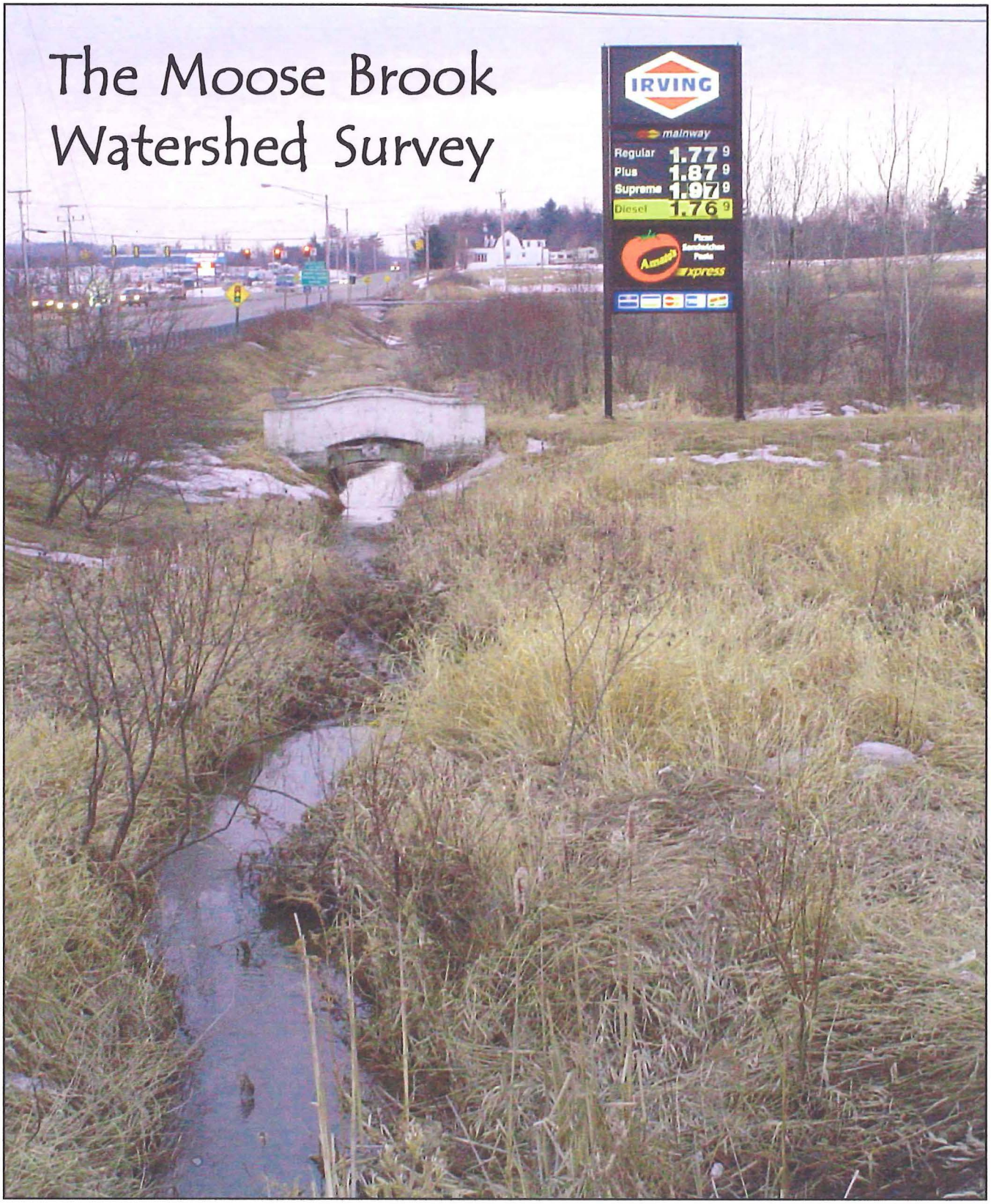
# The Moose Brook Watershed Survey




sponsored by The Friends of the Royal River

# Acknowledgements

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## Watershed Survey Volunteers

| | | |
|---|---|---|
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## Other Special Project Participants

Bruce Bickford, Irvings Corp for providing lunch for survey volunteers
Michael Murphy, Auburn City GIS for data that has proved invaluable
Woody Trask, Formed Fiber Technologies, Inc. for providing meeting space
Ken Lewis, International Paper for Industrial Site Review support
Kristie Rabasca, Edwards and Kelcey, Inc. for Hot-Spot Inventory Forms

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# Table of Contents

# Introduction

The Moose Brook Watershed Survey was undertaken by the Friends of the Royal River over the summer and fall of 2005. Through the survey, the Friends hoped to increase exposure of an undervalued portion of the Royal River watershed. This small tributary of the upper Royal River is in a developing portion of south Auburn, which very few people recognize as a part of the Royal River. It is well understood in watershed ecology that the health of a river is only as good as the sum of its parts. If small, seemingly insignificant portions of watersheds become degraded, eventually the health of the "river" loses its ecological integrity. Conversely, if some portions of degraded watersheds are protected in pristine condition the water quality of the overall watershed can be maintained. Hence the value of a watershed survey.

The survey of Moose Brook provides an understanding of current threats to the stream's water quality by non-point sources of pollution. Non-point sources of pollution are pollutants that wash off the landscape during rain or snowmelt events. Local volunteers and technical staff identified 38 sites within the Moose Brook watershed as potential contributors of polluted runoff. These sites include eroded road shoulders, busy commercial parking lots, failing streambanks and current construction sites, to name a few. The runoff from these sites may contain:

- *nutrients* related to soil erosion, winter sand or fertilizers
- *oil* and other petroleum products from cars and parking lots
- *heavy metals* from industrial activities and parking areas
- *bacteria* from drainage swales, septic systems and leaky dumpsters
- *salts* from winter maintenance activities
- *warm water* from heated pavement during summer rains.

Each of these pollutants, and others, can reduce the ecological integrity of the Moose Brook and eventually the Royal River and its estuary. This report will provide a good place to start to address these potentially chronic problems. Perhaps more importantly, the survey allows us to begin to visualize where future water quality problems are likely to occur and to bring these insights into discussion with municipal planners, state agencies and environmental advocates.

**A watershed is defined as the land that water flows across or under on its way to a water body. Watersheds can be very large like the Mississippi River or small like the hillside in your backyard.**

**We All Live In A Watershed.**

# The Watershed

The Moose Brook is a headwater stream that lies almost entirely within the city of Auburn with a very small portion of the watershed in the town of Poland. The stream drains into the upper Royal River

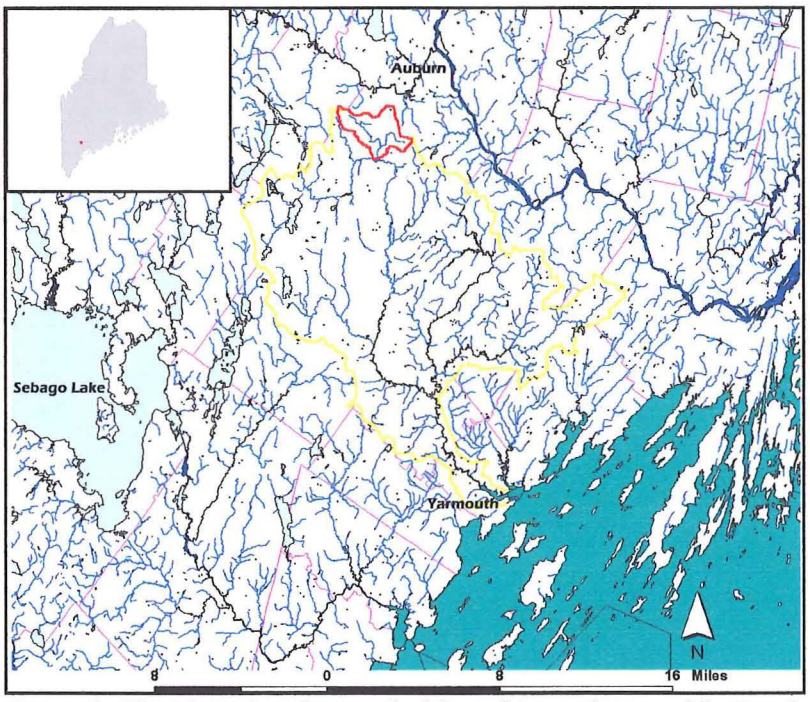



*Figure 1: The Moose Brook watershed (in red) is a tributary of the Royal River (watershed in yellow).*

which eventually reaches the Casco Bay at the town of Yarmouth (Figure 1). The Moose Brook was identified as a watershed of concern in the 1998 Royal River Watershed Management Plan. The water quality of Moose Brook had been sampled over six years in the mid-1990s as a part of a watershed-wide water quality monitoring effort. Five out of eight samples taken in Moose Brook in 1996 did not meet dissolved oxygen standards. Low dissolved oxygen levels may be related to nutrient pollution. Additionally, Moose Brook was only in compliance with E. Coli standards for a Class B stream in 33% of the samples (1993-1999). Continued development pressure in the I-95 interchange area and expanding residential communities will not improve the nutrient and bacteria loading to the stream. Furthermore, research on urbanizing watersheds indicates that heavy metals and increased peakflows may be a significant contributor to biological degradation in stream watersheds.

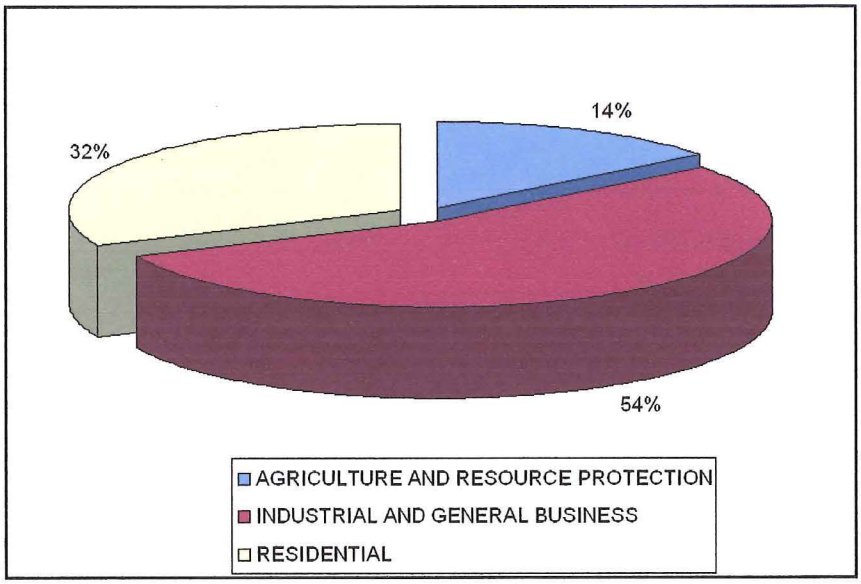



*Figure 2: Zoning districts as a percentage of land area within the Moose Brook Watershed*

The Moose Brook's watershed is approximately 67% forested, but is in a developing area of south Auburn. Based on 1998 aerial photographs, approximately 8% of the watershed was in residential land-use and about 16% in a commercial/industrial land-use. The remaining 8% of the watershed was in agriculture or mixed grassland. *This is likely to change*. An evaluation of the current zoning districts within the watershed indicates that 54% of the watershed area, within the city of Auburn, is zoned for industrial or general business uses (Figure 2). The typical development within this zoning district is comprised of business parks and industrial facilities with corresponding large areas of impervious surfaces (Appendix G-Map 4). The business development of the area is critical to the economic well-being of the city but is likely to contribute to further degradation of the brook. Additionally, 32% of the watershed is zoned for residential development. The combination of this zoning indicates that the Moose Brook watershed could eventually become over 80% developed. This is not a recipe for sustained water quality.

Research on urbanizing watersheds indicates that there is a strong relationship between watershed impervious surfaces and water quality. As watersheds are increasingly developed and impervious surfaces increase, water quality begins to decline. It is a simple and striking relationship. Often watersheds with over 10% of their land area in rooftops, driveways and parking lots (or other impervious surfaces) show signs of stream

**What is an Impervious Surface?**

**Impervious surfaces are hardened areas that restrict the infiltration of water into soil. These include rooftops, driveways (both paved or unpaved), and of course parking lots. These surfaces shed water in a much different way then the original soil beneath them. Often passing along "hitchhiking" pollutants as well.**

degradation. This fact is often related to a combination of increased stream temperature and declines in available stream water oxygen, increases in stream salinity related to road runoff, reduction in stream habitat as streams are confined and straightened, and a slow filling of stream bed gravels (which are necessary for most stream life) with excess sediments. Depending on the location of these impervious surfaces within the watershed the decline may be seen sooner or later. It is the unfortunate story of many streams in urban areas around the world.

Increases in impervious surfaces through development can create the following:

- *Increased runoff volumes* as hard surfaces shed more water than fields or forests.
- *Increased peak runoff discharges*. This means more water in a shorter period of time, creating streambank erosion and downcutting and often creating problems for bridges, culverts and sewer lines.
- *Increased flooding* with greater runoff volumes and increased discharges.
- *Lower base flow* conditions as shallow groundwater under impervious surfaces are starved of water.

These changes create a loss of stream habitat, increases in stream temperature and a decline in abundance and diversity of aquatic life. These effects in combination with the wash-off of pollutants creates unfavorable conditions for aquatic life, increased infrastructure costs for maintenance and design and reductions in the aesthetic value of streams. Each of these can have long-term environmental and economic impacts for an area or region.

## Survey Strategy

Currently ,the Moose Brook watershed has 8% of its land area in impervious surfaces (Appendix G- Map 2). Of these impervious surfaces, 40% is related to paved roadways (Figure 3). The Maine Turnpike and State Route 202 make up large portions of these surfaces. Luckily this percentage is not likely to change in a substantial way in the near future. Parking areas make up the next largest percentage of impervious surfaces at 27% and buildings at 19%. Both of these land-uses are likely to change within the Moose Brook watershed. Based on this information, much of our hope for sustained water quality in the Moose Brook will be the intelligent future design and development of these types of impervious surfaces.

The Moose Brook Survey was developed as a way to gather information and also to distribute it. Initially, a steering committee comprised of the Auburn City Engineer, Androscoggin Soil and Water Conservation District, Maine Department of Environmental Protection (MEDEP) and the Friends of the Royal River helped to guide the educational components of the project. Additionally, a technical team comprised of the Maine Department of Transportation (MaineDOT), MEDEP, Maine State Planning Office, private engineering consultants and the city of Auburn helped to guide the development of the technical survey strategy and to provide input/ interpretation of the survey results. The City of Auburn provided Geographic Information System data that allowed us to determine property owners on the watershed, detailed topography and impervious surfaces, zoning districts and other useful geographic information. In order to inform the public of the survey activity, letters were sent to every landowner on the watershed (Appendix A) informing them of the intention of the survey and inviting their

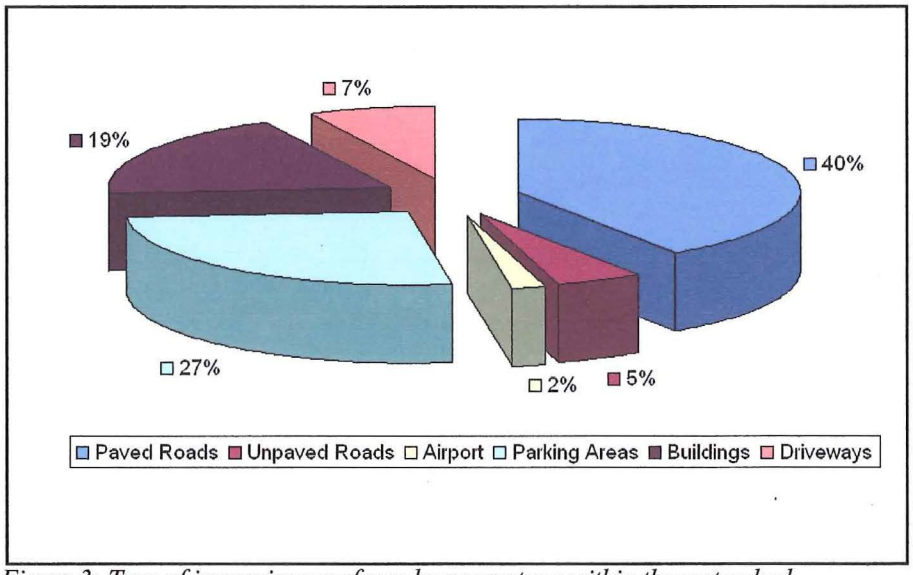



*Figure 3: Type of impervious surfaces by percentage within the watershed.*

active participation. The landowner letter also included a stormwater educational flyer published by the "ThinkBlue" campaign of the MEDEP. A public meeting/training was advertised and held at the Lewiston-Auburn Municipal Airport for potential volunteer survey participants. Topics related to stormwater issues and the watershed survey was discussed. Prior to the survey the detailed stream channel map from the city of Auburn was classified based on land-use within 100' of the stream channel (Appendix G-Map 3). This classification allowed for a prioritization of our efforts for the survey. Areas with the most developed streamside areas received the most scrutiny.

The watershed survey took place over two days and included a brief morning training exercise. Teams of volunteers then headed to the field with forms (Appendix B), equipment and an experienced survey team leader. The survey teams were asked to identify probable sources of non-point source pollution to the Moose Brook. The survey teams focused on distinct sections of the watershed and indicated the likely "trouble spots" on the sector maps. Photos were taken at each site when possible. The source areas for stormwater runoff were identified when possible and the stream buffer between the source area and the stream itself was also assessed. The survey team also conducted a "hot-spot" inventory for selected commercial establishments within the watershed area. The "hot-spot" inventory form was developed through the city of Auburn's stormwater program (Appendix C). The "hot-spot" inventory focused in more detail on select impervious surfaces likely to impact Moose Brook. Recently developed areas within the business parks were not included in the "hot-spot" inventory as they were more likely to have some stormwater management. An article on the first survey team and watershed survey effort was published in the Lewiston Sun Journal (Appendix D).

The survey results were entered into a database and sites were documented as points on a watershed map. As a follow-up to the survey, a technical review of sites was undertaken to determine possible solutions to the identified problems and to provide additional insight on the level of difficulty of the proposed fixes. Site recommendations were created as a result of this technical site review. A second landowner letter was drafted to describe the results of the survey and to provide watershed residents and key watershed stakeholders with a more detailed description of the issues facing Moose Brook (Appendix A). This letter was sent to watershed residents, commercial interests, area legislators and Auburn municipal officials.

## Survey Results

The survey results can be broken down into two categories: Individual Non-Point Source Pollution Locations and Site Recommendations. To make it simple we will consider these as the "Trouble Spots" and "Fixes".

*Trouble Spots*

The watershed survey revealed 38 sites that are likely contributors to watershed non-point source pollution (Appendix E). The sites were classified based on their land-use and Figure 4 indicates the breakdown of each site within its land-use class. Almost half of the identified trouble spots are related to roads. This is not surprising for two reasons: roads

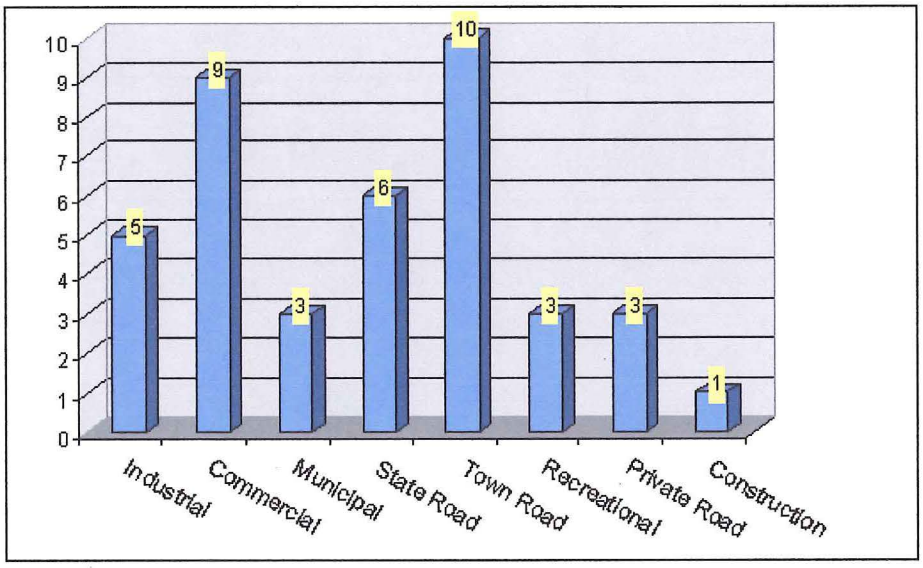



*Figure 4: Identified pollution sites within particular land-use classes.*

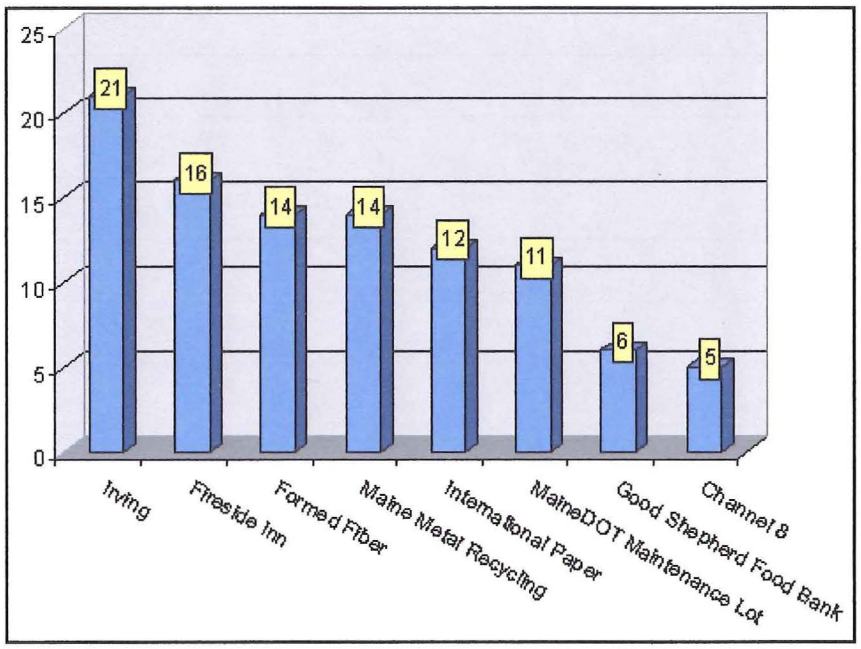



*Figure 5: Potential stormwater "Hot-Spots" and scores. (High scores indicate a more likely hot-spot, scores below 5 are not considered a hot-spot.)*

make up close to 50% of the Moose Brook watershed impervious surfaces and roads are relatively simple to assess given public access. Roads can contribute pollutants directly to streams from surface runoff which often contain salts, sediments, petroleum products and some toxic metals. Erosion along road shoulders is a typical road related pollution source and common within the Moose Brook watershed. Many of the road related trouble spots are related to erosion on the surface of the road (unpaved town ways) or along the shoulders. Luckily it is relatively easy to fix these sources of pollution but the fixes always require maintenance.

Of the other trouble spots, commercial and industrial sites make up the other 36% of the identified sites. Typically these sites have issues related to parking lot runoff. These sites have similar pollutants to roadways, but in some cases the pollutant loads may be more significant. Increases in vehicular traffic, and particularly quick stops, increases the pollutant load. This information makes gas stations, fast food restaurants and convenience stores typical hot spots for pollutant loads in any watershed and this was true on Moose Brook as well. Commercial or industrial businesses with employee parking areas are much less likely to generate heavy pollutant loads. Our hot-spot inventory supported this (Figure 5).

The inventory is a comprehensive evaluation of commercial and industrial sites that provide a way to rank facilities based on a number of factors (Appendix C). The highest scores indicate that a facility is likely to be a stormwater pollution source. Keep in mind that we did not complete a hot-spot assessment of all potential facilities in the watershed. The City of Auburn will use this evaluation to promote a "Green Business" Award for businesses participating in stormwater education and pollution prevention practices.

A number of our "hot spots" also had severely impacted streamside buffers. The development in the area around the Route 202-Maine Turnpike interchange has encroached on the stream channel creating limited streamside buffers and reduces the potential for stormwater runoff treatment. Facilities within this class often ranked medium to high impact. In general, the further the development is from a stream the less likely it will impact that stream. Figure 6 shows the breakdown of probable impacts at the sites surveyed using the "hot-spot" inventory form. Highest scores indicate that a site is more likely to have a stormwater impact.

**The Newest Hot Spot?**

**In stormwater lingo a "hotspot" is a commercial, industrial, municipal or transportation-related operation that produce higher levels of stormwater pollutants or present a greater risk of spills or leaks. Stormwater hotspots may be regulated or unregulated.**

In the Moose Brook watershed, the majority of high impact sites are related to commercial or industrial facilities. Roadways typically have medium to low impact. This information is supported in nationwide research related to the influence of land-use on pollutant loads.

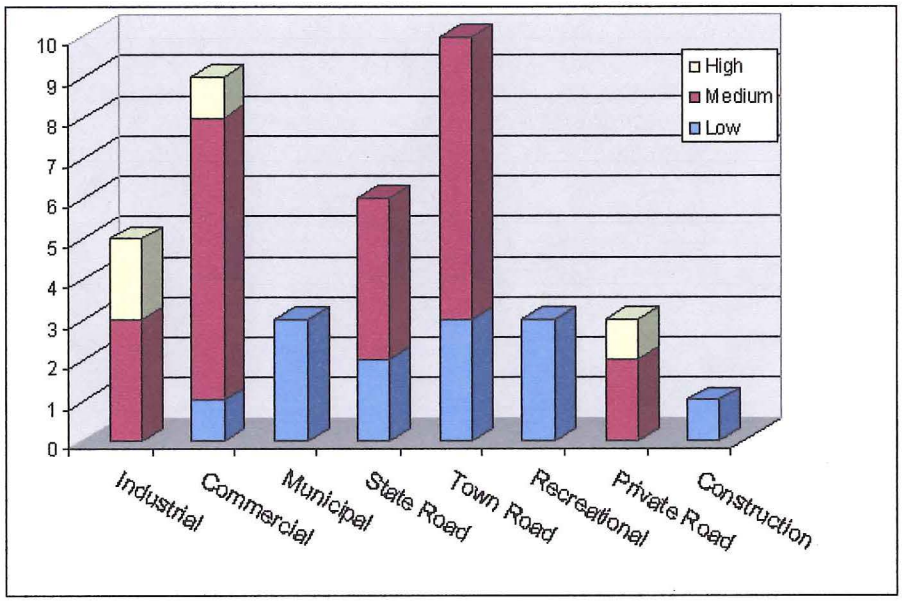


*Figure 6: Potential Impact of Identified "Trouble Spots" within Land-Use Class.*

The survey and analysis of existing watershed data indicates that a major problem area for the future of the Moose Brook is in the area around the Maine Turnpike Interchange. Development is often welcomed around interchanges but unfortunately this particular interchange is directly on or over a significant tributary of the Moose Brook. This tributary has 27 of the 38 identified trouble spots but is less than half the size of the other major tributary of Moose Brook. This area will be a challenge to future protection of the Moose Brook (Appendix G- Map 1).

*Fixes'*

The evaluation of each site also included recommendations for possible solutions. The complete list of recommendations is included in Appendix F.

In general, many of the roadway fixes would be related to improved shoulder maintenance and minor stabilization of eroded areas. By maintaining road shoulders consistently, state and town road departments can usually avoid the stabilization costs associated with addressing gully erosion. Maintaining sheet flow from roadways after a busy winter of plowing snow and sanding roads can be difficult, but a targeted maintenance program aimed at resource sensitive zones, might be a way to balance maintenance needs with limited financial outlay. A review of the stream classification map indicates where these resource sensitive zones are likely to occur. Stream segments shaded red and purple are most likely to require consistent street sweeping, catch basin cleaning and shoulder maintenance to avoid chronic impacts from nearby roads. Other opportunities may exist through improved maintenance of the turnpike interchange area. Extensive mowing reduces buffer value and disturbs small stream tributaries. Recommendations would include lengthening mowing cycles, planting native, low-growing grass/wildflower areas and expanding streamside buffers.

The commercial and industrial sites may require anything from minor maintenance modifications and the implementation of pollution prevention practices to major reconstruction of stormwater treatment systems. The latter can be financially costly while the former can be relatively easy and low-cost. Pollution prevention practices differ between different types of facility, but often include things like improved trash storage (i.e. covered dumpsters), reducing exposure of outdoor material storage, consistent parking lot maintenance and sweeping, landscaped area mulching, improved snow storage locations and others. In some cases the modification of existing stormwater treatment systems or the construction of new systems is the only alternative when a facility is located on or near the brook.

Perhaps the most valuable long-term solution to maintaining a healthy Moose Brook will be through strict enforcement of existing municipal ordinances and state stormwater regulations. The majority of the Moose Brook watershed will likely be developed in the future and only insightful and dedicated adherence to local and state laws will maintain the quality of the stream. A review of town ordinances and regulations in relationship to the

Moose Brook may also be necessary to determine if existing rules support stormwater best management practices. New statewide regulations for stormwater treatment should help, but regulations only apply to new facilities with over one acre of new disturbed area. This may not include many small business and commercial developments.

# Next Steps

√ Find the stream and get to know your segment of it.
√ Reduce the stormwater running off your lot. Capture rooftop runoff in rain barrels and build depressions in your lawn and plant them with flowers or shrubs..
√ Minimize eroding soil by letting your lawn grow a bit longer before mowing and improve the buffer between your home and the brook. Plant native trees, shrubs and other native plants.
√ Never dump oil, gas or other hazardous chemicals on your property. Bring them to the hazardous waste collection facility.
√ Avoid dumping yard waste in or near the stream. Compost away from the stream channel.
√ Check and maintain your septic tanks every 2-3 years.
√ Recreational trail users should maintain trails using best management practices.
√ Only wash your car on a lawn or other area that does not drain to the stream or street.
√ Never drain your pool to the stormdrain system.
√ Reduce or eliminate fertilizer use on your property. Obtain soil tests to determine amount and type of fertilizer actually needed.

**What can businesses do?**
√ Implement Pollution Prevention Practices for your facility. Train your employees in these practices. One good website is http://www.flowstobay.org/p2business/bestmanagementpractices.html for specific practices.
√ Provide consistent parking lot cleaning and trash removal.
√ Locate snow storage facilities away from streams and stormwater treatment systems.
√ Minimize salt use to high traffic areas only. Always follow prescribed application rates.
√ Consult with a professional on possible stormwater retrofit best management practice opportunities during parking lot renovations.
√ Maintain existing stormwater treatment systems and stormwater conveyance systems.
√ Maintain landscaped areas to minimize erosion.
√ Limit exposure of chemicals or hazardous materials during loading and unloading operations.
√ Have a spill prevention plan in place for fuel and other common chemicals on site.

**What can the government do?**
√ Review existing ordinances to determine if they are counterproductive to stormwater best management practices (i.e. required parking spaces, setbacks, drainage systems, etc.).
√ Promote responsible stewardship of the watershed through designation of "Green Business" Parks. Establish site location and stormwater rules specific to proposed commercial areas.
√ Continue to support training for DPW crews and other relevant town employees on water quality needs relevant to maintenance operations.
√ Provide consistent roadside maintenance and upgrades to sensitive resource areas within the watershed.
√ Require new development to implement the best available stormwater treatment technology.

# APPENDICES

## APPENDIX A – LANDOWNER LETTERS

### Residents of Auburn, Help us protect the Casco Bay!

Did you know that you live on the headwaters of the Royal River? It may be surprising but the rain that falls in your neighborhood ends up in the estuary near Yarmouth and eventually the Casco Bay. This connection will be examined in a watershed survey that will take place over the next few months on the Moose Brook in South Auburn. The Moose Brook drains a small watershed area around the Route 202/I-95 interchange.

The Friends of the Royal River will be looking for a few interested volunteers to assist in the survey of this small, but important, tributary of the Royal River. "Keeping the headwaters clean and healthy is of critical importance to the entire watershed. Our efforts aimed at conserving the estuary is only as good as the efforts on the streams that contribute to them." says Henry Nichols, executive director of the Friends.

This watershed survey will focus on the influence of paved area runoff on the Moose Brook. We will be looking specifically at "buffers" between developed areas and the stream. Teams of trained volunteers will be traveling around the Moose Brook area to assess the condition of streamside buffers. This will require some travel on private land and if you do not wish to have the volunteers on your property please contact us at 847-9399. The volunteers will be trained by professional stream ecologists and engineers and we would also be willing to come to your property to help you identify simple things that you can do to improve the water quality leaving your lot.

Locally-led watershed surveys such as this have been used successfully throughout Maine to document threats to water quality. The information we gather will be used to give us a better idea of the problems facing the watershed, will help us work together to address these problems, and enable us to apply for grant funds that can be used to fix priority sites. It is our hope that you will join us for the survey training session and make a small commitment of time to help us better understand the connection between parking lot, stream and estuary. Feel free to contact us for further information regarding the training session or for more information on the effects of stormwater runoff on Maine streams. **Please contact Henry Nichols if you have any other questions, ideas or comments or would like to be a survey volunteer. henry can be reached at the above address, or 847-9399.**

## Moose Brook Survey Completed!

As many of you now know your property is located on the headwaters of the Royal River, and specifically on the watershed of a small stream called Moose Brook. It may be surprising to learn but the rain that falls in your neighborhood ends up in the estuary near Yarmouth and Casco Bay.

The Friends of Royal River with help from local businesses, volunteers and a Youth Conservation Corps have now completed the "examination" of the Moose Brook watershed.

There is some good news!

- The watershed has only 7% hard (impervious) surfaces like rooftops, pavements and driveways. These surfaces can contribute to water quality problems because they concentrate runoff and carry other pollutants such as oils, winter sands, and bacteria. Because most watersheds see declines in water quality at around 10% hard surfaces, we have a chance to preserve good water quality.
- Sections of the watershed on Woodbury Hill, around the Lewiston Junction Road and above the Hotel Road are not developed and are providing good streamside habitat and are contributing clean water to the watershed.
- The City of Auburn has designated certain areas for development and is responsible for regulating the stormwater quality and quantity under its permit with the state of Maine and the US Environmental Protection Agency. This level of review ensures that good water quality practices will be used as sites are developed.

Of course there are always the challenges.....

Moose Brook is in a developing area of Auburn with over 50% of the watershed currently zoned for industrial and commercial development. This will provide a challenge for town planners and state regulators to maintain water quality in Moose Brook. The watershed survey revealed over 35 sources of potentially polluted runoff. These sites include roadsides, parking lots, trash dumps, and logging roads. Some of the sites should be easy to remedy with adequate maintenance or clean ups, others will be much more complicated. Some portions of the watershed will require participation between state, local and private individuals to protect water quality. *THIS CAN BE DONE!!*

A watershed site walk, with representatives from the MaineDOT and the City of Auburn, will be conducted this spring to review town and state road-related pollution sources. Additional efforts are underway to identify grant funding for the demonstration of innovative water quality improvements for parking area runoff. Ultimately, a watershed plan may be developed in order to balance economic development with sensible environmental protection that ultimately should save taxpayers dollars and maintain water quality. If you would like a digital copy of the final report or would like to help us with our next steps, please contact Henry Nichols @ 847-9399.

# Appendix B – Survey Field Form

**Moose Brook, Auburn ME**
**Stream Watershed Survey Field Sheet**

Sector # _____ Date _____ Surveyor Initials _____

Site # _____

Location _____
*(house number, road name,* number of nearest telephone pole, *etc.)*

Photo taken? Y N

Name of Waterbody Affected

GPS Lat. _____

Approx. distance from stream channel

GPS Long. _____

| **Land Use/Source Area:** | **Issue: (Circle)** | |
|---|---|---|
| | **Soil Erosion/Sediment** | **Temperature** |
| Industrial | Bare soil / fields | |
| Commercial | Stockpiled soil / sand | Drainage from paved area |
| Residential | Streambank erosion | Drainage from impoundment |
| Recreational | Unstable construction site | Rooftop runoff discharge |
| Municipal | Road shoulder/Ditch erosion | to pavement |
| State Road | Unstable culvert inlet/outlet | |
| Town Road | Unpaved road / Parking | **Paved Areas** |
| Private Road | | Heavy vehicle traffic |
| Agriculture | **Nutrients** | Uncovered dumpster areas |
| Construction Site | Livestock/Manure storage | Excessive trash |
| | Chemlawn/Fertilizer flags | Curbed with storm drains |
| | Pet waste | No curbing |
| | Severe: Algae mats in stream | Curb breaks |

**Area Description:** _____

**Additional Evaluation Recommendations:** _____

**Buffer Evaluation**

General Condition of Buffer:

Bare
Mowed
Unmowed
Shrubs / Wetland
Wooded/Forested

**Stream Channel**

Channel straightened
Culvert misaligned
Hanging culvert (fish)
Bank downcutting

**Stream Buffer**

Lack of stream shading
Stream does not have access to floodplain
Buffer is not source of woody debris

**Approximate % Shading**

<25% 25-75% >75%

Wetland area

General Slope of Buffer:
0-2%
2-6%
6%+

Confinement of stormflow from source area Y or N

Obvious signs of erosion through buffer Y or N

General Comments/Description of Buffer

**Technical Level to Install Recommended Practices**

| | |
|---|---|
| High: | site requires an engineered design |
| Medium: | technical person should visit the site & make recommendations |
| Low: | property owner can accomplish the BMP with proper reference materials and/or access to technical advice |

| **Impact** | **Consider size of impact, slope, type of pollutant, proximity to waterbody or buffer** |
|---|---|
| High: | large area with significant problem and direct flow to stream, ditch or lake (e.g., bank or road failure, sediment delta, visible stream degradation) |
| Medium: | pollutant transported off site but does not reach high magnitude |
| Low: | pollution potential with limited transport off site |

**Cost**

| | |
|---|---|
| High: | greater than $2,500 |
| Medium: | $501-$2,500 |
| Low: | $500 or less |

| | | | |
|---|---|---|---|
| **Impact:** | High | Medium | Low |
| **Tech. Level to Install:** | High | Medium | Low |

# Appendix C – Hot Spot Inventory Form

## Hotspot Site Investigation

Revised 2/7/05

| A. SITE DATA | | |
|---|---|---|
| Site Name | Site ID | Date |
| Address | | |
| Watershed | Subwatershed | |
| Assessed by | | |
| Category | SIC Code | |
| Weather | | |

| B. VEHICLE OPERATIONS ☐ N/A | | |
|---|---|---|
| B1. Are vehicles stored outside? | # of vehicles _____ | Y/N |
| B2. Are vehicles repaired outside? | # of vehicles _____ | Y/N |
| B3. Is there auto recycling/junk car storage outside? | # of vehicles _____ | Y/N |
| B4. Is there evidence of spills from any vehicles? | | Y/N |
| B5. Are outdoor fueling areas uncovered? | | Y/N |
| B6. Are vehicles washed outdoors? | | Y/N |
| B7. Does vehicle wash water discharge to a storm drain? | | Y/N |

| C. OUTDOOR MATERIALS ☐ N/A | |
|---|---|
| C1. Are loading/unloading operations present? | Y/N |
| C2. Are materials stored outside? | Y/N |
| C3. Types of materials _____ | |
| C4. Are they stored on an impervious surface? | Y/N |
| C5. Does it drain towards a storm drain? | Y/N |
| C6. Is staining or discoloration around the area visible? | Y/N |
| C7. Does outdoor storage area lack a cover? | Y/N |
| C8. Could leaking materials (oil tanks, barrels) enter a storm drain (w/o a berm)? | Y/N |
| C9. Are storage containers in poor condition (unlabeled, missing lid)? | Y/N |

| D. WASTE MANAGEMENT ☐ N/A | | |
|---|---|---|
| D1. Type of waste present: | Garbage | Y/N |
| | Construction Materials | Y/N |
| | Hazardous Materials | Y/N |
| | Other _____ | Y/N |
| D2. Dumpster condition: | No cover/lid open | Y/N |
| | Damaged/poor condition | Y/N |
| | Leaking or evidence of leaking | Y/N |
| | Dumpster overflowing | Y/N |
| D3. Is a storm drain visible from the dumpster? | | Y/N |
| D4. Does the dumpster juice appear to drain towards the storm drain? | | Y/N |

TOTAL Y from Page 1 ☐

## E. IMPERVIOUS SURFACES ☐ N/A

E1. Is the general condition of the property poor? Y/N
E2. Is the parking lot stained, dirty, or damaged? Y/N
E3. Is the majority of the surface area impervious? Y/N
E4. Do downspouts discharge to impervious surface? Y/N
E5. Are downspouts directly connected to storm drains? Y/N
E6. Observed stains leading to storm drains? Y/N
E7. Are leaves, grass clippings observed on impervious surface? Y/N

## F. TURF/LANDSCAPING AREAS (PERVIOUS SURFACES) ☐ N/A

F1. Percentage of site with trees, grass, landscaping, and bare dirt: %
F2. Is there evidence of a permanent sprinkler system? Y/N
F3. Does the grass appear highly maintained? Y/N
F4. Do landscaped areas drain to the storm drain system? Y/N

## G. STORMWATER INFRASTRUCTURE ☐ N/A

G1. Number of storm water structures observed on site and condition

| | Trash? | Sediment? | Leaves/Grass Clippings? |
|---|---|---|---|
| _____ Trench/Ditches | Y/N | Y/N | Y/N |
| _____ Stormwater Ponds | Y/N | Y/N | Y/N |
| _____ Curbs/Gutters | Y/N | Y/N | Y/N |

TOTAL Y from Page 2 ☐

## NOTES/SKETCH

## HOTSPOT RATING

Total Y - Page 1: _____
Total Y - Page 2: _____

GRAND TOTAL ☐

☐ Not a Hotspot (_____ - _____ Y )
☐ Potential Hotspot (_____ - _____ Y )
☐ Confirmed Hotspot (_____ - _____ Y )
☐ Severe Hotspot (_____ - _____ Y )

# Appendix D – Press

DARYN SLOVER/SUN JOURNAL

**BROOK STUDY:** Mary Cloutier, right, uses an abney level Monday morning to measure the slope along Moose Brook in Auburn. Cloutier, a volunteer with the Royal River Youth Conservation Corps and an Edward Little High School graduate, observed and recorded the condition of the brook and its watershed with Erin Crowley of Scarborough, left, and project coordinator Zach Henderson. The section of Moose Brook being examined is on Washington Street near the Maine Turnpike interchange.

# Big scrutiny for a tiny brook

***Volunteers are studying Royal River tributary to see how its water quality has been affected.***

BY SCOTT TAYLOR
*Staff Writer*

AUBURN — Nate Reimensnyder couldn't help himself.

Looking over a ditch between Washington Street and the Irving Mainway parking lot, Reimensnyder just had to clean it up a little. A volunteer with the Youth Conservation Corps, his job Monday was to observe and report the condition of Moose Brook. Strictly hands off.

The shoulder of the ditch wasn't bad, as far as gas station parking lots go. Developers had taken care to keep most of the parking lot runoff from fouling the tiny brook's watershed. But the side was still lined with truck-stop refuse — bottles, cans, food wrappers and rusted bits of metal.

He knelt to pick up a rusted rivet gun by the side of the road.

"No, Nate, we're not here to repair it," said teammate Mary Cloutier.

Repairing it is the next step, a couple of years down the road, according to team leader Zach Henderson. He led a group of eight volunteers Monday as they wandered the Moose Brook watershed to see how its surroundings affect its water quality.

Moose Brook begins somewhere north of Interstate 95's Auburn cloverleaf. It stubbornly winds its way through southern Auburn, past gas stations and busy roads, industrial lands and RV parks. It's never a cascade. It's a 20-foot-wide channel at its widest and runs up to 5 feet deep during the wettest times.

It collects runoff throughout southern Auburn and part of Poland, eventually dumping its haul in the Royal River, which empties into Casco Bay.

"That's what we're looking for today — what's going to eventually make it into the Casco Bay," Henderson said.

It's far from pristine, according to quality studies. Tests in 1996 gave it a failing grade for not having enough dissolved oxygen. It failed two-thirds of the time for E. coli bacteria contamination.

Henderson's group spent Monday trying to figure out why. They looked for ways development might contaminate the brook. The watershed is already 6 percent developed, covered with hard materials such as

SEE **BROOK** PAGE **B2**

## Brook

CONTINUED FROM PAGE **B1**

asphalt and concrete. Trash left along the side of the road, spilled motor oil and gasoline can roll off those hard surfaces, winding up in the brook.

There's going to be more development. Much of the watershed is zoned for industrial use or commercial uses, and Henderson said he expects to see much more asphalt in the area.

"When we get to 10 percent coverage, that's when we start to see big problems with watersheds," he said.

The solution isn't to stop development but to do it wisely. Henderson gave high marks to the developers of the Irving Mainway for collecting their runoff in a pond south of the building.

"Some of it's easy stuff, like keeping dumpsters covered," he said. Other solutions might be tougher and involve redeveloping a site.

A second team will go back in the fall to look more closely at questionable parts of the watershed, Henderson said. He expects to issue a report next spring.

staylor@sunjournal.com

# Appendix E - Survey Results

| Site | Land-Use | Identified Problem | Buffer Conditions | Distance to Stream Channel (ft) | Stream Conditions | Relative Impact | Technical Level to Install BMP |
|---|---|---|---|---|---|---|---|
| 1-11 | Industrial | sand stockpiles, drainage from paved area, paint tank storage | Moderate Slope, unconfined stormflow, mowed | 330 | Sparse shading | Medium | Medium |
| 1-12 | Industrial | Shoulder and ditch erosion, drainage from paved area | Bare, steep, confined | 20 | Densely shaded | High | Medium |
| 1-13 | Private Road | Shoulder and ditch erosion, drainage from unpaved area | Bare, steep, unconfined | 20 | Well shaded | Medium | Medium |
| 1-14 | Commercial | Parking/Paved Area runoff, rooftop runoff to pavement | Mowed, confined, mild slope | 450 | Densely shaded | Low | Medium |
| 2-11 | Commercial | Drainage from paved area with storm drains | Bare, confined, steep | 125 | Densely shaded | Medium | Low |
| 2-12 | Commercial | Excessive trash next to stream, junkyard | Unmowed, steep, unconfined | 20 | Densely shaded | High | Low |
| 2-13 | Private Road | Severely eroded, unpaved road | Bare, steep, confined | 0 | Well shaded | High | Medium |
| 2-14 | Town Road | Drainage from paved area, headwall failure | Unmowed shrubs, mild, confined | 0 | Sparse shading | Medium | Low |
| 2-15 | Town Road | Unpaved and paved road runoff | Bare, steep, unconfined | 0 | Sparse shading | Low | Low |
| 2-16 | State Road | Shoulder runoff and erosion | Unmowed, moderate slope, confined | 150 | Sparse shading, straightened, floodplain limited | Medium | Low |
| 2-17 | Town Road | Trash dump on closed road | Unmowed, mild, confined | 80 | Well shaded | Medium | Low |
| 2-18 | Town Road | Shoulder erosion and paved area runoff | Forested, mild, confined | 45 | Well shaded | Medium | Low |
| 2-19 | Industrial | Railroad siding area drains across roadway to stream | Mowed moderate, unconfined | 350' | Well shaded | Medium | Low |
| 3-11 | State Road | Drainage from paved area contributing to road shoulder erosion | Armored downspout, steep, confined | 20 | Well shaded, straightened, floodplain limited | Medium | Medium |
| 3-12 | Commercial | Drainage from paved area, uncovered dumpster drainage | Armored downspout, steep, confined | 20 | Well shaded, straightened, floodplain limited | Medium | High |
| 3-13 | Commercial | Drainage from paved area, heavy vehicle traffic/gas station | Steep, confined stormdrain | 0 | Well shaded, straightened, floodplain limited | Medium | High |
| 3-14 | Commercial | Drainage from paved area to eroding road shoulder | Mowed, confined, steep slope | 15 | Well shaded, straightened, floodplain limited | Medium | Medium |
| 3-15 | State Road | Drainage from paved area to eroding road shoulder, excessive trash | Mowed, steep, unconfined | 50 | Well shaded, straightened, floodplain limited | Medium | Low |
| 3-16 | State Road | Drainage from paved area to eroding road shoulder | Unmowed, steep, confined | 125 | Well shaded, straightened, floodplain limited | Medium | Low |
| 3-17 | State Road | Drainage from paved area to eroding road shoulder | Unmowed, steep, confined | 40 | Well shaded, straightened, floodplain limited | Low | Medium |
| 3-18 | Commercial | Streambank erosion, mass failure | Steep, bare, unconfined | 0 | Well shaded, straightened, floodplain limited | Medium | Medium |
| 3-19 | State Road | Drainage from paved area to eroding road shoulder | Bare, Moderate slope, confined | 80 | Well shaded, straightened, floodplain limited | Low | Low |
| 3-20 | Commercial | Streambank erosion at utility crossing | Bare | 0 | Well shaded, straightened, floodplain limited | Medium | Medium |
| 3-21 | Town Road | Drainage from paved area to eroding road shoulder, unstable inlet | Wooded | 0 | Densely shaded | Low | Low |
| 3-22 | Industrial | Stormwater runoff from large industrial facility -Numerous inputs | Shrubs/Wetland, low slope, unconfined | 50 | Well shaded | Medium | High |
| 3-23 | Industrial | Stormwater runoff from large industrial facility -Numerous inputs with parking lot direct discharge to stream | Bare | 0 | Well shaded | High | High |
| 4-11 | Construction | Stockpiled soil, bare soil, unpaved road | Wetland shrubs, mild slope, unconfined | 50 | Well shaded | Low | Low |
| 4-12 | Town Road | Drainage from paved area to eroding road shoulder/unstable inlet | Shrubs | 0 | Well shaded, hanging culvert | Low | Low |
| 4-13 | Commercial | Drainage from paved area | Wooded, moderate slope, confined flow | 150 | Bank downcutting, densely shaded | Medium | High |
| 5-11 | Municipal | Streambank erosion | Mowed, steep, confined | 0 | Bank downcutting, densely shaded | Low | - |
| 5-12 | Municipal | Streambank erosion, unstable culvert inlet | Mowed, steep, unconfined | 0 | Bank downcutting, densely shaded | Low | - |
| 5-13 | Recreational | Eroded ATV trail across brook | Wooded, steep, unconfined | 0 | Well shaded | Low | - |
| 5-14 | Municipal | Drainage from paved area, algae mats in stream | Mowed, mild slope, unconfined | 40 | Sparse shading | Low | - |
| 6-11 | Town Road | Confined wetland flow to culvert creates channel downcutting | Not Applicable | 0 | Bank downcutting, floodplain limited, densely shaded | Medium | High |
| 7-11 | Town Road | Unpaved town road drainage to stream crossing | Wooded, steep, unconfined | 50 | Densely shaded, minor bank downcutting | Medium | Medium |
| 7-12 | Town Road | Unpaved town road drainage and eroded sholder to stream crossing | Wooded, steep, unconfined | 25 | Densely shaded | Medium | Medium |
| 7-13 | Town Road | Unpaved town road drainage and eroded sholder to stream crossing | Wooded, moderate slope, confined flow | 25 | Densely shaded | Medium | Medium |
| 7-14 | Private Road | Power-line road access erosion at stream crossing | Bare | 0 | Sparse shading, bank downcutting | Medium | Medium |

# Appendix F – Site Recommendations

Site Recommendations:

1-11
Consistent snow storage area cleanout each spring. Improve sediment detention of snow storage areas through use of check dams. Implement facility pollution prevention practices, including truck washing area away from drainage area. Construct water quality and quantity treatment area within MaineDOT and Maine Turnpike buffer/Right of Way. Create permanent storage area away from drainage area. Pave parking area to reduce sediment runoff from unpaved portions of parking lot.

1-12
Roadway reconstruction needed. Improve crown, cross slope and shoulder. Preferably pave driving surface and shoulder. Sufficient buffer area for multiple turnouts at stream crossing approaches. Remove roadside sediment berms. Maine metal recycling storage area should be stabilized using aggregate or paved with paved area sediment control and stormwater BMP's. Implement pollution prevention practices for trash storage areas. Divert runoff from Maine metal recycling "dooryard" to avoid routing metal dump runoff down roadway and into stream channel.

1-13
Roadway reconstruction needed. Improve crown, cross slope and shoulder. Preferably pave driving surface and shoulder. Road may require underdrain ditches to accommodate water in confined areas. Divert runoff from metal scrap yard into buffer.

1-14
Provide consistent maintenance for parking lot landscaped areas to reduce potential for sedimentation within stormwater drainage areas.

2-11
Maintain turnouts off paved area from RV Lot. Improve turnouts for concentrated shoulder runoff along Town Road.

2-12
Clean-up needed of hazardous trash. Improve streamside buffer on private residence.

2-13
Permanently close logging road with waterbars and turnouts. Revegetate using shade tolerant logging road mix. Logging road bridge across stream may become a hazard for railroad culvert just downstream.

2-14
Provide consistent maintenance at road crossing, including street sweeping.

2-15
Reshape and pave roadway to eliminate unpaved road runoff. Reshape road to maximize use of buffer and minimize direct discharge to stream. Buffer improvement on residential lot and along roadway. Town road maintenance to minimize shoulder runoff from Black Cat Road.

2-16
Reshape and maintain road shoulder in order to eliminate concentrated flows and shoulder erosion. Provide improved ditch sedimentation area or filtration along Route 202.

2-17
Cleanup of trash dump. Remove all hazardous materials and acquire soil samples for hazardous materials leaks. Construct permanent gate at intersection of Town Road to restrict access and eliminate future dumping.

2-18
Road maintenance to reduce concentrated flows along road shoulder. Create turnout to reduce potential of direct discharge to stream channel.

2-19
Maintain or improve pollution prevention practices for railroad yard. Reduce potential for runoff from this area reaching the stream by improving Town Road crown and shoulder. Force water to buffer before it reaches Moose Brook.

3-11
Improve shoulder maintenance to reduce direct discharge to stream.

3-12, 3-13
Irvings Gas Station with Amato's. The following recommendations include parking areas draining to the stormwater dry pond system. Implement pollution prevention practices for trash storage; including disposal of food byproducts/oils from Amato's. Multiple leaking canisters of waste oil present at dumpster. Proximity of dumpster to catch basin inlet is less than 15'. Construct dumpster cover. Place "No Dumping" signage on edges of truck parking area. Obvious oil spills, trash and animal feces in this area. Snow storage locations should be reconsidered on paved surfaces in order to provide improved clean-up options. Currently snow is plowed into stormwater pond and loads system with winter sand/debris. Catch basin retrofit for drainage area 3-13. This area drains the gas station islands and should be reconstructed or retrofitted to protect for oils and greases. This may include absorbent pads, oil/water separator outlet retrofit or other. Concrete stormwater pond outlet pipe has separated at junctions. This allows for additional bypass above specified detention. Stormwater dry pond retrofits are possible at this site. The system is currently allowing bypass of low to moderate flows and might be adjusted to meet current standards.

3-14
Fireside Inn. Front (east) parking lot could be retrofitted with bioretention system. Sufficient treatment area is available and grades appear sufficient to allow surface water inlets through curb breaks. Develop buffer enhancement plan for front and highway side of building, Pollution prevention practices for lawn care and fertilizer use. Site lawn mowing may have contributed to destabilization at site 3-18. Currently dumping lawn clippings into brook near stormwater system discharge pipe. Dry swale retrofit option available for north lot treatment. Food waste handling BMP's for café. Currently storing open trash containers outside.

3-15, 16, 17
Improve shoulder maintenance to reduce direct concentrated flow to stream. Revegetate shoulder, improve buffer along road inslope.

3-18
Fireside Inn. Revegetate area with consistent seeding and hay mulch. Reduce potential for future mass wasting through expansion of buffer on mown fill area.

3-19
Improve landscape management around park and ride to decrease mowing related erosion, provide additional buffer along drainage swales and stream channel, and decrease costs. Possible parking area perimeter swale enhancements using ditch filter berms, check dams or other sediment control structures. Planting to enhance and expand streamside buffer. Some rill erosion and mass failure around pipe inlet under park and ride. Additional stabilization here would improve condition and longevity. Cloverleaf area in vicinity could also use buffer enhancement.

3-20
Fireside Inn. Remove failing berms and replace with clean riprap.

3-21
Curbside street sweeping maintenance needed. Minor erosion around culvert inlets, some headwall failure may require reconstruction/maintenance.

3-22
Formed Fiber. Implement pollution prevention practices for employee parking areas and loading/unloading area. Reduce sediment loads from lot by improving overall landscape management. Mulch disturbed and eroded areas.

3-23
International Paper. Snow storage improvements to avoid brook. Currently two primary snow storage areas are into or within 15' of stream channel. Nearby locations offer increased buffer. Minor modifications to buffer with gravel/mulch level spreader may help to contain winter sand. Construct cover over refueling area. Catch basin retrofits in parking area to avoid direct discharge to Moose Brook. Stream currently flows under parking area.

4-11
Prevent sedimentation of wetland stream in this area through construction BMP's. Promote site stewardship for post-construction runoff controls.

4-12
Minor erosion around road crossing. Consistent maintenance checks and additional revegetation using shade-tolerant seed mixes.

4-13
Channel 8. Continue to maintain "clean" employee parking lot area and well-landscaped. Implement pollution prevention practices for landscaped areas. Stormwater retrofit options available here during lot reconstruction or other capital improvements.

5-11, 12, 14
Airport fill areas should be stabilized using dry site seed mix. Promote enhanced buffer along incised stream.

5-13
Provide ATV stream crossing stabilization. Reduce direct discharge to brook with turnouts.

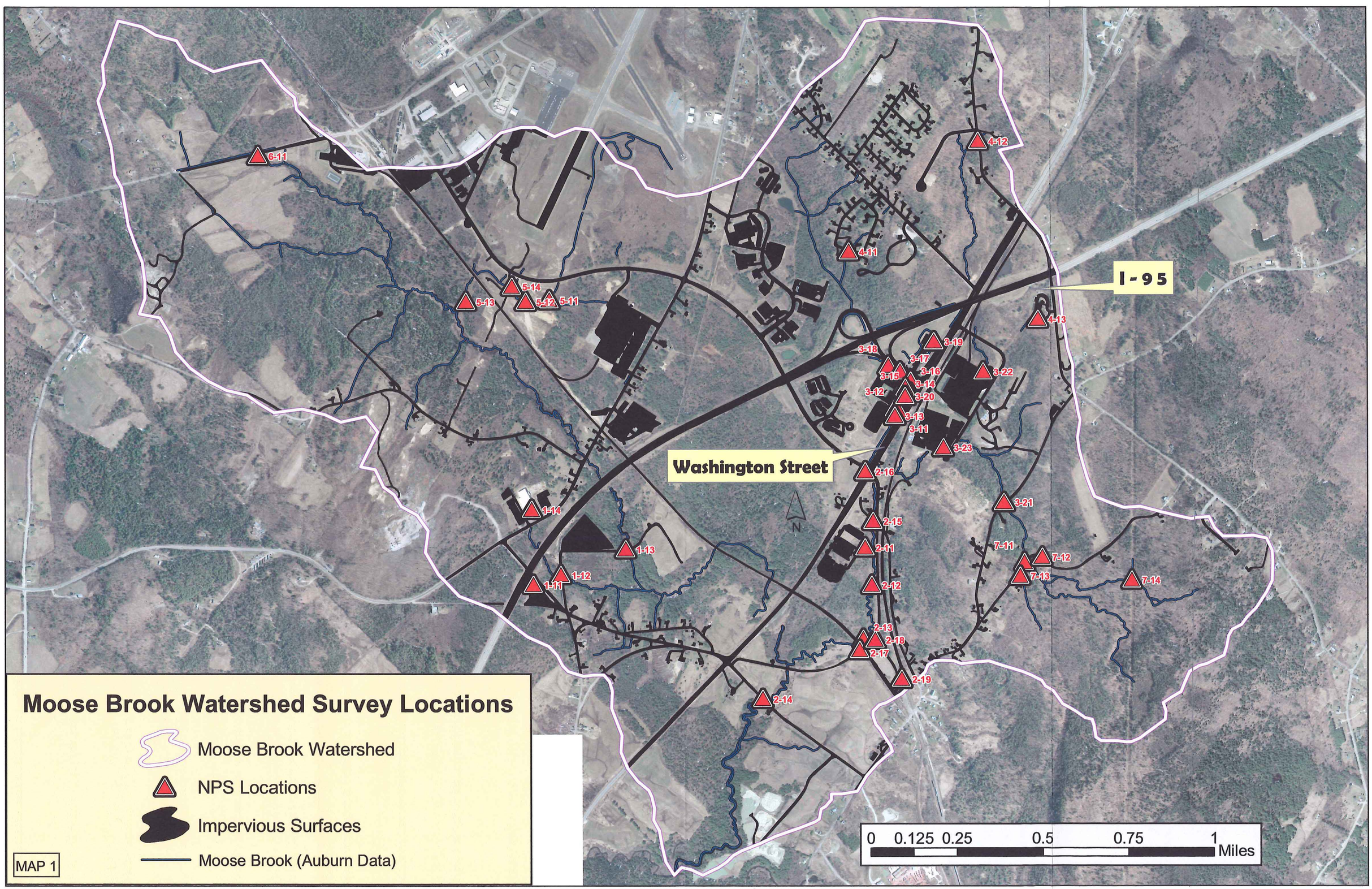
6-11
Reduce concentration of flows to one cross pipe through Town Road drainage reconstruction. Promote buffer expansion in area to reduce potential mass failures around incised stream.

7-11,12,13
Roadway reconstruction needed. Improve crown, cross slope and shoulder. Preferably pave driving surface and shoulder. Create turnouts and sediment traps where possible. Road may require underdrain ditches to accommodate water in confined areas.

7-14
Improve cross-drainage and turnouts off of powerline access road. Armor areas around brook where turnouts are not possible.

# Appendix G – Watershed Maps

Map 1 – Watershed Survey Points
Map 2 – Impervious Surfaces in the watershed
Map 3– Land-Use Type within 100' of Stream Channel
Map 4– Current Auburn Zoning Overlay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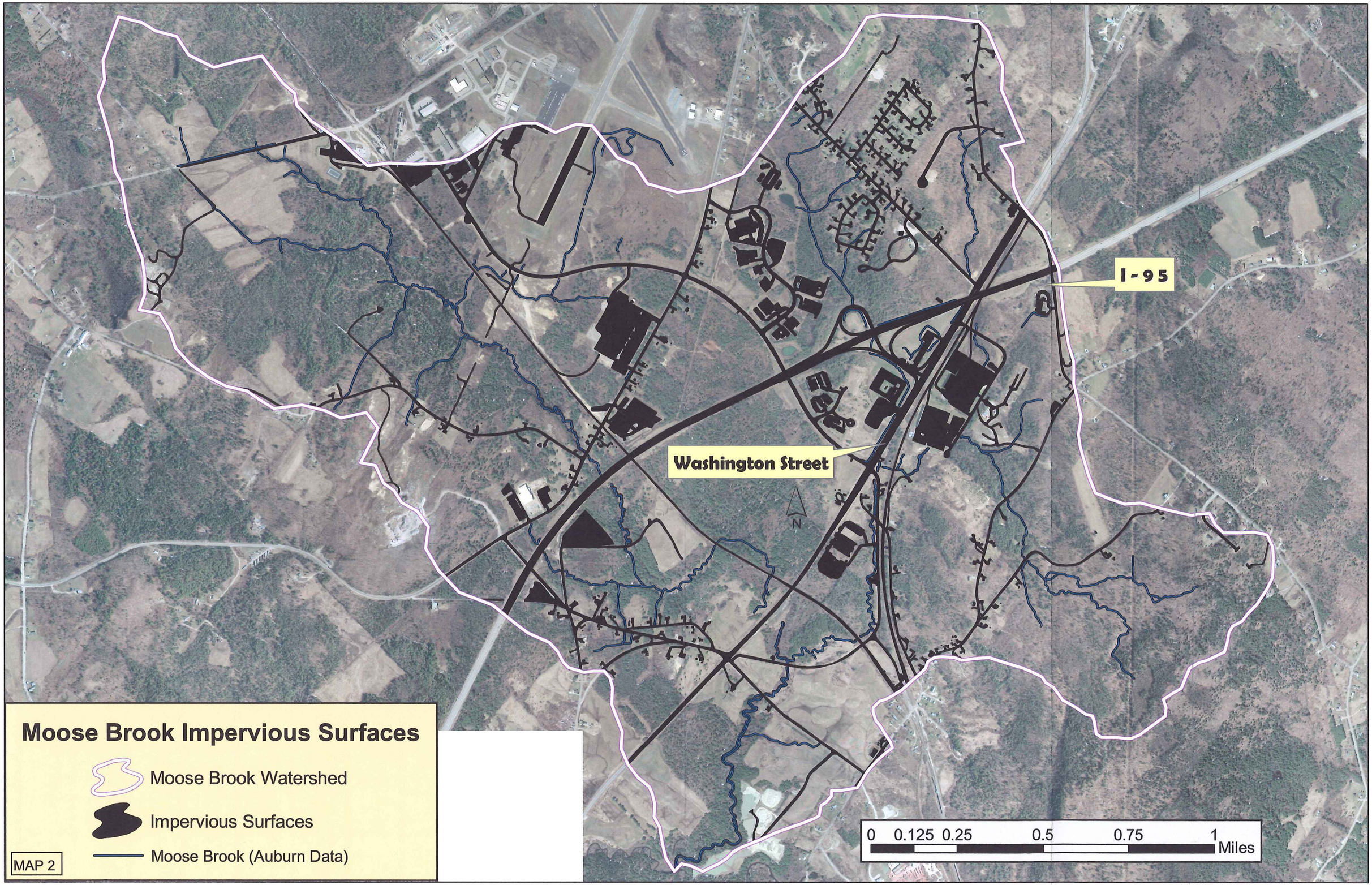
Moose Brook Watershed Survey Locations
Moose Brook Watershed
NPS Locations
Impervious Surfaces
Moose Brook (Auburn Data)
MAP 1
0 0.125 0.25 0.5 0.75 1
Miles




# Moose Brook Impervious Surfaces

Moose Brook Watershed

Impervious Surfaces

Moose Brook (Auburn Data)

MAP 2

I-95

Washington Street

N

# Stream Buffer Classification Land-Use Within 100'

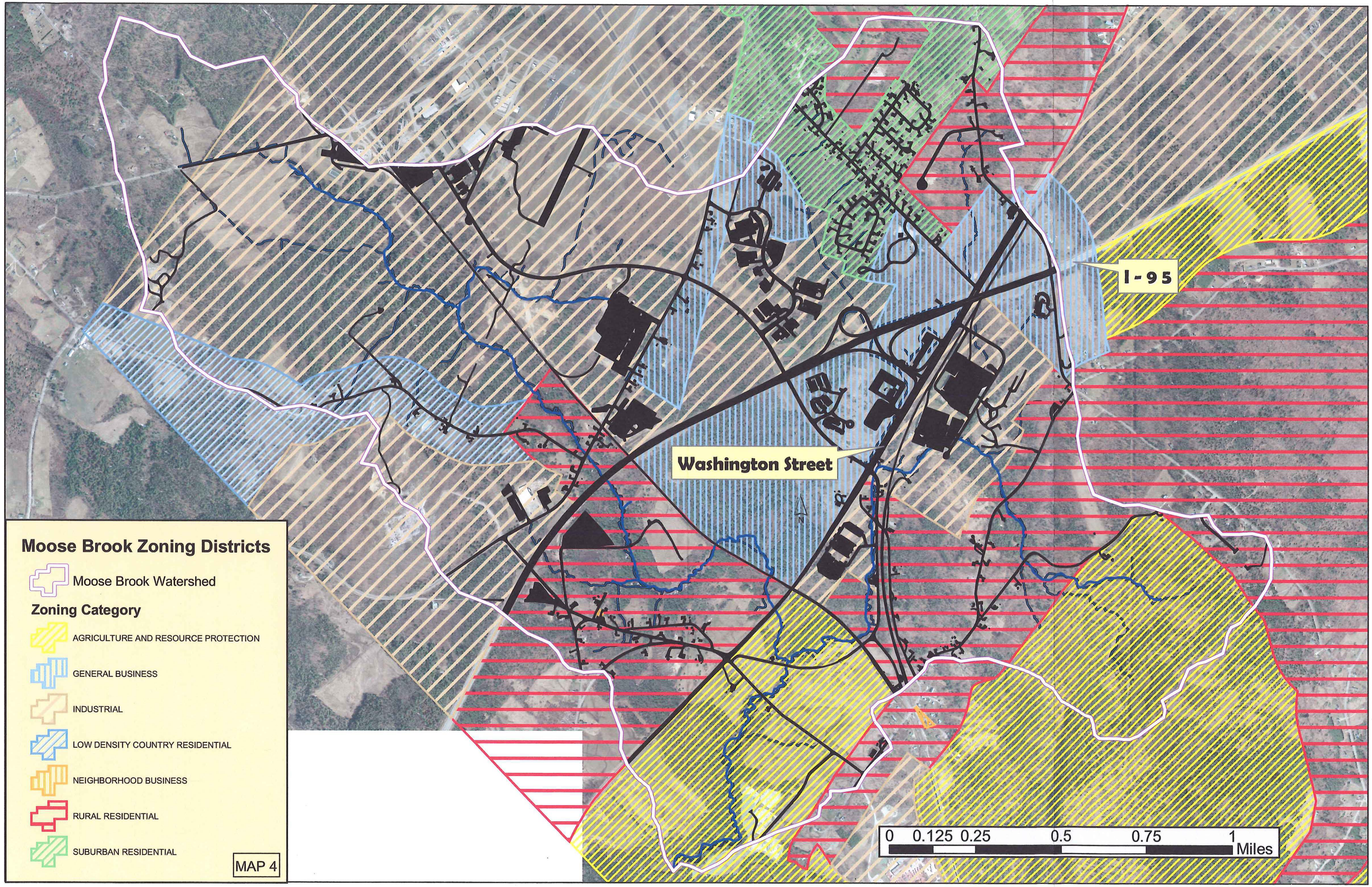
Moose Brook Watershed

**Classification**

- Agriculture
- Developed Commercial
- Forested
- Residential
- Road Crossing
- Roadside
- Transitional
- Wetland

MAP 3

0 0.125 0.25 0.5 0.75 1 Miles




## Moose Brook Zoning Districts

Moose Brook Watershed

**Zoning Category**

- AGRICULTURE AND RESOURCE PROTECTION
- GENERAL BUSINESS
- INDUSTRIAL
- LOW DENSITY COUNTRY RESIDENTIAL
- NEIGHBORHOOD BUSINESS
- RURAL RESIDENTIAL
- SUBURBAN RESIDENTIAL

MAP 4