4.1-b INFILTRATION BASIN

Alternative Names: Infiltration Pond

BMP DESIGN APPROACH
☐ Pollutant Source Control
■ **Hydrologic Source Control**
■ **Stormwater Treatment**
SCALE OF APPLICATION
☐ All SFR and MFR < 1 acre
■ **MFR 1-5 Acre and CICU < 5 acres**
■ **MFR and CICU > 5 acres and all WQIPs**
TYPE OF APPLICATION
☐ Temporary
■ **Permanent**

DESCRIPTION

An infiltration basin is a large engineered structure designed to detain stormwater runoff and infiltrate the detained runoff over a period of days. Infiltration basins, while similar in design to a dry basin, do not include an outlet structure that is designed to slowly draw down the water quality storage volume of the basin. Infiltration basins designed as on-line facilities include a high-flow bypass or emergency spillway. Infiltration basins designed as off-line facilities may not have an emergency spillway, as runoff can be designed to bypass the facility based on the elevation of the water stored in the facility.

APPLICABILITY

- Not appropriate for soils with infiltration rates less than 1"/hr or areas with seasonally high groundwater (e.g., SEZ) where groundwater contamination and low Ksat rates are concerns.
- Site above-ground infiltration basins on relatively flat terrain (less than a 5 percent slope).
- Subsurface infiltration basins can be sited on terrain steeper than 5 percent; however, engineering design and installation procedures are more complex for this type of application.
- Infiltration basins shall not be located near building foundations or other structural features. As a rule of thumb, site an infiltration basin at least 10 feet down gradient and 50 feet up gradient of a structural feature. (Suggested distances may be shortened or lengthened at the discretion of the licensed

professional civil engineer dependent on the measures taken to mitigate potential damages from seepage).

- Install as close to the source of runoff as possible, while still remaining in compliance with building practices identified directly above.
- Avoid siting within 600 feet of a drinking water source.
- Avoid using an infiltration basin as a snow storage facility unless the basin was specifically designed for this purpose as snow storage activities can damage or block the inlet and outlet structures to the basin.

Advantages

- Reduces stormwater discharged to surface waters and can provide effective removal of pollutants of concern to lake clarity.
- When land area is adequate, an appropriately sized infiltration basin can replicate predevelopment runoff characteristics more closely than most other BMPs included in this Handbook.
- Can provide stormwater volume reductions to prevent downstream channel erosion and can reduce potential downstream flooding.

Disadvantages

- Applicability limited to sites with higher soil Ksat rates and low pollutant loads (unless pretreatment is provided). Depending upon inflowing pollutant loads, frequent maintenance may be necessary to maintain effectiveness.
- Siting is frequently constrained due to a lack of available land area and high seasonal groundwater elevations.

DESIGN CONSIDERATIONS

The following guidelines are water quality design considerations for infiltration basins. Refer to applicable drainage design manuals within the responsible jurisdiction for requirements associated with structural integrity, drainage design, public safety, and other factors.

- Consider designing an accessible forebay or an equivalent pretreatment device at the inlet of an infiltration basin for removal of coarse sediments and debris. Accessible maintenance facilities, especially for subsurface infiltration basins, can markedly improve the ease of maintenance and contribute to extended effectiveness.
- A soils/hydrology investigation is typically necessary when siting an infiltration basin to determine soil permeability, depths to seasonal high groundwater, depths to restrictive layers, and any other potential impediments to successful infiltration.
- The bottom of an infiltration basin shall not be closer than 1 foot to high seasonal groundwater indicators.
- Where space is available, size the basin to retain at least the 20-yr/1-hr volume generated from the tributary impervious area.

- Above ground infiltration basins shall be designed to infiltrate stormwater within 96 hours.
- An underdrain system may be used to increase infiltration through above ground systems during winter periods when soils are more likely to freeze. A minimum 8-inch diameter underdrain pipe, encased in gravel, can be used to drain the soils below infiltration basins. A valve attached to the underdrain system can be used to control the rate of draw down in the basin. The valve can either be actively managed, or left open during the winter season to allow snowmelt to quickly move through the soils in the basin and reduce the potential for frozen soils to occur.
- In areas where salt-based deicers are directed to infiltration basins, soil may become less fertile and less capable of supporting vegetation. Incorporating organic amendments such as dry wood chips or composted material can help to mitigate this potential problem.
- Snow storage within infiltration basins may be acceptable if the following conditions are met:
    - Drainage design standards for the responsible jurisdiction allow the practice.
    - The limits of snow storage within the basin are clearly designated and do not encroach on the inlet and outlet structures of the basin.
    - Basin capacity has been increased to accommodate expected snow storage amounts in addition to the design storm (typically the 20-yr/1-hr storm). The basin must retain the capacity to hold the design storm at all times during snow storage operations.
    - Stabilized access for snow plowing equipment is provided.
    - Maintenance is conducted annually after spring snowmelt to remove material and debris from the basin, rehabilitate the infiltration capacity of the basin, and to confirm conveyance facilities are functional.

An infiltration basin functioning during a summer storm event.

INSTALLATION CONSIDERATIONS

- Remove and stockpile any native topsoil for use after rough grading basin dimensions.
- After completing basin grading activities, till back in topsoil or other soil amendments to improve infiltration capacity, which may be diminished by compaction from heavy equipment during grading. Tilling activities are typically at least 12 inches deep.
- The basin bottom shall be graded flat to provide uniform ponding and infiltration across the surface area of the basin.

INSPECTION AND MAINTENANCE

The following inspection and maintenance protocols were developed generally following those outlined in the BMP Rapid Assessment Methodology (RAM) for the Lake Tahoe Region. RAM protocols include setting and monitoring benchmark and threshold standard values for infiltration, material accumulation, and vegetation establishment within an infiltration basin.

EFFECTIVENESS CONSIDERATIONS

An appropriately sized infiltration basin that is adequately maintained is assumed to be one of the most effective BMPs described in this Handbook for removal of pollutants of concern while achieving runoff reductions from development. However, continued effectiveness may require frequent maintenance, especially if infiltrated stormwater contains significant sediment loads. Infiltration basins are relatively easy to construct when adequate land is available, and are typically less maintenance intensive than BMPs relying on filtration of stormwater for pollutant load reductions.

Very few performance monitoring studies have been conducted in the Tahoe Basin and outside the Tahoe Basin to assess the short- and long-term performance of

infiltration basins, as well as the potential impacts of infiltrated stormwater on groundwater quality. This research deficiency primarily arises because infiltration basins are exceptionally difficult to monitor, as a properly functioning infiltration basin routes surface runoff into the soil and groundwater. The *Lake Tahoe BMP Monitoring Evaluation Process*[5] analyzed results from three performance monitoring studies conducted in Tahoe Basin that attempted to characterize potential impacts to groundwater quality from infiltration. The report noted the following:

- No significant impact to shallow groundwater quality with respect to nutrients (and most other chemical compounds, Iron being the exception) was observed in one study.
- Nitrate is known to migrate freely in groundwater. Limited nutrient sampling results in one study suggested a nitrate pulse in shallow groundwater during spring snowmelt conditions.
- Hydrocarbons when infiltrated at concentrations typical of Tahoe Basin stormwater do not appear to pose a risk to groundwater quality when infiltrated through the soil column before reaching shallow groundwater.

[5] 2nd Nature, 2006, *Tahoe Basin BMP Monitoring Evaluation Process: Synthesis of Existing Research* prepared for USFS Tahoe Basin Management Unit

Infiltration Basin Inspection and Maintenance Table

INSPECTION AND MAINTENANCE ACTIVITIES	SUGGESTED FREQUENCY	INSPECTION EQUIPMENT	MAINTENANCE EQUIPMENT
Inspect inlets and outlets to ensure stormwater is being properly conveyed. ▪ Repair any blocked or diverted conveyances.	During major storms		Tools as needed for repair
Inspect forebays or pretreatment devices at the inlet of infiltration basin for accumulated sediment and debris. ▪ Remove sediment and debris.	Annually in spring and after major storms		
Inspect the basin for standing water 96 hours after a storm event. If water has not fully infiltrated, then infiltration rehabilitation is needed. ▪ Drain and rehabilitate basin (described below). ▪ Contact your local vector abatement office for specific instructions on controlling mosquitoes until rehabilitation can be performed.	96 hours after major storms		Tools suggested per qualified individual
Inspect for trash and debris especially at the inlet structures. ▪ Remove trash and debris from basin.	Annually in spring and after major storms		Trash Bag
Inspect for erosion, especially at the inlet locations. ▪ Identify causes for erosion and stabilize.	Annually in spring and after major storms		Erosion Control Blanket, Coir Logs
Inspect for invasive weeds[6]. ▪ Remove invasive weeds monthly during the first two growing seasons. Thereafter, weed annually, or as needed.	Monthly during first growing season and annually thereafter	Invasive Weeds Inspector	Tools as needed to control infestation
Inspect vegetation for percent cover according to BMP RAM protocols[7]. ▪ If riparian and wetland species percent cover is greater than 20%, vegetation removal is needed. Presence of riparian or wetland vegetation likely indicates a decline in infiltration rate. (reference CHP protocols described below) ▪ Prune and remove woody vegetation (leaving the roots) in the fall. ▪ If vegetation exceeds 12", mow to 6" height, use care (such as not mowing while ground is moist) to avoid excess compaction. ▪ Remove and compost or otherwise dispose of vegetative cuttings and debris.	Spring and fall	Vegetation Inspector	Loppers Mower Trash Bag
Inspect site for unusual or unsafe conditions (snowplow damage, structural damage, dumping, vandalism, etc.). ▪ Repair structural components as necessary.	Annually in spring		Tools as needed

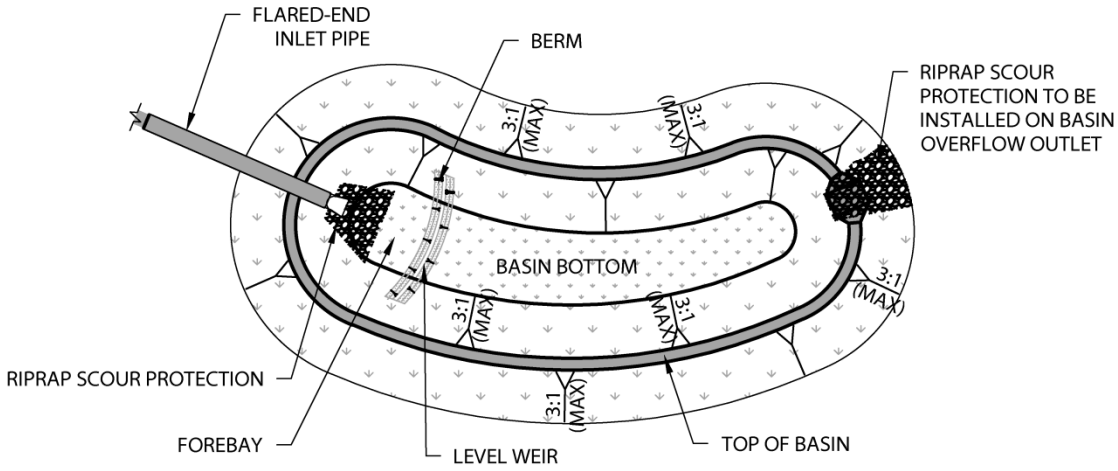
6 Lake Tahoe Basin Weed Coordinating Group. http://www.tahoeinvasiveweeds.org/
7 The Lake Tahoe Stormwater Community and Environmental Improvement Program, Final – September 2009, *BMP RAM Users Manual V.1. Step 4. Field Observation Protocol. Vegetation Cover. pg 63-64*

INSPECTION AND MAINTENANCE ACTIVITIES	SUGGESTED FREQUENCY	INSPECTION EQUIPMENT	MAINTENANCE EQUIPMENT
Measure depth of sediment to determine accumulated depth according to BMP RAM protocols[8]. ▪ If accumulated material has decreased basin capacity by 30%, removal of accumulated material as needed. To prevent compaction, perform only when basin is dry.	Annually in summer	Staff plate or Stadia rod	Shovel, Backhoe, or Vactor Truck Pickup or Dump Truck Aerator for Basin Bottom
Perform Constant Head Permeameter (CHP) infiltration tests according to BMP RAM protocols[9] to determine current infiltration rates. ▪ Compare Ksat test results to initial Ksat rates of the basin. If the rate has decreased by 20%, rehabilitation of the basin is needed. ▪ Rehabilitate basin to restore infiltration capability. To prevent compaction, perform maintenance only when basin is dry. Rehabilitation options include: o Scrape bottom (shovel, backhoe, or other equipment to remove sediment. o Dispose of sediment at an approved facility. o Remove riparian vegetation species with accumulated sediment. o Till the bottom of basin to restore Ksat rate and reseed/replant if necessary.	Annually in summer	CHP kit and instructions	Shovel, Backhoe, or Equipment Needed Pickup or Dump Truck Tilling Equipment

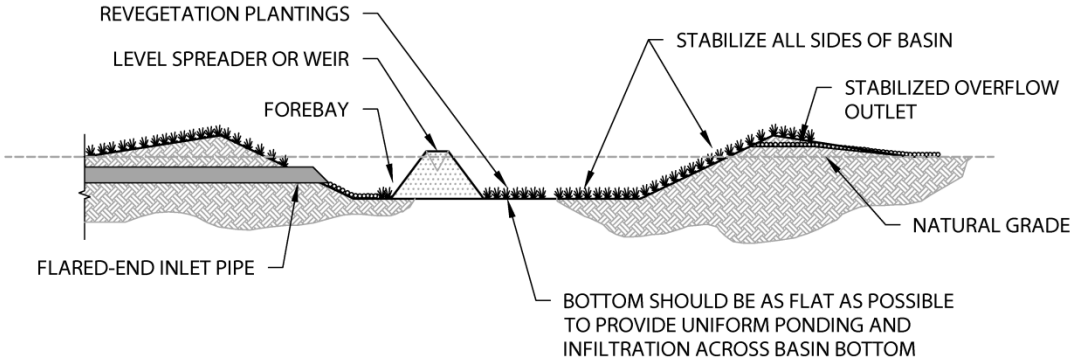
8 The Lake Tahoe Stormwater Community and Environmental Improvement Program, Final – September 2009, *BMP RAM Users Manual V.1. Step 4. Field Observation Protocol. Material Accumulation. pg 55-57*

9 The Lake Tahoe Stormwater Community and Environmental Improvement Program, Final – September 2009, *BMP RAM Users Manual V.1. Step 4. Field Observation Protocol Constant Head Permeameter (CHP). pg 49-52*

Infiltration Basin Figure



PLAN VIEW



SECTION VIEW

NOTES:

1. THIS DETAIL DISPLAYS KEY CONCEPTS FOR AN INFILTRATION BASIN AND IS NOT INTENDED TO BE APPLICABLE TO A SPECIFIC SITE. INDIVIDUAL DESIGN OF AN INFILTRATION BASIN SHOULD BE VERIFIED BY THE APPROPRIATE REVIEW AGENCY AND/OR ENGINEER.
2. WHERE ADEQUATE SPACE IS AVAILABLE, SIZE INFILTRATION BASIN TO RETAIN AT LEAST THE 20-YEAR 1-HOUR VOLUME GENERATED FROM THE TRIBUTARY IMPERVIOUS AREA.
3. DESIGN INFILTRATION BASIN TO INFILTRATE STORMWATER WITHIN 96 HOURS.
4. INSTALL PRETREATMENT FOR INFILTRATION BASIN TO REMOVE COARSE SEDIMENT AND OTHER POLLUTANTS, AND TO REDUCE MAINTENANCE COSTS. PRETREATMENT OPTIONS INCLUDE CHECK DAM, FORE BAY, OR OTHER SEDIMENT TRAP DEVICES.
5. BASINS STEEPER THAN 3:1 SHALL REQUIRE MECHANICAL STABILIZATION.