Nevada Partners for Conservation and Development
Pre and Post Habitat Treatment Vegetation Sampling Protocol

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Plot establishment

1. Team members navigate as close as possible to each random location using maps and GPS units. At the random location, a wooden center stake is driven into the ground and marked with the Plot ID. Transects are then laid out using the standard spoke design (Figure 1). Figure 2 provides a detailed view of each plot type to be sampled along the transects.
2. After the center point is established, three transects at 0° (true north), 120°, and 240° are assigned and placed for vegetation sampling using a compass. Transects can be adjusted from these bearings if obstructions (e.g., rock outcrop, unburned area in a burn-type plot, etc.) exist. Each transect begins 5 m from the center stake and extends 50 meters (Figure 1).
3. In each of the 3 directions, a survey tape is laid out and the beginning of the transect is marked and staked using rebar 5 m from the center. The tape is then laid out 50 m and the end of each transect is marked with a permanent stake (rebar) to ensure relocation.

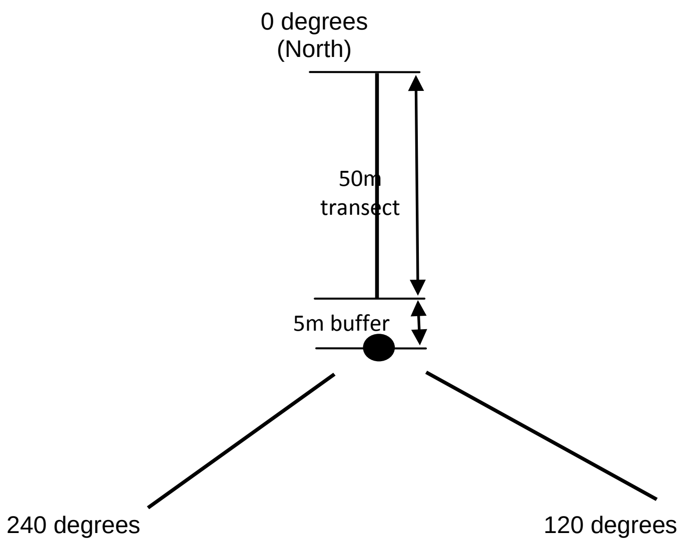

Figure 1. Plot layout based on the standard spoke design

4. Label the monitoring plot description form and checklist for the plot. Be sure to include: plot code, date, actual bearings of the sampling transects, personnel names and UTM coordinates of the plot center location.

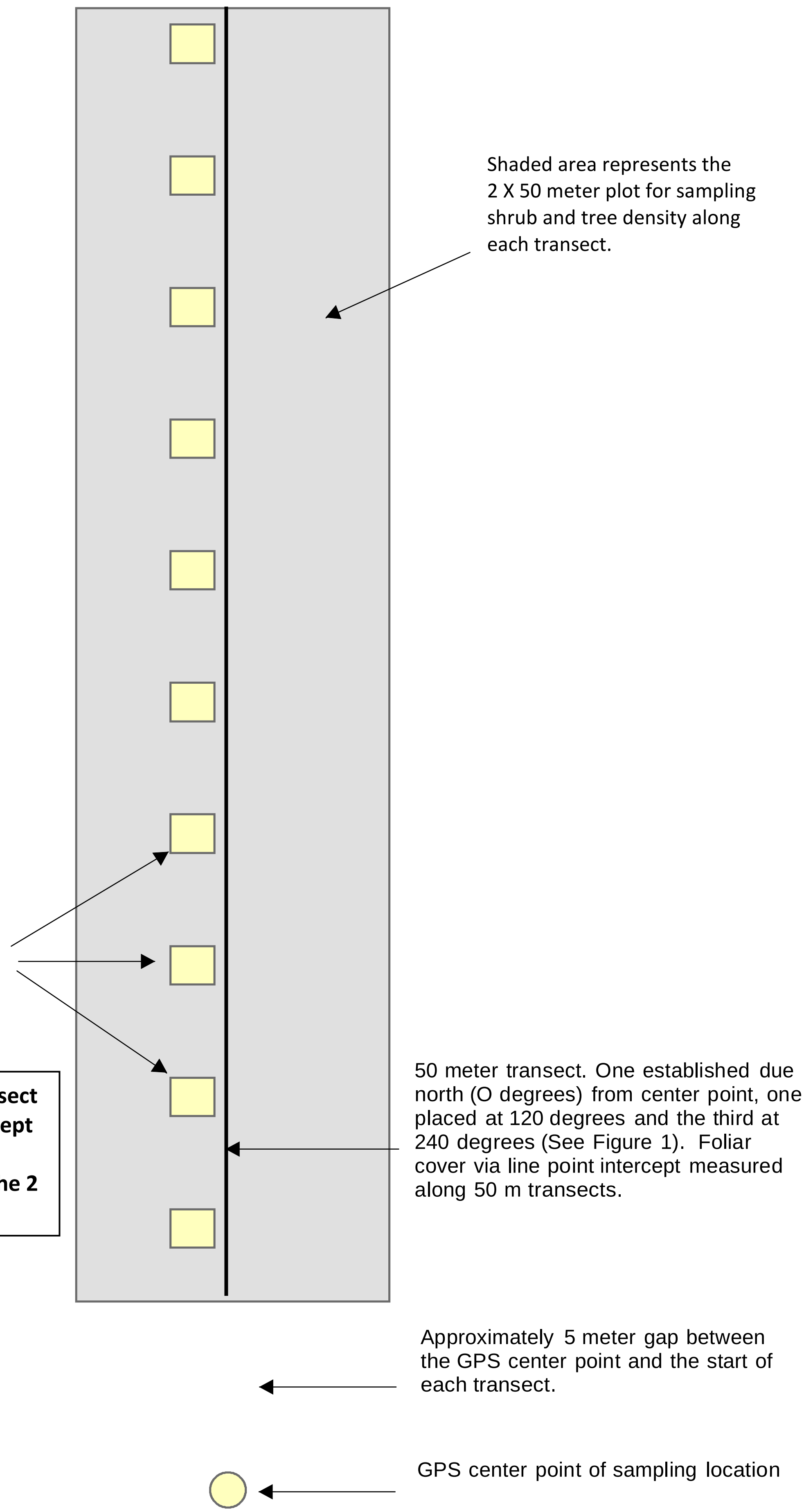

Figure 2. Detail view of one 50 m transect showing the 50 meter line point intercept plot, the 1 m^2 perennial grass and forb plots (only sampled at seedings) and the 2 X 50 m shrub and tree density plot.

Reference photos

Line photos are taken at each transect to document the conditions at the site.

Line photos

1. Label photo point ID board with the site, date, plot, transect, and transect direction. Lean it next to or hang it on the stake at 0 meters of the first transect.

2. Stand at plot center point and align camera in direction of the transect

3. Align photo so that the bottom of transect stake is at the photo's bottom center (Figure 3).

4. Take photo and name the file using plot info.

5. Repeat Steps 1 - 4 for the other two line transect photos.

Figure 3. Line photo example

Foliar Cover (Line-point intercept)

Line-point intercept is a rapid, accurate method for quantifying soil cover, including vegetation, litter, rocks and biotic crusts. These measurements are related to wind and water erosion, water infiltration and the ability of the site to resist and recover from degradation.

Materials

- **Measuring tape (50 meters)**
- **Two steel pins or rebar for anchoring tape**
- **One pointer—a straight piece of wire or rod, such as a long pin flag, at least 75 cm long and less than 1 mm in diameter**
- **Clipboard, Line-Point Intercept Data Form and pencil(s)**

Figure 4. **Transect line.**

Standard methods (rule set)

1. Pull out the tape and anchor each end with a steel pin (Figure 4).
Rules

1.1 Line should be taut.

1.2 Line should be as close to the ground as possible (thread under shrubs using a steel pin as a needle).

2. Begin at the "0" end of the line.

3. Working from left to right, move to the first point on the line at 1.0 meters (next point at 2.0 meters, 3.0 meters, 4.0 meters… out to 50.0 meters for a total of 50 points). Always stand on the right side of the line.

4. Drop a pin flag to the ground from a standard height of 5 cm above herbaceous canopy next to the tape.

4.1 The pin should be vertical.

4.2 The pin should be dropped from the same height each time. A low drop height minimizes "bounces" off of vegetation but increases the possibility for bias.

4.3 Do not guide the pin all the way to the ground. It is more important for the pin to fall freely to the ground than to fall precisely on the mark.

5. Once the pin flag is flush with the ground, record every plant species it intercepts. All plants must be identified to species.

5.1 Record the species of the first stem, leaf or plant base intercepted in the "Top canopy" column using the PLANTS database species code (http://plants.usda.gov/), a four-letter code based on the first two letters of the genus and species, or the common name.

5.2 If no leaf, stem or plant base is intercepted, record "NONE" in the "Top canopy" column (Figure 5).

5.3 Record all additional species intercepted by the pin.

5.4 Record herbaceous litter as "L," if present. Litter is defined as detached dead stems and leaves that are part of a layer that comes in contact with the ground. Record "W" for detached woody litter that is greater than 5 mm (or ~1/4 in) in diameter and in direct contact with soil.

5.5 Record each canopy species only once, even if it is intercepted several times.

5.6 If you can identify the genus, but not the species either use the PLANTS database genus code (http://plants.usda.gov) or record a number for each new species of that genus. ALWAYS define the genus portion of the code and the functional group at the bottom of the data form (*Artemisia* species = AR01).

5.7 If you *cannot* identify the genus, use the following codes:

AF# = Annual forb (also includes biennials)
PF# = Perennial forb
AG# = Annual graminoid
PG# = Perennial graminoid
SH# = Shrub

If necessary, collect a sample of the unknown off the transect for later identification.

5.8 Canopy can be live or dead, but only record each species once. Be sure to record all species intercepted.

6. Record whether the pin flag intercepts a plant base or one of the following in the "Soil surface" column.

GR = Gravel (2-75mm),
CB = Cobble (75-250mm)
ST = Stone (250-600mm)
BY = Boulder (>600mm)
BR = Bedrock
P = Plant base as ground cover
EL = Embedded litter
D = Duff
M = Moss
LC = Lichen crust on soil (lichen on rock is recorded as "R")
S = Soil that is visibly unprotected by any of the above

6.1 For unidentified plant bases, use the codes listed under 5.7.

7. Height of canopy. At 5 meter intervals (starting at 5 meters), record canopy height of shrub and herbaceous vegetation. Measure at highest point in a 25 cm diameter circle surrounding the mark on the tape.

Figure 5. Point falling on bare soil (NONE/S)

7. Tree Cover

7.1 Where tree cover is above the transect tape, a vertical densitometer will be used to determine the aerial cover for each tree species. (http://www.grsgis.com/publications/densdocumentation2008.pdf)
7.2 Place densitometer on the top of the pin flag, level using bubble indicators within the densitometer then record if tree branches, stems or needles intersect the crosshairs. Only record the tree species if the crosshairs are covered by a tree part. If there is no part of the tree intersecting the crosshairs then nothing is recorded. On the line point intercept data sheet the tree species would be recorded in the "Top Canopy" box.

Canopy Gap Intercept

Gap intercept measurements provide information about the proportion of the line covered by large gaps between plants. Large gaps between plant canopies are important indicators of potential wind erosion and weed invasion. Large gaps between plant bases are important indicators of runoff and water erosion.

Materials.
- **Measuring tape**
- **Two steel pins for anchoring tape**
- **Meter stick or other stiff stick**
- **Clipboard, Gap Intercept Data Form and pencil(s)**

Standard methods (rule set)
1. Pull out the tape and anchor each end with steel pin.
   1.1 Line should be taut.
   1.2 Line should be as close to the ground as possible (thread under shrubs using a steel pin as a needle).
2. Begin at the "0" end of the line.
3. Work from left to right, move to the first point on the line. Always stand on the same side of the line.
   3.1 Look straight down on the tape. Use a meter stick or other stiff stick to project a line vertically to the ground.
   3.2 Assume that there is a wall at each end of the tape. Do not consider gaps or vegetation that occur off the end of the tape.
4. Record canopy gaps between perennial vegetation (P only).
   4.1 Canopy gaps between perennial vegetation types greater than 20 cm are recorded.
   4.2 Record the beginning and end of each gap between plant canopies longer than 20 cm. When using the Rangeland Database, record "P only" canopy gaps in the "Canopy Gap" portion of the Gap Intercept data form.
   4.3 Canopy occurs any time 50% of any 3 cm segment of tape edge intercepts live or dead plant canopy based on a vertical projection from canopy to ground. Always read the graduated side of the tape.
   4.4 A plant canopy can stop a gap whether live or dead.
   4.5 Record the start and end of a gap to the nearest centimeter.
   4.6 Apply the same method each year.

Shrub Density

This should be done after all other transect measurements are complete because it requires the data collector to walk along the graduated side of the tape where all other measurements are taken from.

1. Shrub Density will be sampled on the 0° (true north), 120°, and 240° transects.
2. At each plot use a 2 m x 50 m belt transect
3. With the PVC pole perpendicular to the line, walk along each side of the transect and count the number of shrubs within 1 meter (on each side) of the tape.
4. All shrubs must be identified to species.

   Rules

   Shrub density counts are recorded by species.

   Use the following three different height classes

   - *Up to 15 cm or just above one's ankle*
   - *15-40cm or just above one's ankle to around the middle of one's thigh and*
   - *>40 cm*

   All dead shrubs will be counted and lumped into a 'dead' category.

   <u>Shrubs that straddle the 2 X 50 m plot boundaries</u>

   There will be individuals that straddle the boundaries of the plot. Plants that touch the side of the plot that is adjacent to the center point of the sampling location (Figure 1) and the right side (facing away from the center toward the 50 meter mark of the tape) will be counted as 'inside'. Plants that touch the other two sides of the plot will be counted as 'outside' and will not contribute to density measures (Elizinga et al 1998).

Perennial Grass and Forb Density *ONLY AT SEEDINGS*

This should be done after all other transect measurements are complete because it requires the data collector to walk along the graduated side of the tape where all other measurements are taken from.

1. Perennial Grass and Forb Density will be sampled on the 0° (true north), 120°, and 240° transects.
2. At each plot, locations of density sampling quadrats will be at 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 meters.
3. Each density quadrat will be 1 m^2.
4. Rare grasses and forbs should be captured in the 2 m x 50 m belt transect (See below)
5. All perennial grasses and forbs must be identified to species.

   Rules

   <u>Minimum number of individuals from a species</u>

   Set ten as the minimum number of individuals per species necessary to be detected using only quads at a sampling location. If fewer than ten individuals were counted within the 30 1m^2 plots, then also count that species in the shrub density transects.

   For example, we are interested in measuring bluebunch wheatgrass (Pseudoroegneria spicata (PSSP6)) density at a sampling location, first count PSSP6 in the 1 m^2 plots. If only five individuals were counted in the plots (total count for all 30 quads at the plot), count PSSP6 also in the shrub density transects.

   <u>Grasses and forbs that straddle the 1 m^2 quadrat boundaries</u>

   There will be individuals that straddle the boundaries of the quadrat. Plants that touch the side of the quadrat that is adjacent to the tape measure and the side nearest the center point of the sampling location (Figure 1) will be counted as 'inside'. Plants that touch the other two sides of the quadrat will be counted as 'outside' and will not contribute to density measures (Elizinga et al 1998).

Tree Density

This should be done after all other transect measurements are complete because it requires the data collector to walk along the graduated side of the tape where all other measurements are taken from.

1. Tree Density will be sampled on the 0° (true north), 120°, and 240° transects.
2. Along each 50 m transect a 2 m x 50 m belt transect will be sampled
3. With the PVC pole perpendicular to the line, walk along each side of the transect and count the number of trees within 1 meter (on each side) of the tape.
4. Use the following size classes:
   - 4.1 < 0.5 m tall
   - 4.2 > 0.5 m tall and:
     - 4.2.1 2-10 cm DRC
     - 4.2.2 11-20 cm DRC
     - 4.2.3 > 21 cm DRC
5. DRC is Diameter at Root Crown (ground level)

   Rules

   <u>Trees that straddle the 2 X 50 m plot boundaries</u>

   There will be individuals that straddle the boundaries of the plot. Trees whose trunks straddle the side of the plot that is adjacent to the center point of the sampling location (Figure 1) and the right side (facing away from the center toward the 50 meter mark of the tape) will be counted as 'inside'. Trees whose trunks straddle the other two sides of the plot will be counted as 'outside' and will not contribute to density measures (Elizinga et al 1998).

Soil stability test

The Soil stability test provides information about the degree of soil structural development and erosion resistance. It also reflects soil biotic integrity, because the "glue" (organic matter) that binds soil particles together must constantly be renewed by plant roots and soil organisms. This test measures the soil's stability when exposed to rapid wetting. It is affected by soil texture, so it is important to limit comparisons to similar soils that have similar amounts of sand, silt and clay (see Volume II, Appendix E for a simple field procedure to determine soil texture).

Materials:

- **Complete soil stability kits (see Appendix A in Vol. II for construction and suppliers)**
- **Deionized water (or any noncarbonated bottled water, except mineral water) 1 L (32 oz)**
- **Clipboard, Soil Stability Test Data Form (page 27) and pencil(s)**
- **Stopwatch**

Standard methods (rule set)

This is easier than it sounds! With a little practice, it takes about 10-15 minutes to sample and 10 minutes to test 18 samples.

1. Randomly select 18 sampling points and decide whether you will collect surface samples only (1 box), or surface and subsurface samples (2 boxes).

Rules

1.1 Use 18 randomly selected points along the transects used for line-point and gap intercept measurements.

1.2 Record sampling locations (points) under "Pos" on the data form.

1.3 Always sample at least 5 cm (2 in) from any vegetation measurement line.

1.4 Include subsurface samples if you are interested in soil erodibility after disturbance.

2. Determine the dominant cover class over the random point and enter this into the "Veg" column on the data form.

Rules

2.1 The area to be classified is effectively as large as the sample area (6-8 mm (1/4 in) in diameter).

2.2 Record the dominant cover class in the "Veg" column (optional):

NC	=	no perennial grass, shrub or tree canopy cover
G	=	perennial grass canopy and grass/shrub canopy mixture
F	=	perennial forb
Sh	=	shrub canopy
T	=	tree canopy

3. Collect a surface sample.

Rules

3.1 Excavate a small trench (10-15 mm (1/2 in) deep) in front of the area to be sampled (Fig. 13).

3.2 Lift out a soil fragment and trim it (if necessary) to the correct size.

3.3 The soil fragment should be 2-3 mm (<1/8 in) thick and 6-8 mm (1/4 in) in diameter (Figs. 14 and 15). This is the diameter of a wood pencil eraser. Try to fit sample in this dot (6-8 mm dia.).

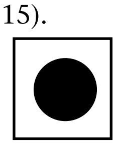

Figure 13. Excavate small trench.

Figure 14. Collect surface sample.

Figure 15. Ensure correct sample size.

3.4 Collect samples at the exact point. Move the sample point only if it has been disturbed during previous measurements or the soil surface is protected by a rock or embedded litter. Move the point a standard distance (1 m) and note this change on the data form.
3.5 Minimize shattering by: a) slicing the soil around the sample before lifting; b) lifting out a larger sample than required, and trimming it to size in the palm of your hand; or c) misting the sample area before collection (see 3.6).
3.6 If the soil sample is too weakly structured to sample (falls through the sieve), mist it lightly with deionized water (use an atomizer or equivalent) and then take a sample. Perfume and plastic hair spray bottles work well for this. If the sample still will not hold together, record a "1" on the data form.
3.7 If the soil surface is covered by a lichen or cyanobacterial crust, include the crust in the sample. If the sample is covered by moss, collect the sample from under the moss.
3.8 Gently place the sample in a dry sieve (Fig. 16); place sieve in the appropriate cell of a dry box.

4. Collect a subsurface sample (optional, see Step 1).
Rules
4.1 Sample directly below the surface sample.
4.2 Use the flat, square (handle) end of the scoop to gently excavate the previous trench (in front of the surface sample) to a depth of 3-4 cm (1 1/2 in).
4.3 Directly below the surface sample, remove soil so that a "shelf" is created with the top step 2-2.5 cm (3/4-1 in) below the soil surface (Fig. 17).
4.4 Use the scoop to lift out a subsurface sample from below (Fig. 18).
4.5 The soil fragment should be 2-3 mm (<1/8 in) thick and 6-8 mm (1/4 in) in diameter.
4.6 See steps 3.5-3.6. If you encounter a rock, record "R" and move to the next sample.
4.7 Place the sample in a dry sieve; place sieve in the dry box. Leave box lid open (Fig. 19).

Riparian note: No changes are needed for this method in riparian systems.

Figure 16. Place sample in sieve.

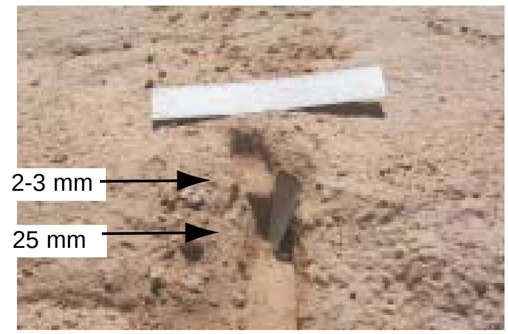

Figure 17. Excavate trench for subsurface sample.

Figure 18. Collect subsurface sample.

Figure 19. Complete soil stability kit with water and samples.

5. Make sure the surface and subsurface samples are dry.

Rules

5.1 Samples must be dry before testing. If samples are not dry after collecting, allow to air dry with the lid off.

5.2 Do not leave lid closed on samples for more than 1 minute on hot/sunny days. Excessive heat can artificially increase or decrease stability.

6. Fill the empty (no sieves) box with deionized or distilled water (Fig. 19).

Rules

6.1 Fill each compartment to the top.

6.2 The water should be approximately the same temperature as the soil.

7. Test the samples.

Rules

7.1 Lower the first sieve with the sample into the respective water-filled compartment—upper left corner of sample box to upper left corner of water box (Fig. 20).

7.2 From the time the sieve screen touches the water surface to the time it rests on the bottom of the box, 1 second should elapse.

7.3 Start the stopwatch when the first sample touches the water. Use Table 7 to assign samples to stability classes.

7.4 After five minutes, follow the sequence of immersions on the data form, adding one sample every 15 seconds. Beginners may want to immerse a sample every 30 seconds. This allows nine samples to be run in 10 minutes, so it takes 20 minutes to test one box of 18 samples.

Figure 20. Place first sample in water.

7.5 Observe the fragments from the time the sample hits the water to 5 min (300 sec) and record a stability class based on Table 7.

7.6 Raise the sieve completely out of the water and then lower it to the bottom without touching the bottom of the tray. Repeat this immersion a total of five times. Do this even if you have already rated the sample a 1, 2 or 3 (you are allowed to change your rating if after sieving, >10% of soil remains on sieve).

7.7 It should take 1 second for each sieve to clear the water's surface and 1 second to return to near the bottom of the box.

7.8 Hydrophobic samples (float in water after pushed under) are rated 6.

Bottlecap test
(Semiquantitative alternative)

Place a soil fragment in a bottle cap filled with water. Watch it for 30 seconds. Gently swirl the water for 5 seconds. Assign one of three ratings:

M= Melts in first 30 seconds (without swirling)
D= Disintegrates when swirls (but does not melt)
S= Stable (even after swirling)

Table 7. Stability class ratings.

Stability class	Criteria for assignment to stability class
1	50% of structural integrity lost (melts) within 5 seconds of immersion in water, **OR** soil too unstable to sample (falls through sieve).
2	50% of structural integrity lost (melts) 5-30 seconds after immersion.
3	50% of structural integrity lost (melts) 30-300 seconds after immersion, **OR** < 10% of soil remains on the sieve after five dipping cycles.
4	10–25% of soil remains on the sieve after five dipping cycles.
5	25–75% of soil remains on the sieve after five dipping cycles.
6	75–100 % of soil remains on the sieve after five dipping cycles.

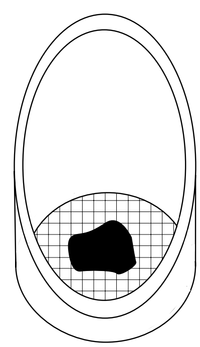

Figure 21. Sample in sieve, drawn to scale.

Sequence for stability class = 1.

Original sample | After 5 seconds | After 5 minutes | After 5 dips

Sequence for stability class = 4

Original sample | After 5 seconds | After 5 minutes | After 5 dips

Sequence for stability class = 5.

Original sample | After 5 seconds | After 5 minutes | After 5 dips

Sequence for stability class = 6.

Original sample | After 5 seconds | After 5 minutes | After 5 dips

Figure 22. The photos above illustrate the key steps of testing a soil sample for four different stability rankings. **Important note:** Some of the fragments shown in these samples may appear large. They are for illustration only. Be sure to follow the size guidelines (6-8 mm or 1/4 in) in Rule 3.3 and Fig. 21.

Soil Stability Test Data Form

Monitoring plot: ______________ Observer: ______________ Date: ______________

Recorder: ______________ Page _____ of _____

Veg = NC (no perennial canopy), **G** (grass or grass/shrub mix), **F** (forb), **Sh** (shrub), **T** (tree). **# = Stability value** (1-6)**.** Circle value if samples are hydrophobic.

Surface

Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip	
Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#
		0:00	5:00				0:15	5:15				0:30	5:30				0:45	5:45				1:00	6:00				1:15	6:15	
		1:30	6:30				1:45	6:45				2:00	7:00				2:15	7:15				2:30	7:30				2:45	7:45	
		3:00	8:00				3:15	8:15				3:30	8:30				3:45	8:45				4:00	9:00				4:15	9:15	

Notes: ______________

Subsurface

Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip	
Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#
		0:00	5:00				0:15	5:15				0:30	5:30				0:45	5:45				1:00	6:00				1:15	6:15	
		1:30	6:30				1:45	6:45				2:00	7:00				2:15	7:15				2:30	7:30				2:45	7:45	
		3:00	8:00				3:15	8:15				3:30	8:30				3:45	8:45				4:00	9:00				4:15	9:15	

Notes: ______________

Avg. Stability = Sum of Stability Rankings (i.e., #) / Total No. Samples Taken

	All samples		Protected samples (Samples w/Veg = G, Sh, or T)		Unprotected samples (Samples w/ Veg = NC)	
Line	Surface	Subsurface	Surface	Subsurface	Surface	Subsurface
Plot Avg.						

Soil stability indicator calculations

1. Calculate the average stability for all samples.

Rules

1.1 Add together all stability values. Divide this sum by the total number of samples taken. Record this value as the average stability for "All samples" on your data form.

2. Calculate the stability for protected soil (Veg = G, F, Sh, or T).

Rules

2.1 Add together all values that were protected by canopy (Veg = G, F, Sh, or T). Divide this sum by the number of samples in this group. Record this value as the average stability for "Protected samples" on your data form.

3. Calculate the average stability for unprotected samples.

Rules

3.1 Add together all stability values that were classified as no canopy (Veg = NC). Divide this sum by the number of samples in this group. Record this value as the average stability for "Unprotected samples."

4. Averages should be calculated separately for surface and subsurface samples.

Table 8. Data form and calculations example for soil surface samples.

Surface

Line 1										Line 2									
Pos	Veg	In time	Dip time	#	Pos	Veg	In time	Dip time	#	Pos	Veg	In time	Dip time	#	Pos	Veg	In time	Dip time	#
7	NC	0:00	5:00	3	28	NC	0:45	5:45	3	6	G	1:30	6:30	5	24	G	2:15	7:15	6
14	S	0:15	5:15	5	35	S	1:00	6:00	4	12	NC	1:45	6:45	1	30	S	2:30	7:30	3
21	G	0:30	5:30	6	42	G	1:15	6:15	5	18	S	2:00	7:00	4	36	NC	2:45	7:45	1

Avg. Stability = Sum of Stability Rankings (i.e., #) / Total No. Samples Taken

	All samples		Protected samples (Samples w/Veg = G, F, Sh, or T)		Unprotected samples (Samples w/o Veg = NC)	
Line	Surface	Subsurface	Surface	Subsurface	Surface	Subsurface
1	4.3		5.0		3.0	
2	3.3		4.5		1.0	
Plot Avg.	3.8		4.75		2.0	

Soil stability test basic interpretation

Increases in stability of both **surface** and **subsurface** samples reflect increased soil erosion resistance and resilience. Surface stability is correlated with current erosion resistance, while subsurface stability is correlated with resistance following soil disturbance. Sites with average values of 5.5 or above generally are very resistant to erosion, particularly if there is little bare ground and there are few large gaps. Maximum possible soil stability values may be less than 6 for very coarse sandy soils. High values usually reflect good hydrologic function. This is because stable soils are less likely to disperse and clog soil pores during rainstorms. High stability values also are strongly correlated with soil biotic integrity. Soil organisms make the "glue" that holds soil particles together. In most ecosystems, soil stability values decline first in areas without cover (Veg = NC). In more highly degraded systems, Veg = Canopy values also decline.

Use these indicators together with the indicators from the **Line-point intercept** and the **Gap intercept** to help determine whether observed erosion changes are due to loss of cover, changes in vegetation spatial distribution or reduced soil stability. For more information about how to interpret these indicators, please see Chapter 17 in Volume II.

	Typical effect on each attribute of an increase in the indicator value		
Indicator	**Soil and site stability**	**Hydrologic function**	**Biotic integrity**
All samples	+	*	+
Veg = Canopy	+	*	+
Veg = NC	+	*	+

* Usually positive, but can be negative for hydrophobic (water-repellent) soils. Large increases in water repellency (after a very hot fire) can negatively affect soil and site stability by increasing the amount of runoff water available to erode soils downslope.

References used

Elzinga CL, Salzer DW and Willoughby JW. 7998. Measuring and Monitoring Plant Populations. BLM Technical Reference 1730-1.

Forbis, T., L. Provencher, L. Turner, G. Medlyn, J. Thompson and G. Jones. 2007. A Method for Landscape-Scale Vegetation Assessment: Application to Great Basin Rangeland Ecosystems. *Rangeland Ecology and Management* 60:209-217.

Herrick J., J. Van Zee, K. Havstad, L. Burkett and W. Whitford. 2005. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. Vol II: Design, Supplementary Methods and Interpretation. Tucson AZ. Univ of Arizona Press. 200p.

Monsen, S., R. Stevens, and N. Shaw. 2004. Restoring Western Ranges and Wildlands. Gen. Tech. Ref. RMRS-GTR-136-Vols I, II, III. USDA Rocky Mntn Res. Station.

Pellant, M., D. Shaver, D. Pyke and J. Herrick. 2005. Interpreting Indicators of Rangeland Health, Ver.4. Tech Ref 1734-6. USDOI, BLM.

Gear Needed

- 50 Meter tapes (4 per crew of 2 people)
- 2 Meter 1" PVC pipe for belt transect (Total of four sections if measuring grass density)
- GPS accurate to approx. 1 meter
- Compass
- Pin flags at least 75 cm tall
- Digital cameras
    - Spare batteries
    - Spare memory cards
    - Charger for vehicles
- Densitometers
- Topo maps
    - Electronic
    - Paper
- White Board for plot info photos
    - Dry Erase markers
- Hand lenses
- Plant Press
    - Cardboard
    - Drying sheets
    - Newspaper
- 5 gallon bucket with tool caddy
- Soil Stability kits (small container of water)
- Intermountain Flora
- Various photo books of Great Basin plants
    - Sagebrush Country: A Wildflower Sanctuary. R. J. Taylor (author) and K. Ort (editor)
    - Shrubs of the Great Basin: A Natural History. Hugh Mozingo
    - Weeds of the West. Tom Whitson
    - Intermountain Flora. All Volumes. Various authors.
    - Great Basin Wildflowers: A Guide to Common Wildflowers of the High Deserts of Nevada, Utah and Oregon (Wildflower Series). Laird Blackwell.
- Tablet Computer
    - DIMA database loaded http://jornada.nmsu.edu/monit-assess/dima
- Paper copies of datasheets in the event of tablet computer problem

DATA FORMS

Photo Point
Line Point Intercept
Canopy Gap
Shrub, Perennial Forb and Perennial Grass Density
Soil Stability Test

Site:

Date:

Plot:

Line #:

Direction:

Photo point ID card

Gap Intercept Data Form

Monitoring plot: ________ **Line:** ___________ **Date:** ________ Shaded cells for calculations

Reader: ______________ **Recorder:** ________ **Line Length** ___m or ft **Page**___of ______

Circle one: includes only perennial vegetation OR includes annual and perennial vegetation													
Canopy gaps: Minimum size = _cm (__ft)							**Basal gaps: Minimum size = _cm (__ft)**						
Starts	Ends	Gap (cm)	25-50	51-100	101-200	>200	Starts	Ends	Gap (cm)	25-50	51-100	101-200	>200
		size (ft)	1-2	2.1-3	3.1-6	>6			size (ft)	1-2	2.1-3	3.1-6	>6
SUM (cm/ft)							SUM (cm/ft)						
LINE LENGTH (cm/ft)							LINE LENGTH (cm/ft)						
SUM ÷ LINE LENGTH							SUM ÷ LINE LENGTH						

	x 100	x 100	x 100	x 100		x 100	x 100	x 100	x 100
% of line in gaps					**% of line in gaps**				

Example: If SUM 25-50 = 1,573, Line Length = 5,000 cm, then % of line in gaps 25-50 cm = 100 x (SUM 25-50/line length) = 100 x (1,573/5,000) = 31.5%.

Density Data Form

Monitoring Plot:	Date:
Reader:	Recorder:

Tree Size Class A=<0.5 m tall	B=1-10cm DRC	C=10-20cm DRC	D=>20cm DRC
(DRC= Diameter Root Crown)			
Shrub Size Class A= up to 15 cm tall		Shrub Size Class B=15-40 cm	Shrub Size Class C >40 cm

Record perennial grass and forb species tallies and totals under size class A column

Line:				Direction:				
Species	A (tally)	Total	B (tally)	Total	C (tally)	Total	D (tally)	Total

Soil Stability Test Data Form

Monitoring plot: ______________________ **Observer:** ______________________ **Date:** ______________________

Recorder: ______________________ **Page** _____ **of** _____

Veg = NC (no perennial canopy), **G** (grass or grass/shrub mix), **F** (forb), **Sh** (shrub), **T** (tree). **# = Stability value** (1-6)**.** Circle value if samples are hydrophobic.

Surface

Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip	
Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#
		0:00	5:00				0:15	5:15				0:30	5:30				0:45	5:45				1:00	6:00				1:15	6:15	
		1:30	6:30				1:45	6:45				2:00	7:00				2:15	7:15				2:30	7:30				2:45	7:45	
		3:00	8:00				3:15	8:15				3:30	8:30				3:45	8:45				4:00	9:00				4:15	9:15	

Notes: ____

Subsurface

Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip	
Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#
		0:00	5:00				0:15	5:15				0:30	5:30				0:45	5:45				1:00	6:00				1:15	6:15	
		1:30	6:30				1:45	6:45				2:00	7:00				2:15	7:15				2:30	7:30				2:45	7:45	
		3:00	8:00				3:15	8:15				3:30	8:30				3:45	8:45				4:00	9:00				4:15	9:15	

Notes: ____

Avg. Stability = Sum of Stability Rankings (i.e., #) / Total No. Samples Taken

Line	All samples		Protected samples (Samples w/Veg = G, Sh, or T)		Unprotected samples (Samples w/ Veg = NC)	
	Surface	Subsurface	Surface	Subsurface	Surface	Subsurface
Plot Avg.						