
Part 640

**Guidance for Assessing and
Reporting Stream Miles
Affected by Activities
Completed Under
Conservation Practice
Standard 396, Fish Passage**

Part 640

Guidance for Assessing and Reporting Stream Miles Affected by Activities Completed Under Conservation Practice Standard 396, Fish Passage

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640.00 Introduction

Revisions completed in October 2006 to Conservation Practice Standard 396, Fish Passage (CPS 396) resulted in changing the reporting unit from Number (No.) to Miles (Mi.). This amendment to the National Biology Handbook provides concepts, methods, and information resources required to assess and report (via the Performance Results System (PRS)) stream miles affected by passage improvement or restoration activities completed under CPS 396. The intent of this set of standardized methods is to ensure repeatability in PRS, as well as to quantifiably portray the biological benefits of a given action to migratory aquatic animals.

Many aquatic organisms (fish, crustaceans, mollusks, and amphibians) undertake daily, seasonal, or annual migrations (Gross 1987; Gross, Colman, and McDowall 1988). Migration is a natural, usually seasonal biological function where animals move singly or in large numbers from one habitat type to another to spawn, feed, grow, or seek refuge from predators. For example, anadromous trout and salmon spawn and rear in freshwater, move to saltwater environments to grow to adulthood, and return to freshwater after a period of months or years to reproduce and die (Groot and Margolis 1991). Other amphidromous fish commonly use estuaries, river mouths, and the lower reaches of rivers within a span of a few days for feeding, sheltering, or as refuge from predators (Gross, Colman, and McDowall 1988). Young (1994) found that brown trout in south-central Wyoming moved more than 60 miles during the spawning season between mainstem rivers and adjoining tributaries. Further studies by Young (1996) and Colyer, Kershner, and Hilderbrand (2005) suggest that salmonids often undertake lengthy daily and seasonal migrations to exploit feeding areas, seek refuge or resting cover, and colonize new habitats. Numerous warm-water species of fish (redhorses, carpsuckers, catfish, muskellunge, walleye, and northern pike) have been observed migrating both up- and downstream in river systems of the Mississippi Basin for foraging or spawning purposes (Warren and Pardew 1998; Illinois Department of Natural Resources 2000).

Consequently, barriers that block the movement of fish or other aquatic organisms often result in negative long-term population trends. These barriers are often instream features or water management practices that limit or prohibit the passage of aquatic organisms, deny access to important breeding or foraging habitats, and isolate populations of fish and other aquatic animals. Passage barriers are a problem for aquatic organisms trying to move upstream and downstream in an estuary, river, or stream.

640.01 Identifying passage barriers

The timing, duration, and frequency of aquatic animal migrations must be accounted for when planning and implementing passage improvement or restoration projects within a watershed. Many passage barriers to aquatic organisms are relatively easy to identify. For example, a stream reach completely dewatered by diversions or blocked by a dam poses obvious challenges to migratory aquatic organisms. However, many other subtle but just as ecologically significant passage barriers are common throughout the United States and its protectorates. Note that beaver dams generally do not prevent aquatic organism migration and should not be identified as passage barriers unless supporting information can be provided.

Both natural and manmade barriers occur within river, stream, estuary, and tidal systems. Natural physical barriers include waterfalls, cascades, large rapids, or stream reaches that seasonally dewater. Common manmade physical barriers include tide gates, dams, diversions, culverts, weirs, excessively high-grade control structures, or buried sills with broad crests. Chemical and biological barriers such as water quality (temperature, contaminants, and low streamflows) and predation from nonnative species also exist in many rivers across the United States. However, these types of passage problems are often seasonal and can be difficult to identify with limited field time and site-specific data.

Passage barriers are typically categorized by characteristics such as water velocity, water depth, and barrier height in relation to the passage requirements of a given species and/or life stage. Three commonly used barrier classes are:

- partial—impassable to some species or certain age classes all or most of the time
- temporary—impassable during some times to all or most species and/or age classes (during low flow conditions)
- complete—impassable to all fish at all times

For example, a poorly designed or damaged culvert may be a temporary barrier to upstream migrating adults when flows are high because velocities within the culvert barrel exceed their natural swimming capabilities. Some highly migratory fishes like Pacific salmonids can leap 6 feet or more to bypass a small waterfall, whereas shad in the same river will be faced with a complete barrier (Bell 1990; Groot, Margolis, and Clarke 1995; Monk et al. 1989; Haro and Kynard 1997). Thus, it is often necessary to identify a primary target species (and life stage) when evaluating passage barriers relative to a given project.

(a) Barrier examples

Numerous information resources are available to help identify passage barriers to measure and report in PRS the number of stream miles affected by the project. State game and fish agencies generally have both online resources and personnel located around each state, and these professionals are usually excellent sources of information regarding species status, distribution, and possibly barrier inventories. The Association of Fish and Wildlife Agencies (<http://www.iafwa.org>) maintains a list and contact information for fisheries and wildlife agencies in each state.

Federal agencies (U.S. Fish & Wildlife Service (FWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries) associated with the protection and/or management of migratory aquatic organisms often maintain online databases of information. For example, the FWS Fish Passage Decision Support System (FPDSS, <http://fpdss.fws.gov>) is an extensive, geographically referenced database containing thousands of barriers. Users can select a barrier and model the effect of its removal—including generating a report that estimates the mileage of newly accessible habitat.

If these resources do not provide the level or amount of information required to identify passage impediments, the following list contains examples of complete, temporary, and partial barriers to aquatic organism passage:

(1) Complete barriers

- waterfalls (height varies with species, but most over 8 vertical feet are complete barriers)
- stream reaches that seasonally run dry
- dams (mill, low-head, roller, irrigation, hydro-power, and/or storage)
- siphon, pipeline, sewerage, or utility crossings that act as dams or broad-crested weirs
- culverts where the barrel is perched (elevated) above the outlet pool
- for most anadromous salmonids, headwater stream reaches that exceed 10 percent gradient (often coincides with the limit of anadromy because of a general lack of spawning gravels)

- false attraction flows (power or sewer treatment plant effluents, irrigated agriculture runoff, or storm water)
- all non-self-regulating tide and/or flood gates (iron or steel flap-style gates)

The preceding list outlines a few situations where natural features, manmade structures, or management practices result in passage barriers to aquatic organisms. However, variations exist, especially as geographies and target species change.

(2) Temporary barriers

- culverts where the barrel width is less than the bankfull channel width
- culverts where the barrel slope is greater than the channel slope
- excessively long culverts with no resting areas
- large unscreened pump intakes
- livestock and/or equipment crossings where streamflow is fast and shallow (less than 6 in) across smooth or uniform surface at least half as wide (from upstream to downstream) as the bankfull channel width. For example, a 12-foot-wide hardened vehicle ford that crosses a stream with a bankfull width of 20 feet is likely a temporary passage barrier.

(3) Partial barriers

- Culverts where:
 - barrel alignment doesn't match the stream alignment
 - inlet or outlet is plugged with debris
 - inlet or outlet shows sign of erosion or instability
- steep cascades or large rapids, especially when formed by recent slope failures or landslides
- improperly designed or damaged fishways or ladders

640.02 Assessing reportable miles

Reporting stream miles in PRS for passage activities completed under CPS 396 must be completed in the following manner:

Step 1 Referring to section 640.01, identify the next mainstem upstream barrier from the project. For PRS reporting purposes regarding CPS 396, any structure or management practice that creates a complete, partial, or temporary passage problem will be considered as this barrier, regardless of the target species and life stage for which the project was intended.

Step 2 Using available resources (Geographic Information Systems, U.S. Geological Survey topo maps, commercially available mapping software, FPDSS), measure the approximate mileage upstream from your project to the next mainstem barrier identified in step 1. Note the following special circumstances:

- For river systems with more than one channel or route to the next upstream barrier, select and measure the straightest natural route. Do not include ditches, wasteways, or other drainage features specifically created for supplying or draining water.
- If one or more natural channels parallel the mainstem and contain suitable habitat (side channels, braids, or oxbows), measure and include mileage up to barriers identified per step 1.
- If the project opens access to suitable tributary habitat, measure and include tributary mileage up to barriers identified per step 1.
- In the absence of identifiable barriers in headwater situations, measure up to the upstream limit of perennial flow or the drainage divide (whichever occurs first or is most appropriate for your target species).

- If the watercourse traverses a lake or reservoir to this barrier, measure the straight-line distance between the impoundment outlet and incoming stream or river.
- If the project provides or improves passage into a lake or reservoir for shoreline spawners (pike, bull trout, kokanee, or sockeye salmon), also measure and include the total mileage of suitable shoreline spawning habitat.
- If the project provides or improves passage for amphidromous organisms (migratory shrimp, killifishes, shads, gobies, and sticklebacks) that migrate between salt- and freshwater, measure and include the total mileage of suitable foraging habitat.
 - Report in PRS the total mileage measured according to steps 1 and 2 to one (1) decimal place. For smaller projects, report all linear feet as increments of a mile (800 ft = 0.2 mi).

Step 3 Project mileage reported in PRS must comply with these standard guidelines. Stream miles may only be measured and reported once, regardless of the number of species for which the project is intended to improve passage conditions. In other words, if a project opens up 10 miles of habitat for five migratory aquatic organisms known to inhabit the area, the reportable PRS mileage is 10 miles (not 50).

For additional information, call the Fishery Biologist, East National Technology Support Center at (336) 370-3331. For other information concerning aquatic ecology, call the National Aquatic Ecologist, Ecological Sciences Division, National Headquarters at (202) 690-0082.

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Subpart D

**Reporting Procedures for Conservation
Practice Standards**

National Biology Handbook
Aquatic and Terrestrial Habitat Resources

Part 640

Guidance for Assessing and Reporting Stream
Miles Affected by Activities Completed Under
Conservation Practice Standard 396, Fish
Passage

640.04 Reserved

Part 641

**Guidance for Effective
Implementation and
Reporting of Conservation
Practice Standard 395,
Stream Habitat Improvement
and Management**

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Part 641

Guidance for Effective Implementation and Reporting of Conservation Practice Standard 395, Stream Habitat Improvement and Management

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Subpart D

Part 641

Reporting Procedures for Conservation Practices

Guidance for Effective Implementation and Reporting of Conservation Practice Standard 395, Stream Habitat Improvement and Management

641.00 Introduction

The Stream Habitat Improvement and Management Conservation Practice Standard (CPS) 395 was revised in August 2006. This standard provides guidance for implementing stream and riparian conservation actions and the aquatic species that are affected by them, as defined in CPS 395: *Maintain, improve or restore physical, chemical and biological functions of a stream, and its associated riparian zone, necessary for meeting the life history requirements of desired aquatic species.*

Revisions made to the CPS 395 include:

- expanding the *Purpose* to provide suitable habitat for riparian and aquatic species, including but not limited to, endangered and threatened species and species of concern and their communities
- broadening the *Conditions* for the practice to include additional physical features of stream habitats such as backwaters, flood plains and riparian corridors where habitat deficiencies limit survival, growth, reproduction, and/or diversity of aquatic species of concern in relation to the potential of the stream
- expanding the *Considerations* to include fish barriers, fish screens, and geomorphic features of streams

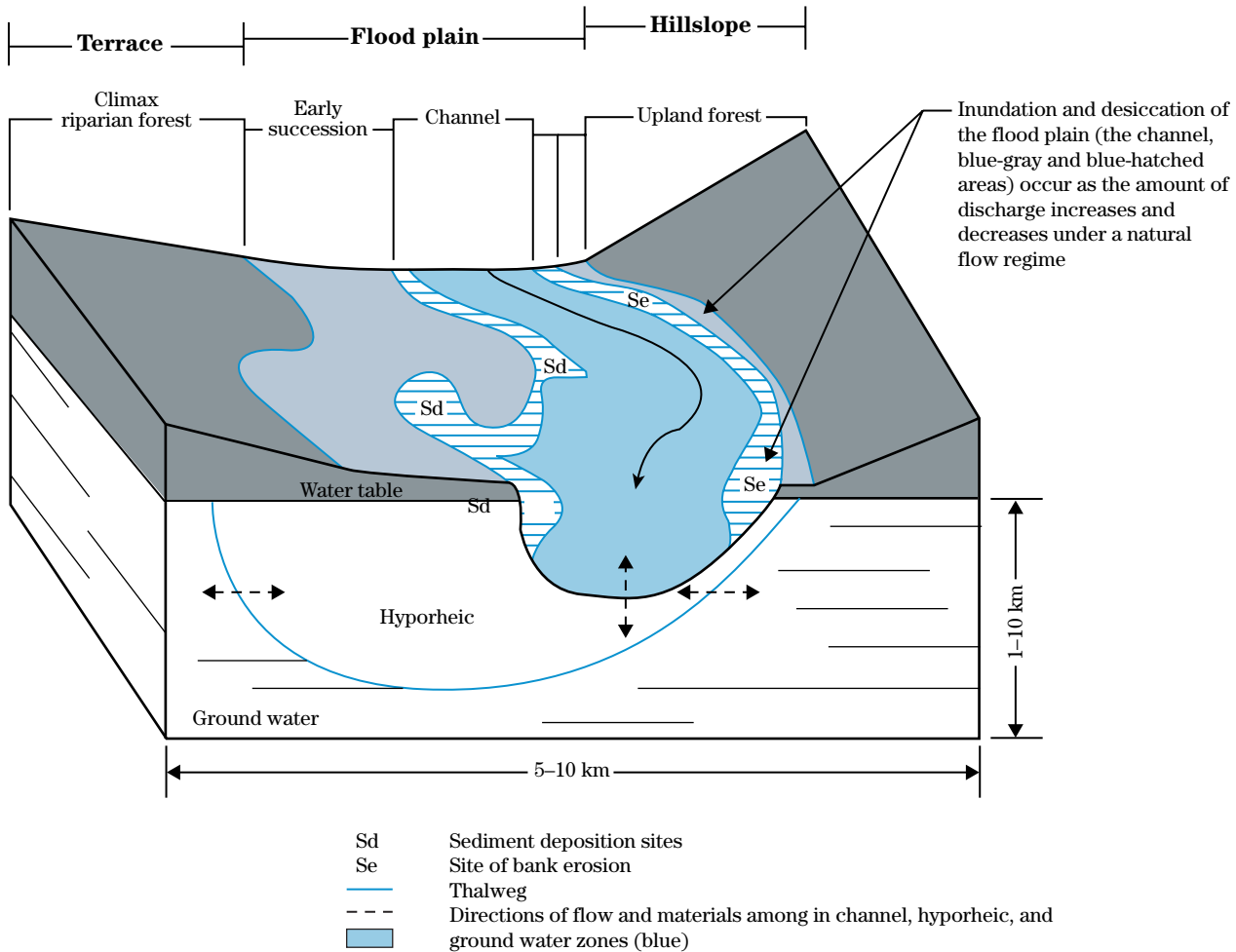
This subpart of the National Biology Handbook (NBH) provides information for implementation and reporting of actions completed under CPS 395. Guidance is provided for computing the number of acres improved and/or managed to meet the purposes of the practice, which are to provide suitable habitat for desired aquatic species and provide stream channel and associated riparian conditions that maintain ecological processes and connections of diverse stream habitat types important to aquatic species.

641.01 Implementing CPS 395

Regardless of their size, natural or minimally altered stream corridors tend to be physically complex. Transport of water, sediment, and wood throughout the stream corridor system creates a complex three-dimensional (longitudinal, lateral, and vertical) arrangement of different stream, riparian, and flood plain habitats with physical features that change through time (Ward 1989). Figure 1 illustrates a cross-sectional view of a generalized stream corridor segment showing the three spatial dimensions in which stream corridor habitats are formed through time. Biota may reside in all dimensions (riparian, in-channel, hyporheic, and/or ground water zone). This complexity of habitats and their dynamic nature contributes to the high level of biological diversity typical of stream corridors. Studies in stream ecology emphasize the importance of linkages between stream channels, riparian areas, and flood plains (Gregory et al. 1991; Stanford and Ward 1992; Brookes, Baker, and Redmond 1996; Huggenberger et al. 1998; Molles et al. 1998; Tockner, Malard, and Ward 2000). Ecological processes occurring among the different elements of stream corridors include energy flow, nutrient cycling, riparian succession, and aquatic and terrestrial species interactions. Intensive land use activities in a stream corridor and its watershed often simplify the physical structure of streams and disrupt linkages important to ecological processes and biological communities (Vondracek et al. 2005). For example, removing riparian vegetation often contributes to bank instability and subsequent bank failure, sedimentation of stream habitat, and changes in stream fauna and flora. Installing dams fragments connectivity between the stream and its flood plain or between downstream and upstream reaches, preventing or limiting ecological processes and interactions important to many species (Allan 2004; Poff et al. 2007).

The purpose of CPS 395 is to manage streams to conserve/protect natural and healthy stream conditions or improve conditions that have deteriorated due to land use actions at the site or in the watershed. For a more thorough description of ecological and physical considerations of stream projects, refer to the National

Figure 1 Cross-sectional view of a generalized stream corridor segment showing the three spatial dimensions in which stream corridor habitats are formed through time (modified from Stanford and Ward 1992)



Engineering Handbook, Part 654 (NEH 654), Stream Restoration Design.

Actions implemented individually or as part of an integrated suite of actions under CPS 395 may be focused in the stream or within the stream corridor. These include:

- riparian conservation practices such as fencing or establishment of riparian buffers, channel bank vegetation, grassed waterways, filter strips, and hedgerows
- flood plain conservation measures such as restoration of emergent wetlands, removal of berms to reconnect isolated channels and sloughs, or reestablishment of connections between the channel and its flood plain
- bank protection practices such as streambank and shoreline protection, grade control, use exclusion, and prescribed grazing
- instream improvements such as water control structure modifications to protect aquatic species (screens), placement of wood and/or boulders, replacement of culverts, dam removal, construction of rock weir complexes, meander restoration, and reestablishing fish passage

Aquatic habitat management or improvement provisions targeted through the use of this practice should benefit as many ecological functions of streams and associated riparian areas, as physically and economically feasible. All actions implemented within the stream channel can be enhanced by protecting or improving the condition of the riparian area. Practices installed under CPS 395 should result in improved conditions over time, as assessed by stream habitat evaluations suitable for the watershed being treated, such as the NRCS Stream Visual Assessment Protocol.

641.02 Reporting acres improved or managed using CPS 395

CPS 395 is a selected conservation practice for the NRCS Performance Reporting System (PRS), specifically Annual Performance Measures 3.1: Grazing and forest land with conservation applied to protect and improve the resource base (acres) and 3.2: Non-Federal land with conservation applied to improve fish and wildlife habitat quality (acres).

Stream habitat improvement actions will influence stream corridors differently, depending on the existing conditions and dynamic responses of the stream and its flood plain. For purposes of reporting, professional judgment of an aquatic biologist, hydraulic engineer, and other qualified specialists should be sought to determine the length of the stream (L) influenced by treatments implemented under this standard. This will assure the most accurate assessment of the effectiveness of the actions implemented. In some cases, L may be difficult to determine because of complex site conditions, multiple project treatments, or disagreements between project personnel. Thus, unless a project includes aquatic organism passage as the primary objective (see #6), or the length of the stream influenced is determined by consensual professional judgment, the maximum length of stream (L) used to calculate acres of improvement will be the total project boundary length (l_1) measured in feet, plus the number of feet equal to 10 average bankfull channel widths (l_2), regardless of treatments, structures, or actions applied. Refer to figure 2 for estimating the bankfull channel width: the stream width (in feet) at the flow that forms and controls the shape and size of the active channel.

l_1 = number of feet in total project boundary, or the number of feet of the linear distance from the point in the channel or bank where a project activity begins to the point where the activity or actions end

l_2 = average bankfull channel width in feet multiplied by 10

Example: The total project boundary length (l_1) is estimated to be 900 feet. The average BFW is estimated to be 20 feet, so l_2 is estimated to be 20 feet multiplied by 10. Thus, the length of stream influenced by treatment (L), is

$$L = (l_1) + (l_2)$$

$$L = [900 \text{ ft} + 10(20)] = 1,100 \text{ ft} \quad (\text{eq. 1})$$

To determine *acres of stream habitat improved* under CPS 395, use the following general guidelines:

1. Instream structures installed to improve stream habitat (large wood and/or boulder placement, rock weirs, intake pipe screen): length of stream influenced by treatment (L), multiplied by the average bankfull width of stream (BFW), divided by 43,560.

$$\text{Acres improved} = \frac{(L)(\text{BFW})}{43,560} \quad (\text{eq. 2})$$

2. Bank structures (barbs, groins, and lunkers) to contribute to stream habitat improvement: length of stream influenced by treatment (L) multiplied by average bankfull width (BFW) of stream, divided by 43,560.

$$\text{Acres improved} = \frac{(L)(\text{BFW})}{43,560} \quad (\text{eq. 2})$$

3. Bank structures plus reestablishment or protection of riparian vegetation on both sides of stream: sum of the average BFW, riparian vegetation width of left bank (RW_l), and riparian vegetation width of right bank (RW_r) multiplied by the length of stream influenced (L), divided by 43,560.

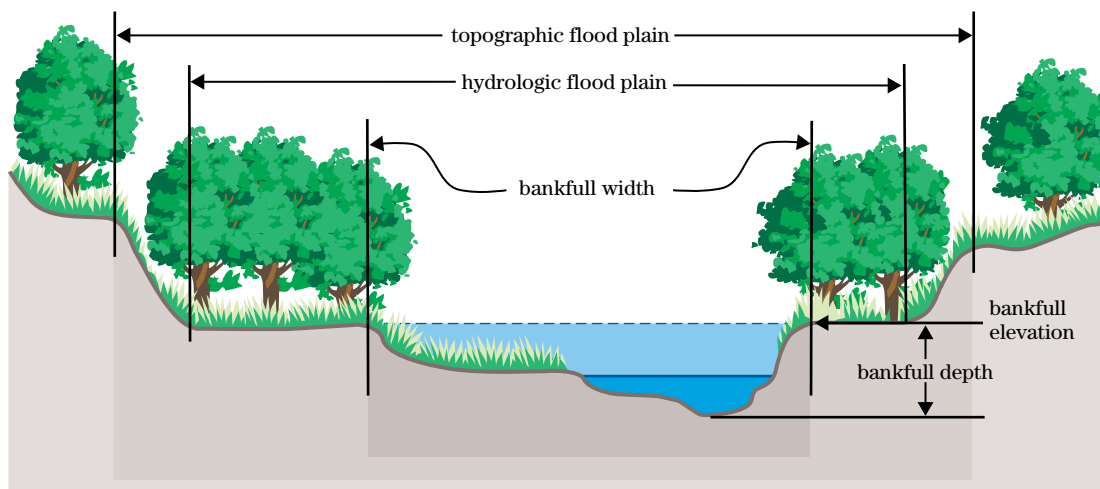
$$\text{Acres improved} = \frac{(\text{BFW} + RW_l + RW_r)(L)}{43,560} \quad (\text{eq. 3})$$

4. Riparian restoration: if restoration is on both sides of the stream, computation is the same as that for treatment 3. If riparian restoration is on one side only, add only the riparian vegetation width for the side treated (RW_l) to the BFW before multiplying by length of stream.

Acres improved if riparian area is restored on both sides of the stream:

$$\text{Acres improved} = \frac{(\text{BFW} + RW_l + RW_r)(L)}{43,560} \quad (\text{eq. 3})$$

Figure 2 Estimating the bankfull channel width



Acres improved if riparian area is restored on only one side of the stream:

$$\text{Acres improved} = \frac{(\text{BFW} + \text{RW}_t)(L)}{43,560} \quad (\text{eq. 4})$$

5. Improve lateral connectivity: if the objectives of the project are to increase connectivity between the stream channel and flood plain, estimate the total area of the stream channel and its flood plain, including any off-channel habitats (such as emergent wetlands) that are connected at least seasonally by the action (refer to fig. 1). In this case, the width of the area would be the width, in feet, of the entire active flood plain, as measured from hillslope to terrace, or terrace to terrace, depending on the shape of the valley.

$$\text{Acres improved} = \frac{(\text{width of flood plain})(L)}{43,560} \quad (\text{eq. 5})$$

6. Improve longitudinal connectivity: if the objective of the project is to improve connectivity of upstream and downstream habitats for aquatic species, such as improved fish passage, add the area influenced by the fish passage structure, including the total area of stream habitat upstream that is "connected" by the action. Measure upstream mileage according to the NBH, Subpart D, Part 640, Guidance for Assessing and Reporting Stream Miles Affected by Activities Completed Under Conservation Practice Standard 396, Fish Passage, and use guideline 1 to estimate acres improved.
7. For performance measure 3.1, *if stream improvements are accompanied by a grazing management plan that identifies fish and riparian habitat conservation objectives*, report the sum of the total acres associated with the riparian zone, the active flood plain, and the bankfull stream channel within or adjacent to the resource land use area being used for grazing livestock.

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