Visual Inspection for Infiltration Practices

Visual inspection is a rapid assessment procedure for qualitatively evaluating the functionality of a stormwater best management practice (BMP). Visual inspections use a set of criteria that, under certain circumstances (described in chapter 3), determine if the stormwater BMP is malfunctioning. Detailed instructions for visual inspection of infiltration practices are included below and reproduced in appendix B, part 2, which can be easily printed out and taken to the field.

Scheduling Maintenance for Infiltration Basins and Trenches

The following section provides discussion about each question answered on the field data sheet above.

1)Has visual inspection been conducted on this location before?

It is important to determine whether this location has been previously assessed so that assessment efforts are cost effective (i.e., neither duplicated nor wasted). If previous assessment has occurred, the current assessment should verify that actions suggested by the previous assessment were completed and are effective.

2)Has it rained within the last 48 hours at this location?

Many infiltration practices are designed to drain the design storm volume (i.e., water quality volume, maximum storage volume) within 48 hours (Minnesota Stormwater Steering Committee 2005). Assessing a infiltration practice within 48 hours of a rainfall event may provide additional assessment clues than assessment during a long dry period. Additionally, rainfall within the last 48 hours at a location will alter how answers to other questions in this assessment are interpreted.

3)Does this infiltration basin or trench utilize any pretreatment practices upstream?

If any pretreatment practices exist they should also be inspected and maintained on a regular basis.

4)Access

Access to the areas upstream and downstream of the site as well as the site itself is needed in order to properly assess the practice. This is true regardless of the level of assessment applied.

5b)Are any of the inlet structures clogged?

Inlet structures should be free of any debris, sediment, vegetation, and other obstructions so that stormwater runoff can easily enter the infiltration practice. If an inlet structure is even partially clogged, suspended solids may be deposited in the upstream conveyance system, or upstream areas may flood because the conveyance systems are limited by such obstructions. Any obstructions should be removed immediately to ensure proper operation of the infiltration practice.

5c)Are any of the inlet structures askew or misaligned?

Misaligned inlet structures often allow stormwater runoff to enter or exit an infiltration practice by means other than those intended by design or prevent stormwater runoff from entering the infiltration practice at all. This condition can result in erosion, channelization, or flooding of surrounding areas, which can further exacerbate the misalignment or create other problems.

Inlet structures can become misaligned for several reasons, including frost heave of the soil, vehicular collision, and geotechnical failure. Misaligned inlet structures should be repaired or replaced as soon as possible to reduce detrimental impact. Any obstructions should be removed immediately to ensure proper operation of the infiltration practice.

6)Is there standing water in the infiltration basin or trench?

Standing water in an infiltration practice is the result of one of three possibilities: (1) rainfall has occurred recently such that stormwater runoff has not had 48 hours to infiltrate, (2) the infiltration rate of the practice is slow such that stormwater runoff does not infiltrate within 48 hours, but does infiltrate given enough time, or (3) the infiltration practice is clogged and does not infiltrate any stormwater runoff. If it has rained in the last 48 hours (question 2), then the infiltration practice may be functioning properly and requires additional assessment (level 2 or higher). If, however, it has not rained in the last 48 hours, it is likely that the infiltration practice is either option (2) or (3).

Question 6a provides clues that may determine whether the infiltration practice is clogged. Surface sheen is caused by hydrocarbon substances such as automotive oil or gasoline and may indicate illicit discharges. If hydrocarbons are proven not to be illegally discharged into the infiltration practice, then a surface sheen may indicate that stormwater runoff is stored in the infiltration practice such that the small amounts of hydrocarbons typically found in stormwater runoff are accumulating. If this is happening, then the infiltration practice is failing. There are several illicit discharge manuals available for identifying, locating, and eliminating illicit discharges (e.g., Brown et al. 2004).

Stormwater runoff with a murky color is evidence of a high suspended solids concentration that is most likely made up of fine particle sizes, such as clays and silts, because sand particles settle out of standing water very rapidly (as discussed in Chapter 10: Sedimentation).

Stormwater runoff with a murky color further indicates that the watershed may be a significant source of fine particle suspended solids, which can quickly clog an infiltration practice.

Stormwater runoff with a green color from algae or biological activity has been stored in the infiltration practice for a long period of time such that microorganisms have developed. The infiltration practice is not infiltrating stormwater runoff and is therefore failing.

7)Is there evidence of illicit storm sewer discharges?

An illicit discharge manual (e.g., Brown et al. 2004) should be consulted for identifying and locating illicit stormwater discharges.

8)Does the infiltration basin or trench smell like gasoline or oil?

If an infiltration practice smells like gasoline or oil it is possible that hydrocarbon substances such as automotive oil or gasoline are being illicitly discharged into the practice or upstream in the watershed. If hydrocarbons are proven not to be illegally discharged into the infiltration practice, then an oil/gasoline smell may indicate that stormwater runoff is stored in the infiltration practice such that the small amounts of hydrocarbons typically found in stormwater runoff are accumulating. For more information on identifying, locating, and eliminating illicit discharges, refer to a manual such as Brown et al. (2004).

9)What is the approximate percentage of vegetation coverage in the practice?

Vegetation in the bottom of an infiltration basin can increase the infiltration effectiveness. Plants can lose 30% of their root structures annually, which produces macropores. Macropores in a infiltration practice can increase the infiltration rate of the basin or trench so that more stormwater runoff is infiltrated. Additionally, vegetation can reduce overland flow velocities and can therefore reduce erosion and resuspension of captured solids. Infiltration trenches typically have a larger grain size so that vegetation cannot grow without clogging of the pores.

Vegetation can also be an indication of the drain time of an infiltration basin. Terrestrial vegetation often cannot withstand long periods of inundation, and some cannot withstand short periods of inundation. If an infiltration practice has an abundance of terrestrial vegetation, it is likely that the practice infiltrates stormwater runoff quickly (< 48 hours) and is therefore operating properly. If, however, the infiltration practice has signs of aquatic vegetation, the practice may not be infiltrating stormwater runoff and is therefore failing.

10)Are there indications of any of the following in the bottom of the infiltration basin or trench?

Sediment deposition may indicate that pretreatment devices have reached sediment storage capacity, are not efficiency removing settable solids, or are not present. Sediment deposition may also indicate a significant source of sediment in the watershed that may require remediation to prevent downstream pollution. Sediment deposition reduces the surface area available for infiltration and therefore can reduce the stormwater runoff volume that is infiltrated.

Erosion or channelization indicates that the velocity of flow entering, or in, the infiltration practice is large or that stormwater runoff is entering the infiltration practice by means other than those intended by design. Erosion or channelization indicates that the velocity of flow entering, or in, the infiltration practice is large or that stormwater runoff is entering the infiltration practice by means other than those intended by design. In either case, stormwater runoff is not stored such that significant infiltration is occurring in the areas where erosion and channelization are present.

Vegetation, especially with deep roots, can increase and maintain infiltration rates in infiltration basins and trenches. If the surface of the infiltration practice becomes clogged or sealed, vegetation can provide pathways for stormwater runoff to penetrate the surface and subsequently infiltrate into the underlying soils. Excessive vegetation, if greater than the optimal vegetative density, can negatively impact the performance of the system. Thus, vegetation in infiltration basins and trenches should only be controlled to reduce the plant density or if it is undesirable for aesthetic or nuisance reasons.

Bare soil or lack of healthy vegetation significantly different from the original design may indicate that the infiltration practice is not operating properly. For example, if the infiltration basin or trench was designed to include vegetation and that vegetation has died or is unhealthy, it could indicate standing water has remained in the system for excessively long time periods. This may also be indicated if the plants are transitioning from the original vegetation to wetland species.

Litter and debris in an infiltration practice are indications that pretreatment practices are failing or not present. Litter and debris may limit the effectiveness of infiltration practices by reducing the surface available for infiltrating stormwater runoff.

Most infiltration basins and trenches are designed to pass runoff within 48 hours. If it has been more than 48 hours since the end of the last runoff event and the infiltration basin or trench still has standing water on the surface, it is an indication that the basin or trench is clogged and/or not operating properly.

11)Are there indications of any of the following on the banks of the infiltration basin or trench?

Erosion or channelization on the banks of an infiltration practice indicates that stormwater runoff is entering at a large velocity by means other than those intended by design. Erosion and channelization on the banks can fill the practice with sediments from the bank and subsequently reduce effectiveness by clogging the soil or sealing the surface and reducing the volume available for stormwater storage.

Soil slides or bulges indicate that the soil is, or potentially will be, unstable and further sliding or bulging may lead to complete bank failure. If this occurs, the filtration unit could become completely clogged and the collapsed soil could be washed downstream.

Animal burrows may also lead to soil failure and clogging of the infiltration basin or trench as described in the previous paragraph.

Seeps and wet spots indicate subsurface flow into the infiltration basin or trench and could lead to soil slides or erosion and channelization on the banks of the practice.

Poorly vegetated areas can lead to increased erosion, which can clog the infiltration basin or trench and lead to the collapse of the bank.

Trees on constructed slopes can damage the infiltration practice and the loss of leaves in the autumn can lead to clogging of the infiltration basin or trench.

12)Is the bottom of the infiltration basin or trench covered with a layer of silts, clays, or both?

A visible layer of silts, clays, or both is a likely indication that the infiltration practice is clogged. Infiltration basins collect particles on the surface and in the pore spaces of the soil. Silts, clays, or both present on the surface of the basin or trench indicates that the pore spaces within the soil are likely filled or that stormwater runoff is stored in the basin or trench long enough for these fine particles to settle out or for the stored stormwater runoff to evaporate. The infiltration practice is not likely infiltrating stormwater runoff in less than 48 hours as recommended by design guidelines (Minnesota Stormwater Steering Committee 2005).

13)Are any overflow structures clogged?

Infiltration basins and trenches typically have overflow structures instead of outlet structures. Outflow for an infiltration practice is intended to go into the soil such that deep percolation or evaporation occurs. The overflow structure should be free of any debris, sediment, vegetation, and other obstructions so that stormwater runoff can easily exit the infiltration practice in the event of a large storm event. If the overflow structure is partially or completely clogged, surrounding areas may be flooded by stored stormwater runoff. Any obstructions should be removed immediately to ensure proper operation of the infiltration practice.

13b)Are any of the overflow structures askew or misaligned from the original design or otherwise in need of maintenance?

Misaligned overflow structures often allow stormwater runoff to enter or exit an infiltration practice by means other than those intended by design or prevent stormwater runoff from entering the infiltration practice at all. This condition can result in erosion, channelization, or flooding of surrounding areas, which can further exacerbate the misalignment or create other problems.

Overflow structures can become misaligned for several reasons, including frost heave of the soil, vehicular collision, and geotechnical failure. Misaligned overflow structures should be repaired or replaced as soon as possible to reduce detrimental impact. Any obstructions should be removed immediately to ensure proper operation of the infiltration practice.

Other issues requiring maintenance include large cracks in concrete structures, corrosion, dents or malformation of the structure, etc.

14) Inspector's Recommendations. When is maintenance needed?

Maintenance is needed “before the next rainfall” for:

- Completely clogged inlet or overflow
- Standing water more than 48 hours after runoff has entered the practice (determine the cause)
- Significant erosion on the banks or within the basin
- Damaged/misaligned/askew inlet or overflow such that flooding or structural instability of adjacent roadways or infrastructure may result

Maintenance is needed “before the next rainy season” for:

- Partially clogged inlet or overflow
- Misaligned inlet or overflow structures that have resulted in some erosion
- Vegetation coverage less than 50% of the design coverage
- Significant sediment deposition (capacity testing for scheduling)
- Litter, large debris, and solid waste
- Sediment deposition downstream of the practice

- Erosion downstream of the practice
- Evidence of illicit discharge
- Excessive or invasive vegetation

Maintenance is needed "within a year or two" for:

- Misaligned inlet/outlet structures that have not resulted in erosion
- Some sediment deposition (capacity testing for scheduling)

References

Brown, E., D. Caraco, and R. Pitt. 2004. Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessment. Center for Watershed Protection, Ellicott City, MD.

Minnesota Stormwater Steering Committee. 2005. The Minnesota Stormwater Manual. Developed by Emmons and Olivier Resources for the Stormwater Steering Committee, Minnesota Pollution Control Agency, St. Paul, MN. http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html

Scheduling Maintenance for Porous Pavements

The following section provides discussion about each question answered on the field data sheet above.

1)Has visual inspection been conducted on this location before?

It is important to determine whether this location has been previously assessed so that assessment efforts are cost effective (i.e., neither duplicated nor wasted). If previous assessment has occurred, the current assessment should verify that actions suggested by the previous assessment were completed and are effective.

2)Has it rained within the last 48 hours at this location?

Porous pavement is designed to drain the design storm volume (i.e., water quality volume, maximum storage volume) immediately (Minnesota Stormwater Steering Committee 2005). Assessing a porous pavement within 48 hours of a rainfall event may provide additional assessment clues than assessment during a long dry period. Additionally, rainfall within the last 48 hours at a location will alter how answers to other questions in this assessment are interpreted.

3)Is there standing water on top of the porous pavement?

For any runoff volume that does not exceed the design storm, porous pavement should not have any standing water. Standing water on top of porous pavement is the result of two possibilities: (1) substantial rainfall above design has occurred recently such that the stormwater has not been able to infiltrate, (2) the porous pavement is clogged and does not infiltrate sufficient stormwater.

4)Are there indications of any of the following on top of the porous pavement?

Sediment deposition may indicate a significant source of sediment in the watershed that may require remediation to prevent downstream pollution. Sediment deposition limits the porous pavement surface area available for infiltration and therefore can reduce the stormwater runoff volume that is infiltrated.

Litter or debris, on a porous pavement may indicate that pretreatment practices are failing or not present. Litter and debris may also limit infiltration by reducing the surface available for infiltrating stormwater runoff.

5) Inspector's Recommendations. When is maintenance needed?

Maintenance is needed “before the next rainfall” for:

- Standing water more than 48 hours after runoff has entered the practice (determine the cause)

Maintenance is needed “before the next rainy season” for:

- Significant sediment deposition (capacity testing for scheduling)
- Litter, large debris, and solid waste

Maintenance is needed “within a year or two” for:

- Some sediment deposition (capacity testing for scheduling)

References

Minnesota Stormwater Steering Committee. 2005. The Minnesota Stormwater Manual. Developed by Emmons and Olivier Resources for the Stormwater Steering Committee, Minnesota Pollution Control Agency, St. Paul, MN. http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html