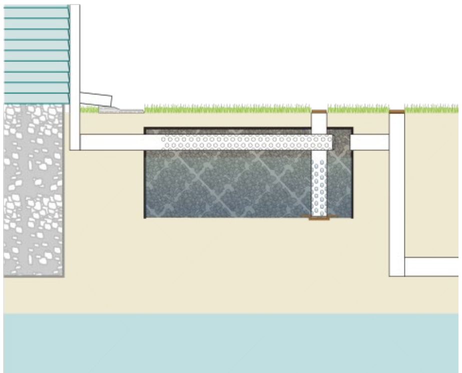
9.2 Dry Wells



Dry wells are subsurface stormwater facilities that are used to collect and temporarily store stormwater runoff generated by clean rooftops; runoff is discharged through infiltration into the subsoil. Dry wells may be used to comply with the groundwater recharge design and performance standard of the Stormwater Management rules. Additionally, they may also be used to reduce the volume of stormwater runoff generated by a clean roof from the Water Quality Design Storm. Dry wells are assigned a 0% total suspended solids (TSS) removal rate.

N.J.A.C. 7:8 Stormwater Management Rules – Applicable Design and Performance Standards		
	Green Infrastructure	Yes
	Stormwater Runoff Quantity	Not Allowed
	Groundwater Recharge	Yes
	Stormwater Runoff Quality	Not Allowed

Groundwater Recharge Mechanism and Corresponding Criteria	
Infiltration	
Maximum Contributory Drainage Area	1 acre
Maximum Design Volume	Water Quality Design Storm Volume
Maximum Drain Time	72 hours, Using Slowest Design Permeability Rate
Permeability Rate Factor of Safety	2
Minimum Design Permeability Rate of the Subsoil	0.5 inches/hour
Maximum Design Permeability Rate	10 inches/hour
Soil Testing Consistent with *Chapter 12: Soil Testing Criteria*	Required
Minimum Distance between Dry Well Bottom and Seasonal High Water Table	2 feet

Introduction

A dry well is a subsurface storage facility, consisting of either a structural chamber or an excavated vault that is only used to collect and temporarily store stormwater runoff generated by a clean roof; treatment of runoff obtained from any other surface is prohibited. For more information and design criteria for other types of subsurface infiltration facilities that may be used to treat runoff from other surfaces, see either *Chapter 9.8: Small-scale Infiltration Systems* or *Chapter 10.2: Infiltration Systems*. Outflow from a dry well is through infiltration into the subsoil, although they are required to have an overflow for diverting runoff generated by larger storms. Dry wells may be used to meet the groundwater recharge design standard at N.J.A.C. 7:8-5.4(b)(1). Additionally, dry wells may be used to reduce the stormwater runoff produced by the Water Quality Design Storm (WQDS) falling on a roof.

In dry wells, the rate of infiltration is affected by the permeability of the underlying soil, the distance separating the dry well bottom from the seasonal high water table (SHWT) and the area of the dry well bottom. While the loss of subsoil permeability through soil compaction is a concern, transport of dissolved pollutants by highly permeable subsoils is of equal concern. Although, in general, rooftops may not be a significant source of total suspended solids (TSS), they may be a source of nutrients and other contaminants. For example, in areas where birds tend to congregate, roofs may be a significant source of nutrients and bacteria; therefore, dry wells should not be sited in areas where there is a likelihood of high levels of rooftop pollutants. Additionally, due to the potential for groundwater contamination, the use of dry wells, and all stormwater infiltration best management practices (BMPs), is prohibited in areas where high pollutant or sediment loading is anticipated. For more information regarding stormwater runoff that may not be infiltrated, refer to N.J.A.C. 7:8-5.4(b)3. However, this prohibition is limited only to areas onsite where this type of loading is expected. Therefore, because dry wells collect only clean roof runoff, they may be used on these types of sites provided the location of the dry well is not inconsistent with an NJDEP-approved remedial action work plan or landfill closure plan.

Discharge from a dry well occurs through infiltration into the subsoil; therefore, they may not be used where their installation would create a significant risk of adverse hydraulic impacts. These impacts may include exacerbating a naturally or seasonally high water table so as to cause surficial ponding, flooding of basements, interference with the proper operation of a subsurface sewage disposal system or other subsurface structure, or where their construction will compact the subsoil. Hydraulic impacts on the groundwater table must be assessed. For more information on groundwater mounding analysis, refer to *Chapter 13: Groundwater Table Hydraulic Assessments for Infiltration BMPs* .

Finally, a dry well must have a maintenance plan and must be reflected in a deed notice recorded in the county clerk's office to prevent alteration or removal..

Applications

Pursuant to N.J.A.C. 7:8-5.2(a)(2), the minimum design and performance standards for groundwater recharge, stormwater runoff quality and stormwater runoff quantity at N.J.A.C. 7:8- 5.4, 5.5 and 5.6 shall be met by incorporating green infrastructure in accordance with N.J.A.C. 7:8-5.3.

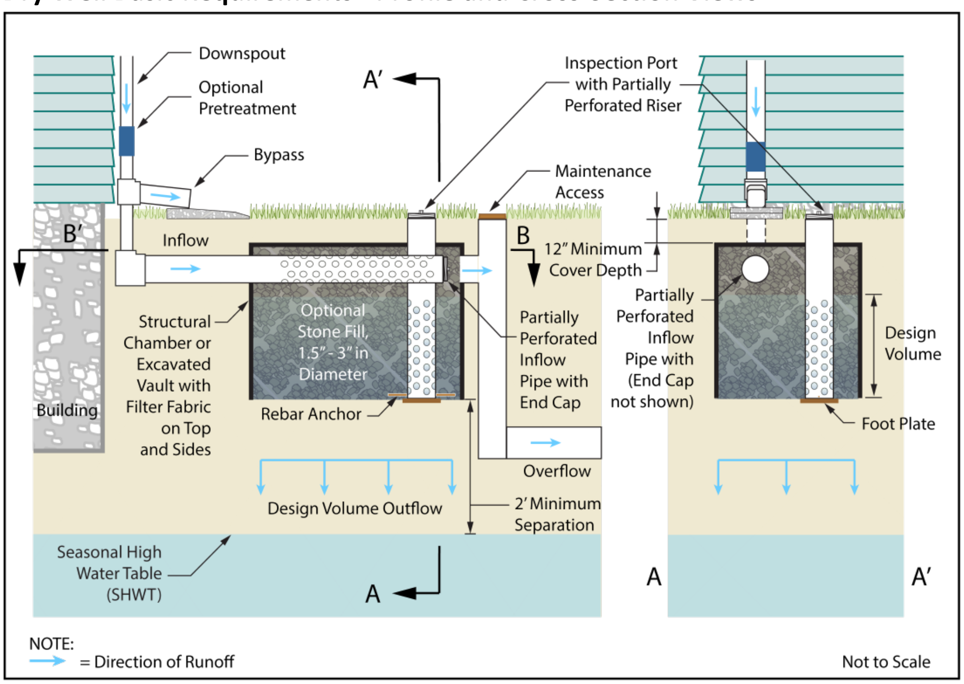
Dry wells may be used to meet the groundwater recharge requirements of the Stormwater Management rules. For more information on computing groundwater recharge, see *Chapter 6: Groundwater Recharge.*

Design Criteria

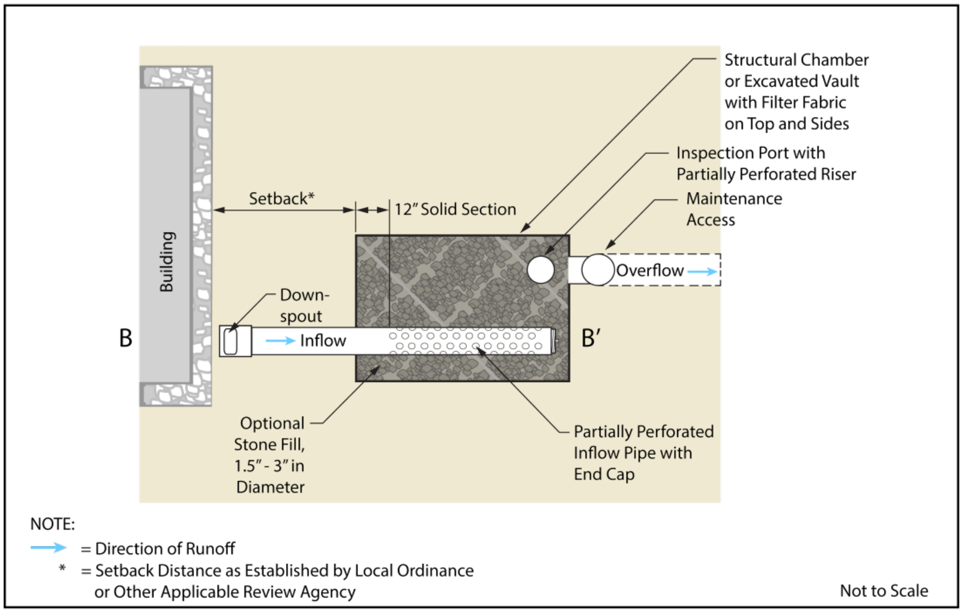
Basic Requirements

The following illustrations show the basic design criteria required for dry wells. The illustrations show possible configurations and flow paths and are not intended to limit the design. Additional information is provided on Pages 4 through 8.

Dry Well Basic Requirements - Profile and Cross-Section Views



Dry Well Basic Requirements – Plan View Section through Inflow Pipe



Contributory Drainage Area

- The maximum contributory drainage area limitation is 1 acre, pursuant to N.J.A.C. 7:8-5.3(b).
- The entire contributory drainage area must be completely stabilized prior to use of the dry well.

Inflow and Pretreatment

- The use of dry wells is limited to the collection of stormwater runoff generated by a clean roof that will not contribute nutrients, sediment or other pollutants to the dry well and is prohibited in areas where high pollutant or sediment loading is anticipated.
- Pretreatment is a requirement for dry wells designed to infiltrate into the subsoil that include exfiltration in the stormwater routing calculations for the 2-, 10- and 100-year design storms.
  - Any roof runoff must be pretreated by leaf screens, first flush diverters or roof washers. For details of these pretreatment measures, see Pages 5 and 6 of *Chapter 9.1: Cisterns.*
  - This pretreatment requirement can be waived by the review agency if the building in question has no potential for debris and other vegetative material to be present in the roof runoff. For example, a building that is significantly taller than any surrounding trees and does not have vegetative roof should not need the pretreatment. However, in making this determination, the review agency must consider the mature height of any surrounding trees.

Physical Components

- The sides and top of the dry well must be completely lined with filter fabric in order to prohibit the migration of fines from the surrounding soil into the dry well, unless a structural chamber is provided.

- The bottom of the dry well must be as level as possible in order to provide a uniform surface for infiltration.

- The seasonal high water table (SHWT) and bedrock must be at least 2 feet below the bottom of the dry well.

- Any stone fill within the dry well must be clean, washed aggregate between 1.5 and 3.0 inches in diameter.

- Perforated pipes must be anchored; an anchor, such as one made from a steel reinforcing bar, and a foot plate, both designed to resist corrosion, are required for vertical pipes.

- The first 12 inches of the perforated inflow pipe must be solid to facilitate the distribution of runoff in the dry well.

- The inflow pipe must be both horizontal and disconnected from any overflow or outflow pipe or riser.

- An inspection port with a crush-resistant, removable cap is required to allow for inspection and maintenance.

Permeability Rates

- The use of dry wells for stormwater management is only feasible where the subsoil is sufficiently permeable to meet the minimum permeability rate specified below.

- Soil tests are required at the exact location of the proposed system in order to confirm its ability to function as designed. The location of all soil testing must be consistent with *Chapter 12: Soil Testing Criteria:* in this manual. Take note that permits may be required for soil testing in regulated areas, such as areas regulated under the Flood Hazard Area Control Act Rules (N.J.A.C. 7:13), the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A), the Coastal Zone Management Rules (N.J.A.C. 7:7), and the Highlands Water Protection and Planning Rules (N.J.A.C. 7:38).

- The testing of all permeability rates must be consistent with *Chapter 12* in this manual, including the required information to be included in the soil logs, which can be found in Section *2b: Soil Log Requirements*. The slowest tested permeability must be used for design purposes.

- Since the actual permeability rate may vary from soil testing results and may decrease over time, a factor of safety of 2 must be applied to the slowest tested permeability rate to determine the design permeability rate. The design permeability rate would then be used to compute the system's drain time for the maximum design volume. The drain time is defined as the time it takes to fully infiltrate the maximum design storm runoff volume through the most hydraulically restrictive layer.

- The maximum design permeability rate of the subsoil is 10 inches/hour for any tested permeability of 20 inches/hour or more.

- The minimum design permeability rate of the subsoil 0.5 inches/hour, which equates to a minimum tested permeability rate of 1.0 inch/hour.

Storage Volume

- Dry wells are intended for small storm events; therefore, a dry well must be sized, subject to the following:
  - The storage volume of a drywell must be no greater than the runoff volume generated by the WQDS or the difference in runoff volume from pre-construction to post-construction for the 2-year storm, whichever is larger.
  - Exfiltration shall be included in the routing calculation used to size the drywell. Exfiltration is defined as the discharge of runoff into the subsoil. The rate of exfiltration is less than or equal to the design soil permeability, i.e., one half the tested permeability determined in accordance with *Chapter 12*.
  - Infiltration of the entire 2-year storm is allowed only when the difference in runoff volume from pre-construction to post-construction is the entire storm, thereby constraining the design to infiltrate 100% of the volume produced by the post-construction condition for the 2-year design storm.
- No standing water may remain in the dry well 72 hours after a precipitation event in order to allow for sufficient storage for the next event. Additionally, storage in excess of 72 hours may render the dry well ineffective and may result in anaerobic conditions, odor and both water quality and mosquito breeding issues.

Routing of Larger Storms through a Dry Well

While the storage volume cannot be calculated using the 10- or 100-year storm, the routings for the stormwater runoff quantity standard can utilize the exfiltration from a dry well, provided all of the conditions regarding the use of exfiltration in stormwater runoff calculations, as published in *Chapter 5* are met. This information is published in the section beginning on Page 7 of *Chapter 5*. The pretreatment requirements outlined under *Inflow and Pretreatment*, which begins on Page 4, must be followed.

Groundwater Mounding Impacts

- As with any infiltration BMP, groundwater mounding impacts must be assessed, as required by N.J.A.C. 7:8-5.2(h). This includes an analysis of the reduction in permeability rate when groundwater mounding is present.
- Exfiltration shall be used in the groundwater mounding analysis. The design soil permeability rate, also referred to herein as the design vertical hydraulic conductivity, of the most hydraulically restrictive soil horizon below an infiltration type BMP, may be used as the exfiltration rate in the routing calculations only when the soil is tested strictly in accordance with *Chapter 12*.
  - Additional trials may be required, including using a reduced recharge rate in accordance with the method published in *Chapter 5: Stormwater Management Quantity and Quality Standards and Computations*, should the calculations demonstrate an adverse impact is produced. Refer to the information labeled "Steps to Follow When an Adverse Impact is Encountered" found on Page 53 of *Chapter 5*.

- Where the mounding analysis identifies adverse impacts, the drywell must be redesigned, the routing run again and another groundwater mounding analysis performed for the redesign. The mounding analysis must provide details and supporting documentation on the methods used and assumptions made, including values used in calculations. For further information on the required groundwater mounding assessment, *see Chapter 13: Groundwater Table Hydraulic Impact Assessments for Infiltration BMPs*.

Safety

- Dry wells must be designed to safely convey overflows to downstream drainage systems. The design of the overflow structure must be sufficient to provide safe, stable discharge of stormwater in the event of an overflow. Safe and stable discharge minimizes the possibility of adverse impacts, including erosion and flooding in down-gradient areas. Therefore, discharge in the event of an overflow must be consistent with the *Standards for Off-Site Stability* found in the *Standards for Soil Erosion and Sediment Control in New Jersey*.

- Blind connections to downstream facilities are prohibited. Any connection to downstream stormwater management facilities must include access points such as inspections ports and manholes, for visual inspection and maintenance, as appropriate, to prevent blockage of flow and ensure operation as intended. All entrance points must adhere to all Federal, State, County and municipal safety standards such as those for confined space entry.

- In instances where the lowest invert in the outlet or overflow structure is below the flood hazard area design flood or tide elevation in a downstream waterway or stormwater collection system, the effects of tailwater on the hydraulic design of the drywell and overflow systems, as well as any stormwater quantity control outlets, must be analyzed. Two methods to analyze tailwater are:

  - A simple method entails inputting flood elevations for the 2-, 10-, and 100-year events as static tailwater during routing calculations for each storm event. These flood elevations are either obtained from a Department flood hazard area delineation or a FEMA flood hazard area delineation that includes the 100-year flood elevation or derived using a combination of NRCS hydrologic methodology and a standard step backwater analysis or level pool routing, where applicable. In areas where the 2-year or 10-year flood elevation does not exist in a FEMA or Department delineation, it may be interpolated or extrapolated from the existing data. If this method demonstrates that the requirements of the regulations are met with the tailwater effect, then the design is acceptable. If the analysis shows that the requirements are not met with the tailwater effects, the detailed method below can be used or the BMP must be redesigned.
  - A detailed method entails the calculation of hydrographs for the watercourse during the 2, 10, and 100-year events using NRCS hydrologic methodology. These hydrographs are input into a computer program to calculate rating curves for each event. Those rating curves are then input as a dynamic tailwater during the routing calculations for each of the 2, 10, and 100-year events. This method may be used in all circumstances; however, it may require more advanced computer programs. If this method demonstrates that the requirements of the regulations are met with the tailwater effect, then the design is acceptable. If the analysis shows that the requirements are not met with the tailwater effects, the BMP must be redesigned.

Construction Requirements

- Pursuant to N.J.A.C. 7:8-5.2(i)3, stormwater management measures shall be designed, constructed and installed to be strong, durable, and corrosion resistant. Measures that are consistent with the relevant portions of the Residential Site Improvement Standards at N.J.A.C. 5:21-7.3, 7.4, and 7.5 shall be deemed to meet this requirement.
- During clearing and grading of the site, measures must be taken to eliminate soil compaction at the location of a proposed dry well.
- The location of the proposed dry well must be cordoned off during construction to prevent compaction of the subsoil by construction equipment or stockpiles.
- The use of the location proposed for a dry well to provide sediment control during construction is discouraged; however, when unavoidable, the bottom of the sediment control basin should be at least 2 feet above the final design elevation of the bottom of the dry well.
- Excavation and construction of a dry well must be performed using equipment placed outside the limits of the dry well.
- The excavation to the final design elevation of the dry well bottom may only occur after all construction within its contributory drainage area is completed and the contributory drainage area is stabilized. If construction of the dry well cannot be delayed, berms must be placed around the perimeter of the dry well during all phases of construction to divert all flows away from the dry well. The berms may not be removed until all construction within the contributory drainage area is completed and the area is stabilized.
- If included, stone aggregate fill should be placed in lifts and compacted using plate compactors. A maximum loose lift thickness of 12 inches is recommended.
- Post-construction testing must be performed on the as-built dry well to ensure that the as-built permeability rate is equal to or greater than the design permeability rate. Where as-built testing results in a longer drain time, corrective action must be taken. The drain time is defined as the time it takes to fully infiltrate the maximum design storm runoff volume through the most hydraulically restrictive layer.

Access Requirements

- At least one inspection port that extends into the subsoil must be provided in the area of the dry well to monitor the functionality of the dry well. The inspection port exterior must be covered in such a way as to prevent the migration of material into the structure. The location of the inspection port must be shown in the maintenance plan. Additionally, the depth of stormwater in the dry well resulting from the maximum design storm must be marked on the structure and its level included in the design report and maintenance plan.
- All points of access must also be covered in such a way as to prevent sediment or other material from entering the system and to prevent the accumulation of standing water, which could lead to mosquito breeding.
- Access provisions must be included in the design to facilitate monitoring and maintenance.

Designing a Dry Well

The following examples illustrate how to use a dry well to reduce the volume generated by the Water Quality Design Storm. Example 1 features a dry well capable of collecting all of the rooftop runoff generated, whereas Example 2 depicts a dry well that captures only a portion. The examples show possible configurations and flow paths and are not intended to limit the design.

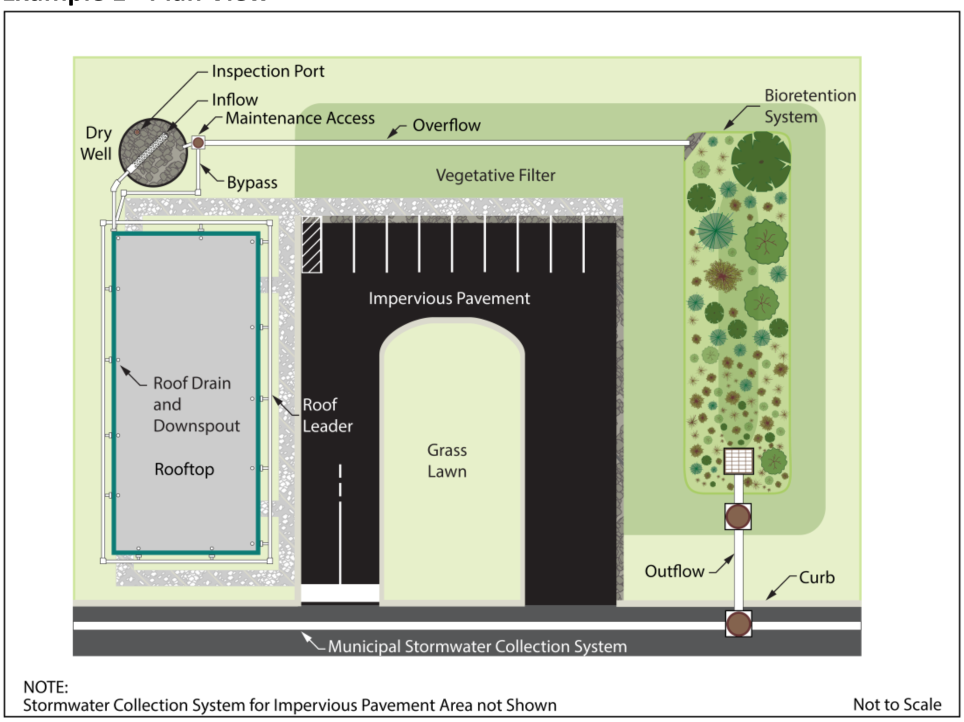
Example 1: An undeveloped, 1-acre site is zoned for commercial use. On this site, the proposed development includes the construction of a 5,000 sf building. The stormwater runoff from the parking lot will be directed to the bioretention system shown via a vegetative filter strip and their design is beyond the scope of this example.

The following parameters apply:

Depth to the SHWT	10 ft
Tested Permeability of Subsoil =	4 in/hr

Design a structural chamber dry well, containing stone fill, that will meet the criteria for the stormwater runoff quality volume reduction if all of the rooftop runoff is directed to it, as shown in the illustration below.

Example 1 - Plan View



Step 1: Runoff Calculations

Using the runoff calculation method described in the NRCS Methodology section of *Chapter 5*, the Water Quality Design Storm runoff volume from the 5,000 sf roof was calculated to be 431 cf. If site conditions allow, the anticipated volume reduction of this dry well is 431 cf.

Step 2: Determine the Required Volume of the Dry Well

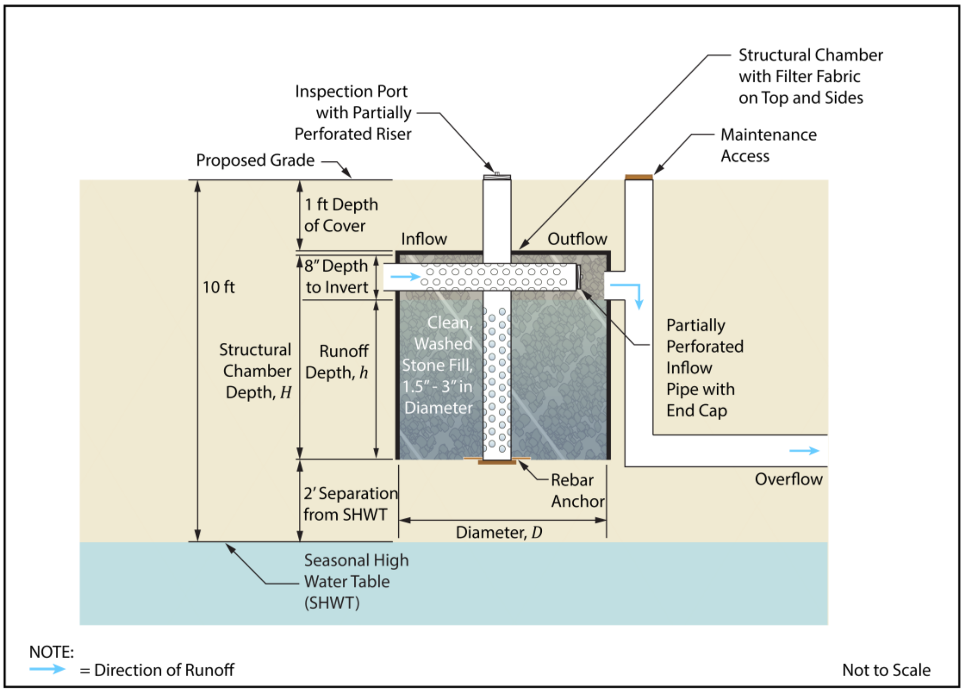
The next step is to determine the required total volume of the dry well. The void space of the crushed stone fill is approximately 40%. The total volume, V, is calculated as follows:

$$Total\ Volume = \frac{431\ cf}{0.40} = 1{,}078 \text{ cf}$$

Step 3: Sizing the Dry Well

In order to receive full credit for volume reduction, the dimensions must be sufficient to contain, below the overflow, the entire volume of stormwater runoff generated by the roof by the WQDS. The following graphic illustrates key elements of the design for this site.

Example 1 - Structural Chamber Dry Well Designed for Volume Reduction



In this example, the depth to the seasonal high water table is 10 feet. Assuming 1-foot depth of cover, the allowable structural chamber depth, H, is calculated as follows, excluding any thickness of the top of the structural chamber and the required filter fabric:

$$H = SHWT\ Depth\ - (\ SHWT\ Separation + Cover)$$

$$= 10\ ft\ - (\ 2\ ft + 1\ ft) = 7 \text{ ft}$$

As shown in the preceding image , the invert of the overflow pipe is 8 inches below the top of the dry well; therefore, the maximum depth, h, to which the runoff can rise with the stone fill in place is

$$h\ = 7\ ft\ - 0.67\ ft = 6.33 \text{ ft}$$

For this example, a circular chamber has been selected for the drywell. Using an exfiltration rate of 2 in/hr, which is one - half the tested soil permeability rate, trial and error routing calculations were performed using hydraulic and hydrologic modeling software, and it was determined that the diameter of the structural chamber required is 14 ft. The highest water depth produced by the WQDS is 6.32 ft, which is less than the maximum depth limit of 6.33 ft. The results are shown below.

WQDS Routing Summary Report

```
Inflow Area =        5,000 sf,100.00% Impervious,  Inflow Depth =   1.03"
Inflow     =      0.33 cfs @    1.09 hrs,  Volume=          431 cf
Outflow    =      0.01 cfs @    2.05 hrs,  Volume=          431 cf,  Atten= 98%,  Lag= 57.3 min
Discarded =       0.01 cfs @    0.60 hrs,  Volume=          431 cf
Primary    =      0.00 cfs @    2.05 hrs,  Volume=            0 cf

Routing by Stor-Ind method, Time Span= 0.00-58.00 hrs, dt= 0.05 hrs
Peak Elev= 6.33' @ 2.07 hrs   Surf.Area= 154 sf   Storage= 390 cf

Plug-Flow detention time= 464.3 min calculated for 431 cf (100% of inflow)
Center-of-Mass det. time= 464.7 min ( 535.0 - 70.3 )

Volume        Invert     Avail.Storage   Storage Description
  #1           0.00'            431 cf   14.00'D x 7.00'H Vertical Cone/Cylinder
                                         1,078 cf Overall  x 40.0% Voids

Device   Routing            Invert   Outlet Devices
  #1     Discarded           0.00'   2.00 in/hr Exfiltration over Surface area
  #2     Primary             6.33'   1.0" Vert. Orifice/Grate X 12.00 columns
                                     X 4 rows with 1.0" cc spacing C= 0.600

Discarded OutFlow  Max=0.01 cfs @ 0.60 hrs  HW=0.07'   (Free Discharge)
└─1=Exfiltration  (Exfiltration Controls 0.01 cfs)

Primary OutFlow  Max=0.00 cfs @ 2.05 hrs  HW=6.33'  (Free Discharge)
└─2=Orifice/Grate  (Orifice Controls 0.00 cfs @ 0.02 fps)
```

Source: HydroCAD® Summary Report; HydroCAD is a registered trademark of HydroCAD Software Solutions LLC. Used with permission.

WQDS Water Depth and Flow Rate Routing Report

Time (hours)	Elevation (feet)	Discarded (cfs)	Primary (cfs)
0.00	0.00	**0.00**	0.00
1.00	1.24	**0.01**	0.00
2.00	**6.32**	0.01	**0.00**
3.00	**5.97**	0.01	**0.00**
4.00	5.55	0.01	0.00
5.00	5.13	0.01	0.00
6.00	4.72	0.01	0.00
7.00	4.30	0.01	0.00
8.00	3.88	0.01	0.00

Source: HydroCAD® Routing Report; HydroCAD is a registered trademark of HydroCAD Software Solutions LLC. Used with permission.

A structural chamber 7 feet in depth and 14 feet in diameter will provide sufficient volume to contain the WQDS volume below the invert of the overflow.

Step 4: Estimated Drain Time Calculations

Calculate the drain time of the dry well to ensure that the subsoil permeability does not limit the design. The design permeability rate must be half of the tested permeability rate; therefore, the design permeability rate is 2 in/hr. An initial estimate is calculated as follows:

$$Outflow\ Rate = Subsoil\ Design\ Permeability\ Rate\ \ x\ Cross\ Sectional\ Area$$

$$= \frac{2\ in}{hr}\ x\ \frac{1\ ft}{12\ in}\ x\ \frac{\pi\ (14)^2}{4} = 25.66\ \text{cf/hr}$$

$$Drain\ Time = \frac{Runoff\ Volume}{Outflow\ Rate} = \frac{431\ cf}{25.66\ cf/hr} = 16.80\ \text{hr}$$

Since this is less than the allowable maximum drain time of 72 hours, the dry well meets the drain time requirement. **As-built testing must be conducted to confirm the design permeability rate of the subsoil and memorialize the design drain time of the dry well in the maintenance plan**.

Step 5: Groundwater Mounding Analysis

Calculate the height of the groundwater mounding caused by infiltration to ensure that it will neither prevent infiltration nor damage nearby structures. For information on conducting a groundwater mounding analysis, see *Chapter 13: Groundwater Table Hydraulic Assessments for Infiltration BMPs.* For this example, it is assumed that the design meets the necessary groundwater mounding analysis requirement.

RESULTS	**Because the dry well was designed to contain the entire volume of rooftop runoff generated by the Water Quality Design Storm, the volume reduction is 431 cf. Therefore, the area to be treated for water quality by the other stormwater BMPs on the site is reduced from 43,560 to 38,560 sf, which is an 11.5% reduction in area to be treated.**

Considerations

When planning a dry well, consideration should be given to soil characteristics, depth to the groundwater table, sensitivity of the region, and inflow water quality. It is also important to note that the use of dry wells is recommended in this manual only for the Water Quality Design Storm or smaller storm events. Use of dry wells to infiltrate larger volumes, should only be considered when another applicable rule or regulation requires the infiltration of a larger storm event. In such a case, the dry well should be designed to infiltrate the minimum storm event required to address that rule or regulation.

In addition to the prohibition of recharge in the areas with high pollutant loading or with runoff exposed to source material as defined in N.J.A.C. 7:8-5.4(b)3, the utilization of dry wells should consider the impact of infiltration on subsurface sewage disposal systems, water supply wells, groundwater recharge areas protected under the Ground Water Quality Standards rules at N.J.A.C 7:9C, streams under antidegradation protection by the Surface Water Quality Standards rules at N.J.A.C. 7:9B or similar facilities or areas geologically and ecologically sensitive to pollutants or hydrological changes. Furthermore, the location and minimum distance of the dry well from other facilities or systems shall also comply with all applicable laws and rules adopted by Federal, State, and local government entities.

Soil Characteristics

Soils are perhaps the most important consideration for site suitability. In general, County Soil Surveys can be used to obtain necessary soil data for the planning and preliminary design of dry wells; however, for final design and construction, soil tests are required at the location of a proposed dry well in accordance with *Chapter 12: Soil Testing Criteria* in this manual. The results of this soil testing must be compared with the County Soil Survey data used in the computation of runoff rates and volumes and the design of BMPs on-site to ensure reasonable data consistency. If significant differences exist between the soil test results and the County Soil Survey data, additional soil tests are recommended to determine and evaluate the extent of the data inconsistency and whether there is a need for revised site runoff and BMP design computations. All significant inconsistencies should be discussed with the local Soil Conservation District prior to proceeding with such redesign to help ensure that the final site soil data is accurate.

Geology

The presence or absence of Karst topography is an important consideration when designing a dry well; in areas of the State with this type of geology, the bedrock is composed of highly soluble rock. If Karst topography is present, infiltration of runoff may lead to subsidence and sinkholes; therefore, careful consideration must be taken in these areas. For more information on design and remediation in areas of Karst topography, refer to the *Standards for Soil Erosion and Sediment Control in New Jersey: Investigation, Design and Remedial Measures for Areas Underlain by Cavernous Limestone.*

Maintenance

Regular and effective maintenance is crucial to ensure effective dry well performance; in addition, maintenance plans are required for all stormwater management facilities associated with a major development. There are a number of required elements in all maintenance plans, pursuant to N.J.A.C. 7:8-5.8; these are discussed in more detail in *Chapter 8: Maintenance of Stormwater Management Measures*. Furthermore, maintenance activities are required through various regulations, including the New Jersey Pollutant Discharge Elimination System (NJPDES) rules, N.J.A.C. 7:14A. Specific maintenance requirements for dry wells are presented below; these requirements must be included in the maintenance plan. Detailed inspection and maintenance logs must be maintained.

General Maintenance

- The maintenance plan must indicate the dry well must not be connected to non-rooftop sources of runoff for its entire lifespan.
- All structural components must be inspected, at least once annually, for cracking, subsidence, spalling, erosion and deterioration. Damaged components must be replaced.

- Components expected to receive and/or trap debris must be inspected for clogging at least four times annually, as well as after every storm exceeding 1 inch of rainfall.

- Disposal of debris, trash and other waste material must be done at suitable disposal/recycling sites and in compliance with all applicable local, state and federal waste regulations.

- Access points for maintenance are required on all dry wells; these access points must be clearly identified in the maintenance plan. In addition, any special training required for maintenance personnel to perform specific tasks, such as confined space entry, must be included in the plan. Furthermore, at the site, access ports must be labeled "Roof Runoff Only."

- A detailed, written log of all preventative and corrective maintenance performed on the dry well must be kept, including a record of all inspections and copies of maintenance-related work orders. Additional maintenance guidance can be found at

  https://www.njstormwater.org/maintenance_guidance.htm.

Drain Time

- The water level in the inspection port is the primary means of measuring the infiltration rate and drain time; therefore, the water level associated with the design storm must be included in the maintenance plan.

- The design drain time for the maximum design storm runoff volume must be indicated in the maintenance plan.

- If the actual drain time is longer than the design drain time, the dry well must be evaluated and appropriate measures must be taken to return the dry well to the as-built condition.

- If the dry well fails to fully drain the Water Quality Design Storm within 72 hours, corrective action must be taken and the maintenance manual revised accordingly to prevent similar failures in the future.

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