Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

ROOF RUNOFF STRUCTURE

CODE 558

(no)

DEFINITION

A structure or system of structures to collect, control, and convey precipitation runoff from a roof.

PURPOSE

This practice may be applied to achieve one or more of the following purposes:

- Protect surface water quality by excluding roof runoff from contaminated areas
- Prevent erosion from roof runoff
- Increase infiltration of roof runoff
- Capture roof runoff for onfarm use

CONDITIONS WHERE PRACTICE APPLIES

Where roof runoff from precipitation needs to be—

- Diverted away from a contaminated area.
- Collected and conveyed to a stable outlet or infiltration area.
- Collected and captured for other uses such as evaporative cooling systems, livestock water, or irrigation.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct the roof runoff structure to comply with all Federal, State, and local laws and regulations. Notify landowner and/or contractor of their responsibility to locate all buried utilities in the project area, including drainage tile and other structural measures. The landowner is also required to obtain all necessary permits for project installation prior to construction.

Evaluate the condition of the existing roof structure prior to installation of a gutter. Install new fascia boards as needed to support gutters and downspouts for the practice life span. Mount gutters on plumb fascia boards. If the building does not have a fascia board, mount to the rafter ends, adding any necessary appurtenances to ensure the gutters are securely attached and positioned to collect runoff from the roof.

Ensure that the gutter support system will withstand the anticipated loading from precipitation including loads from snow and ice, where applicable. Where snow and ice are expected, install roof gutters below the projection of the roof line. If this is not possible with the existing roof, install rigid supports or wraparound straps. If structural supports are missing or insufficient, design the required supports for the gutter.

NRCS reviews and periodically updates conservation practice standards. To obtain the current version of this standard, contact your Natural Resources Conservation Service State office or visit the Field Office Technical Guide online by going to the NRCS website at https://www.nrcs.usda.gov/ and type FOTG in the search field.

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Protect the downspouts, laterals, and cross-pipe pipelines from damage by livestock or equipment with heavy-walled pipe, fencing, or other protective measures to exclude livestock and equipment.

Gutter design capacity
To exclude roof runoff from manure contamination, design roof runoff structures to convey the peak flow from a 25-year, 5-minute rainfall event. (Refer to NRCS National Engineering Handbook (Title 210), Part 651, Agricultural Waste Management Field Handbook, Chapter 10, Appendix 10B.)

For other applications, design roof runoff structures to convey the peak flow from a 10-year, 5-minute rainfall event.

Downspout
Design downspouts, collector pipes, lateral downspouts, or cross-pipes with a capacity that equals or exceeds the designed roof gutter flow rate. If downspouts drain directly onto the ground, use an elbow and energy dissipation device at the outlet to provide erosion protection and direct water away from the foundation of the structure by ensuring that ground slopes away from the building.

Ground gutter
If roof gutters are not feasible, ground gutters may be used in some instances. Ground gutters may not be practical for livestock housing where the purpose is to exclude roof runoff from contaminated areas.

Use ground gutters only on buildings with eaves that extend 12 inches or more horizontally from the building. Where runoff from the roof eave drops onto the ground surface, provide a gutter with the same capacity as required for roof gutters. Ground gutters must convey runoff away from the building to a stable outlet without erosion.

Ground gutters can be rock-lined channels, rock-filled trenches with subsurface drains, or concrete channels.

Outlet
Roof runoff can empty into a subsurface drain, underground outlet, a storage tank, a dry well, or onto an energy dissipation device as described above in section “Downspout.”

Size outlets to handle the design flow from the gutter system. Provide accessible cleanouts for subsurface drains, underground outlets, and storage tanks that are used as outlets.

Use NRCS Conservation Practice Standard (CPS) Subsurface Drain (Code 606) to design subsurface drains if necessary to dewater ground gutters or infiltration ditches.

Use NRCS CPS Underground Outlet (Code 620) to design underground outlets to convey roof runoff to a stable outlet. In cold climates, ensure underground outlets are deep enough to avoid freezing or include a method to bypass the outlet without damage to the downspout.

Underground collection pipes at the end of downspouts shall be non-perforated corrugated polyethylene tubing, PVC pipe, or corrugated metal pipe with stiffness necessary to withstand expected loads at the outlet end.

Materials
Roof gutters and downspouts may be made of aluminum, galvanized steel, plastic, or wood. Aluminum gutters must have a minimum nominal thickness of 0.027 inches. Aluminum downspouts of 3 inches by 4 inches must have a minimum nominal thickness of 0.019 inches. Aluminum downspouts larger than 3 inches by 4 inches must have a minimum nominal thickness of 0.024 inches. Galvanized steel gutters and downspouts must be a minimum of 28 gauge. Plastics must contain ultraviolet stabilizers. Wood gutters must be made of rot-resistant wood free of knots.

To prevent corrosion, avoid contact between components of dissimilar metals.

To improve infiltration for rock-filled trenches and dry wells, use poorly graded gravel.

Where traffic, climatic, or other conditions necessitate the use of reinforced concrete for channels, pads, and slabs, refer to NRCS National Engineering Manual (NEM) (Title 210), Part 536, Section 536.20, “Design Criteria for Reinforced Concrete,” for design and installation of reinforced concrete.

Where nonreinforced concrete is acceptable, refer to NRCS 210-NEM-536, Section 536.22, “Design Criteria for Concrete Slabs-on-Ground,” for design and installation of nonreinforced concrete.

Additional Criteria to Increase Infiltration

Increase runoff infiltration by directing flow to existing vegetation or infiltration features (e.g., lawns, mass planting areas, existing natural areas, infiltration trenches, dry wells, rain gardens, or natural areas). Ensure these areas have the capacity to infiltrate the runoff without flowing directly to surface or ground water, causing excessive erosion, or adversely affecting the desired plant species.

Additional Criteria to Capture Water for Other Uses

Roof runoff can be contaminated with environmental pollutants that have settled on the roof between runoff events. This may make the captured runoff unsuitable for uses such as drinking water for livestock without treatment. The operator is responsible for ensuring that the quality of the runoff is suitable for the intended purpose.

If runoff water is to be stored, determine the tank size based on the planned use of the captured water. Select tank materials that have adequate strength and durability to hold water for the intended purpose and length of time required. Use materials that will not degrade the quality of the stored water for its intended use. Include a drain to allow maintenance of the tank and to protect from damage from freezing.

Install the storage tank on a firm, level foundation that will not settle differentially. Examples of suitable foundation materials are bedrock, concrete, compacted gravel, and stable well-compacted soils. Where necessary, prepare the foundation by removal and disposal of materials that are not adequate to support the design loads. Anchor or brace aboveground tanks as needed to prevent overturning or sliding by wind and animals.

Use NRCS design procedures or manufacturer’s guidelines to ensure that buried tanks will withstand all earth and vehicle loads anticipated for the site.

Include provisions for access to the tank for maintenance and repairs. However, ensure that access points will limit unintended or unauthorized access.

Design tanks connected directly to gutters and downspouts to bypass runoff events that exceed the design capacity of the tank. Include provisions to convey overflows to a stable outlet without excessive erosion.

CONSIDERATIONS

Gutter size can be decreased by increasing the number of downspouts. When designing a gutter and downspout system consider the balance between gutter size and the spacing and sizing of downspouts to optimize the design.

If roof runoff will be used for livestock drinking water, the runoff should be treated before being consumed by livestock. This might include bypassing the first flush of runoff which often contains the majority of pollutants. Depending on the use of the runoff, additional actions may be necessary, such as settling and filtration to remove suspended particles and treatment of pathogens with ultraviolet light or chlorination. See International Code Council, CSA/ICC 805-2018, “Rainwater Harvesting Systems,” for information on water quality treatment options for different end uses of the collected water.

Discharging roof runoff outlets near wells and sinkholes or directly into drainage ditches, streams, or ponds can be a point source of pollution. Consider the use of vegetative filter areas, such as raingardens, at outlets to minimize the pollution potential from roof runoff.

Consider the use of wraparound straps in lieu of rigid supports on steep roofs where the outer edge of the gutter cannot be placed below the projected roof line.

On roofs subject to snow and ice slides, consider additional supports even if the gutter is installed below the projected roof line.

PLANS AND SPECIFICATIONS

Provide plans and specifications that describe the requirements for applying this practice to achieve its intended purpose. As a minimum, include—

- A plan view showing the layout of gutters, downspouts, and outlets.
- Details of gutter installation, including necessary cross sections and slope of gutters.
- Details on the protection of downspouts from damage.
- Details on outlets, storage tanks, or infiltration areas as appropriate.
- Any other site-specific detail drawings necessary for the installation of the practice.
- Requirements for stabilization of any areas disturbed by the installation of the practice.
- Construction specifications describing the installation of the practice, materials, and quantities.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan and review it with the operator. Describe the actions that must be taken to ensure that the facility functions properly for its design life. As a minimum, include—

- A schedule for regularly checking the gutters and downspouts for removal of any accumulated debris, damage from weather events, livestock, and equipment. Additional checks should be made after significant weather events (rain, snow, ice, extended cold periods, or high winds).
- Ensuring that the outlets are freely operating and not causing erosion.
- Ensuring roof runoff structures are clean, operating properly, and overflows are not causing erosion.
- Promptly repairing or replacing any damaged components.

REFERENCES

International Code Council. 2018. CSA/ICC 805-2018 Rainwater Harvesting Systems. ICC, Washington, D.C. https://codes.iccsafe.org/content/CSAB8052018P1

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USDA NRCS. 2021. National Engineering Handbook (Title 210), Part 650, Chapter 2, Estimating Runoff Volume and Peak Discharge. Washington, D.C. https://directives.sc.egov.usda.gov

USDA NRCS. 2009. National Engineering Handbook (Title 210), Part 651, Agricultural Waste Management Field Handbook, Chapter 10, Agricultural Waste Management System Component Design. Washington, D.C. https://directives.sc.egov.usda.gov

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