

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**ROOF RUNOFF STRUCTURE**

(No.)

**CODE 558**

**DEFINITION**

A structure that will collect, control and convey precipitation runoff from a roof.

**PURPOSE**

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

- Protect surface water quality by excluding roof runoff from contaminated areas
- Protect a structure foundation from water damage or soil erosion from excess water runoff
- Increase infiltration of runoff water
- Capture water for other uses

**CONDITIONS WHERE PRACTICE APPLIES**

Where roof runoff from precipitation needs to be:

- diverted away from a contaminated area or the foundation of a structure;
- collected and conveyed to a stable outlet or infiltration area; or
- collected and captured for other uses such as evaporative cooling systems, livestock water and irrigation.

**CRITERIA**

**General Criteria Applicable to All Purposes**

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.

Ensure that the gutter support system will withstand the anticipated loading, including loads from snow and ice, as applicable.

If structural support is missing or insufficient, design the required support for the selected gutter. As an alternative to increasing the structural supports, use a ground gutter design to convey the roof runoff.

Gutter supports shall have sufficient strength to withstand anticipated water, snow, and ice loads. They shall have a maximum spacing of 18 inches for aluminum gutters and 24 inches for steel gutters and consist of either, a *heavy duty gutter hanger* and a roof strap, or, a heavy duty gutter hanger screwed to the fascia. For gutter sizes greater than 6 inches, maximum hanger spacing shall be reduced to 12" for aluminum gutters and 18" for steel gutters.

The need for *lateral supports* will depend on the type of gutter mount installed:

- Gutters mounted on plumb fascia boards do not need lateral supports.
- Gutters mounted on non-plumb fascia boards shall have inward lateral supports.
- Gutters not mounted on fascia boards shall have inward and outward lateral supports.

Lateral support may be provided with *wedges*, *wrap-around straps*, *rigid supports*, or any combination thereof which will provide the necessary inward and/or outward support. Lateral supports shall have a maximum spacing of 8 feet.

On roofs subject to snow and ice slides (ie. metal roofs), gutters should be mounted so the

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top outside edge of the gutter is placed below the extended roof line. Otherwise, the design shall include one or more of the following:

- Wrap-around straps at a maximum spacing of 8 feet.
- Rigid supports at a maximum spacing of 8 feet.
- *Snow guards* installed per manufacturer's recommendations.

Use a pipe guard or pipe casing where necessary to protect the downspout, lateral or cross-pipe pipelines of the roof runoff structure from damage by livestock or equipment.

**Gutter Design Capacity.** When a roof runoff structure is used to protect roof runoff from contamination by manure, design the roof runoff structure to convey the flow rate generated from a 25-year, 5-minute rainfall event. (Refer to Agricultural Waste Management Field Handbook, NEH Part 651 Chapter 10 Appendix 10B).

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

**Downspout.** Use downspouts, collector pipes, lateral downspouts or cross-pipes with a capacity equal or exceeding the roof gutter flow rate.

When a downspout outlets at the ground level, place an elbow and energy dissipation device at the outlet to provide erosion protection and direct water away from the foundation of the structure.

**Ground Gutter.** Where runoff from the roof eave drops onto the ground surface, provide a ground gutter with adequate provision to convey runoff away from the foundation of the structure.

Ground gutter designs can use a rock pad, a rock filled trench with a subsurface drain, a concrete channel, or a pre-cast channel to convey the roof runoff water to a stable discharge location or infiltration area.

**Outlet.** Roof runoff can empty into a subsurface drain, underground outlet, a ground gutter, a storage tank or onto stabilized soil.

Size the outlet to ensure adequate design capacity. Provide for a clean-out of the outlet as appropriate.

Use NRCS Conservation Practice Standard *Subsurface Drain (Code 606)* to design a subsurface drain used to dewater a ground gutter or infiltration ditch.

Use NRCS Conservation Practice Standard *Underground Outlet (Code 620)* to design an underground outlet used to convey roof runoff to a stable outlet.

**Materials.** Roof gutters and downspouts may be made of aluminum, galvanized steel, wood or plastic. Aluminum gutters and downspouts require a minimum nominal thickness of 0.027 inches and 0.020 inches, respectively. Galvanized steel gutters and downspouts require a minimum 28 gauge.

Wood may be redwood, cedar, cypress, or other species that has the desired longevity and will be free of knots. Lumber treated with ACQ, AC2 or other corrosive preservatives shall not be used in contact with metal gutters and downspouts. Fasteners shall be suitable for the materials used.

Plastic must contain ultraviolet stabilizers.

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

To enable infiltration with rock-filled trenches and rock pads use 'poorly graded rock' (rock fragments approximately all the same size) that is free of appreciable amounts of sand or soil particles. Do not use crushed limestone for backfill material unless it has been washed.

Use NRCS National Engineering Manual, Part 536.20, Design Criteria for Reinforced Concrete, for design and installation of reinforced concrete channels, pads or slabs.

For non-reinforced concrete channels or pads use the NRCS National Engineering Handbook, Part 642, Construction Specification 32, Structural Concrete.

#### **Additional Criteria to Increase Infiltration**

Increase runoff infiltration by directing flow to existing landscapes (e.g., lawns, mass planting areas, infiltration trenches, rain gardens or

natural areas). Ensure these areas have the capacity to infiltrate the runoff without adversely affecting the desired plant species and without creating a soil erosion problem.

#### **Additional Criteria to Protect the Foundation of a Structure**

For a design which outlets the roof runoff on the ground, slope the runoff discharge area away from the structure foundation. Use a minimum downspout extension of five (5) feet to discharge runoff away from the foundation of a structure built on expansive soils or a building foundation placed on bedrock.

#### **Additional Criteria to Capture Water for Other Uses**

Design a water storage tank of adequate size, strength and durability to hold water for the intended purpose. Install the tank on a firm, unyielding foundation. Anchor above-ground water storage tanks to prevent damage from wind loads.

Prohibit access to water storage tanks by children and animals to prevent drowning. Protect the area around the tank from erosion caused by overflow from the tank.

Construct or select water storage tanks of materials and in a manner that will not degrade the quality of the stored water. Design water supply attachments to meet system needs. Include a first flush diverter as necessary to reduce sediment, pathogens, and chemical pollutants in the collected water.

The water quality must be suitable for the intended use. The landowner is responsible for any water quality testing and treatment.

#### **CONSIDERATIONS**

Consider the use of multiple downspouts to reduce gutter size.

Discharge of outlets near wells and sinkholes or directly into drainage ditches, streams or ponds can cause point source pollution.

Consider installation of rain gardens at the outlets to clean, transpire and infiltrate runoff water.

When underground outlets are used, consider either a strainer at the head of the downspout, or a clean-out port on the riser pipe.

Avoid discharging outlets directly into surface waters. Consider the use of wrap-around 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.

Consider screwing the top outside lip of the gutter to each hanger, especially where the top outside edge of the gutter cannot be placed below the extended roof line.

For cold climates, ensure the underground outlet is deep enough to avoid freezing or include a method to bypass the outlet without damage to the downspout.

#### **PLANS AND SPECIFICATIONS**

Provide plans and specifications for installing a roof runoff structure that describe the requirements for applying this practice to achieve its intended purpose. At a minimum, include the location, size and any specific installation instructions of all gutters and spacing of downspouts, type of ground gutters, outlets and the types and quality of material to be used.

Include plans and specifications for other practices essential for the proper functioning of the roof runoff structure.

Instruct landowner and contractor of responsibility to locate all buried utilities in the project area, including drainage tile and other structural measures.

#### **OPERATION AND MAINTENANCE**

Develop an operation and maintenance plan that is consistent with the purposes of the practice, site conditions and safety requirements. The plan will contain, but not be limited to, the following provisions:

- Keep roof runoff structures clean and free of obstructions that reduce flow.
- Make regular inspections and perform cleaning and maintenance as needed.

## REFERENCES

NRCS, 2009, National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook, Chapter 10, Agricultural Waste Management System Component Design

NRCS, National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 2, Estimating Runoff

NRCS National Engineering Manual, Part 536.20, Design Criteria for Reinforced Concrete

NRCS National Engineering Handbook, Part 642, Construction Specification 32, Structural Concrete

## DEFINITIONS

Cross pipes – Semi-rigid pipes (PVC) or rigid pipes used to transport runoff from a downspout orifice laterally through a building to an acceptable outlet.

Heavy Duty Gutter Hanger – A gutter hanger that has self-bracing sides and/or reinforcing ribs that run the entire length of the hanger, and continue through the points of greatest stress (ie. corners). Hangers that exceed the minimum thickness and provide equivalent strength are acceptable.

Lateral Supports – Rigid or non-rigid material secured to the building, gutter, and/or roof. They resist the gutter from moving inward, towards the building and/or outward, away from the building.

Rigid Supports – Rigid metal attached to the fascia board or the building and contacting the bottom of the gutter. They resist the weight of snow and ice from tearing the gutter down from the building.

Snow Guard – Devices secured to the roof to prevent snow and ice from sliding off the roof.

Wedges – A triangle shaped device installed between the back side of the gutter and a non-plumb fascia to ensure that the gutter is hung square.

Wrap-around straps – Non-rigid strips of material that are secured to the fascia board or building, wrap around the bottom and outside face of the gutter, and then secured to the roof. They resist the gutter from moving away from the building. They also resist the weight of snow and ice from tearing the gutter down from the building.