LAND USE PLANNING NOTES

Number 3 April 1998
Updated for Clarity April 2010

"STEWARDSHIP IN FORESTRY"

PURPOSE: These technical notes have been developed by the Oregon Department of Forestry (ODF) to help landowners and local governments when they must use an alternative to the USDA Natural Resource Conservation Service (NRCS) Soil Survey or other established data sources to determine the productivity of forestland. Under Oregon Administrative Rules (OAR) 660-006-0005, where sources of data referenced in the rule are not available or are shown to be inaccurate, an alternative method for determining productivity that provides equivalent data may be used. These notes describe the methodologies that the Department of Forestry approves, provides information necessary to use the methodologies and gives direction to counties in evaluating forest productivity reports. Background information is also included to answer commonly-asked questions about forest productivity rating systems. These technical notes and the related tables can be found on the Oregon Department of Forestry's website at:
http://egov.oregon.gov/ODF/STATE_FORESTS/FRP/RP_Home.shtml#Land_Use_Planning.

Please note the Department of Forestry does not measure forest site productivity for landowners. The Department's involvement is focused on establishing a list of approved data sources and methodologies other than those cited in the administrative rule. The Department of Forestry will not issue findings on whether these data sources or alternate methodologies have been employed correctly or if the resulting forest site productivity determinations are accurate. The Department of Forestry is not responsible for verifying field measurements.

Included on page 9 of this guide is a flowchart, which provides a visual aid for counties to step through the process of determining site productivity. Each box in the flowchart is labeled with a number that corresponds to the step and section providing guidance on that topic in these Land Use Planning Notes.

OAR 660-006-0005 (3) Site Productivity Sources are adequate to determine cubic foot/acre/year productivity. 1

Step 1: Using Established Data Sources

Forest landowners who would like to demonstrate its forestland productivity or who question the productivity of their property - whether they wish to have it rezoned for development, want approval for template dwellings, or for another reason - must use established data sources to provide information on soils

The Department of Forestry has concluded that to avoid potential confusion and inconsistent productivity determinations it is important for the department to establish a hierarchy of preferences for the site productivity data listed in OAR 660-006-0005 (2) and (3). In order of preference, the department's hierarchy is as follows:

A. Natural Resource Conservation Service soil surveys[1]
B. Oregon Department of Revenue Western Oregon site class maps
C. USDA Forest Service plant association guides
D. Other existing data sources determined by the State Forester to be of equal or better quality to Items A, B, and C
E. Alternate methods to develop site productivity data based on direct tree measurements and calculations using applicable Douglas-fir, western hemlock, or ponderosa pine site tables, with priority given to the species among these three that dominates the area being evaluated
F. Alternate methods based on direct tree measurements and calculations using other native forest tree species site tables
G. Site-specific soil surveys.

When NRCS soil survey information is available, it should always be considered first when making forest land site productivity determinations. Where the county determines that NRCS or other established data sources approved by the State Forester are available and accurate for determining site productivity at the scale of the tract of interest, the county planning department must make its decision using these data.

If data from an approved established data source (A, B, or C above) do not exist or is shown through site-specific documentation to be inaccurate for determining site productivity at the scale of the tract of interest, only then should other information determined to be of comparable quality by the State Forester (D above) be consulted. These will normally include published data on forest soils or tree measurements. To date, other published forest soils information that has been determined to be of comparative quality includes, but is not limited to, the following:

- August 1997 *Lane County Soil Ratings for Forestry and Agriculture* produced by the Lane County Council of Governments.
- February 8, 1990, *Forest Lands Soils Ratings* – Revisions produced by the Oregon Department of Forestry for the Oregon Department of Land Conservation and Development (applicable to Benton, Lane, Linn, Marion, Polk, and Yamhill Counties except in Lane County where superseded by the August 1997 *Lane County Soils Ratings for Forestry and Agriculture*).
- January , 27, 1989 forest soils rating submitted to the Oregon Department of Land Conservation and Development by the Oregon Department of Forestry (applicable to Benton, Clackamas, Clatsop, Columbia, Hood River, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill Counties except where superseded by the February 8, 1990 *Forest Lands*

[1] Web Soil Survey: Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/ -- last accessed April 29, 2010. Also see Published Soil Surveys for Oregon available online at: http://soils.usda.gov/survey/printed_surveys/state.asp?state=Oregon&abbr=OR -- last accessed April 30, 2010.

Soils Ratings and in Lane County where superseded by the August 1997 *Lane County Soils Ratings for Forestry and Agriculture*)

These documents can be found on the Oregon Department of Forestry's website at: http://egov.oregon.gov/ODF/STATE_FORESTS/FRP/RP_Home.shtml#Land_Use_Planning and may be updated over time as new information becomes available.

Additional information may be assessed and approved by the State Forester on a case by case basis for comparability of quality.

Applicant may use approved ODF methodology for determining Site Index. 2

Step 2: Alternate Methodologies

Where the published site productivity data described above in Step 1 are not available, or when the county determines that it is inaccurate for determining site productivity at the scale of the tract of interest, the alternate methods for determining site productivity described below may be used. [Note: Existence of data listed in Step 1 does not prohibit a landowner from retaining a professional forester or professional soils classifier to measure the productivity of the land if they believe the published data are inaccurate. In such cases, the county must determine which data source it will use in making its decision.]

Alternate methodologies used to measure site productivity must be consistent with the provisions of this Land Use Planning Note and must be considered in the following order:

a. Alternate methods based on direct tree measurements and calculations using applicable Douglas-fir, western hemlock, or ponderosa pine site tables. The tables may also be used for grand fir, Sitka spruce, and Jeffrey pine, as indicated in Step #4 and Attachment A.
b. If none of these six species are present, the next step is to consider using site tables for other tree species.
c. If no adequate trees are present to measure for site productivity, the last available method is to conduct site-specific soil surveys without direct tree measurements.

Where tree measurements are undertaken, a professional forester who is either registered as a full member in good standing with the Association of Consulting Foresters of America or Certified by the Society of American Foresters should be retained by the landowner to take tree measurements and prepare a report.

Consistent and credible site productivity determinations are an important facet of the land use planning process. Attempts to consider a variety of methods simultaneously in hope of arriving at a "preferred" site productivity determination are to be avoided.

The Department of Forestry does not measure sites for landowners. The alternate methodology the Department of Forestry approves to determine the productivity of an area is described in a Weyerhaeuser research paper, by King[2]. Additional information may be found in the *Field instructions for forest surveys in Washington, Oregon, and Northern California. USDA Forest Service, PNW Range and Experiment Station*. These papers describe how to select site-trees and calculate site index.

Sufficient # of trees on-site to determine Site Index? 3

Step #3: Sufficient Number of Trees On-Site?

Site index is based on measurements of breast-height tree age and total height. A sufficient number of measured trees generally consists of 25 dominant and co-dominant trees all of the same species, if possible. This number is adequate to determine forestland productivity as calculated by site index if soil type, species, and aspect of the ground are consistent throughout the sample area. Additional trees will be needed to represent different soil types, species, and aspect if these exist on the tract in question.

Trees of different species may be selected as long as they use the same site index table (See Step #4). Site index should not vary by more than 20 or 30 points between site trees (as indicated on each site table), unless the difference can be explained by actual site variation.

If the tract has been harvested in the recent past, most or all of the dominant trees in the stand may have been removed. Residual suppressed trees are not acceptable trees for site index measurement. If insufficient dominant trees exist on the tract to determine site index, site trees should be selected for evaluation from adjacent or nearby un-harvested properties with the same aspect, elevation and soil type. In some cases, historical records of past harvests, timber yields, and aerial photos may contribute valuable background information for productivity assessments.

A professional forester (as described in Step #2) should determine whether or not adequate numbers of dominant and co-dominant trees exist on site or in the vicinity to perform the analysis. If the forester issues a written statement that inadequate numbers of qualifying trees exist, the applicant may proceed to Step #6 – a soils analysis.

Method for Selecting Site Trees

1. On the property locate an approximately circular area that encompasses 25 trees (the "site index clump") and that is representative of the site being sampled. Where there is a choice, favor well-stocked areas over sparse areas. Of these

[2]King, James E. 1966. Site index curves for Douglas-fir in the Pacific Northwest. Weyerhaeuser Forestry Paper No. 8. Weyerhaeuser Forestry Research Center, Centralia, WA.

25 trees, select five that are dominant; co-dominants may be included if five dominants are not available.

2. If a 25-tree clump is not available, a smaller clump may be used. The site tree sub-sample should still be limited to the 20 percent of the trees in the clump that are dominate or co-dominate **unless** this yields fewer than three site trees. Example: For a 15-tree clump, three site trees would be needed - the minimum sample size allowed.

3. If no suitable site trees are available from the property, select dominant trees from the most similar nearby area with the same general aspect, elevation, and soil type. Note the location of the site trees in your report.

4. Site trees should be evenly distributed across the plot area.

5. Any site tree with a clear history of suppression should be rejected, and the next largest tree selected if it is suitable. However, a suppressed tree may be selected over a shorter, suppression-free tree of the same age.

6. Site trees selected should show no signs of top-out, such as crooks or forks, **unless** these trees are taller than normally-formed trees of the same Diameter at Breast Height.

7. Trees should be measured at Breast Height for age.

8. Trees under 50 years old are undesirable if older trees are available. For ponderosa pine, trees 60 to 120 years old are most desirable.

Definitions:

Age – The age of the tree at Breast Height determined by boring a tree revealing a core piece with notable rings that are counted. Each ring represents a year of age.

Breast Height – A height 4.5 feet from the ground on the uphill side of the tree.

Co-dominant -- Trees with crowns forming the general level of crown cover of the stand.

DBH – The diameter at breast height or 4.5 feet from the ground on the uphill side of the tree.

Dominant – Trees with crowns extending above the general level of the stand. These are the larger than average trees on the property.

Increment Core – This is a core piece of the tree that is removed where rings can be counted to determine age.

Suppressed -- A tree that has been suppressed will have closely-spaced annual growth rings on all or part of its increment core.

Use approved Site Index Tables for DF, WH, & PP. 4

Step #4: Approved Site Index Tables

There are three approved site index tables for Douglas-fir, western hemlock, and ponderosa pine. (Tables A, B, and C in Attachment A). These tables may also be used for grand fir, Sitka spruce, and Jeffrey pine, respectively.

How to use site tables:
The attached site index tables are "upper limit tables." This means that when a tree height indicates a site index that falls between two site indices, the higher one should be used. Example: A site tree is Douglas-fir, breast height age is 75 years old and total height is 115 feet tall. King's 50-year Douglas-fir site index table indicates that a tree with a total height of 115 feet and breast height age of 75 falls between site index 90 and 95; site index is therefore 95.

A, *King's 50-year Douglas-fir table*[3]. Use for Douglas-fir and grand fir.

B. *Barnes' 100-year western hemlock table*[4]. Use for western hemlock and Sitka spruce.

C. *Meyer's 100-year ponderosa pine table*[5]. Use for ponderosa pine and Jeffrey pine. Use this table for stands that are predominantly ponderosa pine, or when pine site trees are all that are available, except in the Willamette Valley[6]. A credible site index or yield table for ponderosa pine applicable in the Willamette Valley has not been found to exist at this point in time. Until a credible Willamette Valley ponderosa pine site table becomes available and is acknowledged in a revised Department of Forestry Land Use Planning Note, the Department of Forestry's position is that it is inappropriate to use ponderosa pine to determine site productivity under OAR 660-006-0005(2) and (3). Thus, the applicant's remaining option for pine stands in the Willamette Valley would be to conduct a soils analysis following OAR 603-080-0040 (3).

The average height and the average age of the site trees can be used with the tables in Attachment A to determine site index. Tracts [as defined in OAR 660-006-0005 (3)] large enough to contain changes in productivity (e.g., multiple soil types or changes in

[3] King, James E. 1966. Site index curves for Douglas-fir in the Pacific Northwest. For. Pap. 8. Centralia, WA: Weyerhaeuser Company, Forestry Research Center. 49 p.

[4] Barnes, George H. 1962. Yield of even-aged stands of western hemlock. USDA, Forest Service. Pacific Northwest Forest and Range Experiment Station Technical Bulletin 1273.

[5] Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (revised 1961).

[6] Willamette Valley is defined as: Clackamas, Linn, Marion, Multnomah, Polk, Washington and Yamhill Counties and that portion of Benton and Lane Counties lying east of the summit of the Coast Range.

aspect) will require mapping the different areas of productivity, making separate calculations for the productivity of each area, and weighted averaging of the productivity across the tract.

Nonstockable Areas:

Nonstockable areas can be caused by the presence of standing or running water, a high water table, saturated soils, rock or shallow soil over rock, severe soil compaction, or mass soil movement. Nonstockable areas should be mapped and deducted from the total productivity of the tract on a percentage of area basis. Appropriate and adequate site-specific documentation is needed to justify these deductions, which in some cases may require the expertise of a professional forester or a professional soils classifier.

Determining Cubic Foot Productivity:

The tables in Attachment B are derived from a US Department of Agriculture[7] publication. They use species-specific site index information as determined from on-site measurements and the site index tables to reference a set of cubic foot productivity tables. To use a species table, find the calculated site index of the property in the left-hand column and obtain the cubic foot per acre per year from the column on the right with the corresponding reference to the site table used.

Documentation:
The consultant should document site index table(s) used, tree selection, and productivity assessment. Site index values are to be correlated with cubic foot per acre per year productivity ratings. A sample data form for forestland site productivity determination using site index is provided at the end of this Technical Note.

ODF may approve other methods or Site Index Tables for other species. 5

Step #5: Other Methods for Other Species

The Department of Forestry may approve other tree measurement methods or site index tables to determine productivity for other tree species. The methods listed in this paper can be used in combination with other published site index and yield tables if the site is not suited to one of the species listed in this paper. However, the use of other tables or the use of other species to determine site index must be approved in writing by the Department of Forestry on a case-by-case basis.

To request approval of other methods not listed in Step #4, contact the Forest Policy Analyst in the Forest Resources Planning Program for the Department of Forestry at 503-945-7411. The Department of Forestry will notify the county in writing of its

[7]USDA. 1986. Culmination of mean annual increment for commercial forest trees of Oregon. Technical Note No. 2. USDA, Soil Conservation Service, Portland, OR. (Note: the SCS - Soil Conservation Service is now the NRCS - Natural Resource Conservation Service)

recommendation that the method be used or not used. If the method is approved for use, a professional forester (as described in Step #2) should document the method used, tree selection and productivity assessment. If the method is not approved for use, or an acceptable alternative proposed, a soils analysis as described in Step #6 below is the remaining option.

Soil Survey is last option; follow OAR 603-080-0040 (3). 6

Step #6: Last Option: Soil Analysis

Where there are an insufficient number of trees on-site or nearby to conduct tree measurements, or where an alternate method for an unlisted tree species has not been approved, a site-specific soil analysis is the last option for determining site productivity. In this case, a professional soils classifier certified by the Soil Science Society of America should be used and the soils reporting provisions of OAR 603-080-0040 must be followed.[8] The Department of Forestry does not have the expertise to evaluate site-specific soil survey information.

County makes decision based on documentation provided and follows all other regulations. 7

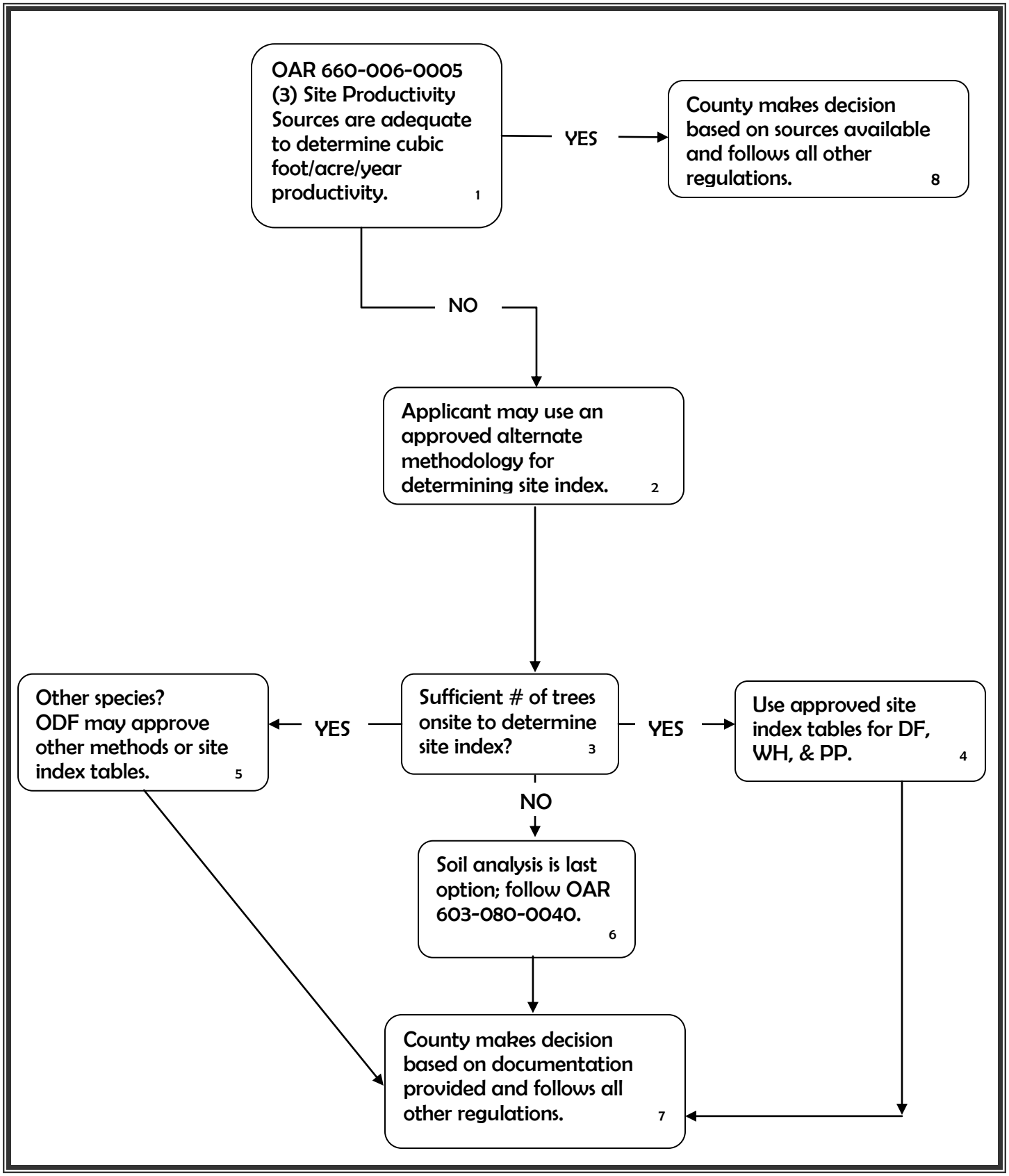
Step #7: County Review of Professional Reports

Professional assessments of forestland productivity must be submitted to the county planning department in report form for its review. Soils reports shall meet the standards for submittal that are set forth in OAR 603 Division 80. The burden of proof is on the applicant and the consultant to demonstrate that information in the submitted report is more accurate than that available in established data sources. The county staff may request the assistance of the State Forester in evaluating whether approved methodologies were used in a consulting forester's report.

The following flowchart will enable planners to determine whether the appropriate forestland productivity data has been gathered.

[8] If a determination is also being regarding whether the tract in question qualifies as agricultural land, the provisions of 2010 House Bill 3647 apply.

A Flow Chart for Determining Forestland Site Productivity



APPENDIX

Background and Additional Information:

Table 1. CUBIC FOOT PRODUCTIVITY CLASSES

CLASS	POTENTIAL YIELD-MEAN ANNUAL INCREMENT
1	225 or more cu.ft./ac./yr.
2	165 to 224 cu.ft./ac./yr.
3	120 to 164 cu.ft./ac./yr.
4	85 to 119 cu.ft./ac./yr.
5	50 to 84 cu.ft./ac./yr.
6	20 to 49 cu.ft./ac./yr.

The Department of Forestry advises using the USDA Cubic Foot Productivity Class[9] system, as opposed to other systems of measure, when making land use planning decisions because it measures the relative productivity of the soil, is not dependent upon the condition of the forest or the species of trees currently growing on the site, and is more consistent than other measures. The cubic foot productivity class system reveals the average growth rate of timber over the life of the stand measured at the peak of that average growth rate. Table 1 above shows the potential timber yields of productivity classes 1 - 6 in cubic feet per acre per year (cu.ft./ac./yr.).

Other measures that might be used to compare productivity, such as site class or site index, are not consistent between species. Site class is commonly used on the west side to describe the productivity of Douglas-fir forests, but not other species. Site index measures productivity as a function of age and is calculated as tree height divided by tree age at a base age of 100 or 50. Since on the same area, in the same length of time, different species grow to different heights, site index is not consistent between species. For example, two species with the same site index will yield different cubic foot ratings, as seen in Table 2 below.

Table 2. RATING SYSTEM COMPARISONS[10]
All Species

Site Index Table	Site indices	Cubic foot comparisons
Douglas-fir (50 yr King Site Index)	100	136
Douglas-fir (100 yr McArdle Site Index)	100	84
Western Hemlock (100 yr Barnes Site Index)	100	142
Ponderosa Pine (100 yr Meyer Site Index)	100	102
White Fir (100 yr Schumacher Site Index)	100	218
Engelmann Spruce (100 yr Alexander Site Index)	100	109

[9] Field instructions for forest surveys in Washington, Oregon, and Northern California. USDA Forest Service, PNW Range and Experiment Station.
[10] Based on: USDA Soil Conservation Service. 1986. Culmination of Mean Annual Increment for Commercial Forest Trees of Oregon. Technical Note No.2 Forestry Revised June 1986. Portland Oregon.

Another advantage of using cubic foot productivity class is that the ratings are available for most forestland without professional assistance. The published soil surveys contain ratings that can be used by county planners or private landowners to evaluate productivity and using the information does not require visiting the site or taking measurements.

Cubic foot site productivity determinations assume fully stocked stands. In this context, "stockable area" means the proportion of an area that can be physically stocked with trees. Rock outcrops, impervious soils, or high water tables are examples of factors that may result in less than 100 percent of the site being stockable.[11] Upon request by a county government, the Department of Forestry will evaluate factors used in calculating reductions in site productivity from fully stocked stand levels.

[11] For more information, consult the USDA Forest Service, Pacific Northwest Research Station *Field instructions for forest surveys in Washington, Oregon, and Northern California* where consideration of stockable area factors are addressed.

Sample Data Form for Forestland Site Productivity Determination using Site Index

Date Prepared:_____ County:_____

Landowner Name: _____

Land use case file number (if available):_____

Location
Township:_____ Range:_____ Section(s):_____ Lot Number:_____

Name of Forester preparing report:_____

Forester's background (work experience, education, training, certifications, etc.):

_____
_____
_____
_____

Methods and equipment used in data collection:

_____
_____
_____
_____

Soil Type(s) and percentages on tract in question:_____

Tree species on tract in question:_____

Number of Dominate or Co-Dominate Trees/Species Sampled: (ex. 5 Douglas-fir, 10 Western Hemlock)

_____
_____

Average Height:_____ Average Age:_____

Average Site Index:_____ Site Productivity cubic feet/ac./yr:_____
(Use appropriate approved Site Index table in Attachment A) (Use Attachment B)

Notes/Comments:_____
_____
_____
_____

- Attach map of property with marked locations of where the trees sampled are located. Map needs to be at appropriate scale for ease of viewing property and understanding where the trees are located.
- Attach site index tables used.
- Attach other documentation and evidence needed to justify methods and conclusions.

Data Collection Form: * Make copies if more than 30 trees sampled.

Tree ID	Tree Species	Height (ft.)	Age (yrs.)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

Sum: _____

Average: _____