U. S. LOTIC WETLAND INVENTORY FORM
USER MANUAL
(Current as of 5/16/2023)

This user manual is intended to accompany the *U. S. Lotic Wetland Inventory Form* for the inventory of riparian wetlands associated with systems having flowing water and (usually) a defined channel. Use this form for a detailed inventory on any size stream. This document serves as the field reference to assist data collectors in answering each item on the form. It can also serve as an aid to the database user in the interpretation of data presented in the *U. S. Lotic Wetland Inventory Form* format. Another form entitled the *U. S. Lentic Wetland Inventory Form,* with a different set of user guidelines, is to be used for lentic (still water) wetlands.

ACKNOWLEDGEMENTS

Development of these assessment tools has been a collaborative and reiterative process. Many people from many agencies and organizations have contributed greatly their time, effort, funding, and moral support for the creation of these documents, as well as to the general idea of devising a way for people to look critically at wetlands and riparian areas in a systematic and consistent way. Some individuals and the agencies/organizations they represent who have been instrumental in enabling this work are Dan Hinckley, Tim Bozorth, and Jim Roscoe of the USDI Bureau of Land Management in Montana; Karen Rice and Karl Gebhardt of the USDI Bureau of Land Management in Idaho; Bill Haglan of the USDI Fish and Wildlife Service in Montana; Barry Adams and Gerry Ehlert of Alberta Sustainable Resource Development; Lorne Fitch of Alberta Environmental Protection; Greg Hale and Norine Ambrose of the Alberta Cows and Fish Program, and Mike Frisina of the Montana Department of Fish, Wildlife and Parks.

BACKGROUND INFORMATION

Flowing Water (Lotic) Wetlands vs. Still Water (Lentic) Wetlands

Cowardin and others (1979) point out that no single, correct definition for wetlands exists, primarily due to the nearly unlimited variation in hydrology, soil, and vegetative types. Wetlands are lands transitional between aquatic (water) and terrestrial (upland) ecosystems. Windell and others (1986) state, “wetlands are part of a continuous landscape that grades from wet to dry. In many cases, it is not easy to determine precisely where they begin and where they end.”

In the semi-arid and arid portions of western North America, a useful distinction has been made between wetland types based on association with different aquatic ecosystems. Several authors have used ***lotic*** and ***lentic*** to separate wetlands associated with running water from those associated with still water. The following definitions represent a synthesis and refinement of terminology from Shaw and Fredine (1956), Stewart and Kantrud (1972), Boldt and others (1978), Cowardin and others (1979), American Fisheries Society (1980), Johnson and Carothers (1980), Cooperrider and others (1986), Windell and others (1986), Environmental Laboratory (1987), Kovalchik (1987), Federal Interagency Committee for Wetland Delineation (1989), Mitsch and Gosselink (1993), and Kent (1994).

Lotic wetlands are associated with rivers, streams, and drainage ways. They contain a defined channel and floodplain. The channel is an open conduit, which periodically or continuously carries flowing water. Beaver ponds, seeps, springs, and wet meadows on the floodplain of, or associated with, a river or stream are part of the lotic wetland.

Lentic wetlands are associated with still water systems. These wetlands occur in basins and lack a defined channel and floodplain. Included are permanent (i.e., perennial) or intermittent bodies of water such as lakes, reservoirs, potholes, marshes, ponds, and stockponds. Other examples include fens, bogs, wet meadows, and seeps not associated with a defined channel.

Functional vs. Jurisdictional Wetland Criteria

Defining wetlands has become more difficult as greater economic stakes have increased the potential for conflict between politics and science. A universally accepted wetland definition satisfactory to all users has not yet been developed because the definition depends on the objectives and the field of interest. However, scientists generally agree that wetlands are characterized by one or more of the following features: 1) ***wetland hydrology,*** the driving force creating all wetlands, 2) ***hydric soils,*** an indicator of the absence of oxygen, and 3) ***hydrophytic vegetation,*** an indicator of wetland site conditions. The problem is how to define and obtain consensus on thresholds for these three criteria and various combinations of them.

Wetlands are not easily identified and delineated for jurisdictional purposes. Functional definitions have generally been difficult to apply to the regulation of wetland dredging or filling. Although the intent of regulation is to protect wetland functions, the current delineation of jurisdictional wetland still relies upon structural features or attributes.

The prevailing view among many wetland scientists is that ***functional wetlands need*** to meet only one of the three criteria as outlined by Cowardin and others (1979) (e.g., hydric soils, hydrophytic plants, and wetland hydrology). On the other hand, ***jurisdictional wetlands need to*** meet all three criteria, except in limited situations. Even though functional wetlands may not meet jurisdictional wetland requirements, they certainly perform wetland functions resulting from the greater amount of water that accumulates on or near the soil surface relative to the adjacent uplands. Examples include some woody draws occupied by the *Fraxinus pennsylvanica*/*Prunus virginiana* (green ash/chokecherry) habitat type and some floodplain sites occupied by the *Artemisia cana*/*Agropyron smithii* (silver sagebrush/western wheatgrass) habitat type or the *Pinus ponderosa*/*Cornus stolonifera* (ponderosa pine/red-osier dogwood) habitat type. Currently, many of these sites fail to meet jurisdictional wetland criteria. Nevertheless, these sites do provide important wetland functions and may warrant special managerial consideration. The current interpretation, at least in the western United States, is that not all functional wetlands are jurisdictional wetlands, but all jurisdictional wetlands are functional wetlands.

Polygon Delineation

The lotic wetland inventory process incorporates data on a wide range of biological and physical categories. The basic unit of delineation within which this data is collected is called a ***polygon.*** A polygon is the area upon which one set of data is collected. One inventory form is completed (i.e., one set of data is collected) for each polygon. One or more (usually several) polygons constitute a project. A lotic (riparian) polygon is an area adjacent to a waterway (stream or river). Polygons are delineated on topographic maps by marking the upper and lower ends before observers go to the field. (The widths of most riparian wetland zones are unknown before the inventory and cannot be pre-marked.) On topographic maps, most polygons are usually drawn as a single line following the stream or river and are numbered sequentially proceeding downstream. It is important to clearly mark and number the polygons on the topo map. Polygons are numbered pre-field (in the office) with consecutive integers (1, 2, 3 . . .). In cases where field inspection shows a need to change the delineation or to subdivide pre-drawn polygons, additional polygons should be numbered using alpha-numerics (e.g., 1a, 1b, 2a, 2b, etc.). When delineated polygons are subsequently combined in the field, the combinations are to be identified by the hyphenated tags of both combined parts (e.g., 1-2, 2-3, etc.).

If aerial photos are available, advance (pre-field) polygon delineations may be based on vegetation differences, geologic features, or other observable characteristics. On larger systems with wide riparian areas, aerial photos may allow the pre-field delineation of multiple polygons away from the channel. In these cases, where polygons can be drawn as enclosed units (instead of just as a line), a minimum mapping unit of 5 or 10 ac (2 to 4 ha) should be used. The size of the minimum mapping unit should be based on factors such as management capabilities and the costs and capabilities of data collection.

In the field, observers are to verify (ground truth) the office-delineated polygon boundaries. If the pre-assigned numbers are used, be sure the inventoried polygons correspond exactly as drawn. Observers are allowed to move polygon boundaries, create new polygons, or consolidate polygons if the vegetation, geography, location of fences, or width of the wetland zone justify it. If polygon boundaries are changed, the changes must be clearly marked on the field copies of the topographic maps. The original polygon numbers should be retained on the map for cross-reference. ***Polygons should not cross fences between areas with different management.***

Upper and lower polygon boundaries are placed at distinct locations such as fences, stream confluences, or stream meanders that can be recognized in the field. Polygons should not cross fences between areas with different management. In most cases, polygons are delineated 0.25-0.75 mi long. On smaller streams, polygons include the land on both sides of the stream. On large rivers, or if property ownership or access differs, polygons may include only one side of a stream.

The outer boundaries of riparian polygons are at the wetland vegetative outer edges. These boundaries are sometimes clearly defined by abrupt differences in the geography and/or vegetation, but proper determination often depends on experienced interpretation of more subtle differences. The area to be assessed includes any terraces dominated by facultative wetland and wetter plant species (Lichvar 2012), the active floodplain, and streambanks (Figure 1). Reference to the NWI list of plants found in wetlands should not be necessary to determine the area for evaluation. The evaluator should simply focus on that area which is obviously more lush, dense, or greener by being closer to the stream.

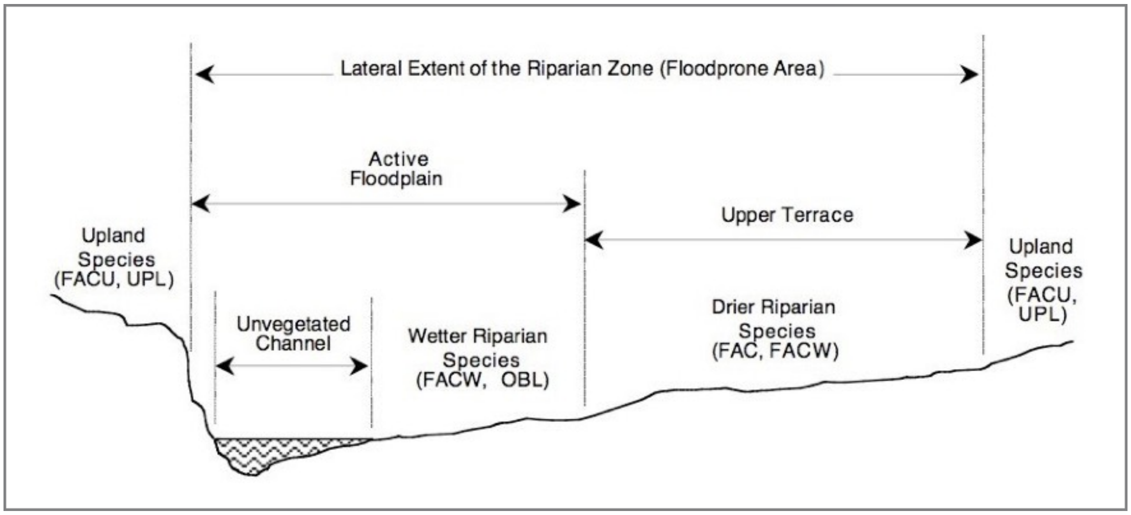

Figure 1. A schematic example of a typical riparian zone cross section showing near-channel landform features. ***NOTE:*** FAC (facultative), OBL (obligate), UPL (upland), etc. refer to categories of frequency a species is found in wetlands (Lichvar 2012).

The location of the inner (or streamside) polygon boundary must be known (at least approximately), even on polygons that span the stream. On most streams the area of the channel bottom is excluded from the polygon. (***NOTE:*** *The whole channel width extends from right bankfull stage to left bankfull stage; however we need to include the lower banks in all polygons, therefore consider for exclusion ONLY the relatively flat and lowest area of the channel—the bottom. Low depositional bars [gravel, sand, or silt] that are logically a part of the channel by being between the banks, and are less than 50 percent covered with vegetation, are part of the channel, and NOT part of the polygon.*) This allows data to be collected on the riparian area while excluding the aquatic zone, or open water, of the stream. The aquatic zone is the area frequently covered by water and lacking persistent emergent vegetation. This includes side, or overflow, channels that may seasonally have open water that lacks persistent emergent vegetation, and is therefore NOT part of the polygon. Persistent emergent vegetation consists of perennial wetland species that normally remain standing at least until the beginning of next growing season, e.g., *Typha* species (cattails), *Scirpus* species (bulrushes), *Carex* species (sedges), and other perennial graminoids.

In many systems, large portions of the channel bottom may become exposed due to seasonal irrigation use, hydroelectric generation, and natural seasonal changes such as are found in many prairie ecosystems. In these cases, especially the prairie streams, the channel bottom may have varying amounts of herbaceous vegetation, and the channel area is ***included*** in the polygon as area to be inventoried. Typically, these are the pooled channel stream type that has scour pools scattered along the length, interspersed with reaches of grass, bulrush, or sedge-covered channel bottom. If over half (>50%) the channel bottom area has a canopy cover of persistent vegetation cover (perennial species), taken over the entire length of the polygon as a whole, then it qualifies for inclusion within the inventoried polygon area. If you are in doubt whether to include the channel bottom in the polygon, then leave it out, but be sure to indicate this in the comment section. This is important so that future assessments of the polygon will be looking at the same area of land.

INVENTORY FORM CODES AND INSTRUCTIONS

Class Codes

Field observers will use class codes to represent ranges of percent wherever percent data is recorded. The class codes are defined below. These codes and range classes are from the USDA Forest Service Northern Regions ECODATA (1989) program.

T = 0.1<1%	**2** = 15<25%	**5** = 45<55%	**8** = 75<85%
P = 1<5%	**3** = 25<35%	**6** = 55<65%	**9** = 85<95%
1 = 5<15%	**4** = 35<45%	**7** = 65<75%	**F** = 95-100%

The class codes are converted to class midpoints in the office. The class midpoints are: **T** = 0.5%; **P** = 3.0%; **1** = 10.0%; **2** = 20.0%; **3** = 30.0%; **4** = 40.0%; **5** = 50.0%; **6** = 60.0%; **7** = 70.0%; **8** = 80.0%; **9** = 90.0%; **F** = 97.5%. These class midpoints are used in data reporting and in all calculations throughout the data analysis process.

Polygon Data

The following are the codes and instructions for the individual data items on the form. All data items are to be recorded in the field unless otherwise noted. Numbering corresponds to that of items on the form. Also included are comments about the data, how it is collected, and its meaning. When the inventory methodology follows a published source, that source is cited. However, in many instances, due to the lack of pre-existing guidelines, we have developed our own methodologies.

Fill in all blanks on the field form, except those that are completed in the office. Enter 0 for any item to indicate the absence of value. Do not use — and do not leave items blank, except for the following: 1) items that logically would not be answered because they follow an answer of No in a leading Yes/No question, and 2) lines in a species list below the last species observed. An answer of 0 means the observer looked and saw none, whereas a blank line means the observer did not look, either by negligence or because the point was moot. ***NA*** means the item is not applicable to a particular polygon. ***NC*** means data was not collected for that item in a particular polygon. Observers must write legibly and should limit their use of abbreviations throughout to those, which allow for no confusion.

Record ID No. This is the unique identifier allocated to each polygon. This number will be assigned in the office when the form is entered into the database.

Administrative Data

A1. Agency or organization collecting the data.

A2. Funding Agency/Organization.

A3a. BLM (Bureau of Land Management) State Office.

A3b. BLM Field Office/Field Station.

A3c. BLM Office Code (recorded in the office).

A3d. Is the polygon in an active BLM grazing allotment (recorded in the office)?

A3e, f. For BLM polygons, the BLM Office Code, whether the polygon is in an active BLM grazing allotment, and the Allotment Number is supplied by the BLM. These items are entered into the computer in the office; the computer then references a master list of Allotment ID's to complete the remaining Allotment information. Because some polygons incorporate more than one Allotment, space is provided to enter two sets of Allotment information. The master Allotment list is periodically updated by the BLM National Applied Resource Sciences Center to make needed corrections.

A4. USDI Fish and Wildlife Service Refuge name.

A5. Indian Reservation name.

A6. USDI National Park Service Park/National Historical Site name.

A7. USFS (Forest Service) National Forest name.

A8. Other location.

A9. Year the field work was done.

A10. Date of field work by day, month, and year.

A11. Names of all field data observers.

NOTE: Information for items **A12a-h** is found in the office; field evaluators need not complete these items.

A12. The several parts of these items identify various ways in which a data record may represent a resampling of a polygon that may have been inventoried again at some other time. The data in this record may have been collected on an area that coincides precisely with an area inventoried at another time and recorded as another record in the database. It may also represent the resampling of only a part of an area previously sampled. This would include the case where this polygon overlaps, but does not precisely and entirely coincide with one inventoried at another time. One other case is where more than one polygon inventoried one year coincides with a single polygon inventoried another year. All of these cases are represented in the database, and all have some value for monitoring purposes, in that they give some information on how the status on a site changes over time. ***This is done in the office with access to the database; field evaluators need not complete these items.***

A12a. Has any part of the area within this polygon been inventoried previously, or subsequently, as represented by any other data record in the database? Such other records would logically carry different dates.

A12b. Does the areal extent of this polygon exactly coincide with that of any other inventory represented in the database? In many cases, subsequent inventories only partially overlap spatially. The purpose of this question is to identify those records that can be compared as representing exactly the same ground area.

A12c. Does this record represent the latest data recorded for this site (polygon)?

A12d. If A12b is answered Yes, then enter the record ID number(s) of any other previous or subsequent re-inventories (resampling) of this exact polygon for purposes of cross-reference.

A12e. Enter the years of any records recorded in item A12d as representing other inventories of this exact polygon.

A12f. Even though this polygon is not a re-inventory of the exact same area as any other polygon, does it share at least some common area with one or more polygons inventoried at another time?

A12g. Enter the years of any other inventories of polygons sharing common ground area with this one.

A12h. If A12f is answered Yes, then enter the record ID number(s) of any other polygon(s) sharing common ground area with this one.

A13a. Has a management change been implemented on this polygon?

A13b. If A13a is answered Yes, in what year was the management change implemented?

A13c. If A13a is answered Yes, describe the management change implemented.

Location Data

B1. State in which the field work was done (recorded in the office).

B2. County or municipal district in which the field work was done (recorded in the office).

B3. This field for allotment, range, or management unit is intended for entities other than the BLM to use for grouping polygons by management unit. The BLM management units are grouped using the grazing allotment information in A3 above.

B4a. For lotic polygons the area is usually listed as a stream name, or other local designation that identifies the area where the inventory is conducted. If possible, use a name that is shown on the 7.5 minute topographic map.

B4b. Record the stream with which the inventoried lotic wetland flows into.

B4c, d. Polygons are grouped together for management purposes. For example, all polygons around Henry's Lake in the Idaho Falls Field Office could be identified as Group Name: Idaho Falls Field Office; Group Number: 1 (recorded in the office).

B5. Polygon number is a sequential identifier of the portion of the area assessed. This is referenced to the map delineations. Sequences normally progress from upstream to downstream.

B6a. Upper end elevation (feet or meters).

B6b. Lower end elevation (feet or meters).

B7. Stream gradient (percent).

B8a. Record the latitude and longitude of the polygon, along with the GPS projection and accuracy. Record the degrees, minutes, and seconds, along with decimal degrees. ***NOTE: All of North America is latitude = North, and longitude = West.***

B8b. Record any comments pertaining to the "other" location.

B9. Identify and record the hydrologic unit code(s) (HUC) associated with the reach of stream contained in the polygon. The HUC data is obtained from the US Geological Survey (USGS) National Hydrography Dataset (NHD) (USGS 2012). Based on the finest level of resolution available from the USGS for the stream reach, the levels of HUC information are entered by the computer onto the form. The USGS has divided the nation into successively smaller hydrologic units, based on drainage basins and watersheds. These units fit into hierarchical levels, uniquely identified by a pair of digits for each successive level (i.e., an eight-digit number identifies a drainage at the fourth (subbasin) level; and a twelve digit HUC identifies one at the sixth (subwatershed) level (Figure 2).

As defined by the USGS (2012), a ***hydrologic unit*** is "a drainage area delineated to nest in a multi-level, hierarchical drainage system. Its boundaries are defined by hydrographic and topographic criteria that delineate an area of land upstream from a specific point on a river, stream or similar surface waters. A hydrologic unit can accept surface water directly from upstream drainage areas, and indirectly from associated surface areas such as remnant, non-contributing, and diversions to form a drainage area with single or multiple outlet points. Hydrologic units are only synonymous with classic watersheds when their boundaries include all the source area contributing surface water to a single defined outlet point."

Provision is made on the data form for multiple HUC units, because a polygon may include all, or part, of more than one HUC unit (especially when finer levels, such as the subwatershed [sixth] level, are identified).

The HUC data provided includes these items:

- HUC identification number to as many digits as have been delineated by USGS, down to the sixth level (12 digits);
- River miles of the stream from this HUC unit that fall within this polygon;
- Percent of the polygon stream reach that is located in this HUC unit (e.g., 100 percent if the entire polygon is all in one HUC unit;
- Name of the region (first level of the HUC) (and its size in square miles);
- Name of the subregion (second level of the HUC) (and its size in square miles);
- Name of the basin (third level of the HUC) (and its size in square miles);
- Name of the subbasin (fourth level of the HUC) (and its size in square miles);
- Name of the watershed (fifth level of the HUC) (and its size in square miles); and
- Name of the subwatershed (sixth level of the HUC) (and its size in acres).

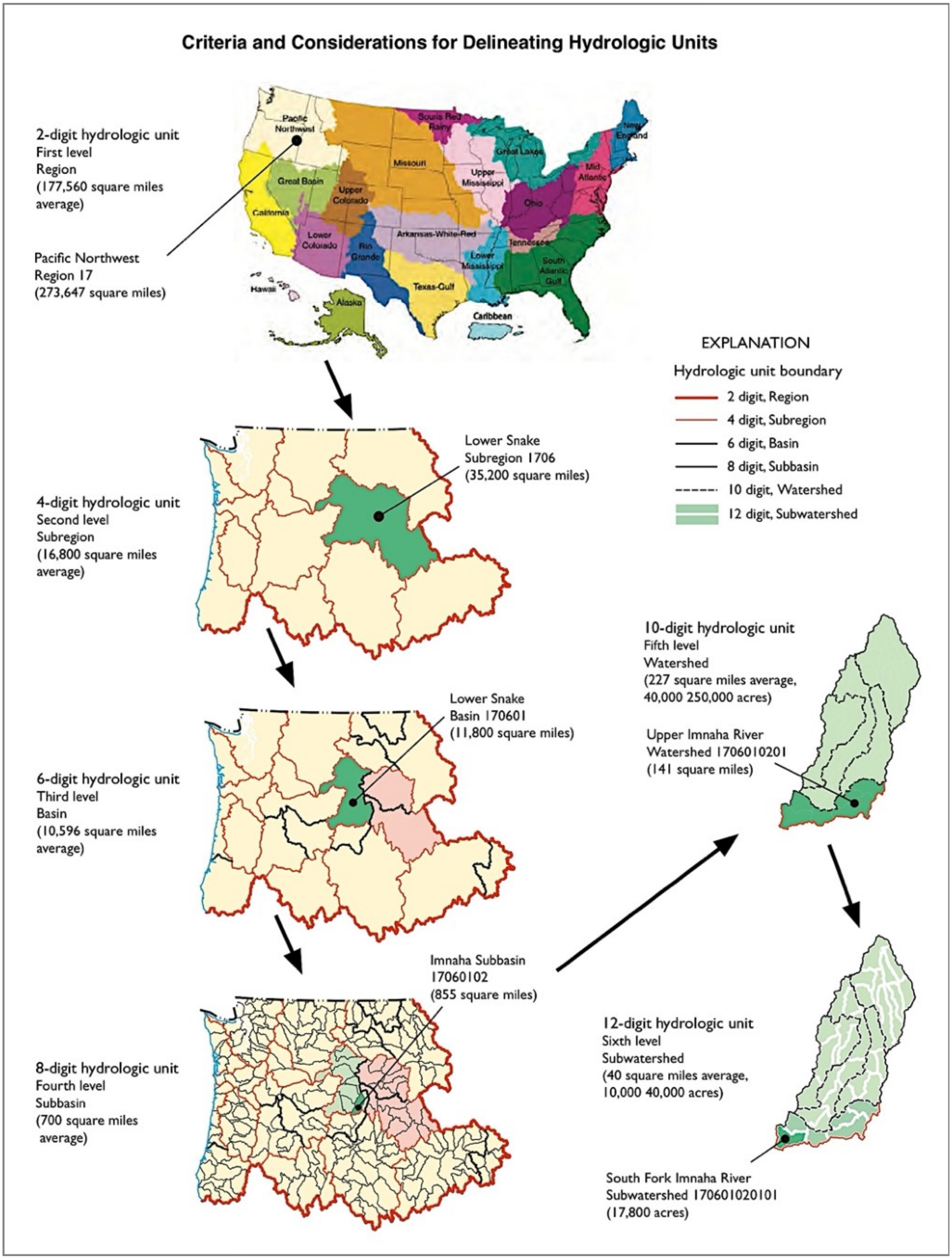

Figure 2. Hierarchy for the six nested levels of hydrologic units, as they are successively subdivided, and the numbering scheme increases by two digits for each level of greater resolution (adapted from the USGS 2012)

Selected Summary Data

C1. Wetland type is a categorical description of the predominant polygon character. Select from the following list of categories that may occur within a lotic system the one that best characterizes the majority of the polygon. Observers will ***select only one category*** as representative of the entire polygon. If significant amounts of other categories are present, indicate this in Vegetation Comments (item D17) or consider dividing the original polygon into two or more polygons.

Category Description

Perennial Stream. A stream or stretch of stream that flows continuously for most of most years. Perennial streams are generally fed in part by springs or discharge from groundwater. Perennial streams are distinguished from larger rivers by size. Streams wider than 15 m (50 ft) are considered rivers for the purpose of this inventory (see below).

Intermittent Stream. A stream or stretch of stream which flows only at certain periods of the year when it receives water from springs, discharge from groundwater, or melting snow in mountainous areas. These streams generally flow continuously at least one month most years.

Ephemeral Stream. A stream or stretch of stream that flows in normal water years only in direct response to precipitation. In normal years, it receives no water from springs and no extended supply from melting snow or other surface source. Ephemeral streams are not in contact with groundwater and normally do not flow continuously for as long as one month. Not all ephemeral streams support riparian plant communities.

Subterranean Stream. A stream that flows underground for part of the stream reach. This occurs on systems composed of coarse textured, porous substrates. Surface flow may disappear and re-emerge farther downstream.

Pooled Channel Stream. An intermittent stream that has significant channel pools after surface flow ceases. Pools are generally at meander curves and are usually considerably deeper than the rest of the channel bottom. Water sources for the pools may be springs or contact with subsurface groundwater. This stream type is typical of fine textured sedimentary plains in semi-arid regions where headwater drainages lack the extended runoff of deep mountain snowpack. This stream type may not be apparent early in the season when flow is continuous.

River. Rivers are generally larger than streams. They flow year around, in years of normal precipitation and when significant amounts of water are not being diverted out of them. Those watercourses having bankfull channel widths greater than 15 m (>50 ft) will be classified as rivers for the purpose of this inventory.

Beaver Dams. A system that is predominantly characterized by beaver dams that change the character of the system from a regular flowing channel to a stepped system of ponds where water is spread wide and flow velocity is apparent only at each dam outlet before it enters the next pond. Water is still flowing through the riparian system.

Wet Meadow. This type of wetland may occur in either running water (lotic) or in still water (lentic) systems. A lotic wet meadow has a defined channel or flowing surface water nearby, but is typically much wider than the riparian zone associated with the classes described above. This is often the result of the influence of lateral groundwater not associated with the stream flow. Lotic and lentic wet meadows may occur in proximity (e.g., when enough groundwater emerges to begin to flow from a mountain meadow, the system goes from lentic to lotic). Such communities are typically dominated by herbaceous hydrophytic vegetation that requires saturated soils near the surface, but tolerates no standing water for most of the year. This type of wetland typically occurs as the filled-in basin of old beaver ponds, lakes, and potholes.

Spring/Seep. Groundwater discharge areas. In general, springs have more flow than seeps. This wetland type may occur in a running water (lotic) or still water (lentic) system.

Irrigation Canal. Includes all types of canals and ditches associated with irrigation systems.

Other. Describe the water source (e.g., irrigation return flow, industrial discharge, etc.).

Upland. This designation is for those areas which are included in the inventoried polygon, but which do not support functional wetland vegetation communities. Such areas may be undisturbed inclusions of naturally occurring high ground or such disturbed high ground as roadways and other elevated sites of human activity.

C2. The size (acres/hectares) of polygons large enough to be drawn as enclosed units on 1:20,000 or 1:50,000 scale maps is determined in the office using a planimeter, dot grid, or GIS. For polygons too small to be accurately drawn as enclosed units on the maps, and which are represented by line segments on the map along the drainage bottom, polygon size is calculated using polygon length and average polygon width (items C5 and C7a).

C3a-d. Evaluators may be asked to survey some areas that have not been determined to be wetlands for the purpose of making such a determination. Other polygons include areas supporting non-wetland vegetation types. A “Yes” answer indicates that no part of the polygon keys to a riparian habitat type or community type (HT/CT). Areas classified in item D15 as any vegetation type described in a riparian and/or wetland classification document for the region in which you are working are counted as functional wetlands. Areas listed as UNCLASSIFIED WETLAND TYPE are also counted as functional wetlands. Other areas are counted as non-wetlands, or uplands. The functional wetland fraction of the polygon area is listed in item C3c in acres and as a percentage of the entire polygon area in item C3d.

C4. Some riparian areas do not contain an unvegetated, defined stream channel. In some cases, these polygons are in ephemeral systems which may flow infrequently, but which do support riparian plant communities. In other cases, these polygons may be associated with larger river systems that have wide floodplains where polygons may be delineated in areas not adjacent to the channel.

C5. Channel length—the length of channel contained within or adjacent to the polygon—is measured by scaling from the map. This data is considered accurate to the nearest 0.16 km (0.1 mi).

C6. In some cases, the polygon record is used to characterize, or represent, a larger portion of a stream system. The length represented by the polygon is given. For example, a 0.8 km (0.5 mi) polygon may be used to represent 6.4 km (4 mi) of a stream. In the case, 0.8 km (0.5 mi) is the channel length of the polygon (item C5), and 6.4 km (4 mi) is entered in item C6.

C7a. Record average width of the polygon, which on smaller streams corresponds to the width of the riparian zone. To determine this width, subtract the width of the non-vegetated stream channel (item F9) from the distance between the two opposite riparian/upland boundaries. In the case of very wide systems where the polygon inventoried does not extend across the full width of the riparian zone (e.g., area with riparian vegetation communities lies outside the polygon), record the average width of the polygon inventoried and make note of the situation in the narrative comments.

C7b. Record the range of width (ft/m), narrowest to widest, of the riparian zone in the polygon.

C8a, b. If the Pfankuch rating was used, record the Pfankuch score for the polygon.

Ecological Health Assessment Summary
C9. Polygon Health (PFC) Score is an ecological function rating for the polygon derived by computer using data from several items in this polygon inventory. For detailed discussion of this process, see the companion document *Lotic Wetland Ecological Health Assessment* (derived from the *Lotic Wetland Inventory Form*). The techniques used to obtain the data do not allow ratings to be interpreted with a fine degree of precision. For example, two polygons rating 76% and 78% should not be interpreted as functionally different from each other, but they both are more likely to differ functionally from a third polygon that rates 61%. Therefore, use of the descriptive categories may be more useful than referring to the specific numerical values.

The health ratings are presented both as an overall polygon score and in two subsections (vegetation and physical site) to give a broad indication of what part of the system may be in need of more management attention.

Vegetation Data
D1a. The United States of America and its territories are geographically divided into 10 distinct wetland delineation regions by the U.S. Army Corps of Engineers (Lichvar 2012) as shown in Figure 3. The National Wetland Plant List has assigned a wetland indicator status for each plant species on the list according to those wetland regions they occur in. Selecting the proper wetland delineation region is essential because this is used to calculate the wetland prevalence index.

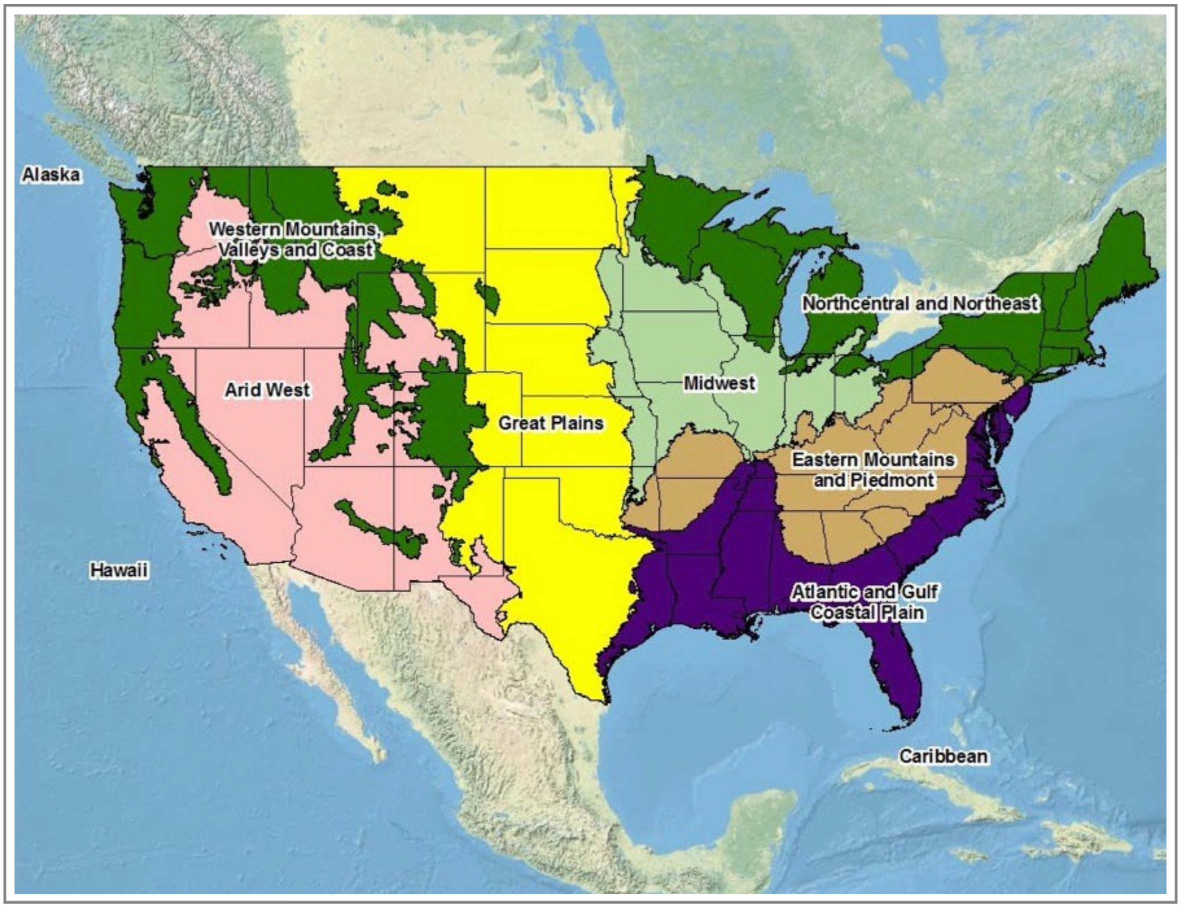

Figure 3. U.S. Army Corps of Engineers wetland delineation regions of the United States of America (Lichvar 2012)

Three U.S. Army Corps of Engineers wetland delineation regions cover the contiguous western United States of America: the Great Plains Region (Figure 4), the Western Mountains, Valleys, and Coast Region (Figure 5), and the Arid West Region (Figure 6). Subregions identified on the maps correspond to USDA Land Resource Regions, however the observer need only identify the primary wetland delineation region the polygon is in. It should be noted that isolated mountainous areas such as the Black Hills, Arizona Mountains, and New Mexico Mountains are included within the Western Mountains, Valleys, and Coast Region.

Figure 4. The Great Plains Region and Subregions.

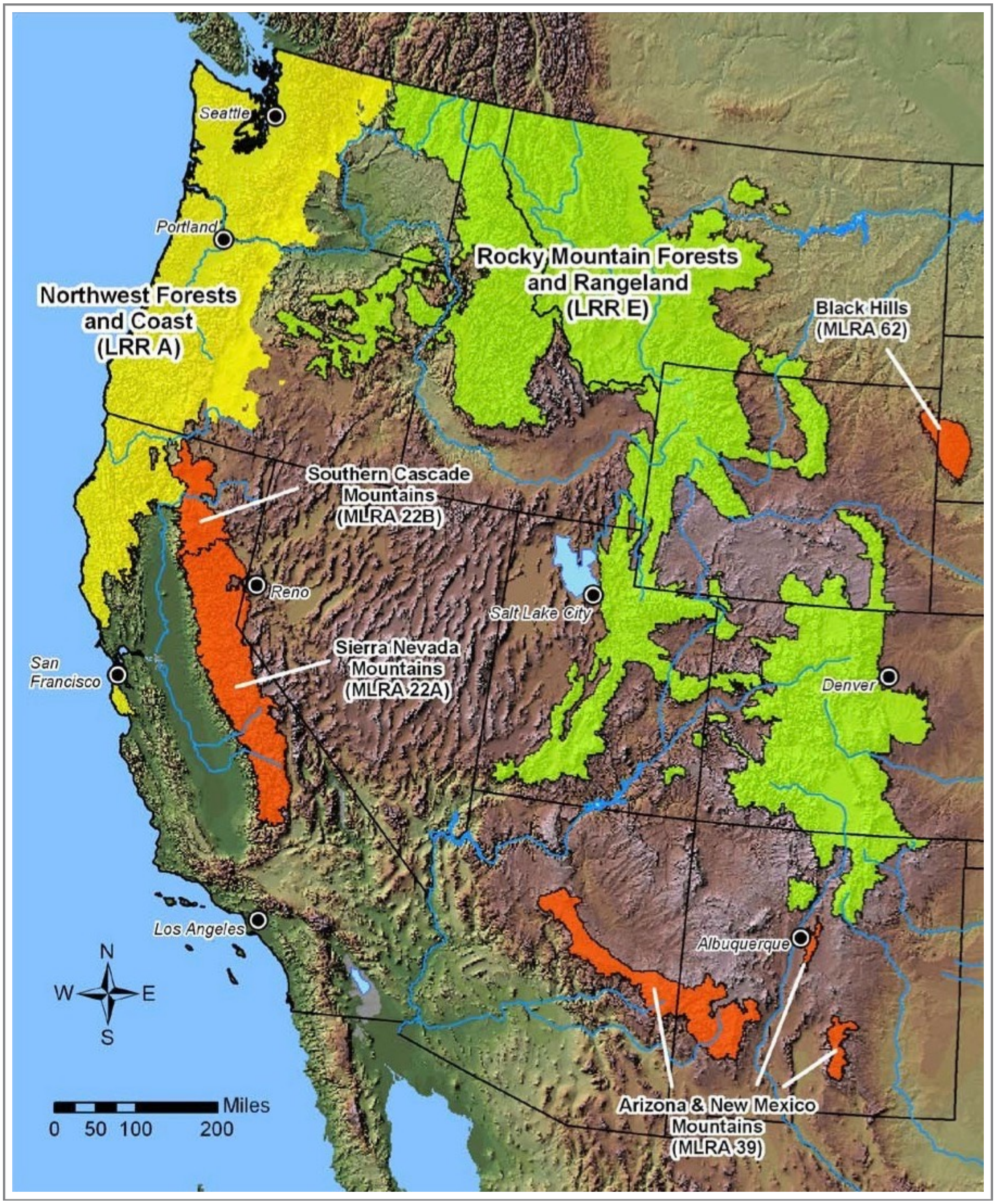

Figure 5. The Western Mountains, Valleys, and Coast Region and Subregions.

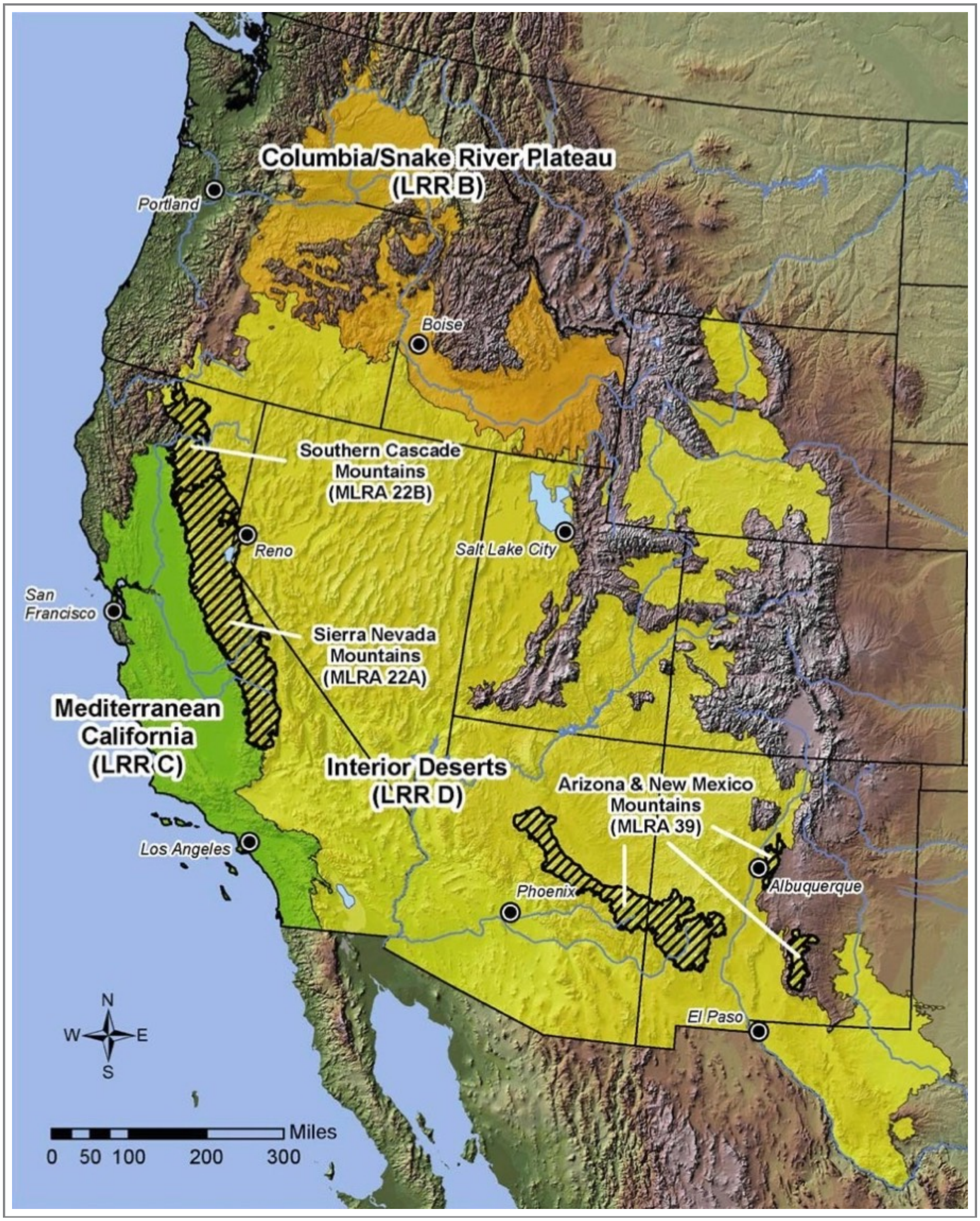

Figure 6. The Arid West Region and Subregions.

D1b. The wetland prevalence index is compiled by the computer from the U.S. National Wetland Inventory (NWI) wetland status classes for plant species recorded on the site (Lichvar 2012) and weighted by species abundance measured in terms of canopy cover. The range of index values is from 1.0 to 5.0. Lower values indicate wetter sites.

D1c. The vegetation structural diversity category is automatically calculated in the office by computer using plant group and height layer data (item D9). Trees and shrubs are considered major components of structural diversity. These terms are used to describe vegetation height: tall = >1.8 m (6.0 ft) (layer 3); medium = >0.5-1.8 m (1.5-6.0 ft) (layer 2); short = <0.5 m (<1.5 ft) (layer 1). Graminoids and forbs are combined as the herbaceous lifeform. Trees and shrubs in layer 2 are also combined as medium trees/ shrubs. A polygon is assigned the highest structural diversity category it can meet. To meet a category, each lifeform (by height) named in the description must have a canopy cover of at least 15% in the polygon. Combination groups (i.e., medium trees/shrubs; and short, medium, and tall herbaceous) must have at least 5% cover of both components or at least 15% cover of one component. ***NOTE:*** Structural diversity on a site can change as succession proceeds or if management changes.

Category Description
Tall trees; tall shrubs; medium trees/shrubs; herbaceous understory present[1]
Tall trees; tall shrubs; herbaceous understory present[1]
Tall trees; medium trees/shrubs; herbaceous understory present[1]
Tall trees; herbaceous understory present[1]
Tall shrubs; medium trees/shrubs; herbaceous understory present[1]
Tall shrubs; herbaceous understory present[1]
Medium trees/shrubs; herbaceous understory present[1]
Tall herbaceous
Medium herbaceous
Short herbaceous
Sparsely vegetated[2]

[1]The herbaceous understory present does not need to have a minimum canopy cover.

[2]Sparsely vegetated refers to polygons in which the minimum canopy cover by the various lifeforms is not met.

D2a, b. If present, record the 6-letter species code and the canopy cover in the two left-most columns for ***ALL*** tree species observed. Canopy cover is evaluated using ocular estimation following the Daubenmire (1959) method. Within the total canopy cover of each species, estimate the proportion of each of five groups (seedling, sapling, pole, mature, and dead trees). The canopy covers of the five groups of each species must total approximately 100%. If some individuals in a size class have at least 30% of the upper canopy dead (are decadent), record the decadence as a percentage of that group. Record the total group cover to the left of the slash (/) and the decadent portion to the right.

Example:

Species	Cover	Sdlg/Dec	Splg/Dec	Pole/Dec	Mat/Dec	Dead
POPBAL	3	T / 0	P / 0	1 / P	8 / 1	P

Note 1: The most common usage of the term ***decadent*** may be for over mature trees past their prime and which may be dying, but we use the term in a broader sense. We count decadent plants, both trees and shrubs, as those with 30% or more dead wood in the upper canopy. In this item, scores are based on the percentage of total woody canopy cover which is decadent or dead, not on how much of the total polygon canopy cover consists of dead and decadent woody material. Only decadent and dead standing material is included, not that which is lying on the ground. The observer is to ignore (not count) decadence in poplars or cottonwoods which are decadent ***due to old age*** (rough and furrowed bark extends substantially up into the crowns of the trees) (species: *Populus deltoides* [Great Plains cottonwood], *P. angustifolia* [narrowleaf cottonwood], and *P. balsamifera* [black cottonwood]), because cottonwoods/poplars are early seral species and naturally die off in the absence of disturbance to yield the site to later seral species. The observer is to consider (count) decadence in these species if apparently caused by de-watering, browse stress, climatic influences, or parasitic infestation (insects/disease). The observer should comment on conflicting or confounding indicators, and/or if the cause of decadence is simply unknown (*but not due to old age*). Do not count plants installed by human planting, that are less than one year old, as dead/decadent.

Tree Size Classes

Size Class	Conifers[1] and Cottonwoods/Poplars	Other Broadleaf Species[2]
Seedling	<1.37 m tall ***OR*** <2.5 cm dbh (<4.5 ft tall ***OR*** <1.0 inch dbh)	<0.91 m tall (<3.0 ft tall)
Sapling	≥1.37 m tall ***AND*** 2.5 cm to 12.4 cm dbh (≥4.5 ft tall ***AND*** 1.0 inch to 4.9 inch dbh)	>0.91 m tall ***AND*** <7.6 cm dbh (>3.0 ft tall ***AND*** <3.0 inch dbh)
Pole	12.7 cm to 22.6-cm dbh (5.0 inch to 8.9-inch dbh)	>1.8 m tall ***AND*** 7.6 cm to 12.7 cm-dbh) (>6.0 ft tall ***AND*** 3.0 inch to 5.0-inch dbh)
Mature	>22.7 cm dbh (>9.0-inch dbh)	>12.7 cm dbh (>5.0-inch dbh)
Dead	100% of canopy is dead	100% of canopy is dead

[1]*Juniperus scopulorum* (Rocky Mountain juniper) is an exception to the specifications given, because it lacks typical coniferous size, age, and growth form relationships. Assign age classes to individuals based on relative size, reproductive ability, and overall appearance.
[2]Other Broadleaf Species may include *Fraxinus pennsylvanica* (green ash), *Acer negundo* (box elder), *Populus tremuloides* (quaking aspen), *Betula papyrifera* (paper birch), and *Ulmus americana* (American elm).

Note 2: Do not count the resprouts from cut-off stumps as regeneration of a plant that was cut. As a general rule, count sprouts ***ONLY*** that emanate from the soil, and ***NOT*** from the stem above ground.

Note 3: For field determination of vegetative cover related questions (questions D2 to D14) include ***all rooted plant material*** (live or dead). Do not include fallen wood or other plant litter. Do not consider the polygon area covered by water (such as between emergent plants).

Note 4: For sites with bioengineering/plantings: If planting has died or is less than one year old it is ***not to be counted as cover*** and therefore will not contribute to the regeneration score. To account for the material present (i.e., dead wood if the stakes do not take root), record as ***NON-VEGETATED GROUND COVER*** in question F17 in the lotic inventory form.

D3. The tree regeneration category is automatically calculated in the office by the computer using the size class data collected with the species' canopy cover as described in item D2b. The canopy covers of the seedling and sapling size classes are combined to quantify tree regeneration. The categories represent actual, not potential, tree regeneration.

Code	Description
1	No seedlings or saplings were observed in the polygon.
2	Seedlings and/or saplings were observed; individually, or in combination, these size classes have less than 5% of the species canopy cover.
3	Seedlings and/or saplings were observed; individually, or in combination, these size classes have 5% or more of the species canopy cover, but less than 15%.
4	Seedlings and/or saplings were observed; individually, or in combination, these size classes have 15% or more of the species canopy cover, but less than 25%.
5	Seedlings and/or saplings were observed; individually, or in combination, these size classes have 25% or more of the species canopy cover.

D4. The tree size class distribution category is automatically calculated in the office by the computer using size class canopy covers recorded in item D2b. In classifying tree size class distribution, the seedling and sapling groups are combined. Three resulting size classes (seedlings/saplings, pole, and mature), ***and*** the percent of the mature individuals which are decadent, determine size class distribution categories.

Decadence of younger size classes is ignored in this calculation. Younger decadent trees are assumed to have the capacity to grow out of any current condition caused by injury, disease, or other non-age related factors. A species with decadent mature individuals may fall into one of two classes: those having 75% or more of mature individuals decadent and those having less than 75% of mature individuals decadent. The age distribution category of a tree species on a polygon is defined by the presence of certain size classes. To be present, size classes must have minimum canopy covers in the polygon: seedlings/saplings must have a combined total canopy cover of at least 1%; pole and mature are treated separately and must each have at least 5% canopy cover.

Tree Size Class Distribution Categories (An X under a size class indicates presence in that category.)

Category Code	Sdlg[1]/Splg[2] (CC >1%)	Pole (CC >5%)	Mature (Decadent[3]) (CC>5%)	Description
1	X			seedling/sapling only
2		X		pole age only
3	X	X		seedling/sapling and pole
4	X		X	seedling/sapling and mature (<75% dec.)
5		X	X	pole and mature (<75% dec.)
6	X	X	X	seedling/sapling, pole, and mature (<75% dec.)
7			X	mature only (<75% dec.)
8	X		X	seedling/sapling and mature (≥75% dec.)
9		X	X	pole and mature (≥75% dec.)
10	X	X	X	seedling/sapling, pole, and mature (≥75% dec.)
11			X	mature only (≥75% dec.)

[1]Sdlg indicates seedlings, Splg indicates saplings, Decadent indicates percent of mature trees, which are decadent

D5a. Record the appropriate category, that best describes the amount of browse utilization (Utl) of the combined seedling (Sdlg) and sapling (Splg) size classes for each tree species. When estimating amount of utilization, count browsed second year and older leaders on representative plants of tree species normally browsed by ungulates. Do not count current year's use, because this would not accurately reflect actual use when more browsing can occur later in the season. Browsing of second year or older material affects the overall health of the plant and continual high use will affect the plant's ability to maintain itself on the site. Determine percentage by comparing the number of leaders browsed or utilized with the total number of leaders available (those within animal reach) on a representative sample (at least three plants) of each tree species present. Do not count utilization on dead plants, unless it is clear that death resulted from over-grazing. ***NOTE:*** If a shrub is entirely mushroom/umbrella shaped by long-term intense browse or rubbing, count browse utilization of it as heavy.

Category	Description
None	0 to 5% of the available second year and older leaders are clipped (browsed).
Light	>5 to 25% of the available second year and older leaders are clipped (browsed).
Moderate	>25 to 50% of the available second year and older leaders are clipped (browsed).
Heavy	More than 50% of the available second year and older leaders are clipped (browsed).
Unavailable	Woody plants provide no browsed or unbrowsed material below 1.5 m (5 ft), or are inaccessible due to location or protection by other plants.
NA	Neither seedlings nor saplings of tree species are present.

D5b. Referring to Keigley and Frisina (1998), characterize seedling and sapling plants (if any) of each tree species by growth architecture type. Polygons will likely exhibit a range of effects caused by browse, therefore choose a best fit category to represent the majority condition for plants of each species. Categories are:

Uninterrupted—The plant has gain height each growing season; has at least one stem that not has no entire annual segment killed by browsing.

Arrested—A plant that has had intense browsing all its life; it is hedged from above.

Retrogressed—The plant grew normally in early life, but was switched to intense browse later in life.

Released—A plant that had intense browsing early in life, but later was switched to lighter use, and allowed to grow taller.

D5c. Referring to Keigley and Frisina (1998) and more recent illustrations (Figure 7a-d) (Keigley and Frisina [in press]) choose one of two categories of browse intensity: ***Light-to-Moderate*** or ***Intense***.

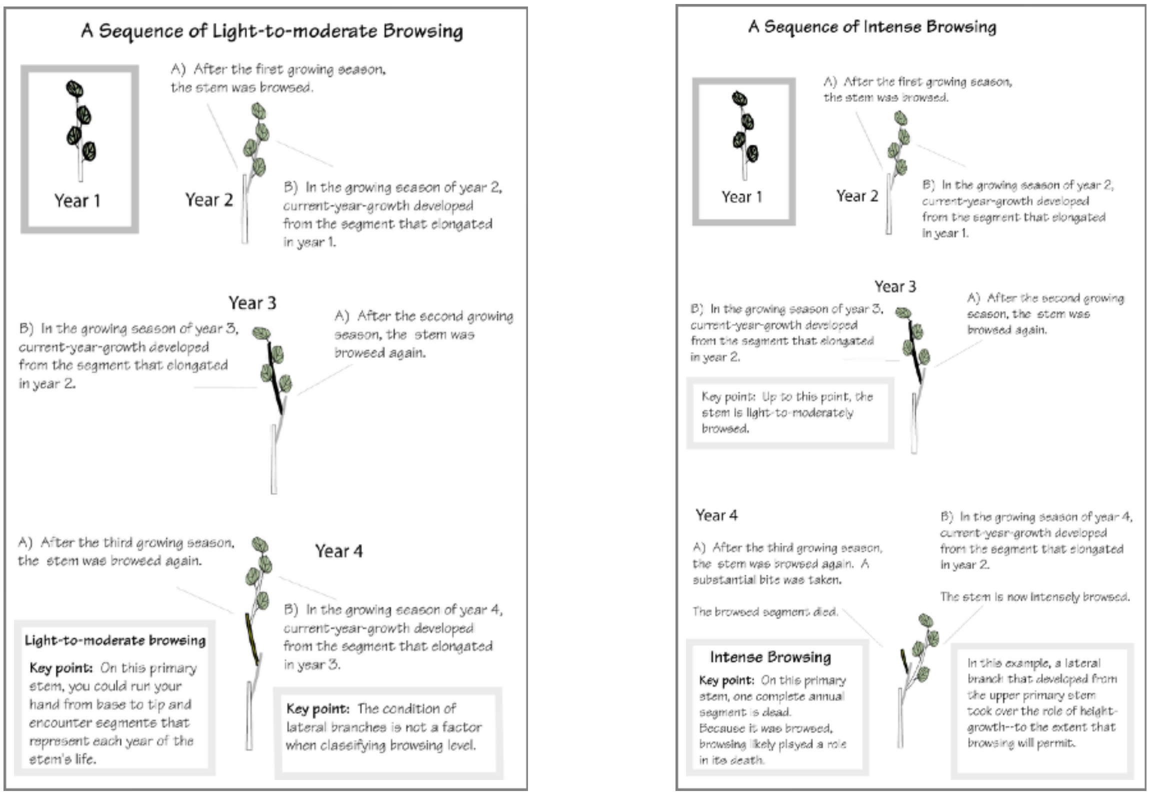

Figure 7a, b. Illustration of sequences of ***Light-to-Moderate*** browsing and ***Intense*** browsing (from Richard Keigley 2008)

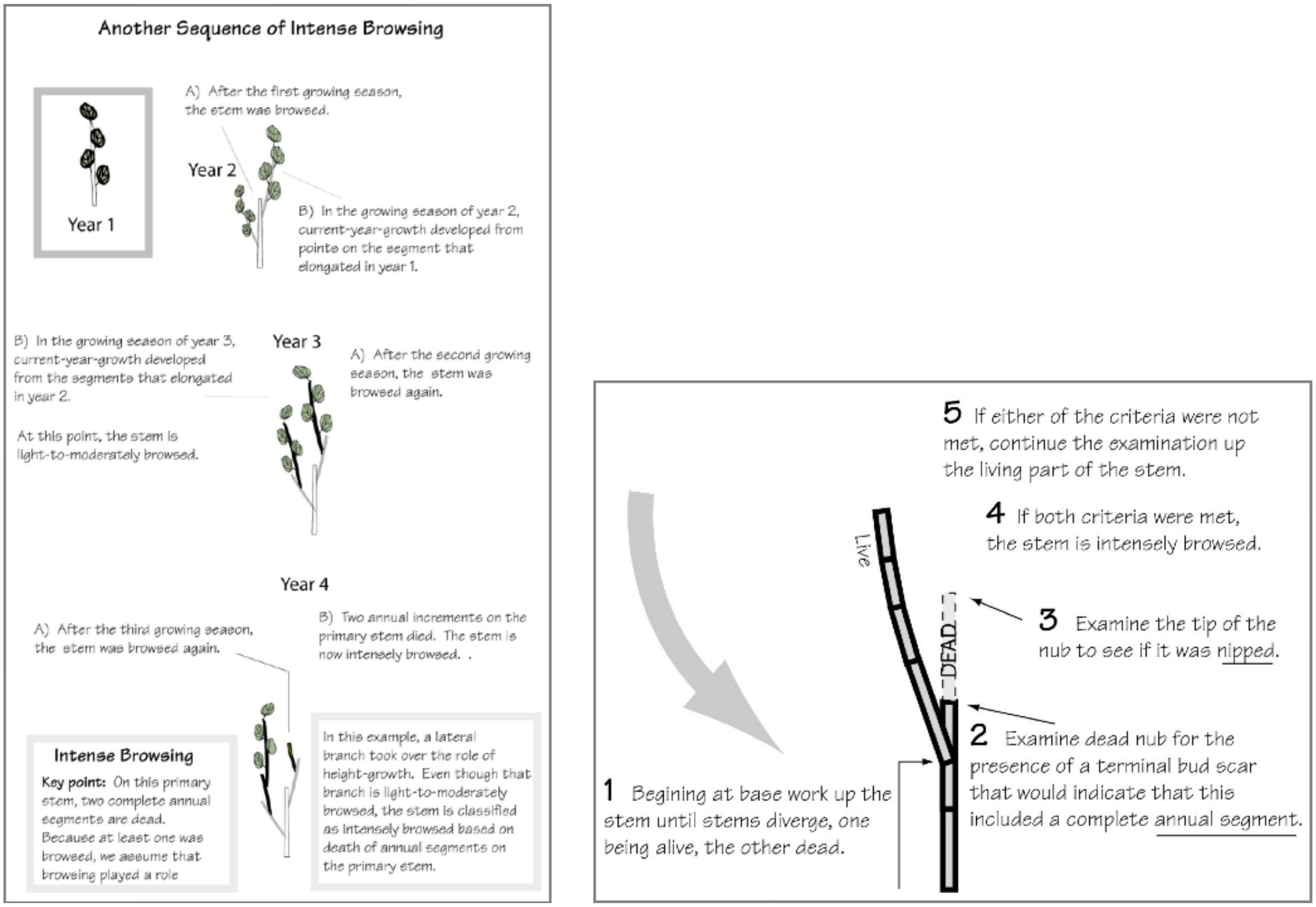

Figure 7c, d. Another sequence of ***Intense*** browsing how to recognize ***Intense*** browsing (from Richard Keigley 2008)

D5d. Estimate the overall proportion (percentage) of all cottonwood regeneration on the polygon (seedlings and saplings of *Populus* species other than *P. tremuloides* [quaking aspen]) that are from seed, ***rather than from any form of asexual reproduction***, such as root sprouts.

D6a, b. Are shrubs present on the polygon, and does the polygon have potential for woody species, such as tall shrubs and trees? Some riparian and wetland sites are marshes, wet meadows, or other wetland types that lack potential for woody species. Such sites should not be penalized on ecological health assessment rating for this lack of potential. Other sites lacking these species do have the potential, but lack the plants due to disturbance. Observers are to answer D6b on the basis of species noted on similar, nearby, less disturbed sites, or other indications. On polygons where the observer cannot find sufficient evidence to make a confident determination, enter NC and explain in the comment field at the end of the Vegetation Section.

D6c. Record the species code and canopy cover for ***every*** shrub species observed on the polygon. Determine the portion of the species cover represented by each of three groups: seedling/saplings, mature, or decadent/dead. (***NOTE:*** For shrubs, all decadent individuals are included in one group with dead individuals. This contrasts with the method of recording tree decadence, where the decadence within each size class is recorded.) As with trees, decadent shrubs are individuals having 30% or more dead material in the canopy. The canopy covers of the three age/size groups for a species must total approximately 100%.

In general, shrub seedling/saplings can be distinguished from mature plants on the following basis: For normally tall shrubs, which have an average mature height of over 1.8 m (6.0 ft), seedlings and saplings will be plants reaching only into the first and second vegetation layers (shorter than 1.8 m [6.0 ft]). For shrub species having normal mature height between 0.5 m (1.5 ft) and 1.8 m (6.0 ft), seedlings and saplings are individuals reaching only into the first vegetation layer (below 0.5 m [1.5 ft]). For short shrub species, whose mature height is 0.5 m (1.5 ft) or less, observers must judge individual plants for height, reproductive structures, and other characteristics that indicate relative age. Refer to reference manuals on the regional flora for information of normal sizes for unfamiliar species. Remember that browsing may have shortened the stature of mature specimens.

When estimating degree of utilization, count browsed second year and older leaders on representative plants of woody species normally browsed by ungulates. Do not count current year's use, because this would not accurately reflect actual use when more browsing can occur later in the season. Browsing of second year or older material affects the overall health of the plant and continual high use will affect the plant's ability to maintain itself on the site. Determine percentage by comparing the number of leaders browsed or utilized with the total number of leaders available (those within animal reach) on a representative sample (at least three plants) of each shrub species present. Do not count utilization on dead plants, unless it is clear that death resulted from over-grazing. ***NOTE:*** If a shrub is entirely mushroom/umbrella shaped by long-term intense browse or rubbing, count browse utilization of it as heavy. Record to the right of the slash (/) the ***one category*** that best describes shrub utilization for each size class (using the five categories in item D5 above).

Example:

Species	Cover	Sdlg-Splg/Util	Mature/Util	Dec-Dead/Util	Shrub Growth Form
ALNINC	2	P / Moderate	7 / Light	3 / Unavail.	N

D6d. Record the category best describing the dominant appearance of each shrub species in the polygon.

Code	Description
N	***Normal Growth Form.*** No apparent deviation from the normal appearance of the lifeform.
F	***Flat-Topped Growth Form.*** Shrubs with the tallest leaders hedged (e.g., hedging from the top down). (Moose during winter in deep snow browse exposed branches of shorter plants.)
U	***Umbrella-shaped/Heavily-hedged/High-lined.*** Shrubs that have most of the branches (up to 1.5 m [5 ft] in height) removed by browsing.
C	***Cut Off at or Near the Ground.*** Shrubs that have been cut off by beaver or humans, at or near the base of the main stem(s).

D6e. For each shrub species listed, record the type of architecture caused by browsing. Follow Keigley and Frisina (1998) in determining the architecture type. Refer to the Keigley and Frisina (1998) document (*Browse Evaluation by Analysis of Growth Form*) for greater detail and illustrations for this determination. Evaluate typical specimens of each species observed in making the determination. On some polygons there may be multiple situations causing different architecture types in the same species to occur (i.e., when there are areas of different accessibility within the polygon, causing browsing intensity to be greater in places). In such cases, enter multiple types for the species in descending order of the relative abundance (i.e., enter the type representing the greatest number of plants first, etc.). On the field data form, enter the codes from the table below.

Architecture Type	Description
Uninterrupted	The terminal leader of the plant has not had an annual growth segment killed by browsing.
Arrested	The plant has been intensely browsed all its life, and no stem has escaped having an entire annual segment killed.
Retrogressed	After a period of light-to-moderate browsing early in life, the plant then is intensely browsed from above.
Released	An ***arrested*** or ***retrogressed*** plant has had the intense browsing removed and has been allowed to resume normal vertical growth.

D6f. For each shrub species listed, record the level of browse intensity that characterizes usage of that species throughout the polygon. This is a generalization that acknowledges there is typically a range of usage levels determined by differing degrees of accessibility and animal movement patterns across the polygon. Follow Keigley and Frisina (1998) to determine which of the two levels of browse intensity (***Intense*** or ***Light-to-Moderate***) represents the predominant condition on the polygon. Browsing is ***Intense*** when a complete annual segment is killed. Describe wide variations in level of use that might exist and the reasons for it in the comment field (D17).

D6g. Excessive cutting or removing parts of plants or whole plants by agents other than browsing animals (e.g., human clearing, cutting, beaver activity, etc.) can result in many of the same negative effects to the community that are caused by excessive browsing. However, other effects from this kind of removal are direct and immediate, including reduction of physical community structure and wildlife habitat values. ***Do not include natural phenomena such as natural fire, insect infestation, etc. in this evaluation.***

Removal of woody vegetation may occur at once (a logging operation), or it may be cumulative over time (annual firewood cutting or beaver activity). **This question is not so much to assess long-term incremental harvest, as it is to assess the extent that the stand is lacking vegetation that would otherwise be there today.** Give credit for re-growth. Consider how much the removal of a tree many years ago may have now been mitigated with young replacements.

Invasive woody species or genera are excluded from consideration because these are aggressive, invasive exotic plants that should be removed. They are *Elaeagnus angustifolia* (Russian olive), *Rhamnus cathartica* (common buckthorn), *Caragana arborescens* (common caragana), and *Tamarix* species (saltcedar; tamarisk).

Determine the extent to which woody vegetation (trees and shrubs) is lacking due to being physically removed (i.e., cut by beaver, cut by humans, mowed, trimmed, logged, or otherwise removed from their growing position). The timeframe is less important than the ecological effect. Time to recover from this kind of damage can vary widely with site characteristics. The objective is to measure the extent of any damage remaining ***today*** to the vegetation structure resulting from woody removal. We expect that the woody community will recover over time (re-grow), just as an eroding bank will heal with re-growing plant roots. **This question simply asks how much woody material is still missing from what should be on the site?** The amount of time since removal doesn't really matter, if re-growth has been allowed to progress. If 20 years after logging, the site has a stand of sapling spruce trees, then it should get partial re-growth credit, but not full credit, since the trees still lack much of their potential habitat and ecological value. (***NOTE:*** In general, the more recent the removal, the more entirely it should be fully counted; and conversely, the older the removal, the more likely it will have been mitigated by re-growth.)

This question is really looking at volume (three dimensions) and not canopy cover (two dimensions). For example, if an old growth spruce tree is removed, a number of new seedlings/saplings may become established and could soon achieve the same canopy cover as the old tree had. However, the value of the old tree to wildlife and overall habitat values is far greater than that of the seedling/saplings. It will take a very long time before the seedlings/saplings can grow to replace all the lost habitat values that were provided by the tall old tree. On the other hand, shrubs, such as willows, grow faster and may replace the volume of removed plants in a much shorter time. **Answer this question by estimating the percent of woody material that is missing from the site due to having been removed by human action or beaver (active or inactive) or other methods regardless of timeframe. Select a range category from the choices given that best represents the percent of missing woody material.**

Note 1: *If the polygon does not have the ability to support (potential for) any trees and shrubs (example: saline conditions) and there is no evidence that it ever had any,* ***record as NA*** *and record the reason in D6h.*

Note 2: *If the polygon has potential for trees and shrubs but they are not present, look for evidence (i.e. stumps or cut woody plants within the polygon or other indicators [e.g. adjacent lands, across the fence, surrounding landscape, personal communication, historical imagery]).*

Note 3: *When insufficient data/evidence is available to make a call,* ***record as NC*** *and record the reason in D6h. Also used for old polygons when data was not collected.*

D6h. Record comments giving evidence for the above call.

D7 and **D8.** Record the species code and the percent canopy cover for graminoid and forb species observed in the polygon. ***As a minimum,*** include all species having at least 5% cover on the polygon. This inventory is not intended to be comprehensive. It is not necessary to search for obscure species, just record all species readily seen. Observers should especially look, however, for hydrophytic (wetland) species that may be reduced to trace representation by site disturbance. Herbaceous species other than invasive plant species (see item D13) with minor presence may be overlooked without serious compromise to the inventory value.

D9. The purpose of this item is to describe the vegetation structure in terms of height layers and plant lifeforms on the polygon. (Think of the layering as though it were a GIS file with 12 layers, each one representing one of four lifeforms [trees, shrubs, graminoids, and forbs] in one of three height layers.) Include the canopy cover on the polygon that is provided by all rooted plants (live or dead). Do not include fallen wood or other plant litter. Do not consider the polygon area that is covered by water (such as between emergent plants).

Record the percent canopy cover of each plant lifeform in each of the three height layers. Consider each group in each layer separately. For example, shrubs in layer 2 will be the canopy cover of all plants of all shrubs in the polygon between 0.5 m (1.5 ft) and 1.8 m (6.0 ft) tall (roughly knee high to head high). In estimating this value, ignore all plants taller and shorter than this range. Similarly, estimate the cover separately of those taller and those shorter shrubs. Proceed in this way through each lifeform and layer. As a check, refer to your species/canopy lists to help remember what all you have seen on the site. ***Leave no field blank;*** enter 0 to indicate absence of a value. (A blank field means the observer forgot to collect the data; a value means the observer looked.) See further discussion in the note for item D10.

D10. Record the total percent of the polygon area occupied by canopy cover of each plant lifeform. Include the canopy cover on the polygon that is provided by all rooted plants (live or dead). Do not include fallen wood or other plant litter. Do not consider the polygon area that is covered by water (such as between emergent plants). Avoid counting overlapping areas more than once for one group. (For example, an area is not counted twice for total tree cover if seedlings cover all ground under mature trees.) However, the same piece of ground may occur under the canopy of more than one group. (For example, areas covered by grass which are also under trees would be counted for both tree and grass lifeforms.) On the other hand, when estimating total cover of all plants (item D12), the area covered by both trees and grass would only be counted once—trees and grass in this case being part of the same group (all four plant groups).

D11. Record the percent of the polygon area covered by tree and shrub (woody species) canopy considered as a group in the sense described above. Include the canopy cover on the polygon that is provided by all rooted plants (live or dead). Do not include fallen wood or other plant litter. Do not consider the polygon area that is covered by water (such as between emergent plants).

D12. Record the percent of the polygon area covered by the canopy of all four plant groups together. Include the canopy cover on the polygon that is provided by all rooted plants (live or dead). Do not include fallen wood or other plant litter. Do not consider the polygon area that is covered by water (such as between emergent plants).

D13a, b. Invasive plants (noxious weeds) are alien species whose introduction does or is likely to cause economic or environmental harm. Without regard to whether the disturbance that allowed their establishment is natural or human-caused, weed presence indicates a degrading ecosystem. While some of these species may contribute to some riparian functions, their negative impacts reduce overall site health. This item assesses the degree and extent to which the site is impacted by the presence of noxious weeds. The severity of the weed problem on a site is a function of density/distribution (pattern of occurrence), as well as abundance of the weeds. A weed list should be used that is standard for the region.

Record the combined percent canopy cover and the overall density distribution class of all invasive plants on the polygon. Common invasive plant species are listed on the form. ***Leave no listed species field blank, however;*** enter 0 to indicate absence of a species. (A blank field means the observer forgot to collect the data; a value means the observer looked.) For each weed species observed record canopy cover as a percentage of the polygon (area being evaluated) and density/distribution class. Choose a density/distribution class from the chart (Figure 8) below that best represents each species' pattern of presence on the site.

CLASS	DESCRIPTION OF ABUNDANCE	DISTRIBUTION PATTERN
0	No invasive plants on the polygon	
1	Rare occurrence	
2	A few sporadically occurring individual plants	
3	A single patch	
4	A single patch plus a few sporadically occurring plants	
5	Several sporadically occurring plants	
6	A single patch plus several sporadically occurring plants	
7	A few patches	
8	A few patches plus several sporadically occurring plants	
9	Several well spaced patches	
10	Continuous uniform occurrence of well spaced plants	
11	Continuous occurrence of plants with a few gaps in the distribution	
12	Continuous dense occurrence of plants	
13	Continuous occurrence of plants associated with a wetter or drier zone within the polygon.	

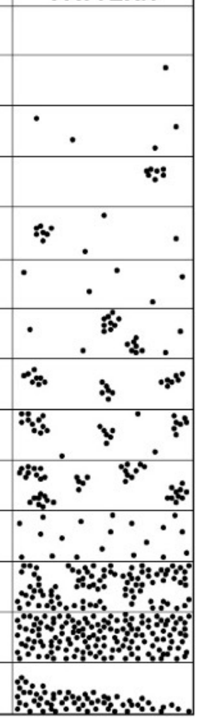

Figure 8. Invasive plant species class guidelines (figure adapted from Adams and others [2003])

D13c. Record total presence of all invasive plant species on the polygon. Use the same method described above without consideration of individual species, but instead by considering all weed species together as though they were one. Enter the total canopy cover of all invasive plant species and the density/distribution class of all invasive plant species considered together.

D14a, b. Areas with historically intense grazing often have large canopy cover of undesirable herbaceous species, which tend to be less productive and which contribute less to ecological functions. A large cover of disturbance-increaser undesirable herbaceous species, native or exotic, indicates displacement from the potential natural community (PNC) and a reduction in upland health. These species generally are less productive, have shallow roots, and poorly perform most upland functions. They usually result from some disturbance, which removes more desirable species. Invasive plant species considered in the previous item are not reconsidered.

A list of disturbance-increaser undesirable species that are counted is presented below. Other disturbance-increaser undesirable species may also be present on a site, but consistency and comparability will be maintained by always counting the same set of species.

Achillea millefolium (common yarrow)	*Agropyron repens* (quackgrass)	*Antennaria* species (everlasting; pussytoes)
Artemisia ludoviciana (cudweed sagewort)	*Descurainia sophia* (fixweed)	*Fragaria virginiana* (wild strawberry)
Juncus balticus (Baltic rush)	*Lepidium perfoliatum* (clasping pepperweed)	*Medicago lupulina* (black medick)
Mentha arvense (field mint)	*Plantago major* (common plantain)	*Poa pratensis* (Kentucky bluegrass)
Potentilla anserina (silverweed)	*Sisymbrium* species (tumblemustard)	*Taraxacum officinale* (common dandelion)
Thlaspi arvense (field pennycress)	*Trifolium* species (clover)	*Verbascum thapsus* (common mullein)

D15. List the riparian habitat type(s) and/or community type(s) found in the polygon using a manual for identifying types in the region in which you are working, such as *Classification and Management of Montana's Riparian and Wetland Sites* (Hansen and others 1995), *Classification and Management of USDI Bureau of Land Management's Riparian and Wetland Sites in Eastern and Southern Idaho* (Hansen and Hall 2002), *Classification and management of upland, riparian, and wetland sites of USDI Bureau of Land Management's Miles City Field Office, eastern Montana USA* (Hansen and others 2008), or a similar publication written for the region in which you are working. If the habitat type cannot be determined for a portion of the polygon, then list the appropriate community type(s) of that portion. If neither the habitat type nor community type can be determined for any portion of the polygon (or in areas where the habitat and community types have not been named and described), list the area in question as unclassified wetland type and give the dominant species present. Indicate with the appropriate abbreviation if these are habitat types (HT), community types (CT), or dominance types (DT), for example, PSEMEN/CORSTO HT. For each type listed, estimate the percent of the polygon represented. If known, record the successional stage (i.e., early seral, mid-seral, late seral, and climax), or give other comments about the type. As a minimum, list all types which cover 5% or more of the polygon. The total must approximate 100%. Slight deviations due to use of class codes or to omission of types covering less than 5% of the polygon are allowed. ***NOTE:*** For any area classified as an unclassified wetland type, it is important to list any species present which can indicate the wetness or dryness of the site.

NOTE: Open water in the polygon that does not have emergent vegetation, but that is less than 2 m (6.6 ft) deep is counted as a type called Open Water.

D16a-c. Fire plays an important role on shaping our landscape. Fire can dramatically alter the vegetational expression of a polygon, especially woody vegetation. This question pertains to the more recent fire history and its affect on the polygon. Respond "Yes" to D16a only if the polygon vegetation is deemed currently to be altered from what it would otherwise be, by having burned. ***For example:*** Sagebrush has been killed and *Bromus tectorum* (cheatgrass) is more dense than other nearby sites.

Answer item D16b by estimating how long since the fire, unless the exact year of the most recent fire is known. Answer D16c by estimating the most representative category choice.

D17. Select the ***one category*** (Improving, Degrading, Static, or Trend Unknown) that best indicates the current trend of the vegetative community on the polygon to the extent possible. Trend refers, in the sense used, not specifically to successional pathway change, but in a more general sense of apparent community health. By definition, trend implies change over time. Accordingly, a trend analysis would require comparison of repeated observations over time. However, some insights into trend can be observed in a single visit. For example, the observer may notice healing (revegetating) of a degraded shore area and recent establishment of woody seedlings and saplings. This would indicate changing conditions that suggest an improving trend. If such indicators are not apparent, select the category status unknown.

D18. Add any necessary commentary to explain or amplify the vegetation data recorded. ***Do not leave this space blank.*** Describe any unique characteristics of the site and other observations relating to the vegetation. This space is the place for general commentary to help the reader understand the larger context of the data. Such things as landscape setting and local land use history are appropriate.

Physical Site Data

F1. Record whether or not the polygon contains a defined bank or channel bottom. A defined channel will have a mostly (>50%) unvegetated bottom and evidence of at least ephemeral flow. If no defined channel with banks is found in the polygon, skip the channel/bank related items down to the bare ground item F17.

F2a, b. If the channel bottom is visible (water depth or turbidity or depth does not obscure the bottom), record the percent of channel bottom materials in each size group. (Category sizes are based on the measurement of the middle length axis of the particle. This is the dimension that would limit the screen size the particle could pass through.) The sum of these values must approximate 100%. Consider the area within the generally flatter bottom that lies between the left and right bank toes. The goal is to characterize the bed load or materials already entrained in the stream. Of course, some systems lacking stored bed load may be flowing on non-alluvial parent material or native bedrock.

F3a, b. Some streambanks are completely vegetated, so do not disrupt the vegetation to examine the substrates. However, if the bank substrate is visible, record the percent of each size category of materials. (Category sizes are based on the measurement of the middle length axis of the particle. This is the dimension that would limit the screen size the particle could pass through.) Consider the generally sloped area above the bank toes bounding both sides of the channel bottom up to the point at which the bank slope levels off or reaches the first terrace top. The goal is to characterize the materials with the most potential to be eroded into the stream by lateral shear forces of flows up to bankfull, or flood, stage. The bank may have very shallow slope and be indistinct, as is often the case on point bars along inside curves, however every channel must have a bank on each side to contain it.

F4a, b. Record the percent of streambank length within the polygon that displays active lateral cutting. Lateral cutting is indicated by new stream-caused bank disruption along the outside of curves and, much less commonly, along straight reaches. Any lateral cutting occurring during the past year is considered active**.** Cut banks with vegetation establishing are considered to be healing because they are beginning to stabilize the bank, and the cutting is no longer considered to be active. Although lateral cutting is usually restricted to one side of the channel at any point along the stream, this item considers all bank length—not channel length. The answer is to be expressed as a percentage of total bank length that is actively cutting. This approach permits consistency when using the form on a polygon along just one side of a river. Thus, a 30 m (100 ft) length of stream with a total of 3 m (10 ft) lateral cutting would have 5% lateral cutting, because both banks would give a total of approximately 60 m (200 ft). Therefore, only in extreme cases with cutting on both sides of a stream at the same point, might there be a value greater than 50% lateral cutting.

To answer this question, add the footage of all observed lateral cutting in the polygon, and divide by the total length of bank in the polygon. ***NOTE:*** In the past this question was answered differently as total lateral cutting length divided by stream length, which theoretically could yield values greater than 100%.

F5. Record the range category estimated to best characterize the length of polygon streambank instability. There are several types of streambank instability. Unstable banks can be described as follows. ***Undercut banks*** most often indicate a binding root mass which will allow upper streambank layers to persist for some time without support underneath. Highly cohesive soils in the upper banks may also persist above an undercut lower layer without a binding root mass, but this is less common. Not all undercut banks should be called unstable. Some cuts under large trees or shrubs are more stable than banks not undercut held by strongly rooted herbaceous plants. Therefore, consider the timeframe for expected failure in making this call. ***Vertically eroded banks*** are usually composed of cohesive soils (silts and clays), but lack a root mass to significantly increase resistance to erosion. As the stream erodes the bottom of the bank, the top almost immediately collapses. ***Slumping banks*** usually represent the most unstable situation (no cohesive soils or binding root mass). Upper banks crack and give way, often in large chunks, back from the bank top with the material falling toward the stream in mass. The degree of instability in all three cases increases with further disturbance.

NOTE 1: Assess both sides of the stream, so the total bank length evaluated will be approximately twice the stream reach length.

NOTE 2: Rip-rap is the addition of large rock, concrete, or other material along the streambank in an attempt to prevent erosion. Banks treated with rip-rap are unstable if the rip-rap is becoming unstable. Check whether the rip-rap is eroding underneath or behind.

F6a-d. The banks of a stream are formed to contain the channel flow in a delicate balance of forces that can be destabilized by human activities. Altered streambanks are those having impaired structural integrity (strength or stability) usually due to human causes. These banks are more susceptible to cracking and/or slumping. Count as streambank alteration such damage as livestock or wildlife hoof shear and concentrated trampling, vehicle or ATV tracks, and any other human-caused disruption of bank integrity, including rip-rap or use of fill. The basic criterion is any disturbance to bank structure that increases erosion potential or bank profile shape change. One large exception is lateral bank cutting caused by stream flow, even if thought to result from upstream human manipulation of the flow. The intent of this item is to assess only direct, on-site mechanical or structural damage to the banks. Each bank is considered separately, so total bank length for this item is approximately twice the reach length of stream channel in the polygon (more if the stream is braided). ***NOTE:*** Constructed streambanks (especially those with rip-rap) may be stabilized at the immediate location, but are likely to disrupt normal flow dynamics and cause erosion of banks downstream. The width of the bank to be considered is proportional to stream size. The table below gives a conceptual guideline, ***NOT*** an absolute rule, for how wide a band along the bank to assess.

Stream Size (Bankfull Channel Width)	**Width of Band to Assess for Bank Alteration**
Rivers (Larger Than 15 m [>50 ft])	4 m (13 ft)
Small Rivers and Large Streams (Approx. 5-15 m [16-49 ft])	2 m (6 ft)
Small Streams (Up To Approx. 5 m [16 ft])	1 m (3 ft)

If the streambank has not been altered by on-site human activities, answer “No” to **F6a**. Otherwise, in **F6b,** record the total percent of the polygon streambank that is altered. Then, in **F6c,** break down the total streambank alteration into a distribution among the listed potential agents of cause, so that these add to 100%.

F6c. Break down the total streambank alteration into a distribution among the listed potential agents of cause, so that these add approximately to 100%. Leave no line blank. Enter 0 if there is none.

- **Grazing.** Long-term livestock use often results in such physical alterations as erosion, hummocking and pugging in soft soils, and bank damage by hoof shear.
- **Cultivation.** This is the mechanical disruption of natural soil structure by farming activities.
- **Mining.** Mining activities usually cause physical damage to the soil surface, but may also include introduction of waste materials to the site, including chemical effects to the soil.
- **Timber Harvest.** Although it may be minimized, timber harvest usually results in at least some physical damage to the soil surface by the machinery used in the process.
- **Construction.** Human infrastructure (roads, railroads, and/or earth moving for other construction purposes) often is located near streams, causing structural disruption or requiring rip-rap protection.
- **Recreation.** Trails at popular sites often cause soil compaction and erosion, especially where mechanical devices (i.e., off-road vehicles and ATVs) are used. The banks of popular fishing sites are often susceptible to trampling.
- **Other.** List any other causes of physical alteration not listed above, and describe them in the space provided.

In **F6d,** break down the total streambank alteration among the listed potential kinds, so that these also add to approximately 100%. ***NOTE:*** A particular kind of alteration may derive from more than one cause (i.e., there may not be a one-to-one relationship between cause and kind. Leave no line blank. Enter 0 if there is none.

- **Hoof Shear/Trampling.** This kind of alteration is caused by hoofed animals that access streams for water and forage, or simply for thermal cover. It consists of physical breakdown of the structural bank integrity.
- **Vegetation Removal.** This is the physical removal of protective vegetation from the streambanks, such as willows, for such purposes as clearing access for farming hay or opening access to the stream for livestock.
- **Road/Railroad Bed.** Along many streams road and railroad beds are constructed adjacent to the stream channel. These structures represent disruption to the bank integrity, to the bank vegetation.
- **Trails.** Trails are worn pathways caused by animals or humans that disrupt the natural bank structure and integrity.
- **Berms.** A berm of mounded soil is sometimes constructed along (on top of) a streambank to restrict high flows from spreading onto the floodplain.
- **Rip-rap.** This is the unnatural hardening of a streambank, typically with large rock, to protect from lateral erosion.
- **Other.** List any other kind of physical alteration to the actual bank structure, profile, or integrity, that is not named above, and describe it in the space provided.

F7. Vegetation along streambanks performs the primary physical functions of stabilizing the soil with a binding root mass and of filtering sediments from overland flow. Few studies have documented depth and extent of root systems of plant species found in wetlands. Despite this lack of documented evidence, some generalizations can be made. All tree and shrub species are considered to have deep, binding root masses. Among wetland herbaceous species, the first rule is that annual plants lack deep, binding roots. Perennial species offer a wide range of root mass qualities. Some rhizomatous species such as the deep rooted *Carex* species (sedges) are excellent bank stabilizers. Others, such as *Poa pratensis* (Kentucky bluegrass), have only shallow roots and are poor bank stabilizers. Still others, such as *Juncus balticus* (Baltic rush), are intermediate in their ability to stabilize banks. The size and nature of the stream will determine which herbaceous species can be effective. The evaluator should try to determine if the types of root systems present in the polygon are in fact contributing to the stability of the streambanks.

In situations where you are assessing a high, cut bank (usually on an outside bend), the top may be upland, but the bottom is riparian. Do not assess the area that is non-riparian. In cases of tall, nearly vertical cut banks, assess the bottom portion that comes in contact with floodwaters. Omit from consideration those areas where the bank is comprised of bedrock, since these neither provide binding root mass, nor erode at a perceptible rate.

NOTE 1: Access both sides of the stream, so total bank length evaluated will be approximately twice the stream reach length.

NOTE 2: Rip-rap does not substitute for, act as, or preclude the need for deep, binding root mass.

Since the kind and amount of deep, binding roots needed to anchor a bank is dependent on size of the stream, use the following table as a general guide to determine width of a band along the banks to assess for deep, binding roots. This is a rule of thumb for guidance that requires only estimated measurements.

Stream Size (Bankfull Channel Width)	Width of Band to Assess for Deep, Binding Roots
Rivers (Larger Than 15 m [50 ft])	15 m (50 ft)
Small Rivers and Large Streams (Approx. 5-15 m [16-49 ft])	5 m (16 ft)
Small Streams (Up To Approx. 5 m [16 ft])	2 m (6 ft)

F8. Two basic functions of substrate materials (or soil) in riparian areas are to act as a sponge in the storage of water and to support vegetation by serving as rooting medium. The kind and amount of soil materials present determine how well these functions can be fulfilled. For example, soils composed of clays, silts, and, to a lesser degree, sands (particle sizes less than 2 mm) will act as a sponge, while coarser substrates such as gravels, cobbles, and boulders will not. Substrate particle size also plays an important role in a site's quality as a plant rooting medium. Substrates dominated by bedrock, exposed boulders (>25 cm [10 in]), or large cobbles (>12.5 cm [5 in]) provide a poor rooting medium for plant growth. Record the percent range to represent the portion of the polygon having sufficient fine materials to perform these functions.

F9. Record the Rosgen (1994, 1996, 1998, 2006) stream channel geomorphic type(s) observed in the polygon and the percent of total stream reach of each type representing at least 5% of the total reach, except stream types G, F, and D, which are considered degraded (Rosgen 1996). Degraded streams of these Rosgen stream types should be noted regardless of length. Stream reaches with sediment loads that appear higher than natural should also be noted in the comment section (item F29). (***NOTE:*** These observations are generally based on ocular estimates rather than quantitative measurements.)

F10a, b. On many small streams the sinuosity (river length divided by the valley length) cannot be accurately represented on a 7.5 minute topo maps due to limitations of map scale. Field observers are to examine the 7.5-minute map to determine if sinuosity is accurately shown. If the answer is Yes, the field observer will leave item F10b blank, and sinuosity will be determined from the map in the office to the nearest tenth (i.e., 1.1, 1.2, etc.). If the answer is No, the observer will measure sinuosity in the field and enter it into item F10b.

Field measurement of sinuosity is done by pacing the channel length along one edge for at least two meander cycles and dividing this value by the valley length between the same two points. (All sinuosities are at least 1.0, in which case the stream would exactly follow the valley bottom with no meandering whatsoever.)

F11. Record the average non-vegetated stream channel width through the entire polygon. This is the portion of the stream channel which remains unvegetated due to the scouring action of the stream or due to the presence of continual water. Describe in the blank for physical site comment any discontinuous unvegetated channel.

F12. Record the stream channel gradient percent. A clinometer may be used to measure gradient of the water surface over a distance of at least two full meander cycles or 50 m (165 ft) (whichever is greater) or the maximum distance practicable. If the stream is large enough, gradient may be determined in a gross manner from a topographic map. On low gradient streams, an estimate is sufficient for the purposes. It is important to know whether the gradient is more, or less than 2 percent.

F13a, b. Record the percent of channel length showing active downcutting. Active downcutting of a stream may be hard to recognize. Four typical downcutting indicators are: a) headcuts; b) exposed cultural features [pipelines, bridge footings, culverts, etc.]; c) lack of sediment and exposed bedrock; and d) a low, vertical scarp at the bank toe on the inside of a channel bend. Wetland vegetation perched on pedestals above degraded (eroded) surrounding areas can indicate downcutting. The lack of distinct channel bottom materials different from materials comprising adjacent banks can also indicate downcutting. Channels in equilibrium with their flow regime and sediment supply usually have bottoms composed of entrained fluvial materials that differ from the bank material. If the stream has removed this bedload and is flowing on material similar to the banks, this can indicate that the stream has destabilized and is downcutting. Look also for headcuts and exposed bedrock on the bottom to indicate downcutting.

F14a-d. Record the presence, number, average height, and location of erosional headcuts in the polygon. Typically, a headcut is an abrupt step in the longitudinal profile of a stream channel. In other instances, it may occur anywhere in the polygon. A head cut is caused by erosion of channel bed materials at a waterfall point, and may be almost any height. Typically, headcuts are found more on systems with erodible substrates. In more erodible substrates, the headcut proceeds upstream as material is eroded away downstream. However, in very durable bedrock, the headcut may appear stationary (i.e., Niagara Falls) in the human timeframe of reference. Headcuts should not be confused with boulder and log steps in a high gradient, step-pool mountain stream. Such steps are not erosion features in the same sense.

Do not count headcuts less than 30 cm (1 ft) high. These smaller headcuts are taken into account in item F13.

F15a, b. Record the percent of braided stream reach (the stream has more than two active channels) in the polygon. A braided channel is more complex and divided than an occasional island and results most often from excess sediment in the system and/or severe disturbance.

F16. An incised stream channel has experienced vertical downcutting of its bed. Incisement can lower the water table enough to change vegetation site potential. It can also increase stream energy by reducing sinuosity, reduce water retention/storage, and increase erosion. A stream becomes critically incised when downcutting lowers the channel bed so that the two-year flood event cannot overflow the banks. Some typical downcutting indicators are:

a) Headcuts;
b) Exposed cultural features (pipelines, bridge footings, culverts, etc.);
c) Lack of sediment deposits;
d) Exposed bedrock; and
e) A low, vertical scarp at the bank toe on the inside of a channel bend.

NOTE: When to NA Channel Incisement
In sites with artificial, human-made ditched or channelized/straightened (meander removed) systems (even those that might have had some components that were natural systems), ***NA the channel incisement question.***

For systems that have started to or have rebuilt meanders and new floodplain from old channelized systems and at least 50% of the site or more is showing healing aspects (signs of natural processes occurring), the channel incisement question can be included and assessed based on the normal criteria. Document your decision and supporting reasons in the comment section.

Process for Determining Channel Incisement
A severe disturbance can initiate downcutting, transforming the system from one having a high water table, appropriate floodplain, and high productivity to one of degraded water table, narrow (or no) active floodplain, and low productivity. These stages of incisement can be categorized in terms of Schumm's stages of incised channel evolution (Schumm and others 1984). The following indicators, taken together, collectively will enable the observer to assess severity of channel incisement.

Channel bed downcutting—Look for headcuts, lack of bed load sediment and exposed bedrock, a low vertical scarp at toe of bank along straight reaches and inside curves, hanging culverts and exposed cultural features.

Limited access to floodplain by flood flows of 1 to 3 year frequency—Look for a lack of sediment deposits and debris deposits on lower floodplain elevations.

Widening of the incised channel—Look for lateral cutting and sloughing of the high banks. This is one of the early steps in the healing process on a severely incised channel. Initially, the downward bed erosion forms a narrow, deep channel that often resembles a gully. Flood waters in such a channel normally cannot deposit, but can only erode and transport, sediment; therefore the narrow incisement must be widened to provide lateral space for a new floodplain to form. This lateral cutting also supplies the sediment that may be deposited at the bottom to begin the formation of a new floodplain.

New floodplain formation within the incised channel—Look for small depositional bars and low, flat areas near the channel. These will increase in width and length, as the healing process proceeds. Look especially for perennial vegetation becoming established on these depositional features, as it is the vegetation that secures the newly gained floodplain increments. The relative width of the active floodplain (the lowest level, the one that is most frequently flooded) determines to what extent an incisement has healed. Remember that floodplain width is inversely proportional to stream gradient, so that higher gradient (B stream type) channels typically have narrow floodplains (typically less than one bankfull channel width), and C and E stream type have wide to very wide floodplains (typically greater than one bankfull channel width).

A top rating is given to un-incised channels from which the normal 1-2 year high flow can access a well formed floodplain. These can be meandering meadow streams (E stream type) and wide valley bottom streams (C stream type) which access floodplains much wider than the stream channel, or they may be mountain and foothill streams in V-shaped valleys which have narrow floodplains limited by topography or bedrock. These latter types are usually armored (well-rocked) systems with highly stable beds and streambanks that are not susceptible to downcutting (typically mountain and foothill streams of A and B stream types). The lowest rating goes to entrenched channels (F or G stream types) where even medium high flows which occur at 5-10 year intervals cannot over-top the high banks. Intermediate stages may be either improving or degrading, and may reflect slightly incised channels that are not yet downcut so badly that some flood stages still cannot access the floodplain, or they may be old incisements that are now healing and rebuilding a new floodplain in the bottom of the ravine.

Because a channel can be incised in any of several stages, the observer is to examine the channel in the polygon for indicators of the degree of channel bed grade stability and stage of incisement, as illustrated in Figure 9. Figure 9 adapts the Schumm channel evolution model to show a generalized schematic of stages through which a channel progresses from destabilization and downcutting to healing and re-establishment of a new floodplain. Actual sites will often have characteristics that are difficult to match with the generalized drawings in Figure 9. However, make a best fit call for category of incisement based on available evidence. If the indicators are confusing and inconclusive, choose the higher (less incised) indicated category. Explain your call in the comment field, and be sure to provide photo documentation of evidence on severely incised channels.

The following table defines the categories of incisement severity in terms of channel evolution stages, as adapted by Rosgen (2006). Note that with destabilizing disturbance and subsequent change to remove the disturbance, a channel may progress through predictable stages of incisement and healing, returning ultimately to a functional and stable system again.

Using the following descriptions and illustrations, choose the stage of channel incisement (none, slight, moderate, or severe) that best fits the predominant condition in the polygon.

Scoring:

Health Assessment Scoring	Incisement Class	Schumm's Channel Evolution Stages	Rosgen Types Included	Description of Incisement Situation
9	None	A	A, B, C, E	Channel is vertically stable and not incised; 1-2 year high flows can begin to access a floodplain appropriate to stream type. Active downcutting is not evident. Any old incisement is characterized by a broad floodplain in which perennial riparian vegetation well established. This category includes a variety of stream types in all land forms and substrates. The floodplain may be narrow or wide, depending on the type of stream, but the key factor is vertical stability. The system may have once incised, and later become healed and is now stable again, with a new floodplain appropriate to its stream type. In this case, the erosion of the old gully side walls will have ceased, and stabilized. A mature, or nearly mature, vegetation community will occupy much of the new valley bottom.
6	Slight	B/D	C, F, G	This category contains both degrading and healing stages. In either case, the extent of incisement is minimal. In Stage B, the channel is just beginning to degrade, and a 2 year flood event may still access some floodplain, partially or in spots. Downcutting is likely progressing. In Stage D, the system is healing. Downcutting should have ceased at this stage. A new floodplain should be well established with perennial vegetation, although it may not be as wide as the stream type needs. This is indicated by ongoing lateral erosion of high side walls of the original incisement, as the system continues to widen itself at its new grade level.
3	Moderate	B/D	C, F, G	This category also contains both degrading and healing stages. In both cases, the extent of incisement is significant. In Stage B, the channel has downcut to a level that floods of the 1-5 year magnitude cannot reach a floodplain. Downcutting is likely still progressing, but the channel may already look like a gully. In Stage D, the system has only just begun to heal. A small floodplain along the new curves in the gully is forming, and perennial vegetation is starting to colonize new sediment features. The high side walls of the gully are actively eroding as the system widens, and much of the fallen materials is being incorporated along the bottom.
0	Severe	C	F, G	The worst case category, where there is no floodplain in the bottom of a deep entrenchment, and small-to-moderate floods cannot reach the original floodplain level. Downcutting may still be in progress. High side wall banks may have begun to collapse and erode into the bottom, but high flows typically just wash this material directly through the system, with none of it being trapped to build new floodplain. At this stage, the system has lost practically all of its riparian function and habitat value.

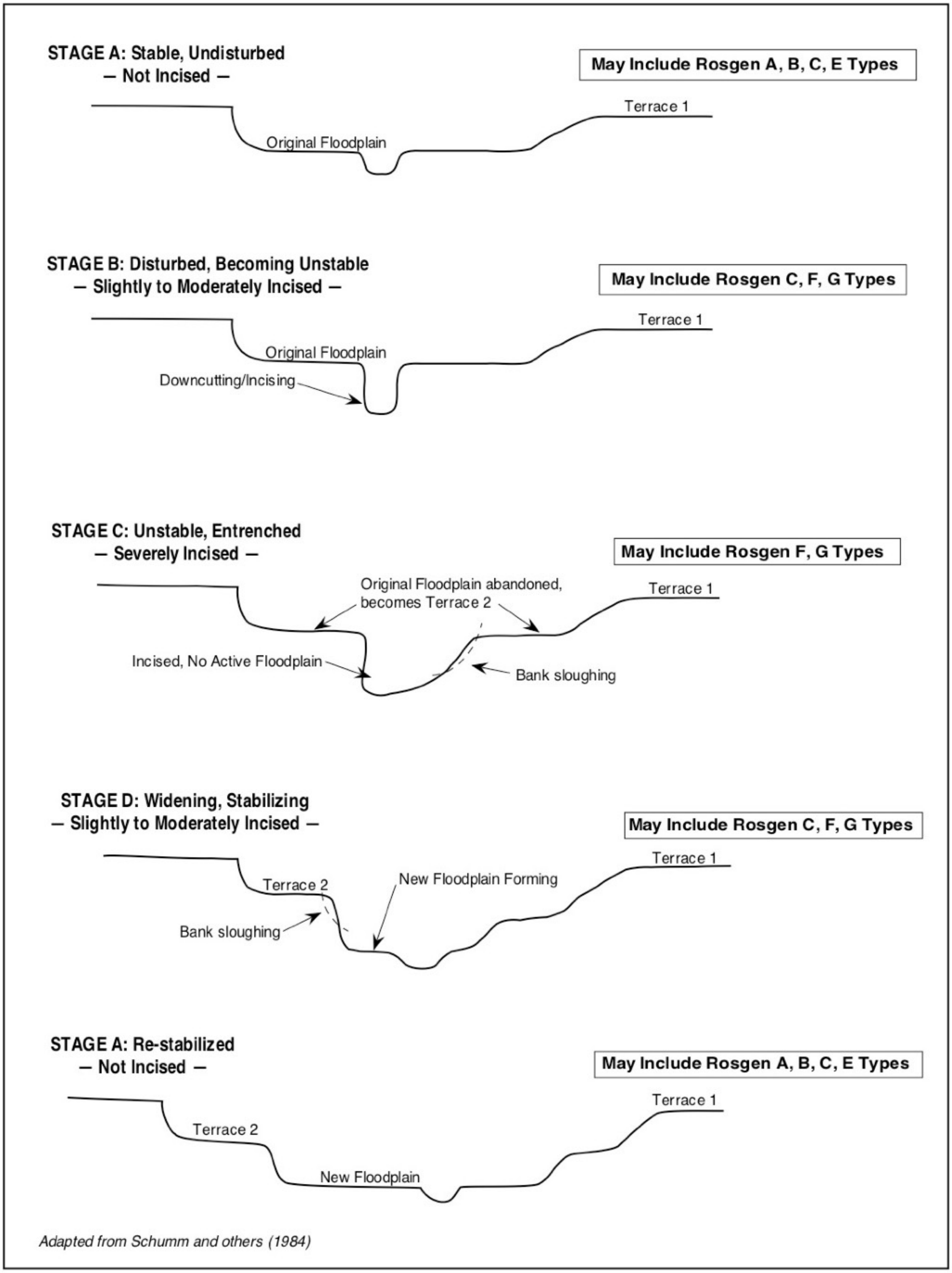

Figure 9. Stages of stream channel evolution, going from initial destabilization and incisement, through ultimate healing and re-stabilization with a new floodplain

F17a, b. Record the portion of the polygon with exposed soil surface (bare ground). Bare ground is soil not covered by plants, litter or duff, downed wood, or rocks larger than 6 cm (2.5 in). Hardened, impervious surfaces (e.g., asphalt, concrete, etc.) are not bare ground—these do not erode nor allow weeds sites to invade. Bare ground caused by human activity indicates a deterioration of riparian health. Sediment deposits and other natural bare ground are excluded as normal or probably beyond immediate management control. Human land uses causing bare ground include livestock grazing, recreation, roads, and industrial activities. The evaluator should consider the causes of all bare ground observed and estimate the fraction that is human-caused.

Stream channels that go dry during the growing season can create problems for polygon delineation. Some stream channels remain unvegetated after the water is gone. On most streams the area of the channel bottom is excluded from the polygon. (***NOTE:*** *The whole channel width extends from right bankfull stage to left bankfull stage; however we need to include the lower banks in all polygons, therefore consider for exclusion ONLY the relatively flat and lowest area of the channel—the bottom.*) This allows data to be collected on the riparian area while excluding the aquatic zone, or open water, of the stream. The aquatic zone is the area covered by water and lacking persistent emergent vegetation. Persistent emergent vegetation consists of perennial wetland species that normally remain standing at least until the beginning of next growing season, e.g., *Typha* species (cattails), *Schoenoplectus* species (bulrushes), *Carex* species (sedges), and other perennial graminoids.

In many systems, large portions of the channel bottom may become exposed due to seasonal irrigation use, hydroelectric generation, and natural seasonal changes such as are found in many prairie ecosystems. In these cases, especially the prairie streams, the channel bottom may have varying amounts of herbaceous vegetation, and the channel area is ***included*** in the polygon as area to be inventoried. Typically, these are the pooled channel stream type that has scour pools scattered along the length, interspersed with reaches of grass, bulrush, or sedge-covered channel bottom. If over half (>50%) the channel bottom area has a canopy cover of persistent vegetation cover (perennial species), taken over the entire length of the polygon as a whole, then it qualifies for inclusion within the inventoried polygon area. If you are in doubt whether to include the channel bottom in the polygon, then leave it out, but be sure to indicate this in the comment section. This is important so that future assessments of the polygon will be looking at the same area of land.

F17c. Separate the exposed soil surface into two categories: that resulting from natural and human causes. These must total approximately 100%. Examples of human causes include livestock wallows and trails, hiking tails, ATV trails, roads, timber harvesting skid trails, mining, and construction activities.

F17d. Within both the natural and human-caused categories, record the proportions of exposed soil surface (bare ground) resulting from the listed causes. Within each category, the portions assigned to the individual causes must total approximately 100%. Explain whatever is put in the other category.

Natural processes are:

- **Erosional.** Natural flows and flood events often result in erosion that removes the soil cover. Attribute polygon bare ground to this process when there is no human cause apparent on the site that would cause the erosion. Wave action along a lake shore is the most common case of erosional bare ground in lentic systems.
- **Depositional.** The deposition of sediment by water flow is perhaps the greatest source of naturally occurring bare ground. This is a significant natural process on certain lotic sites, but is less common on lentic sites. If the source of sediment is some human activity (i.e., sheet erosion from plowed field, road surface, etc.), then list this bare ground under the most appropriate human-caused process.
- **Wildlife Use.** Trails and digging are common wildlife activities that result in natural bare ground.
- **Type Dependent.** Some vegetation types naturally space-out individual plants, leaving bare ground between. Typically this is a characteristic of arid land vegetation.
- **Saline/Alkaline.** The natural accumulation of mineral salts often reaches local concentrations that either support no vegetation, or support only sparse populations of adapted species. The observer should decide whether the source of such mineral accumulation is natural or caused by human activity. If unknown, then default to the natural cause.
- **Within Vegetated Channel Bottoms.** If the channel is deemed to be vegetated and included as area of the polygon, then what percentage of all the naturally occurring bare ground on the polygon does this represent?
- **Other.** Account for any naturally occurring bare ground that is not included in the categories named above, and describe what caused it in the field provided.

Human-caused bare ground may result from:

- **Grazing.** Livestock use often results in bare ground from trailing, trampling, hoof shear, and the removal of vegetation cover by overgrazing.
- **Timber Harvest.** Log skidding and other activities in the process of timber harvest may result in bare ground.
- **Mining.** Extraction and processing of minerals can result in bare ground. The deposition of waste rock (either cast aside overburden or processed tailings) is a common type of mining-caused bare ground.
- **Construction.** Human infrastructure (roads, railroads, and/or earth moving for other construction purposes) often involve excavation, earth moving, and other disruptions of the soil surface or natural soil covering.
- **Recreation.** Many modern forms of recreation involve use of mechanical vehicles that damage the vegetation cover and the integrity of soil. Even foot traffic along trails or popular fishing spots can result in significant areas of bare ground.
- **Other.** Account for any human-caused bare ground that is not included in the categories named above, and describe what caused it in the field provided.

F18. The values for total plant canopy cover and exposed soil surface (bare ground) a brought by the computer from elsewhere on the form and displayed again here, so that the reader may have access in one area of the form to all the various things that account for area on the polygon. Total plant canopy cover and bare ground together usually account for nearly all of a polygon area, but not always. However, any of the non-vegetative things listed under Item F19 may account for a significant area on a polygon. Furthermore, these things may occur under a taller plant canopy, and therefore cause the sum of all ground covers (plant canopy and the items in F19, plus bare ground) to exceed 100 percent. *This question is answered in the office by the computer using data from items elsewhere on the form that are entered in the field.*

F19. Across the area of the polygon, there may be a variety of things covering the soil surface, or nothing covering some of it (the bare ground). It is of value for management reasons to know how great each of these various covers are. Record the percent of the polygon covered independently by each of the items listed. These values are to reflect the entire amount of each of these items on the polygon, without regard to whether or not they may also be covered by vegetation. For example, record the percent of the polygon covered by rocks of cobble size or larger (>6.25 cm [2.5 in]) ignoring everything else; then record the percent covered by all litter/duff, again ignoring everything else; etc. **The sum of these values, plus total vegetation cover and any bare ground, will often exceed 100 percent due to layering.**

NOTE: Animal dung, mulch/wood chips, and dead, non-rooted or rooted plant material that is not considered wood (branches, logs) are all considered litter/duff. This means that rooted standing dead herbaceous plants are considered both litter and vegetative cover. The sum of these values will often exceed the value for “other” in the previous question, because that value does not count rock, litter, wood, etc. that is covered by standing vegetation.

F20. Answer Yes if these bars are being colonized by perennial plant species and No if channel point bars older than the current season are not becoming vegetated by perennial plant species. Answer NA if there is no channel.

F21a-c. Answer Yes if side drainages and hillslopes are ***NOT*** contributing to degradation of the system. Check for sediment and debris being introduced to the channel from side drainages and hill slopes. Indicate whether the problem is human-caused or of natural causes and list the causes of the sedimentation: the kind of human disturbance (grazing, logging, recreation, roads, etc.) or the major soil type of natural causes (e.g., Bear Paw shale, unconsolidated sands and silts, etc.).

F22. Check whether there are forested areas nearby upstream or up slope with potential to deliver significant amounts of large woody debris to the stream channel. Consider scale of the system in this item, but large woody debris is generally understood to mean tree trunks.

F23. Answer “Yes” if there is evidence the riparian zone is widening (e.g., riparian plants near the lateral edges of the zone have young, vigorous individuals and the channel is not incising [Item F16 is either A or B]), or the riparian zone has already achieved its potential extent (e.g., is not incised and has vigorous riparian vegetation growing out laterally on the floodplain to natural topographic limitation, such as a hill toe slope or abandoned floodplain terrace bank).

If the riparian zone is widening, the riparian plant species near the lateral edges of the zone will have young, vigorous individuals among the stands and the channel will not be incising (Item F16 will have been answered either A or B). Answer “No” if riparian species on the edges of the zone are dying or all of old age and if Item F16 is answered C or D. Also

F24. No indicates that channel sinuosity, width/depth ratio, and gradient put the reach into a Rosgen stream type D, G, or F class in a valley type where a stream type B, C, or E class of stream would be expected; or these parameters put the reach into a stream type C class in a meadow situation where an E channel would be expected.

F25a, b. Apart from the streambank, the remaining polygon area is naturally formed to perform riparian functions that may be disrupted by a variety of human-caused disturbances. If the non-streambank area of the polygon has been physically altered by human causes (**F24a**), estimate the total amount of all kinds of physical site alteration to the polygon away from the streambanks (**F24b**).

F25c. Break down the total non-streambank alteration among the listed potential agents of cause, so that these add approximately to 100%. Leave no line blank. Enter 0 if there is none.

- **Grazing.** Long-term livestock use often results in such physical alterations as erosion, hummocking and pugging in soft soils, and bank damage by hoof shear.
- **Cultivation.** This is the mechanical disruption of natural soil structure by farming activities.
- **Timber Harvest.** Although it may be minimized, timber harvest usually results in at least some physical damage to the soil surface by the machinery used in the process.
- **Mining.** Mining activities usually cause physical damage to the soil surface, but may also include introduction of waste materials to the site, including chemical effects to the soil.
- **Construction.** Human infrastructure (roads, railroads, and/or earth moving for other construction purposes) often are located near streams, causing structural disruption or requiring rip-rap protection.
- **Recreation.** Trails at popular sites often cause soil compaction and erosion, especially where mechanical devices (i.e., off-road vehicles and ATVs) are used. The banks of popular fishing sites are often susceptible to trampling.
- **Other.** List any other causes of physical alteration not listed above, and describe them in the space provided.

F25d. Break down the total non-streambank alteration among the listed kinds, so that these add approximately to 100%. ***NOTE:*** A particular kind of alteration may derive from more than one cause (i.e., there may not be a one-to-one relationship between cause and kind. Leave no line blank. Enter 0 if there is none. Potential kinds of alteration are:

- **Soil Compaction.** This kind of alteration includes livestock-caused hummocking and pugging, recreational trails that obviously have compacted the soil, vehicle and machine tracks and ruts in soft soil, etc.
- **Plowing/Tilling.** This is disruption of the soil surface for cultivation purposes. It does not include the alteration of drainage or topographic pattern, which are included in the **Topographic Change** category.
- **Hydrologic Change.** Include area that is physically affected by removal or addition of water for human purpose. The physical effects to look for are structures, such as water diversions, ditches, and canals that affect the drainage pattern; as well as erosion due to reduced or increased water; bared soil surface that had water cover drained away; or area now flooded that previously supported a drier vegetation type.
- **Road/Railroad Bed.** Along many streams road and railroad beds are constructed adjacent to the stream channel. These structures represent disruption to the bank integrity, to the bank vegetation.
- **Topographic Change.** This is the deliberate alteration of terrain for human purposes. It may be a result of earth moving by mining or construction activities, for aesthetic reasons (i.e., landscaping), or other reasons.
- **Impervious Surface.** Including hardened surfaces like roads, sidewalks, roofs, boat launches, or any human made surface from which water will run off, rather than infiltrate the soil.
- **Other.** List any other kinds of physical alteration not described above, and describe them in the space provided.

F26a-c. If pugging and/or hummocking is present in the polygon, record the percent of polygon area affected in **F25a**. Record the amount (**F25b**.) and distribution of the pugging/hummocks between area within the streambanks and area outside the banks in **F25c**.

Pugging is tracking depressions left by large animals (typically hoofed animals, but occasionally humans) left in fine textured soil. Moist clay or silt usually has a consistency to hold tracks. Upon drying, pugged areas will have a hard, irregular surface, difficult to walk across. Bare soil may or may not be present. ***Hummocking*** is a form of micro-topographic relief characterized by raised pedicels of vegetated soil as much as 0.6 m (2 ft) higher than the surrounding ground which results from long-term large animal trampling and tracking in soft soil. Vegetation on the pedicels usually differs from that on the surrounding lower area due to moisture difference between the two levels.

F27a, b. Record the number of springs or seeps observed in the polygon. ***For this item, the non-vegetated stream channel bottom is included in the inventoried area.*** This inclusion allows the recording of springs or seeps found in the bottom or lower banks of commonly dry channels.

F27c. Of those springs and seeps recorded in item F26b, record the number having livestock-caused pugging and/or hummocks on at least 25% of the wet area associated with the spring or seep.

F27d. Record the general position within the polygon of springs and seeps (e.g., upper 1/4 of polygon, middle 1/3 of polygon).

F28a-d. If the wetland type is a pooled channel stream, record the percent of channel length with pooled water. Indicate whether a portion of this water is expected to remain through the growing season. Describe location of pools in the polygon relative to boundaries or other mapped or described features.

F29. Record comments, observations, and/or conclusions as instructed on the form.

F30. Describe the boundaries of the polygon, especially the location of the upper and lower ends, as well as the lateral boundaries. On smaller streams the polygon usually includes the entire width of the riparian zone. Describe what you use as the indicators of the wetland-upland boundary. Use localized geologic, physical, or vegetation information to identify these boundaries of the polygon for future polygon relocation.

Additional Data Items

G1. Record the general aspect of the polygon in standard terminology (i.e., NE, SW etc), not degrees.

G2. Record the rating category that best describes the vegetation use by animals (Platts and others 1987). This is intended as a measure of herbivore utilization of available forage, including only current year growth. However, it may be extended to include human removal of this same forage by mowing or other means. Although Platts and others (1987) state that this available forage is mainly herbaceous, the concept is extended to also include normally utilized and available woody species. Record the category, not a precise value.

Percent Range	Description
0% to 25%	Vegetation use is light or none. Almost all plant biomass at the current development stage remains. Vegetative cover is close to that which would occur without use. Unvegetated areas (such as bedrock) are not a result of land uses.
26% to 50%	Vegetation use is moderate. At least half the potential plant biomass remains. Average stubble height is more than half its potential at the present stage of development.
51% to 75%	Vegetation use is high. Less than half the potential plant biomass remains. Plant stubble height is usually more than 5 cm (2 in) (on many ranges).
76% to 100%	Vegetation use is very high. Only short stubble remains (usually less than 5 cm [2 in] on many ranges). Almost all plant biomass has been removed. Only the root systems and parts of the stems remain.

G3a, b. Break down the polygon and the area adjacent to the polygon using the land uses (activities) listed to reflect what is contributing to the site health. Name any others observed.

No Land Use Apparent—using information provided as well as what is observed at the site suggests there is no human land use. Very light and well managed land uses that show little or no negative impacts should still be recored in the appropriate land use type, not "no land use;"
Turf Grass (Lawn)—ground has been broken and seeded or sodded;
Tame Pasture (Grazing)—lands that are purposefully converted to non-native species for the purpose of livestock grazing;
Native Pasture (Grazing)—refers to grazing environments that are usually dominated by native plants and may occur as grasslands or woodlands (i.e., land that has not been broken and seeded but may contain introduced/invasive species that have encroached due to land practices);
Recreation (ATV Path, Campsites, etc.)—various recreational activities for pleasure or enjoyment;
Development (Building, Corrals, Paved Lots, etc.);
Tilled Cropping—for the raising of crops, by plowing and harrowing;
Perennial Forage (e.g., alfalfa hayland)—herbaceous plants cultivated for livestock feed that have a life span of more than one year;

Roads—prepared/built surfaces used by vehicles;
Logging—process of cutting, processing, and moving trees to a location for transport;
Mining—extraction of valuable minerals or other geological materials;
Railroads—includes actual rail tracks and elevated lands they are built upon; and
Other—describe.

G4. Record the current type(s) of uplands adjacent to the lotic wetland, using these definitions:
Cropland: annual crop production cover;
Grassland: graminoid cover including perennial forage, herbaceous cover;
Shrubland: areas dominated by shrubs;
Forest: areas dominated by trees;
Other: describe.

G5a-c. Record any plant species observed that is listed or being considered for listing as threatened and/or endangered. Note the location of any threatened or endangered (T&E) species observed relative to polygon boundaries, stream, or other mapped features. More precise location can be determined using the GPS unit. If this is done, record the GPS unit number and the name or number of the waypoint designator in item G4c. Refer to the appropriate guide to determine which species to include. (***NOTE:*** This inventory is not a canvas for T&E species. Since this inventory focuses on the more abundant plant species, any T&E plants are likely to be overlooked.)

G6a, b. Underground water sources not recharged by flowing surface water and which are not at the surface in the polygon may still influence the vegetation of the polygon. If this situation is observed, describe it.

G7. The width to depth ratio is the bankfull channel width over the bankfull mean depth. Record both of these values in feet (meters) using numbers which represent averages over the length of the polygon. This expression should be retained as the ratio of two numbers. Do not reduce to a decimal fraction.

G8. Entrenchment ratio is the ratio of the flood-prone width to the bankfull channel width. Flood-prone width is measured at an elevation twice the maximum bankfull depth (one bankfull depth above the bankfull level). Record the range category which contains the average ratio for this polygon.

G9. Record the percent of exposed soil surface (bare ground) within the polygon which occurs on, or between, the actual streambanks and the percent of exposed soil surface (bare ground) which occurs outside the streambanks. The combined values must approximate 100%.

G10. Record the percent of streambank length accessible to large hoofed animals (livestock and wildlife). In general, only consider topography (steep banks, deep water, etc.) and dense vegetation as restricting access. Fences, unless part of an exclosure, do not necessarily restrict livestock access, even though they may appear to be doing so at the time.

G11a-d. Note the types and locations of any of the listed human-caused channel or streambank modifications observed within the polygon. Use other to note channel modifications observed but not included in this list.

G11e, f. Many channel modifications alter flow regimes and natural channel dynamics. Rate the stability of any channel modification according to your perception of probable high flow effects in the stream reach. Describe any apparent effects of the modifications on the immediate and downstream channel and banks.

Wildlife Data (These wildlife data represent incidental observations only.)
G12a-g. Record evidence of beaver activity in the polygon. Record whether the beaver sign appears current (active; meaning in the year of the survey) or old (inactive). Describe the types and amounts of beaver evidence observed.

NOTE: For the "Level of beaver activity (number of stems chewed)" question; a stem is referring to rooted woody material (stumps).

G13a, b. If waterfowl nests or young broods were observed, describe location, type, and whether the nest was in use, of the year, or old.

G14a-e. Respond to the fishery questions based on observations.

G15a, b. Record the type and number of any amphibians observed.

G16a, b. Record the type and number of any reptiles observed.

G17. If possible, record the species name, number of individuals, and sighting locations of amphibians and reptiles (e.g., lower 1/3 of polygon, throughout polygon, upper 1/4 of polygon).

G18a-d. List threatened and endangered animal species observed in the polygon along with any nesting sites. (Include the recently de-listed bald eagle.) Space is provided to list species observed. Consult relevant documents to determine appropriate species. Record the location in the polygon where animals or nests were sighted.

Photograph Data
NOTE: Take a number of photos upstream and downstream at each end of every polygon. This applies even to situations where the polygon is at one end of an inventoried reach and one of the photos is taken into a non-inventoried area, as well as situations in which another polygon is adjacent to the one being inventoried.

When recording the photo number, also provide the compass bearing of the direction of view, so that future evaluations will be able to photograph the same ground—***Example:*** #0028 (245°), #0029 (98°). Care should be taken to minimize influence the photograph location by trampling.

H1. Photos at the ***upstream*** end of the polygon. Take photos looking upstream and downstream. (Remember to record the lat/long of the photo location.)

H2. Photos at the ***downstream*** end of the polygon. Take photos looking upstream and downstream. (Remember to record the lat/long of the photo location.)

H3. Additional photos of the polygon. (A number of photos can be taken at each location. Remember to record the lat/long of the photo location.)

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