Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

STREAM CROSSING

Code 578

(No.)

DEFINITION

A stabilized area or structure constructed across a stream to provide controlled access for people, livestock, equipment, or vehicles.

PURPOSE

This practice is applied to—

- Improve water quality by reducing sediment, nutrient, or organic loading to a stream.
- Reduce streambank and streambed erosion.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where—

- An intermittent or perennial watercourse (stream) exists.
- Controlled access from one side of the stream to the other side is necessary to reduce or eliminate environmental degradation.
- Soils, geology, fluvial geomorphology, and topography are suitable for construction of a stream crossing.

CRITERIA

General Criteria Applicable to All Stream Crossings

Apply this standard in accordance with all Federal, State, Tribal, and local regulations, including floodplain regulations, and flowage easements.

Identify significant cultural resources or threatened or endangered species that could be affected by the implementation of the practice.

The landowner/contractor is responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.

Do not create a passage barrier where aquatic species are present and using the stream.

Location. Locate the stream crossing in an area where the streambed is stable or where the streambed can be stabilized (see NRCS Conservation Practice Standard (CPS) Channel Bed Stabilization (Code 584); and Title 210, National Engineering Handbook (NEH) Part 650, Chapter 16, "Streambank and Shoreline Protection"). Do not place a crossing where the channel grade or alignment changes abruptly, excessive seepage or instability is evident, overfalls exist (evidence of incision and bed instability), where large tributaries enter the stream, or within 300 feet of known spawning areas of listed species.

Install the stream crossing perpendicular to the direction of stream flow where possible. Consider potential future lateral migration of the stream in developing the design.

Avoid the use of or minimize the number of stream crossings through evaluation of alternative trail or travel-way locations, and land user operations. Where feasible, use existing roads. Discourage livestock loafing in the stream by locating crossings, where possible, out of shady riparian areas or by including gates in the design.

Access road crossings. Where the stream crossing is installed as part of an access road, design the crossing in accordance with CPS Access Road (Code 560) and Title 210, National Engineering Manual (NEM), Part 536 “Structural Engineering.”

Width. Provide an adequate travel-way width for the intended use. Make a “livestock-only” crossing no less than 6 feet wide and no more than 30 feet wide, as measured from the upstream end to the downstream end of the stream crossing, not including the side slopes.

Side slopes. Make all side slope cuts and fills stable for the channel materials involved. Make the side slopes of cuts or fills in soil materials no steeper than 2 horizontal to 1 vertical (2:1). Make rock cuts or fills no steeper than 1.5 horizontal to 1 vertical (1.5:1).

Stream approaches. Where possible, blend approaches to the stream crossing with existing site topography. Use streambank soil bioengineering practices and other streambank stabilization measures such as CPS Streambank and Shoreline Protection (Code 580) as appropriate and feasible. Design stable approaches, with gradual ascent and descent grades that are no steeper than 4 horizontal to 1 vertical (4:1). Construct approaches with suitable material to withstand repeated and long-term use. Design the minimum width of the approaches equal to the width of the crossing surface.

Divert surface runoff around the approaches to prevent erosion. Use CPSs Diversion (Code 362), Structure for Water Control (Code 587), Lined Waterway or Outlet (Code 468), or Grade Stabilization Structure (Code 410) as needed.

Rock. Use only rock that is sound, durable, and able to withstand exposure to air, water, and freezing and thawing. Use rock of sufficient size and density to resist mobilization by design flood flows. Use appropriate rock sizes that will accommodate the intended traffic without causing injury to livestock or people, or damage to vehicles using the crossing. For a rock livestock crossing, use a hoof contact zone or alternative surfacing method over the rock.

Fencing. Exclude livestock access to the crossing using fence and gates, as needed. Install cross-stream fencing at fords, with breakaway wire, swinging floodgates, hanging electrified chain, or other devices to allow the passage of floodwater and large woody material during high flows. Design and construct all fencing in accordance with CPS Fence (Code 382).

Vegetation. As soon as practical after construction, vegetate highly disturbed areas in accordance with CPS Critical Area Planting (Code 342). In areas where the vegetation may not survive, use CPS Heavy Use Area Protection (Code 561).

Criteria Applicable to Bridge Crossings

Design the bridge in a manner that is consistent with sound engineering principles and adequate for its intended use. Refer to 210-NEM, Part 536.

Design the bridge to fully span the stream, passing at least the bank-full flow where the design flow is not dictated by regulations. At design flow capacity, the structure must convey stream flow, sediment, and other materials without appreciably altering stream flow characteristics and pass the design flow without causing erosion or overtopping of the structure.

For all bridge crossings, perform a geologic subsurface investigation that is in sufficient detail and analysis to support the design. Describe the soil material observed, subgrade conditions, bearing capacity, and depth to bedrock; and any geologic conditions or hazards that needs to be addressed in the design, construction, or operation of the bridge Refer to 210- NEM, Part 531, "Geology."

Adequately protect the bridge so that flows exceeding the bridge's flow capacity can safely bypass without damaging the bridge or eroding the streambanks.

Follow requirements in 210-NEM, Part 536 on acceptable bridge materials and necessary safety measures.

Criteria Applicable to Culvert Crossings

Design the culvert in a manner that is consistent with sound engineering principles and adequate for its intended use.

If the culvert is not associated with a road crossing, design the culvert to have sufficient capacity to pass at least the bank-full flow or the 2-year, 24-hour storm flow, whichever is greater, without appreciably altering stream flow characteristics. Adequately protect the culvert crossing so that flows in excess of culvert capacity can safely bypass the structure without damaging it, or eroding the streambanks or crossing fill material. Do not use culverts in locations where large flows of sediment or large woody material are expected, or where the channel gradient exceeds 6 percent (100 horizontal to 6 vertical).

At least one culvert pipe must be placed with its entire length set 6 inches below the existing stream bottom. Additional culverts may be used at various elevations to maintain terrace or floodplain hydraulics and water surface elevations. The length of the culvert system must be adequate to extend the full width of the crossing, including side slopes, and inlet or outlet extensions.

Acceptable culvert materials include concrete, corrugated metal, corrugated plastic, new or used high quality steel, and any other materials that meet requirements of CPS Pond (Code 378). Evaluate the need for safety measures such as guardrails at the culvert crossing.

Criteria Applicable to Ford Crossings

Ford crossings have the least detrimental impact on water quality when their use is infrequent. Ford crossings are adapted for crossing wide, shallow watercourses with firm streambeds. Do not place ford crossings immediately downstream from a pipe or culvert because of potential damage from localized high-velocity flows. Use a culvert crossing or curbed bridge if the stream crossing is to have frequent or daily use, such as in a dairy operation.

Ensure that the cross-sectional area of the crossing is equal to or greater than the natural channel cross-sectional area. To the extent possible, design the top surface of the ford crossing to follow contours of the streambed. Slope the crossing toward the center of stream to provide a thalweg (low-flow) channel. Where possible, recess the subgrade of the stream crossing so that the constructed surface of the crossing is at or below the original surface of the streambed. Never construct the top surface of the ford crossing to be higher than 0.5 feet above the original streambed at the upstream edge.

Where possible, design the downstream edge of the ford crossing to be at exactly the same elevation as the original streambed. Never install the downstream edge with a low-flow hydraulic drop greater than 0.5 feet above the original stream bottom. Provide cutoff walls at the upstream and downstream edges of the ford when needed to protect against undercutting.

Evaluate the need for water depth signage.

Concrete fords. Use a concrete ford crossing only where the foundation of the stream crossing has adequate bearing strength. Perform a subsurface investigation that is in sufficient detail and analysis to support the design. Describe the soil material observed, subgrade conditions, bearing capacity, and depth to bedrock. Refer to 210- NEM, Part 531, Subpart B, “Engineering Geology.”

Use a minimum thickness of 5 inches of placed concrete. Construct the concrete slab on a minimum 4-inch-thick gravel base, unless the foundation is otherwise acceptable. Refer to 210- NEM, Part 536 for design criteria.

Dewatering of the site and toe walls is required during placement of the concrete to lessen the potential for segregation and to maintain the proper water/cement ratio. Flowing water will erode concrete that is not sufficiently hardened. The stream must be diverted or retained from flowing over the concrete until the concrete makes its final set, and a minimum of 12 hours after placement of the concrete.

Construct toe walls at the upstream and downstream ends of the crossing. Make the toe walls a minimum of 6 inches thick and 18 inches deep. Extend the toe walls in the stream approaches to the bank-full flow elevation.

Rock fords and the use of geosynthetic materials. In steep areas subject to flash flooding and where normal flow is shallow or intermittent, use coarse aggregate or crushed rock at ford crossings. When the site has a soft or unstable subgrade, use geotextiles to improve the foundation bearing capacity in the design of rock ford crossings. Select geotextile material for separation and stabilization according to American Association of State Highway and Transportation Officials (AASHTO) M-288.

Dewater and excavate the bed of the channel to the necessary depth and width and cover with geotextile material. Install the geotextile material to extend across the bottom of the stream and, at least, up the side slopes to at least the bank-full flow elevation.

Use durable geosynthetic materials and install them according to the manufacturer's recommendations, including the use of staples, clips, and anchor pins. Cover the geotextile material with at least 6 inches of crushed rock. Use minimum 6-inch-deep geocells if geocells are installed.

Design the rock ford stream crossing to remain stable for the bank-full design flow. Compute channel velocities and choose rock size using procedures and guidelines set forth in the appropriate section in 210-NEH, Part 630, “Hydrology;” 210-NEH, Part 654, Technical Supplement (TS) 14N “Fish Passage and Screening Design;” and 210-NEH 650, Chapter 16, Appendix 16A, “Size Determination for Rock Riprap,” or other procedures approved by the State conservation engineer.

CONSIDERATIONS

For culvert crossings, consider incorporating natural streambed substrates throughout the culvert length for passage of aquatic organisms. See Bunte and Abt, (2001) for sampling procedures. Natural streambeds provide passage and habitat benefits to many life stage requirements for aquatic organisms and may reduce maintenance costs.

Consider including a well-graded rock riprap apron on the downstream edge of concrete crossings to dissipate flow energy.

Consider all life stages of aquatic organisms in the stream crossing design to accommodate their passage, in accordance with the species’ requirements. NRCS aquatic organism passage standards can be found in CPS Aquatic Organism Passage (Code 396). Design criteria are available in 210-NEH, Part 654, TS 14N; Clarkin, Keller, et.al, (2006); and Forest Service stream simulation guidance (USFS, 2008). Also, see Harrelson, et al. (1994), for stream reference site descriptions. Consider the habitat requirements of other aquatic or terrestrial species that may be affected by construction of a stream crossing. For example, a crossing may be designed with features that also promote safe crossing by terrestrial vertebrates.

For concrete fords, consider using precast concrete panels in lieu of cast-in-place concrete slabs. To the extent possible, the panels must follow the contours of the streambed in order to avoid potential problems with sediment accumulation. As with the poured-in-place concrete, install a gravel base and toe walls.

Locate stream crossings to avoid adverse environmental impacts and consider—

- Using the “riffle” section of the stream for the proposed crossing, for it is frequently one of the most stable sections of a stream. When riffles are not present, consider using a stable straight reach.
- Effects on upstream and downstream flow conditions that could result in increases in erosion, deposition, or flooding. Consider habitat upstream and downstream of the crossing to avoid fragmentation of aquatic and riparian habitats.
- Short-term and construction-related effects on water quality.
- Overall effect on erosion and sedimentation that will be caused by the installation of the crossing and any necessary stream diversion.
- Effects of large woody material on the operation and overall design of the crossing.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for stream crossings in accordance with this standard. Clearly describe the requirements for applying the practice to achieve its intended purpose in the plans and specifications must as a minimum, include the following in plans and specifications:

- Location of stream crossing.
- Stream crossing width and length with profile and typical cross sections.
- Thickness, gradation, quantities, and type of rock or stone.
- Type, dimensions, and anchoring requirements of geotextile.
- Thickness, compressive strength, reinforcement, and other special requirements for concrete, if used.
- Applicable structural details of all components, including reinforcing steel, type of materials, thickness, anchorage requirements, lift thickness, covering.
- Load limits for bridges and culverts.
- Vegetative requirements that include seed and plant materials to be used, establishment rates, and season of planting.
- Location, type, and extent of fencing required.
- Method of surface water diversion and dewatering during construction or a statement making the contractor responsible for selecting such.
- Location of utilities and notification requirements.
- Additional site-specific considerations.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan and implement it for the life of the practice.

Include the following items in the operation and maintenance plan, as a minimum:

- Inspect the stream crossing, appurtenances, and associated fence at least annually and after each major storm event. Make repairs, if needed.
- Remove any accumulation of organic material, woody material, or excess sediment.
- Replace surfacing stone used for livestock crossing as needed.

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