

**Manti-La Sal & Fishlake National Forests**  
**Existing Vegetation Mapping Project**  
**Field Reference Data Collection Protocol**  
DRAFT - 4/17/2014

## **Introduction**

This document describes the field reference data collection procedures for the Manti-La Sal and Fishlake National Forest Existing Vegetation Mapping Project. Topics covered in this guide include an overview of field reference site selection, a description of sites and types of plots, field materials, data collection protocols, and detailed instructions on populating the field data form. These procedures have been established following direction in the USFS Existing Vegetation Classification and Mapping Technical Guide (GTR WO-67) as well as guidelines from the Remote Sensing Applications Center and Intermountain Region.

## **Background**

The Manti-La Sal and Fishlake National Forests are responsible for managing vegetation to meet a variety of uses while sustaining and restoring the integrity, biodiversity, and productivity of ecosystem components and processes. In building the knowledgebase required to accomplish this mission, existing vegetation information is collected through an integrated classification, mapping, and quantitative inventory process. This information structure is essential for conducting landscape analyses and assessments, developing conservation and restoration strategies, and revising land management plans that guide project development and implementation.

The collected data will be used to create a mid-level (1:100,000 scale) map of current (existing) vegetation communities across the Manti-La Sal and Fishlake National Forests. Data gathered will include information on species composition, canopy cover, and tree diameter. Dominance type and corresponding vegetation type map unit are determined using the *Manti-La Sal and Fishlake Vegetation Keys*. Percent canopy cover and related canopy cover map unit are identified using ocular estimation and line intercept methods. Canopy cover is estimated based on an overhead or “birds-eye” view of the plot from above. Vegetation canopy overlap is not considered. Tree diameter and associated tree size map unit are determined using diameter at breast height or diameter at root collar estimates. All collected data will be recorded in electronic format in the field reference database.

## **Field Reference Site Selection**

A primary objective of reference data collection is to sample the vegetation communities and other landcover types occurring across the project area. A sufficient number of field samples are required for each of the proposed vegetation types to be mapped. In an effort to meet this objective, 1,300 pre-selected reference sites have been distributed across the project area. In addition, 20 sites have

been placed within the Dark Canyon Wilderness Area on the Manti-La Sal Monticello District (pending contract option).

To minimize variation in ecological and vegetation characteristics for the purposes of modeling and mapping across expansive areas, the project area has been divided into two geographic areas (Figure 1). The number of sites allocated to each geographic area (GA) has been based on an analysis of existing vegetation data distributions, satellite image spectral variability, and the relative size of each GA. Approximately 1,000 sites have been placed in GA-1 and 300 sites in GA2 (subject to finalizing the project sample design). Within each GA, a multi-level stratification approach was used to 1) distribute a portion of sites evenly across an unsupervised satellite image spectral classification and 2) distribute the remaining sites based on the relative abundance of combined spectral and existing vegetation strata.

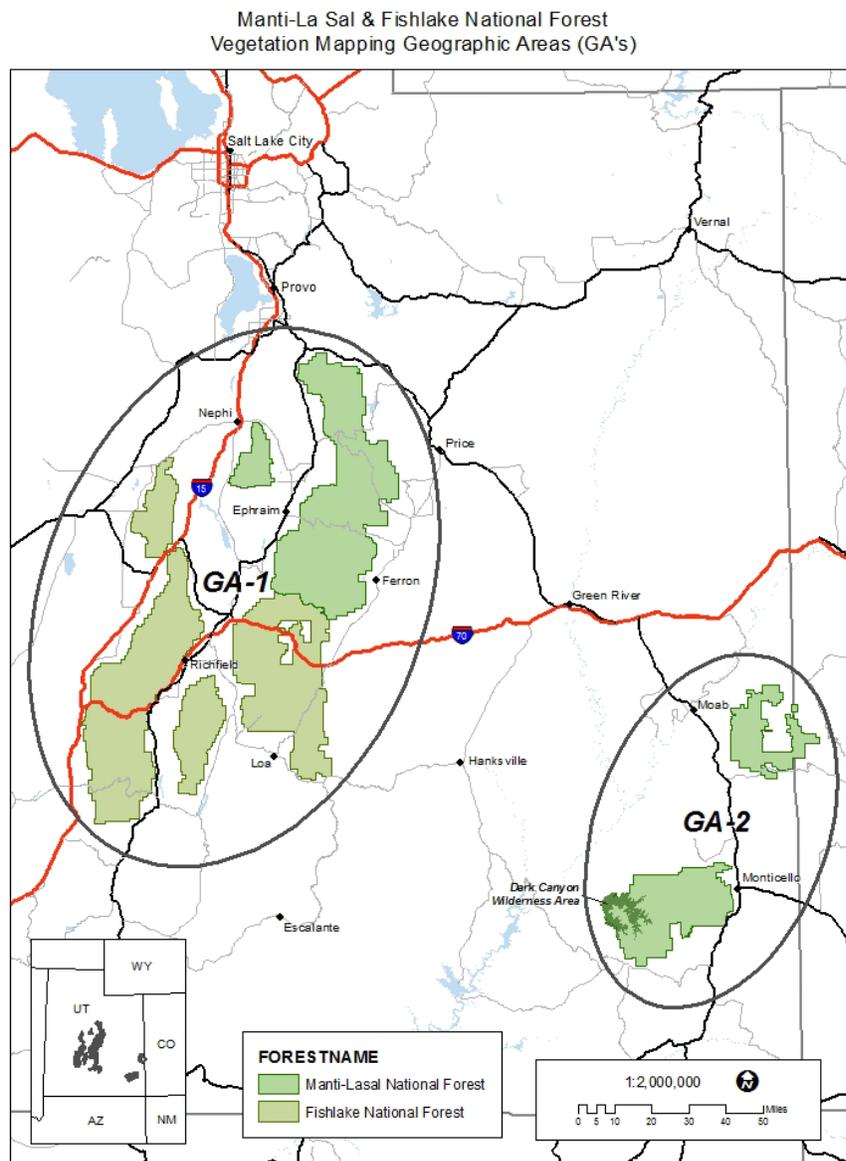


Figure 1. Project Geographic Areas (GA's).

Due to the inherent constraints in accessing remote and extensive areas across the entire project area, sites have generally been selected within a quarter mile of a road or along trails. Consequently, sites for this project do not constitute a random sample of the mapping area, and have not been established along a systematic grid or other sampling scheme. Some sites may be located behind gates of seasonally closed roads or in roadless areas. Any sites located in designated wilderness areas require non-motorized access and possible overnight camping.

## **Field Reference Sites and Types of Plots**

Field reference sites consist of polygons representing relatively homogeneous vegetation patches or stands and non-vegetated elements. Each of these sites contains a predetermined number and distribution of descriptive and/or observation plots as described below. No site contains more than three plots.

Field information is collected using two plot protocols:

- Descriptive Plots
- Observation Plots

### *Descriptive Plots*

Descriptive plots are established to collect vegetation composition data consisting of percent canopy cover by life form, canopy cover by species of the predominant life form, and tree species canopy cover by diameter class. For forest, woodland, and shrubland plots, canopy cover by species is estimated using ocular estimates, and optionally measured using line intercept transects. For herbaceous plots, ocular estimates are used to determine cover by graminoid and forb species. Finally, for forest and woodland plots, cover for tree species by diameter class is ocularly estimated. The resulting cover data are then applied to the vegetation keys and structure characteristic classifications to assign dominance type and map unit attributes including vegetation type, vegetation group, canopy cover and tree size.

One descriptive plot is collected for 800 of the 1300 reference sites, and 20 of the 20 sites within the wilderness area. Descriptive plots provide detailed information on dominance type and map unit description information, and help to calibrate field crews for *observation plot* estimates below. No more than one descriptive plot is contained within a given a reference site.

### *Observation Plots*

Observation plots are collected using ocular estimates to assign dominance type, and vegetation type, vegetation group, canopy cover, and tree size map unit attributes. Unlike descriptive plots, the purpose of collecting observation plots is to quickly and efficiently collect several plots across a reference site for characterizing composition and variability without collecting detailed information.

The number of observation plots collected within a reference site varies between two and three plots depending on whether the site contains a descriptive plot. No more than three observation plots are contained within a given reference site.

## Provided Field Materials

Field crews have been provided the following field materials to support data collection.

- Field data collection protocol and forms: This guidance document and field data collection forms for recording reference site and plot information in the field. Procedures for collecting tree and shrub transect data are included in a separate document and form.
- Vegetation keys and map units: Dichotomous keys to vegetation formations and dominance types, and crosswalks to vegetation group and vegetation type map units. A summary of vegetation type map units and codes is found in the appendices to the keys and Appendix B of this document.
- Structural characteristic map units: Tree and shrub canopy cover, and tree size map units. Map units and codes are included on the field data collection form and in Appendix B of this document.
- Field reference site/plot list and digital plot waypoints: A list of reference site/plot ID's, and digital plot waypoints for uploading to GPS units.
- Field overview map (~1:250,000 scale): National Forest extent, poster-size map depicting all reference site locations, site ID's, and an index grid of field navigation maps below.
- Field navigation maps (~1:50,000 scale): Reduced extent, poster-size maps displaying reference site locations, site ID's, and detailed travel routes.
- Reference site maps (~1:3,000 scale): Limited extent, 8.5 x 11 inch, high resolution imagery maps containing the reference site polygon, and plot locations and coordinates (waypoints) within the polygon.

## Sampling Process

The sampling process involves three main steps: planning, navigation, and data collection.

### *Step 1 - Planning*

Before leaving the office, each crew should know where they are going, understand the information to be collected, and have the appropriate gear to complete the task. Review the overview and navigation maps to determine the best travel routes. Check with your supervisor and/or crew lead before leaving. Coordinate with designated Forest personnel to ensure access before leaving for the field.

Gear check list:

- |                                    |                                    |
|------------------------------------|------------------------------------|
| - GPS unit                         | - Clinometer                       |
| - Digital camera                   | - Densitometer (optional)          |
| - Batteries (GPS and camera)       | - 100ft tape                       |
| - Navigation & reference site maps | - Diameter tape                    |
| - Vegetation keys                  | - Compass                          |
| - Field data forms                 | - Biodegradable flagging           |
| - Pencils                          | - Whiteboard or 3 x 5" cards, etc. |

### Step 2 - Navigation

You have been provided with the coordinates of the reference site centers, plot locations within the reference sites, navigation maps, and individual reference site location maps depicting high resolution aerial imagery to aid in navigating (Figure 2). Digital waypoint coordinates should be preloaded on the GPS unit. Reference sites have been located generally within ¼ mile of a motorized route or foot trail in backcountry areas to make them readily accessible. However, there is no guarantee that sites will be accessible. If you cannot get to a site due to access limitations or safety concerns, record it as not observable, note the specific reason(s), and move on to the next site.

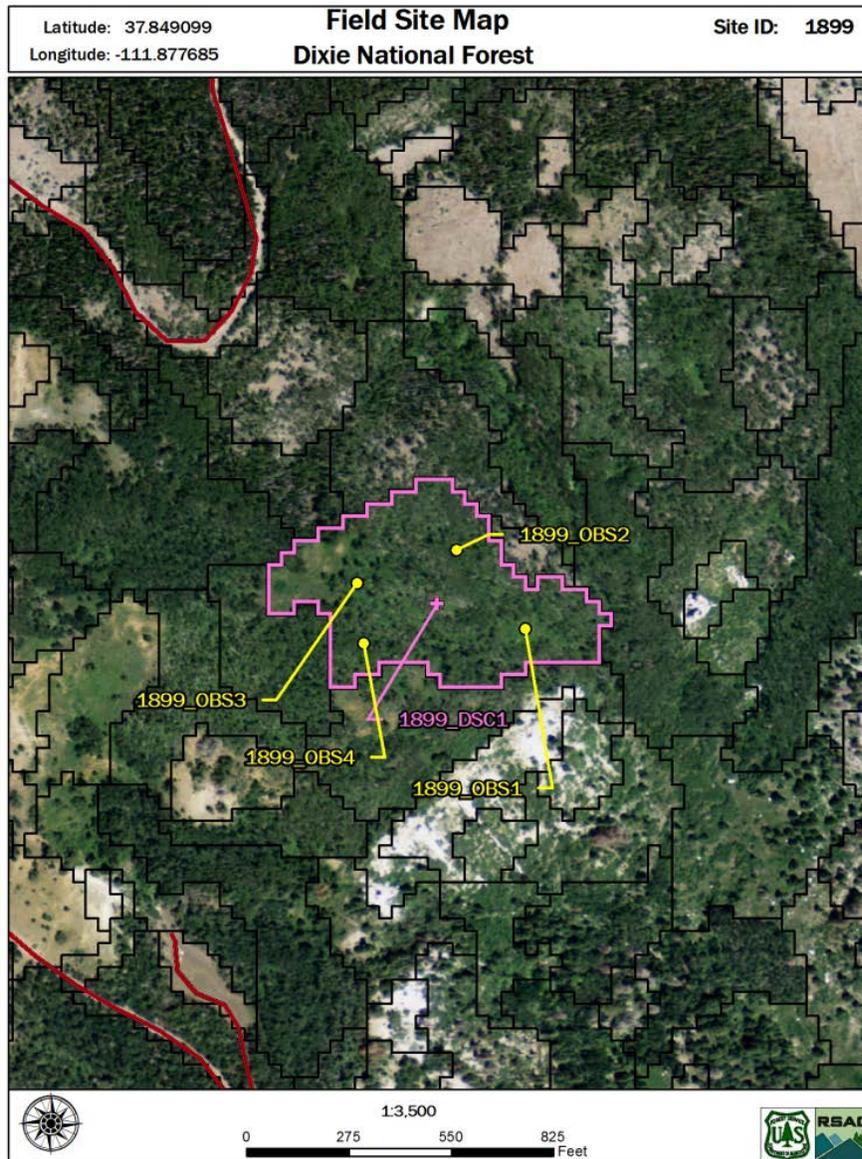


Figure 2. Reference site map depicting a reference site, site coordinates, descriptive and observation plot locations, and roads/trails (example from Dixie NF project – Manti-La Sal & Fishlake example, containing no more than 3 total plots, to be included).

### *Step 3- Data Collection*

#### *Descriptive Plots*

As previously noted, one descriptive plot is collected for 800 of the 1300 reference sites. These plots are annotated on the reference site map using the identifier *DSC* followed by the plot number. Navigate to the waypoint location and place flagging at the plot center. The dimension of each plot consists of a 50 foot radius circle *corrected for slope if 10 percent or greater*. Measure and flag the plot boundaries in each cardinal direction from the center of the plot. Do not adjust for magnetic declination. In designated Wilderness Areas, use sticks or rock cairns to mark the plot instead of flagging.

Estimate all vegetation data within the plot area from an overhead or “bird’s-eye” view of the plot from above. Again, vegetation canopy overlap is not considered, therefore total vegetative/non-vegetative cover for the plot area must equal 100%. It is important to walk through the entire plot before recording the most abundant species, percent canopy cover, and cover by tree diameter class. It may also be helpful to mark out a 5 foot radius subplot representing 1 percent of the plot area to assist in calibrating your estimates.

#### *Observation Plots*

Between two and three observation plots are collected within each reference site. These plots are annotated on the reference site map using the identifier *OBS* followed by the plot number. Again, navigate to the waypoint location of the plot and place flagging at the plot center. In designated Wilderness Areas, use sticks or rock cairns to mark the plot instead of flagging. The dimension of each plot consists of a 50 foot radius circle *corrected for slope if 10 percent or greater*. It is not necessary to flag the plot boundaries. Walk through the plot and apply the same logical procedures used for the descriptive plots to ocularly estimate a dominance type, and vegetation type, vegetation group, canopy cover, and tree size map unit. These plots are meant to be quick, using your best judgment based upon experience gained from collecting descriptive plots.

### **Data Collection Forms**

This section provides information on how to populate the field data forms.

#### *Field Reference Site Information*

1. Reference Site ID: Record the 4-digit site number as identified on the reference site map.
2. Names of collectors: Record the names of the personnel collecting the data by first initial and last name (e.g. J. Doe), or full names to maintain unique crew member identification as needed.
3. Month/Day/Year
4. Access Code: Record the reference site access code as “ACC” for accessible, and “NO” for not observable. (If any *plots* within the reference site are inaccessible, provide a comment in the Notes section for the individual plot.)

5. Geographic Area: Record the geographic area (GA) that the site is located in as identified on the reference site map.

Descriptive Plot Data Items

6. Plot Type: The plot type is “DSC” for a descriptive plot
7. Plot ID: The plot ID is “1” for a descriptive plot (never more than one within a reference site).
8. Latitude/Longitude Decimal Degree Coordinates: Record the coordinates for the center of the plot. It is important to collect positions **from the plot center**, so be at the center to start collection. You should try to collect 180 readings or 100% sample confidence depending on the GPS unit. Fewer than 90 readings or 50% sample confidence must be documented in the Notes section.

GPS units must be set to the following coordinate system:

Latitude/Longitude Decimal Degrees  
WGS84

9. Field Photograph: Take a single representative photo of the plot (more can be taken if necessary) and record the digital photo number and bearing. Take the photo from the plot center in a direction that captures a representative view of the vegetation characteristics contained within the plot. Use a whiteboard or other placard depicting the plot identifier and direction including the reference site ID, plot type and number, and compass bearing direction (e.g. 1024-DSC1-90). Do not adjust for magnetic declination. Upon uploading the photos to a computer, ensure the files are named/renamed to match the plot identifier.
10. Ocular Plot Composition: (Estimated from an overhead perspective of the plot from above). Estimate and record the total canopy cover for each life form including tree, shrub, herbaceous (graminoids and forbs), and non-vegetated. See the vegetation keys for a list of species by life form. Determine percent cover as if you were looking down on the stand from above the plot; do not double count overlapping layers that are not viewable from above. For example, smaller-sized trees being overlapped by larger ones are ignored and not counted in the canopy cover estimate. The sum of canopy cover for trees, shrubs, herbaceous and non-vegetated must total 100%. If the dominant plant species encountered on the site consists of a forb or grass (e.g. cheatgrass - *Bromus tectorum*) in a senesced condition, record the appropriate plant symbol and estimated live percent cover of the plant instead of recording the cover as non-vegetated litter. Cover estimates for nonvascular life forms (e.g. lichen, moss, etc.) are included in the non-vegetated category.

Based on the life form cover estimates, determine the dominant life form using the *Key to Vegetation Formations*. For the dominant tree, shrub, or herbaceous life form identified, list up to the 5 most abundant species having  $\geq 5\%$  (11.2 foot radius circle) cover. For each species, record the USDA PLANTS symbol as found on the Manti-La Sal and Fishlake plant species list. If the symbol for any species is not known, its name should be written out and the symbol

looked up later. If a plant can only be identified to the genus level (e.g. due to seasonal condition or disturbance), record only the plant genus and make a note of it on the form.

One exception exists where a species occurring with less than 5% cover is recorded. On a plot where the most abundant tree, shrub, or herbaceous species occurs with <5% cover, record the single most abundant species in order to determine dominance type and corresponding vegetation type and vegetation group map units.

For each of the species listed, estimate and record the percent canopy cover as viewed from above the plot. For the remaining species not individually listed (including individual species with <5% cover), estimate and record the combined percent cover for the “others combined” item on the form. Percent cover for *combined grasses* and *combined forbs* must be recorded separately. Species cover estimates must sum to the total life form cover estimate previously recorded.

11. Tree Cover by Diameter Class: (Only for Tree life form plots.) If tree canopy information has been collected using the optional transect protocol, list each tree species and canopy cover as recorded on the transect data form. However, if the ocular species cover estimates are considered to be more representative of the plot than the transect data, list each tree species and canopy cover as recorded in #10 and include a note in the Comments section below that the ocular estimates are considered more representative than the transect data.

For each species, estimate the percent cover of each tree diameter class and enter it in the diameter class columns. Timber species less than 4.5 feet tall or woodland species less than 1.0” diameter at root collar are included in the smallest tree diameter class. For trees that are close to a diameter class boundary, measure diameter at breast height (DBH) or diameter at root collar (DRC) to calibrate ocular estimates. Total the estimated percent cover for each diameter class.

Determine percent cover of each diameter class as if you were looking down on the stand from above the plot; do not double count overlapping layers that are not viewable from above. For example, smaller sized trees that are being overlapped by larger ones are ignored and not counted in the diameter class estimate. Overhead crown cover extending into the circular plot area from a stem residing outside or on the border of the plot is assigned to the tree diameter class of the corresponding stem.

Tree diameter is determined by estimating DBH for all tree species except designated woodland species listed in Table 1. For woodland species, tree diameter is determined by estimating DRC. Instructions for measuring DRC for woodland species are contained in Appendix A.

Table 1. *DRC Measured Woodland Species*

JUOS	<i>Juniperus osteosperma</i>	Utah juniper
JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper
ACGR3	<i>Acer grandidentatum</i>	bigtooth maple
CELE3	<i>Cercocarpus ledifolius</i>	curlleaf mountain mahogany
PIED	<i>Pinus edulis</i>	common pinyon
PIMO	<i>Pinus monophylla</i>	singleleaf pinyon
PRGL2	<i>Prosopis glandulosa</i>	honey mesquite

QUGA	Quercus gambelii	Gambel oak
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12. Dominance Type: Determine and record the dominance type of the plot according to the vegetation keys. If the optional transect protocol are used to collect tree or shrub canopy cover, use the species transect cover measurements to determine the dominance type. However, if the ocular species cover estimates are considered to be more representative of the plot than the transect data, use the ocular estimates to determine dominance type and include a comment in the Notes section.
13. Vegetation Type Map Unit: Identify and record the vegetation type map unit for the dominance type of the plot as listed in the vegetation keys. A list of the vegetation type map units will be included in Appendix B.
14. Vegetation Group Map Unit: Identify and record the vegetation group map unit for the dominance type of the plot as listed in the vegetation keys. A list of the vegetation group map units will be found in Appendix B.
15. Canopy Cover Map Unit: (Only for Tree and Shrub life form plots.) Based on the life form and total life form percent canopy cover for the plot, determine and record the canopy cover map unit. For *upland tree* life form plots, record a tree cover map unit (Table B2) based on the total tree cover. Upland tree life form plots include all forest and woodland map units except Riparian Shrublands/Deciduous Tree (RSH). For *shrub* and *riparian tree* life form plots, record a shrub cover map unit (Table B3) based on the *total shrub* or *total tree* cover respectively. For example, a narrowleaf cottonwood plot is assigned to the RSH map unit; therefore a shrub canopy cover map unit is recorded for the plot.

If the optional transect protocol was used to collect tree or shrub canopy cover, use the overall transect cover to determine the canopy cover map unit. However, the ocular estimate can be used if it is considered to be more representative of the plot than the transect data. If transect information was collected and the ocular estimate is used to determine the map unit, include a comment in the Notes section.

16. Tree Size Map Unit: (Only for Tree life form plots.) Based on the total tree canopy cover by diameter class (#11), determine the most abundant diameter class for the plot. In case of a tie, record the largest tree diameter class. For Conifer and Deciduous vegetation group plots, determine and record the *Forest* tree size map unit (Table B4). For Woodland vegetation group plots, determine and record the *Woodland* tree size map unit (Table B5).
17. Notes: Include information on the vegetation conditions, disturbances, approximate age of the disturbance, observed threatened and endangered plant species, invasive plant species, and any other pertinent information that is not included in the field form. This description is often the most valuable piece of information about a plot and provides details that can have an effect on the mapping process.

### Observation Plot Data Items

As noted previously, walk through the plot and apply the same logical procedures used for the descriptive plots to ocularly estimate dominance type and map unit attributes.

18. Plot Type: The plot type is “OBS” for an observation plot.
19. Plot ID: Record the 1-digit plot ID number.
20. Latitude/Longitude Decimal Degree Coordinates: Record the coordinates for the center of the plot using the procedures described for descriptive plots.
21. Field Photograph: Take a single representative photo of the plot using the procedures described for descriptive plots.
22. Dominance Type: Walk through the plot area and ocularly estimate the composition and cover to determine the dominance type of the plot using the vegetation keys.
23. Vegetation Type Map Unit: Identify the vegetation type map unit for the dominance type of the plot as listed in the vegetation keys.
24. Vegetation Group Map Unit: Identify the vegetation group map unit for the dominance type of the plot as listed in the vegetation keys.
25. Canopy Cover Map Unit: (Only for Tree and Shrub life form plots.) Walk through the plot area and ocularly estimate the canopy cover map unit.
26. Tree Size Map Unit: (Only for Tree life form plots.) Walk through the plot area and ocularly estimate the tree size map unit.
27. Notes: Include information on the vegetation conditions, disturbances, approximate age of the disturbance, observed threatened and endangered plant species, invasive plant species, and any other pertinent information that is not included in the field form.

### Field Reference Site Summary

Reference site summary calls are determined based on the majority results from the descriptive and observation plots. In cases where no dominance type or map unit is assigned to a majority of the plots, or the plots are not considered representative of the site, estimate and record a representative dominance type or map unit based on a combination of plot results and observations made while traversing the site between plots. Observations of notably different dominance types or map units while traversing the site should be included in the Notes section.

28. Dominance Type: Determine and record the majority or representative dominance type within the site based on the descriptive and observation plots, and/or notes regarding other observations made while traversing the site.

29. Vegetation Type Map Unit: Identify the vegetation type map unit for the dominance type of the site as listed in the vegetation keys.
30. Vegetation Group Map Unit: Identify the vegetation group map unit for the dominance type of the site as listed in the vegetation keys.
31. Canopy Cover Map Unit: (Only for Tree and Shrub life form reference sites.) Determine and record the majority or representative canopy cover map unit within the site based on the descriptive and observation plots, and/or notes regarding other observations made while traversing the site.
32. Tree Size Map Unit: (Only for Tree life form reference sites.) Determine and record the majority or representative tree size map unit within the site based on the descriptive and observation plots, and/or notes regarding other observations made while traversing the site.
33. Disturbance Event: If there is evidence of a recent disturbance event (fire, timber harvest, insect outbreak, wind event, etc.) within approximately the last 5 years, check the appropriate box and include any relevant information in the notes section, such as whether the plot was previously forested, contains standing dead trees, etc.
34. Notes: Include observations of other notable dominance types or map units within the site and their relative abundance. Record any additional information pertinent to the site and/or site summary calls. Include information on the vegetation conditions, disturbances, approximate age of the disturbance, observed threatened and endangered plant species, invasive plant species, and any other pertinent information that is not included in the field form.

## Appendix A.

### Diameter at Root Collar (DRC)

*(Adapted from Interior West Forest Inventory and Analysis P2 Field Procedures, V5.00)*

For species requiring diameter at the root collar, measure the diameter at the ground line or at the stem root collar, whichever is higher. For these trees, treat clumps of stems having a unified crown and common root stock as a single tree; examples include mesquite, bigtooth maple, juniper, and mountain mahogany. Treat stems of woodland species such as Gambel oak and bigtooth maple as individual trees if they originate below the ground.

**Measuring woodland stem diameters:** Before measuring DRC, remove the loose material on the ground (e.g., litter) but not mineral soil. Measure just above any swells present, and in a location so that the diameter measurements are a good representation of the volume in the stems (especially when trees are extremely deformed at the base). Stems must be at least 1 foot in length and at least 1.0 inch in diameter 1 foot up from the stem diameter measurement point to qualify for measurement. Whenever DRC is impossible or extremely difficult to measure with a diameter tape (e.g., due to thorns, extreme number of limbs), stems may be estimated and recorded to the nearest 1.0-inch class. Additional instructions for DRC measurements are illustrated in Figures A1 and A2.

**Computing and Recording DRC:** For all trees requiring DRC, with at least one stem 1 foot in length and at least 1.0 inch in diameter 1 foot up from the stem diameter measurement point, DRC is computed as the square root of the sum of the squared stem diameters. For a single-stemmed DRC tree, the computed DRC is equal to the single diameter measured.

Use the following formula to compute DRC:

$$\text{DRC} = \text{SQRT} [\text{SUM} (\text{stem diameter}^2)]$$

Round the result to the nearest 0.1 inch. For example, a multi-stemmed woodland tree with stems of 12.2, 13.2, 3.8, and 22.1 would be calculated as:

$$\text{DRC} = \text{SQRT} (12.2^2 + 13.2^2 + 3.8^2 + 22.1^2)$$

$$= \text{SQRT} (825.93)$$

$$= 28.74$$

$$= 28.7$$

If a previously tallied woodland tree was completely burned and has re-sprouted at the base, treat the previously tallied tree as dead and the new sprouts (1.0-inch DRC and larger) as part of a new tree.

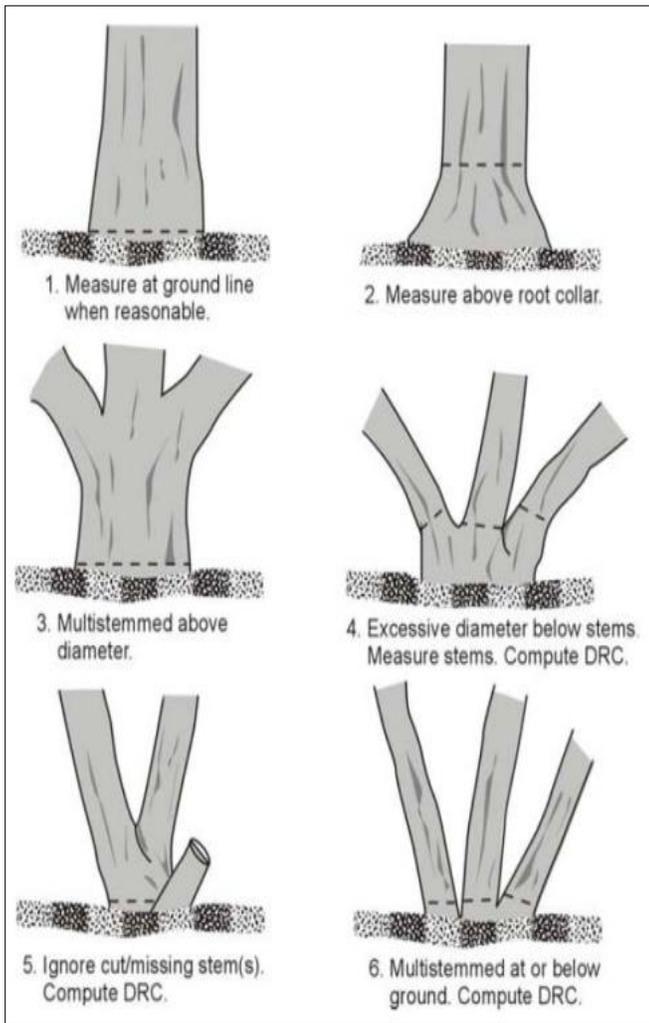


Figure A1. How to measure DRC in a variety of situations. The cut stem in example number 5 is < 1 foot in length.

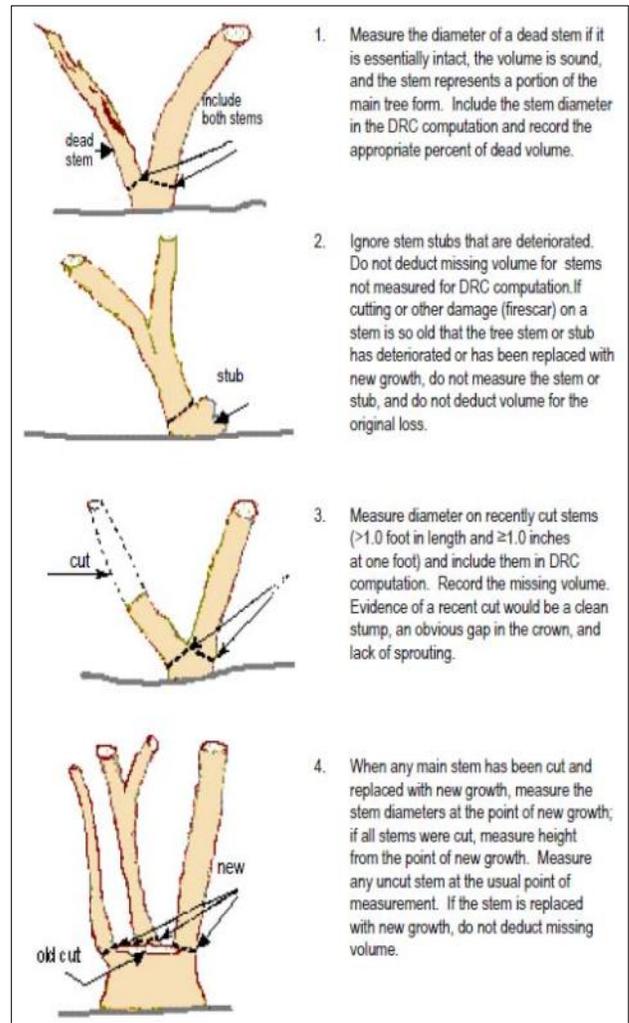


Figure A2. Additional examples of how to measure DRC.



Table B2. *Tree Canopy Cover Map Units (to be determined)*

<b>Tree Canopy Cover Map Unit</b>	<b>Code</b>

Table B3. *Shrub Canopy Cover Map Units (to be determined)*

<b>Shrub Canopy Cover Map Unit</b>	<b>Code</b>

Table B4. *Forest Tree Size Map Units (to be determined)*

<b>Forest (DBH) Tree Size Map Unit</b>	<b>Code</b>

Table B5. *Woodland Tree Size Map Units (to be determined)*

<b>Woodland (DRC) Tree Size Map Unit</b>	<b>Code</b>