

Project Final Report

Monoosnoc Brook Renewal
Project Number 14-03/319

Dates: 3/6/14 – 6/30/17

Grantee: Massachusetts Watershed Coalition

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PREPARED FOR:

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER RESOURCES

AND

US ENVIRONMENTAL PROTECTION AGENCY
REGION 1

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DIVISION OF MUNICIPAL SERVICES
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319 Monoosnoc Brook Renewal

Project Number 14-03/319

Draft Final Report



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A. Project Snapshot

Project Number and Title: Monoosnoc Brook Renewal
Project Number 14-03/319

A1. Project start date: 3/6/14

A2. Date closed: 6/30/17

A3. Basin and HUC 12 subwatershed: Nashua River, HUC ID # 010700040103,
Monoosnoc Brook to mouth

A4. Segment and/or waterbody number(s): Monoosnoc River, MA81-13_2004

A5. Status of waterbody: Category 5

A6. Priority Pollutants targeted: Phosphorus and TSS

A7. Estimated Annual Pollutant removal (quantity, not percentage)

N: 26 lbs. /year

P: 21.3 lbs. /year

Sediment: 149,316 lbs. /year

Bacteria: n/a

Other: n/a

Method of Determination: CEI s.319 NPS method developed for MassDEP.

A8. BMPs installed, number and type:

- (4) Sediment tanks/vaults [Elm Street, Pond Street, Cotton Street, Adams Street]
- (1) Infiltration trench [Adams Street]
- (4) Treebox filters [Gardner Street, Vine Street, Hale Street, Laurie Street]
- (2) Bio-retention areas [Bowen Place & Monoosnoc Brook Walk bioswales]
3,530 square feet of porous pavers for Monoosnoc Brook Walk, Phase I
- (10) Deep sump catch basins [Columbia St, Elm & Pond, Water St, Laurie St]

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 14-03/319

PROJECT TITLE: Monoosnoc Brook Renewal Project
NPS CATEGORY: Urban Runoff
INVESTIGATOR: Massachusetts Watershed Coalition
LOCATION: Nashua Basin
TARGETED POLLUTANTS: Phosphorus and TSS

DESCRIPTION:

Monoosnoc Brook and its watershed are well-used for outdoor recreation activities. The Brook flows out of the Monoosnoc Hills on the west side of Leominster, connecting six impoundments, Leominster's busy downtown area, and a variety of industrial facilities. Densely developed areas are major sources of nonpoint source pollution, and the lower two thirds of the Brook are increasingly impaired for aquatic life and contact recreation uses. The pollutants are transported downstream into the North Nashua River, which is listed as Category 5 on the 2014 Integrated List of Waters for multiple impairments.

This project followed Monoosnoc Brook Project 07-03/319, which implemented initial source reduction BMPs in the Rockwell Pond watershed. Additional remediation practices were installed through Project 10-03/319 in very densely developed areas of the Lower Monoosnoc Brook watershed. Improvements in stream health continue to increase riparian property values, advance reuse of abandoned buildings next to the Brook, and provide an ongoing stimulus for creation of streamside parks and trails.

Activities included installation of sediment vaults, an infiltration trench, tree box filters, porous pavers, bio-swales and deep sump catch basins to reduce the amount of pollutants being discharged to the Brook. The project also created the BMP Cost Catalog to help communities select stormwater BMPs that can achieve more pollutant reduction for less cost.

PROJECT COST: \$ 804,728

FUNDING: \$ 229,000 by the US EPA
\$ 19,998 by MA Watershed Coalition
\$ 118,085 by Gateway City Parks Program (Monoosnoc Brook Walk)
\$ 437,645 by the City of Leominster

DURATION: March 6, 2014 – June 30, 2017

C. Project Finances

The purpose of this section is to summarize how public funds were utilized for the project.

Project Budget:

The following pages provide:

1. Initial contract budget - Scope of Work Attachment B
2. Budget Amendment #1 (1/21/16) approved by DEP Project Officer
3. Budget Amendment #2 (1/26/17) approved by DEP Project Officer
4. Budget Amendment #3 (5/05/17) approved by DEP Project Officer

Project Expenditures and Circumstances:

- Project budget was adjusted for changes in estimated expenses for MWC work, engineering guidance-cost catalog, graphic design, landscaping & construction, and BMP materials.
- Total matching support was more than budgeted amount (see below) including additional engineering, DPW and MWC work required for BMPs design, installation and inspection.
- Expenditures for contractors, BMP supplies and materials were adjusted for changes in site locations and implementation activities.

Match Documentation:

The total match of \$ 575,728 was more than the required match of \$ 286,000. This amount did exceed the 56% non-federal match for total project expenses of \$ 804,728. The total non-federal included: DPW in-kind match; DPW cash match; in-kind match by MWC; and the Gateway City Program.

**Attachment B
Budget**

**Monoosnoc Brook Renewal Project
Project # 14-03/319**

Expense Item	319 Amount	Non-Federal Match	Total
Salaries			
Massachusetts Watershed Coalition: MWC Executive Director (\$50-\$60/hr)	\$54,000	\$9,500	\$63,500
City of Leominster: DPW Highway Director (\$50/hr)	\$	\$8,000	\$8,000
DPW Surveyor (\$40/hr)	\$	\$4,000	\$4,000
Water Dept. Business Manager (\$40/hr)	\$	\$8,000	\$8,000
DPW Cash Match	\$	\$9,000	\$9,000
Subtotal Salaries	\$54,000	\$38,500	\$92,500
Subcontractual			
Engineering Design	\$20,000	\$ 0	\$20,000
Engineering Guidance-Cost Catalog	\$15,000	\$ 2,500	\$17,500
Graphic Design	\$10,000	\$ 0	\$10,000
Landscaping and Construction	\$95,000	\$ 0	\$95,000
City of Leominster (Installations)	\$ 0	\$80,000	\$80,000
Porous Sidewalk & Rain Garden	\$ 0	\$105,000	\$105,000
Subtotal Subcontractual	\$140,000	\$187,500	\$327,500
BMP Materials and Supplies	\$35,000	\$60,000	\$95,000
Travel (.40/mile)	\$ 0	\$ 0	\$ 0
Totals	\$229,000	\$286,000	\$515,000
Percent	44%	56 %	100%

The Department will retain 10% of the total maximum obligation of the 319 grant funds, until all contract provisions are satisfied and final reports and other products are delivered and accepted. This 10% retainage shall be reflected on each invoice submitted by the Grantee and will be cumulative in the amount of \$22,900 (10% of the contract amount).

The Fair Share goals for construction are 3.4% D/MBE and 3.8 % D/WBE on the total project dollars. To comply with DBE participation goals it is anticipated that at least \$17,510 for MBE and \$19,570 for D/WBE will be expended for subcontractual services, as shown above.

**Attachment B
Budget Amendment – January 21, 2016**

**Monoosnoc Brook Renewal Project
Project # 14-03/319**

Expense Item	319 Amount	Amendment	Non-Federal Match	Total
Salaries				
Massachusetts Watershed Coalition: MWC Executive Director (\$50-\$60/hr)	\$54,000	\$63,000	\$9,500	\$72,500
City of Leominster:				
DPW Highway Director (\$50/hr)	\$0	\$0	\$8,000	\$8,000
DPW Surveyor (\$40/hr)	\$0	\$0	\$4,000	\$4,000
Water Dept. Business Manager (\$40/hr)	\$0	\$0	\$8,000	\$8,000
DPW Cash Match	\$0	\$0	\$9,000	\$9,000
Subtotal Salaries	\$54,000	\$63,000	\$38,500	\$101,500
Subcontractual				
Engineering Design	\$20,000	\$20,000	\$0	\$20,000
Engineering Guidance-Cost Catalog	\$15,000	\$18,000	\$ 2,500	\$20,500
Graphic Design	\$10,000	\$10,000	\$0	\$10,000
Landscaping and Construction	\$95,000	\$83,000	\$0	\$83,000
City of Leominster (Installations)	\$0	\$0	\$80,000	\$80,000
Porous Sidewalk & Rain Garden	\$0	\$0	\$105,000	105,000
Subtotal Subcontractual	\$140,000	\$131,000	\$187,500	\$318,500
BMP Materials and Supplies	\$35,000	\$35,000	\$60,000	\$95,000
Travel (.40/mile)	\$0	\$0	\$0	\$0
Totals	\$229,000	\$229,000	\$286,000	\$515,000
Percent	44%	44%	56%	100%

The Department will retain 10% of the total maximum obligation of the 319 grant funds, until all contract provisions are satisfied and final reports and other products are delivered and accepted. This 10% retainage shall be reflected on each invoice submitted by the Grantee and will be cumulative in the amount of \$22,900 (10% of the contract amount).

The Fair Share goals for construction are 3.4% D/MBE and 3.8 % D/WBE on the total project dollars. To comply with DBE participation goals it is anticipated that at least \$17,510 for MBE and \$19,570 for D/WBE will be expended for subcontractual services, as shown above.

**Attachment B
Budget Amendment 2 – January 26, 2017**

**Monoosnoc Brook Renewal Project
Project # 14-03/319**

Expense Item	319 Amount	Amendment	Non-Federal Match	Total
Salaries				
Massachusetts Watershed Coalition: MWC Executive Director (\$50-\$60/hr)	\$63,000	\$68,000	\$9,500	\$77,500
City of Leominster:				
DPW Highway Director (\$50/hr)	\$0	\$0	\$8,000	\$8,000
DPW Surveyor (\$40/hr)	\$0	\$0	\$4,000	\$4,000
Water Dept. Business Manager (\$40/hr)	\$0	\$0	\$8,000	\$8,000
DPW Cash Match	\$0	\$0	\$9,000	\$9,000
Subtotal Salaries	\$63,000	\$68,000	\$38,500	\$106,500
Subcontractual				
Engineering Design	\$20,000	\$20,000	\$0	\$20,000
Engineering Guidance-Cost Catalog	\$18,000	\$18,000	\$ 2,500	\$20,500
Graphic Design	\$10,000	\$ 2,500	\$0	\$ 2,500
Landscaping and Construction	\$83,000	\$78,450	\$0	\$78,450
City of Leominster (Installations)	\$ 0	\$0	\$ 80,000	\$80,000
Porous Sidewalk & Rain Garden	\$ 0	\$0	\$105,000	105,000
Subtotal Subcontractual	\$131,000	\$118,950	\$187,500	\$306,450
BMP Materials and Supplies	\$35,000	\$42,050	\$60,000	\$102,050
Travel (.40/mile)	\$ 0	\$ 0	\$ 0	\$0
Totals	\$229,000	\$229,000	\$286,000	\$515,000
Percent	44%	44%	56%	100%

The Department will retain 10% of the total maximum obligation of the 319 grant funds, until all contract provisions are satisfied and final reports and other products are delivered and accepted. This 10% retainage shall be reflected on each invoice submitted by the Grantee and will be cumulative in the amount of \$22,900 (10% of the contract amount).

The Fair Share goals for construction are 3.4% D/MBE and 3.8 % D/WBE on the total project dollars. To comply with DBE participation goals it is anticipated that at least \$17,510 for MBE and \$19,570 for D/WBE will be expended for subcontractual services, as shown above.

Amended 1/26/2017 to better reflect actual project costs. Approved M. Harper, 1/26/2017.

Attachment B
Budget Amendment 3 -May 5, 2017
Monoosnoc Brook Renewal Project
Project # 14-03/319

Expense Item	319 Amount	Amendment	Non-Federal Match	Total
Salaries				
Massachusetts Watershed Coalition: MWC Executive Director (\$50-\$60/hr)	\$68,000	\$69,043	\$9,500	\$78,543
City of Leominster:				
DPW Highway Director (\$50/hr)	\$0	\$0	\$8,000	\$ 8,000
DPW Surveyor (\$40/hr)	\$0	\$0	\$4,000	\$ 4,000
Water Dept. Business Manager (\$40/hr)	\$0	\$0	\$8,000	\$ 8,000
DPW Cash Match	\$0	\$0	\$9,000	\$ 9,000
Subtotal Salaries	\$68,000	\$69,043	\$38,500	\$107,543
Subcontractual				
Engineering Design	\$20,000	\$19,883	\$0	\$ 19,883
Engineering Guidance-Cost Catalog	\$18,000	\$17,492	\$ 2,500	\$ 19,992
Graphic Design	\$ 2,500	\$ 2,500	\$0	\$ 2,500
Landscaping and Construction	\$78,450	\$78,440	\$0	\$ 78,440
City of Leominster (Installations)	\$0	\$0	\$ 80,000	\$ 80,000
Porous Sidewalk & Rain Garden	\$0	\$0	\$105,000	\$105,000
Subtotal Subcontractual	\$118,950	\$118,315	\$187,500	\$305,815
BMP Materials and Supplies	\$42,050	\$41,642	\$60,000	\$101,642
Travel (.40/mile)	\$0	\$0	\$0	\$0
Totals	\$229,000	\$229,000	\$286,000	\$515,000
Percent	44%		56 %	100%

The Department will retain 10% of the total maximum obligation of the 319 grant funds, until all contract provisions are satisfied and final reports and other products are delivered and accepted. This 10% retainage shall be reflected on each invoice submitted by the Grantee and will be cumulative in the amount of \$22,900 (10% of the contract amount).

The Fair Share goals for construction are 3.4% D/MBE and 3.8 % D/WBE on the total project dollars. To comply with DBE participation goals it is anticipated that at least \$17,510 for MBE and \$19,570 for D/WBE will be expended for subcontractual services, as shown above.

Amended 1/26/2017 to better reflect actual project costs. Approved M. Harper, 1/26/2017.

Amended 5/5/2017 to better reflect final project costs. Approved M. Harper, 5/5/2017.

D. Description of BMP Installations

Location: 11 Elm Street

- D1.Type of BMP: 2,500 gallon sediment vault/tank (aka Water Quality Inlet)
- D2.Date of implementation: August 2016
- D3.Size of treatment area: 8 acres paved roadway & driveways
- D4.Area Land Use: residential area
- D5.Pollutant load removed: 28,000 lbs. TSS; 3.6 lbs. TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: "The estimations in this report were determined using the appropriate estimation model and applied according to the procedures prescribed for the model. To the best of my knowledge these are reasonable estimates using appropriate methods. Documentation is kept on file by the grantee and is available for review by DEP / EPA."
Ed Himlan - Edward Himlan, Massachusetts Watershed Coalition, 3/1/17

Location: 20 Pond Street

- D1.Type of BMP: 2,500 gallon sediment vault/tank (aka Water Quality Inlet)
- D2.Date of implementation: July 2016
- D3.Size of treatment area: 12 acres paved roadway, driveways and paved parking lot
- D4.Area Land Use: high density residential and commercial areas
- D5.Pollutant load removed: 42,000 lbs. TSS; 5.4 lbs.TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: 98 Cotton Street

- D1.Type of BMP: twin 5,000 gallon sediment vault/tank (aka Water Quality Inlet)
- D2.Date of implementation: June 2015
- D3.Size of treatment area: 10.56 acres paved roadway, driveways and paved parking lot
- D4.Area Land Use: residential and commercial areas
- D5.Pollutant load removed: 36,960 lbs. TSS; 4.76 lbs.TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: 20 Adams Street

- D1.Type of BMP: twin 2,500 gallon sediment vault/tank (aka Water Quality Inlet)
- D2.Date of implementation: July 2016
- D3.Size of treatment area: 5.74 acres paved roadway and paved parking lot
- D4.Area Land Use: high density residential and commercial areas
- D5.Pollutant load removed: 20,090 lbs. TSS; 2.58 lbs.TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: 93 Adams Street

- D1.Type of BMP: twin deep sump catch basin and infiltration trench
- D2.Date of implementation: October 2015
- D3.Size of treatment area: 0.23 acres paved roadway and paved parking lot
- D4.Area Land Use: high density residential and commercial areas
- D5.Pollutant load removed: 920 lbs. TSS; 0.57 lbs. TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: 55 Gardner Place

- D1.Type of BMP: StormTree system in road right-of-way
- D2.Date of implementation: October 2015
- D3.Size of treatment area: 0.9 acre paved roadway and driveways
- D4.Area Land Use: Roadway & driveways in high density residential neighborhood
- D5.Pollutant load removed: 4,050 lbs. TSS; 0.88 lbs. TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: 6 Vine Street

- D1.Type of BMP: StormTree system in road right-of-way
- D2.Date of implementation: October 2015
- D3.Size of treatment area: 1.2 acre paved roadway and driveways
- D4.Area Land Use: Roadway & driveways in high density residential neighborhood
- D5.Pollutant load removed: 5,400 lbs. TSS; 1.17 lbs. TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: 10 Hale Street

- D1.Type of BMP: StormTree system in road right-of-way
- D2.Date of implementation: November 2016
- D3.Size of treatment area: 0.7 acre paved roadway and driveways
- D4.Area Land Use: Roadway & driveways in high density residential neighborhood
- D5.Pollutant load removed: 3,150 lbs. TSS; 0.68 lbs. TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: 45 Laurie Drive

- D1.Type of BMP: StormTree system in road right-of-way
- D2.Date of implementation: November 2016
- D3.Size of treatment area: 0.25 acre paved roadway and driveways
- D4.Area Land Use: Roadway & driveways in high density residential neighborhood
- D5.Pollutant load removed: 1,125 lbs. TSS; 0.24 lbs. TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: 10 Bowen Place

- D1.Type of BMP: Bio-retention swale in road right-of-way
- D2.Date of implementation: August 2015
- D3.Size of treatment area: 1.1 acre paved roadway and driveways
- D4.Area Land Use: Roadway & driveways in high density residential neighborhood
- D5.Pollutant load removed: 2,640 lbs. TSS; 0.5 lbs. TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: Monoosnoc Brook Walk, 24 Monument Square

- D1.Type of BMP: Porous Pavers
- D2.Date of implementation: June 2014
- D3.Size of treatment area: 0.08 acre walkway
- D4.Area Land Use: commercial area
- D5.Pollutant load removed: 320 lbs. TSS; 0.2 lbs. TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: Monoosnoc Brook Walk, 24 Monument Square

- D1.Type of BMP: Bio-retention swale
- D2.Date of implementation: June 2014
- D3.Size of treatment area: 0.64 acre paved parking lot
- D4.Area Land Use: commercial areas
- D5.Pollutant load removed: 1,536 lbs. TSS; 0.68 lbs. TP
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP

Location: 15 Columbia Street

- D1.Type of BMP: three (3) deep sump catch basins
- D2.Date of implementation: October 2014
- D3.Size of treatment area: 0.75 acres paved roadway and parking lots
- D4.Area Land Use: residential & commercial areas on Main Street and Columbia Street
- D5.Pollutant load removed: 938 lbs. TSS; no phosphorus
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: Intersection of Pond Street and Elm Street

- D1.Type of BMP: two (2) deep sump catch basins
- D2.Date of implementation: August 2016
- D3.Size of treatment area: 0.5 acres paved roadway on Pond Street and Elm Street
- D4.Area Land Use: Roadway & driveways in high density residential area
- D5.Pollutant load removed: 625 lbs. TSS; no phosphorus
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: 19 Water Street

- D1.Type of BMP: three (3) deep sump catch basins
- D2.Date of implementation: October 2016
- D3.Size of treatment area: 0.75 acre paved roadway & parking lots
- D4.Area Land Use: Roadway & parking lots in commercial area
- D5.Pollutant load removed: 938 lbs. TSS; no phosphorus
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

Location: 48 Laurie Street

- D1.Type of BMP: two (2) deep sump catch basins in road right-of-way
- D2.Date of implementation: November 2016
- D3.Size of treatment area: 0.5 acre paved roadway and driveways
- D4.Area Land Use: Roadway & driveways in high density residential neighborhood
- D5.Pollutant load removed: 625 lbs. TSS; no phosphorus
- D6.Method of determination: CEI s. 319 NPS method developed for MA DEP
- D7.Signed statement: see above

NON-STRUCTURAL BMPs:

- Catch basin cleaning with vacuum truck by DPW – not part of project activities
- Street sweeping by DPW – not part of project activities
- Project activities included publication of BMPs Cost Catalog – see report attachments for Task 5 deliverables.
- Community outreach and education – see report attachments for Task 6 project deliverables, pollutant reductions are not quantifiable.

E. Lessons Learned - Community Stormwater Solutions

Monoosnoc Brook is damaged by polluted runoff from homes, businesses, streets, parking lots and lawns. Hundreds of tons of dirt and other pollutants are discharged to the Brook every year, which cause harmful conditions for people and aquatic life. The once abundant wild trout are almost gone and the Brook's ponds are choked with sediments and weeds.

Structural BMPs installed through 319 projects now capture over 100 tons of pollutants per year. In addition, the DPW greatly reduced sand applied in winter - there is less sand visible on streets and less sand collected by storm drain systems. Decreasing amounts of pollutants will improve the health of the Brook. Better water quality will restore trout, foster expansion of streamside parks and enrich public enjoyment of this unique natural resource.

Along with environmental benefits, the renewal is contributing to revitalization of neighborhoods beside the Brook. Local developers are working with community officials to redevelop former industrial buildings for new housing and business uses.

Streets and Streams

When rain falls, street drains collect sediments, nutrients, bacteria and toxins in polluted runoff and contaminated water is dumped into brooks and ponds without treatment. Additionally, the rapid runoff from impervious areas can amplify flooding of private and public properties. These impervious areas limit groundwater recharge that replenishes streams, which is especially needed during the recent drought that impacts cities and towns in Massachusetts.



People do not know about the vast amounts of stormwater pollutants that are released into streams and lakes. Municipal officials do not have details of pollutant loads, such as how many tons are collected by storm drainage systems and where pollutants enter local waters.

Communities also do not consider the costs for removal of pollutants that continue to accumulate in brooks, ponds and water supplies.

Stormwater pollution is a dynamic process.

Sediments conveyed by storm pipes are deposited in the Brook and cause greater flooding and property damage. In 2013, more than 250 tons of sediments were removed from a slower section of the Brook and this sediment bar is reforming.

During high Brook flows, sediments go to impoundments where it accumulates to reduce water depth and feed pond weeds. Fish kills can result and recreation uses are spoiled as the sediments pile up year after year. The hundreds of tons of pollutants discharged to Monoosnoc Brook every year continue to clog Pierce Pond, Rockwell Pond and Whitney Pond.

Pollutant Loads

EPA stormwater (MS4) permits require regulated communities to identify storm sewer outfalls and map storm drainage systems. These permits also require communities to determine priorities for storm drainage retrofits, and report reductions in pollutant loads from the installation of stormwater BMPs.

MWC applied a simple technique to estimate pollutant loads from storm drain outfalls:

1. Desktop review of streets, storm drains, topography and land use data
2. Dry and wet weather visits to find street drainage areas not connected to streams
3. Identify land uses in the street drainage areas that discharge to streams and lakes
4. Apply the "Simple Method" for pollutant loading to estimate annual pounds of sediment (TSS) and phosphorus (TP) collected by street drainage systems.

The combined loads of street drainage areas is a rough measure of total pollutants discharged to the Brook. Comparisons of annual loads from each drainage area can clarify the best places to capture polluted runoff. Street drainage areas not connected to the Brook are lower priorities, allowing attention to be focused on streets with greater impact.

Annual pollutant loading can estimate cumulative loads for a longer term. Releases by upstream storm drain outfalls indicate the amount of sediments that will build up in pools along the Brook. Over time, Brook sediments are transported downstream and add to the phosphorus and bacteria impairments of the Nashua River.

Proactive Community Development

Community development offers constant opportunities to prevent and fix stormwater problems. There are many projects in Leominster that decreased polluted runoff including commercial, industrial and residential redevelopments, road and bridge reconstruction, new parks and trails. The Monoosnoc Brook Renewal has also served as a catalyst for the DPW to install additional BMPs through MassWorks projects.

Routine maintenance of streets and parking areas provide other opportunities to reduce polluted runoff. It will lower the costs for rain gardens or bioswales when personnel and equipment are onsite for repaving projects. There are also cost-effective ways to redirect road runoff into natural buffers that function as bio-retention areas. The voluntary actions of schools, churches, businesses and homeowners have also helped to improve Monoosnoc Brook.

Municipal Resources

Municipal officials manage the allocation of limited financial and personnel resources. Analysis of street drainage systems shows the best places to capture runoff and to decide priorities for investing municipal resources. Pollutant load analysis can also help to select stormwater BMPs that achieve more pollutant reduction for less cost.

We learned that communities need information to evaluate the costs of stormwater practices. To provide guidance, we prepared the BMP Cost Catalog that compares pollutant removal costs and related factors for structural BMPs. The Catalog also explains nonstructural approaches for source control and pollution prevention, which are cost-effective practices to eliminate polluted runoff. More details about the BMP Cost Catalog are in this final report (see Task 5).

Brook Monitoring

Water quality testing began in 2007. Project partners continued Brook monitoring through 2016 with monthly sampling at three locations from April to October. Water testing indicates better conditions, except high bacteria counts at two sites in summer. Project partners have augmented Brook monitoring with other testing and site visits to identify the bacteria sources.

We also observe aquatic life that may indicate good water quality. Schools of sunfish, bass and minnows are often seen at various places along the Brook including the three monitoring sites. The BMPs installed through the s.319 projects are reducing the pollutants from storm sewers and sightings of stream life may be signs the health of Monoosnoc Brook is improving.