Applied Eco

Durable Solutions for More Than 35 Years

Shullsburg Mine: A Case Study

the journey to a fully reclaimed wildlife habitat site; secure, aesthetically compatible, ecologically functional, and geomorphically resilient

Presentation to
American Society of Mining & Reclamation
June 16, 2014

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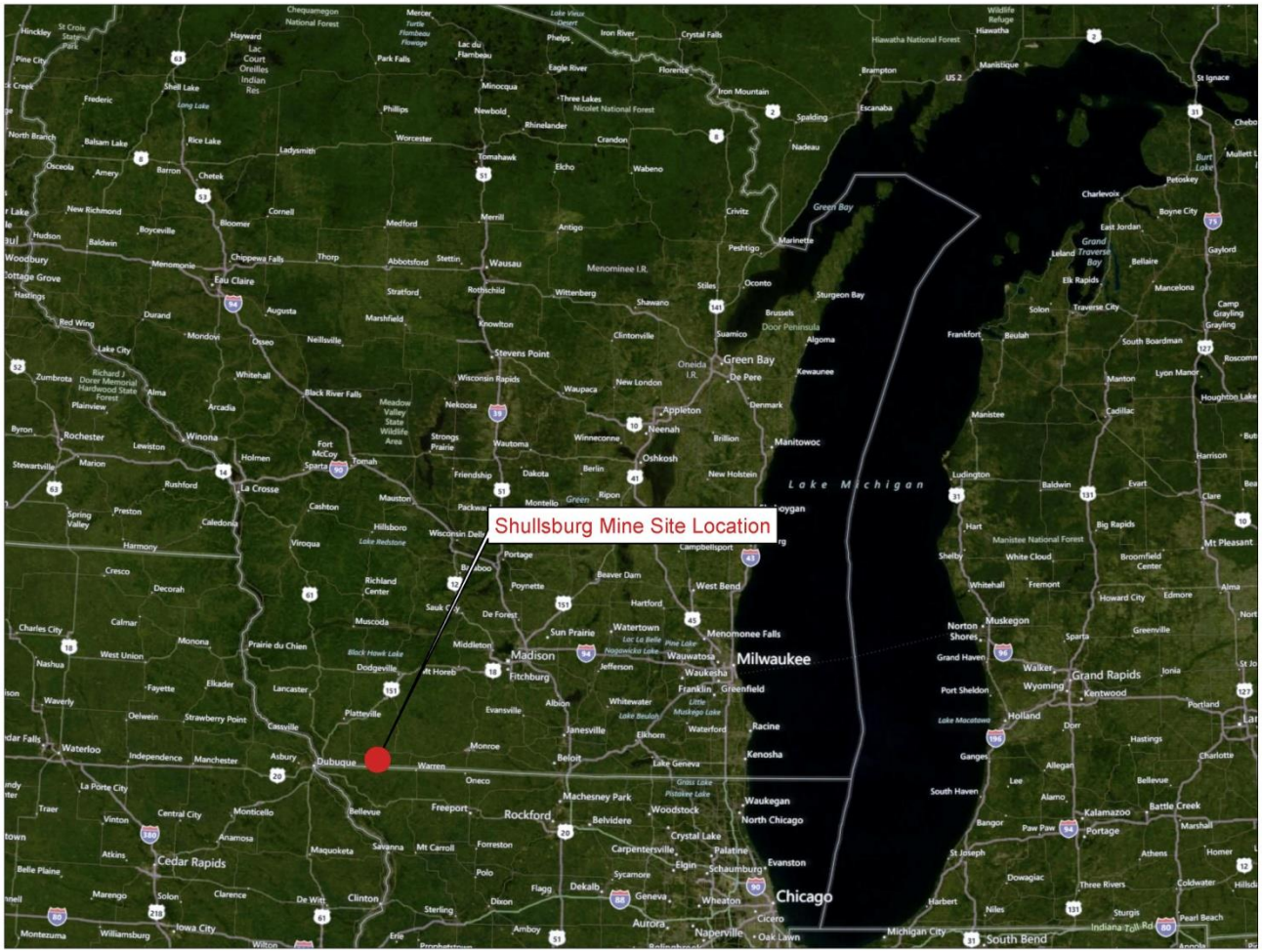
Brodhead, WI

Presentation Overview

- Upper Mississippi Zinc-Lead Mining District
- Shullsburg Mine History and Operations
- Closure Process and Certificate of Completion
- Long-term (20 year) Care Period
- Wildlife Habitat Plan
- Henslow's Sparrow, T&E Species Occupies

Shullsburg Mine Location



Shullsburg Mine

Shullsburg, Layfayette County, Wisconsin

Regional Context Map

0 15 30 60 Miles

1 in = 32 miles

To Scale When Printed at 11"X17"

N

Map Date: 2/26/2013

Map By: D. Aslesen

AES Proj.#: 07-0783

Name: 14_Regional_Context

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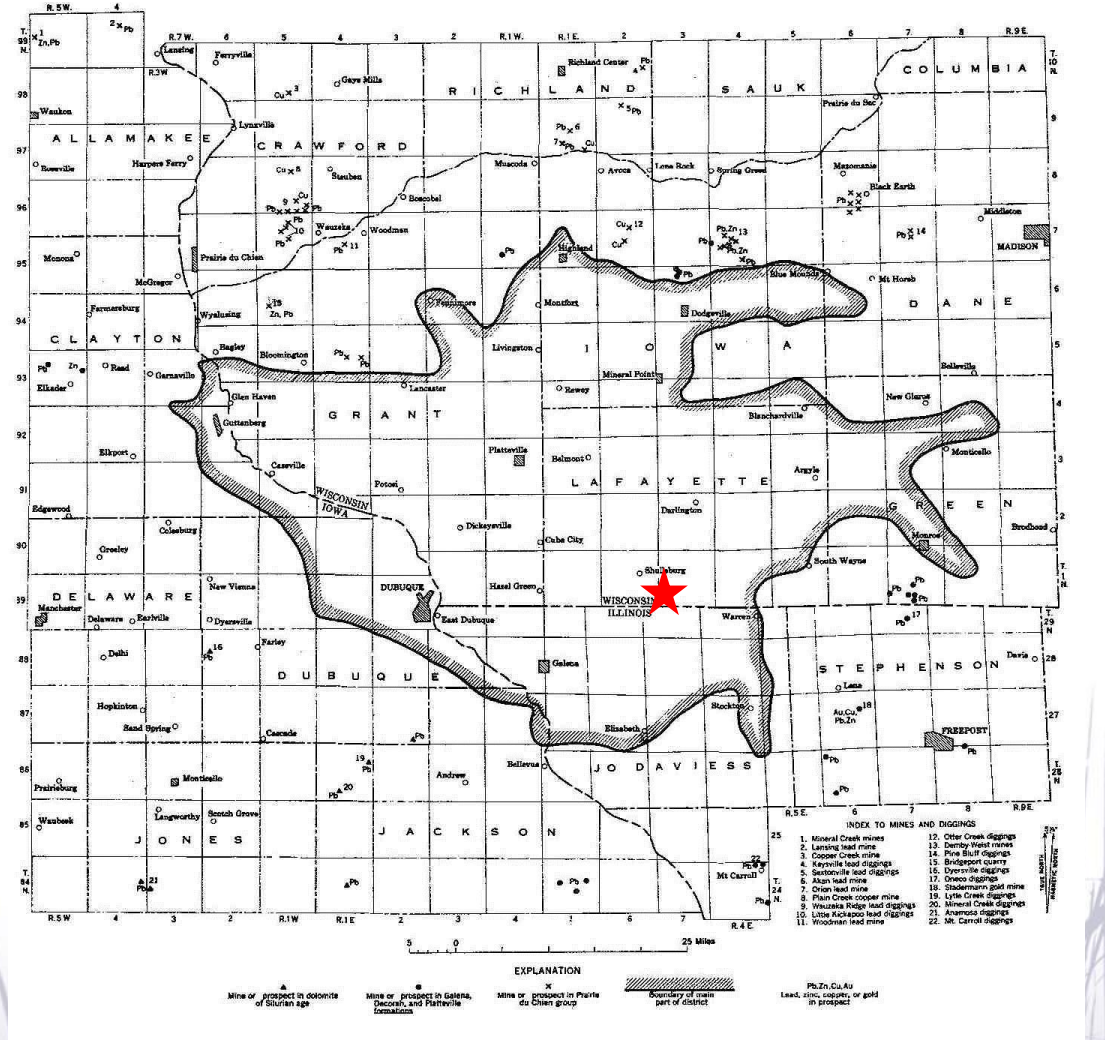
Upper Mississippi Zinc-Lead Mining District



- Mining more or less continuous for the last 300 years – oldest continuously producing district in US
- Major lead producer in early 19th century – "Lead rush" in Upper Mississippi Valley by mid-1830s
- With newer technology in 1850's, miners began extracting zinc from same areas
- Eagle-Picher Industries, Inc. was one of the principle producing companies in the 1960s – a decade when nearly 30 mines were in operation in the district
- The District probably contains as much undiscovered ore in the ground as has been mined in the past though the area has not been thoroughly explored using modern geophysical methods

Map Source: Heyl and others, 1959, fig. 101

Shullsburg Mine Site

Shullsburg founded by an early miner, Jesse Shulls, about 1822

Shullsburg Mine

Shullsburg, Layfayette County, Wisconsin

Regional Context Map

Miles

0 0.25 0.5 1

1 in = 1 miles

To Scale When Printed at 11"X17"

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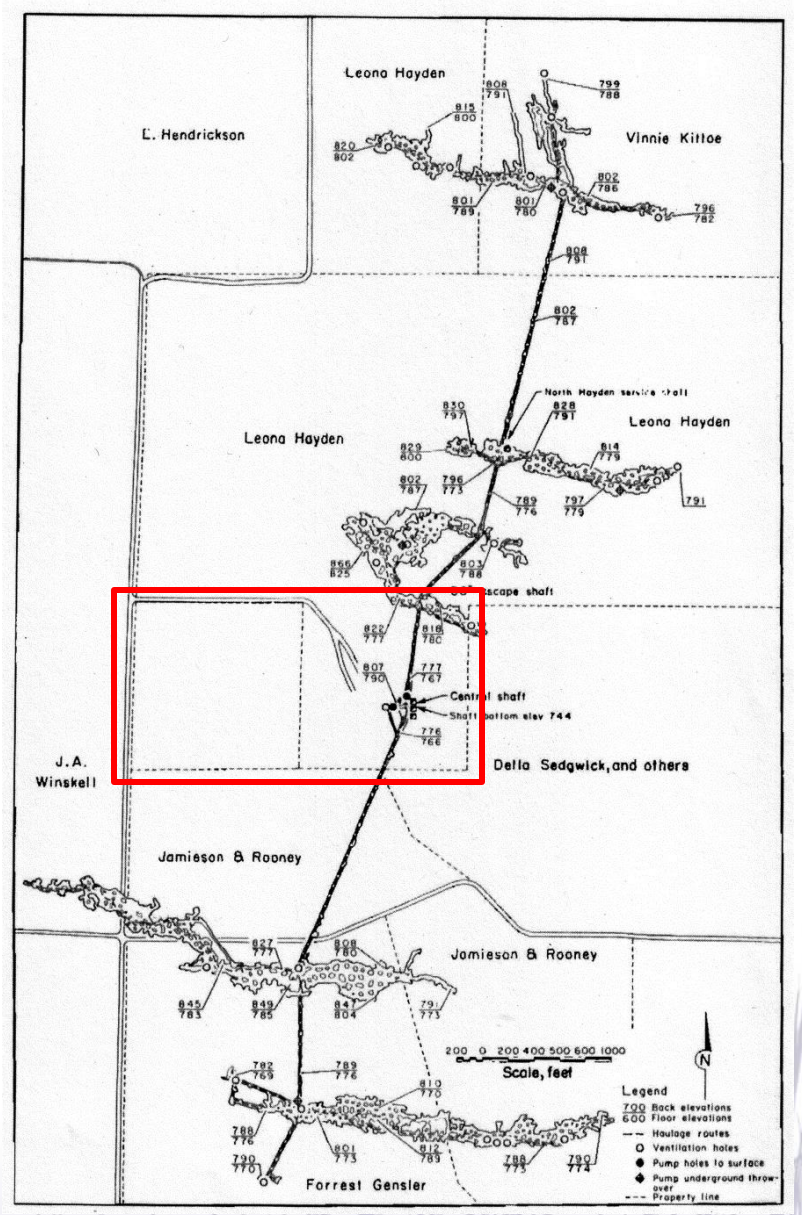
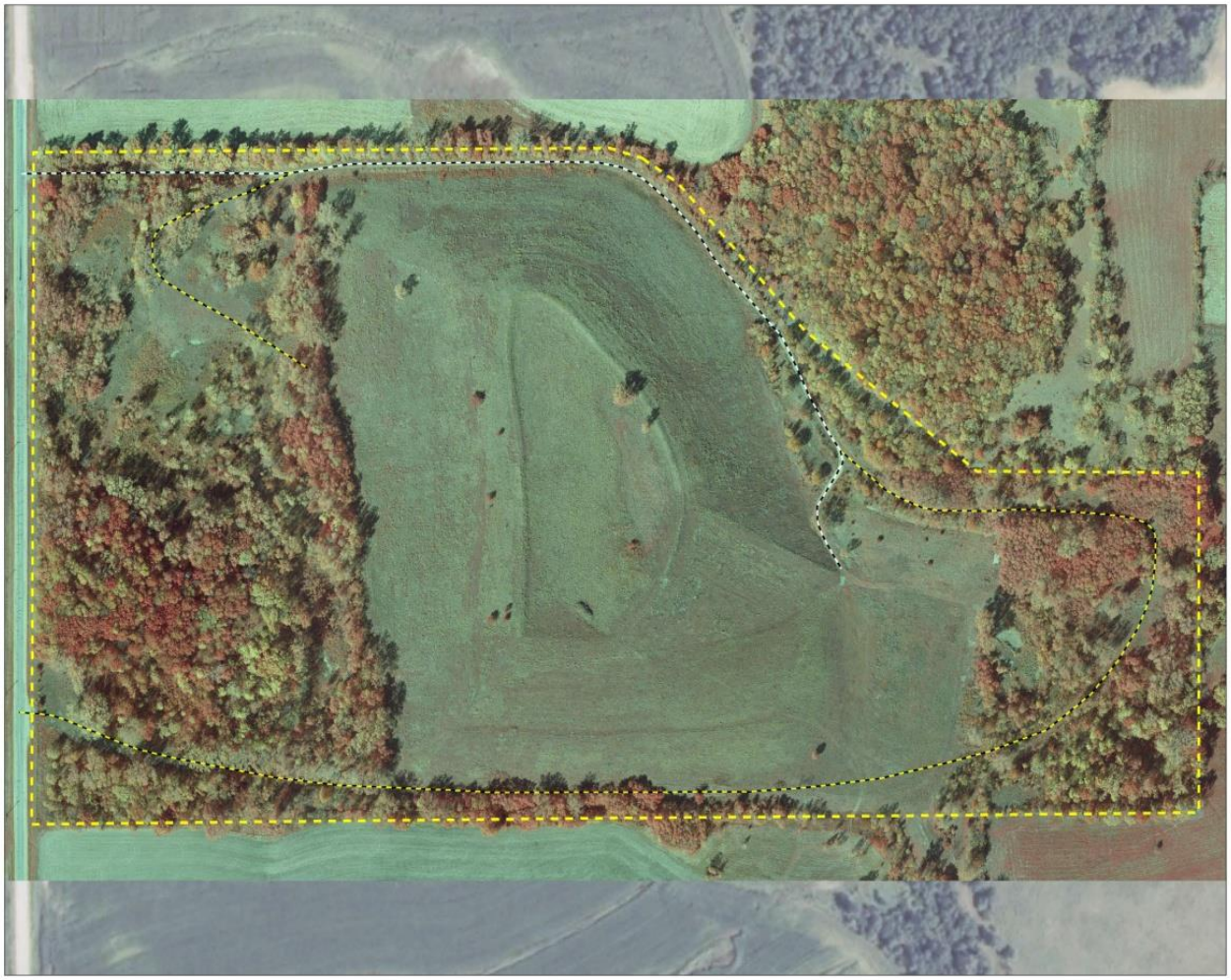


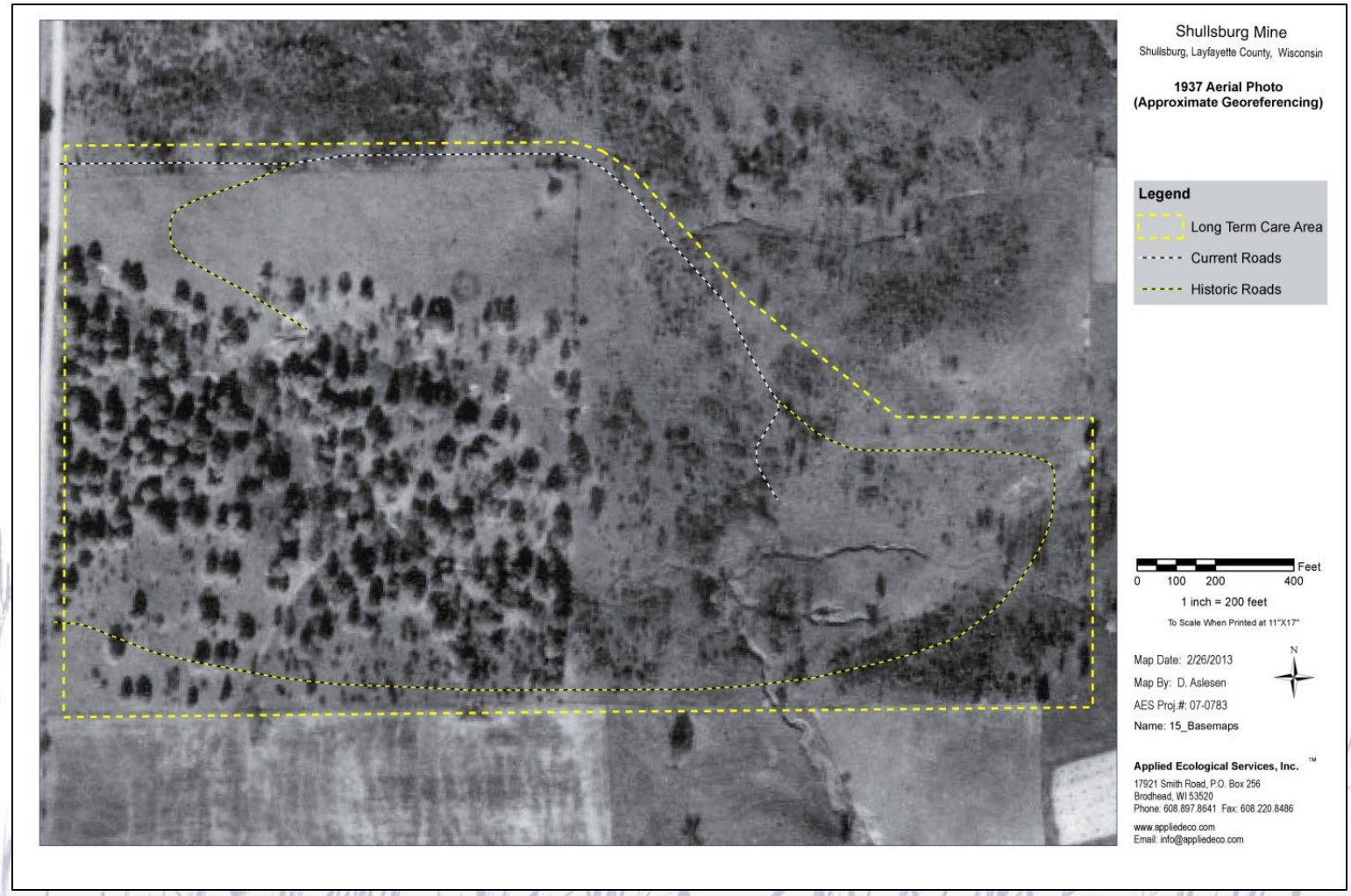
Shullsburg Mine: Site History

- **1948** - Calumet Corporation secured mining leases and assigned to the Calumet and Hecla Consolidated Copper Company same year.
- 1954 - Assignment of mining lease to the Eagle-Picher Company.
- April,1978 - WDNR issues mining permit to Eagle-Picher .
- 1979 - Mining Operations continued.
- 1981 - Assignment of lease to Inspiration Development Corporation.
- 1989 - Mill and jig tails merchantable by-product sales ended.
- 1995 – mill site structures removed/site stabilized, mine shafts and inclines sealed, and tailings pile partially vegetated.
- 2002 – WDNR issued notice of noncompliance with the Reclamation Plan.
- **2014** – WDNR issued the Certificate of Completion/initiated 20-yr Long-term Care Period.

CIR aerial imagery of the Shullsburg Mine site. Surrounding land use predominately row crop agriculture with scattered oak woodlands in various states of degradation.



A 1937 aerial image depicting historic oak savanna conditions in the southwest section of the site. Note historic stream pathways also.



Site During Active Operations - 1964

Shullsburg Mine

Shullsburg, Layfayette County, Wisconsin

Oblique Aerial Photo
November 3, 1964

Photo and annotations courtesy of John Welu.

Facility Legend

Map Label	Description
1	Incline into mine
2	CAP House
3	Pond Area Hillside Washed out 2002
4	Storage floatation tailings
5	Milling Operation Area
6	Crushed Ore Storage Silo
7	Main Crusher
8	Mill Chemical Storage Bldg
9	Electrical Transformer Station
10	Truck Scales
11	Warehouse Bldg
12	Powder House
13	Change House
14	Maintenance Bldg
15	Maintenance Bldg (not shown)
16	Maintenance Bldg
17	Compressor Bldg
18	Settling Pond
19	Tailings Pump
20	Jig Tailings (Coarse Rock)

AES Proj.#: 07-0783
Map By: D. Aslesen
Map Date: 2/26/13

Name: 11_Historical_Mapping_Oblique

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WDNR Regulatory Authority

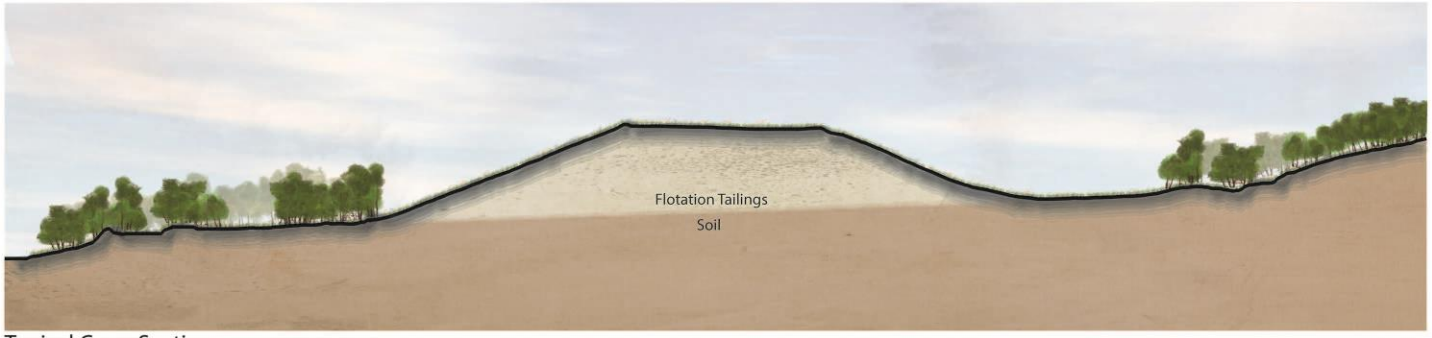
- Wisconsin Statute
  - Mining law is contained in sections 293.01 – 293.95 (Metallic Mining Reclamation Act)
- Wisconsin Administrative Code
  - Chapter NR 132 – Metallic Mineral Mining
  - Chapter NR 182 – Metallic Mining Wastes
  - Chapter NR 289 – Solid Waste Facilities

Site After Closure – Early 1980s

Site Closure and Reclamation – 1980s

Site Closure and Reclamation – 1980s

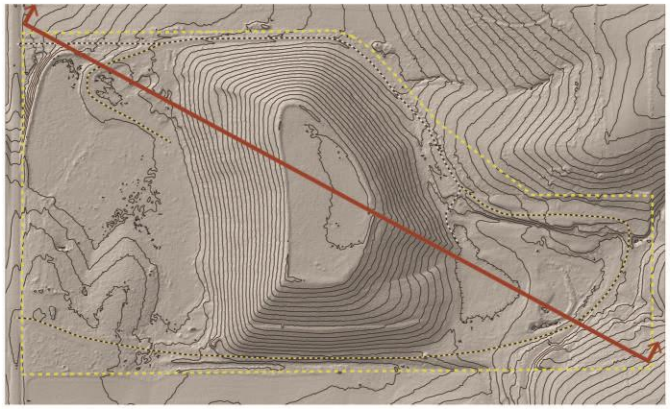
Cross-Section View of Site



Typical Cross Section

Horizontal Scale: 1″=200′ 0′ 200′ 400′

Vertical Scale: 1″=100′ 0′ 100′ 200′



Reference Plan

1″=400′ 0′ 400′ 800′

Site in 1987 with Merchantable Byproduct

AES Began Site Management in 2006

AES Management 2007-2012

- Annual Site Inspection and Reporting
- Treatment of Red Spots on Tailings Pile
- Vegetation Management on Tailings Pile
  - Woody Species Removal
  - Treatment of Invasive species
- Quantitative Monitoring
  - Soils and Vegetation Monitoring in Support of Certification of Completion process
  - All performance criteria met in 2012 for COC

Site After Reclamation Complete (2012)

Certificate of Completion Process Monitoring Period Performance Standards

Plant Cover and Diversity

✓ ≥ 50% plant cover sampled within quadrats shall be native species
Findings plant cover compliance:
Total cover on the site was composed of 51% native species

✓ ≥ 15 native species shall be documented in combined quadrat data and species lists
Findings plant diversity compliance:
28 of the 41 species (68%) were composed of native species

✓ ≥ 95% of all non-native, aggressive tree species (such as black locust, Siberian elm, and box elder) shall be removed across the entire site.
Findings woody species removal compliance:
Eastern cottonwood and Scotch pine comprise a canopy < 0.25 acres. All invasive black locust, Siberian elm, and box elder have been removed from the grassland slopes on the tailings pile

Certificate of Completion Process Monitoring Period Performance Standards

Soils

✓Soil analysis results shall indicate:

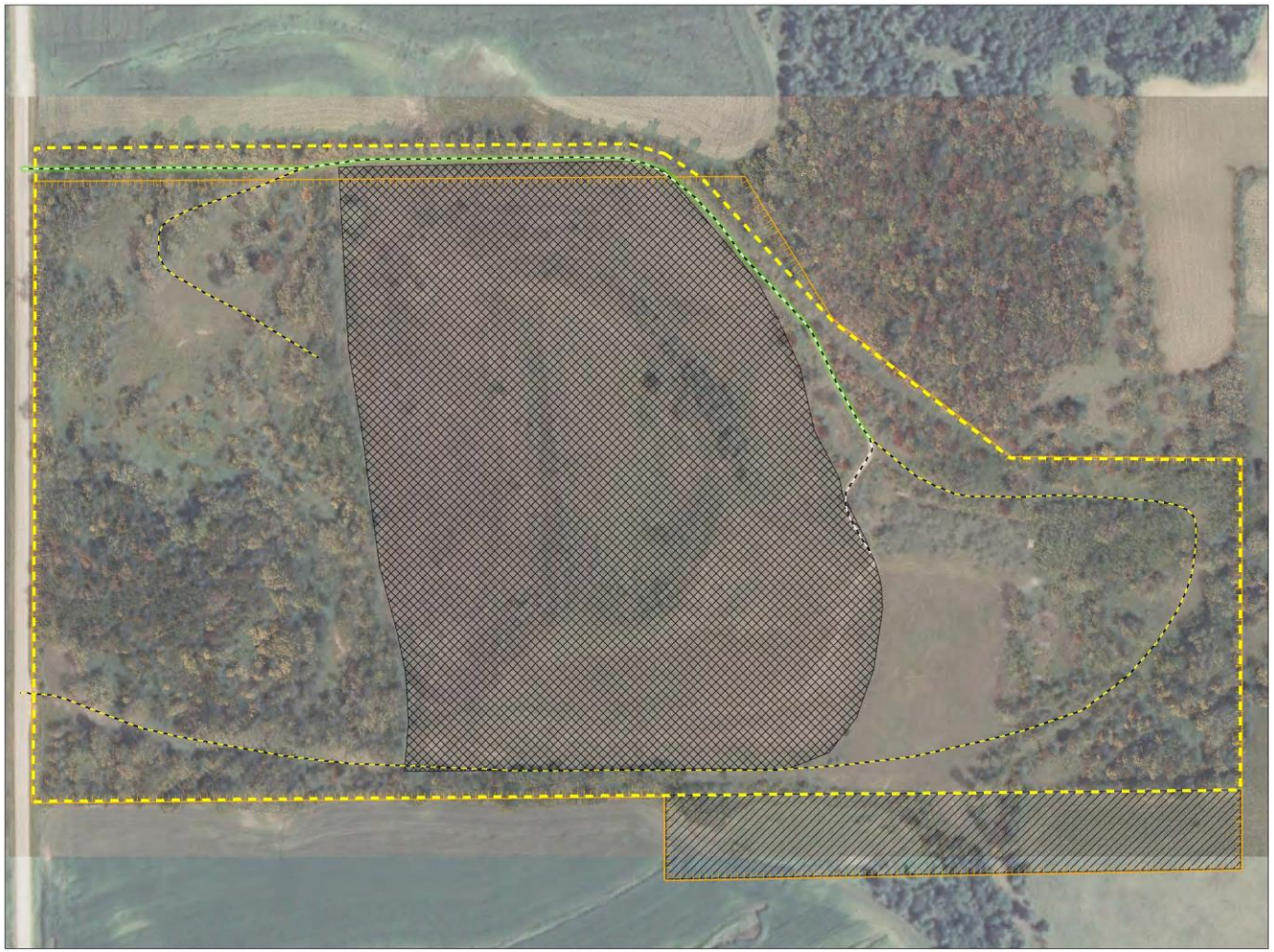
- ✓organic matter content of 1% or greater;
- ✓average pH value no less than 6.5; and
- ✓sufficient nutrient levels for plant growth.

Findings:

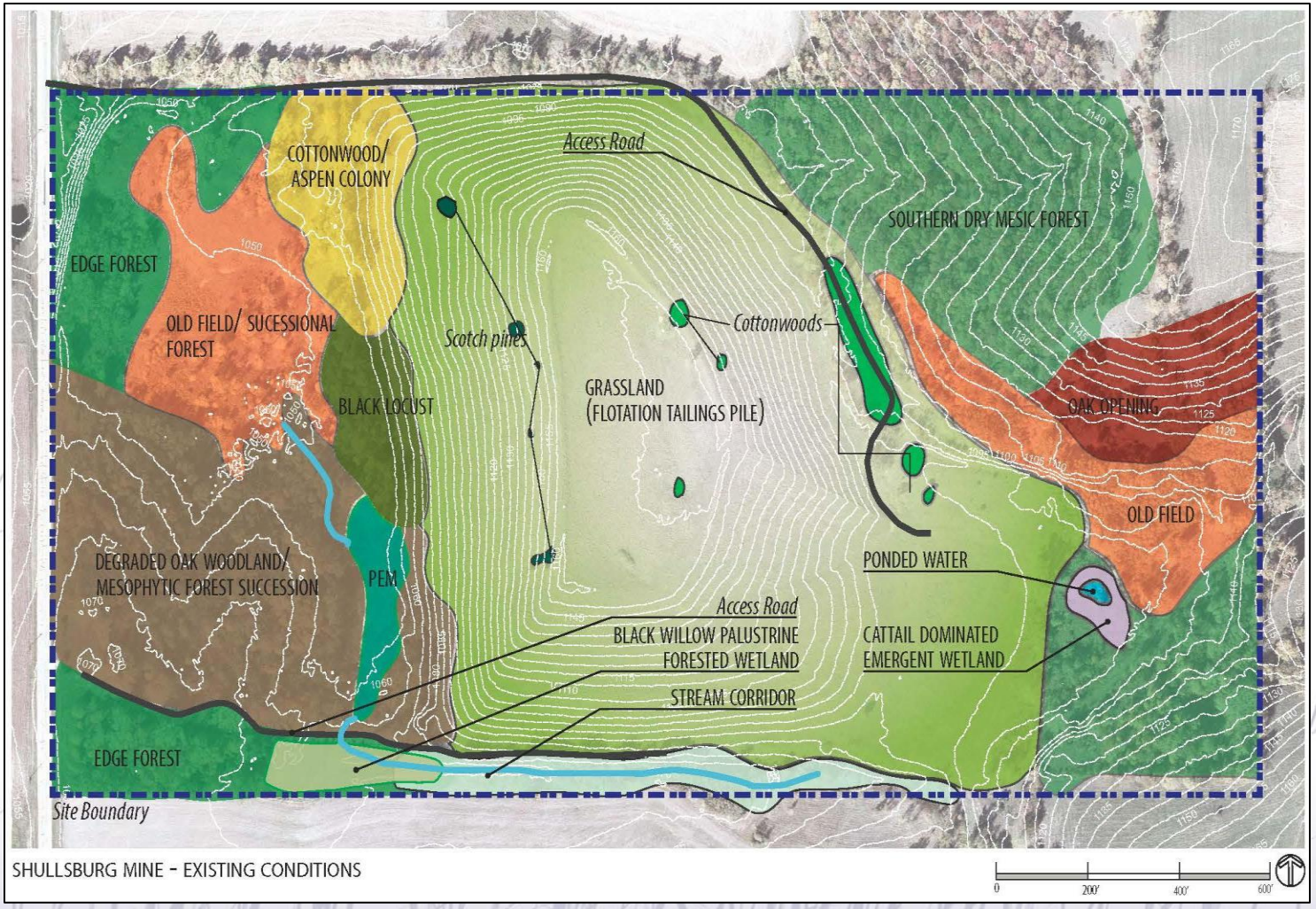
- ✓ **Organic matter content of 1.5%;**
- ✓ **Average pH value 7.0; and**
- ✓ **Nutrient levels: Average phosphorus levels > 20 ppm while average potassium levels were 19 ppm. The nutrients are at an adequate level to sustain vegetation on the site during the long-term care period, though Potassium is slightly less than the optimum level.**

UW Extension Soil Test Recommendations (Publication A2809), optimum Phosphorus for plant growth = 20-30ppm range and the optimum Potassium for plant growth = 60-90ppm range

Certificate of Completion Map



Existing Conditions, Shullsburg mine site.

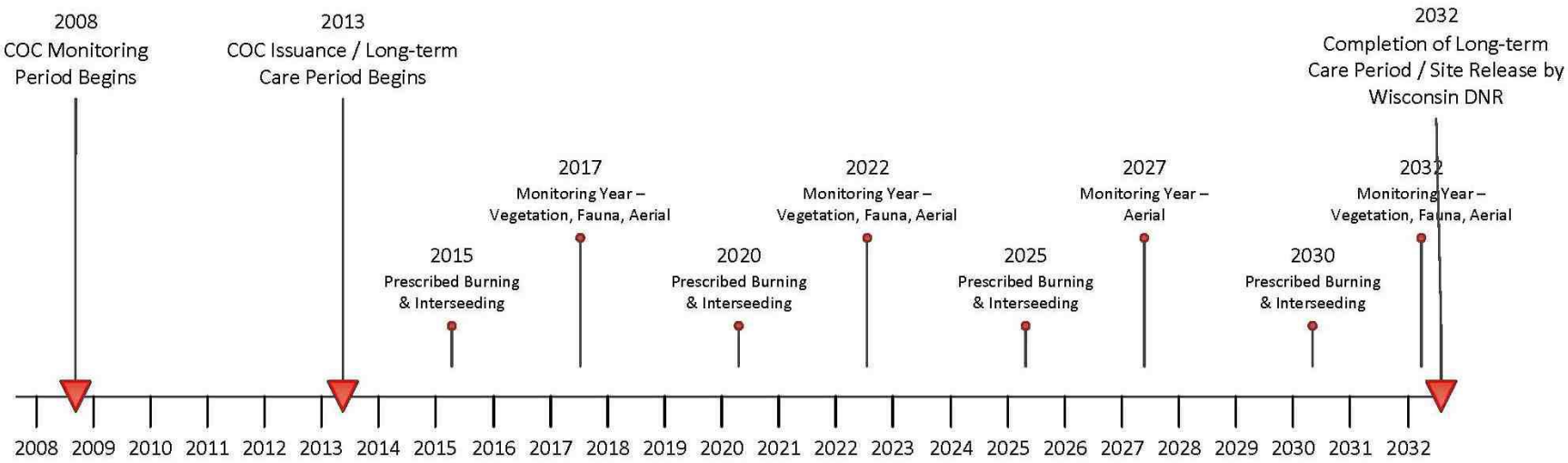


Long-term Care and Monitoring

Pursuant to Wisconsin codes and statutes, long-term monitoring and care (management and maintenance), implemented during the 20-year period will include:

- Closed mine site with secured perimeter.
- Vegetatively stabilized tailings mound.
- Maintenance of grassland, wetland and surrounding forest/savanna habitat which provides diverse wildlife habitat.
- Aesthetically pleasing naturalized landscape for educational use.
- Ingress/egress for maintenance and inspection.
- The program will employ "adaptive management." Regular monitoring will provide immediate feedback on maintenance needs and on the program's overall effectiveness.
- Annual reporting.

COC and Long-Term Care Timeline



2008-2012 COC Monitoring Period

- Annual Site Inspection and Reporting to DNR
- Annual Veg Mgmt
- Red Spot Treatment
- Annual Monitoring

2013-2032 Long-term Monitoring and Care Period

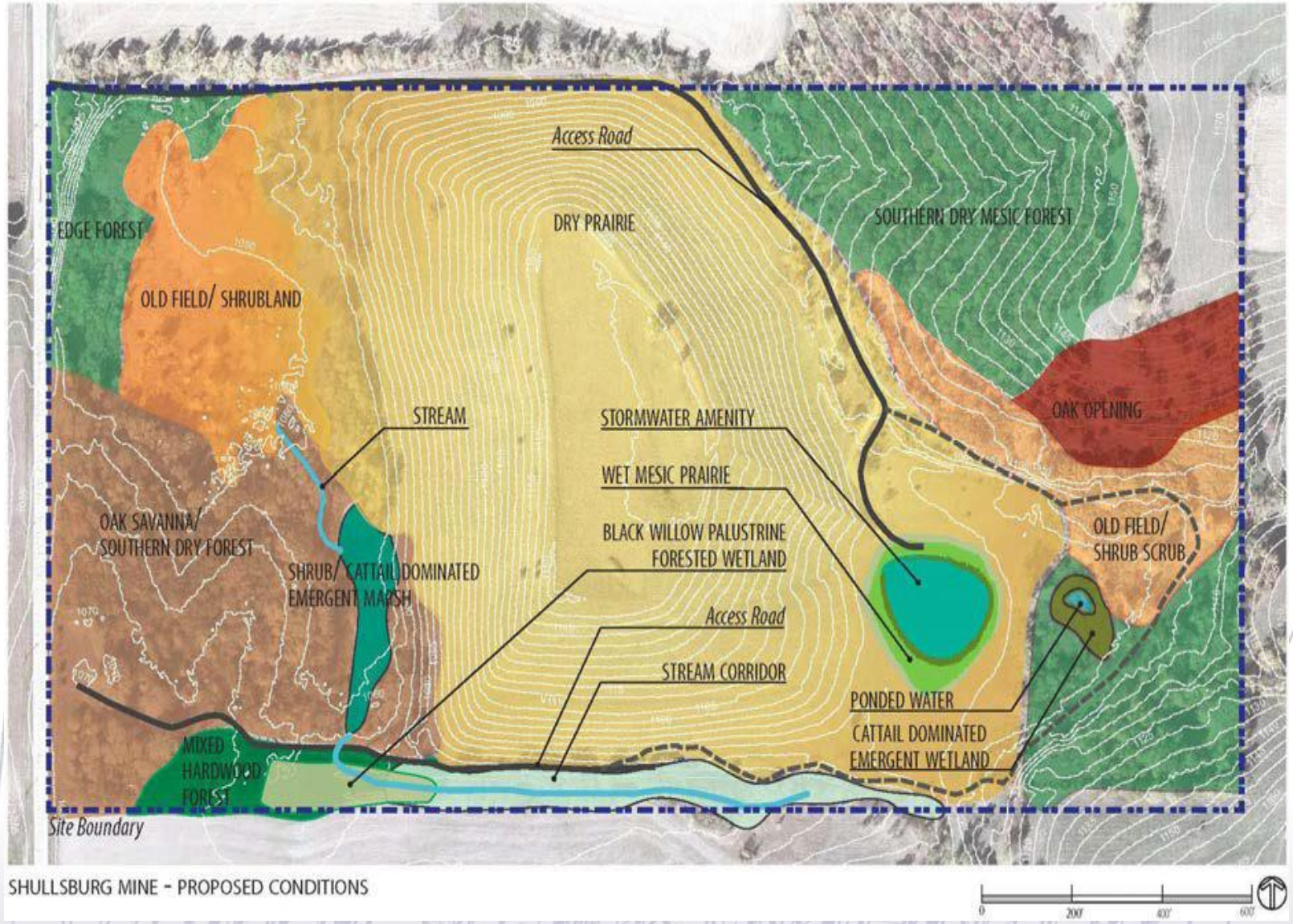
Annual Monitoring and Care Activities on Site

- Site Inspection and Reporting to Wisconsin DNR
- Vegetation Management and Maintenance

Annual Contingency Activities on Site

- Red Spot Treatment

Wildlife Habitat Management Plan for Shullsburg Mine



Dry Prairie

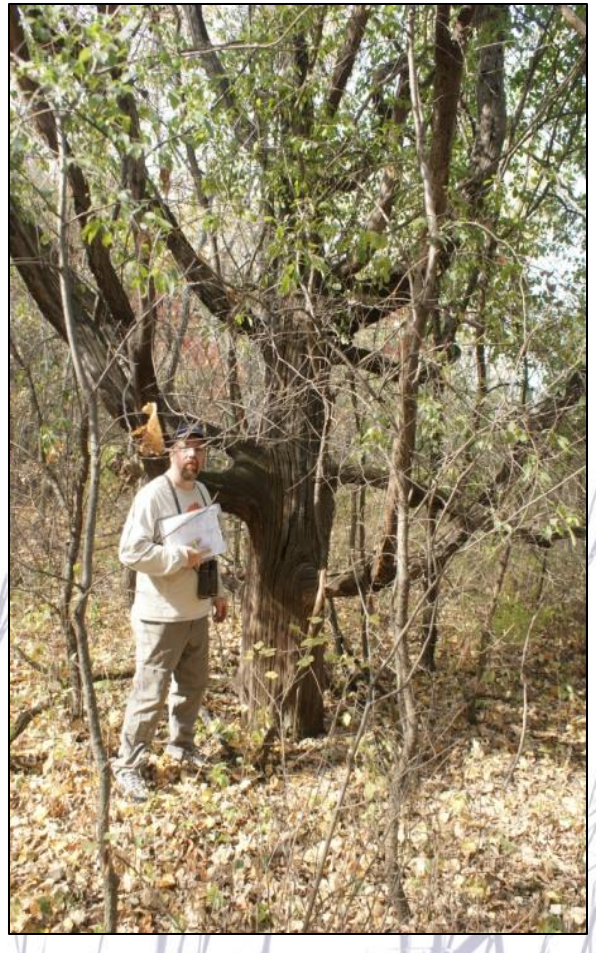
Dry prairie grassland on the tailings mound slope; dominant species are smooth brome (*Bromus inermis*) prairie switchgrass (*Panicum virgatum*) and little bluestem (*Schizachyrium scoparium*).

Top of the mound is good grassland habitat.

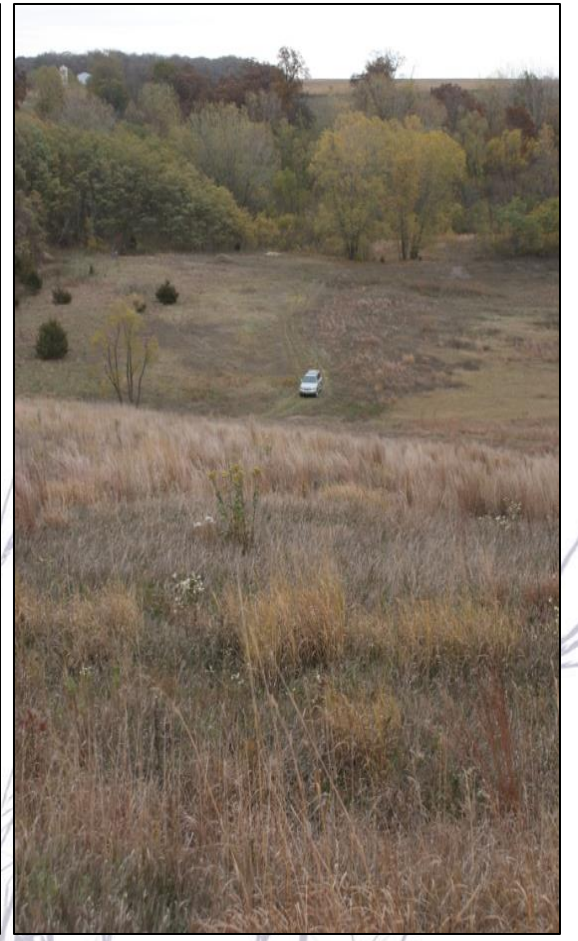
Typical mammal burrow entrance on the mound slope. Excavation piles of abandoned burrows provide nesting habitat for oviviparous snake species.

Old Field

Old Field w/ successional eastern red cedar trees in the background and sapling cottonwoods in the foreground.

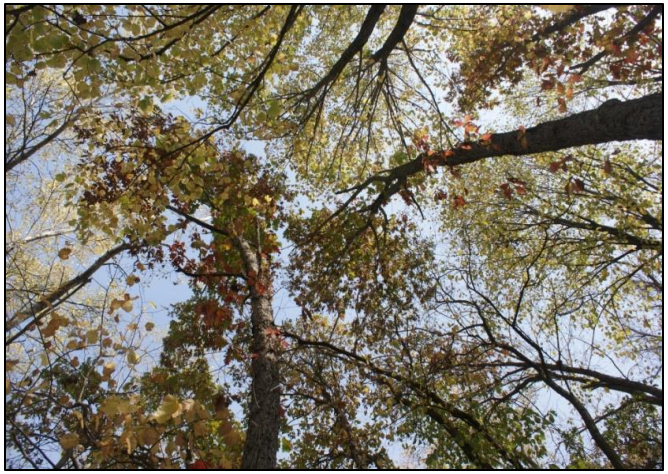


AES Ecologist next to suffocated oak tree in the NW old field (former sediment basin.



Connectivity between the east-facing slope and an adjacent patch of dry prairie grassland

Woodland

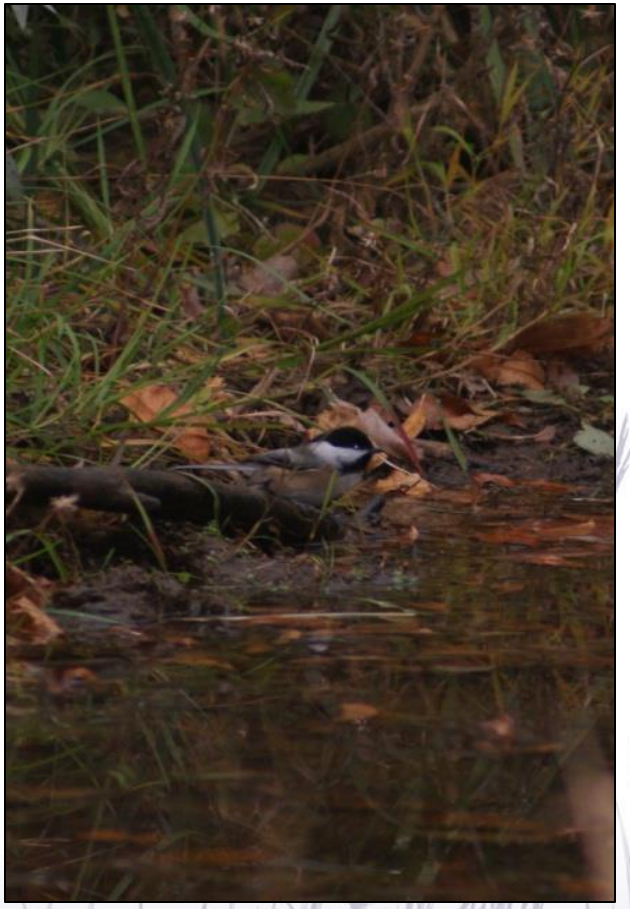


Canopy of mixed hardwood trees found in onsite southern dry-mesic forests.

A sprawling bur oak indicative of savanna conditions during growth.

Fire-suppressed oak savanna on site. Note heavy organic layer on the forest floor.

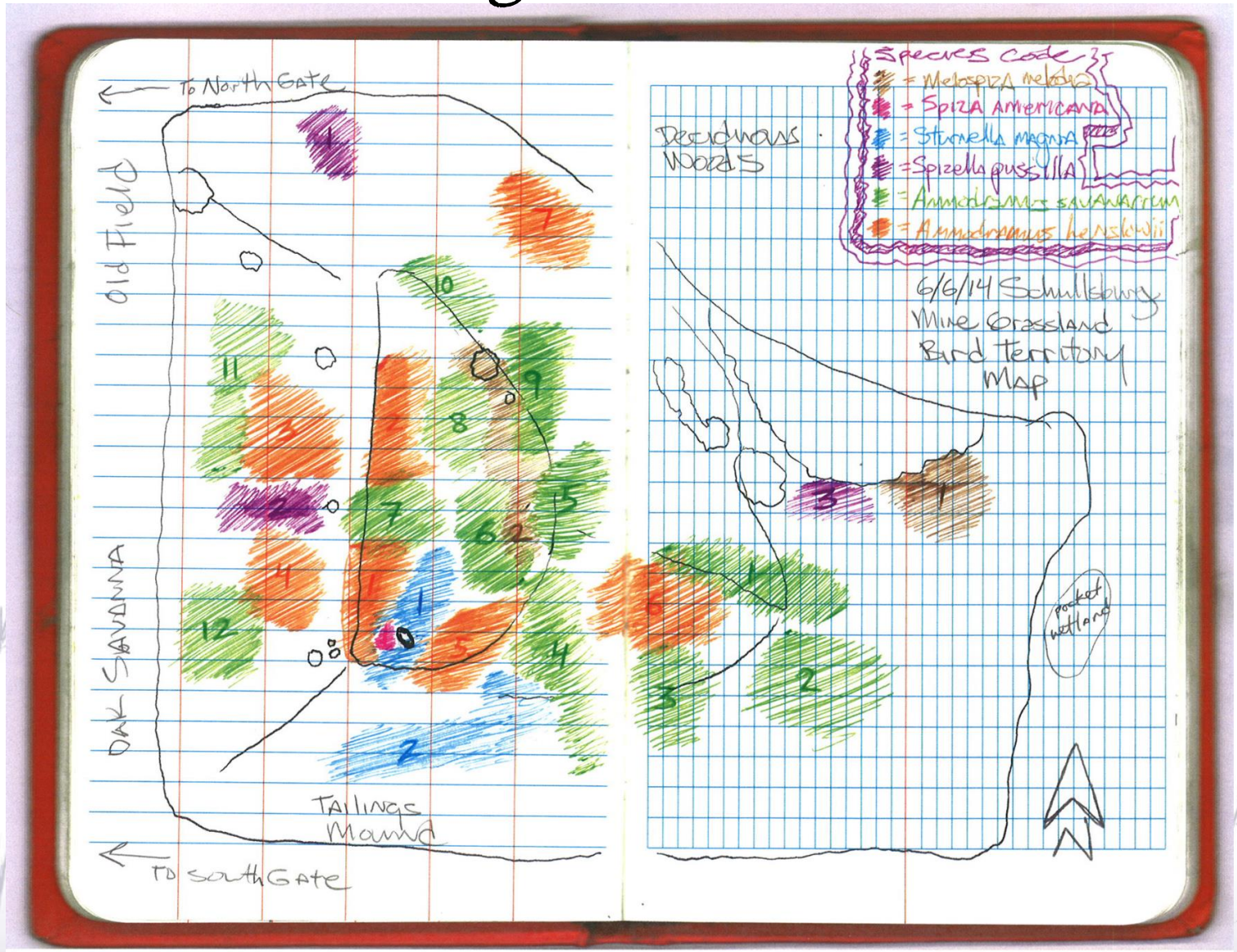
Stream & Wetlands



Black-capped chickadee drinking water from the perennial stream on site.

Cattail-dominated portion of the onsite wetland.

Ecologist's Field Book



SONG SPARROW (Melos*piza melodia),* DICKCISSEL (*Spiza americana),* EASTERN MEADOWLARK (*Sturnella magna*), FIELD SPARROW (*Spizella pusilla*), GRASSHOPPER SPARROW (*Ammodrammus savannarum*), HENSLOW'S SPARROW (*Ammodrammus henslowii)*,

,

Photo © Tom Schultz

Henslow's Sparrow (*Ammodramus henslowii*)

listed as Threatened in Wisconsin has suffered significant declines in many parts of its breeding range. It is an **obligate** grassland nester.

Management Guidelines: The U.S. population of this rare species has **declined** >68% from 1966-1991. The Wisconsin population has dropped an average of 5% per year. This **habitat specialist** that has suffered from the loss of a mosaic of patchy areas within tall, dense grassland vegetation. Henslow's sparrow ranked highest in the Wisconsin Grassland Bird Study's ranking of birds of management and conservation concern in the state. The control of woody vegetation is critical. And, because this species requires dense litter layers, it benefits directly from management that promotes short burning rotations. Burning should not occur more often than once in 3 years. **Patch burning** preferable.

Badger (*Taxidea taxus*): Wisconsin's state mammal

Badger ©Tom Prestby

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Thank You!

Questions?