4.4-c DRY BASIN

Alternative Names: Dry Pond, Extended Detention Basin, Detention Basin, Sediment Basin

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

A dry basin is a large engineered structure designed to detain stormwater runoff and provide infiltration and particle settling. Stormwater runoff is detained within the basin and slowly released through one or more outlet structures. Vegetation may be present in the basin; however, significant amounts of wetland and riparian species of vegetation should not be present. The term "dry" implies that there is no permanent pool of water in the basin between storm runoff events.

APPLICABILITY

- Relative to other large engineered structures defined in this Handbook, a dry basin may be more applicable in the following cases:
  - Relative to wet ponds – a dry basin may be more applicable when a perennial or seasonal baseflow is not available to sustain a permanent pool of water and wetland species of vegetation.
  - Relative to infiltration basins – a dry basin may be more applicable for locations with relatively low Ksat rates, poor quality stormwater runoff, or when available land area limits the size of the basin at or below the desired water quality volume.
- Dry basins should be sited on relatively flat terrain (typically less than a 5 percent slope).
- Avoid using a dry 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.
- Avoid locating a dry basin that infiltrates stormwater runoff within 600 feet of a drinking water source.

Advantages

- Can provide control of stormwater runoff for both water quality and peak flow attenuation for flood control.
- Can provide benefits besides water quality, such as wildlife habitat and open space.

Disadvantages

- When adequate maintenance is lacking, or when design flaws occur, settled particulates may be re-suspended and discharged during subsequent runoff events.
- When outlet designs are used for flood control (rapid draw down of the storage volume) the basin may be ineffective for removal of pollutants of concern.

DESIGN CONSIDERATIONS

The following guidelines are water quality design considerations for dry 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 at the inlet of a dry basin for removal of coarse sediments and debris. A forebay sized at roughly 5 to 10 percent of the designed water quality volume of a dry basin is typically sufficient. While the inclusion of a forebay may not be aesthetically pleasing, a forebay can markedly improve the ease of routine maintenance of a dry basin and contribute to extended effectiveness.
- The length to width ratio of a dry basin should be at least 2:1 (run to rise), but preferably 3:1 or greater.
- Locate inlets as far away from the outlet structure as possible to minimize potential short-circuiting. Short-circuiting occurs when water passes from the inflow to outflow without moving through the longest axis of the basin. Baffles or berms may be used to decrease the potential for short-circuiting and to reduce incoming stormwater velocity.
- Maximize the residence time of the water quality volume within basin. The outlet structure should be designed to release the maximum water quality volume in 72-96 hours. Residence times longer than 96 hours may be a concern for vector control. However, the water quality volume may be retained longer than 96 hours between October 1 and April 15.
- Where space is available, size the basin to retain at least the 20-yr/1-hr storm volume generated from the tributary impervious area. A shallow basin with a large surface area is preferable to a deep basin with a small surface area to promote particle settling and infiltration. Depths for water storage ranging from 1 to 3 feet are preferred.
- Include a trash rack on the outlet riser to prevent floating debris and trash from entering the downstream drainage system.
- Design side slopes to generally be 3:1 (run to rise) or flatter to encourage growth of vegetation and generally slope stability. Emergent vegetation (grasses, sedges, rushes) within the basin are encouraged to reduce mixing and re-suspension of settled pollutants.
- Pretreatment should be provided if a dry basin will infiltrate stormwater with potentially significant groundwater contaminants.
- Snow storage within dry 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 snowplowing 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.

INSTALLATION CONSIDERATIONS

- Remove and stockpile any native topsoil for use after grading basin dimensions.
- After completing basing grading activities, till back in topsoil or other soil amendments to improve infiltration capacity, which may have been diminished by compaction from heavy equipment during grading. Tilling activities should be at least 12 inches deep.
- Install energy dissipaters at all outlet and inlet areas to reduce the potential for scour.
- Remove or stabilize sediment in the basin disturbed by construction activities.

INSPECTION AND MAINTENANCE

Inspection and maintenance should follow the protocols 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 a dry basin. Refer to the Dry Basin Inspection and Maintenance Activities Table.

Dry Basin Inspection and Maintenance Activities Table

INSPECTION AND MAINTENANCE ACTIVITIES	SUGGESTED FREQUENCY	INSPECTION EQUIPMENT	MAINTENANCE EQUIPMENT
Inspect for signs that stormwater runoff is properly accessing any inlets and outlets. Look for any blockages or diversions. Emergency overflow spillways should be structurally sound and accessible. ▪ Repair any blocked or diverted conveyances, inlets and outlets and ensure that emergency spillways are structurally sound and functioning.	Before and During Major Storms		Trash Bag Shovel
Inspect for standing water 96 hours after a storm event between April 15th and October 1st. ▪ If water is present, then contact your local vector abatement office for specific instructions on controlling mosquitoes until rehabilitation can be performed ▪ Drain basin and unclog the outlet and check that the emergency overflow is sound.	96 hours after major storms		Tools suggested per qualified individual
Inspect for trash and debris. ▪ Remove trash and debris from basin.	Monthly (April–Oct)		Trash Bag
Inspect for erosion and undercutting, especially along the adjacent slopes, and at the inflow and outflow areas. ▪ Stabilize eroded slopes and undercut and eroded areas at inflow and outflow structures.	Monthly (April–Oct)		Erosion Control Blanket, Coir Logs
Inspect for successful vegetation establishment and initial die off to determine if any remedial actions are needed, such as reseeding and irrigation the first year. ▪ Amend soils, reseed/replant, mulch, and irrigate as necessary to achieve desired vegetative establishment.	Monthly During First Growing Season	Vegetation Inspector	Soil Amendment Seeds/Plants Mulch Irrigation
Inspect for invasive weeds[8]. ▪ 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 in-basin vegetation and measure percent cover per BMP RAM protocols.[9] Wetland and riparian species indicate that the soil is becoming plugged with fines, infiltration capability has diminished, and rehabilitation of the infiltration basin is necessary. ▪ Analyze inspection report. Percent cover of riparian and wetland species should be below 20%. ▪ If wetland and riparian species (willows, rushes, sedges, etc.) covers the basin by greater than 20%, it can indicate fine particulate buildup and lower infiltration capacity. Remove wetland and riparian species and associated sediment buildup. ▪ Prune and remove woody vegetation (leaving the roots) in the fall to prevent establishment of woody vegetation for fire defensible space, aesthetic, loss of capacity, or structural integrity concerns. ▪ If vegetation is greater than 12" high, mow and remove herbaceous vegetation in the fall to 6" height. Use care (such as not mowing while ground is moist) to avoid excess compaction[10].	Spring and Fall	Vegetation Inspector	Clippers Loppers Mower Trash Bag

[8] Lake Tahoe Basin Weed Coordinating Group. http://www.tahoeinvasiveweeds.org/.
[9] BMP RAM Users Manual V.1. The Lake Tahoe Stormwater Community and Environmental Improvement Program. Final – September 2009. Step 4. Field Observation Protocol. Vegetation Cover. pg 63-64.
[10] Caltrans BMP Retrofit Pilot Program Maintenance Indicator Document. Pg. 9

INSPECTION AND MAINTENANCE ACTIVITIES	SUGGESTED FREQUENCY	INSPECTION EQUIPMENT	MAINTENANCE EQUIPMENT
Inspect site for unusual or unsafe conditions (snow plow damage, structural damage, dumping, vandalism, etc.). ▪ Repair structural components as necessary.	Annually in Spring		Tools as needed
Measure depth of sediment to determine accumulated depth according to BMP RAM protocols[11]. ▪ If accumulated material has decreased basin capacity by 30%, removal of accumulated material is needed. To prevent compaction, perform only when basin is dry. ▪ Scrape bottom (shovel, backhoe, or vactor) to remove sediment and restore original cross-section.	Annually in Summer	Staff Plate	Shovel, Backhoe, or Vactor Truck Pickup or Dump Truck
Perform Constant Head Permeameter (CHP) infiltration tests according to BMP RAM protocols[12] to determine current infiltration rates. Only perform when basin is dry. ▪ Compare infiltration test results to initial infiltration 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 only when basin is dry. Rehab options include: o Scrape bottom (shovel, backhoe, or vactor) to remove sediment and restore original cross-section and infiltration rate. o Dispose of sediment out of the Tahoe Basin. o Remove riparian vegetation species with accumulated sediment. o Aerate the bottom of basin to restore infiltration rate and reseed/replant if necessary.	Annually in Summer	CHP Kit and Instructions	Shovel, Backhoe, or Vactor Truck Pickup or Dump Truck Aerator for basin bottom
Inspect for animal burrows, holes and mounds. ▪ If burrows are causing erosion or compromising structural integrity, backfill firmly.	Annually in Fall after vegetation trimming		Tools as needed to repair
Monitor ongoing effectiveness and determine whether another BMP type or additional BMPs could improve long-term effectiveness and improve benefits to costs versus the existing dry basin. ▪ Analyze Inspection and Maintenance Log for trends and recurring issues. ▪ Prepare a plan that more effectively addresses stormwater runoff, reduces long term maintenance costs and improves overall effectiveness and safety of the BMP.	Every 5 years	Qualified Inspector or Consultant	Qualified Inspector or Consultant

[11] BMP RAM Users Manual V.1. The Lake Tahoe Stormwater Community and Environmental Improvement Program. Final – September 2009. Step 4. Field Observation Protocol. Material Accumulation. pg 55-57.
[12] BMP RAM Users Manual V.1. The Lake Tahoe Stormwater Community and Environmental Improvement Program. Final – September 2009. Step 4. Field Observation Protocol Constant Head Permeameter (CHP). pg 49-52

EFFECTIVENESS CONSIDERATIONS

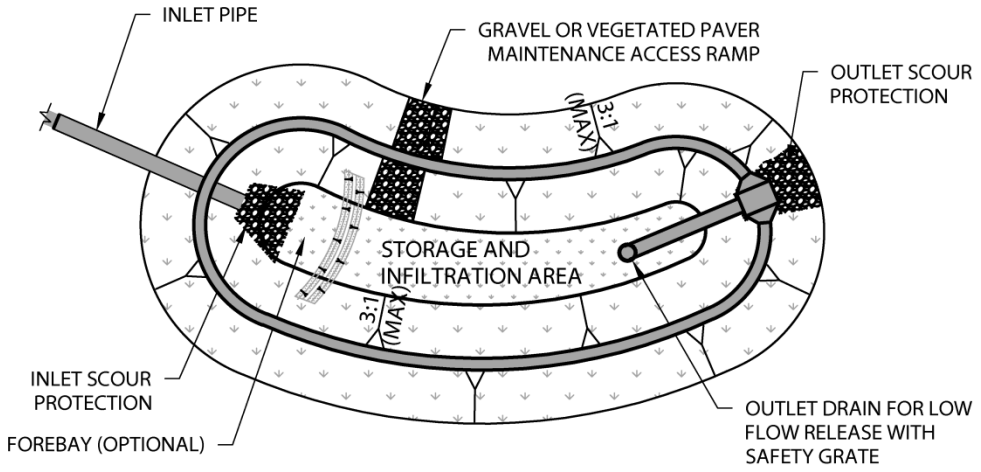
Dry basins primarily rely on particle settling as a pollutant removal mechanism to improve the quality of stormwater that passes through the dry basin. Consequently, their effectiveness for removal of fine sediment particles and other pollutants of concern is questionable. In terms of treated effluent quality, dry basins are considered less effective relative to other stormwater treatment BMPs that employ filtration as a pollutant removal mechanism, such as wet ponds or media filters. However, dry basins also provide stormwater volume reductions from evapotranspiration and infiltration, which can provide significant reductions in pollutant loading. Furthermore, dry 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.

The *Lake Tahoe BMP Monitoring Evaluation Process*[13] analyzed results from five performance monitoring studies conducted on Tahoe Basin dry basins and noted the following:

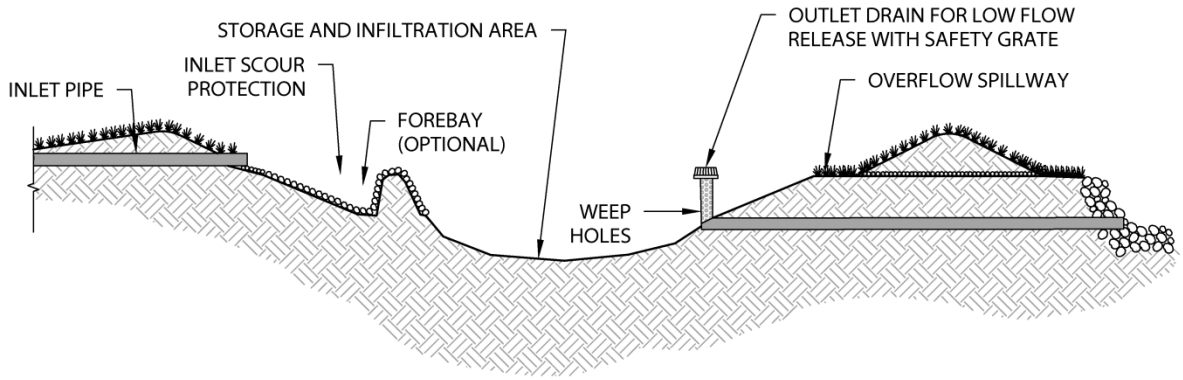
- TSS concentrations were consistently reduced, with at least a 68% event mean concentration (EMC) reduction in TSS reported from influent to effluent.
- Total organic nitrogen (TKN) and particulate phosphorous (PP) concentrations were consistently reduced from influent to effluent.
- Performance for reducing dissolved nutrient concentrations was highly variable. Based on review of the data, the author's theorized that there may be an achievable effluent quality limit, below which dry basins cannot provide treatment for dissolved nutrients when influent concentrations are at or below: Nitrate-Nitrite (NOx) < 250 ug/L; Ammonia (NH4+) < 50 ug/L, Soluble Reactive Phosphorus (SRP) < 50 ug/L; and Dissolved Phosphorus (DP) < 80 ug/L.
- Fine sediment particle concentrations were not analyzed among the five studies reviewed.

[13] 2NDNATURE, 2006, *Tahoe Basin BMP Monitoring Evaluation Process: Synthesis of Existing Research* prepared for USFS Tahoe Basin Management Unit.

Detention Basin Figure



PLAN VIEW



SECTION VIEW

NOTES:

1. THIS DETAIL DISPLAYS KEY CONCEPTS FOR A DRY BASIN AND IS NOT INTENDED TO BE APPLICABLE TO A SPECIFIC SITE. DRY BASINS SHALL BE DESIGNED BY AN ENGINEER FOR INDIVIDUAL SITES.
2. DESIGN DRY BASIN TO DRAIN/INFILTRATE STORMWATER WITHIN 96 HOURS.
3. LENGTH TO WIDTH RATIO SHALL BE A MINIMUM OF 2:1, BUT PREFERABLY 3:1 OR GREATER.
4. DESIGN SIDE SLOPES TO BE 3:1 OR FLATTER TO ENCOURAGE GROWTH OF VEGETATION AND SLOPE STABILITY.