Ecological Site Description

Till Protected Backslope Forest F109XY009MO

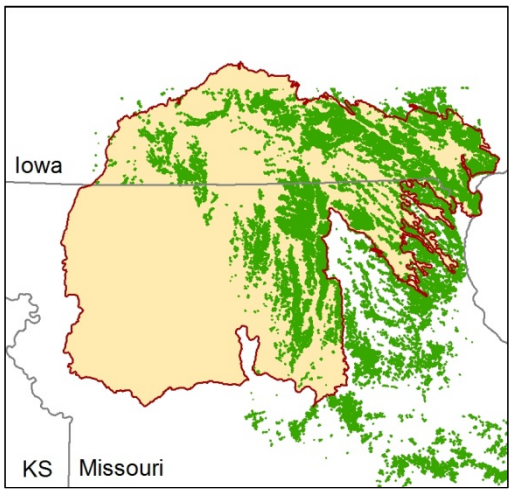
- *(Quercus alba - Quercus rubra/Ostrya virginiana – Aesculus glabra/Erigenia bulbosa - Podophyllum peltatum)*
- (white oak – northern red oak/eastern hop hornbeam – Ohio buckeye/harbinger of spring – May apple)

An Ecological Site Description (ESD) is a reference document of ecological knowledge regarding a particular land area (ecological site). An ESD describes ecological potential and ecosystem dynamics of land areas and their potential management. Ecological sites are linked to soil survey map unit components, which allows for mapping of ecological sites. (***NOTE:*** *This is a "provisional" ESD, and is subject to change. It contains basic ecological information sufficient for conservation planning and land management in Missouri. After additional information is developed and reviewed, a "Correlated" ESD will be published and will be available via the Web Soil Survey* http://websoilsurvey.nrcs.usda.gov .)

Major Land Resource Area (MLRA): 109 – Iowa and Missouri Heavy Till Plain

Introduction

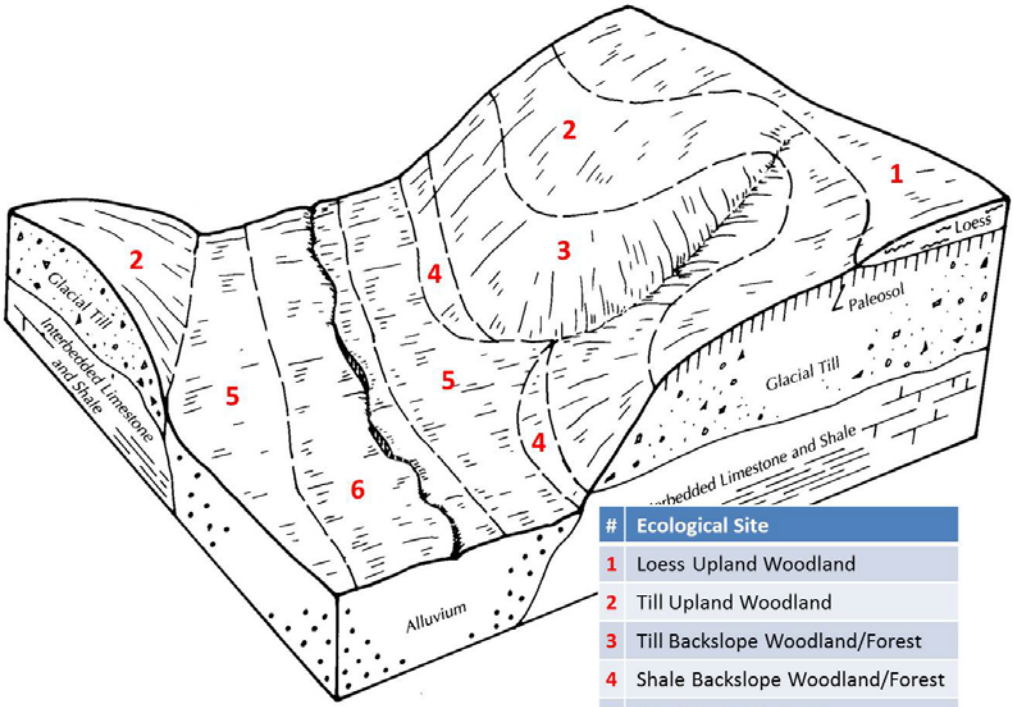
The Iowa and Missouri Heavy Till Plain (area outlined in red on the map) is an area of rolling hills interspersed with interfluve divides and alluvial valleys. Elevation ranges from about 660 feet along the lower reaches of rivers, to about 980 feet on stable interfluve summits in southern Iowa. Relief is about 80 to 160 feet between major streams and adjacent interfluve summits. Most of the till plain drains south to the Missouri River via the Grand and Chariton River systems, but the northeastern portion drains southeast to the Mississippi River. Loess caps the pre-Illinoisan aged till on interfluves, whereas the till is exposed on side slopes. Mississippian aged limestone and Pennsylvanian aged sandstone and shale crop out on lower slopes in some areas.



Till Protected Backslope Forests (green areas on the map) occupy the northerly and easterly aspects of steep, dissected slopes, and are mapped in complex with the Till Exposed Backslope Woodland ecological site. These ecological sites occur primarily in the eastern and southeastern portion of the Till Plain. They are typically downslope from Loess Upland Woodland or Till Upland Woodland ecological sites, and generally occupy the lowest portion of the hillslope. In a few places, a narrow band of Shale Protected Backslope ecological site is downslope. Soils are very deep, with dense till subsoils that are mainly clay loam. The reference plant community is forest dominated by white and northern red oaks, with a well-developed understory and a rich herbaceous ground flora.

Physiographic Features
This site is on upland backslopes, with slopes of 14 to 45 percent. It is on protected aspects (north, northeast, and east), which receive significantly less solar radiation than the exposed aspects. The site receives runoff from upslope summit and shoulder sites, and generates runoff to adjacent, downslope ecological sites. This site does not flood.

The adjacent figure (adapted from Festervand, 1994) shows the typical landscape position of this ecological site, and landscape relationships among the major ecological sites in the uplands and adjacent floodplains. The site is within the area labeled "3", and is typically downslope from Till Upland Woodland ecological sites. In areas where the local drainageways have not dissected into the underlying residuum, Upland Drainageway or Floodplain ecological sites are directly downslope.



#	Ecological Site
1	Loess Upland Woodland
2	Till Upland Woodland
3	Till Backslope Woodland/Forest
4	Shale Backslope Woodland/Forest
5	Wet Floodplain Prairie
6	Loamy Floodplain Forest

Soil Features
These soils have no major rooting restriction. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. Parent material is till. They have loam surface layers, with dense subsoils that are mainly clay loam. These soils are not affected by seasonal wetness. Soils in this protected aspect ecological site typically have thicker surface horizons relative to similar soils on exposed aspects (Steele, 2011). Soil series associated with this site include Brevator, Keswick, Lindley, and Winnegan.

Ecological Dynamics
Information contained in this section was developed using historical data, professional experience, field reviews, and scientific studies. The information presented is representative of very complex vegetation communities. Key indicator plants, animals and ecological processes are described to

help inform land management decisions. Plant communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Till Protected Backslope Forests historically occurred in the most protected landscape positions on lower, steep slopes in the deeper valleys furthest from the prairie uplands. The reference plant community is a forest dominated by white and northern red oaks and characterized by a tall (70 to 90 feet), closed canopy (80 to 100 percent) with a well-developed understory of white ash, eastern hop hornbeam, Ohio buckeye and haws, providing woody structural diversity not found in many adjacent woodland communities. The ground flora has many spring ephemerals and other shade loving herbaceous plant species.

While the upland prairies and savannas in the area may have had a fire frequency of 1 to 3 years, Till Protected Backslope Forests would have burned less frequently (10 to 20 years) and with lower intensity. In addition to periodic fire, these ecological sites were subjected to occasional disturbances from wind and ice, as well as grazing by native large herbivores. Wind and ice periodically opened the canopy up by knocking over trees or breaking substantial branches off canopy trees. Grazing by native large herbivores effectively kept understory conditions more open, creating conditions more favorable to oak reproduction.

Today, these ecological sites have been cleared and converted to pasture or have undergone repeated timber harvest and domestic grazing. Most existing forested ecological sites have a younger (50 to 80 years) canopy layer whose species composition and quality has been altered by timber harvesting practices. An increase in hickories over historic conditions is not uncommon. In addition, in the absence of fire, the canopy, sub-canopy and understory layers are more fully developed. On protected slopes, the absence of periodic fire has allowed more shade tolerant tree species, such as sugar maple, white ash, and hickories to increase.

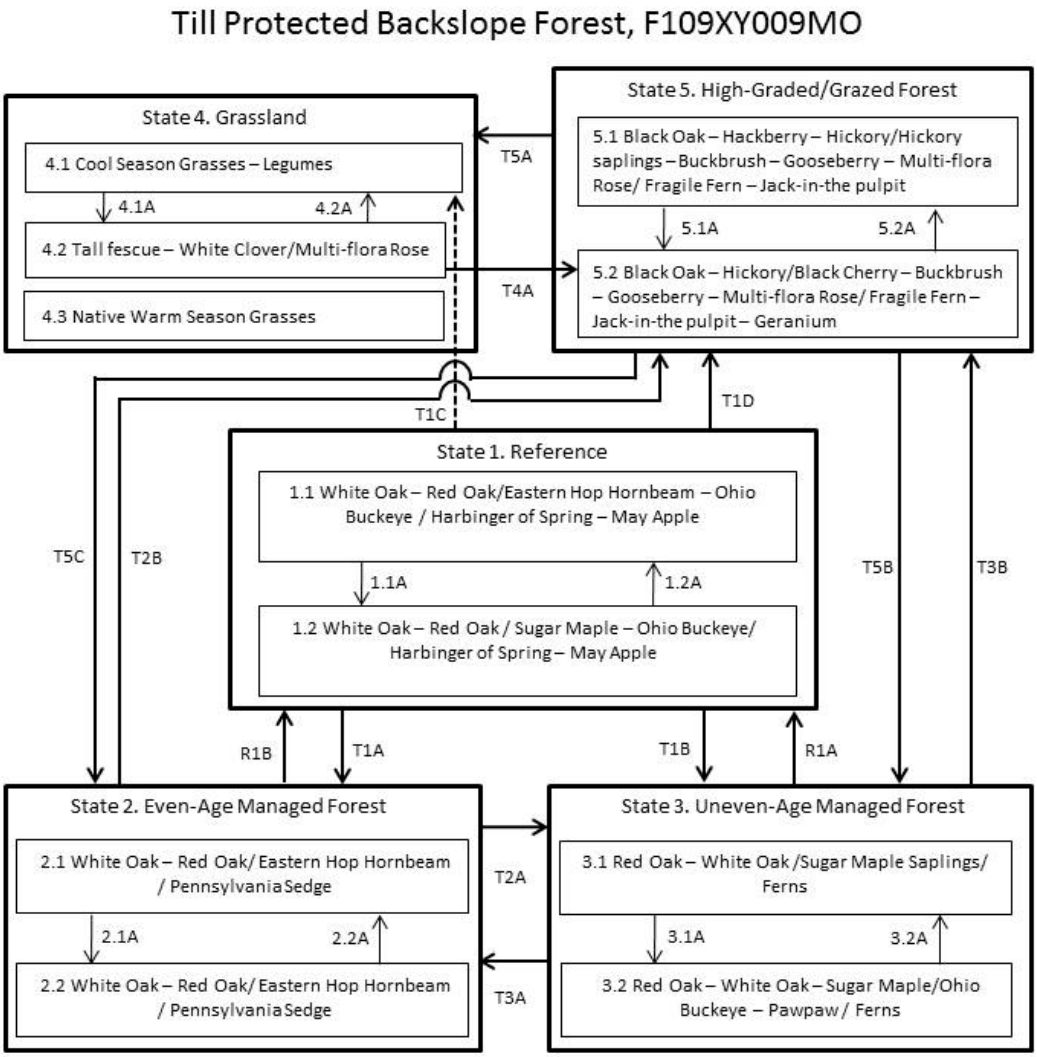
Uncontrolled domestic grazing has also impacted these communities, further diminishing the diversity of native plants and introducing species that are tolerant of grazing, such as buckbrush, gooseberry, and Virginia creeper. Grazed sites also have a more open understory. In addition, soil compaction and soil erosion related to grazing can be a problem and lower site productivity.

These ecological sites are some of the most productive sites in the region. Oak regeneration is typically problematic. Sugar maple, red elm, ironwood, hickories, pawpaw and spicebush are often dominant competitors in the understory. Maintenance of the oak component will require disturbances that will encourage more sun adapted species and reduce shading effects. Single tree selection timber harvests are common in this region and often results in removal of the most productive trees (high grading) in the stand leading to poorer quality timber and a shift in species composition away from more valuable oak species. Better planned single tree selection or the creation of group openings can help regenerate and maintain more desirable oak species and increase vigor on the residual trees. Clearcutting also occurs and results in dense, even-aged stands dominated by oak. This may be most beneficial for existing stands whose composition has been highly altered by past management practices. However, without some thinning of the dense stands, the ground flora diversity can be shaded out and diversity of the stand may suffer.

Finally, on some forested sites in the northern part of the MLRA, invasive non-native species of earthworms are beginning to have broad effects on the nutrient cycles in temperate forests. These earthworms increase the cycling and leaching of nutrients by breaking up decaying organic matter and spreading it into the soil. Temperate forests rely on thick layers of decaying organic matter for growth and nutrition. The invasive earthworm presence and activity is diminishing the diversity of native plants in these environments. This change in the plant diversity directly affects the other organisms of the environment and often leads to increased invasions of exotic species as well as overall forest decline. Restoration to a reference state under these conditions will be more difficult if not dramatically reduced or impossible.

A State and Transition Diagram model is depicted in Figure 1. Detailed descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases.

Figure 1: State and Transition Diagram



Code	Event/Process/Activity
T1A	Harvesting; even-aged forest management
T1B	Harvesting; uneven-age forest management
T1C, T5A	Clearing; forage planting; grassland management
T1D, T2B, 32B	High-grade harvesting; uncontrolled grazing
T2A	Uneven-age forest management; thinning
T3A	Even-age forest management; thinning
T4A	Long-term succession; no grazing
T5B	Uneven-age management; thinning; no grazing
T5C	Even-age management; thinning; no grazing

Code	Event/Process/Activity
R1A, R1B	Extended rotations; long term succession; thinning

Code	Event/Process/Activity
1.1A	No disturbance (20+ years)
1.2A	Disturbance (fire, wind, ice) < 20 years
2.1A	No activity (20+ years)
2.2A	Harvesting; forest stand improvement
3.1A	No activity (20+ years)
3.2A	Harvesting; forest stand improvement
4.1A	Over grazing; no fertilization
4.2A	Brush management; grassland seeding; grassland management
5.1A	No activity (20+ years)
5.2A	Logging; grazing

Ecological States

State 1: Reference

The reference state was dominated by white oak associated with red oak and other mixed hardwoods. Maximum tree age was likely 150 to 300 years. Periodic disturbances from fire, wind or ice maintained the dominance of white oak by opening up the canopy and allowing more light for white oak reproduction. Long disturbance-free periods allowed an increase in more shade tolerant species such as northern red oak and sugar maple. Two community phases are recognized in this state, with shifts between phases based on disturbance frequency.

The reference state can be found in scattered locations throughout the MLRA. Some sites have been converted to grassland (State 4). Others have been subject to repeated, high-graded timber harvests coupled with uncontrolled domestic livestock grazing (State 5). Fire suppression throughout the region has resulted in increased canopy density, which has affected the abundance and diversity of ground flora. Many reference sites have been effectively managed for timber harvesting, resulting in either even-age (State 2) or uneven-age (State 3) managed forests depending upon the removal intensity and the species selection.

White Oak – Northern Red Oak/Eastern Hop Hornbeam – Ohio Buckeye / Harbinger of Spring – May Apple: Community Phase 1.1

This community is one of the more productive upland forests in the MLRA. While the overstory is dominated by white oak and northern red oak, hickories can also be common. This forest community has a multi-tiered structure, and a canopy that is 75 to 100 feet tall with 80 to 100 percent closure. The sub-canopy and understory are well developed, with eastern hop hornbeam and Ohio buckeye (Iowa) as a dominant understory species. A moderate abundance of shade tolerant forest generalists, such as May apple, ferns, tick trefoils and white snakeroot cover the ground.

Periodic disturbances, including fire, ice and wind create canopy gaps, allowing white oak to successfully reproduce and enter the canopy. In the absence of disturbance, more shade tolerant species such as sugar maple (black maple in Iowa), bitternut hickory, white ash, basswood and others increase in importance and add structural diversity to the system. In addition, more shade-loving forest shrub (e.g., pawpaw) and herbaceous (e.g., bloodroot) species also increase. Over time, these gradual species changes result in a reference community phase transition.

White Oak – Northern Red Oak / Sugar Maple – Ohio Buckeye/ Harbinger of Spring – May Apple: Community Phase 1.2

The overstory is a mixture of white oak, northern red oak and more shade tolerant species such as sugar maple (black maple in Iowa), bitternut hickory, white ash and others. This forest community has a multi-tiered structure, and a canopy that is 75 to 100 feet tall with 90 to 100 percent closure. An abundance of shade tolerant forest generalists, such as May apple, fragile fern, tick trefoil and white snakeroot, cover the ground. In addition, more shade-loving forest shrub (e.g., pawpaw) and herbaceous (e.g., bloodroot) species are common. With periodic disturbances, such as fire, ice and wind that create canopy gaps, white oak is allowed to successfully reproduce and enter the canopy. Over time, these disturbance events result in a community phase transition back to the phase 1.1 community phase.

State 2: Even-Age Managed Forest
This forest tends to be rather dense with an even-aged overstory and an under developed understory and ground flora. Thinning can increase overall tree vigor and improve understory diversity. Continual timber harvesting, depending on the practices used and age classes removed, will either maintain this state, or convert the site to uneven-age (State 3) forests.

This state can be restored to a reference state by modifying or eliminating timber harvests, extending rotations, incorporating selective thinning, and re-introducing prescribed fire. (See *Ecological Dynamics* section for caution on sites with invasive non-native species of earthworms)

State 3: Uneven-Age Managed Forest
An uneven-age managed forest can resemble the reference state. The primary difference is tree age, most being only 50 to 90 years old. Composition is also likely altered from the reference state depending on tree selection during harvests and disturbance activities. Without a regular 15 to 20 year harvest re-entry into these stands, they will slowly increase in more shade tolerant species such as sugar maple (black maple in Iowa) and white oak will become less dominant.

This state can be restored to a reference state by modifying timber harvests, extending rotations, incorporating selective thinning, and re-introducing prescribed fire. (See *Ecological Dynamics* section for caution on sites with invasive non-native species of earthworms)

State 4: Grassland
Conversion of forests to planted, non-native cool season grasses and legumes has been common. Without proper grassland management these ecological sites are challenging to maintain in a healthy, productive state. With over grazing and cessation of active pasture management, tall fescue, white clover and multi-flora rose will increase in density. Over a long period of time with no grazing, phase 4.2 will eventually transition to a phase that resembles phase 5.2, *Black Oak – Hickory/Black Cherry – Buckbrush – Gooseberry – Multi-flora Rose/ Fragile Fern – Jack-in-the pulpit – Geranium.*

In some instances, this state has been converted to native warm season grasses, primarily big bluestem, switchgrass, and Indian grass or pure stands of single species. These sites are typically converted through a federal cost share program such as the Conservation Reserve Program (CRP) or the Environmental Quality Incentives Program (EQIP). Some sites are associated with an active rotational grazing system. Without active management with prescribed fire and grassland management these sites will transition to phase 5.2.

State 5: High-Graded/Grazed Forest
Reference or managed forested states subjected to repeated, high-grading timber harvests and uncontrolled cattle grazing transition to this degraded state. This state exhibits an over-abundance of hickory and other less economically desirable tree species and weedy understory species such as buckbrush, gooseberry, poison ivy and multi-flora rose. The vegetation offers little nutritional value for cattle, and excessive livestock stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff. Browsing by goats using good rotational management can open up the shrub layer, eliminate many of the weedy species and increase both native herbaceous vegetation and may induce regeneration of oak and

hickory species. Cessation of active logging and exclusion of livestock from sites in this state will create an idle phase that experiences an increase in black cherry and Ohio buckeye in the understory layer.

Transition back to either an even-age managed or uneven-age managed forest will required dynamic and sustained forest stand improvements, cessation of grazing, and selective thinning of overstory and understory canopies. (See *Ecological Dynamics* section for caution on sites with invasive non-native species of earthworms)

Reference State Plant Community

Canopy Trees

Common Name	Botanical Name	Cover % (low-high)	Canopy Height (ft)
WHITE OAK	*Quercus alba*	50-90	80
NORTHERN RED OAK	*Quercus rubra*	30-50	90
MOCKERNUT HICKORY	*Carya alba*	5-20	70
SHAGBARK HICKORY	*Carya ovata*	5-10	60
BITTERNUT HICKORY	*Carya cordiformis*	5-10	90
SUGAR MAPLE	*Acer saccharum*	5-10	70
BLACK MAPLE*	*Acer nigrum*	5-10	70
RED ELM	*Ulmus rubra*	5-10	60
WHITE ASH	*Fraxinus americana*	5-10	80
BLACK CHERRY	*Prunus serotina*	5-10	70
BASSWOOD	*Tilia americana*	5-10	90
BLACK WALNUT	*Juglans nigra*	5-10	90

*(*increases in frequency in the northern and western parts of the MLRA)*

Understory Trees

Common Name	Botanical Name	Cover % (low-high)	Canopy Height (ft)
HORNBEAM	*Ostrya virginiana*	10-30	40
PAWPAW	*Asimina triloba*	10-20	20
OHIO BUCKEYE	*Aesculus glabra*	10-20	40

Shrubs

Common Name	Botanical Name	Cover % (low-high)	Canopy Height (ft)
FRAGRANT SUMAC	*Rhus aromatica*	0-5	3
AMERICAN HAZELNUT	*Corylus americana*	0-5	4

Vines

Common Name	Botanical Name	Cover % (low-high)
VIRGINIA CREEPER	*Parthenocissus quinquefolia*	10-20
SUMMER GRAPE	*Vitis aestivalis*	10-20

Ferns

Common Name	Botanical Name	Cover % (low-high)
FRAGILE FERN	*Cystopteris fragilis*	5-10
MARGINAL WOOD FERN	*Dryopteris marginalis*	5-10

Forbs

Common Name	Botanical Name	Cover % (low-high)
VIRGINIA-SNAKEROOT	*Aristolochia serpentaria*	5-20
VIRGINIA SPRINGBEAUTY	*Claytonia virginica*	5-20
LESSER YELLOW LADY'S SLIPPER	*Cypripedium parviflorum var. parviflorum*	0-5
WHITE DOG'S TOOTH VIOLET	*Erythronium albidum*	5-20
HEPATICA	*Hepatica nobilis*	5-20
GOLDEN SEAL	*Hydrastis canadensis*	5-20
FALSE SOLOMON'S-SEAL	*Maianthemum racemosum*	5-20
WILD BLUE PHLOX	*Phlox divaricata*	5-20
MAYAPPLE	*Podophyllum peltatum*	5-20
TOAD SHADE	*Trillium sessile*	5-20
BELLWORT	*Uvularia grandiflora*	5-20
JACK-IN-THE-PULPIT	*Arisaema triphyllum*	5-20
CUTLEAF TOOTHWORT	*Cardamine concatenata*	5-20

Grasses and sedges

Common Name	Botanical Name
Typically <5% cover	n/a

Site Interpretations

Wildlife

- This forest type contains high structural and compositional diversity important for a number of songbirds and amphibians.
- Wild turkey, white-tailed deer, and eastern gray squirrel depend on hard and soft mast food sources and are typical upland game species of this type.
- Birds associated with late-successional, mature forests are Whip-poor-will, Great Crested Flycatcher, Ovenbird, Pileated Woodpecker, Yellow-billed Cuckoo, Summer Tanager, Wood Thrush, Red-eyed Vireo, and Scarlet Tanager.
- Reptiles and amphibians associated with these forests include: ringed salamander, spotted salamander, marbled salamander, central newt, long-tailed salamander, dark-sided salamander, southern red-backed salamander, small-mouthed salamander, three-toed box turtle, ground skink, western worm snake, western earth snake, American toad, and eastern timber rattlesnake.

Forestry

- Management: Estimated site index values range from 55 to 65 for oak. Timber management opportunities are excellent. Create group openings of at least 2 acres. Large clearcuts should be minimized if possible to reduce impacts on wildlife and aesthetics. Uneven-aged management may slowly cause an increase in more shade tolerant species such as maple. Using prescribed fire as a management tool could have a negative impact on timber quality, may not be fitting, or should be used with caution on a particular site if timber management is the primary objective. Where possible, favor white oak, black walnut, black cherry, and northern red oak.

- Limitations: Erosion is a hazard when slopes exceed 15 percent. On steep slopes greater than 35 percent, traction problems increase and equipment use is not recommended.

Glossary

Backslope – a hillslope profile position that forms the steepest and generally linear, middle portion of the slope.

Backswamp – marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces

Calcareous – the presence of calcium carbonate in the soil parent material within the rooting zone; relatively alkaline

Claypan – a dense, compact, slowly permeable layer in the subsoil having much higher clay content than the overlying material

Chert – hard, extremely dense or compact crystalline sedimentary rock, consisting dominantly of interlocking crystals of quartz

Cliff – a significant vertical, or near vertical, rock exposure

Dolomite – a type of sedimentary rock that is a carbonate mineral composed of calcium magnesium carbonate

Drainageway – the upper most reach of a stream channel system characterized by little meandering

Dry – a site where soil moisture is limiting during the growing season; low available water capacity

Dune – a low mound, ridge, bank or hill of loose, wind-blown sand

Exposed – steep, south and west-facing slopes, which are warmer and drier than other slope aspects

Flatwoods – a type of woodland that occurs on soils with a root restricting subsoil layer within 20 to 30 inches, resulting in very slow runoff and ponding that remains saturated for most of the winter and early spring months but dries out and becomes very dry in the summer months; plants that grow there must be adapted to both conditions

Floodplain – the nearly level plain that borders a stream and is subject to inundation under flood-stage conditions

Footslope – a hillslope position at the base of a slope where hillslope sediment (colluvium) accumulates

Forest – a vegetative community dominated by trees forming a closed canopy and interspersed with shade-tolerant understory species

Fragipan – a dense, brittle subsoil horizon that is extremely hard and compact when dry

Glade – open, rocky, barren vegetative community dominated by drought-adapted forbs and grasses, typically with scattered, stunted woody plants

Igneous –bedrock formed by cooling and solidification of magma. Granite and rhyolite are typical igneous bedrocks in Missouri

Limestone – a type of sedimentary rock composed largely of calcium carbonate

Loess – material transported and deposited by wind and consisting predominantly of silt-size particles

Loamy – soil material containing a relatively equal mixture of sand and silt and a somewhat smaller proportion of clay

Marsh – a type of wetland that is dominated by herbaceous rather than woody plant species

Moist – a site that is moderately well to well drained and has high available water capacity, resulting in a well-balanced supply of moisture (neither too dry nor too wet).

Mudstone – blocky or massive, fine-grained sedimentary rock in which the proportions of clay and silt are approximately equal

Natric – a soil horizon that displays a blocky, columnar, or prismatic structure and has a subhorizon with an exchangeable-sodium saturation of over 15%

Outwash – stratified sediments of sand and gravel removed or "washed out" from a glacier by melt-water streams

Prairie – a vegetative community dominated by perennial grasses and forbs with scattered shrubs and very few trees

Protected – steep, north- and east-facing slopes, which are cooler and moister than other slope aspects

Residuum - unconsolidated, weathered, or partly weathered mineral material that accumulates by disintegration of bedrock in place

Riser – a component of terraces and flood-plain steps consisting of the steep side slope; the escarpment

Riverfront – a vegetative community in the floodplain immediately adjacent and generally parallel to a river or stream channel

River hills – a geographic area characterized by thick, dissected loess deposits, formed immediately adjacent to the edges of the Missouri and Mississippi River floodplains

Sandy – a coarse-sized soil containing a large mixture of sand and gravels and a somewhat smaller proportion of silts and clays with excessive drainage

Sandstone – a sedimentary rock containing dominantly sand-size particles

Savanna – grasslands interspersed with open-grown scattered trees, groupings of trees, and shrubs

Shale – a sedimentary rock formed from clay, silty clay, or silty clay loam deposits and having the tendency to split into thin layers

Shallow – a site with bedrock within 20 inches of the surface

Shoulder – the slope profile position that forms the convex surface near the top of a hill slope; it comprises the transition zone from summit to backslope

Sinkhole – a closed, circular or elliptical depression, commonly funnel-shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock or by collapse of underlying caves within bedrock

Summit – the top or highest area of a hillslope

Swale –shallow, closed depressions irregularly spaced across a floodplain or terrace with an irregularly undulating surface.

Swamp – an area of low, saturated ground, intermittently or permanently covered with water, and predominantly vegetated by shrubs and trees.

Talus – rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep rock slope.

Terrace – a step-like surface, bordering a valley floor that represents the former position of a flood plain

Till – dominantly unsorted and unstratified soil material deposited directly by a glacier

Upland – a general term for the higher ground of a region, in contrast with a low-lying, adjacent land such as a valley or floodplain

Wet – a somewhat poorly, poorly or very poorly drained site that has an oversupply of moisture during the growing season

Woodland – a highly variable vegetative community with a canopy of trees ranging from 30 to 100 percent closure with a sparse midstory and a dense ground flora of grasses, sedges and forbs

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