



Longleaf Leaflet

LL-#3

April 2011

North Carolina Forest Service

LONGLEAF PINE SITE SUITABILITY

Longleaf pine grows on many different sites and soils within North Carolina's coastal and piedmont regions. Seven distinct longleaf pine plant communities occur in the state: xeric sandhills scrubs, pine/scrub oak sandhill, mesic pine flatwoods, wet pine flatwoods, coastal fringe sandhills, pine savannahs and piedmont longleaf forests. These plant communities range in soil type and wetness class and have been maintained throughout history with frequent, low-intensity fire.

Longleaf Evolved with Fire

Fire plays an important role in shaping longleaf pine forests. Historically and ecologically, it is likely the single most significant influence on longleaf's ability to grow on any particular site. Without fire, over time longleaf will give way to more competitive hardwoods or pines. Longleaf pine has developed unique characteristics that provide a competitive advantage over other less fire resistant species. Longleaf pine is resistant to low intensity fires due to the long needles that protect the terminal bud during the "grass stage". After the grass stage, which usually last 2-to-5 years, the longleaf pine grows in height for another 3-to-5 years. During this early growth phase, the tree is more susceptible to damage and mortality from fire. As the tree grows tall and its bark thickens, longleaf pine once again becomes very tolerant of wood fire. Fire remains just as important as a management tool today as it was in the past to control woody competition, expose mineral soil for seed germination and maintain fire dependant understory plants.

Longleaf Grows on Many Soils and Sites

Longleaf pine is native to a wide variety of sites ranging from wet, poorly drained flatwoods to dry, rocky mountain ridges. Elevation ranges from barely above sea level in the lower Coastal Plain to 1800 feet above sea level in the mountains of Alabama. In North Carolina, most longleaf pine forests are found below 300 feet in elevation. Here the soils are largely derived from marine sediments and range from deep, coarse, excessively drained sands to poorly drained clays. The broad soil orders associated with longleaf pines include Entisols, (deep sandy soil found on dry Sandhills), Ultisols (a red-yellow soil, the most common in NC) and Spodosols (wet sandy coastal plain soils with a shallow water table at or near the surface in the winter). Clay layers found beneath the surface collect and hold rainwater that help longleaf survive on dry, excessively drained sandy soils.

A soil series is a group of soils with similar profiles but differ in the texture of the surface layer

Longleaf pine is found most often in soils that are sandy on the surface, low in organic matter, light colored and are medium to strongly acid. Drainage is often good to excessive. In the Sandhills, the surface sands are yellow-gray, low in organic matter and fertility, strongly acid and underlain by loose yellow sands to a depth of 3-to-80 feet. Drainage is good to excessive. Along the coast, longleaf

grows in the wet flatlands. Soils along the coast that have gray, mottled subsoil, indicating poor drainage and soil aeration, are unsuitable for longleaf. Longleaf soils can be seasonally wet but not saturated for a long time. Longleaf does not tolerate frequent flooding.

Soil Properties and Suitability

There are key soil properties that influence the establishment and growth of longleaf pine. These properties are summarized for each soil type in various tables in county Soil Surveys published by the USDA Natural Resources Conservation Service. They include infiltration, shrink-swell potential, bulk density, site index and ordination symbol.

Common Longleaf Pine Soils with Site Quality Index*

Altavista - 85
Baymeade - 65
Blanton - 70
Bonneau - 75
Chipley - 80
Conetoe - 65
Craven - 67
Dunbar - 70
Exum - 77
Foreston - 75
Fripp - 60
Goldsboro - 77
Kenansville - 65
Kureb - 55
Lakeland - 70
Lenoir - 70
Leon - 70
Lynchburg - 74
Marlboro - 62
Norfolk - 68
Onslow - 67
Osier - 68
Pactolus - 70
Rimini - 55
Wagram - 67

**Site Index is a measure of site/soil quality that represents the predicted tree height at age 50*

Infiltration is a measure of runoff from precipitation when the soil is thoroughly wet. Hydrologic soil groups with high infiltration rates will transmit water and have low runoff. Hydrologic soil groups A and B have high and moderate infiltration rates. Group A soils are deep, well drained sands while Group B soils are deep, moderately to well drained soils that have a moderately fine to moderately coarse texture. These two groups are well suited for longleaf pine. Group C soil have slow infiltration rates when wet. These soils have a layer that impedes water or have a fine texture and therefore are marginal for longleaf. Group D soils are very slow infiltration. They consist of clay soils with a high shrink-swell, permanent high water table, clay layer or shallow soils over an impervious material making them not suited for longleaf pine. Some types of clay soils shrink when dry and swell when wet. Soils that contain this clay type are too dense, hard, wet and airtight for longleaf root growth. Low to moderate **shrink-swell potential** is suitable for longleaf pine. Unless other limitations are present, the clay soils common to the piedmont are suitable for longleaf pine.

Bulk density provides another measure of soil suitability. For clay and silt soils, problems with root growth and water storage occur when bulk density is greater than 1.6. Sandy soils have a higher bulk density due to the large particle size, but restricted root growth is less of a concern because of the greater soil aeration. Compacted soils have higher bulk density; the higher the bulk density, the harder a soil and the more difficult it is for roots to grow. For all soils, tree root growth is severely impacted when bulk density exceeds 1.8. Clay or silt soils with a high bulk density are not recommended for longleaf pine.

Site index is the average total height, in feet, of the dominant and co-dominant trees in a well-stocked, even-aged stand of 50 years of age. It is a means of expressing the potential productivity of a soil for a given kind of tree. An average site index for longleaf pine is between 60 and 70. This index represents more suitable longleaf sites with less risk of establishment failure. Site indices greater than 70 have more risk of establishment failure and increases cost to maintain a pure stand. This range does have benefits for diverse understory vegetation.

In older soil surveys, tables may show an **ordination symbol** to indicate the potential productivity and soil limitation for woodland soils. The number indicates potential annual productivity in cubic meters per hectare; the larger the number, the higher the site quality for tree growth. The letter part of the ordination symbol identifies other limiting factors affecting use and management of woodlands.

Soil Property	County Soil Survey Table or Chapter	Suitability for Longleaf Pine		
		Good	Marginal	Low
Infiltration	Table 15. Soil and Water Features	A, B	C	D
Flooding	Table 15. Soil and Water Features	None	Rare	Frequent
Shrink-Swell Potential	Table 14. Physical and Chemical Properties	Low	Moderate	High
Bulk Density	Table 14. Physical and Chemical Properties	<1.5	1.5 - 1.8	>1.8
Site Index	Woodland Suitability Groups	60-70	>70	<60
Ordination Symbol	Table 6. Woodland Management and Productivity	A, S	W,D,C *	
*identifies a site characteristic that limits Longleaf growth or establishment				

Longleaf forest soils typically have a pH of 5.0- 5.5, a range allowing for best vigor and growth. Problems with nutrient uptake and tree health occur when pH exceeds 6.5, often found in former agricultural fields. Fields with pH more than 6.5 have greater establishment risks, and fields with pH exceeding 7.0 should be avoided.

Soils Where Longleaf Pine is Difficult to Establish or Does NOT Grow Well

- Soils with high shrink-swell potential
- Shallow soils
- Soils with poor soil water infiltration
- Soils with a bulk density greater than 1.6 g/cm³
- Soils with a pH greater than 7.0
- Soils with excessive nutrients
- Wet soils saturated for most of the year or with a high water table during the growing season
- Frequently flooded bottomland soils
- White “sugar “ sand soils which are excessively drained, infertile and low on organic matter
- Areas with too much vegetative competition

An accurate site assessment and careful planning are critical to successful establishment of longleaf pine. An on-site visit with a professional forester is a good first step. A soil sample and soil characteristics found in your county soil survey provide helpful information to evaluate your property. For more assistance in determining if longleaf pine is suitable to grow on your forestland, speak with a registered forester or contact your county forest ranger office. More information is also available on the website: <http://ncforestservation.gov>.




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