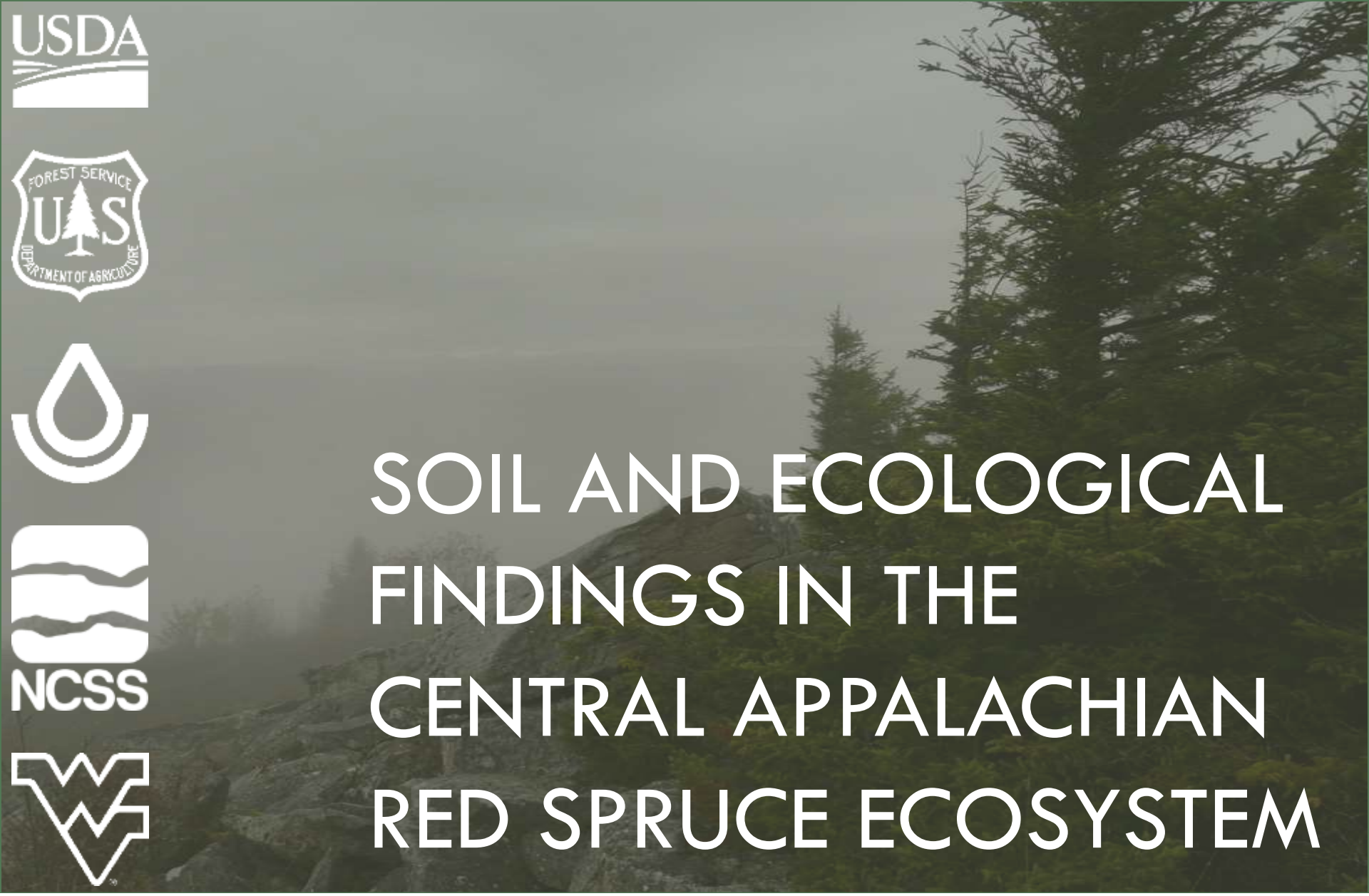

SOIL AND ECOLOGICAL FINDINGS IN THE CENTRAL APPALACHIAN RED SPRUCE ECOSYSTEM

S.J. Connolly, USFS and J.A. Thompson, WVU

WV Soils Partnership

Skip Bell

Jason Teets

Tim Dilliplane

Travis Nauman

Jim Thompson

Wendy Noll

Katey Yoast

Henry Lieberman

Aaron Burkholder

Adrienne Nottingham

Stephanie Connolly

Shane Jones

Steffany Scagline

Pam Edwards

Freddie Wood

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Red Spruce Ecosystem

- Soils and vegetation community have co-evolved
  - Similar drivers
  - Strong interactions

Red Spruce Ecosystem

- Recent observations in the Allegheny Highlands of West Virginia indicated greater distribution of spodic soil properties than was shown in existing inventories
- Soil survey can be employed to improve land management tools
  - soil maps
  - ecological site descriptions

Soil and Ecological Findings

1. Ecological Sites, Ecological Site Descriptions (ESD), and the Role of Soil Survey
2. Development of ESD for High Elevation Red Spruce Ecosystems in Central Appalachia
3. Using ESD to Guide Landscape Level Forest Management

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Ecological Sites

Definition (NRCS, 1997)

- "A distinctive kind of land with specific physical characteristics that differ from other kinds of land in its ability to produce a distinctive kind and amount of vegetation."

Emphasis

- "Interactions among soils, vegetation, and land management"

Ecological Sites

- Land with similar potential and response to management
  - Shared characteristics of climate, soils, and landscape
- Correlated with one or more component soil types

Ecological Sites

Purpose

- Separate landscape by ecological potential
- Specify constraints for desired transitions
- Assess risk of degradation
- Identify specific intervention strategies
- Aid in monitoring design

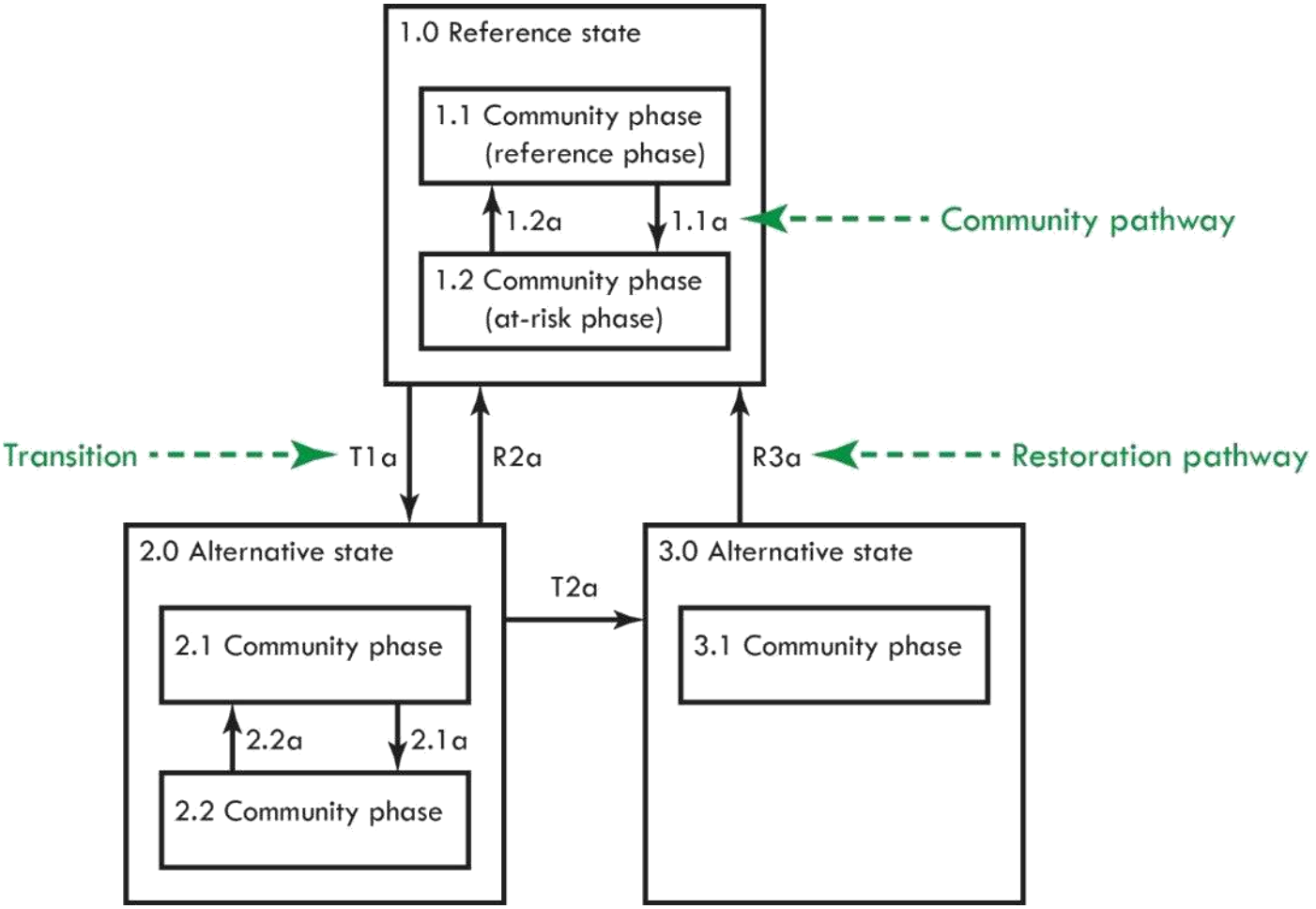
Ecological Site Descriptions (ESD)

- Site characteristics
  - Physiographic, climate, soil, and water features
- Plant communities
  - Ecological dynamics, species, state-and-transition model
- Site interpretations
  - Management recommendations
  - Animal community, recreational uses, wood products
- Supporting information
  - Relevant literature, information and data sources

State-and-Transition Models (STM)

- State = Particular plant community
  - Includes reference state and alternative states
  - Can have multiple communities within state
- Transitions = Particular succession pathway
  - Changes from one state to another
- Experimental data, historical accounts, and local knowledge informs STM

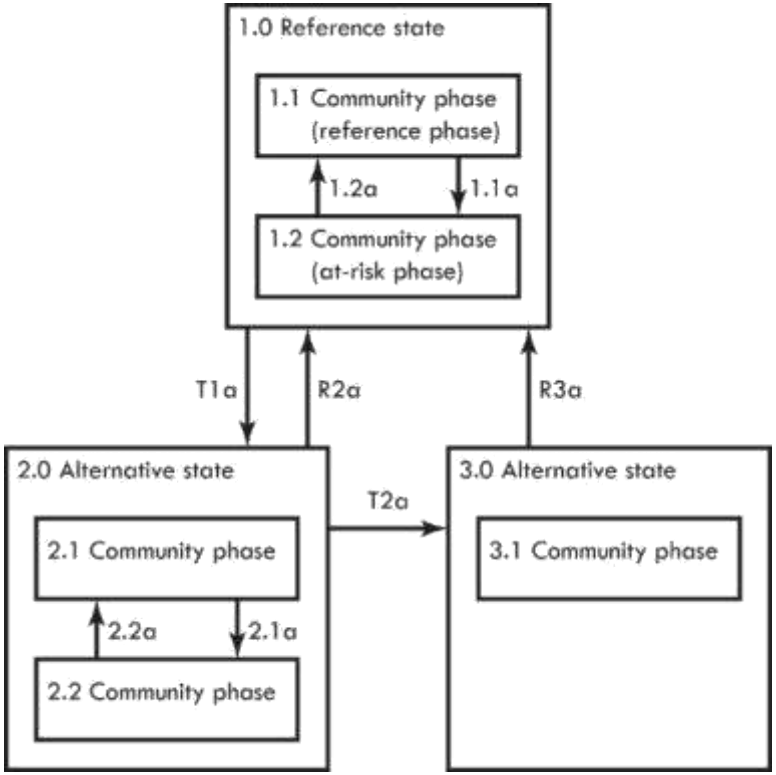
State-and-Transition Models (STM)



State-and-Transition Models (STM)

Provides framework to

- Identify current state
- Identify sites at risk of crossing a threshold
- Predict response to management actions
- Develop management plans



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USDA

United States Department of Agriculture

REVIEW COPY

Ecological Site Description

Spodic Intergrade Shale Upland Hardwood and Conifer Forest

Site ID: F127XY002WV

Helping People Help the Land

USDA

United States Department of Agriculture

REVIEW COPY

Ecological Site Description

Spodic Shale Upland Conifer Forest

Major Land Resource Area 127
Eastern Allegheny Plateau and Mountains

Site ID: F127XY001WV

This ESD document was developed by the Natural Resources Conservation Service in cooperation with the U.S. Forest Service.

Helping People Help the Land

Soil Science Division

Natural Resources Conservation Service

nrcs.usda.gov

USDA NCSS

Spodic Shale Uplands Conifer Forest

Ecological Site Identification

- **Site Stage:** Approved
- **Site name:** Spodic Shale Upland Conifer Forest

  Picea rubens - Tsuga canadensis / Dryopteris intermedia (red spruce - eastern hemlock / intermediate woodfern)
- **Site type:** Forestland
- **Site ID:** F127XY001WV
- **Major land resource area (MLRA)**: 127–Eastern Allegheny Plateau and Mountains

Introduction

The Spodic Shale Upland Conifer Forest ecological site occupies the Allegheny Mountain Section of the Appalachian Highlands. The deeply dissected plateau in this area terminates in a high escarpment, the Allegheny Front, in the eastern part of the area. Steep slopes are dominant, but level to gently rolling plateau remnants occur in the northern part of the area. The area is dominantly forestland containing large blocks of state forest and game lands and national forests. Less than one-tenth of the major land resource area (MLRA) consists of urban areas.

Spodic Shale Uplands Conifer Forest

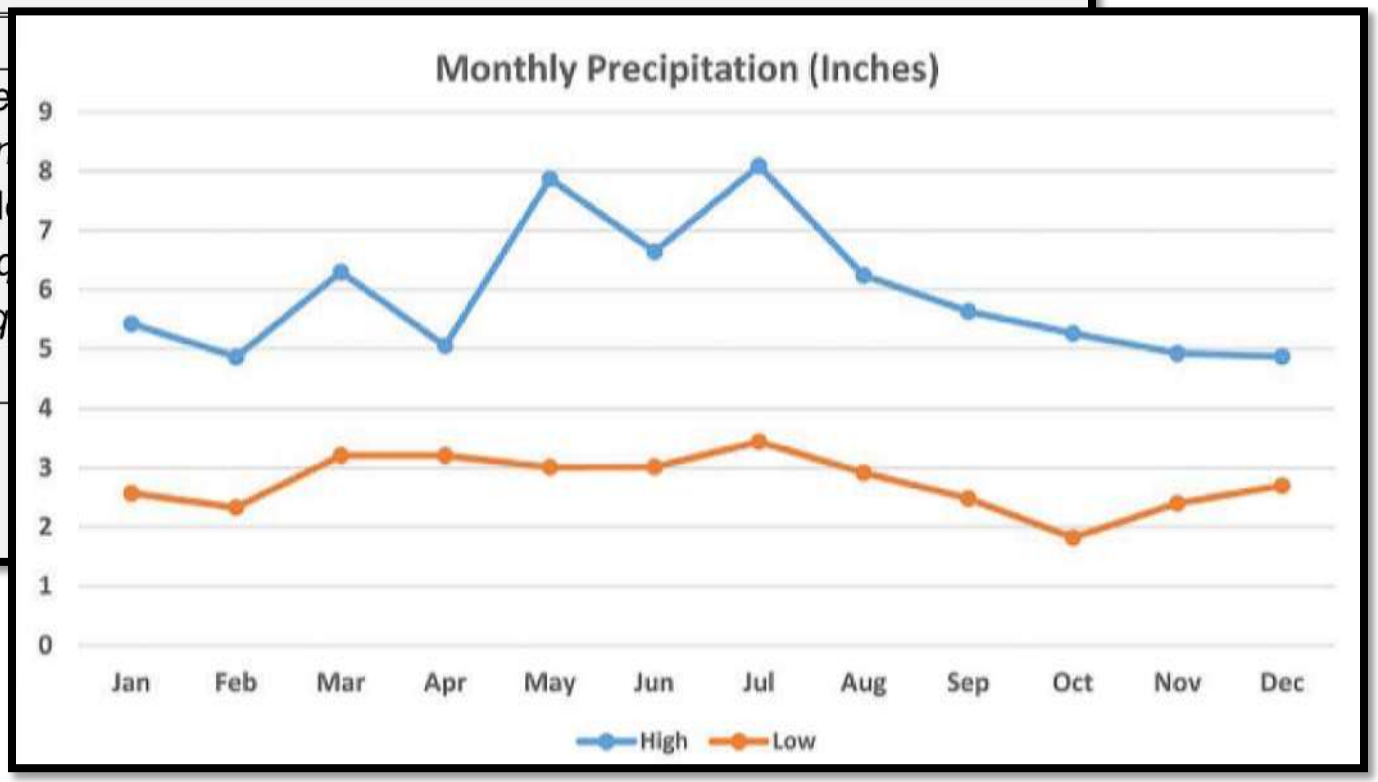
Table 1. Physiographic Features of Spodic Shale Upland Conifer Forest

	Minimum	**Maximum**
Elevation *(feet)*:	2,631	4,583
Slope *(percent)*:	3	80
Water table depth *(inches)*:	60	60
Flooding *(frequency)*:	None	None
Ponding *(frequency)*:	None	None
Runoff class:	Low	High
Aspect:	North East West	

Spodic Shale Uplands Conifer Forest

Table 1. Physiographic Features of Spodic Shale Upland Conifer Forest

Elevation *(fee*
Slope *(percer*
Water table d
Flooding *(freq*
Ponding *(freq*
Runoff class:
Aspect:



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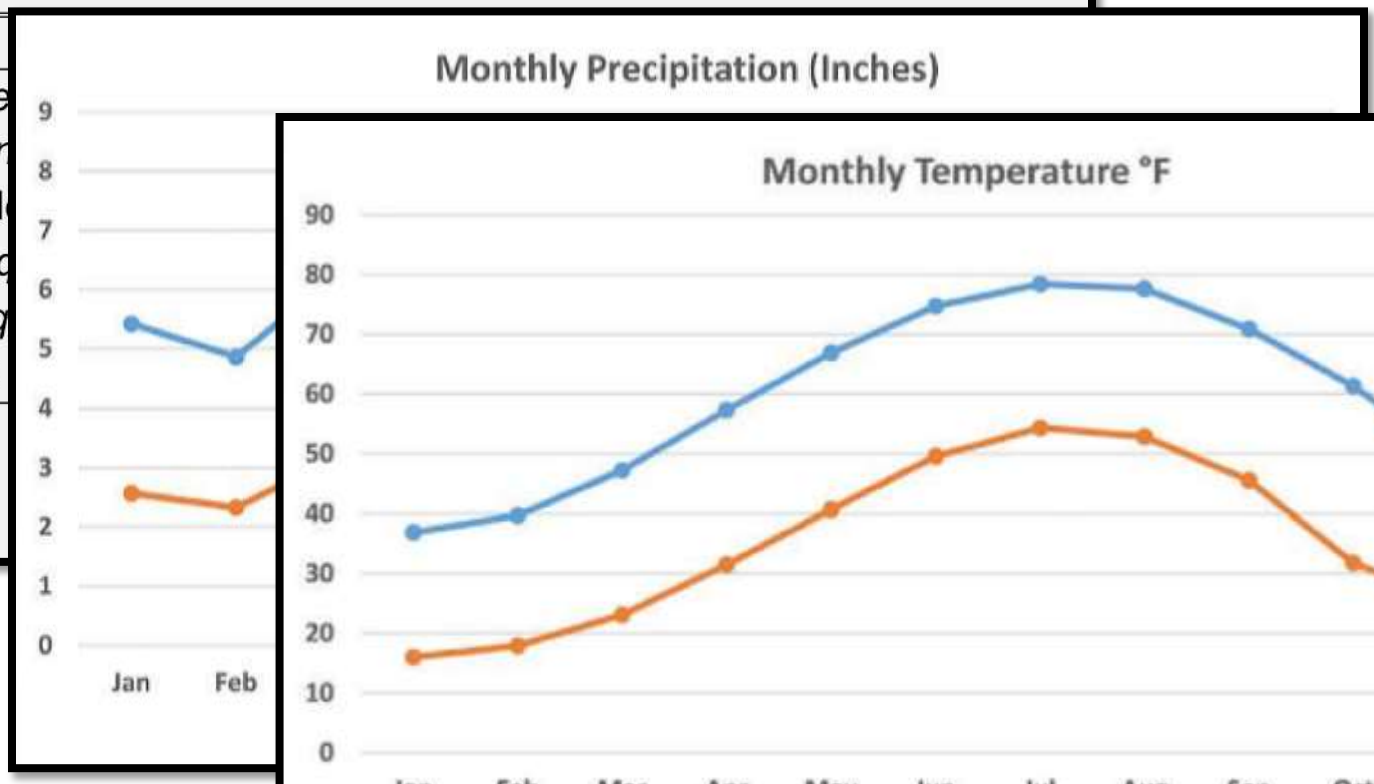


Spodic Shale Uplands Conifer Forest

Table 4. Representative Soil Features

Parent Materials	
Kind:	Cryoturbate, Colluvium, Solifluction deposits
Origin:	Acid shale, Sandstone and shale, Sandstone and siltstone
Surface Texture	(1) Channery Silt loam (2) Very channery Loam (3) Extremely channery Loam
Subsurface Texture Group	Loamy

	Minimum	Maximum
Surface fragments <=3" *(% cover)*:	0	5
Surface fragments >3" *(% cover)*:	0	3
Subsurface fragments <=3" *(% volume)*:	15	60
Subsurface fragments >3" *(% volume)*:	5	40
Drainage class:	Well drained	Well drained
Permeability class:	Moderate	Moderately rapid
Depth *(inches)*:	20	60
Available water capacity *(inches)*:	2.00	5.10
Electrical conductivity *(mmhos/cm)*:	0	0
Sodium adsorption ratio:	0	0
Calcium carbonate equivalent *(percent)*:	0	0
Soil reaction *(1:1 water)*:	3.3	4.8

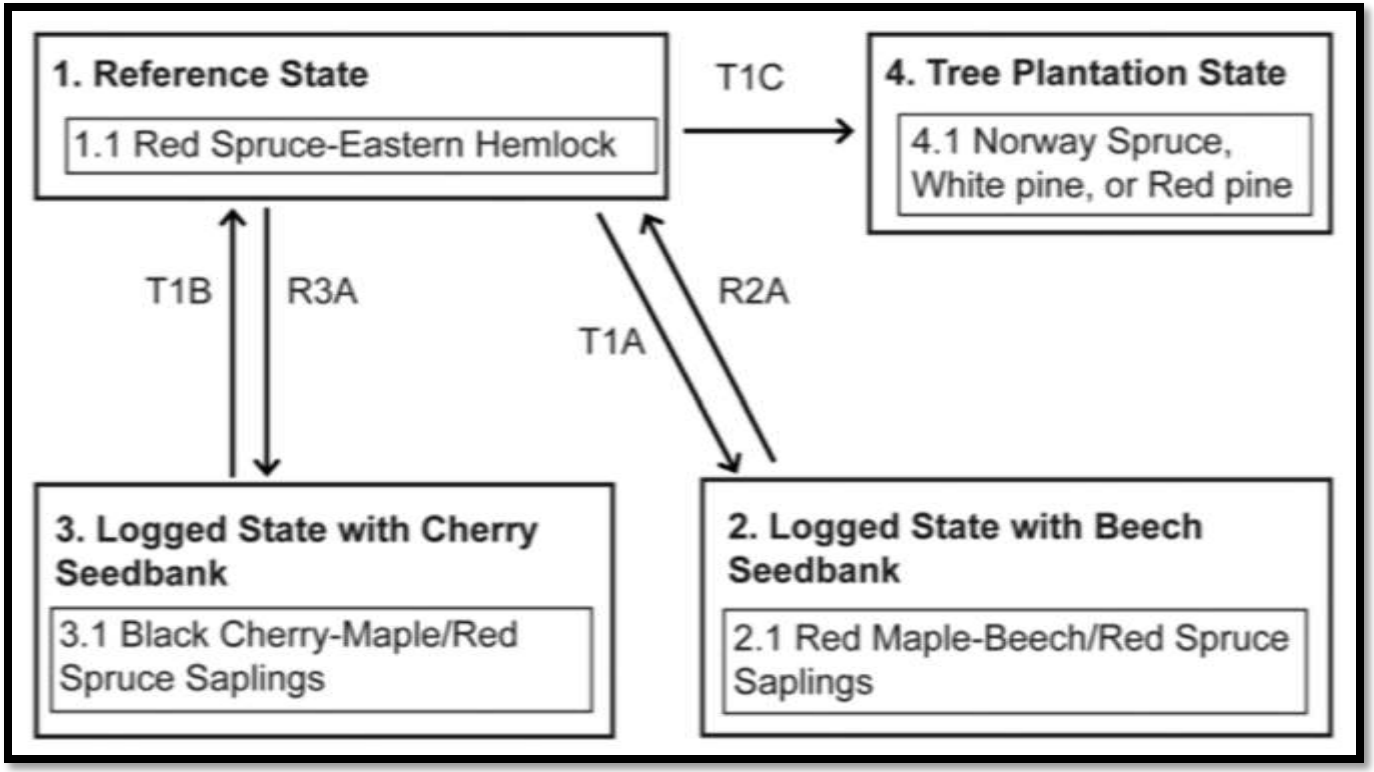
Spodic Shale Uplands Conifer Forest

Table 10. Overstory Plant Type: Tree

common name *Scientific name*	Symbol	Nativity	*Canopy cover (%)*		*Canopy height (ft.)*		*Tree diameter (in.)*		*Basal area (ft.^{2} per acre)*	
			low	high	bottom	top	low	high	low	high
red maple *Acer rubrum*	ACRU	N	10.0	30.0	60.0	115.0	7.0	10.0	10.0	30.0
red spruce *Picea rubens*	PIRU	N	30.0	75.0	80.0	110.0	14.0	17.0	40.0	60.0
Eastern hemlock *Tsuga canadensis*	TSCA	N	10.0	50.0	35.0	110.0	14.0	18.0	20.0	60.0
red spruce *Picea rubens*	PIRU	N	50.0	75.0	65.0	100.0	—	—	—	—
black cherry *Prunus serotina*	PRSE2	N	0.0	10.0	70.0	100.0	12.0	16.0	0.0	10.0
yellow birch *Betula alleghaniensis*	BELE2	N	0.0	10.0	50.0	75.0	7.0	9.0	0.0	10.0
sweet birch *Betula lenta*	BELE	N	0.0	10.0	50.0	75.0	—	—	—	—
eastern hemlock *Tsuga canadensis*	TSCA	N	0.0	20.0	15.0	75.0	—	—	—	—
cucumber tree *Magnolia acuminata*	MAAC	N	0.0	10.0	50.0	65.0	—	—	—	—
Mountain magnolia *Magnolia fraseri*	MAFR	N	0.0	10.0	45.0	60.0	—	—	—	—
eastern hemlock *Tsuga canadensis*	TSCA	N	0.0	5.0	5.0	20.0	—	—	—	—

Note: Nativity — N=native; I=introduced; U=unknown

Spodic Shale Uplands Conifer Forest



Spodic Shale Uplands Conifer Forest

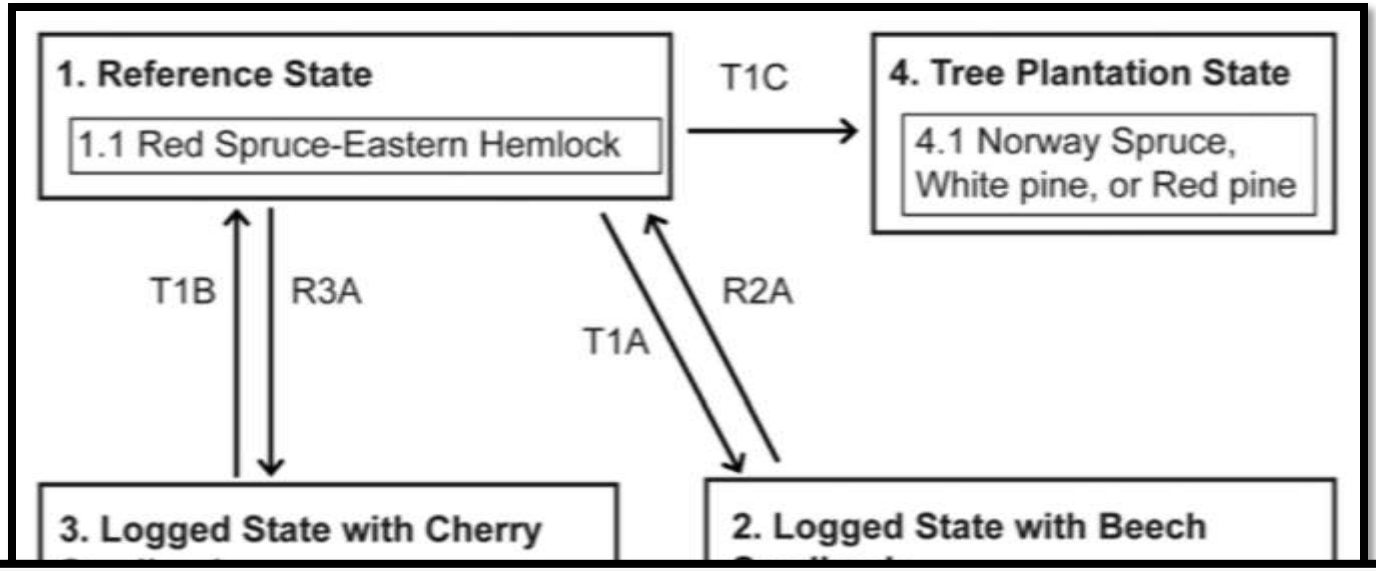


Table 5. State-and-Transition Diagram Legend

Code	Agent/Event/Activity/Process
T1A	Logged state with beech seedbank
T1B	Logged state with cherry seedbank
T1C	Tree plantation state
R2A	Thin hardwoods (cutting, ringing or herbicide application or both) to release spruce
R3A	Thin hardwoods (cutting, ringing or herbicide application or both) to release spruce

Spodic Integrade Shale Upland Hardwood and Conifer Forest

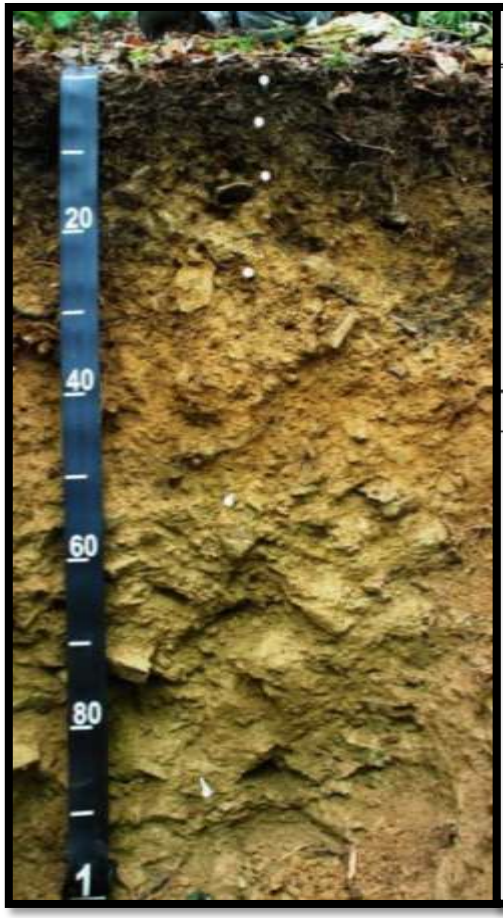
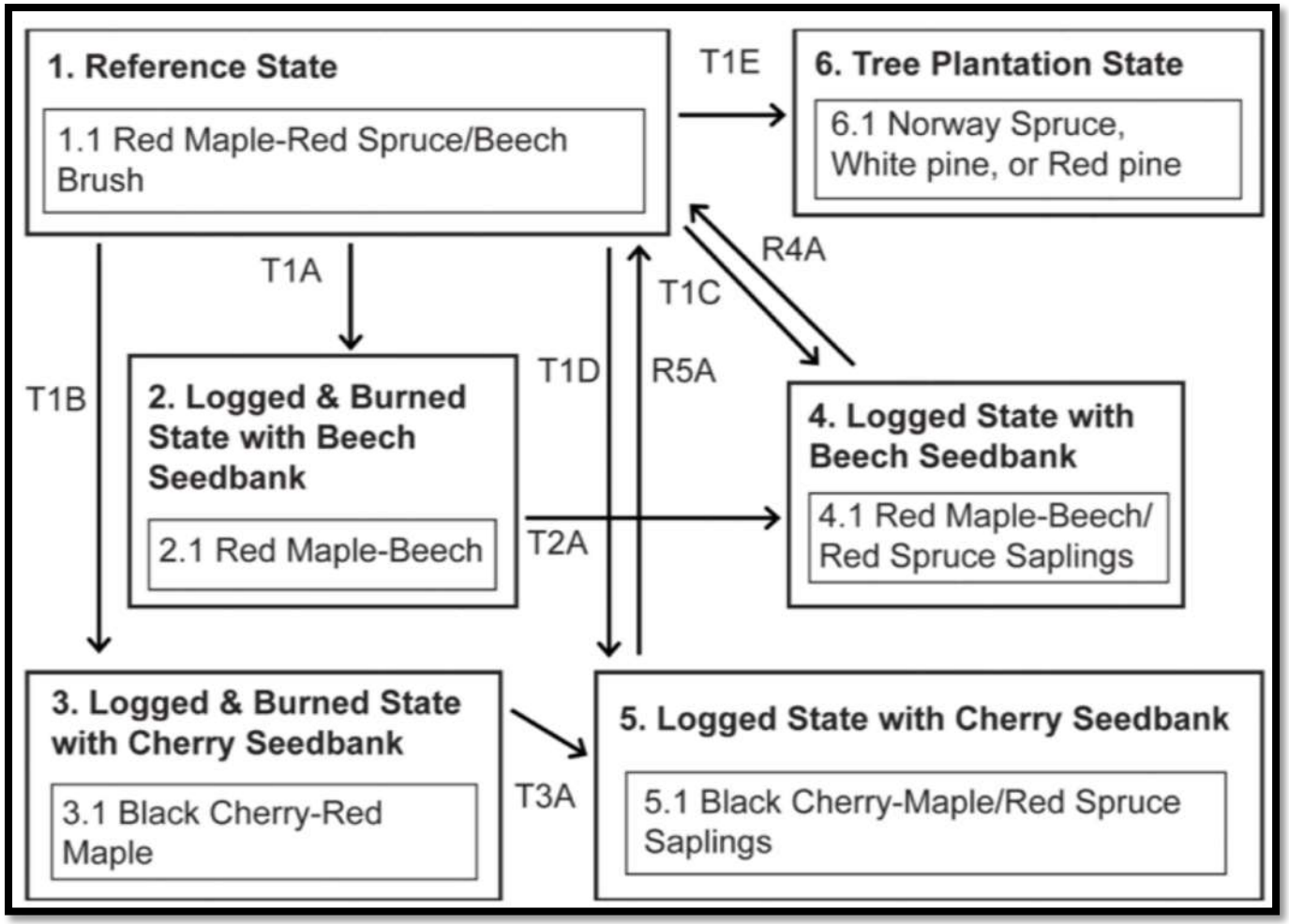


Table 4. Representative Soil Features

Parent Materials	
Kind:	Residuum, Colluvium, Solifluction deposits
Origin:	Acid shale, Sandstone and shale, Sandstone and siltstone
Surface Texture	(1) Channery Silt loam (2) Very channery Loam
Subsurface Texture Group	Loamy

	Minimum	Maximum
Surface fragments <=3" (% cover):	0	5
Surface fragments >3" (% cover):	0	3
Subsurface fragments <=3" (% volume):	15	60
Subsurface fragments >3" (% volume):	5	40
Drainage class:	Well drained	Well drained
Permeability class:	Moderate	Moderate
Depth (inches):	20	60
Available water capacity (inches):	2.10	5.25
Electrical conductivity (mmhos/cm):	0	0
Sodium adsorption ratio:	0	0
Calcium carbonate equivalent (percent):	0	0
Soil reaction (1:1 water):	4.0	5.0

Spodic Integrade Shale Upland Hardwood and Conifer Forest



Spodic Integrade Shale Upland Hardwood and Conifer Forest

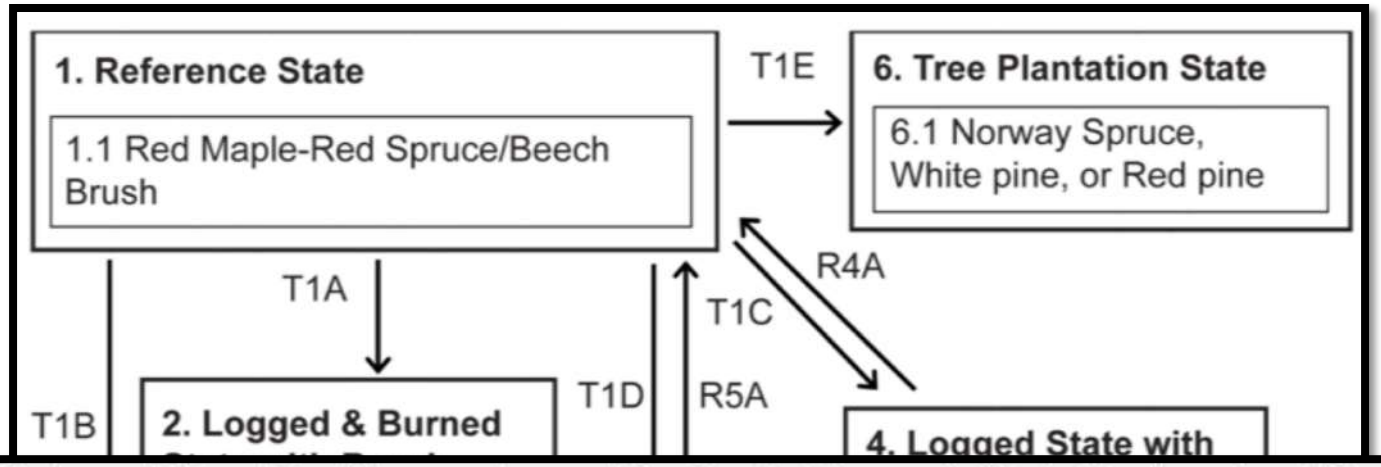
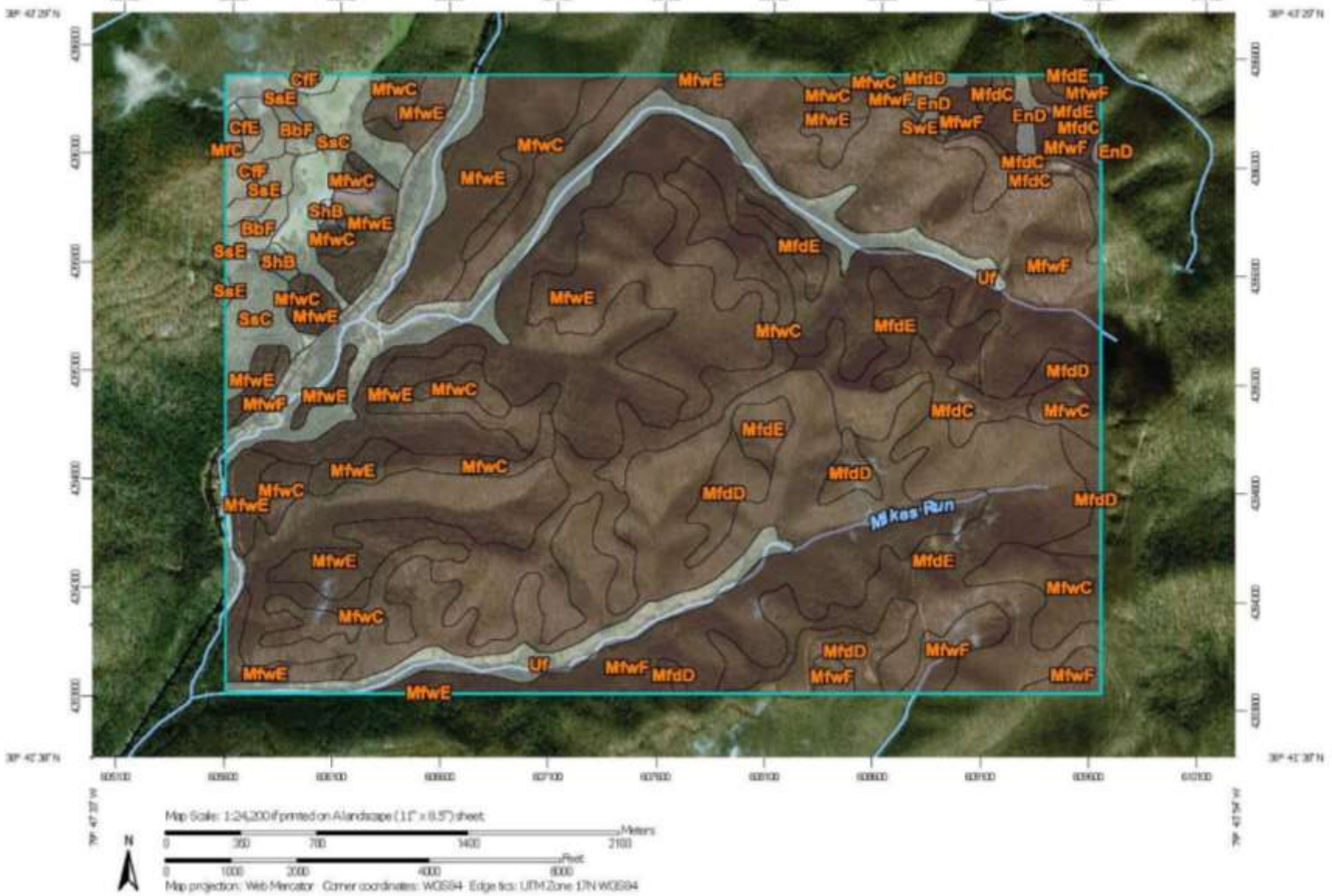


Table 5. State-and-Transition Diagram Legend for Spodic Intergrade Shale Hardwood and Conifer Forest

Code	Agent/Event/Activity/Process
T1A	Logged and burned with beech seedbank
T1B	Logged and burned with cherry seedbank
T1C	Logged with beech seedbank
T1D	Logged with cherry seedbank
T1E	Tree plantation
T2A	Red spruce seedling establish
T3A	Red Spruce seedling establish
R4A	Thin hardwoods (cutting, ringing and/or herbicide application) to release spruce
R5A	Thin hardwoods (cutting, ringing and/or herbicide application) to release spruce

All Ecological Sites -- Forestland—Pocahontas County, West Virginia; and Randolph County Area, Main Part, West Virginia
(Ecological site assesment)



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Why Promote and Restore High Elevation Red Spruce Forests from a Soil Landscape View?

- Habitat restoration

Habitat Restoration

Why Promote and Restore High Elevation Red Spruce Forests from a Soil Landscape View?

- Habitat restoration
- Carbon management

Carbon Management

- More carbon in the soils than in the atmosphere and vegetation combined
- Type of forest controls the amount of carbon in the underlying soil
  - Folistic epipedons and spodic horizons

Carbon Management

- Conversion of the historic red spruce forest to hardwoods resulted in large release of carbon
  - Restoring red spruce can help return much of the lost carbon in less than 100 years

Why Promote and Restore High Elevation Red Spruce Forests from a Soil Landscape View?

- Habitat restoration
- Carbon management
- Water storage

Headwater Systems

- Red spruce ESD located at headwaters where water is stored and collected
- Soils and vegetation play important role in water storage and filtration
- Ecosystem service for downstream users

Why Promote and Restore High Elevation Red Spruce Forests from a Soil Landscape View?

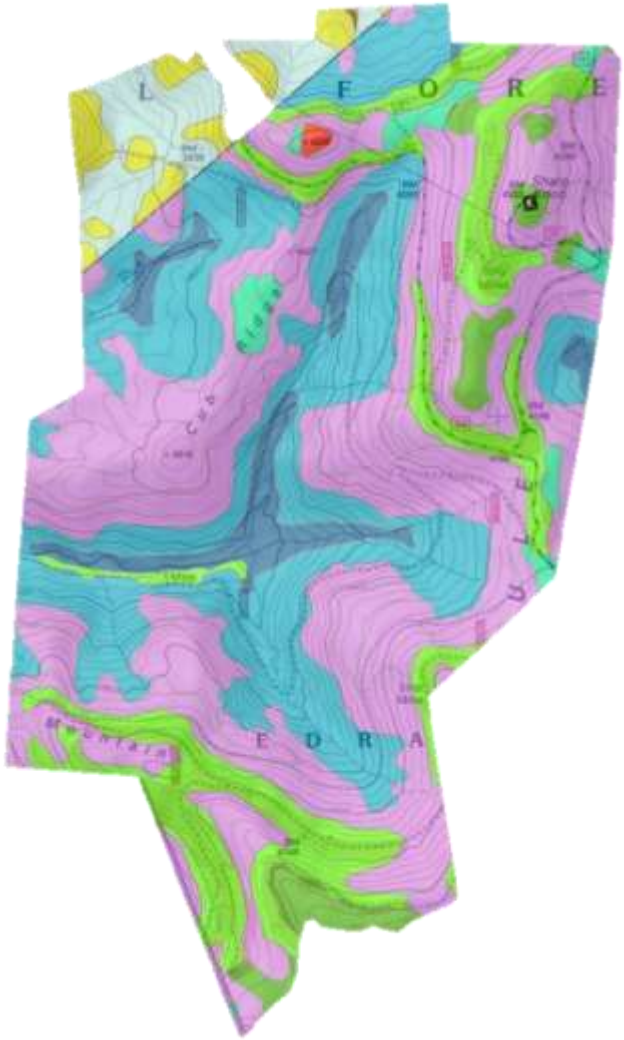
- Habitat restoration
- Carbon management
- Water storage
- Nutrient cycling
- Ecosystem health, biodiversity, and resilience

ESD in the Planning Process

- Assess current state of ecosystem
  - Trajectory vegetative community will follow given management actions
- Identify areas of connectivity and fragmentation
- Prioritize project areas based on available, limited resources (funding, staffing, etc.)

ESD During Project Planning

- Sharp Knob Project Area
- High elevation (>3000 ft)
- Pre-SMCRA coal mine
- Restoration work a priority
- Use ESD to find areas to target red spruce restoration



How to Restore Soils Based on ESD

- Refer to reference conditions
- Assess current soil conditions
- Develop management strategies that will move the landscape in the direction of recovery

Who is Using the Red Spruce ESD

- US Forest Service
- NRCS
  - Forest Stewardship Planning
  - EQIP (Environmental Quality Improvement Program)
- The Nature Conservancy
- US Fish and Wildlife Service
- National Park Service
- Research
- Other partners…