INTERNATIONAL STORMWATER BMP DATABASE
www.bmpdatabase.org

International Stormwater Best Management Practices (BMP) Database

User's Guide for Urban Stormwater BMP Data Entry Spreadsheets

Prepared by
Wright Water Engineers, Inc.
Geosyntec Consultants

Under Support From
Water Research Foundation
Federal Highway Administration
Environment and Water Resources Institute of the American Society of Civil Engineers
U.S. Environmental Protection Agency
American Public Works Association

Release Version 4.0

December 2019

THE Water Research FOUNDATION

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For more information, contact:
The Water Research Foundation

Alexandria, VA Office
1199 North Fairfax Street, Suite 900
Alexandria, VA 22314-1445
Tel: 571.384.2100
www.werf.org
werf@werf.org

Denver, CO Office
6666 West Quincy Avenue
Denver, Colorado 80235-3098
Tel: 303.347.6100
www.waterrf.org
Info@WaterRF.org

WRF Project Number: 4968

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Disclaimer

The BMP Database ("Database") was developed as an account of work sponsored by the Water Research Foundation (WRF), the American Society of Civil Engineers (ASCE)/Environmental and Water Resources Institute (EWRI), the American Public Works Association (APWA), the Federal Highway Administration (FHWA), and U.S. Environmental Protection Agency (USEPA) (collectively, the "Sponsors"). The Database is intended to provide a consistent and scientifically defensible set of data on Best Management Practice ("BMP") designs and related performance. Although the individuals who completed the work on behalf of the Sponsors ("Project Team") made an extensive effort to assess the quality of the data entered for consistency and accuracy, the Database information and/or any analysis results are provided on an "AS-IS" basis and use of the Database, the data information, or any apparatus, method, or process disclosed in the Database is at the user's sole risk. The Sponsors and the Project Team disclaim all warranties and/or conditions of any kind, express or implied, including, but not limited to any warranties or conditions of title, non-infringement of a third party's intellectual property, merchantability, satisfactory quality, or fitness for a particular purpose. The Project Team does not warrant that the functions contained in the Database will meet the user's requirements or that the operation of the Database will be uninterrupted or error free, or that any defects in the Database will be corrected.

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The Project Team's tasks have not included, and will not include in the future, recommendations of one BMP type over another. However, the Project Team's tasks have included reporting on the performance characteristics of BMPs based upon the entered data and information in the Database, including peer reviewed performance assessment techniques. Use of this information by the public or private sector is beyond the Project Team's influence or control. The intended purpose of the Database is to provide a data exchange tool that permits characterization of BMPs solely upon their measured performance using consistent protocols for measurements and reporting information.

The Project Team does not endorse any BMP over another and any assessments of performance by others should not be interpreted or reported as the recommendations of the Project Team or the Sponsors.

Acknowledgments

Research Team

Principal Investigators:
Jane Clary
Wright Water Engineers, Inc.

Marc Leisenring, P.E.
Geosyntec Consultants

Project Team:
Jane Clary, Jonathan Jones, P.E., D.WRE, Andrew Earles, Ph.D., P.E., D.WRE
Wright Water Engineers, Inc.

Marc Leisenring, P.E., Paul Hobson, P.E., Dan Pankani, P.E., and Eric Strecker, P.E.
Geosyntec Consultants

WRF Project Subcommittee Reviewers (2019)

Henry Barbaro
Massachusetts Highway Department

Michael E. Barrett, Ph.D., P.E., D. WRE
University of Texas

Gregory E. Granato
U.S. Geological Survey

Lisa Biddle and Jason T. Bernagros (Berner)
U.S. Environmental Protection Agency

Tracy Tackett, P.E.
Seattle Public Utilities

Bridget Wadzuk, P.E., Ph.D.
Villanova University

Water Research Foundation Staff

John Albert, MPA
Chief Research Officer

Harry Zhang, Ph.D., P.E.
Program Director

Additional Acknowledgments

Original Principal Investigators:
Jonathan Jones, P. E., Wright Water Engineers, Inc.
Eric Strecker, P.E., Geosyntec Consultants
Ben Urbonas, P.E., Urban Drainage and Flood Control District, Denver, CO (retired)

Additional Advisors and Sponsors:

This BMP Database was originally developed as a result of the vision and support of the Urban Water Resources Research Council (UWRRC) of EWRI-ASCE in cooperation with the USEPA Office of Water, Washington, D.C., with Eric Strassler serving as USEPA Project Officer and Carol Bowers serving as ASCE Project Manager. The Project Team gratefully acknowledges the UWRRC of EWRI-ASCE, including many participants who have provided input, review and shared data over the course of this long-term project. Since 1996, the BMP Database project has benefited from the peer review, leadership and contributions of many individuals and organizations. Former project steering committee members have included Patricia A. Cazenas, Office of Natural and Human Environment, Federal Highway Administration (FHWA); Colene Roberts, American Public Works Association (APWA); Brian Parsons, P.E., Environmental and Water Resources Institute of American Society of Civil Engineers (EWRI-ASCE); Eric Strassler, Office of Water/Office of Science & Technology, U.S. Environmental Protection Agency (USEPA). Former project subcommittee members include David R. Graves, Environmental Analysis Bureau, New York State Dept. of Transportation; Jesse Pritts, P.E., Engineering and Analysis Division Office of Water/Office of Science & Technology, USEPA; Charles Rowney, P.Eng., Ph.D., ACR Consulting; and Shaw L. Yu, P.E., Ph.D., Environmental Engineering Department of Civil Engineering, The University of Virginia. Other contributors and advisors include. John O'Brien served as Software Engineer for the BMP Database Project, 1999 - 2008 Releases. Ken Mackenzie, P.E., Urban Drainage and Flood Control District, Denver, CO granted permission to use graphics from the Urban Storm Drainage Criteria Manual, Volume 3, to support this User's Guide.

2008-2009 Expert Advisors: The 2008 Expert Panel Advisors regarding Integration of Low Impact Development (LID) Practices included Richard Horner, Ph.D.; University of Washington; William Hunt, P.E., Ph.D.; North Carolina State University; Robert Pitt, P.E., Ph.D.; University of Alabama; Robert Roseen, P.E. Ph.D., University of New Hampshire; Robert Traver, P.E., Ph.D., Villanova University; and Ben Urbonas, P.E., Urban Water Resources Research Institute.

2019 Manufactured Treatment Device Expert Advisors: Derek Berg, Contech, SWEMA Chairman, WEF STEPP Committee; Jim Lenhart, Contech, WEF STEPP Committee and EWRI Urban Water Resources Research Council Past President; Jay Holz, Oldcastle; Brian Rustia, ADS/Baysaver; Laddie Formelius, Bio Clean/Forterra; Seth Brown, WEF STEPP Committee; Doug Howie, Washington State Department of Ecology TAPE Program and WEF STEPP Committee; Greg Granato, U.S. Geological Survey and BMP Database Project Advisory Committee; Jamie Houle, University of New Hampshire and WEF STEPP Committee; Carla Milesi, University of Washington and TAPE Program Support; Mike Barrett, University of Texas-Austin and BMP Database Project Advisory Committee.

2019 National Cooperative Highway Research Program (NCHRP) Expert Advisors:
Under NCHRP Project 25-25, revisions to Department of Transportation (DOT)-related reporting parameters have been integrated into this User's Guide, as part of a larger project for NCHRP. The Project Team appreciates the input and review from the following technical working group: William Fletcher, Oregon DOT (retired); Fred Noble, Florida DOT; Greg Granato, U.S. Geological Survey; Melissa Scheperle, Missouri DOT; Brandon Slone, Washington State DOT; Scott Crafton, Virginia DOT; Scott McGowen, Michael Baker International; Susan Jones, Federal Highway Administration. The overall NCHRP project was managed by Ann Hartell NCHRP Senior Program Officer.

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Introduction

This User's Guide is provided to assist researchers submitting best management practice (BMP) performance monitoring data to the International Stormwater BMP Database (BMP Database). This guide provides a general overview of the BMP Database project and the structure of the database, followed by more detailed descriptions of the information requested in the BMP Data Entry Spreadsheets (Version 4.0, December 2019).[1] These spreadsheets must be used for submissions of data to the BMP Database.

Software Requirements

Microsoft Excel is required for use of the Data Entry Spreadsheet Package

Microsoft Access (2007 or newer) is required to use the BMP Database, but is not required for use of the Data Entry Spreadsheets.

For users without an Access software license, data can be retrieved from the project website www.bmpdatabase.org.

The BMP Data Entry Spreadsheet package contains 13 spreadsheets for data entry. Data elements are categorized by relative importance for evaluating BMP performance; some data elements are "required" for evaluation of BMP performance, others are "important" but may not currently be commonly reported information, and others are supplemental and identified as "nice to have." Precipitation, flow and water quality data spreadsheets are formatted in a manner that is intended to encourage users to "cut and paste" from existing electronic documents, rather than manually entering data. For example, users are encouraged to paste water quality data from their laboratory's electronic data deliverable (EDD) formats into the water quality spreadsheet to decrease data entry time and errors.

For more information on the project, including the BMP Data Entry Spreadsheets, the master BMP Database, BMP Monitoring Manual, and BMP data analysis summaries, go to www.bmpdatabase.org.

Project Background

In the 1990's, as required by the Clean Water Act, the U.S. Environmental Protection Agency (USEPA) mandated that most municipalities in the United States with populations larger than 10,000 obtain a stormwater runoff discharge permit. One of the requirements of this permit program is the use of non-structural and structural BMPs (also known as stormwater control measures) appropriate to reduce pollutants to the Maximum Extent Practicable (MEP). In response to this program, communities need to know which types of BMPs are appropriate for them (e.g., which BMPs function best in cold climates or in areas of heavy rainfall) and how to monitor the performance of the BMPs they select to ensure they function properly. However, a centralized, easy-to-use, scientifically sound tool for assessing the appropriateness of BMPs under a variety of site conditions was lacking. In addition, BMP studies in the literature had not historically followed standardized or transferable data collection, reporting and performance evaluation protocols, making a scientific and consistent evaluation of these data difficult to impossible.

[1]The BMP Data Entry Spreadsheets replace previous releases of the database dating back to 1999. A variety of web-based data retrieval tools and data summaries are now available on-line at www.bmpdatabase.org.

In response to this problem, the International Stormwater BMP Database project (first known as the National BMP Database) began in 1996 through the efforts of a team of experts from the Urban Water Resources Research Council (UWRRC) of the American Society of Civil Engineers (ASCE) under a grant from the USEPA.

The project's original long-term goal, which remains the central focus of the project, is to gather transferable technical design and performance information to improve BMP selection and design so that local stormwater problems can be cost-effectively addressed. Original project tasks included:

1. Develop a set of recommended monitoring and reporting protocols for BMP monitoring studies.
2. Design and create a national stormwater BMP database.
3. Collect existing BMP design and performance data, evaluate it to ascertain if it could meet the protocols and, if so, enter the data into the BMP Database.
4. Develop a recommended data evaluation approach.
5. Evaluate the data entered into the database and report initial findings.

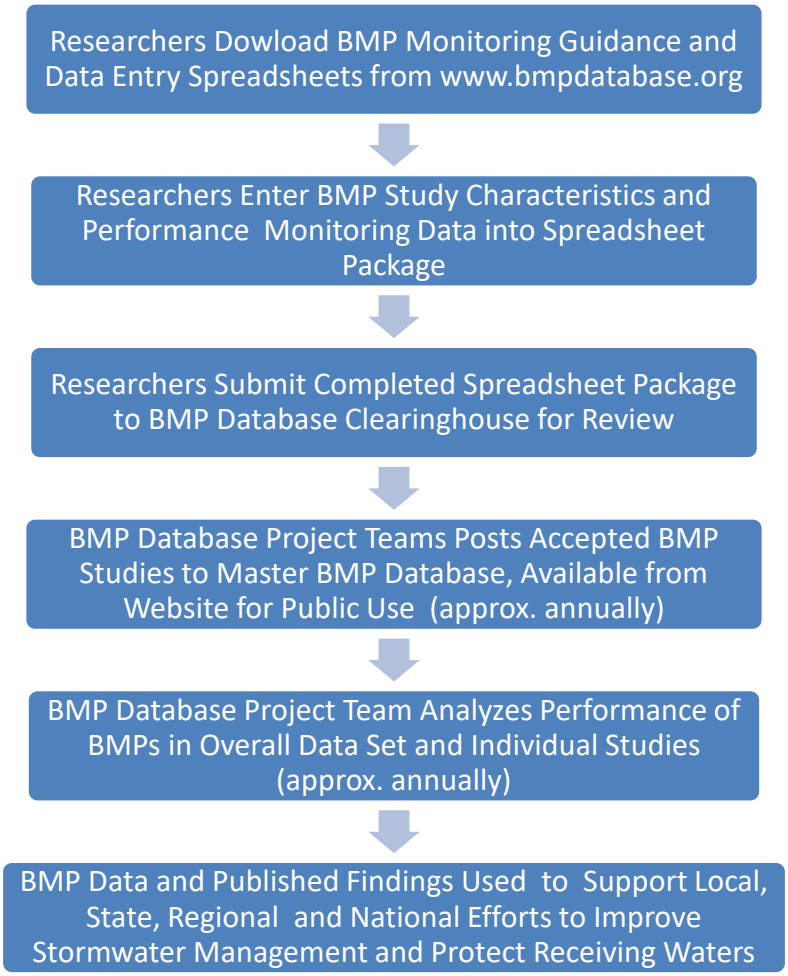
In 2004, the project transitioned from a USEPA grant-funded project to a more broadly supported coalition of partners including the Water Environment Research Foundation (now the Water Research Foundation [WRF]), ASCE Environmental and Water Resources Institute (EWRI), USEPA, Federal Highway Administration (FHWA) and the American Public Works Association (APWA). Wright Water Engineers, Inc. and Geosyntec Consultants manage the BMP Database clearinghouse, answer questions related to the project, conduct and update performance evaluations of the overall data set, and disseminate project findings. The overall project is managed by WRF with the support of an expert advisory committee.

BMP Database

The cornerstones of the project are the BMP monitoring and reporting protocols and the BMP Database itself, which were developed based on the input and intensive review of many experts for the purpose of developing standardized reporting parameters necessary for more accurate BMP performance analysis. The BMP Database encompasses a broad range of study metadata including test site and watershed characteristics, BMP design and layout characteristics, monitoring instrumentation, and monitoring data for precipitation, flow and water quality.

The BMP Database contains hundreds of BMP studies and can be searched on-line or downloaded from the project website. The website also enables dynamic statistical analysis of the BMP performance monitoring data. The Project Team reviews data submissions prior to accepting the studies for inclusion in the Database. The overall project operates within the framework summarized in Figure 1.

Figure 1. BMP Database Project Framework



BMP Monitoring Guidance

During the initial stages of the BMP Database project, it became clear that better guidance was needed regarding stormwater BMP monitoring, particularly if monitoring results were to be valuable to the broader technical, management, and regulatory community. In response, a companion project to the BMP Database was completed in 2002 to provide monitoring guidance to promote collection of more useful and representative data associated with BMP studies, as well as more consistent reporting of monitoring results appropriate for inclusion in the BMP Database. Since that time, both the BMP Database project and stormwater management practices have continued to evolve, prompting a second release of *Urban Stormwater BMP Performance Monitoring* (Geosyntec and WWE 2009) in 2009. This manual can be downloaded at no cost from the BMP Database website (http://www.bmpdatabase.org/MonitoringEval.htm) and is a good overall companion resource to this User's Guide.

The purposes of the updated Monitoring Manual are primarily twofold:

1. Improve the state of the practice by providing and enhancing a recommended set of protocols and standards for collecting, storing, analyzing, and reporting stormwater BMP monitoring data that will lead to better understanding of the function, efficiency, and design of urban stormwater BMPs.

2. Provide monitoring guidance for "Low Impact Development" (LID) strategies at the overall site level (e.g., monitoring overall sites with multiple distributed stormwater controls).

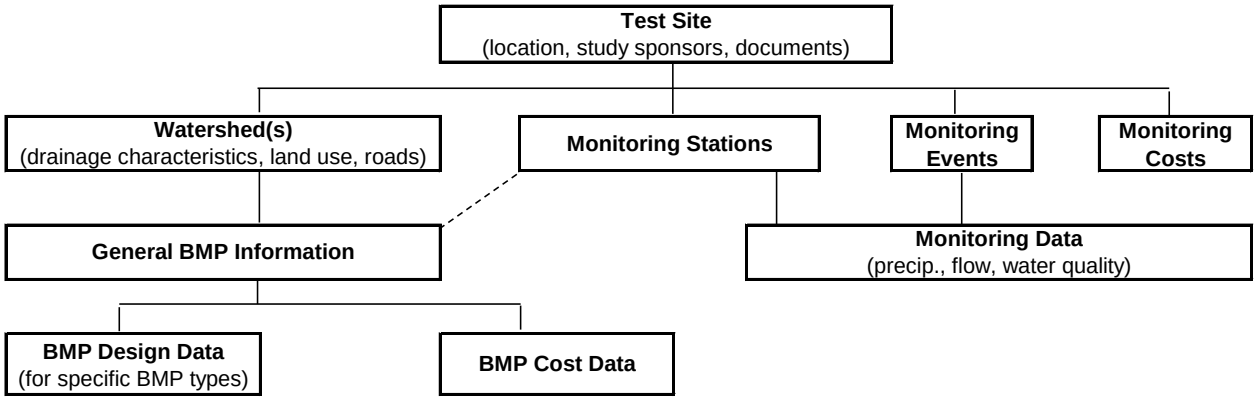
The Monitoring Manual provides guidance for all stages of BMP monitoring programs ranging from the early stages of study design to the end stages of data interpretation and reporting. Guidance is provided for monitoring a broad range of individual BMPs as well as overall site monitoring with multiple distributed BMPs (e.g., LID sites). The Monitoring Manual focuses primarily on the collection, reporting, and analysis of water quantity and quality measurements necessary for quantitative BMP performance evaluation. Detailed information is provided on multiple topics pertinent to BMP monitoring, which is not repeated in this User's Guide. Data providers are encouraged to download the BMP Monitoring Manual as a supplement to this User's Guide. Key areas of focus in the Monitoring Manual include:

1. Designing the Monitoring and Reporting Program
2. Methods and Equipment for Stormwater BMP Monitoring
3. Implementing the Monitoring Program
4. Data Management, Evaluation and Reporting of Results
5. BMP Performance Analysis
6. Low Impact Development (LID)/Distributed Controls Monitoring
7. Data Interpretation and Performance Evaluation of LID Studies
8. LID Case Studies
9. Supplemental Resources on Key Topics (Appendices), providing a summary of the BMP Data Entry Spreadsheets, a comparison of various data analysis approaches, guidance on determining required number of samples for meaningful data interpretation, guidance on error analysis, and supplemental information on statistical issues.

BMP Database Structure and Relationships to Spreadsheets

The downloadable version of the BMP Database is stored in Microsoft Access and includes multiple tables that can be linked together by key fields ("IDs") such as TestSiteID, WSID (Watershed ID), BMPID, MSID (Monitoring Station ID) and EventID. A simplified overview of the general relationships between various types of requested data is provided in Figure 2. A detailed Element-Relationship (E-R) Diagram can be downloaded separately from this User's Guide for more information and is provided in the "reports" module of the BMP Database. The online web tools associated with the project utilize a Microsoft SQL Server version of the database.[2]

Figure 2. Conceptual Overview of BMP Database



The Data Entry Spreadsheets are provided in Microsoft Excel and include 13 worksheets used to upload data to the master BMP Database. Table 1 provides corresponding Access table and Excel worksheet names.

Special Note to Providers of Multiple BMP Studies or Managers of Local BMP Databases

Please contact the BMP Database Clearinghouse prior to entering studies to the Database to determine the most efficient approach for submitting data to the BMP Database. For example, rather than entering data into the spreadsheet package, it may be more efficient to "map" an existing local or regional database to a blank version of the BMP Database in Access, which is available upon request. In some cases, providers of large data sets may choose to use the spreadsheet package for all test site, watershed and BMP design information, but choose to provide monitoring data in the form of an existing local database. Examples of providers of large data sets include state departments of transportation, regional flood control districts, state departments of environmental protection, large-scale university research programs, and others.

[2] Microsoft SQL Server is a relational database management system developed by Microsoft. As a database server, it is a software product with the primary function of storing and retrieving data as requested by other software applications—which may run either on the same computer or on another computer across a network.

Table 1. Relationship Between Excel Worksheets and Master Access/SQL Databases

Excel Worksheet Name	Access Database Table Name
BeginHere	N/A; used to set up initial site data in Excel
PART 1. Site and Study Information	
1. TestSite (*general study information*)	TestSite
2. Agency (*entities* m*onitoring and/or sponsoring study*)	Agency
3. Watershed (*tributary area metadata*)	Watershed
4. LandUse	LandUse
5. BMPInfo (*general to all BMP types*)	BMPInfo
6. BMPDesign (*specific to individual BMP types*)[1]	BMPDesign
PART 2. MONITORING STATIONS	
7. MonitoringStation	MonitoringStation
PART 3. Costs	
8. BMPCost	BMPCost
9. MonitoringCost	MonitoringCost
PART 4. MONITORING EVENTS and RESULTS	
10. Event (*establishes list of monitored events*)	Event
11. Precipitation	Precipitation
12. Flow	Flow
13. WaterQuality	WaterQuality

[1]BMP-specific design information is requested for these BMP Types: Detention (Dry) Basins, Retention (Wet) Ponds, Grass Strips, Grass Swales, Media Filters, Permeable Pavement, Infiltration Basins, Percolation Trenches/ Dry Wells, Wetland Channels, Wetland Basins, Manufactured Treatment Devices (Multiple Types), Bioretention, Green Roofs, Rainwater Harvesting, LID (Low Impact Development), Non-structural BMPs, Other BMPs, Composite BMPs (treatment train).

Brief Overview of Requested Data

In keeping with Figure 2 and Table 1, which provide an overview of the overall BMP Database structure, a brief description of each general data category in the BMP Database follows.

Test Site and Agency

The purpose of the *TestSite* data set is to identify the overall study, geographic characteristics, bibliographical information, and study abstract. Climate information is also entered at the Test Site level based on an EPA-sponsored report by Driscoll et al. (1990) titled *Analysis of Storm Event Characteristics for Selected Rainfall Gages Throughout the United States*. The user can select the closest climate station from a Climate Station Pick-list. The *Agency* table enables users to enter multiple study sponsors and monitoring agencies associated with the study.

Watershed and Land Use (Area Tributary to BMP)

The purpose of the *Watershed* table is to identify the conditions in the area tributary to the BMP. For example, watershed parameters include data elements related to tributary area, land use, soil type, imperviousness, storm drainage system efficiency, and other information. Since initial release of the Database, NCHRP, FHWA and various state departments of transportation have

taken interest in the BMP Database. As a result, additional information is now being requested for sites associated with highways and other transportation-related sites.

More than one watershed may be present at a BMP test site for studies that use a reference (i.e., Control) watershed to compare BMP performance. These study designs are generally referred to as Before-After-Control-Impact (BACI) experimental designs. This approach is often the case for LID and non-structural BMP studies that are either comparing before-after conditions in time or a control site without BMPs against a site with BMPs implemented. Additionally, studies may include data for an overall LID test site, as well as subwatershed monitoring for individual BMPs within the overall site. In such cases, multiple test watershed entries may also be needed as part of overall study submittal.

BMP Information and BMP Design

In the *BMPInfo* table, basic descriptive information is requested for all BMP types, including parameters such as type of BMP, installation date, basic design parameters related to inflow and outflow configurations, and maintenance and rehabilitation descriptions. Multiple BMPs may be entered as part of a single test site submission, provided that they have the same tributary area or are part of an overall LID site. Additionally, for sites using a reference watershed site, a "Control BMP" type must be entered as the BMP type in this table to indicate that BMPs are not in place in the comparative watershed. Data providers can also enter a "Composite BMP" type to enable performance analysis of a BMP system; however, design information must still be entered for the individual BMPs at the test site individually as well. An overview of the type of information requested for structural, nonstructural, LID sites and Composite Sites follows.

Structural BMPs

In the *BMPDesign* table, design data are requested according to the following common groups of BMPs: Detention (Dry) Basins, Retention (Wet) Ponds, Grass Strips, Grass Swales, Media Filters, Permeable Pavement, Infiltration Basins, Percolation Trenches/ Dry Wells, Wetland Channels, Wetland Basins, Manufactured Treatment Devices (Multiple Types), Bioretention, Green Roofs, Rainwater Harvesting, LID (Low Impact Development), Non-structural BMPs, Other BMPs, Composite BMPs (treatment train). The "Other" BMP category is provided to enable flexibility for entry of BMPs that may not fit a predefined category. Most of the parameters requested in the structural BMP tables are identified as "required" in order to compare the effectiveness of various BMP designs.

Non-structural BMPs

Non-structural BMP data requested in the *BMPDesign* table are generally narrative/descriptive information on the type and extent of BMP practice being implemented. Non-structural BMPs are divided into the general categories of education, maintenance, recycling and source controls. Evaluating non-structural BMP characteristics is new ground for many, and defining measurable (i.e., quantifiable) parameters for non-structural BMPs is an evolving science. When more than one non-structural BMP is employed, it can be extremely difficult, if not impossible, to isolate the effectiveness of one BMP from the effects of other non-structural BMP(s) being tested at the same site. Also, a significant amount of data is needed to discern differences in water quality results between comparable watersheds with and without non-structural BMPs. For this reason, nonstructural BMP testing programs will typically need to take place over more than one year. It is likely that confounding variables will be difficult to identify and to isolate in non-structural BMP tests.

Low Impact Development (LID) Sites

LID sites attempt to mimic pre-development site hydrologic conditions by controlling runoff close to its source. As a result, BMPs are typically dispersed throughout a development site. For studies of LID implemented at the site scale, a series of narrative descriptions on key aspects of the site are requested. Designs of individual BMP components (e.g., rain gardens, permeable pavement, grass swales) can also be entered as part of a LID site submission. The *Urban Stormwater BMP Performance Monitoring Manual* (Geosyntec and WWE 2009) provides more detailed information on monitoring LID sites.

Composite BMPs

Effective implementation of BMPs often includes a "treatment train" of practices. The Composite BMP type enables the data provider to identify the overall system in place at a site. Users must also enter design information for the individual BMPs in place at the test site, but the Composite BMP allows evaluation of performance of the overall test site, in addition to evaluation of individual system components.

Monitoring Stations

Monitoring stations must be identified for the test site as a whole, and then the relationship of each monitoring station to each BMP at the test site must be identified (e.g., inflow, outflow, rain gauge). **Proper entry of data into the *MonitoringStation* table is critical to proper analysis and retrieval of data for the test site.** For test sites that contain more than one BMP, two BMPs may share the same monitoring station (e.g., outflow from one BMP represents inflow to a downstream BMP). In such cases, the relationship of the monitoring station must be identified relative to each BMP.

Descriptive information on instruments installed at monitoring stations is also requested in the *MonitoringStation* table. Multiple instruments may be present at a single monitoring station. This information provides much insight into the flow gauging and sampling techniques used and the reliability of the data collected at the site. As a result, instrumentation reporting is encouraged for all new evaluation efforts.

Cost Information

BMP cost information is highly sought after by local governments as part of BMP selection and whole life cycle cost planning. Many researchers monitoring existing BMPs do not have access to construction and maintenance cost data, but it should be provided when available.

Additionally, the database accepts information on the cost of monitoring programs, which can be helpful to local governments with regulatory requirements to conduct BMP monitoring under stormwater permits or due to total maximum daily loads (TMDLs).

Monitored Events and Results

The purpose of the *Event* table is to develop a user-defined list of events monitored at the test site so that precipitation, flow and water quality data can easily be paired together. Monitored events are based on the start date of the storm, and users can provide comments to identify

unusual or important aspects of the storm event or other factors related monitoring during the event.

Monitoring results may include precipitation, storm runoff or base flow, and water quality data associated with a monitoring event. Monitoring results can also include particle size distribution information and sediment-related data, which can be entered in the *WaterQuality* table. Monitoring results must be reported in association with previously defined monitoring events and monitoring stations. For sites also monitoring groundwater levels, the *WaterQuality* spreadsheet can be used to enter depth to groundwater. Each data set is briefly described below.

Data Entry Tips

Double-check units of measure. (e.g., are units of volume used for volume fields? milligrams vs. micrograms properly entered?)

Provide complete water quality parameter names (e.g., orthophosphate reported "as P" or "as PO4") and be sure to specify the sample fraction (e.g., dissolved, total) where necessary.

Provide detection limits and laboratory qualifiers. Non-detected values should not be reported as "0" values; instead, provide the detection limit and a U qualifier.

Use comment fields to explain unusual data results that have been verified, but may appear to be errors or outliers to subsequent data users.

Event, Precipitation, Flow and Water Quality tables all have "flagging" fields that enable the user to specify whether the results are appropriate for analysis. Use these fields and explain anomalies in the comment fields.

Precipitation

Precipitation data such as date and time that the event began and ended, total depth and peak one-hour precipitation rate are important parameters for evaluating BMP performance. For example, a BMP may perform well for a low-intensity, short duration storm, but perform poorly for storms of longer duration. This type of information can help to explain variations in BMP performance. Particularly for LID sites and practices, precipitation data are fundamental to evaluation of BMP performance.

Flow (Runoff and Base Flow)

Documentation of flow conditions is fundamental to evaluation of BMP and site-level LID performance. Requested data include influent and effluent runoff volumes, bypassed volumes (if any) and peak flow rates. Base flow data are also requested, if present. For BMPs where volume reduction is a design objective, flow volumes are fundamental to evaluation of the BMP's or LID site's performance. Additionally, flow volumes are necessary to evaluate load reductions provided by the BMP, as well as to evaluate how the BMP performs under a range of flow conditions. For example, a BMP may perform well under small, frequently occurring storm events for which the facility is designed, but perform poorly under larger, infrequent storm events.

Water Quality

Water quality data are at the core of BMP performance evaluations with regard to characterizing effluent quality achievable by various BMPs, quality of runoff relative to receiving water criteria and objectives, and evaluation of pollutant load reductions. The water quality data entry format in the 2010 release of the spreadsheets has been updated to be compatible with many Electronic Data Deliverable (EDD) formats. The spreadsheet data entry approach enables pasting of EDDs into the BMP Database, thereby reducing the likelihood of data entry errors.

Particle size distribution data, which are important to evaluating the performance of many BMP types, can be entered into the *WaterQuality* table.

Description of Data Priority Codes

In order to enable meaningful analysis of BMP data, a fairly large amount of information is requested in the spreadsheet package. These data requests are prioritized as "required," "important, but not required" or "nice to have," described as follows:

- **Required**: "Required" data are necessary for proper evaluation and comparison of BMP performance. If these data are not provided, then the BMP study may either be rejected from inclusion in the BMP Database or excluded from certain types of analysis.
- **Important**: "Important" data are also necessary for proper evaluation and comparison of BMP data. If these data are currently unavailable, they should be collected in future monitoring efforts. Many of the watershed data elements fall into this category.
- **Nice to have**: "Nice to have" fields provide data that are useful in BMP evaluation but not essential for BMP evaluation. For example, "comments" and cost data are considered nice to have.
- **Variable**: "Variable" fields identify data sets that are required for some BMP types, but not others. Data elements identified as variable are contained primarily in the *Watershed* spreadsheet. Typically, variable fields are required for LID/infiltration-oriented practices and identified as important or nice-to-have for other BMP types.

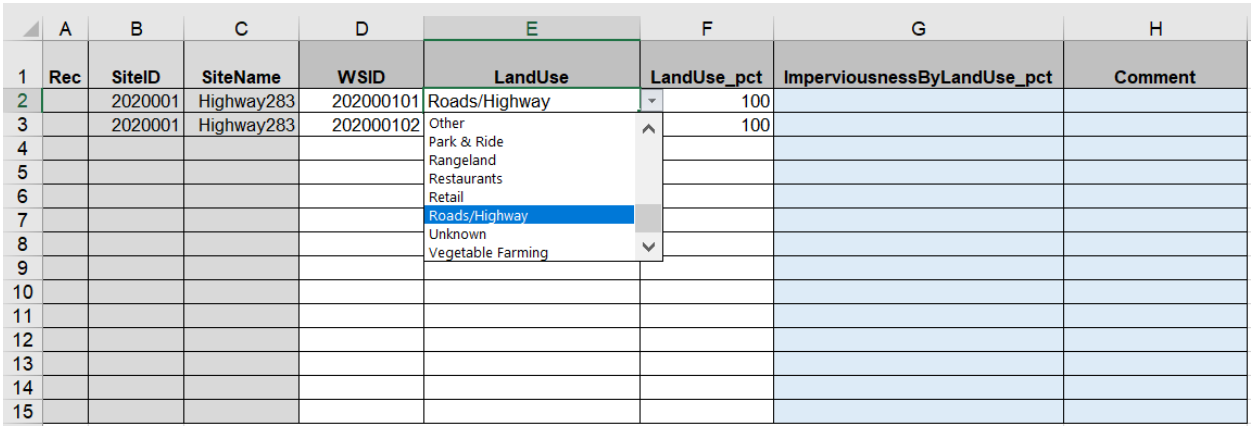
Tip: Use of Comments Fields

Most spreadsheets in the BMP Data Entry package have Comments fields, where the user can provide a descriptive narrative. Users are encouraged to use the comments fields, even though these fields are "nice to have" (optional). Providing simple comments can help to ensure that future users of the data correctly understand the BMP site design, watershed conditions and monitoring data.

Pick-lists

Some fields in the Excel workbook require that entries conform to pre-established "pick-lists". The pick-lists are provided in dropdown boxes on the individual spreadsheets (Figure 3). (In the master BMP Database itself, pick-lists are provided in tables identified by a "tbl" prefix.) When a pick-list is provided, the data provider is not required to manually select a value from the dropdown box, provided that the information entered is a value listed in the pick-list. If the entry is not consistent with the options in the pick-list, then the user will receive an error message. As an example, for the monitoring data spreadsheets, the user must select previously defined monitoring event numbers and monitoring station names from dropdown pick-lists; however, the user can also paste or type in these values, provided that they exist in the pick-list.

Figure 3. Example Pick-list in a Dropdown Box in the Land Use Data Entry Spreadsheet



Although a variety of units may be entered into the data entry spreadsheets, the master Database will convert entries to SI units. Data providers are requested to provide unit conversions prior to submittal of data to the BMP Database. A variety of on-line unit conversion tools are publicly available (e.g., http://www.onlineconversion.com/) to aid data providers in this process.

Attribute Naming Conventions

In the data entry Excel spreadsheets, Access and SQL databases, consistent naming conventions have been followed to facilitate data uploads among the various software formats. In the remainder of this User's Guide, the naming convention used in the software is introduced first followed by a description of the attribute. The naming convention generally follows guidelines illustrated by these examples:

- SiteName means "Site Name"—instead of a space between words, a capital letter is used to indicate a new word.
- OverlandFlowLength_**Avg** means the "Average Overland Flow Length"—an abbreviation for the statistical measure associated with a quantitative value is provided at the end of the attribute name separated by an underscore. Statistical abbreviations include avg (average), pct (percentage), nbr (number) and others.
- Roads_**Descr** means "Road Description"—attributes that provide descriptive (narrative) information include an underscore followed by Descr.
- **DOT**_RoadType indicates that the attribute is of specific interest to departments of transportation (DOTs). (Multiple DOT-flagged parameters were added to the BMP Database in 2019.)
- **Has**CurbGutter indicates a yes/no question related to the presence of a specific feature. If the feature is present, then the desired entry is yes. If the feature is not present, then the answer is no. Unknown is also an option.
- DOT_**flag** indicates that the attribute is used to flag certain types of data used to set query conditions either by the on-line BMP Database analysis tools or in user-created queries.

Flags may be yes/no answers or other values from pick-lists, depending on the particular attribute.

- Area_**unit** indicates the unit of measurement associated with a numeric value. Units of measurement should not be entered in numeric value fields; instead, they must be entered in a separate unit field.

Begin Here: Site Setup

The first worksheet in the data entry workbook (Figure 4) sets up the study in terms of the user-assigned site name (SiteName), the watershed names (WSName), and the BMPs (BMPName) included in the study. Additionally, unique identification numbers are assigned to each feature and used throughout the data entry to enable linkage of study information in the relational database after upload.

SiteName is the name that the site is known by locally (e.g., Shop Creek, First Bank). A test site is a unique geographic location where a BMP testing effort has been conducted. The site may contain more than one BMP, but ONLY if the watersheds tributary to these BMPs are virtually identical. In cases where several BMPs are located in the same general vicinity, new test sites should be identified whenever the tributary watersheds for the BMPs differ by more than five percent in area, even if the BMPs are in series. An exception to this general rule would be LID sites where distributed controls are present throughout a test site area.

WSName is the name of the area tributary to the BMP (watershed name). Most sites will have one watershed unless the study design includes a BACI (Before-After, Control-Impact) type study design for a non-structural BMP or a LID site. For purposes of these data entry spreadsheets, the term "watershed" refers only to the area tributary to the BMP or LID site, not the watershed as a whole. For studies that are conducted over time, if watershed conditions have changed significantly over time (e.g., land use changed from agricultural to commercial) at the test site, set-up a separate test site to enter data collected since the time that the watershed changed.

BMPName is the name of the BMP being studied as it is known by the data provider (e.g., Shop Creek's Bioswale, Detention Basin at First Bank). BMP identifiers entered into the database should be consistent with those used in published reports and/or the underlying researcher's database.

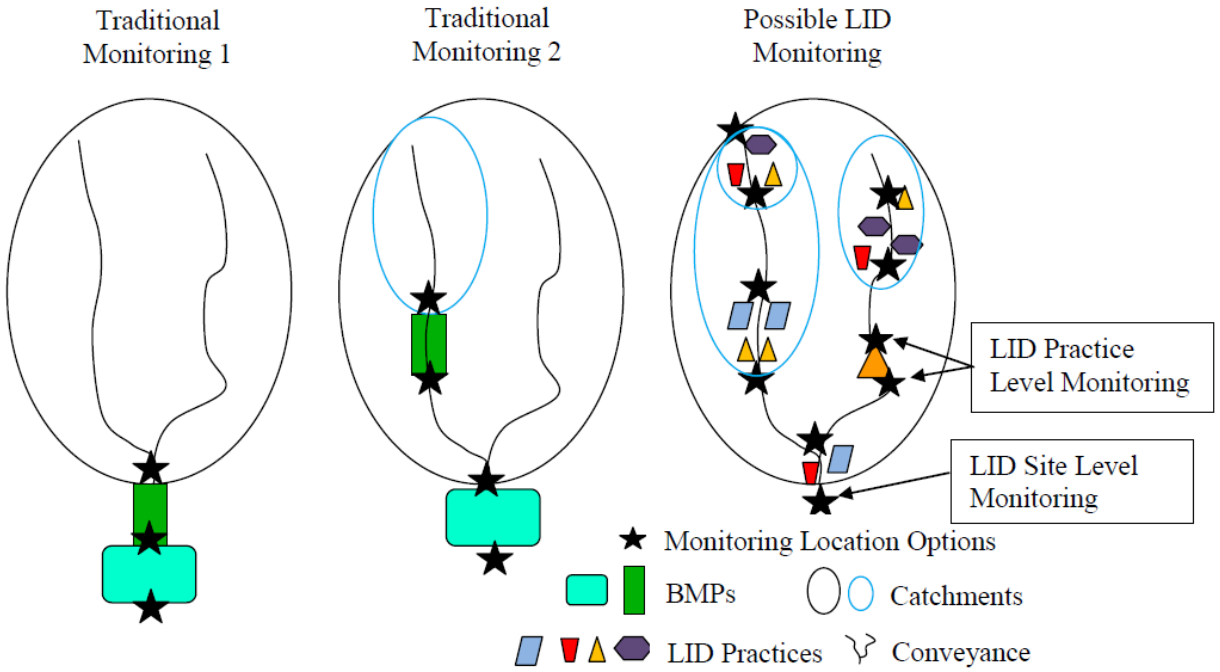
Figure 4. Example Begin-Here Worksheet Establishing Study Features

Set Up Site for Data Entry	
SiteName	SiteID
Highway283	2020001
WatershedName (list in alphanumeric order)	WatershedID
1PreBMP	202000101
2PostBMP	202000102
	202000103
	202000104
	202000105
BMPName (list in alphanumeric order)	BMPID
1FilterStrip	20200010101
2Swale	20200010102
3MediaFilter	20200010103
4Control	20200010104
5CompositeSystem	20200010105
	20200010106
	20200010107
	20200010108
	20200010109
	20200010110

Part 1. General Site Metadata and Study Information

The *TestSite* spreadsheet request information on test site location, location information, and documents associated with the study or test site. Only one test site is allowed per workbook, although the single test site may include multiple BMPs if the tributary watersheds to the BMPs are approximately the same, as shown in "Traditional Monitoring 1" in Figure 5. For "Traditional Monitoring 2" in Figure 5, where the watershed areas between the two BMPs differ significantly (e.g., 50 versus 100 acres), separate test sites would be created, even though the BMPs are in series. In the "Possible LID Monitoring" sketch in Figure 5, the study would be entered as one test site. For large data providers, please contact the BMP Database Clearinghouse in advance to determine the most efficient manner to enter multiple BMP sites.

Figure 5. Test Site Definition Example



Test Site

The purpose of the *TestSite* data is to identify the general study location and related information. The location information is important for a variety of reasons. For example, it enables recognition of the types of conditions under which the BMP test is conducted (e.g., Seattle = lots of low intensity rain much of the year, Phoenix = few high intensity storms). This information also enables interface with other EPA databases. Data requested as part of the *TestSite* spreadsheet are described below**. All test site information is required, unless otherwise noted.**

SiteID [Auto-populated from BeginHere worksheet]

SiteName [Auto-populated from BeginHere worksheet]

City closest to the test site. The site does not have to be within the city limits.

County in which test site is located. This information is nice to have.

State is the U.S. state where test was performed (2 characters). If outside of the U.S., enter ZZ.

ZipCode is the postal code for the test site. This is important information.

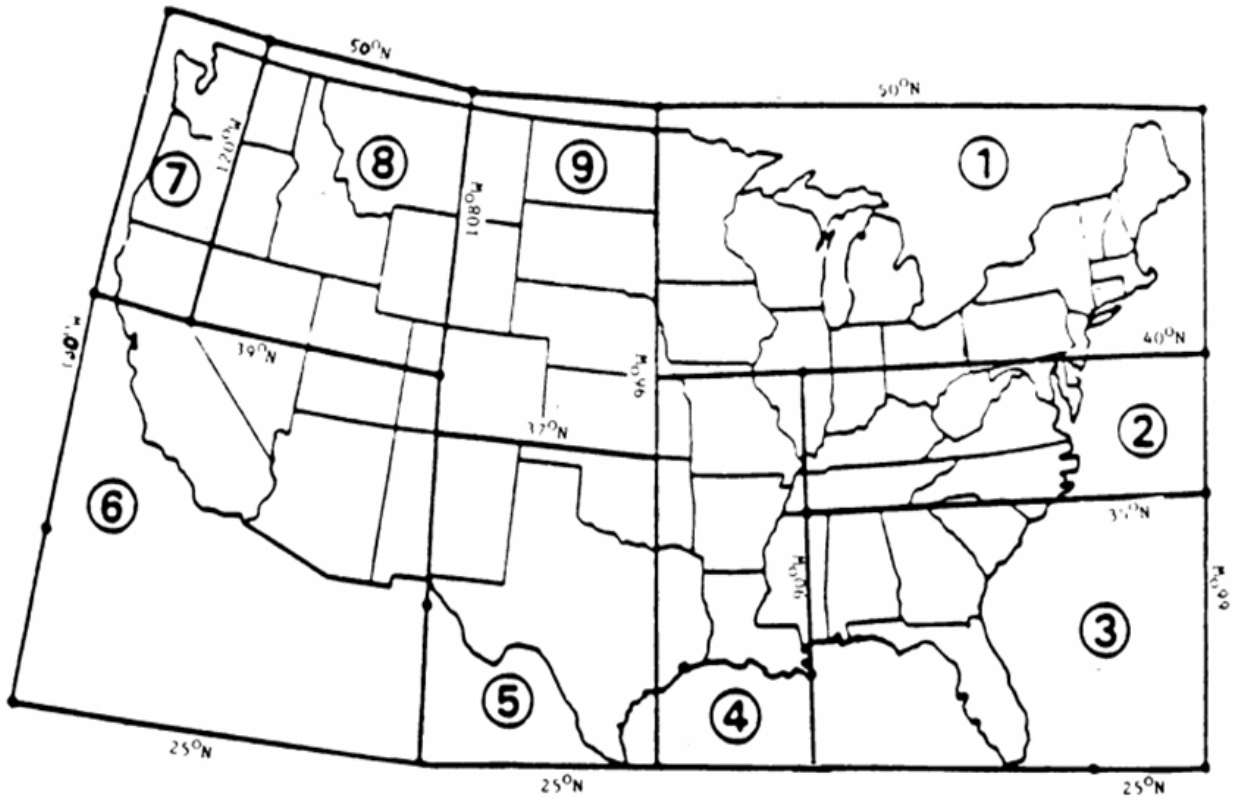
Country is the country where the test site is located. Enter a two-character country code (e.g., use US for the United States).

Latitude is the decimal latitude at approximate midpoint of the project. For large areas, the approximate centroid of the Study Area can be used. Mapping software and services such as Google Earth or the USGS National Map (https://viewer.nationalmap.gov/advanced-viewer/) can be used to obtain the approximate latitude and longitude. In Google Earth, you can zoom into the site location and right-clicking the mouse and selecting "What's Here?" For an online conversion tool from minutes, seconds, degrees, see https://www.fcc.gov/media/radio/dms-decimal. On the USGS National Map Viewer, the latitude and longitude of the cursor is continuously displayed and updated as the user hovers over the map.

Longitude is the decimal longitude at approximate midpoint of project. (See notes for Latitude for additional tips.) This is required information.

EPARainZone is the numeric rain zone number corresponding to the study location based on the U.S. EPA's Rain Zone map depicting nine rain zones in the U.S. If outside the U.S., enter -9.

Figure 6. EPA Rain Zone Map



Graphic Source: NPDES Phase I regulations, 40 CFR Part 122, Appendix E (USEPA 1990)

ClimateID is the regional climate station in the United States that is most relevant to the test site. The ClimateID can be selected from the Climate Station pick-list. If an appropriate climate station is not available, then select "ZZ Not Listed" from the Dropdown list. Storm event statistics have already been calculated for these stations including the average and coefficient of variation for these parameters: number of storms, precipitation (in/yr), storm duration (hours), storm intensity (in/hr), and storm volume (in/hr). These data were taken from *Analysis of Storm Event*

Characteristics for Selected Rainfall Gauges Throughout the United States by Eugene D. Driscoll, Gary E. Palhegyi, Eric W. Strecker and Philip E. Shelley, prepared for the U.S. Environmental Protection Agency, December 1989. For sites outside of the United States, this information can be developed based on the definition of an individual storm being separated by six hours or more of inter-event time. Storms that have less than 0.1 inches of total rainfall should be filtered out before calculating these statistics. For non-United States test sites, this information can be entered into the Comments field.

Elevation is the elevation above mean sea level provided to the nearest 100 feet from a U.S. Geological Survey (USGS) quadrangle map or to the nearest 30 meters for studies outside of the United States. Units of measurement must be provided with elevation entries. This is important information for sites in the United States. Google Earth and the USGS National Map Viewer (see notes on Latitude) can also provide approximate elevations.

USGSHUC8 is the USGS 8-digit hydrologic unit code (HUC) representing a geographic area containing part or all of a surface drainage basin or distinct hydrologic feature. The first two digits of the code represent the water resources region; the first four digits represent the subregion; the first six digits represent the accounting unit; and all eight digits represent the cataloguing unit. The HUC can be looked up on the EPA "Surf Your Watershed" web site at http://www.epa.gov/surf/. If the user's search response is "no results", then higher level tributary names should be tried, or other descriptors such as county name or zip code entered until a HUC is provided. This is important information for sites in the United States.

ReportURL is a user-provided weblink enabling a future user of the data set to download the original study by the data provider. This information is nice to have.

YearAdded helps track growth of the BMP Database over time and is useful to database users wanting to identify recently accepted data sets.

YearAmended helps track sites where new data are added following an initial upload. Amended data could be additional years of monitoring data at an existing site, or backfilling of design information at an existing site. This is required information, if an existing study is being amended.

DataProvider helps track the individual submitting the study for future contact purposes. The data provider may or may not correspond to the entity conducting or sponsoring the study.

ReportTitle, ReportAuthors, and **ReportYear** enable BMP Database users to go to the original underlying research for more detailed information about the BMP study. Whenever peer-reviewed journal papers are available regarding the study, identify these. In some cases, the data source may be "unpublished data" from a department of transportation or department of environmental protection database. If so, describe the underlying data source and date that information was retrieved.

Attachments to Submit with Completed Spreadsheet. Attachments provide the BMP Database users with more information about the BMP study and provide the Clearinghouse with background information needed to verify information about the study. In the spreadsheet, enter Yes (Y) or No (N) to identify whether various attachments have been provided with the study submittal.

Photos and Site Layouts

Site layouts and photos of the BMP and test site should be attached as separate files (e.g., jpg) when submitting a study to the BMP Database. These attachments become accessible to future database users through a table named PhotoLayout. This table provides hyperlinks to the project website where these graphic files are stored for each BMP.

- **ReportIsAttached** enables future BMP Database users/researchers to access more detailed information on the study. These should be provided in PDF format. This information is important.

- **PhotoIsAttached** enables future BMP Database users/researchers to develop a visual image of the BMP. Photos should be provided in "jpg" format.

- **BMPLayoutIsAttached** enables future BMP Database users to develop a clear understanding of the BMP. Drawings of the BMP and/or site layout in plan, profile and layout view are requested. These drawings must be "saved down" to a "jpg" format.

- **QAPPSAPIsAttached** are Quality Assurance Project Plans and Sampling and Analysis Plans that are often developed as part of monitoring efforts. Attaching a PDF of these plans enables future BMP Database users to assess the quality of the data and study design. Although this information is not currently provided on-line to BMP Database users, it is archived by the Project Team and is available upon request for Database users. This information is nice to have.

Abstract enables the data provider to paste a previously developed abstract into the spreadsheet or to create a study abstract for use by future BMP Database users. If an abstract is not available, then the user should provide a few sentences describing the study.

DOT_flag (Y/N) flags the site as associated with a department of transportation study.

Comment field is encouraged to provide a general overview of the study and to identify any concerns or limitations associated with usage of data from the study. Comments are considered nice to have.

Agency

The purpose of this spreadsheet is to provide contact information for the entity(ies) sponsoring the BMP test and the entity(ies) actually conducting the test. For example, EPA may be sponsoring the test by providing funding, while a private firm may be actually conducting the test. All address lines may not be necessary for an entity. For example, there may be no department name and only one address line may be necessary. Multiple entries are allowed for each test site. **All Agency information is required, unless otherwise noted.**

Specific data requested include:

Rec [Record Number auto-populated at time of upload]

SiteID [Auto-populated]

SiteName [Auto-populated]

AgencyName identifies the entities sponsoring and/or monitoring the study.

AgencyRole should be selected from the provided pick-list to identify whether the agency monitored, sponsored or both monitored/sponsored the study. Multiple entities may be involved with a BMP study.

Agency_Desc is a standardized description of the agency type and must be selected from the provided pick-list to identify the agency type. Examples of common entries from the pick-list include Public College/University, Private Industry, U.S. Government/Local.

Address information should be provided for each agency, including the following information: AddressLine1, AddressLine2 (if needed), AddressLine3 (if needed), City, State, PostalCode, CountryCode, Phone, Email. This information is important.

Watershed

Watershed characteristics play a significant role in the types and quantities of pollutants contributed to stormwater runoff as well as hydrologic response of a test site to runoff events. The information requested below is useful for comparing effectiveness of BMPs under various watershed conditions. Requested information ranges from basic watershed geometry and surface characteristics to parameters useful as indicators of time of concentration, hydraulic connectivity, and the potential for conveyance losses. The priority level (e.g., required, nice-to-have) of the data varies based on the type of BMP study being conducted and is described further below.

SiteID [Auto-populated]

WSID [Auto-populated]

WatershedName is selected from a pick-list of watershed names assigned by the user on Begin Here worksheet. This is required information.

Type can either be a Test Watershed or a Reference Watershed and is required information that must be selected from the pick-list. This field is required because LID studies, non-structural BMP studies, and some types of structural BMPs (e.g., permeable pavement) often utilize reference

Minimum Recommended Watershed Characteristics for All Studies

Since release of the BMP Database, some researchers have sometimes reported being overwhelmed with the amount of information requested in the watershed spreadsheet. Regardless of the data priorities identified below, the following parameters are considered reasonably attainable for most BMP studies and should be provided for basic description of the watershed.

- Watershed Type (test or reference)
- Watershed Description (narrative)
- Total Watershed Area
- % Impervious Area
- Hydrologic Soil Group
- Soil Type
- Type of Vegetation
- Land Use Description

More complete data on watershed parameters requested is highly encouraged for sites focusing on evaluation of volume reduction.

watersheds to compare outflow characteristics between test and reference sites. These types of studies can be set-up with two basic approaches:

1) **BMP Performance Comparisons Over Time**. This involves a before-and-after type of approach where measurements are taken in the same watershed prior to BMP implementation and then taken again after BMP implementation. In this case, the first set of measurements serve as the reference, and the second set serve as the BMP test.

2) **BMP Performance Comparisons in Space.** This involves setting up a BMP test using two or more geographically separate watersheds that have similar watershed characteristics. The watershed without BMPs in place serves as the reference and the watershed with BMPs in place serves as the test.

Some structural BMP tests may also incorporate a reference watershed. For example, permeable pavement effectiveness may be evaluated by comparing water quality data from a watershed with permeable pavement in place to a watershed without permeable pavement in place. Typically, structural BMPs are simply evaluated by collecting inflow and outflow data for the subject BMP and comparing the water quality; therefore, only a single test watershed is common for structural BMP studies.

General Drainage Features Characterization

Standard BMP Database Watershed Units

Length = meters

Area = hectares

Area_Descr enables the data provider to narratively describe the watershed and identify any unique or important conditions that may be present. This provides the context and initial screening of comparability to other studies by subsequent users of the study. This information is important if available.

LandUse_Descr is the top three dominant land uses in the watershed, provided as a comma-separated narrative. (Note: more detailed land use information breakdowns should be provided in the *LandUse* table.) This narrative is requested because a basic characterization of land use is needed, even if detailed percentages of land use are not available for entry in the *LandUse* table. This is required information.

LandUse_Adjacent is a description of land use adjacent to the tributary area that could affect pollutant loading at the site. For example, if a metal ore smelter is located nearby, atmospheric deposition of smelter dust may be occurring even if the facility is not actually in the tributary area. This information is nice to have if available.

Area is the topographically defined area draining to the BMP for structural BMP studies or the drainage area studied for non-structural and LID sites. This is required information. Provide units of measurement in Area_unit.

DrainageLength is the length of the watershed along the main drainage path to the furthest point on the watershed divide. For LID studies, this parameter is helpful in estimating watershed lag. Provide units of measurement in DrainageLength_unit. This is important information for LID sites and nice to have for other BMP types.

OverlandFlowLength_Avg describes the area-weighted average drainage path length to an inlet or hardened conveyance. This information provides more refined characterization of the basic

parameter of watershed length for LID studies. This is important information for LID sites and nice to have for other BMP types. Provide units of measurement in OverlandFlowLength_Avg_unit.

FlowPath_Descr enables description of watershed geometry-based LID practices that modify the flow patterns of the site in order to increase time of concentration and promote losses. This is important information for LID sites and nice to have for other BMP types. The potential metrics that may be used in the narrative description of the flow patterns include, but are not limited to, the following:

- Time of concentration (T_c) to a hardened conveyance; accompanied by method used to compute T_c and inputs.
- Hydraulic width, based on Stormwater Management Model (SWMM) documentation.
- Average lot depth.
- Average slope of pervious area.

OpenChannelLength is the total length of grass-lined and natural channels in the watershed. This is the portion of the storm drainage network in the watershed that is not conveyed in concrete channels, storm sewers or pipes. This is important information for LID sites and nice to have for other BMP types. Provide units of measurement in OpenChannelLength_unit.

AreaImpervious_pct ***(****Percent Total Impervious Area in Watershed****)*** represents the percentage of the watershed that is impervious. Common impervious surfaces include, but are not limited to, rooftops, walkways, patios, driveways, parking lots, storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and macadam or other surfaces that similarly impede the natural infiltration of urban runoff. The percent of the total watershed that is impervious can be determined as the total impervious area divided by the total area of the watershed. This is required information.

AreaImperviousHydraulicallyConnected_pct is calculated by dividing the hydraulically connected impervious area by the total impervious area. An example of hydraulically connected impervious area includes building rooftops that drain onto paved areas. This parameter provides a general description of the connectivity of a watershed. (It is the amount of area likely to discharge in a small storm event; however, larger areas may behave as Directly Connected Impervious Area in larger events.) This is important information for LID sites and nice to have for other BMP types.

AreaServedByStormSewers_pct is the percentage of the total watershed area directly served by storm sewers. The percentage of watershed area served by storm sewers is typically higher in urbanized areas than in rural areas. This is important information for LID sites and nice to have for other BMP types.

DesignStormPipes_Year is the most common design storm return period for the storm sewers in the watershed provided in years. The design storm is the storm for which a storm drainage system, flood protection project, spillway or other engineering structure is designed. For example, the storm sewers may be designed to handle flows generated by the 10-year storm. This is important information for LID sites and nice to have for other BMP types.

Slope_Avg is the average unitless slope of the watershed. Calculate slope by dividing the vertical distance (or fall) by the linear length of the flow path (or run). Slope for each linear reach can be determined as the elevation difference for the reach divided by the length of the reach. An average slope for the watershed can then be calculated as a weighted sum of the slopes of individual reaches using the length of the individual reaches relative to the total length of the channel as the weighting factor. This is important information for LID sites and nice to have for other BMP types.

RunoffCoefficient_Avg is based on runoff and rainfall data collected in the watershed using the area-weighted average runoff coefficient. This is the data provider's estimate of the runoff potential of the watershed considering imperviousness and connectivity. Estimating this parameter without long-term monitoring data requires professional judgment. It is typically the intent of LID site studies to quantify the average runoff coefficient. If data permit, calculate the average of individual storm runoff coefficients using each storm's runoff volume divided by its rainfall volume. This is important information for LID sites and nice to have for other BMP types.

NRCSSoilGroup is the dominant Natural Resource Conservation Service (NRCS) hydrologic soil group--A, B, C, or D. The appropriate soil group can be selected from a dropdown box. Hydrologic soil groups are used to estimate runoff from precipitation. Soils are placed in one of four groups on the basis of the infiltration of water after the soils have been wetted and have received precipitation from long-duration storms. The four groups include:

1. Group A soils have a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

2. Group B soils have a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

3. Group C soils have a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture to fine texture. These soils have a slow rate of water transmission.

4. Group D soils have a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high-water table, soils that have a clay pan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

For LID sites, the hydrologic soil group is an indicator of the magnitude of runoff expected from pervious areas. Infiltration characteristics of the soil group may be different in developed conditions than what are reported in the soil survey due to soil compaction or mass grading/relocation as a result of development. This is important information for LID sites and nice to have for other BMP types.

SurfaceSoilType is the general NRCS soil type: clay, silt, or sand. Clay particles are smaller than 0.002 millimeters (mm) in diameter. Silt particles are between 0.002 and 0.05 mm in diameter. Sand particles range from 0.05 mm to 2.0 mm. The relevant soil type can be selected from a dropdown box. This is important information.

NRCSSoilGroupDistribution allows for a more robust narrative description of larger LID sites, or sites with a range of compaction-related impacts. Provide data in terms of percentage of hydrologic soil groups A, B, C and D. This is important information for LID sites and nice to have for other BMP types.

SoilConditions_Descr enables the user to describe important aspects of the site soils. This is important information for LID sites and nice to have for other BMP types.

Representative comments may include:

- Prevalent soil type (Unified Soil Classification) in developed areas at time of monitoring (not in the pre-development).
- Measured saturated hydraulic conductivity in critical locations such as in the vicinity of infiltration-based practices.
- Average and minimum depth to seasonally high groundwater in developed areas.
- Degree of compaction and envelope of disturbance.

Vegetation_Descr is the type of vegetation predominant in pervious areas (grass turf, dryland grasses, etc.) which influences the rate and efficiency of stormwater infiltration and filtration.

General Road and Parking Lot Information

Key factors affecting hydrologic response of a watershed include the characteristics of 1) roads, streets and alleys in the watershed and 2) parking lots in the watershed. Do not include parking lots in the streets, roads and alleys data elements, because parking lot information is requested separately. Priority levels of these data sets depend on the BMP type and the user community (such as DOTs).

Roads_Descr provides a narrative description of road features. This is important information for LID and DOT sites and nice to have for other BMP types.

PavementTypeRoad, streets and alleys can be Concrete, Asphalt, or Both. These values can be selected from a dropdown box. This is important information for LID and DOT sites and nice to have for other BMP types.

RoadArea includes the total area of paved roads, streets and alleys in the watershed as a component of the total impervious area of the watershed. Associated paved shoulders should be included in this area. Provide units of measurement in RoadArea_unit. This is important information for LID and DOT sites and nice to have for other BMP types.

HasCurbGutter (Yes/No) identifies whether the roadways are served by a curb and gutter system. This is important information for LID and DOT sites and nice to have for other BMP types.

PavedAreaDrainage_Descr provides a narrative description of paved area drainage features. This is important information for LID and DOT sites and nice to have for other BMP types.

AreaParkingLots includes the total area of all paved parking lots within the watershed. Paved parking lots can be a significant component of total impervious area within a watershed. Provide

units of measurement in AreaParkingLots_unit. This is important information for LID and DOT sites and nice to have for other BMP types.

ParkingLot_Descr provides a narrative description of parking lot features and configuration in the study drainage area. This is important information for LID and DOT sites and nice to have for other BMP types.

Other Department of Transportation Data

Highway-related data includes usage-related information of interest to many departments of transportation. This information is important to DOTs and nice to have in terms of BMP performance for other entities, unless otherwise noted.

DeicingMethod should be selected from a dropdown box that includes the following options: Salt (unspecified), Sand/Salt, Magnesium Chloride, Calcium Chloride, Sodium Chloride, Potassium acetate (KAc), Calcium Magnesium Acetate (CMA), De-sugared Sugar Beet Molasses Products, Other Chemical, All of the Above, None, and Unknown. Proprietary chemicals can be described further in the DOT_WinterMaintenance_Descr**.**

DOT_AADT is the average annual daily traffic (AADT) volume and should be provided for highways. This information is required for DOT data providers.

DOT_Lane_Count is the number of roadway lanes in the study area.

DOT_HighwayConditions_Descr describes highway conditions narratively, addressing the presence of features such as cruising, acceleration, deceleration, intersections, parking/high turnover (e.g., toll plazas, rest stops, etc.), parking/low turnover (e.g., park and rides).

DOT_HighwayMaintenance_Descr describes highway maintenance practices.

DOT_RoadType describes road type using standard DOT classifications including: Interstate, Other Freeways and Expressways, Other Principal Arterial, Minor Arterial, Major Collector, Minor Collector, or Local. For additional information, see https://www.fhwa.dot.gov/planning/processes/statewide/related/highway_functional_classifications/section03.cfm#Toc336872980.

DOT_Resurfacing_Descr describes resurfacing practices related to the road, including most recent date of resurfacing if known.

DOT_Shoulder_Descr describes shoulder conditions of the roadway.

DOT_WinterMaintenance_Descr describes winter maintenance practices narratively.

DOT_Conveyance_Descr describes the conveyance configuration of the area tributary to the BMP. Describe whether conveyance is overland flow, in grass swales/ditches or piped.

DOT_ActivityType_flag describes the department of transportation related activity in the area draining to the BMP. Values are selected from a pick-list: Borrow Pit, Highway, Maintenance Station, Parking Facility, Service Plaza, Unspecified, Urban Roadway or Not Applicable (if not DOT related). This information is required for DOT data providers.

Comment provide additional information pertinent to the area tributary to the BMP that may affect pollutant loading at the site. This information is nice to have.

Land Use

Land Use information is required for all data submittals. All information is required unless otherwise noted.

Rec [Record Number auto-populated at time of upload]

SiteID [Auto-populated]

SiteName [Auto-populated]

WSID must be selected from the provided dropdown list to associate the land use with the previously identified test or reference watershed.

LandUse should be selected from the dropdown list (e.g., residential, commercial, industrial), entering one land use per row in the spreadsheet. If specific land use percentages are not known, the best available land use information can be provided in the *Watershed* table field named LandUse_Descr**.**

LandUse_pct is the percent of selected land use that is present in the watershed. Enter as a value between 0 and 100. The sum of the land uses entered for a watershed should not exceed 100.

ImperviousnessByLandUse_pct allows a direct estimate of total watershed imperviousness and could support estimates of impervious area draining to LID practices if LID implementation is described by land use. This information is nice to have for LID studies.

Comment can be used to provide additional information about the land use. This information is nice to have.

BMP Info (General BMP Information)

BMPInfo stores general BMP information common to all of the BMP types included in the BMP Database and sets the framework for the *BMPDesign* table, which contains BMP-specific design parameters. All information is required unless otherwise noted.

SiteID [Auto-populated]

WSID must be selected from the dropdown list, as previously defined by the user, in order to place BMP data in the proper watershed context and associate the BMP with the test or reference watershed. This is required information.

BMPID [Auto-populated after BMPName is selected]

BMPName be selected from the dropdown list, as previously defined by the user in the *BeginHere* spreadsheet.

BMPType must be selected from the BMP types in the BMP pick-list. If no BMPs are in place because data are being entered for a reference watershed, select "Control BMP." If multiple BMPs are in place in a watershed and the site is being monitored as an overall site, then enter each BMP in place in the watershed, as well as "Composite BMP" to enable analysis of the overall site, as well as the individual BMPs. If a site-scale LID site is being monitored, select LID Site, as well as any individual LID practices monitored at the site.

BMP_Descr enables the user to describe aspects of the BMP that are important to interpreting BMP performance or provide other comments on the BMP. This information is nice to have.

ConfigInWatershed identifies whether the BMP is on-line, off-line, on-site, regional, etc. This is important information.

SiteFactors_Descr includes information that could affect the types of pollutant loads to the BMP. For example, if extensive construction and land disturbance are present in the tributary watershed, this could affect sediment loading to BMPs and result in clogging that might not be present under fully developed watershed conditions. This is important information.

BasisOfDesign provides information on the type of storm event that the BMP is designed to treat such as the 1-year, 24-hour storm, the 80th percentile storm/water quality capture volume, 2-year storm, etc. If the facility also provides flood control, also describe design flood criteria for the BMP.

Purpose provides information on the treatment objective of the BMP. For example, a BMP may be designed to provide pretreatment for a downstream BMP, be designed to provide volume reduction, or be designed as a multi-purpose facility that integrates water quality and flood control. This is important information.

DesignCriteriaSource identifies the design guidance followed for the BMP design. For example, a user might enter Western Washington Manual, Maryland Stormwater Manual, Urban Drainage and Flood Control District, Denver, CO, 2010 Volume 3 Urban Storm Drainage Criteria Manual. In some cases, the design may be based on academic research objectives. If the design criteria source is unknown, this should be stated. Where available, provide the year of the manual publication, since these are typically revised over time. This is important information.

DateInstalled must be provided in terms of month, day and 4-digit year (e.g., 04/05/1998). If the exact day is unknown, use the first day of the month. For non-structural BMPs, use this field to enter the date that the non-structural measure began being implemented.

Inflow_Count is the number of inflows the BMP and is important information for structural BMPs. For example, a wet pond may receive flow from two storm sewers and one natural drainage, for a total of three separate inflow points. This field is not applicable to non-structural BMPs.

BypassOrOverflow identifies how the BMP functions when full. Select Bypass, Overflow, Both or Unknown from the pick-list. This is required information for structural BMPs, but is not required for non-structural BMPs.

Outlet_Descr may include information such as perforated riser, pipe or plate with a horizontal orifice overflow, three vertical orifices that control water quality capture volume, 2-year and 10-year volumes, etc. This is required information for structural BMPs, but is not required for non-structural BMPs.

UpstreamTreatmentIsPresent must be answered by a yes or no from the dropdown box. This field is important in primarily two situations. The first often occurs in highway settings where roadside drainage may travel over a grass road shoulder or grass ditch prior to reaching the primary facility being monitored such as a detention pond. The second situation occurs where a treatment train of BMPs is being monitored and the BMP received outflow from an upstream BMP. This is required information.

Pretreatment_Descr enables the data provider to narratively describe the upstream treatment that may be present at a site. This is important information and should be provided when "yes" is entered for UpstreamTreatmentIsPresent.

Installation_Descr enables the user to provide information describing the installation conditions, including the following information if known:

- Was qualified engineering oversight provided at construction? This provides information related to quality control for the BMP installation. Certain types of BMPs can be very sensitive to seemingly minor deviations from the BMP design and engineering oversight can help to reduce the likelihood that the BMP was not installed as designed.
- Was structure installed as designed? Installation problems can be a common problem with BMPs that were designed appropriately, but not installed as designed.

This is important information because installation conditions can affect BMP performance.

BMPCondition_Descr enables the user to provide a general characterization of the condition of the BMP at the time that monitoring was conducted. Provide qualitative information on whether the BMP appears to be functioning as designed (e.g., Is the BMP in disrepair? Has the outlet been modified from the design? Is clogging present? Is there excessive sediment accumulation due to road sanding?) This is important information.

MainFreqType_Descr provides a brief narrative description of maintenance activities. This is important information. For example, provide the number of times per year that the following maintenance practices or other site-specific practices were conducted:

- Tree/Shrub/Invasive Vegetation Control
- Mowing
- Algae Reduction
- Sediment Removal/Dredging
- Litter/Debris Control
- Erosion Control/Bank Stability
- Inlet Cleaning
- Outlet Cleaning
- Media Replacement/Regeneration
- Pump Cleaning/Repair
- Valve Cleaning/Repair
- Pipe Cleaning/Repair
- General Maintenance
- Odor Control
- Mosquito Control
- Vector Control
- Other Practice

LastRehab_Date is used to identify when the facility was last rehabilitated and the scope of the rehabilitation effort. Enter month, day and 4-digit year (e.g., 04/05/1998) of rehabilitation. If the exact day is unknown, use the first day of the month. Rehabilitation activities (e.g., dredging a pond, replacing infiltration media) are more extensive than routine maintenance practices. While the goal of maintenance practices is to ensure proper functioning and efficiency of a BMP, rehabilitation is required when a BMP no longer functions properly, in some cases due to lack of routine maintenance. Examples include replacing an outlet structure that has been washed out in a large storm; making repairs needed to put a BMP back on-line that has been out of use for an extended time period due to neglect, lack of funding, etc.; or modifying an existing water quantity control BMP to provide water quality functions. This is important information for structural BMPs, but is not required for non-structural BMPs.

Comment is provided so that the data provider can provide additional information pertinent to the design, installation or maintenance for the BMP. This information is nice to have.

BMP Design

BMP design information should be entered in the *BMPDesign* spreadsheet. Prior to 2019, each BMP type had a separate design data entry spreadsheet. Version 4.0 of the BMPDB has consolidated all requested design attributes for all BMP types into one spreadsheet that is completed after general information is provided in the spreadsheet *BMPInfo*. To begin data entry, the user should filter on the BMP type(s) of interest and provide the requested design information to the extent that it is available. For sites with BMPs in series, the user can filter on the first BMP type and enter data, then filter on other BMP types and enter data for those practices. In the event that two of the same BMP types are in sequence, the data provider can create copies of the relevant design attribute rows and paste them into the bottom of the spreadsheet.

Design attributes may be numeric data or narrative information, as well as numeric data with a supplemental narrative comment. Only numeric data can be entered in the Value field and Units must be provided. No narrative alpha (letter) characters may be entered in the value field.

Table 2. Example Design Data Entry Table Version 4.0

Site ID	BMP ID	BMP Name	BMP Category_Desc	Design Parameter	Value	Units	Narrative_Descr
		Example Pond	Detention Basin	Forebay (yes/no/unknown)?			Yes
		Example Pond	Detention Basin	Water Quality Detention Volume	3000	CF	
		Example Pond	Detention Basin	Water Quality Detention Surface Area When Full	1000	SF	
		Example Pond	Detention Basin	Water Quality Detention Basin Length	100	FT	

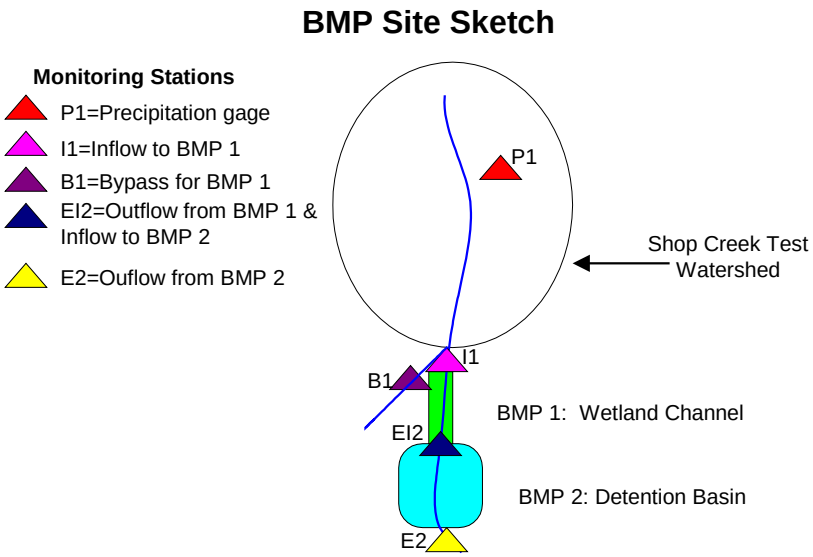
Specific design parameters requested for each BMP type are discussed in more detail in Part 5 of this User's Guide.

Part 2. Monitoring Stations

Monitoring Stations

The *MonitoringStation* spreadsheet must be completed to identify the monitoring stations in place at each test site and the relationship of each monitoring stations to each BMP. This spreadsheet is the basis for all subsequent data entry and is crucial to allow proper data retrieval. If a monitoring station is shared by two BMPs, the relationship of the monitoring station must be identified for each BMP. For example, in Figure 7 below, the station monitoring outflow from BMP 1 also monitors the inflow to BMP 2. The precipitation gauge provides information for both BMPs and must be associated with each BMP. It is recommended that the user sketch the layout of the test site identifying the relative locations of the BMPs and associated monitoring stations as shown in Figure 7.

Figure 7. Example BMP Monitoring Station Site Sketch



Example *MonitoringStation* entries for the Figure 7 example:

BMPName	MSName	MSTpye	Comment
Wetland Channel	P1	Rain Gauge	Shared monitoring station.
Wetland Channel	I1	Inflow	
Wetland Channel	B1	Bypass	
Wetland Channel	EI2	Outflow	Shared monitoring station.
Detention Basin	EI2	Inflow	Shared monitoring station.
Detention Basin	E2	Outflow	
Detention Basin	P1	Rain Gauge	Shared monitoring station.

All fields described below for the *MonitoringStation* spreadsheet are required information, unless otherwise noted. **Absence of this information will cause the test record to be rejected and prevent proper linkage of data to the BMP.**

Rec [Record Number auto-populated at time of upload]

SiteName [Auto-populated]

SiteID [Auto-populated]

WSID [Auto-populated based on selected watershed]

BMPID [Auto-populated based on selected watershed]

WSName must be select from dropdown list of user-defined watersheds at the study site.

BMPName must be selected from the dropdown list of user-defined BMPs at the study site in the selected watershed.

MSID is the user-assigned numeric ID for the subject monitoring station. These can be simple numeric values (e.g., 1, 2, 3).

MSName is the user-assigned name for the subject monitoring station. Stations shared by two BMPs should be entered twice (once for each BMP) in this spreadsheet, along with their corresponding MSID. For example, if a station monitors outflow from one BMP and inflow to another BMP, then the monitoring station and MSID will be entered (repeated) on two rows, but associated with two different BMP entries.

MSType identifies the function of each monitoring station in relation to each BMP. Select one of the following entries from the dropdown pick-list: Inflow, Outflow, Reference Outflow (for outflows from reference sites), Bypass, Overflow, Subsurface, Rain Gauge, Inter (for Intermediate), Receiving Water, Sediment/Solids, or Other. An intermediate location would be a sample taken from the middle of a pond. Subsurface stations could be lysimeters or piezometers.

Analysis Screening in Monitoring Station Table

Following upload to the submitted study to the Access Database, the Clearinghouse conducts additional screening of the submitted data set. In some cases, data sets are flagged for exclusion from analysis. Some BMPs are excluded from "Category Analysis" if they are not representative of the normal range of urban BMP designs or monitoring approaches. In some cases, data sets are excluded from individual BMP analysis, typically due to data reliability concerns or due to an intermediate monitoring location that does not represent inflow or outflow. An Analysis Comment field is provided in the Access database so that users can obtain more information on why the monitoring station is excluded from analysis.

In order to facilitate pairing of reference monitoring locations with treatment monitoring locations, the Clearinghouse will associate a reference outflow with a BMP outflow to facilitate analysis queries. A Reference Site Flag is provided for these monitoring stations in the Access Database.

Instruments_Desc is a narrative description that should include the following important information:

- **Date instruments were installed**.
- **The type of instruments installed at the monitoring station**. Examples include: Automatic Water Quality Sampler, Bubble Gauge, Digital Recorder, Graphic Recorder,

Land Line Telemetered, Radio Telemetered, Satellite Relayed, ADHAS, Crest Stage Indicator, Tide Gauge, Deflection Meter, Stilling Well, CR Type Recorder, Weighing Rain Gauge, Tipping Bucket Rain Gauge, Acoustic Velocity Meter, or Electromagnetic Flow Meter, Pressure Transducer, Unknown or Other.

- **Type of data collected by the instrument.** Data types may include: Tide, Water Flow/Stage Continuous, Water Flow/Stage Intermittent, Water Quality Continuous, Water Quality Grab, Precipitation Continuous, Precipitation Intermittent, Evaporation Continuous, Evaporation Intermittent, Wind Velocity Continuous, Wind Velocity Intermittent, Tide Stage Continuous, Tide Stage Intermittent, Water Quality Probe Continuous, Water Quality Probe Intermittent, Unknown, or Other. If "Other" is selected, describe in the Comments field.
- **Type of Control Structure.** This provides information on features associated with the measurement device that controls or regulates the flow at the measurement location. This feature may be a natural constriction of the channel, an artificial structure, or a uniform cross-section over a long reach of the channel. Examples of artificial structures include weirs and flumes.

Comment should be used to provide any unique conditions or limitations associated with the monitoring station. This information is nice to have.

Part 3. Cost Data

BMP Cost

BMP cost data should be provided whenever possible so that researchers, local governments and others can conduct cost/benefit analysis for various BMP types and designs. The type of cost data varies slightly depending on the BMP type; nonetheless, a common set of BMP cost parameters has been consolidated for all BMP types to enable facilitation of comparisons across BMP types. If a particular parameter is not applicable, then it may be left blank. All cost data are considered nice to have. If provided, then BMP Name and Year of Cost Estimate are required.

Rec [Record Number auto-populated at time of upload]

SiteID [Auto-populated]

SiteName [Auto-populated]

BMPID [Auto-populated based on selected BMP]

BMPName must be entered to associate the cost data with the appropriate BMP.

CostYear is the four-digit year (e.g., 1998) cost basis for the cost estimates.

CostTotal (Base Cost of Original Design, Construction and Installation of BMP, Including Capital and Associated Costs). This is the overall initial cost of the facility. If an overall cost estimate is provided, then a description of items included in the total cost must also be provided.

Cost_Descr. If an overall initial cost of the facility is provided, then the individual cost components must be narratively described so that future comparisons of overall costs can be accurately conducted.

CostAnnualRoutineMaint_Avg is the estimated average annual cost ($/year) of routine maintenance such as mowing, sediment removal, vacuuming, etc., at a frequency that ensures the continued function of the structure.

CostRehab_Avg is the estimated average cost ($/event) of infrequent, rehabilitative maintenance. Examples include cost to revegetate or reseed the structure at a frequency that ensures the continued function of the structure. For media filters, this includes the cost of replacing the filter material at a frequency that ensures the continued function of the BMP. For permeable pavement, this should include estimated average annual cost to revegetate void spaces in modular block pavement.

CostExcavationClearing is the estimated cost of all excavation-related activities, including stripping, drilling and blasting, trenching and shoring.

CostStructuralMaterials is the estimated cost of structural materials for the BMP.

CostInstallConstruct is the estimated cost of installing or constructing the structure.

CostStructuralControls is the estimated cost of establishing all structural control devices, such as inlet and outlet structures, trash racks and energy dissipaters. For grass filters and permeable pavement, this will also include control devices such as slotted curbing or other flow spreading devices, and outflow collection and conveyance systems. Reported costs should include both materials and construction.

CostVegLandscape is the estimated cost of establishing vegetation for the BMP, including acquiring landscape materials, establishing vegetation, and establishing the irrigation infrastructure, if any.

CostEngrOverhead is the estimated cost of engineering and associated overhead costs, including site, structural, and landscape design and engineering expenses.

CostLand is the estimated value of the land dedicated to this BMP or the cost of acquiring this land.

DifferentialCosts_Descr enables the user to provide comments regarding the estimated portion of the BMP costs that would only be incurred due to the installation of the BMP itself. For example, a portion of landscaping, paving, curb and gutter and other similar components of site development would often be incurred even without installation of the BMP. (Differential Cost = All Costs Associated with BMP Installation/Construction – Portion of Costs Incurred Regardless of BMP Installation).

Comment can be used to provide additional information about cost data.

Monitoring Costs

Enter approximate annual monitoring costs for the overall test site for each year. Data are requested for both fixed and temporary monitoring stations. All monitoring cost data should be reported in U.S. currency and are considered nice to have information.

Rec [Record Number auto-populated at time of upload]

SiteID [Auto-populated]

Station_Descr identifies whether the monitoring station is fixed or temporary from a dropdown box.

CostYear is the year during which monitoring was conducted. If monitoring has been conducted over a five-year period, then enter costs for each of the five years. This may be done by simply dividing the total monitoring costs by the number of years.

CostBase is the cost basis year associated with the monitoring activities/equipment. For example, if the instrument was purchased in 1995 for $500, then 1995 is the year of cost basis.

CostEquipment are the costs of sampling and flow gauging equipment (rental or purchase) and installation.

CostSampling is the annual cost of sampling.

CostMaintenance (permanent stations only) is the annual maintenance cost for equipment.

CostAnalysis is the annual cost of sample analysis by a laboratory.

Comment may be needed to clarify unusual monitoring costs or other details as deemed appropriate by the user.

Part 4. Monitoring Events and Results

In order to properly link monitoring events for the overall test site, an *Event* table must be established for the test site as a whole. Because sampling of inflows and outflows associated with storm events may occur on different dates, a date-independent EventID is needed for each monitored storm.

Monitoring results can include data collected for precipitation, flow (storm runoff or base flow) and water quality. All monitoring data must be entered in association with the previously identified Monitoring Station, and Monitoring Event in the following spreadsheets:

1) *Precipitation* Spreadsheet. Enter precipitation data for all precipitation monitoring stations included in the study.

2) *Flow* Spreadsheet. Enter runoff into or from BMPs, bypassed storm runoff, or base flows.

3) *WaterQuality* Spreadsheet. Enter water quality data for an event. Compatibly formatted data may be pasted into the spreadsheet from electronic data deliverables from the analysis

laboratory. Depth to water and particle size distribution data may also be entered into the *WaterQuality* spreadsheet.

Event

The *Event* table is the basis for linking precipitation, flow and water quality data collected at the test site. All information is required unless otherwise noted.

Rec [Record Number auto-populated at time of upload]

SiteID [Auto-populated]

SiteName [Auto-populated]

EventID is pre-entered, numbered from 1 to 300. Additional event numbers may be added, if necessary.

DateStart is the calendar date (month, day and 4-digit year) that the storm started (e.g., 01/01/2010) or that the base flow event was sampled. The event start date may not correspond exactly to the event sample date for longer storms or BMPs with extended release periods.

TimeEvent is the time that the storm (or monitoring event for base flow) started (e.g., 21:00). This is important information to differentiate between storms on the same date.

EventType identifies whether the monitored event is associated with storm runoff, base flow/dry weather, or other event. This information must be selected from a pick-list.

AntecedentDry_hrs is an indicator of antecedent watershed conditions and potential for dry weather pollutant build up. This is important information for LID facilities and infiltration-oriented BMPs and nice to have for other BMP types.

AntecedentCond_Descr is a narrative description of conditions immediately prior to the start of monitoring, including relevant field notes. This is important information for LID facilities and infiltration-oriented BMPs. This is important information for LID facilities and infiltration-oriented BMPs and nice to have for other BMP types.

Comment allows the user to enter observations regarding the event conditions. For example, if the event generated flow conditions greater than the BMP design storm, this could be noted in the event field. This information is nice to have.

Precipitation

Standard BMP Database Precipitation Units

Depth = centimeters

Rate = centimeters/second

Precipitation data should be provided when available. All information is required unless otherwise noted. Precipitation may be entered for multiple rain gauges in the watershed, provided that the locations have been previously identified in the *MonitoringStation* spreadsheet. Enter data for each precipitation event monitored in the watershed. Individual precipitation events are separated by a period of at least six hours of no precipitation. Example: If rainfall ceases at 6:00 p.m. and begins again at 12:00 p.m., then two separate storm events have occurred. If rainfall had begun again at 10:00

p.m., then only one storm event would have occurred. In the latter case, the total rainfall would be summed.

Initial Precipitation Screening

In the Access Database, the Clearinghouse assigns an Initial Screening flag to indicate whether the precipitation value is appropriate for data analysis purposes.

Rec [Record Number auto-populated at time of upload]

SiteID [Auto-populated]

SiteName [Auto-populated]

MSID is the location where the precipitation data were collected, as selected from the pick-list of previously identified monitoring stations.

EventID is the monitoring event associated with the collected precipitation data, as selected from the pick-list of previously identified events.

DateStart is the calendar date (month, day and 4-digit year) that storm started (e.g., 01/01/1998).

TimeStart is the time that the storm started, e.g., 21:00. If only storm duration is provided, enter 00:00 for start time and enter the storm duration for end time. This is important information.

DateEnd is the calendar date (month, day and 4-digit year) that storm ended (e.g., 01/01/1998). This is important information.

TimeEnd is the time that the storm ended, e.g., 13:21. This is important information.

PrecipDepth_Value is the total amount of precipitation that occurred during the storm. For example, a total of 2 cm of rain fell during a 1-hour storm. Units must also be entered for this parameter.

OneHourPeak_Value is the most intense one-hour of rainfall for the storm. For storms with less than one-hour duration, divide the storm rainfall depth by one hour. This parameter is intended to form a basis for linking rainfall intensity with the performance of similar BMPs nationwide. For structural BMPs, this is important information. For non-structural BMPs, this is required information. Units must also be entered for this parameter.

Comment are encouraged to provide any additional relevant information or usage limitations. Comments are considered nice to have.

Flow

All information in the *Flow* table is required unless otherwise noted. Enter the following data collected for each flow monitoring event:

Standard BMP Database Flow Units

Volume = liters (L)

Rate = liters/second (L/sec)

Rec [Record Number auto-populated at time of upload]

SiteID [Auto-populated]

SiteName [Auto-populated]

MSID is the location where the flow data were collected, as selected from the pick-list of previously identified monitoring stations.

EventID is the monitoring event associated with the collected flow data, as selected from the pick-list of previously identified monitoring stations.

DateStart is the date (month, day and 4-digit year) that the measurement began being taken (e.g., 01/01/1998).

TimeStart is the time at beginning of measurement event, e.g., 23:30. If only flow duration is provided, enter 00:00 for start time and enter the flow duration for end time. This is important information.

DateEnd is the date (month, day and 4-digit year) that the measurement event ended (e.g., 01/01/1998). The end of runoff event can be defined as that point in time when the recession limb of the hydrograph is <2% of the peak or is within 10% of the pre-storm base flow, whichever is greater. This is important information.

TimeEnd is the time at the end of the measurement event, e.g., 01:30. The end of runoff event can be defined as that point in time when the recession limb of the hydrograph is <2% of the peak or is within 10% of the pre-storm base flow, whichever is greater. If only flow duration is provided, enter 00:00 for start time and enter the flow duration for end time. This is important information.

Volume_Total is the total flow volume measured at the inflow(s) or outflow(s) from the BMP, excluding bypassed flow volumes, which are entered in a separate field. If the BMP is designed to infiltrate storm runoff and no underdrain discharge is present, enter "0" for the flow volume for the outflow monitoring station. Missing flow records can be identified by "-99999"; **do not use a "0" for missing flow events**. Units must also be entered for this parameter.

PeakFlow_Rate is the greatest rate of storm flow into or from the BMP, for example, 5 L/sec. This is important information. Units must also be entered for this parameter.

BypassVolume_Total quantifies flows bypassed around the BMP. If bypassed flows occurred, this is required information. If bypass flows occurred, but were not quantified, note that bypass flows occurred in the Comments field. Units must also be entered for this parameter.

BypassPeak_Rate is the peak rate of flow measured for flows bypassing the BMP. This is important information. Units must also be entered for this parameter.

BaseFlow_Rate is the flow rate during dry-weather conditions. Base flow is collected during non-wet weather conditions. If base flow related data (i.e., water quality data) are being entered into the BMP Database, then this is required information. Units must also be entered for this parameter.

HydrographCaptured_pct reflects the portion of the hydrograph measured (or "captured") in the sampling event. Typically, 100 percent of the hydrograph is targeted for capture in a monitoring event; however, in some cases, such as "first flush" monitoring, only a portion of the rising limb of the hydrograph may be targeted. In other cases, prolonged storm events such as those that occur in the Pacific Northwest, may make capture of the entire hydrograph logistically challenging. In such cases, the portion of the hydrograph reported should be provided rather than omitting the

data altogether. This is important information. Enter data as a percent value rather than a decimal value (e.g., enter 99% rather than 0.99).

DeminimusFlow_est is provided to acknowledge that even in well-designed BMP monitoring programs, there are often flows into a BMP that may not be fully captured in the inflow monitoring. Using 10 percent as a general rule of thumb to describe de minimus flows, identify flows that may not be fully reflected in monitored flows. Examples include high groundwater and limited sheet flow from adjacent road or facility slopes. If such water sources are present, describe the source of such flows. Understanding of this issue is often particularly important to Departments of Transportation which are also characterizing pavement runoff as part of their monitoring efforts. Additionally, inadequate characterization of de minimus flows can lead to erroneous conclusions if volume reduction is a performance objective for the BMP. This is important information.

Comment is encouraged to provide any additional relevant information or usage limitations. Comments are considered nice to have.

OKForVolumeComparison_flag enter yes if the volume data are of adequate quality to use for volume reduction calculations or comparisons. Enter no if use of the flow data for this purpose could be misleading due to study design, unmeasured flows, or other reasons. This is important information.

Initial Flow Screening

Accurate flow data are often challenging to obtain. In some cases, flow monitoring data may be appropriate for pacing of water quality samples for EMCs, but may not be adequate for evaluating volume reduction benefits of a BMP. The Clearinghouse conducts additional reasonableness checks of flow data following data upload, typically prior to completion of more detailed volume analysis reports, which are accessible at www.bmpdatabase.org.

Water Quality

The *WaterQuality* spreadsheet stores the sampling event results, including water quality analytes, sample fractions, values, units, qualifiers and analysis methods. Data requested in this spreadsheet are described in more detail below. All water quality parameters are required, unless otherwise noted.

Rec [Record Number auto-populated at time of upload]

SiteID [Auto-populated]

SiteName [Auto-populated]

MSID [Autopopulated after MSName entered]

EventID is the monitoring event associated with the collected water quality data, as selected from the pick-list of previously identified monitoring stations.

DateSample is the date that the water quality sample began being collected.

TimeSample is the time that the water quality sample began being collected. This is important information.

SampleMedia can be selected from a dropdown pick-list and includes: Groundwater, Surface Runoff/Flow, Soil, Dry Atmospheric Fallout, Wet Atmospheric Fallout, Pond/Lake Water, Accumulated Bottom Sediment, Biological, or Other.

SampleType can be selected from a dropdown pick-list and includes the type of samples provided including: Flow Weighted Composite EMCs (Event Mean Concentrations), Time Weighted Composite EMCs, Unweighted (mixed) Composite EMCs, or Grab Sample.

Analyte is the name of the constituent analyzed using the analysis name reported by the laboratory.[3]

SampleFraction is the fraction of the water quality constituent that was analyzed (e.g., dissolved, total, total recoverable, etc.). This is required information for certain constituents that are reported in multiple forms (e.g., metals). For purposes of the Access Database, the Clearinghouse renames the original Sample Fraction field to "origSampleFraction" and creates a final Sample Fraction field to support queries. In the final Sample Fraction field, null (missing) sample fractions are replaced with "NS" for not specified.

Value_Raw is the field or analytical result for the water quality sample. If the value is below detection limits, provide the reported detection limit as the value with a "U" qualifier in the qualifier field. If the laboratory reports a "J" qualified value estimated below the detection limit, use the value provided by the laboratory. Do not use minus signs to indicate values below the detection limit. **Do not represent values below detection limits with a "0" or one-half of detection limit**. (Note: The BMP Database Clearinghouse will generate a separate "analysis value" for values below the detection limit, typically using a simple substitution method.)

Standard BMP Database Water Quality Units

Nutrients and Solids = milligrams/L (mg/L)

Metals = micrograms/liter (µg/L)

Organics = µg/L

General Water Quality = mg/L

Field Parameters = parameter-dependent

Unit_Raw is the user-reported unit of measurement for the analyte (e.g., mg/L, MPN/100 mL).

WQQualifier, if any, for the data should be selected from the Water Quality Qualifier Codes pick-list codes, which include the following qualifiers:

- J = Estimated: The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.

[3] In previous releases of the BMP Database, the data provider was asked to name analytes according to the USEPA's "modern STORET" nomenclature being used in USEPA's Water Quality Exchange (WQX) database. Although this is still the preferred nomenclature for the BMP Database, data providers have had significant difficulty "mapping" their sampling program analyte names to the appropriate WQX characteristic. Therefore, the WQX nomenclature requirement has been abandoned. The Clearinghouse now utilizes a post-submittal analyte "look-up" table to map the original user-provided analyte name to a Common Name to support analysis. These common names are provided in supporting tables in the Access database (tblAnalysisGroup).

- R = Rejected: The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.

- U = Not Detected: The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.

- UJ = Not Detected/Estimated: The analyte was not detected at a level greater than or equal to the adjusted CRQL or the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

Water Quality Analysis Values and Units

Following data upload to the Access Database, the Clearinghouse retains the original result and units to fields with "raw" prefix to indicate that these are the originally provided values by the data provider. New standardized fields are then created that provide analysis results in standard units and performs a simple substitution of one-half of the detection limit for non-detects. These are the values used for water quality analysis purposes. Users may choose an alternative substitution method for non-detects if desired for their analyses.

AnalyticalMethod should be provided for the constituent. For example: EPA 8270 or Standard Method 513. This information is typically reported in Electronic Data Deliverables and can be easily pasted into this spreadsheet. If water quality data are being entered into the BMP Database, then this is <u>important</u> information.

DetectionLimit must be provided with sample results so that comparisons between sites can accurately conducted. This information is typically provided in most electronic data deliverables and hard-copy laboratory reports. *(Note: some historical data sets in the BMP Database do not have detection limits provided; however, detection limit is required for all new data submissions.)* Provide units in DetectionLimitUnit.

DetectionLimitType should be provided along with the detection limit. Detection limits are often provided as either Instrument Detection Limits (IDL) or Method Detection Limits (MDL). In some cases, such as for bacteria result, an Upper Quantitation Limit (UQL) may be provided. This information is <u>important</u> and is typically provided in hard-copy laboratory reports

CompositeAliquots_Nbr is the number of sample aliquots used to create a composite sample during a runoff-event using a variety of methods such as flow-weighted, time-weighted, grab samples or other approaches. The purpose of a composite sample is to provide an overall picture of the characteristics of the water throughout the runoff event. This is <u>important</u> information.

InitialScreen_flag Provide a Yes or No. This field enables the data provider to identify data that may have quality limitations or that should not be included in analysis of EMC data. For example, a data provider

CategoryAnalysisScreen_flag

In the Access Database, an additional screening flag is added by the Clearinghouse to support analysis queries. For individual monitoring results appropriate for inclusion in BMP Category Analysis, an "=" is provided, for individual results not appropriate for inclusion in category analysis, an "n" is provided. Examples of individual results flagged for exclusion include clearly erroneous data entry errors that cannot be resolved through communication with the original data providers, first flush sample results, and other conditions identified by the Clearinghouse that would result in misleading analysis results.

may include first-flush data, in addition to EMCs. A "No" flag should be placed on the first flush samples so that they are excluded from EMC-based performance analysis. If a "No" flag is provided, it should be described in the Result Comments field. This information is important.

Comment allows the user to clarify special circumstances associated with the analysis result. This information is nice to have, unless anomalies in monitoring are presents; in such cases, it is required information.

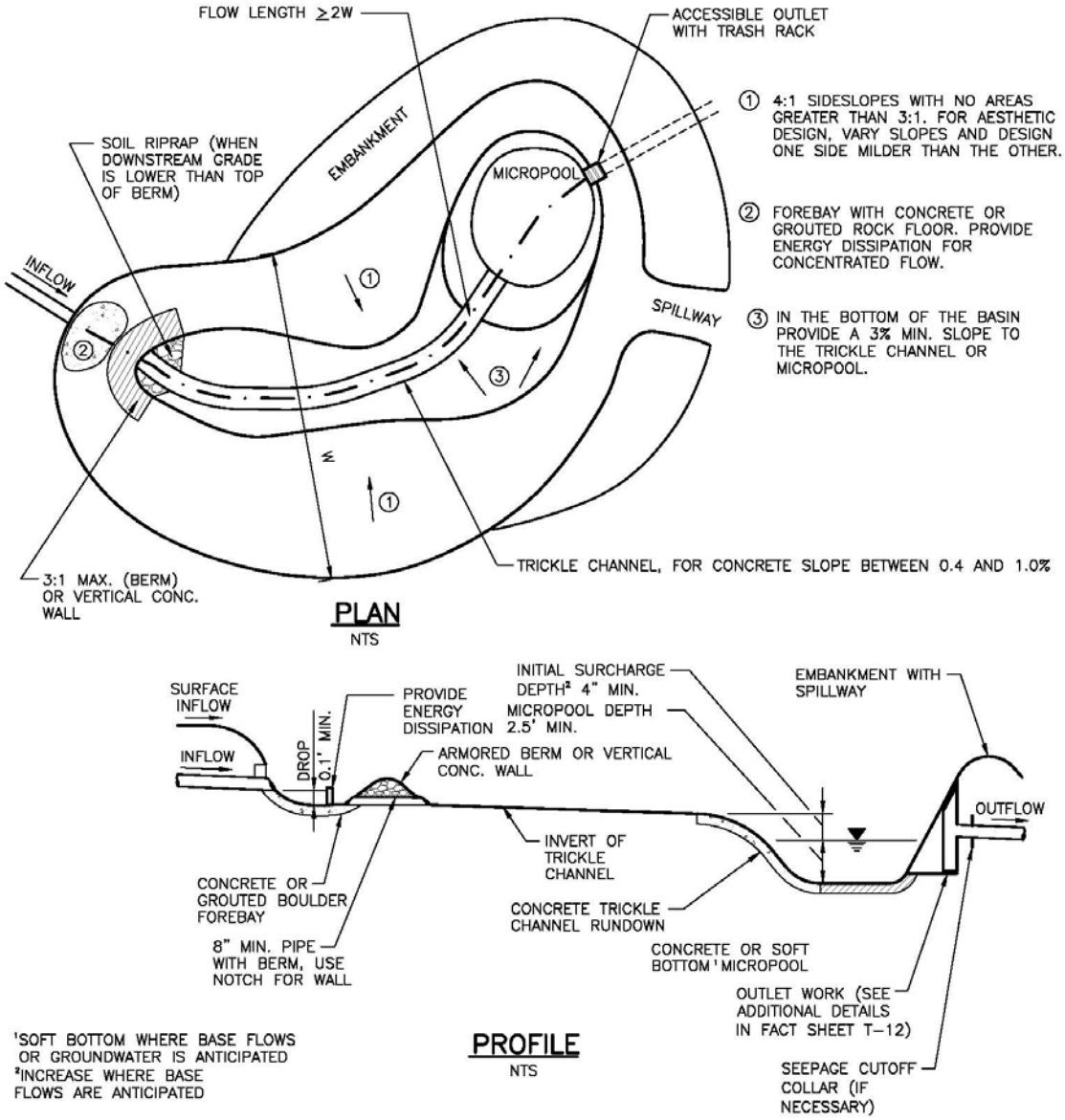
Part 5. Individual BMP Design Characteristics

Part 5 of this User's Manual provides guidance for BMP-specific design parameters to be reported in the *BMPDesign* spreadsheet. To enter design data, begin by filtering on the BMP Type column in the data entry spreadsheet so that the data entry fields are only displayed for the BMP(s) of interest.

Detention (Dry) Basin Design Data

Extended detention (ED) dry basins are designed to completely empty at some time after stormwater runoff ends. These are adaptations of the detention basins used for flood control. The primary difference is in outlet design; the extended detention basin uses a much smaller outlet that extends the detention time for more frequent events so that pollutant removal is facilitated. The term "dry" implies that there is no significant permanent water pool between storm runoff events.

Figure 8. Example Extended Detention Basin Design
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided for numeric entries. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the feature does not exist in the BMP design.

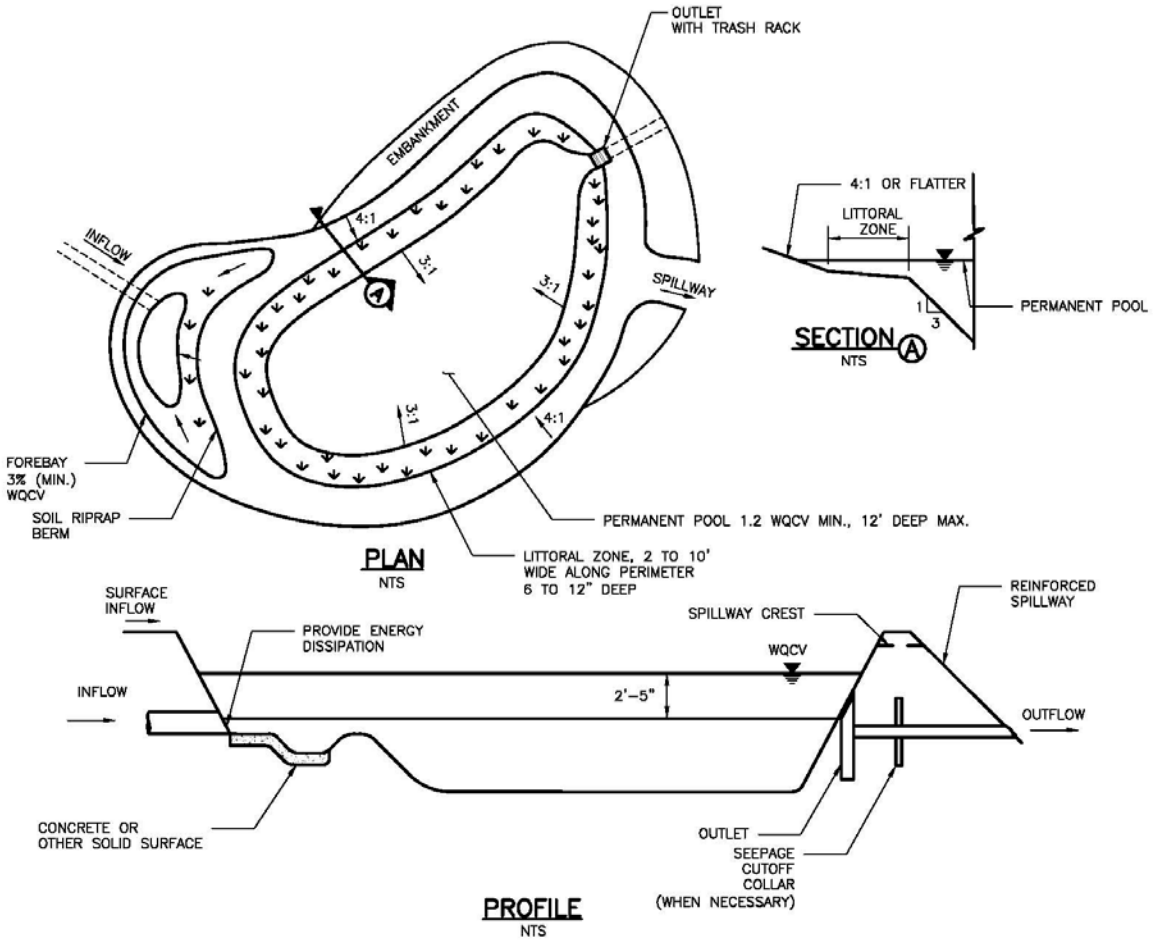
Table 3. Design Attributes to Report for Extended Detention Basins

Attribute	Description
Forebay (yes/no/unknown)?	Identify whether a forebay is provided by entering yes/no/unknown.
Water Quality Detention Volume	The volume of storm runoff that is captured and slowly drained over a period of time (e.g., 12 to 48 hours) to promote settling and other pollutant removal mechanisms.
Water Quality Detention Surface Area When Full	The area of the water surface in the detention basin at full water quality detention volume.
Water Quality Detention Basin Length	Length of the water quality detention basin, measured as the distance between inflow and outflow. If there is more than one inflow point, use the average distance between the inflow points and the outflow weighted by the tributary impervious area.
Brim-full Water Quality Volume Emptying Time (hrs)	Emptying time (in hours) of the water quality detention volume.
Flood Control Volume, If Any	It is often feasible and desirable to establish the water quality detention basin within a larger flood control facility. If this is the case for this basin, record the volume of the flood control detention volume in excess of the water quality detention basin volume (if any).
Describe Vegetation	Describe the types of vegetation on the basin sides and floor.
Is there a micro pool?	Enter Y=Yes or N=No. Identify whether there is a small (i.e., micro) permanent pool within the bottom stage of the basin near the outlet.
Comments	Narratively describe other relevant or unique aspects of the BMP. Additional information about forebay and bottom stage geometry can be provided here, along with information about high groundwater or other factors affecting performance of the facility. Comments are considered nice to have.

Retention (Wet) Pond Design Data

Retention ponds are also commonly known as "wet ponds" because they have a permanent pool of water, unlike detention basins, which dry out between storms. The permanent pool of water is replaced in part or in total by stormwater during a storm event. The design is such that any available surcharge capture volume is released over time. The hydraulic residence time for the permanent pool over time can provide biochemical treatment. A dry weather base flow, pond liner and/or high groundwater table are required to maintain the permanent pool.

Figure 9. Example Retention Pond Design
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

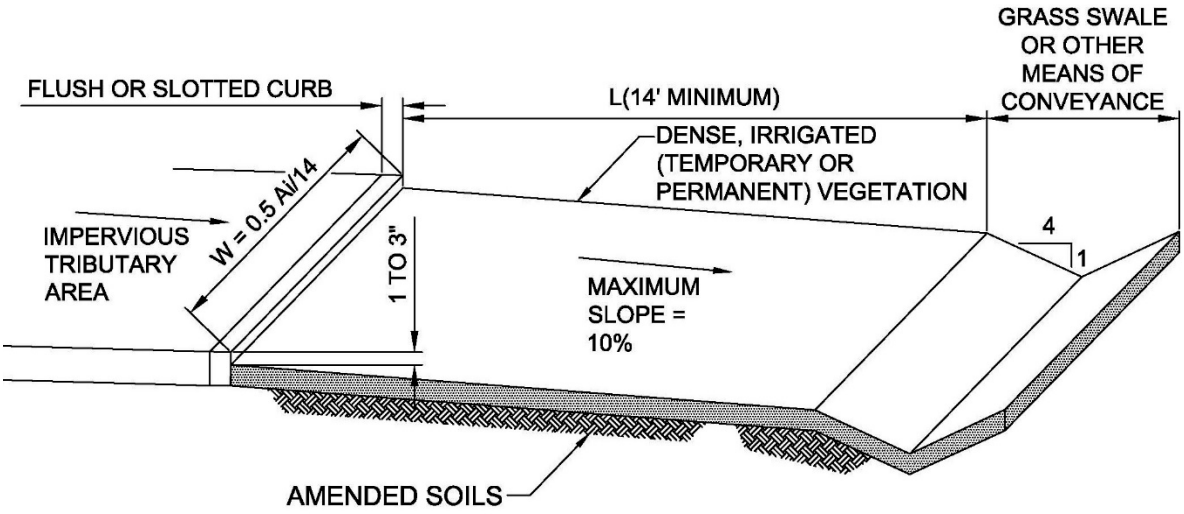
Table 4. Design Attributes to Report for Retention (Wet) Ponds

Attribute	Description
Forebay (yes/no/unknown)?	Identify whether a forebay is provided by entering yes/no/unknown.
Permanent Pool Volume	Volume of the permanent pool of water.
Permanent Pool Surface Area	Area of the water surface for the permanent pool.
Permanent Pool Length	Length of the permanent pool of water, measured as the distance between inflow and outflow. If more than one inflow point, use the average distance between the inflow points and the outflow weighted by the tributary impervious area.
Water Quality Detention Volume	Retention ponds may be designed to handle a specified volume of runoff above the permanent pool, releasing this surcharge volume to the pool over a specified period of time through an outlet structure. Specify the surcharge detention volume when full.
Water Quality Detention Volume Surface Area When Full	The surface area of any supplementary water quality detention volume above the permanent pool, if applicable.
Water Quality Detention Volume Length	Length of the water quality detention volume, measured as the distance between inflow and outflow. If more than one inflow point, use the average distance between the inflow points and the outflow weighted by the tributary impervious area.
Brim-full Water Quality Volume Emptying Time (hrs)	The period of time (in hours) required for the retention pond water quality surcharge detention volume to be released to the permanent pool.
Flood Control Volume	It is often feasible and desirable to incorporate the water quality retention basin within a larger flood control facility. If this is the case for this basin, record the volume of the flood control detention volume in excess of the retention basin volume.
Describe Vegetation	Describe vegetation associated with the facility, particularly the littoral zone. The littoral zone refers to the area above the level of the permanent pool that is periodically and temporarily covered by captured storm runoff.
Comments	Narratively describe other relevant or unique aspects of the BMP. Additional information about forebay and bottom stage geometry can be provided here, along with information about high groundwater or other factors affecting performance of the facility. Comments are considered nice to have.

Grass Filter Strip and Swale Design Data

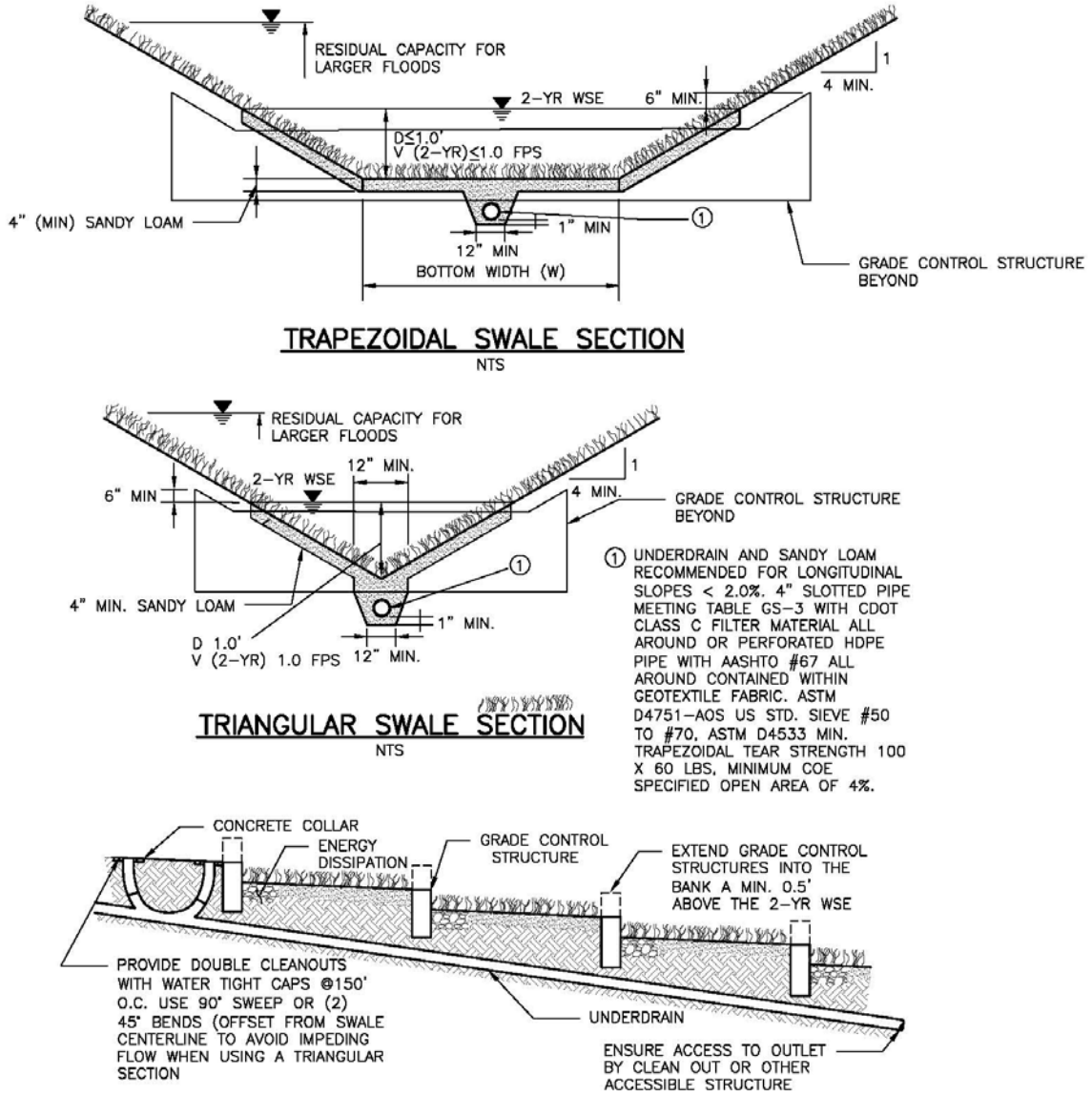
Grass filter strips, sometimes called biofilters or buffer strips, are vegetated areas designed to accept sheet flow provided by flow spreaders which accept flow from an upstream development. Vegetation may take the form of grasses, meadows, forests, etc. The primary mechanisms for pollutant removal are filtration, infiltration, and settling.

Figure 10. Example Grass Buffer Design
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



A **swale**, sometimes called a biofilter, is a shallow grass-lined channel with zero, or little, bottom width designed for shallow flow near the source of storm runoff. Examples of grass-lined swales are provided in Figure 11.

Figure 11. Example Grass Swale Design
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided for numeric values. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

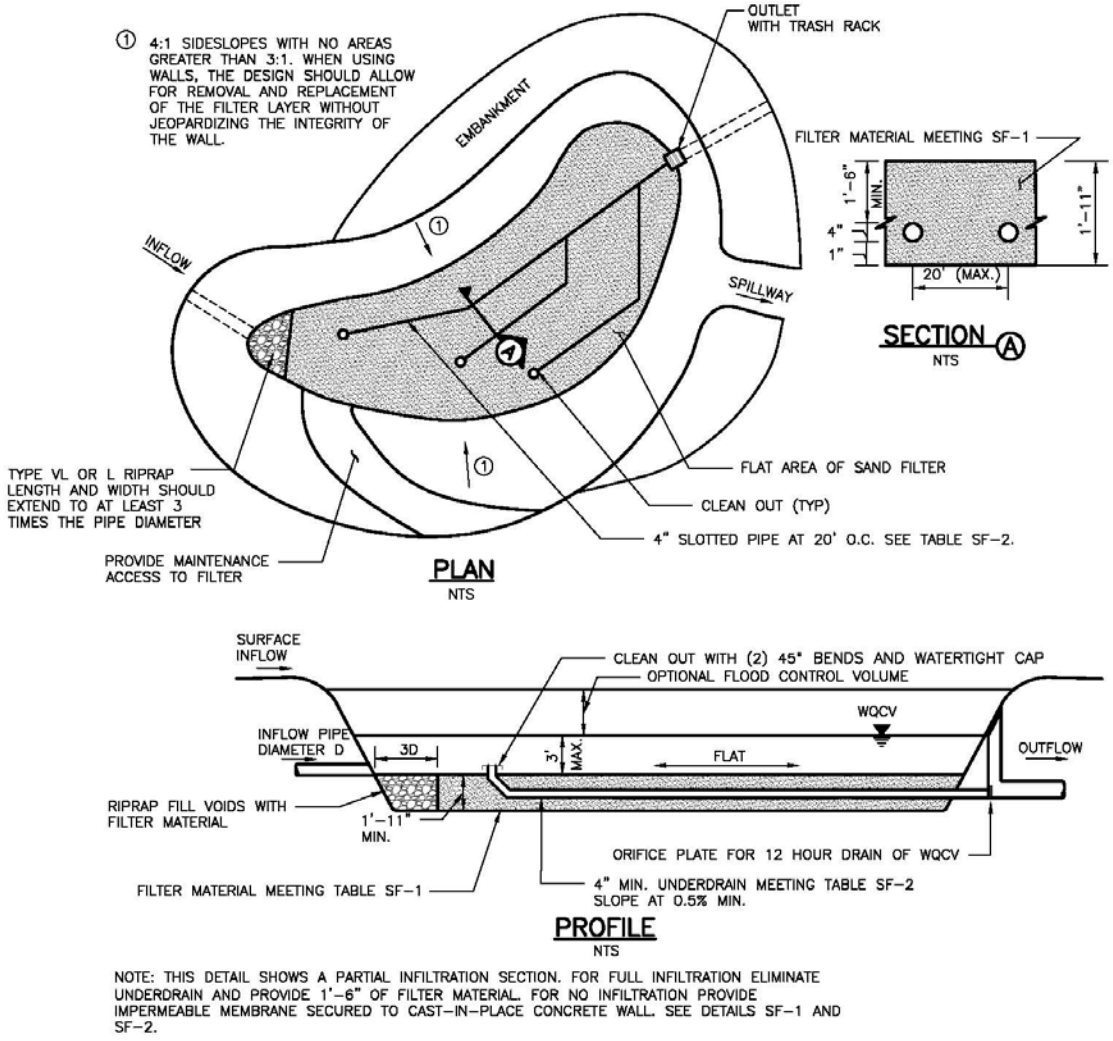
Table 5. Design Attributes to Report for Grass Buffers and Grass Swales

Attribute	Description
Length	Length of the grass strip or swale in the direction of the flow path.
Width	Width of the grass strip or swale perpendicular to the flow path.
Longitudinal Slope	The slope of the strip along the flow path expressed as unit length per unit length (e.g., feet/feet).
Flow Depth during 2-Year Storm	The design depth of flow over the strip during the 2-year storm peak flow.
2-Year Peak Design Flow Velocity	The design flow velocity over the strip during the 2-year peak flow.
Grass Species and Densities	List the grass species and their densities.
Irrigation provided?	Enter Y=Yes if the strip is artificially watered during any part of the year, N=No if it is not.
Manning's n During 2-year Flow	The Manning's roughness factor *n* expresses the degree of resistance to flow over the surface due to filter strip vegetation; here *n* should be estimated for the 2-year peak runoff event. The Manning's *n* is larger for rougher surfaces (e.g., high, dense vegetation) that increase flow friction. This information is nice to have.
Depth to Groundwater	Depth to the seasonal high groundwater table and/or the impermeable layer, whichever is shallower. This information is nice to have.
Saturated Infiltration Rate	Measured rate of infiltration into the filter strip under saturated soil conditions, based on soil surveys or infiltrometer measurements. This information is nice to have.
Soil Group	The Natural Resource Conservation Service Hydrologic Soil Group (e.g., A, B, C, or D) comprising the infiltrating surface. This classification reflects the infiltration rate of the soil, with Group A soils having the highest rates of infiltration and Group D soils having the lowest. This is important information.
Comments	Narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

Media Filter Design Data

A Media Filter is a facility that uses some form of a granular or membrane filter, with or without a pre-settling basin, to filter pollutants from stormwater. The most typical filter is sand, but other materials, including peat mixed with sand, compost with sand, geotextiles, and absorption pads and beds are commonly used.

Figure 12. Example Sand Filter
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are <u>required</u> information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

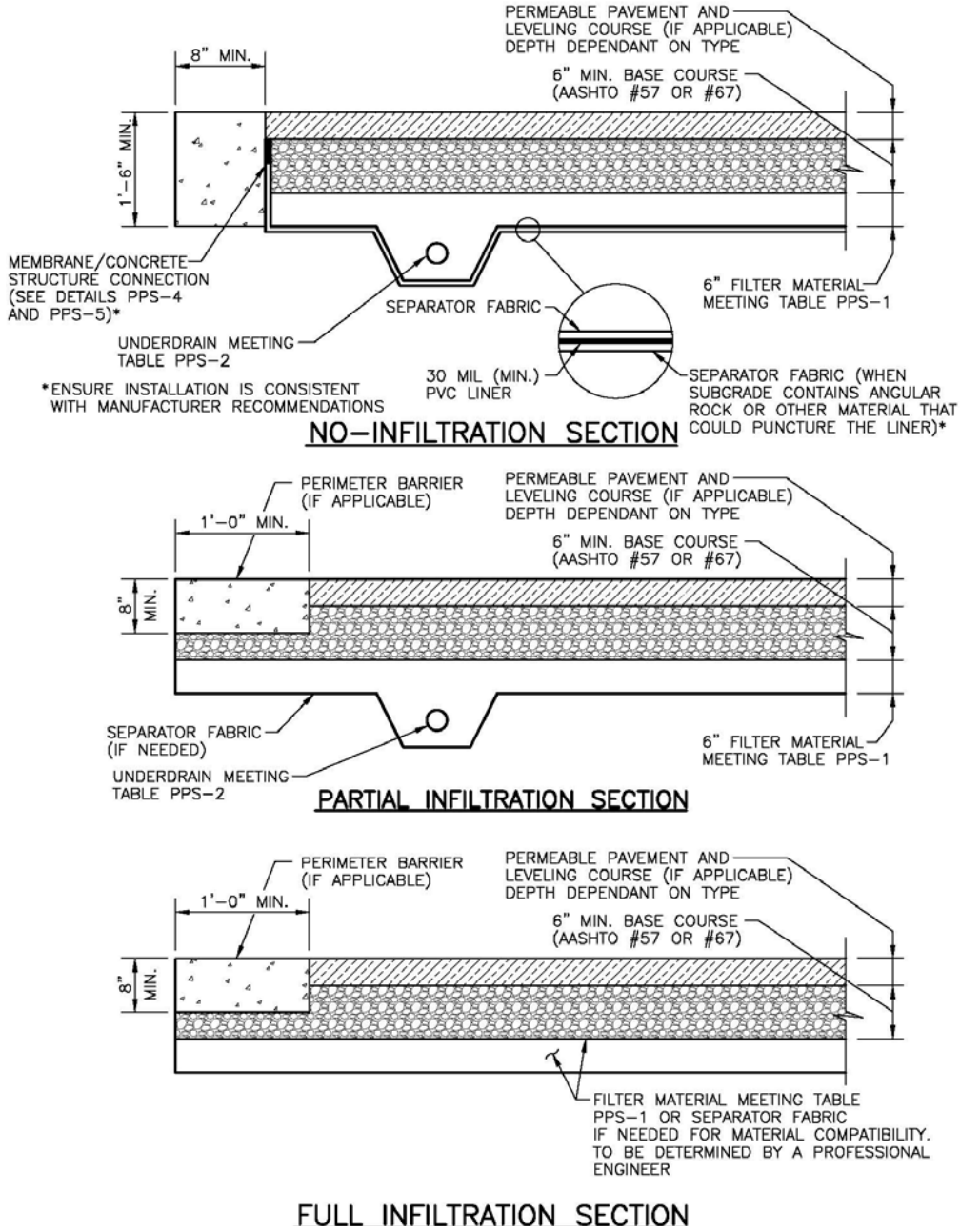
Table 6. Design Attributes to Report for Media Filters

Attribute	Description
Forebay (Yes/No/Unknown)?	Identify whether a forebay is provided by entering yes/no/unknown.
Media Filter's Surface Area	Total surface area of the media filter (e.g., the sand bed or geotextile filter) orthogonal to the flow.
Surcharge Detention Volume's Design Depth	The design depth of water quality capture volume that can be stored above the filter before overflow or runoff bypass occurs.
Surcharge Detention Volume, Including Volume Above Filter Bed	The design water quality capture volume, including the volume above the filter.
Surcharge Detention Volume's Length	The length of the design captured runoff volume, including the portion above the filter, measured as the distance along the flow path. If more than one inflow point, use the average length. This information is nice to have.
Surcharge Detention Volume's Surface Area, Including Area Above Filter Bed	The surface area of the design water quality capture volume including the area above the filter.
Describe Media Type	Describe the type of media used in the filter. (Examples: ASTM C-33 Sand with d50 = 0.7 mm, 50% ASTM C-33 Sand with d50 = 0.6 mm and 50% Peat, Non-Woven Geotextile Fabric with 100-micron effective pore openings, Non-Woven Geotextile with 100-micron effective pore openings above the ASTM C-33 sand with d50 = 0.7 mm, etc.).
Describe Media Layers, Depths, Thicknesses and Configuration	Provide a depth or thickness of each layer, along with configuration (e.g., horizontal, vertical, sloping).
Surcharge Detention Volume's Drain Time in Hours	The design time for complete drawdown (in hours) of the water quality capture volume if the drain time is controlled by a flow regulating device such as an orifice. Leave blank if the drain rate is only a fraction of the filter's flow-through rate.
Comments	Narratively describe other relevant or unique aspects of the BMP. If additional pretreatment or an upstream permanent pool is provided in addition to a forebay, additional information can be provided here. Comments are considered nice to have.

Permeable Pavement Design Data

Permeable pavements include a variety of materials and techniques that allow the movement of water into the paving material and subsurface, helping to reduce the effective imperviousness of developed areas. Examples of permeable paving include pervious concrete, porous asphalt, paving stones or bricks, reinforced turf rings, and other designs. Additionally, permeable friction course monitoring results can also be entered in this category.

Figure 13. Example Permeable Pavement System Design
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Modular block is permeable due to its structure, and poured-in-place concrete or asphalt is permeable due to the mix of the materials. Modular block permeable pavement consists of perforated concrete slab units underlain with gravel. The surface perforations are filled with coarse sand or sandy turf. It is used in low traffic areas to accommodate vehicles while facilitating stormwater runoff at the source. It should be placed in a concrete grid that restricts horizontal movement of infiltrated water through the underlying gravels.

Poured-in-place porous concrete or asphalt is generally placed over a substantial layer of granular base. The pavement is similar to conventional materials, except for the elimination of sand and fines from the mix.

If infiltration to groundwater is not desired, a liner may be used below the porous media along with a perforated pipe and a flow regulator to slowly drain the water stored in the media over an extended time period (e.g., 6 to 12 hours).

Permeable Friction Course (PFC) is an open-graded bituminous mixture placed over an impervious base. The interconnected air voids allow rainwater to drain into the pavement thus providing a safer driving surface in wet weather and a filter for highway runoff.

Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Table 7. Design Attributes to Report for Permeable Pavement

Attribute	Description
Pavement Type	Describes the wearing surface of the permeable pavement. Types may include pervious concrete, porous asphalt, cobblestone blocks, modular blocks, reinforced grass, permeable friction course, etc. Selected from dropdown list.
Design Basis	Design event with an associated depth, duration, and/or frequency. The design basis also could be a percentile event (e.g., the 90th percentile) or a defined storage volume or depth of runoff over the tributary area.
Purpose of Permeable Pavement	Describe the purpose(s) of the permeable pavement (e.g., water quality treatment, reduction in peak surface runoff rate and volume, groundwater recharge, etc.) This information is nice to have.
Ratio of Tributary Area to Pavement Surface Area (hydraulic loading)	Divide the total area draining to the permeable pavement system by the surface area of the permeable pavement. Units for tributary area and pervious pavement surface area must be the same. This is important information.
Description and dimensions of surface layer	Narrative description of the shape of the permeable pavement area and principal dimensions of the shape. For example, for a rectangular permeable pavement area, the length and width of the area should be provided.
Type of asphalt binder	The material that holds the aggregate together in the porous asphalt mix. Most asphalt binders are bitumen-based and may include polymers or other chemicals as additives to modify the elasticity, plasticity, etc., of the mix.
Admixtures	Materials or chemicals that are added to the asphalt mix to improve the strength or durability of the porous asphalt. Common admixtures include polymers, fly ash, and other materials that generally add

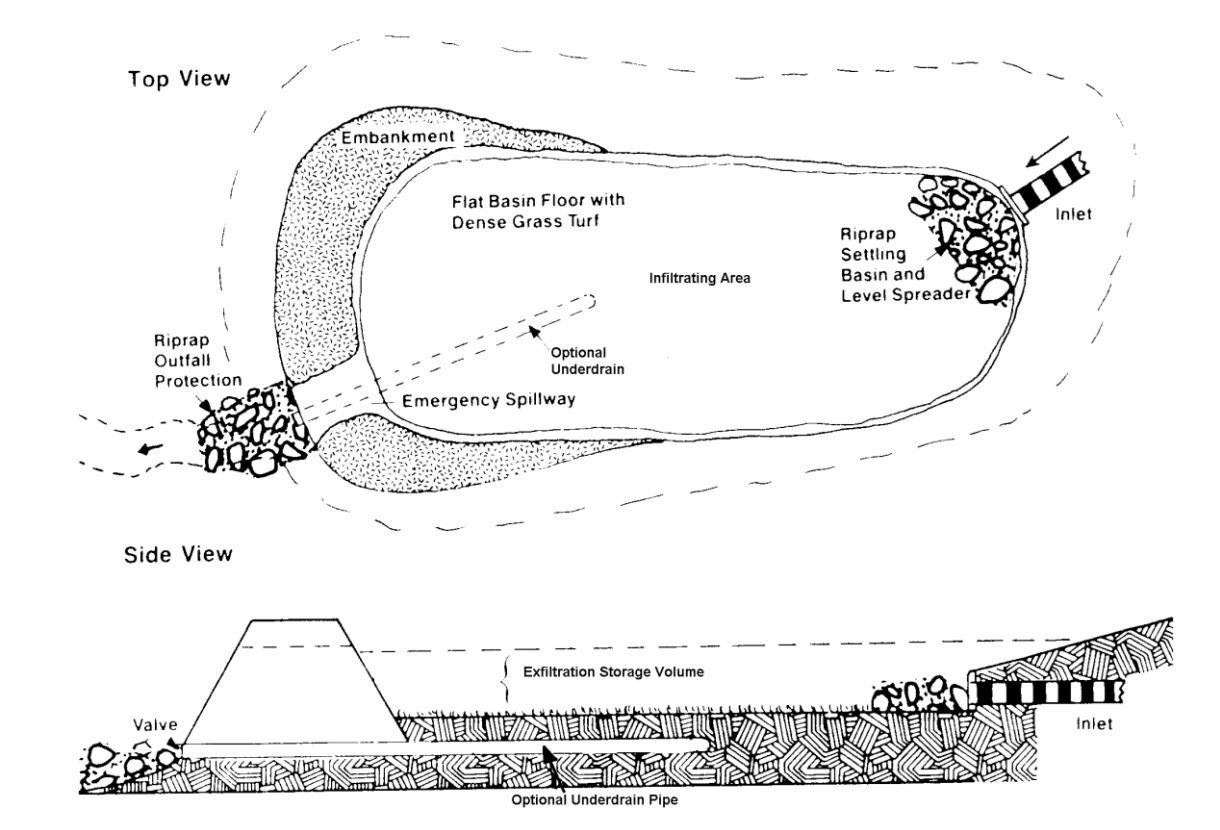
Attribute	Description
	strength and durability to the asphalt while maintaining infiltration capacity.
Surface infiltration rate (at time of study)	The rate, in units of length per time, that runoff is able to penetrate the surface of the permeable pavement system. In most permeable pavement system applications, the surface infiltration rate is not the limiting factor. Rather, the infiltration rate from the aggregate storage layer to the surrounding native soils is typically the controlling factor.
Porous Pavement Surface Area	Surface area of the permeable pavement.
Depth to Groundwater	The minimum depth to the seasonal water table below the permeable pavement.
Depth to Impermeable Layer	The depth to the first impermeable layer below the BMP, if known.
NRCS Hydrologic Soil Group	The Natural Resource Conservation Service Hydrologic Soil Group (e.g., A, B, C, or D) comprising the infiltrating surface beneath the pavement. This classification reflects the infiltration rate of the soil, with Group A soils having the highest rates of infiltration and Group D soils having the lowest. This is important information.
Design Infiltration Rate	Provides information related to the design of the BMP, as opposed to measured infiltration at the site. The design infiltration rate is the rate at which the overall permeable pavement system can infiltrate stormwater runoff. Because of potential for clogging over time, a factor of safety is typically applied to the design infiltration rate to account for blockage and/or reductions in infiltration rates over time. Since different layers of a permeable pavement system may have different infiltration rates, the overall system rate is generally the infiltration rate of the slowest layer. In many cases, the saturated hydraulic conductivity of the underlying soils may be the limiting infiltration rate. This information is nice to have.
Type of Granular or Soil Materials Used in or Below Pavement	Describe the type and depth of each granular material layer under the permeable pavement, if any. Include each layer of geotextile fabric used as though it was a granular layer.
Porosity of Granular or Soil Materials	Provide the porosity (in percent) of the granular or soil filter material. Porosity measures the volumetric portion of the filter material that is not occupied by solid material (for example, clean sands and gravels typically have porosities of 25-50%; this space is occupied by air or water). If the layer is geotextile fabric, give the effective pore size. This is important information.
Is grass growing in modular pores?	Enter Y=Yes or N=No. This is important information.
If yes, is grass healthy?	Enter Y=Yes or N=No. This is important information.
Total Storage Volume in the Granular Media Below Pavement	Give the net available volume of the pore spaces in the granular materials under the permeable pavement, if any. This would normally equal the volume of the granular materials multiplied by their porosity adjusted for loss of volume due to sloping surfaces.
Estimated Drain Time (hrs) of Porous Media Volume	When granular materials under the pavement are used to detain surface runoff which is then released to the surface drainage system,

Attribute	Description
	similar to an underdrain, give the total emptying time (in hours) for this detention volume
Does porous pavement have underdrains?	Enter Y=Yes if this BMP has underdrains, N=No if it does not. The granular base under permeable pavement is frequently drained with the aid of perforated pipes installed at set intervals.
Slope	Slope of the system can be determined by subtracting the lowest elevation of the pervious surface from the highest elevation of the pervious surface and dividing by the distance between these two points.
Aggregate Base	The aggregate base is the layer beneath the wearing course and leveling course in a permeable pavement system that provides structural support for the pavement surface as well as pore space storage of runoff. Provide the size of the aggregate used for this layer as well as the thickness of the layer. If multiple aggregate layers are provided, provide size and thickness for each layer as well as any separator fabric used between layers.
Separation Layer Description	The separation layer in a permeable pavement system may be a geotextile separator fabric, or it may be a layer of aggregate that meets Terzaghi's filter criteria with respect to the layers it is intended to separate. For geotextile layers, describe the type of geotextile separator fabric used. For filter layers based on Terzaghi's filter criteria, provide the gradation of the layer and the thickness. This is important information.
Water Quality Treatment Layer Description	Describe the type and depth of each granular material layer under the permeable pavement, if any. Include each layer of geotextile fabric used as though it was a granular layer.
Degree of compaction of pavement subbase	Specify compaction criteria for the native material beneath the permeable pavement section. If known, identify whether geotechnical testing from the construction phase confirmed if these criteria were met.
Underdrain Description	Diameter, material, slot/perforation dimensions, area of openings per unit length, spacing between separate underdrain lines, and other parameters that describe the underdrain.
Depth of Underdrain Below Surface	This is the depth from the surface of the permeable pavement system to the lowest point of the underdrain pipe.
Comments	Narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

Infiltration Basin Design Data

An infiltration basin is a basin that can capture a given stormwater runoff volume and infiltrate it into the ground, transferring this volume from surface flow to groundwater flow. A schematic of an infiltration basin is provided below.

Figure 14. Infiltration Basin Schematic Design
(Source: Schueler 1987)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are <u>required</u> information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

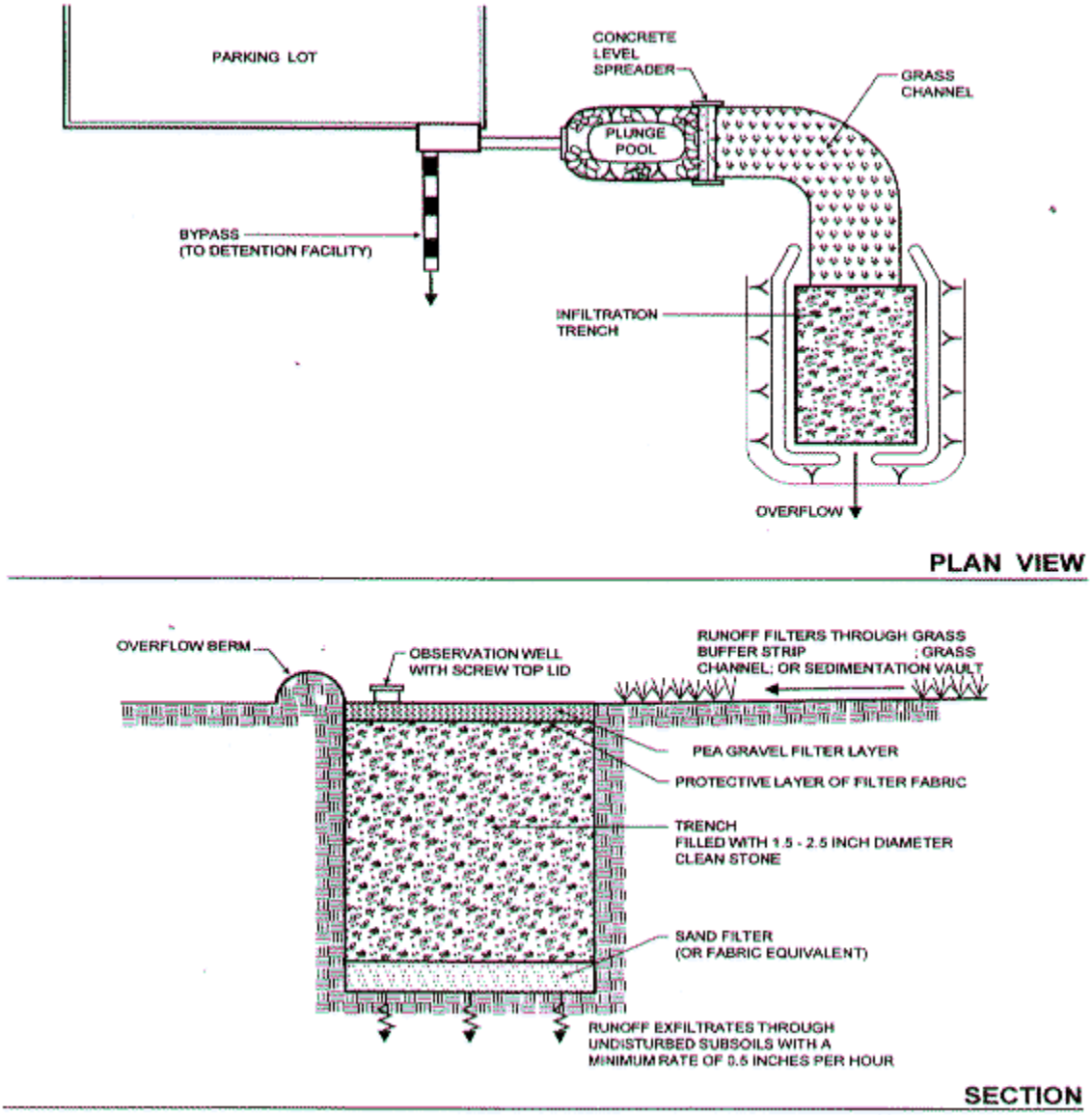
Table 8. Design Attributes to Report for Infiltration Basins

Attribute	Description
Forebay (Yes/No/Unknown)?	Identify whether a forebay is provided by entering yes/no/unknown.
Infiltrating Surface Area	The plan area of the surface used to infiltrate the water quality volume.
Capture Volume of Basin	The design runoff capture volume of the basin.
Basin Length	Length of the infiltration basin, measured as the distance between inflow and outflow. This information is nice to have.
Depth to Impermeable Layer	Depth to the impermeable layer, if any.
Depth and Type of Each Soil Layer Below Basin	Give the order of stratification (from the surface downward) and the depth of each layer of soils at the infiltration basin site, to a depth of at least ten feet (3.05 meters). This is important information.
Hydraulic Conductivity of Underlying Soils	The hydraulic conductivity of the soils underlying the infiltration surface. Hydraulic conductivity is an expression of the permeability of a material. This is important information.
Soil Group	The Natural Resource Conservation Service Hydrologic Soil Group (e.g., A, B, C, or D) comprising the infiltrating surface. This classification reflects the infiltration rate of the soil, with Group A soils having the highest rates of infiltration and Group D soils having the lowest. This is important information.
Granular Material on Infiltrating Surface	Describe the granular material, if any, and its depth and porosity, if such material is used to cover basin's bottom instead of grass.
Plant Species on Infiltrating Surface	List the plant species (by Latin names, if known) and densities of cover on the bottom of the infiltration basin.
Infiltration Rate	The saturated soil infiltration rate, based on soil surveys, infiltrometer measurements or observed drawdown of a new basin. This is important information.
Flood Control Volume above Water Quality Detention Volume	It is often feasible and desirable to establish the infiltration basin within a larger flood control facility. If this is the case for this basin, record the volume of the flood control detention volume above the infiltration basin volume. This is important information.
Surface Area of Capture Volume When Full	The area of the water surface in the infiltration basin, when full.
Depth to Groundwater	Depth to the seasonal high groundwater table.
Comments	Narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

Percolation Trench and Dry Well Design Data

Percolation or infiltration trenches can be generally described as a ditch filled with porous media designed to encourage rapid percolation of runoff to the groundwater. A dry well is a drilled well, often drilled through impervious layers to reach lower pervious layers, filled with porous media designed to percolate surface water to groundwater. An illustration of an idealized percolation trench is provided below.

Figure 15. Infiltration Trench Design Example
(Source: http://www.stormwatercenter.net/Manual_Builder/infiltration_design_example.htm)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

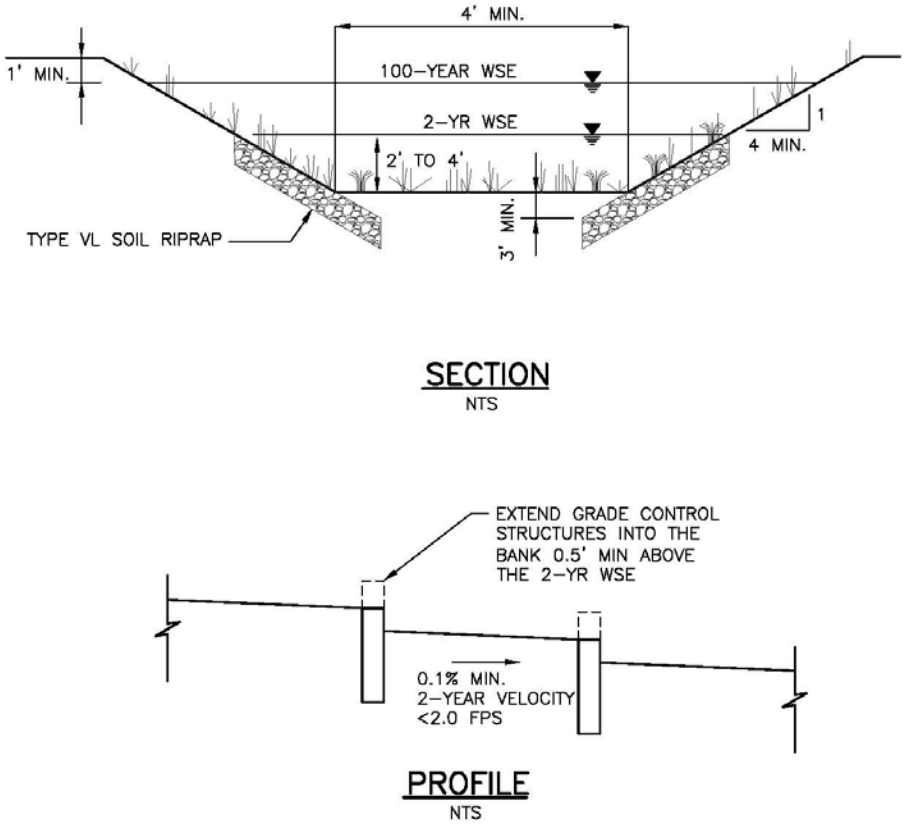
Table 9. Design Attributes to Report for Percolation Trenches and Dry Wells

Attribute	Description
Percolation Trench/Well Surface Area	The top surface area of the percolation trench or well.
Total Storage Volume	Give the volume of the available pore space in the granular materials. This will normally equal the product of the volume of granular material and its porosity.
Percolation Trench/Well Length	The length of the percolation trench, or the diameter of the well.
Depth to Impermeable Layer	The depth to the first impermeable layer below the trench or well.
Depth and Type of Each Soil Layer	Provide the order of stratification (from the surface downward) and the depth of each layer of soils at the BMP site.
Hydraulic Conductivity of Soils	The hydraulic conductivity of the soils adjacent to the trench or well infiltration surfaces. Hydraulic conductivity is an expression of the permeability of porous material.
Porosity of Granular Material	Give porosity (in percent) of the granular fill material. Porosity measures the portion of the fill material volume that is not occupied by solids (for example, clean sands and gravels typically have porosities of 25-50%; this volume is occupied by air or water). If the layer is geotextile fabric, give the effective pore size.
Percolation Trench/Well Depth	The depth at which the trench or well is exposed to permeable soils.
Type and Gradation of Granular Materials Used	Describe the type and depth of granular material used in the trench or well.
Depth to Groundwater	The minimum depth to the seasonal high groundwater table below the trench or well.
Describe Geotextile Use (if any)	Describe whether geotextile was used above granular fill, on the sides of fill, or on the bottom of fill. Include description of geotextile characteristics.
Comments	Narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

Wetland Channel and Swale Design Data

A **wetland channel** is a channel designed to convey flow very slowly, often less than 2 ft/sec at the 2-year flood peak flow rate. A wetland channel is designed to support dense wetland vegetation on its bottom.

Figure 16. Constructed Wetland Channel
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

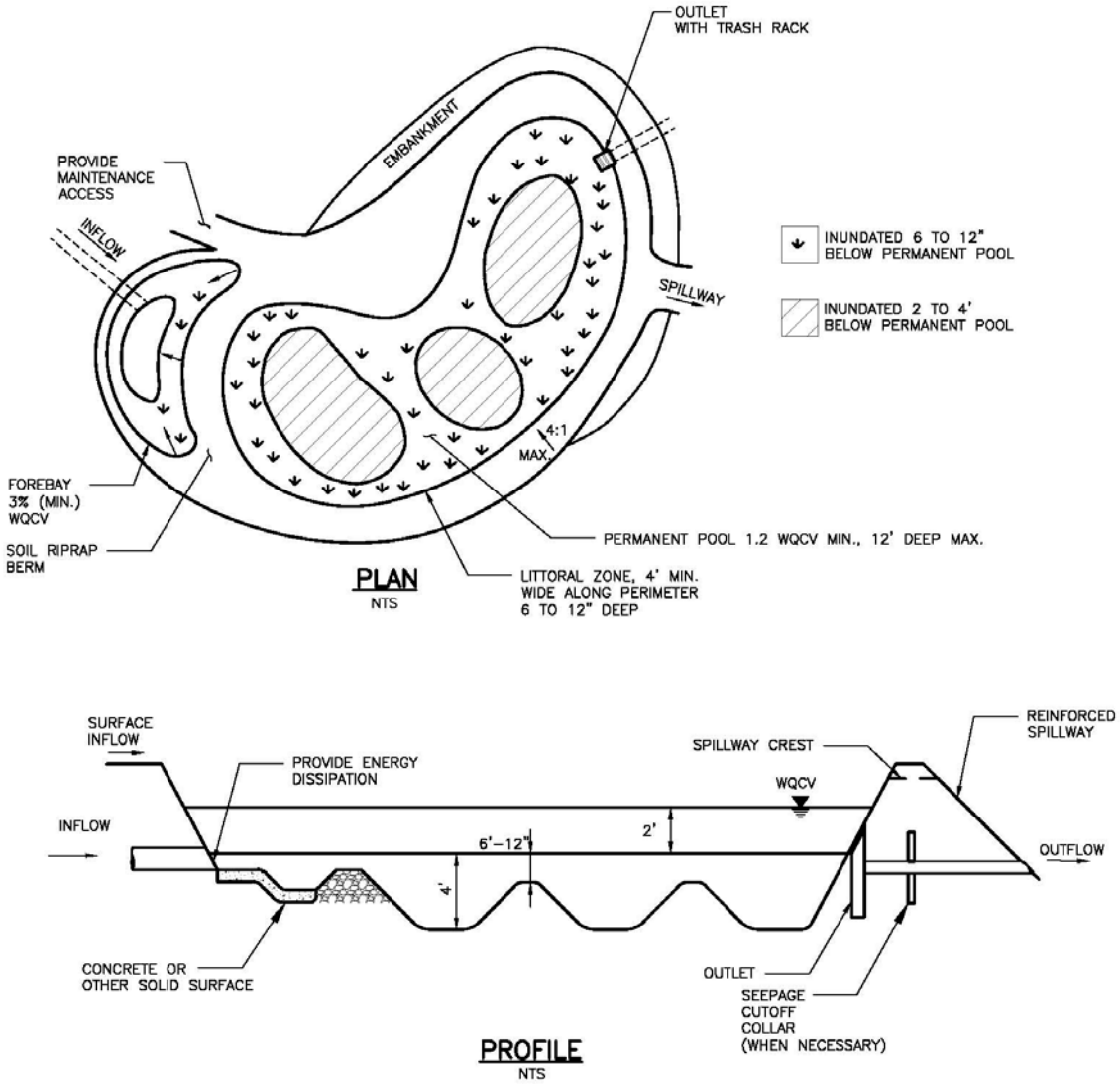
Table 10. Design Attributes to Report for Wetland Channels and Swales

Attribute	Description
Length of Channel/Swale	The length of the wetland channel or swale, from the stormwater inflow to outflow point.
Longitudinal Slope of Channel/Swale	The average longitudinal slope (in unit length per unit drop, e.g., feet per feet or meter per meter) of the wetland channel or swale, as measured between grade control structures.
Bottom Width of Channel/Swale	The average width of the nearly-flat bottom of the channel or swale between its side slopes.
Side Slope of Channel/Swale	The average (in vertical unit length per horizontal unit length) of the channel or swale's side slopes.
2-Year Flow Design Depth in Channel/Swale	The average depth of water in the channel or swale during the two-year flood peak flow.
2-Year Peak Design Flow Velocity	The flow velocity in the channel or swale during the two-year flood peak flow.
Plant Species in Wetland Zone/Swale	List the plant species, percent of cover and densities.
Maximum Design Flow Capacity Return Periods	The flood return period that the channel has been designed to convey within its banks in addition to the water quality design event. (Example: 2-year and 10-year flood). This information is nice to have.
Comments	Narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

Wetland Basin Design Data

A wetland basin is a BMP similar to a retention pond (with a permanent pool of water) with more than 50 percent of its surface covered by emergent wetland vegetation, or similar to a detention basin (no significant permanent pool of water) with most of its bottom covered with wetland vegetation.

Figure 17. Wetland Basin
(Source: Urban Drainage and Flood Control District, Denver, CO 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Table 11. Design Attributes to Report for Wetland Basins

Attribute	Description
Forebay (yes/no/unknown)?	Identify whether a forebay is provided by entering yes/no/unknown.
Permanent Pool Volume	Volume of the permanent pool of water, if any.
Permanent Pool Surface Area	Area of the water surface in the permanent pool, if any.
Permanent Pool Length	Length of the permanent pool of water, if any, measured as the distance between inflow and outflow. If more than one inflow point, use the average distance between the inflow points and the outflow weighted by the tributary impervious area.
Water Quality Detention Volume	Wetland basins may be designed to handle a specified volume of runoff above the permanent pool, releasing this surcharge volume to the pool over a specified period of time through an outlet structure. Specify the surcharge detention volume when full.
Water Quality Detention Volume Surface Area When Full	The surface area of any supplementary water quality detention volume above the permanent pool when full, if applicable.
Water Quality Detention Volume Length	Length of the water quality detention volume when full, measured as the distance between inflow and outflow. If more than one inflow point, use the average distance between the inflow points and the outflow weighted by the tributary impervious area.
Brim-full Water Quality Volume Emptying Time (hrs)	The period of time (in hours) required for the wetland basin's water quality surcharge detention volume to be released down to the permanent pool level.
Flood Control Volume	It is often feasible and desirable to incorporate the wetland basin within a larger flood control facility. If this is the case for this basin, record the volume of the flood control detention volume above the wetland basin volume.
Describe Vegetation	Provide type and percent cover of the wetland basin by each wetland species, and densities.
Wetland Surface Area	Surface area of the wetland basin, including all pond areas and meadow wetland areas. Use permanent pool surface area if no other wetland area exists adjacent to the pool.
Describe wetland water depths and features	If available, provide pond depth percentages as follows: • Percent of Pond with 6" (0.15 m) Depth • Percent of Pond with 6 -12" (0.3 m) Depth • Percent of Pond with 12 - 24" (0.3 - 0.6 m) Depth • Percent of Pond with 24 - 48" (0.6 - 1.3 m) Depth • Percent of Pond with > 48" (>1.3 m) Depth • Percent of area that is meadow wetland
Comments	Narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

Manufactured Treatment Device Design Data

The Manufacture Treatment Device (MD) category represents a wide range of various proprietary and non-proprietary device types. BMPs categorized as Manufactured Treatment Devices incorporate or emphasize a variety of different unit processes and design elements (e.g., storage versus flow-through designs, inclusion of media filtration, etc.) that vary significantly throughout the category. Table 12 lists the BMP Database analysis subcategories for these practices.

The BMP Database Project has a written policy regarding inclusion of proprietary products in the BMP Database, which can be downloaded from the project website under "Policies." This policy is updated periodically and is intended to support the BMP Database project in maintaining an unbiased manufactured treatment device data set, requiring third party involvement and/or varication of studies submitted to the BMP Database.[4]

Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Table 12. Manufactured Treatment Device Analysis Categories for BMP Database

Analysis Category	Category Description	Description
HRBF	High Rate Biofiltration	Media filtration devices that support plants.
HRMF	High Rate Media Filtration	Media filtration devices with a variety of inert and sorptive media types and configurations (e.g., cartridge filters, upflow filters, membrane filters, vertical bed filters, etc.)
CBI	Catch Basin Inserts	Catch basin insert devices designed primarily for gross solids capture and oil & grease absorption.
MCTT	Multi-chamber Treatment Train	Multiple treatment processes in series, such as screening, sedimentation, skimming, and engineered media filtration.
HDS	Hydrodynamic Separators	Gravitational settling with hydrodynamic devices.
OGS	Oil/Grit Separators and Baffle Boxes	Oil/grit separators and baffle boxes designed for removing floatables and coarse solids.
VC	Volume Control/Attenuation	Detention vaults, pipes, or other structures with open bottoms that allow infiltration of stored water.
OT	Other	Unique practices that should be evaluated separately such as custom active treatment designs, trash nets.

[4] Mention of trade names or commercial products in the BMP Database, website, or associated work product does not in any way constitute endorsement or recommendation by the Project Sponsors or Project Team for their use as BMPs. Similarly, omission of products or trade names from the BMP Database does not indicate a Project Sponsor or Project Team position regarding the product effectiveness or applicability. Many different vendor technologies are commercially available for which there are no data currently included in the BMP Database. The data that have been included in the BMP Database are voluntarily submitted for inclusion by third parties and accepted into the BMP Database by the Project Team in accordance with the data protocols.

Table 13. Design Attributes to Report for Manufactured Treatment Devices

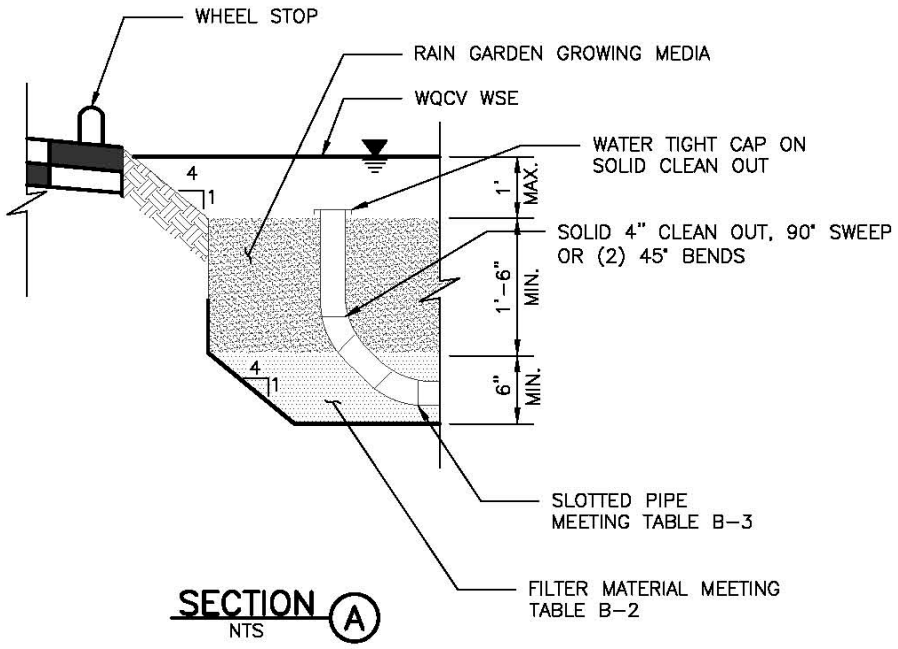
Attribute	Description
Analysis Category	Select BMP Database Analysis Category from pick-list: HRBF, HRMF, CBI, MCTT, HDS, OGS, VC, OT. (See Table 12 for additional explanation.)
Device Type	Select device type that best describes the Manufactured Treatment Device from pick-list: Flow through - single-chamber, Flow through - multi-chamber, Volume Capture - extended detention w/ pool, Volume Capture - extended detention w/o pool, Media Filter- single-chamber, Media Filter - multi-chamber, Catch basin insert, Multi-chambered Treatment Train, Underground infiltration chamber, High-rate biofiltration unit, High-rate media filtration unit, Oil and Water Separator, Other. (Note this attribute supplements the Analysis Category.)
Device Name, Model, Date	Device Name, Model, Date are important information for BMP Database users to obtain additional information on the device unit. This information may also be used to "screen" for obsolete units included in the BMP Database.
Describe Unit Treatment Processes	List unit treatment processes present in the BMP, entered as comma-separated list.
Manufacturer	Provide manufacturer's name.
Field Verification Program	Provide field verification program name, if applicable. Examples include TAPE and NJCAT, as two examples. If a Pre-Approved Technology Evaluation Facility was used for testing, include the facility name.
Targeted Pollutants	List the targeted pollutants are the water quality constituents that the Manufactured Treatment Device is best suited for removing from stormwater runoff. For example, a BMP based on coarse screening might target gross solids as a pollutant for removal; however, such a system would not likely target dissolved phosphorus, since there would be no unit process capable of removing this pollutant for this type of BMP. This information is important.
Treatment Level Certified	List the treatment level certified as part of the study, if applicable. This information is important.
Pollutant Type Certified	List the pollutant type for which the Manufactured Treatment Device was certified as part of the study, if applicable. This information is important.
Sizing Methodology	Describe the basis of design for the Manufactured Treatment Device. This may be a design event that is described by depth, duration, frequency, and/or intensity; it may be a predetermined depth of rainfall or runoff; it may be a percentile storm (e.g., 90th percentile event); or it may be a maximum design flow rate.
Design Inflow Rate	Describe design inflow rate(s) for treatment, include maximum rate if different. For Manufactured Treatment Devices that are sized based on a design or maximum flow rate, indicate the range of flow rates that the device is intended to treat. If there is a flow rate above which bypass occurs, also indicate this flow rate. Provide in narrative column if a range or description is needed.

Attribute	Description
Design Hydraulic Loading Rate	The design hydraulic loading capacity is expressed as flow per unit surface area. The design hydraulic loading capacity should be provided by the manufacturer. It can be calculated by dividing the flow rate for a design event by the plan-view surface area of the Manufactured Treatment Device.
Measured Hydraulic Loading Rate during Study	Provide the measured hydraulic loading rate during the study.
Describe Design Outflow Rate	Describe outflow rates corresponding to the inflow rate listed above. Note that for flow-through Manufactured Treatment Devices, outflow rates may equal inflow rates. For storage-based Manufactured Treatment Devices, outflow rates generally are lower than inflow rates, since the storage provides attenuation of peak flow rates.
Describe Outlet Conditions/Features	Provide a geometric description of the Manufactured Treatment Device outlet. Examples would include number of orifices, diameter of orifices, weir length, etc. Also identify whether the outfall is controlled by gravity or pumped.
Water Quality Design Volume	Manufactured Treatment Devices may be designed to handle a specified volume of runoff above a permanent pool, releasing this surcharge volume over a specified period of time through an outlet structure. If so, provide the water quality design volume when full.
Describe Physical Features/Geometry	Describe the physical features and geometry of the device including surface area, length, depth, volume, treatment train configuration and other important characteristics of the device.
Permanent Pool Volume, if any	Provide the permanent pool volume, if any. Enter none if not applicable.
Describe Media Characteristics, if any	Media Filter or Insert Design Parameters include basic dimensions of the filter media, including parameters such as surface area, thickness, volume, number of cartridges, and other information.
On-line or Off-line Configuration	Describe whether the device is installed in an on-line or off-line configuration.
Problems/ Limitations (if any)	Identify any known installation problems or study conditions that affect performance. This information is nice to have.
Maintenance Frequency Recommended by Manufacturer	Describe maintenance practices including sediment removal; disposal of hydrocarbon absorbent mats; pumping out of water, sediment and/or other captured materials; etc. Describe how frequently these maintenance activities should be performed to enable the Manufactured Treatment Device to continue to function as designed. This information is nice to have.
Maintenance Frequency during Study	Describe the maintenance frequency during the study. This information is important.
Comments	Narratively describe other aspects of the BMP that are relevant to understanding the study. This information is nice to have.

Bioretention Design Data

Bioretention areas, or rain gardens, are landscaping features adapted to provide on-site treatment of stormwater runoff. They are commonly located in parking lot islands or within small pockets of residential land uses. Surface runoff is directed into shallow, landscaped areas with engineered soils, with or without underdrain systems. The filtered runoff can be collected in a perforated underdrain and returned to the storm drain system or infiltrated into the ground.

Figure 18. Bioretention Cell with Partial Infiltration Section
(Source: UDFCD 2010)



Relevant fields for this BMP are described below. **Units** of measurement must also be provided. All of the requested design fields are required information necessary for the BMP test evaluation, unless otherwise noted or unless the design feature does not exist in the BMP design.

Table 14. Design Attributes to Report for Bioretention

Attribute	Description
Type of Bioretention	Select bioretention type from pick-list provided in dropdown box. • Bioretention Cell – Non-linear, not associated with conveyance. • Off-line bioretention area – Placed next to swale at lower elevation to increase storage • In-line bioretention area – Linear, incorporating cell and swale characteristics for conveyance as well as retention and treatment, but low velocity. • Sloped (weep garden) bioretention area – Behind retaining wall on relatively steep gradient. • Sloped biodetention vegetative barrier – Placed along slope contour to retard runoff. • Tree box filter – Enlarged planting pit, usually with drain inlet and underdrain.
Forebay?	Provide yes/no/unknown answer regarding whether a forebay is present.
Ratio of Tributary Area to Bioretention Surface Area	This ratio can be determined by dividing the area of the drainage basin contributing runoff to the bioretention area by the surface area of the bioretention area. Both the tributary area and bioretention surface area should have the same units to calculate a proper ratio.
Is Pretreatment Provided?	Provide yes/no/unknown answer. Pretreatment for bioretention facilities may include sediment forebays, filtration via a grass buffer or swale, or other methods to remove gross solids and other coarse pollutants. Not all bioretention areas include pretreatment. This is important information.
Pretreatment Description	If a pretreatment area is provided, describe the pollutants targeted by the pretreatment area, as well as physical characteristics of the pretreatment area, including plan-view and vertical dimensions, construction materials, primary unit processes, etc.
Flow Entrance Description	Describe how flow enters the bioretention area. Flow may enter the bioretention area via a curb cut, a closed conduit, as surface sheet flow, etc. This is important information.
Bioretention Surface Area	This is the plan-view surface area of a bioretention facility. This is also typically equivalent to the plan-view area of inundation for the design event.
Ponding Volume above Bioretention Media Surface	Describe the volume of temporary storage provided above the ground surface in a bioretention facility for the design event.
Average Ponding Depth above Media Surface	The average ponding depth can be calculated by dividing the ponding volume by the surface area.
General Shape of Bioretention Feature	Describe the geometric shape of the bioretention facility (e.g., rectangular, circular, curvilinear, etc.). Provide approximate principal dimensions of shape if available or if they can be estimated from photographs or other documentation.

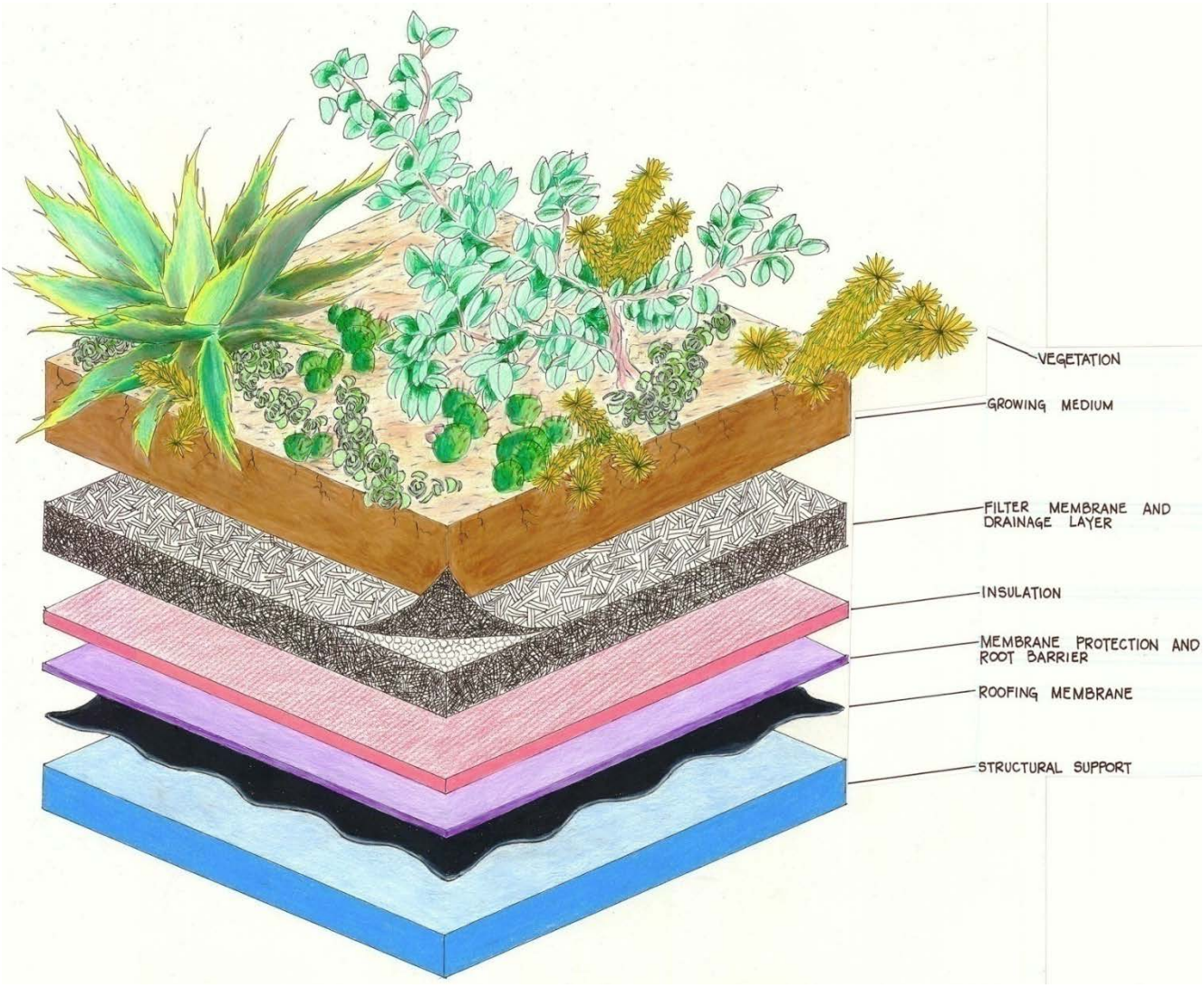
Attribute	Description
Is "Internal Water Storage Zone" Created?	Enter yes/no/unknown. For bioretention facilities with underdrains, an internal water storage zone can be created by "perching" the underdrain pipe above a portion of the media underlying the bioretention facility. The internal water storage zone generally has no outlet other than infiltration into the underlying native soil.
Subsurface Storage Volume	The subsurface storage volume is the volume that is provided in the pore space of the bioretention media beneath the ground surface. The subsurface volume can be calculated by multiplying the volume of media used by the porosity of the media.
If subsurface storage provided, then height of outlet above bottom of bioretention media	Provide the difference between the outlet invert elevation and the bottom of the bioretention media elevation in units of length.
Bioretention Media Depth	The bioretention media depth can be determined by dividing the total volume of the media by the surface area over which the media is placed. This will provide an average depth.
Bioretention Media Design Specifications/ Description	Describe properties of the bioretention media including composition of the media, compaction criteria, gradation specifications, design infiltration rate, moisture content, organic content, and other physical and chemical characteristics. As part of this description, identify whether natural soils or amended soils are used. Provide relevant information on supplemental media characteristics such as clay content, pH, cation exchange capacity, carbon:nitrogen ratio, moisture content, metals contents, inerts contents
Describe Media Phosphorus Content	Phosphorus (P) content of bioretention media can influence phosphorus retention or export from bioretention media. A variety of soil tests are available to characterize the phosphorus content in soil; however, there is some regional variation in how these results are reported. To account for this regional variation, provide phosphorus concentration in mg/kg, where available. A "P" index may also be provided, including the state in which the test is conducted. The NRCS "P" index includes a combination of eight characteristics that include a soil phosphorus test (concentration) but also factors including soil erosion, irrigation erosion, runoff class, P fertilizer application rate, P fertilizer application method, organic P source application rate, and organic P source application method. This information is important. For more information on "P" Index, see https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/rca/?cid=nrcs143_014203.
Describe Vegetation	Provide a characterization of the vegetated community present in the bioretention facility such as species, canopy layers and their approximate cover, and other factors.

Attribute	Description
Describe Mulch (if present)	Mulch is often placed in bioretention facilities to provide surface area for trapping sediment and to protect underlying media from raindrop impact erosion and wind erosion. Mulch also may help to retain soil moisture for plant growth and to protect recently germinated plants from intense sunlight. There are many different types of mulch including wood-chip mulch, gravel mulch, etc. Describe the type of mulch and application depth.
Surface Infiltration Rate (at time of study)	The surface infiltration rate is the average rate at which soil percolates into the soil from the surface ponding area.
Design Infiltration Rate (including safety factor for clogging)	The design infiltration rate is the rate at which the bioretention system can infiltrate stormwater runoff. Because of potential for clogging over time, a factor of safety is typically applied to the design infiltration rate to account for blockage and/or reductions in infiltration rates over time. Since different layers of a bioretention system may have different infiltration rates, the overall system rate is generally the infiltration rate of the slowest layer. In many cases, the saturated hydraulic conductivity of the underlying soils may be the limiting infiltration rate.
Number of Underdrains Provided (if none, enter 0)	Describe the number of perforated underdrain lines provided for the bioretention facility (if none, enter 0).
Description and Dimensions of Underdrain(s), if present	Provide the diameter, material, slot/perforation dimensions, area of openings per unit length, spacing between separate underdrain lines, and other parameters that describe the underdrain.
Underdrain Gravel Layer Thickness, if present	If the underdrain pipe is embedded in gravel or if a gravel layer alone is used as an underdrain, provide the thickness of this layer.
Description and Dimensions of Surface Overflow, if present	A surface overflow directs runoff in excess of the ponded storage volume out of the bioretention facility. Typical surface overflow structures include weirs and/or stand pipes.
Is a Hydraulic Restriction Layer (Liner) Provided? (Yes/No/Unknown)	Provide yes or no answer. A hydraulic restriction layer may be a geo-membrane (liner) or a naturally occurring or anthropogenic layer of very low permeability (e.g., clay).
Description of Hydraulic Restriction Layer, if present	If a hydraulic restriction layer is present, describe the type and thickness of the layer (e.g., PVC geo-membrane, 30-mil plastic, compacted clay, etc.).
Seasonal High Water Table Position Relative to Invert	This is the depth from the lowest point of the underdrain system to the seasonal high-water table.
Comments	Narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

Green Roof Design Data

Green roofs, also known as vegetated roof covers, eco-roofs or nature roofs, are multi-beneficial structural components that help to mitigate the effects of urbanization on water quality by filtering, absorbing or detaining rainfall. They are constructed of a lightweight soil media, underlain by a drainage layer, and a high-quality impermeable membrane that protects the building structure. The soil is planted with a specialized mix of plants that can thrive in the harsh, dry, high temperature conditions of the roof and tolerate short periods of inundation from storm events.[5]

Figure 17. Typical Green Roof Cross Section
(Source: UDFCD 2010, Graphic by Adia Davis)



See the LID website (http://www.lid-stormwater.net/greenroofs/greenroofs_home.htm) or the

[5] Definition from Velazquez, Exploring the Ecology of Organic Green Roof Architecture (www.greenroofs.com).

Green Roof (http://www.greenroofs.com/) website for more information about Green Roof design features. All fields associated with Green Roofs are required information unless otherwise noted.

Table 15. Design Attributes to Report for Green Roofs

Attribute	Description
Roof Type (Intensive or Extensive)	Extensive green roofs typically feature a growing medium of four inches or less. An extensive green roof weighs less than an intensive green roof and contains shallow growing medium. These types of green roofs may be continuous or modular consisting of a series of trays that contain the growing media and vegetation. Intensive green roofs feature a growing medium depth of more than four inches. These may resemble conventional gardens due to their deeper growing medium. A wider range of plant material choices is possible on an intensive or semi-intensive green roof.
Purpose of Roof	Green Roofs may be implemented for a variety of environmental and aesthetic reasons. Provide a short description of the purpose of the roof (e.g., stormwater treatment, LEED credit, heat island reduction, outdoor living environment, etc.).
Describe Green Roof	Describe the key features of the green roof design.
Describe Vegetation	Identify the types of vegetation planted on the roof and the general condition of the vegetation. For example, sedum spp. in healthy condition with 90 percent coverage of the green roof surface area.
Irrigation provided?	Identify whether supplemental irrigation is provided on the green roof by answering yes (Y) or no (N).
Roof Media's Surface Area	Provide the area covered by the growing medium.
Roof Slope (0 to 90 degrees)	This field identifies whether the roof is flat or sloping. Enter 0 for a flat roof or the dimensionless slope value, if the roof is sloping.
Number of Media Layers	Identify the number of layers associated with the growing media.
Type and Depth (or Thickness) of Each Media Layer	Describe the type and depth or thickness of each media layer.
% Compost or Organic Material of Media at Installation	Organic matter in growing media can affect nutrient export from the roof. This information is nice to have.
Description of Roofing Material	Describe the roofing membrane**.**
Detention Volume	This is the design water quality capture volume for the green roof.
Detention Volume's Drain Time in Hours	The design time for complete drawdown (in hours) of the water quality capture volume if the drain time is controlled by a flow regulating device such as an orifice. Leave blank if the drain rate is only a fraction of the growing media's flow-through rate.
Underdrain Description	Describe the key features of the green roof underdrain design.
Comments	Provide any additional information needed to properly evaluate the green roof's performance. This information is nice to have.

Stormwater Harvesting (Cisterns/Rain Barrels)[6] Design Data

Stormwater harvesting systems can range from simple residential cisterns (rain barrels) that collect runoff from a single residential rooftop to supplement landscape irrigation to advanced rainwater harvesting systems at the development scale that can be supplemented with potable water and used for toilet flushing, irrigation systems, car washing and other non-potable uses. Key benefits of rainwater harvesting include reduced runoff volumes and reduced potable water demand.

Figure 19. Schematic of a Simple Residential Rainwater Harvesting System
(Source: North Carolina State University[1], http://www.bae.ncsu.edu/topic/waterharvesting/layout.html)

[6]Rainwater harvesting information adapted from North Carolina State University Biological Agricultural Engineering Program, Stormwater Engineering Group, and Cooperative Extension (http://www.bae.ncsu.edu/topic/waterharvesting/index.html) and personal communication with Dr. William Hunt, North Carolina State University.

Table 16. Design Attributes to Report for Stormwater Harvesting

Attribute	Description
Basic System Description	Provides a narrative description of the harvesting system components, scale of application, and intended uses.
Number of Units in Watershed	Provides quantification of the scale on which rainwater harvesting is being implemented in the watershed.
Contributing Rooftop Size	Determines the expected runoff volume available for harvesting for various storm events.
Roofing and Gutter Material	Provides information potentially affecting water quality of the rooftop runoff (e.g., from metal fixtures).
Storage Volume	Provides the maximum capture volume of the cistern. The cistern is the main component of a water harvesting system. Cisterns are generally made from either metal or plastic and come in a wide variety of sizes. The volume of the cistern depends on rainfall and usage data and can be sized using a computer model.
Drain Time at Capacity (minutes)	Provides information regarding the storage recovery of the system following a precipitation event.
Expected Long-term Capture Volume	Provides the expected benefit of the system based on computer simulation used determine the appropriate cistern size. Models are typically based on rainfall data and anticipated usage to establish cistern inputs and outputs. This is important information.
Model Used for Capture Volume Simulation	Provides supporting information regarding the basis of the expected long-term capture volume. A variety of computer programs are available for this purpose and may yield differing results. This is important information.
% Bypass	Describes percent bypass of the system, which is relevant to hydrologic performance of the system.
Describe Emergency Spillage (Overflow)	The overflow provision allows runoff to bypass the cistern when it has reached maximum capacity.
Describe Mosquito Prevention	Mosquito prevention may include a screen at points where standing water could be exposed to the outside environment to prevent mosquitoes from breeding within the cistern. This information is nice to have.
Intended Use of Captured Water	Intended Use of Captured Water may include a variety of applications such as supplemental irrigation, primary irrigation, toilet flushing, groundwater recharge, or other non-potable uses. This information is nice to have.
Can Potable Water Supplement Tank?	Provide yes or no answer. In situations where reliable water availability is important, a supplemental water supply may be an important consideration enabling practical use of the system.
Type of Irrigation System	Provides supplemental information regarding how the harvested rainwater is used and can range from simple to complex applications. This information is nice to have.
Reason System Selected	Describes the objectives of the rainwater harvesting system, which may or may not include stormwater runoff reduction as an objective.
Comments	Narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

Low Impact Development (LID)[7] Design Data

Low Impact Development (LID), also known as Green Infrastructure (GI), is an overall site design approach that is intended to mimic pre-development hydrology through the use of dispersed on-site controls. These sites typically have multiple small BMPs dispersed at the lot level through a development, rather than having the traditional detention pond located at the low corner of the development. See http://www.lid-stormwater.net for detailed information. All fields provided below are required.

Table 17. Design Attributes to Report for Low Impact Development

Attribute	Description
List BMPs Monitored Within LID Site (as entered into BMP Database).	Relates overall LID site design to individual practices monitored and/or implemented at the site (e.g., bioretention, permeable pavement).
Describe Site Design	Narratively describe the key features of the site design.
Describe Monitoring Design	Narratively describe the key features of the monitoring design. For example, the data provider may monitor a comparable development as a reference site. Monitoring may occur at multiple BMPs, or may occur at a few separate representative outflow locations. (More detailed guidance on LID monitoring designs may be obtained in the *Urban Stormwater BMP Performance Monitoring Manual* accessible at www.bmpdatabase.org).
Method for Flood Control	Identifies flood control method and the extent to which LID is used for water quality and flood control, or water quality only. Some LID sites have "hybrid" characteristics incorporating LID practices with traditional flood control approaches (e.g., are centralized detention and LID techniques).
Narrative Descriptions of LID Practices: Describe the extent to which the following LID practices are implemented at the overall site:	
Conservation Features	Include conserving natural areas Includes preservation of existing trees, other vegetation, and soils.
Minimizing Disturbance	Includes minimizing soil excavation and compaction and vegetation disturbance.
Minimizing Building Coverage	Includes minimizing impervious rooftops and building footprints.
Minimizing Travelway Coverage	Includes constructing streets, driveways, sidewalks, and parking lot aisles to the minimum widths necessary, provided that public safety and a walkable environment for pedestrians are not compromised.
Maintaining Natural Drainage Patterns and Designing Drainage Paths to Increase Time of Concentration	Includes measures such as: maintaining depressions and natural swales; emphasizing sheet flow instead of concentrated flow; increasing the number and lengths of flow paths; maximizing non-hardened drainage conveyances; and maximizing vegetation in areas that generate and convey runoff.

[7] Site-level LID reporting parameters based on communication with Dr. Richard Horner, University of Washington, December 2008.

Attribute	Description
Source Controls	Include minimizing pollutants; isolating pollutants from contact with rainfall or runoff by segregating, covering, containing, and/or enclosing pollutant-generating materials, wastes, and activities; conserving water to reduce non-stormwater discharges.
Permeable Pavements	Include constructing low-traffic areas with permeable surfaces such as porous asphalt, open-graded Portland cement concrete, coarse granular materials, concrete or plastic unit pavers, and plastic grid systems. Representative applications may include driveways, patio slabs, walkways and sidewalks, trails, alleys, and overflow or otherwise lightly-used parking lots.
Natural Drainage System Elements	Include bioretention areas (rain gardens), vegetated swales, vegetated filter strips and other similar features.
Stormwater Harvesting	Includes use of cisterns, rain barrels or rain storage units
Green Roof (vegetated)	Green roofs include vegetated roofs with stormwater-related design components.
Other Site Features (including traditional BMPs)	Describe other key site features or traditional BMPs.
Comments/Other Description	Narratively describe other aspects of the LID site that are relevant to understanding the study. Ideally, LID studies will provide a more detailed evaluation of hydrologic performance. See guidance below for reporting hydrologic parameters.

Hydrologic Parameters

Several hydrologic parameters are also requested to enable comparisons between LID sites. (More information on these parameters can be obtained in the *Urban Stormwater BMP Performance Monitoring Manual*, which is the source of the descriptions provided below.)

Estimate of Hydrologically Available Temporary Storage at Site This information helps to normalize the relationship between source areas and storage areas, both in terms of routing and relative volume for purposes of comparing LID sites. Tabular estimates of detained, retained and excess volume for a range of storm events are beneficial in developing these estimates. A PDF providing this information can be attached separately, or this information can be summarized narratively. Also provide units of measurement (e.g., acre-feet, watershed inches). This is nice to have information.

The concept of "hydrologically available temporary storage" can be used to describe the storage volume of a LID site. Hydrologically available temporary storage at the site potentially includes the following components:

- Surface storage (e.g., natural, pervious, and impervious depression storage; surface retention) that is not surface discharged. This represents volume that is eventually lost through evapotranspiration and/or infiltration but would not have become surface discharge.

- Surface storage (e.g., natural, pervious, and impervious depression storage; surface detention) that is eventually surface discharged after detention and/or infiltration occurs whereby slowing the surface discharge.

- Subsurface LID practice temporary storage, including all pore space within LID practices (e.g., in bioretention soils, stone infiltration trenches, planter media, green roof media) that is not surface discharged. This also represents the volume that is eventually recovered through evapotranspiration and/or infiltration, but would not have become surface discharge.

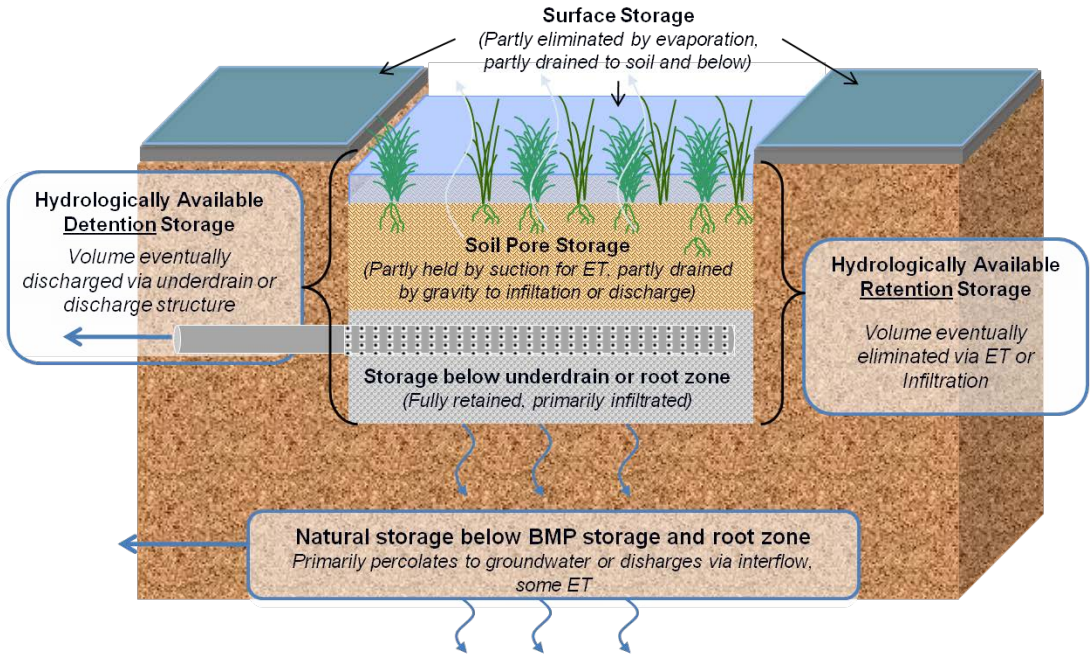
- Subsurface LID practice temporary storage, including all pore space within LID practices (e.g., in bioretention soils, stone infiltration trenches, planter media, green roof media) that is eventually surface discharged via an underdrain system.

- Volume in cisterns and rain barrels in excess of average long-term retained volume that is eventually recovered through evapotranspiration (e.g., irrigation reuse, cooling water makeup reuse, drip hose), infiltration, and/or export (e.g. toilet flushing use).

- Figure 20 illustrates components of hydrologically available temporary storage that may be present in an individual practice. The location of available storage relative to sources of runoff is a critical aspect in determining the amount of storage that is "hydrologically available" to store runoff.

To quantify the effective storage volume, estimate the volume of storage available on the site that is effective in storing stormwater, and divide this estimate between storage volume that is retained and does not discharge to the surface and storage volume that is detained and discharges back to the downstream system via underdrains or discharge structures. If the overall site water balance is an important feature in a study, the storage that is retained can be further divided by the ultimate fate of the retained water: infiltration, evapotranspiration, or exportation off-site (e.g., toilet flushing). The quantity and distribution of storage volume has important theoretical influence on the amount of stormwater expected to discharge from the site.

Figure 20. Components of Hydrologically Available Temporary Storage Typically Present in LID Features (Source: Geosyntec and WWE 2009)



Estimated Storage Recovery Rate in Watershed (days) describes the time for the LID site to recover hydrologically available temporary storage. Estimates of minimum, maximum and average recovery rates for retained and detained volumes should be provided. This is nice to have information.

Different storage elements may regenerate storage at different rates depending on their characteristics. For example, a bioretention facility with underdrains may drawdown its stored volume within 12 hours after a storm, while the same storage volume in a cistern used for irrigation may not begin to drawdown its stored volume for a few days following an event and may take a week to drawdown completely. Drawdown rate is also influenced by season of year, day of the week, and/or other factors. For example, seasonal variations in temperature can affect evapotranspiration and infiltration rates. Seasonal conditions can also affect irrigation demand, thus affecting drawdown rates for rainwater harvesting practices that commonly use harvested water to for irrigation. The day of the week can also affect regenerated storage rates. For example, the demand for captured water used for indoor toilet flushing in a commercial office building would be expected to be greater during the business week than on the weekend. The rate of recovery of storage has important theoretical influence on the hydrologic response of watersheds, specifically LID watersheds, in consecutive events. While storage recovery rate is an important component of watershed characterization, it is can be difficult to quantify for a composite site. It is also perhaps one of the aspects of watershed characterization most unique to LID watersheds, and thus has not been well standardized and demonstrated.

Describe Key Weather Parameters During Study Period (e.g., ET, temperature, etc.) Weather conditions can significantly affect the water balance of LID sites. Frozen soils can reduce infiltration rates; conversely, high ET is associated with increased evapotranspiration rates.

Characterization of ET, temperature and other similar factors are important in normalizing comparisons among LID sites. This is nice to have information.

Non-structural BMP Information

A non-structural BMP can generally be described as a preventative action to protect receiving water quality that does not require construction. Nonstructural BMPs rely predominantly on behavioral changes or effective implementation of certain activities in order to be effective. Major categories of non-structural BMPs include education, recycling, maintenance practices and source controls, as described below.

- **Educational** BMPs include efforts to inform city employees, the public, and businesses about the importance of using practices that protect stormwater from improper use, storage, and disposal of pollutants, toxics, household products, etc. The ultimate goal of educational BMPs is to cause behavioral changes.

- **Recycling** BMPs include measures such as collecting and recycling automotive products, household toxics, leaves, landscaping wastes, and others.

- **Maintenance practices** include measures such as catch-basin cleaning, parking lot sweeping, road and street pavement repair, road salting and sanding, roadside ditch cleaning and restoration, street sweeping, and others.

- **Source controls** include preventing rainfall from contacting pollutant-laden surfaces and preventing pollutant-laden runoff from leaving locations such as automobile maintenance, salvage and service stations; commercial, restaurant and retail sites; construction sites; farming and agricultural sites; industrial sites, and others.

- The following non-structural BMP fields should be completed for each non-structural BMP present at the test site. Multiple non-structural BMPs may be present at a test site and be entered into the BMP Database. Enter all data for each non-structural BMP before entering the next non-structural BMP record.

Table 18. Design Attributes to Report for Non-structural Practices

Attribute	Description
Type of BMP Being Tested	Select from dropdown pick-list.
Describe Practice	Describe the quantity or measure of the BMP being practiced. See additional guidance below.
Comments	Narratively describe other relevant or unique aspects of the BMP. Comments are considered nice to have.

Examples of approaches to describe the quantity or measure of the BMP being practiced include:

- **Educational** BMP "measurements" could include, as examples: the number of brochures distributed per resident and employee in watershed per year on the quantities of pesticide/herbicide application, automotive product disposal or recycling, household toxics use and disposal, yard waste management, etc. Other examples include the number of elementary school children living in the watershed reached through classes at local schools;

number of public notices on TV, radio and/or major newspapers per year; number of billboards per acre of watershed used per year; percent of stormwater inlets in the watershed stenciled.

- **Recycling** BMP "measurements" could include gallons of used oil collected per resident in the watershed; pounds of household toxics collected per resident in the watershed; tons of landscaping waste per resident collected, etc.

- **Maintenance** BMP "measurements" could include percent of stormwater catch basins cleaned once each year, twice each year, etc.; tons of materials removed per average inlet each year; lane miles of street swept each year and tons of material removed per lane mile each year; acres of parking lots swept each year and tons of material removed each year per acre of parking lot swept; type and pounds of deicing materials used per lane mile of road per year; percent of salt in deicing materials used during the year; number of de-icing applications during the year; percent of roadside ditch miles cleaned in watershed during the year; tons of solids removed during the year from roadside ditches; percent of roadside ditch miles stabilized for erosion control during year, etc.

- **Source Control** "measurements" could include percent of industrial storage area in watershed that is covered; percent of materials handling sites in watershed that are covered; percent of gasoline stations with pumps that have overhead cover and how far these covers extend beyond the pumps, etc. The total area, number or mass of sources should be provided as well as the percentages in order to facilitate comparison to other source control BMP tests.

Cost data for non-structural BMPs should be recorded in the BMP Cost worksheet. Representative considerations for reporting cost data include:

- **Initial Costs** include the time and measures necessary to design and implement a program. For example, if brochures were developed on proper disposal of household waste, the cost of development and initial printing would be the initial cost. Subsequent distribution and reprints of the brochures would be considered annual costs. Another example could include inventorying the types of maintenance practices that should be conducted, creating a routine schedule and assigning personnel to complete the work.

- **Annual Costs** are the year-to-year costs once the initial program has been developed.

Other BMP Design Information

An "Other" BMP type is provided to enable users to enter data for other BMP types not included in the BMP Database. **A PDF report on the study must be attached to the data submittal in such cases.** All fields are required information.

Table 19. Design Attributes to Report for Other BMP Types

Attribute	Description
Describe Key Structural Features	Enables the user to narratively describe the key structural or design features that are relevant to understanding the study.
Describe Key Landscaping/Vegetation Features	Enables the user to narratively describe the key landscaping or vegetation features that are relevant to understanding the study.
Comments	Enables the user to narratively describe other aspects of the BMP that are relevant to understanding the study.

Composite BMP Design Information

A "Composite" BMP type is provided to enable users to enter data for other BMP types not included in the BMP Database. All fields are required information.

Table 20. Design Attributes to Report for Composite BMP Types

Attribute	Description
Describe Individual BMP Components	Provides a simple narrative description of the treatment train in place at the site, including the user-defined names of the individual BMPs entered in the Database Design characteristics of individual BMPs should be entered separately, in addition to the composite BMP.
Number of BMP Components Monitored	Provides the number of BMPs in the treatment train.
Describe Key Structural Features	Enables the user to narratively describe the key structural or design features that are relevant to understanding the study.
Describe Key Landscaping/Vegetation Features	Enables the user to narratively describe the key landscaping or vegetation features that are relevant to understanding the study.
Comments	Enables the user to narratively describe other aspects of the BMP that are relevant to understanding the study.

References

Driscoll, E. Palhegyi, G., Strecker, E. and P. Shelley. 1989. *Analysis of Storm Event Characteristics for Selected Rainfall Gauges Throughout the United States*. Prepared for the U.S. Environmental Protection Agency.

Geosyntec Consultants and Wright Water Engineers, Inc. 2009. *Urban Stormwater BMP Performance Monitoring.* http://www.bmpdatabase.org/monitoring-guidance.html

Low Impact Development Center: http://www.lowimpactdevelopment.org/.

National LID Clearinghouse: http://www.lid-stormwater.net/clearinghouse/index.html.

North Carolina State University/North Carolina Cooperative Extension Stormwater Engineering Group: http://www.bae.ncsu.edu/stormwater/.

Schueler, T. 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban Best Management Practices*. MWCOG. Washington, D.C.

Urban Drainage and Flood Control District. 2010. *Urban Storm Drainage Criteria Manual, Volume 3 Best Management Practices*. Denver, CO. http://udfcd.org/

Selected Pick-lists

Entries for various data elements in the BMP Database are restricted to pick-lists. Most pick-lists are relatively short and easy to view in the dropdown boxes provided in the data entry spreadsheet. Two of the longer pick-lists are provided below for ease of reference. These include the Climate Station codes in the *TestSite* spreadsheet and the BMP Type in the *BMPInfo* spreadsheet. The BMP Type pick-list is divided into structural and non-structural BMP types in the pick-list tables provided below.

Climate Station Codes

State Code	Station ID	Station Name
AK	280	ANCHORAGE WSCMO AP
AL	831	BIRMINGHAM FAA AP
AL	5550	MONTGOMERY WSO AP
AR	2574	FORT SMITH
AR	4248	LITTLE ROCK FAA AP
AZ	6468	PETRIFIED FOREST N.P.
AZ	6481	PHOENIX WSFO AP
AZ	8820	TUCSON WSO AP
CA	442	BAKERSFIELD WSO AP
CA	925	BLYTHE
CA	3257	FRESNO WSO AP
CA	5114	LOS ANGELES WSO AP
CA	6335	OAKLAND WSO AP
CA	7295	REDDING 5 SSE
CA	7630	SACRAMENTO FAA AP
CA	7740	SAN DIEGO WSO AP
CA	7769	SAN FRANCISCO WSO AP
CO	2220	DENVER WSFO AP
CO	3005	FORT COLLINS
CO	3488	GRAND JUNCTION WSO AP
CO	6740	PUEBLO WSO AP
CT	806	BRIDGEPORT WSO AP
CT	3451	HARTFORD BRAINARD FLD
DE	9595	WILMINGTON WSO AP
FL	4358	JACKSONVILLE WSO AP
FL	5663	MIAMI WSCMO AP
FL	6638	ORLANDO WSO AP
FL	7886	ST PETERSBURG
FL	8758	TALLAHASSEE WSO AP
GA	451	ATLANTA WSO AP
GA	2166	COLUMBUS WSO AP
HI	1919	HONOLULU WSFO 703 AP
IA	2203	DES MOINES WSFO AP
IA	2367	DUBUQUE WSO AP
IA	7700	SIOUX CENTER 2 SE
ID	1022	BOISE WSFO AP

State Code	Station ID	Station Name
NC	9457	WILMINGTON WSO AP
ND	819	BISMARCK WSFO AP
ND	2859	FARGO WSO AP
NE	4795	LINCOLN WSO AP
NE	6065	NORTH PLATTE WSO AP
NH	1683	CONCORD WSO AP
NJ	311	ATLANTIC CITY WSO AP
NJ	6026	NEWARK WSO AP
NM	234	ALBUQUERQUE WSFO AP
NM	7609	ROSWELL WSO AP
NV	2573	ELKO FAA AP
NV	4436	LAS VEGAS WSO AP
NV	6779	RENO WSFO AP
NV	7620	SMOKEY VALLEY
NY	1012	BUFFALO WSFO AP
NY	5801	NEW YORK CENTRAL PARK
NY	7167	ROCHESTER WB AP
NY	8383	SYRACUSE WB AP
OH	1786	COLUMBUS WSO AP
OH	9406	YOUNGSTOWN WSO AP
OK	6661	OKLAHOMA CITY WSFO AP
OR	4670	LAKEVIEW 2 NNW
OR	5429	MEDFORD WSO AP
OR	6546	PEDELTON WSO AP
OR	6751	PORTLAND WSFO AP
OR	7500	SALEM WSO AP
PA	2682	ERIE WSO AP
PA	6889	PHILADELPHIA WSCMO AP
PA	6993	PITTSBURGH WSCMO2 AP
SC	1549	CHARLESTON WSO CI
SC	1939	COLUMBIA WSFO AP
SD	5691	MOBRIDGE
SD	6937	RAPID CITY WSO AP
SD	7667	SIOUX FALLS WSFO AP
TN	1094	BRISTOL WSO AP
TN	1656	CHATTANOOGA WSO AP

State Code	Station ID	Station Name
ID	7211	POCATELLO WSFO AP
IL	1577	CHICAGO MIDWAY AP 3 SW
IL	8179	SPRINGFIELD WSO AP
IN	3037	FORT WAYNE WSO AP
IN	4259	INDIANAPOLIS WSFO
KS	1699	COLBY 1 SW
KS	2543	EMPORIA
KY	4746	LEXINGTON WSO AP
KY	4954	LOUISVILLE WSFO
LA	98	ALEXANDRIA
LA	6660	NEW ORLEANS WSCMO AP
LA	8440	SHREVEPORT WSO AP
MA	770	BOSTON WSO AP
MA	9923	WORCESTER WSO AP
MD	465	BALTIMORE WSO AP
ME	6905	PORTLAND WSMO AP
MI	2103	DETROIT METRO WSO AP
MI	4641	LANSING WSO AP
MN	2248	DULUTH
MN	5435	MINN-ST PAUL WSO AP
MO	4379	KANSAS CITY U of MO
MO	7455	ST LOUIS WSCMO AP
MO	7976	SPRINGFIELD WSO AP
MS	4472	JACKSON WSFO AP
MT	807	BILLINGS WSO AP
MT	1309	BUTTE 8 S
MT	3558	GLASGOW WSO AP
MT	3751	GREAT FALLS WSCMO AP
NC	312	ASHFORD
NC	1458	CAPE HATTERAS WSO
NC	1690	CHARLOTTE WSO AP
NC	2230	DALTON
NC	2719	ELIZABETH CITY
NC	7069	RALEIGH DURHAM WSFO AP

State Code	Station ID	Station Name
TN	4950	KNOXVILLE WSO AP
TN	5954	MEMPHIS FAA-AP
TN	6402	NASHVILLE WSO AP
TX	16	ABILENE WSO AP
TX	211	AMARILLO WSO AP
TX	428	AUSTIN WSO AP
TX	1136	BROWNSVILLE WSO AP
TX	2015	CORPUS CHRISTI WSO AP
TX	2244	DALLAS FAA AP
TX	2797	EL PASO WSO AP
TX	3284	FTWORTH MEACH WSO AP
TX	4311	HOUSTON-ALIEF
TX	4329	HOUSTON-SATSUMA
TX	5411	LUBBOCK WSFO AP
TX	5890	MIDLAND/ODESSA WSO AP
TX	7945	SAN ANTONIO WSFO
UT	3418	GREEN RIVER
UT	7516	ST GEORGE
UT	7598	SALT LAKE CITY NWSFO AP
VA	5120	LYNCHBURG WSO AP
VA	6139	NORTHFOLK WSO AP
VA	8906	WASH NATL WSCMO AP
VT	1081	BURLINGTON WSO AP
WA	7473	SEATTLE TAC WSCMO AP
WA	7938	SPOKANE WSO AP
WA	9465	YAKIMA WSO AP
WI	3269	GREEN BAY WSO AP
WI	4961	MADISON WSO AP
WI	5479	MILWAUKEE WSO AP
WV	1570	CHARLESTON WFSO AP
WY	1570	CASPER WSO AP
WY	6597	MUD SPRINGS
WY	7105	PATHFINDER DAM

Structural BMP Type Codes

BMP Category Code	BMP Category Desc	BMP Type Code	BMP Type Desc
BI	Grass Strip	BI	Biofilter - Grass Strip
BR	Bioretention	BR	Bioretention
BS	Grass Swale	BS	Biofilter - Grass Swale
CO	Composite	CO	Composite - Overall Site BMP
DB	Detention Basin	DB	Detention Basin (Dry) - Surface Grass-Lined Basin That Empties Out After A Storm
DB	Detention Basin	DC	Detention Basin (Dry) - Concrete or Lined Tank/Basin with Open Surface
DB	Detention Basin	DT	Detention - Deep Tunnel
DB	Detention Basin	DU	Detention - Underground Vault, Tank or Pipe(s)
GR	Green Roof	GR	Green Roof
IB	Infiltration Basin	IB	Infiltration Basin
LD	LID	LD	Low Impact Development-Site Scale
MD	Manufactured Treatment Device	CBI	Catch Basin Insert
MD	Manufactured Treatment Device	DIS	Disinfection System
MD	Manufactured Treatment Device	HDS	Hydrodynamic Devices (e.g. Swirl Concentrators, Separation Systems, etc.)
MD	Manufactured Treatment Device	HRBF	High Rate Biofiltration
MD	Manufactured Treatment Device	HRMF	High Rate Media Filtration
MD	Manufactured Treatment Device	MCTT	Multi-chambered Treatment Train
MD	Manufactured Treatment Device	OGS	Oil/Grit Separators and Baffle Boxes
MD	Manufactured Treatment Device	UN	Manufactured Treatment Device-Uncategorized
MD	Manufactured Treatment Device	VC	Volume Control/Attenuation
MF	Media Filter	FB	Filter - Carbon Granules
MF	Media Filter	FC	Filter - Compost Mixed with Sand
MF	Media Filter	FH	Filter - Geotextile Fabric Membrane (Horizontal)
MF	Media Filter	FL	Filter - Combination of Media or Layered Media
MF	Media Filter	FO	Filter - Other Media
MF	Media Filter	FP	Filter - Peat Mixed with Sand

BMP Category Code	BMP Category Desc	BMP Type Code	BMP Type Desc
MF	Media Filter	FS	Filter - Sand
MF	Media Filter	FV	Filter - Geotextile Fabric Membrane (Vertical)
OT	Other	OT	Other--Uncategorized BMP
PF	Permeable Friction Course	PF	Permeable Friction Course
PP	Porous Pavement	PA	Porous Pavement - Porous Asphalt
PP	Porous Pavement	PC	Porous Pavement - Pervious Concrete
PP	Porous Pavement	PG	Porous Pavement - Porous Aggregate
PP	Porous Pavement	PM	Porous Pavement - Modular Blocks
PP	Porous Pavement	PT	Porous Pavement - Porous Turf
PP	Porous Pavement	PU	Porous Pavement - Uncategorized
PT	Percolation Trench/Well	IT	Infiltration (Percolation) Trench
PT	Percolation Trench/Well	IW	Infiltration (Dry) Well
RP	Retention Pond	RL	Retention Tank (Wet) - Surface Tank with Impervious Liner
RP	Retention Pond	RP	Retention Pond (Wet) - Surface Pond with a Permanent Pool
RP	Retention Pond	RT	Retention Tunnel (Wet) - Deep Tunnel with Permanent Water
RP	Retention Pond	RV	Retention Underground Vault or Pipes (Wet)
RW	Rainwater Harvesting	RW	Rainwater Harvesting
WB	Wetland Basin	WB	Wetland - Basin with Open Water Surfaces
WB	Wetland Basin	WM	Wetland - Basin without Open Water (Wetland Meadow Type)
WC	Wetland Channel	BW	Biofilter - Wetland Vegetation Swale
WC	Wetland Channel	WC	Wetland - Channel with Wetland Bottom

Non-structural BMP Type Codes

Category Code	BMP Category Desc	BMP Type Code	BMP Type Desc
ED	Education	EA	Education - Automotive Product Disposal
ED	Education	EC	Education - Construction Site BMP Design, Installation, Maintenance Training
ED	Education	EE	Education - Schools (Elementary)
ED	Education	EG	Education - General Community Outreach
ED	Education	EH	Education - Schools (High School)
ED	Education	EI	Education - Industrial Good Housekeeping
ED	Education	EJ	Education - Schools (Jr. High School)
ED	Education	EO	Education - Commercial, Restaurant, and Retail Districts Good Housekeeping
ED	Education	EP	Education - Pesticide/Herbicide Use
ED	Education	ES	Education - Inlet Stenciling
MP	Maintenance Practice	MC	Maintenance Practices - Catch Basin Cleaning
MP	Maintenance Practice	MP	Maintenance Practices - Parking Lot Sweeping
MP	Maintenance Practice	MR	Maintenance Practices - Road and Street Pavement Repair, Sealing, Overlay, etc.
MP	Maintenance Practice	MS	Maintenance Practices - Road Salting and Sanding
MP	Maintenance Practice	MT	Maintenance Practices - Street Sweeping
MP	Maintenance Practice	MX	Maintenance Practices - Roadside Ditch Cleaning and Restoring
RC	Recycling	RA	Recycling - Automotive Products
RC	Recycling	RH	Recycling - Household Toxics Collection & Recycling Programs
SC	Source Controls	SA	Source Controls - Automobile Service Stations
SC	Source Controls	SC	Source Controls - Construction Activities
SC	Source Controls	SF	Source Controls - Farming and Agricultural Sites
SC	Source Controls	SI	Source Controls - Industrial Sites
SC	Source Controls	SM	Source Controls - Automobile Maintenance Sites
SC	Source Controls	SO	Source Controls - Commercial, Restaurant and Retail Sites
SC	Source Controls	SS	Source Controls - Automobile Salvage Facilities