*Urban Subwatershed Restoration Manual Series*

11

# Unified Subwatershed and Site Reconnaissance: A User's Manual

*Version 2.0*



February 2005


Center for Watershed Protection

Manual 11

*Photo Acknowledgments*

*Figure 11f:* *Roger Bannerman*
*Figure 15:* *City of Memphis*
*Figure 17:* *Regional Water Quality Control Board, Region 3*
*Figure 18:* *Unites States Department of Energy*
*Figure 21:* *City of Memphis*

*Urban Subwatershed Restoration Manual No. 11*

# UNIFIED SUBWATERSHED AND SITE RECONNAISSANCE: A USER'S MANUAL

*Version 2.0*


Prepared by:

Tiffany Wright, Chris Swann, Karen Cappiella, and Tom Schueler
Center for Watershed Protection
8390 Main Street, 2nd Floor
Ellicott City, MD 21043
www.cwp.org
www.stormwatercenter.net



Prepared for:

Office of Water Management
U.S. Environmental Protection Agency
Washington, D.C.

February 2005

# Foreword

This manual distills our experience in evaluating the restoration potential of urban subwatersheds that we have acquired in dozens of rapid restoration assessments over the past decade. We have assembled a basic assessment approach into a single package, known as the Unified Subwatershed and Site Reconnaissance, or USSR. Over the past two years, we have continuously sought to refine, test and expand this assessment approach in our watershed practice, and it has undergone at least four major revisions. We expected that it would be further adjusted over time; therefore, we are pleased to release this manual in Version 2.0, in response to user feedback and new resources.

Thanks also to our external reviewers, who included participants at our inaugural Watershed Restoration Institute, as well as local watershed organizations, such as the Gwynns Falls Watershed Association, South River Federation, and others. Special thanks to the Chesapeake Bay Trust and the National Fish and Wildlife Foundation for providing community watershed grants that allowed us to keep on testing the USSR in a variety of urban watershed conditions.

The Center staff team that contributed to the development of the USSR included Ted Brown, Anne Kitchell, Tiffany Wright, Chris Swann, Karen Cappiella, Jennifer Zielinski, Stephanie Sprinkle, and Tom Schueler.

Special thanks are extended to Heather Holland and Lauren Lasher for able assistance in editing, proofing, and otherwise helping to produce this manual. This manual was produced under a cooperative agreement with U.S. EPA Office of Water CP-82981501, and we are grateful to our EPA project officer, Robert Goo, for his patience, insights, and flexibility during the two years it took to produce this manual series.

Sincerely,

Tiffany Wright
Center for Watershed Protection

# About the Restoration Manual Series

This is the last in a series of 11 manuals that provides detailed guidance on how to repair urban watersheds. The entire series of manuals was written by the Center for Watershed Protection to organize the enormous amount of information needed to restore small urban watersheds into a format that can easily be accessed by watershed groups, municipal staff, environmental consultants and other users. The contents of the manuals are organized as follows.

## Manual 1: An Integrated Approach to Restore Small Urban Watersheds

The first manual introduces the basic concepts and techniques of urban watershed restoration, and sets forth the overall framework we use to evaluate subwatershed restoration potential. The manual emphasizes how past subwatershed alterations must be understood in order to set realistic expectations for future restoration. Toward this end, the manual presents a simple subwatershed classification system to define expected stream impacts and restoration potential. Next, the manual defines seven broad groups of restoration practices, and describes where to look in the subwatershed to implement them. The manual concludes by presenting a condensed summary of a planning approach to craft effective subwatershed restoration plans.

## Manual 2: Methods to Develop Restoration Plans for Small Urban Watersheds

The second manual contains detailed guidance on how to put together an effective plan to restore urban subwatersheds. The manual outlines a practical, step-by-step approach to develop, adopt and implement a subwatershed plan in your community. Within each step, the manual describes 32 different desktop analysis, field assessment, and stakeholder involvement methods used to make critical restoration management decisions.

The next seven manuals provide specific guidance on how to identify, design, and construct the seven major groups of watershed restoration practices. Each of these "practice" manuals describes the range of techniques used to implement each practice, and provides detailed guidance on subwatershed assessment methods to find, evaluate and rank candidate sites. In addition, each manual provides extensive references and links to other useful resources and websites to design better restoration practices. The seven manuals are organized as follows:

## Manual 3: Storm Water Retrofit Practices

The third manual focuses on storm water retrofit practices that can capture and treat storm water runoff before it is delivered to the stream. The manual describes both off-site storage and on-site retrofit techniques that can be used to remove storm water pollutants, minimize channel erosion, and help restore stream hydrology. The manual then presents guidance on how to assess retrofit potential at the subwatershed level, including methods to conduct a retrofit inventory, assess candidate sites, screen for priority projects, and evaluate their expected cumulative benefit. The manual concludes by offering tips on retrofit design, permitting, construction, and maintenance considerations in a series of 17 retrofit profile sheets.

## Manual 4: Urban Stream Repair Practices

The fourth manual concentrates on practices used to enhance the appearance, stability, structure, or function of urban streams. The manual offers guidance on three broad approaches to urban stream repair – stream cleanups, simple repairs, and more sophisticated comprehensive repair applications. The manual emphasizes the powerful and relentless forces at work in urban streams, which must always be carefully evaluated in design. Next, the manual presents guidance on how to set appropriate restoration goals for your stream, and how to choose the best combination of stream repair practices to meet them.

The manual also outlines methods to assess stream repair potential at the subwatershed level, including basic stream reach analysis, more detailed project investigations, and priority screenings. The manual concludes by offering practical advice to help design, permit, construct and maintain stream repair practices in a series of more than 30 profile sheets.

## Manual 5: Riparian Management Practices

The fifth manual examines practices to restore the quality of forests and wetlands within the remaining stream corridor and/or flood plain. It begins by describing site preparation techniques that may be needed to make a site suitable for planting, and then profiles four planting techniques for the riparian zone, based on its intended management use. The manual presents several methods to assess riparian restoration potential at the subwatershed level, including basic stream corridor analysis, detailed site investigations, and screening factors to choose priority reforestation projects. The manual concludes by reviewing effective site preparation and planting techniques in a series of eight riparian management profile sheets.

## Manual 6: Discharge Prevention Practices

The sixth manual covers practices used to prevent the entry of sewage and other pollutant discharges into the stream from pipes and spills. The manual describes a variety of techniques to find, fix and prevent these discharges that can be caused by illicit sewage connections, illicit business connections, failing sewage lines, or industrial/transport spills. The manual also briefly presents desktop and field methods to assess the severity of illicit discharge problems in your subwatershed. Lastly, the manual profiles different “forensic” methods to detect and fix illicit discharges. Manual 6 is also known as the *Illicit Discharge Detection and Elimination Guidance Manual: a guidance manual for program development and technical assessment*, and is referenced as Brown *et al.*, 2004, throughout this manual.

## Manual 7: Watershed Forestry Practices

The seventh manual reviews subwatershed practices that can improve the quality of upland pervious areas, which include techniques to reclaim land, revegetate upland areas, and restore natural area remnants. When broadly applied, these techniques can improve the capacity of these lands to absorb rainfall and sustain healthy plant growth and cover. This brief manual also outlines methods to assess the potential for these techniques at both the site and subwatershed scale.

## Manual 8: Pollution Source Control Practices

Pollution source control practices reduce or prevent pollution from residential neighborhoods or storm water hotspots. Thus, the topic of the eighth manual is a wide range of stewardship and pollution prevention practices that can be employed in subwatersheds. The manual presents several methods to assess subwatershed pollution sources in order to develop and target education and/or enforcement efforts that can prevent or reduce polluting behaviors and operations. The manual outlines more than 100 different “carrot” and “stick” options that can be used for this purpose. Lastly, the manual presents profile sheets that describe 21 specific stewardship practices for residential neighborhoods, and 15 pollution prevention techniques for control of storm water hotspots.

## Manual 9: Municipal Practices and Programs

The ninth manual focuses on municipal programs that can directly support subwatershed restoration efforts. The five broad areas include improved street and storm drain maintenance practices, development/ redevelopment standards, stewardship of public land, delivery of municipal stewardship services, and watershed education and enforcement. This last “practice” manual presents guidance on how municipalities can use these five programs to promote subwatershed restoration goals. The manual also contains a series of profile sheets that recommends specific techniques to implement effective municipal programs.

The series concludes with two user manuals that explain how to perform field assessments to discover subwatershed restoration potential in the stream corridor and upland areas.

## Manual 10: The Unified Stream Assessment (USA): A User’s Manual

The Unified Stream Assessment (USA) is a rapid technique to locate and evaluate problems and restoration opportunities within the urban stream corridor. The tenth manual is a user’s guide that describes how to perform the USA, and interpret the data collected to determine the stream corridor restoration potential for your subwatershed.

## Manual 11: The Unified Subwatershed and Site Reconnaissance (USSR): A User’s Manual

The last manual examines pollution sources and restoration potential within upland areas of urban subwatersheds. The manual provides detailed guidance on how to perform each of its four components: the Neighborhood Source Assessment (NSA), Hotspot Site Investigation (HSI), Pervious Area Assessment (PAA) and the analysis of Streets and Storm Drains (SSD). Together, these rapid surveys help identify upland restoration projects and source control to consider when devising subwatershed restoration plans.

Individual manuals in the series are scheduled for completion by 2006, and can be downloaded or delivered in hard copy for a nominal charge. Be sure to check the Center website, www.cwp.org, to find out when each manual will be available and how it can be accessed.

# Table of Contents

## List of Tables

## List of Figures

**List of Acronyms and Abbreviations**

The following list describes the many acronyms and abbreviations used in the manual to described the methods, practices, models used to restore small urban watersheds.

| | |
|---|---|
| GIS: | Geographic Information System |
| GPS: | Global Positioning System |
| HOA: | Homeowner's Association |
| HSI: | Hotspot Site Investigation |
| NPDES: | National Pollutant Discharge Elimination System |
| NSA: | Neighborhood Source Assessment |
| PAA: | Pervious Area Assessment |
| RCRA: | Resource Conservation and Recovery Act of 1976 |
| SARA: | Superfund Amendments and Reauthorization Act |
| SCP: | Source Control Plan |
| SIC: | Standard Industrial Classification |
| SSD: | Streets and Storm Drains |
| USGS: | United States Geological Survey |
| USSR: | Unified Subwatershed and Site Reconnaissance |

# Introduction

This manual presents the Unified Subwatershed and Site Reconnaissance (USSR), a rapid field method to evaluate potential pollution sources and find restoration opportunities in subwatersheds. This manual is organized into seven chapters.

## Chapter 1: The Basics of the Unified Subwatershed and Site Reconnaissance

This chapter introduces the basics of the USSR. It describes the four assessment components and explains how each component helps identify upland pollution sources and/or restoration opportunities. Next, it provides step-by-step guidance on how to conduct a USSR, and explains how the data acquired fits into the overall subwatershed plan. The chapter concludes by introducing methods to organize and interpret data to develop certain subwatershed metrics that rank restoration opportunities and pollution sources.

## Chapter 2: Preparation Needed to Conduct the USSR

This chapter outlines the basic mapping, equipment, field forms, and staffing needed to perform a USSR. Next, the chapter introduces desktop analysis steps required to delineate neighborhoods, identify sites to visit, and recruit stakeholders. Chapter 2 concludes by offering staffing and cost estimates to scope and budget a USSR.

## Chapter 3: Neighborhood Source Assessment (NSA)

Every subwatershed has many neighborhoods, which can be significant sources of pollution and offer many restoration opportunities. Chapter 3 introduces the basics of the neighborhood in the context of the USSR, and introduces the four lawn and yard behaviors assessed during the NSA. It also provides detailed guidance on completing the NSA form in the field. The chapter concludes with tips on organizing and analyzing NSA data to rank priority restoration opportunities and determine pollution severity at the neighborhood scale.

## Chapter 4: Hotspot Site Investigation (HSI)

Hotspots are specific operations in a subwatershed that may generate high storm water pollution. This chapter introduces the basics of hotspots and the six areas common to each hotspot that are assessed during the HSI. It also provides specific guidance on completing the HSI field form, and concludes by ranking the severity of hotspot sites and recommending pollution prevention practices that may be warranted.

## Chapter 5: Pervious Area Assessment (PAA)

Natural area remnants and large parcels of open land are found in every subwatershed, and they represent opportunities for reforestation and restoration. This chapter introduces the basics of pervious areas and introduces the PAA field form. It also offers guidance on how to complete the PAA in the field and make specific management recommendations for reforestation and restoration.

## Chapter 6: Streets and Storm Drains (SSD)

This chapter presents the basics of urban streets and storm drains, and introduces the SSD form used to assess subwatershed maintenance practices, and parking lot retrofits. The chapter concludes with detailed guidance on completing the SSD form and making specific recommendations on better municipal practices.

## Chapter 7: Interpreting USSR Data to Develop Better Subwatershed Restoration Plans

The final chapter discusses seven methods used to translate USSR data into effective upland restoration projects, including data management, mapping, quality control, subwatershed metrics, and source control analysis. The chapter ends by offering information on more detailed follow-up investigations needed to assess the feasibility and design of restoration practices.

## Appendices

Copies of USSR field forms are provided in Appendix A. Appendix B offers specific information on land uses, associated Standard Industrial Classification codes, and NPDES regulatory status. Appendix C presents a “cheat sheet” that can be taken into the field when conducting the USSR to help identify hotspots.

# Chapter 1: The Basics of the Unified Subwatershed and Site Reconnaissance

Urban subwatershed restoration has traditionally focused on the stream corridor, with less attention paid to upland areas where neighborhoods and businesses are located. However, these upland areas are important in subwatershed restoration, since they contribute storm water pollutants to the stream corridor. The Unified Subwatershed and Site Reconnaissance (USSR) is designed to assess these upland areas for behaviors that can potentially influence water quality and to identify promising restoration project opportunities.

The USSR is a rapid field survey to evaluate potential pollution sources and restoration opportunities within urban subwatersheds. It was developed to help watershed groups, municipal staff, and consultants quickly assess subwatershed restoration potential. The USSR is quick and inexpensive, applies over a wide range of urban conditions, and has four major assessment components:

- *Neighborhood Source Assessment (NSA)* that profiles pollution source areas, stewardship behaviors, and residential restoration opportunities within individual neighborhoods.
- *Hotspot Site Investigation (HSI)* that ranks the potential severity of each commercial, industrial, municipal or transport-related hotspot found within a subwatershed.
- *Pervious Area Assessment (PAA)* that evaluates the potential to reforest turf areas or restore natural area remnants at all open parcels within a subwatershed.
- *Streets and Storm Drains (SSD)* that measures the average pollutant accumulation in the streets, curbs, and catch basins of a subwatershed, and investigates the on-site retrofit potential for parking lots.

The concept behind the USSR is to provide a quick but thorough characterization of all upland areas to identify major source areas that are contributing pollutants to the stream and control them through source controls, pervious area management, and improved municipal maintenance.

The USSR is a "windshield survey" that requires you to drive down every street in a subwatershed to locate possible restoration sites and assess their restoration potential, and determine specific pollution sources and hotspots. The USSR can be a powerful tool for shaping your initial subwatershed restoration strategy and locating upland restoration projects that deserve further investigation.

This user's manual provides extensive guidance on how to conduct each assessment, including desktop preparation, field analysis, and data management and interpretation. Together, the four USSR assessments produce a wealth of useful data to identify and locate potential restoration practices in a subwatershed, including the following:

- Lawn Care Education
- Pet Waste Management
- Natural Landscaping and Reforestation
- Storm Water Pond Maintenance
- Bufferscaping
- Potential for Rooftop Disconnection
- On-site Residential Retrofits
- Hotspot Permit Enforcement
- Targets for Hotspot Pollution Prevention
- Parking Lot Retrofits
- Illicit Discharge Investigations
- Upland Soil Reclamation
- Upland Reforestation
- Natural Area Restoration
- Storm Drain Stenciling
- Street Sweeping
- Catch Basin Clean-outs

The USSR is used to rapidly assemble an initial inventory of subwatershed restoration practice sites that merit additional investigation. USSR data is also commonly aggregated to produce various subwatershed "metrics" and maps that are used to devise an initial upland restoration strategy. The USSR is intended to be flexible. You are encouraged to customize the assessment forms to meet your own local needs, and only use the forms you need.

## 1.1 Four Assessment Components of the USSR

The USSR employs four different assessment components to identify and record potential pollution sources and subwatershed restoration projects (Figure 1). A specific field form is associated with each component:

- Neighborhood Source Assessment (NSA)
- Hotspot Source Investigation (HSI)
- Pervious Area Assessment (PAA)
- Streets and Storm Drains (SSD)

You can use all four field forms, or just the ones that suit your purposes.

## 1.2 How the USSR Helps Identify Pollution Sources and Restoration Opportunities

The USSR helps restoration planning by identifying potential pollution sources in the upland areas of the subwatershed that may adversely affect water quality, and assembling a comprehensive initial inventory of promising restoration projects (Table 1). The USSR also identifies additional stakeholders in each subwatershed that can be invited to join the restoration planning process.

The USSR generates a wealth of data that can help you narrow your focus on those behaviors, practices, or sites that have the greatest impact on pollutant load or runoff reduction in the subwatershed. After analyzing your USSR data, you will have a better handle on what restoration practices are appropriate for specific neighborhoods, hotspots and large pervious areas. Later chapters describe the corresponding restoration practices that can address these problems.


**Figure 1: Four USSR Assessment Field Forms**

**Table 1: How the USSR Helps in Subwatershed Restoration**

Neighborhoods
- Evaluates pollutant-producing behaviors in individual neighborhoods and assigns a pollution severity index for screening purposes
- Rates each neighborhood for overall restoration potential and identifies specific restoration projects
- Examines the feasibility of on-site storm water retrofits
- Indicates restoration projects that may require more direct municipal assistance for implementation (tree planting, storm drain stenciling, etc.)

Hotspots
- Creates an inventory of storm water hotspots, including regulated and non-regulated sites
- Rates the severity of each hotspot with regard to its potential to generate storm water runoff or illicit discharges
- Suggests appropriate follow-up actions for each hotspot, including referral for immediate enforcement
- Examines the feasibility of on-site storm water retrofits

Pervious Areas
- Evaluates the current condition of natural area remnants and their potential management needs
- Determines the reforestation potential of large pervious areas

Streets and Storm Drains
- Estimates the severity of pollutant accumulation on roads and within storm drain systems
- Assesses large parking areas for storm water retrofit potential
- Rates the feasibility of four municipal maintenance strategies

## 1.3 Basic Steps to Conduct a USSR Survey

The USSR is performed in three phases: a desktop analysis, the actual field survey, and a post-field data analysis. The desktop analysis is needed before going out into the field and often consumes the most time, simply because a lot of data and mapping must be compiled. Table 2 summarizes the seven basic steps of the USSR.

## 1.4 Where and When Data Fits Into the Subwatershed Planning Process?

The USSR is extremely helpful in many of the steps of subwatershed restoration plan development. For example, USSR data are frequently used to identify additional field investigations to craft the subwatershed restoration strategy, and can also help identify additional stakeholders to involve in the planning process. The USSR data also help derive input variables to estimate the potential effectiveness of restoration projects in reducing pollutant loads. In addition, USSR data can be used to screen restoration potential both in individual subwatersheds and across all the subwatersheds located within a watershed. Table 3 describes the steps in the subwatershed planning process where USSR data is explicitly used.

The USSR is normally combined with its counterpart, the Unified Stream Assessment (USA), which documents conditions and restoration opportunities within the stream corridor. Together, the surveys provide a comprehensive picture of the restoration potential in a subwatershed and insight into the relationship between upland areas and the stream corridor. This information can help compare restoration potential across subwatersheds and prioritize restoration projects with the greatest overall benefit to stream health.

**Table 2: Seven Steps of the USSR**

| Phase | Step | Tasks |
|---|---|---|
| *Pre-Field* | Step 1:<br>Gather required information | NPDES permittees<br>Existing neighborhood maps<br>Municipal maintenance schedule for roads<br>Census data<br>List of HOA and contact information<br>Current development projects<br>Mapping data and aerial photographs |
| | Step 2:<br>Generate field maps | Delineate subwatersheds<br>Delineate residential neighborhoods<br>Review environmental databases for regulated hotspots<br>Perform business permit review for additional hotspots<br>Put together emergency contact list |
| *Field* | Step 3:<br>Conduct the USSR | Drive all roads<br>Evaluate residential neighborhoods (NSA form)<br>Survey all hotspot locations (HSI form)<br>Complete PAA form for all pervious area sites<br>Complete SSD form at select storm drains<br>Take photos and GPS readings |
| *Post-Field* | Step 4:<br>Verify data/maps | Rectify differences between pre-fieldwork maps and field notes<br>Identify additional data to be collected |
| | Step 5:<br>Data entry | Enter data from field forms into a spreadsheet or GIS. This involves downloading GPS unit and digital cameras (or getting film developed), and recording details on field maps |
| | Step 6:<br>Produce list and map of candidate sites for each subwatershed | Screen retrofit, restoration, and pollution prevention projects to identify sites where further investigation is needed |
| | Step 7:<br>Compile data for all subwatersheds into a single table | Develop subwatershed metrics to develop initial restoration strategy |

**Table 3: Steps In Subwatershed Restoration Where USSR Data Is Explicitly Used**

| Name |
|---|
| Comparative Subwatershed Analysis |
| Detailed Subwatershed Analysis |
| Stakeholder Identification and Recruitment |
| Initial Subwatershed Restoration Strategy |
| Candidate Project Investigations |
| Input to Subwatershed Treatment Analysis |
| *More information on the subwatershed planning process is provided in Manual 2.* |

## 1.5 How to Organize and Interpret USSR Data

The USSR gathers a large amount of data to prepare an initial restoration strategy for each subwatershed. This data must be organized in a way that is easily transferable to stakeholders, funders, and other municipal agencies. USSR outputs can be useful to explain the current subwatershed condition, identify projects that may alleviate any problems, and identify residents in each subwatershed that should be involved in the subwatershed planning process. For example, USSR data can be condensed into subwatershed metrics that describe the following:

- Fraction of the subwatershed with on-site retrofit potential
- Fraction of the subwatershed where turf is intensively managed
- Number of neighborhoods where pollution prevention education can be targeted
- Number of storm water treatment practices and maintenance needs
- Density of storm water hotspots and associated land uses
- Fraction of the subwatershed with upland reforestation potential
- Location of natural area remnants that merit greater protection or restoration
- Fraction of streets and storm drains that can be effectively treated with maintenance practices

USSR data can also be portrayed on maps, and analyzed by spreadsheets. Based on these analyses, you can select the upland restoration strategies that make the most sense for your subwatershed, and identify the specific project locations that require additional field and desktop investigation. The most common desktop investigation is the Source Control Plan (SCP), which is used to define the focus, targets, methods and scope for residential and/or business source control programs in the subwatershed. The SCP recommends specific outreach, education and municipal assistance tools to control the major pollution source(s) in your subwatershed. Chapter 7 discusses the many different ways USSR data can be incorporated into your subwatershed restoration plan.

# Chapter 2: Preparation Needed to Conduct the USSR

## 2.1 What Do I Need to Get Started?

The USSR requires minimal field equipment, mapping, and staff effort, although access to Geographic Information Systems (GIS) data layers can greatly enhance the efficiency of the survey. Timing is important to consider when scheduling USSR fieldwork. Two scheduling decisions need to be made: the season, and the day of the week that will provide the most useful USSR data. In general, the USSR is most useful in spring, summer, or fall. Winter surveys are not recommended, especially for NSA and PAA components. The day of the week is important due to its influence on the NSA and HSI components. While weekends are probably best to accurately characterize residential behaviors such as car washing, lawn care, and car maintenance, weekday surveys of hotspots are more likely to discover discharges from storm water hotspots.

### *Maps*

Good maps are essential for the USSR. Easy desktop analysis is needed to screen the individual neighborhoods, parcels, and hotspots to be investigated. These sites should be identified and delineated based on predetermined selection criteria to keep the number of sites to a manageable level. Some selection criteria rely on a minimum site area requirement to ensure that restoration is feasible. Table 4 shows some examples of selection criteria used to identify sites.

Basic USSR field maps consist of the following:

- A minimum 1": 2000’ scale (e.g., scale of a 7.5 minute USGS quadrangle sheet) street map and/or aerial photograph. Street maps offer the advantage of simplicity, availability, and well-labeled road networks and urban landmarks, but fall short on land use details that recent aerial photographs provide.
- The location of all known NPDES industrial storm water, SARA 312, and RCRA permittees, as well as storm water treatment practices.
- All publicly-owned pervious areas greater than two acres, and all privately-owned pervious areas greater than five acres.
- Boundaries of all neighborhoods and major commercial, industrial and institutional parcels.

**Table 4: Selection Criteria for USSR Site Assessment**

| USSR Field Form | Land Use | Selection Criteria |
|---|---|---|
| NSA | Residential | Visit all neighborhoods and sample a subset of individual homes |
| HSI | Commercial<br>Industrial<br>Institutional<br>Municipal<br>Transport - Related | Visit all regulated hotspots and priority non-regulated hotspots |
| PAA | Pervious Areas | Visit all publicly-owned pervious areas > 2 acres and all privately-owned pervious areas > 5 acres |
| SSD | Streets and Storm Water Conveyance | Evaluate road and storm drain conditions at random, pre-selected points<br>Evaluate all parking lots > 2 acres |

To prevent cluttering maps with too much detail, you should generate two base maps: one that delineates pervious areas and neighborhoods, and a second one that shows the locations of potential storm water hotspots. Subwatershed reconnaissance maps are then developed that show the locations of sites, neighborhoods, parcels, and hotspots to visit in the field (Figure 2).

### Equipment

The USSR requires relatively little field equipment, including measuring tapes, cameras, and field forms (Table 5). GPS units are helpful to mark locations if you need to track data spatially. Many GPS units are relatively inexpensive, with adequate units costing about $150. Cell phones and emergency numbers allow field crews to communicate with each other and to contact agencies for immediate response. Pepper spray is sometimes recommended if stray dogs are likely to be encountered in the field. A list of contact numbers for emergency assistance can be pasted to the field crew's clip board to immediately report problems to the appropriate agency. Examples include illegal dumping, sanitary sewer overflows, hazardous waste spills, clogged storm drains, or illicit discharges.

### Staff

To avoid the logistical problem of trying to simultaneously navigate while recording data, two people should perform the USSR. One crew member drives, while the other notes addresses, marks hotspot locations, fills out the field forms, scouts out dining locations, and takes photographs.

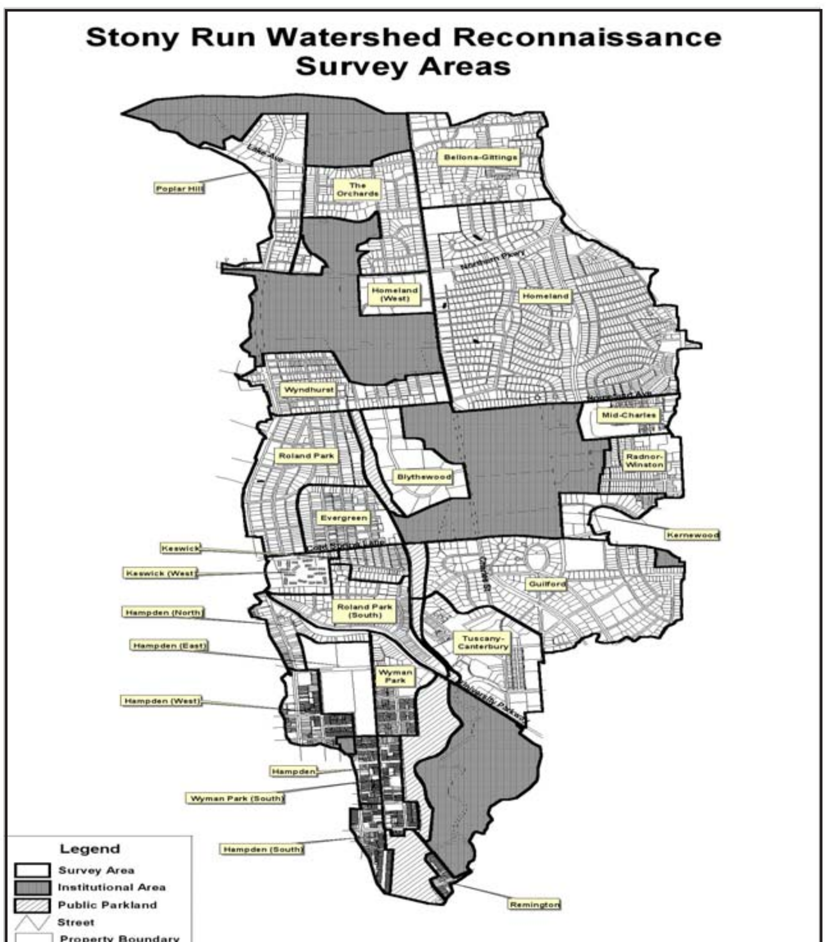



**Figure 2: Sample Subwatershed Residential Reconnaissance Map**

## 2.2 Desktop Analysis to Support a USSR Survey

Before you go out to the field, a desktop analysis is needed to acquire current mapping and subwatershed data. These data are then transferred to a working reconnaissance map to make field site visits more efficient and help organize post-field data analysis.

Local agencies often possess most of the data needed for the desktop analysis, although it is often housed in many different departments. These data need to be compiled and consolidated before fieldwork begins. Table 6 lists some of the local agencies that may possess useful data. The lack of complete data, however, should not prevent you from getting started.

Many local agencies also have GIS mapping data layers or paper maps that can be used to create USSR field maps. Table 7 lists layers that are both required and helpful to generate USSR field maps. Although aerial photos are listed as optional, they are extremely helpful, and every effort should be made to acquire them. Aerial photos make fieldwork easier and enable easier computation of variables, such as lot size and pervious area locations.

**Table 5: USSR Field Equipment Needs**

| Equipment/Data | NSA | HSI | PAA | SSD |
|---|---|---|---|---|
| Aerial photos | X | X | X | |
| Basic street map | X | X | X | X |
| Camera | X | X | X | X |
| Safety items: cell phone, pepper spray, first aid kit | X | X | X | X |
| Emergency contact numbers | X | X | X | X |
| Field Forms, clipboard, pencils | X | X | X | X |
| Flashlight | | | X | X |
| GPS unit | | X | X | X |
| Screwdriver | | | X | |
| HOA data | X | | | |
| Authorization letter from local government | X | X | X | X |
| Measuring tape | X | X | X | X |
| Pry bar | | | | X |
| Sediment measuring rod | | | | X |

**Table 6: Data Requirements for USSR Fieldwork**

- Industrial storm water NPDES permittees (State or County Environmental Office)
- Prior restoration activities (Environmental Office, Department of Parks, Department of Public Works)
- Existing neighborhood maps (Office of Planning)
- Municipal maintenance schedule for roads (Department of Public Works)
- Census data (Office of Planning or Community Development)
- List of Homeowner’s Associations and contact information (Office of Planning)
- Current development projects and permits (Office of Planning, Zoning)
- Wetland forest projects (State wetland inventory maps)

| Table 7: Mapping Data for USSR Fieldwork | |
|---|---|
| **Required** | **Useful** |
| • Roads<br>• Topography<br>• Tax maps with parcels<br>• Vegetative cover | • Aerial photos<br>• Utilities (sewer, storm drain system)<br>• Soils<br>• Storm water treatment facilities<br>• Point sources (storm water treatment plants, NPDES permittees)<br>• Buildings/parking lots<br>• State wetland inventory map |

## 2.3 Site and Neighborhood Delineation/Mapping to Support the USSR

The next step involves delineating subwatersheds and individual neighborhoods, and locating known hotspots and open parcels. This step is essential to help plan your time and routes in the field.

### *Subwatershed Delineation*

The boundaries of the watershed and its component subwatersheds should be delineated first. Subwatersheds generally have a drainage area of 10 square miles or less and include streams ranging from first to third order. In practice, you will need to exercise some discretion in drawing actual subwatershed boundaries. Manual 2 provides practical techniques to help delineate subwatersheds.

### *Neighborhood Delineation*

Subwatersheds should be further subdivided into individual neighborhood units that will be examined during the NSA. Delineation of neighborhood units is somewhat subjective, and several options exist to define them. The easiest option is to use existing subdivisions that have already been mapped. Other options include delineating neighborhood units based on similar lot size, similar age of development, or the boundaries of existing homeowner or community associations.

### *Hotspot Site Identification*

Existing business and permitting databases should be screened to locate regulated hotspots and determine when they were last inspected. These databases may be housed in the local storm water agency, state environmental agencies, or the regional EPA office. The EPA also has several national databases to retrieve data on industrial and municipal dischargers.

Efforts should also be made to identify potential non-regulated hotspots during the desktop analysis. Many communities have extensive business databases that are organized by Standard Industrial Classification (SIC) codes. By comparing each database to a list of likely hotspots, you can generate a list of potential hotspots, along with contact information and the actual address. Appendix B presents a simple method to perform potential hotspot screening. Keep in mind that these databases are not always accurate or inclusive, so expect to find additional hotspots while driving the subwatershed.

### *Pervious Area Site Identification*

Possible sites for pervious area restoration are usually identified by analyzing aerial photographs or GIS layers. The choice of the minimum size for pervious area parcels should be based on staff, budget, and resources. Generally, all natural area remnants and other publicly-owned pervious areas larger than two acres should be delineated. Privately-owned pervious areas greater than five acres may also be delineated.

### *Parking Lot Site Identification*

Aerial photos or detailed maps can be analyzed to find large parcels of contiguous impervious cover, such as institutional, municipal, or commercial parking lots. These parking lots are often good potential retrofit sites, and are examined during the Streets and Storm Drain (SSD) assessment.

### *Stakeholder Identification*

Many communities have databases on homeowner associations, civic associations, and other community groups. These should be analyzed to identify new stakeholders and get reliable data on neighborhood characteristics for the NSA. Personal visits during fieldwork are often a good opportunity to recruit new stakeholders to the restoration planning process.

## 2.4 Budgeting and Scoping a USSR Survey

The budget for a full USSR will vary for each subwatershed, but averages $2,500-$7,400. The desktop analysis and mapping steps usually consume the most staff time, so be sure to budget enough time for these important steps. Up to a week of staff time may be needed to perform the desktop analysis. Also NSA, HSI, PAA, and SSD forms should be filled out with as much characterization data as possible before starting fieldwork. The desktop analysis gives you a better handle on the number of sites your field crew will need to visit.

Several factors come into play when budgeting and scoping a USSR, including the area of the subwatershed, field crew experience, available staff, equipment needed, and the number of sites to visit. The desktop analysis step can help estimate the total area to be surveyed, so that you can estimate staff time needed. You may want to plan for more staff time if a large number of hotspots or neighborhoods are expected. At least a week of staff time should always be allocated to process and interpret USSR data (e.g., data entry, quality control, and data evaluation). Table 8 provides a generic budget breakdown for the cost of performing the USSR on a 10 square mile subwatershed. Note that this budget does not account for using volunteers, which can result in a USSR cost of as little as $2,500.

| Table 8: Generic USSR Budget for Hypothetical Subwatershed | |
|---|---|
| **Salaries** | |
| Pre-field desktop analysis | |
| Training volunteers (2 staff, 24 hrs each) | $1,200 |
| Generating field maps Watershed Planner (40 hrs) | $1,000 |
| Field work | |
| Performing USSR (16 staff days) | $3,200 |
| Post-field desktop analysis | |
| Data processing (data entry/evaluation, quality control) Watershed Planner (40 hrs) | $1,000 |
| **Supplies and Equipment**<br>GPS unit ($150 per unit)<br>Camera (disposables + film processing or digital; $75-300)<br>Street maps/aerial photos ($25-50) | $250-500 |
| **Printing and Reproduction** | $500 |
| **Total Costs** | **$7,150 - $7,400** |

*Notes*
- *Budget assumes a 10 square mile, moderately urbanized subwatershed*
- *These cost estimates assume an hourly rate of $25. To get accurate estimates for your subwatershed, enter your expected staff costs (which can be zero for trained volunteers) or your prevailing hourly wage.*

# Chapter 3: Neighborhood Source Assessment (NSA)

## 3.1 Basics of Neighborhoods

Neighborhoods are an important focus for subwatershed restoration. Each residential neighborhood has a distinctive character in terms of age, lot size, tree cover, drainage, lawn size, general upkeep, and resident awareness. In addition, neighborhoods are rather homogenous when it comes to resident behaviors, stewardship, and involvement in restoration efforts. These unique characteristics directly influence the ability to widely implement restoration practices, such as on-site retrofits, neighborhood source controls, and better stewardship. While some neighborhood characteristics can be discerned from maps and aerial photographs, field assessments are needed to get quantitative data on pollutant source areas and their restoration potential.

The neighborhood is the fundamental unit for residential source control. Residential pollution sources can only be assessed neighborhood-by-neighborhood within a subwatershed. The residential behaviors that contribute to storm water quality problems can be systematically assessed by the Neighborhood Source Assessment (NSA), which looks at four specific source areas of the "average" neighborhood:

- Yards and Lawns
- Driveways, Sidewalks, and Curbs
- Rooftops
- Common Areas

Table 9 describes the polluting behaviors measured by the NSA, and the next section describes the four neighborhood source areas where they can occur.

**Table 9: Key Behaviors Within Residential Source Areas**

| Source Area | Polluting Behavior |
|---|---|
| **Yards and Lawns** | Over-Fertilization |
| | Excessive Pesticide Application |
| | Over-Watering |
| | Extensive Turf Cover |
| | Tree Clearing |
| | Improper Yard Waste Disposal |
| | Soil Compaction |
| | Soil Erosion |
| | Failing Septic Systems |
| | Pool Discharges |
| **Driveways, Sidewalks, and Curbs** | Car Washwater Flows |
| | Hosing/Leafblowing |
| | Application of Salts and other Deicers |
| | Dumping of Household Hazardous Waste |
| | Dumping of Oil/Antifreeze |
| **Rooftops** | Downspout Connections |
| | Added Impervious Cover/Exposed Soils |
| **Common Areas** | Pet Waste |
| | Unmaintained Storm Water Practices |
| | Buffer Encroachment |
| | Storm Drain Dumping |

*Yards and Lawns* - Individual yards account for about 70% of the turf cover in urban subwatersheds, and usually the majority of total pervious cover. Yards tend to be intensively managed, and can be a potentially significant source of nutrients, pesticides, sediment, and runoff.

At least 10 different behaviors in the yard can have an impact on subwatershed quality (Table 9), including lawn fertilization, pesticide use, watering, landscaping, and yard waste. Research has shown a link between these behaviors and water quality problems in local streams. Yard behaviors tend to be similar within a neighborhood, since most individual lots often have the same area, age, and tree canopy cover. The NSA quickly profiles the most prevalent lawn care and landscaping behaviors in order to target the education, enforcement, and municipal stewardship programs needed to change them.

*Driveways, Sidewalks, and Curbs* – Driveways, sidewalks, and curbs are endemic to nearly all neighborhoods, and they often provide a direct link to the street and storm drain system. As a result, many behaviors that occur on driveways and sidewalks can cause pollutants to directly wash off into the storm drain system. Notable examples include washing cars, hosing driveways, and applying deicing compounds during the winter. These behaviors can introduce nutrients, oil, organic carbon, sediment, and chlorides into the storm drain system.

*Rooftops* - Residential rooftops are another focus of the NSA. Rooftop runoff can contain many pollutants and produce storm water runoff. The NSA is used to calculate the proportion of neighborhood rooftops with downspouts that are directly connected to the storm drain system. If most downspouts are directly connected, this presents a potential restoration opportunity if they are disconnected by rain barrels and rain gardens. These on-site residential retrofits can help reduce or delay storm water runoff delivered to a stream (see Manual 3). Stream hydrology can be improved and pollutants can be reduced if a large fraction of neighborhood rooftops can be disconnected. However, downspout disconnection is not always feasible in all neighborhoods; small lots, basements, impermeable soils, and steep slopes can constrain widespread implementation.

The NSA also examines whether new “rooftops” are being built in the neighborhood, such as additions, decks, outbuildings, and residential redevelopment. Collectively, these additions and expansions can sharply increase neighborhood impervious cover and become a source of sediment erosion during construction. If the NSA reveals significant redevelopment activity in a neighborhood, it may indicate a need for residential erosion and sediment control and education.

Many residents also store household hazardous wastes, such as fertilizers, pesticides, paints, and oil. The NSA asks whether garages are present, which provides clues as to where and how household hazardous wastes are managed.

*Common Areas* - Newer neighborhoods often have considerable areas of community open space in the form of stream buffers, protected flood plains, storm water management practices, rights-of-way, and pocket parks. Common areas are an important focus of the NSA, even though they are located outside of the individual home site. Specific behaviors assessed in common areas include how residents dispose of pet waste, how storm water practices are maintained, how buffers and natural areas are managed, and whether storm drains are stenciled. It is also helpful to assess the general upkeep of common areas to determine whether a homeowner or neighborhood association is active.

## 3.2 Introduction to the NSA

Urban neighborhoods have a large number of potential pollution sources, but also offer many opportunities to educate residents about stewardship activities that can improve stream quality. Table 10 summarizes the neighborhood factors assessed by the NSA and how they are linked to specific stewardship or restoration techniques.

The NSA quantifies potential pollution sources within neighborhoods, and identifies potential residential restoration projects. To fill out an NSA field form, you need to drive every street in the neighborhood and subsample individual lots, curbs, catch basins, and common areas. Key outputs from the NSA are an index of the severity of neighborhood non-point source pollution and an index of potential neighborhood restoration opportunities.

The NSA field form is composed of six parts:

*Neighborhood Characterization* – Compiles basic information about the neighborhood.

*Yard and Lawn Conditions* – Assesses vegetative cover and management practices on the typical lawn.

*Driveways, Sidewalks, and Curbs* – Estimates pollutant accumulation and evaluates housekeeping on these impervious areas.

*Rooftops* – Quantifies how rooftop runoff is managed on the average residential lot.

*Common Areas* – Evaluates practices in common neighborhood areas, such as storm water ponds, buffers, and flood plains.

*Recommended Actions and Initial Assessment* – Makes specific recommendations on key residential behaviors that could be improved, and derives an index that rates pollution severity and restoration opportunities in the neighborhood as a whole.

**Table 10: NSA Factors Assessed and Corresponding Techniques**

| Source Area | Neighborhood Factor Assessed | Corresponding Stewardship Technique* |
|---|---|---|
| **Yards and Lawns** | High management turf | Reduced Ferilizer Use (N-1, N-7) |
| | Potential pesticide use | Reduced pesticide use (N-2) |
| | Non-target irrigation | Xeriscaping (N-3) |
| | Extensive turf cover | Natural landscaping (N-4) |
| | Low forest canopy | Tree planting (N-5) |
| | Improper yard waste disposal | Yard waste composting (N-6) |
| | Soil erosion | Erosion repair (N-8) |
| | Construction activity | Single lot control (H-9 and N-17) |
| | Presence of septic systems | Septic system clean-outs (N-9) |
| | Presence of swimming pools | Safe pool discharge (N-10) |
| **Driveways, Sidewalks, and Curbs** | Driveway/curb flows | Safe car washing (N-11) |
| | Driveway conditions | Driveway sweeping (N-12, N-13) |
| | Outdoor car maintenance | Car fluid recycling (N-15) |
| | Sidewalk zone conditions | Pet waste pick-up (N-18), Streetscaping (RP-10) |
| **Rooftops** | Downspout connection | Downspout disconnection or treatment (N-16, OS-15 to OS-17) |
| **Common Areas** | Evidence of pet waste | Pet waste education/enforcement (N-18) |
| | Presence of storm water ponds | Storm water maintenance (N-19) |
| | Turf cover in open space | Bufferscaping (N-20), reforestation (F-5) |
| | Condition of storm drain inlets | Storm drain stenciling (N-21) |
| | Sidewalk zone | Streetscaping (SR-5) |
| | Evidence of dumping | Prevention/removal of dumping (RP-10) |

**The code in parentheses refers to the appropriate restoration profile sheet in the Restoration Manual Series. Codes are as follows:*

- *OS- and SR- sheets can be found in Manual 3: Storm Water Retrofit Practices*
- *N- and H- sheets can be found in Manual 8: Pollution Source Control Practices*
- *RP- sheets can be found in Manual 9: Municipal Practices and Programs*

### Desktop Analysis

The most important desktop analysis is the delineation of neighborhoods within the subwatershed. Individual neighborhoods can be grouped together if they have similar characteristics. For example, three adjacent neighborhoods with the same basic lot size, road widths, setbacks, and house types can be lumped into a single unit neighborhood. This should be verified in the field, and adjustments made to group similar neighborhoods or ungroup dissimilar ones. Two methods of neighborhood delineation are offered here: one using aerial photographs, and the other using street maps.

Using aerial photographs. Local planning departments should be consulted to see if they have GIS data layers and/or aerial photos to analyze neighborhoods. If these are not available, data may be available on websites such as www.gisdatadepot.com. When GIS data is available, it can be used to easily delineate neighborhoods, especially if data layers include tax maps and parcel boundaries. If only aerial photos are available, simply print the photos and use them to delineate neighborhoods manually using the method described here.


**Figure 3: Aerial Photo Showing Delineated Neighborhoods in Maidens Choice Subwatershed in Baltimore, MD**

On the printed photo, highlight or use a marker to circle each distinct neighborhood and record its Unique Site ID. Figure 3 shows how an aerial photo was used to delineate a neighborhood for an NSA conducted in Baltimore, MD. Pink circles on the photos designate discrete neighborhoods, and the Unique Site ID is recorded and highlighted in yellow. Major roads were labeled in the office. The white circle identifies a specific neighborhood for which a sample NSA form will be completed.

Using street maps. Street maps often label major neighborhoods and subdivisions, and you can use major roads to divide them, as needed. You will want to check tax maps to verify that these neighborhoods have similar lot dimensions (e.g., setbacks, house sizes, lot sizes, and age). This method requires more effort since you often need to adjust boundaries based on field observations. Also, make sure you have the most recent street map available, since many neighborhoods are being continually developed or redeveloped. Figure 4 illustrates a neighborhood using a standard street map.

### Field Work

Once neighborhoods are delineated, you can map out a route through the subwatershed. You should assess every neighborhood identified on your map using a "random sample" method. An NSA form should be completed for at least three randomly-selected lots in the neighborhood. Together, the lot samples represent the average conditions for the neighborhood as a whole. Randomly selecting lots from aerial photos or tax maps is ideal, but if this cannot be done, lots can be randomly selected in the field. Each NSA form should include a sketch of the lot with the driveway, house, sidewalk, landscaping features, and any forest canopy cover.

As an alternative, crews can drive the entire neighborhood and make a composite sketch of the "average lot" on a single NSA form. The composite sheet method is suitable for crews that have acquired a lot of experience with the NSA.

### NSA Field Forms

Each neighborhood is assigned its own Unique Site ID. A simple way to label neighborhoods is to combine the names of the subwatershed and the subdivision. For example, a subdivision called City Heights located in the Maidens Choice subwatershed would be identified as MC-CH, followed by a consecutive number for each individual lot sampled. Thus if three lots are sampled, they would be assigned Unique Site IDs of MC-CH-1, MC-CH-2, and MC-CH-3.

The NSA form also contains an index to rate the pollution severity and restoration potential of the neighborhood as a whole. The index is best computed when you get back to the office unless field crews are extremely familiar and experienced with the NSA.

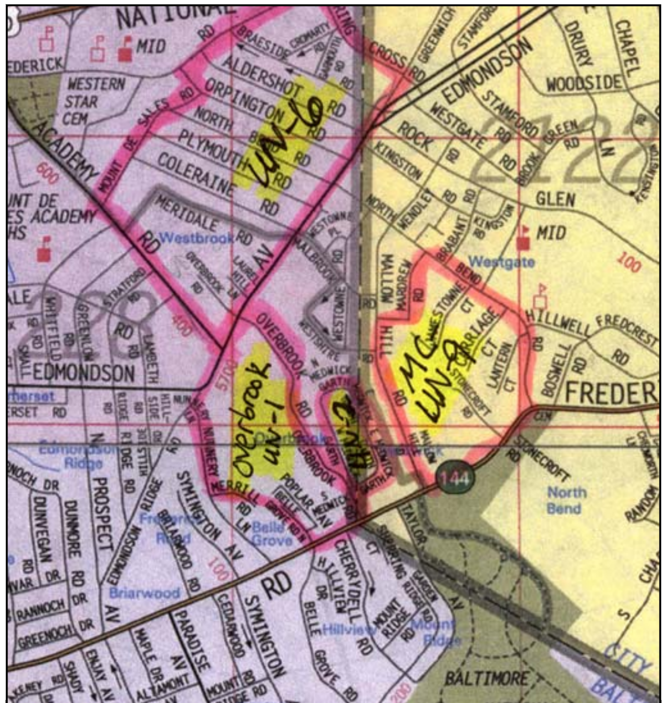



**Figure 4: Street Map of the Partially Delineated Maidens Choice Subwatershed**

The remainder of this chapter provides specific guidance on how to complete the six parts of the NSA form. A snapshot of the part of the field form under discussion is included in each section, and a copy of the full field sheet is included in Appendix A.

## 3.3 Characterizing the Neighborhood

The top part of the NSA form is used to record locational information about the neighborhood (Box 1). You are asked to provide the name of the watershed and subwatershed, and assign it a Unique Site ID. You should also record the date of your visit, the members of your survey team, and any information about the camera and photo numbers taken at the site. Photos are important for several reasons. First, they can help jog your memory of what you saw at a particular site once you are back in the office. Secondly, they can be an important part of the stakeholder process. Showing neighborhood photos of pollution problems and restoration opportunities can be a powerful tool for stakeholder meetings. Lastly, field photos can be useful when it comes time to assess the restoration potential of individual homes.

The next part of the NSA form characterizes general information about the neighborhood (Box 2).

| | | |
|---|---|---|
| WATERSHED: Gwynns Falls | SUBWATERSHED: Maidens Choice | UNIQUE SITE ID: MC-CH-1 |
| DATE: 11/06/03 | ASSESSED BY: SLS, AW | CAMERA ID: digital 2 PIC#: 13 |

**Box 1:** *In this example, the field crew assessed a neighborhood within the Maidens Choice subwatershed of Gwynns Falls watershed known as Court Hill. They assigned it a unique site ID of MC-CH-1, and took a digital photo, which was the 13th on the camera roll.*

**A. NEIGHBORHOOD CHARACTERIZATION**

Neighborhood/Subdivision Name: Jamestowne Ct. Townhomes + Mallow Hill Apts    Neighborhood Area (acres) ______
If unknown, address (or streets) surveyed:

Homeowners Association? ☐ Y ☒ N ☐ Unknown If yes, name and contact information: ______

Residential *(circle average single family lot size):*

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre    ☒ Multifamily (Apts, Townhomes, Condos)
☐ Single Family Detached <¼ ¼ ½ 1 >1 acre    ☐ Mobile Home Park

Estimated Age of Neighborhood: 25 years | Percent of Homes with Garages: 0 % With Basements 0 %

Sewer Service? ☒ Y ☐ N

Index of Infill, Redevelopment, and Remodeling ☒ No Evidence ☐ <5% of units ☐ 5-10% ☐ >10%

***Box 2:*** *In this example, the field crew profiled the Jamestowne Court Townhouses and Apartments. They quickly estimated that the complex was about 25 years old, found manholes indicating that it was serviced by sewer, and observed no garages or basements. Prior desktop analysis did not indicate that there was an active civic association, and the crew saw no evidence of redevelopment or construction activity on the premises.*

You should record the name of the neighborhood or subdivision. If there are no signs to identify the neighborhood, simply record the street names. If you choose to complete a composite form for the neighborhood, record the name of the intersection at the neighborhood entrance.

Many neighborhoods have a **homeowner's association** (HOA). HOA contact information is important for several reasons. First, HOAs will be your primary point of contact if the NSA reveals any neighborhood restoration opportunities. Second, HOAs can be important stakeholders to involve in subsequent steps of the subwatershed restoration planning process. Lastly, HOA contacts may be able to quickly provide neighborhood information to complete the NSA form, such as the age of development. HOA and contact information should have been acquired during the desktop analysis.

**Sample Lot Size Calculation**

Frontage = 120 feet; Depth = 180 ft

Area = 120ft x 180ft = 21,600ft$^2$

21,600/43,560 = 0.50 acres

Check the appropriate box if the neighborhood has multi-family housing, such as condominiums or apartments or is a mobile home park. If the neighborhood consists of single family homes, record the estimated area of the average lot (in acres). Lot size is important, since larger lots are linked to more frequent fertilization and herbicide application than smaller ones. Also, certain restoration opportunities such as rain gardens can be directly influenced by **lot size**. Lot size can be derived from tax maps or plats, or directly measured from GIS parcel data. Multiply lot frontage (length along the street) and lot depth (from front to back), to compute square footage, and divide by 43,560 to convert the area into acres (see example at left).

Two methods are available to measure lot size in the field. The first method is to walk the lot using calibrated paces. A more accurate method is to physically measure lot dimensions with a 100-foot measuring tape. Lot depth can be hard to measure if you don't have access to backyards. When measuring the lot, you should also measure house dimensions, which will be needed later.

You should also estimate the **age of the neighborhood**, which helps explain many neighborhood characteristics. For example, storm drain inlet catch basins are more common in older neighborhoods, while storm water treatment practices are more common in newer ones. Age can be estimated by looking at features such as the architecture of the house, by analyzing tax maps/plats, or by directly contacting the HOA.

**Garages** and **basements** are two other important features to note in a neighborhood. Most homeowners use and store household hazardous wastes, such as  paint, used oil, and pesticides. If garages are *not* present, it may suggest that household wastes are stored outside and are more likely to pollute storm water runoff. The presence of basements is an important indicator of the feasibility of downspout disconnection. Homeowners with basements may be less likely to disconnect downspouts because of fears about water seeping in or the basement flooding. Simply note the percentage of homes in the neighborhood that have garages and basements.

**Sanitary sewers** are the most common method for disposing of wastewater in most urban neighborhoods, although some large lots may still rely on septic systems. To determine if sewers are present, simply look for manhole covers that are labeled "Sanitary Sewer" (Figure 5). If no signs of sewer service are found, look for evidence of septic system drain fields. Septic systems can be a pollution source area if they are not properly maintained.

Another key neighborhood characteristic is the **Index of Infill, Redevelopment and Remodeling**. Infill is development that occurs on small lots that were previously undeveloped, while redevelopment occurs when existing developed areas are renovated, expanded, and/or restored. Remodeling refers to changes, such as the addition of a deck, garage, or outbuilding, or larger expansions of the existing house. Try to estimate the percentage of homes in the neighborhood currently undergoing infill, redevelopment, or remodeling. If more than 10% of the homes in a neighborhood fall into this category, it suggests that construction could be a significant pollution source.


**Figure 5: Sanitary Sewer Manhole Popped Open for Inspection**

## 3.4 Assessing Yard and Lawn Conditions

This part of the NSA form assesses the average yard and lawn condition for the neighborhood (Box 3).

Nine questions profile potential pollution sources and behaviors in the yard or lawn. You must first estimate the percentage of five lot cover types for the average residential lot (Figure 6):

- Impervious cover
- Grass cover
- Landscaping cover
- Bare soil cover
- Forest canopy cover

**Impervious cover** is defined as any surface that cannot absorb or infiltrate rainfall, and is a useful indicator of the impacts of development on aquatic systems. Examples of impervious cover in residential lots include houses, garages, outbuildings, carports, paved/concrete driveways and sidewalks, decks, and swimming pools.

The NSA then asks for an estimate of the percentage of **grass cover** on the lot and an assessment of how intensively it is managed. High management turf is defined as lawns that

| *Record percent observed for each of the following indicators, depending on applicability and/or site complexity* | Percentage | Comments/Notes |
|---|---|---|
| **B. Yard and Lawn Conditions** | | |
| **B1.** % of lot with impervious cover | 20 \| 10 \| 15 | 15 |
| **B2.** % of lot with turf grass | 60 \| 80 \| 70 | 70 |
| **B3.** % of lot with landscaping (e.g., mulched bed areas) | 20 \| 10 \| 15 | 15 |
| **B4.** % of lot with bare soil | 0 \| 0 \| 0 | 0 |
| **Note: B1 through B4 must total 100%* | | |
| **B5.** % of lot with forest canopy | 30 \| 10 \| 20 | 20 |
| **B6.** Evidence of permanent irrigation or "non-target" irrigation | yes | |
| **B7.** Proportion of *total neighborhood* turf lawns with following management status: | High: 60%<br>Med: 40%<br>Low: 0 | |
| **B8.** Outdoor swimming pools? [X] Y ☐ N ☐ Can't Tell Estimated # 12 | | |
| **B9.** Junk or trash in yards? ☐ Y [X] N ☐ Can't Tell | | |

***Box 3:*** *In this example, the field crew evaluated yard and lawn conditions in a five-year old suburban neighborhood consisting of half-acre residential lots. The crew measured cover types at three randomly selected lots, and reported turf and forest canopy cover at 70% and 20%, respectively. Using the visual lawn indicators, they rated 60% of the turf as being in the high input category, and the remainder in the medium input category. They noticed about a dozen backyard swimming pools in the neighborhood, but found no obvious trash or junk in any yards. The crew leader made a note on the form that lawn care practices and swimming pool discharges might be a potential pollution source for the neighborhood.*

**Figure 6: A Typical Lot Demonstrating Yard and Lawn Cover Types**

are over-fertilized, over-watered, or treated with pesticides, which increases the chance that these pollutants will run off lawns during storms.

**Landscaped areas** are operationally defined as mulched beds that typically have plants, small ornamental trees less than six inches in trunk diameter (such as dogwood, cherry and pear trees), and/or shrubs. Landscaped areas represent a restoration opportunity if a natural landscaping approach is used. Natural landscaping can reduce runoff and pollutant inputs compared to turf areas (Figure 7) by using native vegetation that is already adapted to the water and soil conditions of the area, and reducing the amount of fertilizer and irrigation needed.

**Bare soil** presents a potential source of sediment from the lawn. The percentage of bare or exposed soil should be directly recorded on the sheet. Any bare soil areas on lawns should be replanted immediately to reduce the risk of erosion and sediment runoff during storms.

**Forest canopy** is operationally defined as the portion of the average lot covered by trees with a diameter greater than six inches. Forest canopy cover includes *any* part of the lot covered by the tree "drip line," which is illustrated in Figure 8. A drip line is an imaginary area on the ground that encircles the outermost foliage of the tree above.

Figure 7: Example of Bayscaping

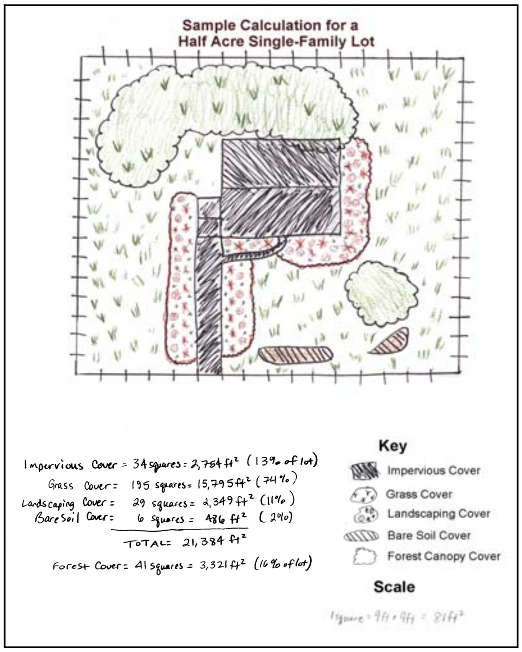

Figure 8: Tree Drip Line

### *Estimating Cover Area*

You will need to sketch the lot to accurately calculate each of the five cover types. The bottom right corner of the back of the NSA form contains a grid, and Figure 9 provides a sample sketch and calculation. The process of sketching lot cover types to scale has four steps. In the first step, you set the scale for the grid based on the lot size. Table 11 can help you choose the appropriate scale to mark your grid. The second step assumes that the lot is square, which makes subsequent calculations much easier. The five lot cover types are then sketched on the grid in the third step.

The last step involves calculating the percentage of each cover type from the ground. You can make a visual estimate directly from the sketch or calculate it using the square counting method, as illustrated in Figure 9.

The **management status** of the grass cover on the lot is very important to determine when completing the NSA, since high input turf can result in polluted storm water runoff. High turf input is defined as lawns where fertilizers, pesticides, and irrigation appear to be used to maintain a dense grass cover. You can rate the turf management status by looking at simple indicators on the lawn, as shown in Table 12.




***Steps in the Square Counting Method***

1. Count the total number of squares occupied by each cover type
2. Multiply that number by the area included in each square, as shown above in Table 10 or on your grid.
3. Divide that number by the area of the entire lot calculated in Section A and multiply by 100 to get the percentage of the lot. Remember that the percentages of impervious cover, grass, landscaping and bare soil calculated should total 100.

**Figure 9: Sample Sketch and Ground Cover Calculation and Square Counting Method**

**Table 11: Selecting a Grid Scale**

| Lot Size (acres) | Lot Size ($ft^2$) | Scale and Area of Each Square |
|---|---|---|
| 1/10 | 4,356 | 1 square = 4 feet x 4 feet = $16ft^2$ |
| 1/8 | 5,445 | 1 square = 4.6 feet x 4.6 feet = 21 $ft^2$ |
| 1/4 | 10,890 | 1 square = 6.5 feet x 6.5 feet = 42 $ft^2$ |
| 1/3 | 14,520 | 1 square = 7.5 feet x 7.5 feet = $56ft^2$ |
| 1/2 | 21,780 | 1 square = 9 feet x 9 feet = $81ft^2$ |
| 1 | 43,560 | 1 square = 13 feet x 13 feet = 169 $ft^2$ |
| 1.5 | 65,340 | 1 square = 16 feet x 16 feet = $256ft^2$ |

**Table 12: Turf Management Indicators**

| Management Status | Indicators | | Example |
|---|---|---|---|
| High Input | • Well-manicured<br>• Lush and dense<br>• Short, evenly cut<br>• Lawn care company signs<br>• Grass clippings<br>• Weed free | • Single shade of green<br>• One grass species<br>• Edging around driveways, sidewalks, and landscaping<br>• Permanent irrigation system<br>• Visible fertilizer pellets |  |
| Medium Input | A few indicators from both the high and low categories | | |
| Low Input | • Non-manicured appearance<br>• Build-up of thatch (small dead stems and brush) | • Patchy grass with soil/dirt showing through<br>• Varying height of grass with dandelions/weeds<br>• Varying shades of green |  |

High input turf can be a source of pollutants in urban neighborhoods. Lawns that are lush, dense, and consistently green may suggest the use of fertilizers and/or herbicides, particularly if they are managed by a lawn care company. Pollutants from the lawn can be washed into storm drains if permanent irrigation systems exist installed or routine lawn watering occurs.

Non-target irrigation occurs when sprinklers, hoses, or permanent irrigation sprinkler heads are misdirected over driveways and sidewalks. Pollutants that have accumulated on impervious surfaces can wash into the storm drain system if they receive non-target irrigation (e.g., fertilizer, oil, sediments, etc.). Manual 8 includes Profile Sheets that offer tips on reducing pollutant runoff from highly-managed lawns.

The last two yard factors to examine are the presence of **swimming pools** and **junk or trash.** Improperly drained swimming pools can discharge chlorinated water to streams that harms aquatic life. As you drive the neighborhood, estimate the percentage of homes that have outdoor swimming pools. The presence of junk or trash in yards is used to generate an index of neighborhood housekeeping. The NSA form asks you to estimate the amount of junk or trash in yards, and characterize its type, which can be recorded in the "Notes" box provided. Three important types of residential junk worth noting are abandoned cars, building materials, and household garbage.

## 3.5 Assessing Driveways, Sidewalks, and Curbs

This part of the NSA form evaluates pollutant accumulation in driveways, sidewalks and curbs in the neighborhood (Box 4).

First, record the percentage of lots in the neighborhood that have impervious driveways and describe their basic condition. A clean driveway may indicate that the homeowner regularly hoses it down, potentially washing pollutants to the storm drain, whereas a stained driveway may suggest that outdoor car maintenance or leaking vehicles could contribute pollutants to the stream.

**C. Driveways, Sidewalks, and Curbs**

**C1.** % of driveways that are impervious [ ] N/A — 100%

**C2.** Driveway Condition [ ] Clean [ ] Stained [X] Dirty [X] Breaking up

**C3.** Are sidewalks present? [X] Y [ ] N If yes, are they on one side of street [ ] or along both sides [X]

[ ] Spotless [X] Covered with lawn clippings/leaves [ ] Receiving 'non-target' irrigation

What is the distance between the sidewalk and street? 6 ft.

Is pet waste present in this area? [X] Y [ ] N [ ] N/A

**C4.** Is curb and gutter present? [X] Y [ ] N If yes, check all that apply:

[ ] Clean and Dry [ ] Flowing or standing water [X] Long-term car parking [X] Sediment

[X] Organic matter, leaves, lawn clippings [X] Trash, litter, or debris [X] Overhead tree canopy

***Box 4:*** *In this example, the field crew evaluated the condition of driveways, sidewalks, and curbs in a city neighborhood that primarily consisted of 1/8 acre detached homes. All homes in the neighborhood had impervious driveways, and most were dirty and breaking up. Sidewalks were present on both sides of the street, and they were partially covered by leaves, lawn clippings, and other kinds of organic matter. The distance from the street to the sidewalk measured six feet, and the crew observed a considerable amount of dog poop in this zone. The street had curb and gutters, which contained about an inch of accumulated sediment, organic matter and litter, some of which appeared to come from the tree canopy overhead. Cars were parked on both sides of the street, which would make access by street sweepers difficult without parking restrictions. The field crew noted that the driveways, sidewalk zone, and curbs were a significant pollution source for this neighborhood.*

**Sidewalks** are often found along streets in urban neighborhoods (Figure 10). The NSA form asks you to note the condition of the sidewalk, if one is present. Sidewalks that are covered in lawn clippings or leaves can be a pollution source if this organic matter is washed into the storm drain. Ideally, residents would manually sweep sidewalks, collect the waste, and properly dispose of it.

Next, you should record the width of the **zone between the sidewalk and the street.** This zone is where pet waste tends to accumulate, since it is where most residents walk their dogs. During storms, pet waste can be easily washed from the sidewalk zone to the storm drain system, and send bacteria to streams (see Profile Sheet N-18 in Manual 8 for more information). Check to see if pet waste is present in the sidewalk zone, and record it on the form.

**Figure 10: Sidewalk-Lined Street with Trees**

**Curb and gutters** are used to quickly deliver storm water from the road to storm drains, and provide no pollutant removal (Figure 11a). If curb and gutters are present, you should look closely at the level of pollutant and organic matter **accumulation in the gutters**. Clean and dry gutters suggest that the municipality may be performing routine street sweeping, while flowing or standing water may indicate non-target irrigation, illicit discharges, or clogging of the storm drain inlet (Figure 11b).

The NSA form asks for an estimate of the density of car parking along the curb (Figure 11c). Long-term parking can make street sweeping difficult, and may be a potential source of pollution. Note the presence of any sediment, organic matter, or litter accumulated in the curb and gutter. Overhead tree canopy, illustrated in Figure 11a, can also be a source of organic matter in the street. Look above you to see if the canopy extends over the curb or street, and record it on the form.

## 3.6 Assessing How Rooftop Runoff is Managed

This part of the NSA form assesses how rooftop runoff is managed in the neighborhood (Box 5). Five questions are asked to determine if downspouts are directly connected to the storm drain system, and if there is any realistic potential to disconnect them or direct this runoff volume elsewhere.


a. Curb and Gutter System    b. Clogged Storm Drain Inlet    C. Long-Term Car Parking

**Figure 11: Common Driveway, Sidewalk, and Curb Conditions**

| D. ROOFTOPS | | |
|---|---|---|
| **D1.** Downspouts are directly connected to storm drains or sanitary sewer | 20% | |
| **D2.** Downspouts are directed to impervious surface | 40% | |
| **D3.** Downspouts discharge to pervious area | 40% | |
| **D4.** Downspouts discharge to a cistern, rain barrel, etc. | 0 | |
| **Note: C1 through C4 should total 100%* | | |
| **D5.** Lawn area present downgradient of leader for rain garden? ☒ Y ☐ N | 20% | * basements |

**Box 5:** *In this example, the field crew investigated rooftop runoff at a 20-year old subdivision with quarter acre residential lots and basements. The crew visually inspected ten homes and came up with a composite score for the neighborhood. The crew found that many homeowners had modified their rooftop drainage over time. Nearly 20% of all downspouts were now directly connected to the curb, while another 40% were indirectly connected (e.g., discharged to driveways and then to the street). About 40% of the downspouts discharged to lawns over a distance greater than 15 feet. In general, front lawns were flat and short, and the crew estimated that rain gardens or other on-site retrofit practices could only be applied to about 20% of the indirectly- or directly-connected downspouts in the neighborhood.*

When rain falls on a residential rooftop, runoff travels through the gutter to downspouts, also known as roof leaders. From there, runoff can be discharged one of five ways. The most undesirable discharge is when downspouts are **directly connected** to the storm drain system. These downspouts continue underground, and reach the storm drain without any treatment (Figure 12a and 12b).

Another undesirable discharge occurs when downspouts are **indirectly connected**. These downspouts drain to an impervious surface on the lot, such as a driveway or sidewalk (Figure 12c), allowing runoff to reach the storm drain with little or no treatment or infiltration.

A more desirable discharge is when the downspout drains to the front lawn, where runoff can infiltrate into the ground. Downspouts are considered **disconnected** if there is at least 15 feet of lawn available for infiltration to occur (Figure 12d).

An even better situation is when the individual downspouts discharge to a rain barrel or cistern. That stores runoff for irrigation later (Figure 12e). Techniques to disconnect rooftop runoff are discussed in Profile sheet OS-15 in Manual 3.

The best situation is when the downspout is directed into a rain garden that it is **totally disconnected** from the storm drain system. A rain garden, illustrated in Figure 12f, is a small, landscaped depression with native plants that captures and infiltrates rooftop runoff (see Profile sheet OS-16 in Manual 3). The NSA asks you to check if the average lot has several hundred square feet of lawn area available down gradient from the downspout to potentially plant a rain garden.

## 3.7 Assessing Common Areas

This part of the NSA assesses management practices at common areas in neighborhoods, such as streets, storm water ponds, and open spaces (Box 7).

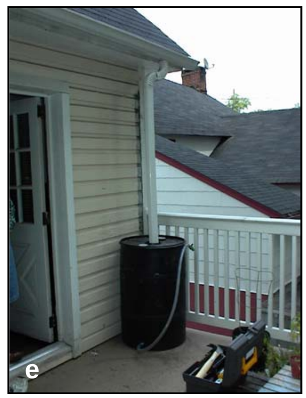
You are asked to make several observations along streets. First, are **storm drain inlets** present? While storm drains can have different configurations, they are often found along the curb, as shown in Figure 13. You should check to see if storm drain inlets are stenciled or clogged with sediment and debris. Storm drain stenciling teaches residents that what enters a storm drain will eventually enter the stream (see Profile Sheet N-21 in Manual 8).


Directly Connected to Storm Drain System


Directly Connected; Flowing Onto Street Through Underground Pipe


Indirectly Connected; Flowing to Impervious Surface


Disconnected; Flowing to Pervious Surface




Disconnected; Flowing to Rain Barrel

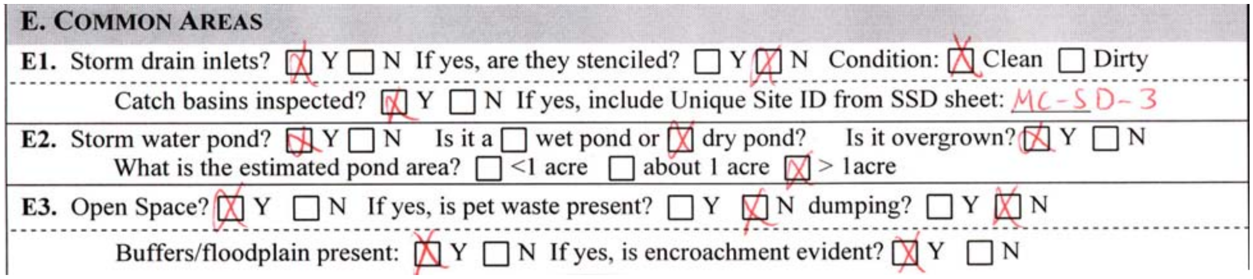

Disconnected; Flowing to Rain Garden

**Figure 12: Different Ways Downspouts Discharge Rooftop Runoff**

In some neighborhoods, storm drain inlets may have a device called a **catch basin**, which is designed to "catch" excess sediment and trash before it enters the storm drain pipe. If present, catch basins will be located inside the inlet, which can be accessed through a manhole. If catch basins are present in the neighborhood, you should inspect a few using the Streets and Storm Drains (SSD) field form. You should first get permission from the local public works department before popping manholes to inspect catch basins.

Newer subdivisions may have a **storm water management pond.** The NSA asks you to note whether the pond is a wet pond or dry pond, and its approximate area (in acres). Wet ponds have a permanent pool of water and are more desirable since they offer better water quality treatment. In contrast, dry ponds seldom have standing water, except after larger storms, and provide pollutant removal. If a fence surrounds the perimeter of the pond, use it as a guide to


**Figure 13: Stenciled Storm Drain Inlet**



**E. COMMON AREAS**

**E1.** Storm drain inlets? [X] Y [ ] N If yes, are they stenciled? [ ] Y [X] N Condition: [X] Clean [ ] Dirty

Catch basins inspected? [X] Y [ ] N If yes, include Unique Site ID from SSD sheet: MC-SD-3

**E2.** Storm water pond? [X] Y [ ] N Is it a [ ] wet pond or [X] dry pond? Is it overgrown? [X] Y [ ] N

What is the estimated pond area? [ ] <1 acre [ ] about 1 acre [X] > 1acre

**E3.** Open Space? [X] Y [ ] N If yes, is pet waste present? [ ] Y [X] N dumping? [ ] Y [X] N

Buffers/floodplain present: [X] Y [ ] N If yes, is encroachment evident? [X] Y [ ] N

***Box 7:*** *The field crew in this example investigated how open space was managed in a 10-year old, large lot subdivision. While driving through the neighborhood, the crew noted that storm drain inlets were present, and inspected one catch basin, using the SSD form. The storm drain inlets were not stenciled, but no sediment or pollutant accumulation was observed in the catch basin. Traveling downhill, the crew found that the storm drains led to a large dry storm water pond. They took two digital photos of the pond that was overgrown with willows, and noted that it might be worth investigating later as a possible retrofit. The remaining open space consisted of a few acres of floodplain setbacks and a utility right-of-way, both of which were regularly mowed, and no dumping or pet waste was observed.*

measure the pond area. Be sure to take a few photos of the pond for your retrofit expert. Manual 3 provides detailed information on storm water practices used to retrofit neighborhoods.

Routine maintenance is vital to the proper function of any storm water pond. Vegetation can be present in different areas of the pond, but should not be growing out of control. Figure 14 compares an overgrown dry pond that is not functioning as designed with a well-maintained dry pond. Both of these ponds may be good candidates for storm water retrofitting.

**Neighborhood open space** presents an opportunity for restoration. Any stream buffers, floodplains, and open areas in the neighborhood should be assessed. Dumping, mowing, and sheds/buildings are some typical examples of encroachment. As a rule of thumb, look for large mowed open areas that might be potential candidates for reforestation.

## 3.8 Recommended Actions and Neighborhood Indexes

After the neighborhood survey is done, you are asked to compile indices that rank the overall neighborhood nonpoint pollution severity and restoration opportunities for the neighborhood. This section provides guidance on deriving neighborhood indexes and making initial recommendations for neighborhood restoration and stewardship actions.


**Figure 14: Overgrown Dry Pond (a) and a Well-Maintained One (b)**

To start, the form asks you to rate the major pollutants that are potentially being generated by the neighborhood (Box 8).

To help you make this determination, Table 13 indicates the specific NSA questions linked to specific pollutant sources. If two or more questions are answered affirmatively, you should check the appropriate pollutant index box. Boxes are also provided to describe any recommended restoration actions for the neighborhood.

This part of the NSA also asks you to recommend specific actions for neighborhood restoration or retrofits, based on your initial field observations. Other Restoration Manuals offer more specific guidance on how to make neighborhood recommendations.

**On-site retrofits** are used by homeowners to reduce storm water runoff generated by their lots, by disconnecting downspouts. Examples include rain gardens, rain barrels, and cisterns, which are described in Manual 3.

**Table 13: Pollution Indicators**

| Pollutant | Reference Questions | Potential Cause |
|---|---|---|
| Nutrients | B7 (High level) | Fertilizer |
| | C3 | Lawn clippings |
| | C4 | Organic matter (Leaves, Lawn Clippings) |
| Oil and Grease | C1 | Stained driveways |
| | C4 | Long-term car parking |
| Trash/Litter | B9 | Trash in Yards |
| | E3 | Dumping |
| Bacteria | A (Sewer Service) | If *not* present, potential from septic tanks |
| | C3 | Pet waste |
| | E3 | Pet waste |
| Sediment | B4 | Erosion |
| | C2 | Driveways that are breaking up |
| | C4 | Sediment in curb and gutter |

**F. Initial Neighborhood Assessment and Recommendations**

Based on field observations, this neighborhood has significant indicators for the following: (*check all that apply*)

☒ Nutrients ☐ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☒ Sediment ☐ Other ______

| Recommended Actions | Describe Recommended Actions: |
|---|---|
| *Specific Action* | - parking lot could have bioretention |
| ☐ Onsite retrofit potential? | |
| ☒ Better lawn/landscaping practice? | mowed grass to edge of stream |
| ☐ Better management of common space? | |
| ☒ Pond retrofit? - possible conversion to wet pond | |
| ☒ Multi-family Parking Lot Retrofit? | |
| ☒ Other action(s) clean-up of dry pond | |

***Box 8:*** *In this example, the field crew assessed a townhouse community with a curb and gutter system with accumulated sediment. The sidewalk was covered with lawn clippings and leaves that appeared to come from overhead tree canopy. Based on these observations, the field crew determined that the neighborhood could be a significant source of nutrients and sediment. The field crew also made a several initial recommendations for the neighborhood. For example, they suggested that the large parking lot had retrofit potential since portions of it were sloped towards an area that was already landscaped. They also recommended that the dry storm water pond that was in severe need of maintenance, and that it could potentially be converted into a wet pond. Finally, the field crew suggested that the landscaping contractor stop mowing so close to the edge of the stream.*

**Better lawn/landscaping practices** may be needed in neighborhoods where high input lawns and extensive turf cover are prevalent. Better lawn care practices minimize the use of chemicals and encourage the use of native landscaping. Specific lawn care techniques are discussed in Manual 8.

When dumping, pet waste, or stream buffer encroachment is observed in neighborhoods, **better management of common space** may be recommended. Manuals 5 and 7 provide more information on restoration techniques that can be applied to neighborhood open space.

Neighborhoods with existing storm water ponds may be candidates for a **pond retrofit**. Retrofit options may involve improved maintenance practices or converting a dry pond into a wet pond or wetland to increase pollutant removal. Consult Manual 3 for more guidance on pond retrofits.

Multi-family parking lots found in apartment and townhouse complexes may sometimes present a good opportunity to provide a storm water retrofit. If parking lots are landscaped, there may be potential to turn these areas into bioretention areas for pollutant removal. Manual 3 provides more information on types of retrofits appropriate for parking lots.

Be sure to include a brief description of the types of actions needed when recommending specific follow-up activities, such as retrofits and better stewardship.

The last step in the NSA involves computing index values on the left-hand side of the field sheet. The **Pollution Severity Index**, denoted by open circles in the “Index” column on the NSA, is used to rate the severity of pollution generated by the neighborhood. The **Restoration Opportunity Index**, denoted by diamonds in the “Index” column on the NSA, rates the feasibility of potential residential restoration projects identified for the neighborhood as a whole. Some suggested benchmark values for each index are offered in Tables 14 and 15. These benchmarks should be adjusted if there is a specific pollutant of concern in the subwatershed.

**Table 14: Benchmarks Used to Establish Pollution Severity Index**

| Reference Question | Neighborhood Feature | Benchmark (% of neighborhood) |
|---|---|---|
| Part A | Septic System Presence | Answering “No” to sewer |
| Part A | Construction Activity | At least 5% |
| B2 | High Turf Coverage on Lot | At least 50% |
| B4 | Bare Soil Coverage on Lot | At least 5% |
| B6 | Irrigation Evident | At least 15% |
| B7 | High Turf Management | At least 20% |
| B8 | Outdoor Swimming Pools | At least 10% |
| B9 | Junk or Trash | At least 25% |
| C2 | Driveway Condition (Stained) | At least 25% |
| C3 | Sidewalk Condition (Leaf Cover) | At least 25% |
| C3 | Pet Waste | At least 25% |
| C4 | Curb and Gutter Condition | At least 20% with flowing/standing water and/or sediment/organic matter |
| D1 | Rooftop Connection | At least 25% |
| E1 | Catch Basin Condition | More than three inches of accumulation |
| E3 | Open Space Management | At least 40% answering “Yes” to either *OR* At least 25% answering “Yes” to both |
| Part F | Source of Pollutant | Any pollutant is selected |

| **Table 15: Benchmarks Used to Establish Restoration Opportunity Index** | | |
|---|---|---|
| **Reference Question** | **Neighborhood Feature** | **Benchmark (% of neighborhood)** |
| B3 | Landscaping | Less than 25% |
| B5 | Forest Canopy Coverage | Less than 40% |
| C3 | Sidewalk Zone | At least 25% with sidewalk zone width of six feet or more |
| C4 | Curb and Gutter | At least 25% of curb and gutter with trash, organic matter, *or* sediment accumulation |
| D1 | Rooftop Connection | More than 25% of connected roofs are feasible for disconnection |
| D5 | Rain Garden | More than 25% |
| E1 | Storm Drain Inlets | Less than 10% stenciled |
| E2 | Storm Water Pond | Answering "Yes" to overgrown or to dry pond |

To complete the index, compare your NSA field value to the benchmark, and if it exceeds the benchmark, check the circle or diamond. Next, count the total number of checked circles or diamonds and rate the neighborhood using the scoring system provided below.

### *Pollution Severity Index*

- More than 10 circles checked indicates **severe** potential to generate pollutants
- Five to 10 circles checked suggests a **high** potential to generate pollutants
- One to five circles checked suggests a **moderat**e potential to generate pollutants
- If no circles were checked, the neighborhood has a **low** potential to generate pollutants

### *Restoration Opportunity Index*

- More than five diamonds checked suggests a **high** restoration potential for this neighborhood
- Three to five diamonds checked indicates a **moderat**e restoration potential
- If two or fewer diamonds are checked, this suggests a **low** restoration potential for this neighborhood

Both indexes are used to compare and rank neighborhoods across subwatersheds to prioritize restoration projects and stewardship campaigns. More guidance on interpreting and using NSA index data to screen subwatersheds is provided in Chapter 7 of this manual.

# Chapter 4: Hotspot Site Investigation (HSI)

## 4.1 Basics of Hotspots

Storm water "hotspots" are defined as commercial, industrial, institutional, municipal, or transport-related operations that produce higher levels of storm water pollutants, and/or present a higher potential risk for spills, leaks or illicit discharges. Table 16 lists potential pollutants that can be generated from hotspot sites.

There are two basic types of hotspots. **Regulated** hotspots are known sources of pollution and are subject to federal or state regulations. **Unregulated** hotspots are operations suspected to be potential pollution sources, but which are not currently regulated. Storm water hotspots can be found in a variety of land uses, and many different hotspot operations are usually found in each subwatershed. Appendix B contains a classification of potential hotspot operations, which is based on the Standard Industrial Classification (SIC) code system.

**Commercial** hotspots consist of a small subset of businesses in a subwatershed associated with specific activities that can generate higher pollutant loads. Commercial hotspots typically experience a great deal of vehicle inputs, generate waste or wash water, handle fuel or repair vehicles, or store products outside. While commercial hotspots are quite diverse, they tend to be clustered together within a subwatershed. Each kind of commercial hotspot tends to generate its own blend of storm water pollutants, which can include nutrients, hydrocarbons, metals, trash or pesticides. Each potential commercial hotspot operation needs to be inspected during the Hotspot Site Investigation (HSI) to confirm whether it actually represents a real pollution source or risk.

**Industrial** hotspots are always a major focus of the HSI since they use, generate, handle or store pollutants that can potentially be washed away in storm water runoff, spilled, or inadvertently discharged into the storm drain system. Many industrial operations are regulated storm water hotspots under the Environmental Protection Agency's NPDES industrial storm water permit program, although the individual owner or operator may be unaware of that fact. Appendix B provides a list of specific industries subject to NPDES regulations that is based on SIC codes.

**Institutional hotspots** include larger, privately-owned facilities that have extensive parking, landscaping, or turf cover. In addition, they may possess vehicle fleets and maintenance operations. By and large, institutional hotspots are not regulated. The most common pollutants generated at institutional hotspots are nutrients and pesticides applied to maintain grounds and landscaping. Large institutional parking lots produce large volumes of storm water runoff and associated pollutants, and are natural targets for storm water retrofitting.

| Table 16: Potential Pollutants From "Hotspot" Businesses and Activities | |
|---|---|
| Nutrients (e.g., phosphorus and nitrogen) | Road salt |
| Pesticides | Bacteria |
| Solvents (e.g., paints and paint thinners) | Trace metals (e.g., copper, zinc, lead, cadmium, aluminum, and chromium) |
| Fuels (e.g., gasoline, diesel, kerosene) | Polychlorinated Biphenyls |
| Oil and grease | Polycyclic Aromatic Hydrocarbons |
| Toxic chemicals | Volatile Organic Compounds |
| Sediment | |

**Municipal hotspots** include many local government operations that handle solid waste, wastewater, road and vehicle maintenance, and yard waste. Most of these operations are defined as regulated hotspots in communities subject to NPDES municipal separate storm water system permits. Municipal hotspots must prepare pollution prevention plans and implement source control practices that are essentially the same as for regulated hotspots. Municipal hotspots can generate the full range of storm water pollutants, including nutrients, hydrocarbons, metals, chloride, pesticides, bacteria, and trash.

**Transport-related uses** are the last hotspot category to investigate within a subwatershed. Many, but not all, transport-related uses are regulated hotspots. They tend to generate higher loads of hydrocarbons, metals, and sediment in storm water runoff, are often associated with large areas of impervious cover, and have an extensive private storm drain system. Transport-related hotspots are not always present in every subwatershed, but if they are, they should be thoroughly investigated.

Table 17 provides a rapid guide to identify common hotspots. You should become familiar with the potential hotspot categories before starting your HSI.

**Table 17: Common Hotspot Operations**

| Commercial | Industrial* |
|---|---|
| Animal Care Services | Auto Recyclers and Scrap Yards |
| Auto Repair | Beverages and Brewing |
| Automobile Parking | Boat Building and Repair |
| Building and Heavy Construction | Chemical Manufacturing |
| Building Materials | Food Processing |
| Campgrounds/RV parks | Garbage Truck Washout Activities |
| Car Dealers | Heavy Manufacturing |
| Car Washes | Leather Tanners |
| Commercial Laundry/Dry Cleaning | Metal Production, Plating and Engraving Operations |
| Convenience Stores | Paper and Wood Products |
| Food Stores and Food and Beverage Wholesalers | Petroleum Storage and Refining |
| Equipment Repair | Printing |
| Gasoline Stations | **Institutional** |
| Heavy Construction Equipment Rental and Leasing | Cemeteries |
| Marinas | Churches |
| Nurseries and garden centers | Colleges and Universities |
| Oil Change Shops | Corporate Office Parks |
| Restaurants | Hospitals |
| Swimming Pools | Private Golf Courses |
| Warehouses | Private Schools |
| Wholesalers of Chemical and Petroleum | |
| **Municipal** | **Transport-Related** |
| Composting Facilities | Airports |
| Landfills and Hazardous Waste Material Disposal | Petroleum Bulk Stations or Terminals |
| Local Streets | Ports |
| Maintenance Depots | Railroads |
| Municipal Fleet Washing | Rental Car Lots |
| Public Schools/Golf Courses | Street and Highway Construction |
| Public Works Yards | US Postal Service |
| Steam Electric Plants | Trucking Companies and Distribution Centers |
| Treatment Works | |

**Please consult Appendix B for a complete list of Industrial SIC Codes*

## Assessing Individual Storm Water Hotspots

The site is the fundamental unit to evaluate potential storm water hotspots. Each hotspot site has its own unique operations, drainage system, and potential pollution risk. As a result, each hotspot must be individually inspected to identify current practices, spill risks, and storm water problems. Hotspots do have common operations and activities that can contribute to storm water quality problems (Figure 15). The Hotspot Site Investigation (HSI) evaluates six common operations at each potential hotspot:

- Vehicle Operations
- Outdoor Materials
- Waste Management
- Physical Plant
- Turf/Landscaping
- Storm Water Infrastructure

*Vehicle Operations* - Nearly all hotspots devote some portion of the site to vehicle operations, which may include maintenance, repair, recycling, fueling, washing or long-term parking. Vehicle operations can be a significant source of trace metals, oil and grease, and hydrocarbons, and is the first area evaluated when performing an HSI. Vehicle maintenance and repair often produces waste oil, fluids and other hazardous products. The procedures for handling and safely disposing/recycling of these products should be assessed at every site. In addition, any connections between vehicle fueling or washing operations and the storm drain system should be thoroughly explored.

*Outdoor Materials* - Virtually every hotspot site handles some kind of material, which may cause storm water problems if not properly handled or stored. The HSI examines locations where materials are loaded and unloaded at the site to see if materials are exposed or spilled and can enter the storm drain system. It also looks at materials stored outdoors, and their possible exposure to rainfall or runoff. Stains on paved areas are usually a good indicator of poor outdoor storage practices.


**Figure 15: Six Common Operations Found at a Hotspot**

*Waste Management* - Every business generates waste as part of its daily operations, some of which can be hazardous, and most of which is temporarily stored at the site pending disposal. The HSI looks at the nature and manner in which wastes are stored and disposed, and the location of waste storage in relation to the storm drain system.

*Physical Plant Practices* - The fourth operation common to most hotspots consists of practices used to clean, maintain or repair the physical plant, which includes the building, outdoor work areas, and parking lots. Routine cleaning and maintenance practices can cause runoff of sediment, nutrients, paints, and solvents from the site. Sanding, painting, power-washing, and resealing of buildings and parking lot surfaces all deserve scrutiny, particularly if they are done close to storm drains.

*Turf and Landscaping* - Many commercial, industrial, institutional, and municipal hotspots directly manage or hire contractors to maintain turf and landscaping, apply fertilizers or pesticides and provide irrigation. The HSI thoroughly evaluates the current pollution potential of practices used to maintain the grounds (e.g., fertilizer, pesticides, and water).

*Streets and Storm Drains* - The sixth common hotspot operation worth investigating is the street and storm drain network that serves the facility. Many hotspot operations contain private storm water conveyance structures such as catch basins, as well as privately-owned storm water treatment practices. Maintenance practices for this private infrastructure should be investigated to ensure that they are regularly inspected, swept or cleaned out to reduce storm water pollution. In addition, you should complete an SSD assessment for private road conditions and large parking areas.

## 4.2 Introduction to the HSI

The HSI provides a way to quantify the impacts of hotspot activities on urban subwatersheds, and identify possible restoration practices that may be needed. The HSI asks you to assess six distinct pollution sources at each site, and to identify targeted pollution prevention techniques or restoration practices to address those sources (Table 18). The result of the HSI is a comprehensive database of confirmed hotspots for each subwatershed, each of which is ranked in terms of its severity. The database can be used to

**Table 18: HSI Assessment Factors and Possible Restoration Recommendations**

| Hotspot Factor Assessed | Pollution Prevention Activity* |
|---|---|
| Potential, Confirmed or Severe Hotspot | Permit enforcement (D-12) |
| Vehicle Source Areas | Vehicle pollution prevention practices (H-1 to H-4) |
| Outdoor Storage Source Areas | Storage pollution prevention practices (H-5/6) |
| Waste Management Source Areas | Waste pollution prevention practices (H-7/8) |
| Physical Plant Operations | Maintenance pollution prevention practices (H-9 to 11) |
| Turf/Landscaping Source Areas | Landscaping pollution prevention practices (H-12/13) |
| Uncontrolled Storm Water Discharge | Parking lot retrofit (SR-6, OS-7 through 11) |
| Suspected Source of Illicit discharge | Investigate discharges (M6) |
| Observed Spill or Illicit Discharge | Contain and fix discharges (M6 and H-7) |
| Unique Hotspot | Special pollution prevention practices (H-14/15) |
| Catch Basin Accumulation | Catch basin clean-outs (M-9) |

**The code in parentheses refers to the appropriate restoration profile sheet in the Restoration Manual Series. Codes are as follows:*

- *OS- and SR- sheets can be found in Manual 3: Storm Water Retrofit Practices*
- *H- sheets can be found in Manual 8: Source Control Practices*
- *M-9= Manual 9: Municipal Practices and Programs*
- *M-6= Illicit Discharge Detection and Elimination Guidance Manual (Brown et al. 2004)*

determine what, if any, pollution prevention or discharge prevention strategies need to be incorporated into the overall subwatershed restoration plan.

The HSI field form consists of eight parts:

*Site Data and Basic Classification* – Collects basic location and land use information about the hotspot site, and a brief description of its operations.

*Vehicle Operations* – Evaluates routine vehicle maintenance and storage practices at the site, as well as vehicle fueling and washing operations.

*Outdoor Materials* – Examines the type and exposure of any outdoor materials stored at the site.

*Waste Management* – Assesses housekeeping practices for waste materials generated at the site.

*Physical Plant* – Assesses maintenance practices used for cleaning, remodeling or repairing buildings, outdoor work areas and parking lots.

*Turf/Landscaping Areas* – Examines the practices used to maintain lawn or landscaping areas, with special emphasis on fertilizer use and non-target irrigation.

*Storm Water Infrastructure* – Evaluates the condition of practices used to convey or treat storm water, including the curb and gutter, catch basins, and any storm water treatment practices.

*Initial Hotspot Status - Index Results* – Provides an initial assessment of whether the site is a hotspot, and any specific follow-up actions that may apply.

The HSI field form also includes a grid to sketch the individual site and to locate possible pollution prevention activities. The sketch complements photos taken during the HSI, and you should note photo locations on the sketch.

You should have located many potential storm water hotspot sites to visit before heading out to the field. These potential hotspots are identified during the database screening stage, which is described in Appendix B. While database screening may reveal many regulated hotspots, it does not always pick up unregulated hotspots. Therefore, you should closely study land use patterns in the subwatershed, with a special emphasis on clusters of industrial and commercial land. These clusters should be marked on your subwatershed field map, and scouted thoroughly. It is always a good idea to review the business categories on the hotspot cheat sheet provided in Appendix C so you can look for these sites as you drive through the subwatershed.

The remainder of this chapter provides guidance on how to complete the HSI field form. A snapshot of each part of the field form is included in each section, and a blank field form can be found in Appendix A.

The first part of the HSI form asks for basic information such as the name of your watershed and subwatershed, and the **Unique Site ID** for the site being assessed (Box 9). You should record the date of your site visit, the members of your survey team, and any information about the camera used and picture

| | | | |
|---|---|---|---|
| WATERSHED: Gwynns Falls | SUBWATERSHED: Smiley Run | | UNIQUE SITE ID: SR-IN-2 |
| DATE: 11/03/03 | ASSESSED BY: TW | CAMERA ID: digital | PIC#: 2 |
| MAP GRID: | LAT 39° 17' 30" LONG 76° 42' 30" | | LMK # 4 |

**Box 9:** *In this example, the field crew assigned this industrial hotspot with the Unique Site ID of SR-IN-2 and recorded.*

numbers taken at the site. This is the part where you record the latitude and longitude coordinates for the site (if you are using a GPS unit), and the map grid coordinate (if you are using paper maps).

You should assign a Unique Site ID for the hotspot to reference in the hotspot database. A simple naming convention is recommended. The first initials give the name of the subwatershed. For example, in the Smiley Run subwatershed, the first identifier would be SR. The next two-letter designation is for the land use type (see Table 19). Hotspots within the same land use category are assigned a sequential number.

Taking photos is important to document behaviors and pollution sources. Pollution prevention experts can infer a lot about the severity of the hotspot and the feasibility of prevention techniques from well-chosen photos. Finally, photos are a powerful tool for subsequent enforcement or education efforts.

Commercial developments such as strip malls offer a challenge to field crews. Some businesses within the strip mall may qualify as hotspots, while many others do not. In this situation, you should complete one HSI form for each potential hotspot business and one for the entire mall as a whole. Different pollution prevention or retrofit opportunities may apply to individual businesses, as compared to the site as a whole.

**Table 19: Hotspot Land Uses and Letter Designation**

| Land Use Type | Site ID Designation |
|---|---|
| Commercial development | CO |
| Industrial land | IN |
| Institutional locations | IL |
| Municipal sites | MU |
| Transport related businesses | TR |
| Miscellaneous (see Manual 8) | MI |

## 4.3 Characterizing the Site

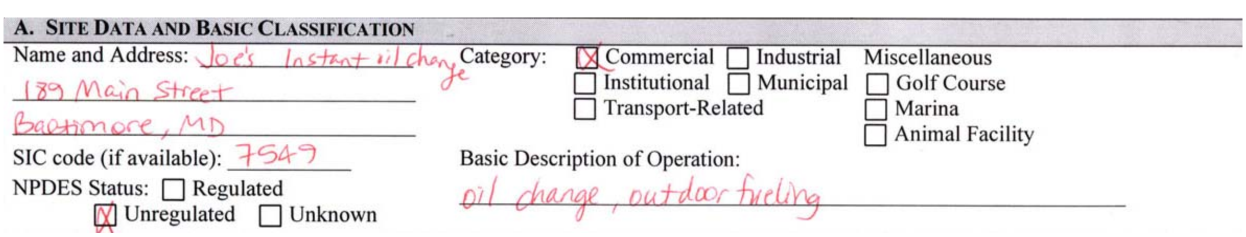
This part of the HSI form provides a basic profile of the potential hotspot (Box 10).

You are asked to record general information about the site including its address, **SIC code**, and regulatory status, if known. You should check the box that most appropriately describes its hotspot category, and briefly describe its operation.

## 4.4 Assessing Vehicle Operations

Nearly all hotspots devote some part of their site to vehicle operations, which can include maintenance, repair, recycling, fueling, washing, or long-term parking. The HSI form begins by asking three questions on the type and estimated number of vehicles present, and the nature of vehicle operations (Box 11). The number of vehicles can be estimated by counting actual vehicle or parking spaces, depending on whether the facility is open. Check to see which of the six vehicle operations take place at this site.

The next five questions focus on the potential for spills or storm water runoff from vehicle operations, with special emphasis on the connection between vehicle operations and the storm drain system. The HSI form asks you to



A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: Joe's Instant oil change
189 Main Street
Baltimore, MD

Category: ☒ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

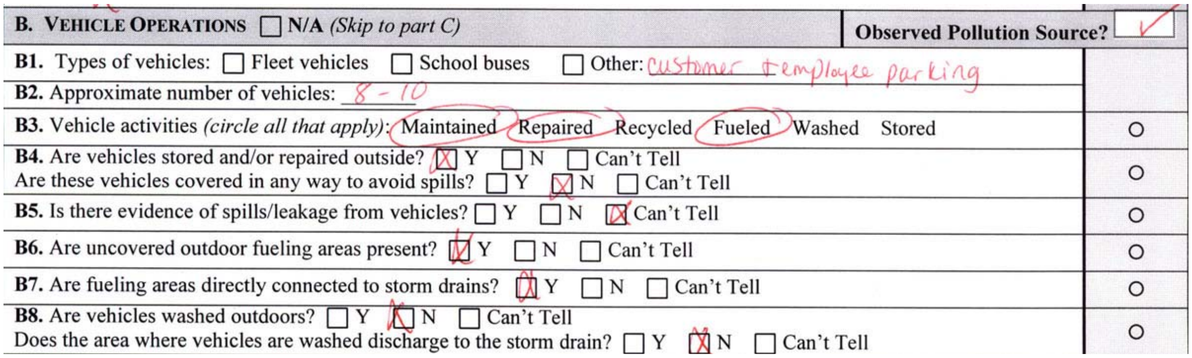
Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): 7549

NPDES Status: ☐ Regulated ☒ Unregulated ☐ Unknown

Basic Description of Operation: oil change, outdoor fueling

***Box 10:** In this example, the site was a commercial oil change and gas station operation, which is classified as a non-regulated hotspot according to Appendix B.*



**B. Vehicle Operations** ☐ N/A *(Skip to part C)* | **Observed Pollution Source?** ☑

**B1.** Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: customer + employee parking

**B2.** Approximate number of vehicles: 8 - 10

**B3.** Vehicle activities *(circle all that apply)*: (Maintained) (Repaired) Recycled (Fueled) Washed Stored ○

**B4.** Are vehicles stored and/or repaired outside? ☒ Y ☐ N ☐ Can't Tell
Are these vehicles covered in any way to avoid spills? ☐ Y ☒ N ☐ Can't Tell ○

**B5.** Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☒ Can't Tell ○

**B6.** Are uncovered outdoor fueling areas present? ☒ Y ☐ N ☐ Can't Tell ○

**B7.** Are fueling areas directly connected to storm drains? ☒ Y ☐ N ☐ Can't Tell ○

**B8.** Are vehicles washed outdoors? ☐ Y ☒ N ☐ Can't Tell
Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☒ N ☐ Can't Tell ○

***Box 11:*** *The field crew investigated vehicle operations at Joe's Instant Oil Change. They counted about 10 vehicles parked in the lot, most of which were used by customers and employees, but two of which were wrecked. The crew noted three operations that could make this business a storm water hotspot: outdoor car repair, wrecked vehicle storage, and outdoor fueling. The crew did not have full access to the site, but could not find any containment or cover used for the outdoor repair and vehicle storage. They also noted that the outdoor fueling area was uncovered and directly connected to the storm drain system. Based on the fact that all three vehicle operations were uncovered and directly connected to the storm drain system, the crew decided to check the box indicating that site was an observed pollution source. This meant that the site would be designated as a confirmed or severe hotspot, depending on scores from other parts of the HSI form.*

note whether any pollution prevention practices are being used for outdoor **vehicle storage and repair**, such as the use of tarps and drip pans. Evidence of spills and leaks should also be noted (Figure 16), with stains or leaks that lead to the storm drain providing good visual documentation of pollution.

The next two questions examine **fueling areas** and their relationship to the storm drain system. Fuel spills frequently occur at self-service facilities, and fuel island covers can help reduce exposure to storm water (Figure 17). How drainage from the fueling area is handled is also a concern, so you should determine if the fueling areas are directly connected to the storm drain system. A direct connection will allow pollutants to more easily enter the system in the event of a spill or leak (Figure 18).

Lastly, you should evaluate outdoor **vehicle washing practices**. Vehicle washing occurs at many commercial, industrial, institutional, municipal, and transport-related fleet operations. Unfortunately, wash water may contain sediments, phosphorus, metals, oil and grease, and other pollutants. If vehicles are

**Figure 16: Leak During Vehicle Repair**


**Figure 17: Uncovered Fueling Island**

**Figure 18: Stain from Uncovered Fueling Area Leading to Storm Drain**

**Figure 19: Dedicated Truck Wash Site with Runoff Controls**

washed on impervious surfaces, such as parking lots, dirty wash water can be an illicit discharge to the storm drain. Look carefully at where vehicles are washed to see how wash water is handled and whether it discharges to the storm drain system. Ideally, washing would occur at a contained site where wash water is treated prior to discharge (Figure 19).

## 4.5 Assessing Outdoor Material Storage

This part of the HSI evaluates how outdoor materials are stored and handled at the site (Box 12).

Nearly every hotspot site handles some kind of material, which can wash off in storm water runoff if it is not properly managed or stored. The HSI form specifically looks at where materials are loaded/unloaded and checks outdoor storage areas to see if materials are exposed to rainfall or can spill.

| C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)* | Observed Pollution Source? ☒ |
|---|---|
| **C1.** Are loading/unloading operations present? ☒ Y ☐ N ☐ Can't Tell<br>If yes, are they uncovered *and* draining towards a storm drain inlet? ☒ Y ☐ N ☐ Can't Tell | ○ |
| **C2.** Are materials stored outside? ☒ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☒ Solid Description: _______<br>Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area | ○ |
| **C3.** Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☒ Can't Tell | ○ |
| **C4.** Is staining or discoloration around the area visible? ☒ Y ☐ N ☐ Can't Tell | ○ |
| **C5.** Does outdoor storage area lack a cover? ☒ Y ☐ N ☐ Can't Tell | ○ |
| **C6.** Are liquid materials stored without secondary containment? ☐ Y ☐ N ☒ Can't Tell | ○ |
| **C7.** Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☒ Can't Tell | ○ |

***Box 12:*** *While driving through a commercial area, the field crew came across a large lawn and garden center where products were stored outside on pavement. Although the business was not identified during the desktop screening phase, the crew elected to complete an HSI form since it was in a business category found on the hotspot cheat sheet. The crew noted that plants, mulch, and lawn care products were stored outside with no cover, and that frequent watering and hosing by employees could also wash materials into the storm drain system. They found staining and discoloration on the pavement, but after 15 minutes could not figure out how the storm drain system worked. Based on their inspection, the crew tentatively checked the box indicating that the lawn and garden center was an observed pollution source.*


**Figure 20: Three Loading Dock Observations: Uncovered Dock (a), Leakage from Loading Dock Reaching Storm Drain (b), Covered Dock (c)**

**Loading and unloading** of materials normally takes place at outside docks or terminals at most commercial, industrial, institution, and municipal operations. Materials spilled or leaked during the loading process can either be carried away in storm water runoff or be washed off when the area is cleaned. The HSI asks you to record whether the loading areas are covered or uncovered (Figure 20a), and if loading areas are connected to the storm drain system (Figure 20b). The ideal situation is a covered loading dock (Figure 20c).

**Figure 21: Poor Outdoor Storage at a Garden Center**

Many hotspot operations **store materials outside**. The risk of storm water pollution is greatest for operations that store large quantities of liquids or bulk materials at sites that are connected to the storm drain system. The HSI records the type of material stored, its location on site (Figure 21), and its connection to the storm drain system. A direct connection to the storm drain system means that there will be little opportunity for treatment (Figure 22), so search for signs of possible discharges from stored materials to the storm drain system. Common signs are staining, or discoloration or obvious leakage. If these signs are present, outdoor storage areas may require containment or better storm water treatment.

**Figure 22: Outdoor Storage Area Connected to Storm Drain System**

Next, you are asked to see if covers are used to protect outdoor storage areas. Covers can be an effective source control practice for non-hazardous materials, and can be as simple as plastic sheeting or a tarp, or more elaborate, such as roofs and canopies. Site layout, available space, and affordability dictate the type of cover may be present at a site. If a cover is present, check to see if it fully covers the stored materials and is firmly anchored in place.

An extra measure of protection is needed for some outdoor storage areas to prevent and contain spills. "**Secondary containment"** structures are used to contain liquid spills and to prevent storm water runon from entering outdoor storage areas (Figure 23). Secondary containment structures vary in design, ranging from berms and drum-holding areas, to specially-designed solvent storage rooms. The HSI looks at whether stored materials may need secondary containment structures, and whether they are already present at the site.

Lastly, you should look at the condition and labeling of outdoor storage containers. Proper labeling and well-maintained storage containers may indicate that accurate material inventories are being kept and that inspection of storage areas is an ongoing practice, while poorly-maintained storage containers can be a source of storm water pollution (Figure 24).

**Figure 23: Two Examples of Secondary Containment**

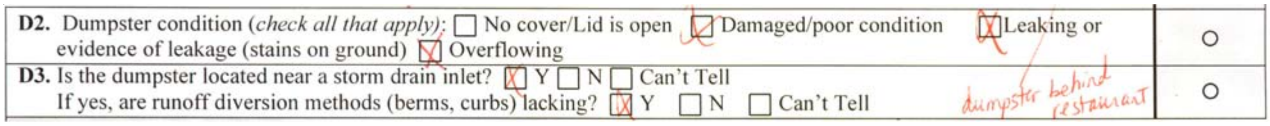
**Figure 24: Improperly Labeled and Stored Restaurant Storage Containers**

## 4.6 Assessing Waste Management Practices

This part of the HSI looks at how outside wastes are managed at the site (Box 13).

Solid wastes are often temporarily stored in **dumpsters**, which are an unregulated and potentially significant pollution source in a subwatershed. Many dumpsters are uncovered, which allows rainfall to mix with the wastes, creating a potent brew we affectionately call "dumpster juice." When combined with inevitable spillage, dumpster juice can be a source of trash, oil and grease, metals, bacteria, organic matter, nutrients, and sediments to the stream.

You should look for poor dumpster practices such as missing lids, leakage, and overloading (Figure 25). In addition, you should note where dumpster juice flows in relation to the storm drain system.



| | |
|---|---|
| **D2.** Dumpster condition (*check all that apply*): ☐ No cover/Lid is open ☒ Damaged/poor condition ☒ Leaking or evidence of leakage (stains on ground) ☒ Overflowing | ○ |
| **D3.** Is the dumpster located near a storm drain inlet? ☒ Y ☐ N ☐ Can't Tell<br>If yes, are runoff diversion methods (berms, curbs) lacking? ☒ Y ☐ N ☐ Can't Tell dumpster behind restaurant | ○ |

***Box 13:*** *In this example, the field crew drove behind a fast food restaurant, and discovered an overflowing dumpster. They elected to fill out an HSI form, since it appeared to be an obvious pollution source. The dumpster contained garbage, had no lid, and lacked any kind of runoff diversion method. The crew noted staining and leakage between the dumpster and a drop inlet at the edge of the parking lot. Based on this connection, they checked the box indicating that the dumpster was an observed pollution source, even though it was a very small site.*

## 4.7 Assessing the Physical Plant

This part of the HSI form evaluates whether maintenance practices at the physical plant could be a source of storm water pollution or illicit discharge (Box 14).

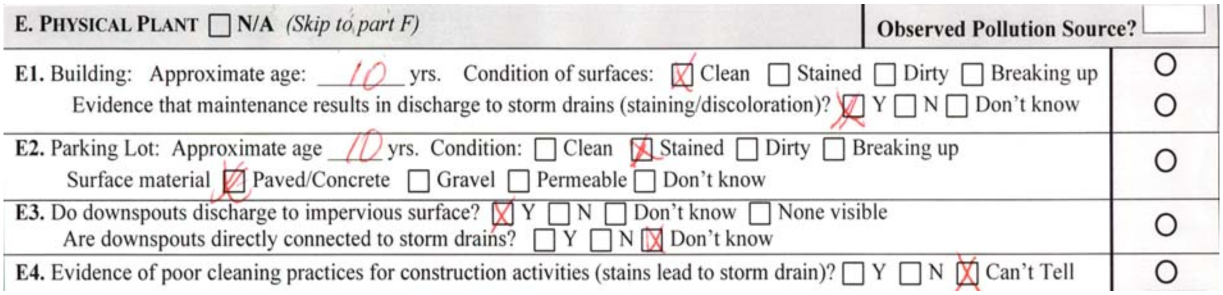
Many routine practices used to maintain walls and rooftops of buildings can potentially cause storm water pollution. Examples include washing, power washing, sanding, sandblasting, painting, graffiti removal, and roof maintenance. Maintenance practices generate polluted wash water that can directly enter the storm drain system during dry weather. Other maintenance practices can deposit fine particles or chemicals that wash off during storms (e.g., cleaners, paint, solvents, or sealers).

You should estimate the approximate **age of the building** and its general condition. Older buildings often require more maintenance and upkeep, which might mean that repairs and cleaning occur frequently. The simplest method to get the building's age is to look at the original building permit. If you can't determine the age of the building, just skip the question.

Parking lots are found at nearly every storm water hotspot. Parking lots requires periodic maintenance, including litter pickup, sweeping, pothole repair, power washing, steam cleaning, de-greasing, re-striping or re-surfacing. Parking lot **maintenance operations** can potentially pollute storm water runoff, if sensible pollution prevention practices are not used.

**Figure 25: Dumpster With Open Lid and Stain Showing Evidence of Leakage to Storm Drain**

Next, you will want to examine how downspouts discharge **rooftop runoff** from the hotspot site. Rain that lands on rooftops is directed into gutters and downspouts, also known as roof leaders. From there, runoff can be discharged directly to the storm drain system (Figure 26a), to an impervious surface, such as a sidewalk or parking lot (Figure 26b), or may drain onto a pervious surface, such as a lawn or landscaped area. Good opportunities to disconnect downspouts are frequently found at institutional and municipal hotspots that have greater amounts of pervious areas adjacent to buildings.



**E. PHYSICAL PLANT** ☐ N/A *(Skip to part F)* | **Observed Pollution Source?**

**E1.** Building: Approximate age: 10 yrs. Condition of surfaces: ☒ Clean ☐ Stained ☐ Dirty ☐ Breaking up ○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☒ Y ☐ N ☐ Don't know ○

**E2.** Parking Lot: Approximate age 10 yrs. Condition: ☐ Clean ☒ Stained ☐ Dirty ☐ Breaking up ○
Surface material ☒ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know

**E3.** Do downspouts discharge to impervious surface? ☒ Y ☐ N ☐ Don't know ☐ None visible ○
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☒ Don't know

**E4.** Evidence of poor cleaning practices for construction activities (stains lead to storm drain)? ☐ Y ☐ N ☒ Can't Tell ○

***Box 14:*** *The field crew in this example inspected a trucking distribution center identified during the desktop screening phase. The site consisted of a large pre-fabricated warehouse that appeared to be about ten years old, as well as an adjoining parking lot where truck rigs were parked. The crew noted that maintenance crews were power washing the building's exterior during their visit, and observed a small amount of flow reaching the parking lot. Downspouts from the building discharged directly to the parking lot, but there were no pervious areas available near the building to disconnect them. The crew then looked at the parking lot, and noticed a few oil stains. Once again, they had a hard time figuring out how the storm drain system worked at the site, so they checked "don't know" and "can't tell" in the appropriate boxes.*

of pervious areas adjacent to buildings.

Many building construction, repair, and remodeling operations are too small to be covered by local or state erosion and sediment control permits. These operations can be a significant source of pollution unless good practices are used. The HSI asks you to assess any **construction materials** that are temporarily stored at the site, and determine if construction activities are causing sediment pollution (Figure 27).

## 4.8 Assessing Turf/Landscaping Practices

This part of the HSI assesses the pollution potential of turf and landscape management practices used at a site (Box 15).

Most hotspot sites contain some turf or landscaping for aesthetics and buffering. You should examine both areas to determine current management practices, particularly in regard to the inputs of fertilizers, pesticides, and water. The goal is to establish natural landscaping areas that utilize the least amount of fertilizers, pesticides, and water possible. To see if this approach makes sense for the site, you need to estimate the percentage of four pervious covers at the hotspot site. Techniques for estimating each cover type are described here.

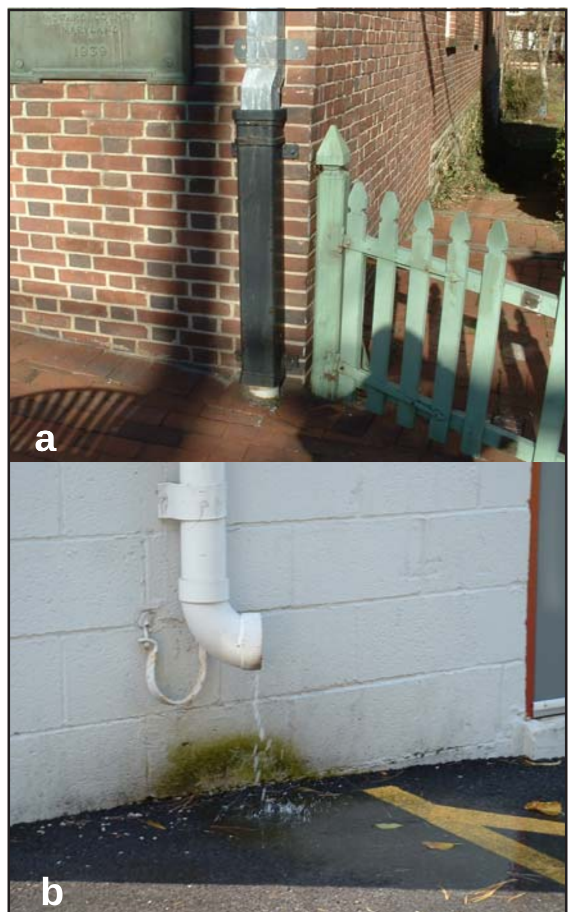



**Figure 26: Directly Connected Downspout (a); Indirectly Connected Downspout Draining to Impervious Surface (b)**

| F. TURF/LANDSCAPING AREAS ☐ N/A *(skip to part G)* | Observed Pollution Source? ☑ |
|---|---|
| **F1.** % of site with: Forest canopy 0 % Turf grass 5 % Landscaping 10 % Bare Soil 0 % | O |
| **F2.** Rate the turf management status: ☐ High ☒ Medium ☐ Low | O |
| **F3.** Evidence of permanent irrigation or "non-target" irrigation ☒ Y ☐ N ☐ Can't Tell | O |
| **F4.** Do landscaped areas drain to the storm drain system? ☒ Y ☐ N ☐ Can't Tell | O |
| **F5.** Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☒ Y ☐ N ☐ Can't Tell | O |

***Box 15:*** *In this example, the field crew investigated turf and landscaping practices at a small corporate office park. The crew estimated that about 10% of the site was devoted to landscaping and about 5% to mowed and non-irrigated turf. The crew looked closely at the landscaping areas situated in close proximity to the parking lot. They noticed that the landscaping beds contained permanent sprinkler systems, were elevated in relation to the parking lot, and appeared to be directly connected to the storm drain system. Some evidence of organic matter and non-target irrigation flows were observed on the parking lot. As a result, the crew checked the box that landscaping could be a pollution source at the office park.*

**Forest canopy cover** varies greatly at hotspot land uses, with institutional and municipal lands usually having the most forested cover. Commercial, industrial, and transport-related sites have little or no forest cover, and trees that exist are often small, ornamental varieties used for landscaping or as a buffer between land uses. When estimating forest canopy at hotspot sites, only count trees that are greater than six inches in diameter. Forest canopy cover should include any part of the site that is included under the tree "**drip line**." The drip line is an imaginary circle around the tree that extends to the outermost foliage of the tree above (see Figure 8 in Chapter 3).

**Figure 27: Poorly-Managed Construction Site**

**Turf grass** refers to intensely managed, single-species grass cover maintained at the hotspot site. Institutional land uses often have large expanses of turf grass that may be candidates for reforestation. Areas with turf grass are important to evaluate at the site because they often receive intensive input of fertilizers, pesticides and irrigation.

**Landscaping** is a common feature at many hotspot land uses, especially at commercial sites. While the main purpose is aesthetics or separation of traffic in parking lots, landscaped areas can also be designed for storm water treatment. Landscaped areas typically have plants, small ornamental trees, and/or shrubs planted in them (Figure 28).

**Figure 28: Landscaped Parking Lot Island**

**Bare soil** presents a potential source of sediment runoff pollution. Any bare soil areas should be replanted immediately to reduce this potential. Tree plantings are preferred, but planting grass is an acceptable alternative.

The HSI asks you to rate the management level of existing turf and landscaped areas. **High input management** indicates intensive pesticide, herbicide, and/or fertilizer use. Table 12 presents some indicators for assessing the management of turf and landscaped areas.

**Non-target irrigation** occurs when permanent irrigation systems are misdirected and send water to adjacent impervious surfaces (Figure 29). Consequently, pollutants that accumulate on impervious surfaces can be washed directly into the storm drain system.

**Figure 29: Non-Target Irrigation Runoff at a Retail Garden Center**

The final two questions focus on whether landscaping areas are generating storm water runoff. Field indicators can help answer this question. The first field indicator is to determine the elevation of the landscaping in relation to adjacent land. In many cases, landscaping is higher than surrounding areas, which causes water to flow from the landscaped area. The second indicator is the proximity between landscaping beds and impervious surfaces. If landscaping is located next to an impervious surface, runoff can be carried away more readily. The third field indicator to check is whether impervious surfaces drain to the storm drain system. If all three indicators are positive, the landscaping area can be a pollution source. You should also look for staining and discoloration that may show a direct discharge from the landscaping to the storm drain system.

## 4.9 Evaluating Private Storm Water Infrastructure

Many hotspot sites contain privately maintained storm drain inlets and **catch basins**, as well as privately owned **storm water treatment practices** (Figure 30). Private storm water infrastructure should be investigated to ensure they are regularly inspected, swept, or cleaned to reduce storm

**G. Storm Water Infrastructure** ☐ N/A *(skip to part H)* — **Observed Pollution Source?** ☑

**G1.** Are storm water treatment practices present? ☐ Y ☐ N ☒ Unknown If yes, please describe: ________ ○

**G2.** Are private storm drains located at the facility? ☒ Y ☐ N ☐ Unknown ○
Is trash present in gutters leading to storm drains? If so, complete the index below.

| Index Rating for Accumulation in Gutters | Clean | | | | Filthy |
|---|---|---|---|---|---|
| Sediment | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☒ 5 |
| Organic material | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☒ 5 |
| Litter | ☐ 1 | ☐ 2 | ☒ 3 | ☐ 4 | ☐ 5 |

**G3.** Catchbasin inspection – Record SSD Unique Site ID here: SC-SD-4 Condition: ☒ Dirty ☐ Clean

***Box 16:*** *In this example, a field crew investigated the storm water infrastructure at the local public works yard. No storm water treatment practices could be found at the 40-year old facility, and the gutters contained several inches of sediment and organic matter accumulation, and were rated "filthy." The crew managed to get access to one catch basin, and completed SSD form MU-SD-4, which was also rated as dirty. The crew checked the box indicating that the yard was an observed pollution source, and made a note to check whether the municipality had a current pollution prevention plan for the yard.*

water pollution (Box 16). Also, hotspot sites may have been required to install storm water treatment practices when they were first built. Some communities keep track of these facilities, and you may want to consult their database before or after fieldwork to determine the type of storm water treatment facility present.

To assess the condition of private storm drain inlets (Figure 31), you need to remove the manhole cover to see if the inlet has a catch basin. If it does, you should examine the depth and type of sediment or pollutant accumulation using the SSD form described in Chapter 6.

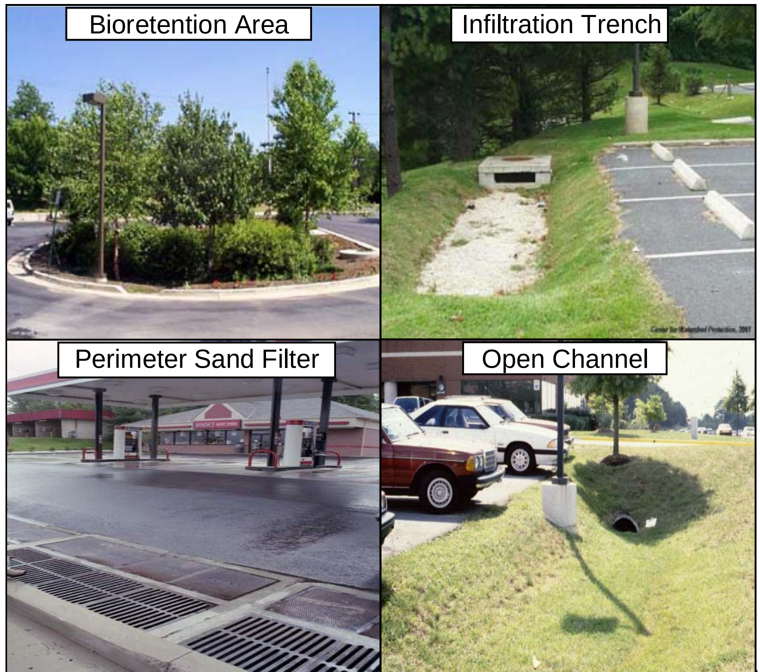



**Figure 30: Four Storm Water Treatment Practices Used in Hotspot Areas**

## 4.10 Designating Storm Water Hotspot Status

The last part of the HSI form assesses the overall pollution potential for the hotspot site and assigns it a hotspot designation: not a hotspot, potential hotspot, confirmed hotspot, or severe hotspot.

The hotspot designation is derived using the index in the right hand column of the HSI field form, and it determines follow-up actions needed after the HSI is complete. The criteria used to make hotspot designations and corresponding follow-up actions are described below. The **observed pollution source** boxes are used to record observable types of pollution problems occurring at the site. Examples might include a dumpster that is actively leaking "dumpster juice" to a storm drain, or a stained path from the dumpster or vehicle storage area to a storm drain. In the example shown in Figure 32, vehicle leaks and staining around outdoor storage areas and "dumpster juice" leading to the storm drain were all observed, so the observed pollution source box was checked for each of these questions.

The circles in the index column are used to rate the potential of the site to generate pollutants. The general rule is when "Yes" is checked for a site question (or for both questions when a second one is asked), the circle that corresponds to that question should be checked. Some further guidance for deciding when to check the circle for the questions that have multiple answer choices is provided in Table 20.

Once all appropriate boxes and circles have been checked on the form, the severity of pollution at the hotspot site can be easily computed by counting the number of checked circles and boxes and comparing these totals to the criteria that follow to define the severity of the hotspot.

### *Not a Hotspot*

A sites is not considered a hotspot if fewer than

**Figure 31: Storm Drain Inlet Clogged With Organic Matter and Litter**

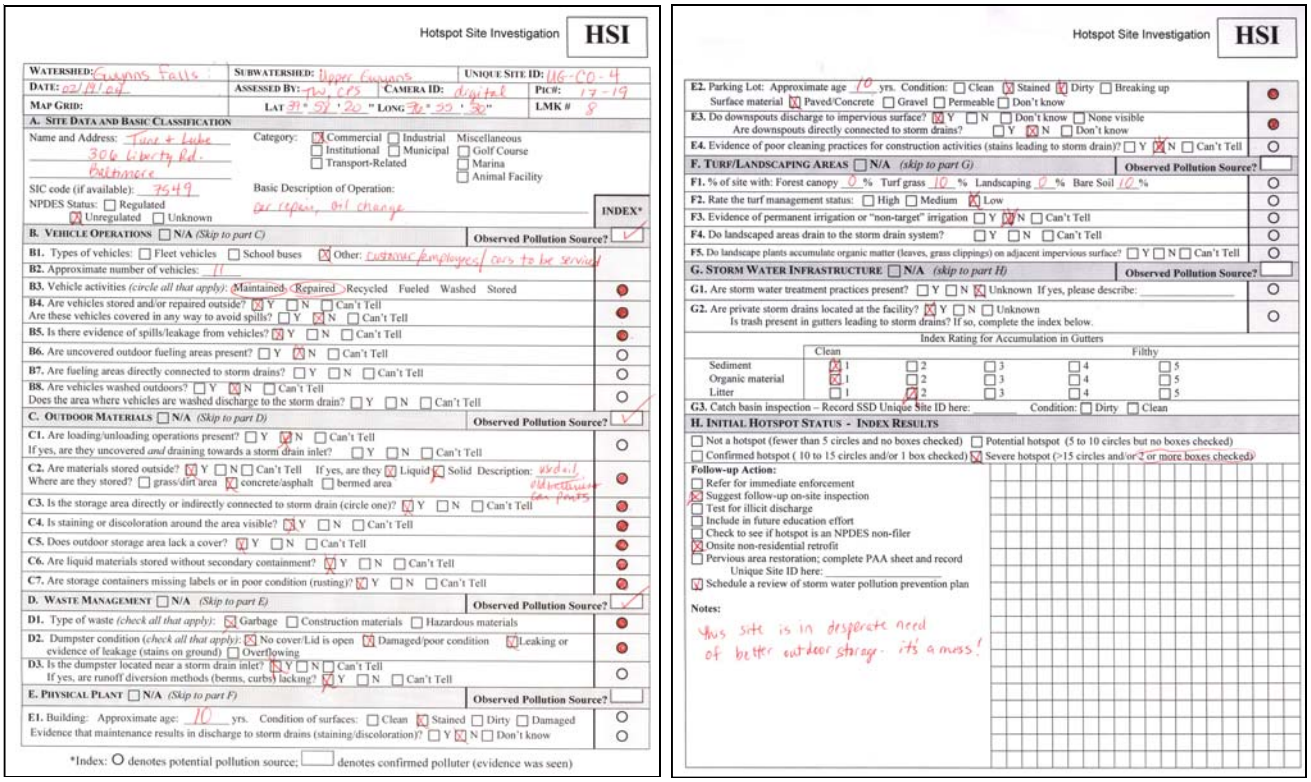


**Figure 32: Sample Completed Field Form for an Individual Hotspot Site**

**Table 20: Hotspot Designation Criteria**

| Question Number | Check the circle if…… |
|---|---|
| B3 | Any of the listed vehicle activities are present |
| C2 | Wastes are stored on asphalt/concrete or liquid wastes are stored in an area without a berm |
| D1 | Any of the listed waste products are present |
| D2 | Any of the listed dumpster conditions exist |
| E1 | Building condition is stained, dirty or damaged; *OR* if evidence of poor maintenance practices exists |
| E2 | Parking lot condition is stained, dirty or breaking up; *OR* if surface material is paved/concrete |
| F1 | Bare soil is greater than 20% of site |
| F2 | More than 40% of site has medium or high maintenance turf grass |
| G1 | No storm water treatment practice is present |
| G2 | Two or more types of material were rated 3 or higher |

five "potential pollution source" circles are checked on the HSI form and no "observed pollution source" boxes are checked. These sites may have potential for on-site retrofits or pervious area restoration, but are not a priority for enforcement follow-up pollution prevention assessments.

### Potential Hotspot

Potential hotspots are designated when current operations suggest that the site may be a hotspot but no pollution indicators are observed. Sites receive this designation when five to 10 "potential pollution source" circles are checked but no "observed pollution source" boxes are checked. Follow-up actions at potential hotspots involve targeted pollution prevention, and possible inspections once all confirmed and severe hotspot sites in the subwatershed have been corrected.

### Confirmed Hotspot

A site is designated as a confirmed hotspot if 10 to 15 "potential pollution source" circles are checked on the HSI form and/or one "observed pollution source" box is checked. Several follow-up actions should be considered for confirmed hotspots, starting with efforts to see if the site is subject to NPDES industrial storm water permit regulations. You may also want to arrange an on-site inspection, illicit discharge investigation, or a review of the storm water pollution prevention plan for the site.

### Severe Hotspot Designation

This is the most serious hotspot designation and is assigned to sites where immediate enforcement action is needed. A site is designated as a severe hotspot when 15 or more "potential pollution source" circles are filled in on the HSI form, and/or two or more "observed pollution source" boxes are checked. Severe hotspots warrant immediate referral for inspection, enforcement, and/or testing for illicit discharges.

A list of recommended follow-up actions for hotspots can be found in Table 21. If you are interested in managing a particular pollutant in your subwatershed, you may want to consult Table 22, which matches HSI question responses with specific pollutants. You may choose to use this approach to rank your hotspots.

The **HSI Pollution Severity Index** can be used to determine subwatershed hotspot density, and establish whether detailed follow-up investigations are needed. It also allows you to compare hotspots across subwatersheds to determine if a particular land use is generating a disproportionate number of hotspots. If such a cluster is found, you will certainly want to target these land uses for education or compliance programs. Chapter 7 provides extensive guidance on how to interpret HSI data to screen subwatershed hotspots to target education and enforcement efforts.

**Table 21: Follow-Up Actions for Hotspots and Manuals Where More Information Can be Found**

| Follow-up Action | Urban Subwatershed Restoration Manual |
|---|---|
| Follow-up on-site inspection | Manual 8 |
| Test for illicit discharge | Brown *et al*, 2004 |
| Onsite non-residential retrofit | Manual 3 |
| Pervious area restoration | Manual 7 |
| Review of storm water pollution prevention plan | Manual 8 |

**Table 22: Possible Pollution Indicator Questions**

| Type of Pollution | Indicator Question(s) |
|---|---|
| Nutrients | B8, C1-C7, D1-D3, F2, F5, G2 |
| Oil and Grease | B3-B7, C1-C5, E2 |
| Trash/Litter | D1-D3, G2 |
| Bacteria | C2-C6, D1-D3 |
| Sediment | E1-E4, F1, G2 |
| Hydrocarbons | B5-B6, E2 |

# Chapter 5: Pervious Area Assessment (PAA)

## 5.1 Basics of Pervious Areas

Pervious areas and natural remnants often present an opportunity for restoration in subwatersheds. Most pervious areas are municipally-owned, but institutional land owners can also have extensive lawns and open space (Figure 33).

The Pervious Area Assessment (PAA) looks at **large parcels of open land**, such as parks, public golf courses, schools, rights-of-way, or protected open space. Together, pervious areas may comprise as much as five to 10% of total subwatershed area. Large institutional land owners such as hospitals, colleges, corporate parks, private golf courses, cemeteries, and private schools may also contain underutilized areas on their grounds with restoration potential. Both municipal and institutional pervious areas are attractive from the standpoint of restoration because of their large size and ownership. Portions of each parcel may be good candidates for land reclamation, reforestation or revegetation.

The PAA also evaluates the status of larger **natural area remnants** that still exist in the subwatershed. Forest and wetland fragments are potential targets for forest or wetland restoration for their own sake. In addition, the possibility to expand natural areas or link them to the stream corridor or other remnants should always be considered. Table 23 summarizes the site factors assessed by the PAA and the corresponding practices to restore pervious area parcels.

**Figure 33: Two Pervious Area Parcels Commonly Seen in Urban Subwatersheds**

| Table 23: PAA Factors and Possible Restoration Recommendations | |
|---|---|
| **Pervious Area Site Factor** | **Corresponding Restoration Practice*** |
| Large turf of bare soil cover | Reforestation (F-5 through F-7) |
| Dumping of trash or rubble | Prevention and removal (SP-1) |
| Presence of invasive plants | Removal and management (SP-2) |
| Soil compaction | Soil reclamation (SP-3) |
| Storm water influence | Storm water management (SP-4) |
| Degraded natural area remnant | Restoration (F-8) |
| **The code in parentheses refers to the appropriate restoration profile sheet in the restoration manual series* <br>• *F- and SP- sheets can be found in Manual 7: Watershed Forestry Practices* | |

## 5.2 Introduction to the PAA

The Pervious Area Assessment (PAA) evaluates factors that influence the feasibility of upland restoration projects, and is conducted on all parcels identified during the preliminary desktop analysis. The minimum area for selecting parcels is left up to you, based on your staff and budget capacity. We recommend assessing all natural area remnants and other publicly-owned, pervious areas larger than two acres. Privately-owned pervious areas greater than five acres can also be assessed.

### *Pre-Field Work*

Pervious area sites are identified using aerial photos or GIS parcel data, land use data, or tax maps. The desktop assessment may even be used to fill out part of the PAA field form. For example data on parcel area, current management, ownership, and connection to other pervious areas can often be derived from good quality aerial photos and GIS parcel data. If GIS data are available, your local planning agency may be able to supply parcel layers that identify land owners and parcel areas before you go out to the field. If a GIS parcel layer is not available, check to see if local agencies have tax maps or land use maps that can be helpful to identify PAA sites.

A separate PAA form should be completed for each pervious parcel with a unique landowner. For example, if a local government owns two acres of an eight-acre contiguous forest, and the remaining six acres are privately owned, two PAA forms should be completed.

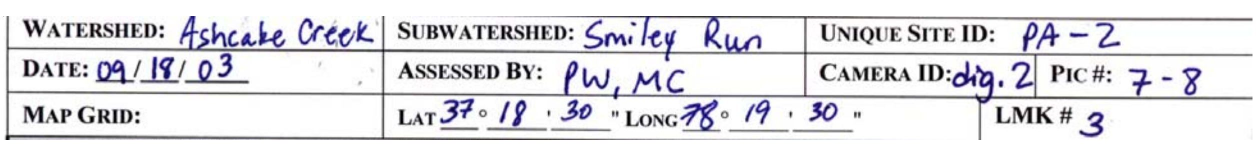
As far as special equipment goes, aerial photographs and a screwdriver are helpful. You might also want to consult good field guides on native tree/shrub species and invasive plant species, and learn the basics of field identification.

### *Field Work*

The PAA form is divided into three parts. The parts you fill out depend on the type of parcel assessed. Part I is used to evaluate natural area remnants, such as forest parcels and wetland fragments, while Part II is designed to assess open pervious areas, such as turf, vacant land and meadows. Part III is used to sketch the parcel. Each part of the PAA asks a series of questions about vegetative characteristics and current impacts on the parcel.

The header of the PAA form asks for information on the watershed, subwatershed, assessment date, team members, and camera information (Box 17).

You will also need to record the Unique Site ID, which can be assigned with subwatershed initials first, "PA" next, and then the unique identifier. The site ID can be assigned in the office and noted on the aerial photo and/or street map before heading into the field. You should also record the latitude and longitude, and landmark (LMK) number generated by your GPS unit.



| | | | |
|---|---|---|---|
| WATERSHED: Ashcake Creek | SUBWATERSHED: Smiley Run | UNIQUE SITE ID: PA-2 | |
| DATE: 09/18/03 | ASSESSED BY: PW, MC | CAMERA ID: dig. 2 | PIC #: 7-8 |
| MAP GRID: | LAT 37° 18' 30" LONG 78° 19' 30" | LMK # 3 | |

***Box 17:*** *In this example, the crew visited a school in the Ashcake Creek subwatershed that had been identified from aerial photos during the desktop screening phase. When they arrived at the site they noticed that it contained both a forest fragment and unutilized open space, so they elected to report each on a separate PAA form.*

## 5.3 Basic Parcel Characterization

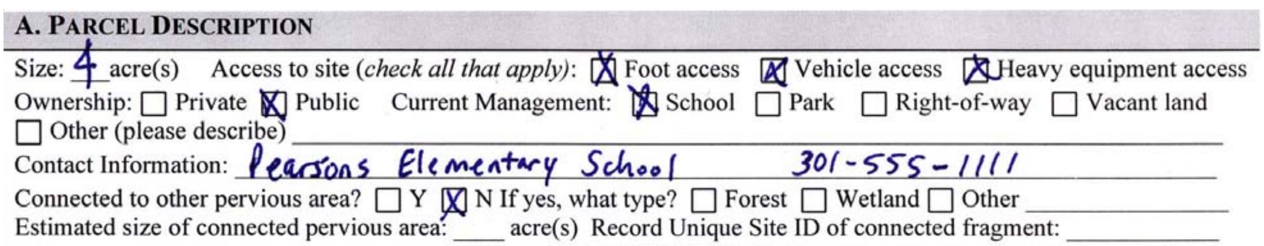
This part of the PAA form describes the parcel in terms of area, access, ownership, and relation to other parcels (Box 18).

The first feature to estimate is the **parcel area**. Pervious areas of the subwatershed have already been screened by the two- or five-acre thresholds. Getting a better estimate of parcel area is important since it is often directly related to restoration potential; larger parcels are usually better candidates than smaller parcels. Tax maps or aerial photos can be used to determine parcel area in the office. In both cases, remember to double-check the parcel in the field in case boundaries have changed since the map or photo was produced. If neither is available, make a visual estimate of parcel area in the field.

**Access** is an important factor for ranking potential upland restoration projects. For example, if access is poor, and extensive work is needed, the parcel may not be a realistic restoration target. Likewise, a parcel with an unwilling landowner can make restoration infeasible. You can discover **land ownership** on tax maps or from GIS parcel data, and remember to record the owner's name and any contact information on the PAA form.

## 5.4 Assessing Natural Area Remnants

This part of the PAA form examines the condition and quality of the vegetative cover in natural area remnants (Box 19).


A. PARCEL DESCRIPTION

Size: 4 acre(s) Access to site (*check all that apply*): [X] Foot access [X] Vehicle access [X] Heavy equipment access

Ownership: [ ] Private [X] Public Current Management: [X] School [ ] Park [ ] Right-of-way [ ] Vacant land

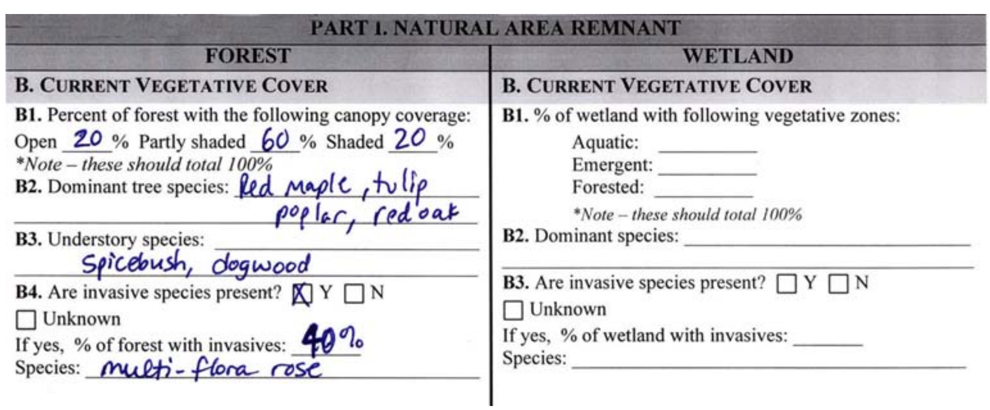
[ ] Other (please describe) ______

Contact Information: Pearsons Elementary School 301-555-1111

Connected to other pervious area? [ ] Y [X] N If yes, what type? [ ] Forest [ ] Wetland [ ] Other ______

Estimated size of connected pervious area: ____ acre(s) Record Unique Site ID of connected fragment: ______

***Box 18:*** *The field crew first tackled the forest fragment adjacent to Pearsons Elementary School, which was about four acres in size. Before starting the forest survey, they dropped by the office to get permission to be on school grounds, and obtained follow-up contact information. The crew indicated that the site was not connected to any other natural area remnants after looking more closely at their aerial photos.*


PART 1. NATURAL AREA REMNANT

| FOREST | WETLAND |
|---|---|
| **B. CURRENT VEGETATIVE COVER** | **B. CURRENT VEGETATIVE COVER** |
| **B1.** Percent of forest with the following canopy coverage: Open 20 % Partly shaded 60 % Shaded 20 % **Note – these should total 100%* | **B1.** % of wetland with following vegetative zones: Aquatic: ____ Emergent: ____ Forested: ____ **Note – these should total 100%* |
| **B2.** Dominant tree species: red maple, tulip poplar, red oak | **B2.** Dominant species: ______ |
| **B3.** Understory species: spicebush, dogwood | **B3.** Are invasive species present? [ ] Y [ ] N [ ] Unknown If yes, % of wetland with invasives: ____ Species: ______ |
| **B4.** Are invasive species present? [X] Y [ ] N [ ] Unknown If yes, % of forest with invasives: 40% Species: multi-flora rose | |

***Box 19:*** *In this example, the crew surveyed a forest fragment at the elementary school. They estimated the fragment to be about 20 years old, based on the size of the trees. The fragment was mixed with respect to canopy coverage, with 20% open, 60% partly shaded, and 20% shaded. The dominant native tree species were red maple and tulip poplar, with a few red oaks interspersed. Only a few native species were found in the understory, but multi-flora rose and invasive plants covered nearly 40% of the forest floor.*

The PAA form provides a column for two types of vegetative cover: **forest** and **wetland**. If the remnant is a forested wetland, complete both columns. Forest fragments are important features of the subwatershed, and are quickly assessed by the PAA. Spring and summer are the best seasons to evaluate forest fragments, as both forest species and canopy coverage are more easily observed. In terms of **canopy coverage,** shaded areas are defined as parcels receiving little or no direct sunlight. Partly shaded areas receive intermittent, direct sunlight for less than six hours each day. Open areas receive full sunlight throughout the day. Record the percent of the forest area fragment that is subject to each of these canopy conditions, and make sure they total 100%.

Next, you should survey the overhead canopy and record the **dominant tree species** of the forest fragment. The **understory** is comprised of small trees, shrubs and vegetation that grow under the larger trees in the fragment, and you should also record the dominant understory species. You may also want to make notes about estimated age and structure of the forest remnant.

**Invasive species** are any non-native species introduced into a remnant that can potentially damage the function and quality of the forest. The presence of invasive plants may require more extensive site preparation for restoration. List the dominant invasive species present on the PAA form, and record the percent of the forest remnant covered by invasive plants. Field guides can help you identify the types of invasive trees, shrubs, and vines found in the forest fragment. Another resource for invasive species identification is available online at http://www.invasivespecies.gov, and provides links to information on invasive species found in each state.

### Wetland

Remaining wetlands are of particular interest in subwatershed restoration. Three broad wetland types are defined: aquatic, emergent, and forested. **Aquatic wetlands** have shallow water areas with floating or submerged vegetation. **Emergent wetlands** are dominated by rooted, soft-stemmed plants such as cattails, and are subject to periodic inundation. **Forested wetlands** are dominated by woody shrubs and trees, and often have saturated soils. In the field, you should classify the type of wetland and record the dominant plant species along with any invasive species. Often, wetland parcels can be identified in the office using National Wetland Inventory maps.

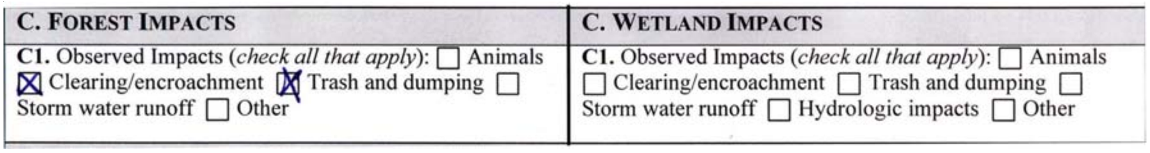
### Impacts

Many urban forest and wetland remnants are highly impacted. In this part of the form (Box 20), you evaluate the major impacts found in the fragment using the following criteria:

*Animals:* Deer, beaver, rodents, insects, and geese can damage existing vegetation within natural area remnants. Evidence of animal impacts includes a browse line, trees with outer layers of bark removed, multiple insect nests in trees, or ragged and chewed leaves on the majority tree species. Trees that have been felled by beaver are easy to identify, along with beaver dams (Figure 34). A deer browse line is usually when all understory vegetation up to a height of four or five feet has been removed. You should become familiar with the types and impacts of urban wildlife that use the remnant as habitat.

*Clearing/encroachment:* Note if trees or other vegetation have been removed from the natural area remnant, particularly along property boundaries. Tree stumps, mowing, tree falls, or extensive turf areas may indicate clearing or encroachment.

**Figure 34: Evidence of Beaver Activity**



| C. FOREST IMPACTS | C. WETLAND IMPACTS |
|---|---|
| C1. Observed Impacts (*check all that apply*): ☐ Animals ☒ Clearing/encroachment ☒ Trash and dumping ☐ Storm water runoff ☐ Other | C1. Observed Impacts (*check all that apply*): ☐ Animals ☐ Clearing/encroachment ☐ Trash and dumping ☐ Storm water runoff ☐ Hydrologic impacts ☐ Other |

***Box 20:*** *The field crew in this example continued its survey of the forest fragment to look for impacts. They noted that about 20% of the fragment had recently been cleared, and observed moderate dumping activity at the end of the school access road, which they included on their sketch.*

*Trash and dumping:* Natural area remnants are commonly used as dumping grounds, so significant trash or rubble is often found, especially near access roads. Trash may include old tires, residential trash, building rubble, appliances and old automobiles (Figure 35). You are asked to describe the type and amount of trash found in the remnant, and determine if heavy equipment will be needed to remove it.

*Storm water runoff:* Natural area remnants can be impacted by untreated storm water runoff from an adjacent area. The presence of pipes, outfalls, or small channels may indicate a problem. Do not check this box if sheetflow or treated storm water runoff is being directed to the site, unless there are obvious problems such as erosion and gullies.

*Hydrologic Impacts:* Record any evidence of **water level fluctuation** in the wetland, such as debris lines, water marks or sediment stains on trees, and look for any evidence that the wetland has been partially drained, filled or impounded. You may want to look for drainage tiles or ditches within the wetland. Also look for hydraulic impacts caused by culverts that may occur near roads as they may create localized wetland conditions. Beaver dams may also cause water level fluctuations. Each of these hydrologic impacts can cause dramatic changes in wetland function, vegetation and habitat.

### Notes and Sketch

This part of the PAA form is where you record detailed notes on any impacts observed, or other unique features associated with the natural area remnant. You should also sketch the natural area remnant, including some of the following features:

- Gullies
- Varying vegetative cover
- Dumping locations
- Storm water outfalls or channels
- Locations of water sources
- All streams, roads, impervious cover, and structures
- Access points
- Proposed planting areas
- Overhead wires
- Invasive species
- Important natural features (e.g., endangered species, specimen trees
- Any other important or unique features

In addition, you should take several digital photos of each remnant for further analysis.

**Figure 35: Trash and Dumping in Two Pervious Areas**

**PART II. OPEN PERVIOUS AREAS**

**A. CURRENT VEGETATIVE COVER**

**A1.** Percent of assessed surface with:
Turf 100 % Other Herbaceous _____% None (bare soil) _____% Trees _____% Shrubs _____% Other _____%
(please describe): ______________________ **Note – these should total 100%*

**A2.** Turf: Height: 1.5 inches Apparent Mowing Frequency: ☒ Frequent ☐ Infrequent ☐ No-Mow ☐ Unknown
Condition (*check all that apply*): ☐ Thick/Dense ☒ Thin/Sparse ☒ Clumpy/Bunchy ☐ Continuous Cover

**A3.** Thickness of organic matter at surface: 0 inches

**A4.** Are invasive species present? ☐ Y ☒ N ☐ Unknown If yes, % of site with invasives: _____
Species: ______________________

***Box 21:*** *The field crew looked at the acre of unutilized open land at the back boundary of the school property in this example. They didn't bother to assess the other four acres of ball fields on the school grounds, since the crew figured they were not suitable for reforestation any time soon. The crew noted that the unutilized open land parcel had 100% turf and was mowed frequently. The grass itself was bunchy and sparse, and no organic matter was found at the soil surface.*

## 5.5 Assessing Open Pervious Areas

This part of the PAA form quickly assesses whether large parcels of open pervious land are suitable for reforestation or reclamation (Box 21).

The form asks you to assess the condition and management regime for the current vegetative cover at the parcel. Most open parcels are dominated by one or more types of ground cover, such as turf grass, herbaceous cover, bare soil, and shrubs. Some parcels may also have a few trees or impervious cover, as well. You should quickly estimate the percentage of each type of cover on the parcel.

If turf grass is present, you will need to record data about its height, mowing frequency, and condition. First, record the approximate height of the turf. If height varies significantly across the site, record it as a range (e.g., two to 10 inches). Second, you will need to determine the apparent mowing frequency. Turf height, evidence of recent mowing (grass clippings, mow lines, lawnmowers), and current land use will help you decide which category to select. A parcel that is frequently mowed is usually less feasible for restoration than a parcel that is infrequently mowed.

Third, assess and record the turf condition. Thick, dense turf may indicate good soil quality, while thin and sparse turf may be evidence of soil compaction. Soil quality and compaction are important factors to determine the restoration potential for the parcel. Grass that grows in clumps or bunches, with only spotty coverage across the parcel may also be a sign of poor soil quality.

Organic matter at the soil surface is directly related to soil fertility. Low organic matter means that soil amendments may be needed to restore the site, which may bump it down on the priority list. To judge this in the field, look at the top few inches of soil and record the extent of organic matter and compaction. If the soil looks dark, moist, and rich, this usually means it has high organic matter content. If depth of organic matter seems to vary across the site, take a few measurements and record it as a range (in inches). Another important factor to assess at the parcel is the presence or absence of invasive plant species. Using a field guide or color photos, record the percent of the site covered by invasive plants, and list major species that are found.

**B. IMPACTS**

**B1.** Observed Impacts (*check all that apply*): ☒ Soil Compaction ☒ Erosion ☐ Trash and Dumping ☐ Poor Vegetative Health ☐ Other (describe): ______________________

***Box 22:*** *The field crew in this example recorded that both soil compaction and erosion were evident in the turf area at the back of the school. They could only penetrate the soil a few inches with a screwdriver, and observed rills and gullies on steeper slopes that had patchy grass cover, which they drew on their sketch.*

### Impacts

This part of the PAA evaluates possible impacts that will influence what site preparation techniques may be needed to restore the parcel (Box 22).

The degree of site preparation needed before reforestation or reclamation can have an impact on restoration project ranking. Five basic site impacts are provided on the form: soil compaction, erosion, trash/dumping, poor vegetative health, and other impacts (e.g., storm water runoff). You are asked to visually determine if more detailed soil or planting investigations will be needed in subsequent visits.

*Soil Compaction:* Look for evidence of potential soil compaction, which can include standing water, surface crusting of soil, or evidence of construction traffic. Take a screwdriver, to see how easily it can penetrate the soil. If you can only go down a few inches, you may have to deal with soil compaction in your planting design.

*Erosion:* You should assess the extent of exposed soil on the parcel, and look for signs, such as rills and gullies. Steep slopes are also prone to erosion, so be sure to note these on your sketch.

*Trash and Dumping:* Look to see if the parcel is used as a dumping ground. Significant accumulations of trash and debris should be noted, and are often found near access roads. Describe the type and amount of trash present on the parcel and note if heavy equipment will be needed for clean-up.

*Poor Vegetative Health:* The current vegetative health is always an important impact to assess at the parcel. You should look for any of the following signs:

- Mechanical injury to plant parts
- Presence of insects or disease
- Evidence of mower or string trimmer damage to trunks of trees and shrubs
- Excessive surface rooting
- Small, off-color leaves that drop early in the fall on trees and shrubs
- Leaf scorch
- Branch tip dieback
- Bare patches of soil
- Dead plants

Poor vegetative health may be a sign that poor soil quality or other stressor needs to be addressed in any future planting design. Describe symptoms of poor health on the form, along with any information on the apparent cause.

### Reforestation Constraints

This part of the PAA form asks you to consider some common constraints that may hinder reforestation (Box 23).

The major factors that constrain reforestation are sun exposure, adjacent water, and infrastructure. The following criteria can help you evaluate reforestation constraints.

*Exposure:* Parcels that are fully exposed to sun and wind may experience poor planting survival, therefore you should rate the amount of exposure at the planting site. Full sun is defined as more than six hours of direct sunlight each day, whereas partial sun refers to areas that get direct sunlight for less than six

**C. Reforestation Constraints**

C1. Sun exposure: ☒ Full sun ☐ Partial sun ☐ Shade ☐ Unknown

C2. Nearby water source? ☒ Y ☐ N ☐ Unknown

C3. Other constraints: ☐ Overhead wires ☐ Underground Utilities ☐ Pavement ☒ Buildings
☐ Other (please describe): ____________

***Box 23:** In this example, the field crew noted that the site received full sunlight and was near a water source, which would make reforestation easier. They did notice, however, that buildings were nearby, and they drew this on the sketch.*

hours a day, or filtered light throughout the entire day. A planting site is considered shady if it gets little or no direct sunlight, or receives less than six hours of filtered light per day from the overhead canopy.

*Nearby water source:* Urban trees usually require supplemental water to survive the first few years after planting. Therefore, check to see if a nearby water source is present and describe it (e.g., automatic irrigation system, perennial stream, nearby faucet or hose, or storm water pond).

*Other constraints:* Urban reforestation must always respect adjacent infrastructure, so check for overhead wires, pavement, buildings or underground utilities that may constrain planting. If any of these are present, you should make notes about the approximate location and sketch them for future reference.

### Notes and Sketch

The last part of the PAA form is where you can provide notes on any impacts or unusual features found at the parcel. When you draw a rough sketch of the site, be sure to show your proposed planting area, and include other features such as the following:

- Adjacent streams, roads, impervious cover and structures
- Gullies
- Vegetative cover types
- Dumping locations
- Any storm water outfalls or channels
- Location of supplemental water sources and access points
- Proposed planting areas
- Overhead wires and potential underground utilities
- Invasive species

## 5.6 Initial Management Recommendations

This part of the PAA form asks you to initially recommend possible restoration actions for the parcel.

### Natural Area Remnant

Three initial recommendations can be made to restore or conserve a forest or wetland fragment, and determine what, if any, additional field surveys are needed (Box 24).

*Good candidate for conservation/ protection:* Natural area remnant sites are

**E. Initial Recommendation**

☐ Good candidate for conservation/protection
☒ Potential restoration candidate
☐ Poor restoration or conservation candidate

***Box 24:** In this example, the field crew determined that 40% of the parcel was covered with invasive plants, and trash dumping and clearing were evident, but given the good access and public ownership, they recommended that this site be included as a potential candidate for restoration.*

good candidates for conservation or protection if they possess a large parcel area, are adjacent to other pervious areas, and are publicly-owned. Mature forest sites with shaded canopy, and few invasive plants and impacts are a good example. Any parcel that is part of a migratory corridor or green way, or possesses specimen trees, or rare, threatened, or endangered species should always be considered. Sites meeting these criteria should be referred for additional wetland and/or forest investigations, and should be a priority for conservation.

*Potential restoration candidate:* These natural area remnants show clear signs of impacts from adjacent urban areas, but could potentially be improved if trash, invasive plants, or storm water are controlled better. The restoration potential for these sites can only be determined through additional field surveys.

*Poor restoration or conservation candidate:* Natural area remnants are normally considered poor candidates for restoration if they have one or more of the following characteristics: poor access, an unwilling land owner, conflicting land use, potential soil or water contamination from past use, dominant invasive species, or extensive storm water impacts. Unless these parcels are the only ones that remain in your subwatershed, they are a low priority for further investigation.

### Reforestation Recommendation

Four basic recommendations can be made for potential reforestation, and the criteria to make them are described below (Box 25).

*Good candidate for natural regeneration:* Parcels are good candidates for natural regeneration if they have desirable trees to provide a seed source, few invasive species, full or partial sun exposure, or existing signs of natural regeneration. Good regeneration sites also have good soils, infrequent mowing regimes, and a potentially willing land owner. Parcels that meet these criteria are good candidates for more detailed investigations and land owner contact.

*May be reforested with minimal site preparation:* Good reforestation sites will have full or partial sun, a nearby water source, easy access, and few site constraints. In addition, sites should have little evidence of soil compaction, invasive plants, and trash/dumping, and be reforested with minimal site preparation. Parcels that meet these criteria are good candidates for more detailed investigations and land owner contact.

*May be reforested with extensive site preparation:* These parcels may be good candidates for reforestation, but may require more costly site preparation. Parcels have full or partial sun and a nearby water source but suffer from soil compaction, invasive plants, trash/dumping, or storm water erosion. Heavy equipment may be needed to remove rubble or invasive plants, or to amend soils. Depending on their size and location, these parcels may be recommended for further investigation.

*Poor reforestation or regeneration site:* Parcels are considered poor candidates for reforestation if they have three or more of the following characteristics: poor access, an unwilling land owner, a conflicting land use, potential soil or water contamination, dominant invasive species, and extensive storm water or dumping impacts. These factors can preclude cost-effective reforestation, and make the parcel a low priority for further investigation.

**E. INITIAL RECOMMENDATION**

- [ ] Good candidate for natural regeneration
- [x] May be reforested with minimal site preparation
- [ ] May be reforested with extensive site preparation
- [ ] Poor reforestation or regeneration site

**Box 25:** *In this example, the field crew felt the parcel would be a good candidate for reforestation based on its good access and public ownership, even though some site preparation would be needed to alleviate soil compaction and the lack of organic matter.*

# Chapter 6: Streets and Storm Drains (SSD)

## 6.1 Basics of Streets and Storm Drains

Urban streets and storm drains can accumulate and store urban pollutants. Relatively minor changes in municipal maintenance procedures can help remove these pollutant loads in some subwatersheds. The condition of the local road and storm drain infrastructure can be quickly assessed by checking to see if current maintenance practices could reduce pollutant accumulation (Figure 36).

## 6.2 Introduction to the SSD

The Streets and Storm Drains (SSD) form helps quantify the impacts of subwatershed maintenance practices on urban streams, and identify potential pollutant reduction strategies. The SSD asks you to visually inspect pollutant accumulation along streets, curb and gutters, and storm drain inlets, and assesses the retrofit potential of large parking lots. The SSD also randomly inspects storm drains to estimate pollutant accumulation in catch basins, and evaluate a series of factors to determine the feasibility of street sweeping as a pollutant reduction strategy for the subwatershed. The output from the SSD is an estimate of the severity of pollutant accumulation within the road and storm sewer system of the subwatershed, as well as specific retrofit opportunities for large parking lots. Table 24 summarizes six pollutant sources assessed by the SSD, and the corresponding restoration practices used to reduce pollution from them.

The SSD form consists of five parts:

*Location* – Collects basic location information on street names and adjacent land use at the points sampled in the subwatershed.

*Street Condition* – Measures the degree of pollutant accumulation on street surfaces and curbs, and characterizes street type and condition, access, and parking issues that influence the feasibility of street sweeping.

*Storm Drain Inlets and Catch Basins* – Characterizes the current condition of the storm drain infrastructure and the degree of pollutant accumulation in catch basins, if present.

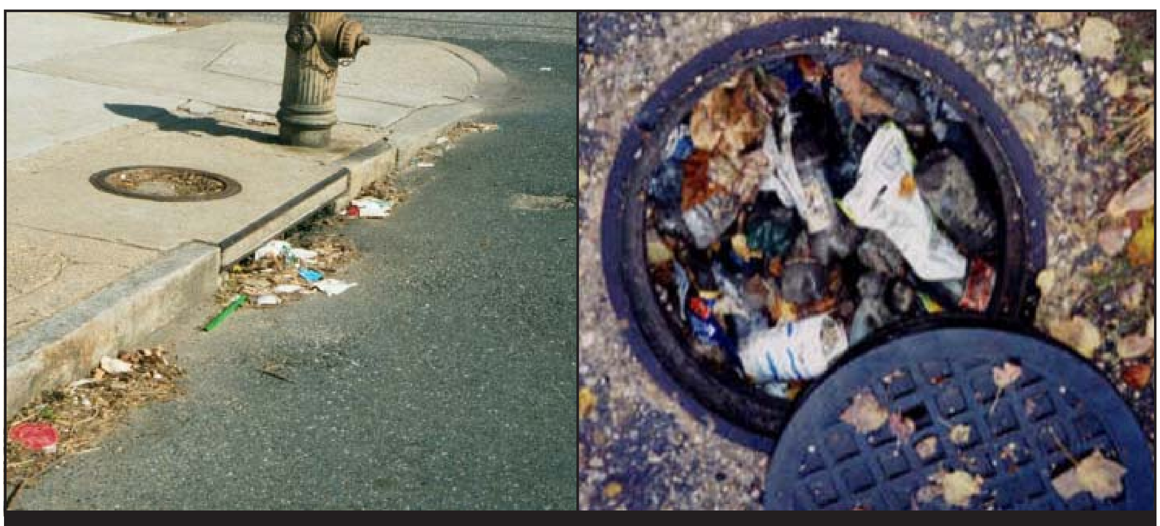


Figure 36: Indicators that Changes in Municipal Street Maintenance May Be Needed

| Table 24: SSD Assessment Factors and Possible Restoration Recommendations | |
|---|---|
| **Street or Storm Drain Factor Assessed** | **Corresponding Restoration Practice*** |
| Pollutant accumulation in road or curbs | Street sweeping (M-9) |
| Pollutant accumulation in catch basins | Catch basin clean-outs (M-9) |
| Unlabeled storm drains | Storm drain stenciling (N-21) |
| Parking lot maintenance | Power washing pollution prevention practices (H-11) |
| Uncontrolled storm water discharge | Parking lot retrofit (SR-6, OS-7 to 11) |
| Ongoing road construction/repair | Road maintenance pollution prevention practices (M-9) |
| **The code in parentheses refers to the appropriate restoration profile sheet in the Restoration Manual Series. Codes are as follows:*<br>• *OS- and SR- sheets can be found in Manual 3: Storm Water Retrofit Practices*<br>• *N- and H- sheets can be found in Manual 8: Pollution Source Control Practices*<br>• *M–9: Manual 9: Municipal Practices and Programs* | |

*Non-Residential Parking Lots* –Assesses the condition, size, and retrofit potential of larger parking lots.

*Pollution Reduction Strategies* –Makes an initial recommendation as to the feasibility of improving municipal maintenance practices, as well as parking lot retrofit potential.

Before you conduct an SSD, you need to gather the proper equipment and maps (Table 5 in Chapter 2). Two key items are a pry bar and a sediment measuring rod, which are used to gain access to storm drain manhole covers and catch basins to measure pollutant accumulation. The measuring rod should be at least six feet long and be marked at six-inch intervals to estimate the amount of sediment in the bottom of the catch basin. A permission letter from the local public works department may also be needed to open up catch basins.

### Completing the Field Form

Each SSD form begins with basic information on the watershed and subwatershed, as well as a Unique Site ID assigned to the street or storm drain assessed (Box 26). Record the date, members of the field crew, and information about the camera and picture numbers taken at the site. Note if it has rained in the last 24 hours to determine if the street or storm drain system may have been "cleaned" by the runoff from a recent storm event.

## 6.3 Basic Characterization

This part of the SSD form records general information about where the streets and storm drains are located (Box 27).

You should record the name of the street(s) in the neighborhood, or the location of the large parking lot. Also, record the type of adjacent land use, and indicate whether an HSI or NSA form was completed. If so, make sure to cross-reference the Unique Site ID on both field forms.

## 6.4 Street Conditions

This part of the SSD form looks at the degree of pollutant accumulation on street surfaces and curbs (Box 28).

To start, you need to classify the street or road being assessed. Four basic types of roads potentially exist in a subwatershed, ranging from wide arterials to narrow alleys. Road classification is important since each type has different traffic volumes, parking requirements, and curb access that influence maintenance and sweeping schedules. The following criteria can be used to classify four types of roads:

**Arterial roads** are the largest roads in a subwatershed, and carry through-traffic between and across developed areas and from suburban areas to urban areas. They often have controlled exits and entrances, and have the highest design speeds. Arterial roads can have four to six traffic lanes with large rights-of-way.

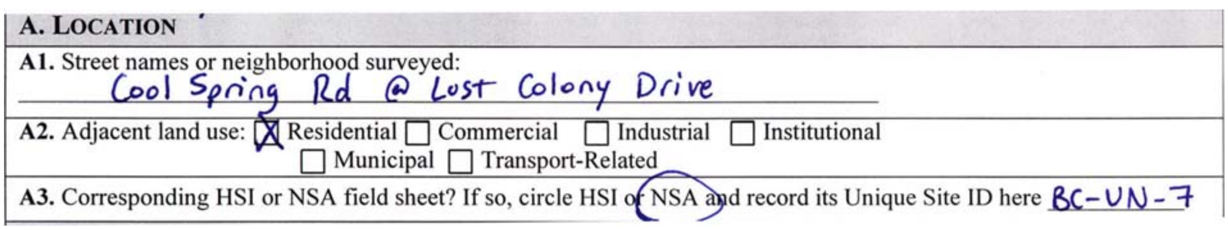
**Collector roads** connect traffic between arterial and local roads and sometimes offer direct access to commercial or residential properties. The design speeds of collector roads are slightly higher than local roads (25-40 miles per hour), and they typically have two to three traffic/parking lanes with larger rights-of-way.

**Local roads** are designed to carry local traffic and provide direct access to residential and commercial properties. These roads often have design speeds of 25 miles per hour or less and have two to four traffic lanes. The width of the travel lanes and rights-of-way of local roads are usually narrower than collector or arterial roads.

**Alleys** (a.k.a. alleyways) are narrow service streets providing access to the rear of a lot, and are typically the narrowest road type allowed in most communities.

| | | |
|---|---|---|
| WATERSHED: Little River | SUBWATERSHED: Back Creek | UNIQUE SITE ID: BC-SD-2 |
| DATE: 02/03/04 | ASSESSED BY: TW, JF | CAMERA ID: disposable 2 |
| MAP GRID: #19, F-3 | RAIN IN LAST 24 HOURS ☐ Y ☒ N | PIC #: 11 & 12 |

***Box 26:*** *The field crew in this example examined streets and storm drains in a residential neighborhood in the Back Creek subwatershed of Little River. The crew located the neighborhood using map coordinates, took two photos using a disposable camera, and noted that it had not rained in the last 24 hours.*



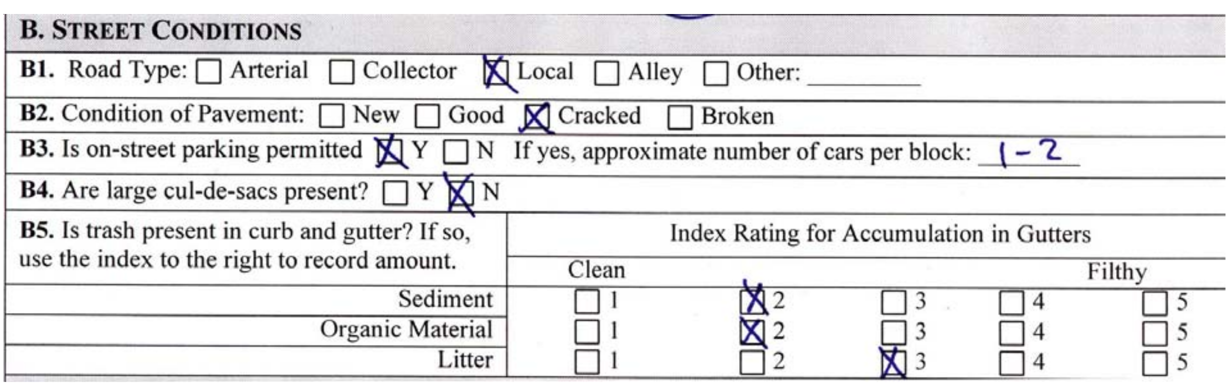
A. LOCATION

A1. Street names or neighborhood surveyed: Cool Spring Rd @ Lost Colony Drive

A2. Adjacent land use: ☒ Residential ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

A3. Corresponding HSI or NSA field sheet? If so, circle HSI or NSA and record its Unique Site ID here BC-UN-7

***Box 27:*** *The field crew assessed street and storm drain conditions at the intersection of Cool Spring Road and Lost Colony Drive, and noted the residential land use on this part of the SSD form. They inspected two catch basins at the intersection.*



B. STREET CONDITIONS

B1. Road Type: ☐ Arterial ☐ Collector ☒ Local ☐ Alley ☐ Other: ______

B2. Condition of Pavement: ☐ New ☐ Good ☒ Cracked ☐ Broken

B3. Is on-street parking permitted ☒ Y ☐ N If yes, approximate number of cars per block: 1-2

B4. Are large cul-de-sacs present? ☐ Y ☒ N

| B5. Is trash present in curb and gutter? If so, use the index to the right to record amount. | Index Rating for Accumulation in Gutters: Clean | | | | Filthy |
|---|---|---|---|---|---|
| Sediment | ☐ 1 | ☒ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Organic Material | ☐ 1 | ☒ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Litter | ☐ 1 | ☐ 2 | ☒ 3 | ☐ 4 | ☐ 5 |

***Box 28:*** *In this example, the crew classified both neighborhood streets as local, based on their widths and posted traffic speeds. The pavement surface showed some cracks, and a few cars were parked on the street. The crew then looked at pollutant accumulation in the gutters, and rated them as having low levels of sediment and organic matter, and a moderate amount of litter at the time of the survey.*

Once the street has been classified, you should assess the condition of the surface. Pavement condition is important, since it can be significant source of sediment, as well as oil and grease and trace metals from ordinary car wear and tear. Pavement conditions also provide clues about the nature and extent of recent street maintenance. Poor pavement condition may also suggest that the street may be a source of sediment and other pollutants. **Cracked pavement** refers to hairline fractures in the pavement where water seeps into the roadbed. **Broken pavement** occurs when the surface has deteriorated to the point that gaps, potholes, patches, or “alligatoring” are common. Sediments and other pollutants can be trapped in broken pavement, making it difficult to remove them during street sweeping operations.

The feasibility of street sweeping also depends on access to the curb, so the next question examines the prevalence of **on-street parking**. Access to the curb and gutter, and storm drain inlets can be limited if on-street parking is permitted (unless temporary parking restrictions are imposed). Look for signs that indicate parking restrictions, and assume that on-street parking is permitted if no signs are present. Note the extent of on-street parking if it occurs.

You should investigate any **cul-de-sacs** present in the neighborhood. Cul-de-sacs are local access streets with a closed circular end to allow vehicles to turn around. Many of these cul-de-sacs can have a radius of more than 40 feet. From a storm water perspective, cul-de-sacs create a huge bulb of impervious cover, increasing the amount of storm water runoff. Retrofitting cul-de-sacs with small landscaped islands in the center that can infiltrate storm water runoff may help alleviate storm water impacts (Figure 37).

Next, turn your attention to the **curb and gutter** and evaluate its current pollutant accumulation. A curb and gutter system is a type of storm water conveyance that quickly delivers storm water from the road into storm drains (Figure 38). They are not designed to provide any treatment or pollutant removal. If curb and gutters are present in the neighborhood, look along the sides of the street and rate the level of pollutant accumulation in the system. Clean and dry curbs may suggest that the street has recently been swept, good housekeeping, or merely a recent storm. Flowing or standing water could mean that storm drain inlets are clogged or an illicit discharge is occurring.

You are asked to separately rate the degree of sediment, organic matter, and litter in the curb on a five-point scale, with a value of one indicating no accumulation, and a value of five indicating heavy accumulation (Figure 39).

**Figure 37: Cul-de-sac With Landscaped Island**

**Figure 38: Examples of a Curb and Gutter System Going to Storm Drain**

## 6.5 Storm Drain Inlets and Catch Basins

This part of the SSD form is where you inspect the condition and pollutant accumulation of storm drain inlets and catch basins (Box 29).

**Storm drain inlets** are the locations in the street where storm water runoff enters the underground storm drain system (see Figure 39). Some inlets are also equipped with a **catch basin** to capture and settle sediment, debris and other pollutants. The ability of catch basins to consistently remove sediment and other pollutants requires routine clean-outs to maintain their storage capacity.


| Rating of 1 | Rating of 3 | Rating of 5 |
|---|---|---|

**Figure 39: Varying Degrees of Trash and Debris Accumulation in Curb and Gutter and Storm Drain Inlets**

**C. Storm Drain Inlets and Catch Basins**

**C1.** Type of storm drain conveyance: ☐ open ☐ enclosed ☒ mixed

**C2.** Percentage of inlets with catch basin storage: 20% ☐ N/A

| *Sample 1-2 catch basins per NSA/HSI* | **C3.** Catch basin #1 | **C4.** Catch basin #2 |
|---|---|---|
| Latitude | 37° 65' 10" | 37° 65' 12" |
| Longitude | 77° 40' 29" | 77° 40' 31" |
| LMK # | 9 | 10 |
| Picture # | 12 | 13 |
| Current Condition | ☐ Wet ☒ Dry | ☒ Wet ☐ Dry |
| Condition of Inlet | ☒ Clear ☐ Obstructed | ☒ Clear ☐ Obstructed |
| Litter Accumulation | ☐ Y ☐ N | ☐ Y ☒ N |
| Organics Accumulation | ☒ Y ☐ N | ☒ Y ☐ N |
| Sediment Accumulation | ☒ Y ☐ N | ☒ Y ☐ N |
| Sediment Depth (in feet) | 0.5 ft. | 0.5 ft. |
| Water Depth | 0 ft. | 1.0 ft. |
| Evidence of oil and grease | ☐ Y ☒ N | ☐ Y ☒ N |
| Sulfur smell | ☐ Y ☒ N | ☒ Y ☐ N |
| Accessible to vacuum truck | ☒ Y ☐ N | ☒ Y ☐ N |

***Box 29:*** *After driving the entire neighborhood, the crew estimated that only 20% of its storm drain inlets had catch basins, and classified the entire storm water conveyance system as being mixed (both grass channels and storm drain pipes). The crew successfully popped two manhole covers to get access to the catch basins, and recorded their GPS coordinates. The first catch basin was dry and had six inches of sediment and litter accumulation on the bottom. No evidence of oil and grease or sulfur was recorded. The second catch basin, located only a few hundred feet away, was much different. It was wet and had a foot of water overlying six inches of sediment and organic matter deposits. No oil was observed, but the crew detected a sulfur smell. Both catch basins were deemed accessible for clean-out by vacuum truck.*

The first question asks you to describe the type of storm drain conveyance along the road. **Open** is defined as a concrete channel or grass swale, and **enclosed** means that runoff travels through underground concrete or metal pipes.

If you have enclosed storm drains, walk down the road to look for storm drain inlets. Look for manhole covers over the inlet, where you can access the catch basin below. You should inspect several features of catch basins, if they are present.

First, GPS the latitude, longitude, and LMK for the inlet, so it can be found later. Next, open the manhole and use the flashlight and measuring rod to inspect the catch basin. Check to see if the catch basin is wet or dry, and note the depth of accumulation. If possible, characterize the type of pollutants that are found (oil and grease, sediment, litter, organic matter) and note them on the field form.

Sediment depth is measured using the rod, and should be recorded in inches. Note the top of the watermark on the measuring rod, and record its depth in inches. The difference between the top of the watermark and the top of the sediment mark will be the water volume (Figure 40). Visual observations such as oil and grease sheens or dark staining can be helpful. Use your nose to see if the catch basin smells like rotten egg smell. Lastly, check to see if the inlet is accessible by a vacuum truck (i.e., is there enough space for vacuum trucks to adequately clean out the catch basin).

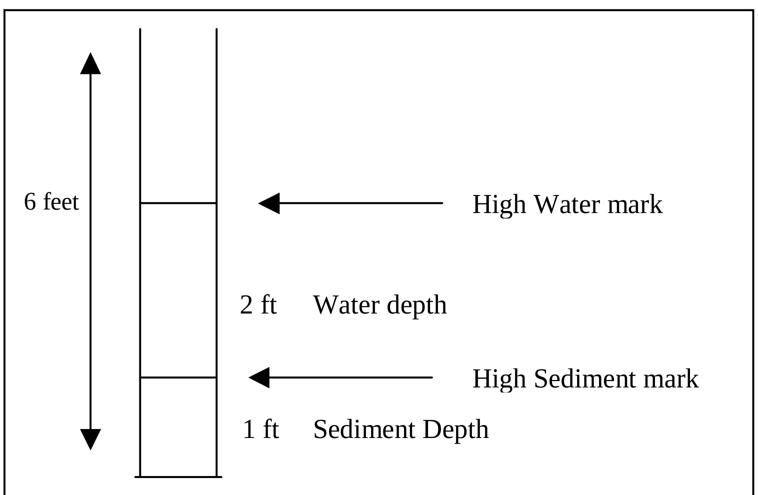



**Figure 40: Catch Basin Illustration**

Next, draw a rough sketch of the dimensions of the catch basin on the back of the SSD form. The length and width of the catch basin can be measured using a measuring tape. The measuring rod is then used to estimate the depth of the catch basin. Multiplying all three dimensions gives you an estimated sump volume, which should be noted on the sketch. Other things to note on the sketch include the location of inlet and outlet pipes, and their estimated sizes. These measurements are important when using the Watershed Treatment Model later in the restoration planning process to estimate potential pollutant reduction through clean-outs.

## 6.6 Non-Residential Parking Lots

This part of the SSD form assesses the retrofit potential for large parking lots encountered in the subwatershed, using on-site or adjacent storage retrofit techniques (Box 30). This part also asks you to investigation whether enough space is available to install storage retrofits, bioretention, swales, trenches, or permeable pavement at the parking lot. Manual 3 provides more detailed information on these retrofits.

The first few questions ask you to evaluate the size and condition of the parking lot. The approximate area of the parking lot can be determined prior to the field survey (using GIS to estimate length and width), or can be measured in the field using a measuring tape or calibrated paces. Next, you should rate the general condition of the parking lot surface, and check to see if it is served by any kind of storm water treatment practice. If so, take a photo, and note it on the sketch.

To rate the **retrofit potential** of a parking lot, you should consider the following four factors:

**D. NON-RESIDENTIAL PARKING LOT** (>2 acres)

**D1.** Approximate size: 2.5 acres

**D2.** Lot Utilization: ☐ Full ☐ About half full ☒ Empty (assessed during non-business hours)

**D3.** Overall condition of Pavement: ☐ Smooth (no cracks) ☒ Medium (few cracks) ☐ Rough (many cracks) ☐ Very Rough (numerous cracks and depressions)

**D4.** Is lot served by a storm water treatment practice? ☐ Y ☒ N If yes, describe: ______

**D5.** On-site retrofit potential: ☐ Excellent ☐ Good ☒ Poor

***Box 30:*** *The crew investigated a parking lot at an older strip shopping center with an area of about 2.5 acres. The lot had been identified from aerial photographs during the desktop screening phase. The lot was basically empty, because it was surveyed in the early morning before shops had opened. The field crew had a good opportunity to inspect the condition of the parking lot, and found a few cracks and potholes, and rated the pavement condition as medium. The crew traced the storm drain system through the lot, and could find no evidence of any treatment practice, which was not surprising since it had been built prior to local storm water regulations. The crew then evaluated the potential to construct an on-site retrofit to treat storm water. While they did find a few thousand square feet of adjacent unutilized land, it was located up-gradient from the parking lot and appeared to be crossed by underground utilities. Consequently, the crew rated the parking lot as having poor on-site retrofit potential.*

1. Is there any **unutilized land** adjacent to or within the parking lot that might be suitable for a retrofit?
2. Is this land mostly downgradient of the parking lot? This is important since runoff needs to flow downhill into retrofit site to ensure treatment.
3. Is the available land at least 10% of the size of the contributing parking lot area?
4. Does it appear that underground sewers, cables, or other utilities are absent from the parcel?

If you can answer yes to all four questions, it usually means the parking lot has excellent retrofit potential. Answering yes to three questions indicates good retrofit potential, while two or fewer yes answers would suggest that the parking lot has little retrofit potential and should be dropped from further consideration. Parking lots with good or excellent potential can be referred for subsequent investigations in a Retrofit Reconnaissance Inventory (RRI).

## 6.7 Recommended Municipal Practices

The last part of the SSD form asks you to make an initial recommendation as to the feasibility of four pollutant reduction strategies (Box 31).

The four pollutant reduction strategies for streets and storm drains are described below.

**Street sweeping** can be an effective maintenance practice, since roads can comprise as much as 10 to 20% of total impervious cover in suburban subwatersheds and even more in highly urban subwatersheds. If pollutant accumulation is significant along curbs, street sweeping may be an effective pollutant reduction strategy, particularly in highly urban subwatersheds with many streets but few other retrofit opportunities. Sweeping may not be feasible, however, if pavement is in poor condition, or on-street parking is prevalent.

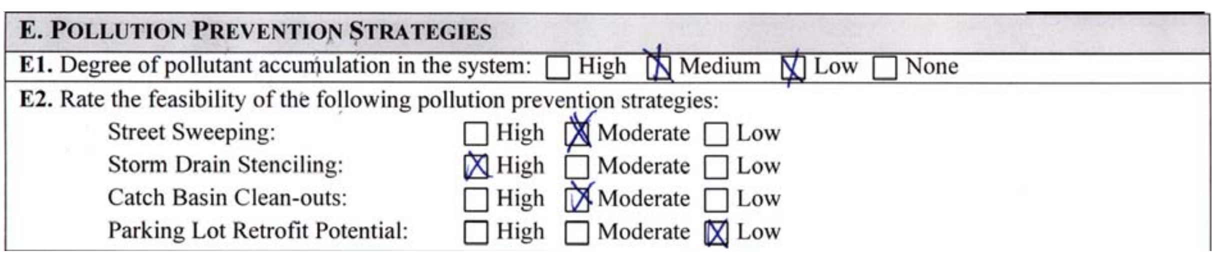
**Storm drain stenciling** can educate residents and owners to keep leaf litter, organic matter, and trash out of the storm drain system, and may reduce dumping, spills and illicit discharges. Stenciling is also a direct and local way to increase subwatershed awareness and practice neighborhood stewardship.

**Catch basin clean-outs** present the last opportunity to prevent pollutants from entering the storm drain system. The effectiveness of this pollutant reduction strategy depends on the basic design of the storm water conveyance and the volume of trapped pollutants within the catch basin. Each catch basin or sump pit tends to be unique in how quickly it fills up, and whether the trapped material is liquid, solid or organic. To this extent, each catch basin reflects the immediate conditions and behaviors that occur in the few hundred feet of the street it serves. If catch basins are present, they can be cleaned out several times a year with a vactor truck, and the contents disposed of properly. Clean-outs have been shown to be effective in removing trash, sediment, nutrients, trace metals, organic carbon, and other pollutants from downstream waters.

**Parking lot retrofits** refer to a variety of practices that provide storm water treatment in parking lots where it previously did not exist or was not effective. Consult Manual 3 for more details on the design of parking lot retrofits.

Table 25 offers some suggested benchmark values to evaluate the feasibility of the four pollution reduction strategies for the subwatershed. The benchmark values rate the feasibility as high, medium, or low based on the percentage of streets or storm drains that can be effectively treated in the neighborhood or subwatershed. You may adjust these benchmarks if there is a specific pollutant of concern in the subwatershed.

Feasibility ratings are used to quickly prioritize which combination of pollutant reduction strategies warrants future detailed investigation. For example, a high accumulation rating may suggest that more regularly scheduled street sweeping and catch basin clean-outs could play a role in your subwatershed restoration strategy. More guidance on how to interpret SSD data to select subwatershed pollutant reduction strategies is provided in the next chapter.


E. POLLUTION PREVENTION STRATEGIES

E1. Degree of pollutant accumulation in the system: [ ] High [X] Medium [X] Low [ ] None

E2. Rate the feasibility of the following pollution prevention strategies:

| | | | |
|---|---|---|---|
| Street Sweeping: | [ ] High | [X] Moderate | [ ] Low |
| Storm Drain Stenciling: | [X] High | [ ] Moderate | [ ] Low |
| Catch Basin Clean-outs: | [ ] High | [X] Moderate | [ ] Low |
| Parking Lot Retrofit Potential: | [ ] High | [ ] Moderate | [X] Low |

***Box 31:*** *The field crew rated the pollutant accumulation along the residential streets as low to medium. The crew rated the feasibility of both street sweeping and catch basin clean-outs as moderate, given the low-density (1-2 cars per block) street parking, and access to catch basins for clean-outs. A single parking lot was assigned a low potential retrofit rating due to the lack of current storm water treatment and the poor condition of the pavement surface.*

**Table 25: Benchmarks Used to Select SSD Pollution Prevention Strategies**

| Pollution Prevention Strategies | Indicator | Benchmark Rating | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| Street Sweeping | Percentage of the streets where curb and gutter accumulation is rated three or higher in SSD and access for sweeping is available or can be controlled | >40% | 20-40% | <20% |
| Storm Drain Stenciling | Percentage of storm drains that are *not* stenciled | >50% | 40-50% | ≤20% |
| Catch Basin Clean-outs | Percentage of catch basins with six inches of accumulation and are accessible for cleanout | >50% | 40-50% | <40% |
| Parking Lot Retrofit Potential | Acreage of parking lots rated excellent or good retrofit | ≤25 acres | 5-24 acres | ≤5 acres |

# Chapter 7: Interpreting USSR Data to Develop Better Subwatershed Restoration Plans

## 7.1 Introduction

The USSR generates a wealth of information to define an initial restoration strategy for upland areas of your subwatershed. This chapter presents a series of methods to compile, organize, and interpret USSR data. Seven different methods can be used to translate USSR data into effective upland restoration projects:

- Basic Data Management and Quality Control
- Simple Subwatershed Project Counts
- Mapping USSR Data
- Devising USSR Metrics
- Subwatershed and Neighborhood Screening
- Source Control Plan
- Additional Subwatershed Project Investigations

The choice of which data analysis method(s) are used depends on your local resources, restoration goals, and the actual problems and opportunities discovered during the USSR.

## 7.2 Basic Data Management and Quality Control

The USSR produces an enormous amount of raw data to characterize subwatershed conditions. It is not uncommon to compile dozens and even hundreds of individual forms in a single subwatershed. The real trick is to devise a system to organize, process and translate USSR data into simpler outputs and formats that can guide subwatershed restoration efforts. The system starts with effective quality control procedures in the field.

At the end of each day, field crews should regroup at a predetermined location to compare notes. The crew leader should confirm that all subwatershed areas have been covered, discuss initial findings, and deal with any logistical problems. It is also a good time to check whether field crews are measuring and recording data in the same way, and are consistent in what they are (or are not) recording. Crew leaders should also review field forms for accuracy and thoroughness. Illegible handwriting should be neatened, details added to notes and sketches, and all photos and GPS waypoints accurately checked and cross-referenced. The crew leader should always organize the forms together in a master binder for future reference.

Once the crews return from the field, data from the field forms can be entered into a spreadsheet or directly into a GIS system. Spreadsheets are probably the easier method for sorting and organizing USSR data. You should start with key parameters such as neighborhood pollution severity rating, hotspot density, on-site retrofit potential or pervious area restoration potential. Spreadsheet data can also easily be imported into a GIS system for subsequent mapping. The GIS system can create its own database table to create subwatershed or neighborhood maps.

You should be sure to spot-check the quality of USSR data after it has been entered into the spreadsheet. One simple quality control technique is to compare how site location data aligns with urban landmarks on aerial photos or maps to catch any mistakes during field transcription or data entry.

Two databases should be created to analyze USSR data. The first master database contains all major NSA, HSI, PAA, and SSD outputs, while the second database contains more detailed information on potential storm water hotspots. The HSI database is needed to make hotspot data management easier and track every potential, confirmed and severe hotspot in the subwatershed. Hotspot data can also be used to discern whether hotspots are clustered around specific land uses, and guide follow-up inspection and enforcement activity.

## 7.3 Simple Subwatershed Project Counts

An early screening analysis can save a lot of time. This analysis counts the major USSR outputs that appear to have the greatest subwatershed restoration potential. For example, you may want to count the number and distribution of the following:

- Neighborhoods with severe nonpoint source potential ratings
- Neighborhoods with high on-site retrofit potential
- Neighborhoods with a large proportion of high management turf
- Neighborhoods with high or low forest canopy coverage
- Potential, confirmed, and severe hotspots
- Potential generating land uses for illicit discharges
- Candidate sites for natural area restoration
- Candidate sites for pervious area restoration
- Length of streets treatable by regular sweeping
- Fraction of storm drain system treatable by catch basin clean-outs
- Candidate sites for parking lot retrofits

At this stage, simply count the number of sites in each of the major categories, or express them as a fraction of total subwatershed or neighborhood area. Examples might include high input turf as a percent of total neighborhood area, or pervious area restoration sites as a percent of total subwatershed area. Based on these counts, you may discover that a particular upland restoration strategy may not be applicable in the subwatershed. For example, if no confirmed or severe hotspots exist in the subwatershed, business pollution prevention efforts do not need to be a part of your initial subwatershed restoration strategy. On the other hand, your counts may reveal that there are so many pollution sources or candidate sites that it makes sense to immediately pursue more detailed field investigations or go straight to a Source Control Plan (sections 7.7 and 7.8). The key point is to avoid getting lost in the raw data, but focus instead on the data patterns that can shape the development of your initial restoration strategy.

## 7.4 Mapping USSR Data

Maps are always an excellent way to portray subwatershed data. If your GIS system is linked to the USSR database, you can create many different kinds of subwatershed maps that show the distribution of pollution sources or restoration projects. What you choose to map depends entirely on your initial findings, restoration goals, and GIS capability. Examples of helpful maps that can guide restoration efforts include the following:

- Basic neighborhood maps (these are great for showing local stakeholders where they live in relation to the subwatershed)
- Neighborhoods with high on-site retrofit potential
- Neighborhoods with high nonpoint source severity index scores
- Clusters of severe or confirmed storm water hotspots
- Candidate sites for upland reforestation
- Remaining forest and wetland fragments
- Parking lot retrofit sites
- Neighborhoods with storm drain stenciling potential

Subwatershed maps that depict the locations of all potential upland restoration sites are especially helpful. For example, maps that overlay project locations over aerial photographs can show stakeholders and team members exactly where candidate restoration sites are located in the subwatershed (Figure

41). These maps can also help identify adjacent stakeholders that should be consulted about proposed restoration projects.

Where possible, you should try to integrate USSR outputs with USA outputs to better understand the relationship between upland areas and the stream corridor. For example, you may want to see how the potential for rooftop disconnection in upland areas can influence stream corridor restoration projects, as shown in Figure 42. By combining USSR and USA data on a single map, you may discover connections between upland sites with high pollution potential and stream corridor areas that reflect these impacts (e.g., suspect outfalls, dumping sites, bank erosion, etc.). These maps can powerfully demonstrate the link between current residential behaviors and stream quality in the subwatershed.

The key point to remember is that maps are only a tool of restoration and not a product unto themselves. Try to map with a purpose in mind. A large number of cluttered subwatershed maps may only confuse you, while a smaller number may stimulate ideas for the initial restoration strategy.

## 7.5 Deriving Subwatershed and Neighborhood Metrics

"Subwatershed metrics" is a term used to describe the process of aggregating data from individual USSR forms to get a clearer picture of what is happening at the neighborhood or subwatershed scale. An example of a subwatershed metric is the percent of the subwatershed that can potentially be treated by on-site retrofits. This metric can be estimated by analyzing NSA forms for individual neighborhoods. You can start by estimating the fraction of rooftop area for the neighborhood (i.e., number of homes multiplied by the average area of the rooftop), and then multiply it by the fraction of rooftops that can be feasibly disconnected. Next, add up the total acreage of disconnectable rooftops for all the neighborhoods in the subwatershed. You would then add to this any additional on-site retrofit acreage possible from parking lot retrofits (from the SSD forms) and hotspot retrofits (from the HSI forms). Lastly, you would divide the total potential acreage from all three types

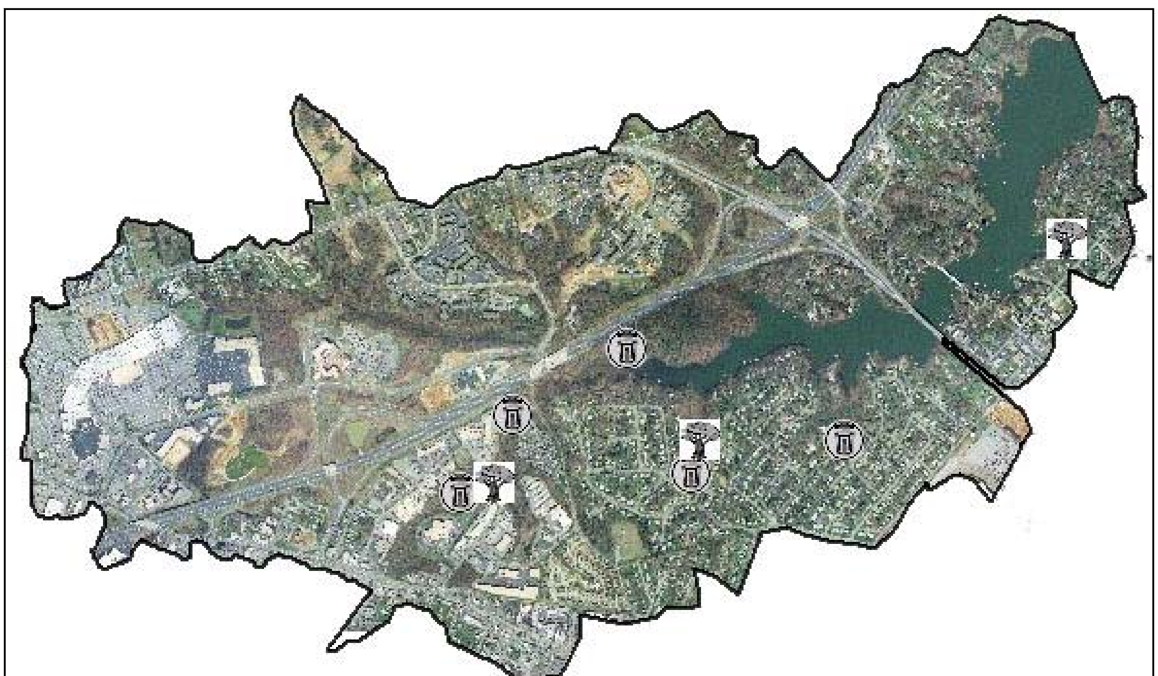


**Figure 41: USSR Subwatershed Map Showing Pervious Area Cleanup and Reforestation Project Sites**


**Figure 42: Stream Bank Erosion Identified in USA Survey and Targeted Neighborhood for Retrofit**

of on-site retrofits by the total subwatershed area to obtain the percentage of the subwatershed treatable by on-site retrofits. This metric is extremely useful to determine whether on-site retrofits will be an effective restoration strategy for the subwatershed as a whole.

A second useful subwatershed metric is the potential area available for pervious area restoration. This metric can be calculated by comparing the aggregate acreage of good and potential restoration sites (identified during the PAA) to the total subwatershed area. If the metric indicates that pervious area restoration sites comprise a minuscule fraction of total subwatershed area, you may want to direct your restoration efforts elsewhere (although you may want to consult with subwatershed stakeholders before dropping them completely).

A third helpful metric is the acreage of high input turf in a neighborhood. This metric can be directly computed from the NSA form by multiplying the fraction of turf cover on the average lot by the proportion of high input lawns in the neighborhood. This fraction can then be multiplied by total neighborhood area to get a planning estimate of the acreage of high input turf for the neighborhood as a whole. Once again, the metric is computed by aggregating the results from all the neighborhoods that compose the subwatershed. The high input turf metric provides insight about the significance of lawns as a potential pollution source at the subwatershed level, and can be used to target lawn care education efforts at the neighborhood level. Additional ideas on how to compute other neighborhood and subwatershed metrics are provided in Table 26.

## 7.6 Screening Across Neighborhoods and Subwatersheds

Subwatershed metrics have considerable value to screen or rank the restoration potential among groups of neighborhoods and subwatersheds. The basic approach is simple: select metrics that are most important to your watershed planning goals, then see how individual neighborhoods or subwatersheds rank in the process. A simple example of how metrics can be used for screening is provided in Table 27. In this hypothetical example, stakeholders selected three subwatersheds to compare upland restoration potential, based on four different metrics related to subwatershed treatment. The four metrics were the percent of subwatershed area that could be treated by on-site retrofits, source controls, street sweeping, and pervious area restoration. Based on the screening, subwatershed 2 clearly had the greatest overall restoration potential according to three of the four metrics and was selected for priority implementation.

The same basic approach can be used to screen neighborhoods within in a subwatershed to effectively target education efforts. Table 28 provides a hypothetical example of how neighborhood screening works. In this case, the pollutants of concern for the subwatershed were nutrients and bacteria. Four neighborhood metrics were developed that were strongly related to these pollutants. These metrics include the proportion of high input turf, overall turf cover, and the presence of pet waste and septic systems. Based on this simple screening process, it was evident that neighborhood A should be the top priority for nutrient education since it scored high for three of the four metrics.

**Table 26: USSR Subwatershed Metrics Data**

| Subwatershed Metrics | Data Sources |
|---|---|
| Acreage of high input turf in each neighborhood/subwatershed | NSA+HSI |
| Percent of the subwatershed that can potentially be treated by on-site retrofits | NSA+SSD+HSI |
| Percent of subwatershed/neighborhood undergoing redevelopment | NSA |
| Percent of subwatershed with reforestation potential | NSA+PAA |
| Percent of subwatershed with neighborhoods that have severe NPS rating | NSA |
| Percentage of hotspots in subwatershed with severe rating | HSI |
| Estimated percentage of catch basins in need of cleaning | SSD |
| Percentage of street curb and gutter in need of cleaning | SSD+NSA |
| Total area available for pervious area/natural area restoration | PAA |

**Table 27: Example of USSR Data Being Used to Compare Across Subwatersheds**

| | % with On-site Retrofit Potential | % Treatable by Source Controls | % Treatable by Street Sweeping | Pervious Area Restoration as % of Subwatershed Area |
|---|---|---|---|---|
| Subwatershed 1 | 35 | 54 | 6 | 8 |
| Subwatershed 2 | 52 | 66 | 14 | 2 |
| Subwatershed 3 | 24 | 45 | 3 | 2 |

**Table 28: Example of USSR Data Being Used to Compare Across Neighborhoods**

| | % High Input Turf | Turf Cover as % of Lot Area | Pet Waste Scores | Presence of Septic Systems |
|---|---|---|---|---|
| Neighborhood A | 65 | 70 | Yes | 15 |
| Neighborhood B | 10 | 35 | No | 12 |
| Neighborhood C | 5 | 35 | No | 17 |

## 7.7 Source Control Plan

Pollution sources and control opportunities are different in every subwatershed. Consequently, a unique pollution source control strategy must be developed for each subwatershed. An assessment framework, known as a Source Control Plan (SCP), has been developed to define the focus, targets, methods and delivery of subwatershed source control efforts. The SCP is a simple desktop analysis of NSA, HSI and other subwatershed data to develop the most cost effective strategy to promote better stewardship and pollution prevention practices.

If a large number of pollution sources are discovered in your subwatershed, an SCP should be prepared. The SCP essentially represents the "design" of a subwatershed source control program. It outlines the carrots and sticks to control priority pollution sources, accompanied by a budget and delivery system to implement them. The specific methods to prepare an SCP are presented in Manual 8, but its four basic steps are summarized below:

*Step 1: Compile Subwatershed Source Control Profile.* In the first step, individual NSA and HSI forms are analyzed to identify key neighborhood behaviors and hotspot operations that are generating pollutant(s) of concern. These pollution sources become the primary target for subsequent pollution source control.

*Step 2: Prioritize Outreach Targets*. In the second step, neighborhood characteristics and hotspot clusters are analyzed to determine *where* source control efforts will be most effective in the subwatershed. Contact information for neighborhoods and businesses are also compiled to determine *who* should be targeted for outreach.

*Step 3: Choose Effective Carrot and Sticks*. The third step chooses the carrots and sticks needed to change the major behavior or practices you have targeted. Since you are working at the subwatershed scale, most carrots and sticks involve direct or "retail" outreach methods. Examples include mailings, meetings, and enhanced delivery of municipal services, such as lawn care assistance.

*Step 4: Develop Budget and Delivery System*. In the last step, a multi-year source control budget is computed so that source control practices can be compared with other restoration practices being considered within the overall subwatershed restoration plan. A key budget choice is selecting which partners will be responsible for delivering the stewardship or pollution prevention message. Potential partners include local agencies, community volunteers, local watershed groups, private sector allies, and state regulatory agencies.

## 7.8 Additional Subwatershed Project Investigations

Your USSR data analyses should have shed light on the initial priorities for the most effective restoration strategies. The next step is to undertake more detailed follow-up investigations to assess the feasibility of each project and begin designing restoration projects or programs. Many different kinds of investigations may be needed to create an inventory of upland restoration projects for the subwatershed.

Table 29 describes the range of additional candidate project investigations that may be triggered by your USSR data analysis. These are summarized in Manual 2, and an expanded description of each field or desktop method can be found in Manuals 3, 6, 7, 8, and 9. You should carefully choose the ones that are right for your subwatershed. Good hunting!

**Table 29: Follow-up Investigations Triggered by USSR Metrics**

| Restoration Practices | Follow-up Investigations | Corresponding Restoration Manual |
|---|---|---|
| Neighborhoods | Source Control Plan | Manual 8 |
| | Residential Behavior Survey | Manual 8 |
| | Pipe Discharge Investigation | Brown *et al.*, 2004 |
| | Municipal Regulation Analysis | Manual 9 |
| | Retrofit Reconnaissance Inventory (on-site) | Manual 3 |
| Hotspots | Hotspot Compliance Investigation | Manual 8 |
| | Retrofit Reconnaissance Inventory | Manual 3 |
| | Source Control Plan | Manual 8 |
| Pervious Area | Natural Area Remnant Investigations | Manual 7 |
| | Watershed Forestry Inventory | Manual 7 |
| Streets and Storm Drains | Municipal Operations Analysis | Manual 9 |
| | Retrofit Reconnaissance Inventory (on-site) | Manual 3 |

# Appendix A: USSR Field Sheets

| | | | |
|---|---|---|---|
| **WATERSHED:** | **SUBWATERSHED:** | **UNIQUE SITE ID:** | |
| **DATE:** ___/___/_____ | **ASSESSED BY:** | **CAMERA ID:** | **PIC#:** |

## A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: ___________________________________________ Neighborhood Area (acres) _______

If unknown, address (or streets) surveyed:

_________________________________________________________________________

Homeowners Association? ☐ Y ☐ N ☐ Unknown If yes, name and contact information: ____________________________

Residential *(circle average single family lot size):* ____________________________

☐ Single Family Attached (Duplexes, Row Homes) <1/8 1/8 ¼ 1/3 1/3 acre ☐ Multifamily (Apts, Townhomes, Condos)

☐ Single Family Detached <¼ ¼ ½ 1 >1 acre ☐ Mobile Home Park

| | | | INDEX* |
|---|---|---|---|
| Estimated Age of Neighborhood: _____ years | Percent of Homes with Garages: _____% With Basements ____% | | |
| Sewer Service? ☐ Y ☐ N | | | ○ |
| Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of units ☐ 5-10% ☐ >10% | | | ○ |
| ***Record percent observed for each of the following indicators, depending on applicability and/or site complexity*** | **Percentage** | **Comments/Notes** | |
| **B. YARD AND LAWN CONDITIONS** | | | |
| **B1.** % of lot with impervious cover | | | |
| **B2.** % of lot with grass cover | | | ○ |
| **B3.** % of lot with landscaping (e.g., mulched bed areas) | | | ◇ |
| **B4.** % of lot with bare soil | | | ○ |
| **Note: B1 through B4 must total 100%* | | | |
| **B5.** % of lot with forest canopy | | | ◇ |
| **B6.** Evidence of permanent irrigation or "non-target" irrigation | | | ○ |
| **B7.** Proportion of *total neighborhood* turf lawns with following management status: | High: ____ | | ○ |
| | Med: ____ | | |
| | Low: ____ | | |
| **B8.** Outdoor swimming pools? ☐Y ☐N ☐ Can't Tell Estimated # ____ | | | ○ |
| **B9.** Junk or trash in yards? ☐ Y ☐ N ☐ Can't Tell | | | ○ |
| **C. DRIVEWAYS, SIDEWALKS, AND CURBS** | | | |
| **C1.** % of driveways that are impervious ☐ N/A | | | |
| **C2.** Driveway Condition ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up | | | ○ |
| **C3.** Are sidewalks present? ☐ Y ☐ N If yes, are they on one side of street ☐ or along both sides ☐ | | | |
| ☐ Spotless ☐ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation | | | ○ |
| What is the distance between the sidewalk and street? _____ ft. | | | ◇ |
| Is pet waste present in this area? ☐ Y ☐ N ☐ N/A | | | ○ |
| **C4.** Is curb and gutter present? ☐ Y ☐ N If yes, check all that apply: | | | |
| ☐ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☐ Sediment | | | ○ |
| ☐ Organic matter, leaves, lawn clippings ☐ Trash, litter, or debris ☐ Overhead tree canopy | | | ◇ |

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

| D. ROOFTOPS | | | |
|---|---|---|---|
| **D1.** Downspouts are directly connected to storm drains or sanitary sewer | | | ◇ ○ |
| **D2.** Downspouts are directed to impervious surface | | | |
| **D3.** Downspouts discharge to pervious area | | | |
| **D4.** Downspouts discharge to a cistern, rain barrel, etc. | | | |
| **Note: C1 through C4 should total 100%* | | | |
| **D5.** Lawn area present downgradient of leader for rain garden? ☐ Y ☐ N | | | ◇ |

| E. COMMON AREAS | |
|---|---|
| **E1.** Storm drain inlets? ☐ Y ☐ N If yes, are they stenciled? ☐ Y ☐ N Condition: ☐ Clean ☐ Dirty | ◇ |
| Catch basins inspected? ☐ Y ☐ N If yes, include Unique Site ID from SSD sheet: ________________ | ○ |
| **E2.** Storm water pond? ☐ Y ☐ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N<br>What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre | ◇ |
| **E3.** Open Space? ☐ Y ☐ N If yes, is pet waste present? ☐ Y ☐ N dumping? ☐ Y ☐ N | ○ |
| Buffers/floodplain present: ☐ Y ☐ N If yes, is encroachment evident? ☐ Y ☐ N | |

| F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS | |
|---|---|
| Based on field observations, this neighborhood has significant indicators for the following: (*check all that apply*)<br>☐ Nutrients ☐ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☐ Sediment ☐ Other __________________ | ○ |

**Recommended Actions**

*Specific Action*

- ☐ Onsite retrofit potential?
- ☐ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☐ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☐ Other action(s) __________________________

**Describe Recommended Actions:**

**Initial Assessment**

**NSA Pollution Severity Index**

- ☐ Severe (More than 10 circles checked)
- ☐ High (5 to 10 circles checked)
- ☐ Moderate (Fewer than 5 circles checked)
- ☐ None (No circles checked)

**Neighborhood Restoration Opportunity Index**

- ☐ High (More than 5 diamonds checked)
- ☐ Moderate (3-5 diamonds checked)
- ☐ Low (Fewer than 3 diamonds checked)

**NOTES:**

| | | | |
|---|---|---|---|
| **WATERSHED:** | **SUBWATERSHED:** | | **UNIQUE SITE ID:** |
| **DATE:** ___/___/_____ | **ASSESSED BY:** | **CAMERA ID:** | **PIC#:** |
| **MAP GRID:** | **LAT** ___°_____'_____" **LONG** ___°_____'____" | | **LMK #** |

**A. SITE DATA AND BASIC CLASSIFICATION**

Name and Address: ___________________

___________________________________

___________________________________

SIC code (if available): ___________

NPDES Status: ☐ Regulated ☐ Unregulated ☐ Unknown

Category: ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

Basic Description of Operation:

___________________________________________________________

| | INDEX* |
|---|---|
| **B. VEHICLE OPERATIONS** ☐ **N/A** *(Skip to part C)* | **Observed Pollution Source?** ☐ |
| **B1.** Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: ____________ | |
| **B2.** Approximate number of vehicles: _______ | |
| **B3.** Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored | ○ |
| **B4.** Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell<br>Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **B5.** Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **B6.** Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **B7.** Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **B8.** Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell<br>Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **C. OUTDOOR MATERIALS** ☐ **N/A** *(Skip to part D)* | **Observed Pollution Source?** ☐ |
| **C1.** Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell<br>If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **C2.** Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: _______<br>Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area | ○ |
| **C3.** Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **C4.** Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **C5.** Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **C6.** Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **C7.** Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **D. WASTE MANAGEMENT** ☐ **N/A** *(Skip to part E)* | **Observed Pollution Source?** ☐ |
| **D1.** Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials | ○ |
| **D2.** Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐Leaking or evidence of leakage (stains on ground) ☐ Overflowing | ○ |
| **D3.** Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell<br>If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **E. PHYSICAL PLANT** ☐ **N/A** *(Skip to part F)* | **Observed Pollution Source?** ☐ |
| **E1.** Building: Approximate age: ________ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged<br>Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know | ○<br>○ |

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

| | |
|---|---|
| **E2.** Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up<br>Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know | ○ |
| **E3.** Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible<br>Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know | ○ |
| **E4.** Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **F. TURF/LANDSCAPING AREAS** ☐ **N/A** *(skip to part G)* | **Observed Pollution Source?** ☐ |
| **F1.** % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% Bare Soil ____% | ○ |
| **F2.** Rate the turf management status: ☐ High ☐ Medium ☐ Low | ○ |
| **F3.** Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell | ○ |
| **F4.** Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **F5.** Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell | ○ |
| **G. STORM WATER INFRASTRUCTURE** ☐ **N/A** *(skip to part H)* | **Observed Pollution Source?** ☐ |
| **G1.** Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: _________________ | ○ |
| **G2.** Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown<br>Is trash present in gutters leading to storm drains? If so, complete the index below. | ○ |

Index Rating for Accumulation in Gutters

| | Clean | | | | Filthy |
|---|---|---|---|---|---|
| Sediment | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Organic material | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Litter | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

**G3.** Catch basin inspection – Record SSD Unique Site ID here: _________ Condition: ☐ Dirty ☐ Clean

**H. INITIAL HOTSPOT STATUS - INDEX RESULTS**

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot ( 10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

**Follow-up Action:**

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: _____________________
☐ Schedule a review of storm water pollution prevention plan

**Notes:**

| **WATERSHED:** | **SUBWATERSHED:** | **UNIQUE SITE ID:** | |
|---|---|---|---|
| **DATE:** ___/___/_____ | **ASSESSED BY:** | **CAMERA ID:** | **PIC #:** |
| **MAP GRID:** | **LAT** ___°_____'_____" **LONG** ___°_____'_____" | | **LMK #** |

## A. PARCEL DESCRIPTION

Size: ___acre(s) Access to site (*check all that apply*): ☐ Foot access ☐ Vehicle access ☐ Heavy equipment access
Ownership: ☐ Private ☐ Public Current Management: ☐ School ☐ Park ☐ Right-of-way ☐ Vacant land
☐ Other (please describe) ____________________
Contact Information: ____________________
Connected to other pervious area? ☐ Y ☐ N If yes, what type? ☐ Forest ☐ Wetland ☐ Other ________________
Estimated size of connected pervious area: ____ acre(s) Record Unique Site ID of connected fragment: ____________

## PART I. NATURAL AREA REMNANT

### FOREST

#### B. CURRENT VEGETATIVE COVER

**B1.** Percent of forest with the following canopy coverage:
Open _____% Partly shaded _____% Shaded _____%
**Note – these should total 100%*
**B2.** Dominant tree species: ____________________
____________________
**B3.** Understory species: ____________________
____________________
**B4.** Are invasive species present? ☐ Y ☐ N
☐ Unknown
If yes, % of forest with invasives: _______
Species: ____________________

#### C. FOREST IMPACTS

**C1.** Observed Impacts (*check all that apply*): ☐ Animals ☐ Clearing/encroachment ☐ Trash and dumping ☐ Storm water runoff ☐ Other

#### D. NOTES

### WETLAND

#### B. CURRENT VEGETATIVE COVER

**B1.** % of wetland with following vegetative zones:
Aquatic: __________
Emergent: __________
Forested: __________
**Note – these should total 100%*
**B2.** Dominant species: ____________________
____________________
**B3.** Are invasive species present? ☐ Y ☐ N
☐ Unknown
If yes, % of wetland with invasives: _______
Species: ____________________

#### C. WETLAND IMPACTS

**C1.** Observed Impacts (*check all that apply*): ☐ Animals ☐ Clearing/encroachment ☐ Trash and dumping ☐ Storm water runoff ☐ Hydrologic impacts ☐ Other

#### D. NOTES

## E. INITIAL RECOMMENDATION

☐ Good candidate for conservation/protection
☐ Potential restoration candidate
☐ Poor restoration or conservation candidate

## PART II. OPEN PERVIOUS AREAS

### A. CURRENT VEGETATIVE COVER

**A1.** Percent of assessed surface with:
Turf _____% Other Herbaceous _____% None (bare soil) _____% Trees _____% Shrubs ____ % Other _____%
(please describe): ________________________________________ **Note – these should total 100%*

**A2.** Turf: Height: _____ inches Apparent Mowing Frequency: ☐ Frequent ☐ Infrequent ☐No-Mow ☐ Unknown
Condition (*check all that apply*): ☐ Thick/Dense ☐ Thin/Sparse ☐ Clumpy/Bunchy ☐ Continuous Cover

**A3.** Thickness of organic matter at surface: _______ inches

**A4.** Are invasive species present? ☐ Y ☐ N ☐ Unknown If yes, % of site with invasives: _____
Species:________________________________________________________________________________

### B. IMPACTS

**B1.** Observed Impacts (*check all that apply*): ☐ Soil Compaction ☐ Erosion ☐ Trash and Dumping
☐ Poor Vegetative Health ☐ Other (describe): ____________________________________

### C. REFORESTATION CONSTRAINTS

**C1.** Sun exposure: ☐ Full sun ☐ Partial sun ☐ Shade ☐ Unknown

**C2**. Nearby water source? ☐ Y ☐ N ☐ Unknown

**C3.** Other constraints: ☐ Overhead wires ☐ Underground Utilities ☐ Pavement ☐ Buildings
☐ Other (please describe): __________________

### D. NOTES

### E. INITIAL RECOMMENDATION

☐ Good candidate for natural regeneration
☐ May be reforested with minimal site preparation
☐ May be reforested with extensive site preparation
☐ Poor reforestation or regeneration site

## PART III. SKETCH

| | | |
|---|---|---|
| **WATERSHED:** | **SUBWATERSHED:** | **UNIQUE SITE ID:** |
| **DATE:** ___/___/_____ | **ASSESSED BY:** | **CAMERA ID:** |
| **MAP GRID** | **RAIN IN LAST 24 HOURS** ☐ Y ☐ N | **PIC #** |

## A. LOCATION

**A1.** Street names or neighborhood surveyed:

______________________________________________________________________

**A2.** Adjacent land use: ☐ Residential ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

**A3.** Corresponding HSI or NSA field sheet? If so, circle HSI or NSA and record its Unique Site ID here _____________

## B. STREET CONDITIONS

**B1.** Road Type: ☐ Arterial ☐ Collector ☐ Local ☐ Alley ☐ Other: _________

**B2.** Condition of Pavement: ☐ New ☐ Good ☐ Cracked ☐ Broken

**B3.** Is on-street parking permitted ☐ Y ☐ N If yes, approximate number of cars per block: ________

**B4.** Are large cul-de-sacs present? ☐ Y ☐ N

| **B5.** Is trash present in curb and gutter? If so, use the index to the right to record amount. | Index Rating for Accumulation in Gutters | | | | |
|---|---|---|---|---|---|
| | Clean | | | | Filthy |
| Sediment | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Organic Material | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Litter | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

## C. STORM DRAIN INLETS AND CATCH BASINS

**C1.** Type of storm drain conveyance: ☐ open ☐ enclosed ☐ mixed

**C2.** Percentage of inlets with catch basin storage: ________ ☐ N/A

| ***Sample 1-2 catch basins per NSA/HSI*** | **C3.** Catch basin #1 | **C4.** Catch basin #2 |
|---|---|---|
| Latitude | ___° _____' _____" | ___° _____' _____" |
| Longitude | ___° _____' _____" | ___° _____' _____" |
| LMK # | | |
| Picture # | | |
| Current Condition | ☐ Wet ☐ Dry | ☐ Wet ☐ Dry |
| Condition of Inlet | ☐Clear ☐Obstructed | ☐Clear ☐Obstructed |
| Litter Accumulation | ☐Y ☐ N | ☐Y ☐ N |
| Organics Accumulation | ☐Y ☐ N | ☐Y ☐ N |
| Sediment Accumulation | ☐Y ☐ N | ☐Y ☐ N |
| Sediment Depth (in feet) | __________ ft. | __________ ft. |
| Water Depth | __________ ft. | __________ ft. |
| Evidence of oil and grease | ☐Y ☐ N | ☐Y ☐ N |
| Sulfur smell | ☐Y ☐ N | ☐Y ☐ N |
| Accessible to vacuum truck | ☐Y ☐ N | ☐Y ☐ N |

## D. NON-RESIDENTIAL PARKING LOT (>2 acres)

**D1.** Approximate size: _________ acres

**D2.** Lot Utilization: ☐ Full ☐ About half full ☐ Empty

**D3.** Overall condition of Pavement: ☐ Smooth (no cracks) ☐ Medium (few cracks) ☐ Rough (many cracks) ☐ Very Rough (numerous cracks and depressions)

**D4.** Is lot served by a storm water treatment practice? ☐ Y ☐ N If yes, describe: _______________________

**D5.** On-site retrofit potential: ☐ Excellent ☐ Good ☐ Poor

## E. Municipal Pollutant Reduction Strategies

**E1.** Degree of pollutant accumulation in the system: ☐ High ☐ Medium ☐ Low ☐ None

**E2.** Rate the feasibility of the following pollution prevention strategies:

| | | | |
|---|---|---|---|
| Street Sweeping: | ☐ High | ☐ Moderate | ☐ Low |
| Storm Drain Stenciling: | ☐ High | ☐ Moderate | ☐ Low |
| Catch Basin Clean-outs: | ☐ High | ☐ Moderate | ☐ Low |
| Parking Lot Retrofit Potential: | ☐ High | ☐ Moderate | ☐ Low |

**Catch Basin Sketches**

**#1**

**#2**

**Notes:**

# Appendix B: Storm Water Hotspots and Potential Discharge Generators

## Overview

Identification of land uses that may impact water quality in local streams can be a difficult and time-consuming task. Research suggests that program managers might wish to preferentially investigate certain land uses when looking for the sources of possible pollutant loads. These land uses are all considered to be hotspot sites where routine operations can produce higher levels of storm water pollutants, and/or present a higher potential risk for spills, leaks or illicit discharges. The two basic types of hotspots are *regulated hotspots* that are known sources of pollution and are subject to federal or state regulations, and *unregulated hotspots,* which are operations suspected to be potential pollution sources and are not currently regulated.

### *Identifying Potential Generating Sites*

The number and type of hotspot sites present in a subwatershed may vary greatly, and currently there is no public database available to identify all the regulated sites in a subwatershed. Instead, multiple databases need to be queried to identify generating sites that may be targets for source control or illicit discharge investigations. A three-phase approach is useful for gathering as much information as possible on suspect sites within a subwatershed that may qualify for more intensive scrutiny.

*Phase 1. Consult Publicly-Available Databases*
The federal government has a number of databases that may help identify locations for investigation. The Environmental Protection Agency (EPA) operates two such databases. The first is the Enforcement and Compliance History Online (ECHO) database. With this system, you can look up facility compliance history and find facilities based on geographic location (county level) or zip code (http://www.epa.gov/echo/index.html). The other database is Envirofacts (http://www.epa.gov/enviro/). This website provides access to multiple EPA databases to provide information about environmental activities (including RCRA and Toxic Release Inventory [TRI] facilities) that may affect air, water, and land anywhere in the United States. The website also provides access to Enviromapper, which will display the location of regulated facilities.

Several commercial databases can provide information on regulated industries based on manufacturing or industrial Standard Industrial Classification (SIC) codes. These databases are not free, and have limitations since they are designed primarily for marketing.

*Phase 2. Consult State and Local Agencies*
Most states have NPDES permit programs, and track permit application to some extent. You can consult state or local regulatory agencies to obtain lists of industries that have filed a Notice of Intent (NOI) to obtain storm water permits, as well as those that have filed under TRI requirements. Other agencies that may have information on local generating sites include fire departments (for hazardous waste), and sanitation or wastewater treatment agencies.

*Phase 3. Permit Review*
The final source for information is a review of local permits. Most permit databases have SIC codes as one of the fields. These codes can be matched against the SIC codes in Table B1, which list common generating sites under major land use headings. If a local permit database does not exist, it may be worthwhile to simply get the local phone book and do a quick look for businesses that are similar to those listed in Table B1.

Compiling the findings from the various databases will provide an initial list of potential generating sites for future investigation. However, research has found that most of these databases can miss many of the industries that are subject to regulation (Duke *et al.*, 1999 and Duke and Shaver, 1999), and further identification may be necessary. Field investigation with techniques can assist in identifying many of these generating sites that should likely be regulated by communities.

## Reference Tables

This appendix is designed to assist in identifying the land uses and associated generating sites in a subwatershed where routine activities may result in pollution being discharged to the storm drain system. There are two tables provided, each of which is described below.

Table B1 presents a listing of common land uses that may qualify as a hotspot based on regular activities or practices. Column one describes the general industry type. Column two lists their associated SIC codes, if known. Column three identifies whether an industry type is subject to NPDES industrial storm water permit requirements (designated by "X"). Facilities where only certain activities or facilities at the site are subject to regulation are noted (this pertains mostly to the transport-related industries). In addition, storm water permits are required for many "light" industrial facilities only if material handling equipment or activities, raw materials, immediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water. Industries where this applies are noted with an asterisk. If only specific SIC codes within a major group qualify for this exception, they are noted in parentheses. Municipal facilities that are subject to NPDES MS4 permit requirements are designated by "MS4." Column four identifies those businesses that can be considered an unregulated storm water hotspot (also designated by "X"). Column five looks at the illicit discharge potential of each of the businesses listed. The potential for a business to produce an illicit discharge is rated as either high (H) medium (M) or low (L). This rating is based on the likelihood that it has a direct connection to the storm drain system (direct), or that it can produce a transitory discharge (indirect).

Table B2 provides a list of the SIC Codes that are regulated by the Industrial Multi Sector General Permit (MGSP). The list includes the four-digit SIC codes along with the official description. This table is provided for those who wish to know the full description of each SIC code that is regulated by NPDES industrial storm water permits.

| Table B1: Common Storm Water Hotspots and their Pollution Potential | | | | | |
|---|---|---|---|---|---|
| Industry Type/ General Description | Associated SIC Code(s) | Regulated Storm Water Hotspot | Unregulated Storm Water Hotspot | Illicit Discharge Potential | |
| | | | | Direct | Indirect |
| **Commercial** | | | | | |
| Animal Care Services | 0742,0752 | | X | L | L |
| Auto Repair | 7532-7539, 7549 | | X | M | M |
| Automobile Parking | 7521 | | | L | M |
| Building Materials | 5211-5251 | | X | L | L |
| Campgrounds/RV parks | 7033 | | X | L | M |
| Car Dealers | 5511-5599, | | X | M | M |
| Car Washes | 7542 | | X | L | L |
| Commercial Laundry/Dry Cleaning | 7211-7219 | | X | L | L |
| Convenience Stores | 5399 | | X | L | L |
| Food Stores and Wholesale Food and Beverage | 5141-5149 5411-5499 | | X | L | M |
| Equipment Repair | 7622-7699 | | X | L | L |
| Gasoline Stations | 5541 | | X | M | M |
| Heavy Construction Equipment Rental and Leasing | 7353 | | X | L | H |
| Building and Heavy Construction | 1521-1542 1611-1629 | X (For land disturbing activities) | X | L | H |
| Marinas | 4493 | X | | L | M |
| Nurseries and garden centers | 5261 | | X | L | M |
| Oil Change Shops | 7549 | | X | | M |
| Restaurants | 5812,5813,7011 | | X | M | L |
| Swimming Pools | 7997, 7999 | | X | L | L |
| Warehouses | 4221-4226 | X* (4221-4225) | | L | L |
| Wholesalers of Chemical and Petroleum | 5162-5169,5172 | | X | L | L |
| **Industrial** | | | | | |
| Apparel and Other Fabrics | 2311–2399 3131–3199 | X* | | 2300 L 3100 H | L M |
| Auto Recyclers and Scrap Yards | 5015, 5093 | X | | L | H |
| Beverages and Brewing | 2082-2087 | X* | | L | L |
| Boat Building and Repair | 3731,3732 | X | | L | H |
| Chemical Products | 2812-2899 | X* (2830, 2850) | | 2810 H 2820 H 2840 H 2860 M 2830 L 2850 L 2870 L 2890 L | 2810 L 2820 L 2840 L 2860 L 2830 L 2850 L 2870 L 2890 L |

| Table B1: Common Storm Water Hotspots and their Pollution Potential | | | | | |
|---|---|---|---|---|---|
| Industry Type/ General Description | Associated SIC Code(s) | Regulated Storm Water Hotspot | Unregulated Storm Water Hotspot | Illicit Discharge Potential | |
| | | | | Direct | Indirect |
| **Industrial (continued)** | | | | | |
| Food Processing | 2011–2141 | X* | | 2010 H<br>2020 H<br>2030 H<br>2040 H<br>2050 L.<br>2060 L<br>2070 M<br>2090 L<br>2110 M | 2010 L<br>2020 L<br>2030 L<br>2040 L<br>2050 L.<br>2060 L<br>2070 L<br>2090 L<br>2110 L |
| Garbage Truck Washout Activities | 4212 | | X | L | H |
| Industrial or Commercial Machinery, Electronic Equipment | 3511–3599<br>3612–3699 | X* | | L | L |
| Instruments; Photographic and Optical Goods, Watches and Clocks and other Miscellaneous Manufacturing | 3812–3873<br>3933-3999 | X* | | L | L |
| Leather Tanners | 3411 | X | | H | M |
| Metal Production, Plating and Engraving Operations | 2514, 2522, 2542, 3312-3399, 3411-3499, 3590 | X* (2514,2522, 2542, 3411-3433, 3442-3499, 3590) | | H | L |
| Paper and Wood Products | 2411-2499, 2511, 2512, 2517, 2519, 2521, 2541, 2611–2679 | X* (2434, 2652–2657, 2671–2679) | | 2400 L<br>2500 L<br>2600 H | 2400 H<br>2500 L<br>2600 H |
| Petroleum Storage and Refining | 2911 | X | | 2911 H | H |
| Printing | 2711–2796 | X* | | L | L |
| Rubber and Plastics | 3011-3089 | X* | | M | L |
| Stone, Glass, Clay, Cement, Concrete, and Gypsum Product | 3211-3299 | X* (3233) | | L | L |
| Textile Mills | 2211–2299 | X* | | H | L |
| Transportation Equipment | 3711–3728, 3743-3799 | X* | | H | M |
| **Institutional** | | | | | |
| Cemeteries | 6553 | | X | L | L |
| Churches | 8661 | | X | L | L |
| Colleges and Universities | 8221-8222 | | X | L | M |
| Corporate Office Parks | | | X | L | L |
| Hospitals | 8062-8069<br>8071-8072 | | X | L | L |
| Private Golf Courses | 7997 | | X | L | L |
| Private Schools | 8211 | | X | L | L |

| Table B1: Common Storm Water Hotspots and their Pollution Potential | | | | | |
|---|---|---|---|---|---|
| **Industry Type/ General Description** | **Associated SIC Code(s)** | **Regulated Storm Water Hotspot** | **Unregulated Storm Water Hotspot** | **Illicit Discharge Potential** | |
| | | | | **Direct** | **Indirect** |
| **Municipal** | | | | | |
| Composting Facilities | 2875 | X | | L | L |
| Public Golf Courses | 7992 | | X | L | L |
| Landfills and Hazardous Waste Material Disposal | 4953, HZ, LF | X | | L | H |
| Local Streets | | MS4 | X | L | H |
| Maintenance Depots | 4173 | MS4 | | M | H |
| Municipal Fleet Washing | 4100 | MS4 | | L | M |
| Public Works Yards | | MS4 | | M | H |
| Steam Electric Plants | SE | X | | L | L |
| Treatment Works | TW | X | | L | L |
| **Transport-Related** (NPDES regulation is for the portion of the facility dedicated to vehicle maintenance shops, equipment-cleaning operations, and airport deicing operations) | | | | | |
| Airports | 4581 | X | | L | M |
| Streets and Highways Construction | 1611, 1622 | | X | L | H |
| Ports | 4449, 4499 | X | | L | H |
| Railroads | 4011, 4013 | X | | L | H |
| Rental Car Lots | 7513-7519 | X | | L | M |
| US Postal Service | 4311 | X | | L | M |
| Trucking Companies and Distribution Centers | 4212-4215, 4231 | X | | L | M |
| Petroleum Bulk Stations or Terminals | 5171 | X | | L | H |

| Table B2: SIC Codes for NPDES Industrial Storm Water Regulated Facilities | |
|---|---|
| **A. Timber Products** | |
| 2411 | Log Storage and Handling |
| 2421 | General Sawmills and Planning Mills |
| 2426 | Hardwood Dimension and Flooring Mills |
| 2429 | Special Product Sawmills, Not Elsewhere Classified |
| 2431–2439 | Millwork, Veneer, Plywood, and Structural Wood (except 2434) |
| 2448, 2449 | Wood Containers |
| 2451, 2452 | Wood Buildings and Mobile Homes |
| 2491 | Wood Preserving |
| 2493 | Reconstituted Wood Products |
| 2499 | Wood Products, Not Elsewhere Classified |
| **B. Paper and Allied Products Manufacturing** | |
| 2611 | Pulp Mills |
| 2621 | Paper Mills |
| 2631 | Paperboard Mills |
| 2652–2657 | Paperboard Containers and Boxes |
| 2671–2679 | Converted Paper and Paperboard Products, Except Containers and Boxes |
| **C. Chemical and Allied Products Manufacturing** | |
| 2812–2819 | Industrial Inorganic Chemicals |
| 2821–2824 | Plastics Materials and Synthetic Resins, Synthetic Rubber, Cellulosic and Other Manmade Fibers Except Glass |
| 2833–2836 | Medicinal chemicals and botanical products; pharmaceutical preparations; in-vitro and in-vivo diagnostic substances; biological products, except diagnostic substances |
| 2841–2844 | Soaps, Detergents, Cleaning Preparations; Perfumes, Cosmetics, Other Toilet Preparations |
| 2851 | Paints, Varnishes, Lacquers, Enamels, and Allied Products |
| 2861–2869 | Industrial Organic Chemicals |
| 2873–2879 | Agricultural Chemicals, Including Facilities that Make Fertilizer Solely from Leather Scraps and Leather Dust |
| 2891–2899 | Miscellaneous Chemical Products |
| 3952 (limited to list) | Inks and Paints, Including China Painting Enamels, India Ink, Drawing Ink, Platinum Paints for Burnt Wood or Leather Work, Paints for China Painting, Artist's Paints and Watercolors |
| **D. Asphalt Paving and Roofing Materials Manufacturers and Lubricant Manufacturers.** | |
| 2951, 2952 | Asphalt Paving and Roofing Materials |
| 2992, 2999 | Miscellaneous Products of Petroleum and Coal |
| **E. Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing** | |
| 3211 | Flat Glass |
| 3221, 3229 | Glass and Glassware, Pressed or Blown |
| 3231 | Glass Products Made of Purchased Glass |
| 3241 | Hydraulic Cement |
| 3251-3259 | Structural Clay Products |
| 3261-3269 | Pottery and Related Products |
| 3271-3275 | Concrete, Gypsum and Plaster Products |
| 3281 | Cut Stone and Stone Products |
| 3291–3292 | Abrasive and Asbestos Products |
| 3295 | Minerals and Earth's, Ground, or Otherwise Treated |
| 3296 | Mineral Wool |
| 3297 | Non-Clay Refractories |
| 3299 | Nonmetallic Mineral Products, Not Elsewhere Classified |

| Table B2: SIC Codes for NPDES Industrial Storm Water Regulated Facilities | |
|---|---|
| **F. Primary Metals** | |
| 3312–3317 | Steel Works, Blast Furnaces, and Rolling and Finishing Mills |
| 3321–3325 | Iron and Steel Foundries |
| 3331–3339 | Primary Smelting and Refining of Nonferrous Metals |
| 3341 | Secondary Smelting and Refining of Nonferrous Metals |
| 3351–3357 | Rolling, Drawing, and Extruding of Nonferrous Metals |
| 3363–3369 | Nonferrous Foundries (Castings) |
| 3398, 3399 | Miscellaneous Primary Metal Products |
| **G. Metal Mining (Ore Mining and Dressing)** | |
| 1011 | Iron Ores |
| 1021 | Copper Ores |
| 1031 | Lead and Zinc Ores |
| 1041, 1044 | Gold and Silver Ores |
| 1061 | Ferroalloy Ores, Except Vanadium |
| 1081 | Metal Mining Services |
| 1094, 1099 | Miscellaneous Metal Ores |
| **H. Coal Mines and Coal Mining-Related Facilities** | |
| 1221–1241 | Coal Mines and Coal Mining-Related Facilities Sector |
| **I. Oil and Gas Extraction and Refining** | |
| 1311 | Crude Petroleum and Natural Gas |
| 1321 | Natural Gas Liquids |
| 1381–1389 | Oil and Gas Field Services |
| 2911 | Petroleum refining |
| **J. Mineral Mining and Dressing** | |
| 1411 | Dimension Stone |
| 1422–1429. | Crushed and Broken Stone, Including Rip Rap |
| 1481 | Nonmetallic Minerals, Except Fuels |
| 1442, 1446. | Sand and Gravel |
| 1455, 1459 | Clay, Ceramic, and Refractory Materials |
| 1474–1479 | Chemical and Fertilizer Mineral Mining |
| 1499 | Miscellaneous Nonmetallic Minerals, Except Fuels |
| **K. Hazardous Waste Treatment Storage or Disposal Facilities** | |
| HZ | Hazardous Waste Treatment, Storage or Disposal |
| **L. Landfills and Land Application Sites** | |
| LF | Landfills, Land Application Sites and Open Dumps |
| **M. Automobile Salvage Yards** | |
| 5015 | Automobile Salvage Yards |
| **N. Scrap Recycling Facilities** | |
| 5093 | Scrap Recycling Facilities |
| **O. Steam Electric Generating Facilities** | |
| SE | Steam Electric Generating Facilities |
| **P. Land Transportation** | |
| 4011, 4013 | Railroad Transportation |
| 4111–4173 | Local and Highway Passenger Transportation |
| 4212–4231 | Motor Freight Transportation and Warehousing |
| 4311 | United States Postal Service |
| 5171 | Petroleum Bulk Stations and Terminals |
| **Q. Water Transportation** | |
| 4412–4499 | Water Transportation |
| **R. Ship and Boat Building or Repairing Yards** | |
| 3731, 3732 | Ship and Boat Building or Repairing Yards |
| **S. Air Transportation Facilities** | |
| 4512–4581 | Air Transportation Facilities |

| Table B2: SIC Codes for NPDES Industrial Storm Water Regulated Facilities | |
|---|---|
| **T. Treatment Works** | |
| TW | Treatment Works |
| **U. Food and Kindred Products** | |
| 2011–2015<br>2021–2026<br>2032<br>2041–2048<br>2051–2053<br>2061–2068<br>2074–2079<br>2082–2087<br>2091–2099<br>2111–2141 | Meat Products<br>Dairy Products<br>Canned, Frozen and Preserved Fruits, Vegetables and Food Specialties.<br>Grain Mill Products<br>Bakery Products<br>Sugar and Confectionery Products<br>Fats and Oils<br>Beverages<br>Miscellaneous Food Preparations and Kindred Products<br>Tobacco Products |
| **V. Textile Mills, Apparel, and Other Fabric Product Manufacturing** | |
| 2211–2299<br>2311–2399<br>3131–3199 | Textile Mill Products<br>Apparel and Other Finished Products Made From Fabrics and Similar Materials<br>Leather Products (except 3111) |
| **W. Furniture and Fixtures** | |
| 2511–2599<br>2434 | Furniture and Fixtures<br>Wood Kitchen Cabinets |
| **X. Printing and Publishing** | |
| 2711–2796 | Printing, Publishing and Allied Industries |
| **Y. Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries** | |
| 3011<br>3021<br>3052, 3053<br>3061, 3069<br>3081–3089<br>3931<br>3942–3949<br>3951–3955<br>3961, 3965<br><br>3991–3999 | Tires and Inner Tubes<br>Rubber and Plastics Footwear<br>Gaskets, Packing, and Sealing Devices and Rubber and Plastics Hose and Belting.<br>Fabricated Rubber Products, Not Elsewhere Classified<br>Miscellaneous Plastics Products<br>Musical Instruments<br>Dolls, Toys, Games and Sporting and Athletic Goods<br>Pens, Pencils, and Other Artists' Materials. (except 3952)<br>Costume Jewelry and Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal<br>Miscellaneous Manufacturing Industries. |
| **Z. Leather Tanning and Finishing** | |
| 3111 | Leather Tanning and Finishing. |
| **AA. Fabricated Metal Products** | |
| 3411–3499<br><br>3911–3915<br>3479 | Fabricated Metal Products, Except Machinery and Transportation Equipment and Cutting, Engraving and Allied Services<br>Jewelry, Silverware, and Plated Ware<br>Coating, Engraving, and Allied Services |
| **BB. Transportation Equipment, Industrial or Commercial Machinery** | |
| 3511–3599<br>3711–3799 | Industrial and Commercial Machinery (except 3571–3579)<br>Transportation Equipment (except 3731, 3732) |
| **CC. Electronic, Electrical, Photographic and Optical Goods** | |
| 3612–3699 3812–3873<br><br>3571–3579 | Electronic, Electrical Equipment and Components, Except Computer Equipment<br>Measuring, Analyzing and Controlling Instrument, Photographic/Optical Goods, Watches/Clocks<br>Computer and Office Equipment |
| **DD. Construction** (based on land disturbing activities) | |
| 1521-1542<br>1611-1629 | Building Construction General Contractors And Operative Builders<br>Heavy Construction Other Than Building Construction Contractors |

## References

Duke, D., K Patel, and B. Masek. 1999. Widespread Failure to Comply with U.S. Storm Water Regulations for Industry-Part I: Publicly Available Data to Estimate Number of Potentially Regulated Facilities. Environmental Engineering Science, Volume 16, Number 4.

Duke, D and K. Shaver. 1999. Widespread Failure to Comply with U.S. Storm Water Regulations for Industry-Part II: Facility-Level Evaluations to Estimate Number of Regulated Facilities. Environmental Engineering Science, Volume 16, Number 4.

Final Reissuance of National Pollutant Discharge Elimination System (NPDES) Storm Water Multi-Sector General Permit for Industrial Activities. 65 Federal Register 210 (Monday, October 30, 2000), pp.64746-64799.

Pitt, R. 1993. Investigation of Inappropriate Pollutant Entries Into Storm Drain Systems. EPA, Office of Research and Development, Washington, DC. EPA/600/R-92/238.

# Appendix C: Hotspot Field Identification Sheet

# HOTSPOT FIELD IDENTIFICATION SHEET

## Commercial

Animal Care Services
  Racetracks, kennels, fenced pens, veterinarians and businesses that provide boarding services for animals including horses, dogs, and cats
Auto Repair
Automobile Parking
Building Materials
Campgrounds/RV parks
Car Dealers
Car Washes
Commercial Laundry/Dry Cleaning
Convenience Stores
Equipment Repair
Gasoline Stations
Grocery Stores
Food and Beverage Wholesalers
Construction Equipment Rental and Leasing
Building and Heavy Construction
Marinas
Nurseries and garden centers
Oil Change Shops
Restaurants
Swimming Pools
Warehouses
Wholesalers of Chemicals and Petroleum

## Industrial

Apparel and Other Fabrics
Beverages and Brewing
Boat Building and Repair
Chemical Manufacturing
  Manufacturers of chemicals such as acids, alkalis, inks, chlorine, industrial gases, pigments, fibers and plastics, synthetic rubber, soaps and cleaners, pharmaceuticals, cosmetics, paints, varnishes, resins, photographic materials, chemicals, organic chemicals, agricultural chemicals, adhesives, sealants, and ink.
Food Processing
  Meat packing plants, poultry slaughtering and processing, sausage and prepared meats, dairy products, preserved fruits and vegetables, flour, bakery products, sugar and confectioneries, vegetable and animal oils, canned, frozen or fresh fish, snack foods, and manufactured ice
Garbage Truck Wash-out Activities
Equipment
  Engines and turbines, farm and garden equipment, construction and mining machinery, metal working machinery, computers and office equipment, automatic vending machines, refrigeration and heating equipment, etc.
Heavy Manufacturing
Metal Production, Plating and Engraving Operations
Paper and Wood Products
Petroleum Storage and Refining
  Gasoline, kerosene, distillate and residual oils, lubricants, and asphalt paving and roofing materials
Printing

## Institutional

Cemeteries
Churches
Colleges and Universities
Corporate Office Parks
Hospitals
Private Golf Courses
Private Schools

## Municipal

Composting Facilities
Public Golf Courses
Landfills/Hazardous Waste Material Disposal
Local Streets
Maintenance Depots
Municipal Fleet Washing
Public Works Yards
Steam Electric Plants
Treatment Works

## Transport-Related

Airports
Streets and Highways Construction
Ports
Railroads
Rental Car Lots
US Postal Service
Trucking Companies and Distribution Centers
Petroleum Bulk Stations or Terminals