing downspout disconnection. Guidance provided by the West Hartford Department of Public Works recommends redirecting rain downspouts to lawn areas as one possible measure to alleviate flooding problems in areas with combined sewers. However, the municipal code and regulations related to sewers may conflict with downspout disconnection and, if so, should be revised accordingly.
- Discretion to require an E&S plan as needed for certain sites where disturbance is less than ½ acre but erosion risk is high.
- Explicit protection of steep slopes from development.
- Specific regulations concerning engineered septic systems.
- Inclusion of unique species, natural communities, habitat continuity, and ecosystem services as protection goals in regulations.
- Amend the Inland Wetlands and Watercourses Regulations to incorporate revised stormwater management standards and LID practices, including reference to the Connecticut Stormwater Quality Manual (as amended).
- Amend the Inland Wetlands and Watercourses Regulations to promote the preservation and restoration of vegetative buffers, including recommended minimum buffer widths (100 feet for the North Branch Park River) and the preservation of natural buffers similar to the Bloomfield regulations.

Greater Hartford Flood Commission

Although the Greater Hartford Flood Commission regulations address potential erosion and sedimentation due to flooding, they do not directly address water quality or related issues such as riparian zone protection, impervious cover limits, etc. Opportunities exist to incorporate additional protection of the riparian zone within the Flood Plain District, which would provide additional water quality benefits for the North Branch Park River. Potential modifications to the regulations that should be considered include:

- Acknowledge the importance of maintaining native vegetation within the riparian zone. Healthy vegetation adjacent to surface waters is essential for maintaining bank stability and water quality. The disturbance of such vegetation destabilizes the banks of channels and other surface waters, which leads to increased erosion and sedimentation that exacerbates the intensity and frequency of flooding. The loss of vegetation adjacent to surface waters also reduces filtration of stormwater runoff and thus degrades the quality of these waters. Such impacts adversely affect the health and habitat of fish and wildlife that depend upon clean surface waters and therefore disrupt the ecological balance that is necessary for life. Humans are ultimately affected by this imbalance, since clean water

is essential for all life (New Jersey Department of Environmental Protection, Flood Hazard Area Control Act Rules, November 5, 2007). Invasive species removal and the restoration of native vegetation provides habitat for migratory songbirds that often connect urban residents to environmental values and an interest in natural sciences.

- Establish regulated riparian zones within the Flood Plain District.
- Establish maximum disturbance and include vegetation replacement and mitigation for various activities.
- Limit the area of vegetation that can be disturbed for various regulated activities. A permit for activity involving disturbance of the riparian zone would be issued only if specific conditions are met, such as:
    - The basic purpose of the project cannot be accomplished on site without disturbing vegetation in the riparian zone.
    - Disturbance to the riparian zone is eliminated where possible and minimized where not possible by relocating the project, reducing the size of the project, or situating the project in portions of the riparian zone where previous development or disturbance has occurred.
    - Any temporarily cleared area of vegetation must be replanted with indigenous, non-invasive vegetation.
    - Limits on the amount of disturbance allowed for specific activities.
- Limit disturbance within specified distances from the top of bank for certain activities.
- Where the standards cannot be met, providing greater than 1:1 compensation in the form of re-vegetation and placing a deed restriction on the compensation area.

Metropolitan District Commission

As part of its ongoing green infrastructure planning efforts, the MDC, working together with its member communities within the watershed, should conduct a comprehensive review of its sewer ordinance, standards, and policies to identify and remove potential regulatory barriers to green infrastructure and LID, including barriers to downspout disconnection. The MDC should also evaluate the feasibility of a stormwater utility or other financing mechanism for green infrastructure programs, as well as incentives for downspout disconnection by private property owners.

3.1.4 Smart Growth

"Smart growth" includes a range of development and conservation strategies that help protect natural resources and make communities more attractive, economically stronger, and more socially diverse. Smart growth practices have a number of benefits including lessening the environmental impacts of development with techniques that include compact development, reduced impervious surfaces and improved water detention, safeguarding of environmentally sensitive areas, mixing of land uses, transit accessibility, and better pedestrian and bicycle amenities. Compact development and open space preservation can help protect water quality by reducing the amount of paved surfaces and by allowing natural lands to filter rainwater and runoff before it reaches water resources (EPA Website, Accessed June 25, 2010).

Smart growth practices can benefit both developed and undeveloped communities. For largely undeveloped communities with significant development potential, smart growth can shape the future development of homes, neighborhoods, and entire communities. Smart growth

principles can also benefit developed areas through infill redevelopment and redevelopment of underutilized sites.

The communities of West Hartford and Hartford have already adopted smart growth planning principles through their municipal Plans of Conservation and Development. Bloomfield is in the process of revising its Plan of Conservation and Development. Bloomfield also has the greatest potential for future new development within the North Branch Park River watershed, and much of the development potential is associated with residential and industrial-zoned properties near sensitive headwater streams. Therefore, a key opportunity exists for Bloomfield to incorporate smart growth principles into its revised Plan of Conservation and Development, which would promote resource conservation and sustainable land development in sensitive areas of the watershed. Specific recommendations related to smart growth include:

- Bloomfield should incorporate smart growth principles in its revised Plan of Conservation and Development.
- All of the watershed communities should consider modifying local land development codes and ordinances (see recommendations in *Section 6.1.3*) to promote the use of and remove common barriers to implementing smart growth principles. General recommendations include:
  - Allow or require mixed-use zones
  - Use urban dimensions in urban places to allow for more compact development
  - Revise/reduce parking requirements to reduce unnecessary impervious cover
  - Increase density and intensity in centers
  - Modernize street standards
  - Designate and support preferred growth areas and development sites
  - Use green infrastructure and LID to manage stormwater
  - Establish a water budget based on site conditions prior to development and strive to preserve pre-development site hydrology

3.1.5 Urban Watershed Forestry

What is Urban Watershed Forestry?

Urban forest research over the last several decades and new technical analysis tools have defined a wider role and value for urban trees. Urban trees and forests improve air and water quality, reduce stormwater runoff, conserve energy, and protect public health (*Table 3-3*). At the same time, the loss of trees and forests in suburban and urban watersheds continues through removal or lack of replacement. The ongoing conversion of forests to urban uses underscores the need for greater integration of forest and land use planning (USDA Forest Service, 2005).

Traditional approaches to restoring urban watersheds that have relied on structural solutions have failed to protect and restore urban streams. Through green infrastructure approaches, vegetation and natural systems are now considered a key tool in the protection and restoration of urban watersheds.

Urban watershed forestry integrates the fields of urban and community forestry and watershed planning. Urban and community forestry is the management of the urban forest for environmental, community, and economic benefits, while watershed planning promotes sound

land use and resource management to improve water resources within a watershed. Therefore, urban watershed forestry sets watershed-based goals for managing the urban forest as a whole rather than managing forest resources on a site-by-site or jurisdictional basis, and provides strategies for incorporating forests into urban watershed management (USDA Forest Service, 2005).

Urban watershed forestry has three principal goals:

1. Protect undeveloped forests from human encroachment and the impacts of land development by creating and applying various planning techniques, regulatory tools, and incentives.
2. Enhance the health, condition, and function of urban forest fragments.
3. Reforest open land through active replanting or natural regeneration to regain some of the functions and benefits of a forest and to increase overall watershed forest cover, tree canopy, and forest connectivity along stream corridors.

Urban Tree Canopy

Urban Tree Canopy (UTC) is defined as the layer of tree leaves, branches, and stems that cover the ground when viewed from above. Tree canopy is a useful parameter because it provides such benefits as rainfall interception, pollutant removal, and reduced temperatures due to shading of streams and impervious surfaces, and can be measured using remote sensing and/or field techniques.

Many communities have assessed the tree canopy in their community and developed urban tree canopy goals as numerical targets to guide urban watershed forestry planning efforts.

Table 3-3. Watershed Benefits of Forest Cover

Benefit	Description
Reduce storm water runoff and flooding	• Trees intercept rainfall in their canopy, reducing the amount of rain that reaches the ground. A portion of this intercepted rainwater evaporates from tree surfaces. This effect is greater in low rainfall events. • Trees take up water from the soil through their roots during transpiration, which increases soil water storage potential and lengthens the amount of time before rainfall becomes runoff • Trees promote infiltration by attenuating runoff and by increasing soil drainage due to the creation of macropores by tree roots. The addition of organic matter (e.g., leaf litter) also increases storage of water in the soil, further reducing runoff. • Reduced runoff from forested land reduces the frequency and volume of downstream flood events.
Improve regional air quality	• Trees absorb nitrogen dioxide, carbon monoxide, ozone, and particulate matter from the atmosphere. • Trees reduce air temperature which reduces formation of pollutants that are temperature dependent, such as ozone • Trees indirectly improve air quality by cooling the air, storing carbon, and reducing energy use, which reduces power plant emissions
Reduce stream channel erosion	• Trees growing along a stream bank prevent erosion by stabilizing the soil with root systems and the addition of organic matter, and by substantially dispersing raindrop energy • Reduced runoff volume due to forests upstream can reduce downstream flood flows that erode the stream channel

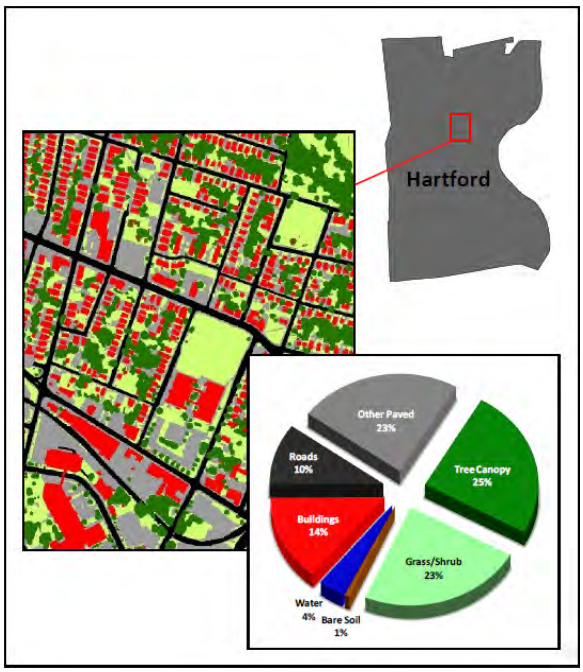
Table 3-3. Watershed Benefits of Forest Cover

Benefit	Description
Improve soil and water quality	• Trees prevent erosion of sediment by stabilizing soil with root systems and the addition of organic matter, and by substantially dispersing raindrop energy • Trees take up nutrients such as nitrogen from soil and groundwater • Forested areas can filter sediment and associated pollutants from runoff • Certain tree species break down pollutants commonly found in urban soils, groundwater, and runoff, such as metals, pesticides and solvents
Provide habitat for terrestrial and aquatic wildlife	• Forests (and even single trees) provide habitat for wildlife in the form of food supply, interior breeding areas, and migratory corridors • Streamside forests provide habitat in the form of leaf litter and large woody debris, for fish and other aquatic species • Forest litter, such as branches, leaves, fruits, and flowers, form the basis of the food web for stream organisms
Reduce summer air and water temperatures	• Riparian forests shade the stream and regulate summer air and water temperatures, which is critical for many aquatic species • Trees and forests shade impervious surfaces, reducing temperature of storm water runoff, which can ameliorate the thermal shocks normally transmitted to receiving waters during storms.

Source: Adapted from USDA Forest Service, 2005.

Based on a recommendation of American Forests (2009), 40% forest cover is a reasonable overall threshold goal for urban areas, and many communities have adopted this or similar canopy goals as existing tree canopy is typically significantly lower. As indicated in the baseline watershed assessment (*Appendix A*), forest cover in the North Branch Park River watershed is estimated at approximately 35%, with some areas having forest cover between 10% and 20%. The overall North Branch Park River watershed and many of its subwatersheds are below the recommended goals for urban areas.

The City of Hartford has begun to assess the existing tree canopy within the city limits and establish a city-wide tree canopy goal. The City of Hartford, Knox Parks Foundation, the USDA Forest Service and the Department of Environmental Protection's Division of Forestry conducted a tree canopy survey in the summer of 2007 (Knox Parks Foundation, undated). The study estimated the existing tree canopy in Hartford at 26%, which compares favorably with other major cities in the Northeast, including Boston (22%), New York (21%) and Washington DC (29%).



City of Hartford 2010 tree canopy assessment.

The City of Hartford, in conjunction with the USDA Forest Service and the University of Vermont, also recently performed a city-wide tree canopy assessment using high-resolution aerial imagery (O'Neil-Dunne, 2010). The assessment estimated existing tree canopy within the City of Hartford at 26%, and within the Hartford portion of the North Branch Park

River watershed between 24% and 36%. The assessment suggested a potential tree canopy goal for the watershed of between 40% and 50%.

The City of Hartford has also proposed a city-wide tree ordinance that recommends the establishment of a Tree Master Plan for Parks, Open Space and Streets. The proposed ordinance also recognizes the need to protect legacy trees of unique value, such as heirs to seeds collected from the Connecticut Charter Oak tree, and large "champion" trees. Many of these legacy trees have been already been identified and mapped by Ed Richardson.

Plan Recommendations

A key objective of this watershed management plan is to protect and enhance forests and urban tree canopy and restore understory vegetation within the North Branch Park River watershed. Specific recommendations include:

- Conduct a watershed-wide tree canopy analysis, building on the previous urban forest canopy assessments performed by the City of Hartford, Knox Parks Foundation, USDA Forest Service, CTDEP Division of Forestry, and University of Vermont. The watershed tree canopy analysis will help target priority areas, identify ownership, and establish a baseline for the watershed. The analysis should use high-resolution aerial imagery and analysis techniques similar to those used in the University of Vermont study.
- Review the conditions of understory vegetation for invasive species and appropriate habitat for migratory songbirds. This process, will involve bringing together foresters, invasive species specialists, and ornithologists to review restoration strategies.
- Adopt the proposed City of Hartford Tree Ordinance. The City should also develop a comprehensive urban forest master plan that distinguishes sites and woodland ecosystem variations within parks, open spaces, and stream corridors as well as trees for streetscapes and parking lots to enhance LID and green infrastructure benefits.
- Quantify the value of urban forestry and tree programs for improving the City's appearance, improving energy efficiency and air quality, providing wildlife habitat, recreational opportunities, real estate values, and most importantly job opportunities. Tools to quantify such benefits are available online (http://www.itreetools.org/). Undertake efforts to monitor, maintain and enhance these resources through tree improvement programs as part of the City's maintenance and capital planning programs
- Establish Town-based UTC goals for other municipalities in the watershed and develop a plan to achieve those goals. Potential recommendations include:
  - Land acquisition and conservation easements
  - Amend site development regulations and zoning to encourage tree retention and maintenance, restrict tree removal, and require landscaping and parking lot shading
  - Reforest public lands, beginning with priority sites
  - Encourage large trees wherever possible
  - Encourage reforestation of private land by developing education, stewardship and incentive programs. For larger parcels, contact a CTDEP Service Forester or private consulting forester to developing specific goals and objectives for that property.
  - Consider tree ordinances similar to the proposed Hartford ordinance
- Identify priority parcels for reforestation based on watershed field inventories and detailed tree canopy analysis results.

- Engage the tree wardens in the watershed municipalities regarding tree health, tree retention, and canopy cover goals.
- Use demonstration projects to demonstrate the importance of trees and vegetation as green infrastructure to help manage water quality and temperatures in the vicinity of the North Branch Park River.
- Promote urban agriculture within the watershed through community gardens, backyard gardens, and schoolyard edible efforts. Promote and establish community gardens in denser population areas of the watershed, in addition to those maintained by the Town of Bloomfield at the Tunxis Flood Control Reservoir and private community gardens maintained at the Seabury Retirement Community and the Duncaster Heartcare Facility in Bloomfield.
- Promote low-maintenance seasonal mowing schedules for municipal open space with respect to bird nest patterns within native meadows. This program can be developed with area landscape businesses and the Connecticut Northeast Organic Farming Association.

3.1.6 Illicit Discharge Detection and Elimination

Illicit discharges are non-stormwater flows that discharge into the stormwater drainage system or directly into surface waters. Failing septic systems, wastewater connections to the storm drain system, and illegal dumping are among the types of illicit discharges that can occur in residential and commercial areas. Depending on the source, an illicit discharge may contain a variety of pollutants that can impact both human health and the aquatic environment. A number of potential illicit discharges were identified throughout the watershed during the stream inventories. Identifying and eliminating these discharges is an important means of pollution source control for the watershed.

All of the watershed municipalities are subject to the requirements of the NPDES Phase II stormwater program, which is regulated under the CTDEP General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 General Permit). The MS4 General Permit regulates the quality of discharges from municipal storm drainage systems. The program requires municipalities to implement an ordinance or other regulatory mechanism to effectively prohibit non-stormwater discharges into the municipal storm drainage system, as well as sanctions to ensure compliance. This includes developing an Illicit Discharge Detection and Elimination (IDDE) Plan to detect and eliminate existing and future non-stormwater discharges, including illegal dumping.

The MS4 General Permit is scheduled for re-issuance by January 2011, which represents an opportunity for the watershed municipalities to review their municipal stormwater management plans relative to the MS4 General Permit requirements, including the illicit discharge detection and elimination component.

The following recommendations apply to each of the watershed municipalities:

- Review and update municipal stormwater management plans to ensure that IDDE efforts of the watershed municipalities (required by the MS4 General Permit) include their respective areas of the North Branch Park River watershed.
- Review and update municipal stormwater management plans to ensure that the watershed municipalities implement IDDE programs as required by the existing and future MS4 General Permit, including an ordinance or other regulatory mechanism to effectively prohibit non-stormwater discharges into the regulated municipal separate storm sewer system and an IDDE Plan to detect and eliminate existing and future non-stormwater discharges, including illegal dumping.
- Conduct follow-up illicit discharge investigations at priority outfall locations identified during the watershed inventories (see Targeted Recommendations).
- Implement priority stream cleanup projects identified during the watershed field inventories (see Targeted Recommendations).

3.1.7 Downspout Disconnection

Residential and commercial areas in the watershed contribute significant quantities of rooftop runoff to the storm drainage system. Opportunities exist to disconnect residential rooftop runoff from the storm drainage system or surface waters directly, and reduce the quantity of runoff by redirecting the runoff to pervious areas or through the use of rain barrels or rain gardens.

Rain barrel used to capture and re-use rooftop runoff (Source: CWP, 2007).

Downspout disconnection (also referred to as "roof leader disconnection") is a cost-effective on-site option for reducing the volume and cost of stormwater that requires public management. Runoff from residential rooftops is collected by eaves troughs, which are installed along the edge of the roofline. Water collected in the eaves trough is conveyed to ground level by one or more downspouts. Downspouts may then connect directly into the storm sewer system or discharge to driveways, which in turn convey the water to the street and storm drainage system. Similarly, building roof drainage in older commercial developments is typically tied directly to the on-site storm drainage system.

Downspout disconnection has a number of economic and environmental benefits to the municipality and the property owner. The major benefits include:

- Reduces volumes of flows conveyed and resulting loads to watercourses,
- Reduces the volume of flow to the municipal storm drainage system,
- Increases infiltration and groundwater recharge,
- Provides options to "recycle" rainwater.

Downspout disconnection is ideal in neighborhoods where roof leaders are directly connected to the storm drainage system and in medium density residential areas with lot sizes in the 0.25 to 1.0 acre range (CWP, 2007). However, most residential areas that contribute rooftop runoff to the storm drainage system are potential retrofit candidates for some form of rooftop disconnection.

Runoff from commercial rooftops can be directed to bioretention planting beds (Source: CWP, 2007).

A variety of alternatives are available for residential and non-residential rooftop disconnections, ranging from simple disconnections to more complex delivery systems. Residential rooftop disconnection options include (*Figure 3-3*):

- Simple disconnection
- Rain barrels and rain gardens
- French drain or dry wells

Non-residential rooftop disconnection options include (*Figure 3-3*):

- Simple disconnection
- Rain gardens
- Stormwater planters and cisterns
- Green rooftops

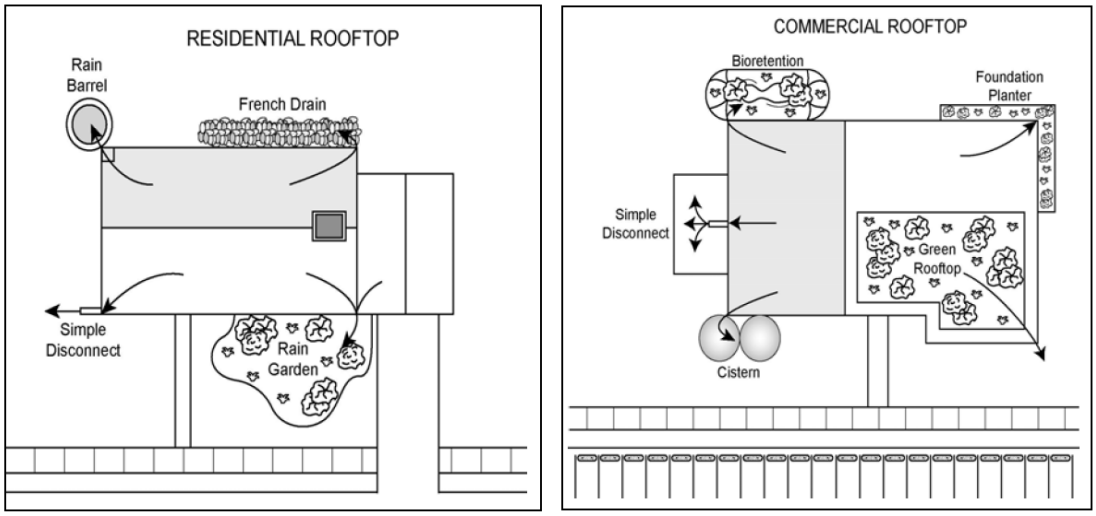


Figure 3-3. Residential and Commercial Rooftop Disconnection Retrofit Strategies (Source: CWP, 2007)

The watershed municipalities should encourage disconnection of rooftop runoff from the storm drainage system by redirecting the runoff to pervious areas or through the use of rain barrels or rain gardens. Municipalities should demonstrate the use of rain barrels and other forms of downspout disconnection at public facilities and parks, as well as offer incentives for downspout disconnection on private property through rain barrel rebates and similar programs. Municipalities should also review their municipal code and regulations for potential regulatory

barriers to implementing downspout disconnection and revise the ordinances/regulations accordingly. Local municipal stormwater standards and design guidance should include specific criteria regarding the suitability and design of various rooftop disconnection practices.

Individual rooftop retrofits target a small area, requiring the participation of many homeowners and businesses to make a measurable difference across a watershed. As a result, a coordinated effort is required for widespread participation in such a program, which typically includes a combination of targeted education, technical assistance, and financial subsidies to homeowners or the business community. Examples of effective local downspout disconnection programs are presented in *Urban Stormwater Retrofit Practices* (CWP, 2007).

3.1.8 Education and Outreach

Often, the public is not aware of the critical role they have in protecting water resources. Public education is critical to the long-term success of watershed management, especially in urban areas, because it raises awareness of both personal responsibilities and the responsibilities of others relative to environmental protection and teaches people what individual actions they can take to protect and improve water resource conditions in their watershed. This increased understanding has the additional benefit of fostering support for watershed management efforts and cultivating a long-term urban-environmental watershed stewardship ethic, particularly with respect to the benefits of green infrastructure.

The public education and stewardship recommendations of this plan are an extension of the education and outreach efforts that were conducted during the plan development process. Four primary target audiences were identified as having the greatest potential to affect long-term change and improve water resource conditions in the North Branch Park River watershed:

- Students (K-12)
- Campus facility managers and large property owners
- Homeowners and residential land use
- Municipalities and businesses

Education and outreach recommendations that are tailored to each of these audiences are described in the following sections. Watershed public outreach and educational programs will coordinate with existing CTDEP, MDC, municipal, and local non-profit educational programming. The watershed management plan website for the North Branch Park River (www.northparkplan.net) will continue to serve as a clearinghouse for watershed information, watershed-based education and outreach materials, past and upcoming events, and opportunities for public involvement.

Students

A key objective of this watershed management plan is the creation of a formal comprehensive K-12/higher education and stewardship network along the North Branch Park River by capitalizing on the numerous educational institutions within the watershed. Specific recommendations include:

- Develop a framework for watershed place-based K-12 education that strengthens comprehensive relationships between local, regional and global natural science as well as guidelines for local environmental stewardship. This Park Watershed Educational Stewardship Network, which could serve as a state-wide model, will develop a sequence of K-12 field research, classroom experiences and regional networking into learning activities that build shared scientific knowledge and stewardship experiences.
- Work with K-12 educators within the Park River watershed as well as with area higher-education teacher training programs to build a place-based educational "toolkit" along with a school stewardship network. The toolkit will include recommendations for field research and documentation (photographs and GIS mapping) that can link into an online network, allowing for both internal and external (public) postings. Guidelines for learning activities will conform to state curriculum standards.
- Encourage watershed colleges and universities to participate in the educational stewardship network and through relevant research.
- Develop career path exerience towards new green jobs.

Campus Facility Managers and Large Property Owners

The institutional facilities within the North Branch Park River watershed (University of Hartford, UConn Law School, other schools, corporate campus facilities, hospitals, golf courses, etc.) are major land owners that can have a significant impact on the water quality of the North Branch Park River through land development and grounds management activities. The large institutional land owners, like residential and municipal land owners in the watershed, will therefore play an important collective role in the success of the watershed management plan.

An objective of this watershed management plan is to conduct outreach to campus facility managers and large property owners about the water quality and nonpoint impacts of campus management practices. Education and outreach programs should emphasize the importance of LID and green infrastructure approaches such as the use of pervious pavement, rain gardens, and green roofs. Grounds management issues include operation and maintenance activities with potential for water quality impacts, which are common to these large, institutional land owners. Specific recommendations include:

- Host a series of hands-on workshops to demonstrate best practices and local resources regarding LID and green infrastructure approaches, as well as operation and maintenance activities with potential for water quality impacts:
    - Integrated pest management
    - Turf management and low fertilizer usage
    - Grass clippings management
    - Leaf/brush waste management
    - Parking lot and road maintenance (deicing, snow management)
    - Drainage system maintenance (catch basins, storm drains, LID and traditional structural stormwater BMPs,)
    - Water quantity and flooding issues

  Provide funding and/or project assistance incentives for facility managers who complete the program.

- Encourage awareness and involvement of students and faculty in campus (and golf course) management decisions, including annual or bi-annual volunteer service events.
- Conduct a comprehensive, integrated evaluation of the institutional properties along the North Branch Park River north of Albany Avenue (University of Hartford, University High School, Weaver High School, Annie Fisher Magnet School, and Watkinson School) relative to riparian corridor restoration and maintenance, including definition of the stream corridor edges and landscape features, and invasive species removal.

Homeowners and Residential Land Use

Another objective of the watershed management plan is to build awareness of land stewardship and management practices and reduce nonpoint source impacts in residential areas, which comprise approximately one-third of the watershed land area. Specific recommendations include:

- Foster a "block-by-block" approach for the restoration and conservation of stream reaches and ponds. This urban stewardship approach encourages neighbors to "self-organize" around shared interests. Neighbors living along the North Branch Park River have expressed an interest in professional support in removing invasive species so as to restore native vegetation that serves as habitat for migratory birds. Homeowners are often willing to undertake environmental improvement projects – and assist with the labor – yet recognize the need for technical guidance.

- Increase watershed stewardship signage (watershed, stream, stormwater pollution prevention, and storm drain markings). Stewardship signage can be an effective way of educating the public on the importance of preserving natural resources and common ways in which they may be impacting these resources. The general public is often unaware of the cumulative effects of their every-day activities. Signage can play an important role in making the connection between every-day activities and their sometimes harmful results. Educational signage can take the form of kiosks in public areas, storm drain markers or stencils, anti-dumping signs, proper pet waste management signs, and roadside/stream side signage (examples include "adopt a stream/roadway" programs).

  The watershed field inventories identified very little evidence of storm drain stenciling or watershed stewardship signage. Stormwater and pollution prevention signage is generally lacking in most residential areas of the watershed. The watershed municipalities, together with other local stakeholders and volunteers, should consider additional storm drain marking in residential neighborhoods, heavy pedestrian areas served by storm sewers, and municipal facilities (schools, town offices, parks, libraries, etc.).

- Tailor education efforts to the types of pollution producing behaviors observed in residential neighborhoods throughout the watershed (buffer encroachments, yard waste, piped discharges, septic system maintenance for unsewered areas, etc.).

- Encourage the creation of backyard habitat in residential areas that abut the North Branch Park River and its tributaries and recognize efforts of the public.

- Encourage disconnection of rooftop runoff from the storm drainage system to reduce the quantity of runoff by redirecting the runoff to pervious areas or through the use of rain barrels or rain gardens (see *Section 6.1.7*).

Municipalities and Businesses

Municipal and businesses in the watershed can also impact water quality. An objective of this watershed management plan is to advance local government and community business awareness of the North Branch Park River through pollution prevention education and watershed restoration outreach activities

- The municipal facilities and businesses that were observed during the field inventories exhibited examples of both good pollution prevention practices and opportunities for improvement. The watershed municipalities should review the current compliance of their respective facilities (public works/maintenance facilities, parks, schools, public safety facilities, etc.) in the watershed with pollution prevention best management practices and applicable regulatory requirements. "Good housekeeping" at municipal facilities should serve as demonstration sites for comparable private operations, many of which are also subject to stormwater pollution prevention and other similar state and federal regulatory programs (oil pollution prevention, hazardous waste, air emissions). Examples of good practices should be recognized and modeled. The proposed watershed organization should provide guidance (e.g., visits, group training, and/or printed materials) and develop incentives to encourage local businesses to adopt these model practices.

- Watershed municipalities should create incentives (such as fast-track permits/approvals) for projects that utilize Low Impact Development or green infrastructure, incorporating state-wide guidance currently being developed by the CTDEP.

- With the pending re-issuance of the CTDEP MS4 General Permit, the watershed municipalities have an opportunity to re-evaluate and improve upon the effectiveness of their municipal stormwater management programs. This includes the municipal good housekeeping minimum measure contained in the General Permit. The towns should review and modify as necessary their stormwater management plans to include audits of pollution prevention and good housekeeping practices at their respective municipal facilities, as well as re-evaluate their municipal street sweeping, catch basin cleaning, and drainage system maintenance efforts. At a minimum, all streets in the watershed should be swept at least twice per year, with more frequent sweeping of targeted areas, as necessary and as equipment and funding allow. Vacuum-assisted sweeping has been shown to be more effective than conventional mechanical broom sweeping for removing finer particulates.

- Conduct compliance assistance outreach (e.g., visits, group training, and/or printed materials) for specific types of businesses in the watershed (e.g., light industry, offices, commercial retail centers, golf courses, restaurants).

- Promote private investment and participation in green infrastructure improvements through "Institutional Stewardship" workshops for large private property owners (see

recommendations for Campus Facility Managers and Large Property Owners), networking with area business research divisions to explore green technologies, and arranging training workshops for small landscape business owners

- Increase watershed stewardship signage (watershed, stream, stormwater pollution prevention, and storm drain markings) and create educational displays in highly visible, strategic locations throughout the watershed to highlight water quality and habitat amenities, and to reinforce the watershed protection efforts in the watershed. Increased educational signage explaining the linkage between recreational centers in the watershed and the North Branch Park River is also recommended within parks, greenways, and other recreational areas throughout the watershed.

- Improve maps, online resources, and signage to educate citizens about the environment of the Metacomet Ridge within the MDC Reservoir area.

3.1.9 Water Quality Monitoring Program

Long-Term Monitoring Program

A long-term water quality (chemical and biological) monitoring program should be established for the Park River, including both the North and South Branches, to refine the understanding of water quality impacts from potential point and non-point pollution sources in the watershed, to continue developing a water quality database for the watershed to guide environmental decision-making, and to measure the progress toward meeting watershed management goals. The monitoring program could build upon the ongoing water quality monitoring program led by Dr. Jonathan Gourley of the Trinity College Environmental Science Program, as well as the state-wide RBV citizen volunteer monitoring. Additional funding sources should be sought to finance future monitoring efforts.

Recommended enhancements to the previous and ongoing water quality monitoring efforts include:

- Monitoring should be coordinated with wet and dry weather conditions to assist in assessing potential causes and sources of water quality impacts.
- Continue RBV bioassessment and CTDEP ambient water quality monitoring programs in the North Branch Park River watershed. Bioassessments should be performed at common chemical monitoring locations, where feasible. Biological monitoring should be expanded to the major North Branch tributaries, including Wash Brook, Tumbledown Brook, and Beamans Brook.
- *Escherichia coli* is the preferred indicator bacteria for chemical monitoring for consistency with the Connecticut Water Quality Standards.

Stormwater Retrofit Demonstration Monitoring

Water quality monitoring (runoff volumes and pollutant concentrations) is recommended in conjunction with the potential LID and green infrastructure retrofit demonstration projects that are described in the Targeted and Site-Specific Recommendations sections of this plan. Monitoring of the retrofit site(s) is recommended before and after the installation of the retrofit. Such a monitoring program could help quantify the benefits of innovative LID and green

infrastructure techniques within the North Branch Park River watershed, but would require a significant funding source for a comprehensive and statistically-valid "before and after" study design.

3.2 Targeted Recommendations

Targeted recommendations are tailored to address issues within specific subwatersheds or areas, rather than watershed-wide. Targeted recommendations also include actions to address common types of problems that were identified at representative locations throughout the watershed, but where additional studies or evaluations are required to develop site-specific recommendations. Targeted recommendations can have both short and long-term benefits.

3.2.1 Stormwater Retrofits

Stormwater retrofits are structural practices installed in upland areas to capture, treat, and store or infiltrate stormwater runoff before it is discharged to a water body or wetlands. Stormwater retrofits include end-of-pipe treatment measures installed in the downgradient portion of a storm drainage system to treat flows prior to discharge, as well as structural practices that can be added to existing, developed sites including LID and green infrastructure approaches.

End-of-pipe stormwater retrofits tend to be larger and more expensive, but they generally provide treatment for a larger area and can be more cost-effective when installed as a retrofit (although recent research, including the Jordan Cove Urban Watershed Project in Waterford, Connecticut, has shown them to be less cost-effective than LID measures when installed as part of new construction). In contrast, LID and green infrastructure retrofits are distributed practices that can often be integrated into the existing landscape with minor infrastructure modifications. LID practices typically place maintenance responsibilities on individual property owners.

Opportunities for stormwater retrofits at municipal, state, and private outfalls and/or sites in the North Branch Park River watershed include:

- Parking lot upgrades (bioretention, pervious pavement, vegetated buffers, water quality swales)
- Athletic fields at parks and educational institutions (water quality swales, vegetated buffers, infiltration, bioretention, stormwater reuse for irrigation)
- Road repair/upgrades (green streets – bioretention, water quality swales, tree planters, below-ground infiltration chambers)
- Roadway stormwater outfalls, particularly at or near roadway stream crossings
- New stormwater outfalls resulting from separation of combined sewers (distributed LID practices, end-of-pipe stormwater wetlands)

Table 3-4 lists priority outfall retrofit sites that were identified during the watershed field inventories. This list is not intended to be all-inclusive, as only several representative subwatersheds and target areas were included in the field inventories. Rather, the identified outfall retrofit sites are representative of the types of retrofit opportunities that exist throughout the watershed. The outfall retrofit locations are also shown on the watershed mapping in

Appendix D. The feasibility of retrofits at these locations should be further evaluated based on consideration of site-specific factors including hydraulic head, available space, soil conditions, and easements. Several example stormwater retrofit concepts for specific sites are presented in the Site-Specific Recommendations section of this plan.

Table 3-4. Priority Outfall Retrofit Sites

Watershed	Stream Reach	ID	Description
Blue Hills Reservoir	BHR-01	OT-A	Open channel outfall with observed trickle flow and oily deposits; bank erosion at this location.
Blue Hills Reservoir	BHR-02	OT-A	12" concrete pipe; bank erosion.
Filley Brook	FYB-01	OT-C	Several (approx 7) outfalls along grass swales with unknown source; discharge investigation and possible retrofit candidate.
Filley Brook	FYB-02	OT-A	Open earthen channel drainage from parking lot; poor design, good retrofit candidate.
Filley Brook	FYB-02	OT-B	Various outfalls behind apartment and senior center buildings with evidence of scour and erosion; retrofit candidate and discharge investigation recommended.
Filley Brook	FYB-03	OT-A	There are a few open channel outfalls and approx 21 closed pipe outfalls along this reach. No unusual observations, although restoration to divert some stormwater inputs may be possible.
North Branch Park River	NBP-04	OT-B	16" concrete closed pipe; Discharge investigation recommended.
North Branch Park River	NBP-04	OT-C	16" concrete closed pipe; Discharge investigation recommended due to scum on and near pipe.
North Branch Park River	NBP-13	OT-A	Local stream repair/stabilization recommended.
North Branch Park River	NBP-14	OT-A	18" concrete closed pipe behind 10-story building with orange, cloudy discharge; Local stream repair/stabilization recommended.
North Branch Park River	NBP-14	OT-B	24" concrete closed pipe; no dry-weather discharge; concrete pieces around outfall require restoration.
North Branch Park River	NBP-14	OT-D	Approx 10 ft downstream of sewer manholes along bank; smelled like sewage; no discharge from outfalls. Discharge investigation recommended.
North Branch Park River	NBP-15	OT-F	Open channel on left bank with steep grade and evidence of scour; stormwater retrofit candidate.
North Branch Park River	NBP-16	OT-E	36" metal pipe; investigate source, possible combined sewer overflow location.
Tumbledown Brook	TDB-14	OT-A	Discharge investigation for open earthen channel; potential nutrient loading source.
Wash Brook South	WBS-11	OT-A	Open channel outfall with clear dry weather flow, smell of sewage.
Wintonbury Reservoir	WTR-01	OT-A	Earthen channel impacted by erosion from impervious surfaces and steep slope. Major erosion in stream channel; Discharge investigation and retrofit candidate.

3.2.2 Illicit Discharge Investigations

Outfalls were observed from virtually all of the land uses encountered during the stream assessments. Some appear to be associated with sources having low potential for water quality impacts (i.e., residential foundation drains), while others were of unknown origin and should be the focus of future investigation. Priority outfalls that were identified for follow-up illicit discharge investigations are depicted on the watershed mapping in *Appendix D* and summarized in *Table 3-4*. The watershed municipalities should continue to implement illicit discharge detection and elimination (IDDE) programs as required by the CTDEP MS4 General Permit.

Methods for identifying illicit discharges can vary widely in the level of effort and cost required for implementation. The following field-based methods are typically used to identify illicit discharges:

- *Testing of Dry Weather Discharges* – Flows from stormwater outfalls during dry weather may indicate an illicit discharge. A combination of visual inspection and chemical analysis of dry weather discharges can aid in identifying potential discharge sources.
- *Visual Inspection* – Examination of piping connections by either physical examination or closed-circuit camera can be used to identify possible illicit connections.
- *Review of Piping Schematics* – Examination of architectural plans and plumbing details can reveal potential sites of improper connections.
- *Smoke Testing* – Injection of a non-toxic vapor (smoke) into the facility plumbing system and following its path of travel can be used to locate connections.
- *Dye Testing* – In this method, appropriate colored dyes are added into the drain water of suspect piping. Appearance of the dyed water in the storm drainage system indicates an illicit discharge. As mentioned in the discussion of septic system discharges, testing for optical brighteners can provide an indication of the presence of domestic wastewater flows.
- *Infrared, Aerial, and Thermal Photography* – Use of aerial, infrared, and thermal photography to locate patterns of stream temperature, land surface moisture, and vegetative growth are emerging techniques to identify potential illicit discharges to stormwater systems.

Other sources of information on performing illicit discharge investigations include:

- *Illicit Discharge Detection and Elimination Manual - A Handbook for Municipalities,* New England Interstate Water Pollution Control Commission (2003) http://www.neiwpcc.org/neiwpcc_docs/iddmanual.pdf
- *Illicit Discharge Detection and Elimination - A Guidance Manual for Program Development and Technical Assessments*, Center for Watershed Protection (2004)

3.2.3 Riparian Buffer Restoration

A healthy riparian buffer along Wash Brook.

Riparian buffers are naturally vegetated areas adjacent to streams, ponds, and wetlands. Vegetative buffers help encourage infiltration of rainfall and runoff, and provide absorption for high stream flows, which helps reduce flooding and drought. The vegetative community of riparian buffers provides habitat for plants and animals, many of which are dependent on riparian habitat features for survival. Since, in many areas, riparian buffers are becoming reduced in size and impacted by roadways and development, many species of plants and animals that are dependent on the unique blend of characteristics that buffers provide are threatened or endangered species. The buffer area provides a living cushion

between upland land use and water, protecting water quality, the hydrologic regime of the waterway and stream structure. The naturally vegetated buffer filters out pollutants, captures sediment, regulates stream water temperature and processes many contaminants through vegetative uptake. Riparian buffers should be kept intact or restored wherever possible (Delaware Riverkeeper Network, undated).

Stream buffer encroachments are present throughout the North Branch Park River watershed along stream corridors in or near areas of residential and commercial development. In many areas, residential lawns and institutional grounds extend down to the banks of the stream. Yard and grounds keeping waste such as grass clippings, leaves, and brush, as well as trash, are common in and near areas where easy access exists to streams. Parking lots and buildings are also common along the banks of the North Branch Park River within the City of Hartford. There are also many instances where riparian buffers are impacted as streams, especially Tumbledown Brook, flow through or adjacent to golf courses in the western portion of the watershed.

Table 3-5 lists potential buffer restoration candidates that were identified during the watershed field inventories. These locations are also shown on the watershed mapping in *Appendix D*. In general, riparian buffers are most effective along smaller, headwater streams, although larger streams including the main stem of the North Branch Park River could also benefit significantly from riparian corridor enhancements. Potential riparian buffer restoration approaches for the watershed include:

- Installation of new riparian buffers
- Widening existing riparian buffers
- Invasive species removal/management
- Tree planting/reforestation

The feasibility of riparian buffer restoration at these sites should be further evaluated based on consideration of site-specific factors including site access, available land area, land ownership, soil conditions, appropriate buffer width, and native plant species.

Table 3-5. Priority Riparian Buffer Restoration Sites

Watershed	Stream Reach	ID	Description
Beamans Brook West	BBW-02	IB-A	Impacted buffer from park; good restoration candidate since plenty of staging area and good access.
Beamans Brook West	BBW-02	IB-B	Yard waste piled on right bank, homeowner draining pool to stream.
Filley Brook	FYB-01	IB-A	Railroad tracks and rip-rap along both banks.
Filley Brook	FYB-01	IB-B	Stormwater outfalls without canopy cover; vegetation and topsoil cleared from left bank and replaced with straw; mowed lawns to bank without vegetation in riparian zone; approx. 30% canopy cover.
Filley Brook	FYB-03	IB-A	Rip-rap on banks to stabilize along many sections of the reach. Not likely restoration candidate unless bioengineered alternative to rip-rap.
North Branch Park River	NBP-04	IB-A	Yard to top of bank, short grass, yard waste dumping.
North Branch Park River	NBP-04	IB-B	Outflow pipe approx. 5 feet upstream from erosion.
North Branch Park River	NBP-09	IB-A	Thin forested, open lawn on other side of Univ. Hartford campus. Impacted buffer from 8-bay culvert to student overpass bridge.

Table 3-5. Priority Riparian Buffer Restoration Sites

Watershed	Stream Reach	ID	Description
North Branch Park River	NBP-09	IB-B	Maintained lawn, yard waste at edge of river, bedrock cliff river bank.
North Branch Park River	NBP-10	IB-A	Rip-rap, chunks of concrete, exposed concrete, parking lot and lawn.
North Branch Park River	NBP-14	IB-A	Minor bank erosion.
North Branch Park River	NBP-15	IB-A	Maintained lawns, parking lots, invasive plants, concrete retaining wall and trash.
North Branch Park River	NBP-16	IB-A	Good restoration candidate; bank failure on right bank, residential lawn and parking lots on left bank side with leaf and waste dumping.
North Branch Park River	NBP-16	IB-B	Rip-rap with wire mesh and minor bank erosion.
North Branch Park River	NBP-16	IB-C	Rip-rap along left bank; leaf dumping and possible winter snow piling from parking lot.
North Branch Park River	NBP-16	IB-D	Rip-rap on both banks and minor bank erosion.
North Branch Park River	NBP-16	IB-E	Rip-rap on banks, parking lot and lawn encroachment, and minor erosion on both banks.
Tumbledown Brook	TDB-06	IB-A	Approx. 600 feet impacted buffer with turf up to stream bank.
Tumbledown Brook	TDB-08	IB-A	Rip-rap on both banks and lawn encroachment on right bank.
Tumbledown Brook	TDB-12	IB-A	Rip-rap on left bank.
Tumbledown Brook	TDB-14	IB-A	Rip-rap on bank; near golf course turf.
Wash Brook North	WBN-06	IB-A1	Train track encroachment, not a restoration candidate.
Wash Brook North	WBN-06	IB-A2	Erosion due to yard encroachment and yard waste dumping within channel.
Wash Brook South	WBS-01	IB-A	Lawn encroachment on both banks.
Wash Brook South	WBS-03	IB-A	Concrete patio to bank of stream.
Wash Brook South	WBS-04	IB-B	Stream encroachment from farmland.
Wash Brook South	WBS-06	IB-A	Lawn encroachment on both banks.
Wash Brook South	WBS-06	IB-B	Residential lawn impacting buffer; invasive species covering much of the banks.
Wash Brook South	WBS-11	IB-A	Impacted buffer along entire reach, including rip-rap, gabion walls, sever erosion due to lawn encroachment from residences and golf course.

The following sections describe additional riparian corridor recommendations for targeted institutional and other large property owners in the watershed.

Institutional and Large Property Owners

- Golf courses in the watershed should work to increase riparian buffers by establishing buffers of native trees and shrubs in out-of-play areas and working to establish low-growing native plants along stream reaches along in-play areas.

- A comprehensive, integrated evaluation of the institutional properties along the North Branch Park River north of Albany Avenue (University of Hartford, University High School, Weaver High School, Annie Fisher Magnet School, and Watkinson School) is recommended relative to riparian corridor restoration and maintenance, including definition of the stream corridor edges and landscape features and invasive species removal. The University of Hartford is encouraged to take a leadership role in this effort, including an evaluation of potential corridor enhancement opportunities associated with 1) several campus parking lots that abut the North Branch Park River, 2) future repair, replacement, or removal of the University of Hartford dam, and 3) a proposed on-campus greenway trail along the North Branch Park River.

3.2.4 Fish Passage Assessment

The North Branch Park River and its tributaries support a variety of resident fish and migratory eel. A dam on the University of Hartford campus serves as the first significant obstruction to fish passage upstream of the North Branch Park River conduit entrance. According to the CTDEP Fisheries Division, the dam prevents passage of resident (non-migratory) fish, including trout that are present, as well as migratory eel that can pass through the flood control conduit from the Connecticut River.

A number of existing or potential barriers to fish passage were identified during the stream inventories. A more comprehensive fish passage assessment is recommended to refine the understanding of fish passage barriers throughout the watershed and opportunities for restoring fish passage and aquatic habitat for various parts of the river system. The assessment should investigate the feasibility of removal or modification of the dam at the University of Hartford campus (see Site-Specific Recommendations) to provide passage of resident fish and migratory eel. The need for a fish/eel ladder at the North Branch Park River conduit entrance north of Farmington Avenue should also be evaluated because of a reported 8 to 12 foot drop/water fall into the conduit.

Local storm drainage design standards and regulations should also be revised to require that new or modified stream crossings be designed consistent with the CTDEP Stream Crossing Guidelines to promote improved stream continuity.

3.2.5 Stream Restoration

Areas of moderate to severe stream bank erosion were observed in many areas of the assessed portions of the watershed. *Table 3-6* lists stream reaches with moderate to severe bank erosion that were identified during the watershed field inventories. These reaches are potential stream restoration candidates, and their locations are shown on the watershed mapping in *Appendix D*. Typical stream restoration techniques that could be implemented in the watershed include:

- Slope Stabilization Techniques
- Redirective or Flow Changing Techniques
- Toe Protection Techniques
- Bioengineering Techniques
- Grade Control Techniques

- Riparian Buffer Improvement

Several proposed stream restoration concepts are also presented in the Site-Specific Recommendations section of this plan.

Access to many of the potential stream restoration sites is limited; therefore, potential candidate sites should be evaluated further for overall feasibility including land ownership, erosion severity, upstream and downstream conditions, infrastructure constraints, and construction access to the stream.

Table 3-6. Priority Stream Restoration Sites

Watershed	Stream Reach	Description
Filley Brook	FYB-02	Minor slope failure at confluence with Wash Brook South. Adjacent to senior living facility, good access.
Filley Brook	FYB-03	Minor bank erosion and slope failure throughout the reach, area behind Wesleyan Terrace neighborhood.
North Branch Park River Tributary	NBP-06 and NBP-07	Severe bank erosion and sediment deposition in several areas within Hartford Golf Club due to on-site impacts and impacts from the upstream drainage area. Good access; proposed restoration has the support of the Town of West Hartford.
North Branch Park River	NBP-10	Bank erosion at bend in stream south of Univ. of Hartford campus.
Wash Brook South	WBS-06	Minor bank erosion behind residences; lower priority restoration candidate.

3.2.6 Stream Cleanups

The watershed field inventories identified areas of trash and debris dumping along many of the assessed streams. Stream clean-ups and trash removal are often cosmetic and temporary. However, they are an effective tool for involving and educating the public about stream degradation. In addition, some trash and debris accumulation may present risks to infrastructure and increased flooding, such as when outfalls and culverts become clogged with trash.

Table 3-7 lists stream reaches where significant trash and debris were observed. These locations, which are shown on the watershed mapping in *Appendix D,* are recommended candidates for targeted stream cleanups.

Table 3-7. Priority Stream Cleanup Sites

Watershed	Stream Reach	ID	Description
Beamans Brook East	BBE-02	TR-A	Old abandoned car on right bank, may require heavy equipment.
Blue Hills Reservoir	BHR-01	TR-A	Plastic, tires, appliances (washing machine & A/C units), automotive, construction (concrete debris, metal piping, telephone poles) and yard waste. Good restoration candidate.
Blue Hills Reservoir	BHR-01	TR-B	Car dumped in stream.
Blue Hills Reservoir	BHR-01	TR-C	Sediment washout and trash, tires, and concrete from construction activities; wetland restoration.
Blue Hills Reservoir	BHR-01	TR-D	Yard waste and metal scraps.

Table 3-7. Priority Stream Cleanup Sites

Watershed	Stream Reach	ID	Description
Blue Hills Reservoir	BHR-02	TR-A	Automotive parts, possible oil drums, and garbage cans; access may be difficult.
Filley Brook	FYB-01	TR-A	Dumping throughout reach, including oil bottles, plastic bottles, shopping carts, and tires. Various car parts near Park Avenue.
Filley Brook	FYB-02	TR-A	Plastic and paper debris dumping near senior living center and apartment building.
North Branch Park River	NBP-11	TR-A	Dumping of shopping cart, crates, tires, railroad ties, plastic bottles, broken glass, etc.
North Branch Park River	NBP-11	TR-B	Notable litter problem at this site. Dumping of plastic bottles and crates washed up against fallen trees.
Tumbledown Brook	TDB-05	TR-A	Heating oil tank on left bank, automobile oil drums, tires, stove, sink, toilet, etc. on right bank. Note invasive species growing along bank.
Wash Brook North	WBN-04	TR-A	Dump on banks and in channel includes old car, stove, foundation, piping, possible oil tank, and garbage.
Wash Brook South	WBS-04	IB-A	Dumping of AC unit, pots, bricks, bottles, insulation, parts of above-ground swimming pool.
Wash Brook South	WBS-04	TR-A	Stone slabs, old tractor tires, landscaping stones placed in stream.
Wash Brook South	WBS-11	TR-A	Behind medical center, dumping including wheelchair, AC unit, plastic bottles, yard waste. Many golf balls in stream adjacent to golf course.
Wintonbury Reservoir	WTR-01	TR-A	Trash & dumping problem along entire reach; auto parts, plastic buckets, cups, etc.)
Wintonbury Reservoir	WTR-02	TR-A	Broken glass, tires, toilet, & miscellaneous debris.

3.2.7 Invasive Plant Species Management

Invasive plant species (Multiflora Rose, Barberry, Japanese Knotweed, Garlic Mustard, Phragmites, Cattails, Reed Canary Grass, etc.) were observed in stream corridors in many areas of the watershed during the field inventories. Invasive species removal efforts should focus on site-specific and targeted stream corridor improvements. Key recommendations include:

- Implement priority invasive species management projects identified during the watershed field inventories.
- Develop an invasive species management plan for targeted areas of the watershed, including prevention and education efforts to preempt arrivals, early detection and citizen monitoring efforts, rapid response measures for successful eradication, and when a species cannot be eradicated, continued control efforts that are necessary to minimize ecological and economic impacts. The plan could identify prevention and education efforts to preempt arrivals, early detection and citizen monitoring efforts, response measures for successful eradication, and when a species cannot be eradicated, continued control efforts that are necessary to minimize ecological and economic impacts. Information on invasive plant species planning and management can be obtained from:
    - U.S. Fish and Wildlife Service: (http://www.fws.gov/invasives/staffTrainingModule/planning/introduction.html),
    - The Connecticut Department of Environmental Protection,
    - The Nature Conservancy (TNC),

  - Connecticut Invasive Plant Working Group (CIPWG).
- Educate residents, facility maintenance personnel, landscapers, and land use commissions about the negative effects of non-native invasive species.
- Involve individuals and neighborhood block associations in invasive species removal and stream corridor improvements.

3.2.8 Open Space Protection

Conservation of open space is critical in protecting and preserving the health of a watershed by limiting development and impervious cover, preserving natural pollutant attenuation characteristics, and supporting other planning objectives such as farmland preservation, community preservation, and passive recreation.

There are several common ways that undeveloped land can be preserved and protected as open space. These include outright purchase (fee simple), conservation easements, purchase of development rights, and land donations. Regardless of the mechanism, critical to the success of protecting open space land is having a source of funding that can be readily accessed when windows of opportunity to acquire significant parcels arise.

The watershed communities have identified open space protection goals and priorities within the watershed primarily through their Plans of Conservation and Development. Private groups, such as the Wintonbury Land Trust in Bloomfield, also maintain open space throughout the watershed with plans to preserve additional areas.

The watershed towns, working closely with local land trusts and other stakeholders including local land owners, should:

- Continue efforts to protect and/or acquire unprotected open space as recommended in this watershed management plan and by municipal Plans of Conservation and Development and related planning efforts.
- Implement existing municipal open space plans and update the plans at least once every 5 years. Endorse the remaining priority open space in the watershed as high priority open space conservation areas in the municipal open space plans and Plans of Conservation and Development.
- Continue ongoing efforts by the Bloomfield Conservation, Energy & Environment Committee to identify and protect priority farmland.
- Seek alternative funding sources and approaches for open space acquisition such as state grants, limited market rate development on a parcel to help fund the acquisition of the remainder of the parcel as open space, and transferring development rights from sensitive locations to locations better suited for development.
- Create a watershed-wide "green" map of environmental features and recreational amenities, including existing protected open space (through land ownership or conservation restrictions) in the watershed. Promote awareness and appropriate use of existing open space by publicizing parks, trails, community gardens, and historic landscapes as well as educational events, (such as a bio-blitz) on open space parcels.

Priority for open space protection should be given to properties that meet one or more of the following general criteria:

- *Size*: Larger parcels provide greater opportunity for contiguous undeveloped areas to benefit wildlife, water quality and provide recreation.
- *Water Resources*: Parcels that provide buffers for larger rivers and streams and associated riparian communities, and/or headwater streams.
- *Wetlands and Wildlife Habitat*: Parcels that provide upland buffers around high quality wetlands and habitat areas that supports, enhances or protects biodiversity.
- *Floodplain Protection*: Parcels in floodplain areas to provide habitat, protect or improve water quality, and preserve natural flood storage or function (to the 500-year flood level).
- *Streamflow Protection*: Parcels that provide protection of groundwater recharge areas and headwater streams, protect large areas or parcels of unfragmented forest or parcels whose protection would prevent fragmentation of a large protected forest tract.
- *Recreation*: Parcels that provide water and land-based recreational opportunities including swimming, fishing, boating, hunting, other water-access, or could accommodate multi-use trails as part of an existing or planned greenway, trail or linear park or provide connectivity of existing trail systems.

Undeveloped and underdeveloped parcels in the watershed were assessed based upon the above factors to help identify open space protection priorities. Two types of protection were considered – acquisition or protection through a conservation easement or restriction. Parcels that are currently undeveloped were given higher priority for acquisition, while those parcels that are partially developed but have potential for future development are assigned higher priority for a conservation restriction. *Figure 3-4* summarizes the results of the screening-level assessment, identifying parcels in the watershed that are recommended for acquisition or a conservation restriction and their relative priorities. Details of the assessment method and results are provided in *Appendix E* of this watershed management plan.

Several of these parcels, which are among the highest priorities for open space protection in the watershed, are also described below.

Kelly Farm

Kelly Farm is an approximately 45-acre parcel located between Duncaster Road and Arnold Drive in the western portion of Bloomfield (identified as Parcel 9 in *Figure 3-4*). The Kelly Farm parcel consists of cultivated fields, forest, and wetlands. The parcel is located near the headwaters of Cold Spring Reservoir and Wash Brook, is contiguous with other existing protected open space, and is the site of the proposed LaSalette Trail. Kelly Farm is currently proposed for acquisition by the Wintonbury Land Trust for permanent preservation. The Kelly Farm parcel is also an example of a priority acquisition parcel in a sensitive headwater area of Bloomfield, where a significant portion of the remaining undeveloped land exists within the watershed.

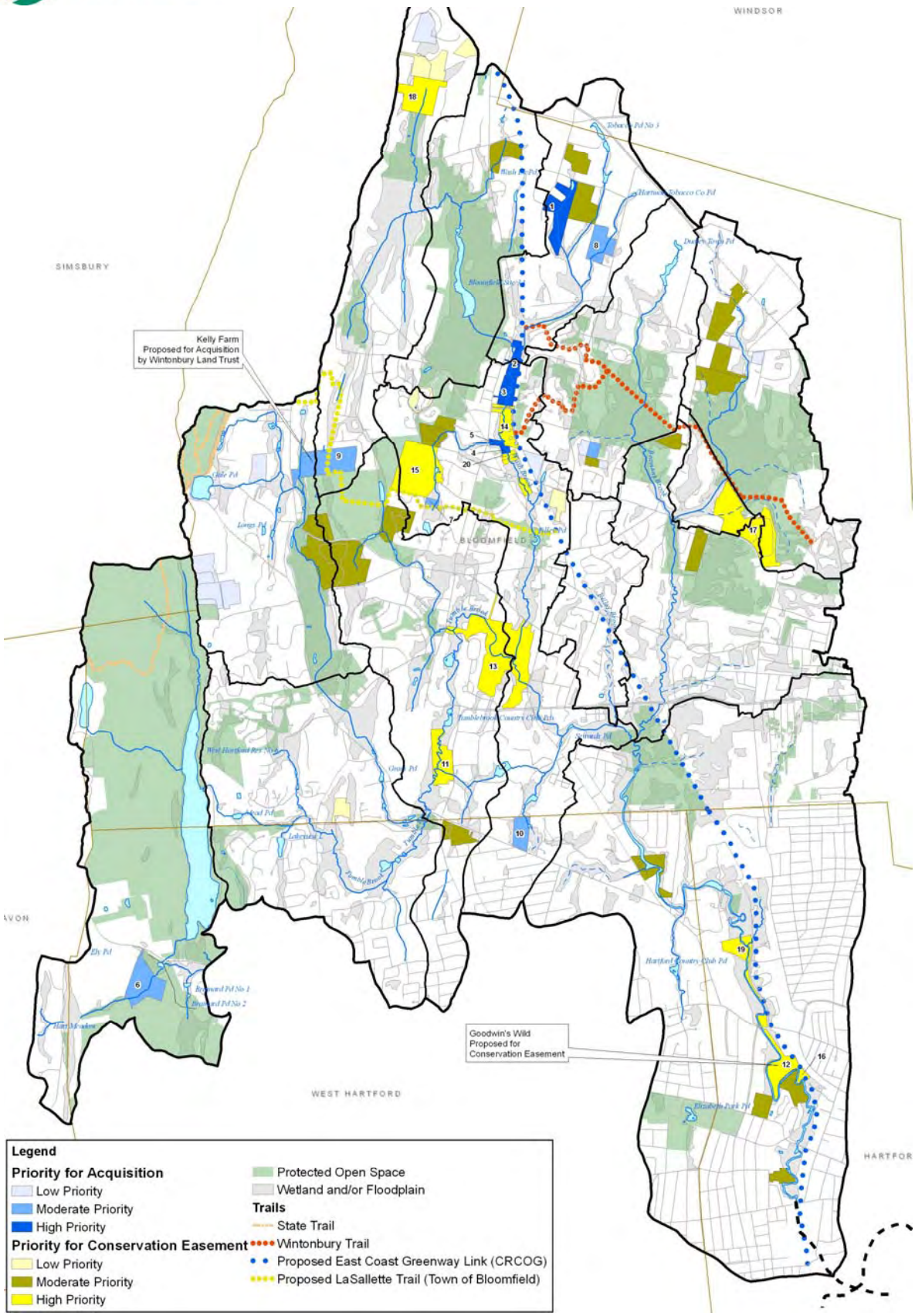


Figure 3-4. Open Space Priority Parcels

Goodwin's Wild

This area of largely forested open space is situated on the east side of the North Branch Park River in the West End and Asylum Hill neighborhoods of Hartford. The area, known as Goodwin's Wild for its "urban wild" forestland and river, includes approximately 30 acres of land and is generally bounded by Asylum and Albany Avenues, the North Branch Park River, and Woodland and Homestead Avenues. This land and section of the river have historically been protected as part of Goodwin's larger estate. Goodwin's Wild currently consists of two adjacent parcels. The larger parcel (identified as Parcel 12 in *Figure 3-4*) is owned by the Greater Hartford Flood Commission and is largely forested riparian area and floodplain. The smaller parcel situated to the south (identified as Parcel 16 in *Figure 3-4*) is owned by the City of Hartford and is associated with the Woodland Drive public housing complex. A portion of this parcel is developed as part of the adjacent housing complex and is in poor condition, with an abandoned building, trash dumping, construction and demolition debris, and landscaping debris.

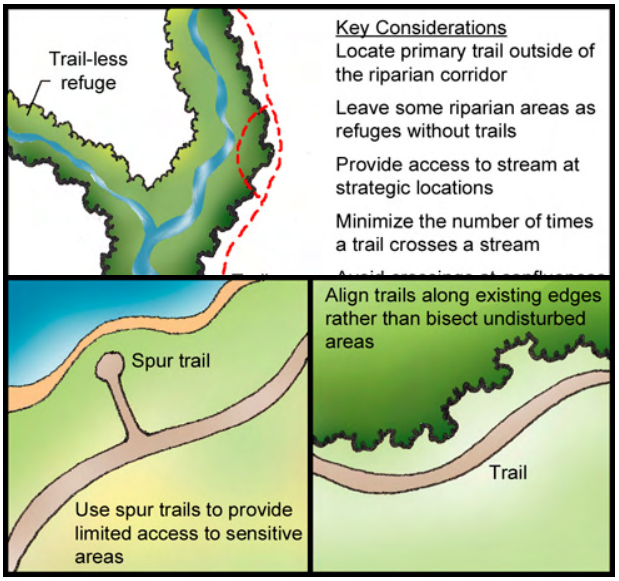
Through the efforts of the neighborhood residents, the Goodwin's Wild area has been recognized in the City of Hartford Plan of Conservation and Development as protected open space. It is recommended that the City of Hartford and the Greater Hartford Flood Commission approve and grant a conservation easement to permanently protect the existing wooded areas of Goodwin's Wild from development, recognizing the land's high ecological value and important role in protecting the water quality of the North Branch Park River. As described in the Site-Specific Recommendations section of this plan, the developed, underutilized portions of the smaller parcel also have the potential for reuse as regional stormwater retrofit site to treat existing and future stormwater discharges associated with the MDC combined sewer separation efforts.

3.2.9 Low-Impact, Context-Sensitive Greenway Development

A number of existing and planned recreational trails are located within the North Branch Park River watershed. The planned recreational trails include completion of key links in the East Coast Greenway Project, including the Park River Greenway along portions of the North and South Branches of the Park River and connections between Bloomfield and the existing trails in Simsbury and Granby (*Figure 3-4*). The Town of Bloomfield is also proposing a trail (LaSalette Trail) that would provide a westerly connection to the greenway system through existing and proposed open space areas.

The proposed Park River Greenway has been identified in state, regional, and municipal planning documents. Construction of the South Branch Trail of the Park River Greenway is underway. One segment of this project along the South Branch is expected to be completed in 2011. The North Branch segment, as depicted schematically in *Figure 3-4*, is identified in the Capitol Region Council of Governments (CRCOG) Regional Pedestrian and Bicycle Plan (April 2008), the City of Hartford Plan of Conservation and Development "One City, One Plan," and the Town of Bloomfield "Proposed Trails" mapping (March 2010). The Park River Greenway is envisioned as a recreational pathway and a commuter route, and has the potential to connect to the regional East Coast Greenway system.

Greenways and recreational trails along river systems can impact riparian vegetation, water quality, wildlife, and other important ecological functions provided by the riparian corridor. Careful design of greenways and recreational trails within the river corridor and wetlands is critical to avoiding or minimizing impacts on these sensitive natural resources. Locating recreational trails in urban settings can also be challenging due to potential conflicts between the needs of local residents and regional recreation interests.



Examples of Low-Impact Trail Design Considerations (Bentrup, 2008).

A goal of this watershed management plan is to promote the development of a greenway network within the watershed and the region without adversely impacting water quality and natural resources and taking into consideration the concerns and needs of local residents along the proposed trail routes. Specific recommendations include:

- Develop a Greenway between Bloomfield and Hartford that protects the stream corridor, and links the East Coast Greenway recreational trail to neighborhood cultural points of interest. Study alignments and feasibility of connecting north Bloomfield with the existing pathway systems in Simsbury and Granby, as well as the feasibility of locating a path in the North Branch corridor in Hartford consistent with regional and City planning initiatives.
- With respect to block-by-block urban contextual differences, improve and protect the stream corridor within the City of Hartford and other highly urban areas of the watershed. Distinguish between the needs of residents, and the interests of regional recreational projects as well as water quality and habitat values. Concerns of local residents and abutters on both sides of the trail should be accommodated in the trail alignment and design.
- The greenway recreational trail should be routed to avoid disturbing ecologically sensitive areas of the river corridor including wetlands, floodplains, sensitive wildlife areas and existing or planned open space.
- Incorporate LID and other sensitive design elements into greenway trail designs including maintaining and/or restoring native riparian vegetation along the stream banks, appropriate setbacks/buffers for wetlands and streams, designated access points to the river to maintain as much natural riparian habitat as possible, use of permeable pavement or other materials to reduce runoff, and use of other LID techniques. Incorporate these recommendations into local and facility master planning documents.

3.2.10 Public Access to the River

An objective of this watershed management plan is to increase public access to the North Branch Park River and its tributaries to enhance public appreciation and stewardship of the river. Recommendations to achieve this objective include:

- Where appropriate, enhance river access at existing public open spaces.
- Develop a public access area inventory (existing and potential) for the North Branch Park River and its tributaries. The inventory should include a list and map of the areas with location, size of area, ownership, and potential active and passive uses.
- Public access areas should not adversely affect sensitive areas.
- Incorporate LID and other sensitive design elements into access area designs. Incorporate these recommendations into local and facility master planning documents.
- Introduce signage, interpretive stations and online resources to tell the story of the North Branch Park River's history and natural environment.
- Provide linkages between the North Branch Park River and the cultural institutions within the lower NBPR watershed building upon planning principles from the "iQuilt" project, which is a vision for the City of Hartford that aims to weave together Hartford's key cultural sites and institutions around the theme of cultural innovation to promote economic growth and the redevelopment of the Capitol district (http://www.hartfordiquilt.org/).

3.2.11 Additional Subwatershed Field Assessments

Due to limited project funding, not all stream segments in the priority subwatersheds were assessed, and other subwatersheds were not assessed as they were determined to be less vulnerable to future development impacts. The remaining subwatersheds and stream reaches (*Table 3-8*) should be assessed over the next two years, pending the availability of funding, to identify additional site-specific issues and potential watershed restoration opportunities.

Table 3-8. Additional Subwatersheds and Stream Reaches to be Assessed

Subwatershed	Stream Reach	Proposed Schedule
Wash Brook North	WBN-01, WBN-02, WBN-03, WBN-05, WBN-07	2011
Wash Brook South	WBS-02, WBS-05, WBS-07 through WBS-10, WBS-12 through WBS-19	2011
Beamans Brook West	BBW-01, BBW-03 through BBW-06	2011
Tumbledown Brook	TDB-01 through TDB-04, TDB-7, TDB-09, TDB-10, TDB-11, TDB- TDB-13, TDB-15, TDB-16, TDB-17	2011
North Branch Park River	NBP-01 through NBP-03, NBP-05, NBP-06, NBP-07, NBP-08, NBP-12, NBP-17, NBP-18	2011
Wintonbury Reservoir	WTR-03, WTR-04, WTR-05	2012
Blue Hills Reservoir	BHR-03 through BHR-09	2012
Beamans Brook East	BBE-03	2012
Wash Brook West	All reaches	2012
Tunxis Reservoir	All reaches	2012
Cold Spring Reservoir	All reaches	2012
Tumbledown Brook South	All reaches	2012
West Hartford Reservoir	All reaches	2012

3.2.12 Estimated Costs

Planning-level costs were estimated for the targeted recommendations in this plan, where sufficiently detailed information was available. The cost estimates assist watershed stakeholders to evaluate the financial resources and funding sources that may be required to implement the plan. Planning-level cost estimates for site-specific project recommendations are presented for each site-specific restoration concept (*Section 3.3*).

Table 3-9 summarizes typical ranges of planning-level unit costs for the targeted recommendations that are identified in this plan. Additional information is required to develop more detailed cost estimates for these recommendations.

Table 3-9. Typical Costs for Targeted Plan Recommendations

Recommendation	Planning-Level Cost (2010 Dollars)	Typical Range	Source
Invasive Species Management Plan	$25,000	$15,000 - $35,000	Professional engineering experience
Targeted Stormwater Retrofits			Center for Watershed Protection Urban Stormwater Retrofit Practices (2007)
Constructed Wetlands (ac. treated)	$3,400	$2,400 - $11,110	
Extended Detention (ac. treated)	$4,400	$2,600 - $8,700	
Wet Ponds (ac. treated)	$9,700	$3,600 - $33,000	
Water Quality Swale (ac. treated)	$20,900	$12,500 - $42,000	
Bioretention/infiltration (ac. treated)	$29,300	$23,000 - $48,000	
Stormwater Curb Extensions - per 1000 sf IC treated	$195,000	$140,000 - $290,000	City of Portland (2005)
Pervious Pavement (square foot)	$10	$5 to $15	R.S. Means - includes limited subgrade modifications
Fish Passage Assessment			
Lower North Branch Park River	$15,000	$10,000 - $20,000	Varies depending on volunteer involvement
Entire Watershed	$20,000	$15,000 - $30,000	
Illicit Discharge Investigation	Varies significantly based on methods used		NEIWPCC IDDE Manual (2003), CWP IDDE Manual (2003)
Additional Subwatershed Field Assessments (per stream mile)	$1,000	$200 - $2,000	Varies depending on volunteer involvement, summary reports prepared, difficulty of terrain
Reforestation and Riparian Buffer Restoration			
Herbaceous buffer in grassed area (ac.)	$2,000	$1,000 - $3,000	R.S. Means, depends on existing condition
Trees and Shrubs (ac.)	$15,000	$5,000 - $20,000	U.S. Forest Service Urban Watershed Forestry Manual (2006), R.S. Means
Reforestation of Paved Areas (ac.)	$75,000	$50,000 - $100,000	R.S. Means
Streambank Restoration			
Bank Stabilization (linear ft of bank)	$40	$10 - $100	Derrick (1997), NOAA (2000)
Redirective Techniques (each)	$4,000	$3,000 - $10,000	Professional engineering experience
Channel Rehab. (linear ft of channel)	$30	$11 - $37	NOAA (2000)
Stream Daylighting (linear ft of channel)	$1,100	$300 - $3000	Small streams at less constrained sites
Priority Stream Cleanups	Varies significantly based on amount of donated supplies and services		
Fish Passage Enhancement	Varies significantly based on methods used		

3.3 Site-Specific Recommendations

Site-specific recommendations are tailored to address issues at selected sites that were identified during the watershed field inventories. The site-specific recommendations presented in this section are intended to serve as concepts for further refinement and to provide examples of the types of projects that could be implemented at similar sites throughout the watershed, including other priority sites identified in the Targeted Recommendations section of this management plan. It is important to note that the concepts presented in this section are examples of relevant opportunities, yet do not reflect site-specific proposals developed in one-on-one meetings with property owners, nor specific suggestions from municipal government staff unless otherwise noted. Property owners and other affected parties are responsible for evaluating the ultimate feasibility of these and similar site-specific concepts.

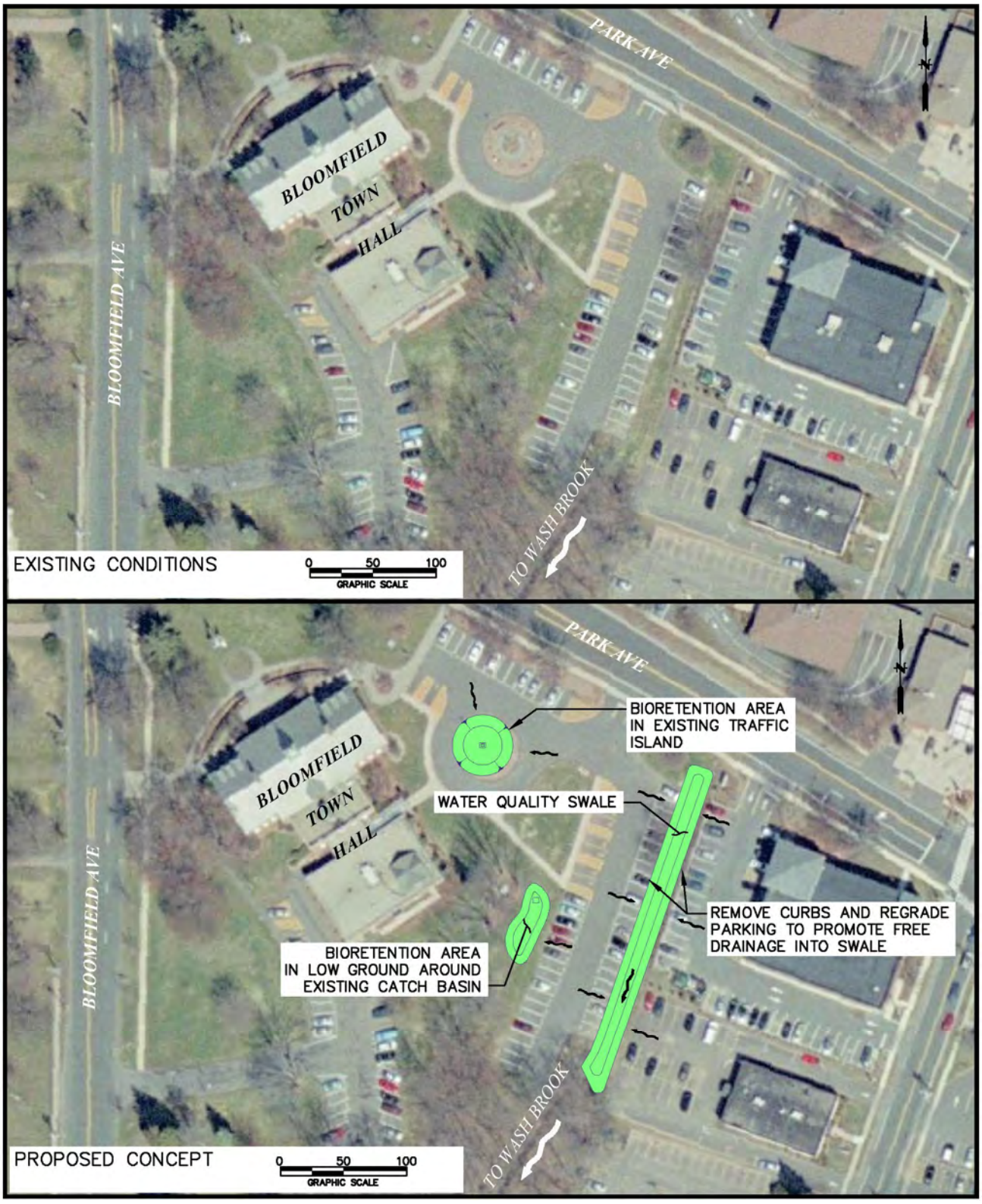
Preliminary, planning-level costs were estimated for the site-specific restoration concepts presented in this section. These estimates are based upon unit costs derived from published sources and the proposed concept designs. Capital (construction, design, permitting, and contingency) and operation and maintenance costs were included in the estimates, and total annualized costs are presented in 2010 dollars based on the anticipated design life of each restoration concept. A range of likely costs is presented for each concept, reflecting the inherent uncertainty in these planning-level cost estimates. A more detailed breakdown of the cost estimates is included in *Appendix F*.

3.3.1 Bloomfield Town Hall LID Retrofits

Bloomfield Town Hall LID Retrofits	
Objectives:	Runoff reduction Pollutant reduction Public outreach
Estimated Cost:	$200,000 - $300,000
Responsible Entity:	Town of Bloomfield
Timeline:	2 to 3 years

The Bloomfield Town Hall on Bloomfield Avenue is surrounded by landscaped grounds, driveways, and parking areas that provide a good opportunity for a high-profile LID retrofit project. Currently, some of the stormwater from parking areas at the site flows overland and discharges directly to a tributary of Wash Brook. Other areas, which consist primarily of grass and a driveway that surrounds a circular traffic island, are served by catch basins and storm drains. Many permeable areas of the grounds lie at a lower elevation than paved areas, but water is directed away from these areas by curbing around the pavement. On the eastern portion of the site, a grass swale is located between an on-site parking lot and an adjacent commercial parking lot.

Existing landscaped areas of the site could be converted to bioretention areas to treat and potentially infiltrate stormwater from the parking lots. Curbing at the parking lot edges could be replaced with a wheel stop at each parking stall, spaced to allow water to flow off the pavement and onto the grass areas. The grass areas could be regraded to retain water and promote infiltration into the underlying soils, or an underdrain could be installed to receive treated stormwater below a filtration layer that would serve as the growing media for landscape plants. Existing stormwater infrastructure could be used to provide overflow drainage for larger storms and receive discharges from underdrains. *Figure 3-5* presents a bioretention retrofit concept for the Bloomfield Town Hall site.



(Photo Source: U.S. Geological Survey, 2008)

Figure 3-5. Bloomfield Town Hall LID Retrofit Concept

3.3.2 Hartford Seminary Bioretention

Hartford Seminary Bioretention	
Objectives:	Runoff reduction Pollutant reduction Public Outreach
Estimated Cost:	$50,000 - $75,000
Responsible Entity:	Hartford Seminary
Timeline:	2 to 3 years

The Hartford Seminary, located between Sherman Street and Girard Avenue in Hartford, has landscaped grounds similar to Bloomfield Town Hall, with a main building surrounded by grass and ornamental landscaping. The on-site storm drainage system is connected to the City's combined sewer system. Portions of the site experience localized flooding that is believed to be associated with blockages in the on-site drainage system and/or capacity issues associated with the combined sewers in the neighborhood.

Areas on the southern portion of the site could be retrofitted to function as bioretention systems, treating and potentially infiltrating stormwater from the parking lot and lawn (*Figure 3-6*). A bioretention retrofit project in this location would also provide educational and outreach benefits for visitors to the site and residents of the surrounding neighborhood.

3.3.3 Connecticut Historical Society Stormwater Retrofit

Connecticut Historical Society Stormwater Retrofit	
Objectives:	Stormwater treatment Flood detention restoration Public outreach
Estimated Cost:	$1,800,000 - $3,800,000
Responsible Entities:	Connecticut Historical Society MDC City of Hartford CTDEP
Timeline:	3 to 6 years

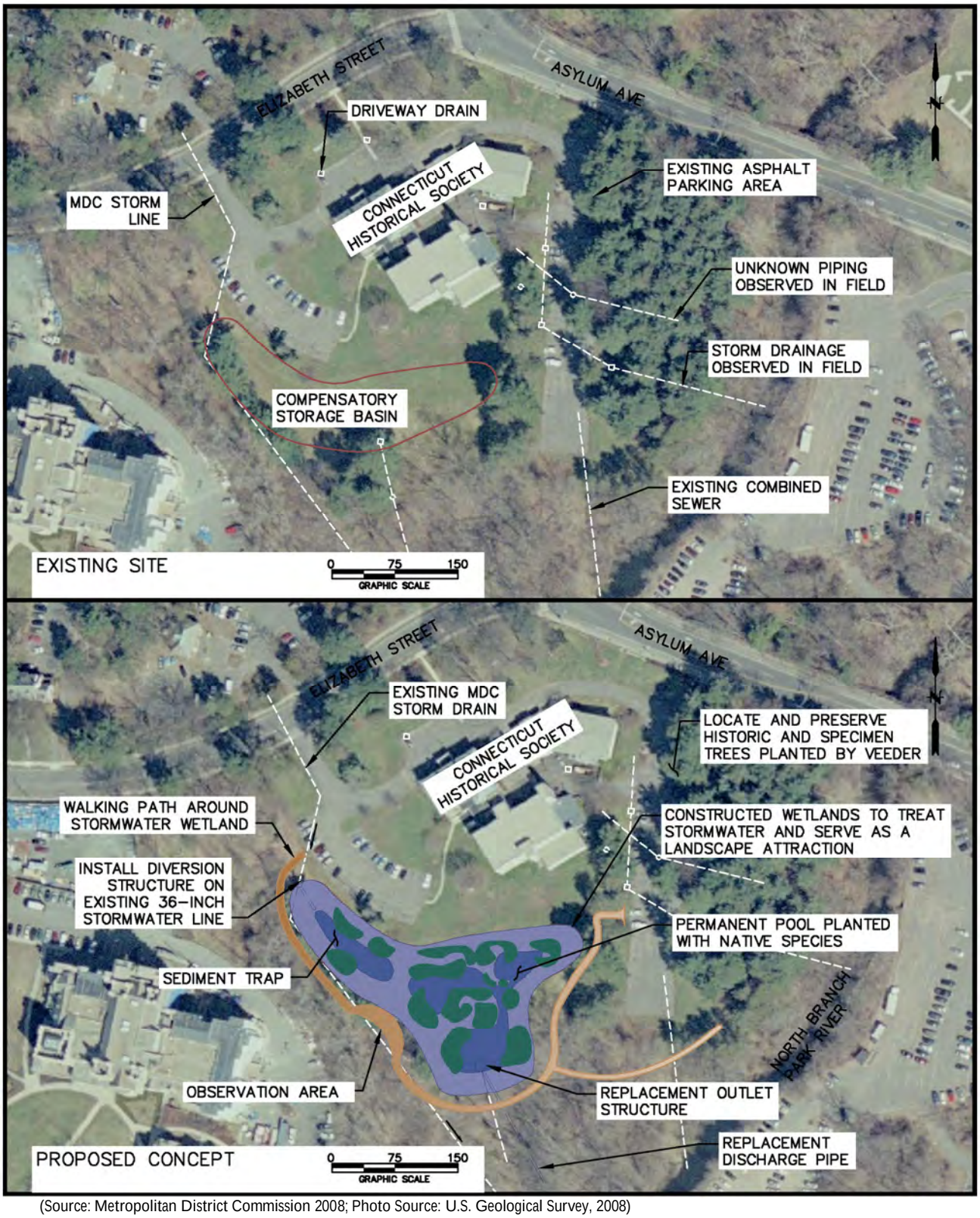
The Connecticut Historical Society (CHS) is located at the Veeder Estate south of the intersection of Elizabeth Street and Asylum Avenue and is situated along the North Branch Park River. Beneath the site is located a combined sewer pipe that crosses under the river as well as a separate stormwater drainage system that receives discharges from residential areas to the north and west. The southern portion of the site contains a large depression that was constructed as compensatory flood storage for building expansion that occurred on the site, although the hydraulic connection between the compensatory storage area and the river is now minimal or non-existent due to a failed outlet structure.

Staff at CHS report that the grounds historically contained a pond and gardens, but these site features were abandoned at some point during the 20th century. A handful of rare specimen trees that were incorporated into the estate gardens may still remain within the wooded fringes of the parcel. The CHS grounds provide opportunity for both LID and end-of-pipe stormwater retrofits.

LID management measures that could be implemented at the site to infiltrate and treat stormwater most cost-effectively may include rooftop leader disconnection from the Historical Society building and bioretention areas to collect and infiltrate stormwater from existing paved parking areas and driveways. If additional funding can be secured, other more significant restoration measures could be incorporated into the project, including retrofitting the parking area from a conventional asphalt lot to permeable pavement and reducing the size of the parking area since a portion of the lot appears to be underutilized. Such measures would need to be implemented in keeping with the historical context of the site.

(Photo Source: U.S. Geological Survey, 2008)

Figure 3-6. Hartford Seminary Bioretention Retrofit Concept



(Source: Metropolitan District Commission 2008; Photo Source: U.S. Geological Survey, 2008)

Figure 3-7. Connecticut Historical Society Stormwater Wetland Concept

An opportunity also exists to convert the compensatory storage area behind the building into a regional stormwater treatment wetland and an educational attraction. A stormwater wetland including shallow emergent wetlands, small pockets of open water, and higher steps could potentially treat on-site stormwater and stormwater from the existing drainage line that passes below the site (*Figure 3-7*). The project could also include restoring the hydraulic connection between the North Branch Park River and the basin, restoring its function as a storage area for flood flows.

Since CHS is a high-traffic location with an educational focus and a popular location for picnicking and dog-walking, a walking trail could be incorporated into the perimeter of the site, following the approximate alignment of a path that existed historically on the estate's grounds. The path could provide both access points to the stormwater wetland as well as remaining historical site features, such as rare and specimen trees.

Incorporating a regional stormwater treatment wetland as well as educational and recreational amenities into the CHS site is a major project that would require a significant financial commitment and cooperation between multiple entities including the City of Hartford, CHS, MDC, CTDEP, and others. A detailed cost-sharing agreement would be required to ensure that long-term maintenance would be performed and would not pose a financial hardship on CHS.

3.3.4 Green Streets Retrofit

Green Streets Retrofit	
Objectives:	Runoff reduction Pollutant reduction
Estimated Cost:	Varies
Responsible Entities:	MDC City of Hartford
Timeline:	2 to 10 years

Residential land use is the single most common land use in the North Branch Park River watershed. Stormwater from most residential neighborhoods discharges to separated storm drainage systems, which in turn discharge directly to the North branch Park River and its tributaries, or discharges to combined sewers. Proposed sewer separation efforts by the MDC will also result in several new separated stormwater outfalls to the North Branch Park River. Opportunities exist to augment proposed sewer separation efforts and ongoing municipal stormwater management in residential areas through distributed stormwater management approaches. A green streets retrofit project is recommended in a residential area of the City of Hartford to demonstrate the potential benefits and feasibility of LID and green infrastructure approaches within the public realm in a residential neighborhood.

Adams Street, located between Albany Avenue and Norfolk Street, is a typical dense residential neighborhood with multi-family residences that appear to date from the early 20th century. Adams Street is currently served by combined sewers with traditional curb and gutter drainage. The roof drains of the majority of residences are piped into the sanitary sewer as well. Adams Street is not proposed for combined sewer separation under the MDC CSO Long Term Control Plan, although surrounding neighborhoods are. The paved width of the street itself is approximately 31 feet, and sidewalks on each side extend the width of the City's Right of Way to approximately 43 feet. The street is designated as one-way, with on-street parking allowed on both sides and more than adequate width for vehicle travel in the center.

Figure 3-8a through Figure 3-8c present several concepts that illustrate alternative green streets and associated lot-level LID approaches to stormwater management. The first concept illustrates a traditional separation approach; a new stormwater collector is installed, roadway catch basins are connected to it, and roof leader downspouts are disconnected from each residence and directed to the adjacent ground surface. The second concept illustrates lot-level bioretention, where a rain garden is incorporated into landscaped areas on individual residential lots. Wide-scale implementation of this approach is likely unrealistic due to issues related to public acceptance, cost, maintenance requirements, and site constraints such as existing utilities, soils, and available space. The third and fourth concepts illustrate green streets approaches, using a portion of the public road right-of-way for the dual purpose of stormwater management and traffic calming. . Stormwater swales and stormwater curb extensions, such as the concepts presented in the Adam Street example, as well as other green streets retrofit options are being implemented in cities across the country.

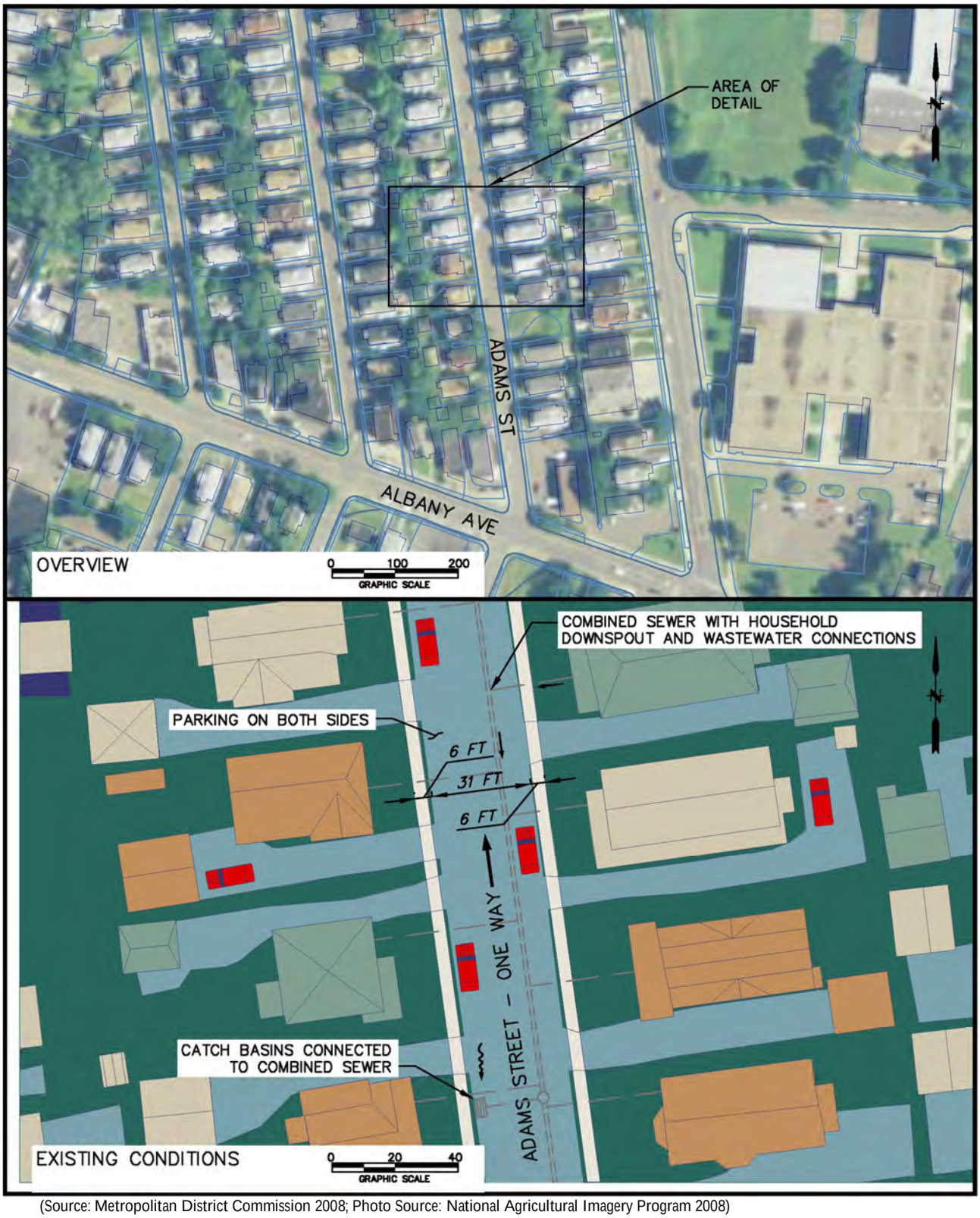
3.3.5 Woodland Drive Stormwater Retrofit

Woodland Drive Stormwater Retrofit	
Objectives:	Stormwater treatment Open space protection
Estimated Cost:	$530,000 - $1,100,000
Responsible Entities:	MDC City of Hartford
Timeline:	2 to 5 years

A large area of combined sewers north of Albany Avenue is proposed for separation, which will result in a new stormwater discharge to the North Branch Park River. The new outfall is proposed for a City of Hartford-owned parcel adjacent to Woodland Drive. This parcel is associated with an adjacent public housing complex and is currently in degraded condition; it contains an abandoned building, a paved area, and several areas of dumping. Three existing stormwater outfalls discharge to the river in this area. This parcel is also along the route of the proposed Park River Greenway and is identified in this watershed management plan (as well as the City of Hartford Plan of Conservation and Development), along with an adjacent parcel to the north, for a conservation restriction as part of "Goodwin's Wild."

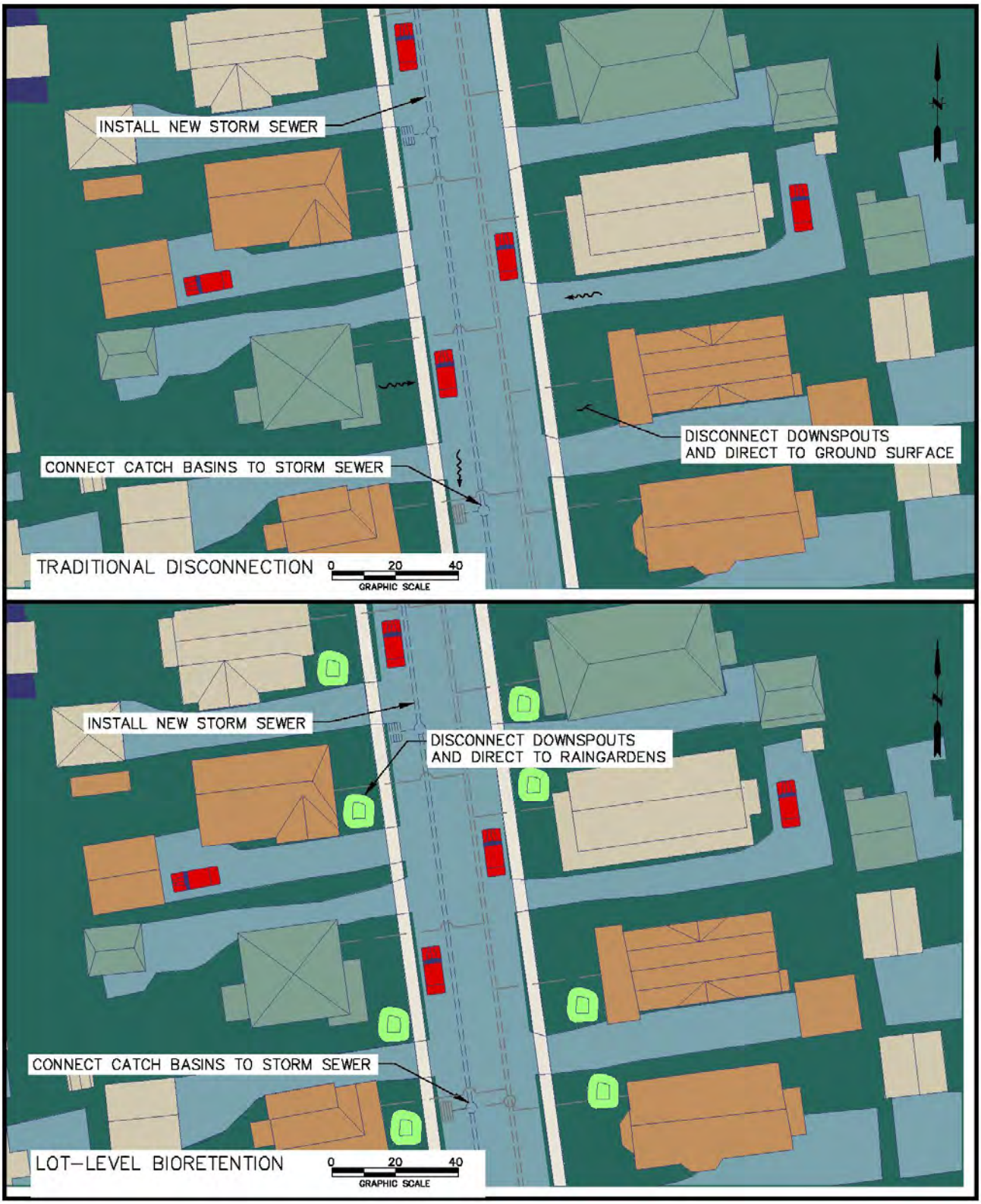
This site provides an opportunity for achieving multiple goals and benefits, including treating new stormwater discharges through a regional stormwater wetland system, conserving a portion of the site as riparian forest area through a conservation restriction, and accommodating the planed Park River Greenway trail system using a low-impact, context sensitive approach. A constructed stormwater wetland on this site could treat existing and proposed stormwater discharges from the adjacent neighborhood. The stormwater wetland could be designed with a high-flow bypass to target the water quality volume and serve a larger drainage area.

Other areas of the parcel, generally located along the river on the parcel's western boundary, are better wooded and have less evidence of dumping, although invasive plant species are thick in some areas. This portion of the parcel should be protected as open space under a conservation restriction to preserve the existing riparian buffer and wildlife habitat. Additionally, it appears that the proposed greenway trail could be accommodated along existing disturbed areas on the parcel, either along the existing rail line to the east, or starting from the north along the rail line and then diverting to the south, hugging the development envelop of the residential buildings along Woodland Drive. *Figure 3-9* illustrates the restoration concept for this site.



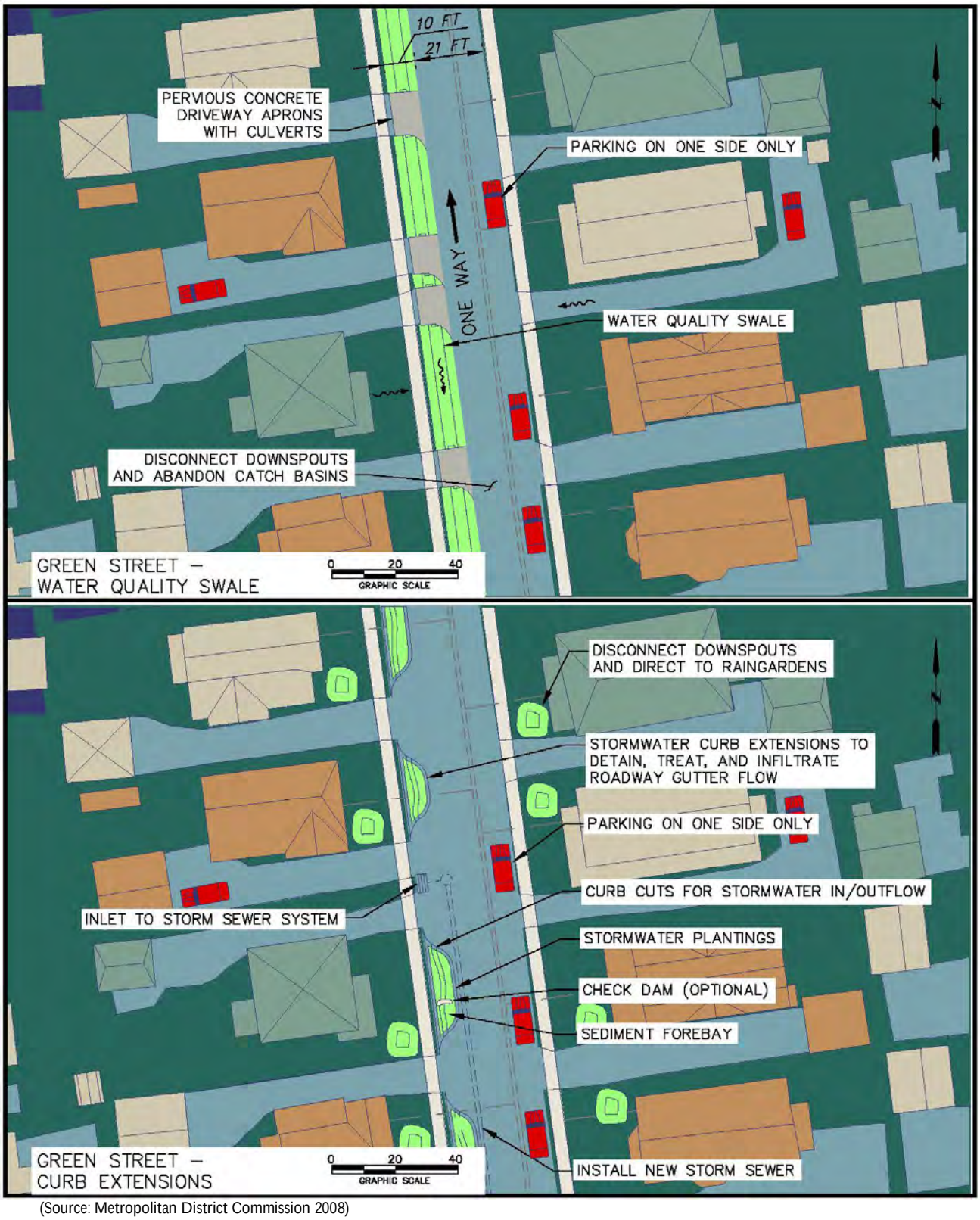
(Source: Metropolitan District Commission 2008; Photo Source: National Agricultural Imagery Program 2008)

Figure 3-8a. Adams Street Stormwater Management Alternatives – Existing Conditions



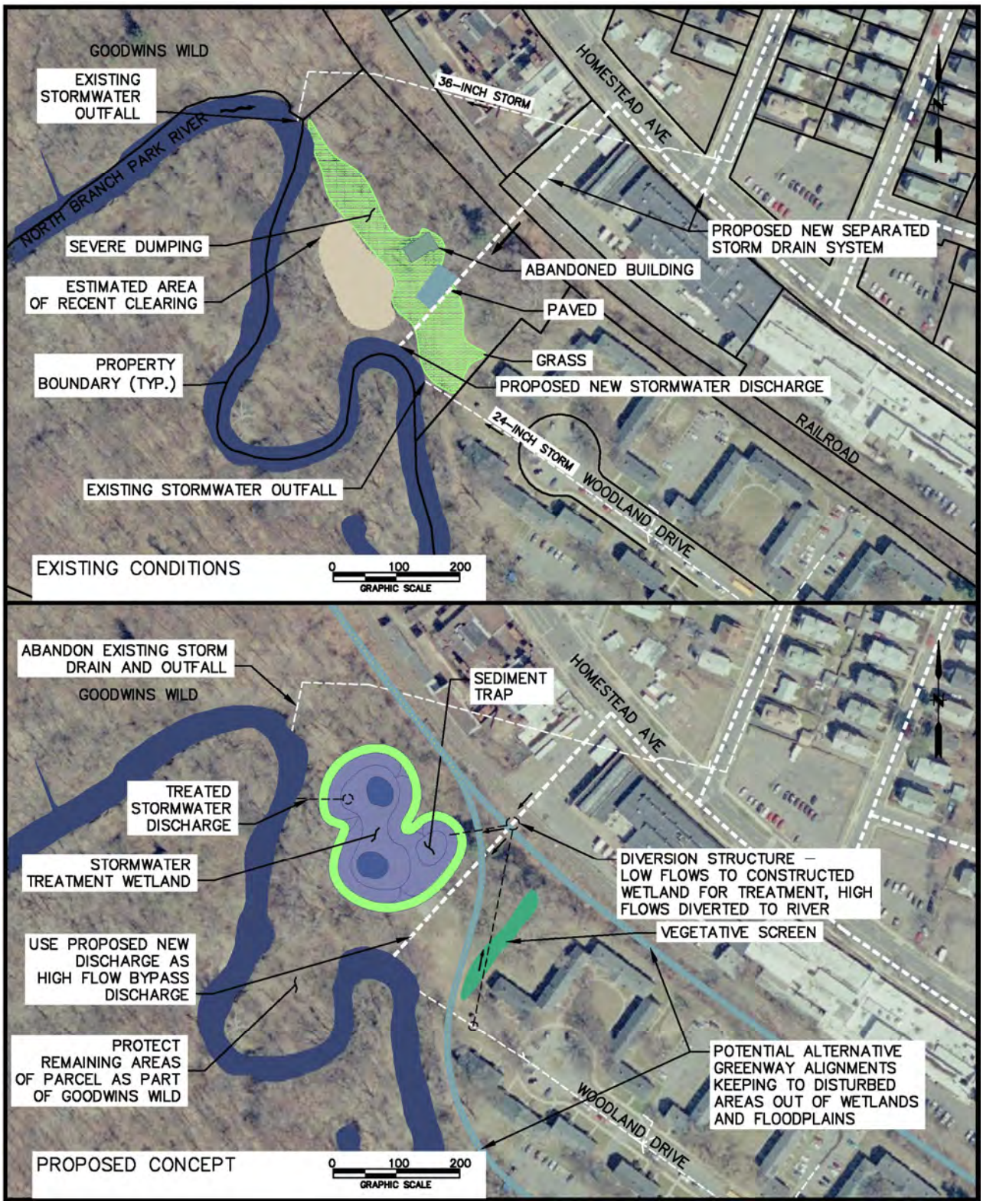
(Source: Metropolitan District Commission 2008)

Figure 3-8b. Adams Street Stormwater Management Alternatives – Downspout Disconnection and Lot-Level Bioretention



(Source: Metropolitan District Commission 2008)

Figure 3-8c. Adams Street Stormwater Management Alternatives – Water Quality Swale and Stormwater Curb Extensions



(Source: Metropolitan District Commission 2008; Photo Source: U.S. Geological Survey, 2008)

Figure 3-9. Woodland Drive Parcel –
Stormwater Wetland and Open Space Protection Concept

3.3.6 Laurel School Restoration

Laurel School Restoration	
Objectives:	Stormwater treatment Riparian restoration Increased tree canopy
Estimated Cost:	$80,000 - $170,000
Responsible Entity:	Town of Bloomfield
Timeline:	2 to 3 years

The Laurel School is a Town of Bloomfield public primary school with students in Kindergarten through fourth grade, located on Filley Street. Immediately adjacent to the school to the northeast is an impacted reach of Beamans Brook. The school's grounds encroach on the brook, with paved parking lots and lawn located within 20 feet of the stream bank in one area. Two stormwater drainage pipes discharge to the brook adjacent to the school grounds.

Athletic fields are located on school grounds west of the main building, but large expanses of unused lawn areas are located north and south of the building and between the school's driveway, parking areas, and Filley Street. The Laurel School site, like other schools in the watershed, presents an opportunity for stormwater retrofits, riparian buffer restoration, and increased tree canopy. The proposed concept (*Figure 3-10*) consists of:

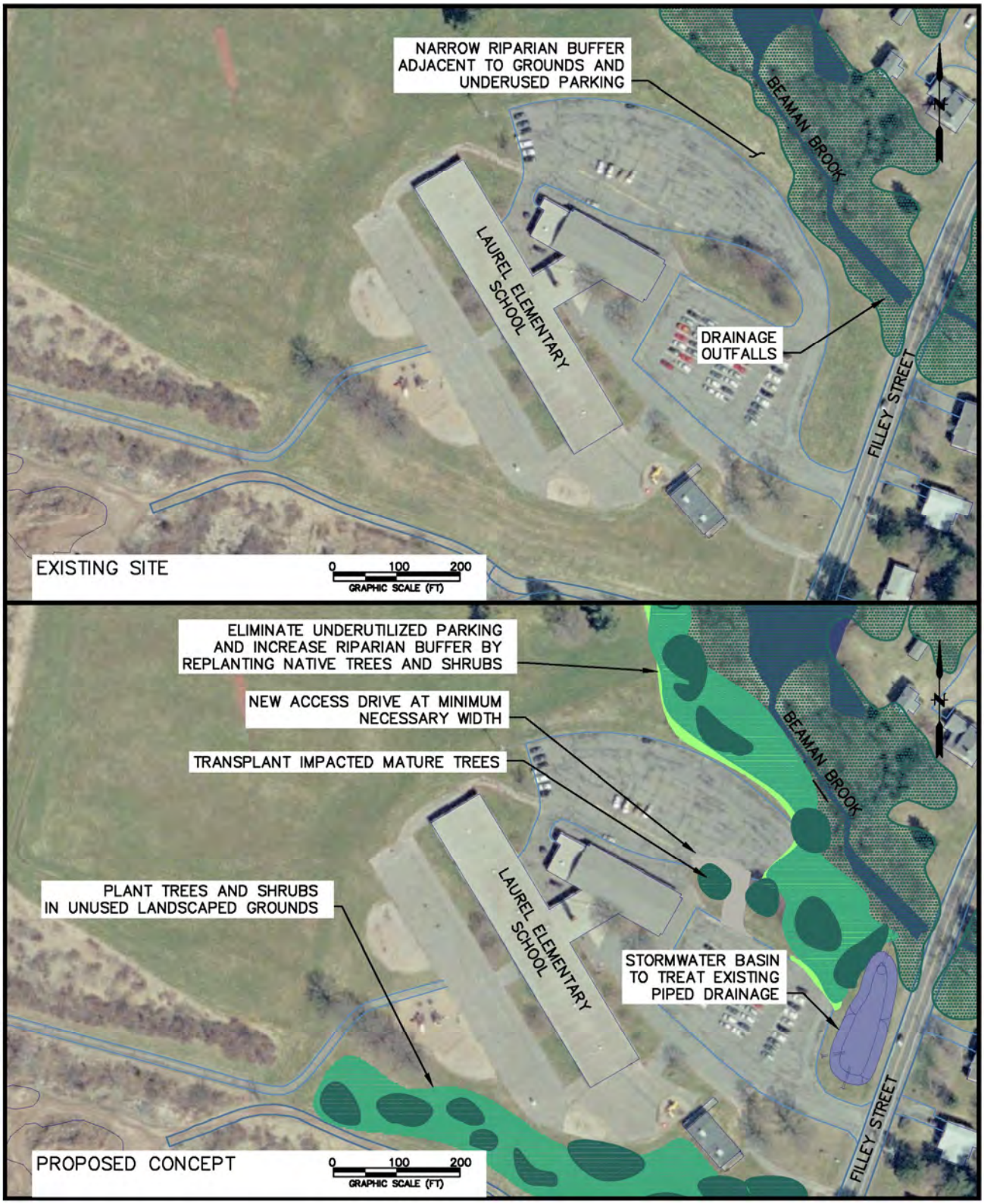
- Reduce the area of the existing parking lot north of the school and along Beamans Brook, and consider permeable pavement for all or portions of the lot as part of future site improvements. Plant the reclaimed area with native trees and shrubs to increase the riparian buffer.
- Install a stormwater basin or bioretention system in the landscaped area between Filley Street and the school's primary parking area. This stormwater retrofit is design to treat and potentially infiltrate stormwater runoff that is currently discharging directly to the river via the on-site drainage system.
- Plant native trees and shrubs in landscaped areas around the school that are not currently used for recess or athletics to increase the tree canopy and reduce maintained lawn areas on the site.

3.3.7 Filley Park Improvements

Filley Park Improvements	
Objectives:	Recreation enhancement Fish passage enhancement Streambank restoration Stormwater treatment
Estimated Cost:	$2,600,000 - $3,300,000
Responsible Entity:	Town of Bloomfield
Timeline:	2 to 5 years

Filley Park, located along Tunxis Avenue in Bloomfield, is a valuable recreational resource, providing skating and recreational water access to an artificial impoundment on Wash Brook. However, there is little or no riparian buffer, with grass down to the river. Geese congregate in the area since the river is impounded by a small dam and the grass area around the pond provides ideal habitat. Additionally, the pond has filled with sediment from upstream sources that have further degraded aquatic habitat and reduced recreational opportunities.

The Town of Bloomfield is currently evaluating improvements that will enhance the appearance and use of the park. The project provides an opportunity to incorporate water quality and habitat considerations into the design, to make the area more attractive to users, dissuade geese from using the area, and provide stream shading and riparian buffer to improve water quality and habitat and to stabilize the banks of the impoundment.



(Source: Metropolitan District Commission 2008; Photo Source: U.S. Geological Survey, 2008)

Figure 3-10. Laurel Elementary School –
Stormwater Treatment, Riparian Restoration, and Reforestation Concept

Although a design is not yet available, the Town is currently planning to provide a riparian buffer along the water's edge, limit access points to the water, construct a sediment trap to capture solids before they enter the pond, and treat stormwater discharges to the stream. *Figure 3-11a and Figure 3-11b* show potential concepts for incorporating water quality and wildlife enhancements into the project design.

3.3.8 Lower North Branch Park River Riparian Restoration

Lower North Branch Park Riparian Restoration	
Objectives:	Public access Riparian restoration Impervious surface reduction
Estimated Cost:	$900,000 - $1,900,000
Responsible Entities:	City of Hartford Private Landowners
Timeline:	5 to 10 years

The lower reaches of the North Branch Park River, between Asylum Avenue and Farmington Avenue, is the last segment of the river upstream of the flood control conduit entrance and is severely impacted by riparian encroachments and in-stream modifications. Public and private parking for institutional and residential buildings are located along the east bank of the river and within the floodplain. Portions of several of these lots are known to flood periodically and have signs warning drivers not to park in areas along the river. One parking lot is state-owned and seldom used, but it is being retained as a real-estate asset.

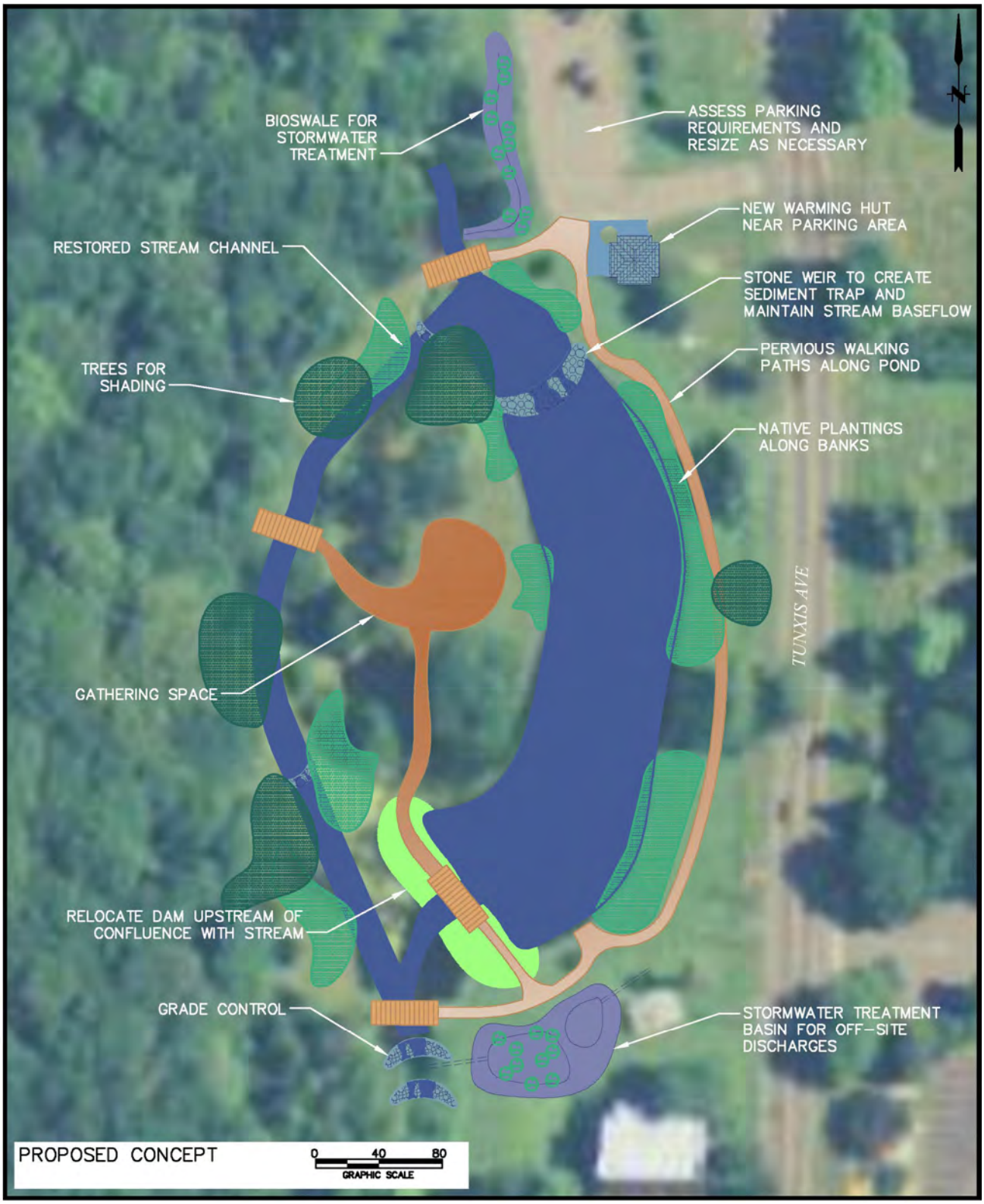
Despite the extensive development along this portion of the river, access to the river is limited, especially along the east bank and near the conduit entrance. One of the few access points to the lower reaches of the river exists along the west bank adjacent to the UConn Law School campus.

The lower reaches of the North Branch Park River have the potential to provide significant water quality, ecological, recreational, and aesthetic benefits. Enhancements to the riparian corridor in this area are recommended to enhance these benefits. The proposed riparian restoration concepts for this area include (*Figure 3-12a and Figure 3-12b*):

- Access Improvements
  - Improve public accessibility along the lower North Branch Park river by designating access points, parking, and signage at locations such as the UConn Law School campus and locations on the east side of the river.
  - Provide limited public access and educational signage in the area of the conduit entrance. Currently, this area is privately-owned and "no trespassing" is posted in many areas.
- Riparian Buffer Improvements
  - When parking lots are resurfaced or repaved, reconfigure parking areas away from the river, providing potential areas for riparian buffer reforestation. Consider whether the parking provided is needed (e.g., in one lot, the trailer for a tractor-trailer truck appears to have been parked in the same location for several years, occupying parking spaces for numerous passenger vehicles). Excess parking could be converted to vegetated riparian area with public access points. There are several areas along the river where additional riparian buffer can be gained without loss of parking through minor lot reconfiguration.

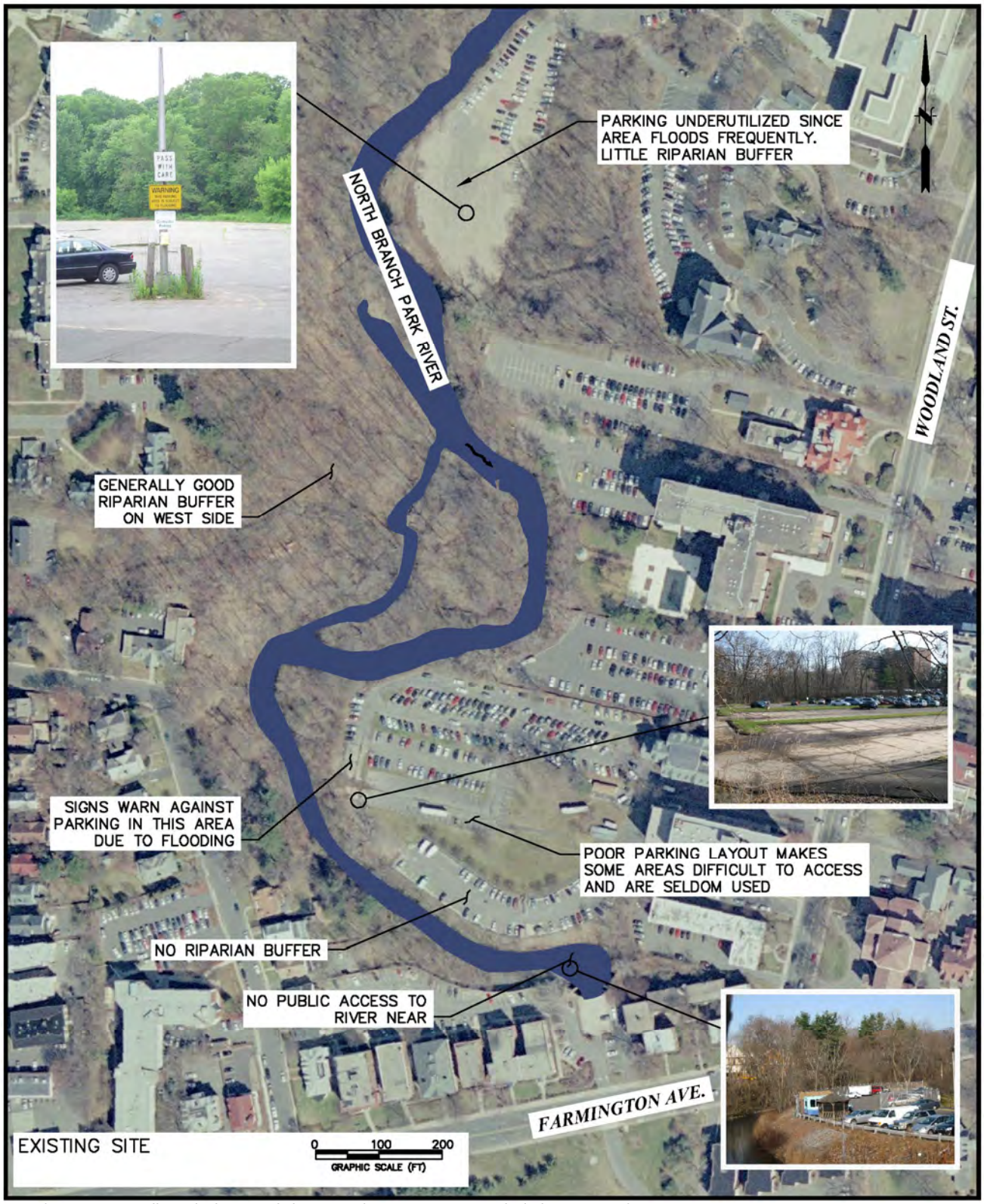
(Source: National Agricultural Imagery Program 2008)

Figure 3-11a. Filley Park Pond – Existing Conditions



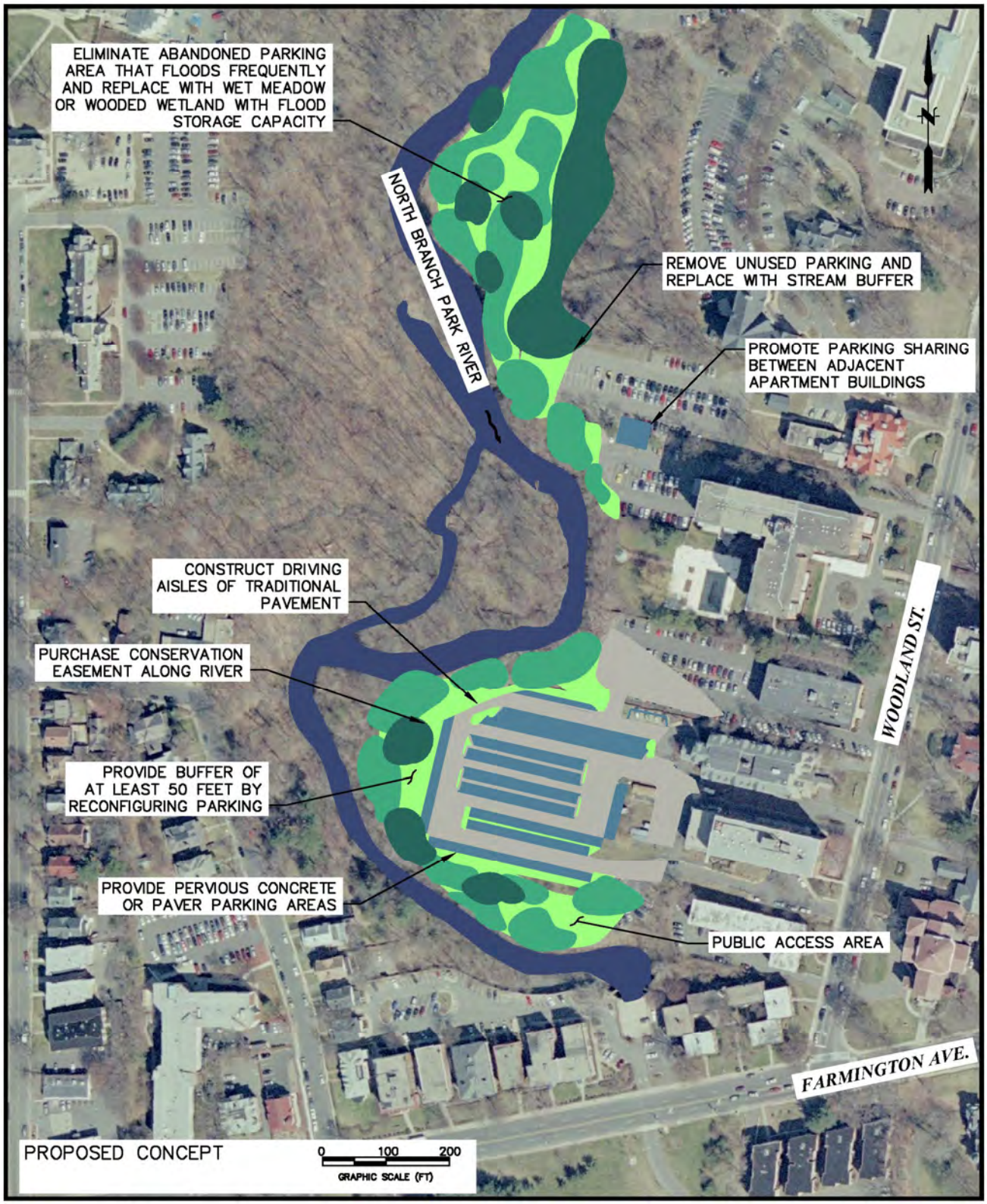
(Source: National Agricultural Imagery Program 2008)

Figure 3-11b. Filley Park Pond Habitat Improvement Concept



(Source: Metropolitan District Commission 2008; Photo Source: U.S. Geological Survey, 2008)

Figure 3-12a. Lower North Branch Park River – Existing Conditions



(Photo Source: U.S. Geological Survey, 2008)

Figure 3-12b. Lower North Branch Park River – Riparian Reforestation Concept

- Plant lawn and grass areas along the river with native shrubs and trees to improve habitat and stream shading, primarily along the east bank where lawn and parking dominate the riparian area. Adjacent to parking lots, seek a minimum riparian buffer of 30 feet of native trees and shrubs, plus 10 to 15 feet of native, mowable, low-growing grasses adjacent to parking areas for snow removal, stormwater management, and as a transition zone between parking lots and forested riparian areas.

3.3.9 Wash Brook Bank Erosion Repair

Wash Brook Bank Erosion Repair	
Objectives:	Bank stabilization Infrastructure protection Sediment load reduction
Estimated Cost:	$170,000 - $360,000
Responsible Entities:	CTDOT Town of Bloomfield
Timeline:	Immediate

Significant bank erosion has occurred along Wash Brook near the intersection of Bloomfield Avenue (Route 189) and Cottage Grove Road (Route 218) in Bloomfield. This reach of Wash Brook is migrating laterally, with severe bank erosion at two locations. The upstream location, located on the right bank approximately 300 yards downstream of Cottage Grove Road, may soon undermine Bloomfield Avenue if erosion continues. The bank at the other location, approximately 280 yards downstream on the left bank, has been armored with concrete and gabion baskets, and debris dumping is present nearby.

Stream restoration techniques are proposed to address the ongoing bank erosion in these two areas. Potential restoration efforts to address the problem would require coordination between the Town of Bloomfield, the Connecticut Department of Transportation, and private property owners. The proposed stream restoration concepts (*Figure 3-13a through Figure 3-13d*) include the following elements:

- Obtain property easements to:
  - Ensure construction and future maintenance access to the project sites.
  - Prevent landowners from removing or otherwise impacting management measures in the future.
- Implement stream restoration measures at the upstream location, which may include:
  - Redirective techniques, such as a transverse vane or stream barbs to direct stream energy away from the eroding bank (stream barbs are shown in the concept sketch). The purpose of the proposed redirective techniques is to transfer the stream energy at the outer bank of the river toward the center of the river or the opposite bank.
  - Stabilize the roadway embankment. An engineered structure such as a retaining wall or gabion wall may be necessary since little area is available between the river and the edge of the roadway and because there will be very little tolerance for further migration of the stream channel following construction. The toe of the wall will also need to be protected against scour and ice damage. Additionally, these techniques should be extended beyond the eroded area, especially downstream, to avoid impacting the residences that abut the river.
  - Increase the riparian buffer width on the opposite bank, since redirecting stream energy could cause stream migration in the opposite direction over time. No

structures or infrastructure are present, so migration in this direction could be tolerated. Enhanced riparian vegetation could also reduce further migration of the stream channel and provide wildlife habitat benefits.

- Downstream location:
  - Remove dumped landscaping debris and trash
  - Consider implementing redirective techniques when additional stabilization becomes necessary in the future

3.3.10 University of Hartford Dam Removal

University of Hartford Dam Removal	
Objectives:	Fish passage Riparian buffer restoration
Estimated Cost:	$2,000,000 - $4,000,000
Responsible Entity:	University of Hartford
Timeline:	2 to 5 years

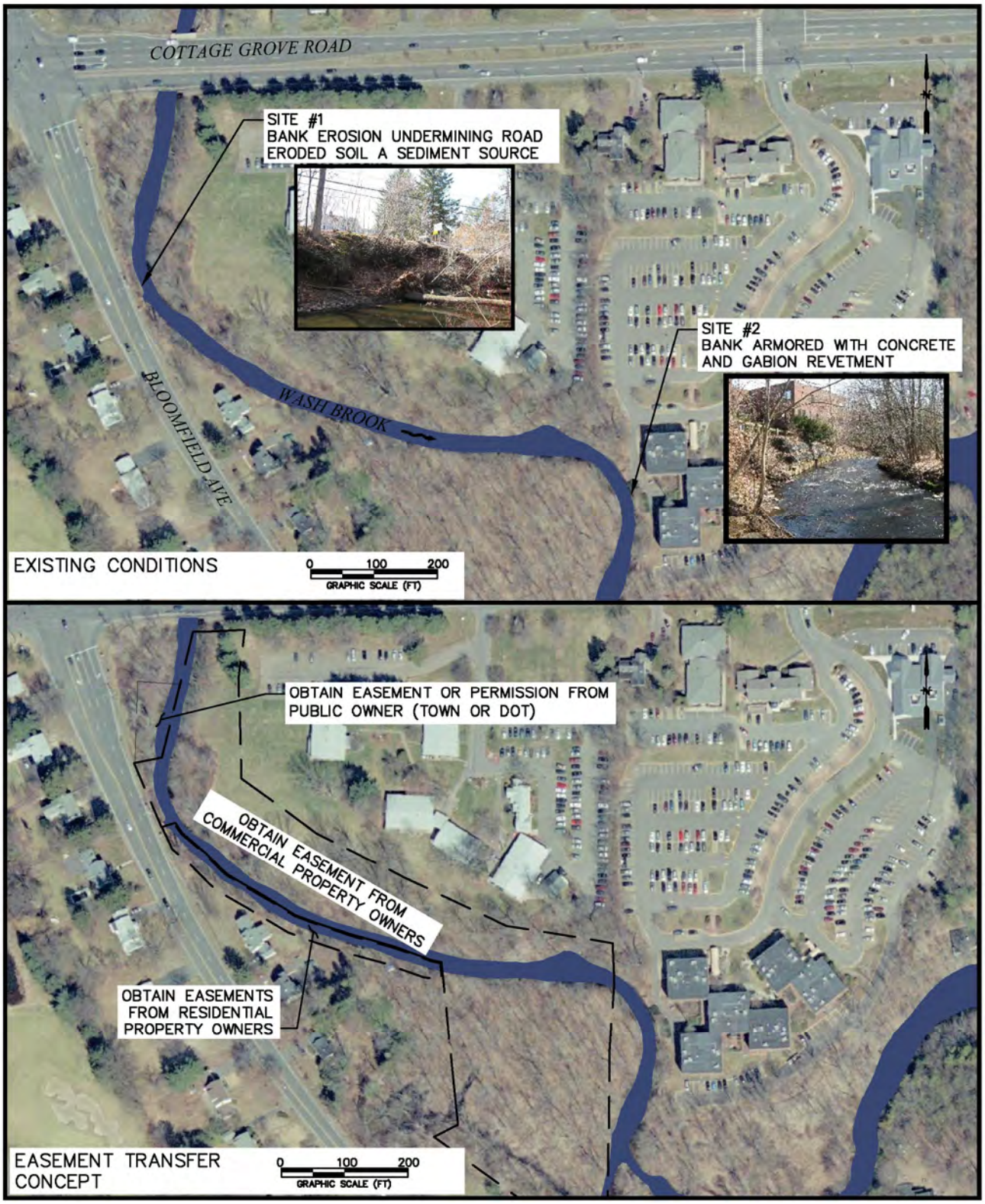
A dam on the University of Hartford campus serves as the first obstruction upstream of the North Branch Park River conduit entrance. The dam is an earth embankment structure with a campus roadway along its crest. The river is conveyed through the dam via eight large corrugated metal pipes.

The pond today, has very little open water due to the accumulation of river sediment over the past half a century. The dam has reached its useful design life and is now beginning to fail. It was designed in the 1950s using a technology that was prevalent at the time. The main spillway and drain pipes through the dam are composed of corrugated metal pipe or CMP. CMPs have been observed to have a useful design life of approximately 50 years. They fail by corrosion of the metal and therefore loss of structural integrity. The piping in the dam is beginning to fail due to corrosion.

According to the CTDEP Fisheries Division, the dam also prevents passage of resident (non-migratory) fish, including trout that are present, as well as migratory eel that can pass through the conduit from the Connecticut River. Several large parking lots are also located along the right bank of the river for much of its length upstream of the impoundment.

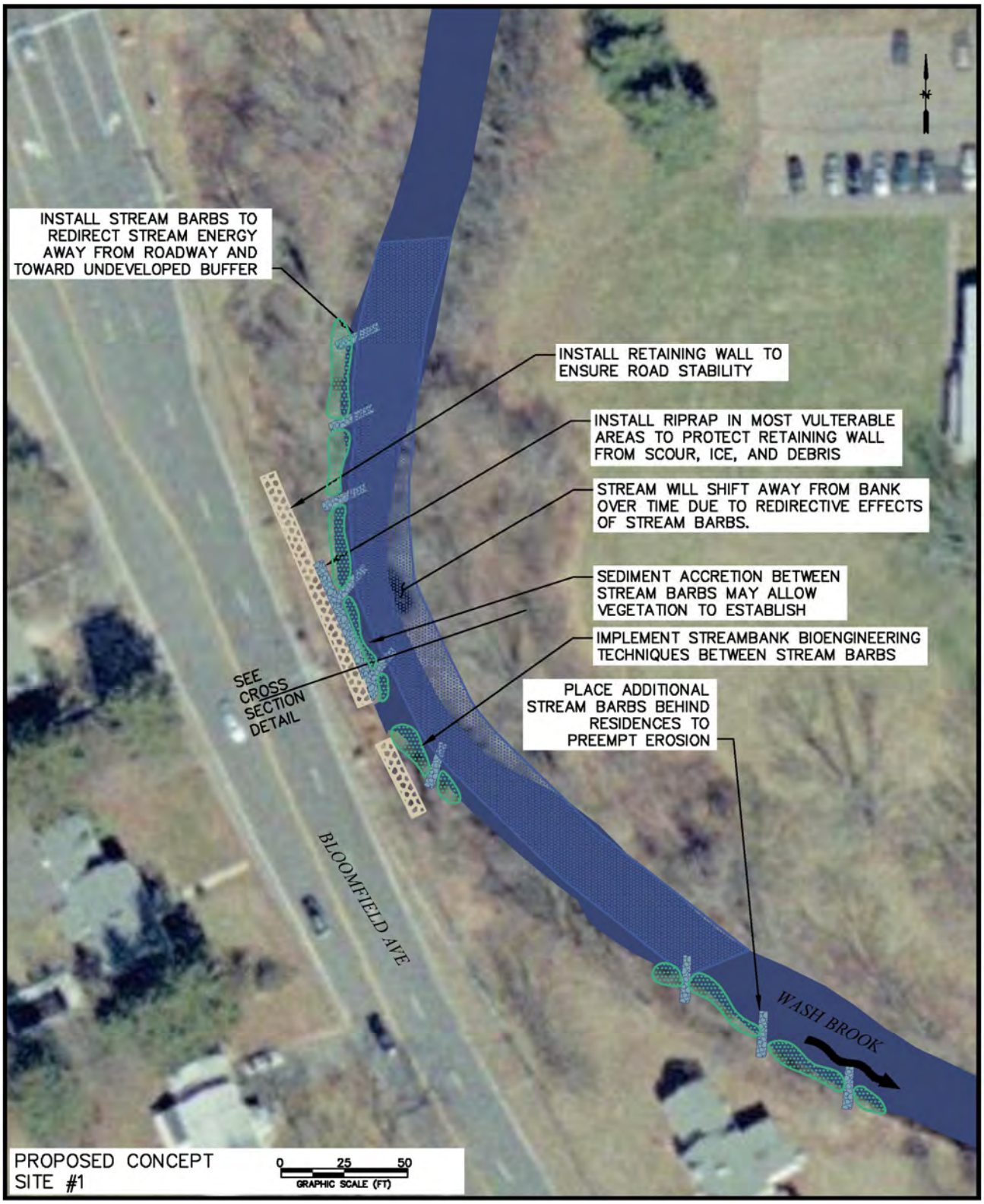
The University of Hartford is currently considering options for repair, replacement or removal of the dam, with the goal of ensuring a reliable structure with a minimum 50-year design life. An opportunity exists to reinforce the University's relationship to the river in a positive way by reducing flood potential and improving the ecological health of the river. A dam removal option that includes river and riparian corridor restoration could enhance ecological conditions along the North Branch Park River, including restoration of fish passage to upstream areas of the river and its major tributaries.

Dam removal provides other advantages as well. The riparian buffer through the campus is impacted by encroachments from campus development. Removing the dam and accumulated sediment would decrease the elevation of the water surface of the river through a portion of the campus, resulting in a narrower stream channel. The exposed bank area provides additional, undeveloped land that can be planted with native trees and shrubs to restore and enhance the riparian buffer.



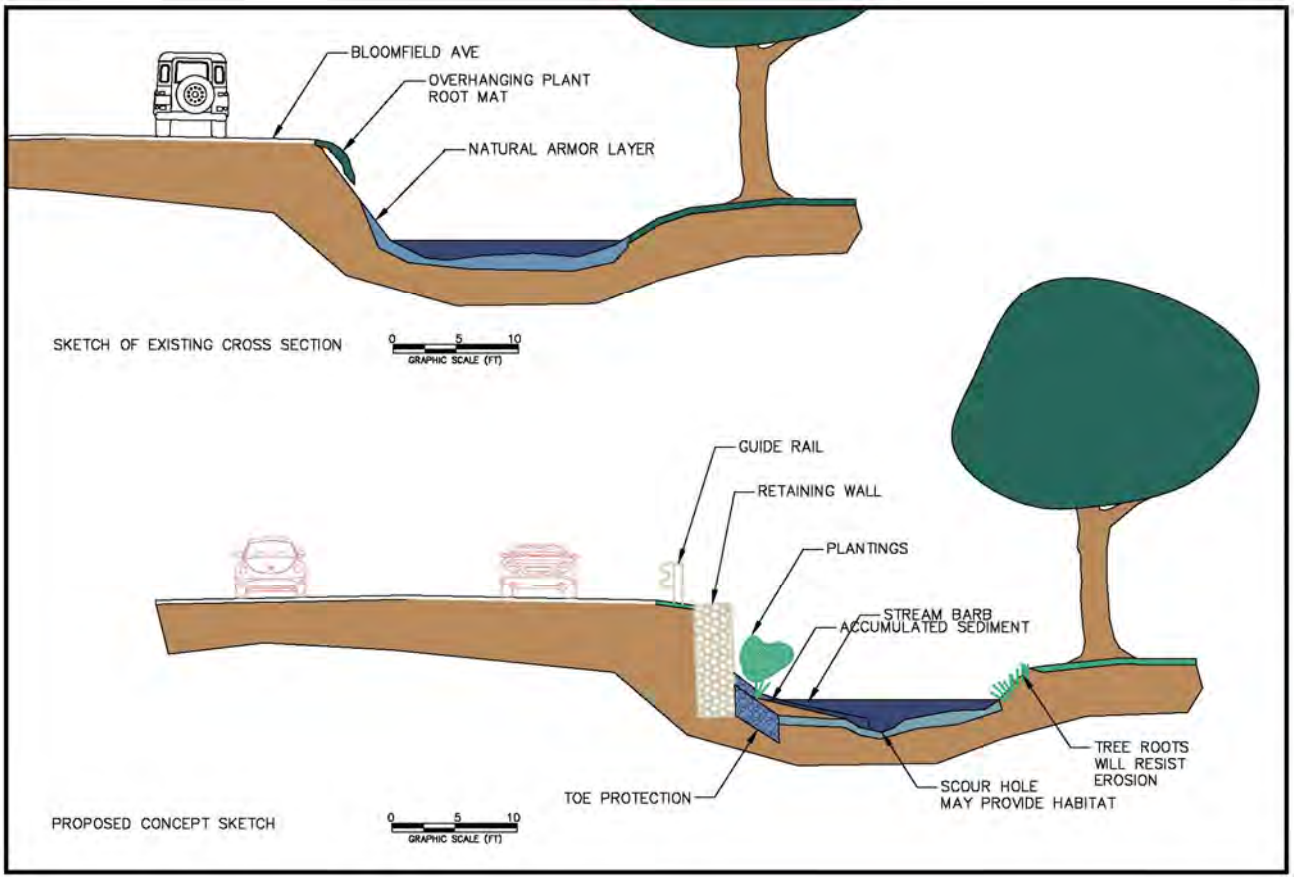
(Source: Metropolitan District Commission 2008; Photo Source: U.S. Geological Survey, 2008)

Figure 3-13a. Wash Brook Bank Erosion –
Existing Conditions Plan and Easement Transfer Concept



(Photo Source: U.S. Geological Survey, 2008)

Figure 3-13b. Wash Brook Bank Erosion Site #1 Bank Stabilization Concept



(Source: Visual observations recorded in field, 2010)

Figure 3-13c. Wash Brook Bank Erosion Site #1 Bank Stabilization Concept Existing Conditions and Proposed Concept Cross Sections

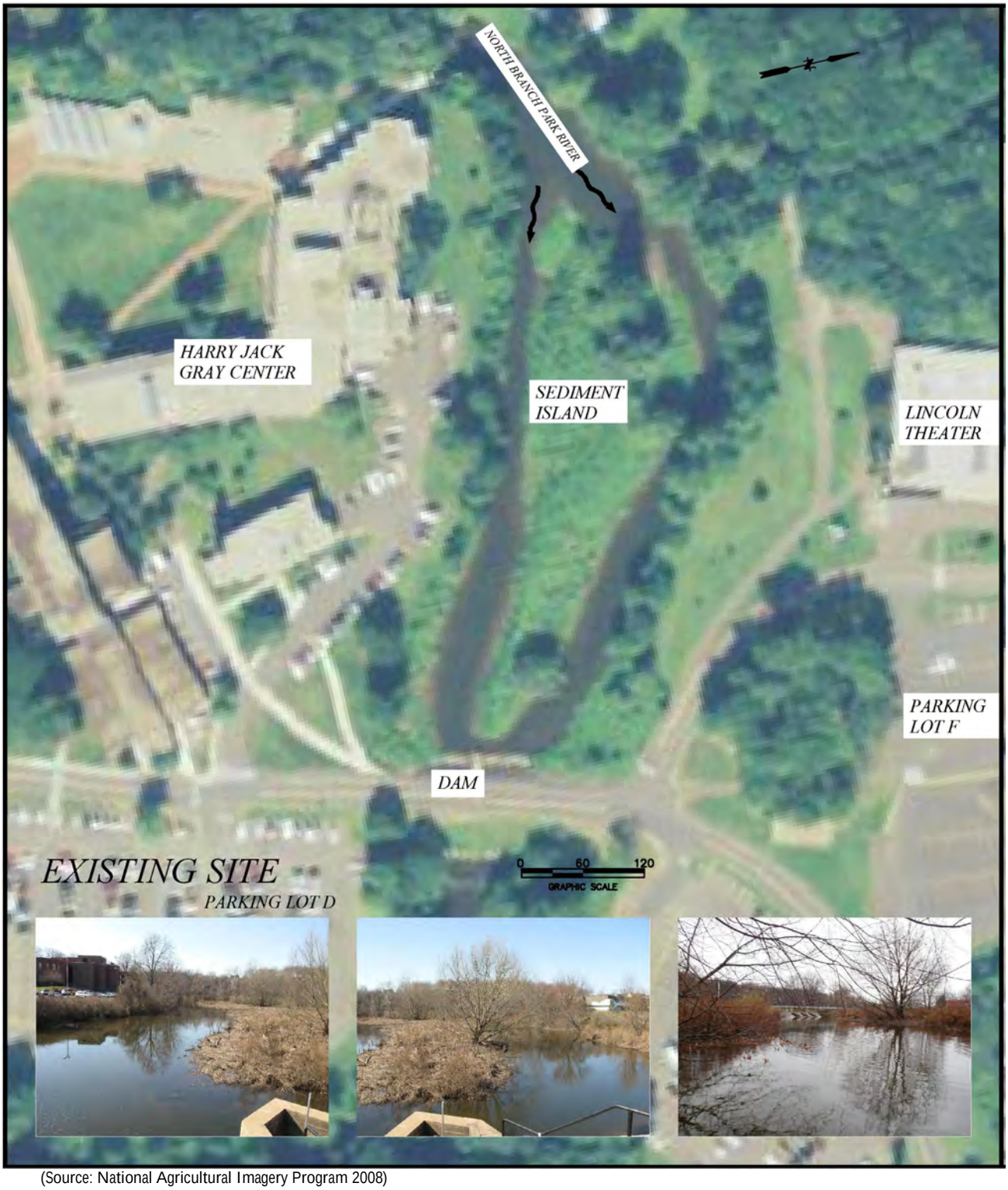
(Photo Source: U.S. Geological Survey, 2008)

Figure 3-13d. Wash Brook Bank Erosion Site #2 Bank Stabilization Concept

Removal of the University of Hartford dam poses several challenges, including sediment management, potential flooding impacts, vehicle traffic and pedestrian access, and provisions for existing utility lines. Of these, sediment management is perhaps the most significant issue. The pond is full of sediment that will move downstream if the dam is removed. The sediment therefore needs to be managed appropriately depending on the degree of contamination in the sediment.

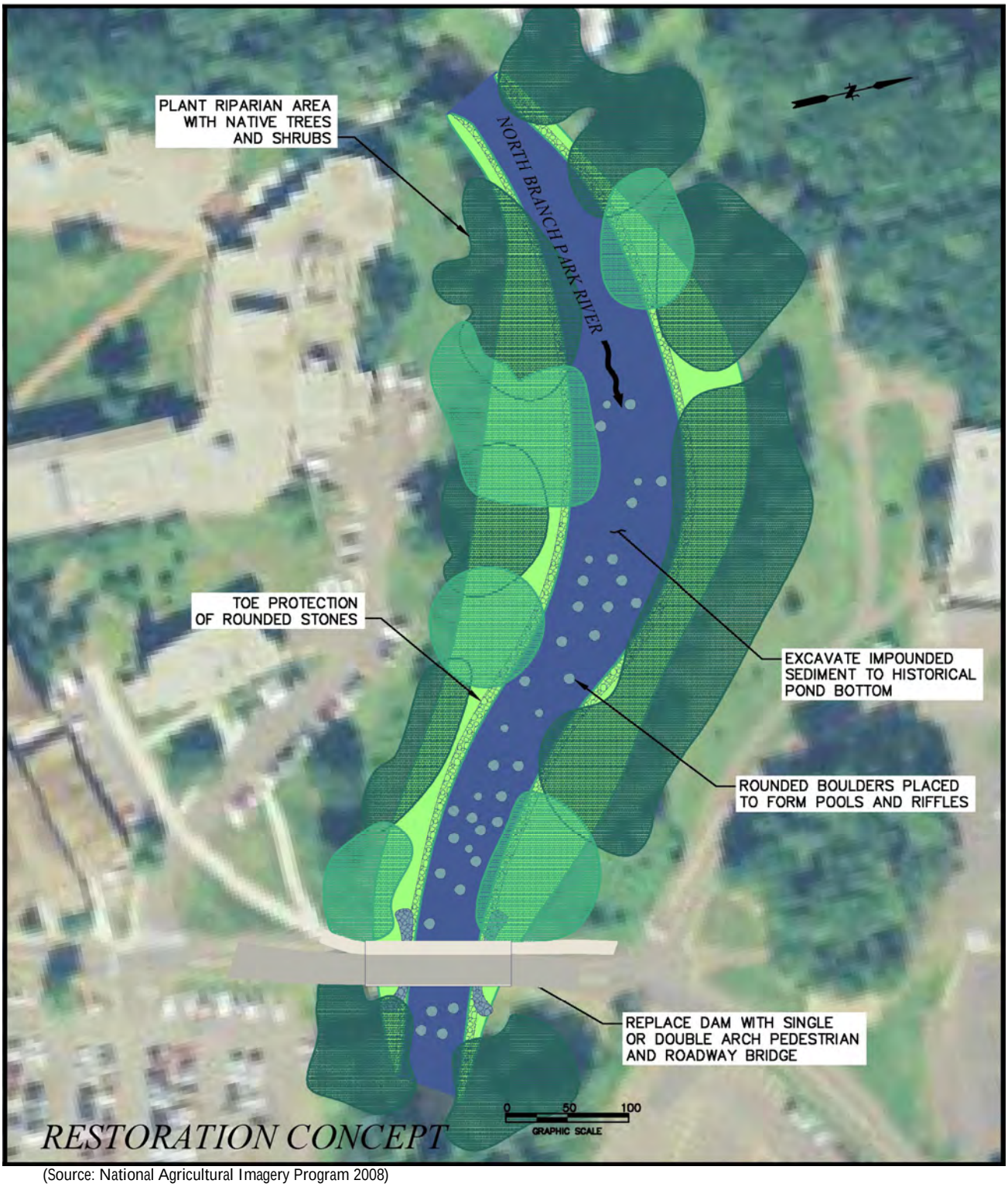
Figure 3-14a and Figure 3-14b illustrate design concepts that would serve river restoration and ecological goals for the project. Concepts that should be considered include:

- Stream Restoration Improvements
  - Rather than repair the dam, remove it, along with the accumulated sediment.
  - If the dam is to remain in-place, modify at least one of the culverts that pass through the dam, to provide passage to resident fish and migratory eel.
  - If the dam is removed but the sediment is managed in-place rather than through removal, facilitate fish and eel passage around, over, or through the obstruction.
  - Remove or rebury an exposed conduit running across the stream
  - Consider supplementing or replacing hard armor along the stream banks with stream bank bioengineering where movement of the stream might be tolerable.
- Riparian Buffer Improvement
  - If the dam and sediment are removed, plant the exposed banks with native trees and shrubs to increase the riparian buffer width.
  - Plant grass areas along river with native shrubs and trees to improve habitat and stream shading. Adjacent to parking lots, seek a minimum riparian buffer of 30 feet of native trees and shrubs, plus 10 to 15 feet of native, mowable, low-growing grasses adjacent to parking areas for snow removal, stormwater management, and as a transition zone between parking lots and forested riparian areas.
  - When parking lots are resurfaced or repaved, reconfigure parking areas away from the river, providing potential areas for riparian buffer reforestation. There are several areas along the river where additional stream buffer can be provided without loss of parking through minor lot reconfiguration.
- Public Access
  - Provide a greenway along the river to encourage access, such as that included in a proposal for the University's Master Plan Update. The greenway trail should be routed to avoid disturbing ecologically sensitive areas of the river corridor including wetlands, floodplains, sensitive wildlife areas and existing or planned open space.
  - Incorporate LID and other sensitive design elements into the greenway trail design including maintaining and/or restoring native riparian vegetation along the stream bank, appropriate setbacks/buffers for wetlands and streams, designated access points to the river to maintain as much natural riparian habitat as possible, use of permeable pavement or other materials to reduce runoff, and use of other LID techniques.



(Source: National Agricultural Imagery Program 2008)

Figure 3-14a. University of Hartford Dam – Existing Conditions



(Source: National Agricultural Imagery Program 2008)

Figure 3-14b. University of Hartford Dam Removal Concept

3.3.11 Upper North Branch Park River

The upper reaches of the North Branch Park River suffer from culverting, stream bank erosion, uncontrolled stormwater discharges, and impacted riparian buffers. The downstream reach in this portion of the river, located across Mark Twain Drive from the University High School of Science and Engineering (designated as reach NBPR-11 in the watershed field inventories), is severely degraded, likely by high velocity flows discharging from a culverted reach that passes below Weaver High School and associated athletic fields along Granby Street. Immediately downstream of the culvert discharge, the river is contained within a concrete channel. Immediately upstream of the culvert entrance, the City of Hartford recently removed riparian vegetation and increased the channel capacity to reduce flooding around the culvert entrance.

The current degraded conditions in this area provide opportunities for significant improvements from future restoration efforts. The following restoration activities are recommended for this area (note that design sketches and costs were not developed for these concepts due to the broad scope of the potential improvements and the preliminary nature of these recommendations):

- Stream Daylighting
  - Remove the concrete lining of the channel downstream from the culvert discharge.
  - Daylight the stream through the culverted section to the extent feasible. Daylighting of the entire length of stream channel to improve flood capacity and restore aquatic and riparian habitat would only be feasible as part of major capital improvements to Weaver High School.
  - Replace the culvert below Mark Twain Drive to improve stream continuity. During the stream inventories performed as part of the baseline watershed assessment, it appeared that the culvert may prevent passage of some aquatic organisms.
- Culvert Velocity Dissipation
  - Provide energy dissipation for discharges from the culverted reach to reduce flow velocities at reach NBPR-11, assuming that complete daylighting of the stream is not feasible.
- Riparian Restoration
  - The downstream portion of reach NBPR-19 is severely impacted by recent disturbance and would benefit from riparian restoration.
  - Reach NBPR-11 is severely impacted by trash, invasive species, bank erosion, and downcutting. This reach could benefit from trash cleanup, invasive species removal, and bank stabilization.
- Stormwater Improvements
  - A housing development discharges stormwater to the upstream portion of reach NBPR-19, and several stormwater outfalls discharge to the culverted reach of the river near its upstream end. Stormwater retrofits should be considered for these stormwater discharges to provide treatment and detention.

3.3.12 UConn Law School Athletic Field Improvements and Stormwater Infiltration

UConn Law School Athletic Field Improvements and Stormwater Infiltration	
Objectives:	Stormwater volume reduction Groundwater infiltration Reduce impacts of combined sewer separation
Estimated Cost:	$315,000 - $675,000
Responsible Entity:	UConn Law School
Timeline:	2 to 5 years

Opportunities to implement LID and green infrastructure retrofits within the urban roadway network or right-of-way can be constrained by space limitations and existing subsurface utilities and infrastructure. Athletic fields at the numerous public education institutions in the watershed provide opportunities for potential stormwater infiltration retrofits given their large land area, particularly when undertaken in conjunction with planned athletic field upgrades. The existing athletic field along Girard Avenue at the UConn Law School is an example of one such opportunity.

Separation of combined storm and sanitary sewers is proposed in the area immediately west of the UConn Law School. A new storm drainage system is proposed for Kenyon Street, Girard Avenue, and Fern Street. The new separate storm drainage system would likely pass near the existing UConn Law School athletic field on Girard Avenue.

The proposed sewer separation project and the location of the athletic field together provide a potential retrofit opportunity for infiltration of stormwater into soils below the athletic field from the approximately 12-acre drainage area consisting of a portion of the campus and the adjacent residential neighborhood.

A series of chambers installed below the upgraded athletic field could receive separated stormwater for storms up to approximately the one-year frequency event (approximately 2.4 inches of precipitation). This stored water could then infiltrate into the ground, if soil conditions are favorable for infiltration, or discharge slowly back into the drainage system to reduce peak stormwater flow rates. A drainage manhole in the street would serve as a diversion structure, directing low flows into the system below the field while diverting excess flows back into the drainage system to avoid overwhelming the infiltration chambers. A pre-treatment system of gross-particle separators would also be required to reduce the risk of sediment accumulation and clogging within the infiltration chambers. A sketch of this concept is presented in *Figure 3-15*.

The potential retrofit would ideally be implemented in conjunction with planned upgrades of the athletic field for increased cost effectiveness. The athletic field upgrades could include improvements to the playing surface and associated drainage to maintain more uniform soil moisture on the playing surface. The athletic field drainage system could also be designed to discharge directly or indirectly to the subsurface infiltration chambers.

The technical and economic feasibility of such a retrofit project will depend upon several site-specific factors such as the design of the proposed separated storm drainage system and the infiltration capacity of the soils beneath the athletic field.

(Photo Source: U.S. Geological Survey, 2008)

Figure 3-15. Uconn Law School Athletic Field Upgrade and Stormwater Infiltration Concept

4 Pollutant Load Reductions

Pollutant load reductions were estimated for the following watershed management plan recommendations using the Watershed Treatment Model (WTM) pollutant loading model described in the baseline watershed assessment:

1. **CSO Abatement.** The MDC CSO Long Term Control Plan for the North Branch Park River drainage district is designed to eliminate CSOs during storms up to and including the typical one-year frequency event, which is defined as a storm total of 2.4 inches. This will essentially eliminate CSOs to the North Branch Park River on an annual average basis.

2. **Green Infrastructure Retrofits.** The watershed management plan promotes the use of green infrastructure approaches within the City of Hartford to augment traditional CSO control strategies such as sewer separation and to address municipal stormwater management requirements. The goal is to implement green infrastructure retrofits to reduce stormwater discharge volumes and associated pollutant loads to the North Branch Park River and other receiving water bodies.

   Potential load reductions were modeled for roof leader disconnections and green street retrofits, which are practices that could potentially be implemented in the Hartford portion of the North Branch Park river watershed. Conservative model assumptions were used to estimate the potential area (1.5% of the total impervious cover within the Hartford portion of the watershed) served by the retrofits given the challenges of implementing green infrastructure retrofits on private property, within the public right-of-way, and with other site constraints such as poor soils and limited land area.

3. **Additional Stormwater Retrofits.** Stormwater retrofits are also recommended in the other watershed communities. In these less densely developed areas, stormwater retrofits are most feasible at commercial, industrial, municipal, institutional and roadway land uses in the form of on-site or outfall retrofits. Potential load reductions were estimated for a variety of stormwater and LID retrofit practices (bioretention, infiltration, water quality swales, and stormwater basins) applied to these land uses throughout the watershed. Similar to the green infrastructure retrofits scenario, conservative model assumptions were used to estimate the potential area (between 0.04% and 1.9% of the total impervious cover within each subwatershed) served by the retrofits. The modeled effectiveness of the proposed retrofits was further reduced to reflect system maintenance and design (system bypass during larger storms) factors.

4. **Stormwater Management for New Development and Redevelopment.** The watershed management plan promotes effectiveness stormwater management for future development and redevelopment throughout the watershed through land use regulatory mechanisms and the local site plan review process. Potential load reductions were estimated for implementation of stormwater management practices (bioretention, infiltration, stormwater ponds, and water quality swales) for all future new development and redevelopment in the watershed, based on the watershed buildout presented in the baseline assessment report. The modeled effectiveness of the proposed stormwater

controls was further reduced to reflect system maintenance and design inefficiencies and assuming that 70% of new development has regulated stormwater management.

5. **Riparian Buffer Restoration.** Potential pollutant load reductions were estimated for restoration of impacted riparian buffers in the watershed. The total length of streams within each subwatershed with impacted buffers was estimated from aerial photography. Under the modeled restoration scenario, a 50-foot vegetative riparian buffer was assumed for those areas currently with impacted buffers.

6. **Reforestation.** The watershed management plan promotes preservation and enhancement of tree canopy through various urban watershed forestry approaches. Potential pollutant load reduction benefits were estimated for a watershed reforestation scenario, using the tree canopy goals presented in the baseline assessment report as a future target. Subwatersheds that are currently below their respective tree canopy goals (Beamans Brook East, Beamans Brook West, Tumbledown Brook, and Wash Brook West) were included in the analysis. The reforestation scenario also included the North Branch Park River subwatershed based on the more detailed tree canopy assessment performed by the City of Hartford, USDA Forest Service, and the University of Vermont (O'Neil-Dunne, 2010). For these subwatersheds, the amount of land conversion required to achieve the recommended tree canopy goal was modeled by converting existing institutional (including municipal) and commercial land use to forest.

7. **Open Space Protection.** Potential pollutant load reductions were estimated for an open space protection scenario consistent with the open space recommendations in *Section 3.2.8* of this plan. Parcels recommended for acquisition as protected open space were assumed to remain as forest or undeveloped open space under a future watershed buildout scenario. Parcels recommended for conservation restrictions were assumed to remain in their current land use under the future buildout scenario. Predicted future pollutant loads from these parcels under a "protection" scenario were compared to predicted future loads under a future buildout scenario in which the land is assumed to be developed as allowed by current zoning.

8. **Public Education.** Pet waste, lawn care, and other nonpoint source education programs can change behaviors that affect pollutant loads. Pollutant load reductions were estimated for pet waste and lawn care education programs based on the number of dwellings, average fraction of pet-owners, pet-owners who already clean up after their pets, and average fraction willing to change their behavior. Conservative model assumptions were used to avoid over-estimating the load reduction benefits of these programs.

9. **Illicit Discharge Detection and Elimination and Septic System Repairs.** Illicit stormwater connection removal and septic system repairs were considered in each subwatershed based on the existing estimated number of households served by septic systems and estimated numbers of illicit connections associated with commercial and residential land uses. The illicit connection removal scenario assumes that 20% of the existing illicit discharges are detected and eliminated. The septic system repair scenario assumes an 80% inspection rate and a 60% repair rate.

Annual average pollutant load reductions for bacteria, total suspended solids (TSS), phosphorus (P), and nitrogen (N) for the above scenarios were estimated for 1) existing conditions, 2) future buildout of the watershed without the proposed watershed management plan recommendations, and 3) future buildout assuming implementation of the proposed watershed management plan recommendations.

Table 4-1 summarizes the anticipated pollutant load reductions for the watershed-wide and targeted plan recommendations for which pollutant loads can be reasonably quantified. The load reduction values presented in *Table 4-1* are for the entire North Branch Park River watershed. Load reduction summaries by subwatershed are provided in *Appendix G*.

As indicated in *Table 4-1*, CSO abatement through implementation of the MDC LTCP is estimated to result in the most significant load reductions, particularly with respect to bacteria loads (approximately 94% reduction in fecal coliform loading within the North Branch Park River subwatershed and 86% reduction watershed-wide). Load reductions for the other watershed management recommendations listed in *Table 4-1* are expressed as a percentage of the remaining watershed pollutant loads following elimination of CSOs to the North Branch Park River consistent with the MDC LTCP. Of these recommendations, stormwater retrofits, open space protection, and illicit discharge detection and elimination and septic system controls are anticipated to result in the greatest reductions in bacteria loads. The effectiveness of the watershed management recommendations varies by pollutant, but is generally relatively low compared to CSO elimination.

Table 4-1. Anticipated Load Reductions of Watershed Management Recommendations

Watershed Management Recommendation	N (lb/yr)	P (lb/yr)	TSS (lb/yr)	Fecal Coliform (billion/yr)	N	P	TSS	Fecal Coliform
CSO Abatement	3,653	731	73,054	10,654,285	2.3%	3.6%	0.54%	86.1%
Load reductions for the following management recommendations are expressed as a percentage of the remaining watershed pollutant loads following elimination of CSOs								
Green Infrastructure Retrofits	256	38	18,182	585	0.17%	0.19%	0.14%	0.04%
Additional Stormwater Retrofits	1,750	302	88,060	32,523	1.1%	1.5%	0.66%	2.4%
Stormwater Management for New Development and Redevelopment	258	49	18,635	2,821	0.17%	0.25%	0.14%	0.21%
Riparian Buffer Restoration	64	3	5,345	0	0.04%	0.02%	0.04%	0.00%
Reforestation	88	12	1,416	220	0.06%	0.06%	0.01%	0.02%
Open Space Protection	4,230	538	340,049	54,081	2.8%	2.8%	2.5%	4.1%
Public Education	6,778	167	0	4,522	4.4%	0.85%	0.00%	0.34%
IDDE/Septic System Repairs	1,750	302	88,060	32,523	1.1%	1.5%	0.66%	2.4%

Table 4-2 summarizes the anticipated combined effectiveness for all of the watershed management recommendations considered. The pollutant loadings and load reductions presented in *Table 4-2* reflect a comparison of modeled future pollutant loadings for the entire North Branch Park River watershed, with and without implementation of the watershed

management recommendations. Overall, a significant reduction in bacteria loads is anticipated (87.1%), largely due to CSO abatement, with smaller reductions anticipated for nitrogen (12%), phosphorus (10.5%), and total suspended solids (4.7%).

Table 4-2. Summary of Existing and Future Pollutant Loads With and Without Watershed Management Recommendations

Pollutant	Existing Conditions	Future Buildout without Controls	Future Buildout with Controls	Load Reduction	Load Reduction (%)
Nitrogen (lb/yr)	136,389	156,673	137,847	18,827	12.0%
Phosphorus (lb/yr)	17,108	20,345	18,203	2,142	10.5%
TSS (lb/yr)	11,173,372	13,418,963	12,786,163	632,800	4.7%
Fecal Coliform (billion/yr)	12,054,165	12,376,811	1,595,252	10,781,558	87.1%

Figures 4-1 through *4-4* depict the existing and anticipated future pollutant loading rates for the watershed, with and without implementation of the watershed management plan recommendations. The pie charts in *Figures 4-1* through *4-4* show the relative contribution of the management plan recommendations to the predicted load reductions.

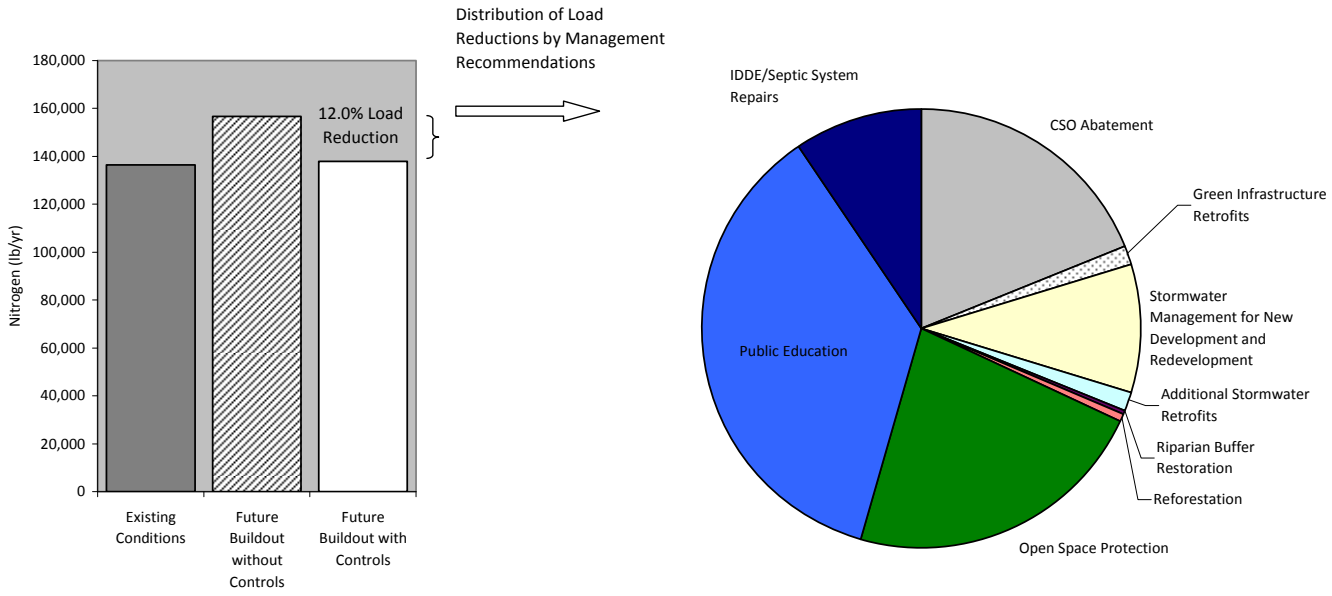


Figure 4-1. Anticipated Existing and Future Nitrogen Loads and Load Reductions With Future Watershed Management Implementation

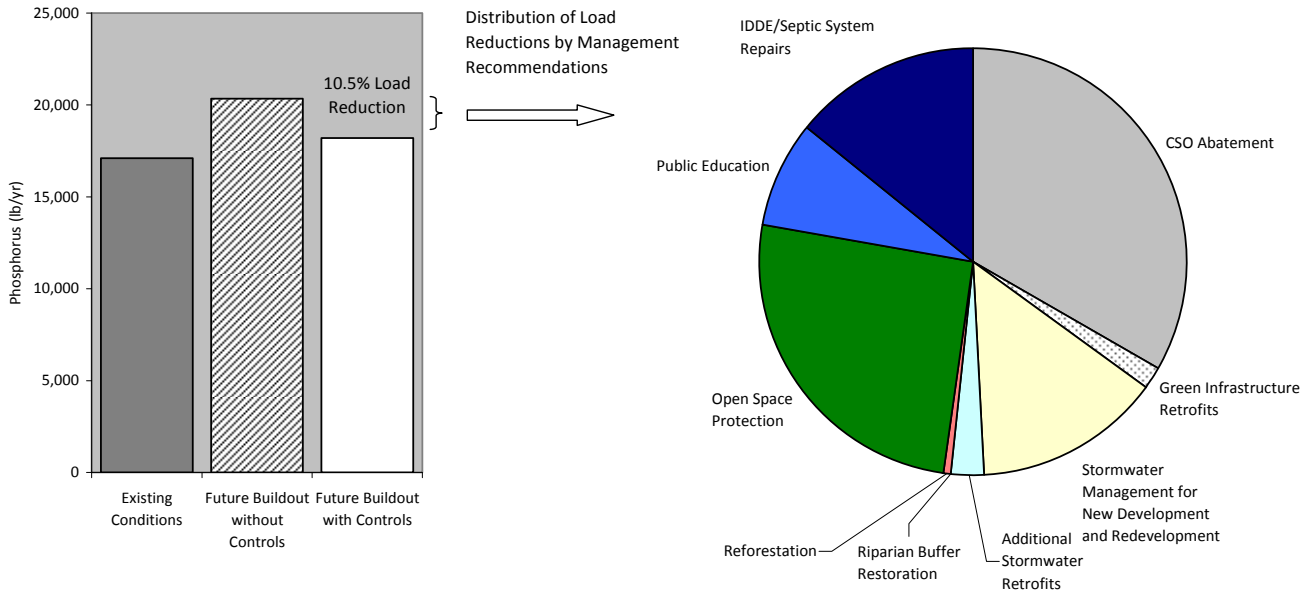


Figure 4-2. Anticipated Existing and Future Phosphorus Loads and Load Reductions With Future Watershed Management Implementation

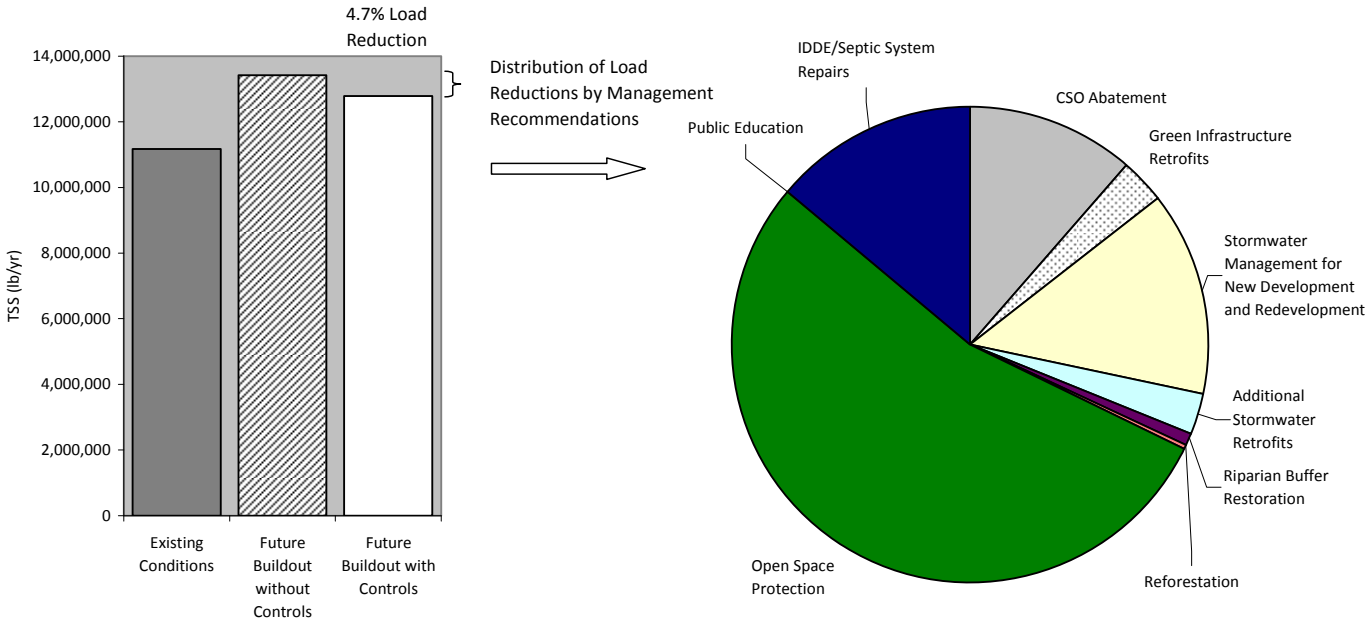


Figure 4-3. Anticipated Existing and Future Sediment (TSS) Loads and Load Reductions With Future Watershed Management Implementation

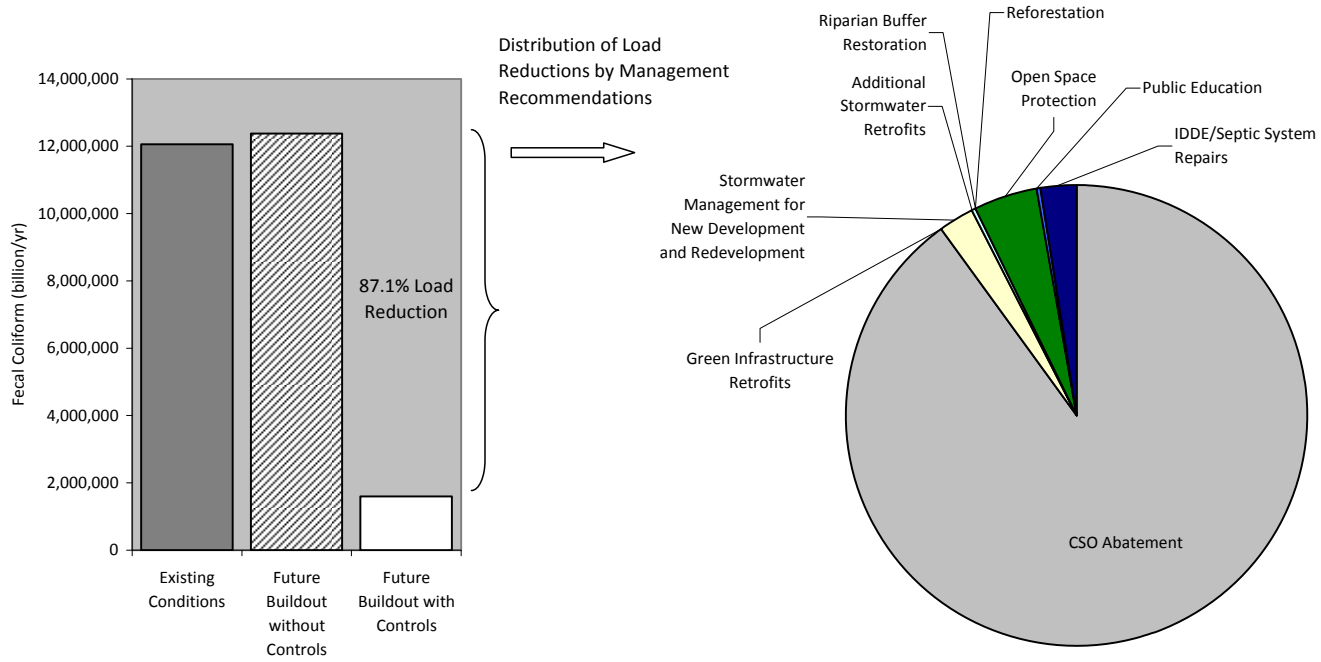


Figure 4-4. Anticipated Existing and Future Fecal Coliform Loads and Load Reductions With Future Watershed Management Implementation

5 Plan Implementation

5.1 Schedule and Milestones

Appendix H contains a proposed implementation schedule, including actions/milestones, anticipated timeline, products, and evaluation criteria. This table should be revised as necessary to reflect future changes to the watershed plan and implementation activities.

5.2 Funding Sources

A variety of local, state, and federal sources are potentially available to provide funding for the implementation of this watershed management plan, in addition to potential funds contributed by local grassroots organizations and concerned citizens. *Appendix I* contains a list of potential funding sources that has been developed by CTDEP and NRCS, and further refined through this planning process. The table is not intended to be an exhaustive list but can be used as a starting point to seek funding opportunities for implementation of the recommendations in this watershed plan. The information presented in this watershed management plan and the supporting study documentation will support future grant proposals by demonstrating a comprehensive, scientifically-based approach for addressing identified concerns consistent with EPA's recommended watershed-based approach. The table of potential funding sources is intended to be a living document that should be updated periodically to reflect the availability of funding or changes to the funding cycle, and to include other funding entities or grant programs.

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Appendix A

Baseline Watershed Assessment Report (on CD)

Appendix B

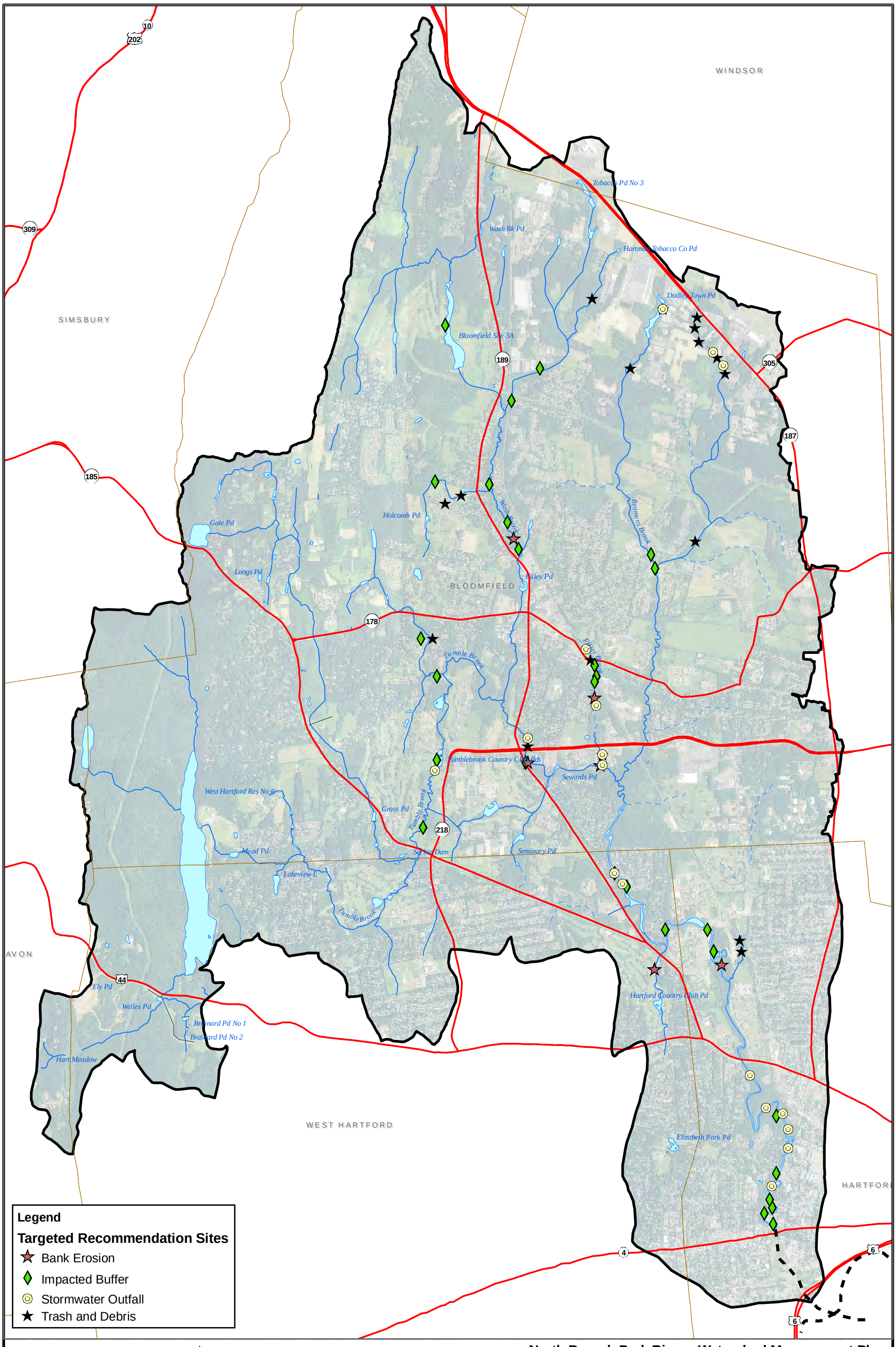
Watershed Field Assessment Report (on CD)

Appendix C

Land Use Regulatory Review Report (on CD)

Appendix D

Map of Targeted Recommendations


WINDSOR
SIMSBURY
BLOOMFIELD
WEST HARTFORD
AVON
HARTFORD
Tobacco Pd No 3
Wash Bk Pd
Hartmans Tobacco Co Pd
Dudley Town Pd
Bloomfield Site 3A
Holcomb Pd
Gale Pd
Longs Pd
Wash Brook
Beamans Brook
Filley Pd
Tumble Brook
Fiddyment Brook
Tumblebrook Country Club Pds
Sewards Pd
West Hartford Res No 6
Gross Pd
Mead Pd
Lakeview L
Seminary Pd
Ely Pd
Welles Pd
Brainard Pd No 1
Brainard Pd No 2
Hart Meadow
Hartford Country Club Pd
Elizabeth Park Pd
10
202
309
185
189
305
187
178
218
44
4
6
Legend
Targeted Recommendation Sites
Bank Erosion
Impacted Buffer
Stormwater Outfall
Trash and Debris
0
1
Miles
N
North Branch Park River - Watershed Management Plan
Targeted Recommendation Sites
Data sources: CTDEP, CTOPM, and CTDPS (TeleAtlas),
Town of Bloomfield; Printed July 2010

Appendix E

Open Space Priority Parcel Assessment

Summary of Open Space Acquisition and Conservation Easement Recommendation Metrics

Metric	How Metric is Measured	Indicates Higher Protection Priority When	Metric Points
1. Parcel Size	Parcel Area (acres)	**Parcel size is large,** suggesting greater opportunity for contiguous undeveloped areas to benefit wildlife and provide recreation.	> 50 ac = 5pts; 25 to 50 ac = 4 pts; 15 to 25 ac = 3 pts; 10 to 15 ac = 2 pts; < 10 ac = 1 pt.
2. Connectivity	Area of adjacent protected open space and/or connectivity to existing or proposed trail systems	**Connectivity is high;** the parcel is adjacent to other protected areas (prevent fragmentation of a large protected forest tract), undeveloped forested areas, or provides access to existing or proposed trails.	Ranking from 1 pt = minimal adjacent existing open space or connectivity to trails to 5 pts = parcel adjacent to large unfragmented forested area with access to trails.
3. Development Potential	Based on slope, wetland, and floodplain areas	**Development potential is high;** suggesting that the parcel is a good candidate for future development based on slope, wetland, and floodplain areas.	Ranking from 1 pt = low development potential to 5 pts = high development potential.
4. Floodplain Area	Percentage of parcel containing 100- or 500-year flood zone areas	**A higher percentage floodplain area in the parcel;** preserve natural flood storage or function (to the 500 year flood level).	Ranking from 1 pt = no flood zone area in the parcel to 5 pts = majority of parcel contains flood zone areas.
5. Wetland Area	Percentage of parcel containing wetland soils	**Wetland soils percentage is high;** suggesting that the parcel supports, enhances or protects biodiversity.	Ranking from 1 pt = no wetland soils in the parcel to 5 pts = majority of parcel contains wetland soils.
6. Stream Vicinity	Length of stream that is within or buffering the parcel	**A high order or headwaters stream is located on the parcel;** suggesting that protecting the parcel would maintain stream buffers for wildlife habitat and biodiversity.	Ranking from 1 pt = parcel does not buffer or contain a stream to 5 pts = parcel buffering or contains a high order or headwater stream. Higher ranking is given to higher order streams and headwater streams compared to tributaries.

Ranking Results for Priority Parcel Acquisition and Conservation Easement Recommendations

Parcel No.	Location	Parcel Size (acres)	Criteria Ranking (scoring ranges from 1=low priority to 5=high priority)						
			Parcel Size	Connectivity	Development Potential	Floodplain Area	Wetland Area	Stream Vicinity	Total Score
Parcels Recommended for Acquisition:									
1	Griffin Rd/Newbury Rd	33.7	4	3	4	4	4	4	23
2	Tunxis Ave @ Ridgeview Dr	11.2	2	3	2	5	4	5	21
3	Tunxis Ave @ Ridgeview Dr	13.6	2	3	2	5	4	5	21
4	Tunxis Ave @ Terry Plains Rd	2.2	1	3	2	5	4	5	20
5	Tunxis Ave @ Terry Plains Rd	2.6	1	3	2	5	4	5	20
6	Albany Ave	35.0	4	4	5	1	2	3	19
7	Sharon St	3.2	1	4	3	1	5	5	19
8	Woodland Ave	21.8	3	3	5	2	2	3	18
9	Duncaster Rd (Kelly Farm)	44.9	4	5	4	2	2	1	18
10	Simsbury Rd	15.1	3	1	3	1	5	4	17
Parcels Recommended for Conservation Easement:									
11	Hall Blvd	28.3	4	5	1	5	5	5	25
12	Homestead Ave (Goodwin's Wild)	26.0	4	5	3	4	4	5	25
13	Maple Ave	109.3	5	1	2	5	5	5	23
14	Dorothy Dr	17.5	3	3	2	5	4	5	22
15	Ryefield Hollow Dr	63.6	5	4	5	1	2	5	22
16	Homestead Ave (Goodwin's Wild)	4.1	1	5	3	4	4	5	22
17	Wintonbury Ave	70.5	5	4	5	1	2	4	21
18	Harvest Ln	36.3	4	4	2	1	5	5	21
19	Mark Twain Dr	24.0	3	1	1	5	5	5	20
20	Wyndemere Rd	1.1	1	3	2	5	4	5	20

Appendix F

Site-Specific Project Cost Estimates

North Branch Park River
Watershed Management Plan
Site-Specific Recommendations
Cost Worksheet

	Unit Cost	Unit	Quantity	Cost (2010$)	Design, and Planning Allowance	Cost	Total Cost	Order of Magnitude Cost Range -30%	50%	Lifespan (yrs)	Annual Cost Over Lifespan	O&M (% Cost)	O&M ($/yr)	Total Capitalized Cost/yr over lifespan	Source
Bloomfield Town Hall															
Bioretention in Traffic Island	$17.50	/ft2 (commercial/industrial area	2000	$35,000	55%	$19,000	$54,000	$38,000	$81,000	15	$4,520	8%	$360	$4,880	1
Bioretention Area West of Parking Lot	$17.50	/ft2 (commercial/industrial area	1320	$23,000	55%	$13,000	$36,000	$25,000	$54,000	15	$3,020	8%	$240	$3,260	1
Water Quality Swale	$12.50	/ft2 (commercial/industrial area	5400	$68,000	55%	$37,000	$105,000	$74,000	$158,000	30	$5,360	6%	$320	$5,680	2
Hartford Seminary															
Bioretention Area Conversion	$8.40	/ft2 (developed area)	2650	$22,000	55%	$12,000	$34,000	$24,000	$51,000	15	$2,850	8%	$230	$3,080	2
Bioretention Area Conversion	$8.40	/ft2 (developed area)	1150	$10,000	55%	$6,000	$16,000	$11,000	$24,000	15	$1,340	8%	$110	$1,450	2
Connecticut Historical Society															
Stormwater wetlands and grounds improvements	$7.00	/ft2 (developed area)	276225	$1,934,000	32%	$619,000	$2,553,000	$1,787,000	$3,830,000	30	$130,250	8%	$10,420	$140,670	
Laurel School															
Wet Detention Pond	$4.00	/ft3 treated	10,600	$42,000	32%	$13,000	$55,000	$39,000	$83,000	30	$2,810	6%	$170	$2,980	3
Tree planting on grassed area	$0.30	/ft^2	70,000	$21,000	32%	$7,000	$28,000	$20,000	$42,000	50	$1,090	0%	$0	$1,090	1
Reforestation of pavement	$1.75	/ ft2	8,200	$14,000	32%	$4,000	$18,000	$13,000	$27,000	50	$700	0%	$0	$700	1
Replace driveway	$3.00	/ft2	3,000	$9,000	32%	$3,000	$12,000	$8,000	$18,000	20	$810	0%	$0	$810	1
Transplant tree	$2,000.00	ea	1	$2,000	0%	$0	$2,000	$1,000	$3,000	50	$80	0%	$0	$80	1
Filley Park*															
Parking Lot Swale	$12.50	/ft^2	2000	$25,000	32%	$8,000	$33,000	$23,000	$50,000	30	$1,680	8%	$130	$1,810	2
Stormwater basin	$4.00	/ft3 treated	50000	$200,000	32%	$64,000	$264,000	$185,000	$396,000	30	$13,470	8%	$1,080	$14,550	2
Sediment Trap	$20,000.00	ea.	1	$20,000	32%	$6,000	$26,000	$18,000	$39,000	30	$1,330	10%	$130	$1,460	5
Reconstruct or replace dam	$200,000.00	ea.	1	$200,000	32%	$64,000	$264,000	$185,000	$396,000	30	$13,470	0%	$0	$13,470	5
Dredging	$70.00	cubic yard	3,000	$210,000	32%	$67,000	$277,000	$194,000	$416,000	30	$14,130	0%	$0	$14,130	5
Riparian plantings	$10,000.00	acre	0.5	$5,000	32%	$2,000	$7,000	$5,000	$11,000	30	$360	6%	$20	$380	1
University of Hartford Dam Removal*															
Replace dam with bridge	$1,500,000	ea.	1	$1,500,000	32%	$480,000	$1,980,000	$1,386,000	$2,970,000	50	$76,950	8%	$6,160	$83,110	5
Remove Sediment	$70	cubic yard	7,000	$490,000	32%	$157,000	$647,000	$453,000	$971,000	100	$20,480	0%	$0	$20,480	5
Riparian Plantings	$10,000.00	acre	2	$20,000	32%	$6,000	$26,000	$18,000	$39,000	100	$820	0%	$0	$820	1
Bank stabilization	$50	ft	1700	$85,000	32%	$27,000	$112,000	$78,000	$168,000	100	$3,540	0%	$0	$3,540	4
Greenway	$3	ft2	10,000	$30,000	32%	$10,000	$40,000	$28,000	$60,000	30	$2,040	6%	$120	$2,160	1

North Branch Park River
Watershed Management Plan
Site-Specific Recommendations
Cost Worksheet

	Unit Cost	Unit	Quantity	Cost (2010$)	Design, and Planning Allowance	Cost	Total Cost	Order of Magnitude Cost Range -30%	50%	Lifespan (yrs)	Annual Cost Over Lifespan	O&M (% Cost)	O&M ($/yr)	Total Capitalized Cost/yr over lifespan	Source
Lower NBPR Buffer Improvements															
Reconfigure Parking	$3	ft2	96,000	$288,000	32%	$92,000	$380,000	$266,000	$570,000	30	$19,390	0%	$0	$19,390	1
Reforestation of pavement	$1.75	ft2	150,000	$263,000	32%	$84,000	$347,000	$243,000	$521,000	100	$10,980	0%	$0	$10,980	1
Property easement/acquisition	$5	ft2	246,000	$1,230,000	5%	$62,000	$1,292,000	$904,000	$1,938,000	100	$40,890	0%	$0	$40,890	5
Wash Brook Erosion Repair															
Site #1															
Commericial property easement/acquisition	$0.00	ft2/undevelopable land	196,000	$0	5%	$0	$0	$0	$0	100	$0	0%	$0	$0	5
Residential easement	$15,000	residence	3	$45,000	5%	$2,000	$47,000	$33,000	$71,000	100	$1,490	0%	$0	$1,490	5
Gabion Wall	$300	l.f. @ 12 ft high	150	$45,000	32%	$14,000	$59,000	$41,000	$89,000	20	$3,970	8%	$320	$4,290	1
Excavation/backfill	$40	cy	100	$4,000	32%	$1,000	$5,000	$4,000	$8,000	20	$340	8%	$30	$370	1
Bank Stabilization	$50	ft	400	$20,000	32%	$6,000	$26,000	$18,000	$39,000	20	$1,750	8%	$140	$1,890	4
Stream Barbs	$4,000	ea.	9	$36,000	32%	$12,000	$48,000	$34,000	$72,000	20	$3,230	8%	$260	$3,490	4
Site #2				$0											
Bank Stabilization	$50	ft	340	$17,000	32%	$5,000	$22,000	$15,000	$33,000	20	$1,480	8%	$120	$1,600	4
Stream Barbs	$4,000	ea.	6	$24,000	32%	$8,000	$32,000	$22,000	$48,000	20	$2,150	8%	$170	$2,320	4
Woodland Drive Stormwater Basin															
Stormwater Wetland	$21,000.00	acre treated	27	$567,000	32%	$181,000	$748,000	$524,000	$1,122,000	20	$50,280	8%	$4,020	$54,300	3
UConn Law School Athletic Field Infiltration System	$10	cubic foot treated	35,000	$350,000	32%	$112,000	$462,000	$323,000	$693,000	30	$23,570	8%	$1,890	$25,460	1

Note:
Rate of Inflation used = 4%
Interest (discount) rate used = 7%
*Projects are proposed for these locations already. Costs estimated in this table are for adding ecological and water quality elements to the assumed original purpose of the proposed projects.

Sources:
1. Derived by F&O based on R.S. Means
2. CWP data normalized using F&O derived cost
3. CWP Urban Subwatershed Restoration Manual 2 Appendix E
4. Derrick, David (1997). Harland Creek Bank Stabilization Demonstration Project. Land and Water Magazine, Sept/Oct 1997. Accessed at www.landandwater.com on July 7, 2010.
5. Estimate from Professional Exp

Appendix G

Pollutant Load Reduction Model Results

Fecal Coliform Load Reductions with Watershed Management Recommendations

	Existing Conditions	Future Buildout without Controls	Load Increase without Controls	Load Increase with Contols							
Watershed Management Recommendation	billion/yr	billion/yr	billion/yr	Green Infrastructure in CSO areas	New Development LID	Stormwater Retrofits	Riparian Buffer Restoration	Reforestation	Open Space Protection	Public Education	IDDE/Septic systems
BBE	18,530	27,600	9,070	9,070	8,156	8,148	9,070	9,070	6,650	9,049	8,156
BBW	63,816	77,163	13,347	13,347	12,002	11,764	13,347	13,222	9,223	12,847	12,002
BHR	27,292	36,848	9,556	9,556	8,593	8,441	9,556	9,556	7,269	9,537	8,593
CSR	95,667	121,300	25,633	25,633	23,049	22,938	25,633	25,633	18,849	25,454	23,049
FYB	30,696	33,202	2,506	2,506	2,253	2,116	2,506	2,506	2,506	2,250	2,253
NBP (no CSOs)	279,377	333,157	53,780	53,195	48,359	47,736	53,780	53,773	50,304	52,292	48,359
TDB	93,446	113,685	20,239	20,239	18,199	17,855	20,239	20,174	12,038	19,864	18,199
TBS	84,370	126,752	42,382	42,382	38,110	37,945	42,382	42,382	41,638	42,057	38,110
TUX	41,445	56,544	15,099	15,099	13,577	13,469	15,099	15,099	15,081	14,943	13,577
WBN	26,722	35,206	8,484	8,484	7,629	7,419	8,484	8,484	6,680	8,412	7,629
WBS	111,061	143,257	32,196	32,196	28,951	28,584	32,196	32,196	19,068	31,608	28,951
WBW	68,767	116,664	47,897	47,897	43,069	42,990	47,897	47,874	41,337	47,600	43,069
WHR	33,749	59,727	25,978	25,978	23,360	23,319	25,978	25,978	23,008	25,958	23,360
WTR	34,393	50,871	16,478	16,478	14,817	14,578	16,478	16,478	14,915	16,254	14,817
Watershed	1,009,330	1,331,976	322,646	322,061	290,123	287,302	322,646	322,426	268,565	318,124	290,123

Fecal Coliform Load Reductions with Watershed Management Recommendations

	Existing Conditions	Future Buildout without Controls	Load Reduction due to Controls							
Watershed Management Recommendation	billion/yr	billion/yr	Green Infrastructure in CSO areas	New Development LID	Stormwater Retrofits	Riparian Buffer Restoration	Reforestation	Open Space Protection	Public Education	IDDE/Septic systems
BBE	18,530	27,600	0.0%	10.1%	10.2%	0.00%	0.00%	26.7%	0.2%	10.1%
BBW	63,816	77,163	0.0%	10.1%	11.9%	0.00%	0.94%	30.9%	3.8%	10.1%
BHR	27,292	36,848	0.0%	10.1%	11.7%	0.00%	0.00%	23.9%	0.2%	10.1%
CSR	95,667	121,300	0.0%	10.1%	10.5%	0.00%	0.00%	26.5%	0.7%	10.1%
FYB	30,696	33,202	0.0%	10.1%	15.6%	0.00%	0.00%	0.0%	10.2%	10.1%
NBP (no CSOs)	279,377	333,157	1.1%	10.1%	11.2%	0.00%	0.01%	6.5%	2.8%	10.1%
TDB	93,446	113,685	0.0%	10.1%	11.8%	0.00%	0.32%	40.5%	1.9%	10.1%
TBS	84,370	126,752	0.0%	10.1%	10.5%	0.00%	0.00%	1.8%	0.8%	10.1%
TUX	41,445	56,544	0.0%	10.1%	10.8%	0.00%	0.00%	0.1%	1.0%	10.1%
WBN	26,722	35,206	0.0%	10.1%	12.6%	0.00%	0.00%	21.3%	0.9%	10.1%
WBS	111,061	143,257	0.0%	10.1%	11.2%	0.00%	0.00%	40.8%	1.8%	10.1%
WBW	68,767	116,664	0.0%	10.1%	10.2%	0.00%	0.05%	13.7%	0.6%	10.1%
WHR	33,749	59,727	0.0%	10.1%	10.2%	0.00%	0.00%	11.4%	0.1%	10.1%
WTR	34,393	50,871	0.0%	10.1%	11.5%	0.00%	0.00%	9.5%	1.4%	10.1%
Watershed	1,009,330	1,331,976	0.2%	10.1%	11.0%	0.00%	0.07%	16.8%	1.4%	10.1%

Sediment (TSS) Load Reductions with Watershed Management Recommendations

	Existing Conditions	Future Buildout without Controls	Load Increase without Controls	Load Increase with Controls							
Watershed Management Recommendation	lb/yr	lb/yr	lb/yr	Green Infrastructure in CSO areas	New Development LID	Stormwater Retrofits	Riparian Buffer Restoration	Reforestation	Open Space Protection	Public Education	IDDE/Septic systems
BBE	65,702	103,961	38,259	38,259	36,243	36,231	38,081	38,259	27,052	38,259	36,243
BBW	892,088	1,001,484	109,396	109,396	106,035	104,660	109,142	108,232	87,108	109,396	106,035
BHR	500,837	601,382	100,545	100,545	93,124	90,713	100,438	100,545	78,224	100,545	93,124
CSR	499,416	575,831	76,415	76,415	75,224	74,883	76,310	76,415	54,567	76,415	75,224
FYB	454,764	531,371	76,607	76,607	73,218	72,417	76,607	76,607	76,607	76,607	73,218
NBP (no CSOs)	3,537,838	3,991,783	453,945	435,762	435,891	432,106	453,475	454,633	435,333	453,945	435,891
TDB	1,112,424	1,254,746	142,323	142,323	136,375	134,388	140,646	141,713	76,192	142,323	136,375
TBS	895,817	1,127,110	231,293	231,293	228,635	228,055	230,271	231,293	227,513	231,293	228,635
TUX	381,828	439,446	57,617	57,617	55,905	55,189	57,437	57,617	56,986	57,617	55,905
WBN	527,067	837,496	310,429	310,429	292,233	289,677	310,091	310,429	244,140	310,429	292,233
WBS	1,263,600	1,422,426	158,826	158,826	154,454	152,434	158,287	158,826	84,867	158,826	154,454
WBW	329,983	466,272	136,289	136,289	132,743	132,525	135,887	135,943	118,531	136,289	132,743
WHR	246,421	334,238	87,817	87,817	87,129	86,870	87,817	87,817	77,777	87,817	87,129
WTR	389,091	654,922	265,831	265,831	250,322	248,748	265,759	265,831	260,647	265,831	250,322
Watershed	11,096,876	13,342,468	2,245,591	2,227,409	2,157,531	2,138,896	2,240,247	2,244,176	1,905,543	2,245,591	2,157,531

Sediment (TSS) Load Reductions with Watershed Management Recommendations

	Existing Conditions	Future Buildout without Controls	Load Reduction due to Controls							
Watershed Management Recommendation	lb/yr	lb/yr	Green Infrastructure in CSO areas	New Development LID	Stormwater Retrofits	Riparian Buffer Restoration	Reforestation	Open Space Protection	Public Education	IDDE/Septic systems
BBE	65,702	103,961	0.0%	5.3%	5.3%	0.47%	0.00%	29.3%	0.0%	5.3%
BBW	892,088	1,001,484	0.0%	3.1%	4.3%	0.23%	1.06%	20.4%	0.0%	3.1%
BHR	500,837	601,382	0.0%	7.4%	9.8%	0.11%	0.00%	22.2%	0.0%	7.4%
CSR	499,416	575,831	0.0%	1.6%	2.0%	0.14%	0.00%	28.6%	0.0%	1.6%
FYB	454,764	531,371	0.0%	4.4%	5.5%	0.00%	0.00%	0.0%	0.0%	4.4%
NBP (no CSOs)	3,537,838	3,991,783	4.0%	4.0%	4.8%	0.10%	-0.15%	4.1%	0.0%	4.0%
TDB	1,112,424	1,254,746	0.0%	4.2%	5.6%	1.18%	0.43%	46.5%	0.0%	4.2%
TBS	895,817	1,127,110	0.0%	1.1%	1.4%	0.44%	0.00%	1.6%	0.0%	1.1%
TUX	381,828	439,446	0.0%	3.0%	4.2%	0.31%	0.00%	1.1%	0.0%	3.0%
WBN	527,067	837,496	0.0%	5.9%	6.7%	0.11%	0.00%	21.4%	0.0%	5.9%
WBS	1,263,600	1,422,426	0.0%	2.8%	4.0%	0.34%	0.00%	46.6%	0.0%	2.8%
WBW	329,983	466,272	0.0%	2.6%	2.8%	0.30%	0.25%	13.0%	0.0%	2.6%
WHR	246,421	334,238	0.0%	0.8%	1.1%	0.00%	0.00%	11.4%	0.0%	0.8%
WTR	389,091	654,922	0.0%	5.8%	6.4%	0.03%	0.00%	2.0%	0.0%	5.8%
Watershed	11,096,876	13,342,468	0.8%	3.9%	4.8%	0.24%	0.06%	15.1%	0.0%	3.9%

Nitrogen Load Reductions with Watershed Management Recommendations

	Existing Conditions	Future Buildout without Controls	Load Increase without Controls	Load Increase with Controls							
Watershed Management Recommendation	lb/yr	lb/yr	lb/yr	Green Infrastructure in CSO areas	New Development LID	Stormwater Retrofits	Riparian Buffer Restoration	Reforestation	Open Space Protection	Public Education	IDDE/Septic systems
BBE	778	1,824	1,046	1,046	982	981	1,043	1,045	709	994	982
BBW	8,917	9,895	979	979	905	886	976	942	730	530	905
BHR	6,740	8,113	1,374	1,374	1,263	1,233	1,373	1,374	981	1,056	1,263
CSR	8,825	9,621	796	796	729	724	795	796	503	510	729
FYB	4,349	4,832	483	483	440	428	483	483	483	330	440
NBP (no CSOs)	37,808	42,098	4,290	4,034	3,962	3,906	4,285	4,267	4,101	2,822	3,962
TDB	15,486	17,236	1,750	1,750	1,611	1,582	1,731	1,731	870	1,175	1,611
TBS	10,149	11,516	1,367	1,367	1,259	1,249	1,354	1,367	1,345	666	1,259
TUX	7,142	7,722	579	579	528	518	577	579	573	275	528
WBN	5,187	8,013	2,827	2,827	2,604	2,573	2,823	2,827	2,192	2,555	2,604
WBS	13,603	15,352	1,749	1,749	1,612	1,583	1,743	1,749	907	1,203	1,612
WBW	6,680	6,234	-447	-447	-576	-579	-452	-455	-675	-822	-576
WHR	1,839	2,525	687	687	629	627	687	687	599	-206	629
WTR	4,719	7,523	2,804	2,804	2,584	2,562	2,803	2,804	2,737	2,418	2,584
Watershed	132,220	152,504	20,284	20,028	18,534	18,276	20,221	20,196	16,054	13,506	18,534

Nitrogen Load Reductions with Watershed Management Recommendations

	Existing Conditions	Future Buildout without Controls	Load Reduction due to Controls							
Watershed Management Recommendation	lb/yr	lb/yr	Green Infrastructure in CSO areas	New Development LID	Stormwater Retrofits	Riparian Buffer Restoration	Reforestation	Open Space Protection	Public Education	IDDE/Septic systems
BBE	778	1,824	0.0%	6.1%	6.2%	0.28%	0.05%	32.2%	4.9%	6.1%
BBW	8,917	9,895	0.0%	7.5%	9.5%	0.30%	3.75%	25.4%	45.9%	7.5%
BHR	6,740	8,113	0.0%	8.1%	10.2%	0.08%	0.00%	28.6%	23.1%	8.1%
CSR	8,825	9,621	0.0%	8.4%	9.0%	0.15%	0.00%	36.8%	36.0%	8.4%
FYB	4,349	4,832	0.0%	9.0%	11.3%	0.00%	0.00%	0.0%	31.7%	9.0%
NBP (no CSOs)	37,808	42,098	6.0%	7.6%	9.0%	0.13%	0.54%	4.4%	34.2%	7.6%
TDB	15,486	17,236	0.0%	7.9%	9.6%	1.10%	1.10%	50.3%	32.8%	7.9%
TBS	10,149	11,516	0.0%	7.9%	8.6%	0.95%	0.00%	1.6%	51.3%	7.9%
TUX	7,142	7,722	0.0%	8.8%	10.5%	0.34%	0.00%	1.1%	52.5%	8.8%
WBN	5,187	8,013	0.0%	7.9%	9.0%	0.12%	0.00%	22.5%	9.6%	7.9%
WBS	13,603	15,352	0.0%	7.9%	9.5%	0.35%	0.00%	48.1%	31.2%	7.9%
WBW	6,680	6,234	0.0%	-28.9%	-29.7%	-1.21%	-1.79%	-51.2%	-84.1%	-28.9%
WHR	1,839	2,525	0.0%	8.4%	8.7%	0.00%	0.00%	12.8%	130.0%	8.4%
WTR	4,719	7,523	0.0%	7.8%	8.6%	0.03%	0.00%	2.4%	13.8%	7.8%
Watershed	132,220	152,504	1.3%	8.6%	9.9%	0.31%	0.43%	20.9%	33.4%	8.6%

Phosphorus Load Reductions with Watershed Management Recommendations

	Existing Conditions	Future Buildout without Controls	Load Increase without Controls	Load Increase with Controls							
Watershed Management Recommendation	lb/yr	lb/yr	lb/yr	Green Infrastructure in CSO areas	New Development LID	Stormwater Retrofits	Riparian Buffer Restoration	Reforestation	Open Space Protection	Public Education	IDDE/Septic systems
BBE	112	197	84	84	77	77	84	84	58	83	77
BBW	1,096	1,227	131	131	119	115	130	125	105	115	119
BHR	1,115	1,342	227	227	206	200	227	227	173	222	206
CSR	822	934	112	112	101	100	112	112	75	105	101
FYB	543	641	98	98	89	87	98	98	98	92	89
NBP (no CSOs)	5,121	5,749	628	590	571	561	628	627	604	583	571
TDB	1,660	1,885	224	224	204	198	223	221	116	208	204
TBS	937	1,118	181	181	164	162	181	181	178	163	164
TUX	672	748	75	75	68	66	75	75	74	67	68
WBN	845	1,363	518	518	470	464	518	518	406	518	470
WBS	1,778	1,982	204	204	186	180	204	204	107	186	186
WBW	602	779	178	178	158	157	177	176	148	167	158
WHR	332	439	107	107	96	95	107	107	93	99	96
WTR	657	1,126	469	469	426	422	469	469	462	462	426
Watershed	16,291	19,528	3,237	3,199	2,935	2,886	3,233	3,225	2,698	3,070	2,935

Phosphorus Load Reductions with Watershed Management Recommendations

	Existing Conditions	Future Buildout without Controls	Load Reduction due to Controls							
Watershed Management Recommendation	lb/yr	lb/yr	Green Infrastructure in CSO areas	New Development LID	Stormwater Retrofits	Riparian Buffer Restoration	Reforestation	Open Space Protection	Public Education	IDDE/Septic systems
BBE	112	197	0.0%	8.6%	8.7%	0.18%	0.03%	31.0%	1.4%	8.6%
BBW	1,096	1,227	0.0%	8.9%	11.8%	0.12%	4.52%	19.6%	11.8%	8.9%
BHR	1,115	1,342	0.0%	9.2%	11.9%	0.03%	0.00%	23.9%	2.5%	9.2%
CSR	822	934	0.0%	10.1%	11.0%	0.06%	0.00%	32.8%	6.6%	10.1%
FYB	543	641	0.0%	9.3%	11.4%	0.00%	0.00%	0.0%	6.2%	9.3%
NBP (no CSOs)	5,121	5,749	6.0%	9.1%	10.7%	0.04%	0.18%	3.8%	7.2%	9.1%
TDB	1,660	1,885	0.0%	9.2%	11.5%	0.45%	1.38%	48.1%	7.1%	9.2%
TBS	937	1,118	0.0%	9.5%	10.4%	0.34%	0.00%	1.9%	10.0%	9.5%
TUX	672	748	0.0%	9.4%	12.0%	0.14%	0.00%	1.5%	10.4%	9.4%
WBN	845	1,363	0.0%	9.2%	10.5%	0.04%	0.00%	21.6%	0.1%	9.2%
WBS	1,778	1,982	0.0%	9.0%	11.7%	0.16%	0.00%	47.4%	8.9%	9.0%
WBW	602	779	0.0%	11.0%	11.4%	0.15%	0.81%	16.8%	6.0%	11.0%
WHR	332	439	0.0%	10.0%	10.4%	0.00%	0.00%	12.7%	7.1%	10.0%
WTR	657	1,126	0.0%	9.2%	10.1%	0.01%	0.00%	1.5%	1.5%	9.2%
Watershed	16,291	19,528	1.2%	9.3%	10.8%	0.10%	0.36%	16.6%	5.1%	9.3%

Appendix H

Implementation Schedule

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North Branch Park River Watershed Management Plan - Proposed Implementation Schedule

Action Items	Lead Entity	Timeline	Products	Evaluation Criteria
Objective A-1. Establish Watershed Organization				
Establish watershed organization	FRWA/PRWRI	I yr	Watershed organization established, coordinator hired, advisory committee formed, plan adoption, grant applications	Amount of funding secured and grant applications submitted
Secure funding and hire coordinator	Watershed Organization			
Establish advisory committee	Watershed Organization			
Adopt watershed management plan	Towns			
Identify potential funding sources	Watershed Organization			
Submit grant applications	Watershed Organization and Towns			
Objective A-2. Conduct Additional Field Assessments				
Perform additional field assessments	Watershed Organization	1-2 yrs	Assessment findings	Number of unassessed reaches and areas completed
Objective B-1. Reduce or Eliminate CSO Discharges				
Implement Long Term Control Plan	MDC	Ongoing	Projects completed	
Consider green infrastructure to augment LTCP	MDC	2-10 yrs	Green infrastructure plan	Number of green infrastructure projects implemented
Objective B-2. Implement LID and Green Infrastructure				
Evaluate feasibility of incorporating green approaches in LTCP and City of Hartford stormwater management program	MDC, City of Hartford	Ongoing	Evaluation findings and green infrastructure plan	
Albany Ave and Granby St outfall controls	MDC	1 yr	Modified designs	Controls implemented
Implement green infrastructure demonstration projects	MDC, City of Hartford	1-5 yrs	Completed projects	Number of sites, monitoring
Require green approaches in MDC project design	MDC	Ongoing	Contract/RFP language	
Modify municipal land use regulations to promote LID	Towns	1-2 yrs	Modified/new regulations	
Adopt green infrastructure and LID in municipal projects	Towns	2-10 yrs	Revised standards and completed projects	Number of projects, monitoring
Implement priority stormwater retrofits	Watershed Organization	2-10 yrs	Completed projects	Photos, number of sites, monitoring
Objective B-3. Identify and Eliminate Illicit Discharges				
Targeted illicit discharge investigations	Towns	1-2 yrs	Investigation findings	Number of discharges removed
Implement municipal IDDE programs	Towns	2-5 yrs	Investigation findings	Number of discharges removed
Implement priority stream cleanup efforts	Watershed Organization	1-2 yrs	Completed projects	Photos, number of sites, monitoring
Objective B-4. Protect and Restore Riparian Buffers				
Priority riparian buffer restoration projects	Watershed Organization	2-10 yrs	Completed projects	Photos, number of sites, monitoring
Adopt/strengthen stream buffer regulations	Towns	2-5 yrs	Modified/new regulations	

North Branch Park River Watershed Management Plan - Proposed Implementation Schedule

Action Items	Lead Entity	Timeline	Products	Evaluation Criteria
Incorporate minimum buffer widths into municipal wetland regulations	Towns	1-2 yrs	Modified/new regulations	
Adopt developer incentives to restore buffers	Towns	1-2 yrs	New incentives	Number of projects
Amend Greater Hartford Flood Commission regulations	City of Hartford, Flood Commission	1-2 yrs	Modified regulations	
Objective B-5. Implement Water Quality Monitoring Program				
Develop and implement long-term monitoring program	Watershed Organization	1-2 yrs	QAPP, monitoring data, reporting	Monitoring results, findings
Implement field monitoring study of LID effectiveness	Watershed Organization	2-5 yrs	QAPP, monitoring data, reporting	Monitoring results, findings
Objective C-1. Enhance In-stream and Riparian Habitat				
Conduct watershed fish passage assessments	Watershed Organization	1-2 yrs	Assessment findings	
University of Hartford dam feasibility study	University of Hartford	Ongoing	Feasibility study report	Habitat and water quality enhancements completed
Revise stream crossing & stormwater design standards	Towns	1-2 yrs	Revised standards	
Implement priority stream restoration projects	Watershed Organization and Towns	2-10 yrs	Completed projects	Photos, number of sites, monitoring
Implement stream daylighting projects	Watershed Organization and Towns	5-10 yrs	Completed projects	Photos, number of sites, monitoring
Objective C-2. Protect and Enhance Forests and Urban Tree Canopy and Restore Understory Vegetation				
Conduct watershed-wide urban tree canopy analysis	Watershed Organization	1-2 yrs	Analysis report	Existing tree canopy and potential UTC goals
Develop Town-based UTC goals and plan	Towns	2-5 yrs	Established canopy goals and plan	Plan implementation
Amend municipal regulations	Towns	1-2 yrs	Amended regulations	
Implement priority reforestation projects	Towns	2-10 yrs	Completed projects	Photos, number of sites, monitoring
Engage tree wardens in watershed municipalities	Watershed Organization	1-5 yrs	Meetings and discussions with tree wardens	Participation by tree wardens in urban forestry efforts
Implement reforestation demonstration projects	Watershed Organization and Towns	1-5 yrs	Completed projects	Photos, number of sites, monitoring
Landowner education, stewardship, incentive programs	Watershed Organization and Towns	1-2 yrs	Educational events and materials	Number of participants and audience reached
Adopt City of Hartford Tree Ordinance and master plan	City of Hartford	Pending	Adopted ordinance and plan	Number of projects and plan recommendations implemented
Promote urban agriculture, community gardens	Towns	2-5 yrs	Community gardens	Number of gardens
Objective C-3. Control Invasive Species				
Develop invasive species management plan	Watershed Organization,	2-5 yrs	Management plan	

North Branch Park River Watershed Management Plan - Proposed Implementation Schedule

Action Items	Lead Entity	Timeline	Products	Evaluation Criteria
	Towns, Universities & Schools			
Implement priority invasives management projects	Watershed Organization, Towns, Universities & Schools	2-10 yrs	Completed projects	Photos, number of sites, monitoring
Objective D-1. Promote Smart Growth				
Modify municipal land use codes, ordinances, and plans	Towns	1-2 yrs	Modified land use codes, ordinances, and plans	
Objective D-2. Protect Open Space				
Priority land acquisitions and conservation restrictions	Towns	1-5 yrs	Protected land	Number of sites and acres protected
Continue to implement municipal open space plans	Towns	Ongoing		
Seek alternative open space funding sources	Towns	1-5 yrs		
Promote use of open space through trail maps & events	Watershed Organization	1-5 yrs	New maps and events	Number of maps and events
Identify and protect priority farmland	Town of Bloomfield	2-5 yrs	Prioritized list, and protected land	Number of sites and acres protected
Objective D-3. Promote Low-Impact, Context-Sensitive Greenways				
Develop greenway links	City of Hartford, Town of Bloomfield, UHartford	2-10 yrs	Projects completed	Number of trail miles completed
Incorporate LID and conservation design elements	City of Hartford, Town of Bloomfield, UHartford	2-10 yrs	Project designs	Low impact and context sensitive design elements
Objective D-4. Increase Public Access to the River				
Enhance river access on public lands	Towns	5-10 yrs	Completed projects	Number of sites
Develop public access inventory for the watershed	Watershed Organization	1-2 yrs	Inventory mapping	
Implement signs, interpretive stations, online resources	Watershed Organization	2-5 yrs	New signage, stations, updated website	Number implemented, audience reached
Provide linkages between river and cultural institutions	City of Hartford	2-5 yrs	Completed projects	
Objective E-1. Creation of Education & Stewardship Network				
Develop framework for K-12 education network	Watershed Organization	1-2 yrs	Program framework	
Develop toolkit and establish network	Watershed Organization	2-5 yrs	Completed toolkit and formal network established	Number of participants and audience reached
Objective E-2. Campus Facility Managers Outreach				
Organize and host workshops	Watershed Organization	1-5 yrs	Workshop events and outreach materials	Number of events and audience reached
Encourage student/faculty involvement	Universities and Schools	1-5 yrs	University and school programs	Number of participants
Objective E-3. Residential Outreach				
Foster a "block-by-block" approach for the restoration and conservation of stream reaches and ponds.	Watershed Organization, landowners, neighborhood	1-5 yrs	Completed projects	Number of events, participants, and projects completed

North Branch Park River Watershed Management Plan - Proposed Implementation Schedule

Action Items	Lead Entity	Timeline	Products	Evaluation Criteria
	groups			
Increase watershed stewardship signage	Towns	2-5 yrs	New signage	Number of signs and program participants
Encourage and provide incentives for roof disconnection	Towns	2-5 yrs	Incentive programs	Number of disconnections
Develop education/outreach materials	Watershed Organization	1-2 yrs	Educational materials	Number of participants and audience reached
Deliver education/outreach to the public	Towns	2-5 yrs		
Objective E-4. Municipal and Business Outreach				
Review municipal facility compliance	Towns	1-2 yrs	Revised municipal stormwater management plan and program	MS4 General Permit compliance
Improve municipal stormwater management programs	Towns	1-5 yrs		
Develop education/outreach materials	Watershed Organization	1-2 yrs	Educational materials	Number of participants and audience reached
Deliver education/outreach to the public	Towns	2-5 yrs		
Increase watershed stewardship signage	Towns	2-5 yrs	New signage	Number of signs and participants

Appendix I

Potential Funding Sources

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North Branch Park River Watershed Management Plan - Potential Funding Sources

Funding Source	Maximum Dollar Amount	Minimum Dollar Amount	Required Match	Applications Open	Deadline
DEP Watershed Funding Website					
http://www.ct.gov/dep/cwp/view.asp?a=2719&q=335494&depNav_GID=1654&pp=12&n=1 Index of many potential funding sources for funding watershed-based planning projects.					
EPA Green Infrastructure Funding Website					
http://cfpub.epa.gov/npdes/greeninfrastructure/fundingopportunities.cfm Index to funding opportunities for LID practices and pollution reduction projects.					
DEP CT Landowner Incentive Program	Up to $25,000	At least 25%			
http://www.ct.gov/dep/cwp/view.asp?a=2723&q=325734&depNav_GID=1655					
DEP Long Island Sound License Plate Program	$25,000			January	March
http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323782&depNav_GID=1635					
DEP Open Space and Watershed Land Acquisition				March	June
860-424-3016 david.stygar@ct.gov http://www.ct.gov/dep/cwp/view.asp?a=2706&q=323834&depNav_GID=1641					
DEP Recreation and Natural Heritage Trust Program					
http://www.ct.gov/dep/cwp/view.asp?a=2706&q=323840&depNav_GID=1641					
DEP America the Beautiful Grant Program	$8000		50%	May	June
USDA Forest Service funding through the CTDEP Division of Forestry to support urban forestry efforts. www.ct.gov/dep/forestry					
Eastman Kodak / Nat'l Geographic American Greenways Awards optional Program	$2500	$300	Optional	April	June
jwhite@conservationfund.org, Jen White					
EPA Healthy Communities Grant Program	$35,000	$5,000	Optional, up to 5%	March	May
617-918-1698 Padula.Jennifer@epa.gov					
Northeast Utilities Environmental Community Grant Program	$1,000	$250			April 15
http://www.nu.com/environmental/grant.asp Cash incentives for non-profit organizations					
EPA Targeted Watershed Grants Program			25% of total project costs (non-federal)		
http://www.epa.gov/twg/ Requires Governor nomination.					
DEP CWA Section 319 NPS			40% of total project costs (non-federal)		October 15
Nonpoint Source Management http://www.ct.gov/dep/nps 20-25 projects targeting both priority watersheds and statewide issues.					

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North Branch Park River Watershed Management Plan - Potential Funding Sources

Funding Source	Maximum Dollar Amount	Minimum Dollar Amount	Required Match	Applications Open	Deadline
DEP Section 6217 Coastal NPS			N/A		
http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323554&depNav_GID=1709 Section 6217 of the CZARA of 1990 requires the State of Connecticut to implement specific management measures to control NPS pollution in coastal waters. Management measures are economically achievable measures that reflect the best available technology for reducing nonpoint source pollution. Hartford and Windsor, but not Bloomfield nor West Hartford, are located in this area.					
DEP Hazard Mitigation Grant Program			75% Federal / 25% Local		
http://www.ct.gov/dep/cwp/view.asp?a=2720&q=325654&depNav_GID=1654 Provides financial assistance to state and local governments for projects that reduce or eliminate the long-term risk to human life and property from the effects from natural hazards.					
NRCS Conservation Reserve Program					
http://www.nrcs.usda.gov/programs/crp/ Joyce Purcell, 860-871-4028 This program is available to farmers and ranchers to address natural resource concerns on their lands.					
American Rivers – NOAA Community-Based Restoration Program Partnership					
http://www.americanrivers.org/our-work/restoring-rivers/dams/noaa-grants-program.html These grants are designed to provide support for local communities that are utilizing dam removal or fish passage to restore and protect the ecological integrity of their rivers and improve freshwater habitats important to migratory fish.					
FishAmerica Foundation Conservation Grants	Average $7,500				
703-519-9691 x247 fishamerica@asafishing.org					
Municipal Flood & Erosion Control Board	1/3 project cost	2/3 project cost			
NOAA Open Rivers Initiative	$3,000,000	$100,000	Optional 1:1 non-federal		Nov. 17, 2010
http://www.habitat.noaa.gov/funding/ori.html Tisa Shostik (Tisa.Shostik@noaa.gov) 301-713-0174 x184 Cathy Bozek (Cathy.Bozek@noaa.gov) 301-713-0174 x150					
NFWF Long Island Sound Futures Fund Small Grants	$6,000	$1,000	Optional (non-federal)	Fall/Winter	Spring/ Summer
NFWF Long Island Sound Futures Fund Large Grants	$150,000	$10,000	Optional (non-federal)	Fall/Winter	Spring/ Summer
631-289-0150 Lynn Dwyer Lynn.Dwyer@nfwf.org					
NRCS Conservation Reserve Program					
http://www.nrcs.usda.gov/programs/crp/ Joyce Purcell, 860-871-4028 This program is available to farmers and ranchers to address natural resource concerns on their lands.					
NRCS Wildlife Habitat Incentives Program (WHIP)	$50,000/year	$1,000	25%		
Joyce Purcell, 860-871-4028 http://www.ct.nrcs.usda.gov For creation, enhancement, maintenance of wildlife habitat; for privately owned lands.					
NRCS Environmental Quality Incentives Program (EQIP)	$50,000/year		25-50%		
Joyce Purcell, 860-871-4028 http://www.ct.nrcs.usda.gov For implementation of conservation measures on agricultural lands.					
NRCS Healthy Forests Reserve Program					
http://www.nrcs.usda.gov/programs/hfrp/proginfo/index.html For restoring and enhancing forest ecosystems					

North Branch Park River Watershed Management Plan - Potential Funding Sources

Funding Source	Maximum Dollar Amount	Minimum Dollar Amount	Required Match	Applications Open	Deadline
NRCS Wetlands Reserve Program					
Nels Barrett, (860) 871-4015 http://www.ct.nrcs.usda.gov For protection, restoration and enhancement of wetlands					
USFS Watershed and Clean Water Action and Forestry Innovation Grants					
http://www.na.fs.fed.us/watershed/gp_innovation.shtm This effort between USDA FS-Northeastern Area and State Foresters is to implement a challenge grant program to promote watershed health through support of state and local restoration and protection efforts.					
Corporate Wetlands Restoration Partnership (CWRP)	Typically $20,000	Typically $5,000	3 to 1	April and August	
http://www.ctcwrp.org/9/ Can also apply for in-kind services, e.g. surveying, etc.					
River's Alliance Watershed Assistance Small Grants Program			40% of total project costs (non-federal)		
http://www.riversalliance.org/watershedassistancegrantrfp.cfm 860-361-9349 rivers@riversalliance.org Funding passed through River's Alliance from CTDEP's 319 NPS grant program for establishing new or emerging river – watershed organizations.					
Trout Unlimited Embrace A Stream	$5,000				
http://www.tu.org/conservation/watershed-restoration-home-rivers-initiative/embrace-a-stream					
USFWS National Coastal Wetlands Conservation Grant Program	$1 million		50%		
Ken Burton 703-358-2229 Only states can apply.					
YSI Foundation	$60,000		Optional	March	April
937-767-7241 x406 Susan Miller Susan Miller smiller@ysi.com					

Other Financial Opportunities

Private Foundation Grants and Awards

http://www.rivernetwork.org Private foundations are potential sources of funding to support watershed management activities. Many private foundations post grant guidelines on websites. Two online resources for researching sources of potential funding are provided in the contact information.

Hartford Foundation for Public Giving - Greater Hartford's community-wide charitable endowment. Hartford Foundation for Public Giving provides financial and other support that enables people and institutions to serve the community effectively; promote informed charitable giving in order to expand the region's philanthropic resources; and participate actively in efforts to identify important community needs and opportunities, as well as the means to address them. http://www.hfpg.org/

Congressional Appropriation - Direct Federal Funding

Congressman Larson, Courtney, DeLauro, Himes, Murphy

State Appropriations - Direct State Funding

http://www.cga.ct.gov/

Membership Drives

Membership drives can provide a stable source of income to support watershed management programs.

Donations

Donations can be a major source of revenue for supporting watershed activities, and can be received in a variety of ways.

User Fees, Taxes, and Assessments

Taxes are used to fund activities that do not provide a specific benefit, but provide a more general benefit to the community.

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North Branch Park River Watershed Management Plan - Potential Funding Sources

Funding Source	Maximum Dollar Amount	Minimum Dollar Amount	Required Match	Applications Open	Deadline
Rates and Charges					
State law authorizes some public utilities to collect rates and charges for the services they provide.					
Stormwater Utility Districts					
A stormwater utility district is a legal construction that allows municipalities to designated management districts where storm sewers are maintained in order to the quality of local waters. Once the district is established, the municipality may assess a fee to all property owners.					
Impact Fees					
Impact fees are also known as capital contribution, facilities fees, or system development charges, among other names.					
Special Assessments					
Special assessments are created for the specific purpose of financing capital improvements, such as provisions, to serve a specific area.					
Sales Tax/Local Option Sales Tax					
Local governments, both cities and counties, have the authority to add additional taxes. Local governments can use tax revenues to provide funding for a variety of projects and activities.					
Property Tax					
These taxes generally support a significant portion of a county's or municipality's non-public enterprise activities.					
Excise Taxes					
These taxes require special legislation, and the funds generated through the tax are limited to specific uses: lodging, food, etc.					
Bonds and Loans					
Bonds and loans can be used to finance capital improvements. These programs are appropriate for local governments and utilities to support capital projects.					
Investment Income					
Some organizations have elected to establish their own foundations or endowment funds to provide long-term funding stability. Endowment funds can be established and managed by a single organization-specific foundation or an organization may elect to have a community foundation to hold and administer its endowment. With an endowment fund, the principal or actual cash raised is invested. The organization may elect to tap into the principal under certain established circumstances.					
Emerging Opportunities For Program Support					
Water Quality Trading allows regulated entities to purchase credits for pollutant reductions in the watershed or a specified part of the watershed to meet or exceed regulatory or voluntary goals. There are a number of variations for water quality credit trading frameworks. Credits can be traded, or bought and sold, between point sources only, between NPSs only, or between point sources and NPSs.					
Mitigation and Conservation Banks are created by property owners who restore and/or preserve their land in its natural condition. Such banks have been developed by public, nonprofit, and private entities. In exchange for preserving the land, the "bankers" get permission from appropriate state and federal agencies to sell mitigation banking credits to developers wanting to mitigate the impacts of proposed development. By purchasing the mitigation bank credits, the developer avoids having to mitigate the impacts of their development on site. Public and nonprofit mitigation banks may use the funds generated from the sale of the credits to fund the purchase of additional land for preservation and/or for the restoration of the lands to a natural state.					