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TECHNICAL NOTE
190-VI

SUBJECT: BIOLOGY TECHNICAL NOTE NO. 99, **STREAM VISUAL ASSESSMENT PROTOCOL**

Purpose. To transmit to all Oregon offices the above named technical note.

Effective Date. Upon receipt.

Filing Instructions. File in correct numerical order in the Biology section of your Technical Note Binder. Replace Table of Contents with enclosed updated Table of Contents.

The Stream Visual Assessment Protocol provides an easy to use assessment procedure to evaluate the condition of aquatic ecosystems associated with streams. This assessment can be conducted with the landowner.

This technical note is to be used when developing a conservation plan and a stream is located on or directly adjacent to the property and the landowner is not proposing any instream channel work (i.e., rock barbs).

The State Office has an additional supply of this technical note. Please contact the Technology Team for additional copies.

RUSSELL R. HATZ
Leader – Technology Development

Enclosures

DIST:
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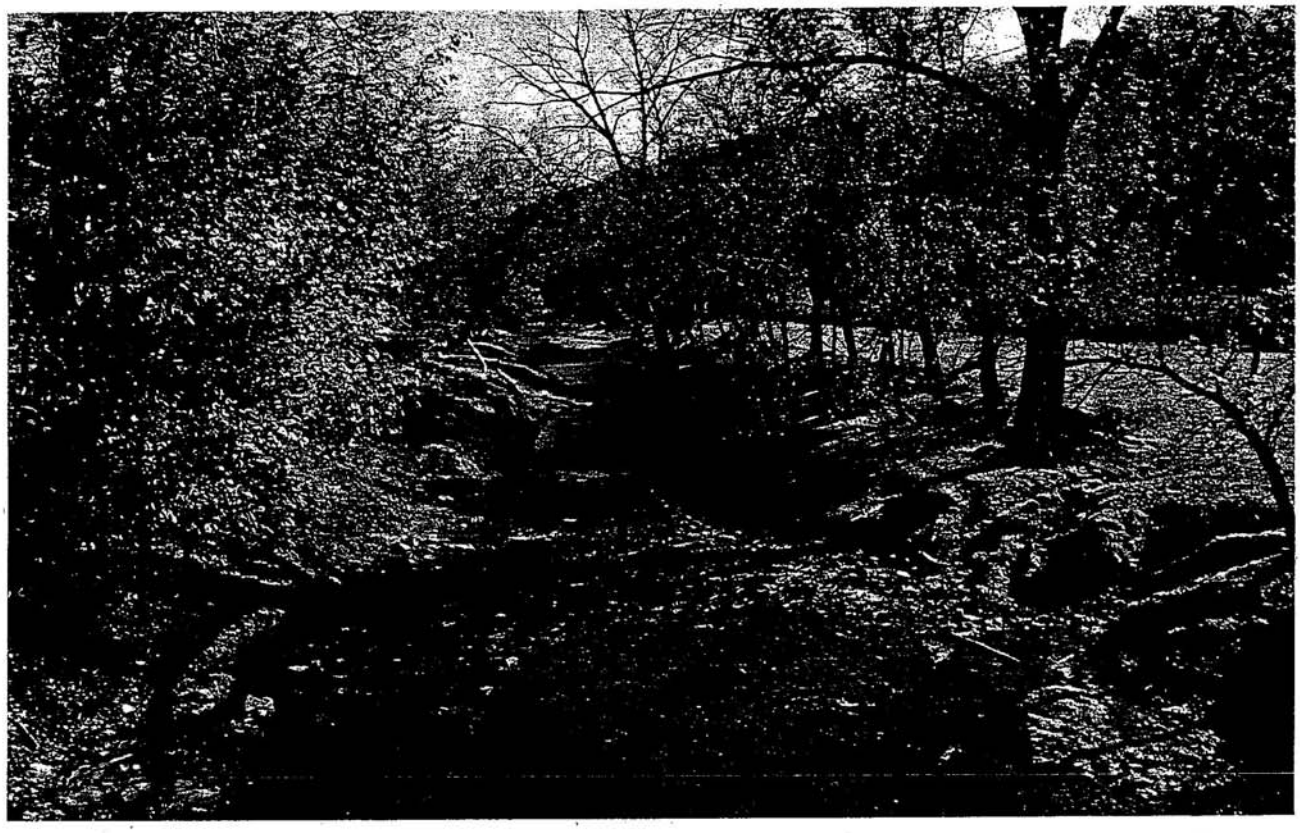
BIOLOGY TECHNICAL NOTE 99

Portland, OR

June 2002

Stream Visual Assessment Protocol



Issued December 1998

Cover photo: Stream in Clayton County, Iowa, exhibiting an impaired riparian zone.

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(NWCC Technical Note 99–1, Stream Visual Assessment Protocol, December 1998)

Preface

This document presents an easy-to-use assessment protocol to evaluate the condition of aquatic ecosystems associated with streams. The protocol does not require expertise in aquatic biology or extensive training. Least-impacted reference sites are used to provide a standard of comparison. The use of reference sites is variable depending on how the state chooses to implement the protocol. The state may modify the protocol based on a system of stream classification and a series of reference sites. Instructions for modifying the protocol are provided in the technical information section. Aternatively, a user may use reference sites in a less structured manner as a point of reference when applying the protocol.

The Stream Visual Assessment Protocol is the first level in a hierarchy of ecological assessment protocols. More sophisticated assessment methods may be found in the Stream Ecological Assessment Field Handbook. The field handbook also contains background information on basic stream ecology. Information on chemical monitoring of surface water and groundwater may be found in the National Handbook of Water Quality Monitoring.

The protocol is designed to be conducted with the landowner. Educational material is incorporated into the protocol. The document is structured so that the protocol (pp. 7–20) can be duplicated to provide a copy to the landowner after completion of an assessment. The assessment is recorded on a single sheet of paper (copied front and back).

Acknowledgments

This protocol was developed by the Natural Resources Conservation Service (NRCS) Aquatic Assessment Workgroup. The principal authors were **Bruce Newton**, limnologist, National Water and Climate Center, NRCS, Portland, OR; **Dr. Catherine Pringle**, associate professor of Aquatic Ecology, University of Georgia, Athens, GA; and **Ronald Bjorkland**, University of Georgia, Athens, GA. The NRCS Aquatic Assessment Workgroup members provided substantial assistance in development, field evaluation, and critical review of the document. These members were:

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Stream Visual Assessment Protocol

Introduction

This assessment protocol provides a basic level of stream health evaluation. It can be successfully applied by conservationists with little biological or hydrological training. It is intended to be conducted with the landowner and incorporates talking points for the conservationist to use during the assessment. This protocol is the first level in a four-part hierarchy of assessment protocols. Tier 2 is the NRCS Water Quality Indicators Guide, Tier 3 is the NRCS Stream Ecological Assessment Field Handbook, and Tier 4 is the intensive bioassessment protocol used by your State water quality agency.

This protocol provides an assessment based primarily on physical conditions within the assessment area. It may not detect some resource problems caused by factors located beyond the area being assessed. The use of higher tier methods is required to more fully assess the ecological condition and to detect problems originating elsewhere in the watershed. However, most landowners are mainly interested in evaluating conditions on their land, and this protocol is well suited to supporting that objective.

What makes for a healthy stream?

A stream is a complex ecosystem in which several biological, physical, and chemical processes interact. Changes in any one characteristic or process have cascading effects throughout the system and result in changes to many aspects of the system.

Some of the factors that influence and determine the integrity of streams are shown in figure 1. Often several factors can combine to cause profound changes. For example, increased nutrient loads alone might not cause a change to a forested stream. But when combined with tree removal and channel widening, the result is to shift the energy dynamics from an aquatic biological community based on leaf litter inputs to one based on algae and macrophytes. The resulting chemical changes caused by algal photosynthesis and respiration and elevated temperatures may further contribute to a completely different biological community.

Many stream processes are in a delicate balance. For example, stream power, sediment load, and channel roughness must be in balance. Hydrologic changes that increase stream power, if not balanced by greater channel complexity and roughness, result in "hungry" water that erodes banks or the stream bottom. Increases in sediment load beyond the transport capacity of the stream leads to deposition, lateral channel movement into streambanks, and channel widening.

Most systems would benefit from increased complexity and diversity in physical structure. Structural complexity is provided by trees fallen into the channel, overhanging banks, roots extending into the flow, pools and riffles, overhanging vegetation, and a variety of bottom materials. This complexity enhances habitat for organisms and also restores hydrologic properties that often have been lost.

Chemical pollution is a factor in most streams. The major categories of chemical pollutants are oxygen depleting substances, such as manure, ammonia, and organic wastes; the nutrients nitrogen and phosphorus; acids, such as from mining or industrial activities; and toxic materials, such as pesticides and salts or metals contained in some drain water. It is important to note that the effects of many chemicals depend on several factors. For example, an increase in the pH caused by excessive algal and aquatic plant growth may cause an otherwise safe concentration of ammonia to become toxic. This is because the equilibrium concentrations of nontoxic ammonium ion and toxic un-ionized ammonia are pH-dependent.

Finally, it is important to recognize that streams and flood plains need to operate as a connected system. Flooding is necessary to maintain the flood plain biological community and to relieve the erosive force of flood discharges by reducing the velocity of the water. Flooding and bankfull flows are also essential for maintaining the instream physical structure. These events scour out pools, clean coarser substrates (gravel, cobbles, and boulders) of fine sediment, and redistribute or introduce woody debris.

What's the stream type?

A healthy stream will look and function differently in different parts of the country and in different parts of the landscape. A mountain stream in a shale bedrock

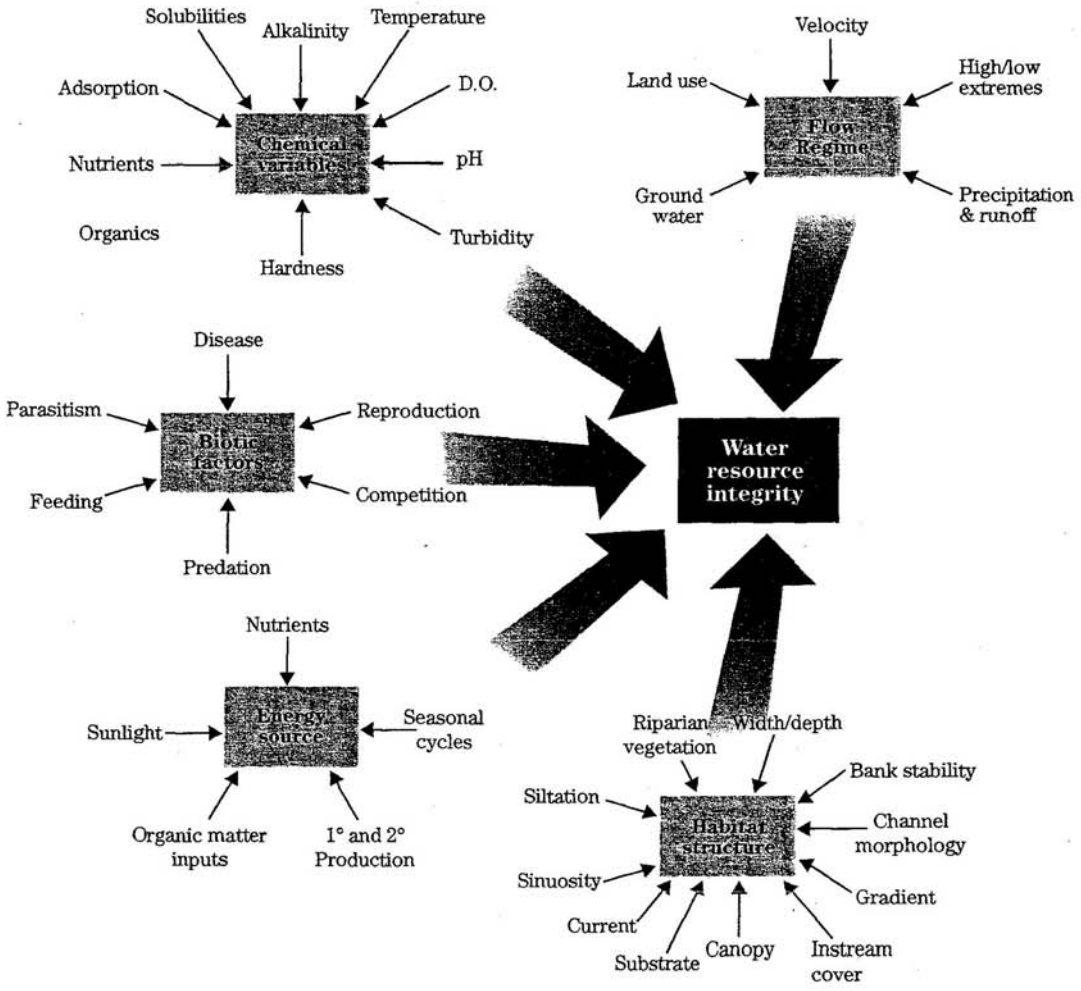
is different from a valley stream in alluvial deposits. Coastal streams are different from piedmont streams. Figuring out the different types of streams is called stream classification. Determining what types of streams are in your area is important to assessing the health of a particular stream.

There are many stream classification systems. For the purpose of a general assessment based on biology and habitat, you should think in terms of a three-level classification system based on ecoregion, drainage area, and gradient. *Ecoregions* are geographic areas in which ecosystems are expected to be similar. A national-level ecoregion map is available, and many states are working to develop maps at a higher level of resolution. *Drainage area* is the next most important factor to defining stream type. Finally, the slope or *gradient* of the reach you are assessing will help you determine the stream type. If you are familiar with another classification system, such as Rosgen or Montgomery/Buffington, you should use that system. This protocol may have been adjusted by your state office to reflect stream types common in your area.

Reference sites

One of the most difficult issues associated with stream ecosystems is the question of historic and potential conditions. To assess stream health, we need a benchmark of what the healthy condition is. We can usually assume that historic conditions were healthy. But in areas where streams have been degraded for 150 years or more, knowledge of historic conditions may have been lost. Moreover, in many areas returning to historic conditions is impossible or the historic conditions would not be stable under the current hydrology. Therefore, the question becomes what is the best we can expect for a particular stream. Scientists have grappled with this question for a long time, and the

Figure 1 Factors that influence the integrity of streams (modified from Karr 1986)



consensus that has emerged is to use reference sites within a classification system.

Reference sites represent the best conditions attainable within a particular stream class. The identification and characterization of reference sites is an ongoing effort led in most states by the water quality agency. You should determine whether your state has identified reference sites for the streams in your area. Such reference sites could be in another county or in another state. Unless your state office has provided photographs and other descriptive information, you should visit some reference sites to learn what healthy streams look like as part of your skills development. Visiting reference sites should also be part of your orientation after a move to a new field office.

Using this protocol

This protocol is intended for use in the field with the landowner. Conducting the assessment with the landowner gives you the opportunity to discuss natural resource concerns and conservation opportunities.

Before conducting the assessment, you should determine the following information in the field office:

- ecoregion (if in use in your State)
- drainage area
- stream gradients on the property
- overall position on the landscape

Your opening discussion with landowners should start by acknowledging that they own the land and that you understand that they know their operation best. Point out that streams, from small creeks to large rivers, are a resource that runs throughout the landscape—how they manage their part of the stream affects the entire system. Talk about the benefits of healthy streams and watersheds (improved baseflow, forage, fish, waterfowl, wildlife, aesthetics, reduced flooding downstream, and reduced water pollution). Talk about how restoring streams to a healthy condition is now a national priority.

Explain what will happen during the assessment and what you expect from them. An example follows:

This assessment will tell us how your stream is doing. We'll need to look at sections of the stream that are representative of different conditions. As we do the assessment we'll discuss how the functioning of different aspects of the stream work to keep the system healthy. After we're done, we can talk about the results of the assessment. I may recommend further assessment work to better understand what's going on. Once we understand what is happening, we can explore what you would like to accomplish with your stream and ideas for improving its condition, if necessary.

You need to assess one or more representative reaches. A reach is a length of stream. For this protocol, the length of the assessment reach is 12 times the active channel width. The reach should be representative of the stream through that area. If conditions change dramatically along the stream, you should identify additional assessment reaches and conduct separate assessments for each.

As you evaluate each element, try to work the talking points contained in the scoring descriptions into the conversation. If possible, involve the owner by asking him or her to help record the scores.

The assessment is recorded on a two-page worksheet. A completed worksheet is shown in figure 2. (A worksheet suitable for copying is at the end of this note.) The stream visual assessment protocol worksheet consists of two principal sections: reach identification and assessment. The identification section records basic information about the reach, such as name, location, and land uses. Space is provided for a diagram of the reach, which may be useful to locate the reach or illustrate problem areas. On this diagram draw all tributaries, drainage ditches, and irrigation ditches; note springs and ponds that drain to the stream; include road crossings and note whether they are fords, culverts, or bridges; note the direction of flow; and draw in any large woody debris, pools, and riffles.

The assessment section is used to record the scores for up to 15 assessment elements. Not all assessment elements will be applicable or useful for your site. Do not score elements that are not applicable. Score an element by comparing your observations to the descriptions provided. If you have difficulty matching descriptions, try to compare what you are observing to the conditions at reference sites for your area.

The overall assessment score is determined by adding the values for each element and dividing by the number of elements assessed. For example, if your scores add up to 76 and you used 12 assessment elements, you would have an overall assessment value of 6.3, which is classified as *fair*. This value provides a numerical assessment of the environmental condition of the stream reach. This value can be used as a general statement about the "state of the environment" of the stream or (over time) as an indicator of trends in condition.

Figure 2 Stream visual assessment protocol worksheet

USDA

Stream Visual Assessment Protocol

Owners name Elmer Smith Evaluator's name Mary Soylkahn Date 6-20-99

Stream name Camp Creek Waterbody ID number

Reach location About 2,000 feet upstream of equipment shed

Ecoregion Drainage area 2,200 acres Gradient 1.2 % (map)

Applicable reference site Cherry Creek north of the Rt 310 bridge

Land use within drainage (%): row crop 40 hayland 30 grazing/pasture 20 forest 10 residential

confined animal feeding operations Cons. Reserve industrial Other:

Weather conditions-today clear Past 2-5 days clear

Active channel width 15 feet Dominant substrate: boulder gravel X sand X silt mud

Site Diagram

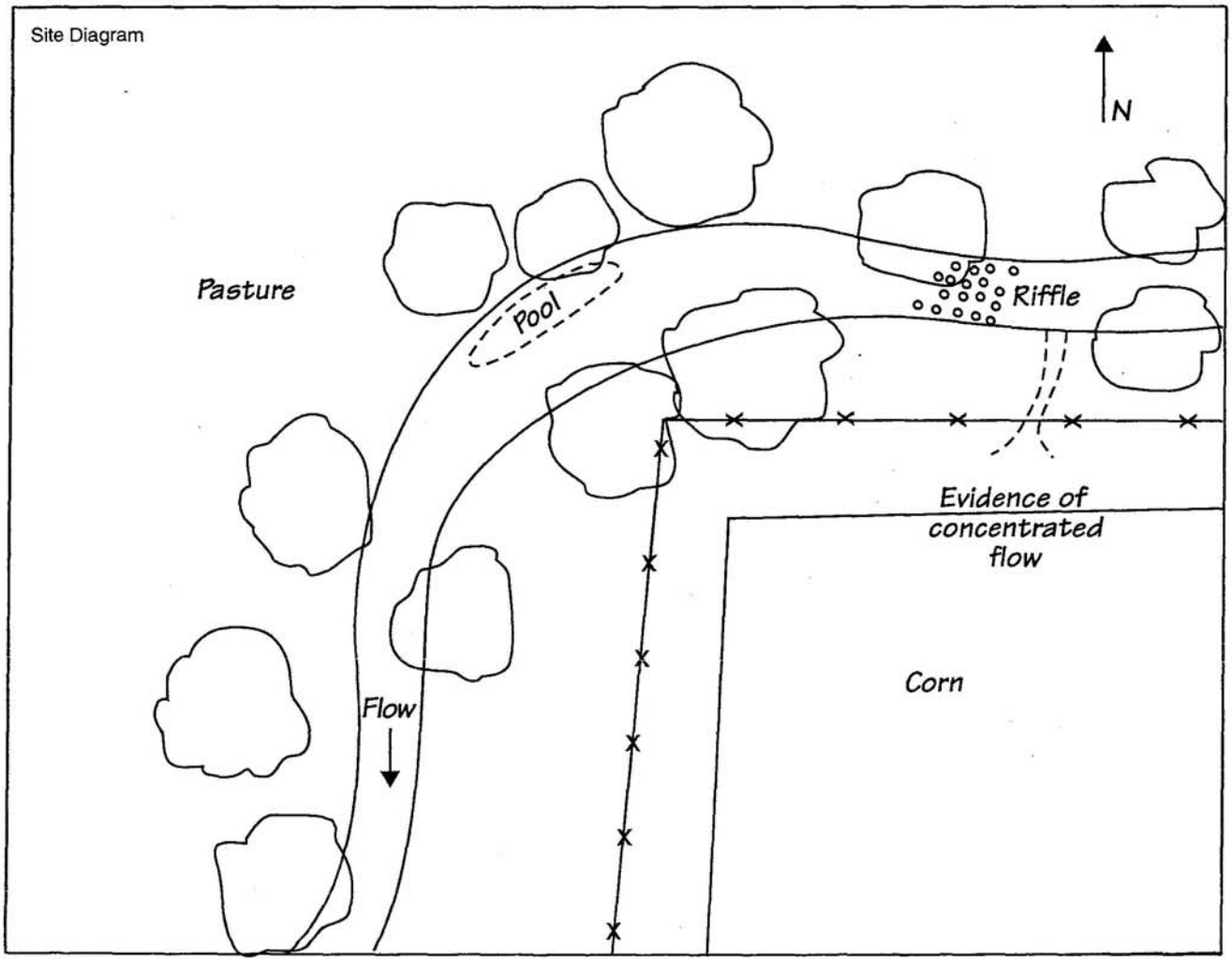


Figure 2 Stream visual assessment protocol worksheet—Continued

Assessment Scores

Channel condition	8
Hydrologic alteration	10
Riparian zone	1
Bank stability	5
Water appearance	3
Nutrient enrichment	7
Barriers to fish movement	10
Instream fish cover	3

Pools	3
Invertebrate habitat	7

Score only if applicable

Canopy cover	3
Manure presence	1
Salinity	
Riffle embeddedness	5
Marcroinvertebrates Observed (optional)	10

Overall score (Total divided by number scored)			
76/14	5.4	<6.0	**Poor**
		6.1-7.4	**Fair**
		7.5-8.9	**Good**
		>9.0	**Excellent**

Suspected causes of observed problems *This reach is typical of the reaches on the property. Severely degraded riparian zones lack brush, small trees. Some bank problems from livestock access. Channel may be widening due to high sediment load. Does not appear to be downcutting.*

Recommendations *Install 391-Riparian Forest Buffer. Need to encourage livestock away from stream using water sources and shade or exclude livestock. Concentrated flows off fields need to be spread out in zone 3 of buffer. Relocate fallen trees if they deflect current into bank–use as stream barbs to deflect current to maintain channel.*

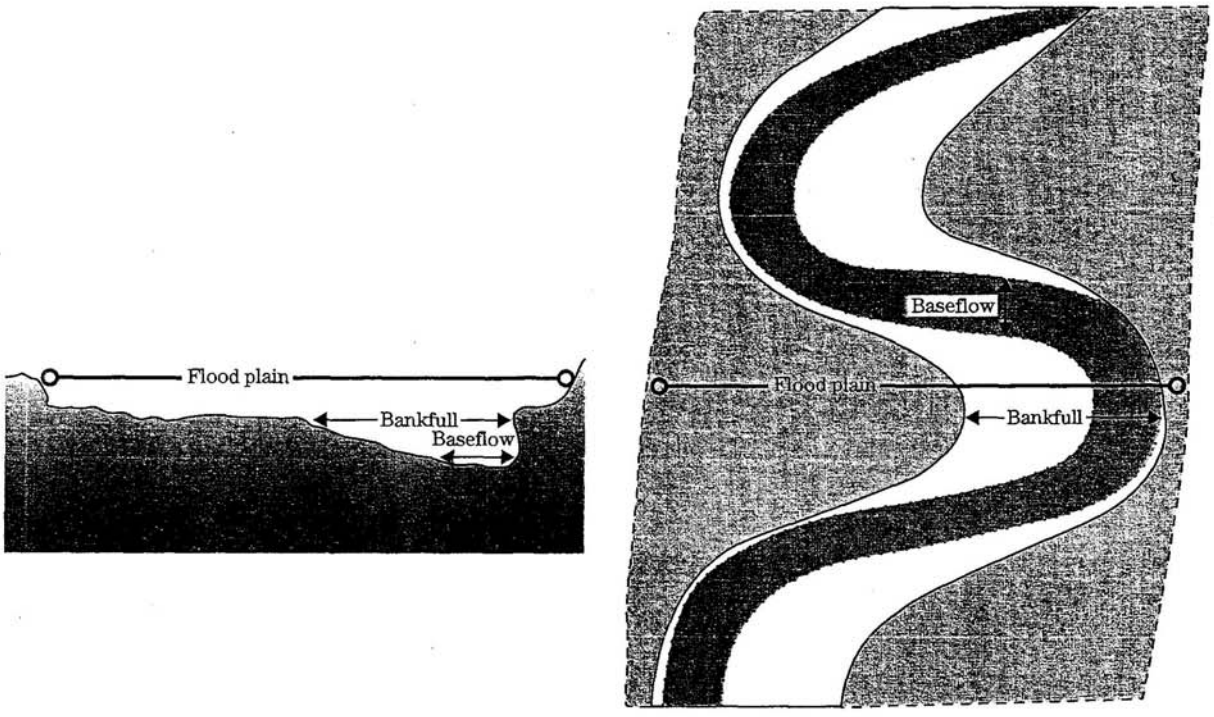
Reach description

The first page of the assessment worksheet records the identity and location of the stream reach. Most entries are self-explanatory. Waterbody ID and ecoregion should be filled out only if these identification and classification aids are used in your state.

Active channel width can be difficult to determine. However, active channel width helps to characterize the stream. It is also an important aspect of more advanced assessment protocols; therefore, it is worth becoming familiar with the concept and field determination. For this protocol you do not need to measure active channel width accurately — a visual estimate of the average width is adequate.

Active channel width is the stream width at the bankfull discharge. Bankfull discharge is the flow rate that forms and controls the shape and size of the active channel. It is approximately the flow rate at which the stream begins to move onto its flood plain if the stream has an active flood plain. The bankfull discharge is expected to occur every 1.5 years on average. Figure 3 illustrates the relationship between baseflow, bankfull flow, and the flood plain. Active channel width is best determined by locating the first flat depositional surface occurring above the bed of the stream (i.e., an active flood plain). The lowest elevation at which the bankfull surface could occur is at the top of the point bars or other sediment deposits in the channel bed. Other indicators of the bankfull surface include a break in slope on the bank, vegetation change, substrate, and debris. If you are not trained in locating the bankfull stage, ask the landowner how high the water gets every year and observe the location of permanent vegetation.

Figure 3 Baseflow, bankfull, and flood plain locations (Rosgen 1996)



Scoring descriptions

Each assessment element is rated with a value of 1 to 10. Rate only those elements appropriate to the stream. Using the Stream Visual Assessment Protocol worksheet, record the score that best fits the observations you make based on the narrative descriptions provided. Unless otherwise directed, assign the lowest score that applies. For example, if a reach has aspects of several narrative descriptions, assign a score based on the lowest scoring description that contains indicators present within the reach. You may record values intermediate to those listed. Some background information is provided for each assessment element, as well as a description of what to look for. The length of the assessment reach should be 12 times the active channel width.

Channel condition

Natural channel; no structures, dikes. No evidence of downcutting or excessive lateral cutting.	Evidence of past channel alteration, but with significant recovery of channel and banks. Any dikes or levies are set back to provide access to an adequate flood plain.	Altered channel; <50% of the reach with riprap and/or channelization. Excess aggradation; braided channel. Dikes or levees restrict flood plain width.	Channel is actively downcutting or widening. >50% of the reach with riprap or channelization. Dikes or levees prevent access to the flood plain.
10	7	3	1

Stream meandering generally increases as the gradient of the surrounding valley decreases. Often, development in the area results in changes to this meandering pattern and the flow of a stream. These changes in turn may affect the way a stream naturally does its work, such as the transport of sediment and the development and maintenance of habitat for fish, aquatic insects, and aquatic plants. Some modifications to stream channels have more impact on stream health than others. For example, channelization and dams affect a stream more than the presence of pilings or other supports for road crossings.

Active downcutting and excessive lateral cutting are serious impairments to stream function. Both conditions are indicative of an unstable stream channel. Usually, this instability must be addressed before committing time and money toward improving other stream problems. For example, restoring the woody vegetation within the riparian zone becomes increasingly difficult when a channel is downcutting because banks continue to be undermined and the water table drops below the root zone of the plants during their growing season. In this situation or when a channel is fairly stable, but already incised from previous downcutting or mechanical dredging, it is usually necessary to plant upland species, rather than hydrophytic, or to apply irrigation for several growing seasons, or both. Extensive bank-armoring of channels to stop lateral cutting usually leads to more problems (especially downstream). Often stability can be obtained by using a series of structures (barbs, groins, jetties, deflectors, weirs, vortex weirs) that reduce water velocity, deflect currents, or act as gradient controls. These structures are used in conjunction with large woody debris and woody vegetation plantings. Hydrologic alterations are described next.

What to look for: Signs of channelization or straightening of the stream may include an unnaturally straight section of the stream, high banks, dikes or berms, lack of flow diversity (e.g., few point bars and deep pools), and uniform-sized bed materials (e.g., all cobbles where there should be mixes of gravel and cobble). In newly channelized reaches, vegetation may be missing or appear very different (different species, not as well developed) from the bank vegetation of areas that were not channelized. Older channelized reaches may also have little or no vegetation or have grasses instead of woody vegetation. Drop structures (such as check dams), irrigation diversions, culverts, bridge abutments, and riprap also indicate changes to the stream channel.

Indicators of downcutting in the stream channel include nickpoints associated with headcuts in the stream bottom and exposure of cultural features, such as pipelines that were initially buried under the stream. Exposed footings in bridges and culvert outlets that are higher than the water surface during low flows are other examples. A lack of sediment depositional features, such as regularly-spaced point bars, is

normally an indicator of incision. A low vertical scarp at the toe of the streambank may indicate downcutting, especially if the scarp occurs on the inside of a meander. Another visual indicator of current or past downcutting is high streambanks with woody vegetation growing well below the top of the bank (as a channel incises the bankfull flow line moves downward within the former bankfull channel). Excessive bank erosion is indicated by raw banks in areas of the stream where they are not normally found, such as straight sections between meanders or on the inside of curves.

Hydrologic alteration

Flooding every 1.5 to 2 years. No dams, no water withdrawals, no dikes or other structures limiting the stream's access to the flood plain. Channel is not incised.	Flooding occurs only once every 3 to 5 years; limited channel incision. or Withdrawals, although present, do not affect available habitat for biota.	Flooding occurs only once every 6 to 10 years; channel deeply incised. or Withdrawals significantly affect available low flow habitat for biota.	No flooding; channel deeply incised or structures prevent access to flood plain or dam operations prevent flood flows. or Withdrawals have caused severe loss of low flow habitat. or Flooding occurs on a 1-year rain event or less.
10	7	3	1

Bankfull flows, as well as flooding, are important to maintaining channel shape and function (e.g., sediment transport) and maintaining the physical habitat for animals and plants. High flows scour fine sediment to keep gravel areas clean for fish and other aquatic organisms. These flows also redistribute larger sediment, such as gravel, cobbles, and boulders, as well as large woody debris, to form pool and riffle habitat important to stream biota. The river channel and flood plain exist in dynamic equilibrium, having evolved in the present climatic regime and geomorphic setting. The relationship of water and sediment is the basis for the dynamic equilibrium that maintains the form and function of the river channel. The energy of the river (water velocity and depth) should be in balance with the bedload (volume and particle size of the sediment). Any change in the flow regime alters this balance.

If a river is not incised and has access to its flood plain, decreases in the frequency of bankfull and out-of-bank flows decrease the river's ability to transport sediment. This can result in excess sediment deposition, channel widening and shallowing, and, ultimately, in *braiding* of the channel. Rosgen (1996) defines braiding as a stream with three or more smaller channels. These smaller channels are extremely unstable, rarely have woody vegetation along their banks, and provide poor habitat for stream biota. A *split channel*, however, has two or more smaller channels (called side channels) that are usually very stable, have woody vegetation along their banks, and provide excellent habitat.

Conversely, an increase in flood flows or the confinement of the river away from its flood plain (from either incision or levees) increases the energy available to transport sediment and can result in bank and channel erosion.

The low flow or baseflow during the dry periods of summer or fall usually comes from groundwater entering the stream through the stream banks and bottom. A decrease in the low-flow rate will result in a smaller portion of the channel suitable for aquatic organisms. The withdrawal of water from streams for irrigation or industry and the placement of dams often change the normal low-flow pattern. Baseflow can also

be affected by management and land use within the watershed — less infiltration of precipitation reduces baseflow and increases the frequency and severity of high flow events. For example, urbanization increases runoff and can increase the frequency of flooding to every year or more often and also reduce low flows. Overgrazing and clearcutting can have similar, although typically less severe, effects. The last description in the last box refers to the increased flood frequency that occurs with the above watershed changes.

What to look for: Ask the landowner about the frequency of flooding and about summer low-flow conditions. A flood plain should be inundated during flows that equal or exceed the 1.5- to 2.0-year flow event (2 out of 3 years or every other year). Be cautious because water in an adjacent field does not necessarily indicate natural flooding. The water may have flowed overland from a low spot in the bank outside the assessment reach.

Evidence of flooding includes high water marks (such as water lines), sediment deposits, or stream debris. Look for these on the banks, on the bankside trees or rocks, or on other structures (such as road pilings or culverts).

Excess sediment deposits and wide, shallow channels could indicate a loss of sediment transport capacity. The loss of transport capacity can result in a stream with three or more channels (braiding).

Riparian zone

Natural vegetation extends at least two active channel widths on each side.	Natural vegetation extends one active channel width on each side. or If less than one width, covers entire flood plain.	Natural vegetation extends half of the active channel width on each side.	Natural vegetation extends a third of the active channel width on each side. or Filtering function moderately compromised.	Natural vegetation less than a third of the active channel width on each side. or Lack of regeneration. or Filtering function severely compromised.
10	8	5	3	1

This element is the width of the natural vegetation zone from the edge of the active channel out onto the flood plain. For this element, the word *natural* means plant communities with (1) all appropriate structural components and (2) species native to the site or introduced species that function similar to native species at reference sites.

A healthy riparian vegetation zone is one of the most important elements for a healthy stream ecosystem. The quality of the riparian zone increases with the width and the complexity of the woody vegetation within it. This zone:

- Reduces the amount of pollutants that reach the stream in surface runoff.
- Helps control erosion.
- Provides a microclimate that is cooler during the summer providing cooler water for aquatic organisms.
- Provides large woody debris from fallen trees and limbs that form instream cover, create pools, stabilize the streambed, and provide habitat for stream biota.
- Provides fish habitat in the form of undercut banks with the "ceiling" held together by roots of woody vegetation.
- Provides organic material for stream biota that, among other functions, is the base of the food chain in lower order streams.
- Provides habitat for terrestrial insects that drop in the stream and become food for fish, and habitat and travel corridors for terrestrial animals.
- Dissipates energy during flood events.
- Often provides the only refuge areas for fish during out-of-bank flows (behind trees, stumps, and logs).

The type, timing, intensity, and extent of activity in riparian zones are critical in determining the impact on these areas. Narrow riparian zones and/or riparian zones that have roads, agricultural activities, residential or commercial structures, or significant areas of bare soils have reduced functional value for the stream. The filtering function of riparian zones can be compromised by concentrated flows. No evidence of concentrated flows through the zone should occur or, if concentrated flows are evident, they should be from land areas appropriately buffered with vegetated strips.

What to look for: Compare the width of the riparian zone to the active channel width. In steep, V-shaped valleys there may not be enough room for a flood plain riparian zone to extend as far as one or two active channel widths. In this case, observe how much of the flood plain is covered by riparian zone. The vegetation must be natural and consist of all of the structural components (aquatic plants, sedges or rushes, grasses, forbs, shrubs, understory trees, and overstory trees) appropriate for the area. A common problem is lack of shrubs and understory trees. Another common problem is lack of regeneration. The presence of only mature vegetation and few seedlings indicates lack of regeneration. Do not consider incomplete plant communities as natural. Healthy riparian zones on both sides of the stream are important for the health of the entire system. If one side is lacking the protective vegetative cover, the entire reach of the stream will be affected. In doing the assessment, examine both sides of the stream and note on the diagram which side of the stream has problems. There should be no evidence of concentrated flows through the riparian zone that are not adequately buffered before entering the riparian zone.

Bank stability

Banks are stable; banks are low (at elevation of active flood plain); 33% or more of eroding surface area of banks in outside bends is protected by roots that extend to the base-flow elevation.	Moderately stable; banks are low (at elevation of active flood plain); less than 33% of eroding surface area of banks in outside bends is protected by roots that extend to the baseflow elevation.	Moderately unstable; banks may be low, but typically are high (flooding occurs 1 year out of 5 or less frequently); outside bends are actively eroding (overhanging vegetation at top of bank, some mature trees falling into steam annually, some slope failures apparent).	Unstable; banks may be low, but typically are high; some straight reaches and inside edges of bends are actively eroding as well as outside bends (overhanging vegetation at top of bare bank, numerous mature trees falling into stream annually, numerous slope failures apparent).
10	7	3	1

This element is the existence of or the potential for detachment of soil from the upper and lower stream banks and its movement into the stream. Some bank erosion is normal in a healthy stream. Excessive bank erosion occurs where riparian zones are degraded or where the stream is unstable because of changes in hydrology, sediment load, or isolation from the flood plain. High and steep banks are more susceptible to erosion or collapse. All outside bends of streams erode, so even a stable stream may have 50 percent of its banks bare and eroding. A healthy riparian corridor with a vegetated flood plain contributes to bank stability. The roots of perennial grasses or woody vegetation typically extend to the baseflow elevation of water in streams that have bank heights of 6 feet or less. The root masses help hold the bank soils together and physically protect the bank from scour during bankfull and flooding events. Vegetation seldom becomes established below the elevation of the bankfull surface because of the frequency of inundation and the unstable bottom conditions as the stream moves its bedload.

The type of vegetation is important. For example, trees, shrubs, sedges, and rushes have the type of root masses capable of withstanding high streamflow events, while Kentucky bluegrass does not. Soil type at the surface and below the surface also influences bank stability. For example, banks with a thin soil cover over gravel or sand are more prone to collapse than are banks with a deep soil layer.

What to look for: Signs of erosion include unvegetated stretches, exposed tree roots, or scalloped edges. Evidence of construction, vehicular, or animal paths near banks or grazing areas leading directly to the water's edge suggest conditions that may lead to the collapse of banks. Estimate the size or area of the bank affected relative to the total bank area. This element may be difficult to score during high water.

Water appearance

Very clear, or clear but tea-colored; objects visible at depth 3 to 6 ft (less if slightly colored); no oil sheen on surface; no noticeable film on submerged objects or rocks.	Occasionally cloudy, especially after storm event, but clears rapidly; objects visible at depth 1.5 to 3 ft; may have slightly green color; no oil sheen on water surface.	Considerable cloudiness most of the time; objects visible to depth 0.5 to 1.5 ft; slow sections may appear pea-green; bottom rocks or submerged objects covered with heavy green or olive-green film. or Moderate odor of ammonia or rotten eggs.	Very turbid or muddy appearance most of the time; objects visible to depth < 0.5 ft; slow moving water may be bright-green; other obvious water pollutants; floating algal mats, surface scum, sheen or heavy coat of foam on surface. or Strong odor of chemicals, oil, sewage, other pollutants.
10	7	3	1

This element compares turbidity, color, and other visual characteristics with a healthy or reference stream. The depth to which an object can be clearly seen is a measure of turbidity. Turbidity is caused mostly by particles of soil and organic matter suspended in the water column. Water often shows some turbidity after a storm event because of soil and organic particles carried by runoff into the stream or suspended by turbulence. The water in some streams may be naturally tea-colored. This is particularly true in watersheds with extensive bog and wetland areas. Water that has slight nutrient enrichment may support communities of algae, which provide a greenish color to the water. Streams with heavy loads of nutrients have thick coatings of algae attached to the rocks and other submerged objects. In degraded streams, floating algal mats, surface scum, or pollutants, such as dyes and oil, may be visible.

What to look for: Clarity of the water is an obvious and easy feature to assess. The deeper an object in the water can be seen, the lower the amount of turbidity. Use the depth that objects are visible only if the stream is deep enough to evaluate turbidity using this approach. For example, if the water is clear, but only 1 foot deep, do not rate it as if an object became obscured at a depth of 1 foot. This measure should be taken after a stream has had the opportunity to "settle" following a storm event. A pea-green color indicates nutrient enrichment beyond what the stream can naturally absorb.

Nutrient enrichment

Clear water along entire reach; diverse aquatic plant community includes low quantities of many species of macrophytes; little algal growth present.	Fairly clear or slightly greenish water along entire reach; moderate algal growth on stream substrates.	Greenish water along entire reach; overabundance of lush green macrophytes; abundant algal growth, especially during warmer months.	Pea green, gray, or brown water along entire reach; dense stands of macrophytes clog stream; severe algal blooms create thick algal mats in stream.
10	7	3	1

Nutrient enrichment is often reflected by the types and amounts of aquatic vegetation in the water. High levels of nutrients (especially phosphorus and nitrogen) promote an overabundance of algae and floating and rooted macrophytes. The presence of some aquatic vegetation is normal in streams. Algae and macrophytes provide habitat and food for all stream animals. However, an excessive amount of aquatic vegetation is not beneficial to most stream life. Plant respiration and decomposition of dead vegetation consume dissolved oxygen in the water. Lack of dissolved oxygen creates stress for all aquatic organisms and can cause fish kills. A landowner may have seen fish gulping for air at the water surface during warm weather, indicating a lack of dissolved oxygen.

What to look for: Some aquatic vegetation (rooted macrophytes, floating plants, and algae attached to substrates) is normal and indicates a healthy stream. Excess nutrients cause excess growth of algae and macrophytes, which can create greenish color to the water. As nutrient loads increase the green becomes more intense and macrophytes become more lush and deep green. Intense algal blooms, thick mats of algae, or dense stands of macrophytes degrade water quality and habitat. Clear water and a diverse aquatic plant community without dense plant populations are optimal for this characteristic.

Barriers to fish movement

No barriers	Seasonal water withdrawals inhibit movement within the reach	Drop structures, culverts, dams, or diversions (< 1 foot drop) within the reach	Drop structures, culverts, dams, or diversions (> 1 foot drop) within 3 miles of the reach	Drop structures, culverts, dams, or diversions (> 1 foot drop) within the reach
10	8	5	3	1

Barriers that block the movement of fish or other aquatic organisms, such as fresh water mussels, must be considered as part of the overall stream assessment. If sufficiently high, these barriers may prevent the movement or migration of fish, deny access to important breeding and foraging habitats, and isolate populations of fish and other aquatic animals.

What to look for: Some barriers are natural, such as waterfalls and boulder dams, and some are developed by humans. Note the presence of such barriers along the reach of the stream you are assessing, their size, and whether provisions have been made for the passage of fish. Ask the landowner about any dams or other barriers that may be present 3 to 5 miles upstream or downstream. Larger dams are often noted on maps, so you may find some information even before going out into the field. Beaver dams generally do not prevent fish migration. Look for structures that may not involve a drop, but still present a hydraulic barrier. Single, large culverts with no slope and sufficient water depth usually do not constitute a barrier. Small culverts or culverts with slopes may cause high water velocities that prevent passage.

Instream fish cover

>7 cover types available	6 to 7 cover types available	4 to 5 cover types available	2 to 3 cover types available	None to 1 cover type available
10	8	5	3	1

Cover types: Logs/large woody debris, deep pools, overhanging vegetation, boulders/cobble, riffles, undercut banks, thick root mats, dense macrophyte beds, isolated/backwater pools, other: _____.

This assessment element measures availability of physical habitat for fish. The potential for the maintenance of a healthy fish community and its ability to recover from disturbance is dependent on the variety and abundance of suitable habitat and cover available.

What to look for: Observe the number of different habitat and cover types *within a representative subsection of the assessment* reach that is equivalent in length to *five times* the active channel width. Each cover type must be present in appreciable amounts to score. Cover types are described below.

Logs/large woody debris—Fallen trees or parts of trees that provide structure and attachment for aquatic macroinvertebrates and hiding places for fish.

Deep pools—Areas characterized by a smooth undisturbed surface, generally slow current, and deep enough to provide protective cover for fish (75 to 100% deeper than the prevailing stream depth).

Overhanging vegetation—Trees, shrubs, vines, or perennial herbaceous vegetation that hangs immediately over the stream surface, providing shade and cover.

Boulders/cobble—Boulders are rounded stones more than 10 inches in diameter or large slabs more than 10 inches in length; cobbles are stones between 2.5 and 10 inches in diameter.

Undercut banks—Eroded areas extending horizontally beneath the surface of the bank forming underwater pockets used by fish for hiding and protection.

Thick root mats—Dense mats of roots and rootlets (generally from trees) at or beneath the water surface forming structure for invertebrate attachment and fish cover.

Dense macrophyte beds—Beds of emergent (e.g., water willow), floating leaf (e.g., water lily), or submerged (e.g., riverweed) aquatic vegetation thick enough to provide invertebrate attachment and fish cover.

Riffles—Area characterized by broken water surface, rocky or firm substrate, moderate or swift current, and relatively shallow depth (usually less than 18 inches).

Isolated/backwater pools—Areas disconnected from the main channel or connected as a "blind" side channel, characterized by a lack of flow except in periods of high water.

Pools

Deep and shallow pools abundant; greater than 30% of the pool bottom is obscure due to depth, or the pools are at least 5 feet deep.	Pools present, but not abundant; from 10 to 30% of the pool bottom is obscure due to depth, or the pools are at least 3 feet deep.	Pools present, but shallow; from 5 to 10% of the pool bottom is obscure due to depth, or the pools are less than 3 feet deep.	Pools absent, or the entire bottom is discernible.
10	7	3	1

Pools are important resting and feeding sites for fish. A healthy stream has a mix of shallow and deep pools. A *deep* pool is 1.6 to 2 times deeper than the prevailing depth, while a *shallow* pool is less than 1.5 times deeper than the prevailing depth. Pools are abundant if a deep pool is in each of the meander bends in the reach being assessed. To determine if pools are abundant, look at a longer sample length than one that is 12 active channel widths in length. Generally, only 1 or 2 pools would typically form within a reach as long as 12 active channel widths. In low order, high gradient streams, pools are abundant if there is more than one pool every 4 channel widths.

What to look for: Pool diversity and abundance are estimated based on walking the stream or probing from the streambank with a stick or length of rebar. You should find deep pools on the outside of meander bends. In shallow, clear streams a visual inspection may provide an accurate estimate. In deep streams or streams with low visibility, this assessment characteristic may be difficult to determine and should not be scored.

Insect/invertebrate habitat

At least 5 types of habitat available. Habitat is at a stage to allow full insect colonization (woody debris and logs not freshly fallen).	3 to 4 types of habitat. Some potential habitat exists, such as overhanging trees, which will provide habitat, but have not yet entered the stream.	1 to 2 types of habitat. The substrate is often disturbed, covered, or removed by high stream velocities and scour or by sediment deposition.	None to 1 type of habitat.
10	7	3	1

Cover types: Fine woody debris, submerged logs, leaf packs, undercut banks, cobble, boulders, coarse gravel, other: _____.

Stable substrate is important for insect/invertebrate colonization. *Substrate* refers to the stream bottom, woody debris, or other surfaces on which invertebrates can live. Optimal conditions include a variety of substrate types within a relatively small area of the stream (5 times the active channel width). Stream and substrate stability are also important. High stream velocities, high sediment loads, and frequent flooding may cause substrate instability even if substrate is present.

What to look for: Observe the number of different types of habitat and cover within a representative subsection of the assessment reach that is equivalent in length to five times the active channel width. Each cover type must be present in appreciable amounts to score.

Score the following assessment elements only if applicable

Canopy cover (if applicable)

Coldwater fishery

> 75% of water surface shaded and upstream 2 to 3 miles generally well shaded.	>50% shaded in reach. or >75% in reach, but upstream 2 to 3 miles poorly shaded.	20 to 50% shaded.	< 20% of water surface in reach shaded.
10	7	3	1

Warmwater fishery

25 to 90% of water surface shaded; mixture of conditions.	> 90% shaded; full canopy; same shading condition throughout the reach.	(intentionally blank)	< 25% water surface shaded in reach.
10	7		1

Do not assess this element if active channel width is greater than 50 feet. Do not assess this element if woody vegetation is naturally absent (e.g., wet meadows).

Shading of the stream is important because it keeps water cool and limits algal growth. Cool water has a greater oxygen holding capacity than does warm water. When streamside trees are removed, the stream is exposed to the warming effects of the sun causing the water temperature to increase for longer periods during the daylight hours and for more days during the year. This shift in light intensity and temperature causes a decline in the numbers of certain species of fish, insects, and other invertebrates and some aquatic plants. They may be replaced altogether by other species that are more tolerant of increased light intensity, low dissolved oxygen, and warmer water temperature. For example, trout and salmon require cool, oxygen-rich water. Loss of streamside vegetation (and also channel widening) that cause increased water temperature and decreased oxygen levels are major contributing factors to the decrease in abundance of trout and salmon from many streams that historically supported these species. Increased light and the warmer water also promote excessive growth of submerged macrophytes and algae that compromises the biotic community of the stream. The temperature at the reach you are assessing will be affected by the amount of shading 2 to 3 miles upstream.

What to look for: Try to estimate the portion of the water surface area for the whole reach that is shaded by estimating areas with no shade, poor shade, and shade. Time of the year, time of the day, and weather can affect your observation of shading. Therefore, the relative amount of shade is estimated by assuming that the sun is directly overhead and the vegetation is in full leaf-out. First evaluate the shading conditions for the reach; then determine (by talking with the landowner) shading conditions 2 to 3 miles upstream. Alternatively, use aerial photographs taken during full leaf out. The following rough guidelines for percent shade may be used:

stream surface not visible ..... >90
surface slightly visible or visible only in patches .. 70 – 90
surface visible, but banks not visible ..... 40 – 70
surface visible and banks visible at times ..... 20 – 40
surface and banks visible ..... <20

Manure presence (if applicable)

(Intentionally blank)	Evidence of livestock access to riparian zone.	Occasional manure in stream or waste storage structure located on the flood plain.	Extensive amount of manure on banks or in stream. or Untreated human waste discharge pipes present.
	5	3	1

Do not score this element unless livestock operations or human waste discharges are present.

Manure from livestock may enter the water if livestock have access to the stream or from runoff of grazing land adjacent to the stream. In some communities untreated human waste may also empty directly into streams. Manure and human waste increase biochemical oxygen demand, increase the loading of nutrients, and alter the trophic state of the aquatic biological community. Untreated human waste is a health risk.

What to look for: Do not score this element unless livestock operations or human waste discharges are present. Look for evidence of animal droppings in or around streams, on the streambank, or in the adjacent riparian zone. Well-worn livestock paths leading to or near streams also suggest the probability of manure in the stream. Areas with stagnant or slow-moving water may have moderate to dense amounts of vegetation or algal blooms, indicating localized enrichment from manure.

Salinity (if applicable)

(Intentionally blank)	Minimal wilting, bleaching, leaf burn, or stunting of aquatic vegetation; some salt-tolerant streamside vegetation.	Aquatic vegetation may show significant wilting, bleaching, leaf burn, or stunting; dominance of salt-tolerant streamside vegetation.	Severe wilting, bleaching, leaf burn, or stunting; presence of only salt-tolerant aquatic vegetation; most streamside vegetation salt tolerant.
	5	3	1

Do not assess this element unless elevated salinity from anthropogenic sources is known to occur in the stream.

High salinity levels most often occur in arid areas and in areas that have high irrigation requirements. High salinity can also result from oil and gas well operations. Salt accumulation in soil causes a breakdown of soil structure, decreased infiltration of water, and potential toxicity. High salinity in streams affects aquatic vegetation, macroinvertebrates, and fish. Salts are a product of natural weathering processes of soil and geologic material.

What to look for: High salinity levels cause a "burning" or "bleaching" of aquatic vegetation. Wilting, loss of plant color, decreased productivity, and stunted growth are readily visible signs. Other indicators include whitish salt encrustments on the streambanks and the displacement of native vegetation by salt-tolerant aquatic plants and riparian vegetation (such as tamarix or salt cedar).

Riffle embeddedness (if applicable)

Gravel or cobble particles are < 20% embedded.	Gravel or cobble particles are 20 to 30% embedded.	Gravel or cobble particles are 30 to 40% embedded.	Gravel or cobble particles are >40% embedded.	Riffle is completely embedded.
10	8	5	3	1

Do not assess this element unless riffles are present or they are a natural feature that should be present.

Riffles are areas, often downstream of a pool, where the water is breaking over rocks or other debris causing surface agitation. In coastal areas riffles can be created by shoals and submerged objects. (This element is sensitive to regional differences and should be related to reference conditions.) Riffles are critical for maintaining high species diversity and abundance of insects for most streams and for serving as spawning and feeding grounds for some fish species. Embeddedness measures the degree to which gravel and cobble substrate are surrounded by fine sediment. It relates directly to the suitability of the stream substrate as habitat for macroinvertebrates, fish spawning, and egg incubation.

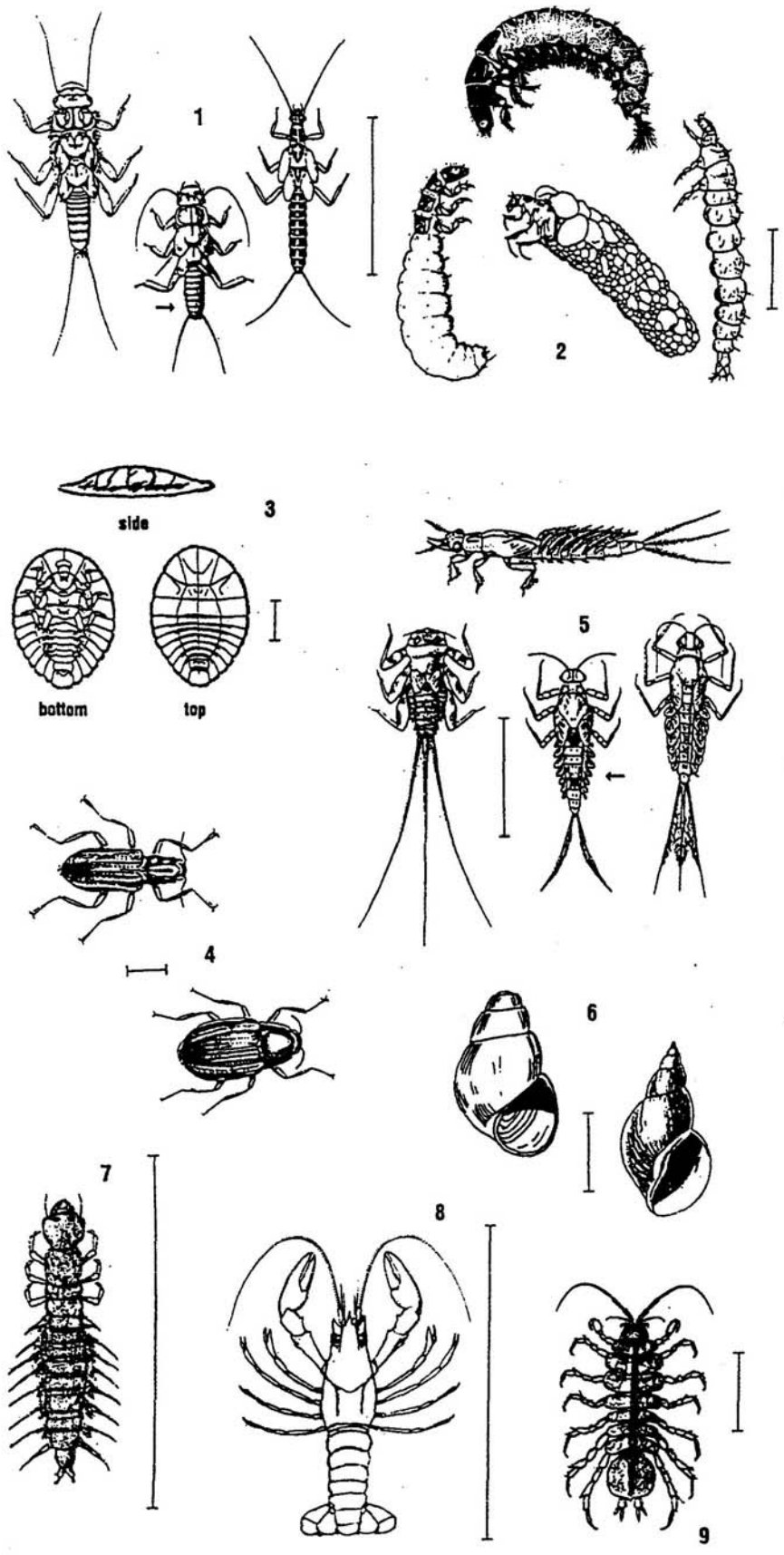
What to look for: This assessment characteristic should be used only in riffle areas and in streams where this is a natural feature. The measure is the depth to which objects are buried by sediment. This assessment is made by picking up particles of gravel or cobble with your fingertips at the fine sediment layer. Pull the particle out of the bed and estimate what percent of the particle was buried. Some streams have been so smothered by fine sediment that the original stream bottom is not visible. Test for complete burial of a streambed by probing with a length of rebar.

Macroinvertebrates observed

Community dominated by Group I or intolerant species with good species diversity. Examples include caddisflies, mayflies, stoneflies, hellgrammites.	Community dominated by Group II or facultative species, such as damselflies, dragonflies, aquatic sowbugs, blackflies, crayfish.	Community dominated by Group III or tolerant species, such as midges, craneflies, horseflies, leeches, aquatic earthworms, tubificid worms.	Very reduced number of species or near absence of all macroinvertebrates.
15	6	2	–3

This important characteristic reflects the ability of the stream to support aquatic invertebrate animals. However, successful assessment requires knowledge of the life cycles of some aquatic insects and other macroinvertebrates and the ability to identify them. For this reason, this is an optional element. The presence of intolerant insect species (cannot survive in polluted water) indicates healthy stream conditions. Some kinds of macroinvertebrates, such as stoneflies, mayflies, and caddisflies, are sensitive to pollution and do not live in polluted water; they are considered Group I. Another group of macroinvertebrates, known as Group II or facultative macroinvertebrates, can tolerate limited pollution. This group includes damselflies, aquatic sowbugs, and crayfish. The presence of Group III macroinvertebrates, including midges, craneflies and leeches, suggests the water is significantly polluted. The presence of a single Group I species in a community does not constitute good diversity and should generally not be given a score of 15.

What to look for: You can collect macroinvertebrates by picking up cobbles and other submerged objects in the water. Look carefully for the insects; they are often well camouflaged and may appear as part of the stone or object. Note the kinds of insects, number of species, and relative abundance of each group of insects/macroinvertebrates. Each of the three classes of macroinvertebrates are illustrated on pages 19 and 20. ***Note that the scoring values for this element range from – 3 to 15.***



Bar line indicate relative size

Stream Invertebrates

Group One Taxa

Pollution sensitive organisms found in good quality water.

1 **Stonefly Order Plecoptera.** 1/2" to 1 1/2", 6 legs with hooked antenna, 2 hair-line tails. Smooth (no gills) on lower half of body (see arrow).

2 **Caddisfly: Order Trichoptera.** Up to 1", 6 hooked legs on upper third of body, 2 hooks at back end. May be in a stick, rock, or leaf case with its head sticking out. May have fluffy gill tufts on underside.

3 **Water Penny: Order Coleoptera.** 1/4", flat saucer-shaped body with a raised bump on one side and 6 tiny legs and fluffy gills on the other side. Immature beetle.

4 **Riffle Beetle: Order Coleoptera.** 1/4", oval body covered with tiny hairs, 6 legs, antennae. Walks slowly underwater. Does not swim on surface.

5 **Grilled Snail: Class Gastropoda.** Shell opening covered by thin plate called operculum. When opening is facing you, shell usually opens on right.

6 **Mayfly: Order Ephemeroptera.** 1/4" to 1", brown, moving, plate-like or feathery gills on the sides of lower body (see below), 6 large hooked legs, antennae, 2 or 3 long hair-like tails. Tails may be webbed together.

7 **Dobsonfly (hellgrammite): Family Corydalidae.** 3/4" to 4", dark-colored, 6 legs, large pinching jaws, eight pairs feelers on lower half of body with paired cotton-like gill tufts along underside, short antennae, 2 tails, and 2 pairs of hooks at back end.

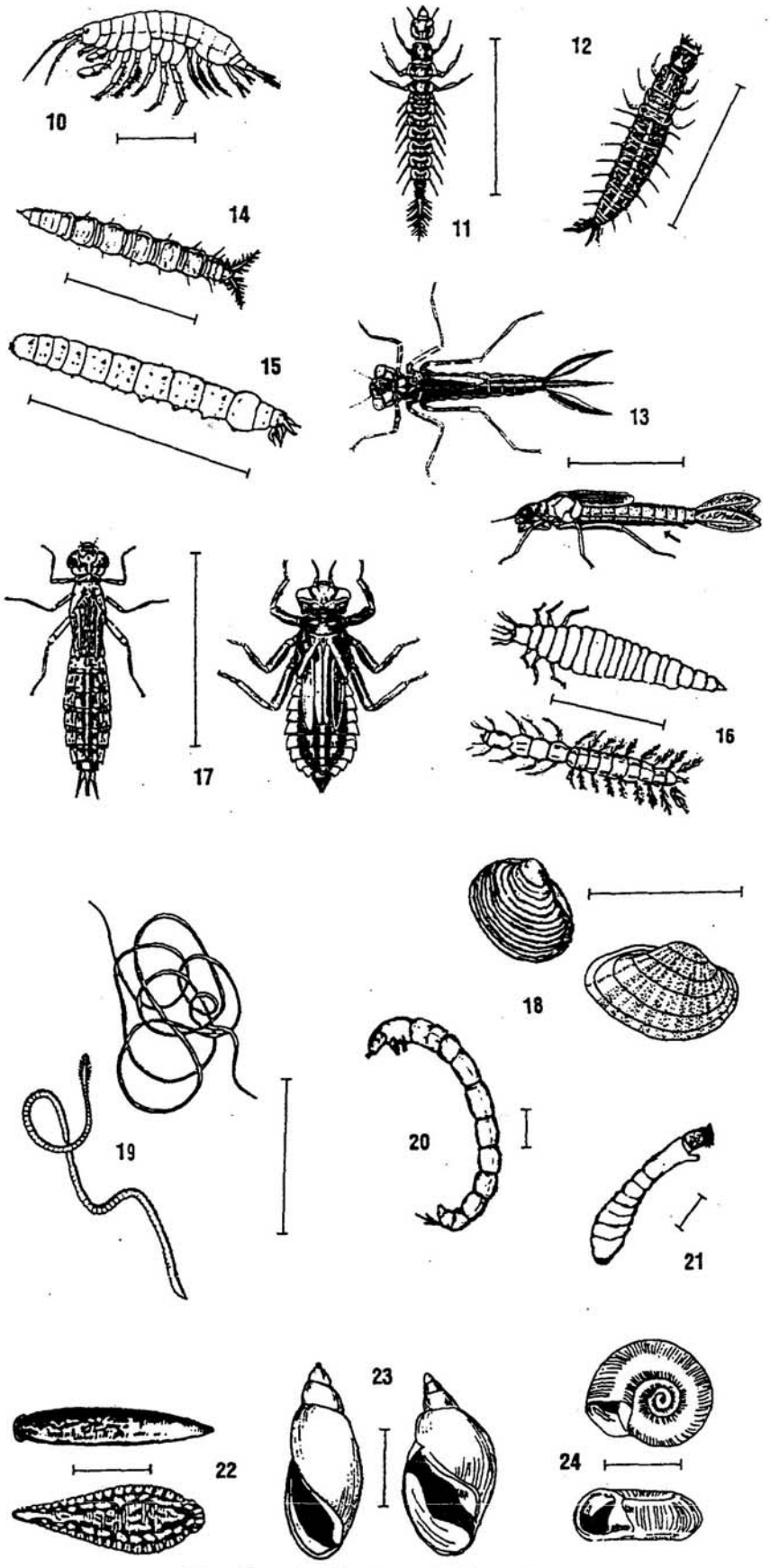
Group Two Taxa

Somewhat pollution tolerant organisms can be in good or fair quality water.

8 **Crayfish: Order Decapoda.** Up to 6", 1 large claws, 8 legs, resembles small lobster.

9 **Sowbug: Order Isopoda.** 1/4" to 3/4", gray oblong body wider than it is high, more than 6 legs, long antennae.

Source: Izaak Walton League of America, 707 Conservation Lane, Gaithersburg, MD 20878-2983. (800) BUG-IWLA



Bar line indicate relative size

Group Two Taxa

Somewhat pollution tolerant organisms can be in good or fair quality water.

10 **Scud: Order Amphipoda.** 1/4", white to gray, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp.

11 **Alderfly Larva: Family Sialedae.** 1" long. Looks like small Hellgramite but has long, thin, branched tail at back end (no hooks). No gill tufts underneath.

12 **Fishfly Larva: Family Cordalidae.** Up to 1/2" long. Looks like small hellgramite but often a lighter reedish-tan color, or with eyllowish streaks. No gill tufts underneath.

13 **Damselfly: Suborder Zugoptera.** 1/2" to 1" large eyes, 6 thin hooked legs, 3 broad oar-shaped tails, positioned like a tripod. Smooth (no gills) on sides of lower half of body. (See arrow.)

14 **Watersnipe Fly Larva: Family Atherici-dae (Atherix).** 1/4" to 1", pale to green, tapered body, many caterpillar-like legs, conical head, feathery "horns" at back end.

15 **Crane Fly: Suborder Nematocera.** 1/3" to 2", milky, green, or light brown, plump caterpillar-like segmented body, 4 finger-like lobes at back end.

16 **Beetle Larva: Order Coleoptera.** 1/4" to 1", light-colored, 6 legs on upper half of body, feelers, antennae.

17 **Dragon fly: Suborder Anisoptera.** 1/2" to 2", large eyes, 6 hooked legs. Wide oval to round abdomen.

18 **Clam: Class Bivalvia.**

Group Three Taxa

Pollution tolerant organisms can be in any quality of water.

19 **Aquatic Worm: Class Oligochaeta.** 1/4" to 2", can be very tiny, thin worm-like body.

20 **Midge Fly Larva: Suborder Nemato-cera.** Up to 1/4", dark head, worm-like segmented body, 2 tiny legs on each side.

21 **Blackfly Larva: Family Simulidae.** Up to 1/4", one end of body wider. Black head, suction pad on other end.

22 **Leech: Order Hirudinea.** 1/4" to 2", brown, slimy body, ends with suction pads.

23 **Pouch Snail and Pond Snails: Class Gastropoda.** No operculum. Breath air. When opening is facing you, shell usually open to left.

24 **Other Snails: Class Gastropoda.** No operculum.Breath air. Snail shell coils in one plane.

Technical information to support implementation

Introduction

This section provides a guide for implementation of the Stream Visual Assessment Protocol (SVAP). The topics covered in this section include the origin of the protocol, development history, context for use in relation to other methods of stream assessment, instructions for modifying the protocol, and references.

Origin of the protocol

In 1996 the NRCS National Water and Climate Center surveyed the NRCS state biologists to determine the extent of activity in stream ecological assessment and the need for technical support. The survey indicated that less than a third of the NRCS states were active in supporting stream assessment within their state. Most respondents said they believed they should be more active and requested additional support from the National Centers and Institutes. In response to these findings, the NRCS Aquatic Assessment Workgroup was formed. In their first meeting the workgroup determined that a simple assessment protocol was needed. The Water Quality Indicators Guide (WQIG) had been available for 8 years, but was not being used extensively. The workgroup felt a simpler and more streamlined method was needed as an initial protocol for field office use.

The workgroup developed a plan for a tiered progression of methods that could be used in the field as conservationists became more skilled in stream assessment. These methods would also serve different assessment objectives. The first tier is a simple 2-page assessment — the Stream Visual Assessment Protocol (SVAP). The second tier is the existing WQIG. The third tier is a series of simple assessment methods that could be conducted by conservationists in the field. An example of a third tier method would be macroinvertibrate sampling and identification to the taxonomic level of Order. The fourth tier is fairly sophisticated methods used in special projects. Examples of fourth tier methods would be fish community sampling and quantitative sampling of macroinvertebrates with shipment of samples to a lab for identification.

The workgroup also found that introductory training and a field handbook that would serve as a comprehensive reference and guidance manual are needed. These projects are under development as of this writing.

Context for use

The Stream Visual Assessment Protocol is intended to be a simple, comprehensive assessment of stream condition that maximizes ease of use. It is suitable as a basic first approximation of stream condition. It can also be used to identify the need for more accurate assessment methods that focus on a particular aspect of the aquatic system.

The relationship of the SVAP to other assessment methods is shown in figure 4. In this figure a specific reference to a guidance document is provided for some methods. The horizontal bars indicate which aspects of stream condition (chemical, physical, or biological) are addressed by the method. The SVAP is the simplest method and covers all three aspects of stream condition. As you move upwards in figure 4 the methods provide more accuracy, but also become more focused on one or two aspects of stream condition and require more expertise or resources to conduct.

The SVAP is intended to be applicable nationwide. It has been designed to utilize factors that are least sensitive to regional differences. However, regional differences are a significant aspect of stream assessment, and the protocol can be enhanced by tailoring the assessment elements to regional conditions. The national SVAP can be viewed as a framework that can evolve over time to better reflect State or within-State regional differences. Instructions for modification are provided later in this document.

Development

The SVAP was developed by combining parts of several existing assessment procedures. Many of these sources are listed in the references section. Three drafts were developed and reviewed by the workgroup and others between the fall of 1996 and the spring of 1997. During the summer of 1997, the workgroup conducted a field trial evaluation of the third draft. Further field trials were conducted with the fourth draft in 1998. A report on the field trial results is appendix A of this document.

The field trials involved approximately 60 individuals and 182 assessment sites. The field trial consisted of a combination of replication studies (in which several individuals independently assessed the same sites) and accuracy studies (in which SVAP scores were compared to the results from other assessment methods). The average coefficient of variation in the replication studies was 10.5 percent. The accuracy results indicated that SVAP version 3 scores correlated well with

other methods for moderately impacted and high quality sites, but that low quality sites were not scoring correspondingly low in the SVAP. Conservationists in the field who participated in the trial were surveyed on the usability and value of the protocol. The participants indicated that they found it easy to use and thought it would be valuable for their clients.

Revisions were made to the draft to address the deficiencies identified in the field trial, and some reassessments were made during the winter of 1998 to see how the revisions affected performance. Performance was improved. Additional revisions were made, and the fifth draft was sent to all NRCS state offices, selected Federal agencies, and other partners for review and comment during the spring of 1998.

Comments were received from eight NRCS state offices, the Bureau of Land Management, and several NRCS national specialists. Comments were uniformly supportive of the need for the guidance and for the document as drafted. Many commenters provided improved explanatory text for the supporting descriptions accompanying the assessment elements. Most of the suggested revisions were incorporated.

Implementation

The SVAP is issued as a national product. States are encouraged to incorporate it within the Field Office Technical Guide. The document may be modified by States. The electronic file for the document may be downloaded from the National Water and Climate Center web site at http://www.wcc.nrcs.usda.gov.

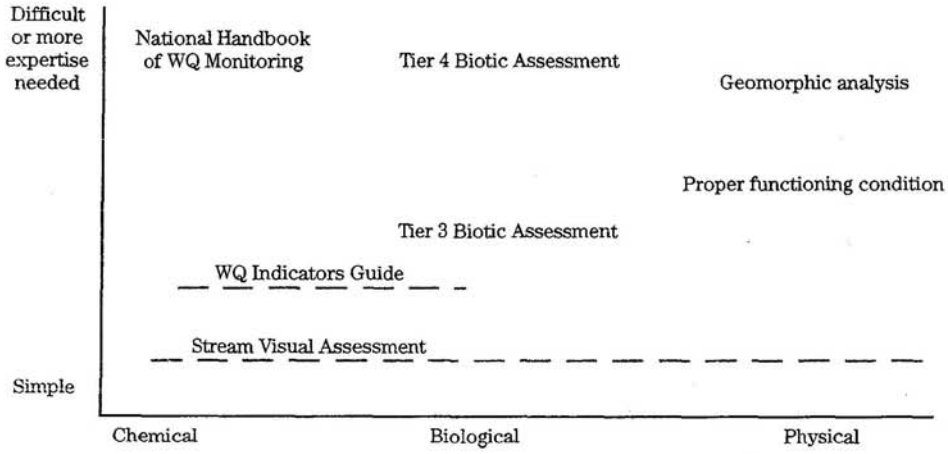
A training course for conservationists in the field suitable for use at the state or area level has been developed to facilitate implementation of the SVAP. It is designed as either a 1-day or 2-day session. The first day covers basic stream ecology and use of the SVAP. The second day includes an overview of several stream assessment methods, instruction on a macroinvertebrate survey method, and field exercises to apply the SVAP and macroinvertibrate protocols. The training materials consist of an instructor's guide, slides, video, a macroinvertebrate assessment training kit, and a student workbook. Training materials have been provided to each NRCS state office.

Instructions for modification

The national version of the Stream Visual Assessment Protocol may be used without modification. It has been designed to use assessment elements that are least sensitive to regional differences. Nonetheless, it can be modified to better reflect conditions within a geographic area. Modifying the protocol would have the following benefits:

- The protocol can be made easier to use with narrative descriptions that are closer to the conditions users will encounter.
- The protocol can be made more responsive to differences in stream condition.
- Precision can be improved by modifying elements that users have trouble evaluating.
- The rating scale can be calibrated to regionally-based criteria for excellent, good, fair, and poor condition.

Figure 4 Relationship of various stream condition assessment methods in terms of complexity or expertise required and the aspects of stream condition addressed



Two parts of the SVAP may be modified—the individual elements and their narrative descriptions, and the rating scale for assigning an overall condition rating of excellent, good, fair, or poor.

The simplest approach to modifying the SVAP is based on professional experience and judgment. Under this approach an interdisciplinary team should be assembled to develop proposed revisions. Revisions should then be evaluated by conducting comparison assessments at sites representing a range of conditions and evaluating accuracy (correlation between different assessment methods), precision (reproducibility among different users), and ease of use.

A second, more scientifically rigorous method for modifying the protocol is described below. This approach is based on a classification system for stream type and the use of reference sites.

Step 1 Decide on tentative number of versions.
Do you want to develop a revised version for your state, for each ecoregion within your state, or for several stream classes within each ecoregion?

Step 2 Develop tentative stream classification.
If you are developing protocols by stream class, you need to develop a tentative classification system. (If you are interested in a statewide or ecoregion protocol, go to step 3.) You might develop a classification system based on stream order, elevation, or landscape character. Do not create too many categories. The greater the number of categories, the more assessment work will be needed to modify the protocol and the more you will be accommodating degradation within the evaluation system. As an extreme example of the latter problem, you would not want to create a stream class consisting of those streams that have bank-to-bank cropping and at least one sewage outfall.

Step 3 Assess sites.
Assess a series of sites representing a range of conditions from highly impacted sites to least impacted sites. Try to have at least 10 sites in each of your tentative classes. Those sites should include several potential "least impacted reference sites." Try to use sites that have been assessed by other assessment methods (such as sites assessed by state agencies or universities). As part of the assessments, be sure to record information on potential classification factors and if any particular elements are difficult to score. Take notes so that future revisions of the elements can be rescored without another site visit.

Step 4 Rank the sites.
Begin your data analysis by ranking all the sites from most impacted to least impacted. Rank sites according to the independent assessment results (preferred) or by the SVAP scores. Initially, rank all of the sites in the state data set. You will test classifications in subsequent iterations.

Step 5 Display scoring data.
Prepare a chart of the data from all sites in your state. The columns are the sites arranged by the ranking. The rows are the assessment elements, the overall numerical score, and the narrative rating. If you have independent assessment data, create a second chart by plotting the overall SVAP scores against the independent scores.

Step 6 Evaluate responsiveness.
Does the SVAP score change in response to the condition gradient represented by the different sites? Are the individual element scores responding to key resource problems? Were users comfortable with all elements? If the answers are yes, do not change the elements and proceed to step 7. If the answers are no, isolate which elements are not responsive. Revise the narrative descriptions for those elements to better respond to the observable conditions. Conduct a "desktop" reassessment of the sites with the new descriptions, and return to step 4.

Step 7 Evaluate the narrative rating breakpoints.
Do the breakpoints for the narrative rating correspond to other assessment results? The excellent range should encompass only reference sites. If not, you should reset the narrative rating breakpoints. Set the excellent breakpoint based on the least impacted reference sites. You must use judgment to set the other breakpoints.

Step 8 Evaluate tentative classification system.
Go back to step 4 and display your data this time by the tentative classes (ecoregions or stream classes). In other words, analyze sites from each ecoregion or each stream class separately. Repeat steps 5 through 7. If the responsiveness is significantly different from the responsiveness of the statewide data set or the breakpoints appear to be significantly different, adopt the classification system and revise the protocol for each ecoregion or stream class. If not, a single statewide protocol is adequate.

After the initial modification of the SVAP, the state may want to set up a process to consider future revisions. Field offices should be encouraged to locate and assess least impacted reference sites to build the data base for interpretation and future revisions. Ancillary data should be collected to help evaluate whether a potential reference site should be considered a reference site.

Caution should be exercised when considering future revisions. Revisions complicate comparing SVAP scores determined before and after the implementation of conservation practices if the protocol is substantially revised in the intervening period. Developing information to support refining the SVAP can be carried out by graduate students working cooperatively with NRCS. The Aquatic Assessment Workgroup has been conducting a pilot Graduate Student Fellowship program to evaluate whether students would be willing to work cooperatively for a small stipend. Early results indicate that students can provide valuable assistance. However, student response to advertisements has varied among states. If the pilot is successful, the program will be expanded.

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Glossary

Active channel width — The width of the stream at the bankfull discharge. Permanent vegetation generally does not become established in the active channel.

Aggradation — Geologic process by which a stream bottom or flood plain is raised in elevation by the deposition of material.

Bankfull discharge — The stream discharge (flow rate, such as cubic feet per second) that forms and controls the shape and size of the active channel and creates the flood plain. This discharge generally occurs once every 1.5 years on average.

Bankfull stage — The stage at which water starts to flow over the flood plain; the elevation of the water surface at bankfull discharge.

Baseflow — The portion of streamflow that is derived from natural storage; average stream discharge during low flow conditions.

Benthos — Bottom-dwelling or substrate-oriented organisms.

Boulders — Large rocks measuring more than 10 inches across.

Channel — A natural or artificial waterway of perceptible extent that periodically or continuously contains moving water. It has a definite bed and banks that serve to confine the water.

Channel roughness — Physical elements of a stream channel upon which flow energy is expended including coarseness and texture of bed material, the curvature of the channel, and variation in the longitudinal profile.

Channelization — Straightening of a stream channel to make water move faster.

Cobbles — Medium-sized rocks which measure 2.5 to 10 inches across.

Confined channel — A channel that does not have access to a flood plain.

Degradation — Geologic process by which a stream bottom is lowered in elevation due to the net loss of substrate material. Often called downcutting.

Downcutting — See Degradation.

Ecoregion — A geographic area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.

Embeddedness — The degree to which an object is buried in steam sediment.

Emergent plants — Aquatic plants that extend out of the water.

Flood plain — The flat area of land adjacent to a stream that is formed by current flood processes.

Forb — Any broad-leaved herbaceous plant other than those in the Gramineae (Poceae), Cyperacea, and Juncaceae families (Society for Range Management, 1989).

Gabions A wire basket filled with rocks; used to stabilize streambanks and to control erosion.

Geomorphology The study of the evolution and configuration of landforms.

Glide A fast water habitat type that has low to moderate velocities, no surface agitation, no defined thalweg, and a U-shaped, smooth, wide bottom.

Gradient Slope calculated as the amount of vertical rise over horizontal run expressed as ft/ft or as percent (ft/ft * 100).

Grass An annual to perennial herb, generally with round erect stems and swollen nodes; leaves are alternate and two-ranked; flowers are in spikelets each subtended by two bracts.

Gravel Small rocks measuring 0.25 to 2.5 inches across.

Habitat The area or environment in which an organism lives.

Herbaceous Plants with nonwoody stems.

Hydrology The study of the properties, distribution, and effects of water on the Earth's surface, soil, and atmosphere.

Incised channel A channel with a streambed lower in elevation than its historic elevation in relation to the flood plain.

Intermittent stream A stream in contact with the ground water table that flows only certain times of the year, such as when the ground water table is high or when it receives water from surface sources.

Macrophyte bed A section of stream covered by a dense mat of aquatic plants.

Meander A winding section of stream with many bends that is at least 1.2 times longer, following the channel, than its straight-line distance. A single meander generally comprises two complete opposing bends, starting from the relatively straight section of the channel just before the first bend to the relatively straight section just after the second bend.

Macroinvertebrate A spineless animal visible to the naked eye or larger than 0.5 millimeters.

Nickpoint The point where a stream is actively eroding (downcutting) to a new base elevation. Nickpoints migrate upstream (through a process called headcutting).

Perennial stream A steam that flows continuously throughout the year.

Point bar A gravel or sand deposit on the inside of a meander; an actively mobile river feature.

Pool Deeper area of a stream with slow-moving water.

Reach A section of stream (defined in a variety of ways, such as the section between tributaries or a section with consistent characteristics).

Riffle A shallow section in a stream where water is breaking over rocks, wood, or other partly submerged debris and producing surface agitation.

Riparian The zone adjacent to a stream or any other waterbody (from the Latin word ripa, pertaining to the bank of a river, pond, or lake).

Riprap Rock material of varying size used to stabilize streambanks and other slopes.

Run A fast-moving section of a stream with a defined thalweg and little surface agitation.

Scouring The erosive removal of material from the stream bottom and banks.

Sedge A grasslike, fibrous-rooted herb with a triangular to round stem and leaves that are mostly three-ranked and with close sheaths; flowers are in spikes or spikelets, axillary to single bracts.

Substrate The mineral or organic material that forms the bed of the stream; the surface on which aquatic organisms live.

Surface fines That portion of streambed surface consisting of sand/silt (less than 6 mm).

Thalweg The line followed by the majority of the streamflow. The line connecting the lowest or deepest points along the streambed.

Turbidity Murkiness or cloudiness of water caused by particles, such as fine sediment (silts, clays) and algae.

Watershed A ridge of high land dividing two areas that are drained by different river systems. The land area draining to a waterbody or point in a river system; catchment area, drainage basin, drainage area.

Appendix A—1997 and 1998 Field Trial Results

Purpose and methods

The purpose of the field trials was to evaluate the accuracy, precision, and usability of the draft Steam Visual Assessment Protocol. The draft protocols evaluated were the third draft dated May 1997 and the fourth draft dated October 1997. A field trial workplan was developed with study guidelines and a survey form to solicit feedback from users. Accuracy was evaluated by comparison to other stream assessment methods. Precision was evaluated by replicate assessments conduced by different individuals at the same sites. In all studies an attempt was made to utilize sites ranging from high quality to degraded. Results consisted of the scoring data and the user feedback form for each site.

Results

Overall, 182 sites were assessed, and approximately 60 individuals participated in the field trials. The individual studies are summarized in table A–1.

Precision could be evaluated using data from the Colorado, New Jersey, Oregon, Virginia, and Georgia studies. Results are summarized in table A–2. The New Jersey sites had coefficients of variation of 9.0 (n=8), 14.4 (n=5), and 5.7 (n=4) percent. The Oregon site with three replicates was part of a course and had a coefficient of variation of 11.1 percent. One Georgia site was assessed using the fourth draft during a pilot of the training course. There were 11 replicates, and the coefficient of variation was 8.8 percent. In May 1998 the workgroup conducted replicate assessments of two sites in Virginia using the fifth draft of the protocol. Coefficients of variation were 14.7 and 3.6 percent. The average coefficient of variation of all studies in table A–2 is 10.5 percent.

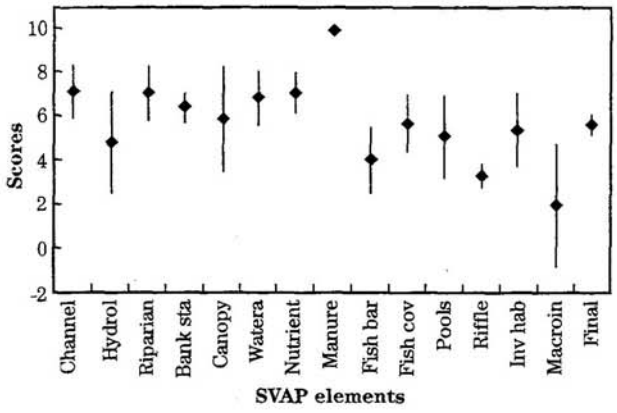
Variability within the individual elements of the SVAP was evaluated using the Georgia site with 11 replicates. The results of the individual element scores are presented in figure A–1. It should be noted that two individuals erroneously rated the "presence of manure" element.

Accuracy was evaluated by comparing the SVAP rating to other methods as noted in table A–1. Some of the comparisons involved professional judgment. In others the SVAP score could be compared with a quantitative evaluation. Figures A–2 through A–5 present data from the two studies that had larger numbers of sites. The Pearson's Correlation Coefficient is presented for these data. The results from other sites are presented in table A–3.

Table A–1 Summary of studies in the field trial

Location	Number of sites	Number of replicates	SVAP compared to	SVAP conducted by
VA	56	3, 5	IBI (fish) and Ohio QHEI	FO personnel
NC/SC	90	none	IBI, EPT	Soil scientists
MI	5	none	professional judgment	State biologist
NJ	3	4, 5, 8	NJDEP ratings	FO personnel
OR	3	none	IBI	NWCC scientist
CO	1	3	professional judgment	FO personnel
WA	3	none	professional judgment	State biologist
OR	2	3	no comparisons	FO personnel
GA	8	4-5	macroinvertebrates	FO personnel
GA	2	12, none	IBI, macroinvertebrate	FO personnel

Figure A–1 Means and standard deviations from the Parker's Mill Creek site in Americus, GA (n=11) (mean plus and minus one standard deviation is shown; SVAP version 4 used)



The SVAP version 3 scores correlated extremely well with the Ohio Qualitative Habitat Index and reasonably well with the fish community IBI in the Virginia study (fig. A–2 and A–3). However, the SVAP version 3 scores in the Carolinas study did not correlate well with either IBI or EPT Taxa (fig. A–4 and A–5). These results may reflect the fact that the SVAP primarily assesses physical habitat within the assessment reach whereas IBI and EPT Taxa are influenced by both physical habitat within the assessment reach and conditions within the watershed. Onsite physical habitat may have been a relatively more important factor at the Virginia sites than at the Carolina sites.

Overall, the field trial results for the third draft seemed to indicate that SVAP scores reflected conditions for sites in good to moderate condition. However, SVAP scores tended to be too high for poor quality sites.

Both the user questionnaires and verbal feedback indicated that users found the SVAP easy to use. Users reported that they thought it would be an effective tool to use with landowners. The majority indicated that they would recommend it to landowners.

Table A–2 Summary of replication results (version refers to the SVAP draft used; mean for overall score reported)

Site	SVAP version	No. replicates	Mean 1/	Standard deviation	Coefficient of variation
Alloway Cr. NJ	3	5	3.6 F	0.52	14.4
Manasquan R. NJ	3	4	5.1 G	0.29	5.7
S. Br. Raritan R. NJ	3	8	5.9 G	0.53	9.0
Gales Cr. OR	3	3	5.5 G	0.61	11.1
Clear Cr. CO	3	3	5.4 G	0.74	13.7
Piscola Cr. GA #1	4	5	9.2 E	0.77	8.4
Piscola Cr. GA #2	4	5	9.0 E	0.85	9.4
Piscola Cr. GA #3	4	4	4.7 F	1.10	23.4
Piscola Cr. GA #4	4	4	7.4 G	0.96	13.0
Little R. GA # 1	4	4	8.3 E	0.73	8.8
Little R. GA # 2	4	4	7.4 E	0.83	11.2
Little R. GA # 3	4	4	8.1 E	0.41	5.1
Little R. GA # 4	4	4	7.3 G	0.60	8.2
Parker's Mill Cr. GA	4	11	5.7 F	0.50	8.8
Cedar Run (up), VA	5	5	7.7 G	1.1	14.7
Cedar R. (down), VA	5	5	6.6 F	.2	3.6

1/ Includes SVAP narrative ratings (P = poor, F = fair, G = good, E = excellent)

Table A–3 Accuracy comparison data from studies with too few sites to determine a correlation coefficient

Site	SVAP version	SVAP score and rating	Comparative rating	Comparative method
Alloway Cr. NJ	3	3.6* — fair	12 — mod. impaired	NJIS (macro.)
Manasquan R. NJ	3	5.1* — good	12 — mod. impaired	NJIS (macro.)
S. Br. Raritan R. NJ	3	5.9* — good	30 — not impaired	NJIS (macro.)
Site 1 OR	3	2.7 — fair	12 — very poor	IBI (fish)
Site 2 OR	3	4.6 — good	22 — poor	IBI (fish)
Site 3 OR	3	7.0 — excellent	44 — good	IBI (fish)
Muckalee Cr. GA	4	8.6 — good	good to excellent	mussel taxa

* Mean value of replicates

Figure A–2 Correlation between SVAP and IBI values in the Virginia study (n=56)

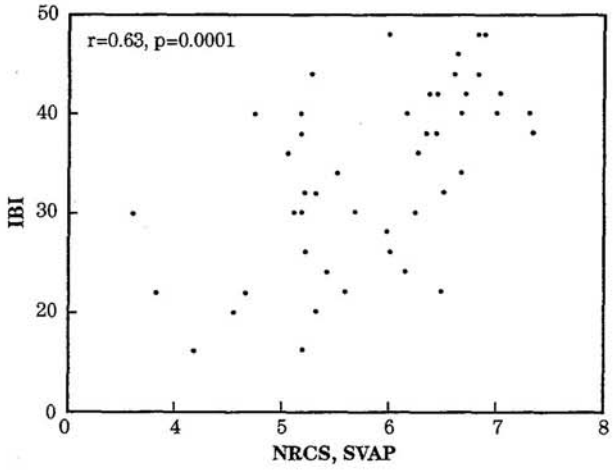


Figure A–3 Correlation between SVAP and Ohio Qualitative Habitat Evaluation Index values in the Virginia study (n=56)

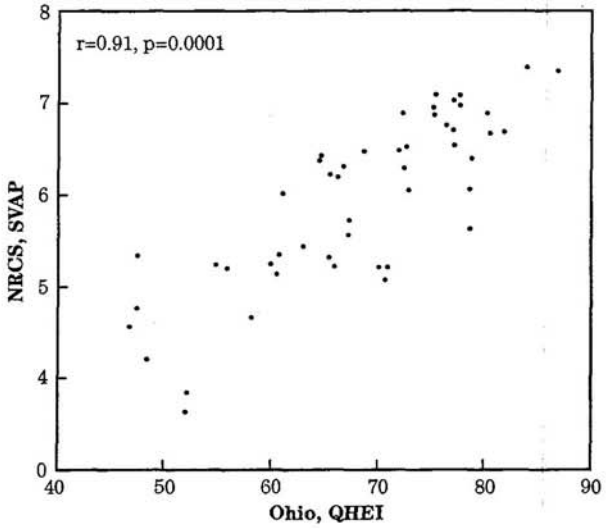


Figure A–4 Correlation between SVAP and IBI values in the Carolinas study (n=90)

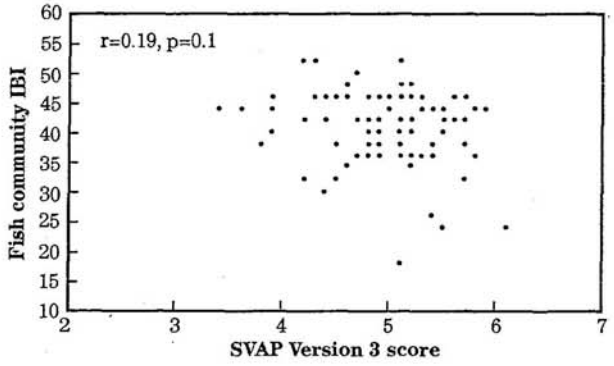
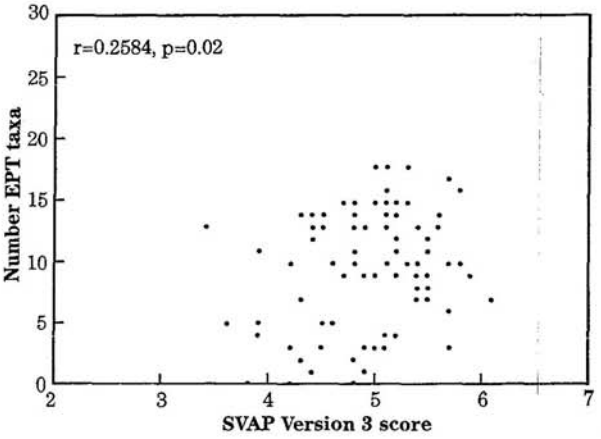


Figure A–5 Correlation between SVAP and macroinvertebrate index values in Carolinas study (n=90)



Discussion

Overall, the workgroup concluded from the first field trial that the SVAP could be used by conservationists in the field with reasonable reproducibility and a level of accuracy commensurate with its objective of providing a basic assessment of ecological condition provided the poor response to degraded streams could be corrected.

Several potential causes for the lack of accuracy with degraded sites were identified by the workgroup as follows:

- Because the overall score is an average of all assessed elements, the effect of low scoring elements can be damped out by averaging if the degradation is not picked up by many of the other assessed elements.
- Some of the elements needed to be adjusted to give lower scores for problems.
- The numerical breakpoints for the narrative ratings of poor/fair and fair/good were set too low.

To correct these problems the number of assessment elements was reduced and the instructions were modified so that certain elements are not scored if they do not apply. For example, the "presence of manure" element is not scored unless there are animal operations present. These changes reduced the potential for low scores to be damped out by the averaging process.

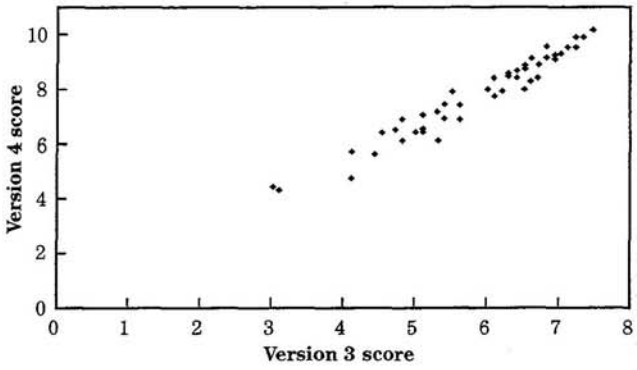
Several elements were also rewritten to reduce ambiguity at the low end of the rating scale. Additionally, several elements were rewritten to have five narrative descriptions instead of four to address a concern that users might err on the high side. The scoring scale was changed from a scale of 1 to 7 to a scale of 1 to 10 because it was felt that most people have a tendency to think in terms of a decimal scale.

The revisions were incorporated into a fourth draft and evaluated by the workgroup. Sites from the first field trial were rescored using the new draft. Response seemed to have improved as indicated by the greater separation of sites at lower scores in figure A–6.

During pilot testing of the training materials in March 1998, the fourth draft was used by 12 students independently at one site and collectively at another site. The coefficient of variation at the replication site was 8.8 percent. One of the sites had been previously assessed using other methods, and the SVAP rating corresponded well to the previous assessments.

After the evaluation of the fourth draft, minor revisions were made for the fifth draft. The breakpoints for the narrative rating of excellent, good, fair, and poor for the fifth draft were set using the Virginia data set. These breakpoints may be adjusted by the NRCS state office as explained in this document.

Figure A–6 Version 4 scores for VA plotted against version 3 scores (n=56)



Stream Visual Assessment Protocol

Owners name _____ Evaluator's name_____ Date _____

Stream name _____ Waterbody ID number _____

Reach location _____

_____

Ecoregion _____ Drainage area _____ Gradient_____

Applicable reference site _____

Land use within drainage (%): row crop _____ hayland _____ grazing/pasture _____ forest _____ residential _____

confined animal feeding operations _____ Cons. Reserve _____ industrial _____ Other: _____

Weather conditions-today _____ Past 2-5 days _____

Active channel width _____ Dominant substrate: boulder _____ gravel _____ sand _____ silt _____ mud _____

Site Diagram

Assessment Scores

Channel condition		Pools	
Hydrologic alteration		Invertebrate habitat	
Riparian zone			
Bank stability			
Water appearance			
Nutrient enrichment			
Barriers to fish movement			
Instream fish cover			

Score only if applicable

Canopy cover	
Manure presence	
Salinity	
Riffle embeddedness	
Marcroinvertebrates observed (optional)	

Overall score (Total divided by number scored)			
	_____	<6.0	**Poor**
		6.1-7.4	**Fair**
		7.5-8.9	**Good**
		>9.0	**Excellent**

Suspected causes of observed problems_____

_____

_____

_____

Recommendations_____

_____

_____

_____

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_____