

Brightside Farm Park

Ecoassessment and Ecological Restoration Plan

Charlestown Township

EAC and Public Meeting

February 8, 2023



Jessie Buckner (she/her), Certified Ecologist, MSAG
Project Manager | Ecologist

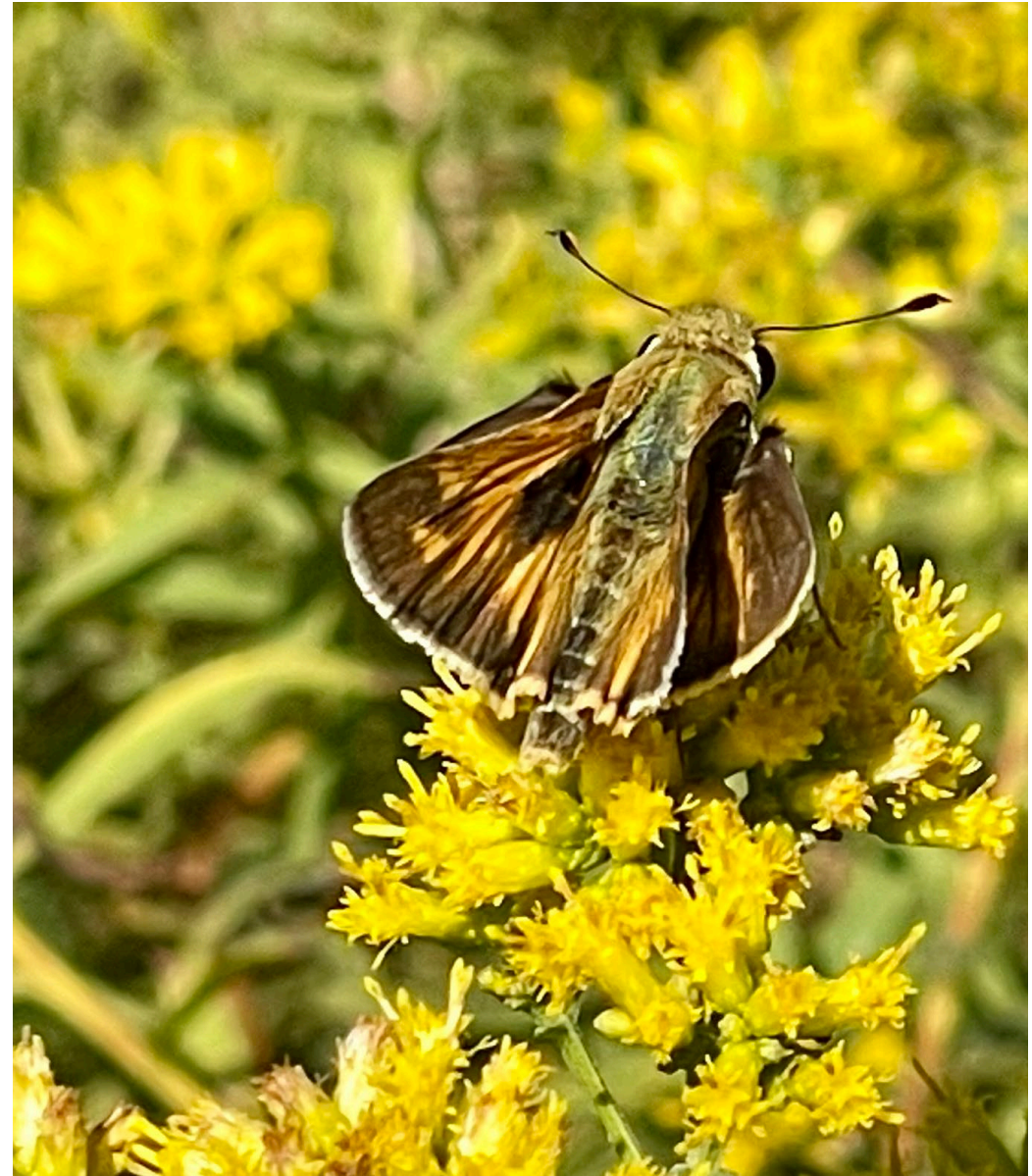
jbuckner@res.us

Michael J. McGraw (he/him) MES, QAWB, ACE
Senior Wildlife Biologist | Ecologist

mmcgraw@res.us

Agenda

- Who We Are
- Project Goals
- Process and Timeline
- Ecological Assessment
 - Methodology
 - Findings
- Ecological Restoration Plan
- Climate Change and Resilience
- Examples
- Questions and Answers



Who We Are

Our Team



Project Role

- Project Manager, Ecologist

Education

- MS Applied Geosciences

Project Experience: 10+ years

Certifications & Affiliations:

- Certified Ecologist- Ecological Society of America

Relevant Project Experience:

- Greer Park, Newtown Square, PA
- Laurel Hill Cemetery, Philadelphia, PA



Project Role

- Senior Wildlife Biologist, Ecologist, Ornithologist

Education

- MA Environmental Studies

Project Experience: 20+ years

Certifications & Affiliations:

- Qualified Airport Wildlife Biologist
- ACE

Relevant Project Experience:

- Longwood Meadows, Kennett Square, PA
- Seneca Meadows, Waterloo, NY

Who is RES?

RES is restoring a resilient earth for a modern world, project by project.



- Founded in 2007, inspired by notion that restoration can be a win/win for both humanity and the environment
- Nation's largest ecological restoration company, creating ecological uplift by doubling down on nature's own processes
- Pioneered how to make environmental mitigation markets work with a turnkey, total-stewardship business model
- Innovative ecological problem solvers dedicated to being long-term stewards of the earth



The ecological uplift of a mitigation project helps offset unavoidable impacts of infrastructure projects like highway expansions.

Restoring our land and waters



406

Mitigation sites



22,900,000

Trees planted



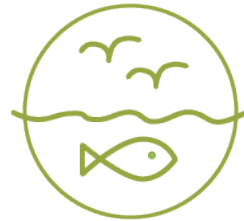
73,932

Acres of restored and protected lands



607

Miles of streams restored and conserved



20,200

Acres of special-status species habitats



292

Tons of water quality nutrient reductions

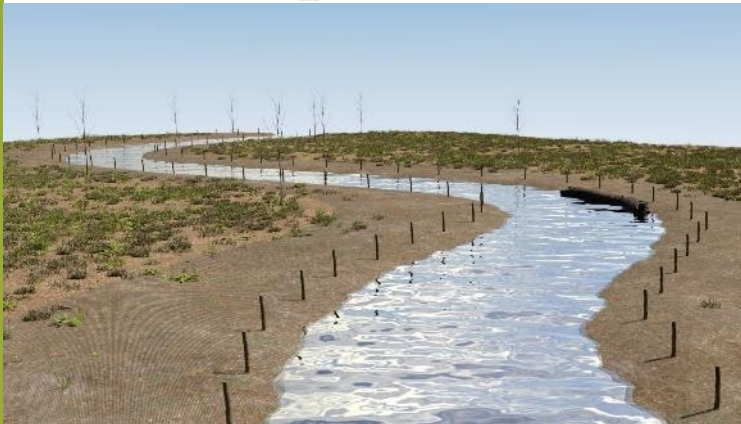
Stewardship

A long game, with resiliency as the prize

406

Mitigation sites

Designed and Built
since 2007



294

Mitigation sites

Under
Active Stewardship



112

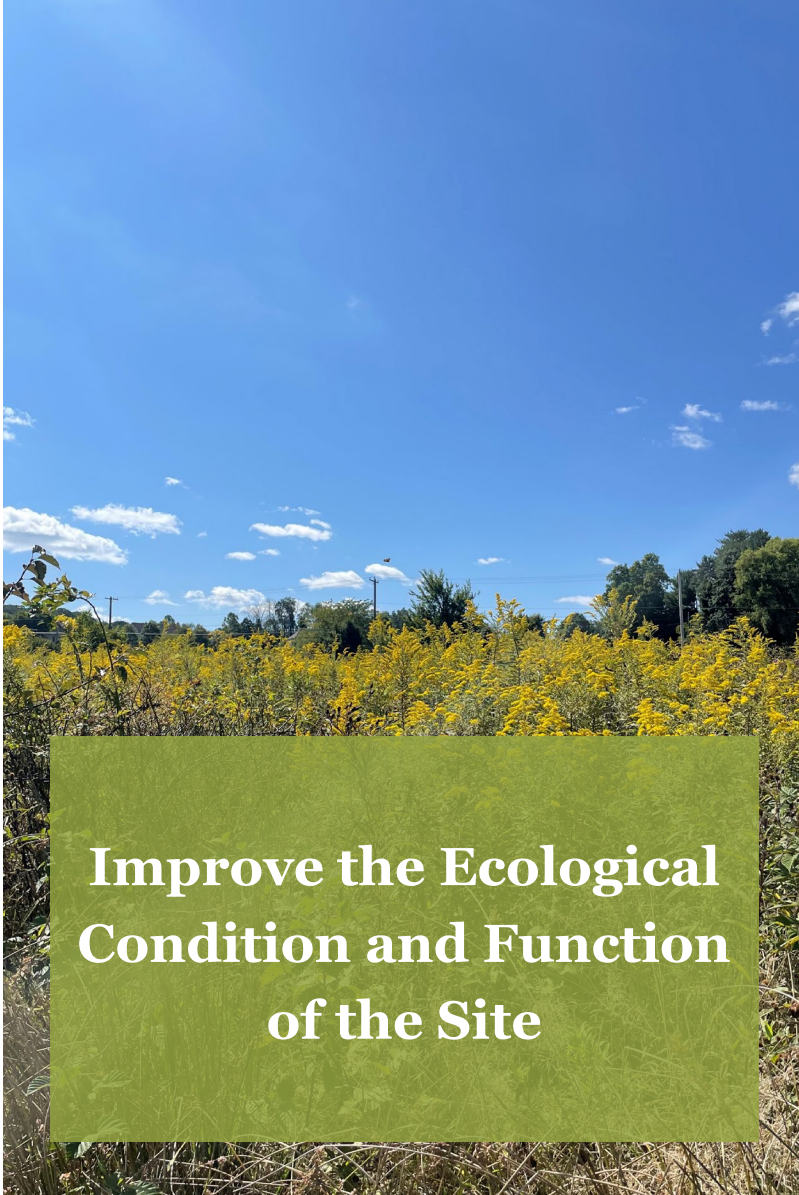
Mitigation sites

Self Sufficient,
Permanently Preserved



Project Goals

Project Goals



Importance of Grassland Creation/Stewardship

- Grassland birds are in alarming decline
 - Loss of habitat
 - Fragmentation of habitat
 - Invasive species
- PGC has major initiative to promote grassland habitat stewardship especially in SE PA

RESEARCH | REPORT

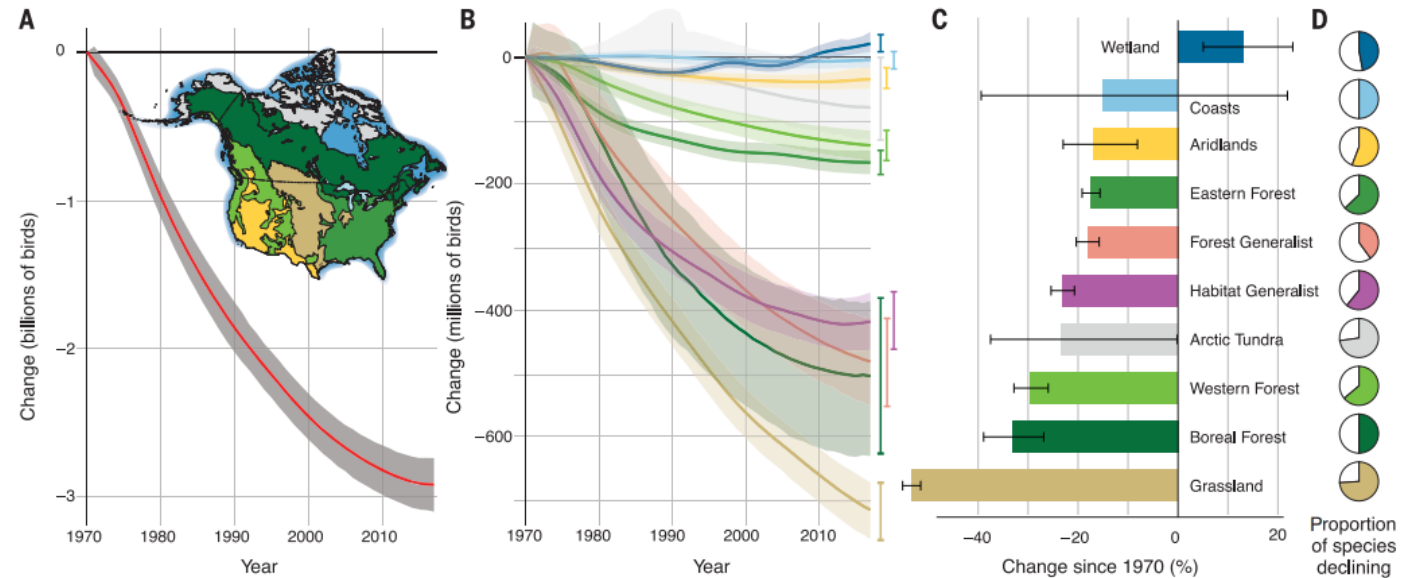


Fig. 1. Net population change in North American birds. (A) By integrating population size estimates and trajectories for 529 species (18), we show a net loss of 2.9 billion breeding birds across the continental avifauna since 1970. Gray shading represents the 95% credible interval (CI) around total estimated loss. Map shows color-coded breeding biomes based on

Bird Conservation Regions and land cover classification (18). (B) Net loss of abundance occurred across all major breeding biomes except wetlands (see Table 1). (C) Proportional net population change relative to 1970, $\pm 95\%$ CI. (D) Proportion of species declining in each biome.

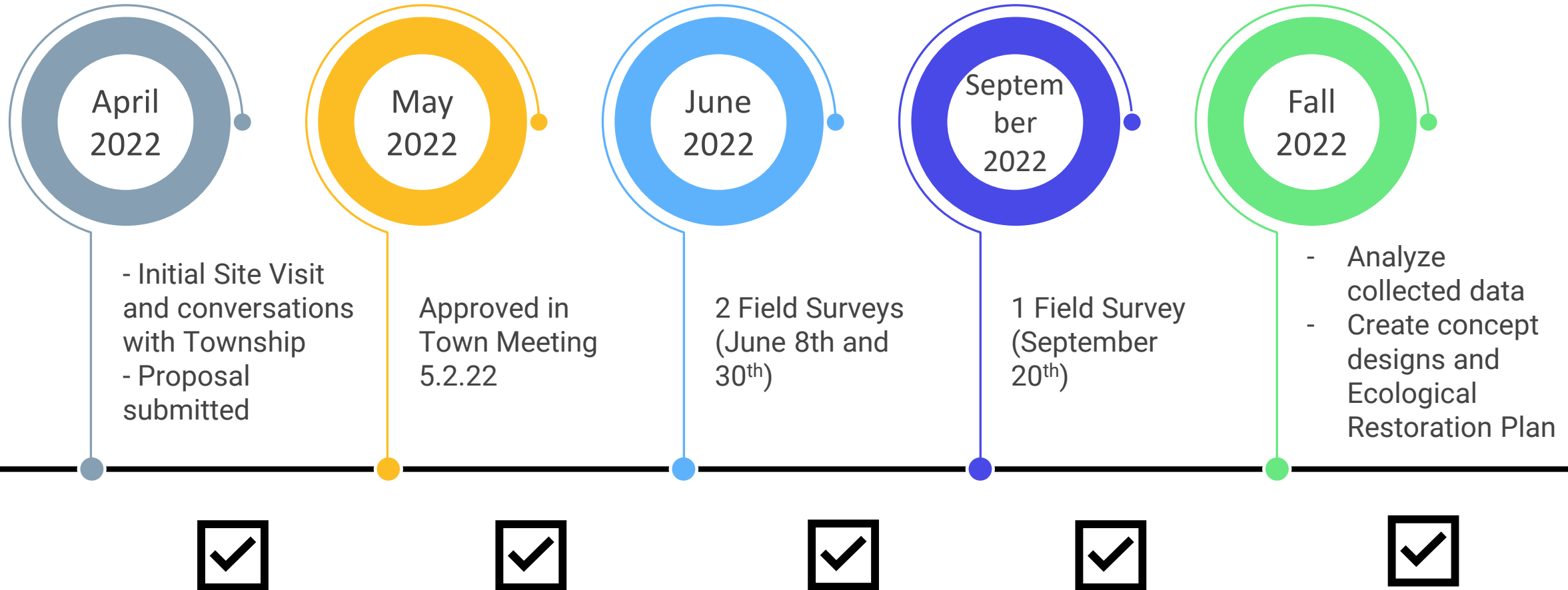
Importance of Grassland Creation and Stewardship

- Opportunity to slow the trend!
- Temperate NA Upland Grassland Birds = largest threat of extinction in the Americas!
- Aesthetics of a functional grassland are exceptionally stunning
- Other habitat enhancements for savanna, edge, wetland, and forest species incorporated as well

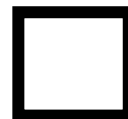
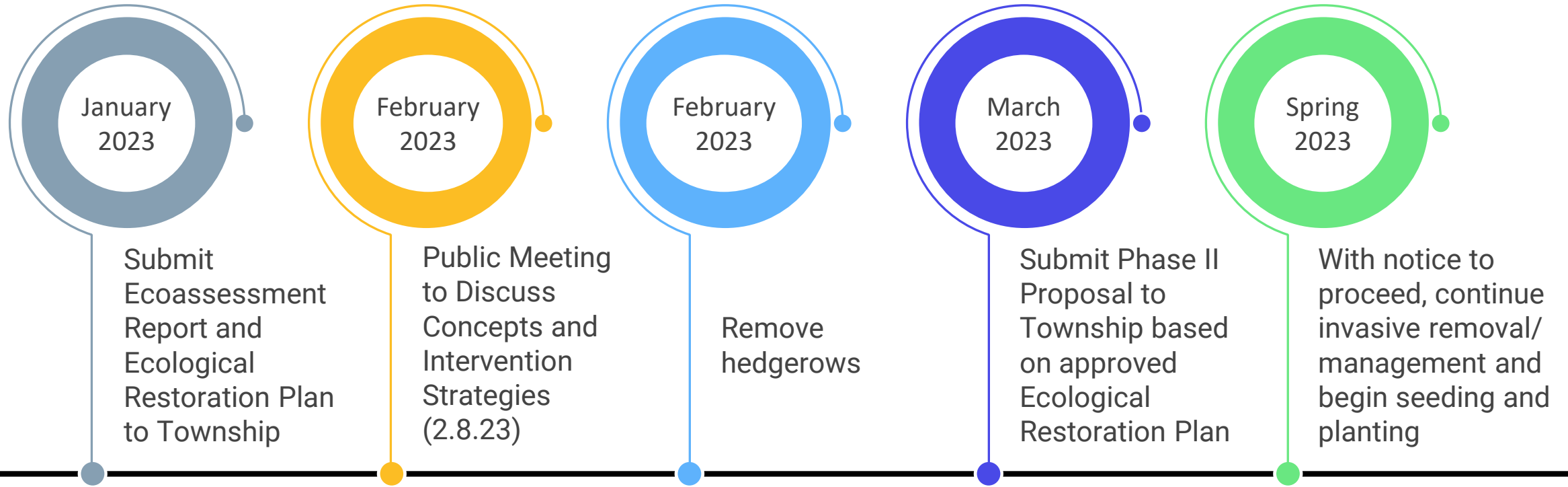
Species group	No. of species	Net abundance change (millions) and 95% CIs			Percent change and 95% CIs			Proportion species in decline
		Change	LC95	UC95	Change	LC95	UC95	
Species summary								
All N. Am. species	529	-2,911.9	-3,097.5	-2,732.9	-28.8%	-30.2%	-27.3%	57.3%
All native species	519	-2,521.0	-2,698.5	-2,347.6	-26.5%	-28.0%	-24.9%	57.4%
Introduced species	10	-391.6	-442.3	-336.6	-62.9%	-66.5%	-56.4%	50.0%
Native migratory species	419	-2,547.7	-2,723.7	-2,374.5	-28.3%	-29.8%	-26.7%	58.2%
Native resident species	100	26.3	7.3	46.9	5.3%	1.4%	9.6%	54.0%
Landbirds	357	-2,516.5	-2,692.2	-2,346.0	-27.1%	-28.6%	-25.5%	58.8%
Shorebirds	44	-17.1	-21.8	-12.6	-37.4%	-45.0%	-28.8%	68.2%
Waterbirds	77	-22.5	-37.8	-6.3	-21.5%	-33.1%	-6.2%	51.9%
Waterfowl	41	34.8	24.5	48.3	56.0%	37.9%	79.4%	43.9%
Aerial insectivores	26	-156.8	-183.8	-127.0	-31.8%	-36.4%	-26.1%	73.1%
Breeding biome								
Grassland	31	-717.5	-763.9	-673.3	-53.3%	-55.1%	-51.5%	74.2%
Boreal forest	34	-500.7	-627.1	-381.0	-33.1%	-38.9%	-26.9%	50.0%
Forest generalist	40	-482.2	-552.5	-413.4	-18.1%	-20.4%	-15.8%	40.0%
Habitat generalist	38	-417.3	-462.1	-371.3	-23.1%	-25.4%	-20.7%	60.5%
Eastern forest	63	-166.7	-185.8	-147.7	-17.4%	-19.2%	-15.6%	63.5%
Western forest	67	-139.7	-163.8	-116.1	-29.5%	-32.8%	-26.0%	64.2%
Arctic tundra	51	-79.9	-131.2	-0.7	-23.4%	-37.5%	-0.2%	56.5%
Aridlands	62	-35.6	-49.7	-17.0	-17.0%	-23.0%	-8.1%	56.5%
Coasts	38	-6.1	-18.9	8.5	-15.0%	-39.4%	21.9%	50.0%
Wetlands	95	20.6	8.3	35.3	13.0%	5.1%	23.0%	47.4%
Nonbreeding biome								
Temperate N. America	192	-1,413.0	-1,521.5	-1,292.3	-27.4%	-29.3%	-25.3%	55.2%
South America	41	-537.4	-651.1	-432.6	-40.1%	-45.2%	-34.6%	75.6%
Southwestern aridlands	50	-238.1	-261.2	-215.6	-41.9%	-44.5%	-39.2%	74.0%
Mexico–Central America	76	-155.3	-187.8	-122.0	-15.5%	-18.3%	-12.6%	52.6%
Widespread neotropical	22	-126.0	-171.2	-86.1	-26.8%	-33.4%	-19.3%	45.5%
Widespread	60	-31.6	-63.1	1.6	-3.7%	-7.4%	0.2%	43.3%
Marine	26	-16.3	-29.7	-1.2	-30.8%	-49.1%	-2.5%	61.5%
Coastal	44	-11.0	-14.9	-6.7	-42.0%	-51.8%	-26.7%	68.2%
Caribbean	8	-6.0	1.4	-15.7	12.1%	-2.8%	31.7%	25.0%

Process and Timeline

Project History



Ongoing Project Timeline



Proposed 10 Year Schedule

Task 1- Development of an Ecological Restoration Plan

	Year(s)	January	February	March	April	May	June	July	August	September	October	November	December
1.a Rapid Ecological Assessment	1												
	2 & 3												
	4 & 5												
	6-10												
1.b Concept Design and Ecological Restoration Plan	1												
	2 & 3												
	4 & 5												
	6-10												
1.c Public Meetings	1												
	2 & 3												
	4 & 5												
	6-10												
1.d GIS Set-up, Maintenance	1												
	2 & 3												
	4 & 5												
	6-10												
1.e MS4 BMP Feasibility and Analysis	1												
	2 & 3												
	4 & 5												
	6-10												
1.f Project Management	1												
	2 & 3												
	4 & 5												
	6-10												

Proposed 10 Year Schedule

Task 2- Ecological Restoration

	Year(s)	January	February	March	April	May	June	July	August	September	October	November	December
2.a Invasive Species Control	1												
	2 & 3												
	4 & 5												
	6-10												
2.b Winter Woody Plant and Hedgerow Removal	1												
	2 & 3												
	4 & 5												
	6-10												
2.c Overseeding of Fields	1												
	2 & 3												
	4 & 5												
	6-10												
2.d Plug Planting in Hot Spots	1												
	2 & 3												
	4 & 5												
	6-10												
2.e Tree and Shrub Planting	1												
	2 & 3												
	4 & 5												
	6-10												

Proposed 10 Year Schedule

Task 3- Adaptive Maintenance and Monitoring

	Year(s)	January	February	March	April	May	June	July	August	September	October	November	December
3.a Monitoring	1												
	2 & 3												
	4 & 5												
	6-10												
3.b Maintenance	1												
	2 & 3												
	4 & 5												
	6-10												
3.c Ecological Memos	1												
	2 & 3												
	4 & 5												
	6-10												

Ecological Assessment

Methodology and Findings

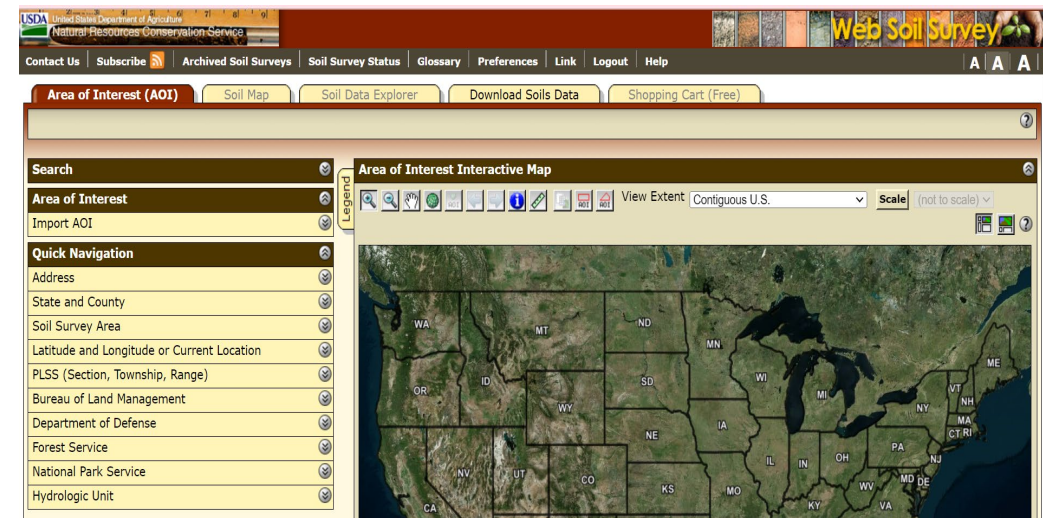
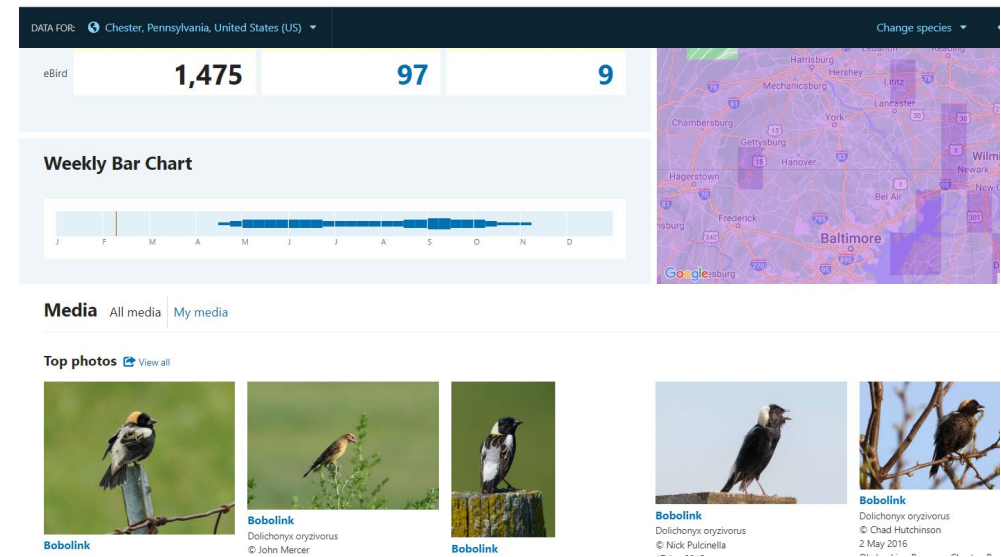
Methodology



Methodology

Desktop Analysis

- Property Boundaries
- Soils
- Wetlands
- eBird/iNaturalist Data
- Aerial imagery
- Elevation
- Historic land use
- Create Management Units
- Create ArcCollector workspace for Field Collection of data



Methodology

Avifauna Survey

- Choose representative survey points
- Follow standard protocols to observe bird species and abundance visually and aurally



Methodology

Vegetation Survey

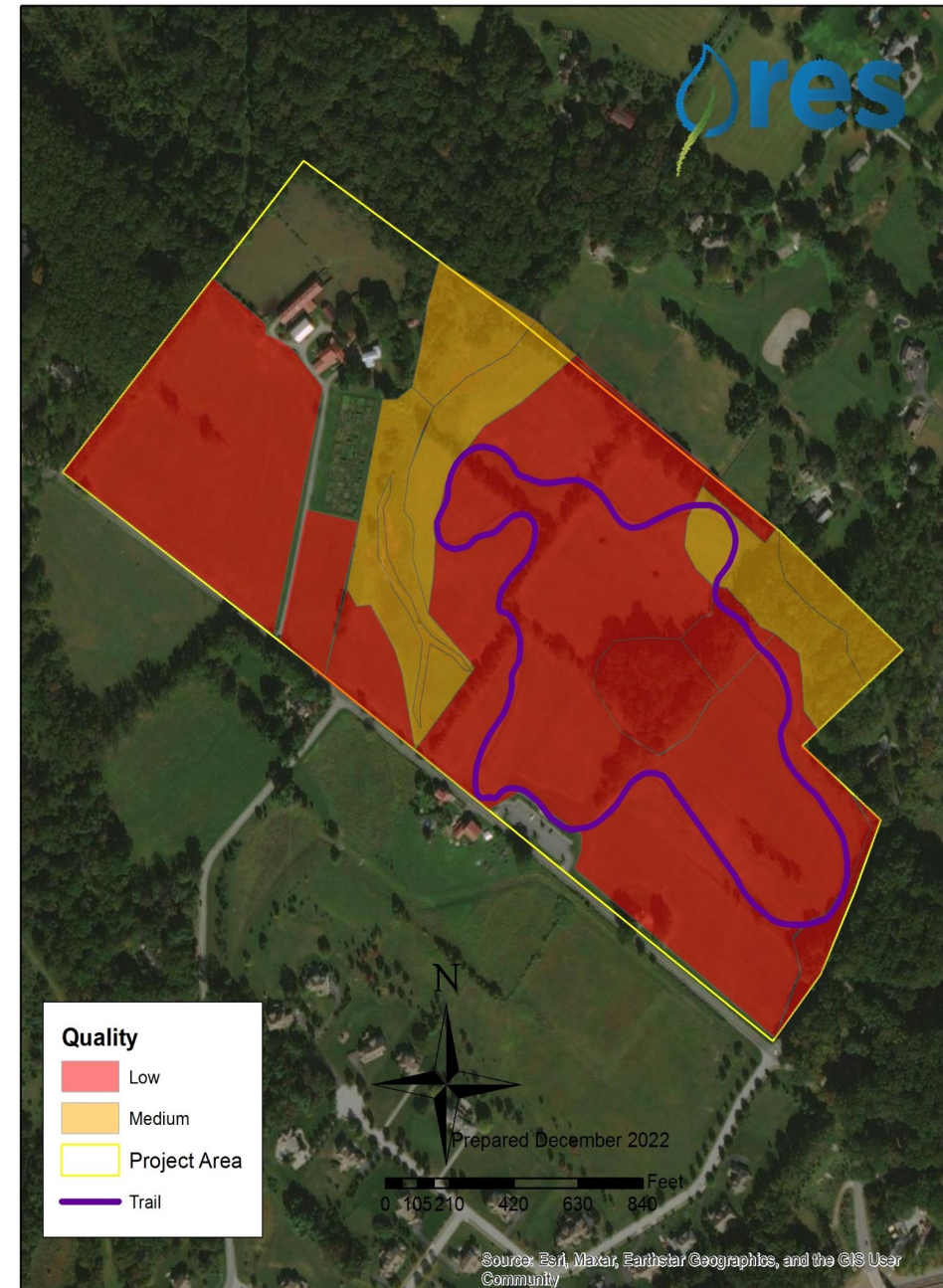
- Identify plants to a species level within 10 meters of the bird survey points
- Perform timed meander in each management unit to capture diversity, abundance, and any threatened or endangered species or invasive species



Methodology

Habitat Characterization

- Use Floristic Quality Assessment calculator to determine floristic quality of found species as relevant to local conditions
- Look at bird diversity, abundance, and distribution
- Synthesize desktop, avifauna, and vegetation data with general observations to characterize habitat type and condition within each management unit



Findings



Observed Birds

Common Name	Scientific Name	Count	Observations	Summer	Fall
Blue Jay	Cyanocitta cristata	26	14	2	12
Red-winged Blackbird	Agelaius phoeniceus	21	17	17	0
European Starling	Sturnus vulgaris	19	8	6	2
Turkey Vulture	Cathartes aura	16	8	1	7
American Goldfinch	Spinus tristis	12	8	4	4
Song Sparrow	Melospiza melodia	8	8	7	1
Tree Swallow	Tachycineta bicolor	20	7	7	0
American Crow	Corvus brachyrhynchos	5	5	2	3
American Robin	Turdus migratorius	5	5	4	1
Yellow Warbler	Setophaga petechia	5	5	5	0
Red-shouldered Hawk	Buteo lineatus	5	4	0	4
Eastern Bluebird	Sialia sialis	4	4	3	1
Northern Mockingbird	Mimus polyglottos	4	4	3	1
Willow Flycatcher	Empidonax traillii	4	4	4	0
Common Yellowthroat	Geothlypis trichas	3	3	3	0
Gray Catbird	Dumetella carolinensis	3	3	2	1
House Wren	Troglodytes aedon	3	3	2	1
Orchard Oriole	Icterus spurius	3	3	3	0
Warbling Vireo	Vireo gilvus	3	3	3	0
Common Grackle	Quiscalus quiscula	6	2	2	0
Black Vulture	Coragyps atratus	4	2	0	2
Cedar Waxwing	Bombycilla cedrorum	4	2	2	0
Barn Swallow	Hirundo rustica	3	2	2	0
American Redstart	Setophaga ruticilla	2	2	2	0
Baltimore Oriole	Icterus galbula	2	2	2	0

Common Name	Scientific Name	Count	Observations	Summer	Fall
Brown Thrasher	Toxostoma rufum	2	2	2	0
Brown-headed Cowbird	Molothrus ater	2	2	1	1
Eastern Towhee	Pipilo erythrophthalmus	2	2	2	0
Mourning Dove	Zenaidura macroura	2	2	2	0
Northern Cardinal	Cardinalis cardinalis	2	2	1	1
Northern Flicker	Colaptes auratus	2	2	1	1
Northern Harrier	Circus hudsonius	2	2	0	2
Pileated Woodpecker	Dryocopus pileatus	2	2	2	0
Red-bellied Woodpecker	Melanerpes carolinus	2	2	1	1
Red-eyed Vireo	Vireo olivaceus	2	2	1	1
Chimney Swift	Chaetura pelagica	30	1	0	1
Northern Rough-winged Swallow	Stelgidopteryx serripennis	3	1	1	0
American Kestrel	Falco sparverius	2	1	1	0
Bald Eagle	Haliaeetus leucocephalus	1	1	0	1
Carolina Chickadee	Poecile carolinensis	1	1	0	1
Carolina Wren	Thryothorus ludovicianus	1	1	0	1
Cooper's Hawk	Accipiter cooperii	1	1	0	1
Eastern Wood-Pewee	Contopus virens	1	1	1	0
Field Sparrow	Spizella pusilla	1	1	0	1
Great Blue Heron	Ardea herodias	1	1	0	1
Great Crested Flycatcher	Myiarchus crinitus	1	1	1	0
Hairy Woodpecker	Dryobates villosus	1	1	1	0
House Finch	Haemorhous mexicanus	1	1	1	0
Indigo Bunting	Passerina cyanea	1	1	1	0
Peregrine Falcon	Falco peregrinus	1	1	0	1
Red-tailed Hawk	Buteo jamaicensis	1	1	0	1
Savannah Sparrow	Passerculus sandwichensis	1	1	1	0
Sharp-shinned Hawk	Accipiter striatus	1	1	0	1
White-breasted Nuthatch	Sitta carolinensis	1	1	0	1
TOTAL		261	167	109	58

Bird Findings

- 54 species observed
- ~40 breeding on the site
- Ground-foraging generalists dominant
 - Blue jays, starlings, crows, and red-winged blackbirds
- Next is aerial gleaning insectivores
 - Swifts and swallows
- Few habitat-specific species
- Forest blocks and riparian area
- 2 grassland obligates
 - Savanna sparrow (one male on territory)
 - 1 kestrel pair (with successful nest box)



Vegetation Findings

Conservatism-Based Metrics:	
Total Mean C:	1.4
Native Mean C:	2.5
Total FQI:	14.1
Native FQI:	19
Adjusted FQI:	18.9
% C value 0:	48.5
% C value 1-3:	38.6
% C value 4-6:	9.9
% C value 7-10:	3
Native Tree Mean C:	2.8
Native Shrub Mean C:	2.5
Native Herbaceous Mean C:	2.7

Physiognomy	Native	Non-native	N/NN	Total
Tree	15	2	1	18
Shrub	3	7	0	10
Vine	3	2	1	6
Forb	38	20	6	64
Graminoid	8	7	2	17
Total	67	38	10	115



Vegetation Findings

Analysis

- Most species found were generalists (C value 0-3)
- Overall Floristic Quality Index score of 14.1 indicates low quality vegetation
- Invasive species were in higher abundance than native species although more native species were identified than non-native (*many of the cut grasses that dominate the landscape were binned as hay/cut grasses and not captured as separate species which skews the proportions*)

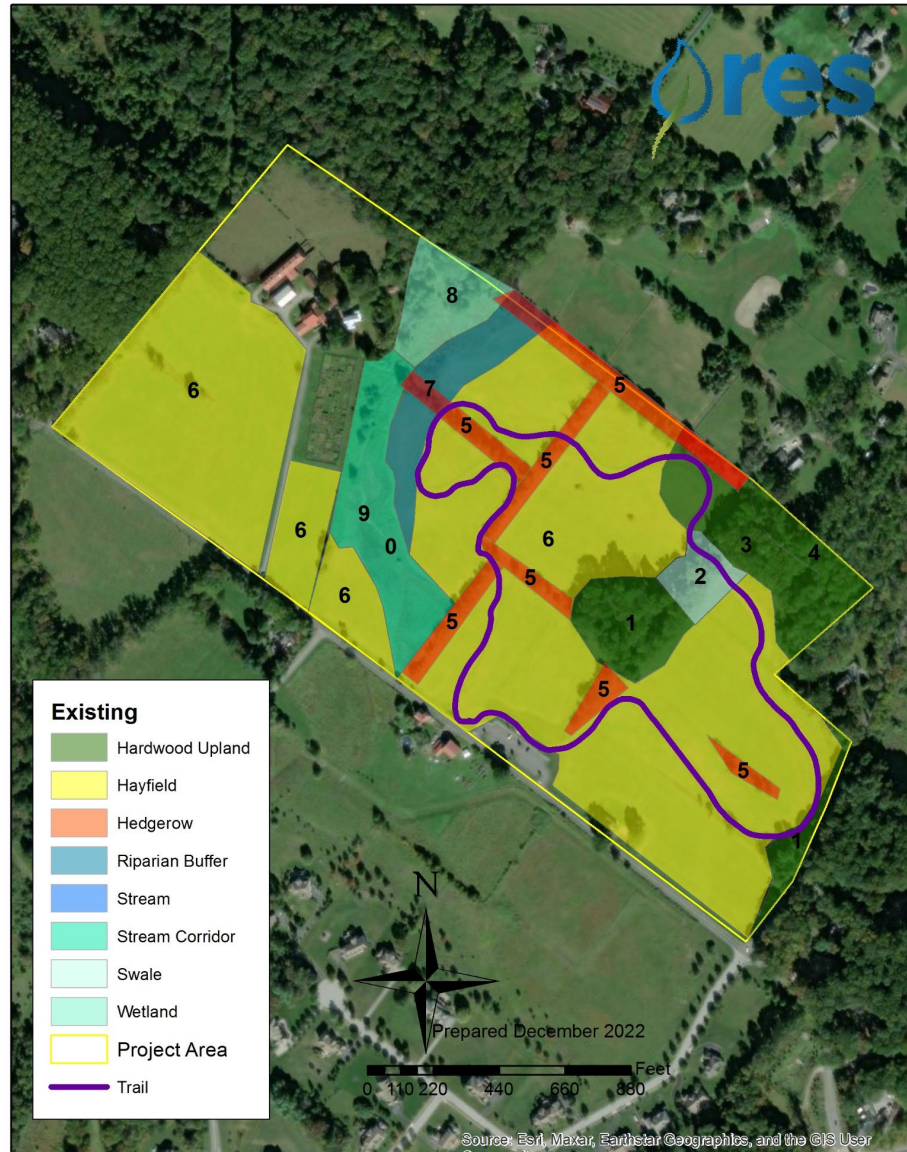
The full species list can be found in the Ecoassessment Report submitted 2.7.23

Scientific Name	Common Name	Family	Native?	C-VALUE	Physiognomy
<i>Acer saccharinum</i>	sugar maple	Aceraceae	native	5	Tree
<i>Acer saccharum</i>	Silver maple	Aceraceae	native	6	Tree
<i>Ageratina altissima</i>	White snakeroot	Asteraceae	native	3	Forb
<i>Agrimonia parviflora</i>	Harvestlice	Rosaceae	native	3	Forb
<i>Amaranthus hybridus</i>	smooth pigweed	Amaranthaceae	native	0	Forb
<i>Ambrosia artemisiifolia</i>	Ragweed	Asteraceae	native	1	Forb
<i>Ambrosia trifida</i>	giant ragweed	Asteraceae	native	2	Forb
<i>Amphicarpaea bracteata</i>	Hog peanut	Fabaceae	native	4	Forb
<i>Andropogon virginicus</i>	Broomsedge bluestem	Poaceae	native	2	Graminoid
<i>Apocynum cannabinum</i>	Dogbane	Apocynaceae	native	2	Forb
<i>Artemisia vulgaris</i>	Mugwort	Asteraceae	non-native	0	Forb
<i>Asclepias incarnata</i>	swamp milkweed	Asclepiadaceae	native	5	Forb

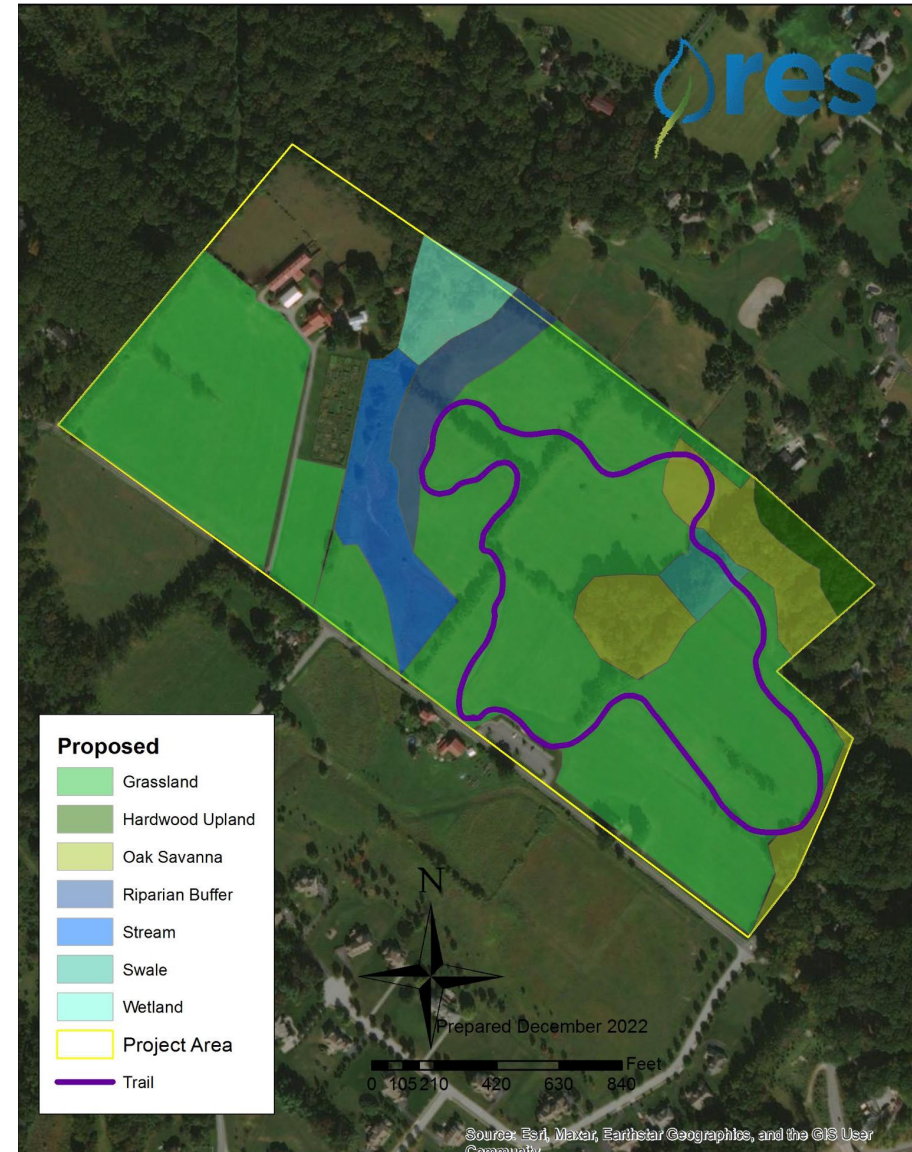
Ecological Restoration Plan

And Concept Designs

Concept Design



Existing Conditions



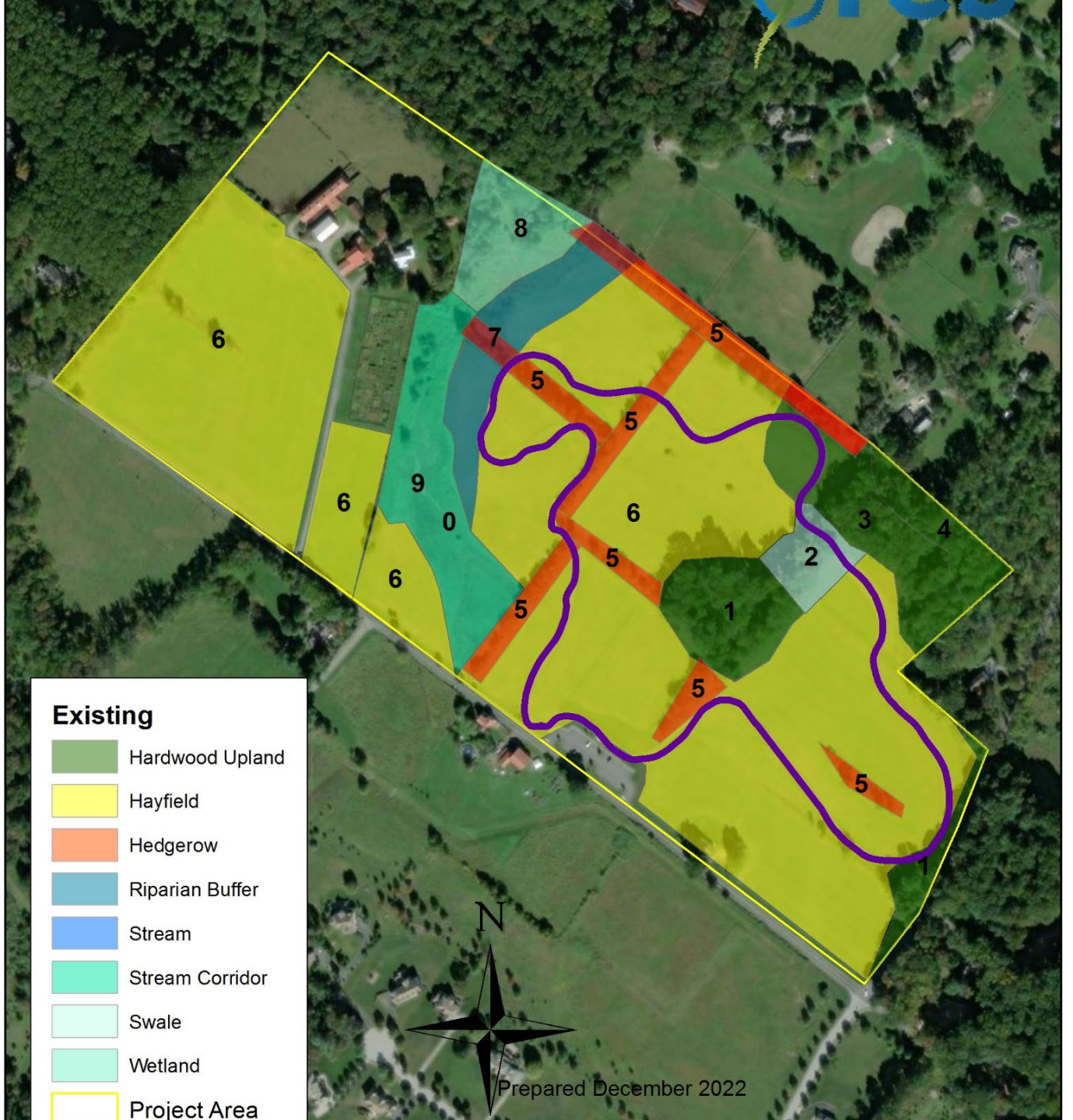
Proposed Habitats

Habitat Type, Quality, and Interventions

Area Number	Existing Type	Quality	Proposed Type	Interventions	Notes	Methods
1	Hardwood Upland	Low	Savanna	Selectively thin canopy of walnut, cherry, poplar, and all invasives. Retain hickory and oaks. Plant native shrub and tree clusters. Remove groundstory and vining invasives	Low quality hardwood upland with anthropogenic clearing in center. Proliferation of invasives. Retain 20% canopy, 20% clusters, 60% open	cut/stump treat; foliar herbicide; dead-head trees to create snags, seed, plug, deer protection (cluster fences)
2	Swale	Low	Swale	Control invasives. Create enhanced buffer using livestock and seed. Remove invasive understory, retain spicebush.	Stabilize drainageway	cut/stump treat; foliar herbicide; seed/plant/livestake; potential e-mat
3	Hardwood Upland	Medium	Savanna	Selectively thin canopy to 40%. Remove invasives, plant native clusters.	Transition to woodland. Swale moves through area.	cut/stump treat; foliar herbicide; dead-head trees to create snags, seed, plug, deer protection (cluster fences)
4	Hardwood Upland	Medium	Hardwood Upland	Control invasives. Create enhanced buffer using livestock and seed. Remove invasive understory, retain spicebush.	May need to overseed or plant depending on proliferation of invasives	cut/stump treat; foliar herbicide; dead-head trees to create snags, seed, plug, deer protection (cluster fences)
5	Hedgerows	Low	Grassland	Remove all woodies. Retain select native trees/shrubs like Prunus. Control invasives.	Critical for grassland habitat creation	pre-application of bark penetrating oil for clonal offshoot species; forestry mower; winter brushing; on-site chipping; foliar application for resprouts; return application of herbicide; seed grassland mix and maintain
6	Hayfield	Low	Grassland	Convert to high-quality warm season grassland through mowing and seeding	Connecting patches and increasing native grass/forb community will greatly increase bird habitat suitability	mow; drill-seed grassland mix; spot treat invasives with backpack sprayer or mechanical removal
7	Riparian Buffer	Medium	Riparian Buffer	Convert to warm season grass and plant native fac/facw shrubs	Denser plantings in the north, gradient into grassland going south.	Mow; drill-seed grassland mix; spot treat invasives with backpack sprayer or mechanical removal. Plant trees and shrubs in clusters, mostly shrubs. Deer protection fencing of clusters. Maintain.

Hayfields

Yellow (6)



Hayfield to Grassland

Invasive Control

- Mow
- Herbicide (glyphosate)
- Targets: Johnson Grass (*Sorghum halepense*), Japanese Stiltgrass (*Microstegium vimineum*), and autumn olive (*Eleagnus umbellata*)

PA Piedmont Province UPL Meadow Mix - ERNMX-260-1

Botanical Name	Common Name
61.80 % <i>Schizachyrium scoparium, Fort Indiantown Gap-PA Ecotype</i>	Little Bluestem, Fort Indiantown Gap-PA Ecotype
20.00 % <i>Elymus virginicus, Madison-NY Ecotype</i>	Virginia Wildrye, Madison-NY Ecotype
3.00 % <i>Chamaecrista fasciculata, PA Ecotype</i>	Partridge Pea, PA Ecotype
3.00 % <i>Rudbeckia hirta</i>	Blackeyed Susan
2.00 % <i>Heliopsis helianthoides, PA Ecotype</i>	Oxeye Sunflower, PA Ecotype
1.80 % <i>Penstemon digitalis, PA Ecotype</i>	Tall White Beardtongue, PA Ecotype
1.00 % <i>Liatris spicata</i>	Marsh Blazing Star
1.00 % <i>Pycnanthemum tenuifolium</i>	Narrowleaf Mountainmint
1.00 % <i>Rudbeckia triloba, WV Ecotype</i>	Browneyed Susan, WV Ecotype
0.90 % <i>Monarda fistulosa, Fort Indiantown Gap-PA Ecotype</i>	Wild Bergamot, Fort Indiantown Gap-PA Ecotype
0.80 % <i>Aster prenanthoides, PA Ecotype</i>	Zigzag Aster, PA Ecotype
0.80 % <i>Senna hebecarpa, VA & WV Ecotype</i>	Wild Senna, VA & WV Ecotype
0.60 % <i>Oenothera fruticosa var. fruticosa</i>	Sundrops
0.40 % <i>Aster laevis, NY Ecotype</i>	Smooth Blue Aster, NY Ecotype
0.40 % <i>Aster lateriflorus</i>	Calico Aster
0.40 % <i>Aster novae-angliae, PA Ecotype</i>	New England Aster, PA Ecotype
0.30 % <i>Asclepias syriaca, PA Ecotype</i>	Common Milkweed, PA Ecotype
0.30 % <i>Solidago nemoralis, PA Ecotype</i>	Gray Goldenrod, PA Ecotype
0.20 % <i>Aster pilosus, PA Ecotype</i>	Heath Aster, PA Ecotype
0.20 % <i>Solidago juncea, PA Ecotype</i>	Early Goldenrod, PA Ecotype
0.10 % <i>Solidago odora, PA Ecotype</i>	Licorice Scented Goldenrod, PA Ecotype

Seed Mixes

Showy Northeast Native Wildflower Mix - ERNMX-153-1

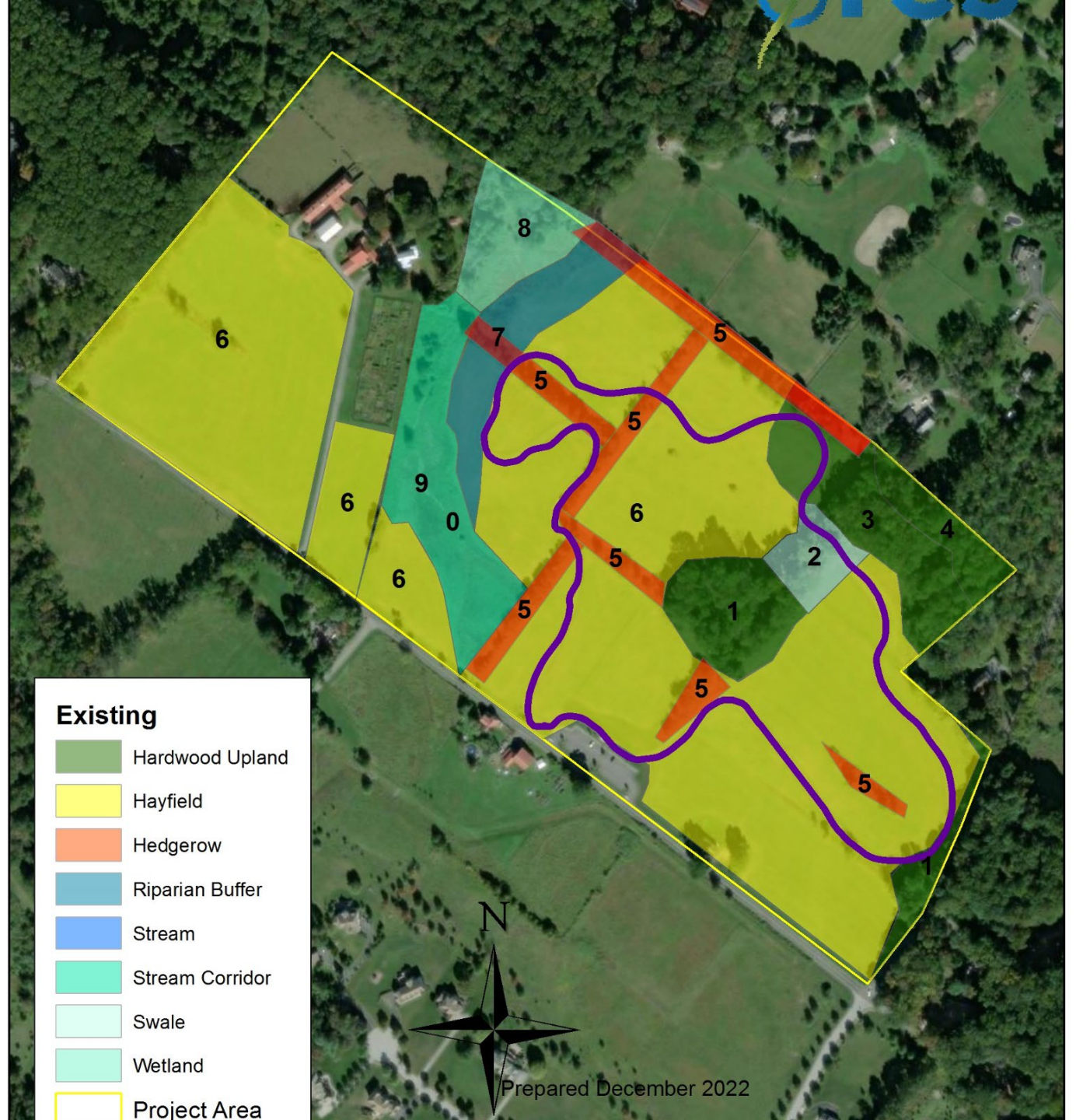
Botanical Name	Common Name
27.90 % <i>Echinacea purpurea</i>	Purple Coneflower
8.80 % <i>Chamaecrista fasciculata, PA Ecotype</i>	Partridge Pea, PA Ecotype
8.80 % <i>Coreopsis lanceolata</i>	Lanceleaf Coreopsis
6.60 % <i>Rudbeckia hirta</i>	Blackeyed Susan
5.90 % <i>Asclepias tuberosa, PA Ecotype</i>	Butterfly Milkweed, PA Ecotype
5.90 % <i>Heliopsis helianthoides, PA Ecotype</i>	Oxeye Sunflower, PA Ecotype
5.90 % <i>Penstemon digitalis, PA Ecotype</i>	Tall White Beardtongue, PA Ecotype
4.40 % <i>Zizia aurea, PA Ecotype</i>	Golden Alexanders, PA Ecotype
2.90 % <i>Liatris spicata</i>	Marsh Blazing Star
2.90 % <i>Rudbeckia triloba, WV Ecotype</i>	Browneyed Susan, WV Ecotype
2.40 % <i>Lespedeza capitata, RI Ecotype</i>	Roundhead Lespedeza, RI Ecotype
2.20 % <i>Baptisia australis, Southern WV Ecotype</i>	Blue False Indigo, Southern WV Ecotype
1.80 % <i>Aster oblongifolius, PA Ecotype</i>	Aromatic Aster, PA Ecotype
1.80 % <i>Lespedeza virginica, VA Ecotype</i>	Slender Lespedeza, VA Ecotype
1.80 % <i>Pycnanthemum tenuifolium</i>	Narrowleaf Mountainmint
1.80 % <i>Senna hebecarpa, VA & WV Ecotype</i>	Wild Senna, VA & WV Ecotype
1.20 % <i>Aster laevis, NY Ecotype</i>	Smooth Blue Aster, NY Ecotype
1.20 % <i>Aster novae-angliae, PA Ecotype</i>	New England Aster, PA Ecotype
1.00 % <i>Monarda fistulosa, Fort Indiantown Gap-PA Ecotype</i>	Wild Bergamot, Fort Indiantown Gap-PA Ecotype
0.90 % <i>Solidago bicolor, PA Ecotype</i>	White Goldenrod, PA Ecotype
0.90 % <i>Solidago nemoralis, PA Ecotype</i>	Gray Goldenrod, PA Ecotype
0.70 % <i>Senna marilandica</i>	Maryland Senna
0.70 % <i>Tradescantia ohioensis, PA Ecotype</i>	Ohio Spiderwort, PA Ecotype
0.60 % <i>Penstemon hirsutus</i>	Hairy Beardtongue
0.40 % <i>Aster pilosus, PA Ecotype</i>	Heath Aster, PA Ecotype
0.30 % <i>Oenothera fruticosa var. fruticosa</i>	Sundrops
0.30 % <i>Solidago odora, PA Ecotype</i>	Licorice Scented Goldenrod, PA Ecotype

PA Piedmont Province UPL Grass Mix - ERNMX-260

Botanical Name	Common Name
31.00 % <i>Schizachyrium scoparium, Fort Indiantown Gap-PA Ecotype</i>	Little Bluestem, Fort Indiantown Gap-PA Ecotype
30.00 % <i>Sorghastrum nutans, PA Ecotype</i>	Indiangrass, PA Ecotype
26.00 % <i>Elymus virginicus, Madison-NY Ecotype</i>	Virginia Wildrye, Madison-NY Ecotype
8.00 % <i>Andropogon gerardii, 'Niagara'</i>	Big Bluestem, 'Niagara'
5.00 % <i>Panicum virgatum, NJ Ecotype</i>	Switchgrass, NJ Ecotype

Hedgerows

Red (5)



Hedgerows to Grassland

Invasive Control

- Mechanical brushing using forestry mower and chainsaws
- Herbicides (Garlon 3 & 4)
- Targets: Johnson Grass (*Sorghum halepense*), Japanese Stiltgrass (*Microstegium vimineum*), and autumn olive (*Eleagnus umbellata*)

Seed Mixes

PA Piedmont Province UPL Meadow Mix - ERNMX-260-1

Botanical Name	Common Name
61.80 % <i>Schizachyrium scoparium</i> , Fort Indiantown Gap-PA Ecotype	Little Bluestem, Fort Indiantown Gap-PA Ecotype
20.00 % <i>Elymus virginicus</i> , Madison-NY Ecotype	Virginia Wildrye, Madison-NY Ecotype
3.00 % <i>Chamaecrista fasciculata</i> , PA Ecotype	Partridge Pea, PA Ecotype
3.00 % <i>Rudbeckia hirta</i>	Blackeyed Susan
2.00 % <i>Heliopsis helianthoides</i> , PA Ecotype	Oxeye Sunflower, PA Ecotype
1.80 % <i>Penstemon digitalis</i> , PA Ecotype	Tall White Beardtongue, PA Ecotype
1.00 % <i>Liatris spicata</i>	Marsh Blazing Star
1.00 % <i>Pycnanthemum tenuifolium</i>	Narrowleaf Mountainmint
1.00 % <i>Rudbeckia triloba</i> , WV Ecotype	Brownleaf Susan, WV Ecotype
0.90 % <i>Monarda fistulosa</i> , Fort Indiantown Gap-PA Ecotype	Wild Bergamot, Fort Indiantown Gap-PA Ecotype
0.80 % <i>Aster prenanthoides</i> , PA Ecotype	Zigzag Aster, PA Ecotype
0.80 % <i>Senna hebecarpa</i> , VA & WV Ecotype	Wild Senna, VA & WV Ecotype
0.60 % <i>Oenothera fruticosa</i> var. <i>fruticosa</i>	Sundrops
0.40 % <i>Aster laevis</i> , NY Ecotype	Smooth Blue Aster, NY Ecotype
0.40 % <i>Aster lateriflorus</i>	Calico Aster
0.40 % <i>Aster novae-angliae</i> , PA Ecotype	New England Aster, PA Ecotype
0.30 % <i>Asclepias syriaca</i> , PA Ecotype	Common Milkweed, PA Ecotype
0.30 % <i>Solidago nemoralis</i> , PA Ecotype	Gray Goldenrod, PA Ecotype
0.20 % <i>Aster pilosus</i> , PA Ecotype	Heath Aster, PA Ecotype
0.20 % <i>Solidago juncea</i> , PA Ecotype	Early Goldenrod, PA Ecotype
0.10 % <i>Solidago odora</i> , PA Ecotype	Licorice Scented Goldenrod, PA Ecotype

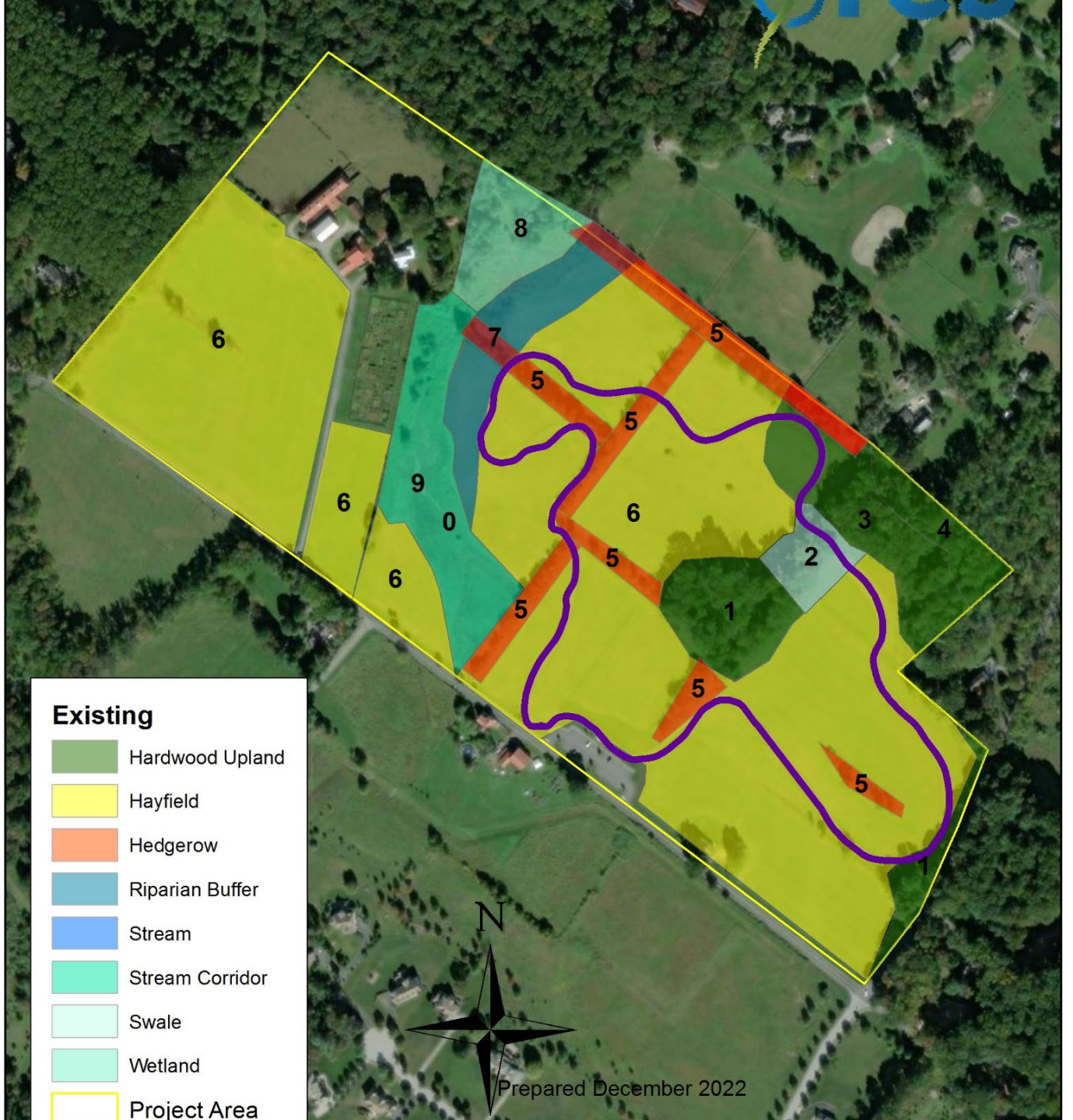
PA Piedmont Province UPL Grass Mix - ERNMX-260

Botanical Name	Common Name
31.00 % <i>Schizachyrium scoparium</i> , Fort Indiantown Gap-PA Ecotype	Little Bluestem, Fort Indiantown Gap-PA Ecotype
30.00 % <i>Sorghastrum nutans</i> , PA Ecotype	Indiangrass, PA Ecotype
26.00 % <i>Elymus virginicus</i> , Madison-NY Ecotype	Virginia Wildrye, Madison-NY Ecotype
8.00 % <i>Andropogon gerardii</i> , 'Niagara'	Big Bluestem, 'Niagara'
5.00 % <i>Panicum virgatum</i> , NJ Ecotype	Switchgrass, NJ Ecotype



Hardwood Upland

Green (1, 3, 4)



Hardwood Upland

Area 1

- Remove invasive trees, selectively thin generalist natives, retain all older open-form native trees
- Goal: 60% openness and 40% canopy closure (retained second-growth trees), with clustered plantings of native shrubs

Area 3

- Remove invasives
- Goal: Retain 50-60% canopy cover

Area 4

- Remove invasive species
- Retain spicebush (*Lindera benzoin*) understory

All Areas

Invasive Management

- Invasive trees will be cut and stump treated with Garlon-3.
- Some trees will be dead-headed to create snags for wildlife habitat.
- Persistent herbaceous invasives will be treated with glyphosate using backpack application
- Invasive woodies will be targeted with triclopyr.



Hardwood Upland

Seeding

Partially Shaded Area Roadside Mix - ERNMX-140

Botanical Name	Common Name
51.90 % <i>Schizachyrium scoparium</i> , Fort Indiantown Gap-PA Ecotype	Little Bluestem, Fort Indiantown Gap-PA Ecotype
16.80 % <i>Elymus virginicus</i> , PA Ecotype	Virginia Wildrye, PA Ecotype
9.00 % <i>Echinacea purpurea</i>	Purple Coneflower
6.50 % <i>Elymus hystrix</i> , PA Ecotype	Bottlebrush Grass, PA Ecotype
3.50 % <i>Chamaecrista fasciculata</i> , PA Ecotype	Partridge Pea, PA Ecotype
3.00 % <i>Rudbeckia hirta</i>	Blackeyed Susan
2.00 % <i>Heliopsis helianthoides</i> , PA Ecotype	Oxeye Sunflower, PA Ecotype
1.20 % <i>Pycnanthemum tenuifolium</i>	Narrowleaf Mountainmint
1.00 % <i>Penstemon digitalis</i> , PA Ecotype	Tall White Beardtongue, PA Ecotype
0.60 % <i>Liatris spicata</i>	Marsh Blazing Star
0.50 % <i>Baptisia australis</i> , Southern WV Ecotype	Blue False Indigo, Southern WV Ecotype
0.50 % <i>Geum canadense</i> , PA Ecotype	White Avens, PA Ecotype
0.40 % <i>Asclepias tuberosa</i> , PA Ecotype	Butterfly Milkweed, PA Ecotype
0.40 % <i>Aster lateriflorus</i>	Calico Aster
0.40 % <i>Aster macrophyllus</i> , PA Ecotype	Bigleaf Aster, PA Ecotype
0.40 % <i>Monarda fistulosa</i> , Fort Indiantown Gap-PA Ecotype	Wild Bergamot, Fort Indiantown Gap-PA Ecotype
0.30 % <i>Asclepias syriaca</i> , PA Ecotype	Common Milkweed, PA Ecotype
0.30 % <i>Oenothera fruticosa</i> var. <i>fruticosa</i>	Sundrops
0.20 % <i>Aquilegia canadensis</i>	Eastern Columbine
0.20 % <i>Aster prenanthoides</i> , PA Ecotype	Zigzag Aster, PA Ecotype
0.20 % <i>Penstemon laevigatus</i> , PA Ecotype	Appalachian Beardtongue, PA Ecotype
0.20 % <i>Solidago bicolor</i> , PA Ecotype	White Goldenrod, PA Ecotype
0.10 % <i>Aster pilosus</i> , PA Ecotype	Heath Aster, PA Ecotype
0.10 % <i>Penstemon hirsutus</i>	Hairy Beardtongue
0.10 % <i>Solidago juncea</i> , PA Ecotype	Early Goldenrod, PA Ecotype
0.10 % <i>Solidago nemoralis</i> , PA Ecotype	Gray Goldenrod, PA Ecotype
0.10 % <i>Solidago odora</i> , PA Ecotype	Licorice Scented Goldenrod, PA Ecotype



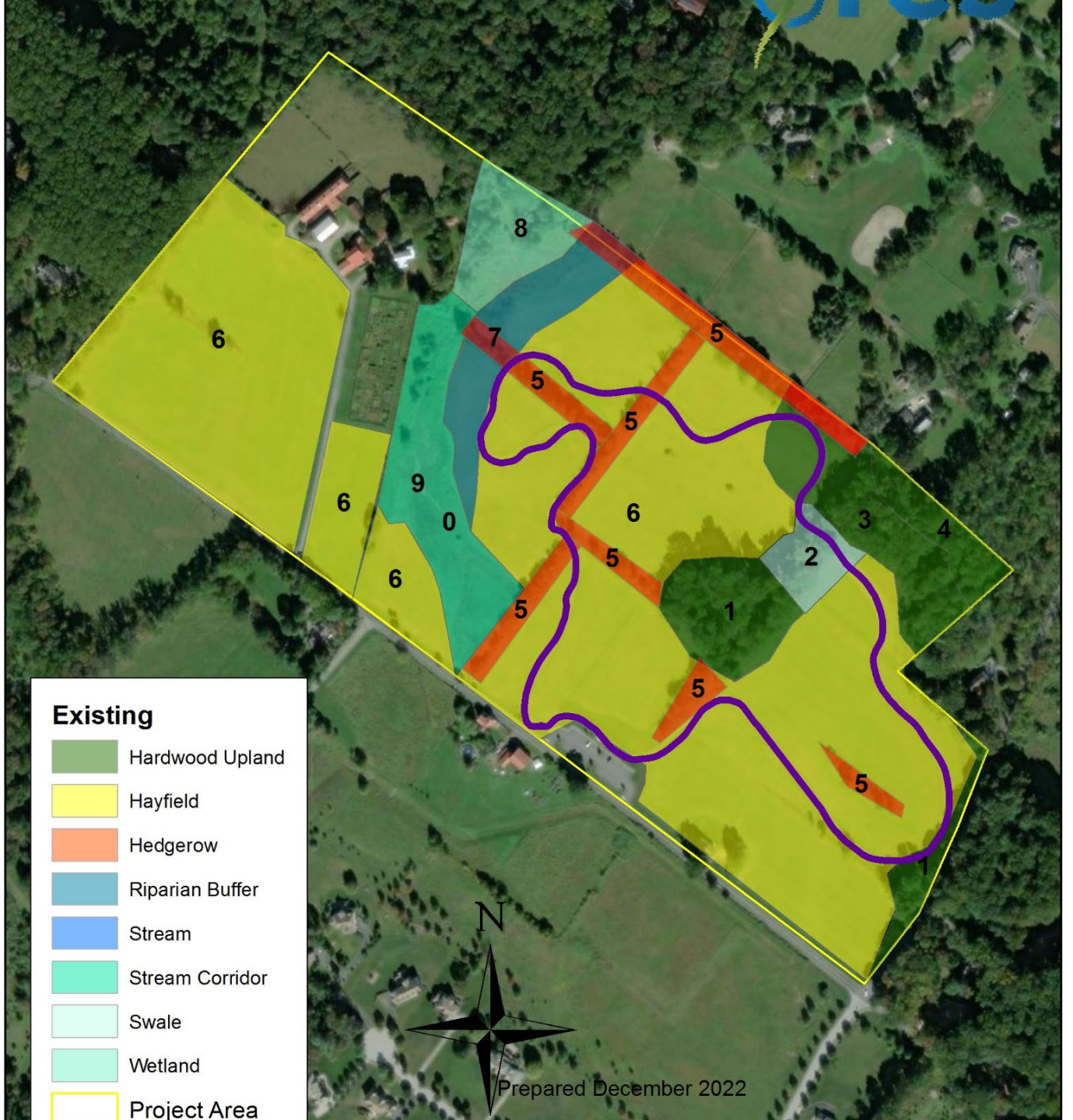
Plug Planting

- Winterberry (*Ilex verticillata*)
- Elderberry (*Sambucus canadensis*)
- Red Osier dogwood (*Cornus sericea*)
- Mapleleaf viburnum (*Viburnum acerifolium*)
- Blackhaw (*Viburnum prunifolium*)

Plugs will be planted in clusters surrounded by deer fencing

Upland Swale

Light Blue (2)



Upland Swale

Invasive Management

- Mechanical brushing
- Surgical herbicide application of Garlon-3 or 4 to woodies
- Triclopyr for foliar application

Other

- It may be necessary to place e-matting and native seed mixes to prevent erosion and sediment input into the existing drainageway and stabilize the area.

PA Piedmont Province Riparian Mix - ERNMX-263

Botanical Name	Common Name
12.70 % <i>Andropogon gerardii</i> , 'Niagara'	Big Bluestem, 'Niagara'
12.70 % <i>Sorghastrum nutans</i> , PA Ecotype	Indiangrass, PA Ecotype
12.60 % <i>Schizachyrium scoparium</i> , Fort Indiantown Gap-PA Ecotype	Little Bluestem, Fort Indiantown Gap-PA Ecotype
10.00 % <i>Elymus riparius</i> , PA Ecotype	Riverbank Wildrye, PA Ecotype
10.00 % <i>Elymus virginicus</i> , Madison-NY Ecotype	Virginia Wildrye, Madison-NY Ecotype
8.00 % <i>Panicum clandestinum</i> , Tioga	Deertongue, Tioga
7.00 % <i>Carex vulpinoidea</i> , PA Ecotype	Fox Sedge, PA Ecotype
7.00 % <i>Panicum rigidulum</i> , PA Ecotype	Redtop Panicgrass, PA Ecotype
5.00 % <i>Panicum virgatum</i> , NJ Ecotype	Switchgrass, NJ Ecotype
3.00 % <i>Chamaecrista fasciculata</i> , PA Ecotype	Partridge Pea, PA Ecotype
2.00 % <i>Helianthus helianthoides</i> , PA Ecotype	Oxeye Sunflower, PA Ecotype
2.00 % <i>Juncus effusus</i>	Soft Rush
2.00 % <i>Verbena hastata</i> , PA Ecotype	Blue Vervain, PA Ecotype
1.40 % <i>Asclepias incarnata</i> , PA Ecotype	Swamp Milkweed, PA Ecotype
1.30 % <i>Senna hebecarpa</i> , VA & WV Ecotype	Wild Senna, VA & WV Ecotype
0.50 % <i>Eupatorium perfoliatum</i> , PA Ecotype	Boneset, PA Ecotype
0.50 % <i>Helenium autumnale</i> , PA Ecotype	Common Sneezeweed, PA Ecotype
0.50 % <i>Monarda fistulosa</i> , Fort Indiantown Gap-PA Ecotype	Wild Bergamot, Fort Indiantown Gap-PA Ecotype
0.50 % <i>Vernonia noveboracensis</i> , PA Ecotype	New York Ironweed, PA Ecotype
0.40 % <i>Aster novae-angliae</i> , PA Ecotype	New England Aster, PA Ecotype
0.40 % <i>Aster prenanthoides</i> , PA Ecotype	Zigzag Aster, PA Ecotype
0.30 % <i>Eupatorium fistulosum</i> , PA Ecotype	Joe Pye Weed, PA Ecotype
0.20 % <i>Solidago rugosa</i> , PA Ecotype	Wrinkleleaf Goldenrod, PA Ecotype

Seeding

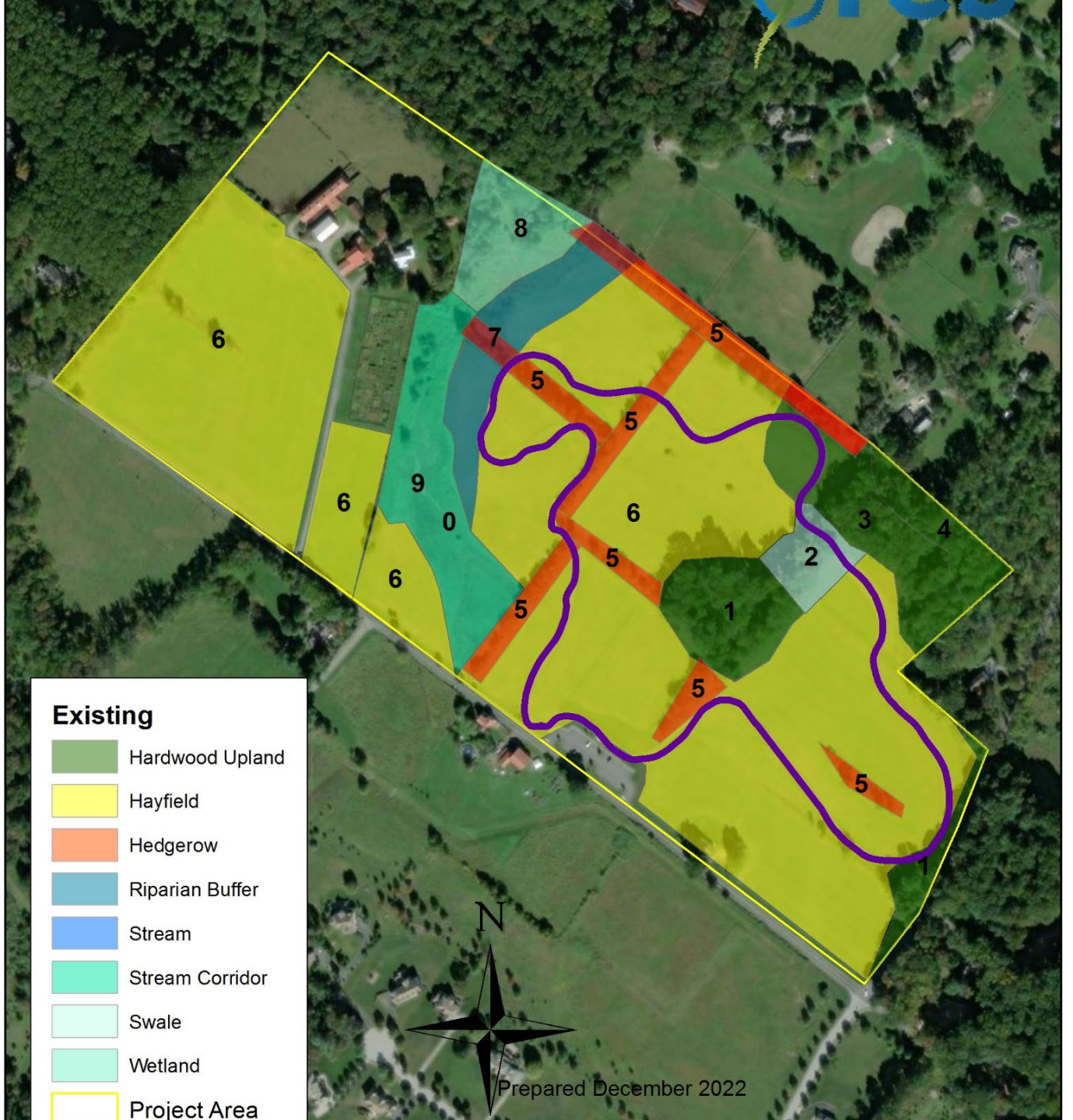


Live Stakes

- Black willow (*Salix nigra*)
- Ninebark (*Physocarpus opulifolius*)
- Elderberry (*Sambucus canadensis*)
- Smooth alder (*Alnus serrulata*)
- Silky dogwood (*Cornus amomum*)

Riparian Buffer

Dark Blue (7)



Riparian Buffer

Invasive Management

- Mechanical removal
- Mowing
- Precision application of glyphosate with backpack sprayer only if necessary.

Seed Mixes

PA Piedmont Province UPL Meadow Mix - ERNMX-260-1		
	Botanical Name	Common Name
61.80 %	<i>Schizachyrium scoparium</i> , Fort Indiantown Gap-PA Ecotype	Little Bluestem, Fort Indiantown Gap-PA Ecotype
20.00 %	<i>Elymus virginicus</i> , Madison-NY Ecotype	Virginia Wildrye, Madison-NY Ecotype
3.00 %	<i>Chamaecrista fasciculata</i> , PA Ecotype	Partridge Pea, PA Ecotype
3.00 %	<i>Rudbeckia hirta</i>	Blackeyed Susan
2.00 %	<i>Heliopsis helianthoides</i> , PA Ecotype	Oxeye Sunflower, PA Ecotype
1.80 %	<i>Penstemon digitalis</i> , PA Ecotype	Tall White Beardtongue, PA Ecotype
1.00 %	<i>Liatris spicata</i>	Marsh Blazing Star
1.00 %	<i>Pycnanthemum tenuifolium</i>	Narrowleaf Mountainmint
1.00 %	<i>Rudbeckia triloba</i> , WV Ecotype	Browneyed Susan, WV Ecotype
0.90 %	<i>Monarda fistulosa</i> , Fort Indiantown Gap-PA Ecotype	Wild Bergamot, Fort Indiantown Gap-PA Ecotype
0.80 %	<i>Aster prenanthoides</i> , PA Ecotype	Zigzag Aster, PA Ecotype
0.80 %	<i>Senna hebecarpa</i> , VA & WV Ecotype	Wild Senna, VA & WV Ecotype
0.60 %	<i>Oenothera fruticosa</i> var. <i>fruticosa</i>	Sundrops
0.40 %	<i>Aster laevis</i> , NY Ecotype	Smooth Blue Aster, NY Ecotype
0.40 %	<i>Aster lateriflorus</i>	Calico Aster
0.40 %	<i>Aster novae-angliae</i> , PA Ecotype	New England Aster, PA Ecotype
0.30 %	<i>Asclepias syriaca</i> , PA Ecotype	Common Milkweed, PA Ecotype
0.30 %	<i>Solidago nemoralis</i> , PA Ecotype	Gray Goldenrod, PA Ecotype
0.20 %	<i>Aster pilosus</i> , PA Ecotype	Heath Aster, PA Ecotype
0.20 %	<i>Solidago juncea</i> , PA Ecotype	Early Goldenrod, PA Ecotype
0.10 %	<i>Solidago odora</i> , PA Ecotype	Licorice Scented Goldenrod, PA Ecotype

	Botanical Name	Common Name
31.00 %	<i>Schizachyrium scoparium</i> , Fort Indiantown Gap-PA Ecotype	Little Bluestem, Fort Indiantown Gap-PA Ecotype
30.00 %	<i>Sorghastrum nutans</i> , PA Ecotype	Indiangrass, PA Ecotype
26.00 %	<i>Elymus virginicus</i> , Madison-NY Ecotype	Virginia Wildrye, Madison-NY Ecotype
8.00 %	<i>Andropogon gerardii</i> , 'Niagara'	Big Bluestem, 'Niagara'
5.00 %	<i>Panicum virgatum</i> , NJ Ecotype	Switchgrass, NJ Ecotype

Plugs

Trees

- American Holly (*Ilex opaca*)
- Black Willow (*Salix nigra*)
- River Birch (*Betula nigra*)
- White Oak (*Quercus alba*)
- Common hackberry (*Celtis occidentalis*)

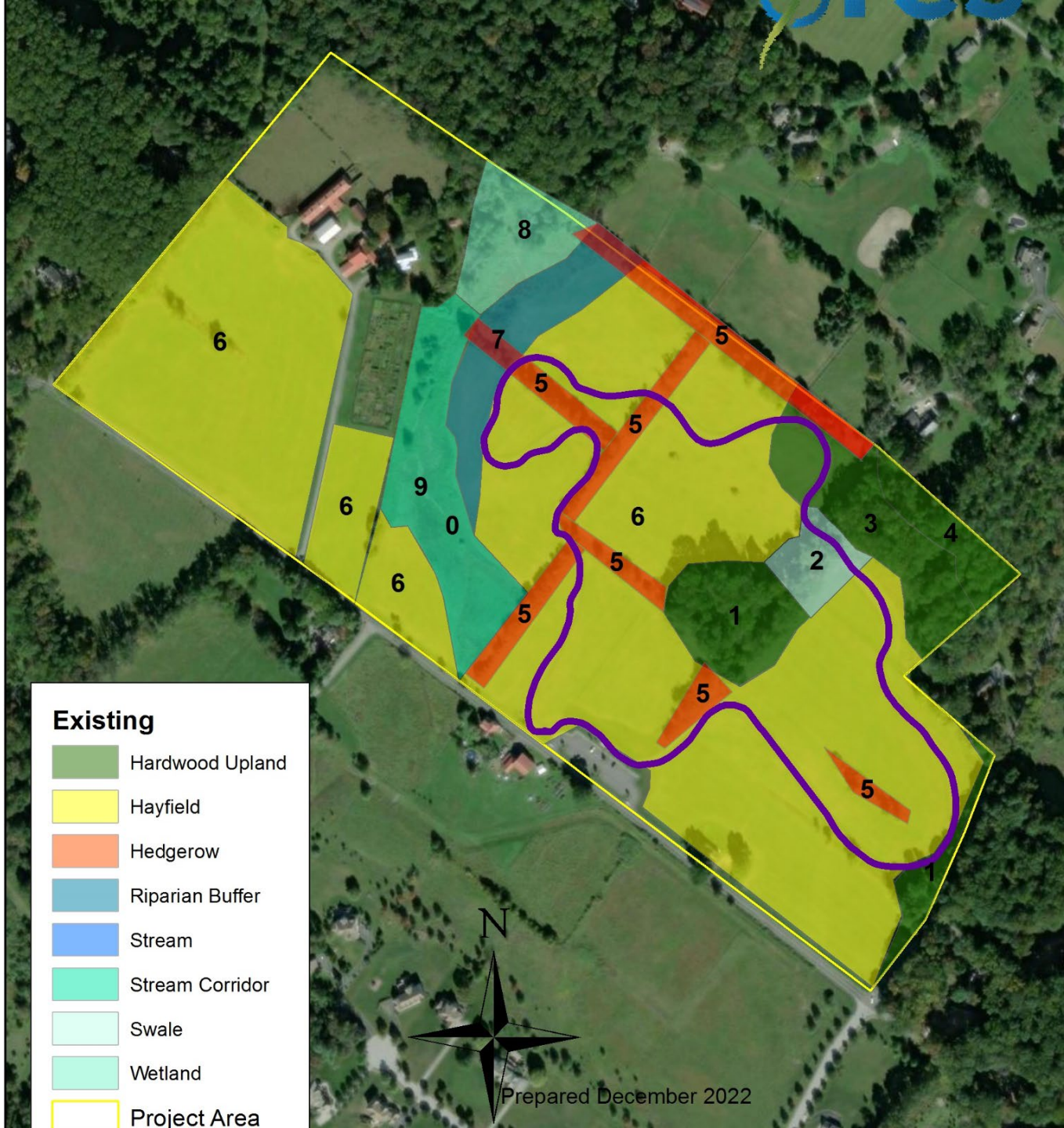
Shrubs

- Inkberry (*Ilex glabra*)
- Flowering dogwood (*Cornus florida*)
- Mapleleaf viburnum (*Viburnum acerifolia*)
- Nannyberry (*Viburnum lentago*)

Plugs will be planted in clusters surrounded by deer fencing

Stream and Wetland

Teal (0, 8, 9)



Stream and Wetland

- **Stream and Wetland Restoration is out of scope of this project however it is recommended to:**

- Complete a more detailed stream and wetland analysis
- Create a plan including
 - bank stabilization
 - in-stream control structures
 - beaver dam analogs
- RES Cursory observations include
 - Increased stormwater volume from up-watershed is causing erosion within the wet meadow conveyance (i.e., upper reaches of the stream)
 - Hydrological disconnection between the stream and floodplain/adjacent wetlands and simplification by invasive plant colonization

- ***Retention and enhancement of stream-associated wetlands and intact native forb communities within Unit 9 is an important set of actions and can greatly increase the site's resources for grassland birds as well as other species, while adding beauty and increasing water quality.***



Maintenance and Monitoring



Monitoring and Maintenance

Monitor and Maintain the site for

- Resilient invasives
 - Spot treat with herbicide
 - Remove mechanically
- Underperforming seeding or plugs
 - Overseed
 - Replant

We anticipate 10 maintenance trips after installation.

Task	January	February	March	April	May	June	July	August	September	October	November	December
Invasive Removal												
Hedgerow Removal		0										0
Mow					0				0			
Herbicide Application					0				0			
Planting												
Seeding				0	0						0	
Plugs and Live stakes				0	0							0
Monitoring and Maintenance												
Mow			1,2									
Herbicide					1,2,3			1,2,3				
Overseed			1							1		

Climate Change and Resilience

Future Monitoring and Adaptive Management for Resilience

- We hope that the next phase includes funding for continued ecoassessment to assess
 - Success of habitat transition
 - Recruitment and maintenance of species
 - Long-term trends in population dynamics

This type of monitoring can help adaptively manage by planting more drought-resistant or warmer climate plants for assisted migration. The proposed system is self-maintaining but anthropogenic influence means that there are increased variables.



Examples



Example Meadow and Forest Edge Longwood Gardens

Example Meadow and Forest Edge Longwood Gardens

- Provide "hotspots" along main trails
- Mostly grass-dominated matrix
- Supporting grassland and iconic edge species



Example Meadow and Forest Edge Longwood Gardens

- Took a few years of vine management
- Supported first breeding attempt for clay-colored sparrow in Chester County in over 100 years
- Extremely "valuable" location



Example Meadow Management

- Spot treat for invasives
- Hand-distribute seed in bare spots
- Consider developing a prescribed fire plan!
- Allow adaptive maintenance per the monitoring data (positive feedback loop!)



Questions or
comments?



Contact Us

Jessie Buckner

Project Manager | Ecologist

jbuckner@res.us

Mike McGraw

Senior Wildlife Biologist | Ecologist

mmcgraw@res.us

