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4 Installation

The successful installation of post-construction best management practices (BMPs) is critical for water quality protection, as well as the minimization of excessive long-term maintenance and revised site designs. This section provides guidance for the installation of post-construction stormwater BMPs to assure they perform as intended and are in line with current regulatory and industry standards. Information provided is specific to post-construction BMPs, which are permanent structural BMPs installed as part of a new development, redevelopment or retrofit conditions (e.g., updating existing roadways). It should be noted this guidance does not apply to construction phase BMPs, which are temporary BMPs installed to minimize stormwater impacts during construction activities. However, while not addressed herein, temporary construction BMPs are critical for post-construction BMP protection prior to site stabilization.

This guidance is not a standalone document for successful BMP installation, and should be used in conjunction with design documentation, regulations, contractual obligations and other site-specific criteria related to construction and stormwater quality. This guidance document supplements these types of documents and provides a basis of understanding activities and factors to be considered during BMP installation. Specifically this section provides information and recommendations on contracts, the BMP installation process and timeline, general protection guidelines during site work, and considerations for site-specific conditions. For BMP specific installation guidelines see individual BMP information sheets (BMP Screening Tool).

4.1 Contracts

A well-drafted project contract clearly describes the work to be completed, the price to be paid for the work, and the terms and conditions of payment. The contract allocates various foreseeable risks between the parties, which reduces the potential for disagreements in gray areas. The contract should provide clear, concise expectations to all parties involved, while specifying required actions if unforeseen events occur. Ten Things to Think About Before Signing a Construction Contract

Project contracts are typically formed prior to the bidding process. The owner requests a quote or issues a more formal request for proposals, and contractors wishing to perform the proposed work, respond with the price that they would charge and possibly issue exceptions to the contract. The contractor's bid constitutes a binding offer. The acceptance of a bid is generally referred to as a Bid / Contract Award of the project.

In the case of private construction contracts (as opposed to government contracts), the property owner requesting bids is generally free to accept or reject any bid regardless whether the bid is the lowest or most responsive one. In the case of public contracts, however, the bidding process must follow strict rules set forth in federal, state, and local laws and regulations.

Construction contracts consist of terms of agreement ranging from price and description of materials to be used, to an agreement that resolves disputes through arbitration. Courts are reluctant to imply terms that are not expressly part of the contract, but courts may look to defer to historic precedence or to local custom if the contract is silent on a hotly disputed key issue.

Parties to a construction contract generally select from one of several traditional methods by which the contract is priced. The following are among the most common:

Lump sum. The owner agrees to pay a specific dollar amount for whatever is required to complete the job. If the contractor makes a mistake in the estimate for labor or materials, the contractor bears the loss.

Unit price. The contract is priced by the number of units delivered multiplied by a set rate per unit. Contractors bear less risk under unit price contracts because an error in estimating the size of the job does not stick the contractor with overages.

Cost plus a fee. Under this arrangement, the contractor agrees to keep records of the costs for labor and materials. The owner agrees to pay for all the submitted costs plus a markup, which can be expressed either as a percentage or as a lump sum. If there is a dispute regarding the price, courts will first attempt to determine which type of pricing scheme the parties agreed to use, determine which party assumed risk of error or contingencies, and finally determine which party bears

financial responsibility.

Time and Materials. Under this arrangement, the contractor will be paid the direct costs for labor, materials and equipment used in performing the work determined including labor, materials, equipment rental, etc. Typically the total of the direct costs computed will have an added markup at various rates for labor, cost of materials and equipment rental. These markups should be in accordance with the governing agency as it varies from jurisdiction to jurisdiction.

4.1.1 Breakdown of Contract Considerations (items above):

Time Frame. The agreement should have a well-defined expectation of time and associated schedule with project milestones. Ensure that an appropriate timeline has been provided to complete the scope of services.

Prices. The agreement should clearly state costs. Be wary of additional charges that you have not discussed with the contractor or associated bidders list. Identify a clear approval process for out-of-scope items.

Payment Method. Determine the terms of payment and whether it is appropriate for your financial situation. For example, the contract may call for payments at the end of the month when the majority of company's financial close occurs. One can also negotiate installment payments if a lump sum is not feasible.

Payment Penalties. Determine whether there are penalties for late payment and if they are reasonable.

Inability to Agree. If work needs to start immediately, but parties cannot agree on the final terms of an agreement, you need to verify that you are signing a contract that is not going to be enforceable as a permanent agreement. You can accomplish this by adding language like, "This interim agreement is in effect only until a more permanent agreement can be negotiated by both parties."

Resolution of Anticipated Disputes. No matter how careful you are or how good your relationship with the other party, a dispute may arise. Many contracts include an arbitration clause, which means that a dispute must be settled in arbitration as opposed to in court. Arbitration is generally less costly and less formal than court, but if you sign the contract with the clause intact, you have probably waived your right to take the matter to court.

Anticipated Problems. The party with whom you are contracting may have had prior experiences that have led them to add particular methods of resolution to the contract. Those ideas may be perfectly agreeable, but they could also be unfairly beneficial to the other party. Analyze whether these terms will benefit you.

Attorneys' Fees. Determine if there are conditions related to the payment of the other party's attorney if the contract is breached and/or you lose the case, producing stipulations that will hold you responsible.

Insurance. Identify the required insurance for contractors, ensuring it is sufficient for work to be performed.

Performance Bond. As it relates to a construction contract, typically in the form of a surety bond, issued by an insurance company or a bank, to guarantee satisfactory completion of a project by a contractor.

Performance Guarantee. BMP manufacturers may guarantee the performance of their treatment system if maintenance obligations are met. Availability, cost and conditions of such guarantee should be discussed with the manufacturer.

4.1.2 Construction Submittals

Understanding the required submittals and the role of each component of the BMP is important when researching and determining if materials meet the criteria set forth in the specifications. These can include but are not limited to:

- Cut Sheets
- Shop Drawings
- Product Samples
- Test Reports
- Certificates
- Performance Data

4.2 Installation Inspections and Observations

Thorough inspections throughout the stormwater BMP construction and installation processes are critical. Poor construction or poor material selection can lead to premature failure of stormwater BMPs, resulting in potentially negative environmental impacts and greater overall expense. Properly conducted and communicated inspections during installation ensure BMPs will perform as designed. Inspection needs will vary depending upon legal requirements, BMP type, construction phasing, and site-specific considerations. Construction inspections for stormwater BMPs should consider permits, and state and local laws or regulations as the baseline for inspection requirements and frequency. Additionally, any other legal requirements for the inspection of stormwater BMP construction should be adhered to as a minimum requirement. It is necessary for inspections to take place throughout the installation and construction process to ensure protection of the property owner and the environment.

A number of inspections from varying vantages should take place throughout the BMP construction and installation process.

1. Inspections should be performed by the contractor, design consultant, property owner, third-party inspector, or any other entity having legal authority (e.g., state or local inspectors).

It is the responsibility of the property owner to ensure processes are in place to inspect and communicate BMP construction and installation activities. Having a clear process for communicating construction progress and modifications assists the contractor in working with the property owner, design consultants, and regulator as needed. It is important, that regardless of who is performing an inspection, they be qualified and knowledgeable of materials, installation schedule, proper construction and installation techniques, and any operation and maintenance requirements throughout the construction process.

2. Inspectors should have the authority to escalate items of concern to the appropriate parties until a resolution is executed.

Routine inspections during the construction phase of a project are beneficial, but often overlook important milestones. Inspections should be conducted at key stages of the construction process to avoid missing a critical step in BMP installation, and to provide assurance to the legal authorities that agreed upon stipulations in the stormwater plan are followed.

Stormwater system designs vary for every site, which makes inspections inherently challenging. BMP selection, site constraints, construction phasing and seasonal variations prohibit a one size fits all inspection methodology. A unique inspection timeline and general inspection form should be a part of the initial stormwater design plan. Additionally, individual BMP inspection forms may be used to ensure proper construction and installation. Samples of these forms can be found in Appendices 6-1 through 6-7 of Operation, Maintenance, and Management of Stormwater Systems (USEPA 1997). Additional links to installation inspection checklists can be found in Appendix B.

3. Recording and tracking inspections is as important as conducting the inspection and is often a permit requirement.

Most construction sites require inspectors to check in with personnel prior to conducting any inspections. Ensuring that all inspections are accurately logged and dated assists in identifying when an issue was noted and how it was corrected. This provides accountability and an accurate timeline for construction activities and design modifications. With the advance of technology, many inspections are conducted utilizing electronic checklists and forms. Electronically collecting inspection data can also facilitate more timely feedback and corrections, protecting the contractor, property owner, environment and the public. The systematic collection of inspection data can aid in identifying trends in BMP management prior to completion of construction as well. This knowledge, when properly used, will lead to adjustments in the Operations, Maintenance and Monitoring (OM&M) plan prior to the operation phase.

4.3 Installation Quality Assurance (QA) and Quality Control (QC)

QA/QC criteria are key to the successful execution of any BMP installation project. Without effective QA/QC, BMP installation is unlikely to achieve design criteria, nor water quality standard requirements. Cost, schedule and both short- and long-term maintenance are also critically impacted by improperly conducted QA/QC, which must be implemented by all individuals on any project effort, from field staff to the design engineers. However, at a minimum, QA/QC criteria may be established for every responsible party before the project begins. QA/QC components include:

- QA: involves assuring the systematic process achieves quality standards and is the responsibility of all parties.

The owner, designer, contractors, regulators and any other involved parties must actively be involved with quality assurance throughout all aspects of the project effort.

- QC: inspecting and/or testing quality; must be established and recognized by all parties, but field staff typically implement BMP installation.
- Quality Assurance Project Plan (QAPP): may be established on BMP installation projects to document processes, controls, objectives and responsibilities.

Table 4-1 (USEPA 1997) is provided as an example checklist to assist in the QA/QC of installed BMPs and is not applicable to all sites or BMP types. The checklist is a minimum guidance for BMP installation for identifying issues that can occur and/or must be addressed during the pre-construction, construction and final stabilization phases of the project. This checklist is one of many.

Table 4-1. Stormwater Best Management Practice Installation Inspection Checklist (Appendix B)

Stormwater Best Management Practice Installation Inspection Checklist	
Project Title:	
Permit/Plan Number:	**Owner Name:**
Inspector Name and Company:	**Contractor Name:**
Inspector Contact Information:	
PRE-CONSTRUCTION EFFORT	
Pre-construction site photographs of BMP areas of impact collected:	Yes/No
If so, photograph log name:	
BMP installation responsibilities contractually defined:	Yes/No
Expertise required for BMP installation:	Yes/No
If so, expertise contracted and scheduled:	Yes/No
Communication expectations established for the following:	
Changes in BMP design:	Yes/No
Installation requirements not specified in design:	Yes/No
Material requirements not specified in design:	Yes/No
Upstream conditions inspected for impact to BMP:	Yes/No
Diversion methods defined to minimize impact during construction:	Yes/No
CONSTRUCTION EFFORT	
Weather Conditions:	**Inspection Date and Time:**
Antecedent Dry Period: >72 hours 48-72 hours 24-48 hours <24 hours	
BMP Name:	**Photograph Number:**
BMP Location:	
Required inspection frequency met:	Yes/No
BMP protection established and in good condition:	Yes/No
BMP meets design requirements:	Yes/No
Design modification required:	Yes/No
If yes, approving person name and date:	
Maintenance required:	Yes/No
If yes, specify the following:	Yes/No
Required action:	

Stormwater Best Management Practice Installation Inspection Checklist	
Responsible party:	
Due date:	
FINAL STABILIZATION EFFORT	
BMP installed per design with no impact from construction activities:	Yes/No
BMP free of debris and sediment:	Yes/No
Upstream conveyance system free of debris and sediment:	Yes/No
Design altered:	Yes/No
If yes, Record Drawing prepared and submitted:	Yes/No
Post-construction site photographs of BMP areas of impact collected:	Yes/No
If so, photograph log name:	
For short-term maintenance:	
Schedule established:	Yes/No
Responsible party:	
Contract executed:	Yes/No
Signature of Inspector:	Date:

4.4 Site Specific Conditions

Prior to the installation of any practice or product, site-specific factors that may affect decision-making should be considered. This section discusses specific site conditions to be aware of prior to initiating the BMP selection process. These conditions have been broken up into five categories for evaluation: 1) subsurface investigations, 2) site logistics, 3) ecological, 4) weather/climate variables and 5) regulatory installation criteria.

4.4.1 Subsurface Investigations

Prior to installation, consider the geology at the BMP location and the immediate surrounding area. Important geological conditions to consider prior to installation of BMPs are depth to bedrock, the lithology of the subsurface, the type of parent material expected to be encountered as bedrock, soil type, the potential presence of a karst environment, the morphology of the rock, and the strike and dip of the rock structure (USEPA 2011). A geologic cross-section of the area can help characterize the subsurface as it will include information of the various geologic conditions listed above.

Another important characteristic to consider is the hydrogeology of the area. Important aspects to consider in regards to the hydrogeology of the area are the quality of the groundwater beneath the site and if it will be impacted, depth to groundwater, groundwater flow patterns, the hydraulic conductivity for the location, and the presence of wells that may be impacted by the BMPs. These factors may come into play on a site, local or regional scale. A map illustrating groundwater flow will be necessary to characterize the hydrogeology of the area.

Much of this information should be available from the information gathered during the design of the BMP. Many BMPs use infiltration as a disposal method, instead of discharging to the surface, and knowledge of the groundwater regime is important in this evaluation.

4.4.2 Site Logistics

All adjacent considerations that could have an impact/influence on the zone of work should be defined. Other factors to be considered are site constraints (i.e., buildings, pathways, landscaped areas, utilities, etc.) located in closed proximity to the BMP to be installed and how they could affect the installation. In addition to considering the immediate area surrounding the BMP, it’s important to understand what is adjacent, since it could impact installation or performance of the BMP. For instance, a heavily landscaped area adjacent to a construction site that drains to your BMP, could introduce a large amount

of landscape debris to your site that could clog inlets. Finally, it's important to understand the history of the site. A concise description of all past and present activities on the site in chronological order is helpful in understanding potential site issues, environmental issues encountered in the past and their current status, former structures, and processes and activities on the site. Some examples could have been underground storage, septic tanks, drain fields, or old utility lines.

4.4.3 Ecological/Cultural

In addition to subsurface investigation and site logistics, it is important to understand the potential ecological impacts the site may have on the habitat of fish or wildlife. Various pollutants such as oil, fertilizer, pesticides, sediment and chemicals are washed off both landscaped and impervious surfaces, which then drain to BMPs and eventually discharge to streams, rivers and lakes. The BMPs installed are critical in treating the stormwater prior to discharging into surface waters or the storm drain system. Pollutant levels are typically much higher in the first flush, or first inch of runoff. Studies have shown that approximately 90% of the pollutant loading is contained in the first flush. BMPs are sized based on a treatment flow rate or volume rather than a flood volume, as it is critical to treat the first flush to minimize ecological impacts. Successful installation of post-construction BMPs is critical for water-quality protection that will not adversely affect the diversity of fauna or animal species, threatened or endangered species, migratory patterns of wildlife, and wetland areas on site. A wildlife diversity survey may be applicable to ensure changes to the site do not threaten habitat or life. These ecological factors could restrict work windows and should be considered when scheduling installation and developing installation timelines.

There may also be cultural resources located in the area of the construction such as tribal traditional camping areas or burial grounds. Pre-knowledge of the potential to encounter these cultural resource areas can help you avoid costly delays in construction.

4.4.4 Weather/Climate Variables

Climate and weather patterns should be evaluated for potential impacts to the BMP and the site in general. The severity and frequency of storms and heavy rains, including the likelihood of tornados, hurricanes or temperature fluctuations can influence BMP infrastructure.

Heavy rains can cause flooding, sediment erosion and delays in daily routine. If the site is near bodies of water, excessive rains may cause the water level to rise and breach barriers, impacting your site. Federal Emergency Management Agency (FEMA) floodplain maps should be reviewed in order to determine if the site lies within a floodplain. These maps can be viewed by entering in the site address, a place name, or longitude/latitude coordinates at the FEMA Flood Map Service Center. Another consideration regarding floodplain maps is that sea level elevations could change in the near future due to climate variations. This course of action can help determine alternative methods to use, which may withstand storm impact or display minimal effects.

Erosion is also a factor to be considered. Erosion can be caused by a variety of factors including dry periods followed by heavy rain, wind and lack of vegetation or cover. If a site is down slope from an area where erosion may be a concern, increased amounts of sediment may be experienced, which can affect the effectiveness of the installed BMPs if not maintained regularly. Alternatively, if your site is up hill from another site, an evaluation will be necessary to determine potential impacts. Dust control can be a problem in arid regions and areas of highly erodible soils. Additional erosion control measures may need to be implemented in these areas.

During construction schedule planning, future weather conditions should be considered and planned in advance. For extreme weather, seasonal changes that impact construction should be planned to protect BMPs (USEPA 2017b; NOAA 2017). Regional seasonal changes should be considered including: rainy seasons, frozen ground conditions, snow-melt and/or extreme ground saturation, and any other conditions that impact the BMP effectiveness.

4.4.5 Regulatory Installation Criteria

Installation criteria required by the federal government, states, municipalities and local ordinances could vary. Some items to be aware of include the stringency of local regulations, required contractor licenses and green remediation, or the practice of considering all environmental effects of remedy implementation and incorporating options to minimize the environmental footprints of cleanup actions.

Local regulations may require certain permits for work to be performed or require more stringent regulations than are required by federal or state standards. Work performed may require a licensed contractor. In addition, some states require

green remediation alternatives be evaluated as part of the planning. These techniques and concepts are put into place to make remediation friendly to the environment.

4.5 Temporary BMP Protection during Installation

Many states require construction stormwater pollution prevention plans (SWPPPs) under the National Pollutant Discharge Elimination System (NPDES) permit program, or another document that defines erosion and sediment control and other pollution-prevention measures during construction. These erosion and sediment control measures protect downstream water-bodies and protect post-construction BMPs installed onsite. This section outlines protection measures and installation considerations to protect your post-construction stormwater BMP during site construction. It is recommended that each site develop a site-specific stormwater plan (SSSP) that is specific to protect the post-construction BMPs if a SWPPP and erosion control plans were not required. If a SWPPP or erosion control plans are required, then it is recommended that the protection measures specific to the post construction BMPs are included in that documentation. Hereafter in this document, post-construction BMP protection documents (i.e., SSSP, SWPPP, and/or erosion controls plans) are referred to as BMP protection plans. For BMP-specific protection considerations during construction, please refer to the information sheets that can be accessed through the BMP Screening Tool.

4.5.1 Site-Specific Stormwater Plan for Post Construction BMP Protection

BMP protection plans should be designed to prevent sediment and construction pollution from entering the storm drainage systems. Generally underground pipes and conduits are laid prior to subgrade compaction of the site. During construction, it is important that the site is graded to allow for positive drainage away from any structures or buildings. This prevents ponding in areas close to buildings or in heavily used construction roads or paths and allow for water to leave the site through the installed storm drainage systems during construction without bringing site sediments and pollution with it. At a minimum, erosion control plans include the following information:

- Protection for every inlet onsite and directly downstream of the site where tracking or spills could occur.
- Check dams along the flow line of any swales to reduce run-off velocities and capture any heavy solid particles prior to continuing downstream.
- Protection for outer boundaries of detention and biological treatment devices to capture heavy solid particles prior to entering the basins.
- Protection for boundaries of self-treating areas from sediment deposition.
- Identifying trees to be protected.
- Preventing runoff to off-site areas using perimeter controls.
- Show any temporary detention areas for stormwater and stabilization of those areas.
- Show construction entrances.
- Include an erosion control point of contact.

Within any BMP protection plan, instructions for protection and inspections should be included.

4.5.2 Protection for BMPs during Construction

It is important that BMP protection is implemented immediately after each BMP is installed. Every installed BMP should be protected from erosion and sediment prior to the end of each day USEPA Construction and Development Effluent Guidelines. For instance, if a drainage swale with an erosion control blanket is of significant length and will take weeks to complete, then the construction of the check dams and fiber rolls that protect that swale from soil loss from the surrounding area, should not wait to be installed once the construction of the entire swale is complete. Instead, it is recommended that the erosion control measures should be installed as each piece is completed. As the construction crew leaves each day, ensure the portion of the swale that was constructed has also been protected from tributary area erosion. Similarly, it is not recommended to wait until an entire site storm drainage system and all of the inlet structures are built to install protection. Instead each inlet should be protected with a sediment bag or check dam as each inlet is installed. Some of the general erosion control methods for protecting BMPs are as follows:

- Use erosion control blankets and fiber rolls to protect graded slopes.
- Use inlet sediment bags on installed inlets.
- Add gravel bag check dams in drainage ditches and in gutters.
- Install fiber rolls to protect sediment sensitive areas.
- Construct silt fences and fiber rolls along the perimeter of the site.

- Seed and/or mulch erodible soils.
- Cover and berm stockpiled construction material.
- Avoid ponding water or compaction in areas where post construction BMPs will infiltrate into the ground
- Plan construction of infiltration type BMPs (permeable pavement, bioretention) to ensure construction activities do not reduce the existing infiltration rates

4.5.3 During Construction Inspections

During construction, inspect all storm drainage features and installed BMPs on a regular basis and prior to storm events. If needed, clean the BMPs of any sediment and debris. Prior to any storm events, these features should be inspected and cleaned to ensure that the systems do not carry or become clogged with sediment. All temporary BMP protection should be inspected and cleaned as well to ensure proper erosion prevention before and after storm events. Keep documentation of inspection and save inspection records on site.

4.6 Record Drawings

Detailed record drawings, or as-builts, of post- construction stormwater BMPs may be required by the local regulatory authority as part of the final acceptance process, or before the construction permit can be terminated. For smaller projects, a redline of the design drawing may be sufficient, whereas more detail may be needed for larger projects. It is always recommended to check with the local authority on such requirements before starting to plan for and design a stormwater BMP.

If not required, record drawings are still recommended as verification that the BMP has been installed according to the approved permit or stormwater management plan. They are an important component of any long-term BMP O&M plan as they document the condition of the BMP when it was first placed into service post-construction. This can then be compared to the condition of the BMP during maintenance inspections to determine if the BMP is operating as intended.

Record drawings can also be a critical element if there are plans to evaluate the pollutant removal or flow reduction effectiveness of the BMP. For BMPs to be evaluated accurately and effectively, there should be thorough documentation of the BMP as constructed in the field. Monitoring studies often rely on record drawings to estimate flow rates and assess media composition. Without accurate record drawings, poor BMP performance may be incorrectly attributed to a design that was not adhered to in the field.

4.6.1 Suggested Record Drawing Content

Record drawings should reflect the same degree of detail as the original plan drawings (Section 3.5), calling attention to any revisions to the approved plans. All components of the stormwater BMPs and associated storm drainage structures should be field surveyed and documented, which could include site information, BMP specifications, and dimensions and elevations of all upstream conveyance structures. Please note this is not intended to be a comprehensive list.

4.6.1.1 Site Information

- *Vicinity map*. Shows the general location of the stormwater BMP within the city, town or county.
- *Site location (coordinates and/or street address).* Longitude and latitude coordinates, or street address, documenting the specific location of the stormwater BMP.
- *Elevation*. Site elevation in relation to mean sea level.
- *Drainage basin boundary*. Map showing the delineation of the basin draining to the BMP.
- *Site contours*. Contours of slopes within the basin draining to the BMP.
- *Land cover*. Percent of land within the drainage basin that is pervious/impervious and the predominant land use type.
- *Design flow*. Data and calculations for drainage basin size and expected drainage basin flow volume and/or flow rate.
- *Fill/soil classification*. Classification of the native and fill soils within the drainage basin.

4.6.1.2 Stormwater BMP Specifications

- *BMP type.* Name and model number (if applicable) of stormwater BMP.
- *BMP size*. Field dimensions and details, including dimensions, slope contours and number of treatment cartridges if applicable.

- *Soil/media*. Specifications for any proprietary or non-proprietary soil or media.
- *Vegetation*. As planted plans for BMP, as applicable.
- *Construction material*. Strength and specific materials of BMP components.
- *Hydraulic loading rate.* The design flow or infiltration rate of the BMP.
- *BMP inlets and outlets*. Invert elevation, length, slope and diameter of all inlet and outlet pipes.
- *Outlet control structure*. Description of any outlet control structure (e.g., perforated riser pipe, orifice plate weir, etc.)
- *Bypass structure.* Size, type, elevation and capacity of any internal or external bypass structures.

4.6.1.3 Upstream Drainage System

- Description of any upstream structures providing pretreatment for the BMP.
- *Manholes and catch basins.* Location, dimensions, rim inverts and elevations of all upstream manholes, catch basins and other stormwater system structures.
- *Conveyance system*. Material, diameter, slope, length and elevations of all upstream piping and associated conveyance systems.
- Any other pertinent data relevant to the drainage system upstream of the BMP.

4.6.2 Record Keeping

Once completed, the record drawing should be signed, dated and stamped by a professional engineer or licensed land surveyor. This certifies the plans have been reviewed and revised, if necessary, to accurately show all as-built construction details. Copies of record drawings should be kept with project records as well as the BMP O&M manual.

4.7 Bridge to Operations & Maintenance

Proper selection and installation of BMPs is critical to successful operation and maintenance. Improper BMP installation may result in the failure of a BMP, leading to unmet permit requirements, degradation of water quality, safety concerns and other undesirable effects. Ensuring BMPs are properly installed during construction will save money long-term as well; removing the need for costly maintenance and repairs soon after construction is complete. Adhering to a well, thought-out installation plan will provide a smoother transition period to the operational phase of the BMP and the information needed to effectively operate, monitor and maintain the system for years to come.