3 SITE SOIL AND INFILTRATION ASSESSMENT

The purpose of the site soil assessment and infiltration testing is to determine where BMPs should be located on the site and if infiltration BMPs are feasible on the site. This chapter is intended for Tier 3 projects. Refer to Section 5-2 in Chapter 5 for soil assessment methodologies for Tier 1 and Tier 2 projects.

Site soil assessment and infiltration testing should be conducted early in the design process to facilitate LID site design principles and practices. When sites are designed without initially assessing the site's soil characteristics or considering LID site design principles and practices in the initial design process, often times the chance to preserve the site's natural hydrology, distribute post-construction storm water BMPs appropriately across a site, and preserve the site's soil infiltration capacity in areas where at appropriate BMP locations is limited. However, if the site soil assessment and infiltration testing occurs early in the design process, potential infiltration sites may be identified and measures can be taken to preserve the infiltration capability of the site and reduce implementation costs.

3.1 Who Should Conduct the Assessment?

A qualified soil scientist or geotechnical professional should conduct the test pit investigation and infiltration tests. The professional should be experienced with not only the testing procedures themselves but also the requirements of the potential BMPs to ensure that additional information regarding the siting of BMPs is acquired during the test pit investigations.

3.2 Preliminary Site Investigation

A preliminary site investigation will likely reduce the number of test pit investigations needed by identifying strategically placed test sites. Prior to developing a detailed site plan or performing soil testing, the site should be evaluated based on existing information. Existing information includes, but is not limited to, soil maps, hydrologic soil group classifications, geology, streams, topography, slope, drainage patterns, existing and previous land uses, and features that may impact design. The proposed development should be considered when evaluating the background information to ensure pertinent information is gathered, specifically related to the development plan. In addition, the development plan in combination with the preliminary site evaluation allows for identification of key locations of concern as well as potential BMP locations, particularly focusing on identifying BMP locations that are most amenable to infiltration.

3.3 Test Pit Investigation

A test pit investigation is an integral part of the site soil assessment since it provides subsurface site specific data that aids in the design of the site and identifies appropriate locations and types of BMPs appropriate for the site. Soil maps and hydrologic soil groups are based on regional data and provide a general understanding of what to expect; however, there are undoubtedly unknowns that will be discovered during these initial observational tests. A test pit investigation involves digging or excavating a test pit (deep hole). By excavating a test pit, overall soil conditions (both vertically and horizontally) can be observed in addition to the soil horizons. To maximize the knowledge gained during the test pit investigation, many tests (to be determined by a licensed civil engineer) and observations should be conducted during this process.

Test pits should be excavated to a depth at least three feet deeper than the proposed bottom of the BMP for non-infiltration BMPs and at least eleven feet deeper than the proposed bottom of the BMP for infiltration BMPs. See the BMP site suitability selection matrix (Table 6-2) for identifying the minimum depth to seasonal high groundwater for the different storm water runoff BMP options for Tier 3 projects.

A project that imports fill must characterize the proposed soil profile at the specified depths. For example, if the proposed depth of fill is 5 feet and an infiltration BMP is to be used in the location of the fill, both the fill and the native subsoil require soil characterization. Figure 3-1 illustrates the proposed soil profile that would result with 5 feet of fill. Note that the infiltration BMP will occupy the first 2 feet of the fill. Since the test pit must be excavated to a depth that is 11 feet deeper than the bottom of the proposed infiltration BMP, a test pit investigation of the top 8 feet of native subsoil is required, in addition to the laboratory sample of the fill material. Characterization of the fill material should be conducted in a laboratory. See Section 3-6 for additional information. It is recommended that soil compaction is limited in the location of a proposed infiltration BMP.

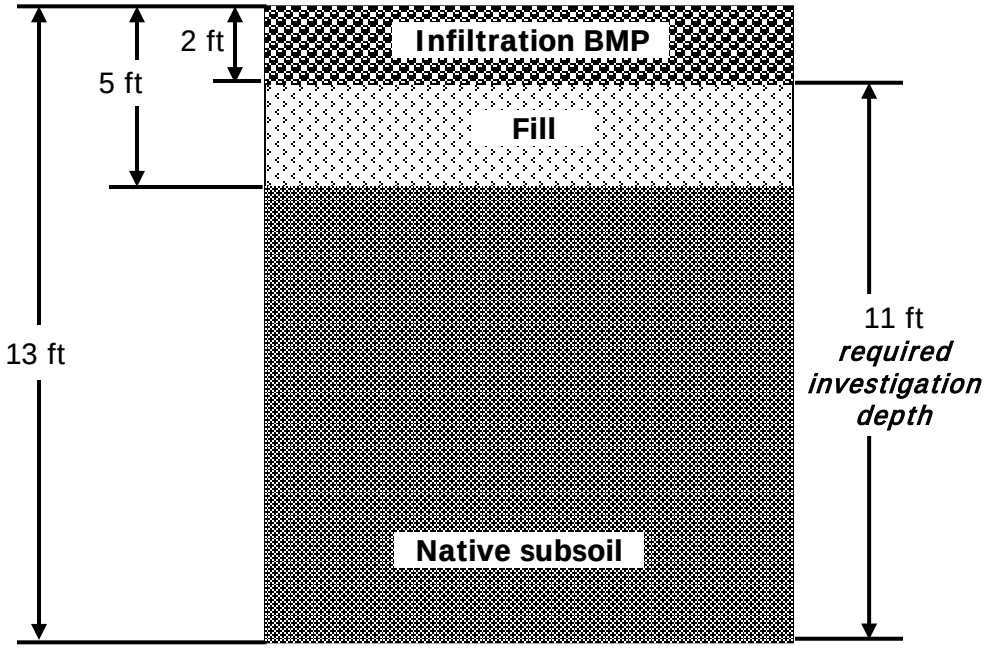

Figure 3-1: Post-fill Soil Profile
Diagram Credit: Geosyntec Consultants

As the test pit is excavated, the following measurements should be made:

- Standard penetration testing to determined the relative density as it changes with depth (minimum intervals of 2-3 feet), and
- Infiltration testing with one test occurring at the proposed bottom of the BMP.

In addition, many observations should be made during and after the excavation of the soil pit, including:

- Elevation of groundwater table or indication of seasonally high groundwater table
- Soil horizon observations, including:
  - Depths indicating upper and lower boundaries of the soil horizons
  - Depths to limiting layers (i.e., bedrock and clay)
  - Soil textures
  - Colors and their patterns
  - Estimates of the type and percent of coarse fragments
- Locations and descriptions of macropores (i.e., pores and roots)
- Other pertinent information/observations

The number of test pits required depends largely on the specific site and the proposed development plan. Additional tests should be conducted if local conditions indicate significant variability in soil types, geology, water table levels, bedrock, topography, etc. Similarly, uniform site conditions may indicate that fewer test pits are required. Excessive testing and disturbance of the soil prior to construction is not recommended. When test pit investigations are complete, including infiltration testing, the pits should be refilled with the original soil and the surface replaced with the original topsoil.

3.4 Infiltration Tests

There are a variety of infiltration field test methodologies available to determine the infiltration capacity of a soil. Infiltration tests should be conducted in the field in order to ensure that the measurements are representative of actual site conditions (including inherent heterogeneity). While it is recommended that these tests occur during the wet season, it is not necessary. When tests are conducted during other seasons, indications of seasonally high groundwater table should be noted using the NRCS hydric soil field indicators guide (NRCS, 2003). None of these tests should be conducted in the rain, or when temperatures are at or below freezing. For a site to be considered amenable to an infiltration BMP, the infiltration rate measured must be between 0.5 and 2.4 in/hr. If the measured infiltration rate is not within this range, it increases the risks of not enough infiltration (e.g., localized flooding) or of too much infiltration (e.g., may indicate macropore flow or other preferential pathway that would not provide adequate treatment). A factor of safety may be added to the measured infiltration rates to account for compaction and clogging over time. If using a BMP that requires infiltration, refer to the information on the specific BMP (Chapter 6) for requirements regarding incorporating a factor of safety.

To ensure groundwater is protected and that the infiltration BMP is not rendered ineffective by overload, it is important to periodically verify infiltration rates of the constructed BMP(s).

3.5 Falling-Head Infiltration Testing Procedure

There are a number of in-situ infiltration test methodologies; however, the method presented here is the falling-head infiltration test, a simple test to perform in the field. Since there are multiple falling head infiltration methods, the expert conducting the test should determine which type of infiltrometer to use for characterizing the infiltration rate based on knowledge of

the methods and the soil types. Usually infiltration rates should be determined at a minimum of two locations in each test pit and one must be conducted at the proposed bottom depth of the BMP. The actual number of tests required depends on the soil conditions; if the soils are highly variable, more tests may be required.

1. Remove any smeared soil surfaces to provide a natural soil interface for testing the percolation of water. Remove all loose material. The U.S. EPA recommends scratching the sides with a sharp pointed instrument. (*Note:* upon tester's discretion, a 2-inch layer of coarse sand or fine gravel may be placed to protect the bottom from scouring and sediment.) Fill casing with clean water and allow to pre-soak for 24 hours or until the water has completely infiltrated.
2. Refill casing and monitor water level (distance from top of casing to top of water) for 1 hour. Repeat this procedure a total of four times. (*Note:* upon tester's discretion, the final field rate may either be the average of the four observations or the value of the last observation. The final rate shall be reported in inches per hour.)
3. Testing may be done through a boring or open excavation.
4. The location of the test must be near the proposed facility.
5. Upon completion of the testing, the casings shall be immediately pulled and the test pit shall be back-filled.

3.6 Laboratory Soil Tests

If fill will be used in identified locations of BMPs, a laboratory test is required to determine the hydraulic conductivity of the soil. A sample of the soil from each area where a BMP will be located must be tested. The soil sample must be compacted to the same degree that will be present after final grading. Once prepared the sample should be sent to a specialty laboratory to conduct a test of the conductivity. These results may then be used to assess the applicability of a specific BMP.