

5.3 BMP Prioritization

The BMPs were prioritized based on several factors including: cost; recharge volume per cost; level of sedimentation observed at the recommended BMP site; the size of the drainage area to be treated; ease of access for maintenance and construction; and availability of land. Table 5.3 summarizes the prioritization of the recommended structural BMPs by subcatchment area with details provided in Appendix I. This was the basis for developing the implementation schedule provided in Table 5.4.

5.4 Non-Structural BMP Recommendations

A good source reduction strategy involves a combination of structural and non-structural BMPs. Non-structural techniques typically target pollution sources through the use of



Table 5.3 BMP Ranking and Prioritization

BMP ID #	BMP Description	Priority	
1	Sub-1 TF Green WWTS & Industrial Drive Drainage Ditch	23	MED
2	Sub-2 Underground Infiltration Chambers	26	HIGH
3	Sub-3 Adrian Street Steam Channel Restoration	21	LOW
3A	Sub-3 Underground Infiltration Chambers	25	MED
3	Sub-4 Adrian Street Steam Channel Restoration	23	MED
4A	Sub-4 Underground Infiltration Chambers	25	MED
5A	Sub-5 Road Crossings	23	MED
5B	Sub-5 Deep Sump Leaching Structure BMPs	28	HIGH
6A	Sub-6 Road Crossings	23	MED
6B	Sub-6 Deep Sump Leaching Structure BMPs	28	HIGH
7A	Sub-7 Road Crossings	23	MED
7B	Sub-7 Deep Sump Leaching Structure BMPs	28	HIGH
8A	Sub-8 Road Crossings	23	MED
8B	Sub-8 Deep Sump Leaching Structure BMPs	28	HIGH
9	Sub-9 Underground Infiltration Chambers	23	MED
10	Sub-10 Underground Infiltration Chambers	24	MED
11	Sub-11 Underground Infiltration Chambers	23	MED
12	Sub-12 Underground Infiltration Chambers	23	MED
13	Sub-13 Underground Infiltration Chambers	26	HIGH
14	Sub-14 Liverpool Street Outlet	20	LOW
15	Sub-15 Underground Infiltration Chambers	26	HIGH
16	Sub-16 Lippitt Elementary School	20	LOW
16A	Sub-16 Underground Infiltration Chambers	24	MED
17A	Sub-17 Benny's Parking Lot	22	LOW
17B	Sub-17 Cove Ave Outlet	33	HIGH
17C	Sub-17 Underground Infiltration Chambers	24	MED
18	Sub-18 Underground Infiltration Chambers	24	MED
EA	Everglade Ave	21	LOW

Ranking:

20-22 = LOW

23-25 = MED

≥26 = HIGH

Refer to Appendix I for more detail on the ranking of BMPs.





Table 5.4 BMP Implementation Schedule

BMP ID	BMP Description	Subcatchment ID	BMP Cost	Schedule for Implementation		
				Short Term (0 - 5 Years)	Intermediate Term (5 - 10 Years)	Long Term (>10 years)
1	TF Green WWTs & Industrial Drive Drainage Ditch	1	\$71,500		<input checked="" type="checkbox"/>	
2	Underground Infiltration Chambers	2	\$124,000	<input checked="" type="checkbox"/>		
3	Adrian Street Stream Channel Restoration	3	\$64,000			<input checked="" type="checkbox"/>
3A	Underground Infiltration Chambers	3	\$86,900		<input checked="" type="checkbox"/>	
3	Adrian Street Steam Channel Restoration	4	\$64,000		<input checked="" type="checkbox"/>	
4A	Underground Infiltration Chambers	4	\$117,500		<input checked="" type="checkbox"/>	
5A	Road Crossings	5	\$157,000		<input checked="" type="checkbox"/>	
5B	Deep Sump Leaching Structure BMPs	5	\$127,000	<input checked="" type="checkbox"/>		
6A	Road Crossings	6	\$157,000		<input checked="" type="checkbox"/>	
6B	Deep Sump Leaching Structure BMPs	6	\$127,000	<input checked="" type="checkbox"/>		
7A	Road Crossings	7	\$157,000		<input checked="" type="checkbox"/>	
7B	Deep Sump Leaching Structure BMPs	7	\$127,000	<input checked="" type="checkbox"/>		
8A	Road Crossings	8	\$157,000		<input checked="" type="checkbox"/>	
8B	Deep Sump Leaching Structure BMPs	8	\$127,000	<input checked="" type="checkbox"/>		
9	Underground Infiltration Chambers	9	\$169,500		<input checked="" type="checkbox"/>	
10	Underground Infiltration Chambers	10	\$98,000		<input checked="" type="checkbox"/>	
11	Underground Infiltration Chambers	11	\$122,000		<input checked="" type="checkbox"/>	
12	Underground Infiltration Chambers	12	\$239,000		<input checked="" type="checkbox"/>	
13	Underground Infiltration Chambers	13	\$191,500	<input checked="" type="checkbox"/>		
14	Liverpool Street Outlet	14	\$188,500			<input checked="" type="checkbox"/>
15	Underground Infiltration Chambers	15	\$115,500	<input checked="" type="checkbox"/>		
16	Lippitt Elementary School	16	\$195,500			<input checked="" type="checkbox"/>
16A	Underground Infiltration Chambers	16	\$391,000		<input checked="" type="checkbox"/>	
17A	Benny's Parking Lot	17	\$134,000			<input checked="" type="checkbox"/>
17B	Cove Ave Outlet	17	\$48,000	<input checked="" type="checkbox"/>		
17C	Underground Infiltration Chambers	17	\$391,000		<input checked="" type="checkbox"/>	
18	Underground Infiltration Chambers	18	\$122,000		<input checked="" type="checkbox"/>	
EA	Everglade Ave Treatment Swale	Everglade Ave	\$133,000			<input checked="" type="checkbox"/>

Note: Construction of underground infiltration chambers should be coordinated with roadway improvements as they occur.

pollution prevention practices that minimize its generation. Pollution prevention BMPs typically include public education and maintenance.

Watershed investigations revealed several pollution sources throughout the watershed, including: dumping of yard waste; pet waste, specifically at the Lippitt Elementary School; and excessive sediment accumulation in structures and outfall pipes. The following non-structural BMP recommendations target these sources.

Perform Public Education and Outreach

Sixty three percent of the Tuscatucket Brook watershed is residential developments. Residential developments contribute pollutant through activities such as yard waste dumped in wetlands; uncontrolled pet wastes; lawn and garden fertilizers; car washing and uncontrolled runoff. Often, the easiest, most effect method to address pollutants from residential sources is through a comprehensive public education program. Such a program should include the following components:

Promote Good Landscape Management

The care of landscaped areas can contribute significant amounts of nutrients to nearby surface waters. During field investigations performed for this study, CEI noted several locations where home owners have pushed their lawns and landscaping to the edge of the water, with yard waste and debris observed along the edge of the Brook. This encroachment into the streams natural buffer provides a direct conduit for fertilizers and pesticides to enter Tuscatucket Brook. Over-fertilization in other areas of the watershed can also significantly add to the nutrient load of Tuscatucket Brook through stormwater runoff and directly connected catch-basins.

To address this issue, CEI recommends a broad based educational program for residents adjacent to the Brook as well as those within the entire watershed system. The education effort should include the sustained distribution of a series of educational materials highlighting the relationship between lawn and garden management, the concept of a watershed, and water quality. Material should focus on one or two main landscaping topics and how each practice can help protect water quality by reducing the amount of nutrients that enter nearby surface waters.

The series of educational material should include information on the following issues:

- Soil testing with test resource information
- Fertilizer minimization and “phosphorus free” fertilizers
- Recycling of yard trimmings
- Composting and its benefit as a fertilizer
- Fertilizer application rates and proper timing
- Use of native vegetation in landscaping
- Runoff potential reduction through proper irrigation and re-use/infiltration of roof run-off



- Use of vegetative buffers between lawns and surface water or between lawns and catch basins

In addition to the above issues and brochures, the educational effort may also include the participation of local nurseries and garden stores as well as garden clubs. These business owners and organizations should be encouraged to hold short workshops for the general public on the above issues. This will help educate their customers as well as allow them an opportunity to showcase some of the products that would cater to the above needs such as phosphorus free fertilizers.

Use Community Based Social Marketing (CBSM) in Education Efforts

Public education can be used to educate homeowners on actions they can take to minimize pollutant loadings. Historically many methods have been used to provide public education, but not all have been successful.

CBSM is a new, more scientific approach to public education where specific behaviors are promoted, and where barriers to these specific behaviors are eliminated. This approach involves the community and direct contact with people as opposed to conventional public education – the advertising approach. Media and advertising can be successful at raising public awareness and providing education on a particular issue (such as educating residents on why protecting the watershed is important) but these approaches have not worked well for environmental issues. This is because most environmental issues, for example, composting yard waste instead of dumping it in water bodies, requires a greater level of commitment and time than changing from one product to another. CEI's approach uses the latest methods found effective at actually changing behavior. Key steps in our approach include:

- **ID Problem Areas**
This includes determining the initial problem area. One example is dumping of yard waste in and around water bodies that results in clogged pipes, flooding and excessive nutrient input. How much of a problem is it and are there other targeted problem areas that should be identified?
- **Determine Target Behaviors**
Based on the yard waste example above, ideal behaviors will be encouraging residents to home compost or utilize the City collection service that accepts yard waste. This step involves identifying the target behaviors to address the problem area: what behavior do you want to change and how?
- **Develop Survey**
A survey can be an ideal tool to determine why residents DO NOT recycle or compost yard waste but will also tell us why people DO recycle and compost yard waste. Are there model citizens in the watershed that do it right? What barriers are stopping people from doing the right thing? Lack of awareness? Time constraints? Other barriers?
- **Pilot and Distribute Survey**



No matter how large or small the survey, it should be piloted to a small group of the target audience to ensure all questions are understandable and desired results are obtained. This group of say 12 people will be individually contacted to make sure the questions made sense to them and to gauge the usefulness of the results that will be tabulated when it is done on a larger scale.

- **Identify Barriers & Competing Behaviors**
Through the above survey and statistical analysis, we can identify barriers and benefits people perceive in the desired behavior. Some residents of the watershed likely already compost: why? The survey will also tell us what barriers prevent others from doing this (don't know how: don't have a vehicle to transport yard waste to the facility, don't care, can't make it during open hours, too time consuming, concerns about odors, etc.).
- **Develop An Action List on How To Tip the Scale**
Once barriers and competing behaviors have been recognized within a target group, we can then determine how to change the ratio of benefits and barriers so that the target behavior(s) becomes more attractive.

Here are a few examples of what this action list can include:

- **Commitment**
Studies show that if people actively make a commitment to do a certain activity they are not only more likely to perform a certain action but maintain that action for a longer period of time.
- **Reminders and Prompts**
Simply put, we all need reminders. Prompts are essential in not only getting people to choose a particular behavior but also maintaining that favorable action. For example, a sign on a trash bin that promotes recycling may encourage use of the container for recycling. Prompts may also be used to dissuade people from choosing a competing behavior. For example, "No Dumping" signs along the Brook.
- **Establish a Norm**
Social norms are a big part of sustainable behavior. An example would be promoting the fact that residents recycle over 50% of their residential waste stream – this will likely nudge others to do the same. Would you want to be left out if all your neighbors are doing it? Establishing and promoting a social norm can do wonders to get people to choose a certain behavior.
- **Create a Vivid Message**
Communicating an effective message is essential in changing a person's behavior. For example, 'after a survey of X stream, it was determined that enough yard waste was illegally dumped within the watershed area to fill a football field XX feet deep'. This or a similar comparison that people are familiar with will surely get their attention.
- **Develop Goals & Feedback**
Studies have shown that people respond positively when goals are established and are more likely to continue an action when they receive feedback. Those little thermometers with \$\$\$ raised in red are good examples.



- **Encourage Personal Contact**
For the most part the media does not influence what actions and behaviors we take, the network of people around us do. Watershed and block leaders can have a significant impact on what behaviors people choose through personal contact.
- **Provide Incentives for the Preferred Behavior**
If possible, an incentive for maintaining a positive behavior can often help extend the preferred action. Public recognition can go a long way and also help establish social norms (see above).
- **Finally, Evaluate the Program's Success**
Determining a method for evaluating the program is essential in determining the success of the program. This data can often be used for future projects and in obtaining future funding such as state and federal grants.

Develop Pet Waste Management Program for the Lippitt Elementary School

The Lippitt Elementary School provides a large open space area that is used recreationally by residents for walking and non-motorized vehicle use. The area is frequented by residents walking their dogs, with a considerable amount of pet waste/fecal matter observed during the field investigations. Runoff from the property discharges directly into a stream flowing behind the school, which outlets into Tuscatucket Brook, north of West Shore Road. Stream samples at this location showed some of the highest fecal coliform results from the URI-CVE study. Fecal matter can carry pathogenic viruses harmful to aquatic life and humans.

Although the City of Warwick currently has a leash law and requires pet waste to be picked up, it is difficult to enforce throughout the City. CEI recommends the following actions to reduce pet waste at the Lippitt Elementary School:

1. Post signs at the elementary school field and walking trails requiring dogs to be on a leash and residents to pick up pet waste. Identify that the area is within a sensitive area of the Tuscatucket Brook watershed. Clearly state the penalties for not following these laws.
2. Install pet waste disposal receptacles with appropriate signage at the elementary school for residents to properly dispose of pet waste.
3. Offer pet disposal bags and educational materials when residents license their dogs. There are various products, such as key chains, that hold and dispense pet waste bags that can be handed out as part of an educational program. The distribution of these materials during licensing will reach all pet owners within the watershed to promote good practices not only at the school, but throughout the watershed.
4. Share educational material with veterinary.

Enforce Mandate to Connect to Sewer

The City of Warwick requires residents to connect to the sewer system within one year of the sewer line installation. However, this is not enforced. There are still homes within the watershed that have not connected to the sewer. CEI recommends that the City enforce connection requirements.

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Final Report, May 2011*



Comply with Upcoming Phase II MS4 Permit

The federal Phase II Stormwater Program has been ongoing since the first permit round began in 2003. That 5-year permit period expired in 2008 and a second 5-year permit is anticipated to be issued in 2011. The new permit will include requirements for:

- Public education and outreach on stormwater impacts and what residents and businesses can do to reduce negative impacts
- Illicit discharge detection and elimination – helps identify illegal sewer/septage discharges/connections
- Regulatory controls for new and redevelopment projects
- Good housekeeping practices for municipally owned facilities
- Maintenance requirements for stormwater infrastructure, including catch basin cleaning, street sweeping and maintenance of city-owned BMPs
- Requirements to meet TMDLs

The purpose of the program is to improve water quality of waterways by addressing stormwater runoff. The City will be required to have adequate regulations and maintenance programs in place under this program. Such requirements will include more frequent catch basin cleaning and street sweeping to minimize sedimentation at outfalls. CEI also recommends that the silted outfalls noted in Table 3.2 be cleaned in conjunction with an increased maintenance program.

Install Storm Drain Markers

CEI recommends marking all of the storm drains that are connected to Tuscatucket Brook with curb markers that identify the catch basin as a conduit to the Brook. Storm drain marking programs have been in effect throughout the U.S. for many years. Traditionally, this has been done through the use of storm drain stencils. Stencils are often spray painted with wording such as “No Dumping – Flows to Waterway”. This has helped educate residents and reduce point and non-point discharges. Although this has been an effective public education effort, the stenciling is not permanent and must be continually redone. It may also send a contradictory message with the use and wear of paint at catch basin locations.

Curb markers offer a more permanent alternative to curb stenciling. Curb markers are quite durable, can be applied to vertical or horizontal surfaces, are easy to install, have no scrap value, and are available in a variety of sizes, shapes, and colors.

Promote LID Throughout the Watershed

The Benny’s site was identified as an ideal location for the use of LID techniques due to the large expanse of impervious area associated with the building and pavement and the highly permeable soils at the site. As a commercial property, the City can require LID practices be incorporated at the site if the facility decides to redevelop or expand, however, this same opportunity to require LID practices is not available for residential properties.

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However, the City can promote the use of LID techniques at residential properties throughout the watershed through a public education program. LID techniques can be relatively inexpensive to implement and can also enhance the aesthetic attributes of a property by introducing beautifully landscaped gardens that offer treatment and infiltration of stormwater runoff from rooftops and driveways. LID practices that can be used throughout the watershed include:

- Disconnecting roof leaders from the City drainage system and instead sending it to a combination of rain barrels and drywells. The rain barrels provide some water for irrigation with the remaining roof runoff recharging groundwater through a drywell.
- Bioretention areas, and smaller rain gardens, are landscaped areas that have been depressed to collect stormwater. The garden is vegetated with native plantings able to withstand site conditions (e.g., salt from roadway maintenance, sun or shade). A thick organic layer provides stormwater treatment and supports the plantings. Private property owners could be encouraged to create rain garden areas.
- Transforming drainage ditches into organic swales that help reduce runoff through increased vegetation and soil absorption and reduce pollution through filtration.
- Sidewalk infiltration through the use of pervious pavers or pavement when sidewalks are undergoing reconstruction.

As funding permits, the City could gauge interest of residents to partake in a demonstration project involving the installation of some of these practices at their homes. The projects could then serve as a visual demonstration for other homeowners and developers interested in applying similar techniques.

