ROCKY MOUNTAIN
RESEARCH STATION

FOREST SURVEY FIELD PROCEDURES

U.S. Department of Agriculture
Interior West Resource Inventory,
Monitoring, and Evaluation Program
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CHAPTER 1 - INTRODUCTION

This manual outlines the resource inventory procedures and definitions used by the Forest Survey field crews, Interior West Resource Inventory, Monitoring, and Evaluation Program (IWRIME), Rocky Mountain Research Station. These instructions cover the establishment and measurement of new and remeasurement field locations.

A. Program Purpose

Field crews conduct continuous and comprehensive resource inventories, on a 10-year cycle, on forest lands in the Interior West. The information obtained through the inventory is used to estimate forest land area, wood fiber, tree volume, growth, mortality, understory composition, recreation opportunities, wildlife habitat, and other related resources. This information provides periodic analysis of renewable resource situations, including current conditions, use trends, and the potential production of forest resources of the Interior West States including Arizona, Colorado, Idaho, New Mexico, Montana, Nevada, Utah, and Wyoming. In addition, data are collected and compiled on certain nonforest lands within these States. Findings of the inventories are published and available to resource planners, managers, and the public.

B. Field Organization

Field work is administered by field supervisors and section leaders. Each field supervisor is responsible for coordinating the field effort for one or more individual field sections; duties include assigning work areas and transferring field crews between sections to meet work schedules. Field supervisors also assist the quality control staff in training field crews and in conducting periodic checks of field locations.

A section leader directs the day-to-day work for two or more field crews working in the same area. Some of the duties of a section leader include assigning field plots to crews, collecting completed field packets, and holding camp safety meetings. Other responsibilities include distribution of field equipment and supplies, and assisting the quality control staff and the field supervisor in on-the-job training of field crews.

Field work is conducted by two- or three-person field crews. The crew leader directs the work of the field crew, but all crew members are responsible for accurate and efficient work, and for ensuring that the field crew has the proper equipment, maps, aerial photographs, field forms, and supplies before beginning each day's work.

C. Quality Control

The goal of the quality assurance program is to ensure that all resource inventory data are scientifically sound, of known quality, and thoroughly documented. Measurement quality objectives (MQO) are established as standards to define data quality and are specified with each data item throughout this manual.

The role of quality control is to determine if the measured data meet the quality standards and to correct measurement or procedure errors. Because each field location sample represents approximately 6,200 acres of land, it is critical that crews exercise necessary care and effort to maintain the standards of accuracy in their work. Individual measurements will be expanded to describe and classify land and vegetation; because of the importance of these data, quality is critical. In addition, because of the effort and cost associated with extensive inventories, data collection efficiency is also critical.

Quality control crews conduct periodic on-site inspections of field locations to ensure that the field work is being performed with the required accuracy and precision. Field checking is also conducted for the following reasons:

1. To obtain uniform and consistent interpretation and application of field instructions among all field crews.

2. To hold technique errors to a minimum.

3. To check the performance of each individual crew member.

4. To reveal inadequacies in the instructions and in the training program.

5. To assess and document the quality (accuracy, precision, completeness) of field data.

D. Personal Conduct and Safety

In the course of establishing and measuring field locations, there will be frequent opportunities for contacts with National Forest personnel, private landowners, and others interested in the work conducted by field crews. Field crew members, as representatives of the USDA Forest Service, are expected to act courteously and diplomatically in all their contacts with the public and other agencies. Field crews are expected to project a professional image; this includes general cleanliness and a neat appearance (t-shirts with alcohol ads, torn or "ratty" field clothing, etc., are unacceptable).

It is particularly important that field crews obtain permission to enter or pass through private land. Be careful to not cause any property damage. Also, leave all gates as they are found.

The field supervisor will contact local National Forest and BLM District offices immediately upon arrival in an area to inform them of field crew activity.

Field personnel are subject to many hazards in the course of their work. Each person is expected to use care, common sense, and judgment in their work to avoid injuries to themselves and fellow workers. **SAFETY IS EVERYONE'S FIRST PRIORITY**.

Read and study carefully the applicable sections of the Forest Service Health and Safety Code Handbook and the Driver-Operator Handbook, and observe the precautions given.

Regulation hard hats must be worn on all field plots and while hiking to and from field plots -- NO EXCEPTIONS. Appropriate footwear, such as all-leather boots, and other protective clothing must be worn while on the job.

Immediately report all injuries to the field supervisor and section leader.

E. Everyday Considerations

The goal of the inventory is to collect the best quality data possible, in a safe and efficient manner. All field personnel must consider their actions with regard to what is safe, efficient, and proper. If it is not safe -- don't do it.

Follow these suggestions:

1. Before you leave camp, plan the travel route to the plot. Always take two or more extra plots each day.

2. If your plot is located far from a road, plan to camp out if necessary.

3. Record your plot destination on the location log in your trailer or attached to the outside of the door for any other housing facility.

4. Check to make sure you have all your equipment before leaving camp: field gear, plot packets, data recorder, GPS, metal stakes, nails, lunch, water, rain gear, etc.

5. Check to make sure you have all the equipment needed to conduct the field inventory when you leave your truck.

6. Perform a thorough plot edit before you leave the location. Check for missing data items as well as field gear.

7. Do not travel through the woods after dark. If you are lost, do not panic, but settle down some place and try to make radio contact with the section leader or with another agency. Know how to use the radio!

8. Keep the first aid kits supplied, and know how to use them.

F. Vehicles

A government owned or leased vehicle will be specifically assigned to each crew supervisor. The vehicle's "green book",contains a fuel card and various documents to maintain records of mileage, utilization, fuel and oil consumption, maintenance, and repairs.

The operator must ensure that the assigned vehicle is properly used, serviced, periodically inspected, and always kept reasonably clean and in safe operating condition and that all documentation is completed as scheduled.

The crew leader (or field supervisor/section leader) may authorize other employees to use the vehicle; however, the operator of a vehicle is responsible for that vehicle and it's equipment while using it. Vehicles must be returned to the assigned driver in good condition.

The field supervisor will monitor compliance with established standards and guidelines.

The fleet manager is responsible for monitoring utilization, the production of yearly use and consumption reports, the monitoring of and arrangement for major repairs and maintenance, upkeep of repair and maintenance records, making vehicle assignments and reassignments. Direct needs and questions regarding trucks, trailers, and field equipment to the fleet manager.

The following schedule of servicing and inspection must be followed:

1. Preventive Maintenance (PM) Check. During the first week of each month, assigned users must complete the monthly PM check card to indicate any needed repairs/maintenance, then forward the card to the section leader. Attachments such as radios, winches, and tools boxes must be inspected as well. The section leader will make repair arrangements through the fleet manager and will forward PM check forms to the fleet manager when services are complete.

2. Oil Changes/Tire Rotation. Every 4,000 miles (3,000 miles for vehicles with more than 50,000 miles), assigned users must arrange for crankcase oil change, air filter and oil filter replacement, gearbox level checks, fluid level inspections, belt and pulley inspections, front end and suspension inspections, and tire rotation at a professional garage.

3. In-Field Repairs. Repairs to WCF (Green Fleet) and GSA vehicles must be coordinated and authorized through the fleet manager. The fleet manager maintains records for warranty work and trend monitoring. Before any work is completed on the vehicle, Program Support Services personnel must authorize payment based on quotes received. Document repairs on the equipment maintenance/use records, and forward invoices and receipts to the fleet manager. Forward all repair invoices to Program Support Services at the time of completion.

4. Tires. Tire purchases must be authorized and arranged through the fleet manager and Program Support Services personnel. Tire repairs may be charged on the vehicle fuel card. For all tire repairs and replacements, complete a tire failure report and forward the report to the fleet manager.

5. Yearly Mechanical Inspection. Once a year, the fleet manager will coordinate an annual vehicle service and inspection for each vehicle; this will be conducted at a dealership or professional garage. Forward all repair invoices and records to the fleet manager.

6. Radios. Each truck and field supervisor's trailer has a mobile radio. Crews are not permitted to reprogram radios without authorization from the fleet manager. CB's are also included in most vehicles for use on move days and in logging areas.

WEAR SEAT BELTS AT ALL TIMES when a vehicle is in operation.

Watch for logging trucks -- they always have the rights-of-way and often use the full roadbed.

All accidents involving government vehicles or other property that result in injury/damage to employees, government property, private citizens, and/or private property **must be promptly reported** to the field supervisor regardless of dollar value. Accident packets are located in every vehicle and must be kept complete and up-to-date by the assigned operator.

G. Equipment and Supplies

Each individual will be issued the necessary field equipment and supplies and will sign two copies of an itemized list for that equipment. The individual will keep one copy while the section leader retains the other. Both copies will be kept current. Individuals will be responsible for the use and care of equipment assigned to them.

CHAPTER 2 - FINDING THE FIELD LOCATION CENTER

This chapter provides instructions for finding the field location center (LC). The LC is based on the intersection of map grid lines and is located in the field using past inventory location reference information and/or photo baseline techniques. The LC is designated as subplot center 1 of the field sample.

A. Land Owner/Management Agency Verification

Prior to the establishment of any field location, **the ownership or managing agency of the field location must be verified.** Upon arrival in each county, or prior to the field season, the field supervisor will designate a field crew to visit the county courthouse to verify the managing agency and to obtain private land ownership information (name, address, phone number). Land management agencies must be contacted to obtain lessee information. Record corrected land ownerships on the field location packet and on the Field Location Description record.

Before visiting each field location, it is particularly important that field crews contact private land owners or lessees to obtain permission to enter or pass through private land. Information about best travel route, locked gates, etc., may also be obtained. If the crew is unable to make contact (no permission letter received, unable to reach owner by phone or by visiting ranch house, etc.), the location will be classified as "access denied"; notify the supervisor immediately.

B. Planning Travel to the Vicinity of the Field Location and LC Pinprick Verification

As an aid in planning travel and in finding a field location, field crews are supplied with forest and highway maps and a field location packet. Each packet contains a USGS 7.5 minute (') topographic map. On the topographic map, the LC of a field location is indicated by the intersection of designated map grid lines. Each packet also contains current aerial photographs with the LC pinpricked on one of the photographs. Remeasurement locations also have photos, a copy of the field location data, and road directions used in the previous inventory.

1. Verify the Placement of the LC Pinprick.

Before going to any field location, first verify that the LC pinprick on the photo is in the same location as the map grid intersection. If they are not the same, inform the section leader.

2. Determine Travel Route.

With the packet items, determine the best route of travel to the field location. As a safety precaution, the crew supervisor will maintain a daily record of planned locations to be visited and/or routes to be traveled; keep this log up to date and accessible in the crew supervisor's trailer or other housing facility.

C. Finding the Field Location Center - New Field Locations

It is the responsibility of the field crew to physically locate the LC on the ground as indicated by the LC pinprick on the aerial photograph. The following procedures describe how to find the LC. **Use a ball-point pen for all photo work** (do not use pencil or felt-tip pen), and use a ruler or other straight edge for drawing lines (protractor edges are not necessarily straight).

Record all baseline and reference point (RP) traverse information on the Field Location Reference record under "Course to Location Center," and "Baseline Information." Also record the traverse information on the back of the aerial photograph containing the LC pinprick.

1. Establishing a Baseline and Scale: Ground/Photo.

Use this technique when in the field and an open area for running a baseline is available.

a. Select landmarks. Select two features easily identifiable on both the ground and on the aerial photo. Trees, road intersections, or other landmarks within sight of each other are adequate. The features should be at least 600 feet apart and at the same relative elevation. Do not use railroad lines, powerline poles, etc., as they will influence compass readings.

Pinprick these two landmarks on the photo that has the LC pinprick. On the back of the photo, circle and label one of the landmark pinpricks as "A" and the other as "B".

b. Determine baseline azimuth. With a compass, determine the azimuth (to the nearest degree) between the landmarks. On the back of the photo, draw a thin, straight line through the center of the two landmark pinpricks (A and B).

Place an arrow on the line, indicating the direction the azimuth was taken (i.e., from A to B, or from B to A), and label the azimuth along the line.

c. Measure baseline distance. Measure the distance between A and B on the photograph (using a .001-foot scale) and on the ground (the horizontal distance, to the nearest foot). **Note:** If the ground distance is measured on a slope of 10 percent or greater, convert the slope distance to horizontal distance with the following formula:

$$\text{Horizontal Ground Distance} = \frac{\text{Slope Distance}}{\text{Slope Correction Factor}}$$

Determine the "slope correction factor" (SCF) for the angle of the slope using a clinometer with a SCF option, or determine the slope percent with a clinometer and find the associated SCF listed in appendix B.1.

d. Compute baseline PSR. Compute a baseline photo scale reciprocal (PSR) using the following formula:

$$\text{PSR} = \frac{\text{Horizontal Ground Distance}}{\text{Photo Distance}}$$

2. Establishing a Baseline and Scale: Map/Photo.

a. Select landmarks. Select two baseline points that are easily identifiable on both the topographic map labeled with the field location center (LC) and on the aerial photo with the LC pinprick. The points must be located stereoscopically on the photo. **Note:** Vegetation lines on the topographic maps are often not accurate, so select points such as road and stream intersections. Mountain tops may be used, but it is extremely important that the top is identifiable by stereoscopic viewing.

Label the points as "A" and "B" on the map, and draw a straight line between these points on the map.

b. Determine baseline azimuth. Determine the baseline azimuth (from point A to point B), to the nearest degree, on the topographic map using the following procedures:

(1) Use the UTM grid lines if preprinted on the map, or draw a north-south or east-west line on the topo map by using

UTM "tick" marks. Make sure the selected line intersects the A-B baseline.

(2) Place a photo protractor on the north-south or east-west line. If it is a north-south line, place the protractor so that the line runs through 0 and 180 degrees; use 90 and 270 degrees for an east-west line.

(3) Slide the protractor along the line until the cross mark in the center of the protractor is over the intersection of the A-B baseline and the north-south or east-west line. Read the baseline azimuth from the protractor (this azimuth is called the "original map azimuth").

(4) Because compasses are set at 0 degrees declination (magnetic north, not true north), the original or measured map (A to B) baseline azimuth must be adjusted to a magnetic azimuth. Use this **adjusted azimuth** for the A-B baseline azimuth on the photo. In the bottom margin, most 7 1/2' quad maps indicate declination offsets between the UTM grid north (indicated by "**GN**") and true north (indicated by a **star**), and between magnetic north (indicated by "**MN**") and true north.

Magnetic declination in the western U. S. is always clockwise from true north; The UTM grid declination may be clockwise or counterclockwise, depending on the map's location in the UTM grid zone. For the Interior West, **subtract** the **total declination offset** (between MN and GN) from the original map (A to B) baseline azimuth. **Total** declination between MN and GN is either:

- Magnetic declination **plus** grid declination, if GN is **counterclockwise** from true north, or

- Magnetic declination **minus** grid declination, if GN is **clockwise** from true north.

Adjusted Azimuth = original map azimuth -
(MN declination ± GN declination)

Examples of computation for both situations are shown on the following page.

Example A:

Original map (A to B) baseline azimuth = 130 degrees
GN declination = 2 degrees (clockwise)
MN declination = 17 degrees

Adjusted Magnetic Azimuth = 130 degrees - (17 degrees - 2 degrees)
= 115 degrees

Use 115 degrees as the baseline azimuth on both photo and compass.

Example B:

Original map (A to B) baseline azimuth = 130 degrees
GN declination = -2 degrees (counterclockwise)
MN declination = 17 degrees

Adjusted Magnetic Azimuth = 130 degrees - (17 degrees + 2 degrees)
= 111 degrees

Use 111 degrees as the baseline azimuth on both photo and compass.

c. Label photo. Pinprick points A and B on the photo (with the LC pinprick), and correctly label these points on the **back** of the photo. On the back of the photo, carefully and accurately draw a line from A to B, place an arrow at the end of the line showing proper direction (this is the map baseline), and record the adjusted baseline azimuth on the back of the photo. Use a **ball-point pen** for all marking on the back of photos.

d. Measure baseline distance. Measure the distance between points A and B on the topo map and on the photo. Make all measurements using the same units (e.g., use a .001-foot scale ruler to measure the map and photo distance). The finer the divisions on the ruler being used, the better the results.

e. Compute baseline PSR. Use the following formula to determine Baseline Photo Scale Reciprocal (PSR):

$$\text{Baseline PSR} = \frac{\text{Baseline Map Distance (ft) X Map Scale Reciprocal}}{\text{Baseline Photo Distance}}$$

Note: If the Map Scale is 1:24,000, then the Map Scale Reciprocal is 24,000.

For example (using a .001-foot scale for map and photo measurements):

Baseline Map Distance (from A to B) = .0153 ft
Baseline Photo Distance (from A to B) = .0082 ft
Map Scale Reciprocal = 24,000

$$\text{Baseline PSR} = \frac{.0153 \times 24000}{.0082}$$

$$= 44{,}780$$

The Baseline PSR is 44,780, so the actual photo scale is 1:44,780

3. Selecting a Reference Point.

Once the baseline azimuth and scale have been determined (ground/photo or map/photo method), designate a reference point (RP) readily identifiable on both the ground and the photograph. The RP should be close to the field location, but at least 100 feet from the LC, if possible. Select a landmark such as a prominent tree or large boulder, a sharp bend in a road or drainage ditch, a fence corner, etc., not likely to die or be removed within the next 10-15 years (Note: do not stand directly next to a barbed-wire fence to measure an azimuth, as it will influence compass readings).

The **RP selection is critical.** The more unique and obvious the RP on both the photos and the ground, the better the chance crews will be able to relocate the plot in the future should significant change occur over time.

Pinprick the RP on the aerial photograph with the LC pinprick. Circle and label the pinpricked RP on the back of the photograph. Refer to page 6-2 for instructions on tagging the RP.

4. <u>Adjusting the Photo Scale Reciprocal (PSR)</u>.

This adjustment to the photo scale is required when the mean elevation of the RP to LC is at least 100 feet different from the mean elevation of the calculated baseline.

- **8.25-inch focal length** (certain NHAP and resource photography - see State Supplement). If the RP to LC mean elevation is **higher** than the baseline, for each 100 feet higher in elevation **reduce** the baseline PSR by 145 units (see below for an example). If the RP to LC mean is **lower** than the baseline, for each 100 feet lower in elevation, **increase** the baseline PSR by 145 units.

- **6.0-inch focal length** (NAPP and certain resource photography - see State Supplement). If the RP to LC mean elevation is **higher** than the baseline, for each 100 feet higher in elevation, **reduce** the baseline PSR by 200 units. If the RP to LC mean is **lower** than the baseline, for each 100 feet lower in elevation, **increase** the baseline PSR by 200 units.

For example:

Baseline PSR = 38,800; Baseline photo scale 1:38,800
Baseline elevation = 6,000 feet; RP elevation = 7,400 feet

7,400 feet
<u>-6,000 feet</u>
1,400 feet difference in elevation

Focal length for photography was 8.25 inches; change baseline 145 units for each 100 feet elevation difference.

1,400 feet / 100 feet = 14
14 X 145 = 2030

38,800 (baseline PSR)
<u>-2,030</u> (change in scale)
36,770 adjusted RP PSR

5. Calculating Azimuth and Distance.

Determine the azimuth and horizontal ground distance from the RP to the LC using the following procedure:

a. Draw RP-LC line. On the back of the photo, draw a thin, straight line through the RP and LC pinpricks. Intersect the RP-LC line with the baseline by extending the RP-LC line (figure 1, example 1). If the baseline and RP-LC line do not intersect on the photograph, draw a line (secondary baseline) that intersects the original baseline and the RP-LC line (figure 1, example 2).

Note: Place arrows on these lines indicating azimuth direction.

b. Determine RP-LC azimuth. To obtain the RP to LC azimuth, orient a photo-scale protractor inverted over the line intersections (in other words, position the protractor "wrong-side" up because the photo work is carried out on the back of the photo). Determine the azimuth from the RP to the LC by lining up the correct azimuth over the baseline and reading the azimuth corresponding to the RP-LC line (figure 1, example 1 and example 2).

If a secondary baseline is used, first determine the azimuth of the secondary baseline by positioning the protractor (wrong-side up) over the intersection of the original and secondary baselines, lining up the correct azimuth for the original baseline, and reading the azimuth corresponding to the secondary baseline. After the azimuth for the secondary baseline is determined, place the protractor over the intersection of the secondary baseline and the RP-LC line to obtain the RP to LC azimuth.

On the back of the photo, record the azimuths along each traverse line.

Figure 1. Examples for two methods of determining azimuth from RP to LC: example 1, the simple baseline; and, example 2, the secondary baseline.

Example 1:

Example 2:

c. Determine RP-LC horizontal distance. To determine the horizontal distance from the RP to the LC, use one of the following methods:

- **".001-foot scale" method** (preferred method)**.** Measure the distance on the photo from the RP pinprick to the LC pinprick to the nearest .001 foot (using a .001-foot scale). Multiply this photo distance by the baseline photo scale reciprocal (PSR as calculated previously) to obtain the RP-LC horizontal ground distance.

  (Photo Distance) x (PSR) = Horizontal Ground Distance

  For example,
  Photo distance between RP and LC = .012 feet
  Photo PSR = 36,770 feet
  Horizontal ground distance from the RP to the LC:
  (.012) X (36,770)= 441 feet

- **"Photo scale" method.** If a .001-foot scale is not available, determine the horizontal ground distance by selecting the photo scale (on a photo-scale protractor) that is closest to the actual photo scale as determined from the calculated PSR, and measure the distance, on the back of the photo, between the RP and LC pinpricks (to the nearest 12.5 feet, which is half of an increment on a scale ruler).

6. <u>Traversing to the LC</u>.

Using a compass and tape, run a traverse from the RP to the LC along the calculated azimuth and horizontal ground distance. Make distance corrections for slope whenever the slope is 10 percent or greater. Use a clinometer to determine the appropriate slope correction for each distance segment traversed (or if needed, appendix B.1 provides a slope correction table for distance). Place a stake at the end of the traverse.

7. LC Verification.

MQO: ±10 feet, 95% of the time.
Upon arrival at the end of the traverse, determine if the calculated ground point is in agreement with the LC pinpricked on the photograph. Examine the ground features near the LC area that would be noticeable on the aerial photograph such as individual trees or tree groupings, openings in the crown canopy, rock outcroppings, etc.

If the calculated ground point and the photo point are clearly not in agreement,

a. Recheck the azimuth and distance calculations for possible errors.

b. Determine the correct ground location based on the photos and map, and place a second stake at the correct ground location. If the RP is visible from the corrected LC, remeasure the actual azimuth and distance directly. Otherwise, determine the azimuth and distance from the initial stake (incorrect location) to the second stake (corrected location). Remove the first stake. Record all adjusted measurements on the Field Location Reference record under "Course To Field Location," and on the Field Location Description record under "Baseline Information."

D. Finding the Field Location Center - Remeasurement Locations

A reference point (RP) and witness trees were established in the previous inventory to aid in relocating the field location.

Find the previously established RP using directions recorded on the old Field Location Record sheet and the old photos. The RP is a landmark (usually a tree) that is identifiable on both the ground and the field location photo, and should be indicated by a pinprick on the old photos. Trees used as RPs were marked with aluminum tags: one tag nailed below stump height (1 foot) facing in the direction of the field location, and two other tags nailed approximately 6 feet above the ground on opposite sides of the tree.

If the RP is suitable for the current inventory, and visible on the new photograph, it may be re-used. If new photography is used for the location, pinprick the RP and label it on the back of the new photo. A tree that is re-used as an RP must be re-tagged if necessary.

Run the traverse from the RP to the LC using the azimuth and horizontal distance recorded under "Course to Sample Location" on the old Field Location Record sheet and/or old photos. If the slope exceeds 10 percent, horizontal distances must be adjusted for slope (determine the slope correction factor, SCF, using a clinometer with a SCF option, or determine the slope percent with a clinometer and find the associated SCF listed in appendix B.1).

Two witness trees (designated "X" and "Y" trees) were established near the LC. The "X" tree was scribed with an X above DBH/DRC (facing the LC) and should generally be near an extension of the course followed from the RP. The "Y" tree was generally located at a right angle to this azimuth. An aluminum tag was nailed below stump height facing the LC stake on both witness trees. Azimuth and distance from the LC stake to each witness tree, plus species and diameter, were recorded under "Witness Trees" on the old Field Location Record sheet.

The crew should arrive in the **vicinity** of the field location by following the RP to LC course. Toward the end of the course, begin looking for the "X" tree. In addition to the "X" tree, look for old flagging, old plot stakes, and nails in trees at DBH/DRC. Place a new stake at the LC, at the location of the old stake; however, the old stake marking the LC may be missing. By triangulating using the witness trees, a new stake can be correctly placed. If the witness trees are missing (cut), use tally trees to triangulate.

The following discussion and instructions cover some of the situations that may occur when searching for the field location. In all situations where a new RP or RP-LC course is established, record the appropriate new information on the new Field Location Reference form, and on both the old and new photographs. Pinprick and label the new RP on the old and new photos.

1. <u>RP Not Found</u>.

Due to incorrect directions, inaccurate field location placement, or disturbance at the location area (clearcut, new roads, etc.), the RP may not be found on the ground. Find the location center by using one of the following methods:

a. Follow the procedures described under "Finding the Field Location Center - New Field Location" (page 2-2), and use the ground/photo method for establishing a baseline.

b. Locate a new RP on the ground that is discernible on both the old and new photos. Using the old photo, compute a new course from the RP to LC using one of the following techniques (**Note:** The new RP must be discernible on the new and old field location photographs):

The .001 Foot Scale Method:

(1) Calculate the **azimuth** from the new RP to the LC (figure 2 example 1):

- Pinprick the new RP on the old photo with the LC pinprick.
- On the back of the old photo, draw a line connecting the new RP pinprick with the LC pinprick.
- Orient a photo protractor inverted (wrong-side up) over the LC using the previously calculated azimuth from the old RP to the LC (this item is recorded on the old field forms). In example 1, the old reading is 43 degrees.
- With the protractor in place, read the azimuth from the new RP to the LC. In example 1, the reading is 320 degrees.

(2) Calculate the **horizontal ground distance**, using a .001 foot scale, from the new RP to the LC (figure 2 example 2):

- Using the old RP to LC line, measure the distance between the RP and LC pinpricks (with the .001 foot scale) on the back of the old photo. In example 2, the distance is .141 foot.

- Divide the ground distance from the old RP to the LC (this item is recorded on the old field forms) by the calculated photo distance (from old RP to LC) to obtain the photo scale reciprocal (PSR). In example 2, the ground distance of 851 feet, divided by the photo distance of .141 foot, yields a PSR of 6035. Actual photo scale is 1:6,035.

- Measure the distance between the new RP and LC pinpricks, using the .001 foot scale, on the new RP to LC line (on the back of the old photo). In example 2, the distance is .069 foot.

- Multiply the PSR by the new RP to LC photo distance to get the new RP to LC horizontal ground distance. In example 2, the PSR of 6035 multiplied by the photo distance of .069 foot, yields a horizontal ground distance of 416 feet.

(3) On the back of the **new photo** with the LC pinprick, pinprick the new RP, and draw a thin, straight line through the center of the two pinpricks. Record the azimuth and horizontal distance from the new RP to the LC, and place an arrow on the RP to LC line, indicating the direction that the azimuth was taken.
Reminder: Use a ball-point pen for all photo work.

(4) Use the new RP to LC azimuth and horizontal distance to find and reference the remeasurement field location.

Figure 2. The .001 foot scale method.

Example 1. The .001 foot method, determining the new azimuth.

(back of the old photo)

Example 2. The .001 foot method, determining the new horizontal ground distance.

(back of the old photo)

The Best Fit Method

(1) Calculate the **azimuth** from the new RP to the LC.
- Pinprick the new RP on the old photo with the LC pinprick.
- Draw a line from the new RP to the LC.
- Orient a photo protractor inverted (wrong-side up) over the LC using the previously calculated azimuth from the old RP to the LC (this item is recorded on the old forms). In figure 3, the old reading is 43 degrees.
- With the protractor in place, determine the new azimuth from the new RP to the LC. In figure 3, the reading is 320 degrees.

(2) Calculate the **horizontal ground distance** from the new RP to the LC:

Using the photo scale (on a photo-scale protractor) that is closest to the nominal photo scale (a nominal photo scale of 1:24,000 in figure 3), measure the horizontal ground distance on the back of the photo, to the nearest 12.5 feet, between the new RP and the LC pinpricks (**note:** the nominal photo scale is often printed on the front of the aerial photograph as a two-digit number, e.g., 24, or by the normal scale reference, e.g., 1:24,000). In figure 3, the measured distance is 850.5 feet.

(3) On the back of the **new photo** with the LC pinprick, pinprick the new RP, and draw a thin, straight line through the center of the two pinpricks. Record the azimuth and horizontal distance from the new RP to the LC, and place an arrow on the RP to LC line, indicating the direction that the azimuth was taken.
Reminder: Use a ball-point pen for all photo work.

(4) Use the new RP to LC azimuth and horizontal distance to find and reference the remeasurement field location.

Figure 3. The best fit method.

Aerial Photo Scale Protractor:

In this example, the nominal photo scale on the old photo is 1:24,000. Therefore, the 1:24.000 scale on the aerial photo-scale protractor is used to measure the distance between the new RP and the LC pinpricks (to determine the horizontal ground distance) on the back of the photo.

On the back of the old photo (Note: The 1:24000 photo scale in the example below has been enlarged and is not to scale):

Previously Calculated	Currently Calculated
Old RP to LC: Azimuth 43 degrees Distance 1,675.5 ft (round to 1,676)	New RP to LC: Azimuth 320 degrees Distance 850.5 ft

(scale used to measure distance)

2. RP Found But Not Usable.

The RP may be found but is no longer suitable for re-use (e.g., dying, dead, or cut). The field location can still be relocated by using the original RP, but a new RP must be established.

Select a new RP and compute a new RP to LC course. This can be accomplished by one of the following methods:

a. Choose an RP that can be seen from the location center and is identifiable on the aerial photos. Take the azimuth and distance directly.

b. Locate a new RP that is discernible on both the old and new photos. Using the old photo, a new course from the RP to LC can be computed. Refer to page 2-13 for examples.

3. Field Location Incorrectly Placed or Not Found.

Spend at least 30 minutes (no more than 1 hour) to thoroughly search the area at the end of the RP-LC chain (within approximately 500 feet); circumstances dictate the actual amount of time to spend (e.g., stand density, site disturbance). Factors that might explain why a field location cannot be found include the following: azimuth and/or distance incorrectly calculated, compass not set at 0° declination, compass not used properly, or corrections for slope were not made while chaining.

Do not re-establish the old field location if any of the following apply:

- the previously established LC (point 1) is more than 500 feet from the correct location center (based on the correct photo pinprick and map grid intersection),
- the previously established LC is in a different condition from the correct location center (refer to chapter 3), or
- the previously established LC is not located in the correct ownership.

If a field location is incorrectly placed or cannot be found, do the following:

a. Locate the correct location center on the ground and determine if a new field location should be established. Establish a new location using the current procedures.

b. On the outside of the field location packet write "old field location not found" or "old field location incorrectly placed" and give a brief explanation. Note if a new field location was established.

c. Cross out preprinted data forms and leave the forms in the field location packet.

d. Inform section leader.

CHAPTER 3 - DEFINING THE CONDITION CLASS

This chapter describes the condition class, provides guidelines for determining condition class on the field location sample, provides definitions necessary for classifying condition class, and provides guidelines for mapping condition classes.

After the location center (LC) has been established on the ground, determine the condition(s) present on the field location (encompassing the 4 subplots). A **condition** is generally defined as an area of relatively uniform ground cover, such as a homogeneous vegetation cover; a **condition class** is a categorization of the condition based on several variables, called **defining attributes** in this manual (see below). A prospective **contrasting condition class** is any condition that may be different than a previously assigned condition class based on the defining attributes.

The purpose of recognizing condition classes is to determine and map each area of the plot occupied by distinct conditions, and to define each condition by various attributes.

A. Determining Condition Class: General Procedures

Every field plot samples at least one condition (the condition at the LC).

The area sampled on the plot is partitioned into separate condition classes first based on the defining attributes of Ground Cover Class and Land Use. Areas classified with a forest land Ground Cover Class are further subdivided into smaller separate condition classes if distinct variations occur in the additional defining attributes: forest type, stand-size, stand origin, and stand density. Areas classified as other tree land and non-tree land are further subdivided if distinct variations occur in the vegetation cover (Dominant Tree Species or Rangeland Cover Type, respectively).

1. Tree land vs Non-tree Land/Water.

a. Ground Cover. The first consideration for defining a condition class is the distinction between the following broad Ground Cover Classes:

- tree land
- non-tree land, and
- water.

Differences between tree land and non-tree land conditions are recognized and classified only if each of the two prospective condition classes are **at least 1 acre in size and 120 feet wide;** these size requirements apply to both tree land and non-tree land. Any area that does not meet this minimum size requirement is not considered distinct from the adjacent or encompassing Ground Cover Class (exemptions to this rule are listed on page 3-10).

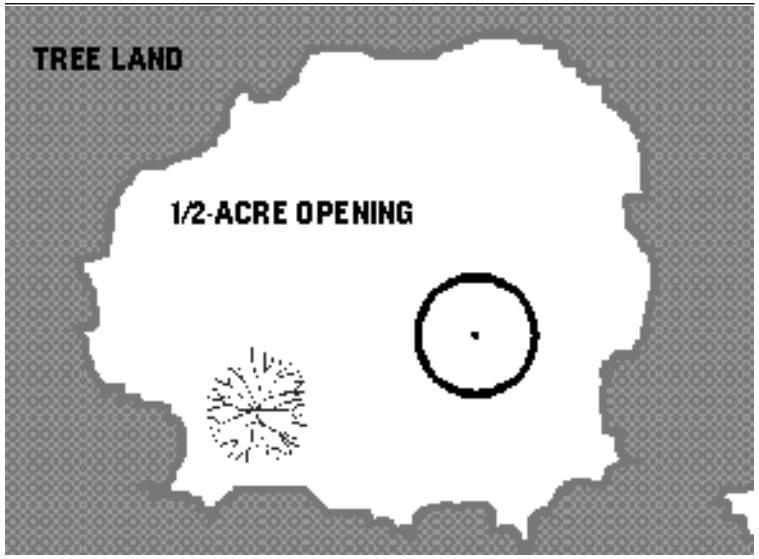
Within a non-tree land condition, tree land areas or linear strips of trees less than 1-acre in size or less than 120 feet wide at the subplot are considered part of the non-tree land condition.

For water features, a minimum size criteria is based on the Census Bureau definitions. To classify water as a condition, the water feature must be at least 1-acre in size and 30 feet in width. Linear water features, such as streams, rivers, and canals, are measured across the channel between points on either side up to which water prevents the normal establishment of trees. To determine if a linear water feature qualifies as a condition, rely on aerial photos, topographic maps, normal high water marks, and past crew classifications. Crews are not expected to measure the length of the feature to determine if it is 1 acre in size.

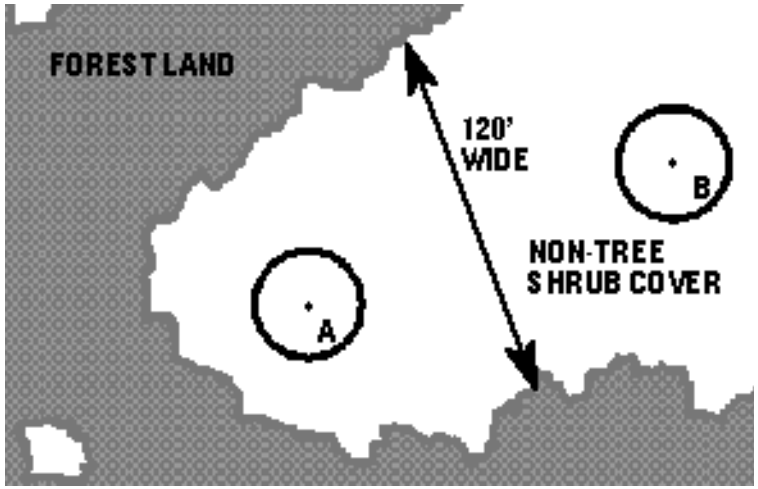
b. Land Use. The second consideration for defining a condition class is a further breakdown of Ground Cover Class called Land Use. Examples of Land Uses include undeveloped tree land, developed tree land, orchards, crop cover, improved pasture, etc. Within a specific Ground Cover Class, contrasting Land Uses are recognized and classified only if each of the two prospective condition classes are **at least 1 acre in size and 120 feet wide;** these size requirements apply to all Land Uses except cultural developments and maintained roads and rights-of-way (see page 3-11). Any area that does not meet this minimum size requirement is not considered distinct from the adjacent or encompassing Land Use.

Refer to figure 4 for examples.

Figure 4. Tree land vs. non-tree land and water classifications.

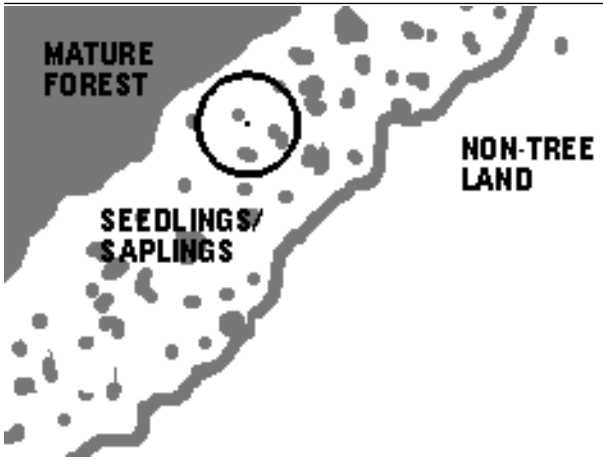


The subplot falls in an opening less than 1 acre in size; the opening does not meet the definition for non-tree land (1-acre in size, 120-feet wide). Therefore, this subplot occurs in a **TREE LAND** condition class.

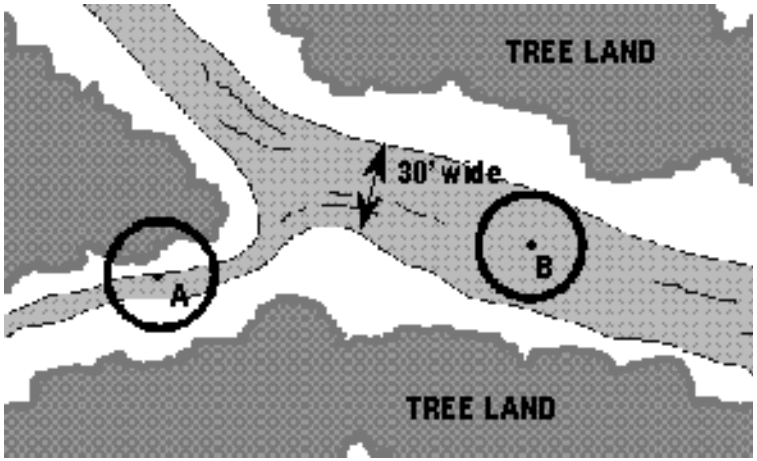


Subplot A falls in a shrub cover inclusion within tree land; even though the area of shrubland is at least 1-acre in size, subplot A occurs in **TREE LAND** because the width of the inclusion at the subplot is less than 120-feet wide. Subplot B also falls in the inclusion, but because the width of the inclusion at the subplot is greater than 120-feet wide, subplot B occurs in **NON-TREE LAND**.

Figure 4. Tree land vs. non-tree land and water classifications (contd).



The subplot falls in a strip of seedling/sapling cover less than 120-feet wide. However, the strip is adjacent to a large area of tree land (forest land), and the strip does meet the 5 percent cover and/or regeneration criteria for tree land. Therefore, the strip is combined with the tree land, and the subplot occurs in **TREE LAND.**



Subplot A falls in a stream less than 30-feet wide, and within tree land. Subplot A occurs in a **TREE LAND** condition class.

Subplot B falls in a stream at least 30-feet wide; subplot B occurs in **WATER.**

2. <u>Within Forest Land Conditions</u>.

Once an area has been classified as forest land, the area can be further subdivided into smaller separate condition classes (of relatively homogeneous tree species composition or structure) if distinct variations exists in any of the following defining attributes:

- Forest Type,
- Stand Size,
- Stand Origin, and
- Stand Density

Contrasting forest land conditions are recognized and classified only if each of the two prospective condition classes are **at least 1 acre in size and 30-feet wide.** Any forest land area that does not meet this minimum size requirement is not considered distinct from the adjacent or encompassing forest land condition class.

To qualify as a separate condition class, a change must be obvious and a boundary must be readily identified on the ground. If there is any doubt as to whether an actual boundary between contrasting forest land condition classes is present, ignore the boundary in question.

Use the following criteria to identify within-forest land condition classes:

a. Forest type: a distinct change in tree species composition. Do not recognize transition zones between forest types as separate condition classes. The following are examples of forest type differences that would distinguish separate condition classes given that the contrasting condition class meets the minimum 1-acre size and 30-feet width requirements.

- An area dominated by softwood species (e.g., Douglas-fir/spruce) bordering an area dominated by hardwood species (e.g., oak/maple).

- A pure ponderosa pine stand adjacent to a pinyon-juniper stand.

b. Stand size: a distinct change in the mean (average) tree diameter. Only recognize very obvious changes between stands of different stand-size class, such as a large diameter

stand adjacent to a small diameter or seedling/sapling stand (refer to Glossary for definitions).

c. **Stand origin**: an abrupt, distinct change between areas that originated by artificial methods versus those areas that have been regenerated by natural means. For a boundary to be recognized, an artificially regenerated area must show clear evidence (e.g., planting in rows or seeding) that it differs significantly from the adjacent natural stand. If it is difficult to determine whether or not a stand has been planted or seeded, or if no distinct boundary exists, ignore the boundary. In many regions of the West, trees are not planted in rows, and planted stands do not differ in physical appearance from natural conditions. In these cases, ignore the boundary.

d. **Stand density**: an abrupt change in the density of tree cover, usually caused by a disturbance (e.g., fire, harvesting, insect damage) or extreme changes in aspect (e.g., ridgeline). Stand density may be characterized by number of stems per acre, basal area per acre, or by stocking (i.e., percent tree cover or vegetative space occupancy). Examples of valid differences in stand density are:

- A clearcut condition that has no tree cover adjacent to a stand with sufficient cover or adequate numbers of seedlings and saplings.

- A partially cutover stand (20 percent crown cover) bordering an undisturbed stand (80 percent cover).

Do not recognize slight differences or gradations.

3. **<u>Within Other Tree Land Conditions</u>.**

Once an area has been classified as other tree land, the area can be further subdivided into smaller separate condition classes -- of relatively homogeneous vegetation - if distinct variations exists in the dominant tree species.

Contrasting other tree land conditions are recognized and classified only if each of the two prospective condition classes are **at least 1 acre in size and 120-feet wide**. Other tree land area that does not meet the minimum size requirements is not considered distinct from the adjacent or encompassing other tree land condition class.

4. Within Non-tree Land Conditions.

Once an area has been classified as non-tree land, the area can be further subdivided into smaller separate condition classes -- of relatively homogeneous vegetation - if distinct variations exists in the Rangeland Cover Type.

Contrasting non-tree land conditions are recognized and classified only if each of the two prospective condition classes are **at least 1 acre in size and 120-feet wide,** with certain size exemptions listed below. Non-tree land area that does not meet the minimum size requirements is not considered distinct from the adjacent or encompassing non-tree land condition class.

To qualify as a separate condition class, a change must be obvious and a boundary must be readily identified on the ground. If there is any doubt as to whether an actual boundary between contrasting non-tree land condition classes is present, ignore the boundary in question.

B. Condition Class Definitions

1. Tree land.

Tree land is any area at least 1 acre in size and 120-feet wide with at least 5 percent cover in species classified as trees. Trees are defined as those species listed in appendix D (Little, Elbert L. Jr. 1979. Checklist of United States Tree. USDA Agriculture Handbook No. 541). However, for this inventory several genus or species will not be measured: those defined in Little, 1979, as primarily shrubs (e.g., Artemesia spp.) and those considered hazardous to sample (the lily and cactus families).

For the purposes of this inventory, tree species are divided into 3 groups and defined as follows:

- **Timber species** -- tree species individually tallied, and measured for diameter at breast height (DBH). Timber species include all species of conifers (except pinyon, juniper, and yew) and aspen, cottonwood (Populus spp.), paper birch, and boxelder hardwood species.

- **Woodland species** -- tree species individually tallied, and measured for diameter at root collar (DRC). Woodland species include pinyon, juniper, oak, mesquite, locust, yew,

curlleaf mountain-mahogany, Rocky Mountain maple, bigtooth maple, and desert ironwood.

- **Other tree species** -- tree species not individually tallied but sampled on the understory vegetation description. Other tree species include those listed in Little, 1979, as trees but not included in the tally tree species list (page 10-9 and 10).

a. **Tree land categories**. Based on composition of tree species, tree land is classified as either **(**1) forest land or (2) other tree land. In addition, both forest land and other tree land are further divided into developed or undeveloped land, though both will have the same ecological characteristics**.**

Developed tree land is tree land that will probably not be managed for wood utilization because of development for recreational, residential, or other Land Uses, but where human activity on the site does not preclude natural succession of the stand. **Undeveloped** tree land is tree land that is not developed. Refer to page 8-3 (Land Use classifications) for the categories of developed and undeveloped forest land.

(1) Forest land. This is tree land that

- has at least 5 percent cover of tally tree species (listed on pages 10-9 and 10),
- has at least 40 tally tree species seedlings and saplings per acre, or
- is currently without cover but formerly had at least 5 percent cover with tally tree species (i.e., the site shows evidence of former tree cover, such as cut or burned stumps, snags), and human activity on the site does not preclude natural succession.

Note: Classify areas as non-tree land if they show evidence of type conversion to a non-tree Land Use (e.g., fire or chaining was used to convert tree land to grass land) and do not currently have adequate crown cover or regeneration of tree species.

(2) Other tree land. This is land that has at least 5 percent cover in tree species (Little, 1979) but does not have at least 5 percent cover in tally tree species (timber or woodland species listed on pages 10-9 and 10). Examples would include land with at least 5 percent cover in tree species such as alder or paloverde, but less than 5 percent cover in tally tree species.

Classify and map other tree lands as a separate condition class from forest land only where both conditions are at least 1 acre in size and 120 feet wide.

b. Sampled vs. nonsampled tree land. In general, field sample most areas of undeveloped and developed tree land (both forest land & other tree land). However, if human activity on the site precludes the natural succession of the vegetation, do not field sample the trees and understory. The following conditions are considered tree land if they meet the tree land definition, but they will be classified as "nonsampled tree land" for this inventory:

- **Nonsampled urban tree land areas** -- portions of cities, towns, etc., where tree cover is at least 5 percent, but human activity and development preclude natural succession. This includes areas such as city parks, picnic grounds and home yards with mowed lawns, golf courses, cemeteries, schools.

- **Christmas tree plantations** -- land meeting the tree land definition, but consisting of various coniferous species, usually planted in rows and often pruned for shape, harvested at seedling/sapling sizes for Christmas trees. Although these plantations consist of tally tree species, natural processes of succession are restricted.

- **Orchards** -- land meeting the tree land definition, but consisting of various nontally tree species that, although they normally reach tree form, are planted and managed as crops for fruit or nut production (walnuts, apples, etc.).

- **Other nonsampled tree land** -- areas meeting the tree land definition, but where
  (1) human activity on the site precludes natural succession, and not defined in one of the previous categories (e.g., improved pasture), or
  (2) the tree species are not sampled for safety purposes (lily and cactus family trees).

2. Non-tree land.

This category includes:

- land that has never supported at least 5 percent cover of trees (e.g., barren areas, alpine tundra, desert shrub), or

- land that formerly had sufficient tree cover but has been converted to a non-tree Land Use (e.g., cropland, improved pasture land): these areas currently do not have adequate tree cover or reproduction due to a specific treatment (e.g., chaining, other land clearing) intended to eliminate trees for the purpose of enhancing or providing for non-wood commodities or uses (e.g., increasing herbage production).

If intermingled in tree land areas, **unimproved roads and openings** must be at least 120-feet wide and 1 acre in size to qualify as non-tree land. Likewise, small patches of tree covered areas or linear strips of trees less than 1 acre in size and 120-feet wide within non-tree land are considered as non-tree land. Exemptions to the non-tree land size criteria are listed below.

3. Tree land and non-tree land size/width exemptions .

The following situations necessitate exemptions to the 1-acre size and 120-feet wide requirement for tree land and non-tree land (figure 5):

a. Distinct alternating strips of tree land and non-tree land. This situation occurs when the sample falls within a strip of land that meets the 1-acre minimum, but is less than 120-feet wide. The strip of land occurs in an area with parallel strips of trees and openings of which none of the strips meet the minimum width requirement. Determine the total area that the intermingled area occupies, and classify the sample according to whatever land occupies the greater area. If the area of alternating strips is so large or indistinctive as to make a total area determination impractical, then classify the sample as tree land.

b. Transition zones or ecotones. The border between tree land and non-tree land is often a gradual change in tree cover with no clear and abrupt boundary. In addition, it may be difficult to determine exactly where the tree land meets the minimum cover criteria and where it does not. For these cases, determine where the land clearly has 5 percent cover,

and where it clearly is less than 5 percent cover; divide the zone between these points in half, and determine which side of the zone the subplot is on. Classify the condition based on this line (figure 5).

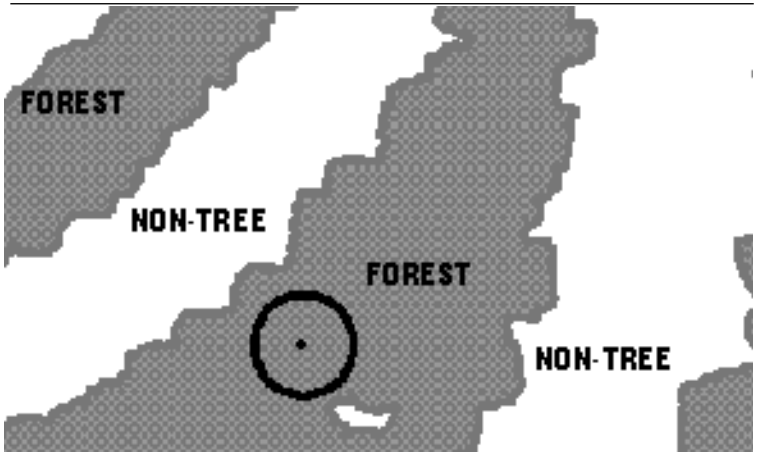
c. Cultural developments. Located within tree land, these are maintained structures or the maintained area surrounding a structure. Examples of cultural developments are houses or trailers on very small lots, pump houses in a small cleared area within tree land, and maintained areas around barns, sheds, or homes. Cultural developments can be of any size and are considered either nonsampled tree land or non-tree land.

d. Maintained roads and rights-of-way. Located within tree land, these areas are often less than 1 acre or 120-feet wide but are non-tree land in characteristic due to permanent human-caused development. Classify the following as non-tree land whether or not they meet the area and width requirement.

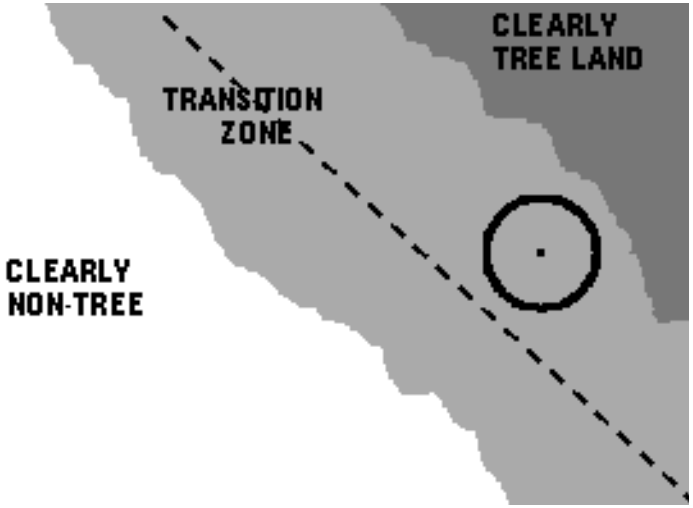
- **Maintained roads** -- improved roads that are built using road building machinery and are periodically maintained for private or public vehicular travel. A maintained road can be any width and is considered non-tree land. If intermingled in tree land, **unimproved roads** must be at least 120-feet wide and 1 acre in size to qualify as non-tree land. A road engineered for the purpose of skidding logs is not considered a maintained road.

- **Maintained rights-of-way** -- areas such as railroads, powerlines, gas lines, and canals, and the buffer strips around them, that are periodically treated to limit vegetative growth and are currently in use for the purpose for which they are designed. A maintained right-of-way can be any width.

Figure 5. Examples of tree land and non-tree land exemptions.

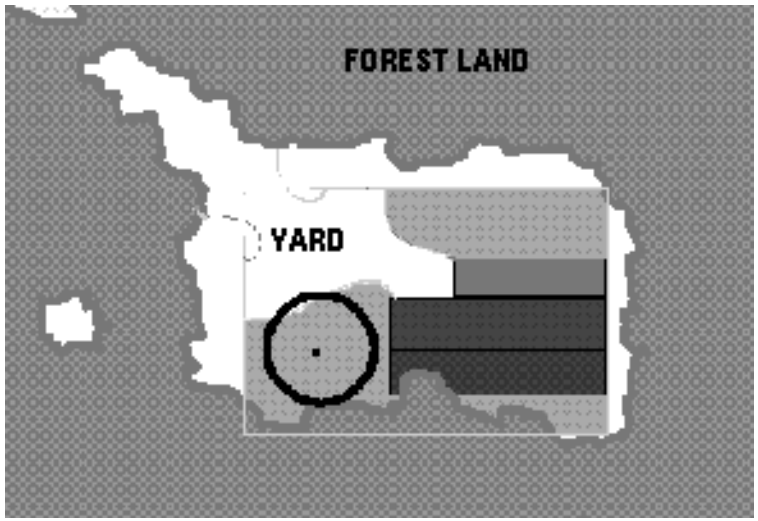


The subplot falls in an area of alternating strips of forest land and non-tree land, none of which meet the 120-feet width criteria. Examine the overall area, and classify the land according to whatever cover occupies the most area. In this example, there is more forest land, so the subplot occurs in a **FOREST LAND** condition class.

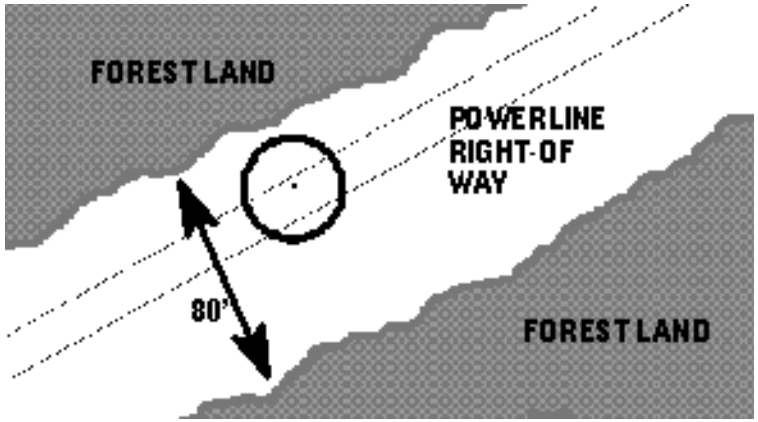


The subplot falls in a transition zone between forest land and non-tree land. Identify where the land is clearly forest land, and where the land is clearly non-tree land. Divide this zone between the defined lands in half. The subplot falls on the forest land side; therefore, the subplot occurs in a **FOREST LAND** condition class.

Figure 5. Examples of tree land and non-tree land exemptions (contd).



The subplot falls in a maintained yard next to a house; the area of the yard and house is less than 1-acre. However, the yard and house are cultural developments; these are considered non-tree land regardless of size. Therefore, the subplot occurs in **NON-TREE LAND**.



The subplot falls in a powerline right-of-way. Although the right-of-way is less than 120-feet wide, maintained roads and rights-of-way are exemptions to the size rule and are considered **NON-TREE LAND** regardless of width.

4. Water.

a. Census water includes inland water in ponds, lakes, reservoirs, or similar areas 4.5 acres or more in size, and streams, rivers, estuaries, and canals more than 200-feet wide at normal high water level. Portions of braided streams meeting the census water definition, comprising more than 50 percent water cover at normal high-water level, are also considered census water.

b. Noncensus water includes inland water in ponds, lakes, reservoirs, or similar areas 1 to 4.5 acres in size, and streams, rivers, estuaries and canals 30-feet to 200-feet wide at normal high-water level. Portions of braided streams not meeting the census water definition, but at least 120-feet wide and comprising more than 50 percent water cover at normal high-water level, are considered noncensus water.

Ephemeral and intermittent streams are classified as land (refer to "Stream" in glossary for definitions).

C. Mapping the Condition Boundary

Boundary reference data are used to compute the percentage of area assigned to each condition class sampled on the plot, and they are used for remeasurement classifications.

Whenever a boundary is recognized between distinct condition classes (meeting the minimum area and width requirements), sketch the boundary on the condition class diagram. In addition, if the recognized boundary occurs on the subplot, reference the boundary by recording azimuths and distances as described below. **Only map abrupt boundaries between distinctly different condition classes** on the subplots.

1. Locating the Boundary.

Use the following guidelines to determine whether to map recognized condition classes on a subplot or microplot:

- **Distinct boundary on a subplot**. When a clear boundary between two or more distinct condition classes occurs within a subplot (or microplot), recognize separate condition classes on the subplot, and map and reference the boundary .

- **Indistinct boundary on a subplot.** When two or more condition classes occur on a subplot, but the boundary between the condition classes is a transition zone and not an abrupt boundary, do not recognize or map separate condition classes on the subplot. Instead, only recognize the individual condition class that predominates the subplot.

  Example: The 4 subplots all sample only forest land. Subplots 1, 3, and 4 sample what is clearly a stand of large sawtimber. Subplot 2 falls in the middle of a stand-size transition zone. Within this transition zone, the large sawtimber stand phases into a sapling stand. Because subplot 2 is within the transition zone, it must not be divided into two mapped condition classes. Instead, the subplot must be treated entirely as part of the large sawtimber condition class or assigned entirely to a new condition class that is classified as a seedling/sapling stand. The latter occurs only if the crew thinks the entire subplot is more like a stand of seedling/saplings than a stand of large sawtimber, and the boundary is assumed to occur between subplot 1 and 2.

- **Condition Boundary or Transition Zone Between Subplots.** When a boundary (either distinct and abrupt or a transition zone) between two or more condition classes occurs between subplots, recognize and classify the separate condition classes, but do not map or reference a boundary on the subplot. Instead, only sketch the boundary on the condition class diagram.

  Example: The northern most subplot (2) samples entirely forest land. The other three subplots, 1, 3, and 4, fall clearly in a non-tree land meadow. Between subplot 1 and 2 is a transition zone; the number of trees present goes from none to what clearly represents at least 10-percent tree stocking. Two condition classes are sampled: forest land sampled on subplot 2, and non-tree land sampled on the other subplots. The boundary is documented by a sketch on the condition class diagram.

2. Delineating the Boundary.

Use the following guidelines for identifying where, on the ground, to map a boundary:

- When the boundary between **any two condition classes** is clearly marked, use that feature to define the boundary. Clear demarcation includes such features as a fenceline, sharp ridgeline, edge of creek channel, ditch, etc.

- When a boundary between **any two condition classes** is a transition zone, assume the boundary occurs between the subplots and not on the subplot.

- When a boundary between **forest land and non-tree land** is not marked by an obvious feature, the boundary should follow the non-tree side of the tree stems/boles at the forest land edge; in other words, map along the outermost edge of the tree stems/boles.

- When the boundary between two contrasting **forest land condition classes** is not clearly marked by a feature such as a fenceline, map along the stems/boles of the contrasting condition class (furthest from the subplot center). When the boundary between two contrasting forest land condition classes is separated by a narrow linear inclusion (creek, fireline, narrow meadow, unimproved road), establish the boundary at the far edge of the inclusion (along the stems/boles of the contrasting condition class).

When a crew remeasures a plot, they should examine the boundaries referenced in the last inventory. If no change has occurred, retain the original boundary data from the last inventory. If the boundary has changed, a new boundary is present, or the previous crew made an obvious error, record a new or updated boundary. Delete boundaries that are no longer distinct.

3. Referencing the Boundary.

A condition class boundary is approximated by a straight line or by a straight line with one corner.

When a boundary between two distinct condition classes crosses through the subplot or microplot, record the azimuths and distances from the subplot center to specific reference points.

Each boundary is referenced, or marked, by a maximum of three reference points: two where the boundary intersects the circumference of the subplot or microplot, and one corner point between the two end points, if necessary. Only the corner point requires a distance, because the distance from the center point to the circumference is always equal to the fixed plot radius.

When a boundary line crosses through the subplot and the microplot, crews must ensure that the reference points provided are along the same approximate boundary line. Circumference azimuths for the subplot and microplot are rarely the same.

Assign all trees sampled along a boundary and within a specific condition class to that same specific condition class regardless of which side of the approximated "boundary line" they occur. However, crews should take extra care to ensure that boundary line references approximate the actual condition classes.

CHAPTER 4 - FIELD PROCEDURE OVERVIEW

This chapter provides a general overview of the field procedures required to conduct the inventory, depending on the field location situation and condition classes present on the location. The first part of this chapter discusses several situations where the crew may not be able to conduct the inventory; the next portion of the chapter describes the basic parts (data forms) of the inventory to be completed. The final section discusses remeasurement and Forest Health field plots, and reserved lands.

A. Circumstances Precluding Field Location Establishment

1. Potential Situations.

The following circumstances may preclude the establishment of any field location:

- **Field location currently being logged**. If the field location is currently being logged, determine when the logging will be completed (ask the foreman), and establish and measure the location only after logging is complete.

- **Inaccessible.** The crew cannot reach or measure the field location center (LC) because of permanent physical conditions (e.g., cliffs) restricting access.

- **Access denied.** The landowner denies access to the field location on private property, or obtaining permission from the owner is not possible. **Promptly leave the property!**

- **Not in Sample Area.** The LC falls outside the State currently being inventoried.

2. Procedures.

When a field location is inaccessible, access denied, or not in the Sample Area, write the appropriate Location Access code on the outside of the field location packet, and record the following information on the **Field Location Description** record:

- State (Item 101),
- Map Number and CPN (Items 102 and 103),
- County and Location Number (Items 104 and 105),
- Owner and Reserved Status (Items 110 and 111),
- Current Date (Item 121),
- Crew Number, Type, and QA Status (Items 122 - 124),
- Location Access (Item 130),
- An explanation in the "General Comments" section (e.g., "we spoke to the landowner at her ranch, but she denied us access to the field location").

Return the plot packet to the section leader and provide the section leader with the details of the situation.

B. Field Locations with Sampled Forest Land Present

Establish and measure a field location if any portion of one of the four subplots occurs within a **sampled forest land** condition class. The field location layout consists of 4 subplots where the LC is the center point of subplot 1. Refer to chapter 5 for field location layout and tree sampling procedures.

Establish these locations using current inventory procedures. For previously established locations using another sample design, re-establish the LC where it was placed before, and sample the location using current inventory procedures. In addition, remeasure the tally tree species using the layout and sampling rules from the previous inventory as described in chapter 12.

For all locations with forest land present, complete the following inventory sections (these will be provided on the data recorder, or use the appropriate field forms). Refer to appendix A for data forms and appendix E for specific items to record:

1. The **Field Location Reference** data (chapter 6).

2. The **Field Location Description** data (chapter 7).

3. The **Condition Class Description** data (chapter 8) for the condition containing the LC and for any additional conditions occurring on the subplots.

4. The **Condition Class Diagram** and **Boundary Information** data (chapter 8).

5. The **Subplot Description** data (chapter 9) for each of the four subplots.

6. The **Tree Data** (chapter 10); record all tally trees present within forest land conditions. If only a portion of a subplot occurs in forest land, only tally the trees within that portion. Refer to chapter 5 for tally tree selection and for shrub-form tally tree special procedures.

7. The **Understory Vegetation Description** data (chapter 11) for each of the four subplots.

8. If necessary, the **Remeasurement Tree** data (chapter 12).

C. Field Locations with No Sampled Forest Land Present, but Sampled Other Tree Land Present

If no portion of the 4 subplots occurs within a sampled forest land condition class, establish a field location if any portion of the 4 subplots occurs within a sampled other tree land condition class. The field location layout consists of 4 subplots where the LC is the center point of subplot 1. Refer to chapter 5 for field location layout and tree sampling procedures.

Establish these locations using current inventory procedures, however, do not individually tally trees. Use the procedures described in chapter 5, page 5-8 for sampling other tree species on the subplots.

For all locations with no sampled forest land condition classes present but other tree land condition classes present, complete the following inventory sections (these will be provided on the data recorder, or use the appropriate field forms). Refer to appendix A for data forms and appendix E for specific items to record:

1. The **Field Location Reference** data (chapter 6).

2. The **Field Location Description** data (chapter 7).

3. The **Condition Class Description** data (chapter 8) for the condition containing the LC and for any additional conditions occurring on the subplots.

4. The **Condition Class Diagram** and **Boundary Information** data (chapter 8).

5. The **Subplot Description** data (chapter 9) for each of the four subplots.

6. The **Understory Vegetation Description** data (chapter 11) for each of the four subplots. Include the other tree species in this section.

D. Field Locations with No Sampled Tree Land Present (Nonsampled Tree Land, Non-tree Land, and/or Water Only)

Field locations with no sampled tree land present will be established and measured ONLY if a rangeland inventory is part of the survey.

- **Within a Rangeland Unit:** For field locations with no sampled tree land present, and located within a rangeland inventory unit, establish the plot. The field location layout consists of 4 subplots where the LC is the center point of subplot 1. Refer to chapter 5 for field location layout and tree sampling procedures, and complete the following inventory sections (these will be provided on the data recorder, or use the appropriate field forms). Refer to appendix A for data forms and appendix E for specific items to record:

  1. The **Field Location Reference** data (chapter 6).

  2. The **Field Location Description** data (chapter 7).

  3. The **Condition Class Description** data (chapter 8) for the condition containing the LC and for any additional conditions occurring on the subplots.

  4. The **Condition Class Diagram** and **Boundary Information** data (chapter 8).

  5. The **Subplot Description** data (chapter 9) for each of the four subplots.

  6. The **Understory Vegetation Description** data (chapter 11) for each of the four subplots. For subplots falling in nonsampled tree land or water condition classes, leave part I blank and record 999 for each entry in Part II.

- **Not Within a Rangeland Unit:** Do not establish and measure a field location if no portion of the four subplots occurs within sampled tree land, and the location is not within a rangeland inventory unit; the subplot layout is located completely within conditions classified as nonsampled tree land, non-tree land, census water, and/or noncensus water.

  For these locations, place a plot stake in the ground at the LC, and do the following. Refer to appendix A for data forms and appendix E for specific items to record:

  1. The **Field Location Reference** data (chapter 6); only the appropriate information is required.

  2. The **Field Location Description** data (chapter 7). Include in the General Comments a brief description of why the field location does not meet the sampled tree land criteria (e.g., this area has been chained and currently has less than 5 percent tree cover and no regeneration).

  3. The **Condition Class Description** data (chapter 8).

  4. The **Subplot Description** data (chapter 9) for each of the four subplots.

  5. On the outside of the field location packet, record the following information:

     - Current Date
     - Crew Number
     - Current Ground Cover Class
     - Land Use

E. Remeasurement and Forest Health Plots

During the course of this field inventory, crews will occasionally revisit previously established plots. Within the Interior West States, numerous field plots have been established to obtain information on forest resources and forest health. Throughout this field manual, subsections referencing remeasurement and Forest Health plots provide additional guidelines for conducting the inventory.

Remeasurement plots indicate a resource inventory plot was previously established at a location: crews will relocate the field plot, in many cases remeasure the trees from the previous inventory, and then establish the current plot design at that same location. Old reference and witness trees can be reused if appropriate.

Forest Health plots are remeasured every one to four years; some forest health plots will be revisited this year, and others in future years. These plots use the same basic layout as the current inventory (refer to chapter 5), so most subplot tree information will reflect previous measurements (e.g., tree number, azimuth, distance -- refer to chapter 10). The microplot, however, is offset for these plots, so crews will need to establish new microplots in this inventory.

Special care is used on Forest Health plots; tally trees are not tagged, nailed, blazed, or bored for age. For this inventory, age, growth, and site tree information is obtained off of the subplot area. In general, only crews with expertise in Forest Health measurements will visit these plots. Refer to the index for various Forest Health topics.

F. Reserved Lands

Because of the legal and social aspects regarding reserved lands (National Parks, NFS and BLM wilderness areas, etc.), crews are required to take extra precautions in monumenting plots as not to "advertise" the presence of the plot. Throughout this manual, several references to reserved lands instruct crews to remove flagging, paint tree tags gray or brown, avoid blazing trees near roads and trails, and others.

However, because it is necessary to relocate field plots wherever they exist, reference trees, plot stakes, tree nails, etc., are still required for reserved plots. On occasion a particular Park or Monument may require adjustments to these guidelines, but crews should follow the procedures in this manual unless specific instructions are included with the plot packet information. Refer to the index for various reserved land topics.

CHAPTER 5 - FIELD LOCATION LAYOUT AND TREE SAMPLING PROCEDURES

This chapter explains the field location layout and tree sampling procedures to use on all locations where tree land is sampled on any of the 4 subplots as described below. In addition, for specific Units, this layout is also used on non-tree land locations.

Remeasurement Plots: A portion of the field locations measured during previous inventories will be revisited during the current inventory. For remeasurement locations that cannot be found, or are mislocated, refer to chapter 2 for instructions. Remeasurement locations will be sampled using the current location layout and sampling procedures, and they will also be remeasured using the previous location layout and sampling procedures. Remeasurement locations will have a separate set of preprinted field forms located in the packet; refer to chapter 12 for remeasurement field location layout and sampling procedures. The location center (LC) will be the same point for both samples.

Forest Health Plots: A portion of the field locations are designated as Forest Health plots. These plots will be treated as remeasurement locations, and they were sampled on a similar layout. All subplot tally trees will be numbered, referenced, and remeasured on the same subplot layout. Seedlings and saplings will require microplot installation using current procedures.

Mark the location center (LC) and subplot centers 2-4 on the ground with a metal stake. If a metal stake cannot be placed in the ground because of bedrock, etc., build a rock cairn (rock pile) around the stake. If the subplot center cannot be monumented at all (e.g., in a river, on a paved road), place a stake where possible (e.g., off the road) and reference the azimuth and distance to the subplot center. Take all measurements from subplot center, not from the offset stake.

A. Field Location Layout

The field location layout (figure 6) consist of 4 fixed-radius subplots for tree and understory measurements and condition class mapping, and 4 fixed-radius microplots for seedling and sapling tally and mapping.

Once the LC has been established, it is designated as the center of subplot 1. Subplots 2-4 are established in a triangle pattern surrounding the LC as follows:

From LC (1) to	Subplot Center	Azimuth and (degrees)	Distance (feet)
	2	360	120
	3	120	120
	4	240	120

Figure 6. Field Location Layout.

In addition, subplots 2-4 can be located from subplots centers other than the LC if necessary:

From Subplot	To Subplot	Azimuth (degrees)	Back Azimuth (degrees)	Distance (feet)
2	3	150	330	207.8
3	4	270	90	207.8
4	2	30	210	207.8

Note: Distance correction for slope is necessary when the slope exceeds 10 percent. Use a clinometer to determine the appropriate slope correction, or see slope correction table in appendix B.1.

B. Sampling Procedures

For sampled forest land condition classes, inventory all subplots as described below. For sampled other tree land condition classes, or for other tree species on forest land condition classes, refer to item 4.

1. Subplot Tree Tally

a. Procedures. The subplot is a 1/24-acre fixed-radius plot (24-foot radius) centered on the stake. At each subplot, stand directly over the center (stake), and starting at 1° azimuth, rotate clockwise and tally qualifying trees that fall within the subplot. Include only those trees within sampled forest land condition classes; do not tally and measure trees in nonsampled tree land or non-tree land condition classes. For a qualifying tree to be tallied, the horizontal distance from the subplot center stake to the geographic center of the stem(s) or the center of the bole (pith) at the base of the tree must be 24 feet or less.

b. Qualifying trees.

(1) **Live timber species trees** (refer to page 3-7) 5.0-inches in diameter at breast height (DBH) or larger. Live timber species trees will be classified as sound, rough, or rotten:

The **merchantable bole** on a timber species is defined as the portion of a tree, 5.0-inches DBH or larger, between a 1-foot stump and a 4.0-inch top diameter. For saplings, examine the stem from a 1-foot stump to a 1.0-inch top.

(a) A **sound** live timber species has at least 1/3 of the merchantable volume in live and solid wood, and contains at least one solid 8-foot section, reasonably free of form defect.

(b) A **rough** live timber species has less than 1/3 of the merchantable volume live and solid, with more than half of the unsound wood due to solid dead wood volume or severe form defect; or, a live tree that does not now, nor prospectively, have at least one solid 8-foot section, reasonably free of form defect, on the bole.

(c) A **rotten** live timber species has less than 1/3 of the volume live and solid, with more than half of the unsound wood due to rotten and/or missing volume.

(2) **Live woodland trees** (refer to page 3-7) with a single stem of at least 5.0-inches diameter at root collar (DRC) or a cumulative (calculated) DRC of at least 5.0-inches. For multistemmed trees, at least one stem must be 1.0-inch DRC or larger.

(3) **Standing dead timber species** 5.0-inches DBH and larger. To qualify as a standing timber species, the main tree stem/bole must be at least 6.0-feet tall and be self-supporting (i.e., a standing timber species cannot be broken below 6.0 feet and cannot be leaning against another tree for support).

Dead trees are classified as either hard or soft:

(a) A **hard** dead timber species has a minimum of 1/3 of the original merchantable volume in solid wood (less than 67 percent rotten and/or missing).

(b) A **soft** dead timber species has less than 33 percent of the original merchantable volume in solid wood (more than 67 percent rotten and/or missing).

(4) **Standing dead woodland trees** with a single stem of at least 5.0-inches DRC or a cumulative (calculated) DRC of at least 5.0-inches. For multistemmed trees, at least one stem must be 1.0-inch DRC or larger, and at least one stem is standing.

To determine if a downed tree is within the subplot, visually upright the tree at its origin (e.g., base of broken tree stem or bole, root system depression) and determine if the center of the tree at its base would fall within the maximum subplot distance for tally (refer to figure 7 for an example).

(5) **Down dead timber species** 5.0-inches DBH and larger. Downed timber species are those with the main stem/bole broken off below 6.0 feet or those not attached for support at the base or ground level (e.g., an upright tree broken at the base, but leaning against another tree for support). For a down dead timber species to be tallied, the center of the stem at DBH must be above the duff layer. Do not tally trees that are severely decayed and no longer have a cylindrical form, though note any questionable trees. Down dead timber species are also classified as either hard or soft (see standing dead above).

(6) **Down dead woodland trees** with a single stem of at least 5.0-inches DRC or a cumulative (calculated) diameter at root collar (DRC) of at least 5.0-inches. For multistemmed trees, at least one stem must be 1.0-inch DRC or larger, but no stems are still standing.

Note (regarding woodland trees): Treat all woodland species (except maple and deciduous oak) that have several stems clumped together, with a unified crown, and appearing to be from the same root origin, as a single tree. Treat maple and deciduous oak species that fork underground as individual trees.

Figure 7. Down tree limiting distance.

2. Microplot Sapling Tally.

a. Procedure. The microplot is a 1/300-acre fixed-radius plot (6.8-foot radius) centered on the subplot stake. At each microplot, stand directly over the center (stake), and starting at 1° azimuth, rotate clockwise and tally qualifying trees that fall within the microplot. Include only those trees within sampled forest land condition classes. For a qualifying tree to be tallied, the horizontal distance from the subplot center stake to the geographic center of the stem(s) at the base of the tree must be 6.8 feet or less.

b. Qualifying trees.

(1) Live and dead timber **species** 1.0- to 4.9-inches DBH. Dead timber species saplings are also classified as hard or soft (see 1. above), and live timber species saplings are classified as either sound or rough; examine these trees from a 1-foot stump to a 1.0-inch top diameter.

(a) A **sound** live timber species sapling has only minor or no evidence of form defects, insects, or disease, and it is expected to become a sound tree 5.0-inches DBH or larger.

(b) A **rough** live timber species sapling has severe form defects or evidence of insects and disease that will preclude it from becoming a sound tree, 5.0-inches DBH or larger.

(2) **Live and dead woodland species**, with a single stem between 1.0 and 4.9-inches DRC or a cummulative DRC of 1.0- to 4.9-inches. For multistemmed trees, at least one stem must be 1.0-inch DRC or larger.

3. Seedling Counts.

Using the same microplot as in 2. above, group and count by species all live tally species smaller than 1.0-inch DBH/DRC, having a root system in mineral soil, and at least 4.0-inches tall for softwoods (e.g., pines, firs, spruces, pinyon, juniper) or 12.0-inches tall for hardwoods (e.g., aspen, cottonwood, oak, maple, mountain-mahogany). Include only those seedlings within sampled forest land condition classes. If more than one forest land condition class occurs on a microplot, conduct a separate count within each condition class.

Do not consider a seedling as established (do not count it) if it is not expected to survive to sapling size due to form defects, insect infestation, or disease.

If there are a large number of seedlings, record an estimate and note "count estimated" in the comments.

4. Other Tree Species and Shrub-form Tally Tree Species

Use the following procedures for sampling trees classified as other tree species (those not included as tally trees on pages 10-9 and 10-10).

In addition, use these procedures in cases where the timber or woodland tally species present on the site will never reach tree form due to poor site conditions. For example, in some areas oneseed juniper or gambel oak, although hundreds of years old, never grows over 3- to 4-feet tall due to rocky sites and dry environments. Likewise, some timber species at high elevations (Krummholz zones) stay short and gnarled in form, with twisted boles and multiple forks.

a. Qualifying tally trees. Use these procedures for other tree species encountered on sampled tree land, and for tally tree species that **do not** meet the following tree form criteria:

- **Timber species.** One or more trees on the site has or will have at least one solid 8-foot section on the merchantable bole, reasonably free of form defect.

- **Woodland species.** One or more trees on the site has or will have at least one 8-foot section, with a minimum bottom diameter of 3.0 inches and a minimum top diameter of 1.5 inches.

Important: If there is any doubt whether or not the tally species will reach tree form, or if there is any evidence the site once supported tree form plants, do not use these procedures for tally trees on the location.

In general, do not use these procedures for individual shrub-form tally species if other tally species on the site reach tree form. Exceptions include shrub form woodland trees (maple, cercocarpus, yew, New Mexico locust) that may occur as a minor shrub component in a coniferous stand.

b. Procedure.

(1) Classify areas with "other tree species" and shrub-form tally tree species as tree land (other tree land or forest land) if they meet the tree land criteria.

(2) Do not individually tally trees at each subplot and do not complete the Tree Data record for the tree species. Instead, include all trees on the **Understory Vegetation** record, and include timber and woodland species trees of any size (not restricted to seedlings and saplings).

CHAPTER 6 -
FIELD LOCATION REFERENCE ITEMS

This chapter describes items for referencing and relocating the field location center (LC), and provides procedures for monumenting the location.

Procedures for monumenting locations on **reserved lands** (wilderness, parks, etc.) and **Forest Health plots** are also included. Because the information documented on the Field Location Reference record (appendix A.1) will be used to find the field location in subsequent inventories, the information must be legibly recorded in understandable terms. Procedures for photographing field locations are provided at the end of this chapter.

A. Identification Items

Write the State, Map, CPN, County, and Field Location numbers in the spaces provided at the top of the Field Location Reference record.

B. Reference Point

MQO: Identification - No errors 100% of the time.
Diameter - 0.2 inch per 20 inches of diameter, 95% of the time.
RP selection is critical to the relocation of any field plot. Extreme care is required to select an RP that is easy to locate, is readily identifiable on the ground and the aerial photos, and will likely be identifiable in 10 years. Refer to "Selecting a Reference Point" (page 2-6).

Remeasurement locations and Forest Health plots: use the reference point from the previous measurement if it meets the site tree requirements.

When a tree is used as an RP, record species and diameter at breast height (DBH) or diameter at root collar (DRC) as appropriate. If a multistemmed woodland tree is selected, measure only one stem, preferably the largest or main stem. Also give a description of the RP and its location, for example, "large ponderosa pine located on the southwest corner of the meadow" or "six-stemmed juniper with a dead top on ridgeline."

If other landmarks are used for an RP, such as a sharp bend in road, a corner of building, the intersection of two fence lines, etc., leave species and DBH/DRC blank and provide an adequate description of the RP selected.

Tagging the RP -- Attach to the RP, when appropriate, aluminum tags labeled "RP LOC #" (Item 105). If a tree is selected as the RP, nail aluminum tags on two sides of the tree approximately 6 feet above ground level, and with at least 1 inch of nail exposed (to allow for tree growth between inventories). Nail one of the tags facing in the general route of approach to the RP. Nail a third tag at ground level facing towards the field location. If the RP is in a place where there is a high probability that a tag at 6 feet above the ground may be vandalized, only attach the tag at ground level and make a note on the Field Location Reference record.

Note: Use steel nails only on woodland species, and avoid tagging aspen trees.

No RP tags are needed if the RP is permanent and readily identifiable, such as the corner of a building or a road intersection. **Never** nail a tag to a private building or other private structure.

Reserved land: Only tag RP trees at the base; do not tag RP trees at 6 feet above the ground. Remove all flagging before you leave the vicinity. For plots near trails or roads, metal tags must be spray painted gray or brown on both sides. The RP must be carefully selected and adequately described to provide adequate means for future relocation.

C. Course to Location Center

MQO: Azimuth ±2 degrees 95% of the time.
Distance ±10 feet 95% of the time.
Record the azimuth (to the nearest degree), horizontal distance (to the nearest foot), and slope distance (to the nearest foot) from the RP to the location center (LC).

D. LC Witness Trees

1. Selection.

Reference the LC with two witness trees ("X" and "Y" trees).
On **remeasurement locations**, use previous witness trees where possible. Preferably, witness trees should be as follows:

- Outside the subplot boundary and spaced approximately at right angles to each other; however, if the vegetation is dense, select trees close to the stake. The "X" tree should be on the

extension (as near as possible) of the azimuth followed to the LC, and the "Y" tree at a right angle to this azimuth.

- Not likely to die within 10 years.

- A species easily located on the site (e.g., an Engelmann spruce in a lodgepole pine forest type). **Note:** Avoid aspen, if possible.

- At least 5.0-inches DBH for timber species and 3.0-inches DRC for woodland trees if possible.

If no live trees are within the vicinity of the LC (e.g., clearcut, burn area) select alternative witness landmarks that are likely to be present in 10 years (e.g., a sound snag, large stump, prominent rock). Describe the alternative landmarks selected on the Field Location Reference record.

2. <u>Recording</u>.

Record the following data for "X" and "Y" trees under the "Witness Trees" section of the Field Location Reference record.

a. **Species**. If the witness is not a tree, indicate what was used (e.g., large boulder).
MQO: No errors 100% of the time.

b. **DBH/DRC** to the last whole 0.1 inch. If a multistemmed woodland tree is used as a witness tree, measure and record the DRC of one stem (the largest or main stem).
MQO: ±0.2 inch per 20 inches diameter, 95% of the time.

c. **Azimuth** (to nearest degree) from the LC stake to the center of tree at its base.
MQO: ±3 degrees 95% of the time.

d. **Slope distance** (to the nearest 0.1 foot) from the top of the LC stake to the nailed tag (see below).
MQO: ±0.2 feet 95% of the time.

3. Marking.

For witness trees outside the subplot radius, scribe an "X" above DBH/DRC on the side of the "X" tree facing the stake (LC); scribe the bark, but be careful not to penetrate the cambium.

For trees not scribed (tree within subplot radius), nail a witness tag approximately 6 feet above the ground facing the LC if appropriate.

If a small tree is used, or if the location is in close proximity to private residence, do not blaze or tag but record a note under the "Witness Trees" section of the Field Location Reference record. If a multistemmed woodland tree is used as an "X" Tree, scribe the "X" on the stem measured for DRC.

For all witness trees, scribe two aluminum tags, one labeled "X LOC #" (with the actual location number) and the other labeled "Y LOC #". Nail each tag to the appropriate witness tree, at ground level, with the tags facing the LC stake. On multistemmed woodland witness trees, nail the tag at ground level to the stem measured for DRC, or at ground level below the stem measured for DRC if the stem originates above ground level. **Note:** When driving nails into trees, leave at least 1 inch exposed to allow for tree growth.

Where the witness is not a tree (e.g., rock), tag the alternative landmarks in some manner if appropriate, with aluminum tags, to aid field crews in re-locating the LC in future remeasurement inventories.

Reserved locations: Metal tags must be spray painted gray or brown on both sides, and do not blaze the X tree if the location is near a road or trail or as otherwise directed.

Forest Health plots: Use previously selected witness trees, and do not scribe the trees.

E. Baseline Information

Record the appropriate baseline information as described in chapter 2.

F. Travel Description

Record road directions from the nearest post office or major highway intersection to the vicinity of the RP. This space can also be used to record other travel information that will assist in relocating the field location (e.g., hiking distance and direction from parking location to RP, specific information about obtaining keys for locked gates).

G. Owner Information

Record the name of the private landowner or the name of the managing agency. If a private landowner is listed, also record the address and telephone number, if known (this information is used for quality control crew access and remains confidential).

Below "Owner Information," record information about landowner contact, recommendations for 4-wheel drive and ATV use, and information about locked gates (in the boxes provided, check "yes" or "no").

H. Field Location Map

On the field location map diagram, draw any physical features that will assist in accurately relocating the field location (e.g., the location of the RP, roads or trails, drainages, ridgelines, fence lines, changes in vegetation type). In addition, **draw and label all condition class boundaries.**

I. Field Crew

Record the first initial and the full last names of the cruiser(s) and the recorder.

J. Photos

Record the aerial photography project, roll, and photo numbers. Place an asterisk (*) immediately before the photo number with the LC pinprick. Also, record the nominal photo scale (usually printed on the photo) and year of photography.

Remeasurement locations: Use the newest photos if possible; however, if the old photographs are at a better scale, and no significant change in the landscape has occurred (e.g., new roads), use the old photo pair.

K. Editing

1. Field Crew Edit.

After measuring the field location, but before leaving the site, the crew supervisor must review the field forms to make sure the required data are correctly and legibly recorded. Examine the following checklist, as a minimum, for completeness:

- All photo work complete, with RP pinpricked.
- Witness trees referenced and data recorded.
- Location and condition class maps drawn; photos taken.
- All data records are complete; no blank spaces.
- Necessary site trees selected and bored.
- Age and radial growth data complete.
- Unknowns collected and pressed.
- Field equipment gathered (PDR, GPS, camera, borer, tatum, plot packet, etc.).

The crew supervisor will then initial and date the Field Location Reference record in the "Field Crew Edit" box.

2. Office Review.

Leave blank; this item is only to be recorded by office or quality control staff.

L. Map Name and Scale

If using the field forms, record the name and scale of the USGS topographic map (provided in each field location packet) that displays the location of the LC (grid line intersection).

M. Legal Description

MQO: No errors 100% of the time.
Record the township, range, and section where the field location is located. Be careful when examining topographic, Forest, or BLM maps; changes in numbering often occur along State, baseline, or other boundaries.

N. Photographing the Field Location

As an additional aid in describing the field location, and as a record of plot conditions at the time of the field inventory, take photographs of the field location using field cameras and color slide film.

Procedure: At each field location, stand over the LC stake and take four photographs in the cardinal directions (i.e., take pictures facing north, east, south, and west). Include a placard in each picture, placed in the lower right-hand corner of the view, indicating the State, county, location number, and direction faced (N, E, S, or W). Be sure the placard is legible, but do not allow the placard to obstruct the view of the site. **Note:** Field compass declination is set to 0°.

It is best to take the photographs in moderate light conditions; shade the lens from direct sunlight when necessary, and use the flash in dark conditions (dense stands, cloudy days, etc.). Also, avoid using the first or last frames of the film for photographing field locations.

O. Global Positioning System (GPS) Reference Data

When a GPS is available to the crew, collect data at 3 sites during data collection activities on all visited field locations. Refer to supplemental instructions for setting up the GPS, and for loading and collecting data points.

Collect and record UTM Zone (11, 12, or 13), UTM Easting, and UTM Northing. If no data were collected, record 0's for each.

1. **Truck** - collect adequate data points at the site where the vehicle is parked to begin hiking. This point will provide information to future crews for access and may also help you relocate your vehicle in an emergency.

2. **Reference Point** - collect adequate data points at the reference point, regardless of how near or far from the LC.

3. **Location Center** - collect adequate data points at the LC. If adequate GPS data cannot be collected at the LC due to terrain or dense tree canopy, collect the data as near the LC as possible, making GPS corrections for the azimuth and distance from the LC (if this is not possible, record in General Comments or Notes the azimuth and distance from the reading site to the LC).

CHAPTER 7 -
FIELD LOCATION DESCRIPTION ITEMS

This chapter presents the field location description items. Refer to appendix A.2 for the Field Location Description record.

Carefully read all instructions for each item. Record leading zeros for each item, where appropriate. When instructed to examine the location area, refer to the area encompassing the subplots, about 2.5 acres (approx. 185-foot radius) centered on the LC.

Refer to the Item Coding Guide (appendix E) for the items to record.

Use the "Baseline Information" section as a work space to record information pertaining to the baseline and traverse used in locating the location center (LC).

ITEM

101 **State**.

MQO: No errors 100% of the time.
Record the code for the State where the field location is located.

Code	State	Code	State	Code	State
04	Arizona	30	Montana	49	Utah
08	Colorado	32	Nevada	56	Wyoming
16	Idaho	35	New Mexico		

102 **Map Number**.

MQO: No errors 100% of the time.
Record the map number assigned to the topographic map for the field location. The map number is indicated on the field location packet. The field location center (LC) is indicated on the topographic map by the intersection of designated map grid lines.

103 **Consecutive Point Number (CPN)**.

MQO: No errors 100% of the time.
Record the CPN assigned to the field location. This item is indicated on the field location packet.

ITEM

104 **County**.

MQO: No errors 100% of the time.
Record the code for the county where the field location is located. This item is indicated on the field location packet. Refer to the appropriate State Supplement for a county code list.

105 **Field Location Number**.

MQO: No errors 100% of the time.
Record the number assigned to the field location. This item is indicated on the field location packet.

ITEM

110 **Current Ownership**.

MQO: No errors 100% of the time.
Record the code for the owner or managing agency class at the LC. If the owner class code on the packet is incorrect, based on verification at the county courthouse, managing agency office, etc., record the correct owner class code on the packet and on the Field Location Description record.

If owner class code 99 (private) is indicated on the packet label, record code 40, 60, or 70 on the Field Location Description record as appropriate.

Code	Owner Class
01	**Census water**
09	**National Park Service**
11	**National Forest**
12	**Bureau of Land Management**
13	**Indian tribal trust and/or allotted trust lands**
14	**Miscellaneous Federal** -- includes Bureau of Indian Affairs (for lands that are government-owned), Bureau of Reclamation, and all Federal agencies not covered by existing codes.
15	**State**
16	**County and municipal**
20	**Forest industry** -- land owned by a company or an individual(s) operating a primary wood-processing plant.
40	**Farmer/Rancher**
60	**Other private, corporate**
70	**Other private, individual**

111 **Reserved Status Class**.

MQO: No errors 100% of the time.
Record one of the following 2-digit codes:

Code	Status
01	**Nonreserved**
02	**Reserved** (see State Supplement)

ITEM

121 Current Date.

MQO: No errors 100% of the time.
Record in order the the month, day, and year that the field location is inventoried. August 12, 1995 would be recorded as 08,12,1995. Use the following codes for month:

Code	Month	Code	Month
01	**January**	**07**	**July**
02	**February**	**08**	**August**
03	**March**	**09**	**September**
04	**April**	**10**	**October**
05	**May**	**11**	**November**
06	**June**	**12**	**December**

122 Crew Number(s).

MQO: No errors 100% of the time.
Record up to 5 crew numbers as assigned to the field crew; always record the crew supervisor first (e.g., for crew supervisor 02 working with crew members 12 and 31, record 02,12,31,00,00).

123 Crew Type.

MQO: No errors 100% of the time.
Record one of the following codes:

Code	Type
1	**Production field crew**
2	**QA field crew - check plot**
3	**Other**

ITEM

124 **QA Status**.

MQO: No errors 100% of the time.
Record as appropriate: default is 1 for all valid production field plots:

Code	Type
1	**Standard field plot**
2	**QA field plot**
3	**QA reference plot**
4	**Training plot**
5	**Botched plot**
6	**Between-crew QA plot**

130 **Location Access.**

MQO: No errors 100% of the time.
Record one of the following codes. For codes other than 01, inform the Section Leader:

Code	Type
01	**Accessible.**
10	**Inaccessible** -- crew cannot access the location center (subplot 1) due to extremes in terrain, such as excessively steep slopes, cliffs, etc. This code must be verified and approved by the Field Supervisor or Quality Control.
11	**Sample Missed** -- this code is for office use only; it is used when a field location is "missed" or not inventoried, for whatever reasons, during the scheduled field season for the State.
12	**Access Denied** -- crew cannot access the location center because the land owner has denied access, either verbally or in writing.
13	**Not in Sample Area** -- this code is used for geographic or ownership areas not included in the Sample Area (e.g., outside State borders). This code is used only in the office.

ITEM

129 Current Location Status.

MQO: No errors 100% of the time.
Record one of the following codes for the location:

Code	Type
1	**At least one sampled tree land condition class** present on one or more of the subplots (Ground Cover Class 20 or 30, and Land Use 11-13).
2	**No sampled tree land** condition classes on any of the subplots; all subplots occur in non-sampled tree land (orchards, etc.), non-tree land (grasslands, etc.), or water.
3	**Not field sampled at all**; entire location is access denied, inaccessible, or other.

131 Sample Kind.

MQO: No errors 100% of the time.
Record the following code for the location:

Code	Sample kind
1	**New field location**

132 Subplot Radius.

MQO: No errors 100% of the time.
Record the following code for the subplot radius:

Code	Subplot Radius
240	**24.0-foot radius (1/24-acre subplot)**

133 Microplot Radius.

MQO: No errors 100% of the time.
Record the following code for the seedling/sapling microplot radius:

Code	Microplot Radius
068	**6.8-foot radius (1/300-acre)**

ITEM

140 **Elevation**.

MQO: ±100 feet, 95% of the time.
Using the topographic map provided in the location packet, determine and record the elevation of the LC as a 5-digit code. Note: some USGS maps are labeled in metric; to convert meters to feet, multiply meters by 3.28.

141 **Size of Forested Area.**

MQO: ±1 class 90% of the time.
Record the code that applies to the size of the entire **continuous** forest land area (all forest land condition classes combined) surrounding the LC. Include any forest condition in any ownership. Use the aerial photographs of the field location to aid in determining the size of the forest land area. Refer to appendix B.2 for map/photo scale ratios.

Code	Size
0	**No forest land on the location**
1	**1-5 acres**
2	**6-10 acres**
3	**11-20 acres**
4	**21-40 acres**
5	**41-160 acres**
6	**161-640 acres**
7	**1-5 square miles**
8	**>5 square miles**
9	**Forest Stringer** - forest land forming a linear cover, at least 120 feet wide, with the length at least 4 times the width.

ITEM

142 **Remote Sensing Cover Type.**

MQO: No errors 90% of the time.
Examine the location area, i.e., the 185-foot radius area encompassing the 4 subplots, and record a primary and secondary Remote Sensing (RS) Cover Type. An RS Cover Type must be at least 2.5 acres in size and at least 100-feet wide. Record the appropriate 3-digit types that best represent the first and second largest areas of that plot; record the primary type first and the secondary type last. If only one RS Cover Type is present on the 2.5 acre area, record 000 for the secondary type. Refer to the appropriate State Supplement for codes and definitions.

143 **Trails or Roads**.

MQO: No errors 90% of the time.
Record the trail or road **nearest, or on,** the field location. Consider only trails/roads for human access within 1 mile of the LC.

Code	Trails or Roads
0	**None within 1 mile**
1	**Paved road or highway**
2	**Gravel road**
3	**Improved dirt road**
4	**Unimproved dirt road**
5	**Jeep road** -- 4-wheel drive road
6	**Improved trail** -- primarily for recreational use, maintained on a regular basis
7	**Unimproved trail** -- primarily for recreational use, not maintained on a regular basis

ITEM

144 **Distance to Improved Road**.

MQO: No errors 90% of the time.
Determine the distance from the LC to the nearest improved road and record the corresponding code. Consider only paved roads, gravel roads, or improved dirt roads regularly maintained for long-term continuing use. Measure the "straight-line" distance on the topographic map. If the nearest improved road is not on the topographic map, estimate the "straight-line" distance.

Code	Distance To Improved Road
11	**Less than 1/2 mile**
12	**1/2 to 1 mile**
13	**1 to 3 miles**
14	**3 to 5 miles**
15	**Greater than 5 miles**

145 **Public Use Restrictions**.

MQO: No errors 90% of the time.
Record the primary and secondary public access or use restrictions encountered while traveling to the location. Record the most significant evidence as primary (first two digits) and any other evidence as secondary (last two digits). For example, a locked gate with a "no hunting" sign posted is coded 01,04. Do not repeat codes for primary and secondary (except code 00 and 09).

Code	Evidence	Code	Evidence
00	**None**	**09**	**Other -** specify
01	**Locked gate**	**10**	**"No motorized vehicles"**
02	**"Keep out"**	**11**	**Water bar/kelly hump**- large mound of soil & rocks to prohibit access
03	**"No trespassing"**		
04	**"No hunting"**		
05	**"No fishing"**		
06	**"No dumping"**		
07	**Other posted signs**		
08	**Owner contact --** sign posted (e.g., "contact owner for permission to access land"), or physical contact with the landowner/manager is necessary to gain access to the field location.		

ITEM

146 **Recreation Use.**

MQO: 1 of 2 correct, 90% of the time.
Record any sign of recreation use **on the area** encompassing the subplots, based on evidence such as campfire rings or compacted areas from tents (camping evidence), hiking trails, bullet/shotgun casings or tree stands (hunting evidence), etc. Examine the area containing the 4 subplots, and record three one-digit codes; record the recreation use that has the most significant impact on the field location first, and then the second and third. Do not code a secondary use without a primary use, or a tertiary use without a secondary. Do not repeat codes, except code 0 and 9.

Code	Recreation Use	Code	Recreation Use
0	**None**	**5**	**Trail bikes**
1	**Hiking**	**6**	**Horse trails**
2	**Hunting**	**7**	**Jeep trails**
3	**Camping**	**8**	**Boating**
4	**Fishing**	**9**	**Other - specify**

147 **Water Proximity**.

MQO: ±1 class, 90% of the time.
Record a code for the distance from the LC to the nearest permanent or reliable source of surface water for any use (e.g., for wildlife, livestock, recreation). Only examine water sources within 1 mile of the LC. For example, if the location is 250 feet from an ephemeral stream, but 1/4 mile from a catchment basin, reference the basin because it will likely hold water throughout a large portion of the year. Consider Regional climate when assessing this variable.

Code	Distance
0	**Adjacent (200 feet or less)**
1	**201-300 feet**
2	**301-500 feet**
3	**501-700 feet**
4	**701-900 feet**
5	**901-1100 feet**
6	**1101-1320 feet**
7	**1/4 - 1/2 mile (1321-2640 feet)**
8	**1/2 - 1 mile**
9	**None -- no water source within 1 mile**

148 **Water Type.**

MQO: No errors 90% of the time.
Record a code for the type of water source used in determining Water Proximity (Item 131) above.

Code	Type
0	**None**
1	**Perennial** -- permanent; a year-round water source
2	**Intermittent** -- seasonal; a water source that occurs throughout a large portion of the year, but is dry during certain months of the year
4	**Ephemeral** -- a water source that only occurs in direct response to rainfall or surface runoff. Use only when no more reliable source is present within the mile.
5	**Catchment basin** -- a human-made structure to catch and store surface runoff for livestock/wildlife
6	**Irrigation** -- human-made ditches or other artificial channels used as a means of supplying water to the land
7	**Other** - specify in notes/comments

149 Land Use Impact.

MQO: 2 of 3 correct, 90% of the time.
Record three 1-digit codes for the three Land Use Impact categories nearest to the LC. Record the nearest first, the next closest second, and the third closest last. Do not record the same category more than once. Use the maps, photos, and on-the-ground observations to classify.

Code	Land Use Impact Categories
1	**Urban buildup** -- residential, industrial, and recreational developments; include areas with concentrations of houses, cabins, or vacation homes.
2	**Lakes and reservoirs** -- includes inlets, necks, and coves attached to larger bodies of open water.
3	**Rivers and streams** -- averaging over 30 feet wide.
4	**Reserved forest land** -- see glossary for definition.
5	**Agricultural lands** -- includes cropland, improved pasture, idle or other farm land, homesteads, and other lands used to support agricultural activities.
6	**Mining.**
7	**Major highways or interstates.**
8	**Other well-maintained roads** -- maintained roads as well as powerlines, pipelines, railroads, and other transmission lines.
9	**Rangeland** -- includes all natural rangeland, openings, or meadows not qualifying as tree land.

150 Land Use Impact Distance.

MQO: No errors 90% of the time.
Record three 1-digit codes for the distances corresponding to the first, second, and third Land Use Impact categories selected (Item 149). The first distance must correspond to the first and nearest Land Use Impact category recorded, the second digit must correspond to the second category recorded, etc.

Code	Distance
0	**0 to 185 feet (on the location)**
1	**185 feet to 1/4 mile**
2	**1/4 to 1/2 mile**
3	**1/2 to 1 mile**
4	**1 to 3 miles**
5	**3 to 5 miles**
6	**More than 5 miles**

ITEM

160 Number of Tree Records.

MQO: No errors 100% of the time.
Record the total number of data lines entered on the Tree Data Record; this item is required only when using paper field forms to collect data. Include tally trees, nontallied site trees, and seedling and sapling count data. Exclude remarks, comments, and blank lines.

161 Number of Conditions.

MQO: No errors 100% of the time.
Record the total number of condition classes encountered on the field location; this item is required only when using paper field forms to collect data. Include the condition class of the LC, and any additional condition classes documented on the Condition Class Record.

CHAPTER 8
CONDITION CLASS DESCRIPTION ITEMS

This chapter presents the Condition Class Description data (appendix A.3), the Condition Class Diagram and Boundary Record (appendix A.4).

Carefully read all instructions for each item. Record leading zeros for each item, where appropriate. To determine a value for an item within a particular condition class, examine the condition class area, generally within 60 feet of the subplot centers.

Use the "General Comments" section to record any notes about the condition class or to record any specific notes that apply to one of the condition description items (e.g., "the condition class #1 habitat type was determined off-site due to severe burning in condition").

A. Condition Class Description

The attributes listed below are the critical variables for recognizing and defining a condition class (refer to chapter 3). Each time a distinct change occurs in one or more of the defining attributes, based on the minimum area size criteria and definitions in chapter 3, a new condition class is recognized. If any portion of a subplot is located within a new condition, the new condition class is to be described by the variables in this chapter.

The defining attributes are:

ITEM	
211	Ground Cover Class
213	Current Land Use
221	Forest Type (forest land)
222	Stand-size Class (forest land)
223	Stand Origin (forest land)
224	Stand Density (forest land)
236	Dominant Tree Species (other tree land)
237	Rangeland Cover Type (non-tree land)

The remaining items (aspect, slope, etc.) provide additional information about the condition class but do not define the condition class.

For each condition class recognized, record each of the following items unless otherwise noted (e.g., some are recorded only for forest land conditions classes). Refer to appendix E for the items to record based on condition classification.

ITEM

201 Condition Class Number.

MQO: No errors 100% of the time.
For each condition class encountered on the subplots, record a condition class number. Record the condition class encompassing the LC as condition class 1. If additional condition classes occur, number and record them consecutively. For example, the first new contrasting condition is 2, the next is 3, etc.

211 Current Ground Cover Class.

MQO: No errors 100% of the time.
For each condition class, record the code for the Current Ground Cover classification that describes the condition. Refer to chapter 3 for definitions:

Code	Cover
--	Tree land:
20	**Forest land**
30	**Other tree land**
60	**Non-tree land**
91	**Census Water**
92	**Noncensus Water**

ITEM

213 Current Land Use (LU) Classification.

MQO: No errors 100% of the time.
For each condition classified as tree land or non-tree land Ground Cover Class, record one of the following Land Use classifications; definitions are listed on pages 8-4 and 5. For conditions classified as water, leave this item blank.

Code	Land Use
Tree Land:	
	Sampled Tree Land --
11	**Undeveloped tree land**
12	**Developed rural tree land**
13	**Developed urban tree land**
	Nonsampled Tree Land --
21	**Nonsampled urban tree land**
22	**Christmas tree plantations**
23	**Orchards**
25	**Other nonsampled tree land**
Non-tree Land:	
61	**Shrub cover**
62	**Natural herbaceous/grass cover**
63	**Crop cover**
64	**Improved pasture**
65	**Natural crest or alpine tundra**
66	**Barren**
71	**Cultural developments** -- sheds, yards, barns, pump-houses, trailers, houses, etc. (refer to page 3-11.
72	**Maintained roads and rights-of-way** -- improved roads, railroads, powerlines, pipelines, and transmission lines (refer to page 3-11)
73	**Other non-tree land** (urban, etc.)

Tree Land (both forest land and other tree land):

Sampled Tree Land --

Undeveloped tree land (code 11). Tree land without the development of recreation or residential homes, businesses, etc.

Developed tree land. Tree land that probably will not be managed for wood utilization because of development for recreational, residential, or other uses. **Note:** For developed sites that meet the requirements to qualify as tree land, human activity on the site must not preclude the natural succession of the vegetation.

Developed urban tree land (code 12). Tree land in or adjacent to a discernible incorporated community. These areas are identified by the presence of homes (buildings) and/or a high road density. An example is a natural or undeveloped park within urban boundaries.

Developed rural tree land (code 13). Tree land located in areas set apart from discernible incorporated communities. Some examples are resorts and recreational areas with a high road density.

Nonsampled Tree Land --

Nonsampled urban tree land (code 21). Land, within cities and towns, that has at least 5 percent cover in trees but where human activity on the site prevents natural succession (e.g., school yards, city parks, cemeteries, golf courses).

Christmas tree plantations (code 22). Land meeting the tree land definition, but consisting of planted native or non-native tree species grown as crops for Christmas trees. Trees are usually planted in rows and harvested in the seedling or sapling sizes.

Orchards (code 23). Land meeting the tree land definition, but consisting of nontally tree species grown for the production of fruit or nuts. These include plantations of walnuts, pecans, peaches, apples, etc.

Other nonsampled tree land (code 25). Land meeting the tree land definition, but (1) natural succession is precluded due to understory treatment (improved pasture, etc.) or development, and not located within cities or towns (i.e., code 21), (2) tree species were eliminated from the sample (lily and cactus families), or (3) other nonsampled tree land not described in other codes.

Non-tree land (less than 5 percent tree cover):

Shrub cover (code 61). Land with less than 5 percent cover of trees, with the majority of vegetation cover consisting of shrubs such as snowberry, sage brush, ocean-spray, ninebark, bitterbrush, etc.

Herbaceous/grass cover (code 62). Land with less than 5 percent cover of trees, with the majority of vegetation cover consisting principally of native grasses, forbs, or cryptograms.

Crop cover (code 63). Land with less than 5 percent cover of trees, with the majority of vegetation cover consisting of planted crops that do not reach tree size such as corn, wheat, oats, etc.

Improved pasture (code 64). Land with less than 5 percent cover of trees, with the majority of cover in natural or planted grasses improved for grazing use as a result of cultivation, seeding, irrigation, or clearing of trees or brush. These areas are generally more extensively managed or maintained than herbaceous/grass cover areas; also, small areas are often fenced.

Natural crest/alpine tundra (code 65). Land with less than 5 percent cover of trees, generally occurring in high elevation areas, with cover consisting of meadow, willow, marsh, and rock fields above timberline.

Barren (code 66). Land with less than 5 percent cover of trees and generally no ground cover vegetation. This includes areas covered by rock out-crops, talus slopes, sand dunes, etc.

Other non-tree land (code 73). Land with less than 5 percent cover of trees but does not meet one of the above non-tree land definitions. Note: If this code is used, describe the situation in the general comments.

ITEM

220 Size of Condition.

MQO: ±1 class 90% of the time.
Record the code that applies to the continuous size of the condition class. Use the aerial photographs for the field location to aid in determining the size of the condition. Refer to appendix B.2 for map/photo scale ratios.

Code	Size
1	**1-5 acres**
2	**6-10 acres**
3	**11-20 acres**
4	**21-40 acres**
5	**41-160 acres**
6	**161-640 acres (1 square mile)**
7	**1-5 square miles**
8	**>5 square miles**
9	**Linear feature** (includes forest stringers at least 30- feet wide, streams, roads, etc.)

230 Stocking Condition Class.

MQO: No errors 90% of the time.
For each **forest land** condition class, select one of the following classes; this variable is used to identify possible causes for nonstocked or nonstockable conditions. Starting with code 51, read each description in order, and assign the first Stocking Condition Class that fits the condition class:

Code	Stocking Condition Class
51	**Inhibiting high brush --** more than 50 percent of the condition is covered by brush or other tree species (tamerisk, Russian olive, willow, etc.) that, when fully grown, overtop an adult person of average height; the brush is of such density as to inhibit natural regeneration.
52	**Inhibiting low brush --** more than 50 percent of the condition is covered by brush that ordinarily does not grow as high as a person (e.g., sagebrush, rabbitbrush, huckleberry, snowberry, most Ribes spp.), but is of such density as to inhibit natural regeneration.

ITEM

230 Stocking Condition Class (contd).

Code	Stocking Condition Class
53	**Inhibiting grass --** more than 50 percent of the condition is covered by grassy sod of such density as to inhibit natural regeneration.
54	**Inhibiting duff** -- more than 50 percent of the condition is covered by duff (decaying vegetative matter) of such depth as to inhibit natural regeneration.
55	**Inhibiting slash and debris --** more than 50 percent of the condition is covered by logging slash and debris sufficient to inhibit natural regeneration.
60	**Not overtopped, inadequate reproduction --** more than 50 percent of the condition is clear to permit the establishment and development of seedlings and is not overtopped by overhanging crowns of trees; inadequate reproduction consists of fewer than 40 live tree species seedlings and/or saplings present per acre.
61	**Not overtopped, adequate reproduction** -- same as code 60, but at least 40 live tree species seedlings and/or saplings are present per acre.
70	**Overtopped, inadequate reproduction --** more than 50 percent of the condition is clear to permit the establishment of seedlings but is sufficiently overtopped by overhanging tree crowns to prevent development of seedlings. Inadequate reproduction consists of fewer than 40 live tree species seedlings and/or saplings present per acre.
71	**Overtopped, adequate reproduction --** same as code 70, but at least 40 live tree species seedlings and/or saplings are present per acre.

ITEM

221 **Forest Type**.

MQO: No errors 95% of the time.
For each **forest land** condition class, estimate and record Forest Type. Forest Type is a classification of forest land based upon and named for the tree species presently forming the majority of live tree stocking (represented by basal area or crown cover) for the condition. Examine all live trees. Where a condition consists of both softwood (pine, fir, spruce, juniper, etc.) and hardwood (aspen, cottonwood, oak, etc.) species groups, determine Forest Type as follows:

a. Sum the stocking percent of all hardwoods;
b. Sum the stocking percent of all softwoods;
c. Determine which of the two groups (hardwood or softwood) contains the most stocking;
d. From the group with the most stocking, select the species with the majority of stocking.

For example, if the condition consisted of 20 percent ponderosa pine, 15 percent juniper, and 25 percent oak, the softwood group would contain the largest amount of stocking (20 percent pine + 15 percent juniper = 35 percent), and ponderosa pine would be selected as the Forest Type.

For nonstocked forest land, estimate the predominant tree species of the previous stand. To make this determination, use evidence such as stumps, downed or residual trees, and adjacent forested areas on similar aspect, slope, and soils.

For situations where the trees tallied do not represent the Forest Type evident on the condition, describe the situation in the notes on the Condition Description record.

Record one of the following two-digit Forest Type codes:

Code	Forest Type	Code	Forest Type
01	**Douglas-fir**	**79**	**Misc. western softwoods** AZ cypress, Apache pine, Chihuahua pine, SW White pine, incense cedar
11	**Ponderosa pine**		
12	**Jeffrey pine**		
14	**Sugar pine**		
21	**Western white pine**		
31	**White fir**	**80**	**Misc. western hardwoods** NM locust, ironwood, boxelder
32	**Calif. and Shasta red fir**		
33	**Grand fir**		
35	**Engelmann spruce**	**82**	**Paper birch**
36	**Engelmann spruce /subalpine fir**	**83**	**Aspen**
		85	**Cottonwood**
38	**Blue spruce**	**88**	**Deciduous oak** -- gambel oak, bur oak
39	**White spruce**		
41	**Western redcedar**	**90**	**Juniper**
45	**Western juniper**	**93**	**Pinyon-juniper**
47	**Mountain hemlock**	**95**	**Bristlecone pine**
48	**Western hemlock**	**96**	**Whitebark pine**
54	**Western larch**	**97**	**Evergreen oak** -- AZ white, gray, Emory, chinkapin, Mexican blue, silver leaf
61	**Lodgepole pine**		
76	**Maple woodland --** bigtooth, Rocky Mountain		
77	**Cercocarpus woodland**	**98**	**Limber pine**
78	**Mesquite woodland**		

ITEM

222 Stand-size Class.

MQO: No errors 90% of the time.
For each **forest land** condition class, estimate and record the appropriate Stand-size Class. The Stand-size Class is a classification of forest land based on the predominant diameter size of the live tally trees presently forming the majority of live tree stocking (represented by basal area or crown cover) on the condition.

For situations where the trees tallied do not represent the Stand-size Class evident on the condition, include a note on the Condition Description record to verify the class recorded.

Record one of the following one-digit codes for each condition:

Code	Size Class
1	**<5.0 inches DBH/DRC: all tree species**
2	**5.0-10.9 inches DBH: aspen, cottonwood, birch, and boxelder**
2	**5.0- 8.9 inches DBH/DRC: all other species not listed above**
3	**≥11.0 inches DBH: aspen, cottonwood, birch, and boxelder**
3	**≥ 9.0 inches DBH/DRC: all other species not listed above**
4	**Nonstocked**

ITEM

223 **Stand Origin**.

MQO: No errors 90% of the time.
For each **forest land** condition class, record one of the following:

Code	Stand Origin
1	**Forest land -** natural, with no evidence of artificial regeneration.
2	**Forest land -** evidence of regeneration originating from artificial planting or seeding.
7	**Forest land -** encroachment on natural rangeland along forest edges.
4	**Nonstocked forest land - insufficient stocking of trees or seedlings.**

224 **Stand Density.**

MQO: No errors 90% of the time.
For each **forest land** condition class, record the appropriate code. Examine the relative differences in crown cover and trees per acre between contrasting conditions.

In order to recognize a contrasting condition based on stand density, differences should be very obvious and distinct, such as abrupt changes caused by thinning, beetle kill, fire, extreme changes in aspect, etc. Do not recognize subtle changes in density caused by slight variations in soils, aspect, slope, etc.

Code	Stand Density
1	**No cover**
2	**Sparse**
3	**Medium**
4	**Dense**

ITEM

231 Stand Structure.

MQO: No errors 90% of the time.
For each **forest land** condition class, record the appropriate code that reflects the basic form of the current stand; include all forest land trees when determining the structure:

Code	Stand Structure
1	**Single-storied**
2	**Two-storied**
3	**Multi-storied**
4	**Mosaic**
5	**Nonstocked**

Stand Structure classes for stocked locations are defined as follows:

Single-storied (code 1). These stands are characterized by an even canopy of uniform height with close competition between trees. The smaller trees are usually members of the stand that were stressed or overtopped and have fallen behind their associates. Regeneration and/or tall relicts from a previous stand may be present. Most of the trees in the condition are within the height class of the average stand height.

Two-storied (code 2). These stands are composed of two relatively even but distinct canopy layers, such as a mature overstory with an understory sapling layer, possibly from seed tree and shelterwood operations, or an overstory of tall conifers with an understory of low hardwoods. Neither canopy is necessarily continuous or closed, but both canopy levels tend to be uniformly distributed across the stand.

Multi-storied (code 3). These stands generally contain trees from every size group on a continuum from seedlings to mature trees and are characterized by a broken or uneven canopy layer. Usually the largest number of trees is in the smaller diameter classes. Consider any stand with three or more structural layers as multi-storied.

ITEM

231 **Stand Structure** (contd)

Mosaic (code 4). These stands contain at least two distinct size classes; however, these classes are not uniformly distributed but are grouped in small repeating aggregations, or occur in stringers less than 120 feet wide, throughout the stand. Each size class aggregation is too small to be recognized and mapped as an individual stand; the aggregations may or may not be single-storied.

232 **Stand Age**.

MQO: ±10 years 90% of the time, timber types;
±20 years 90% of the time, woodland types.

For each **forest land** condition class, estimate and record Stand Age only where no age data were collected for trees representing the recorded Stand-size Class. Stand Age is the average total age of all live tally tree species representing the general Stand-size Class and includes both hardwoods and softwoods in the estimate. For trees measured at DBH, add the following number of years to the measured age to obtain a total age:

Years to add to DBH age:

5	10	20
western white pine	ponderosa pine	subalpine larch
western larch	washoe pine	whitebark pine
cottonwoods	Douglas-fir	limber pine
aspen	lodgepole pine	
	hemlock	

Add 15 years to all other species measured at DBH.

233 **Crown Cover**.

MQO: ±10%, 90% of the time.
Record the percentage of crown cover, to the nearest 1 percent, of **all tally tree species** greater than 1.0" DBH/DRC (refer to the tally tree species list on page 10-9 and 10). Crown cover is the percentage of ground surface area covered by a vertical projection of the live crowns. **Do not** include seedlings.

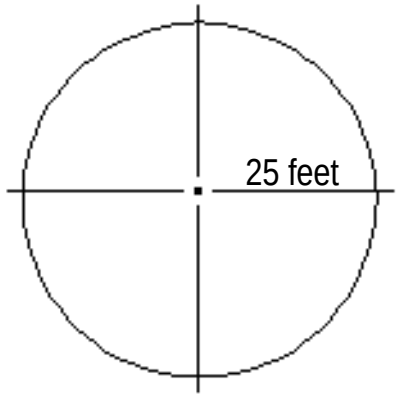
Use the following **line transect method** to determine the percentage of crown cover. Establish four 25-foot transects at each subplot, in the cardinal directions from subplot center (figure 8). Each transect begins 1 foot from the subplot stake; measure the length of live tally tree species crown intercepted (above or below) by the 4 transects at each subplot.

If a condition class boundary crosses the transect line, keep both the length of transect and the intercepted crown cover separated by condition class.

For each condition class, divide the total live tree crown length measured by the total length of transect (400-feet for single-condition class locations).

Note: If the slope of the transects is greater than 10 percent, measure both the transect and the crown length intercept along the slope; correct both the length of crown and the length of the transect for slope before adding to the other transects.

Figure 8. Crown cover transects.



233 **Crown Cover** (contd).

For example, the following crown length was intercepted for the 5 transects:

	Condition 1		Condition 2		
Subplot	length (feet)	intercept (feet)	length (feet)	intercept (feet)	
1	100	32			
2	75	22	25	19	(total length =100 feet)
3	100	38			
4	45	16	55	40	(total length =100 feet)
TOTAL	320	108	80	59	

Dividing the total crown intercept by the total length of transect for each condition gives 34 percent (108/320 = .34) crown cover for condition class 1 and 74 percent (59/80 = 74) crown cover for condition class 2.

If a condition contains less than 400 feet of transect (most multi-condition class plots), or if the transects do not represent the apparent crown cover of the condition class, record the calculated crown cover for Item 233 and record an estimate of cover in the condition comments along with an explanation.

234 **Condition Habitat Type.**

MQO: Series - no errors 95% of the time
Type - no errors 90% of the time.

Record the 7-digit code for the primary and secondary Habitat Types that best represent the condition class. Examine the area surrounding each subplot within a condition class; if several types within a condition class are evident on the subplots, record the type that is most abundant as primary.

For conditions that have had a severe or recent disturbance (e.g., burn or cut), estimate the type from a nearby similar site or use a series level type code and explain in the general comments or notes. Refer to the local Habitat Type key and manual(s).

For condition classes that do not have a defined type or series in the Habitat Type manuals, record code 9999999.

ITEM

236 **Dominant Tree Species**.

MQO: No errors 95% of the time.
For conditions classified as **other tree land**, record the alphanumeric code for the predominant other tree species present using the PLANTS handbook (USDA, Natural Resources Conservation Service. 1994. The PLANTS data base. Ecological Sciences Division, Washington, D.C.). Leave blank for forest land and non-tree land condition classes.

237 **Rangeland Cover Type**

MQO: No errors 95% of the time
For conditions classified as **non-tree land**, record the most appropriate Rangeland Cover Type. Refer to Rangeland Cover Types of the United States (Thomas N. Shiflet, Ed., 1994) for cover type descriptions. For condition classes devoid of vegetation, record 999. For non-tree conditions where shrubs are present on or near the subplots, classify the condition using the appropriate shrub-type category.

Code	Rangeland Cover Type
Pacific Northwest Types (ID/MT):	
101	Bluebunch Wheatgrass
102	Idaho Fescue
103	Green Fescue
104	Antelope Bitterbrush-Bluebunch Wheatgrass
105	Antelope Bitterbrush-Idaho Fescue
106	Bluegrass Scabland
107	Western Juniper-Big Sagebrush-Bluebunch Wheatgrass
Pacific southwest Types (NV,UT,AZ):	
210	Bitterbrush
211	Creosote Bush Scrub
212	Blackbush
Northern Rocky Mountain Types	
301	Bluebunch Wheatgrass-Blue Grama
302	Bluebunch Wheatgrass-Sandberg Bluegrass
303	Bluebunch Wheatgrass-Western Wheatgrass
304	Idaho Fescue-Bluebunch Wheatgrass
305	Idaho Fescue-Richardson Needlegrass
306	Idaho Fescue-Slender Wheatgrass
307	Idaho Fescue-Threadleaf Sedge
308	Idaho Fescue-Tufted Hairgrass

ITEM

237 **Rangeland Cover Type** (contd)

Code	Rangeland Cover Type
Northern Rocky Mountain Types (contd**)**	
309	Idaho Fescue-Western Wheatgrass
310	Needle-and-Thread - Blue Grama
311	Rough Fescue-Bluebunch Wheatgrass
312	Rough Fescue-Idaho Fescue
313	Tufted Hairgrass-Sedge
314	Big Sagebrush-Bluebunch Wheatgrass
315	Big Sagebrush-Idaho Fescue
316	Big Sagebrush-Rough Fescue
317	Bitterbrush-Bluebunch Wheatgrass
318	Bitterbrush-Idaho Fescue
319	Bitterbrush-Rough Fescue
320	Black Sagebrush-Bluebunch Wheatgrass
321	Black Sagebrush-Idaho Fescue
322	Curlleaf Mountain Mahogany-Bluebunch Wheatgrass
323	Shrubby Cinquefoil-Rough Fescue
324	Threetip Sagebrush-Idaho Fescue
Great Basin Types	
401	Basin Big Sagebrush
402	Mountain Big Sagebrush
403	Wyoming Big Sagebrush
404	Threetip Sagebrush
405	Black Sagebrush
406	Low Sagebrush
407	Stiff Sagebrush
408	Other Sagebrush Types
409	Tall Forb
410	Alpine Rangeland
411	Aspen Woodland
412	Juniper-Pinyon Woodland
413	Gambel Oak
414	Salt Desert Shrub
415	Curlleaf Mountain Mahogany
416	True Mountain Mahogany
417	Littleleaf Mountain Mahogany
418	Bigtooth Maple
419	Bittercherry
420	Snowbush
421	Chokecherry-Serviceberry-Rose
422	Riparian

ITEM

237 **Rangeland Cover Type** (contd)

Code	Rangeland Cover Type
Southwestern Types	
501	Saltbush-Greasewood
502	Grama-Galleta
503	Arizona Chapparal
504	Juniper-Pinyon Pine Woodland
505	Grama-Tobosa Shrub
506	Creosote Bush-Bursage
507	Palo Verde-Cactus
508	Creosote Bush-Tarbush
509	Oak-Juniper Woodland and Mahogany-Oak
Northern Great Plains Types	
(E. Interior West states and the Dakotas)	
601	Bluestem Prairie
602	Bluestem-Prairie Sandreed
603	Prairie Sandreed-Needlegrass
604	Bluestem-Grama Prairie
605	Sandsage Prairie
606	Wheatgrass-Bluestem-Needlegrass
607	Wheatgrass-Needlegrass
608	Wheatgrass-Grama-Needlegrass
609	Wheatgrass-Grama
610	Wheatgrass
611	Blue Grama-Buffalograss
612	Sagebrush-Grass
613	Fescue Grassland
614	Crested Wheatgrass
615	Wheatgrass-Saltgrass-Grama
Southern Great Plains Types (E. NM)	
701	Alkali Sacoton-Tobosagrass
702	Black Grama-Alkali Sacaton
703	Black Grama-Sideoats Grama
704	Blue Grama-Western Wheatgrass
705	Blue Grama-Galleta
706	Blue Grama-Sideoats Grama
707	Blue Grama-Sideoats Grama-Black Grama
708	Bluestem-Dropseed
712	Galleta-Alkali Sacaton
713	Grama-Muhly-Threeawn
714	Grama-Bluestem
715	Grama-Buffalograss
716	Grama-Feathergrass

ITEM

237 **Rangeland Cover Type** (contd)

Code	Rangeland Cover Type
Southern Great Plains Types (E. NM) (contd)	
720	Sand Bluestem-Little Bluestem Dunes
721	Sand Bluestem-Little Bluestem Plains
722	Sand Sagebrush-Mixed Prairie
724	Sideoats Grama-New Mexico Feathergrass-Winterfat
725	Vine Mesquite-Alkali Sacaton
730	Sand Shinnery Oak
735	Sideoats Grama-Sumac-Juniper

240 **Slope.**

MQO: ±10%, 90% of the time.
Measure and record the slope percent that best represents the condition class average (within 60 feet of the subplots). When more than one distinct slope (more than 40 percent difference) occurs over the condition class (in the vicinity of the location), record 999 for indeterminate.

241 **Aspect Azimuth**.

MQO: ±10 degrees 90% of the time.
Measure and record the average direction (aspect) that the condition class is facing; examine the condition within 60 feet of the subplots. For example, if the condition generally occurs on a north aspect of 18°, record 018. This variable is based on 0° declination.
Note: Leave this item blank for conditions on level aspects (slopes 0 to 5 percent). Record "360" for 0° azimuth, due north; do not record 000 as an azimuth value. Record "999" for indeterminate aspects (multiple directions).

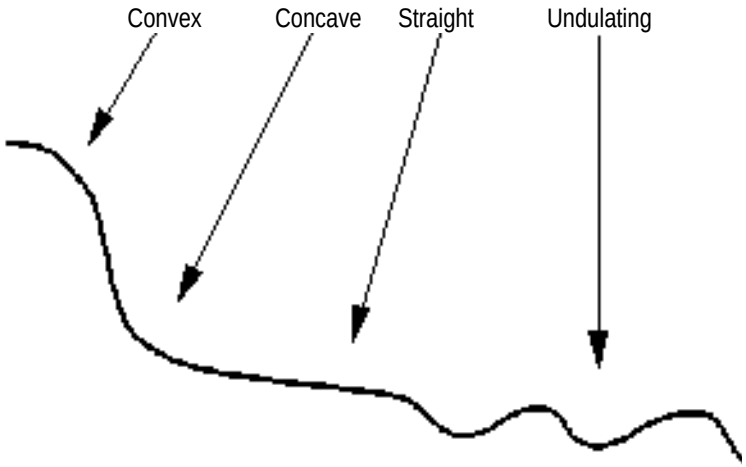
ITEM

242 **Curvature Class.**

MQO: No errors 90% of the time.
Record a code for the curvature class that best represents the condition (figure 9).

Code	Curvature Class
1	**Convex**
2	**Concave**
3	**Straight or level**
4	**Undulating**

Figure 9. Curvature class.

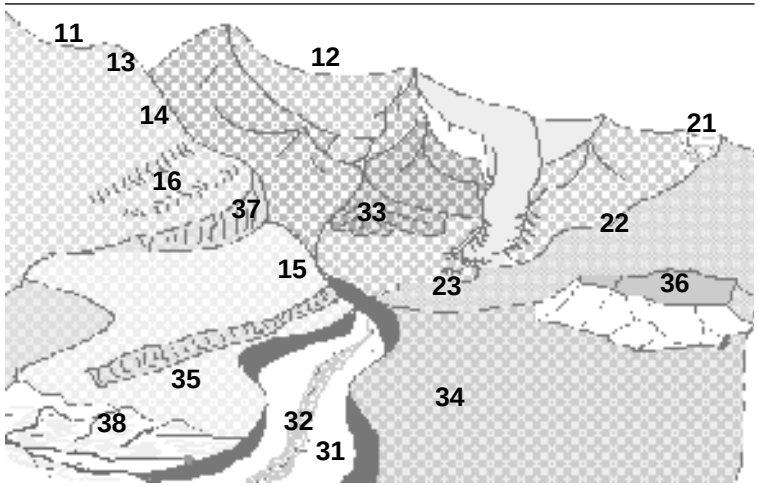


243 Physiographic Class.

MQO: No errors 90% of the time.
Physiographic Class is generally determined by land form and topographic position. Record a code for the physiographic class that best represents the condition (figure 10). Refer to glossary for definitions.

Code	Land Form or Topographic Position
11	**Mountain ridge**
12	**Mountain saddle**
13	**Upper slope**
14	**Mid-slope**
15	**Lower slope**
16	**Bench (use topographic map to discern)**
21	**Cirque**
22	**Glacial lateral moraine**
23	**Glacial terminal moraine**
31	**Stream terrace -- flooded within geologic past**
32	**Stream bottom -- floods frequently**
33	**Alluvial fan**
34	**Flat plain**
35	**Bajada**
36	**Mesa top**
37	**Side of cliff**
38	**Arroyos, washes, and coulees**
49	**Other**

Figure 10. Physiographic class.



ITEM

250 **Soil Group**.

MQO: No errors 90% of the time.
The soil group classification gives an indication of soil limits for tree root development. Estimate the soil group based on visual evidence within the condition class in the area of the subplots. Examine nearby cutbanks, rocks protruding from the soil, and use the plot stake to help estimate depth. Record the appropriate one-digit code.

Code	Group
1	**Very shallow** -- less than 10 inches deep (e.g., bedrock showing).
2	**Shallow** -- 10 to 20 inches deep.
3	**Deep and moderately deep** -- more than 20 inches deep (e.g., accumulation in valley bottoms).
4	**Coarse soils** -- more than 50 percent of the soil in the top 20 inches is made up of fragments coarser than sandy loam.

ITEM

251 Soil Texture.

MQO: No errors 90% of the time.
Determine the soil texture for the A horizon based on a soil sample collected within the condition class. The A horizon is the zone of mixed organic and mineral matter below the humus layer. Use a moist soil sample, rubbed between thumb and fingers, to help detect soil texture. Record the appropriate one-digit code for tree land conditions. **Note:** The general descriptions listed below for each soil type are based on a USDA Soil Texture Class Guide.

Code	Soil Texture
1	**Sands** -- granular appearance, free-flowing when dry; gritty feel; when moist, will crumble when lightly touched; cannot be ribboned between thumb and fingers.
2	**Sandy loams** -- essentially granular appearance (sand characteristics predominate); readily falls apart when dry; when moist, can be carefully handled without breaking; cannot be ribboned between thumb and fingers.
3	**Loams** -- uniform mixture of sand, silt, and clay; when moist, can be freely handled without breaking; cannot be ribboned between thumb and fingers.
4	**Clay loams** -- fine textured (predominantly clay); when moist, can be handled freely without breaking and worked into a dense mass; forms a thin ribbon which readily breaks when rubbed between thumb and fingers.
5	**Clays** -- fine textured, breaks into hard lumps when dry; when moist, can be handled freely without breaking and worked into a dense, compact mass; forms a long, thin, flexible ribbon when rubbed between thumb and fingers.

ITEM

253 **Soil Erosion.**

MQO: No errors 90% of the time.
Determine and record the degree of soil erosion that has occurred based on evidence of sheet and/or rill erosion (defined below), and/or the formation of gullies. Soil erosion is the process of removal of soil material by running water, wind, or gravitational creep. Factors that affect soil erosion are climate, nature of the soil, slope, vegetation, and cultivation practices. Areas that do not have plant/litter cover have a higher potential for surface erosion. To classify the degree of erosion, examine areas of exposed soil.

Code	Degree of erosion
0	**None** -- ground completely covered by plant/litter cover, large rocks, etc.
1	**Light** -- evidence of sheet erosion
2	**Medium** -- both sheet and rill erosion
3	**High** -- severe rill erosion and gullies

Sheet erosion results in a slumping of a uniform layer or downslope movement of the soil surface; this movement is often subtle and occurs slowly.

Rill erosion results in the formation of small channels in the land surface; this type of erosion can lead to a rapid movement of soil and organic debris downslope along the path of the channels creating large gullies.

ITEM

254 **Litter Depth**.

MQO: ±1 inch 90% of the time.
Measure and record the average depth of litter to the nearest 0.1 inch, using a 3-digit code (e.g., record 3.2 inches as 032; record 0.3 inch as 003). Litter consists of undecomposed leaves and/or needles, together with twigs, bark, etc.

Take one measurement at each subplot center where the condition class occurs (at or near the vicinity of the stake), and record an average litter depth. If the condition doesn't occur at a subplot center, take a representative measurement as close to center as possible but within the condition.

For areas dominated by woodland species, record an average litter depth based only on the areas within the condition that have litter; woodland sites often have litter directly beneath tree crowns, but none between tree crowns.

255 **Humus Depth.**

MQO: ±1 inch 90% of the time.
Measure and record the average humus depth, to the nearest 0.1 inch, using a 3-digit code (e.g., record 4.3 inches as 043; record 0.6 inch as 006). Humus is the organic layer, unrecognizable as to origin, immediately beneath the litter layer from which it is derived. Include a note to verify any codes that are unusual for a particular area (e.g., the site indeed has a humus depth of 15.0 inches, code 150).

Take one measurement at each subplot center where the condition class occurs (at or near the vicinity of the stake), and record an average humus depth.

For areas dominated by woodland species, record an average humus depth based only on the areas within the condition that have humus; woodland sites often have humus directly beneath tree crowns, but no humus between tree crowns.

260 **Cutting Type**.

MQO: No errors 90% of the time.
Record the code for the most recent type of cutting evident on the condition class.

Code	Cutting Type
0	**None**
1	**Fuelwood**
2	**Christmas tree cutting** -- removal of large seedling and various sapling-size trees; in the Southwest, generally pinyon, Douglas-fir, and true firs. Evidence may include high stumps.
3	**Post/pole harvest** -- removal of trees, generally 3 to 9-inches DBH, for the purpose of making posts and poles.
4	**Thinning** -- intermediate cuttings made to control the density, composition, or health of the stand; trees removed may be of any size, and may be removed in small groups or scattered throughout.
6	**Clearcut** -- removal of entire stand in one cutting (removed or left on the ground).
7	**Seed tree cut** -- removal of mature trees in one cutting, except for a small number of seed trees left singly or in small groups.
8	**Other - specify** -- provide information on the type or evidence.
9	**Salvage harvest** -- removal of trees that have been killed or damaged by injurious agents (insects, disease, wind, fire, etc.).

261 **Cutting History**.

MQO: ±3 years under 20 yrs, ±10 yrs over 20 yrs, 90% of the time.
Estimate the year that the last timber or wood harvesting occurred within the condition class. If there is no cutting evidence, record 0000; if the evidence is more than 20 years old, and an approximate date cannot be determined or even estimated, record 9999.

Code	Cutting History
0000	**None --** no evidence
1994	**Cutting occurred in 1994**
1993	**Cutting occurred in 1993**
	etc.
9999	**Actual year of cutting cannot be estimated**

ITEM

262 **Burn History**.

MQO: ±3 years under 20 yrs, ±10 yrs over 20 yrs, 90% of the time.
Estimate the year that the last burn occurred, if any, on the condition class. Do not include fire evidence if it did not have an impact on the overall condition area (i.e., do not include burning on an individual slash pile, a spot fire from a lightning-struck tree, or burning in a campfire ring if it did not have a direct impact on the overall condition area).

Code	Burn History
0000	**None --** no evidence
1994	**Burning occurred in 1994**
1993	**Burning occurred in 1993**
	etc.
9999	**Actual year of burning cannot be estimated**

263 **Condition Disturbance Type.**

MQO: No errors 95% of the time.
Record the code for the predominant human-caused influence or natural phenomenon that has had an impact on the vegetation within the condition class.

Code	Disturbance Type
000	**None**
610	**Animal damage** -- excessive browsing, girdling, etc.
620	**Insect damage**
640	**Disease damage**
680	**Weather damage**
681	**Wind damage**
700	**Other land clearing** -- change from tree land to non-tree land (e.g., forest land cleared for crops or improved pasture)
710	**Road building**
730	**Type conversion** -- e.g., a clearcut, previously stocked with mixed-conifer species, planted and regenerated with ponderosa pine species
731	**Chaining or other mechanical treatment**
900	**Other** - specify
910	**Mining**

ITEM

264 **Condition Disturbance History.**

MQO: ±3 years under 20 yrs, ±10 yrs over 20 yrs, 90% of the time.
Estimate the year that the condition disturbance occurred. If the year cannot be estimated, record 9999.

Code	Disturbance History
0000	**None --** no evidence
1994	**Disturbance occurred in 1994**
1993	**Disturbance occurred in 1993**
	etc.
9999	**Actual year of disturbance cannot be estimated.**

270 **Vegetation Concealment**.

MQO: ±1 class 100% of the time.
Record a code to indicate the density of vegetation, on the condition, between ground level and 6.0 feet above the ground. This variable is based on how well a cruiser can be seen at a distance of 100 feet. Record the code that best describes the average concealment for the condition.

Code	Concealment Class
1	**Cruiser can be easily seen**
2	**Cruiser partially obscured**
3	**Cruiser not easily seen**
4	**Cruiser completely obscured**

ITEM

271 **Wildlife Cover**.

MQO: 2 of 3 correct 90% of the time.
Identify and record the primary, secondary, and tertiary types of hiding cover, within the condition, that have the most influence on wildlife habitat. Record three two-digit codes. Code the most influential or primary cover first, and then the second and third. Do not code a secondary cover without a primary cover, or a tertiary cover without a secondary cover. Do not repeat codes except code 00.

Code	Cover
00	**No cover**
01	**Logging slash or brush pile** -- human created
02	**Windrows --** rows of logging slash and/or brush, human created
03	**Mill residue --** slabs, piles of boards, etc.
04	**Abandoned structures --** old homes, barns, etc.
05	**Vegetative thickets --** dense patches or clumps of underbrush or small trees
06	**Hollow log**
07	**Hollow stump**
08	**Fallen tree, limb, or top**
09	**Rock outcrops**
10	**Rock pile**
11	**Gullies** -- a channel, ravine, etc. cut in the earth by running water
12	**Caves**
13	**Burrows** -- a hole or tunnel made in the ground by an animal, for shelter, etc.
14	**Marsh condition --** low wet land, swamp
15	**Garbage or trash pile**
16	**Artificial cover** -- nest boxes, bird houses, etc.

ITEM

272 **Animal Type.**

MQO: 2 of 3 correct 90% of the time.
Determine the types of animals using the condition based upon evidence such as actual sightings, tracks, scat (droppings), browsed vegetation, debarked trees, animal trails, etc. Refer to figure 11 for examples of animal tracks and scat. Code the type(s) of animal having the most significant impact on the vegetation, and/or the site; code the most significant first, and then the second and the third. Do not code a secondary type without a primary type, or a tertiary without a secondary type. Do not repeat codes (except code 0). **Note:** Impact on vegetation or site does not necessarily mean damage.

Code	Animal Type
0	**None apparent**
1	**Deer**
2	**Elk**
3	**Moose**
4	**Cattle**
5	**Sheep**
6	**Beaver**
7	**Porcupine**
8	**Rabbits and small mammals**
9	**Other** - specify

Figure 11. Animal tracks and scat.

Figure 11 (contd). Animal tracks and scat.

ITEM

273 **Browsing Intensity**.

MQO: No errors 90% of the time.
Determine the intensity of utilization of woody twigs, leaves, or shoots -- from shrubs and trees -- as food for livestock or wildlife on the condition. Record the code that best describes the browse utilization on the condition.

Code	Degree of Browsing
0	**No browsing**
1	**Light browsing** -- difficult to find browsed shrubs/trees on the condition; less than 5 percent of the shrubs/trees are browsed.
2	**Moderate browsing** -- 6 to 35 percent of the shrubs/trees on the condition are browsed. Or, a few shrubs/trees on the sample acre are browsed extensively.
3	**Heavy browsing** -- generally more than 35 percent of the shrubs/trees on the condition are browsed.

274 **Grazing Intensity**.

MQO: No errors 90% of the time.
Determine and record the intensity of utilization of graminoids and forbs as food for livestock and wildlife on the condition. Consider only the graminoids/forbs from the current (or most recent) growing season.

Code	Grazing Intensity
0	**None**
1	**Light grazing** -- difficult to find grazed graminoids/forbs on the condition; less than 35 percent of the graminoids/forbs are grazed.
2	**Moderate grazing** -- frequently find evidence of grazing on the condition; generally 35 to 70 percent of the graminoids/forbs are grazed.
3	**Heavy grazing** -- extensive evidence of grazing on the condition; generally more than 70 percent of the graminoids/forbs are grazed.

ITEM

275 **Ground Cover Transects.**

MQO: ±10%, 90% of the time.
One each subplot, use the crown cover transect layout (described in Item 23) to sample ground cover. Using a cloth tape or carpenter's tape, lay out the four 25-foot transects in the cardinal directions from the subplot center. Beginning at the 1-foot mark, place the tip of a plot stake or sharply pointed staff on the ground along the transects (against the side of the tape) at each 1-foot mark, and record each point on the Ground Cover Supplemental Data form (appendix A.9) by the appropriate ground cover category (below). Where more than one condition class occurs on the location, separate and record the point samples by condition class.

After all the 16 transects (4 per subplot) have been sampled, record the total number of "hits" by category sampled on the condition. Where transects are extremely difficult to sample (e.g., within a cholla cactus clump), provide a best estimate of ground cover. There is a total of 400 "hits" combining all categories over all condition classes.

- **Bare Ground** - exposed mineral soil with particles less than 1/8-inch diameter.
- **Pavement** - rocks and pebbles between 1/8 and 3/4-inch diameter (not asphalt).
- **Rocks** - greater than 3/4-inch diameter
- **Litter** - organic debris, freshly fallen or slightly decomposed; includes dead vegetation, animal feces, etc.
- **Cryptobiotic soil crust -** cyanobacteria/algae crust
- **Moss/Lichens**
- **Basal Vegetation** - the area outline of a plant near the ground surface; in grass this comprises the shoot system at ground level, while in trees and shrubs it comprises the stem area.
- **Other** - water, ice, concrete, road asphalt, etc.

B. Condition Class Diagram and Boundary Information

Refer to the boundary mapping instructions described in chapter 3. On the Condition Class Diagram illustrating the location area, sketch all condition class boundaries. In addition, on the individual subplot diagrams, carefully draw all condition class boundaries; be sure the boundary lines intersect the subplots at the same azimuth recorded for the boundary (below). Conditions must be labeled by Ground Cover Class, Land Use, Forest Type, or any other item used to differentiate condition classes. **This map is required even when data are entered on the data recorders.**

See figure 12 for a condition boundary example.

ITEM

281 Subplot Number.

MQO: No errors 100% of the time.
Record the subplot number being mapped.

282 Mapping Plot Type.

MQO: No errors 100% of the time.

Code	Type
1	**Subplot**
2	**Microplot**

284 Contrasting Condition Class Number.

MQO: No errors 100% of the time.
Record the number for the condition class on the far or opposite side of the boundary from the subplot center (refer to Condition Class Description, page 8-1).

ITEM

285 **Azimuth Left and Right**.

MQO: ±10 degrees 90% of the time.
Facing the contrasting condition from the subplot center, record the azimuth where the condition class boundary crosses the subplot or microplot circumference.

287 **Corner Azimuth and Distance**.

MQO: Azimuth ±10 degrees 90% of the time,
Distance ±5 feet 90% of the time.
When the boundary is approximated by a line with one corner, record the azimuth and distance from the subplot center to the corner. Record 000 if no corner is present.

Figure 12. Example condition class diagram and condition boundary information.

Figure 12 (contd). Example condition class diagram and condition boundary information.

CHAPTER 9
SUBPLOT DESCRIPTION ITEMS

This chapter describes the data items that will be collected on each of the 4 subplots on a field location (Subplot Description record, appendix A.2). Complete the following items at each subplot:

ITEM

301 **Subplot Status**.

MQO: No errors 100% of the time.
Record one code for the subplot area as follows:

Code	Subplot Status
1	**Sampled forest land on subplot** (Ground Cover Class 20 & Land Use 11-13)
2	**Sampled other tree land on subplot but no sampled forest land** (Ground Cover Class 30 & Land Use 11-13)
3	**No sampled tree land on subplot**, but nonsampled tree land (LU 21-25) or non-tree land (Ground Cover Class 60, 91, or 92) present.
6	**Access Denied:** most of the subplot cannot be adequately described because land owner denies access to subplot.
7	**Inaccessible:** most of the subplot cannot be adequately described due to extremes in terrain such as cliffs.
8	**Other:** most of the subplot cannot be adequately described for reasons other than listed in codes 6 or 7. The Quality Control crew must verify any subplot with this code.

ITEM

303 **Subplot Center Condition Number.**

MQO: No errors 100% of the time.
For each subplot, record the condition class number for the subplot center. Because the condition class at the location center (LC) is always designated as condition class 1, record 1 for subplot 1. If class 1 is also encountered at other subplot centers, record 1 for those subplots as well.

304 **Condition Number List**.

MQO: No errors 100% of the time.
For each subplot, record the condition class number(s) for all conditions, up to 4, encountered on the subplot. For example, the subplot center condition class is 2, and condition classes 1 and 3 also occur on the subplot, record 1,2,3,0 for this item.

Record the following data only if Subplot Status "1" was selected; otherwise, leave blank.

ITEM

305 **Subplot Stocking Condition**.

MQO: No errors 90% of the time.
If the subplot **center** falls in a forest land condition class, record one of the following codes for the subplot area occupied by that condition. Starting with code 51, read each description in order, and assign the first stocking condition that fits the condition class. If the subplot center is not in a forest land condition, record 00. If more than one forest land condition occurs within the subplot, consider only the forest land condition containing the subplot center.

Code	Stocking Condition
51	**Inhibiting high brush --** more than 50 percent of the subplot is covered by brush or other tree species (tamerisk, Russian olive, willow) that, when fully grown, overtop an adult person of average height; the brush is of such density as to inhibit natural regeneration.
52	**Inhibiting low brush --** more than 50 percent of the subplot is covered by brush that ordinarily does not grow as high as a person (e.g., sagebrush, rabbitbrush, huckleberry, snowberry, most Ribes spp.), but is of such density as to inhibit natural regeneration.
53	**Inhibiting grass --** more than 50 percent of the subplot is covered by grassy sod of such density as to inhibit natural regeneration.
54	**Inhibiting duff** -- more than 50 percent of the subplot is covered by duff (decaying vegetative matter) of such depth as to inhibit natural regeneration.
55	**Inhibiting slash and debris --** more than 50 percent of the subplot is covered by logging slash and debris sufficient to inhibit natural regeneration.

Code	Stocking Condition
60	**Not overtopped, inadequate reproduction --** more than 50 percent of the subplot is clear to permit the establishment and development of seedlings and is not overtopped by overhanging crowns of trees; inadequate reproduction consists of fewer than four live tree species seedlings and/or saplings present on the 1/24-acre subplot.
61	**Not overtopped, adequate reproduction** -- same as code 60, but at least four live tree species seedlings and/or saplings are present on the 1/24-acre subplot.
70	**Overtopped, inadequate reproduction --** more than 50 percent of the subplot is clear to permit the establishment of seedlings but is sufficiently overtopped by overhanging tree crowns to prevent development of seedlings. Inadequate reproduction consists of fewer than four live tree species seedlings and/or saplings present on the 1/24-acre subplot.
71	**Overtopped, adequate reproduction --** same as code 70, but at least four live tree species seedlings and/or saplings are present on the 1/24-acre subplot.
80	**Nonstockable --** the subplot can be considered nonstockable if the establishment of adequate reproduction is prohibited. The following indicate a possible nonstockable subplot: • More than 1/2 of the subplot is covered by bedrock. • More than 1/2 of the subplot is covered by rock or boulders 10-inches in diameter or larger. • More than 1/2 of the subplot is covered by roads, trails or streams. • More than 1/2 of the subplot is characterized by impaired soil drainage as indicated by the presence of bogs, seeps, potholes, and wet meadows. • Plants on the subplot indicate extreme moisture stress.

ITEM

321 Seed Source.

MQO: No errors 90% of the time.
Record one of the following codes to indicate prospects for natural seeding on the subplot:

Code	Seed Source
1	**Adequate timber species softwoods, inadequate timber spp. hardwoods**
2	**Adequate timber species hardwoods, inadequate timber spp. softwoods**
3	**Adequate timber species softwoods and hardwoods**
4	**Inadequate timber species but adequate woodland trees**
5	**Inadequate all species**

A subplot has adequate seed source if seed- or cone-bearing trees are near the subplot. Table 1 may be used as a general guide to determine adequate seed source. The columns under "Seed Trees" indicate (1) how large a tree should be at DBH before it can be considered a predictable producer of seed, and (2) the size of the circular area that might be covered with seed produced by the listed species. If a portion of the subplot is within the respective distance, then the seed source is considered adequate.

Trees at the edge of a nonstocked clearcut will cast seed into the opening as a function of the strength of the prevailing winds and average seed weight per species. The average height of the most common species, times the factor in the column on the right side of the table, will give an approximation of how far into an opening an adjacent forest will cast adequate seed.

Natural regeneration on a site is a good indication that an adequate seed source is present.

Table 1. Guide for rating adequate seed source.

Species	SEED TREES		STAND EDGE
	DBH (inches)	Maximum distance from subplot center (feet)	Maximum distance from subplot center in multiples average tree height[c]
5-needle pines	16+	50	2
Cedar	16+	130	4
Ponderosa pine & Jeffrey pine	12-16	40	2
	18-24	50	2
	26+	70	2
Douglas-fir	10-14	50	2
	16+	60	2
True firs	16+	50	2
Larch	14-18	50	3
	18+	60	3
Spruce	18+	60	3
Lodgepole pine	10+	(a)	(a)
Aspen	(b)	(b)	(b)

(a) Seed source is generally considered adequate only if cone-bearing slash less than 5 years old is present on the ground within the subplot, or if the subplot center is within 130 feet of a stand of live trees.

(b) Seed source is adequate if the subplot center is within 130 feet of a live tree or a stump of a recently cut tree. Major reliance for reproduction in aspen is placed on root suckers, and not seed.

(c) dominant and codominant trees.

ITEM

322 **Root Disease Severity Rating**.

MQO: ±1 class 90% of the time.
For each subplot, record a root disease severity rating for the subplot area. Apply the severity rating on the basis of the percentage of the subplot area affected by root disease; use either canopy reduction or estimate ground area of the plot impacted. The ground area impacted is estimated by projecting the drip line of the overstory crowns onto the ground and estimating the percentage of the area occupied by symptomatic or dead trees. A more direct method is to visualize the root system of infected trees, and then estimate the total root area of the subplot affected.

Generally, the tree species most susceptible to root disease are Douglas-fir, white fir, and subalpine fir. The most tolerant are pine species, though in some areas ponderosa pine is the preferred host species for annosum root disease. It is important to determine the most susceptible species in an area in order to properly rate plots for root disease severity. When evaluating the severity of root disease for the subplot area, consider what is happening on a broader scale, such as at the stand level. Some species are susceptible at a young age, but develop tolerance with age, which needs to be considered when determining the most susceptible species in an area. A good example of this is with Armillaria root disease. All conifer species are susceptible to Armillaria at a young age, but western larch and the pines develop a tolerance to the disease at about 25 to 30 years of age.

Code	Criteria
0	**No evidence of root disease visible within 50 feet of the subplot perimeter.**
1	**Root disease present within 50 feet of the subplot perimeter, but no evidence of root disease on subplot.**
2	**Minor evidence of root disease evident on the subplot** -- suppressed tree killed by root disease, or minor part of overstory showing symptoms of infection. Little or no reduction in canopy closure or volume.

ITEM

322 **Root Disease Severity Rating** (contd).

Code	Criteria
3	**Up to 20 percent canopy reduction evident** -- as a result of the death of one codominant tree on an otherwise fully stocked site. In the absence of mortality, numerous trees showing symptoms of root disease infection.
4	**20 to 30 percent canopy reduction** -- as a result of root disease-caused mortality. The presence of snags and downed dead trees as a result of disease, leaving gaps in the tree canopy, as well as live trees with advanced symptoms of disease.
5	**30 to 50 percent canopy reduction** -- as a result of root disease. Almost half of ground area of subplot considered infested with evidence of root disease-killed trees. **Note:** Subplots representing mature stands with half of their volume in root disease-tolerant species usually don't go much above severity 5 because of the ameliorating effect of the disease tolerant trees.
6	**50 to 75 percent canopy reduction** -- most of the ground area considered infested as evidenced by symptomatic trees. Much of the canopy variation in this category results from disease-tolerant species occupying infested ground.
7	**75 percent or more canopy reduction** -- subplots with this severity level usually were occupied by only the most susceptible species. Very few of the original overstory trees remain, although the infested ground area is often densely stocked with regeneration of the susceptible species.
8	**Entire subplot falls within a definite root disease patch with only one or very few susceptible overstory trees present within the canopy.**
9	**The entire subplot falls within a definite root disease patch with no overstory trees of the susceptible species present within the canopy.**

CHAPTER 10 - TREE DATA

This chapter describes the tree data to be recorded on individual trees and seedling/sapling tree counts and covers instructions for measuring various tree attributes. These instructions apply to trees in forest land condition classes. Refer to appendix A.5 for the Tree Data record. For specific items to record, refer to appendix E.

The number preceding each variable name below refers to the Item Number of the variable used on the Tree Data record. Some items reference only the individual tree tally, some items reference only the seedling counts, and other items reference both. Use the column at the right margin of the data form (comments column), the line immediately beneath a data record, or in the notes on the data recorder, to record any comments or changes pertaining to an individual tree. For example, if a tree diameter on a timber species is taken at a place other than DBH, include a note explaining at what height the diameter was taken.

ITEM

401 **Subplot Number.**

MQO: No errors 100% of the time.
Record for every line of data. Subplot Number refers to a specific place on the field location layout (refer to chapter 5 for location layout procedures).

402 **Tree Number**.

MQO: No errors 100% of the time.
Record Tree Number for all tally trees and nontallied site trees. Repeat the numbering procedure, described below, for each subplot.

Remeasurement locations (including Forest Health plots): Number all remeasurement trees using the past tree numbers listed on the old data. For **Forest Health plots**, locate the "next available tree number" message on the preprinted form to continue numbering new subplot and microplot trees.

a. **Subplot tally.** Standing over the subplot center stake, start at 1° azimuth and rotate clockwise numbering sequentially all tally trees 5.0-inches and greater, beginning with 01. For example, the first tally tree is coded 01, the second tree is 02, and so on.

ITEM

402 **Tree Number** (contd)

b. Microplot tally. Next, begin at 1° azimuth again and rotate clockwise to number the tallied saplings; begin numbering where the subplot tally tree numbers left off.

Assign nontallied site trees to the nearest subplot and give the tree the next available tree number following the tally tree numbers.

404 **Azimuth** and
405 **Horizontal Distance**.

MQO: Azimuth ±5 degrees, 95% of the time. Horizontal distance ±1 foot for 0-22.9 feet, and ±0.2 foot 23-24 feet 90%, of the time. Record an azimuth, to the nearest degree, and a horizontal distance, to the nearest 0.1 foot, for all tally trees and all nontallied site trees. Set compass declination to 0. Do not record 0° (record 360° for due north).

Stand over the subplot center stake and take an azimuth and a horizontal distance from the top of the stake to the geographic center of the stem(s) or bole at the base of the tree:

a. **Standing tally trees -** geographic center at the base (pith of single stem/bole).

b. Downed tally trees - the point of tree origin (e.g., center of the base of tree stem or bole, root system depression).

c. Nontallied site trees - measure directly as in a. above, or if necessary, estimate an azimuth and distance from the nearest subplot center stake (i.e., if the tree is not within view of the stake). For distances greater than 99.9 feet, record 999.

Forest Health plots: use the same azimuths and distances as previously recorded. If the previous crew made an obvious error, record the correct azimuth or distance and make a note on the preprinted form.

ITEM

406 **Condition Class Number**.

MQO: No errors 95% of the time.
Record the appropriate Condition Class Number for the condition class where the tree or tree count occurs. For locations with no condition class boundaries, record 1 for all tally trees and tree counts.

411 **Current Tree History.**

MQO: No errors 100% of the time
For each tally tree and nontallied site tree, record one of the following codes:

Code	Tree History
0	**Nontallied site trees**
1	**Live tally tree**
2	**Dead tally tree**

ITEM

412 **Tree Lean Angle.**

MQO: No errors 100% of the time
For each tally tree and nontally site tree, record one of the following codes:

Code	Tree Angle
00	**Standing tree** -- for **timber species** 1.0-inch DBH and larger**,** the main tree stem/bole must be at least 6.0 feet tall and be self-supporting (i.e., a standing timber species cannot be broken below 6.0 feet and cannot be leaning against another tree for support); for **woodland species** 1.0-inch DRC and larger, there must be at least one standing stem 1.0-inch DRC or larger.
90	**Down tree** -- for **timber species** 1.0-inch DBH and larger, the main stem/bole is broken off below 6.0 feet or not attached for support at the base (e.g., an upright tree broken at the base, but leaning against another tree for support). For a down dead timber species to be tallied, the center of the stem at DBH must be above the duff layer. For trees that are severely decayed and no longer have the cylindrical form, do not tally but note in comments. For **woodland species** 1.0-inch DRC and larger, no stem 1.0-inch DRC and larger is standing.

ITEM

4**14** **Site Tree.**

MQO: Selected as required by the condition class tally, 90% of the time.
Collect and record site tree data only for those species listed as **timber species trees** (refer to species list page 10-9 and 10).
Site trees are selected as indicators of site productivity.
Site tree requirements and selection methods are described below.

If a site tree is selected from one condition class, and can be used for additional condition classes, list these additional classes in the Site Tree Condition List on the data recorder or in the tree notes on the field form.

Record one of the following codes for each live tally tree 5.0-inches DBH/DRC and larger:

Code	Site Tree
0	**Not selected as a site tree**
1	**Suitable site tree**
2	**Unsuitable site tree**

a. **Site tree requirements**.

(1) Suitable site trees:

- live sound tree;
- 5.0-inches DBH or larger;
- open grown, dominant, or codominant throughout most of its life;
- minimum of 35 years (DBH age) for softwoods or minimum of 45 years (DBH age) for hardwoods;
- under rotation age (80 years for aspen and paper birch, 120 years for all other timber species);
- undamaged top (not dead or broken);
- vigorous, having a crown ratio of at least 50 percent, if possible, and have the best height/age ratio of all the trees on the site.

ITEM

4**14** **Site Tree** (contd)

(2) Unsuitable site trees:
- relicts;
- intermediate crown class;
- over rotation age but less than 200 years (DBH age);
- rough trees.

b. **Site tree selection.** Select a minimum of **two** site trees that represent the species of the condition class Forest Type. Also, select at least **two** site trees for each additional timber species representing **20 percent or more** of the live timber trees tallied or counted, and select at least **one** site tree for each species representing **less than 20 percent**. Select no more than 6 site trees per condition class. If more than three timber species are tallied (each representing 20 percent or more tally) within a condition class, select site trees from the three most dominant tallied species.

Note: If only dead trees of a particular species are tallied, and no seedlings of that species were counted, and that species does not represent the Forest Type, it is not necessary to obtain site trees for that species.

If not enough suitable trees can be selected from the subplot tally, then select nontallied suitable site trees (Tree History 00) off the subplots from a nearby site of similar slope, aspect, elevation, and soils. Assign each nontallied site tree selected to the nearest subplot. Obtain only suitable site trees where possible; however, if no suitable site trees are present within 60 feet of the subplots, select an unsuitable site tree. If no site trees are available within 60 feet, do not obtain the site trees **except** for those species representing the Forest Type. For burned or cut stands, go to an adjacent stand to obtain site trees representing the Forest Type if possible.

Note: Do not select aspen site trees from the subplot tally; instead, when aspen site trees are required, select nontallied site trees.

ITEM

415 Mortality.

MQO: no errors, 85% of the time.
A mortality tree is a dead timber or woodland tally tree, standing or down, 1.0-inch DBH/DRC or larger, that was live at the time of previous inventory, or within the past 5 years on a new location, but has died.

Record one of the following one-digit codes for each dead tree. If code 1 is recorded, also record a Cause of Death code (refer to Item 455, page 10-44) and a Past Tree Class code (refer to Item 463, page 10-50).

Code	Mortality
0	**No - tree does not qualify as mortality**
1	**Yes - tree does qualify as mortality**

Refer to the following as a guide to time since death for various tree species:

5-needle pines: **Within past 5 years** - some foliage remaining, >75% twigs and > 30% branches left; bark intact.
More than 5 years - no foliage remaining, <75% of twigs left, many large limbs gone, much bark sloughing (except small trees).

Ponderosa pine: **Within past 5 years** - some foliage remaining, >50% twigs and most branches left; most bark intact.
More than 5 years - no foliage remaining, <50% of twigs left or branches left, most large limbs gone, much bark sloughing (except small trees).

Spruce: **Within past 5 years** - some foliage remaining, >30% twigs and >50% of branches left; little bark sloughing.
More than 5 years - no foliage remaining, <30% of twigs left or >50% branches left, most large limbs gone, bark sloughing (except small trees).

ITEM

415 **Mortality** (contd)

Lodgepole pine: **Within past 5 years** - some foliage remaining, >75% twigs and most branches left.
More than 5 years - no foliage remaining, <75% of twigs left or branches left, bark sloughing.

Douglas-fir: **Within past 5 years** - some foliage remaining, >50% twigs and > 75% of branches left; bark intact.
More than 5 years - no foliage remaining, <50% of twigs and 75% or less branches left, most large limbs gone, bark sloughing.

True firs: **Within past 5 years** - some foliage remaining, >50% twigs and > 70% of branches left; bark unbroken, not curled away from bole.
More than 5 years - no foliage remaining, <50% of twigs and <75% branches left, most large limbs gone, bark heavily checked and curled, much sloughing.

Aspen: **Within past 5 years** - >50% of bark attached to some degree.
More than 5 years - no foliage remaining, bark <50% attached.

Pinyon **Within past 5 years** - some foliage remaining,
More than 5 years - no foliage remaining.

In **all** cases, the presence of sporophore of sapwood rotting fungi such as Polyporus volvatus, Fomes pinicola, etc., is accepted as evidence that the tree has been dead more than 5 years.

ITEM

416 **Species**.

MQO: No errors genus 95% of the time, species 90% of the time. Below is a species list for all timber and woodland tally tree species. Record one of the following species codes for all trees (tallied trees and nontallied site trees) and seedling counts.

Code	Common name	Scientific name	Timber/ Woodland
015	White fir	Abies concolor	T
017	Grand fir	Abies grandis	T
018	Corkbark fir	Abies lasiocarpa var. arizonica	T
019	Subalpine fir	Abies lasiocarpa	T
020	California red fir	Abies magnifica	T
051	Arizona cypress	Cupressus arizonica	T
058	Pinchot juniper	Juniperus pinchotii	W
059	Redberry juniper	Juniperus erythrocarpa	W
062	California juniper	Juniperus californica	W
063	Alligator juniper	Juniperus deppeana	W
064	Western juniper	Juniperus occidentalis	T**
065	Utah juniper	Juniperus osteosperma	W
066	Rocky Mountain juniper	Juniperus scopulorum	W
069	Oneseed juniper	Juniperus monosperma	W
072	Subalpine larch	Larix lyallii	T
073	Western larch	Larix occidentalis	T
081	Incense-cedar	Calocedrus decurrens	T
093	Engelmann spruce	Picea engelmannii	T
094	White spruce	Picea glauca	T
096	Blue spruce	Picea pungens	T
101	Whitebark pine	Pinus albicaulis	T
102	Bristlecone pine	Pinus aristata	T
106	Common pinyon or twoneedle pinyon	Pinus edulis	W
108	Lodgepole pine	Pinus contorta	T
112	Apache pine	Pinus engelmannii	T
113	Limber pine	Pinus flexilis	T
114	Southwestern white pine	Pinus strobiformis	T
116	Jeffrey pine	Pinus jeffreyi	T
117	Sugar pine	Pinus lambertiana	T
118	Chihuahua pine	Pinus leiophylla	T
119	Western white pine	Pinus monticola	T
122	Ponderosa pine	Pinus ponderosa	T
133	Singleleaf pinyon	Pinus monophylla	W

Code	Common name	Scientific name	Timber/ Woodland
134	Border pinyon	Pinus discolor	W
140	Mexican pinyon pine	Pinus cembroides	W
143	Arizona pinyon pine	Pinus edulis var. fallax	W
202	Douglas-fir	Pseudotsuga menziesii	T
231	Pacific yew	Taxus brevifolia	W
242	Western redcedar	Thuja plicata	T
263	Western hemlock	Tsuga heterophylla	T
264	Mountain hemlock	Tsuga mertensiana	T
313	Boxelder	Acer negundo	T
321	Rocky Mountain maple	Acer glabrum	W
322	Bigtooth maple	Acer grandidentatum	W
375	Paper birch	Betula papyrifera	T
475	Curlleaf mountain-mahogany	Cercocarpus ledifolius	W
*740	Cottonwood and poplar	Populus spp.	T
741	Balsam poplar	Populus balsamifera	T
745	Eastern cottonwood	Populus deltoides	T
746	Quaking aspen	Populus tremuloides	T
747	Black cottonwood ssp. tricocarpa	Populus balsamifera	T
748	Fremont's cottonwood	Populus fremontii	T
749	Narrowleaf cottonwood	Populus angustifolia	T
755	Mesquite	Prosopis spp.	W
756	W. honey mesquite	Prosopis glandulosa v. torreyana	W
757	Velvet mesquite	Prosopis velutina	W
758	Screwbean mesquite	Prosopis pubescens	W
*800	Oak--deciduous	Quercus spp.	W
803	Arizona white oak	Quercus arizonica	W
	or Gray oak	Quercus grisea	W
810	Emory oak	Quercus emoryi	W
814	Gambel oak	Quercus gambelii	W
823	Bur oak	Quercus macrocarpa	W
826	Chinkapin oak	Quercus muehlenbergii	W
829	Mexican blue oak	Quercus oblongifolia	W
843	Silverleaf oak	Quercus hypoleucoides	W
*850	Oak--evergreen	Quercus spp.	W
902	New Mexico locust	Robinia neomexicana var neomexicana	W
990	Desert ironwood	Olneya tesota	W

*These codes are only to be used when the individual code by genus and species is not listed.

**Woodland measured at DBH to match PNW.

ITEM

421 **Current DBH/DRC**.

MQO: Standing trees ±0.1 inch per 20 inches of diameter, down trees ±1 inch per 20 inches of diameter, 95% of the time.
The following provides instructions for measuring and recording tree diameter for (a) timber species and (b) woodland species (page 10-9 and 10). Record diameter for all tally trees, 1.0-inch and larger in diameter, and nontallied site trees.

Diameter at Breast Height (DBH) -- timber species:

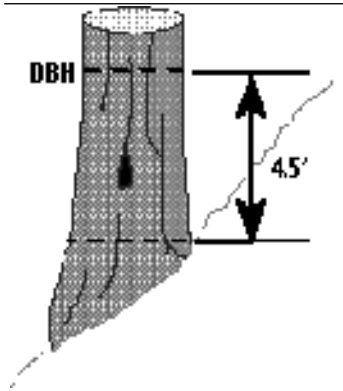
a. **Measuring DBH.** Tree diameter for timber species, 1.0 inch and larger in diameter, is measured at a point 4.5 feet above ground level (referred to as diameter at breast height or DBH) on the uphill side of the tree as shown in figure 13. When measuring 4.5 feet above the ground, it is not necessary to remove litter; however, measure below any large woody debris (e.g., down logs or branches) that may be at the base of the tree. For diameter measurement techniques for timber species, refer to appendix C.1.

In case of a **bole irregularity** at breast height (e.g., swelling, bumps, branches), measure diameter where there is normal stem form, as close to 4.5 feet above the ground as possible (on the uphill side of the tree). Describe the diameter height and the nature of the bole irregularity on the Tree Data record. Some examples of how to measure bole irregularities are as follows (figure 13):

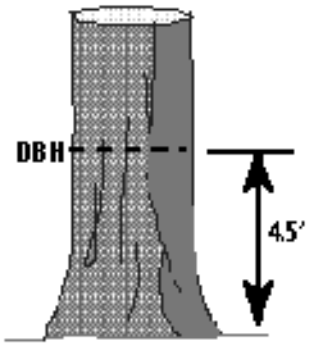
- **Trees with butt-swell --** Measure these trees 1.5 feet above the end of the swell or bottleneck, if the bottleneck is more than 3.0 feet high.

- **Forked trees --** If the point of bole separation (crotch) is **at or above 4.5 feet**, consider the tree as one. Measure the diameter below the swell, as near to 4.5 feet as possible, above ground level on the uphill side. Measure limiting distance to the center of the bole at the base. If the point of bole separation (crotch) is **below 4.5 feet**, consider each fork as a separate tree. For diameter measurement, measure each fork at 3.5 feet above the point of separation, or as near as possible to this height.

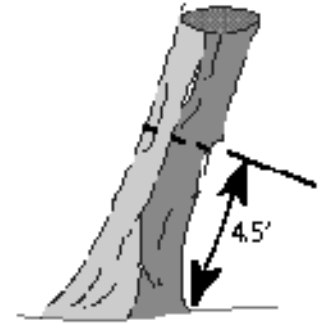
Figure 13. Points of diameter measurement on timber species.



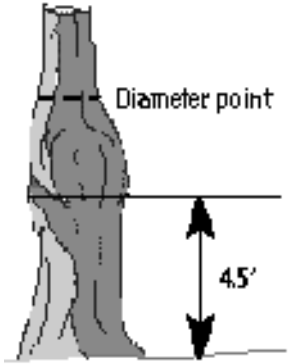
1. Tree on a slope



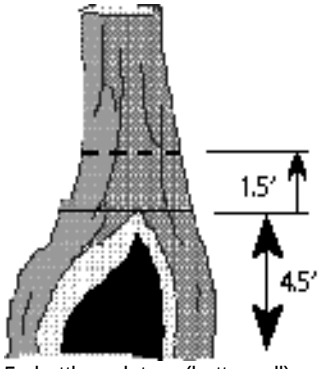
2. Tree on level ground



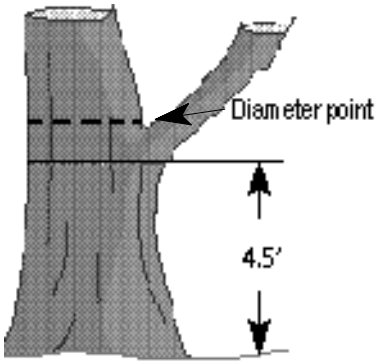
3. Leaning tree



4. Tree deformed at 4.5 feet

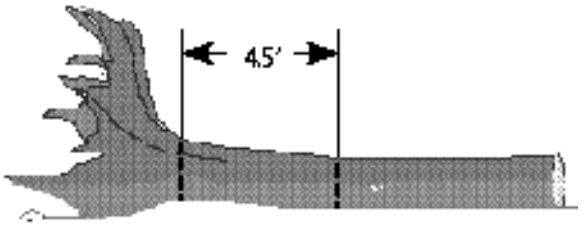


5. bottleneck tree (butt-swell)

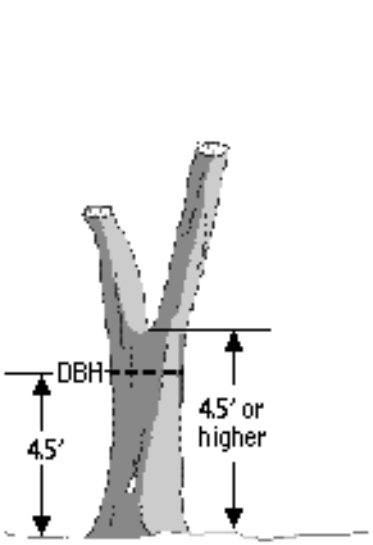


6. Tree with branch at 4.5 feet

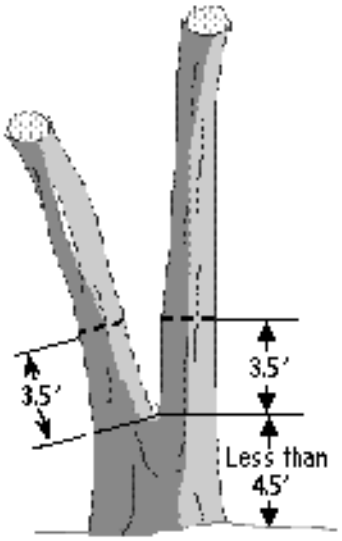
Figure 13 (contd). Points of diameter measurement on timber species.



7. Down tree.



8. Tree forked at 4.5 feet or higher; record as one tree and measure only the main bole



9. Tree forked below 4.5 feet; record each fork as a separate tree

ITEM

421 **Current DBH/DRC** (contd).

- **Leaning trees --** Consider these trees as tally trees if the center of the tree (pith) at the base is within the limiting distance of the subplot. Measure the diameter at 4.5 feet from ground level along the lean, on the uphill or underside side of the tree.

b. **Marking timber species.**

(1) **Standing tally trees.** Mark trees 3.0-inches DBH and larger with an aluminum nail at 4.5 feet above the ground on the uphill side of the tree, except aspen or trees with a bole irregularity at breast height (BH). **Place the nail first, then measure DBH directly above** the nail. Place the nail perpendicular to the tree bole, and etch the tree number in pencil on the nail head. Leave at least 1 inch of the nail exposed to allow for tree growth.

Mark aspen 3.0-inches DBH and larger with a finely scribed horizontal line, approximately 1 to 2 inches in length, at BH.

Mark trees with bole irregularities at the point of diameter measurement.

(2) **Down tally trees.** Place a nail on top of the tree bole at the place of diameter measurement; etch the tree number on the head of the nail.

Forest Health plots: Do not nail or etch the point of diameter measurement on tally trees. Instead, use a marker to indicate the measurement point.

c. **Recording diameter.** Record diameter as a three-digit code to the last whole 0.1 inch. Always **round down.** For example, record a 9.18-inch diameter as 091, and record a 38.23-inch diameter as 382.

ITEM

421 **Current DBH/DRC** (contd).

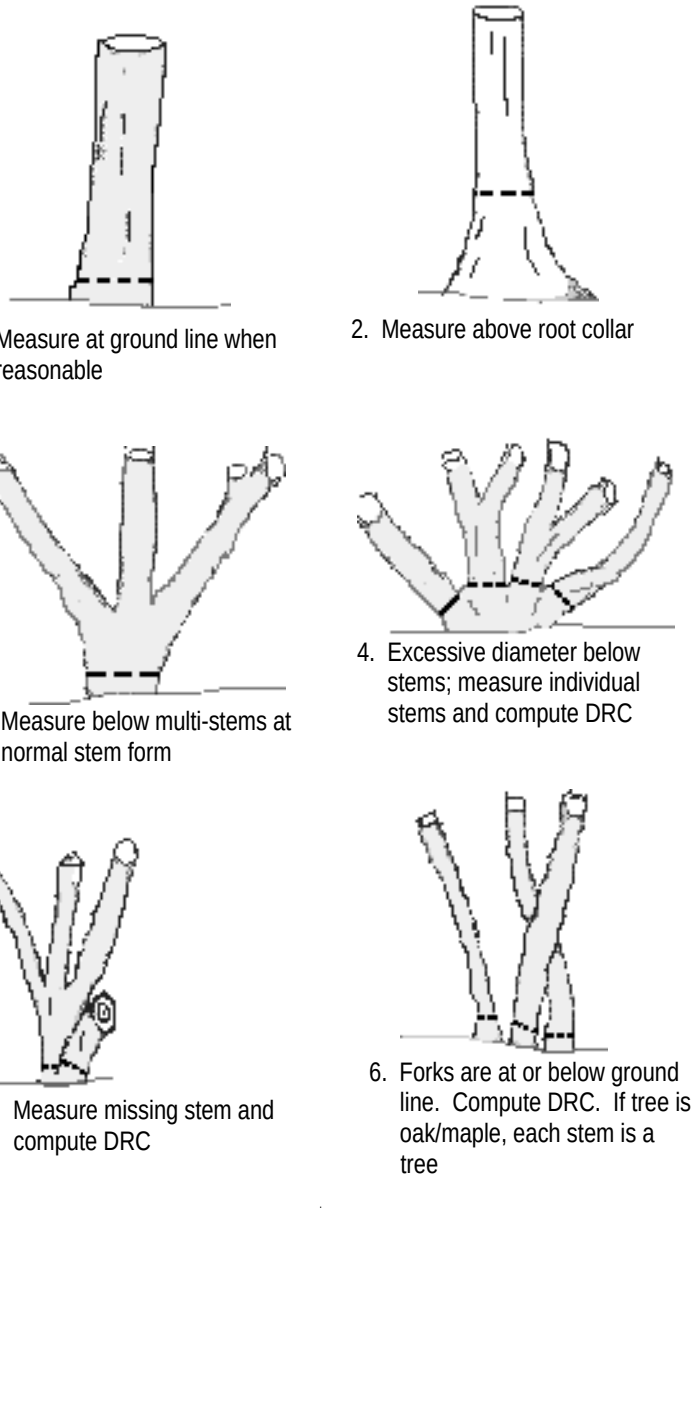
Diameter at root collar (DRC) -- Woodland species

a. **Measuring DRC.** Tree diameter, or DRC, for woodland species is measured at the ground line or at stem root collar, whichever is higher (figure 14).

Unlike timber species, woodland species commonly have multiple stems and are often extremely variable in form. Treat all woodland species (except maple and deciduous oak species) that have several stems clumped together, with a unified crown, and appearing to be from the same root origin, as a single tree. Treat maple and deciduous oak species stems that fork underground as individual trees.

Additional instructions for woodland species DRC measurements are illustrated in figure 15.

Figure 14. Points of diameter measurement on woodland species.



1. Measure at ground line when reasonable

2. Measure above root collar

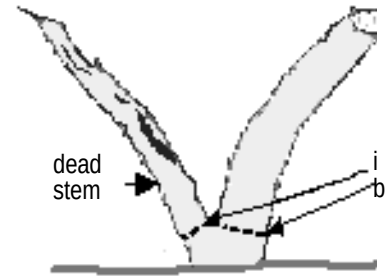
3. Measure below multi-stems at normal stem form

4. Excessive diameter below stems; measure individual stems and compute DRC

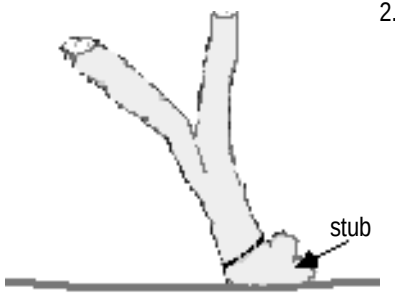
5. Measure missing stem and compute DRC

6. Forks are at or below ground line. Compute DRC. If tree is oak/maple, each stem is a tree

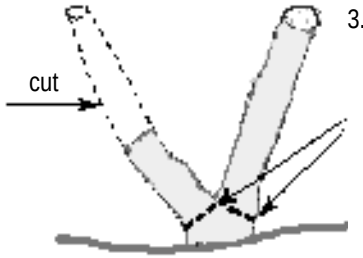
Figure 15. Additional woodland species diameter measurement instructions.



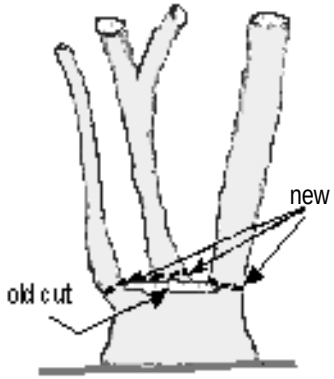
1. Measure the diameter of a dead stem if it is essentially intact, the volume is sound, and the stem represents a portion of the main tree form. Include the stem diameter in the DRC computation and record the appropriate percent of dead volume.



2. Ignore stem stubs that are deteriorated. Do not deduct missing volumefor stems not measured for DRC computation.



3. Measure diameter on recently cut stems and include them in DRC computation. Record the missing volume. Evidence of a recent cut would be a clean stump, an obvious gap in the crown, and lack of sprouting.



4. When any main stem has been cut and replaced with new growth, measure the stem diameters at the point of new growth; if all stemns were cut, measure height from the point of new growth. Measure any uncut stem at the usual point of measurement. If the stem is replaced with new growth, do not deduct missing volume.

ITEM

I421 **Current DBH/DRC** (contd).

Record DRC for woodland tally trees, 1.0-inch and larger in diameter, as specified below. Before measuring the diameter on a stem, 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 reflective of the volume above the stems (especially when trees are extremely deformed at the base). For example, when a single diameter measurement for a tree -- taken below several main stems originating near the root collar -- would grossly over estimate the volume for the tree, individually measure the stems qualifying for diameter measurement above the single diameter location.

Stems must be at least 1.0 foot in length to qualify for measurement; or stems missing due to cutting or damage must have previously been at least 1.0 foot in length. Refer to figure 15, page 10-17.

Woodland species diameter groupings.

- **Saplings** (microplot) -- single-stemmed trees between 1.0 inch and 4.9 inches in diameter, and multistemmed trees with a cumulative DRC between 1.0 inch and 4.9 inches in diameter. For multistemmed trees, measure all stems 1.0 inch in diameter and larger, and at least 1 foot in length, to compute DRC (see formula on next page).
- **Trees** (subplot) -- single-stemmed trees 5.0 inches in diameter or larger and multistemmed trees with a cumulative DRC of at least 5.0-inches or larger. For multistemmed trees, measure all stems 1.0 inches in diameter and larger, and at least 1 foot in length, to compute DRC (see formula on page 10-19).

For trees with several small stems, use the following guidelines to help determine possible trees to tally on the subplot:

Stem Size (inches)	Approx. No. Stems Needed to Total 5.0 inches DRC
4	2
3	2-3
2	4-6
1	8-15

ITEM

421 **Current DBH/DRC** (contd).

b. **Marking woodland species.** For woodland species 1.0-inch DRC and larger, mark the exact location of stem diameter measurement with a lumber crayon. Draw a small line (at least 1.0-inch long and parallel to the diameter tape placement on the stem) on each stem measured for DRC.

In addition, for all standing woodland trees, 5.0-inches DRC and larger, nail a small tag on one stem, preferably the largest or main stem, facing subplot center and approximately 1 foot above ground level. Etch the tree number on the tag. For down woodland trees, nail a tag on top of the largest or main stem. **Note:** The purpose of the tag is to aid in tree relocation and not to mark the exact location of a stem diameter measurement.

Forest Health plots: Do not nail a tag to the tally trees.

Reserved lands: use low gloss gray tags or paint tags gray or brown.

c. **Computing DRC.** For all woodland species tally trees with at least one stem 1.0 inch in diameter or larger at the root collar, DRC is computed as the square root of the sum of the squared stem diameters. For a single-stemmed woodland tree, the computed DRC is equal to the single diameter measured.

The field data recorders calculate DRC using the individual stem diameters entered. Otherwise, use the following formula to compute DRC:

$$DRC = SQRT \left[\sum_{1}^{n} (\text{stem diameter}_i)^2 \right]$$

Round the result to the nearest 0.1 inch. For example, a woodland tree with stems of 4.8, 5.2, 1.5, and 8.7 inches is calculated as:

$$DRC = \sqrt{(4.8^2 + 5.2^2 + 1.5^2 + 8.7^2)}$$

$$= \sqrt{128.02} = 11.3 \text{ inches}$$

ITEM

421 **Current DBH/DRC** (contd).

d. **Recording DRC.** Record the calculated DRC for item 421 as a three-digit code to the last whole 0.1 inch. **Note:** If a calculator is not available, use appendix C.2 to compute DRC.

If using field forms, record individual stem diameters for multistemmed woodland trees on the "Multistemmed Woodland Species Tally" supplemental form (appendix A.8). **Note:** If a multistemmed woodland tree has dead stems, place a small "d" on the "Multistemmed Woodland Species Tally" form next to the individual diameter measurement of the dead stem.

Whenever DRC is impossible or extremely difficult to measure with a diameter tape (e.g., due to thorns, extreme limbiness, packrat's nest, large down stem) the stem(s) may be measured or estimated to the **last** whole inch with the measurement poles. Note which stems were estimated on the "Multistemmed Woodland Species Tally" supplemental form (appendix A.8).

422 **Tree Count.**

MQO: ±10%, 90% of the time.
Record the number of live tally species seedlings counted on the microplot. If there is a large number of seedlings (e.g., more than 20 per species), record an estimate.

423 **DBH/DRC/Count Check.**

MQO: No errors, 100% of the time.
For each diameter measurement or seedling count, record a **0** for DBH and DRC measured normally or for seedlings counted and not estimated. Record a 1 if any of the following apply:

- DBH was estimated, or DBH not measured at 4.5 feet (e.g., diameter taken above 4.5 feet due to fork).
- DRC was estimated.
- A seedling count was estimated due to a large number of trees.

If 1 is coded, explain in the notes.

ITEM

424 **Number of Stems.**

MQO: No errors 95% of the time.
Record this item only for tallied **woodland** species with at least one stem 1.0 inches in diameter or larger. Record the total number of stems that were measured for DRC, as a two-digit code (e.g., record 1 stem as 01; record 12 stems as 12).

430 **Radial Growth** and
431 **Tree Age.**

MQO: Radial growth ±1/20-inch 80% of the time
Age ±5%, 90% of the time.
Collect tree age and radial growth information for specified tally trees, and timber species site trees. In addition, collect age information for timber species seedling counts. Refer to appendix C.3 for instructions on boring trees for radial growth and age.

Forest Health plots: Do not bore tally trees for age and radial growth measurements. Instead, select trees outside the subplot for boring, within the same species and diameter class as required for the tally. Record the age and radial growth as estimates, and make a note in the general comments. If similar trees cannot be found within 60 feet of the subplots, do not collect the data but make a note in the tree comments.

Remeasurement plots: If trees have been remeasured, use the previously recorded age and adjust for the years since the previous inventory (preprinted forms may be pre-adjusted).

a. Radial growth and age tree selection.

(1) **Timber species** (excluding w. juniper)**.**

Radial growth information is required for a minimum of two trees in each diameter class (starting with the 4-inch class) for each species.

Age information is required for a minimum of one tree in each diameter class and species, and for one timber species seedling count per species (i.e., one count for each group for the entire condition class).

ITEM

430/431 Radial Growth and Tree Age (contd).

(1) **Timber species (**contd).

For both radial growth and age, if rough or rotten trees are bored, select additional sound trees if tallied. Ranges of diameters for each diameter class are as follows:

Diam. Class	Class Range (DBH, inches)
Seedling	0.0 - 0.9 (count whorls/scars): age only
2"	1.0 - 2.9 (age at base): age only
4"	3.0 - 4.9 (age at BH): age and radial
6"	5.0 - 6.9 |
etc.	(2-inch classes)

Note: Do not bore tally aspen trees on the subplot area; these trees are highly susceptible to rot and damage. Instead, locate an aspen tree of the same diameter class to bore for age and radial growth measurements within 60 feet of the subplot, if possible. Record this age and radial in the tally tree data.

Select age and radial-growth trees as they are tallied across the subplots, regardless of what order the subplots are sampled:

(a) Select the first timber species tallied by diameter class and species type across the subplots. Obtain age for all trees selected, and radial growth for trees in the 4-inch diameter class and larger. For the seedling class, select the first seedling group counted in each species on the location and obtain age only.

(b) For trees in the 4-inch diameter class and larger, also select the second timber species tallied across the subplots, by diameter class and species type, and obtain radial growth only. To help distribute trees, always select the radial growth tree from a different subplot than the age/growth tree selected in (a) above. **Note:** If a second tree is not tallied on a different subplot, the second radial growth measurement is not required.

ITEM

430/431 Radial Growth and Tree Age (contd).

For example (subplot 1 measured first, and subplot 2 measured second):

	DBH	Species	Diameter Class	Bore for Age	Bore for Radial Growth
Subplot 1:	8.1	Douglas-fir	8"	X	X
	7.2	Douglas-fir	8"		
	5.1	Douglas-fir	6"	X	X
	5.2	White pine	6"	X	X
	6.9	White pine	6"		
	4.1	White pine	4"	X	X
	3.2	White pine	4"		
		White pine	seedling	X	
Subplot 2:	9.3	Douglas-fir	10"	X	X
	8.6	Douglas-fir	8"		X
	7.2	Douglas-fir	8"		
	6.1	White pine	6"		X
	3.8	White pine	4"		X
	2.2	White pine	2"	X	
		White pine	seedling		

In this example, the trees indicated with an "X" are selected to bore for age/radial growth. After measuring two subplots, all of the requirements are met for the 8-inch Douglas-fir class and the 6-inch, 4-inch, and ssedling white pine classes. In addition, the age requirements are met for the 10-inch and 6-inch Douglas-fir classes, and the 2-inch pine class. However, given the types of species and diameter classes tallied so far, one more live sound Douglas-fir in the 10-inch class, and one in the 6-inch class, if tallied on subplots 3 or 4, need to be bored for radial growth.

(2) **Woodland species.** For each woodland genus group tallied across the subplots, select one representative live tally tree within each size class tallied (refer to Stand-size class). Because of the difficulty in reading annual rings on these species, the total-age and radial-growth measurement is determined and entered in the office.

ITEM

430/431 **Radial Growth and Tree Age** (contd).

(2) **Woodland species** (contd).

For each of the selected trees, bore and collect one total age core; however, record 000 for age and 00 for radial growth for bored trees. Count whorls or estimate age if seedlings represent the seedling/sapling size class. **Important:** Do not bore dead trees, and do not bore cercocarpus species or desert ironwood.

Glue cores into a core holder; for pinyon cores, glue with the resin ducts up. On the side of the core holder, place arrows indicating the outside end (bark end) of the cores, and record the appropriate codes for items listed below. **Note:** Do not place age cores from more than one State or county on a single core holder. After the cores are glued, wrap the core holder in flagging to protect the cores, and record the State, County number, Location number(s) on the flagging.

(a) **Species groups.** Woodland genus groups for boring are as follows:

- oak (codes 800-850)
- maple (codes 321-322)
- juniper (codes 058-069)
- pinyon (codes 106, 133, 134, 140, 143)
- mesquite (codes 755-758)
- New Mexico locust (code 902)
- Pacific yew (code 231)

(b) **Saving cores.** Glue the cores into a core holder and label the core holder with the following:

- State
- County
- Location Number
- Subplot Number
- Tree Number
- Species
- Total DBH/DRC of tree
- DRC of stem

ITEM

430/431 **Radial Growth and Tree Age** (contd).

b. **Radial-growth measurement** (timber species, 4-inch diameter class and larger). Measure the last 10 years of radial growth from an increment core taken immediately below the point of diameter measurement and at a right angle to the bole. To reduce bias, bore on the side of the tree facing the subplot center, where reasonable. Using a ruler with a 1/20-inch scale, measure the length of the core from the inner edge of the last (most recent) complete summer wood ring to the inner edge of the summer wood ring 10 years previous (figure 16).

Figure 16. Radial growth measurement.

ITEM

430/431 **Radial Growth and Tree Age** (contd).

c. **Age tree measurement (**timber species).

- **Seedling age group:** For the first timber species seedling group counted (by species) on the location, record an **average total age**. It is not necessary to age seedlings species groups for each condition class. Use the same methods for determining total tree age as for small saplings; however, do not bore seedlings.

- **2-inch diameter class (1.0- to 2.9-inches DBH) age trees:** Measure and record **total tree age**. Use the following methods:

  For **small coniferous saplings**, determine total age by counting the terminal bud scars or the whorls of branches. The terminal bud scars are those that completely encircle the stem of the tree. The scar is left on the stem where the terminal bud lay dormant during the winter.

  For **larger coniferous saplings**, or if an accurate tree age cannot be determined for smaller saplings by counting whorls, bore the tree as close to the base as possible to obtain total age. Be careful not to bore all the way through the tree. Count the growth rings on the increment core from the bark end to the pith (center of the tree).

  For **aspen and cottonwood saplings**, determine tree age by counting the intervals between scars left on the stem by the terminal bud.

If age cannot be accurately determined by the above methods, estimate total age and note in the comments column.

ITEM

430/431 **Radial Growth and Tree Age** (contd)**.**

- **4-inch diameter class and larger age trees:** Measure and record breast height **(BH)** age. Count the growth rings from an increment core taken immediately below the point of diameter measurement and at a right angle to the bole. Bore on the side of the tree facing the subplot center, where reasonable. Count every growth ring from the bark end to the pith (center of the tree). If the age is difficult to determine (e.g., due to indistinct rings, presence of rot), or if the pith was not reached (e.g., diameter too big to bore to center) estimate the age and note in the comments column.

d. **Radial-growth and age tree coding.**

(1) **Radial growth**. Record the radial-growth measurement as a two-digit code; for example, record 6/20 as 06, and record 23/20 as 23.

(2) **Age tree coding.** Record Tree Age as a three-digit number. For example, record 29 years as 029, and record 195 years as 195.

432 **Tree Age Check**.

MQO: No errors 100% of the time.
Record a 0 for age trees with an accurate age count; record a **1** if any of the following apply:

- Age was estimated due to rot.
- Age was estimated because rings were difficult to count (old suppressed trees).
- Age was estimated because the increment bore could not reach the tree center.
- Age was based on a similar tree off the subplot.

If 1 is coded, explain in the notes.

ITEM

441 Current Tree Height.

MQO: Trees >20-feet, ±5%, 90% of the time
Trees ≤20 feet, ±1 foot, 90% of the time.
Determine and record total tree height (from ground level to the top of the main stem) to the nearest foot, for all tally trees and nontallied site trees 1.0-inch DBH/DRC and larger. On multistemmed woodland trees, measure height along the main or largest stem. For measurement examples, refer to appendix C.4.

For a standing tree with a **missing top**, measure the height of the standing portion and add on the estimated height of the missing top (i.e., record the total estimated height). Note the standing height, and that total height was estimated, in the comments column.

For all standing trees that **lean**, go out perpendicular to the lean to determine tree height. For standing trees with **excessive lean** (more than 15° from vertical, or 27 percent), go out perpendicular to the lean, and visually "up-right" the tree to a vertical position before determining height with a clinometer; also, in the comments column, note that tree height was estimated due to lean.

For a **downed tree**, measure total tree height directly along the ground, or if necessary, estimate the previous total height. If total height is estimated, record a note in the comments column.

If a tree bole or stem(s) is growing on an old tree stump, measure tree height from the point of new growth to the top of the tree.

442 Tree Height Check.

MQO: No errors 100% of the time.
Record a 0 for normal height measurements; record a **1** if the height was estimated due to a missing top, severe tree lean, or other reasons.

If 1 is coded, explain in the notes; if the tree had a broken top, record standing height in the notes.

ITEM

443 Uncompacted and
444 Compacted Crown Ratios.

MQO: ±10%, 85% of the time.
Record uncompacted and compacted crown ratios to the nearest percent for live tally timber species, 1.0-inch DBH or larger, and nontallied timber-species site trees. Crown ratio is related to vigor and growth of a tree; it is that portion of the tree bole supporting live, healthy foliage and is expressed as a percent of total tree height.

Calculate crown ratio by **dividing the length of live crown by the total tree height**. Examine and measure live crown from the lowest live branch (where it meets the stem) to the uppermost live leader.

In this assessment, ignore epicormic branches (small branches well below the main crown, usually less than 1-inch in diameter).

For trees with broken or missing tops, use the current length of live crown and the estimated total tree height.

a. Uncompacted crown ratio (71). To determine Uncompacted Crown Ratio (UCR), stand away from the tree about 1 to 1.5 times the tree height and use the crown ratio scale or measure the percent of total tree height supporting live crown, making no adjustment for openings or lopsided crown (figure 17).

$$\text{Calculated UCR} = \frac{\text{(total height) - (height to the lowest live limb)}}{\text{total height}}$$

b. Compacted crown ratio (72). To determine Compacted Crown Ratio, visually transfer lower branches to fill in large holes in the upper portion until a full, even crown is visualized (figure 18). However, **do not compact branches to form an unnaturally dense crown.**

Figure 17. Uncompacted crown ratio example.

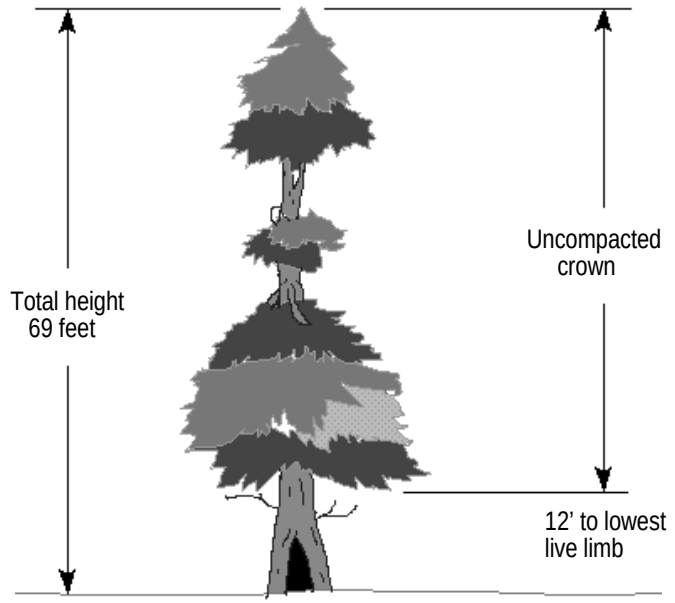
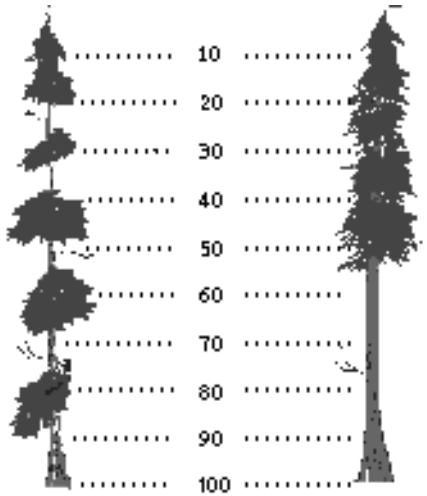


Figure 18. Comparison of uncompacted and compacted ratios.



ITEM

445 Crown Class.

MQO: No errors, 80% of the time.
Record Crown Class for all live tally trees, 1.0-inch DBH and larger, and for nontallied timber-species site trees. Crown class is a categorization of a tree based on dominance in relation to adjacent trees in the stand. This dominance is indicated by crown development and amount of light received from above and the sides.

Each tree must be judged in the context of its immediate environment (that is, those trees affecting it or being affected by it in terms of crown competition). **Note:** For residual trees in recent thinnings or partial cuts, record the crown class that corresponds to the preharvest tree classification (figure 19).

Record Crown Class using one of the following one-digit codes (crown classes are defined below):

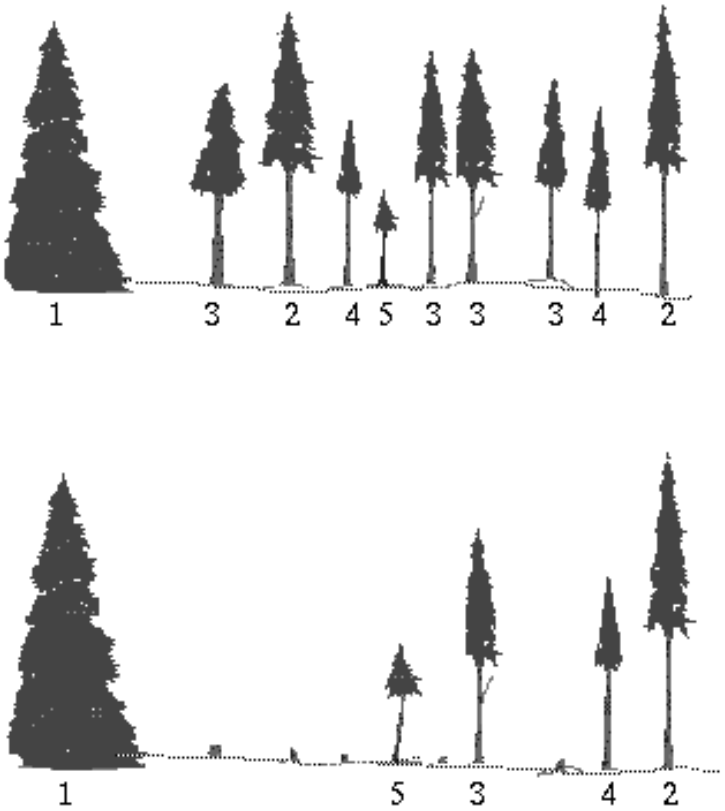
Code	Crown Class
1	**Open grown** -- trees with crowns receiving full light from above and from all sides.
2	**Dominant** -- trees with crowns extending above the general level of the canopy and receiving full light from above and partial light from the sides. These trees are generally larger than the average trees in the stand, and have well-developed crowns that may be somewhat crowded on the sides.
3	**Codominant** -- trees with crowns forming the general level of the canopy and receiving full light from above, but comparatively little from the sides. In stagnated stands, this class includes trees with small-sized crowns crowded on the sides.
4	**Intermediate** -- trees generally shorter than those in the two preceding classes, with crowns either below or extending into the canopy formed by codominant and dominant trees. The crowns of these trees receive little direct light from above and none from the sides, are usually small, and are considerably crowded on the sides.
5	**Overtopped** -- trees with crowns entirely below the general canopy level and receiving no direct light from above or the sides.

ITEM

445 **Crown Class** (contd)**.**

Crown Class definitions are most appropriate when considering a single-storied or clumpy/patchy canopy structure. However, in any type of canopy structure, classify each tree, as stated, in the context of its immediate environment. Therefore, a medium- or small-sized tree in a multistoried canopy structure that receives full light from above and partial light on the sides can be classified as a dominant tree.

Figure 19. Crown class as related to preharvest tree classifications.



ITEM

447 **Cone Serotiny**.

MQO: No errors 80% of the time.
Record the condition of the viable cones for all live lodgepole pine tally trees, 5.0-inches DBH or larger. Serotinous cones are those that mature but remain on the tree without opening for one or more years.

Code	Cone Serotiny
0	**No cones**
1	**Open cones** (less than 50% of the mature cones are closed)
2	**Closed cones** (more than 50% of the mature cones are closed)

450 **Damage.**

MQO: No errors 2 of 3, 80% of the time.
Record a primary, secondary, and tertiary damage code for all live tally trees, 1.0-inch DBH/DRC and larger, and nontallied site trees. Only trees with serious damage, insect, or pathogen activity are to be given damage codes other than 00.

For each tallied tree and nontallied site tree, select the most significant damages present. Record the most significant damage as the primary, the next as secondary, etc. Avoid selecting one of the "other, unidentified, or unknown" categories unless a more specific category cannot be determined. For insect and disease damage, base the ordering of most significant, second most significant, etc., on the Regional priorities provided (refer to State Supplement).

A general rule is to only code a damage category when something is affecting the tree that will cause one of the following:

- **Prevent it from living to maturity, or surviving 10 more years**, if already mature.
- **Prevent it from producing marketable products.** For example, code any damage preventing a timber species from having a minimum of one merchantable bolt (see glossary).
- **Reduce** (or has seriously reduced) **the quality of the tree's products** (e.g., potentially resulting from lightning strike, excessive lean, tree rot).

ITEM

450 **Damage** (contd).

Examine trees carefully. Sometimes serious internal tree damage can only be determined based on external indicators (e.g., small conks on the main bole can indicate serious volume loss that may affect the tree's chance of survival). On the other hand, a minor defect, such as a small fire scar that results in some cull, would not be serious enough to qualify as damage.

It is not necessary to code as damage any form defect items common to a particular species (such as forking on a cottonwood or juniper tree).

Note: General symptoms listed in the damage descriptions below (such as discolored foliage, dead branches or tops, or galls) may be indicative of several damaging agents. Refer to insect pest and disease field guides for damaging insect/disease agent identification and tree damage potential.

	Code	Damage
	00	No serious damage
Insects:	10	Other and unidentified insects
	11	Bark beetles
	12	Defoliators
	14	Terminal weevils
	15	Mountain pine beetle
	16	Ips engraver beetle
Diseases:	20	Other and unidentified diseases
	21	Stem rusts
	22	Stem and butt rots
	23	Cankers
	24	True mistletoe
	26	Dwarf mistletoe -- rating of 4 to 6
	27	Broom rusts
	28	Root diseases
	29	Foliage diseases
Fire:	31	Fire

450 **Damage** (contd).

	Code	Damage
Animals:	40	Unidentified animal
	41	Domestic animal
	42	Porcupine girdling
	43	Other wildlife
	44	Big game
	45	Hares and rabbits
	46	Small rodents
	47	Pocket gophers
	48	Sapsuckers
Atmosphere:	50	Unidentified weather
	51	Wind
	52	Lightning
	53	Snow break or bend
	54	Frost crack
	55	Drought
	56	Sun scald
	57	Winter drying or burn -- red belt
	58	Air pollution
	59	Flooding
Misc:	61	Suppression
	70	Unidentified/unknown
	71	Excessive lean -- more than 15° from vertical
	72	Forked below merchantable top; timber spp. saplings with multiple stems
	73	Broken top
	74	Dead top
	75	Wolf tree: excessively limby timber spp.
	76	Unhealthy foliage
	77	Heartwood scar on bole
	78	Forked above merchantable top; timber species, under rotation age
	79	Excessive crook, sweep, or taper -- timber
Human:	80	Other human
	81	Logging
	82	Timber stand improvement (TSI)
	83	Land clearing
	84	Woodland cutting
	85	Chemical

Definitions for Damage codes are described as follows:

No Serious Damage (code 00). Record this code when serious tree damage is not evident. Some minor damage may be evident, but it will not seriously reduce tree quality or prevent the tree from living to maturity.

Insect Damage (codes 10-12, 14-16). Record only serious insect damage. Nearly any tree in the woods will have insects on it at one time or another, but this presence does not necessarily indicate serious tree damage. Serious insect damaging agents are described below.

Other and Unidentified Insects (code 10): Use this code only for unidentified insect damage or for insect damage not specified in one of the categories below (e.g., wood borers). Describe in the comments column the damage and the type of insect causing the damage, if known.

Bark Beetles (codes 11, 15, 16): These are phloem-feeding insects that bore through the bark and create extensive galleries between the bark and the wood. Symptoms of beetle damage include fading or discolored tree crown (yellow or red), pitch tubes or pitch streaks on the bark, extensive egg galleries in the phloem, boring dust in the bark crevices or at the base of the tree. Bark chipping by woodpeckers may be conspicuous. Examples of tree damaging bark beetles include species of the genera Dendroctonous, Scolytus, and Phloesinus (in juniper), such as **mountain pine beetle (code 15)**, **Ips engraver beetle (code 16)**, and **others (code 11)** such as western pine beetle, Douglas-fir beetle, spruce beetle, and cedar bark beetles.

Defoliators (code 12): These are foliage-feeding insects that may reduce growth and weaken the tree causing it to be more susceptible to other damaging agents. General symptoms of defoliation damage include large amounts of missing foliage (greater than 75 percent defoliated in top 10 feet or 50 percent defoliated over the entire tree), browning foliage, extensive branch mortality, or dead tree tops. Examples include spruce budworm, pine sawflies, Douglas-fir tussock moth, and gypsy moth.

Terminal weevils (code 14): These are insects that feed on the meristematic portion of the tree (tips, terminal and lateral branches). Damage includes reduced tree growth, forking, and deformed crowns, particularly in saplings and seedlings. Symptoms include orange to red colored or dead terminal leaders, stunted or drooping terminal or lateral branches, or galls on branches. Examples are the western pine shoot borer, and the white pine and lodgepole pine terminal weevils.

Damage Definitions (contd).

Disease Damage (codes 20-24, 26-29). Record only serious disease damage. Serious disease damaging agents are described below.

Other and Unidentified Diseases (code 20): Use this code only for unidentified disease damage or for disease damage not specified in one of the categories below. Describe in the comments column the damage and the type of disease causing the damage, if known.

Stem rusts (code 21): A stem rust is a disease caused by fungi that kill or deform all or a portion of the stem or branches of a tree. Sometimes yellow or reddish-orange spores are present giving a "rusty" appearance. Damage occurs when the disease attacks the cambium of the host, girdling and eventually killing the stem above the attack. Symptoms of rusts include galls (an abnormal and pronounced swelling or deformation of plant tissue that forms on branches or stems) and cankers (a sunken lesion on the stem caused by death of the cambium which often results in the death of tree tops and branches). Examples of stem rusts include western gall rust and comandra blister rust (causing cankers and galls on lodgepole and ponderosa pines), and white pine blister rust on five-needle pines.

Stem and Butt Rots (code 22): A rot is a wood decay caused by fungi. Rots are characterized by a progression of symptoms in the effected wood. First, the wood stains and discolors, then it begins to lose its structural strength, and finally the wood starts to break down, forming cavities in the stem. Even early stages of wood decay can cause cull due to losses in wood strength and staining of the wood. Damage includes mortality, cull, increased susceptibility to other agents (such as insects), and wind throw and stem breakage. Any conk (a fruiting body of the causal fungus), or discoloration and decay in more than 1/2 the stem (examine increment core), is serious enough to code. Examples include Indian paint fungus on true firs (characterized by large conks with a rust colored interior), red belt fungus (characterized by a brown cubical decay and a conk-like shelf with a distinctive red band), and white trunk rot of aspen (characterized by a hoof-shaped conk).

Damage Definitions (contd).

Cankers (code 23): A canker -- a sunken lesion on the stem caused by the death of cambium -- may cause tree breakage or kill the portion of the tree above the canker. If cankers occur on the lower 1/2 of the tree bole, the tree will likely be killed. Examples include Atropellis canker in lodgepole pine and ponderosa pine (characterized by a blue-black stain in the wood), Cytospora canker in spruce, fir, and aspen, Ceratocystis canker in aspen (forming highly irregular and blackened callous ridges around the canker), and sooty bark canker in aspen (which kills trees rapidly and causes the underside of dead bark to be blackened and "sooty"). **Note:** Record code 21 for cankers resulting from a stem rust.

True mistletoe (code 24): This is a parasitic plant (Phoradendron spp.) that grows on tree branches or stems of host trees. When it occurs in large amounts on a single tree, true mistletoe can reduce tree growth deform the tree, and increase the tree's susceptibility to other damaging agents. True mistletoes are green plants with or without well developed leaves. Host plants include juniper, oak, mesquite, and poplars (cottonwood, etc.). Code true mistletoe as a damage only when it is present on numerous stems or branches.

Dwarf mistletoe (code 26): This is a parasitic plant (Arceuthobium spp.) that grows on tree branches or stems of host trees and can substantially reduce tree growth, deform the tree, and increase the tree's susceptibility to other damaging agents. Dwarf mistletoe occurs on larch, Douglas-fir, and pines (rarely on true fir and spruce). A mistletoe class rating of 4 to 6 is considered damaging (refer to page 10-45). Signs and symptoms include witches brooms (a massed dense clump of branches, typically with live foliage), the visual presence of the mistletoe plant (simple or branched shoots, approximately 1 to 4 inches in length), and swellings on the tree stem or branches. **Note:** If any dwarf mistletoe occurs on the tree, whether it is coded as a damage or not, enter an appropriate code for Mistletoe Class (Item 456, page 10-45).

Broom rusts (code 27): Broom rusts are diseases that attack the foliage of true firs and spruce. These diseases form spores on the foliage, and also induce the plant to form growth hormones which distort the growth of the tree and form witches brooms (massed dense clumps of tree branches) often containing dead and diseased branches and needles. Code broom rust as a damage only when numerous brooms occur or when the tree has been deformed by the disease.

Damage Definitions (contd).

Root Diseases (code 28): Root disease kills all or a portion of a tree's roots. Quite often, the pathogenic fungus girdles the tree at the root collar. Tree damage includes mortality (often occurring in groups or "centers"), reduced tree growth, and increased susceptibility to other agents (especially bark beetles). General symptoms include resin at the root collar, thin, chlorotic (faded) foliage, and decay of roots. Examples include Armillaria root disease in all tree species (characterized by white mycelial fans - mats of the fungus - between the bark and wood at the base of the tree), Annosus root disease, primarily on true firs but also infecting pines (characterized by white spongy root rot containing black specks and fruiting bodies of the fungus)

Foliage Diseases (code 29): Foliage diseases are caused by fungi and result in needle shed, growth loss, and, potentially, tree mortality. This category includes needle casts, blights, and needle rusts. Examples include Rhabdocline needle cast in Douglas-fir (characterized by numerous brown bands on needles and shed needles causing thinned tree foliage), and snow mold on pines, fir, spruce, and juniper (characterized by gray or black thickly matted needles, killing branches or small trees).

Fire Damage (code 31). Fires may cause scarring to a tree stem or bole or may kill foliage in the lower crown without seriously damaging a tree. Record damage for basal scars due to fire only if the cambium on half or more of the bole circumference has been killed. Also code if fire-killed foliage reaches into the upper one-third of the crown.

Animal Damage (codes 40-48). Record one of the following codes for damage by either wild or domestic animals. Code only when half or more of the bole circumference has been girdled or stripped, or when browsing or trampling has seriously decimated a small tree, and the damage will ultimately prevent the tree from ever becoming a 5.0-inch sound tree with good form and vigor.

Unidentified Animal (code 40): Record this item only if the type of animal (domestic or wild) that caused the damage cannot be determined.

Domestic Animal (code 41): Record for damage (e.g., trampling, browsing) that can be attributed to domestic animals (e.g., cows, sheep, horses).

Porcupine Girdling (code 42): Record for porcupine damage where one-half or more of the bole diameter has been girdled.

Damage Definitions (contd).

Other Wildlife Damage (code 43): Record for damage by wildlife other than big game or small rabbits and rodents. This includes damage by beavers, etc.

Big game (code 44): Record for serious browse damage (i.e., feeding on foliage or bark), trampling, or scraping by elk, moose, deer, or bear.

Hares and rabbits (code 45); small rodents (code 46): Record for serious damage to saplings, such as stem clippings (clean knife-like cuts) by rabbits/hares or small rodents (e.g., voles), or clipping to the terminal leader by squirrels.

Pocket gophers (code 47): Record for root damage to small trees caused by gophers. Gophers often invade openings or cut-over areas and create a network of feeding tunnels just below the ground surface (these tunnels appear as channels of loosened, raised soil).

Sapsuckers (code 48): Sapsuckers are birds that feed on tree sap. Damage is characterized by small wounds in both horizontal and vertical rows, often with oozing resin, on the stem of live trees. Record for damage that occurs over more than 1/2 of the circumference of the stem.

Atmosphere Damage (codes 50-59). Record the appropriate code for weather- or pollution-related damage.

Unidentified weather (code 50): Record if serious damage can be attributed to a weather problem but the specific type cannot be identified. Describe in the comments column the damage present and the cause of the weather damage, if known.

Wind (code 51): Wind may cause serious damage to a tree by breaking numerous branches or the stem/bole, or uprooting the whole tree. Do not code wind damage if another damage (e.g., root rot) was the primary factor affecting or weakening the tree.

Lightning (code 52): Lightning damage often appears as long splits, cracks, or spiral scars down the tree bole; this damage may also cause top sections of the tree to be broken off.

Snow break or bend (code 53): Record for snow damage, such as severe bending (primarily small trees) or breakage to the stem/bole or numerous limbs, resulting from avalanches or from the weight of snow on tree limbs.

Damage Definitions (contd).

Frost crack (code 54): Frost cracks are long vertical splits on the surface of the tree stem, caused by the cooling and contracting of wood. Frost cracks indicate a structure defect in the wood beneath the crack.

Drought (code 55): Drought damage is difficult to determine, but may be identified by widespread foliage damage (wilting, discoloration of new foliage) indicated by yellowing and needle loss.

Sun scald (code 56): Sun scald is the death of a portion of the tree bark caused by exposure to the sun during the winter. Sun scald occurs on young trees and on trees newly exposed to direct sun after an opening occurs in the canopy.

Winter drying or burn (code 57): Winter burn damage on a tree is caused by adverse weather conditions (an extreme drop in temperature) and is characterized by red and green (new needles) foliage above snow-line and green foliage below snow-line.

Air pollution (code 58): Air pollution results in damage to large numbers of trees in the same location. Typically these areas will be in a down-wind location from large industrial sites.

Flooding (code 59): Flooding damage may occur near reservoir sites, washes, streams, or rivers and might be identified by features such as water marks or lines on tree boles, exposed roots (due to soil erosion), or uprooted trees.

Miscellaneous Damage (codes 61, 70-79). Record one of the following codes for miscellaneous damage.

Suppression (code 61): Suppressed trees are characterized by short or nonexistent internodes, gnarled stems, flat crowns, or sparse foliage. For shade-intolerant species such as lodgepole pine, code any indication of suppression. For shade-tolerant species such as spruce, do not code unless the tree is extremely deformed or has no live terminal leader.

Unidentified/Unknown (code 70): Record only if there is serious damage that cannot be identified; describe in the comments column the damage present.

Excessive Lean (code 71): Record for trees leaning more than 15° (27 percent) from vertical. Do not record if a more serious damage is present.

Damage Definitions (contd).

Forked below merchantable top/timber-species saplings with multiple stems (Code 72): Record only for timber species, 5.0-inches DBH and larger, with multiple forks below the merchantable top (4.0-inch diameter top, DOB), or for timber-species saplings, 1.0- to 4.9-inches DBH, with multiple stems.

Broken Top (code 73): Record for timber species broken above 6.0 feet and woodland species with a broken top on the main stem.

Dead Top (code 74): Record for trees with a dead terminal leader.

Wolf Tree (code 75): A wolf tree is a vigorous timber species with poor growth form, usually larger in diameter than the average tree in the stand, with many large and dead limbs forming a rounded crown not typical of a conifer. Wolf trees are often open grown.

Unhealthy Foliage (code 76): Record if a tree has unhealthy foliage or chlorosis (an abnormal yellowing of foliage) and the causal agent (e.g., disease, insect, drought) cannot be identified.

Heartwood Scar on Bole (code 77): Record for any scar on the bole that has penetrated the heartwood, if the actual causal agent cannot be determined.

Forked Above Merchantable Top (code 78): Record only for under-rotation age timber species, 5.0-inches DBH or larger. Code major forks or multiple stems above merchantable height (4.0-inch diameter top, DOB). Do not use this code for trees that are over-rotation age. Rotation age is 80 years for aspen and paper birch, and 120 years for all other timber species.

Excessive Crook, Sweep, or Taper (code 79): Record for timber species trees 5.0-inches DBH and larger that have abnormal diameter to height ratios, or severe sweeps and crooks that will significantly reduce the tree's quality or affect its marketable products.

Human Damage (codes 80-85). Record this code to indicate any tree damage due to logging operations (or related activity) or other human activity.

Other human (code 80): Record this code for damage caused by a human activity not listed under another code. If this code is used, describe in the comments column the damage present.

Damage Definitions (contd).

Logging (code 81): Logging is the felling and extraction of timber. Record this code for severe damage such as partial uprooting, cutting, extensive breakage, or damage to half or more of the bole circumference due to logging activities.

TSI (code 82): Timber stand improvement (TSI) is a term comprising all intermediate cuttings or treatments made to improve the composition, health, and growth of the remaining trees in the stand. Trees removed are often smaller than the minimum sawtimber size. Record for damage caused by TSI activities.

Land clearing (code 83): Land clearing refers to areas where tree land has been converted to non-tree land (e.g., tree land was cleared for homes or pasture). Record for damage caused by land clearing activities such as road building. Damage may be similar to logging.

Woodland cutting (code 84): Record this code for woodland species that have had cutting to stems or branches for use as fuelwood, fence posts, etc.

Chemical (code 85): Chemical damage may result from factors such as the use of salts on roadways, drift from herbicide usage, or spillage from large amounts of fertilizer or other chemicals. Use this code cautiously as it is difficult to determine.

ITEM

455 **Cause of Death.**

MQO: No errors, 80% of the time.
Record the primary Cause of Death (C.O.D.) for all dead tally trees that qualify as mortality (refer to page 10-7). **Use the damage item code list on pages 10-34 and 35 along with the following additional codes**; however, do not use damage code 00 (no serious damage) or codes 71 through 79. Record the item pertaining to the primary C.O.D. factor:

Additional Codes	Cause of Death
90	**Girdling** (death resulting from a timber stand improvement, TSI, girdling treatment - bark removed from entire circumference of a tree)
91	**Poison** (death resulting from TSI poison treatment)
97	**TSI - cut and left** (trees felled during TSI activities but not removed from the forest)
98	**Logging - cut and left** (trees felled during a logging operation but not removed from the forest)
99	**Logging - cut and removed** (trees felled during a logging operation and removed from the forest) - **Remeasurement trees only.**

456 **Mistletoe Class.**

MQO: ±1 class, 90% of the time.
Rate all live timber-species and pinyon tally trees, 1.0-inch DBH/DRC or larger, for **dwarf mistletoe** (Arceuthobium spp.) infection. Dwarf mistletoe occurs on larch, pines (including pinyon), and Douglas-fir (rarely true fir or spruce). Signs and symptoms include witches brooms (a massed dense clump of tree branches, typically with live foliage), the visual presence of the mistletoe plant (simple or branched shoots, approximately 1 to 4 inches in length), and swellings on the tree stem or branches. Code mistletoe as damage (Item 450) for trees with a mistletoe class of 4 or more (unless more serious damages are present).

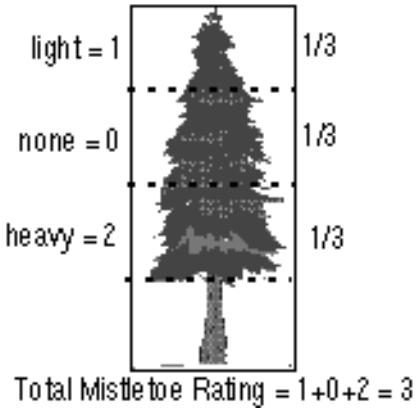
Use the following six-class mistletoe rating procedures:

- Divide live crown into thirds (figure 20);
- Rate each third separately for the amount of infection;

Rating	Amount of Infection (within the third)
0	**No visible infection**
1	**Light infection** -- one-half or fewer of the total branches infected
2	**Heavy infection** -- one-half or more of the total branches infected

- Add the three individual ratings of the thirds to obtain a total mistletoe rating for the tree; enter the total rating as the Mistletoe Class code.

Figure 20. Example six-class mistletoe rating.



ITEM

460-462 Percent Volume Loss - Rotten and Missing (460), Sound Dead (461), and Form Defect (462).

MQO: ±5% for total deductions ≤20%, 90% of the time, and ±10% for total deductions >20%, 90% of the time.

Using the general Seen Defect Guidelines provided (supplement), along with any other evidence, record the percentage of rotten and missing volume, sound dead volume, and form defect (timber species only), to the nearest 1 percent, for all tally trees 1.0-inch DBH/DRC and larger. When estimating volume loss (tree cull) only consider the cull on the merchantable bole/portion of the tree.

Examine the tree first for rotten and missing volume loss, then sound dead volume loss, and finally form defect. Do not "double" volume deduction for an individual section having both form defect and rotten/missing or sound dead volume. If a portion of the tree is both rotten and has form defect, categorize the section as rotten/missing volume only. Likewise, if a section is both sound dead and form defect, categorize the section as sound dead only. The total volume loss will equal 100 percent or less.

The **merchantable bole on a timber species** is defined as the portion of a tree, 5.0-inches DBH or larger, between a 1-foot stump and a 4.0-inch top diameter. For saplings, consider the stem from a 1-foot stump to a 1.0-inch top.

The **merchantable portion of a woodland species** is defined as the portion of a tree, with at least 1 stem 3.0-inches DRC or larger, up to a minimum top diameter of 1.5-inches, and includes all qualifying segments above the place(s) of diameter measurement; do not include sections below the place(s) of diameter measurement. Qualifying segments are stems or branches that are a minimum of 1.0 foot in length and at least 1.5 inch in diameter (at the top). Branches and stems smaller than 1.5 inches in diameter (or portions of branches and stems smaller than 1.5 inches in diameter, such as tips of branches) are **not** included when determining volume loss.

ITEM

460-462 Percent Volume Loss (contd).

Use the following guidelines to estimate tree cull:

a. Timber species, 5.0-inches DBH and larger. Refer to table 2 and supplemental guidelines to compute volume loss.

(1) Rotten and missing volume (Item 460) loss is often difficult to estimate. Use your best judgment and be alert to such defect indicators as the following:

- Cankers or fruiting bodies.
- Swollen or punky knots.
- Dull, hollow sound of bole when struck with an ax.
- Large dead limbs, esp. those with frayed ends.
- Sawdust around the base of the tree.

Regard with suspicion all trees exhibiting any of the characteristics listed above. As a general rule, when boring trees for age and radial growth data, note the presence of any yellow, yellowish brown, or light brown rot on the increment core; this may indicate the presence of butt or stem rot.

Refer to supplemental disease and insect pests field guides as an aid in identifying damaging agents and their impact on volume loss. Refer to appendix C.5 for a guide for estimating circular internal defect (defect deduction table).

(2) Sound dead volume (Item 461) loss can be detected by cutting into a tree with a hatchet and examining the soundness of the wood. Sound dead wood can be caused by insect or animal girdling, lightning or fire damage, etc.

(3) Form defect volume (Item 462). Only consider the form defects (e.g., crooks, sweep, forks) serious enough to reduce the usable merchantable volume of the tree.

Table 2. Seen Defect

ITEM

460-462 Percent Volume Loss (contd).

b. Timber species saplings, 1.0- to 4.9-inches DBH.
Determine Rotten and Missing Volume (Item 460) and Sound Dead Volume (Item 461) for saplings using the same criteria as in larger trees (see Table 3). In general, do not code defect volume for a sapling unless it has any of the following signs or symptoms which indicate the tree will not likely reach a 5.0-inches DBH sound tree with good form and vigor. If a sapling will not become a sound tree of good form and vigor, record "100" for Defect Volume (Item 462):

- Mistletoe, rot, or any canker on the main stem.
- Broken or dead top.
- Any girdling of 1/2 or more of the main stem circumference.
- Suppressed trees that will not be released.
- Severely twisted or gnarled main stems.

c. Woodland species tally trees, at least 1 stem 3.0-inches DRC and larger.

(1) **Rotten volume (Item 460)** may be identified by visual evidence of cubical rot, or indirectly detected by a dull hollow sound when the segment is struck by the flat side of a hatchet. Also, if a tree segment is suspected of containing rot, bore into the segment (but only far enough to detect rot), and check the core for punky wood.

(2) **Missing volume (Item 460)** includes the merchantable portion of the tree that has been cut (e.g., for posts or firewood) or is broken off. If cutting or other damage (fire scar) on a stem is so old that the tree stem or stub has deteriorated or has been replaced with new growth, do not deduct volume for the original loss.

(3) **Sound dead volume (Item 461)** includes dead volume only in the merchantable portion; dead ends of branches and stems less than 1.5 inches in diameter are not part of the merchantable portion of the tree, and therefore are **not** included in determining percent dead volume. Be careful not to overestimate dead volume for trees with numerous dead branch tips.

ITEM

463 Past Tree Class.

MQO: No errors 80% of the time.
Record only for trees qualifying as mortality. Estimate the live tree class immediately prior to death (see sound, rough, and rotten below).

464 Current Tree Class.

MQO: No errors 90% of the time.
Record a Current Tree Class code for all tally trees and nontallied site trees. Base the Tree Class code on the information collected in Items 460, 461, and 462.

Code	Tree Class
1	**Sound (live) - timber species** • a live sapling (1.0- to 4.9-inches DBH), with minor or no evidence of form defects, insects, or disease, that is expected to become a sound tree 5.0-inches DBH or larger with good form and vigor. • a live tree, 5.0-inches DBH or larger, that has less than 67 percent of the merchantable volume cull, and contains at least one solid 8-foot section, reasonably free of form defect, on the merchantable bole.
2	**All live woodland species**
3	**Rough (live) - timber species** • a live sapling (1.0- to 4.9-inches DBH) with form defects or evidence of insects and disease that will preclude it from becoming a sound tree of good form, 5.0-inches DBH or larger. • a live tree, 5.0-inches DBH or larger, with 67 percent or more of the merchantable volume cull, and more than half of this cull due to sound dead wood volume loss or severe form-defect volume loss. • a live tree, 5.0-inches DBH or larger, that does not now, nor prospectively, have at least one solid 8-foot section, reasonably free of form defect, on the merchantable bole.

ITEM

464 **Current Tree Class** (contd).

Code Tree Class

4 **Rotten (live) - timber species**
- a live tree, 5.0-inches DBH or larger, with 67 percent or more of the merchantable volume cull, and more than half of this cull due to rotten and/or missing volume loss.

5 **Hard dead**
- a standing or down dead tree, 1.0-inch DBH/DRC or larger, that has a minimum of 33 percent of the original merchantable volume sound (less than 67 percent rotten and/or missing).

6 **Soft dead**
- a standing or down dead tree, 1.0-inch DBH/DRC or larger, that has less than 33 percent of the original merchantable volume sound (more than 67 percent rotten and/or missing).

470 **Posts - Lines (470) and Corners (471).**
471

MQO: No errors 90% of the time.
Examine all **juniper and oak** tally trees (live or dead) for fence post products. Line posts are placed along a straight length of fence line to keep the fence strands separated. A corner post is a larger segment used to anchor the fence at a selected locations along the fence line, such as a bend or corner. The criteria for posts are as follows:

a. **Corner posts**:
- 8.0 feet minimum length.
- 7.0 - 9.0 inches diameter at butt (large) end.
- 2.5 inches minimum diameter at small end.
- Reasonably straight and solid.

b. **Line posts**:
- 7.0 feet minimum length.
- 5.0 - 7.0 inches diameter at butt (large) end.
- 2.5 inches minimum diameter at small end.
- Reasonably straight and solid.

ITEM

470/471 Posts (contd)

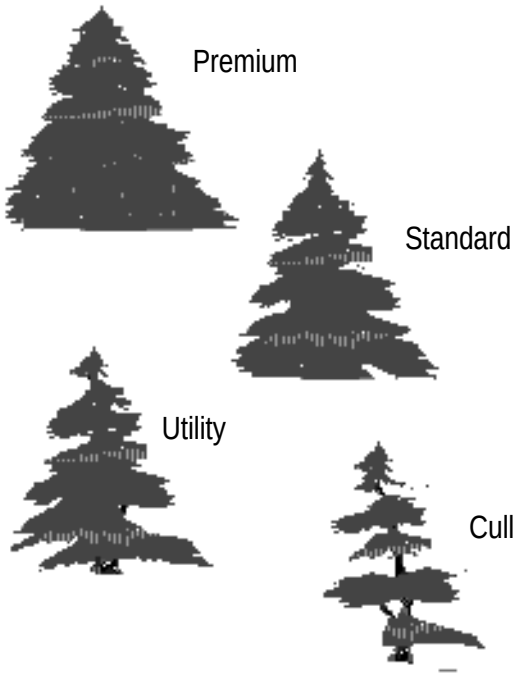
Record the number of corner and line posts per tally tree. Include qualifying stems and large branches. Ignore portions of butt segments larger than 9.0 inches in diameter; however, count any posts that occur above a large butt segment. Include down stem segments, from stems that have been measured for DRC, if the downed segment meets the post criteria. Consider corner posts first. Do not double record the same segment as a corner and line post. Record 0 if there are none.

472 Christmas Tree Grade.

MQO: ±1 class 90% of the time.
Record one of the following one-digit codes for live **pinyon** tally trees, **12 feet or shorter in height**. Refer to figure 21 for illustrations of the following grades:

Code	Grade
1	**Premium** -- excellent conical form with no gaps in branches; trees have a straight stem/bole.
2	**Standard** -- good conical form with small gaps in branches; trees are bent or slightly malformed.
3	**Utility** -- conical in form with branches missing; trees are bent or malformed.
4	**Cull --** not meeting one of the above classifications. Poor conical form; large gaps in branches; may have more than one stem.

Figure 21. Christmas tree grades for pinyon.



CHAPTER 11
UNDERSTORY VEGETATION DESCRIPTION

This chapter gives instructions for the Understory Vegetation Description sample and for recording the presence of noxious weeds. The description sample provides information about the horizontal and vertical distribution, cover, diversity, and composition of the understory vegetation. Cover of the life forms is routinely summarized and tabled for standard reporting. Some other uses for the understory data include estimation of habitat, biomass, and forage availability. Refer to appendix A.6 for the Understory Vegetation Description record.

If the subplot center falls into a water or nonsampled tree land condition class (refer to chapter 3), leave part I of this description blank, and record 999 for each entry in Part II.

When all or part of the vegetation sample cannot be determined due to snow cover, write "snow" in the General Comments and in the notes area on the vegetation description record. For any cover in Part II (below) that cannot be determined due to deep snow, record 999; do not record 0, which means "no cover".

MQO: Plant identification - genus no errors 90% of the time
- species no errors 85% of the time
Layer - no errors 90% of the time
Cover ±10%, 90% of the time.

A. Sample Subplot Size

For each of the subplots, estimate and record understory vegetation data for the 1/24-acre subplot (24.0-foot radius). If a portion of one of the 1/24-acre subplots is not in the condition class of the subplot center (i.e., in a contrasting condition class), determine understory cover percentages based only on the portion of the subplot within the subplot center condition class.

B. Sample Identification

On the Understory Vegetation Description, record the appropriate codes for the header items listed below:

1. State
2. Map Number
3. Consecutive Point Number (CPN)
4. County
5. Field Location Number
6. Subplot Number
7. Subplot Center Condition Class Number

C. Vegetation Description

Part I is an assessment of the major species that have at least 5 percent cover. List the predominant species (a maximum of four per plant group) within each plant group heading (e.g., tree, shrub) by the appropriate plant alphanumeric code and record a percent cover and a code for vegetation layer (as described below).

Part II is an assessment of the plant groups by layer: 0-1.5 feet, 1.6-6.0 feet, and $\geq$ 6.1 feet. Assign a percent cover to each plant group that occurs within each layer.

1. General Definitions.

a. Plant groups. The vegetation is divided into four growth forms or plant groups; these groups are trees, shrubs, forbs, and graminoids, and are defined as follows (classify each species into one category):

- **Trees:** This category includes

  (1) seedlings and saplings of both timber and woodland tally species (refer to page 10-9 and 10),
  (2) trees species defined as "other tree species" (those defined by Little, 1979, as trees but not listed as tally species on pages 10-9 and 10, such as ash, willow, etc.); refer to appendix D for the tree species list; and
  (3) tally species trees exhibiting shrub growth form (refer to chapter 5).

- **Shrubs:** Woody, multiple-stemmed plants, of any size, except species designated as trees above. Most cacti are included in this category.
- **Forbs:** Herbaceous, broad-leaved plants; includes vines, ferns (no longer includes mosses and cryptobiotic crusts).
- **Graminoids:** Grasses and grass-like plants (includes rushes and sedges).

b. Percent cover. Crown canopy cover is defined as the area of ground surface covered by a vertical projection of the canopy of a plant. Estimate cover to the nearest 1 percent of crown canopy by species in Part I and for entire plant groups in Part II.

To record an individual species in Part I, it must have at least 5 percent cover; a circle 5.4 feet in radius or a square 9.5 feet on a side would represent 5 percent of the total 1/24-acre subplot (24.0-foot radius).

Note regarding dead vegetation: Cover by a dead shrub, or portion of a dead shrub (that will not recover) must not be included in cover estimates. However, cover should be estimated for the current season's annual forbs and grass species that have already died. Perennial forbs and grasses may also appear dead, but are actually in an inactive or dormant stage -- these plants should also be included in the cover estimates.

c. Layer codes. One of the following Layer codes will be assigned to individual plant species in Part I and to plant groups in Part II.

Layer Code	Item
1	**Layer 1** (0-1.5 feet)
2	**Layer 2** (1.6-6.0 feet)
3	**Layer 3** ($\geq$ 6.1 feet)

The 1.5- and 6.0-foot boundaries should be considered approximate. For example, visualize layer 1 as graminoids, forbs, and low shrubs that occur (general height) below your knee. Layer 2 includes plants that occur between knee and eye level, possibly grasses or forbs, but usually medium shrubs. Layer 3 includes plants occurring above eye level and usually consist of seedlings, saplings, and tall shrubs only.

Note: For unusual circumstances that may occur (e.g., an entry for a forb or graminoid in Layer 3), include a note at the bottom of the vegetation form to verify the entry.

2. Entries to be Recorded.

a. Understory Vegetation Description record -- Part I (Species List by Cover and Layer). For recording purposes on the Understory Vegetation Description record, start with the first space (or block) under each plant group heading. Do not leave blank spaces above or between individual species listed.

(1) **Species.** In the appropriate plant group column, record up to four plant species (the most dominant) that have 5 percent cover or greater, occurring on the 1/24-acre subplot. Record the alphanumeric code for the plant, as listed in the PLANTS[a] data base. Record all alphanumeric codes in **capital letters** to avoid possible misinterpretation of a small letter. Also, record the entire alphanumeric code listed in the PLANTS handbook.

For field use, many of the plants and associated codes for a particular State or region are summarized on a "common plant" code list(s). These codes have been taken directly from the PLANTS handbook. If a plant is not listed on the "common plant" code list, first check to see if it is listed in the PLANTS handbook. If the alphanumeric code for a certain plant species is not listed in the PLANTS handbook, record an abbreviation for that plant species using the first two letters of both the genus and species followed by an asterisk (*), and write out the abbreviation and the scientific name at the bottom of the vegetation form. For example, the hypothetical plant "Plantus exampleis" would be coded as "PLEX*".

Use the "?" symbol for species that can be identified in the field, but the scientific name or code must be identified at camp; for example "?RedBrome."

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[a] USDA, Natural Resources Conservation Service. 1994. The PLANTS data base. Ecological Sciences Division, Washington D.C.

Some plants require identification only to the genus level. However, field crew supervisors are responsible for identifying indicator plants, used for habitat typing, to the species level (even if some of the indicators are in one of the genera listed below). Plants coded to the genus level are as follows:

Grasses

Carex spp. (CAREX) -- sedge

Forbs

Allium spp. (ALLIU) -- onion
Aster spp. (ASTER) -- aster
Astragalus spp. (ASTRA) -- locoweed, milkvetch, poisonweed
Castilleja spp. (CASTI2) -- paintbrush
Cirsium spp. (CIRSI) -- thistle
Erigeron spp. (ERIGE2) -- fleabane, daisy
Lupinus spp. (LUPIN) -- lupine
Trifolium spp. (TRIFO) -- clover
Viola spp. (VIOLA) -- violet

Shrubs

Rosa spp. (ROSA5) -- wild rose

In the event a qualifying plant species cannot be identified to the species level:

- Record "UNKN1" in the species column for the first unknown, "UNKN2" for the second unknown, and so forth. Each unknown on a field location will have a different unknown number, even if unknowns are from various species groups.

- collect a sample of the unknown to be sent to the office (refer to page 11-10).

Note: When the vegetation cannot be determined due to snow cover, describe the situation in General Comments or Notes, but **do not record snow as a species in Part I**.

(2) **Species canopy cover.** For each individual plant species that makes up at least 5 percent cover, estimate and record crown canopy coverage to the nearest 1 percent. Crown canopy cover is identified as the area of ground surface covered by, in this case, the canopy of each plant species.

(3) **Species vegetation layer.** For each individual plant species recorded, assign one of the vegetation layers (page 11-3). These layers illustrate the vertical diversity of the 1/24-acre subplot.

In this part (Part I), a plant species can be assigned only one vegetation layer; if a plant species is found in more than one layer, assign the layer where the bulk of the species occurs. If a plant species occurs equally in more than one layer, record the highest layer where it occurs.

b. Understory Vegetation Description record -- Part II (Plant Group Cover by Layer). In this part (Part II), determine a total crown canopy coverage by layer for each plant group, and record to the nearest 1 percent.

Crown canopy cover is identified as the area of ground surface area covered by, in this case, the canopy of each plant group occurring in each of the three layers. Plant groups recorded in each layer will include plants whose heights end in that layer. If a plant group does not end (top out) within a layer, record 0 for the Cover code. Record 1 for plant groups occupying a trace to 1 percent cover.

One plant species may be represented on the 1/24-acre subplot by plants growing in two layers. In Part I, because each plant species could be assigned only one layer, the layer where the bulk of the species occurs is recorded. However, in Part II, species detail is not a consideration; **different plants of the same species that occur in more than one layer can be assigned to the different layers**. For example, sagebrush plants may occur with heights ranging from 1.0 foot to 5.0 feet. Individual plants, with heights between 0 and 1.5 feet, would be assigned to layer 1; individual plants, with heights between 1.6 and 6.0 feet, would be assigned to layer 2.

Note: Although different plants of the same species can be divided into more than one layer, parts of an individual plant (e.g., upper half, lower half) cannot be assigned to different layers.

For the total cover, examine the total canopy cover of each lifeform as if the other lifeforms do not exist. Do not double count overlapping layers within a lifeform. The total cover for a specific lifeform must be equal to or greater than the highest cover recorded for an individual layer in that lifeform, and it must be equal to or less than the sum of the covers recorded for all the layers in that lifeform.

This portion (Part II) of the vegetation sampling procedure documents lifeform cover for plants that were too insignificant to record by species (in Part I) but contribute to vegetation cover when grouped together.

Where snow cover obscures the sample, record 999 for cover in the appropriate group layers.

Refer to figure 22 for an example of a completed Understory Vegetation Description record.

D. Noxious Weeds

At each subplot, examine the vegetation within the subplot fixed-radius area for the presence of any designated noxious weeds. Record the species code for any identified weeds, and indicate the subplot number(s) where the plant was found. The list of designated noxious weeds for the Rocky Mountain States (Jan 1997) is as follows:

Code	Common Name	Scientific Name
ACRE3	Russian knapweed	Acroptilon repens
AECY	Jointed goatgrass	Aegilops cylindrica
ARAB3	Absinth wormwood	Artemisia absinthium
AMTO3	Skeletonleaf bursage	Ambrosia tomentosa
ANAR6	Scentless chamomile	Anthemis arvensis
ARMI2	Common burdock	Arctium minus
AVFE	Wild oats	Avena fatua
CAAC	Plumeless thistle	Carduus acanthoides
CANU4	Musk thistle	(Carduus nutans
CARDA2	Hoary cress genus	Cardaria spp.
CACH10	Cardaria	Cardaria chalapensis
CADR	Pepperweed whitetop	Cardaria draba
CADRD	Heartpod hoarycress	Cardaria draba ssp. draba

Code	Common Name	Scientific Name
CAPU6	Hairy whitetop	Cardaria pubescens
CASA3	Hemp, marijuana	Cannabis sativa
CEBI2	Spotted knapweed	Centaurea biebersteinii
CEDET	Meadow knapweed	Centaurea debeauxii spp. thuillieri
CEDI3	Diffuse knapweed	Centaurea diffusa
CESO3	Yellow starthistle	Centaurea solstitialis
CETR8	Squarrose knapweed	Centaurea triumfettii
CHJU	Rush skeletonweed	Chondrilla juncea
CIAR4	Canada thistle	Cirsium arvense
COAR4	Field bindweed	Convolvulus arvensis
COMA2	Poison hemlock	Conium maculatum
CRVU2	Common crupina	Crupina vugaris
CYDA	Bermudagrass	Cynodon dactylon
CYOF	Houndstongue	Cynoglossum offinale
CYSC4	Scotch broom	Cytisus scoparius
ELRER	Quackgrass	Elytigia repens var. repens
EUDE4	Toothed spurge	Euphorbia dentata
EUES	Leady spurge	Euphorbia esula
HIAU	Orange hawkweed	Hieracium aurantiacum
HICA10	Yellow hawkweed	Hieracium caespitosum
HYNI	Black henbane	Hycoscyamus niger
HYPE	St. Johswort	Hypericum perforatum
ISTI	Dyer's woad	Isatis tinctoria
LELA2	Perennial pepperweed	Lepidium latifolium
LEVU	Oxeye daisy	Leucanthemum vulgare
LIDA	Dalmation toadflax	Linaria dalmatica
LIVU2	Toadflax	Linaria vulgaris
LYSA2	Purple loosestrife	Lythrum salicaria
MIVE3	Milium	Milium vernale
NAST3	Matgrass	Nardus stricta
ONAC	Scotch thistle	Onopordum acanthium
PAMI2	Wild proso millet	Panicum miliaceum
PORE5	Sulphur cinquefoil	Potentilla recta
SEJA	Tansy ragwort	Senecio jacobaea
SOAL	Perennial sorghum	Sorghum almum
SOAR2	Perennial sowthistle	Sonchus arvensis
SOCA3	Horsenettle	Solanum carolinense
SOEL	Silverleaf nightshade	Solanum elaeagnifolium
SOHA	Johnsongrass	Sorghum halapense
SORO	Buffalobur	Solanum rostratum
TACA8	Medusahead	Taeniatherum caput-medusae
TAVU	Common tansy	Tanacetum vulgare
TRTE	Puncturevine	Tribulus terrestris
ZYFA	Syrian beancaper	Zygophyllum fabago

Figure 22. Example of a completed understory vegetation description record.

E. Instructions for Collecting Plant Sample "Unknowns"

If a qualifying plant species cannot be identified in the field, do the following:

1. **Collect Sample.** Collect as good a sample as possible -- include roots, leaves, flowers, more than one leaf blade and inflorescence for graminoids, etc. Also, collect more than one specimen of the plant to be identified. Place the unknown in a plastic cover, with a piece of paper for absorbency, and place the cover in a tatum or book so that the sample remains pressed. Do not place the sample in a field vest pocket or lunch bag for it is likely to be crumpled or ruined and may no longer be suitable for identification.

2. **Fill Out an Unknown Identification Document** (ID slip)**.** These forms are located in the notebook included with the plant press. Fill out a form with the following information:

   - State code.
   - County code.
   - Field location number.
   - The subplot number(s) where the unknown was found.
   - The unknown number (e.g., UNKN1, UNKN2); each unknown on a field location must have a unique unknown number.

3. **Place Sample in Camp Plant Press.** It is important that the unknown samples be dried and pressed. After arriving back at camp, carefully take the unknown sample out of the plastic cover (do not leave the unknown samples in the plastic cover overnight). Place the unknown sample in a standard size sheet of newspaper, attach the unknown identification slip, and place the newspaper in the camp plant press.

   Note: Do not put tape directly on plant samples, and do not store plant presses outdoors or in an unprotected location.

After the camp plant press is full, the field supervisor will collect the samples and return them to the office.

CHAPTER 12 - REMEASUREMENT PROCEDURES

For this inventory, a portion of the field locations measured during previous inventories may be revisited. In addition to the current location layout and sampling procedures for sampling trees, previously tallied trees on these locations will be remeasured using the original location layout and sampling procedures. The location center (LC) will be the same point for both samples.

If the field location was not established at the correct map point during the previous inventory, determine whether the location placement meets the following criteria:

- The old plot was established in the correct condition class (refer to chapter 3).
- The old plot was established within 500 feet of the correct map point.

If the old location does not meet both the criteria, remeasure the old plot as instructed in this chapter, but establish the current plot layout in the correct location. Leave the old tags and nails in the trees, but note this re-location in the General Comments or Notes for the current inventory. **Note:** In the first inventory, some fixed-radius plots were "shifted" away from non-tree land, moving the entire sample plot into forest land. For these locations, remeasure the plot as it was previously established, but establish the current design in the correct (original) location.

A. Plot Layout

In the previous inventory, the Sampling Factor designated the plot layout and sampling system used. For field locations with the Sampling Factor coded as a 20 or 40, a 5-point cluster was established, and variable-plot sampling techniques were employed. On locations with the Sampling Factor coded as 91, 92, or 95, a fixed-radius plot was established.

1. Variable-Radius Plots.

The LC was designated as point 1 of 5 points on the field location. Points 2 through 5 were distributed around the LC, and within the condition of the LC, using a triangular grid pattern with 100-foot intervals (figure 23). The spacing and orientation of the primary point positions was as follows:

from LC (1) to	Primary Point	Azimuth and (degrees)	Distance (feet)
	2	60	100
	3	120	100
	4	300	100
	5	240	100

In the previous inventory, when points 2 through 5 fell into vegetation conditions different than the condition at the LC, those points were redistributed back into the LC condition. Refer to the previous field location map to determine the actual point placement established.

At each of the 5 points, timber species trees 5.0-inches DBH and larger, and woodland species trees 3.0-inches DRC and larger, were tallied on a variable-radius main plot; a 20 or 40 basal area factor (BAF) angle gauge, depending on forest type, was used to select tally trees:

Sampling Factor	Basal Area Factor	Forest Types	Limiting Distance to Geographic Center
20	20	Ponderosa pine	DBH/DRC X 1.945
40	40	All other conifer	DBH/DRC X 1.375

In addition, saplings were tallied or counted, and seedlings were counted, on a 1/300 acre fixed-radius microplot centered on the point stake.

Figure 23. Previous variable-radius plot layout.

2. Fixed-Radius Plots.

In general, fixed-radius plots were used to sample locations consisting of woodland tree species; however, some inventories used fixed-radius plots to sample locations consisting of timber species.

The LC was the center point of a fixed-radius plot. One of the following fixed-radius plots (figure 24) was used in the previous inventory to sample trees; refer to the Sampling Factor on the old form:

Prev. Sample Factor	Plot Size (acre)	Plot Radius (feet)	General Grouping of Forest Types, Cover
92	1/20	26.3	oak, ≥ 30% cover
91	1/10	37.3	oak, < 30% cover, or all others, ≥ 30% cover
95	1/5	52.7	all others, < 30% cover

The fixed-radius main plot was divided into four quadrants (points):

Quadrant	Tree Azimuth Range
1	1 to 90 degrees
2	91 to 180 degrees
3	181 to 270 degrees
4	271 to 360 degrees

In each quadrant a 1/300-acre (6.8-foot radius) seedling/sapling microplot was established to sample regeneration and was located in the direction and distance from the LC as follows:

	Azimuth	Distance (feet)	
Quadrant	(degrees)	1/5, 1/10-acre	1/20-acre
1	45	25	15
2	135	25	15
3	225	25	15
4	315	25	15

Figure 24. Previous fixed-radius plot layout.

B. Sampling Methods

Locate and remeasure all trees preprinted on the Remeasurement Tree Data record (appendix A.10) using the preprinted Sampling Factor code as a reference for the plot layout. If a preprinted tree cannot be relocated and the reason cannot be determined, line through the preprinted data for that tree and make a note in comments.

With variable-radius sampling (Sampling Factors 20 and 40), the limiting distance values are related to an individual tree's diameter (DBH or DRC) and its **horizontal** distance from the sample point stake.

For fixed-radius sampling (Sampling Factors 91, 92, and 95), the center of the tree (single-stemmed trees) or the geographic center of the trees stems (multistemmed woodland trees) must be at or within the fixed distance.

Locate individual trees by referencing the preprinted azimuth and distance, or by locating the numbered tree tag. Use the sampling procedures described on pages 12-1 to 5 to help relocate trees.

The following trees were sampled in the previous inventory:

1. Main Plot/Quadrant.

a. Live timber species 5.0-inches DBH and larger.

b. Live woodland trees 3.0-inches DRC and larger. For multistemmed trees, at least one stem was 3.0-inches DRC or larger.

c. Standing dead timber species 5.0-inches DBH and larger.

d. Standing dead woodland trees that had at least one standing qualifying stem (3.0-inches DRC or larger, 8.0 feet in length to a 1.5-inches branch diameter).

2. Seedling/Sapling Microplot.

After trees were tallied on the main plot, the following microplot trees were tallied:

a. Timber species saplings (1.0 - 4.9 inches DBH).

b. Pinyon and juniper saplings (1.0 - 2.9 inches DRC). For multistemmed woodland saplings, one stem was at least 1.0-inch DRC. Only the diameter measurement of the largest stem was recorded.

c. Other woodland species saplings (1.0 - 2.9 inches DRC) to bring the total tally of main plot and microplot live trees to 4.

d. Established seedlings (less than 1.0-inches DRC/DBH) to bring the total tally of main plot and microplot live trees to 4.

C. Tree Data

ITEM

601 Previous Point Number.

Preprinted. Point number refers to the specific point on the 5-point layout or to the specific quadrant on the fixed-plot layout.

602 Point History.

Record a 2-digit code for each preprinted line of data:

Code	History
01	**Forest land before, forest land now**
02	**Forest land before, other tree land or non-tree land now**
04	**Forest land condition different from point 1** (condition of point has changed since the previous inventory)

603 Tree Number. Preprinted.

ITEM

604 Azimuth.

Preprinted for most locations. Item left blank for certain locations where tree tags were used.

605 Distance.

Preprinted for most locations. This value is the slope distance from the center stake or microplot stake to the face of single-stemmed trees or to the geographic center of multistemmed trees. Item left blank for certain locations where tree tags were used.

610 Past Tree History.

Preprinted. Refer to Current Tree History for code definitions. If the past Tree History appears to be incorrect (e.g., Past Tree History preprinted as "4", but tree is alive), cross through the preprinted code and record an estimated Past Tree History.

611 Current Tree History.

Record as a 1-digit code for each preprinted tree.

Code	Current Tree History
1	Live tree
3	Cut, down, or missing due to harvest activity
4	Standing dead tree
6	Down dead tree

616 Species.

Preprinted. Verify for all trees. Refer to Item 416, page 10-9 and 10 for species list; cross out tree records for preprinted species not listed. If species is incorrect, cross through preprinted code and record the correct species code.

620 Past DBH/DRC.

Preprinted. If the preprinted past diameter appears to be incorrect (e.g., past DBH larger than current DBH, and the tree is still alive and growing) cross out the preprinted value and record a past DBH/DRC estimate.

ITEM

621 Current DBH/DRC.

Record as directed in Item 421, starting on page 10-11, for each preprinted tree. If individual stems are nailed, measure the stems at (above) the nail.

623 Past Number of Stems.

Preprinted. If the past number of stems does not equal the current number of stems, do not cross out and change the preprinted value, but make a note in comments suggesting the possible reason for the difference.

624 Current Number of Stems.

Record only for preprinted **woodland** species with at least one stem 3.0 inches in diameter or larger.

640 Past Tree Height.

Preprinted. If past tree height appears to be incorrect, cross out preprinted value and record a past height estimate.

641 Current Tree Height.

Determine tree height for each preprinted tree as directed in Item 441, page 10-28.

ITEM

655 Cause of Death.

Record a 2-digit code that best describes the primary Cause of Death (C.O.D.) for the following preprinted trees:

a. Trees that were alive in the first inventory but are now dead (refer to Tree History) due to natural causes; use the damage code list on page 10-34 and 35, but do not use damage code 00 (no serious damage) or codes 71 through 79.

b. Trees that were tallied in the first inventory but are now dead, cut, or missing due to harvest activity (logging, timber stand improvement (TSI), or other human activity/damage); record one of the following codes:

Code	Cause of Death
Logging	
81	**Damage** (death caused by damage resulting from harvest activities)
98	**Cut and left** (trees felled during a logging operation but not removed from the forest)
99	**Cut and removed from the woods.**
TSI	
82	**Damage** (death caused by damage resulting from TSI activities)
97	**Cut and left** (trees felled during TSI activities but not removed from the forest)
90	**Girdling** (death resulting from a TSI girdling treatment - bark removed from entire circumference of a tree)
91	**Poison** (death resulting from TSI poison treatment)
Human	
80	**Other human damage**
83	**Land clearing** (roads, etc.)
84	**Woodland cutting** - fuel wood, post/pole removal
85	**Chemical** (road salt, herbicide spraying, etc.)

ITEM

663 Past Tree Class.

Preprinted. Refer to Current Tree Class for codes. If the Past Tree Class appears to be incorrect (e.g., tree was coded as rotten in first inventory, but is sound), cross out the preprinted code and record an estimate of the correct Past Tree Class.

664 Current Tree Class.

Record a 1-digit code for each preprinted tree (refer to definitions on page 10-50):

Code	Tree Class
1	Sound (live) - timber species
3	Rough (live) - timber species
4	Rotten (live) - timber species
5	Hard dead - timber species
6	Soft dead - timber species
2	All Woodland species

GLOSSARY

ALLUVIAL FAN: A fan-shaped deposit of unconsolidated material and debris, forming at the point where a stream emerges from a narrow valley onto a broader, less sloping valley floor.

ALPINE: The zone of low arctic-type vegetation above tree line.

AZIMUTH: The horizontal angle or bearing of a point, measured clockwise from north. Note: The azimuth plus or minus 180 degrees is termed the **back azimuth**.

BAJADA: A broad, gently inclined slope formed by the lateral blending of a series of alluvial fans, and having a broadly undulating profile.

BASAL AREA (BA): The cross-sectional area of a tree stem at the point where diameter (DBH/DRC) is measured, inclusive of bark; BA is expressed in square feet. The BA per acre is often used to represent tree stocking.

BASAL AREA FACTOR (BAF): The basal area factor is an index for the sampling angle used in variable-radius plot tree cruising. The BAF is the amount of basal area each tally tree on a sample point represents per acre.

BASELINE: A reference line of sight, located and measured on both the aerial photo and the ground.

BENCH: A nearly level to gently inclined surface developed on resistant strata in areas where valleys are cut, and forming a shelf above the level of the valley bottom.

BH: Breast height: 4.5 feet above the ground. BH is in reference to the place of diameter measurement for timber species.

BOLE: The main stem of a timber species tree. For estimating tree cull, use the merchantable bole -- the section of the tree between a 1-foot stump and a 4-inch top diameter outside bark (DOB). **Note:** Small trees (e.g., seedlings, saplings) are often characterized as having stems; for field use, a tree stem is equivalent to a tree bole.

BUREAU OF LAND MANAGEMENT LANDS: Public lands administered by the Bureau of Land Management (BLM), U.S. Department of the Interior.

CENSUS WATER: Rivers, streams, sloughs, estuaries, and canals, more than 200 feet wide and 4.5 acres and larger in size; only portions of rivers and streams meeting the definition criteria are considered census water. Other census water includes lakes, reservoirs, and ponds 4.5 acres and larger in size. Portions of braided streams meeting the census water definition criteria and more than 50 percent water at normal high-water level are considered census water. Ephemeral and intermittent streams are classified as land.

CHAINING (woodland treatment method): A mechanical method of land clearing (or possible type conversion) to reduce or eliminate undesirable vegetation (e.g., reduce the number of juniper trees to enhance herbage production for livestock use). With this method, a heavy chain is dragged between two tractors for the purpose of uprooting the undesirable vegetation.

CIRQUE: A semicircular, concave, bowl-like area with a steep face, primarily resulting from erosive activity of a mountain glacier. A glacial cirque appears as a amphitheater-like carving in the mountainside, with steep slopes providing headwaters for drainage.

CLIFF: A high, very steep to perpendicular or overhanging face of rock or earth.

CONDITION: An area of relatively uniform ground cover, such as a homogeneous vegetation cover

CONDITION CLASS: A categorization of the condition based on several defining attributes: Ground Cover Class, Land Use; forest land is further defined by Forest Type, Stand-size Class, Stand Origin, and Stand Density. Other tree land is further defined by the Dominant Tree Species, and non-tree lands are further defined by Rangeland Cover Type. A condition class is generally an area of tree land or non-tree land, at least 1 acre in size and 120-feet wide (approximately the radius of a 1-acre circle); water must be at least 30-feet wide and 1 acre in size to be considered a condition. Exceptions to these size and width requirements are described in chapter 3.

CONTRASTING CONDITION CLASS: Any qualifying condition class that is different than a previously assigned class based on the defining attributes.

CONK: The fruiting body of a wood-destroying fungus that projects from the bole, roots, or other tree parts. The size, shape, and color of conks will vary depending on the fungus species.

CORD: A stack of wood equivalent to 128 cubic feet of wood and air space, having standard dimensions of 4 by 4 by 8 feet.

CROOK: An abrupt curvature or bend in a tree bole.

CROPLAND: Land currently used for farm crops that are harvested on a regular basis.

CROWN CLASS: A classification of trees based on dominance in relation to adjacent trees in the stand as indicated by crown development and amount of light received from above and the sides.

CROWN COVER: The ground area covered by a plant crown, as defined by the vertical projection of its outermost perimeter. The field location Crown Cover only includes timber and woodland trees 1.0-inch DBH/DRC and larger.

CROWN RATIO: The portion of tree bole supporting live, healthy foliage, expressed as a percent of total tree height.

CULL: Portions of a tree that are unusable for wood products due to cubic-foot volume loss (e.g., rotten/missing bole sections, dead material bole sections) or severe form-defect volume loss (e.g., severe crook, sweep, forking).

CULL TREE: A live timber species that fails to meet the specifications for a sound tree now or prospectively (see Rotten Tree and Rough Tree).

DBH (DIAMETER ATBREAST HEIGHT): The diameter for timber species, located at 4.5 feet above the ground (breast height) on the uphill side of a tree. The point of diameter measurement may vary on abnormally formed trees.

DEAD VOLUME: That part of a tree's merchantable portion, consisting of sound dead wood (expressed as a percent).

DEVELOPED FOREST LAND: This is forest land that probably will not be managed for wood production because of development for recreational, residential, or other uses, but where human activity on the site does not preclude natural succession of the stand.

DIAMETER CLASS: A grouping of tree diameters (DBH or DRC). For the current inventory, 2-inch diameter classes are used, with the even-inch the appropriate mid-point for a class. For example, the 6-inch class includes trees 5.0- to 6.9-inches DBH inclusive.

DIB: Diameter inside bark.

DOB: Diameter outside bark.

DOWNED TREE: For timber species -- a tree 1.0-inch DBH or larger, broken off below 6.0 feet above ground, or not attached at the base or ground level for support (e.g., an upright tree broken at the base, but leaning against another tree for support). For a woodland species -- a tree 1.0-inch DRC or larger, broken off at ground level.

DRC (DIAMETER AT ROOT COLLAR): The diameter for woodland trees, taken at the root collar or at the point nearest the natural ground line (whichever is higher), that represents the basal area of the tree stem or stems. The place of diameter measurement may vary for woodland trees with stems that are abnormally formed.

EPHEMERAL STREAM: See "Stream, Ephemeral."

ESTABLISHED SEEDLING: A live tree smaller than 1.0-inch DBH/DRC, having a root system in mineral soil, and at least 4.0-inches tall for softwoods (e.g., pines, firs, spruces, pinyon, juniper), or 12.0-inches tall for hardwoods (e.g., aspen, cottonwood, oak, maple, mountain-mahogany). A seedling is not considered established if it will not survive due to form defects, insect infestation, or disease.

FARMER/RANCHER LANDS: Land owned by a person who personally operates, or employs the services of a manager to directly supervise, the work activities on a farm or a ranch.

FIELD LOCATION: A reference to the sample site; an area containing the field location center and all sample points, distributed over an area approximately 2.5 acres in size. A field location consists of four fixed-radius subplots for sampling trees and understory vegetation and 4 microplots for sampling seedlings and saplings.

FIXED-RADIUS PLOT: A circular sample plot of a specified **horizontal** radius: 1/300 acre = 6.8-foot radius
1/24 acre = 24.0-foot radius

FLAT PLAIN: A level or nearly level area of land marked by little or no relief.

FLOOD PLAIN: The nearly level plain that borders a stream and is subject to inundation under flood stage conditions.

FOREST INDUSTRY LAND: Land owned by a company or an individual(s) operating a primary wood-processing plant.

FOREST LAND: This is tree land that (1) has at least 5 percent crown cover (representing 10 percent stocking) or adequate reproduction, or (2) currently nonstocked but formerly having such stocking, with tally tree species (timber and/or woodland), and where human activity on the site does not preclude natural succession of the forest (i.e., the site will be naturally or artificially regenerated). For field use, 5 percent tree crown cover or the presence of sufficient reproduction is used to represent stocking.

The minimum area for classification of forest land is 1 acre in size and 120-feet wide. Unimproved roads, trails, streams, and openings in forest areas are classified as forest land if they are less than 120-feet wide or 1 acre in size.

Note: In some instances, areas previously stocked with woodland species that have had some type of treatment (e.g., chaining or other mechanical treatment) are classified as non-tree land.

FOREST TYPE: A classification of forest land based upon and named for the tree species that forms the majority of live-tree stocking. A Forest type classification for a field location indicates the **predominant** live-tree species cover for the field location; hardwoods and softwoods are first grouped to determine predominant group, and Forest Type is selected from the predominant group. For nonstocked forest land, forest type is based on an estimate of the predominant tree species of the previous stand.

GEOGRAPHIC TREE CENTER: The physical center of a single stemmed tree or the physical center of all the stems of a multistemmed woodland tree (defined as the center of a polygon scribed by connecting the centers of the outermost stems in the tree at the DRC point; stems of any diameter are to be used).

GLACIAL MORAINE: An accumulation of rock material built chiefly by the direct action of glacial ice, glacial drift, or by running water emanating from the glacier. Moraines may be classified as lateral or terminal depending on their relationship to the movement of the ice mass.

Lateral Moraine -- A ridge-like moraine carried on and deposited at the side margin of a valley glacier, composed chiefly of rock fragments derived from valley walls.
Terminal Moraine -- A moraine produced at the front end of an actively flowing glacier. This moraine marks the glacier's farthest advance, and usually has the form of a massive curved ridge or complex of ridges.

GROUND COVER CLASS: The general classification of an area into tree land (forest land or other tree land), non-tree land, or water.

HARD DEAD TREE: A standing dead tally tree, 1.0-inch DBH/DRC or larger, that has a minimum of 1/3 of the original merchantable volume sound (less than 2/3 rotten and/or missing). Formerly called "salvable". Also, a down dead tally tree, 1.0-inch DBH/DRC or larger, with a minimum of 1/3 of the original merchantable volume sound and intact.

HARDWOODS: Trees that are usually broad-leaved and deciduous (leaves that fall off or shed at specific seasons).

HERBACEOUS: Of or relating to a seed-producing annual, biennial, or perennial plant that does not develop persistent woody tissue, and dies down at the end of a growing season.

IMPROVED PASTURE: Land currently improved for grazing use as a result of cultivation, seeding, irrigation, clearing of trees or brush. These areas are generally extensively managed or maintained, unlike natural herbaceous/grass cover. Small areas are often fenced.

IMPROVED ROAD: All roads graded or otherwise regularly maintained for long-term continuing use. These roads are generally paved or gravelled, and may have culverts; however, some temporary logging roads appear as improved roads; reference field maps.

INDIAN TRIBAL TRUST AND/OR ALLOTTED TRUST LANDS: Tribal or individual allotted lands held in trust by the Federal government.

INHIBITING VEGETATION: Includes all vegetation considered to repress the natural establishment of tree seedlings.

INTERMITTENT STREAM: See "Stream, Intermittent."

LAND This includes (1) areas of dry ground and ground temporarily or partly covered by water, such as marshes, swamps, and river flood plains, (2) streams, sloughs, estuaries, and canals less than 30 feet in width, and (3) lakes, reservoirs, and ponds smaller than 1 acre in size.

LAND USE: The classification of a land condition class by use or type.

LIMITING DISTANCE: The maximum horizontal distance a tree can be from the plot center and still be considered for tally. In reference to **fixed-area plots**, limiting distance is determined by the size of the sample; for a 1/24-acre sample, the limiting distance to the geographic center of the tree at the base is 24 feet; for a 1/300-acre sample, the limiting distance is 6.8 feet. In reference to **variable-radius plot** sampling, limiting distance is a function of the selected basal area factor (e.g., 20 or 40) and the diameter of the tree; the distance is measured from the plot center to the center of a single-stemmed tree (to the face of the tree if table is used) at the diameter point or to the geographic center of a multistemmed woodland tree at the average diameter height. A tally tree is one that is at or within its limiting distance from the point stake.

LITTER: The uppermost layer of organic debris on a forest floor; that is, essentially the freshly fallen, or only slightly decomposed material, mainly foliage, but also bark fragments, twigs, flowers, fruits, and so forth**.** For the ground cover transect, litter also includes any dead organic material including carcasses, feces, etc. **Note:** Litter and humus together are often termed **duff**.

LOCATION CENTER (LC): The LC is the intersection of map grid lines as established on the ground; it becomes the center point of the field location, and the center of subplot 1 on the location layout. On previously established locations, the LC is either point 1 of a 5-point "timberland" location layout, or the center of the 1/10-acre or 1/20-acre fixed-radius "woodland" location layout.

LOGGING: The felling and extraction of timber.

MAIN PLOT: For previously sampled "timberland" field location sample points, the main plot is the variable-radius plot. For previously sampled "woodland" field locations, the main plot is the quadrant area sample on a 1/10-acre or 1/20-acre fixed-radius plot. The quadrant area is synonymous with the term "point."

MERCHANTABLE BOLE: On timber species 5.0-inches DBH and larger: the portion of a tree bole between a 1-foot stump and a 4.0-inch top (DOB). For saplings, examine the stem from a 1-foot stump to a 1.0-inch top.

MERCHANTABLE BOLT: On timber species 5.0-inches DBH and larger: a solid 8-foot section of tree bole with a large-end diameter of at least 5.0 inches and a small-end diameter of at least 4.0 inches.

MERCHANTABLE PORTION (woodland species): For woodland trees, the merchantable portion includes all qualifying segments above the place(s) of diameter measurement for any tree with at least one 3.0-inch stem; sections below the place(s) of diameter measurement are not included. Qualifying segments are stems or branches that are a minimum of 1 foot in length and at least 1.5 inches in diameter; portions of stems or branches smaller than 1.5 inches in diameter, such as branch tips, are not included in the merchantable portion of the tree.

MESA: A broad, nearly flat-topped, and usually isolated land formation with steep sides.

MICROPLOT: The 1/300 acre fixed-radius plot (6.8-foot radius), centered on the point, used to sample seedling and sapling trees.

MISCELLANEOUS FEDERAL LANDS: Public lands administered by agencies other than the USDA Forest Service and the USDI National Park Service and Bureau of Land Management (e.g., federal lands administered by the Bureau of Indian Affairs, lands administered by the Bureau of Reclamation).

MORTALITY TREE: A standing or downed tree, 1.0-inch DBH/DRC and larger, that was live within the past 5 years or at the last inventory.

NATIONAL FOREST LANDS: Public lands administered by the Forest Service, U.S. Department of Agriculture, such as National Forests, National Grasslands, and some National Recreation Areas.

NATIONAL PARK LANDS: Public lands administered by the Park Service, U.S. Department of the Interior, such as National Parks, National Monuments, National Historic Sites (such as National Memorials and National Battlefields), and some National Recreation Areas.

NFS: An abbreviation for "National Forest System."

NONCENSUS WATER: Portions of rivers, streams, sloughs, estuaries, and canals that are 30 to 200 feet wide and at least 1 acre in size; and lakes, reservoirs, and ponds 1 to 4.5 acres in size. Portions of rivers and streams not meeting the criteria for census water, but at least 30 feet wide and 1 acre in size, are considered noncensus water. Portions of braided streams not meeting the criteria for census water, but at least 30 feet in width and 1 acre in size and more than 50 percent water at normal high-water level are considered noncensus water. Ephemeral and intermittent streams are classified as land.

NONSAMPLED TREE LAND: This is land that (1) presently meets the requirements for tree land, but human activity on the site will preclude the natural succession of the stand (areas that might be included in this group are golf courses, cemeteries, picnic grounds and home yards with mowed lawns, orchards, Christmas tree plantations), or (2) land with at least 5 percent crown cover in tree species not sampled in this inventory for safety reasons (lily and cactus families) but less than 5 percent cover in tally tree species.

NON-TREE LAND: This is land that (1) has never supported forests (e.g., barren, alpine tundra), or (2) was formerly tree land, but has been converted to a non-tree land status (e.g., cropland, improved pasture).

Other examples of non-tree land are improved roads of any width, graded or otherwise regularly maintained for long-term continuing use, and rights-of-way of all powerlines, pipelines, other transmission lines, and operating railroads. If intermingled in forest areas, unimproved roads and nonforest strips must be at least 120-feet wide and 1 acre in size to qualify as non-tree land.

This category also includes formerly stocked woodland areas if they are currently nonstocked due to a treatment (e.g., chaining, other land clearing). These areas are treated to eliminate woodland trees for the purpose of enhancing or providing for non-wood commodities or uses (e.g., increasing herbage production).

NONSTOCKABLE: Inclusions within forest land not capable of supporting trees because of the presence of rock, water, roads, and so forth.

NONSTOCKED FOREST LAND: Formerly stocked forest land that currently has less than 10 percent stocking (as represented in the field by 5 percent crown cover or adequate reproduction) but has the potential to again become 10 percent stocked. For example, recently harvested, burned, or windthrow-damaged areas.

OTHER TREE LAND: Land that has at least 5 percent cover in trees defined as "other tree species," but does not have at least 5 percent cover in tally tree species. Examples would include land with at least 5 percent cover in tree species such as palo verde, tamerisk, or Russian olive, but less than 5 percent cover in tally tree species.

OTHER TREE SPECIES: All species classified as trees (Little, Elbert L. Jr. 1979. Checklist of United States Trees. U.S. Dep. Agric. Agriculture Handbook No. 541), excluding those species considered for individual tree tally. Other tree species include turbinella oak, Russian olive, acacia, etc.

OUTCROP: Surface exposure of a significant geologic strata.

OWNERSHIP: A classification of land based upon the status of the title holder.

PATHOGEN: An organism capable of causing disease.

PERENNIAL STREAM: See "Stream, Perennial."

POLETIMBER TREES: See "Tree Size Class."

POST (FENCE): Juniper and oak species are evaluated for fence post potential using the following criteria:

Line Post: 7-foot minimum length, 5.0 to 7.0 inches diameter at the butt (large end), 2.5-inches minimum small-end diameter, and reasonably straight and solid.

Corner Post: 8-foot minimum length, 7.0 to 9.0 inches diameter at the butt (large end), 2.5-inches minimum small-end diameter, and reasonably straight and solid.

PRIMARY WOOD-PROCESSING PLANT: An industrial plant that processes roundwood products such as sawlogs, pulpwood bolts, or veneer logs.

REFERENCE POINT (RP): A landmark readily identifiable on both ground and aerial photographs. Examples include the following: a prominent tree or rock; a sharp bend in a road or drainage ditch; a fence corner. The RP for field locations should be either a tree not likely to die, or a landmark not likely to be removed, within the next 10-15 years, and if possible, located at least 100 feet from the location center.

REMEASUREMENT FIELD LOCATION: A field location originally established and measured in a previous inventory.

RESERVED LAND: Land reserved from wood products utilization through statute or administrative designation. Reserved land is withdrawn through administrative designation, based on a written document(s), which carries the weight of legal authority, prohibiting the management of land for the production of wood products (not merely controlling wood harvesting methods). Such authority is usually vested in a public agency, department, etc., and supersedes rights of ownership. The prohibition against management for wood products cannot be changed through decision of the land manager (management agency) or through a change in land management personnel, but is rather permanent in nature. Examples include Wilderness areas and National Parks and Monuments (refer to State Supplement).

ROTATION: The period of years between establishment of a stand of timber and the time when it is considered ready for cutting and regeneration.

ROTATION AGE: The age of a stand when it is considered ready for harvesting. Rotation age is 80 years for aspen and paper birch, and 120 years for all other timber species.

ROTTEN TREE: A live timber species, 5.0-inch DBH and larger, with 2/3 (67 percent) or more of the merchantable volume cull, and more than half of this cull due to rotten and/or missing cubic-foot volume loss.

ROTTEN/MISSING VOLUME: The part of a tree's merchantable portion that is rotten and/or missing (expressed as a percent).

ROUGH TREE: A live timber species, 5.0-inch DBH and larger, with 2/3 (67 percent) or more of the merchantable volume cull, and more than half of this cull due to sound dead wood cubic-foot volume loss or severe form-defect volume loss (e.g., severe sweep and crook, forks, extreme form reduction). Also, a live timber species sapling (1.0- to 4.9-inches DBH) that is not expected to become a sound tree with good form and vigor due to defect, or a timber species (5.0-inches DBH and larger) that does not now, nor prospectively, have at least one solid 8-foot section, reasonably free of form defect, on the merchantable bole.

SAPLING: See "Tree Size Class."

SAWTIMBER TREES: See "Tree Size Class."

SEEDLING: See "Tree Size Class" and "Established Seedling."

SITE TREE: A tree used to provide an index of site quality.

SIZE CLASS: See "Tree Size Class."

SLASH: Unmerchantable tree residue on the ground from logging activities or from natural breakup of trees caused by insects, disease, weather, etc. Slash includes logs, stems, heavier branch wood, stumps, etc.

SOD: A continuous cover of grass and/or herbaceous plants.

SOFT DEAD TREE: A standing dead tally tree, 1.0-inch DBH/DRC or larger, that has less than 1/3 of the original merchantable volume sound (more than 2/3 rotten/missing). Also, a down dead tree, 1.0-inch DBH/DRC or larger, with less than 1/3 of the original merchantable bole sound and intact. Formerly called "nonsalvable".

SOFTWOODS: Coniferous trees that are usually evergreen (retain leaves year-round), and having needle- or scale-like leaves.

SOUND TREE: Formerly called "growing-stock tree." A live timber species, 5.0-inches DBH or larger, that has less than 2/3 (67 percent) of the merchantable volume cull, and contains at least one solid 8-foot section, reasonably free of form defect, on the merchantable bole. Also, a live timber-species sapling (1.0- to 4.9-inches DBH) that is expected to become a sound live tree with good form and vigor, 5.0-inches DBH or larger.

STATE, COUNTY AND MUNICIPAL LANDS: Lands administered by States, counties, and local public agencies or municipalities, or lands leased to these governmental units for 50 years or more.

STOCKING: An expression of the extent to which growing space is effectively utilized by trees.

STOCKING CONDITION CLASS: The general classification of the potential of the subplot or condition to be fully stocked with trees given current tree, understory, or ground cover situations.

STREAM: A body of running water. **Note:** For purposes of this inventory, ephemeral and intermittent streams are classified as land.

Ephemeral: A stream that flows only in direct response to precipitation or surface run-off.

Intermittent: A stream that flows for protracted periods only when it receives ground water discharge or long-continued contributions from melting snow or other surface and shallow subsurface sources.

Perennial: A stream that flows year-round.

STREAM BOTTOM: A gently sloping stream pathway subject to frequent flooding.

STREAM TERRACE: A nearly level strip of land with a more or less abrupt descent along the margin of a river or stream, but not subject to frequent flooding.

STUMP HEIGHT: For purposes of this inventory, stump height for timber species is the height on a tree from ground level to the top of a 1.0-foot stump.

SUBPLOT: The 1/24-acre fixed-radius area (24-foot horizontal radius) used to sample trees 5.0-inches DBH/DRC and larger and understory vegetation.

SUPPRESSION: The process whereby certain trees, shrubs, etc., in a community become weakened and/or stunted, essentially due to competition by surrounding trees, shrubs, etc., in the immediate environment (natural suppression). Suppression may also be the result of human intervention (e.g., selective lopping, girdling, cutting back) or selective browsing by animals (artificial suppression).

SWEEP: A curve in a tree bole, not an abrupt bend (crook).

TALLY TREE: Tree species listed in this manual (chapter 10) as timber or woodland trees measured for volume, growth, and mortality. In some circumstances these species may be sampled on the understory vegetation description form.

TALUS: The accumulated mass of loose, broken rock fragment derived from and lying at the base of a cliff or steep rock slope.

TIMBERLAND: In previous inventories, this was forest land (including areas with mixtures of timber species and woodland trees) where timber species have 5 percent or more crown cover, or forest land with sufficient timber species reproduction (minimum of 40 saplings and/or established seedlings per acre). The timberland designation required the establishment of a 5-point variable-radius tree sample.

TIMBER SPECIES: Tally tree species measured at breast height; these include all species of conifers, except pinyon, juniper, or yew. In addition, hardwoods included in this category are aspen, paper birch, and cottonwood (Populus spp.). Western juniper is measured as a timber species, though measured for age and radial growth using woodland species rules.

TIMBER STAND IMPROVEMENT: A term comprising all intermediate cuttings or treatments made to improve the composition, health, and growth of the remaining trees (TSI) in the stand. Trees removed are often smaller than sawtimber size.

TRAIL: A pathway consistently used by wildlife, domestic animals, or humans.

improved trail: used for human recreation/travel, maintained through tree removal and brush clearing, often with posted signs at a trailhead or fork, and documented on forest/recreation maps.

unimproved trail: used for human recreation/travel, sometimes documented on a forest/recreation map, but rarely cleared or posted.

wildlife/animal trail: not cleared, maintained, posted, or documented for human use.

TREE CLASS: A classification system based on a tree's physical characteristics, and used to classify all live timber species as sound, rough, or rotten trees, and dead timber species as either hard or soft.

TREE LAND: Land at least 1 acre in size and 120-feet wide with at least 5 percent cover in species classified as trees (Little, Elbert L. Jr. 1979. Checklist of United States Trees. U.S. Dep. Agric. Agriculture Handbook No. 541). However, several listed species will not be measured in this inventory: those defined in the text (Little, 1979) as primarily shrubs (e.g., Artemesia), and those which are considered hazardous to sample (the lily and cactus families).

TREE-SIZE CLASS: Classification of trees based on DBH for timber species and DRC for woodland trees.

Seedling: A tree smaller than 1.0-inch DBH for timber species or 1.0-inch DRC for woodland trees (**note:** to be counted, a seedling must be established and expected to survive -- see definition for established seedling).

Sapling: A timber species 1.0- to 4.9-inches DBH and a woodland tree with at least 1 stem 1.0 inch and larger and a cumulative DRC 1.0- to 4.9-inches.

Small Diameter: A woodland tree 5.0- to 8.9-inches DRC (single stem measurement or computed multistem measurement).

Large Diameter: A woodland tree 9.0-inches DRC and larger (single stem measurement or computed multistem measurement).

Poletimber tree: A timber species at least 5.0-inches DBH, but smaller than 9.0-inches DBH for a softwood and smaller than 11.0-inches DBH for a hardwood.

Sawtimber tree: A timber species that is at least 9.0-inches DBH for a softwood and at least 11.0-inches DBH for a hardwood.

UNDEVELOPED FOREST LAND: Forest land that does not have buildings, dwellings, or other developments.

UNIMPROVED ROAD: A road not regularly maintained for long-term continuing use, such as a jeep trail, old logging road, etc. These may or may not be posted with road signs.

URBAN AREAS: Nonsampled tree land or non-tree land within the legal boundaries of cities and towns (e.g., school yards, cemeteries, airports, golf courses).

VARIABLE-RADIUS PLOT: A plot, used in previous inventories, where a predetermined critical angle is projected from a central point and swept in a full circle to determine the basal area (tree count) and volume per unit of area. The radius of this plot is a function of an individual tree's size and distance from the point center.

WATER: In terms of a Ground Cover Classification, water is defined as streams, sloughs, estuaries, and canals more than 30 feet in width; and lakes, reservoirs, and ponds more than 1 acre in size.

For use in determining the "water proximity" or "water type" nearest the field location center, water implies any reliable source of water for wildlife, livestock, recreators, etc.

WILDERNESS: An area of undeveloped land currently included in the Wilderness System, managed so as to preserve its current conditions and retain its natural character and influence.

WOODLAND: In previous inventories, this was forest land with 10 percent or more crown cover in (1) woodland trees, or (2) timber species and woodland trees, but less than 5 percent crown cover in timber species; or forest land with sufficient woodland species reproduction (minimum of 40 saplings and/or established seedlings per acre).

WOODLAND SPECIES: Tally tree species measured at ground level (DRC); these include pinyon, juniper (except Western juniper), oak, mesquite, locust, yew, mountain-mahogany (Cercocarpus spp.), Rocky Mountain maple, bigtooth maple, and desert iron wood.