# RECLAMATION SITE MONITORING

**Draft Protocol 7/14/2017**
**Consistent with the BLM Core Terrestrial Indicators and Methods (see Volume I of the *Monitoring Manual for Grassland, Shrubland, and Savannah Ecosystems* 2nd ed.)**

**Questions? Contact Emily Kachergis, BLM Landscape Ecologist (ekachergis@blm.gov)**

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**Figure 1. Reclamation site in Western Colorado.**

The effects of oil and gas extraction activities are intensive and localized on the landscape. The use of heavy machinery and vehicles and the installation of subsurface equipment results in the damage or removal of both vegetation and soil. Once a facility is installed or equipment is removed, reclamation measures are usually required to mitigate the impacts of these disturbances. Such actions may include replacing soil that was removed from the site during construction, recontouring, reseeding, and removing heavy equipment. By their nature, these reclaimed areas (Figures 1 and 2) will initially, and for some time after reclamation, differ from undisturbed areas around them. Consequently, monitoring the success of reclamation activities is often an important land management objective.

Monitoring reclamation areas poses challenges not found on typical monitoring plots. Often these sites are shaped and sized in such a way that a circular or standard plot-shape will intersect the boundary of the area and extend into the surrounding, undisturbed area. Additional factors such as the systematic distribution of vegetation in seeding rows may also bias plot measurements (Figure 2). Alternative monitoring protocols, such as adjusting the plot layout and adding supplemental indicators, may be necessary to enable collection of data that meet reclamation monitoring objectives.

This draft protocol is intended to be used as a template for field offices planning reclamation monitoring—particularly the vegetation component. Rules apply to an individual reclamation site to be monitored. Broader sample design considerations and how reclamation monitoring is connected with landscape monitoring will be discussed in the Reclamation chapter of Volume II of the *Monitoring Manual for Grassland, Shrubland, and Savannah Ecosystems, 2nd ed.* (forthcoming).

**Figure 2. Large reclamation site with evident seeding rows in Western Colorado.**

Transect direction and length:

Where a plot falls on a right of way, well pad, or similar area where the shortest edge-to-edge distance is less than 64 m, the radial or spoke plot layout (see Volume I) should not be used. Instead, parallel transects should be established. The following guidelines (Rules 2-4) are for establishing consistent plots in this style.

**Standard Methods (Ruleset)**

1. Review the core indicators and select supplemental indicators if necessary.
2. Define your monitoring area.
3. Assess monitoring area characteristics to determine the most appropriate plot layout and transect configuration. The boundaries of a disturbed area are considered to be the interface of the disturbed area with the surroundings which were not affected by that same disturbance (e.g., a road might define one boundary for a drill pad).
4. Establish transects.
5. Collect data.

1. Review the core indicators and select supplemental indicators if necessary.

Rules

1.1 The core terrestrial indicators and methods are recommended for reclamation monitoring: bare ground, vegetation composition, plant species of management concern, invasive species, vegetation height canopy gaps, and soil aggregate stability. See Volume I for methods.

1.2 When the core indicators are not sufficient to address your objectives, select supplemental indicators that do address them. For example, density of desired plant species is a common supplemental indicator in reclamation areas.

2. Define your monitoring area

Rules

2.1 If a GIS polygon shapefile exists for the disturbed area, use that shapefile to define the expected boundaries of your study area.

2.2 If there is no pre-existing polygon shapefile, consider digitizing one by using written documentation of the area, from remotely sensed imagery or an existing point feature class.

2.3 Where observed boundaries for the disturbed area do not coincide with existing documentation or digitized areas, use the observed boundaries at the survey area and record them for future use.

3. Determine the most appropriate plot layout

Rules

3.1 If a plot falls in a disturbed area where there are clear rows of vegetation from reseeding OR the boundaries of the reclamation area are too close for the full extent of a radial or spoke plot layout to fall within them, then set up parallel transects (Figure 3).

3.1.1 If a plot falls in a disturbed area with clear rows of vegetation from reseeding, then orient transects so that the transects are perpendicular to the seeding rows and, where possible, parallel to one another (Figure 3b, d).

3.1.2 If a plot falls in a disturbed area without clear rows of vegetation from reseeding, then adjust the transect orientation so that the transects are perpendicular to the major axis (Figure 3a), or, if no major axis exists, follow a random orientation (Figure 3c).

3.2 If a plot falls in an area that has NEITHER clear rows of vegetation from reseeding NOR boundaries too restrictive to contain the full extent of a radial plot layout, then use an upland radial or spoke plot layout. See Volume I of the *Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems, 2nd edition* for rules regarding upland spoke design plots.

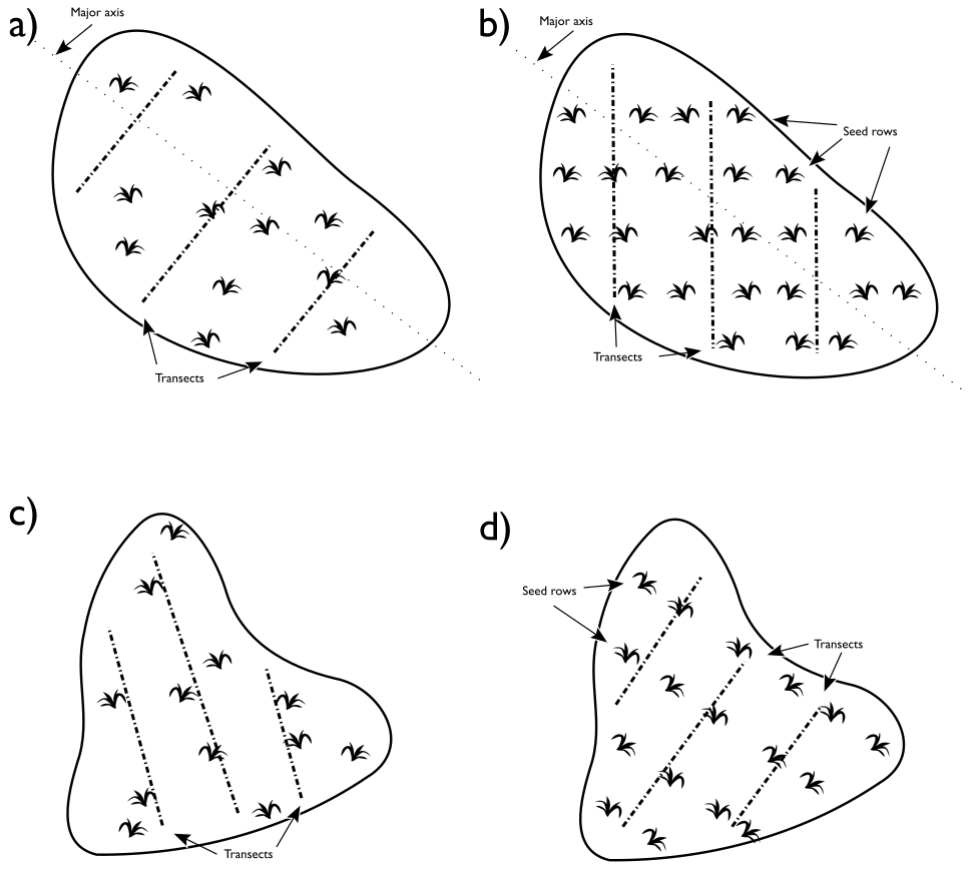


Figure 3. Transect orientation is adjusted based on the features of the monitoring area. In a disturbed area without seed rows, parallel transects are placed perpendicular to the major axis of the disturbed area (a). In a disturbed area with seed rows, parallel transects are placed perpendicular to the seed rows regardless of the presence or orientation of a major axis (b, d). In a disturbed area with neither seed rows or an obvious major axis, parallel transects are placed oriented in a direction randomly selected at the time of the survey (c).

4. Establish transects

Rules

4.1 Space transects evenly across the area. The preferred distance between transects is a 20 m minimum, which should be used when there are no other constraints to spacing. For example, this distance would be appropriate for a pipeline corridor where the boundaries of the disturbed area could permit much greater spacing. Tighter spacing (e.g., 10 m) can be used when the monitoring area is small. Avoid running transects closer together than 2 m.

4.2 Transects should begin and end at least 2 m from the edge of the disturbance area. This ensures that data gathered are from the disturbed area only and not from the surroundings.

4.3 Irregularly-shaped disturbance areas may mean that transects will be different lengths. This is acceptable as long as data are gathered at the same intervals along each (*e.g.,* line-point intercept sampling taking place every 50 cm) and at least 150 line-point intercept samples are taken across the plot.

4.4 If there are clear rows of vegetation from reseeding, all transects should be run perpendicular to those seed rows (see 3.1; Figure 3). Note that in some cases this may result in non-parallel transects. Also, adjust your point interval spacing to 0.5 to 1.5 times the width of the seeded row spacing to ensure an adequate sample (e.g. if the seed rows are 30 cm apart (12 inches) then space points every 45 cm, starting at 0).

4.5 If there are no clear rows of vegetation from reseeding, then transects should be run perpendicular to the longest axis of the reclamation area with their starting points closest to the northeasternmost edge. In the case of pipelines this will be obvious. Where the longest axis is not evident, then select a random direction and run the transects along it.

4.6 A reasonable default parallel transect plot layout is three, 25 m parallel transects spaced 20 m apart This is approximately one third the size of a standard AIM plot. Species inventory data between a reclamation plot and a standard AIM plot should not be compared.

5. Collect data.