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Soil Science Division

Natural Resources Conservation Service

Ecological Site Descriptions: A Tool for Restoration and Conservation Planning

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Presented by: Stacey Clark, Regional Ecologist

Natural Resources Conservation Service

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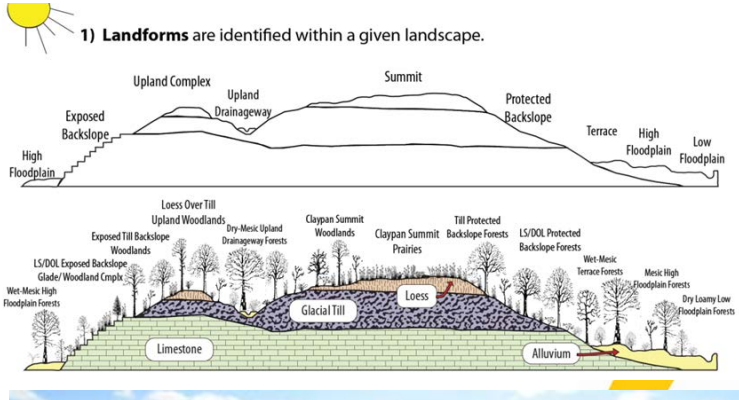
1. Content of ESDs

2. Restoration and Conservation Planning Applications

3. Where to find ESDs

4. Questions?



United States Department of Agriculture
NRCS Natural Resources Conservation Service
Ecological Site Information System

PLANTS | ESIS | ESD | FSGD | ESI Rangeland | ESI Forestland

Quick Access
- About ESIS
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- FSGD- Forage Suitability Groups

Ecological Site Information System (ESIS)

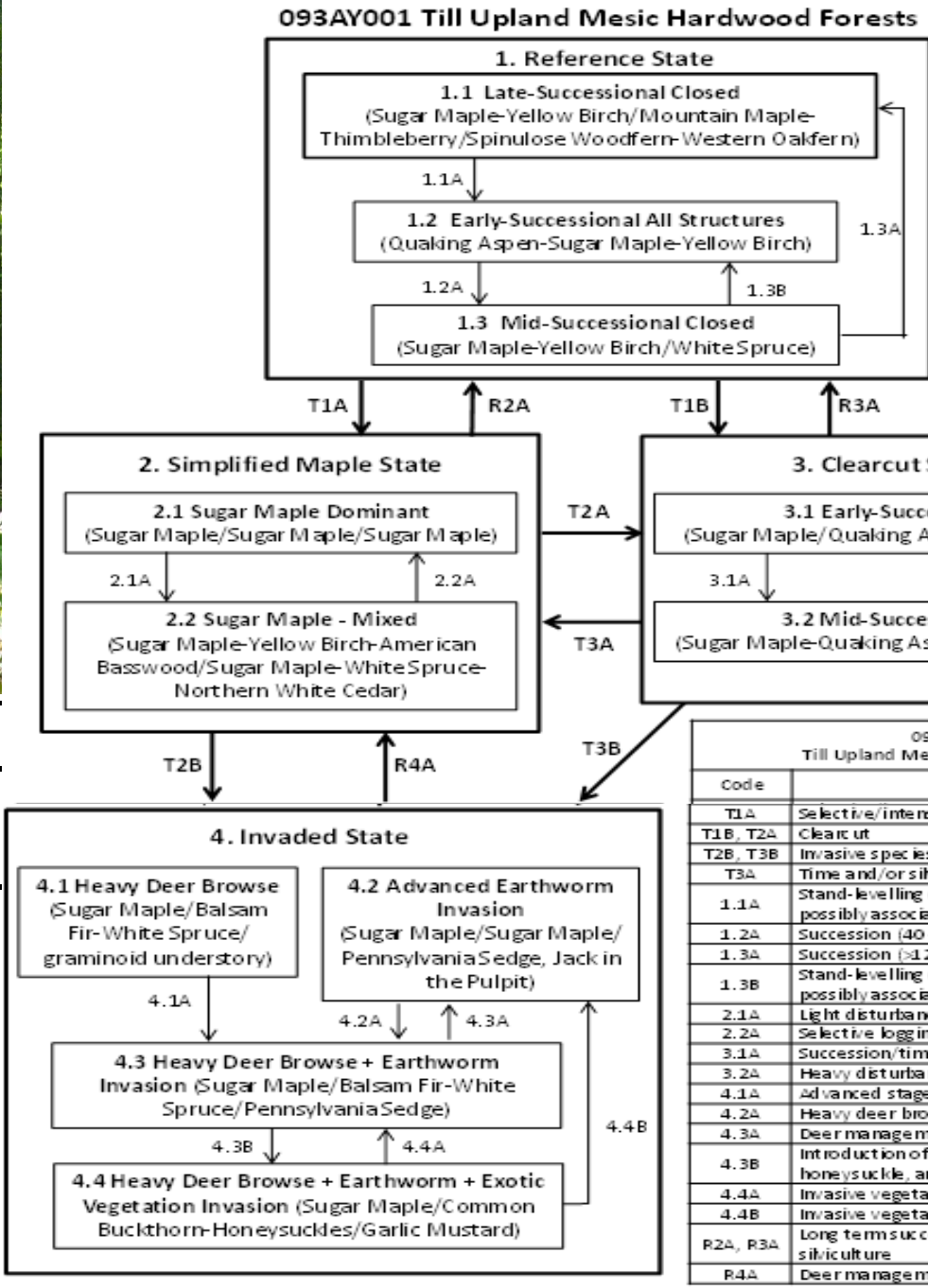
ESIS is the NRCS repository for ecological site descriptions and for information associated with the collection of forestland and rangeland plot data. ESIS is organized into two applications and associated databases; the Ecological Site Description (ESD) application and the Ecological Site Inventory (ESI) application. This section, plus the access tab on the right, provides quick access

Technical Resources
- USDA - ARS Range Database

Natural Resources Conservation Service
nrcs.usda.gov/

Height Above Ground (ft)	Grass/ Grasslike
0.5	1-5
0.5-1	1-5
1-2	-
2-4.5	-
4.5-13	-
13-40	-
40-80	-
80-120	-

State-and-Transition Diagram



093AY001 Till Upland Mesic Hardwood Forest	
Code	Process
T1A	Selective/intensive logging (high-grading)
T1B, T2A	Clearcut
T2B, T3B	Invasive species and/or deer browse
T3A	Time and/or silviculture
1.1A	Stand-levelling disturbance (wind and/or fire possibly associated with drought)
1.2A	Succession (40 – 120 years without disturbance)
1.3A	Succession (>120 years without disturbance)
1.3B	Stand-levelling disturbance (wind and/or fire possibly associated with drought)
2.1A	Light disturbance/canopy openings
2.2A	Selective logging, leaving sugar maple
3.1A	Succession/time
3.2A	Heavy disturbance (clearcut)
4.1A	Advanced stage earthworm invasion
4.2A	Heavy deer browse
4.3A	Deer management
4.3B	Introduction of invasive vegetation (buckthorn, honeysuckle, and/or garlic mustard)
4.4A	Invasive vegetation management
4.4B	Invasive vegetation + deer management
R2A, R3A	Long term succession with or without ecological silviculture
R4A	Deer management (only for phase 4.1)

Figure 2. State-and-transition model for Till Upland Mesic Hardwood Forests.

Example 1: Ecological Site Descriptions for Wetland Management/Restoration

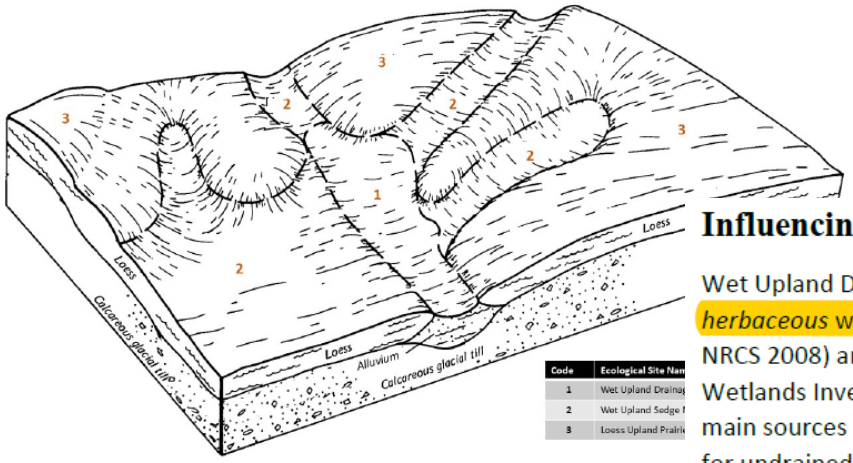


Figure 2. Representative block diagram of Wet Upland Drainageway Prairie and associated ecol

Influencing Water Features

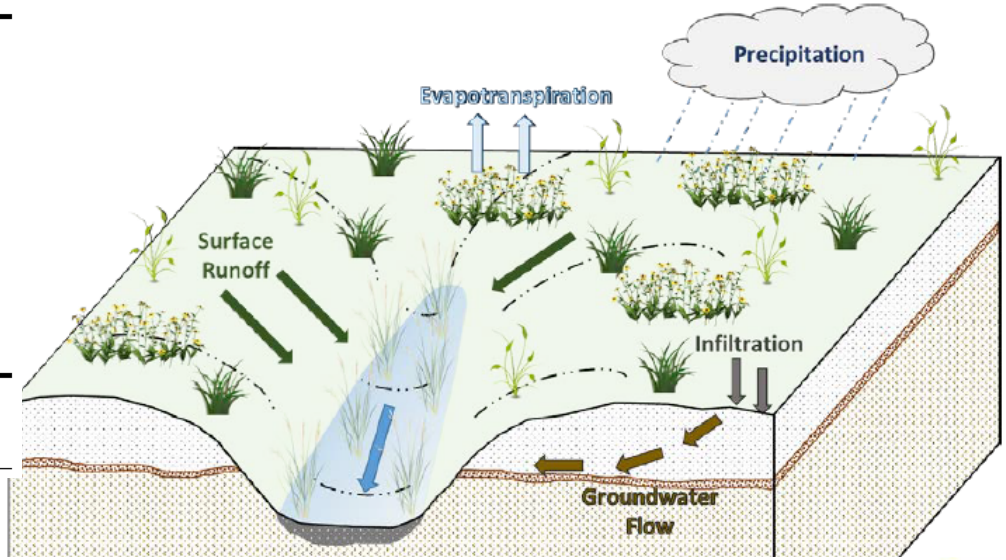
Wet Upland Drainageway Prairies are classified as a SLOPE: Drainageway, Occasionally flooded; *herbaceous* wetland under the Hydrogeomorphic (HGM) classification system (Smith et al. 1995; USDA-NRCS 2008) and as a Palustrine, Persistent, Emergent, Temporarily Flooded Wetland under the National Wetlands Inventory (FGDC 2013). Precipitation, overland flow, and groundwater return flow are the main sources of water for this ecological site (Smith et al. 1995). Infiltration is slow (Hydrologic Group C) for undrained soils, and surface runoff is low to medium (Figure 5).

Table 1. Site Geomorphic/Physiographic properties of Wet Upland Drainageway Prairie. (Data and information presented here are based on NRCS integrated plot data and the National Soil Information System.)

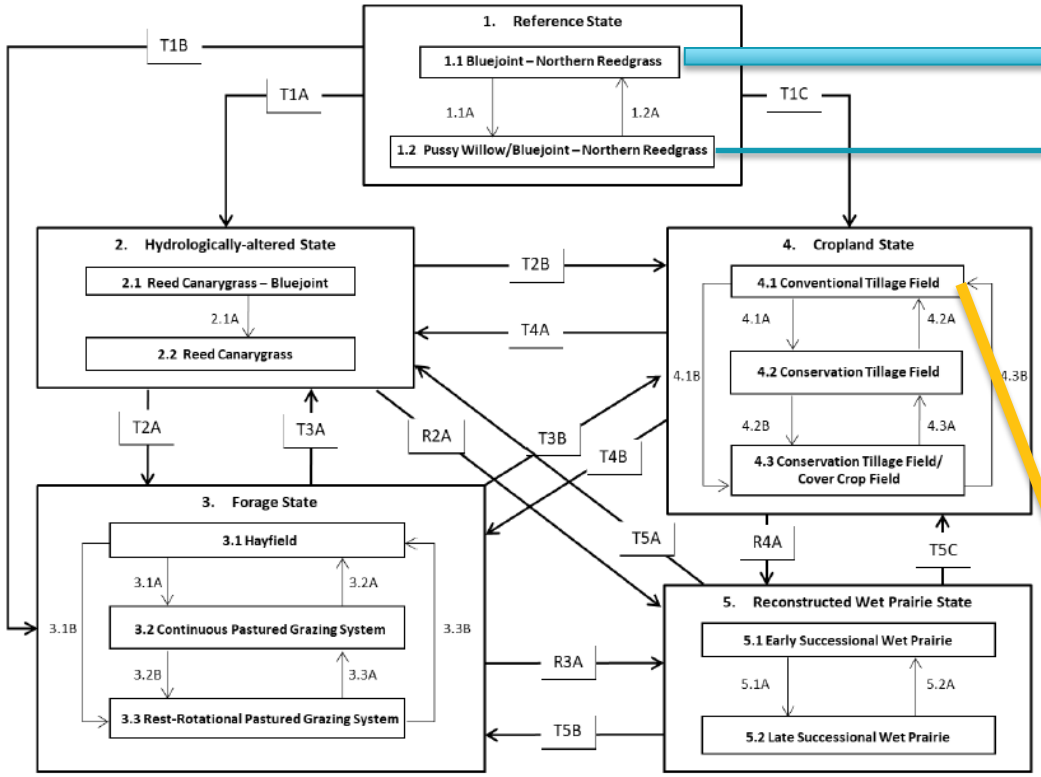
	Minimum	Maximum
Elevation (feet)	499	1801
Slope (percent)	0	5
Water Table Depth (inches)	0	48
Flooding		
Frequency	Occasional	Occasional
Duration	Very Brief	Brief
Ponding		
Depth (inches)	None	None
Frequency	None	None
Duration	N/A	N/A
Runoff Class	Low	Medium

Landform: upland drainageways
Slope Shape: concave (across); linear (down)
Aspect: does not affect site

rimary wetland hydrology indicators[2] for an intact Wet Upland Drainageway Prairie may include: A1 urface water, A2 High water table, and A3 Saturation. Secondary wetland hydrology indicators may nclude: C2 Dry-season water table, D2 Geomorphic position, and D5 FAC-neutral test (USACE 2010).



R107AY210IA Wet Upland Drainageway Prairie



Code	Process
T1A, T3A, T4A, T5A	Changes to natural hydroperiod and/or land abandonment
T1B, T2A, T4B, T5B	Cultural treatments are implemented to increase forage quality and yield
T1C, T2B, T3B, T5C	Agricultural conversion via tillage, seeding, and non-selective herbicide
1.1A	Depth to water table and associated soil saturation is reduced
1.2A	Depth to water table and associated soil saturation is increased
2.1A	Increasing changes to hydrology and increasing sedimentation
R2A, R3A, R4A	Site preparation, non-native species control, and native seeding
3.1A	Mechanical harvesting is replaced with domestic livestock and continuous grazing
3.1B	Mechanical harvesting is replaced with domestic livestock and rest-rotational grazing
3.2A, 3.3B	Tillage, forage crop planting, and mechanical harvesting replace grazing
3.2B	Implementation of rest-rotational grazing
3.3A	Implementation of continuous grazing
4.1A	Less tillage, residue management
4.1B	Less tillage, residue management, and implementation of cover cropping
4.2B	Implementation of cover cropping
4.2A, 4.3B	Intensive tillage, remove residue, and reinitiate monoculture row cropping
4.3A	Remove cover cropping
5.1A	Maintenance of proper hydrology, fire, and nutrient balances
5.2A	Drought or improper timing/use of management actions

© Photos by Steve D. Eggers

A wetland within a cropped field in Kenosha County, Wisconsin

SLOPE Wetland Before “Restoration”

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SLOPE Wetland After “Restoration”

Natural Resources Conservation Service

nrcs.usda.gov/

Current Issues in Stream Restoration Practices

Imposing channel form and dimensions where they don't belong

- Overuse/Misuse of C4 NCD
- "Restoring" Slope headwaters to streams

Design issues related to bankfull flow/discharge estimates

--Merritts et al. 2014

Ignoring the influence of vegetation and large wood on channel metrics

--Wohl, 2013

River systems are still undergoing responses to historic disturbances within the basin, and projects don't account for sediment transport before and after project implementation

--Miller & Kochel, 2009

James Borden / Raleigh Public Record

Channelized Rutherford River, TN Photo by Barry Hart

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Example 2: Ecological Site Descriptions for Riparian Management/Restoration

Riverine Functions:

- Dynamic Floodwater Storage
- Valley Aquifer Storage
- In Channel and Off Channel Habitat
- Sediment and Nutrient Cycling

Bank vegetation restoration, CWD and stream materials

Hydrology/flow accumulation/stream evolution

Sediment load, bank restoration

Stream & Valley Cross-Sections (F5/6 Channel)

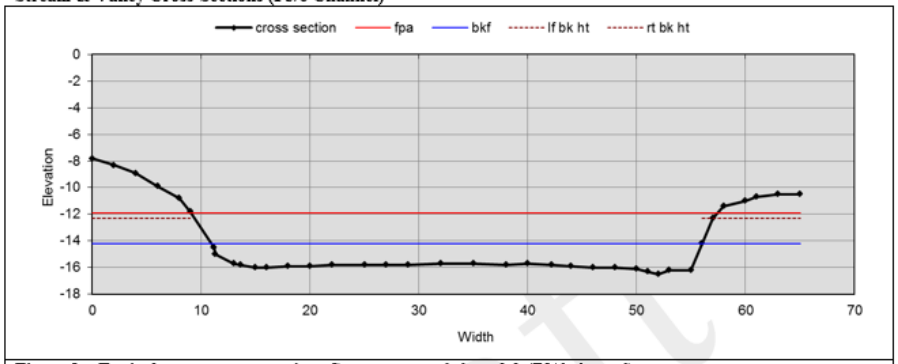


Figure 1 – Typical stream cross-section. *Cross-section of phase 2.2 (F5/6 channel).*

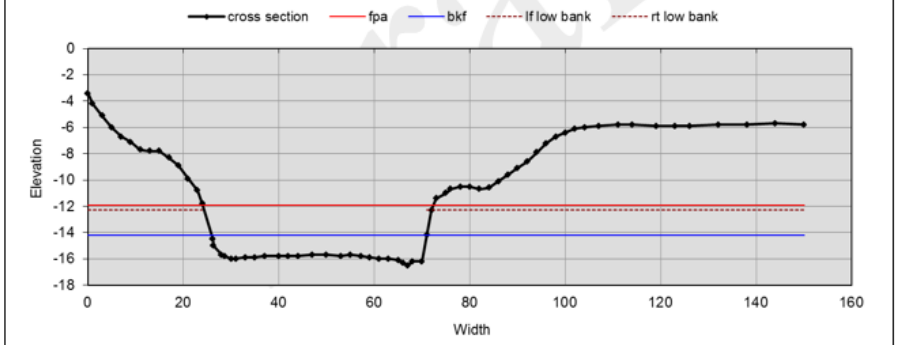


Figure 2 – Typical valley cross-section. *Valley cross-section of Phase 2.2 (widened unstable channel) that has lost connectivity with the floodplain.*

REPRESENTATIVE SOIL FEATURES

Narrative	The soils in MLRA 55B of the Sheyenne River floodplain are deposits of glacial drift. These soils are classified as Entisols and Mollisols soil orders. The soils of the flood plain have also been influenced from the sediments of the glacial drift listed above, and other glacial meltwater sediments. Typically the sediments and soils of the river system consist of a mixture of sediments (sands, silts, clays, and gravels) due to the flow events of the river. There is no soil development on the edge of the river channel (floodplain) due to constant re-working of the sediments, time has not allowed soil development; this zone is considered a miscellaneous land type called "Channel". As you increase in elevation from the channel edge, the soils on the primary steps are Typic Calciaquolls or Cumulic Endoaquolls and typically within the particle size family class is Sandy, Coarse-Loamy or Loamy. There are stratified thin layers of sediments that range from sand to clay loams throughout the soil profile. The soils are frequently flooded and the water table will fluctuate with the depth of water in the river channel. The soils on the floodplain step are Cumulic Endoaquolls or Cumulic Hapludolls and the particle size family class is Fine silty to Fine-loamy. The parent material does have stratified thin layers of sediments that range from loamy sands to silty clay loams in the lower profile. These soils are frequently flooded and the water table will also fluctuate with the depth of water in the river channel. The Low Terrace was classified as a coarse-loamy, mixed, super active frigid, Pachic Hapludolls.

Fluvial Surface/Landform 1	Floodplain
Soil Features Narrative	The soils associated with the floodplain are classified as frigid Typic Calciaquolls (Lowe Series) or frigid Cumulic Endoaquolls (similar to the LaMoure Series). These soils are mixed superactive and calcareous.
Parent Materials - Kind	Silty or Loamy alluvium
Bedrock - Kind	None
Typical Surface Texture (<2mm)	Fine loamy
Surface Texture Modifier	Sand

	Minimum	Maximum
Surface Fragments ≤10" (% cover)	None	None
% Coarse Fragments >2mm (% volume in 10–20" layer)	0	5
Drainage Class	Very poorly	poorly
Saturated Hydraulic Conductivity Class	1	10
Depth to Bedrock (inches)	>72	>72
Depth to Redoximorphic Features (inches)	0	16
Depth of Fine Roots (1-2mm)	0	40
Electrical Conductivity (mmhos/cm)	0	7.9
Sodium Adsorption Ratio within 16" Depth	0	5
Calcium Carbonate Equivalent within Surface 10"	5	30
Soil Reaction within Surface 4 Inches	Slight	Violent
Available Water Capacity (inches)	5.1	11.6

Fluvial Surface/Landform 2	Floodplain Step
Soil Features Narrative	The soils associated with the floodplain step are classified as frigid Cumulic Endoaquolls (similar to the LaMoure Series) or as frigid Cumulic Hapludolls (La Prairie Series). These soils are mixed superactive and calcareous.
Parent Materials - Kind	Silty or Loamy alluvium
Bedrock - Kind	None
Typical Surface Texture (<2mm)	Fine Loamy to Fine Silty
Surface Texture Modifier	Sand

	Minimum	Maximum
Surface Fragments ≤10" (% cover)	0	0
% Coarse Fragments >2mm (% volume in 10–20" layer)	0	0
Drainage Class	Moderately well	Moderately well

STATE 2 SECTION

State Number	2
State Name	Entrenched and/or Widened, Unstable Channels
State Narrative	This state represents a set of degraded channels (G5c – F5) that have crossed a threshold by becoming vertically and laterally unstable resulting in moderately deep entrenchment and loss of floodplain and floodplain step connectivity and vegetation. They are difficult, if not impossible to restore without changing profile, pattern, and dimension of the stream. These channels have little value for wildlife, fish, and water quality unless residual pools are deep enough to remain inundated between recharge or storm events that restore stream flows and re-connect isolated pools.

2.1A Community Phase Change to 2.2

Lateral movement with significant bank erosion, increased sediment load and increase in width/depth ratio.

2.2A Community Phase Change to 2.1

Increased vertical instability and entrenchment from further loss of vegetation (similar to T1A). This may be caused by disturbances that remove stabilizing vegetation, natural flooding, ice or beaver dam failure. Significant increase in bank erosion although some stabilizing vegetation may increase.

State 2 Photos

Photo 1. *Disturbance associated with road washout lead to gully (G channel)and subsequent F channel formation (Phase 2.2).*

Photo 2. *Loss of connectivity to the floodplain results in riparian plants being replaced by upland species, which contributes to bank instability.*

Photo 3. *F5 channel (Phase 2.2). This site has a wide shallow channel with no floodplain.*

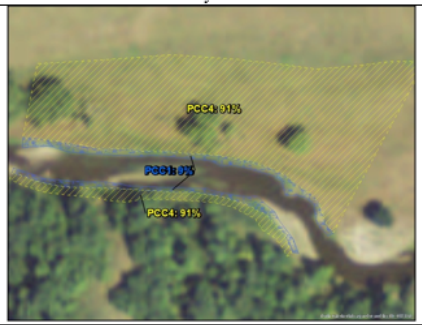


Photo 4. *Aerial view of phase 2.2, F5, showing arrangement of community components.*

State 2 Community Phases

Community Phase Number	2.1
Community Phase Name	G5 Channel (active entrenchment)
Community Phase Narrative	This channel phase is the result of loss of floodplain connectivity and vegetation (PCC1 and possibly PCC2) resulting in rapid vertical instability and deep entrenchment. The forces which cause the entrenchment continue to shape the channel into the next phase (F5) through bank sloughing and accelerated lateral movement.

Plant Community Components

PCC	Plant Association	Fluvial Surface/Landform[1/]	Composition (%)
2	Prairie Cordgrass/Sedge/Western wheatgrass	Floodplain Step	0-10
4	Western wheatgrass/ Green needlegrass	High Terrace (Loamy)	90-100

[1/] Corresponds to fluvial surfaces/landforms in the Physiographic Features and Representative Soil Features sections.

Community Phase Number	2.2
Community Phase Name	F5 Channel (Entrenched/ Widened)
Community Phase Narrative	This channel continues the lateral expansion of phase 2.1 resulting in an F5channel. These channels are highly unstable and further disturbances can force these quickly transform these back into vertically unstable G5 channels. These channels are generally disconnected from the floodplain except for during extreme flooding events. As a result, PCC1 is non-existent and water tables in terraces are further lowered. Fish and wildlife habitat and water quality values are significantly lowered or absent. If carefully managed, these channels can begin to build new floodplains and re-establish floodplain vegetative communities.

Plant Community Components

PCC	Plant Association	Fluvial Surface/Landform[1/]	Composition (%)
1	Obligate Sedge Sp./Prairie Cordgrass	Floodplain	0-15
2	Prairie Cordgrass/Sedge/Western wheatgrass	Floodplain Step	0-10
4	Western wheatgrass/ Green needlegrass	High Terrace (Loamy)	80-95

[1/] Corresponds to fluvial surfaces/landforms in the Physiographic Features and Representative Soil Features sections.

T2A Transition to Entrenched/Constrained Stable Analogue Channels State (State 3) from Entrenched/Widened Unstable Channels State (State 2)

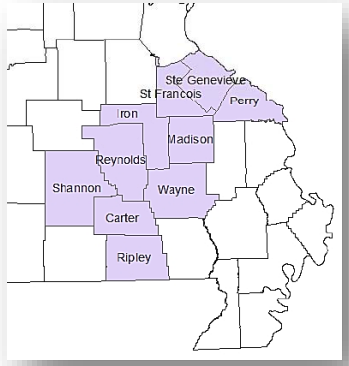
Rehabilitation of entrenchment with stabilizing herbaceous vegetation (increased connectivity and/or formation of new flood plain and return to better energy and sediment balance). Multiple plant community components present on fluvial surfaces. May be significant decreases in bank height ratios.

T3A Transition to Entrenched/Widened Unstable Channels State (State 2) from Entrenched/Constrained Stable Analogue Channels State (State 3)

Disturbance results in entrenchment of stable analogue channels (Bc, C, or E) due to loss of vegetation (obligate and facultative wet plant functional groups), increased bank erosion, and down cutting.

Example 3: USDA Conservation Planning

Restoring Glade and Woodland Communities for Threatened Species in the Ozarks of Southeast Missouri:



- Manage and restore glades, woodland, and forest habitats
- Treat cropland with Environmental Quality Incentives Program
- Target benefits to threatened and declining species.

S7: Is the tract where the planned practice(s) will be applied within the glade/open woodland emphasis area AND at least one planned practice will have a positive impact/benefit on the restoration of glade and/or open woodland ecosystems?
Answer "Yes" if the EQIP offered acres are within the identified glade/open woodland emphasis area; use the shapefile - *EQIP Joint Chiefs Initiative Priority Areas.shp* and Polygon Type = **Glade Woodland Emphasis Area**, and at least one planned practice listed below is implemented to establish or manage glade and/or open woodland natural communities where the Ecological Site Description indicates a glade or open woodland.
Practices include: Brush Management (314) - Glade/Savanna Restoration scenario, Forest Stand Improvement (666) - Open Woodland Restoration scenario, Prescribed Burning (338)

1.1 Longleaf Pine – Wiregrass (<3year fire frequency)

(>5 year fire freq)

1.2 Longleaf Pine Blackjack/Post oak
> 5year fire freq

No fire

2 Mixed Pine-
Hardwood Forest

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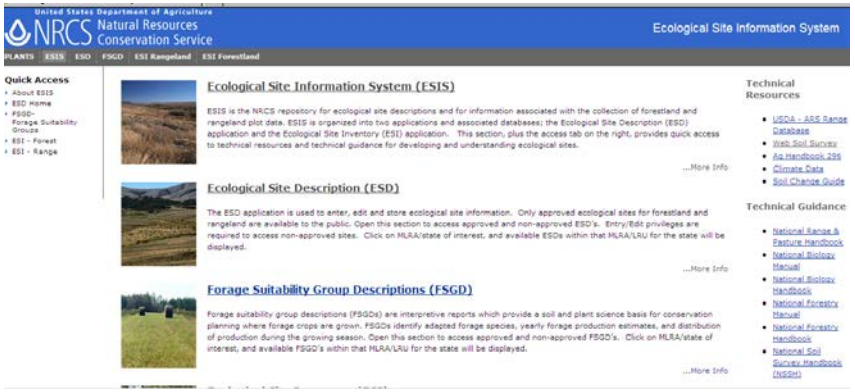
ESD Benefits/Impacts

Strengthened program support *(CRP, EQIP, CSP, ACEP)*

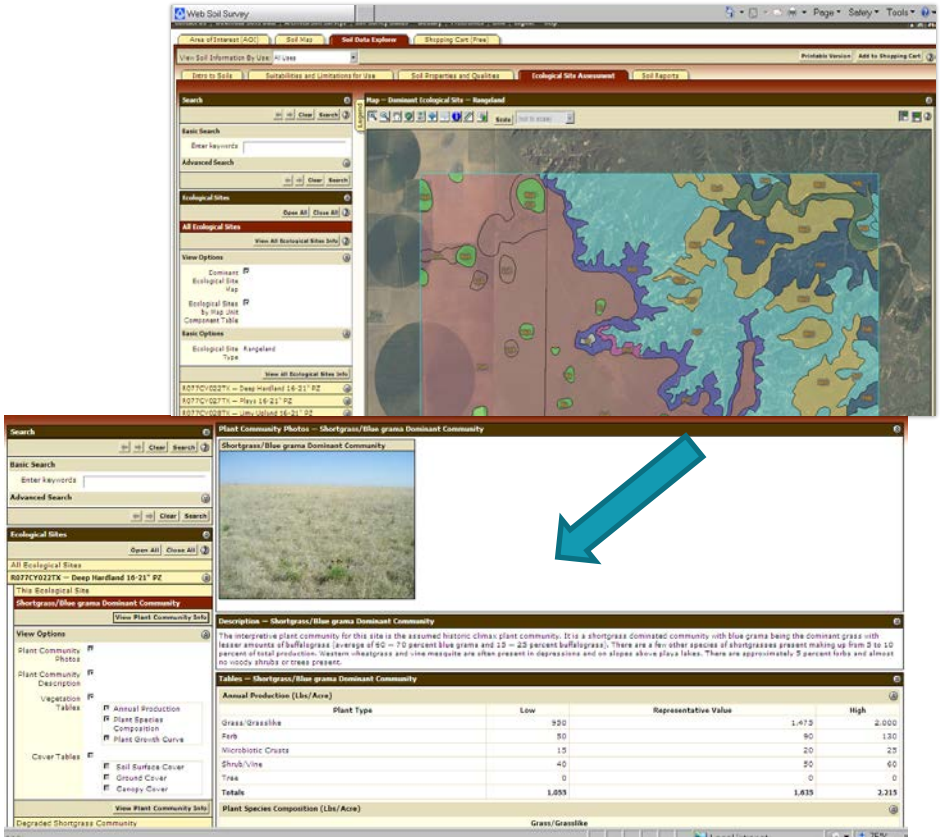
Enhanced application/natural community development *(e.g. 643, 645, 657, CP25, ANM 21)*

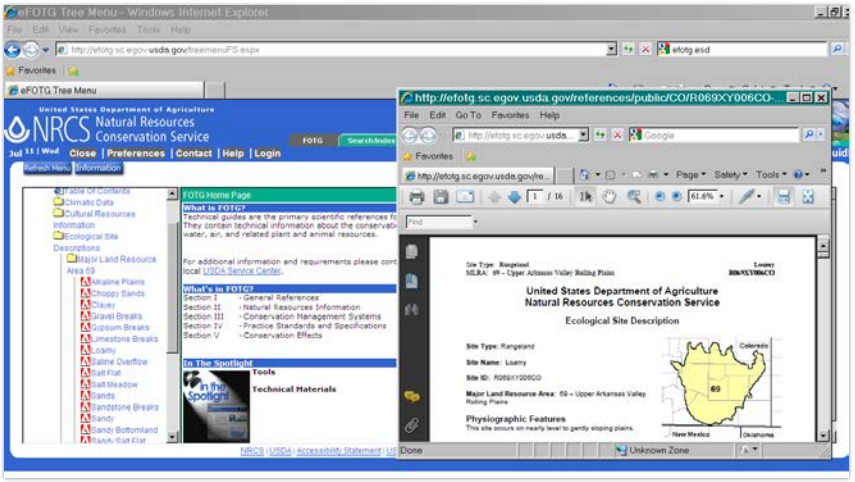
Availability of ESDs

1. ESIS Website: http://esis.sc.egov.usda.gov/



2. Web Soil Survey: http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm





3. NRCS state electronic Field Office Technical Guide (eFOTG)

In Progress: Ecosystem Dyamics Interpretive Tool
https://edit.jornada.nmsu.edu/page?content=about

Natural Resources Conservation Service
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Summary

- **Abiotic properties that drive site functions are important to identify for effective management and restoration**
- **Specific restoration targets and habitat requirements can be identified in a STM**
- **ESDs address ecosystem attribute questions through vegetation composition and structure tables, production estimates, and narratives**
- **Land managers can use transitions and pathways identified in STMS as management tools to shift ecosystem functions and vegetation communities towards desired outcomes**
- **Not all alternative states are restorable, focus management resources**
- **ESDs can be found (*various stages of* d*evelopment*) at:**
  - https://esis.sc.egov.usda.gov
  - *Web Soil Survey*
  - *NRCS state Field Office Technical Guides online*

Questions?