

Appendix 10—Score Sheet for Categorizing Watershed Sensitivity and Resilience and Scoring Values

This appendix provides the data form (A.10.1) and information needed to determine the relative sensitivity and resilience category of the focal watersheds. Identifying information recorded on the data form includes the date, observer, watershed name, and the watershed code in the Great Basin watershed database.

The scores recorded on the form are obtained from the general watershed characteristic data form (A.4.1), the geomorphic data form (A.6.1), and the riparian vegetation data form (A.7.1). One score is entered for the watershed characteristics that were determined in the office, and one score is entered for each stream reach (1 = high, 2 = mid, 3 = low, 4 = additional) that was sampled in the field.

The factors controlling watershed sensitivity and resilience are those that have been shown to influence watershed responses to disturbance. These include certain watershed characteristics, stream channel sediment size and availability, and the dominant riparian vegetation type. To obtain the control values for each reach, (1) the values for the watershed characteristics are summed, (2) the values for sediment size and availability for each reach are summed, and (3) the two sums are added together for each reach.

The response values are those that provide evidence of incision and evidence of avulsion. Values for evidence of incision and avulsion are summed to provide subtotals for each reach. Simple indices are then calculated to help evaluate sensitivity to incision and avulsion. Mathematically, the indices are calculated as follows:

Incision Sensitivity Index = $(\Sigma \text{ of controlling factors}/10) * \Sigma \text{ of subtotal evidence of incision}$

Avulsion Sensitivity Index = (Σ of controlling factors/10) * Σ of subtotal evidence of avulsion

As the values for the controlling factors increase, potential runoff and potential to transport available sediment by the generated runoff increase. Thus, larger values indicate a higher potential for incision and avulsion. The subtotal of the evidence for incision and avulsion provides insights into the magnitude and frequency with which these processes occurred in the past. The controlling factors are divided by 10 to limit the effects of the controlling factors on the observations of past incision or avulsion within the watershed.

The incision and avulsion sensitivity indices determined for the individual reaches represent distinct watershed segments within the watershed. These indices can be calculated for the entire watershed or the basin types within the watershed based on the percentages of the distinct watershed segments that each sampled reach represents. The data needed for these calculations are in form A.4.1.

Typical scoring values of watershed characteristics, sediment availability and size, evidence of incision, and, evidence of avulsions and avulsion channels for each watershed sensitivity/resilience category are in table A.10.2. The values provided are those most commonly observed (median) for the watershed sensitivity/resilience category, with the possible range of values in parentheses. To determine the watershed sensitivity/resilience category, the incision and sensitivity indices calculated in form A.10.1 are compared to those in table A.10.2 to determine the watershed sensitivity/resilience category. Information on incision and avulsion sensitivity and the sensitivity/resilience category for the basin types and watershed as a whole is used to inform conservation and restoration strategies within the watershed (table 6).

Form A. 10.1–Score Sheet for Watershed Sensitivity and Resilience		Date: _____				
Observer:		Database Code:				
Watershed Name:		Basin Type(s) (A ₁ , A ₂ , B, C):				
Vegetation Type(s) (circle): Subalpine-montane conifer (SC); <i>Populus tremuloides</i> (PT); Cold willow (CW); <i>Betula occidentalis</i> (BA); Warm willow (WW); Cottonwood (CT); <i>Artemisia</i> (AR); Meadow (MD)						
General Watershed Characteristics – Form A.4.1						
Mean Annual Precip (mm)	1=<350; 2=350-475; 3=475-600; 4=>600					
Watershed Area (km ²)	1 = <10, 2 = <10-25, 3 = 25-50, 4 = >50					
Basin Connectivity (%)	1 = <80, 2 = 80-90, 3 = 90-95, 4 = >95					
Past Debris Flows (# of flows)	0 = 0-10; 1 = 10-20; 2 = 20-40; 3 = >40					
Fan Influence	0 = basin wide, 1 = regional, 2 = localized, 3 = none					
Watershed characteristics sum						
Geomorphic and Riparian Vegetation Characteristics – Forms A.6.1 and A.7.1					Reach Scores	
Reach 1 = high, 2 = mid, 3 = low, 4 = additional					1	2
Sediment Size and Availability					3	4
Bank/Valley Sediment Size	1 = gravel/boulders, 2 = mixed coarse/fines, 3 = fines					
Bed Clast Immobility (% of bed)	1 = >75%, 2 = 50-75%, 3 = 10-50%, 4 = <10%					
Dominant Vegetation	1=woody species, 2 = mixed woody/grasses/forbs, 3 = grasses/forbs					
Bar Frequency (#)	0 = none, 1 = few (1-2), 2 = common (3-4), 3 = many (>4)					
Bar Extent (% of bed)	0 = none to 10%, 1 = 10-20%, 2 = 20-30%, 3 = >30%					
Gravel Bars on Valley Floor	0 = none, 1 = few (1-2), 2 = common (3-4), 3 = many (>4)					
Sediment size and availability sum for each reach						
Control subtotal (watershed characteristics + sediment size & availability) for each reach						
Evidence of Incision						
Knickpoints (#)	0 = none, 1 = few (1-2), 2 = common (3-4), 4= many (>4)					
Knickpoint Height (cm)	0 = none, 1 = 0-25 cm, 2 = 25-50 cm, 3 = >50 cm					
Insert Terraces (#)	0 = none, 1 = few (1), 2 = common (2-3), 3 = many (>4)					
Incision Depth (m)	0 = none, 1 = 0-1 m, 2 = 1-2 m, 3 > 2 m					
Bedrock Outcrops (% of bed)	0 = extensive, 1 = localized, 2 = none					
Headcut Height (m)	0 = none, 1 = 0-1, 2 = 1-2, 3 = >2					
Reduced Riparian Extent	0 = none, 1 = 1-10%; 2 = 10-30%, 3 = >30%					
Riparian Plants Only in Trench	0 = none, 1 = little, 2 = common, 3 = widespread					
Incision evidence subtotal for each reach						
Evidence of Avulsion						
Anabranching Channels	0 = none, 1 = few, 2 = common, 3 = many					
Gravel Filled Channels	0 = none, 1 = few, 3 = common, 3 = many					
Gravel Aggradation/Debris Dams	0 = none, 1 = few, 2 = common, 3 = many					
Abrasion-adapted Plants	0 = none, 1 = few, 2 = common, 3 = many					
Avulsion evidence subtotal for each reach						
Reach Incision Sensitivity Index: (subtotal of controls/10) * subtotal of incision evidence						
Reach Avulsion Sensitivity Index: (subtotal of controls/10) * subtotal of avulsion evidence						
Average of All Reaches within Basin type: Incision Sensitivity = _____ Avulsion Sensitivity = _____ (Based on percentage of the watershed or basin type that each stream reach represents)						

Appendix 11—Score Sheet for Rating Ecological Integrity and Description of the Rating Variables

This appendix provides the data form (A.11.1) and information needed to determine the ecological integrity of the focal watershed. Identifying information recorded on the data form includes the date, observer, mountain range, watershed name, and the watershed code in the Great Basin watershed database.

The general watershed characteristics determined in the office (form A.4.1) and the data in the score sheet for assessing watershed sensitivity and resilience (form A.10.1) are used to complete the assessment of general geomorphic characteristics. The reach summaries from the riparian vegetation data collected in the field (form A.7.1) are used to complete the assessment of general vegetation characteristics. The scores for the disturbance assessment are derived from the reach-scale disturbance data collected within the watershed (form A.8.1).

Ecological integrity can be evaluated for the individual sampled reaches and the entire watershed. High scores for a particular category (geomorphic, vegetation, disturbances) indicate reduced ecological resilience and low ecological integrity.

A.11.1–WATERSHED ECOLOGICAL INTEGRITY		Date:							
Observer:		Database Code:							
Mountain Range:		Watershed Name:							
Watershed Type: (A ₁ , A ₂ , B, C)									
Watershed Sensitivity and Resilience Type (from A.10.1 and A.10.2): _____ (Flood dominated, Armored, Fan-dominated, Deeply-incised, Pseudo-stable)									
Ratings: High scores for a category (geomorphic, vegetation, disturbances) indicate reduced ecological resilience and low ecological integrity. These can be evaluated at both the reach and watershed scale.									
Reach 1 = high, 2 = mid, 3 = low, 4 = additional					REACH <table border="1"> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> </table>	1	2	3	4
1	2	3	4						
Parameter	Scores	Score							
General Geomorphic Characteristics – Forms A.4.1 and A.10.1									
Debris Flow Activity	0 = none, 2= slight, 3 = moderate, 4 = large								
Active or Recent Channel Incision	0 = none, 2= local, 3 = moderate, 4 = widespread								
Recent Avulsions Preventing Stabilization	0 = none, 2= local, 3 = moderate, 4 = widespread								
Sum of Geomorphic Characteristics =									
General Vegetation Characteristics – Form A.7.1									
Decrease in Riparian Area Extent	0 = none, 2 = low, 3 = moderate, 4 = high								
Vegetation Vigor	1 = high, 2 = moderate, 3 = low								
Vegetation Mortality	1 = high, 2 = moderate, 3 = low								
Wetland Indicator Status	1 = high, 2 = moderate, 3 = low								
Successional Class	1 = high, 2 = moderate, 3 = low								
Bank Stability Class	1 = high, 2 = moderate, 3 = low								
Nonnative Invasive Species	1 = none to few, 2 = common, 3= widespread								
Sum of Vegetation Characteristics =									
Response to Anthropogenic and Other Disturbances – Form A.8.1									
Roads and Road Crossings	0 = none, 2= low, 3 = moderate, 4 = high								
Recreational Activities	0 = none, 2= low, 3 = moderate, 4 = high								
Development (housing)	0 = none, 2= low, 3 = moderate, 4 = high								
Development (mining)	0 = none, 2= low, 3 = moderate, 4 = high								
Surface Water Manipulation	0 = none, 2= low, 3 = moderate, 4 = high								
Groundwater Extraction	0 = none, 2= low, 3 = moderate, 4 = high								
Water Diversion (dams/canals)	0 = none, 2= low, 3 = moderate, 4 = high								
Beaver Dams (incision, etc.)	0 = none, 2= low, 3 = moderate, 4 = high								
Fire Effects	0 = none, 2= low, 3 = moderate, 4 = high								
Livestock Grazing	0 = none, 2= low, 3 = moderate, 4 = high								
Wildhorse Effects	0 = none, 2= low, 3 = moderate, 4 = high								
Other:	0 = none, 2= low, 3 = moderate, 4 = high								
Other:	0 = none, 2= low, 3 = moderate, 4 = high								
Sum of Disturbance Response =									

Table A.11.2- Descriptions of the data needed to complete the data form for the watershed ecological integrity assessment (A.11.1).

General Geomorphic Characteristics

- **Debris Flow Activity:** The watershed score for past debris flow activity (# of flows) in form A.4.1 is used to assign the scores for debris flow activity. The watershed score is entered for each reach as: 0 = none (0-10), 2 = slight (10-20), 3 = moderate (20-40), 4 = large (>40).
- **Active or Recent Channel Incision:** The subtotals for incision evidence for the sampled reaches and incision sensitivity index in form A.10.1 are used to assign the scores for active or recent channel incision. The scores are: 0 (none) = no evidence of recent channel incision affecting channel processes and riparian ecosystems, 2 (local) = channel incision is localized and is affecting only a few areas within the watershed, 3 (moderate) = channel incision is fairly widespread within the watershed, 4 (widespread) = channel incision is progressive and affects the ecological integrity of most of the watershed.
- **Recent Avulsions Preventing Stabilization:** The subtotals for the avulsion evidence for the sampled reaches and avulsion sensitivity index in form A.10.1 are used to assign the scores for active or recent channel incision. The scores are: 0 (none) = no evidence of recent channel avulsion affecting channel processes and riparian ecosystems, 2 (local) = avulsion is localized and is affecting the ecological integrity of only a few areas within the watershed, 3 (moderate) = avulsion is fairly widespread within the watershed and is affecting ecological integrity, 4 (widespread) = channel avulsion occurs throughout the watershed and is significantly affecting ecological integrity.

General Vegetation Characteristics

- **Riparian Area Extent, Vegetation Vigor and Mortality, Wetland Indicator Status, Successional Status, and Bank Stability Status:** These data are collected during the riparian vegetation assessment and are described in table A.7.2. Data on riparian area extent

are from the first section of form A.7.1; data on wetland indicator status, successional status, bank stability status, vegetation vigor and vegetation mortality are from the reach summaries in form A.7.1.

- **Nonnative Invasive Species:** Nonnative invasive species are typically an indicator of anthropogenic disturbance at some point in time. The information entered into this form are derived from the reach summaries for the riparian vegetation data in form A.7.1. Assignment of scores is as follows: 1 = none to few nonnative invasive species occur and cover of these species is very low; 2 = several nonnative invasive species occur and cover of these species is low to moderate; 3 = a large number of nonnative invasive species are present and cover of these species is moderate to high.

Response to Anthropogenic and Other Disturbances

The primary natural and anthropogenic disturbances affecting stream systems and riparian and meadow vegetation are described in the text. The scores are based on the watershed-scale (A.4.1) and reach-scale disturbance data collected within the watershed (A.8.1). Assignment of scores for all disturbances is as follows: 0 = no negative effect; 2 = low if the disturbance is having a minor negative effect on the stream channel, stream banks, or vegetation; 3 = moderate if it is having a clear negative effect on geomorphic processes or riparian vegetation; and 4 = high if the disturbance has significantly altered geomorphic processes or the riparian vegetation in a negative way.

Form A.9.2–MEADOW VEGETATION DATA				Date:		Observer:		
Watershed Name:				Database Code:				
UTM Zone:				Elevation (m):				
UTMs: Northing				Easting				
Location in Basin: Low / Mid / High								
Record the relative aerial cover of the meadow complex by meadow type (%): Standing Water (SW) _____ Wet Meadow _____ Mesic Meadow _____ Dry Meadow _____ Shrub Meadow _____ The meadow types are described in table A.3.1, and their characteristic species are in table A.9.6.								
Record the following data for each meadow type that occurs in the meadow complex: Dominant indicator species and aerial cover (%): record as trace < 1 (trace); 1-5; 5-25; 25-50; 50-75; 75-100. Vigor and mortality of each species: record as high (H), moderate (M), or low (L) as described in table A.9.5. Record the Wetland Indicator Status (WIS), successional status (Succ), and bank stability (Stab) of each species: record values for each species from the meadow species list (A.9.6). Descriptions are in table A.9.5. Nativity of the species: record as yes (Y) or no (N) as indicated in the meadow species list (A.9.6).								
Record the following data for the meadow type summaries: Cover: estimate and record average vegetation cover for the entire meadow type. Vigor and Mortality: record value most indicative of response to disturbance for the meadow type as described in table A.9.5. WIS, Succ, and Stab: record most common values for the meadow type. Native: record total number of nonnative species for the meadow type.								
Meadow Type	Dominant Indicator Species	Cover (%)	Vigor H/M/L	Mort H/M/L	WIS O/F/FW /FU/U	Succ E/M/L	Stab H/M/L	Native Y/N
SW								
SW								
SW								
SW								
SW								
SW								
Standing Water Meadow Summary								
Wet								
Wet								
Wet								
Wet								
Wet								
Wet								
Wet Meadow Summary								

Form A.9.2–MEADOW VEGETATION DATA					Date:	Observer:			
Watershed Name:					Database Code:				
UTM Zone:					Elevation (m):				
UTMs: Northing					Easting				
Location in Basin: Low / Mid / High									
Meadow Type	Dominant Indicator Species	Cover (%)	Vigor H/M/L	Mort H/M/L	WIS O/F/FW /FU/U	Succ E/M/L	Stab H/M/L	Native Y/N	
Mesic									
Mesic									
Mesic									
Mesic									
Mesic									
Mesic									
Mesic Meadow Summary									
Dry									
Dry									
Dry									
Dry									
Dry									
Dry									
Dry Meadow Summary									
Shrub									
Shrub									
Shrub									
Shrub									
Shrub									
Shrub									
Shrub Meadow Summary									
Record the following data for the meadow summary: Cover: estimate and record the average graminoid and forb vegetation cover for the entire meadow. Vigor and mortality: record the value that is most indicative of the meadow response to disturbance as described in table A.9.5. WIS, Succ, and Stab: record value most indicative of reach disturbance response as described in table A.9.5. Native: record total number of nonnative species for the entire meadow.									
Meadow Summary Values									
Indicator Species:									
Notes:									