Green Corridor Pollinator Toolkit

GARDEN
LAWN
MEADOW
WOODLAND
WETLAND

LANDSCAPE DESIGN TO SUPPORT POLLINATOR SPECIES AT RISK IN SOUTHWEST CONNECTICUT

EVAN ABRAMSON

Commissioned by

Aspetuck Land Trust
Westport
Fairfield
Weston
Easton

Project Site
Haskins Preserve
Westport, CT

LANDSCAPE | NTERACTIONS 16 Center Street #426, Northampton, MA 01060 landscapeinteractions.com

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WHAT IS A TOOLKIT?

Replicable landscape designs and habitat management guidelines based on common landscape scenarios and specific selections and arrangements of plants.

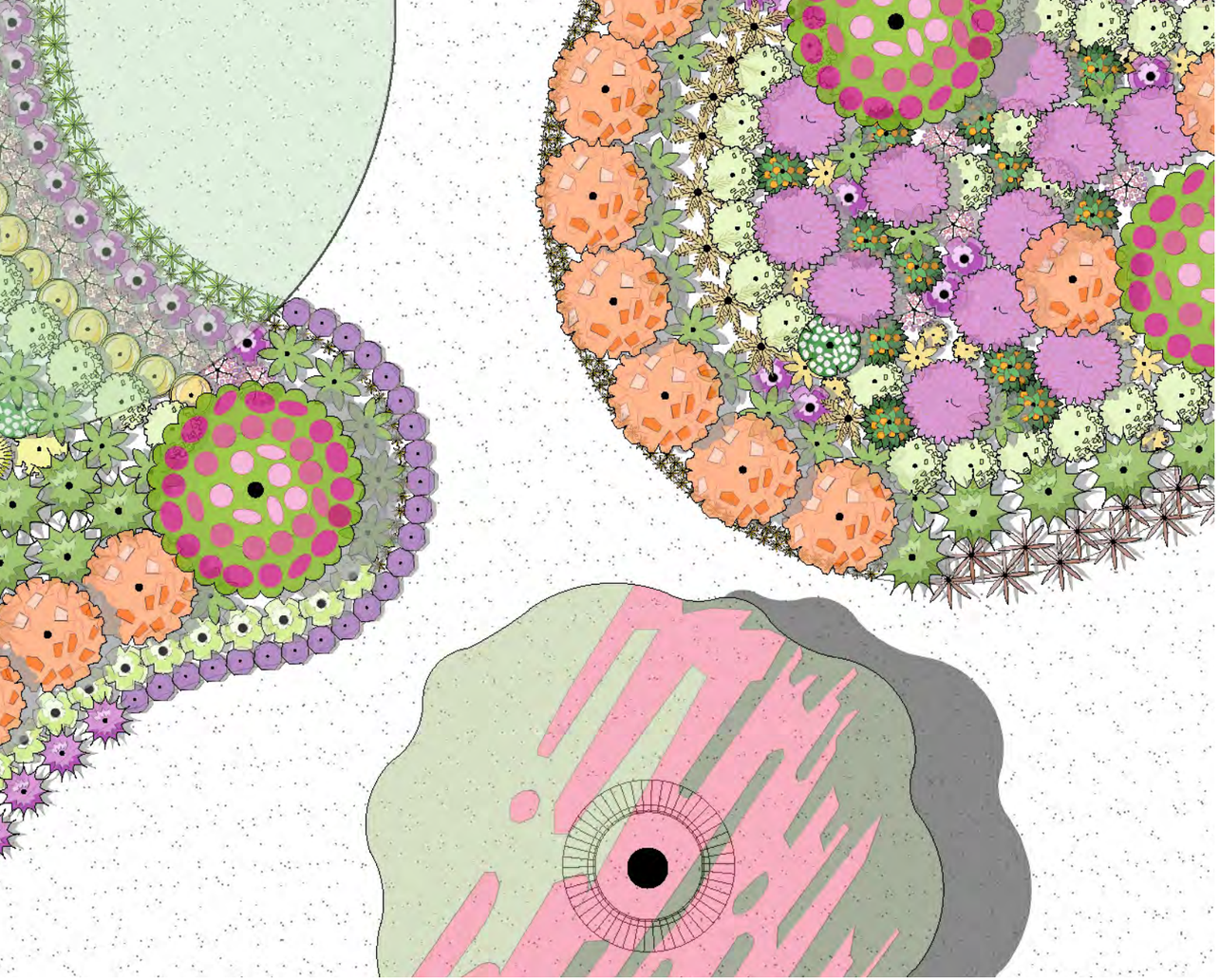
The Toolkit on the following pages was designed by Evan Abramson, Principal at Landscape Interactions, based on years of scientific study by Dr. Robert Gegear of UMass-Dartmouth and the Beecology Project. The featured designs, plant lists and landscape management strategies have been developed specifically to support bee and butterfly species that are of the greatest conservation priority in southwest Connecticut, and represent the most prevalent landscape typologies found in suburban Fairfield County.

WHAT MAKES THESE DESIGNS DIFFERENT?

Most pollinator plantings have focused on overall abundance – "seeing lots of bees" — rather than on the wide range of wild pollinators found in a biodiverse and resilient ecosystem. The same problem arises from habitats planted with generic pollinator seed packets. While we see lots of flowers, those flowers are often providing resources for only a few common species of pollinators, and don't satisfy the full pollen, nectar and nesting requirements of a functionally diverse ecosystem.

HOW SHOULD THIS TOOLKIT BE USED?

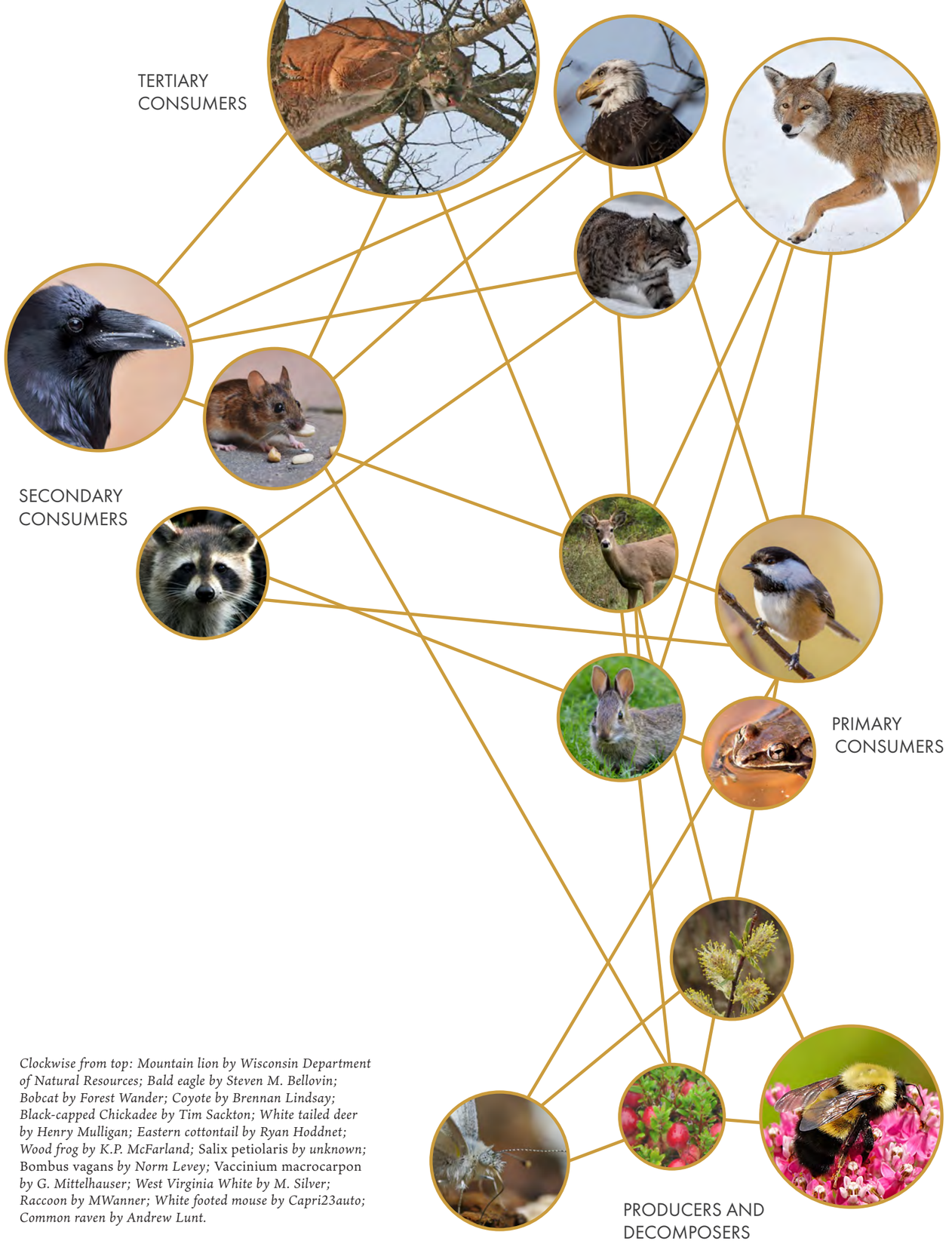
The six design areas in this Toolkit were selected because they represent common landscape "situations" in suburban Connecticut. It is our hope and intention for them to be replicated on properties and in communities throughout the region. The designs were created to increase biodiversity and climate resiliency by attracting and sustaining the widest possible range of pollinator species, and in particular, species of the greatest conservation priority in southwest Connecticut. Each area targets a particular type of landscape or ecological condition: the plant arrangements and lists can therefore be applied to any similar landscape. By replicating the Toolkit across southwest Connecticut and neighboring counties and states, the building blocks for a regional pollinator corridor will be strengthened, and hopefully, many of these at-risk species will not only be attracted to your landscapes, but sustained.



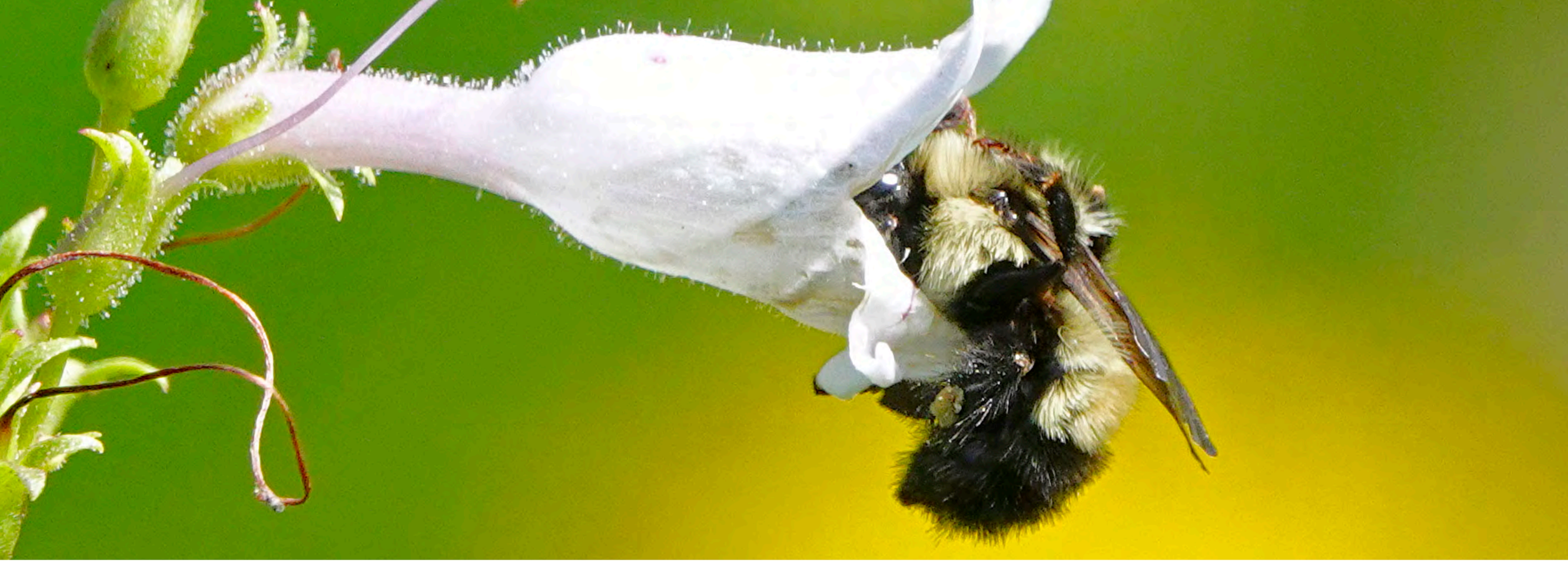
Detail from Sun + Shade Garden design area at Haskins Preserve.

Plants Matter

A truly "pollinator-friendly" landscape is highly diverse in both plant and animal species composition and includes a wide range of native plant types, ensuring that pollen and nectar are available throughout the growing season; and that nesting habitat and host plants are available throughout the year. The focus of this Toolkit is to provide the recommended plants and landscape management strategies to support native pollinator species that are at risk in suburban southwest Connecticut. The loss of these pollinator-plant interactions, or pollination systems, can have catastrophic consequences on the biodiversity of the state, and the region as a whole. But it's not too late to start planting.



Clockwise from top: Mountain lion by Wisconsin Department of Natural Resources; Bald eagle by Steven M. Bellovin; Bobcat by Forest Wander; Coyote by Brennan Lindsay; Black-capped Chickadee by Tim Sackton; White tailed deer by Henry Mulligan; Eastern cottontail by Ryan Hoddnet; Wood frog by K.P. McFarland; Salix petiolaris *by unknown;* Bombus vagans *by Norm Levey;* Vaccinium macrocarpon *by G. Mittelhauser; West Virginia White by M. Silver; Raccoon by MWanner; White footed mouse by Capri23auto; Common raven by Andrew Lunt.*



Bombus vagans on Penstemon digitalis. One of the most abundant bumblebee species in Connecticut a few decades ago, it is now one of the rarest in the state. Photograph by Norm Levey.

Why Pollinators?

Native pollinators are vital to creating and maintaining the habitats and ecosystems that most animals rely on for food and shelter — including humans. What happens (or doesn't happen) at the pollination scale has repercussions all the way up the food chain. Over 80% of the flowering plants on Earth depend upon insect-mediated pollination; bees alone pollinate one-third of the food grown in the United States. In a global study of more than 40 crops in 600 fields across every populated continent, scientists found that wild pollinators were twice as effective as honeybees in producing seeds and fruit (Garibaldi et al.). In the United States, wild bee pollination services were estimated to be worth $3.07 billion in 2006 (Losey & Vaughan). This estimate is a conservative approximation of wild bee pollination's contemporary value, considering the increase in pollinator-dependent crop plants over the past decade (Russo et al.; Mathiasson & Rehan).

As **keystone species**, wild pollinators provide food, shelter and nest sites to wildlife at other trophic levels through their interactions with native flowering plants. Protecting diversity of native pollination systems is therefore critical for maintaining healthy and diverse ecosystems. Pollination systems include bees, butterflies and moths, birds, beetles and flies, and represent over 80% of plant species worldwide.

Just like humans, pollinators need nutrient-dense food, shelter, and successful reproduction to thrive. But not all species require the same thing. A delicate balance exists between native plants and their pollinators, relationships that evolved over millions of years. Some plants have a small guild of species which coevolved with them to ensure their pollination. Similarly, approximately 15% of northeastern native bees are considered pollen specialists (Fowler). For many specialists, once their "partner" is missing from the landscape, they cannot reproduce – and thus risk becoming extirpated, endangered (and eventually, extinct).

A major misconception about pollinator decline is that all species are declining at the same rate. In fact, many species are actually increasing in abundance and geographic distribution as a direct result of human disturbance. "Seeing lots of bees" does not necessarily mean that your landscape is pollinator-friendly. Unfortunately, most efforts to restore pollination systems to date have resulted in increasing the numbers of a few common bee, butterfly and moth species, rather than on the range of wild pollinator species needed for ecosystem health and resiliency.

Above (left to right): Contemporary landscape conditions at Haskins Preserve include a diseased and dying Cornus flordia in the center of the courtyard; the eutrophication of both ponds on the property; non-native Wineberry as a dominant understory plant in forest edges. Below: draft rendering of the six proposed design areas. Photographs by Evan Abramson.

Project Context

The Haskins Preserve is a 16-acre park in the midst of a quiet residential neighborhood in Westport, Connecticut. The property was previously the home and research site of Caryl and Edna Haskins, noted entomologists, government advisors, inventors, authors and philanthropists. The Haskins lived on the site for over 50 years in the latter half of the twentieth century. During this time they made various landscaping changes to the property, including stone walls, gates and the channelization of two perennial streams which drain into and out of two ponds on the site. Also during this time, the Haskins collected and planted numerous exotic tree and shrub species, many of which are still prevalent on the landscape today.

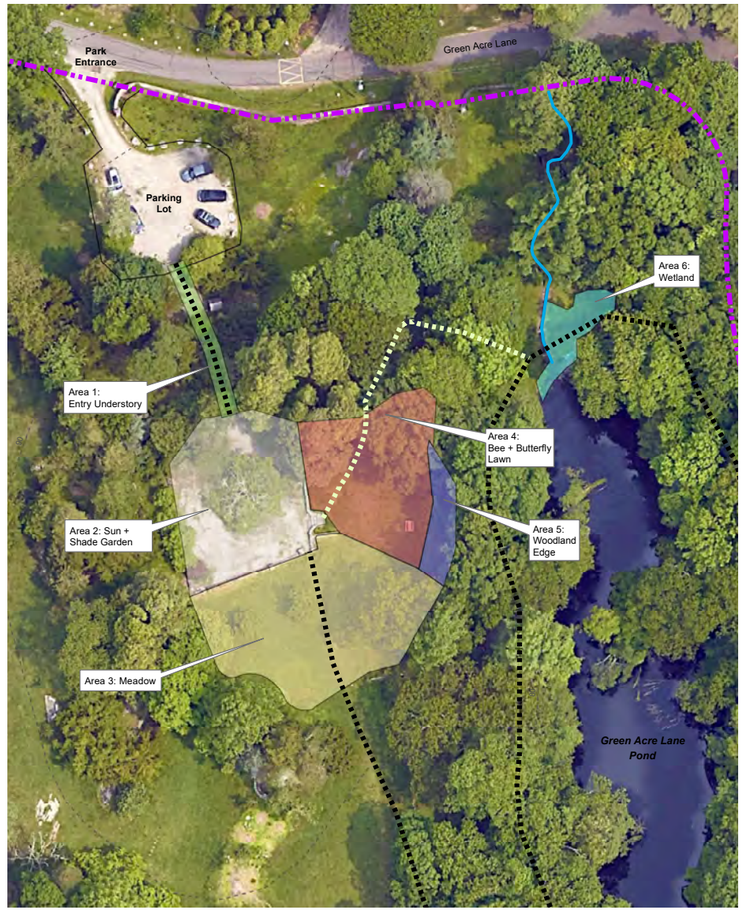
Both of the ponds on the site are man-made: the smaller pond in the western portion of the site (Green Acre Pond) dates to the post-Civil War period, and was dredged to support a dairy farm; the larger pond in the eastern portion of the site (Green Acre Lane Pond) was built in the late 1920s as part of a large estate. A 4,000 sq. ft greenhouse once occupied the property to support the research efforts of the Haskins. Today, the greenhouse is gone, and the site is dominated by open expanses of lawn; mixed hardwood-hemlock forest; and the foundation of what was once the courtyard of the large estate. Dominant invasive species on the site include Japanese stiltgrass *(Microstegium vimineum)* in the lawn areas; Multiflora rose *(Rosa multiflora)*, Morrow's honeysuckle *(Lonicera morrowii)*, Oriental bittersweet *(Celastrus orbiculatus)* and Japanese barberry *(Berberis thunbergii)* in forest edges and forested wetland areas near both ponds. Wineberry *(Rubus phoenicolasius)*, an edible non-native raspberry, is also dominant in edges between forest and lawn.

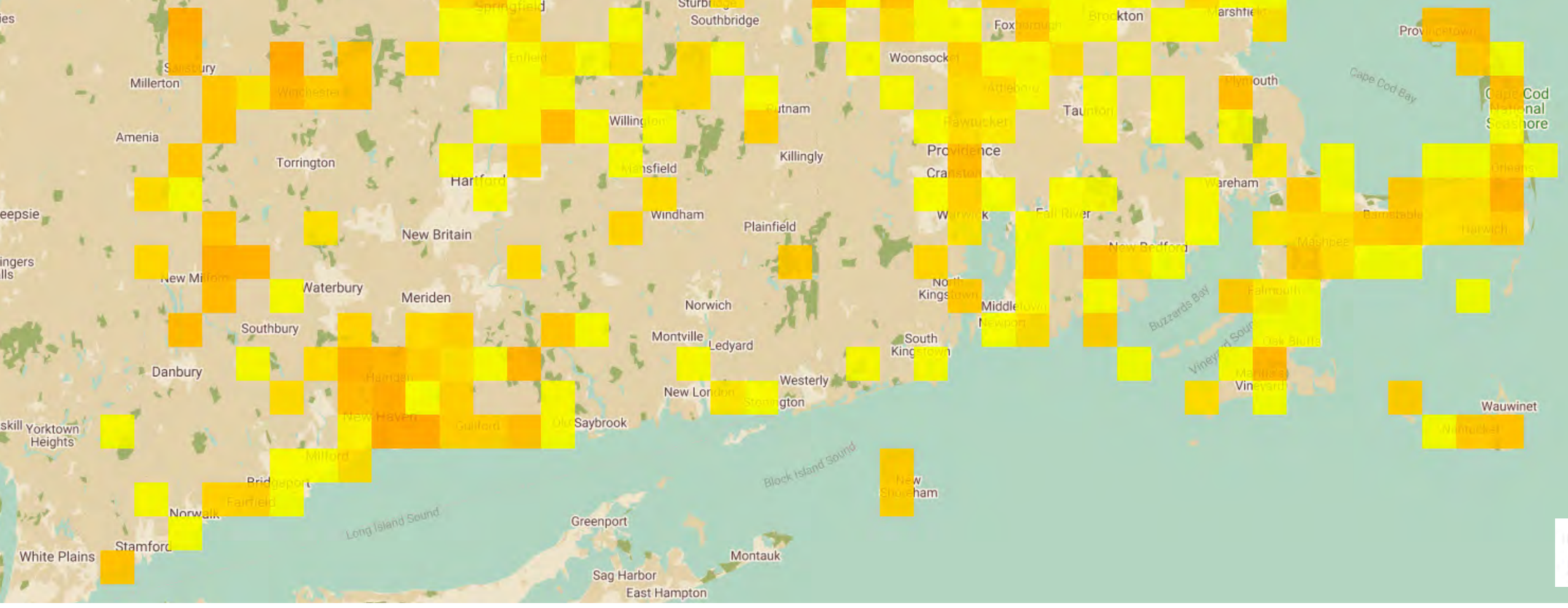
Today, the ponds at Haskins Preserve are following their natural course and silting in. In this eutrophic stage, waters become rich in nitrogen and phosphorus, supporting aquatic plant growth but preventing other components of aquatic ecosystems. Removal of the dam at Green Acre Lane Pond is presently underway, as it has been given a Class B Hazard Classification following an inspection of the structure under the Connecticut Dam Safety Program. Green Acre Lane Pond is an important ecological asset to the property, as it is used by a variety of long-legged waders for foraging, including two state-listed species (Great Egret and Little Blue Heron) (Zemba). A trail system at Haskins Preserve circles both ponds and also makes a loop through upland forested areas in the southern portion of the site.

In late 2019, Evan Abramson of Landscape Interactions was contracted by the Aspetuck Land Trust to create a series of landscape designs on the property to support at-risk pollinator species (see adjacent map). By showcasing a variety of designs and unique approaches to landscape conversion, the vision is for Haskins Preserve to serve as a model for biodiverse, ecologically resilient landscaping to property owners, landscape designers and land managers across the wider region.

For several years, the Aspetuck Land Trust has been establishing a Green Corridor through the towns of Fairfield, Westport, Weston, Easton, Wilton and Redding. The goal of the project is to create a 40,000-acre corridor of protected and planted landscapes, linking existing Aspetuck Land Trust sites and other protected open spaces with privately owned properties that contain a diversity of native plant communities. Over 77% of the land in the Aspetuck Land Trust's Green Corridor plan is privately owned, so homeowners are an integral part of the network.

The six design areas that comprise this Toolkit represent a wide range of land use and ecological conditions commonly found in suburban southwest Connecticut. By viewing the varied designs, plant lists and approaches to site establishment and management, homeowners, designers, landscapers and property managers are equipped with not only the vision but the tools to transform manicured lawn, ornamental plantings and degraded forest edges into functionally diverse, climate resilient native pollinator habitat.





Above: portion of map depicting 8,049 observations of bumblebees in New England based on range of species diversity, 1864-2020. Courtesy the Beecology Project. Below: Dr. Gegear surveys bumblebees during a Beecology citizen scientist training. Photograph by Evan Abramson.

Science Informs Design

Pollination Ecologist and Conservation Biologist Robert Gegear, Ph.D. has been studying the ecology, evolution and conservation of pollination systems native to eastern North America for over 25 years. An Assistant Professor of Biology at the University of Massachusetts-Dartmouth as well as Founder and Director of the New England Beecology Project, Dr. Gegear is a Scientific Consultant at Landscape Interactions whose research informs the plant selection and pollinator species targeted in this Toolkit. Dr. Gegear's research approach spans many boundaries, combining concepts and experimental techniques from behavioral ecology, neurobiology, experimental psychology, molecular biology, population and community ecology, evolutionary biology and computer science.

Haskins Preserve is being surveyed for pollinator species diversity and change over a four-year period by Dr. Robert Gegear. A classic "before and after" experiment, Year One (2020) involved observing and documenting pollinator and plant species interactions on the site before any planting or landscape modifications took place. Years Two and Three (2022 and 2023) will document changes in species presence and interactions after the recommended plants, designs and management guidelines from the Toolkit have been implemented. **This Toolkit has been created to specifically target and support bee and butterfly species which are threatened or at risk in southwestern Connecticut.** The study format is based upon years of intensive field and lab observations by Dr. Gegear, which correlate at-risk bee and butterfly species with particular pollen, nectar and host plants, as well as nesting preferences. It is expected that populations of the at-risk bee and butterfly species targeted in this Toolkit will not only be observed, but sustained on each site in Years Two, Three and beyond.

Using the **Beecology** app that Dr. Gegear created, citizen scientists can contribute to species observations at Haskins Preserve, as well as throughout the region, by uploading videos and photographs of bumblebees on plants. Dr. Gegear and members of his lab verify every bumblebee and plant ID before they are added to the database.

To become a Beecologist you can get started at: https://beecology.wpi.edu/website/participate#apps

Measuring Success

While the subject of pollinator decline is understood by many to be highly significant, few pollinator habitat projects target the range of species at risk in a given geographic area. This is ironic since it is due to the decline of so many pollinator species that we are aware of the pollinator crisis in the first place. **Shouldn't pollinator habitat projects therefore target the species that merit conservation and protection, rather than common or abundant species whose populations are stable?**

Many of the species whose numbers have fallen so sharply in recent decades possess more specialized habitat requirements. With respect to pollinators, this usually involves foraging and/or nesting preferences among particular groups of plants. The same can be said among certain plant taxa, with many of the species experiencing steep declines associated with a limited group of insects for their reproductive needs. Yet **few pollinator habitat design or restoration projects collect data before, during or after recommended plantings and strategies have been implemented.** Limited research based on first-hand field observations exists, in order to demonstrate the efficacy (or inefficacy) of particular plant species or landscape management regimes in promoting the abundance and diversity of those species that are the most in need of conservation.

For the Haskins site, field observations of bumblebee and butterfly species at risk in southwestern Connecticut have been collected by Dr. Gegear throughout the 2020 growing season. To measure the success (or failure) of the Toolkit in attracting and sustaining at-risk pollinator species on the site, the following criteria will be measured over a four-year period (2020-2024):

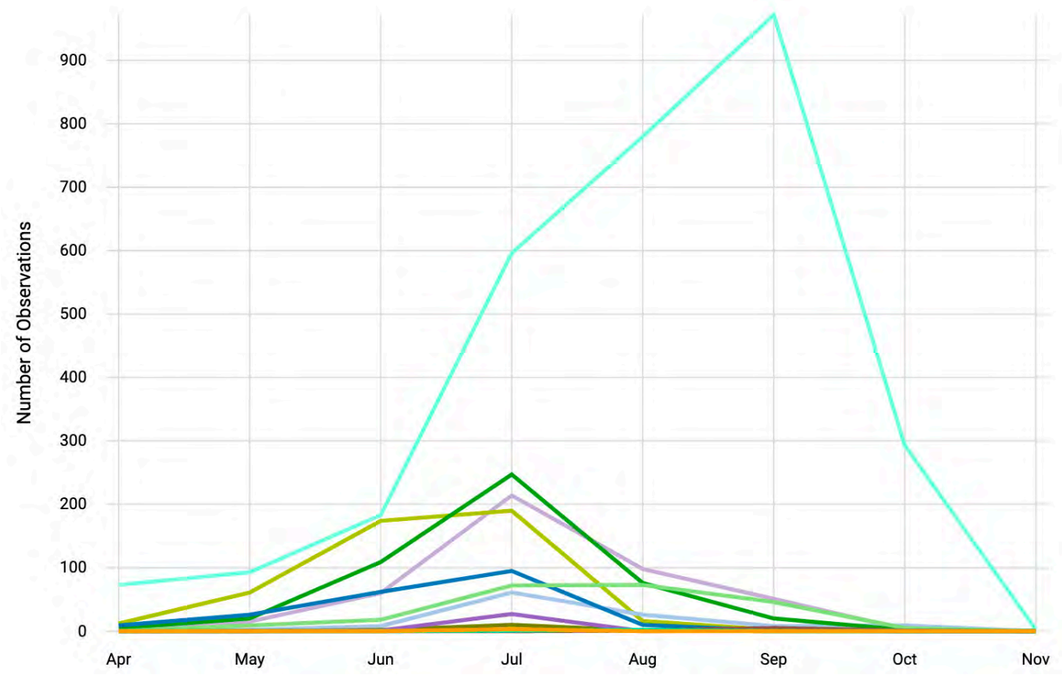
» NATIVE BUMBLEBEE AND BUTTERFLY SPECIES DIVERSITY SUSTAINED *(not just one sighting of a particular species)*

» PLANT SELECTION SUPPORTS SPECIES RICHNESS ACROSS FUNCTIONAL TRAITS, TROPHIC LEVELS AND ANIMAL GROUPS *(bee, butterfly, moth, bird)*

» FUNCTIONAL DIVERSITY IMPROVED OVER TIME

In other words, which bumblebee and butterfly species were on the site before and after the design and habitat modifications were implemented? Which plant species were added? What management changes worked? And how were animals further up the food web affected?

BUMBLEBEE OBSERVATIONS IN SOUTHERN AND CENTRAL NEW ENGLAND BY MONTH (1990-2020)



Historical data courtesy Yale Peabody Museum, contemporary data courtesy Dr. Robert Gegear. Total of 4,966 observations depicted. Graph courtesy the Beecology Project.

SHOULDN'T POLLINATOR HABITAT PROJECTS TARGET SPECIES THAT MERIT CONSERVATION, RATHER THAN COMMON SPECIES WITH STABLE POPULATIONS?

Baseline Survey Results

During the 2020 growing season, Dr. Gegear surveyed the Haskins Preserve for bumblebee and butterfly species at risk in southwestern Connecticut. His observations were compared to historical data for pollinator species in the area. This baseline data will be compared to subsequent surveys in 2022 and 2023 after the designs and landscape management guidelines outlined in this Toolkit have been implemented. This will demonstrate the significance of species-level plant selection and in particular, of combining specific groups of plant species together on a site, to not only attract but sustain populations of pollinator species that are of the highest conservation priority. This science-based approach to landscape biodiversity design is at the core of the work that Landscape Interactions does.

INITIAL SURVEY REPORT FOR HASKINS PRESERVE (2020)

Robert J. Gegear

Historical records of bumblebee species relative abundance and distribution data were obtained from the Yale Peabody Museum for areas close to the study site in Westport. Surveys of bumblebees and at-risk butterflies were taken in spring and summer (one survey per time period). Bumblebee surveys included all species historically present in the area whereas butterfly surveys focused only on species at risk.

The following common bumblebee species were recorded at Haskins Preserve in 2020: *Bombus impatiens, B. griseocollis, B. perplexus* and *B. bimaculatus.* No at-risk bee or butterfly species were observed. A list of the target pollinator species expected to be at the site based on historical records is provided on the following page.

Summary Assessment of Flower Visitors at Haskins Preserve *(based on site size)*: Moderate abundance, low diversity.

At-Risk Pollinators
Supported by this Toolkit

BEES:

- *Bombus affinis* Rusty patched bumblebee
- *Bombus fervidus* Golden northern bumblebee
- *Bombus pensylvanicus* American bumblebee
- *Bombus vagans* Half-black bumblebee

BUTTERFLIES:

- *Amblyscirtes hegon* Pepper and Salt Skipper
- *Amblyscirtes vialis* Common Roadside Skipper
- *Boloria bellona* Meadow Fritillary
- *Callophrys irus* Frosted Elfin
- *Carterocephalus palaemon* Arctic Skipper
- *Chlosyne harrisii* Harris' Checkerspot
- *Erora laeta* Early Hairstreak
- *Euphyes bimacula* Two-spotted Skipper
- *Euphyes conspicua* Black Dash
- *Euphyes dion* Dion Skipper
- *Hesperia leonardus* Leonard's Skipper
- *Hesperia metea* Cobweb Skipper
- *Hesperia sassacus* Indian Skipper
- *Lycaena epixanthe* Bog Copper
- *Lycaena hyllus* Bronze Copper
- *Pieris oleracea* Mustard White
- *Pieris virginiensis* West Virginia White
- *Poanes massasoit* Mulberry Wing
- *Polygonia progne* Gray Comma
- *Satyrium acadica* Acadian Hairstreak
- *Satyrium favonius* Oak Hairstreak
- *Speyeria aphrodite* Aphrodite Fritillary
- *Speyeria atlantis* Atlantis Fritillary

BIGGEST THREATS FACING POLLINATORS

- HABITAT LOSS *(AGRICULTURE + HUMAN DEVELOPMENT)*
- PESTICIDES
- CLIMATE CHANGE

Photographs (clockwise from top left): Bombus vagans by Peter Gorman; West Virginia White by M. Silver; Bombus affinis by Serina Jepsen; Bog Coppers by Jim Brighton; Harris' Checkerspots mating by Tom Halliwell.

Design Overview

HASKINS PRESERVE

The Haskins Preserve has been divided into six design areas. Each represents a distinct landscape typology commonly found in suburban southwest Connecticut. For each area, a selection of plants has been arranged into a landscape design that is appropriate for the ecological conditions of the site, as well as the aesthetics of the particular area, its present land use, and the surrounding landscape.

1 ENTRY UNDERSTORY

A shaded woodland pathway under coniferous canopy serves as a visitor's first impression of the site after parking.

2 SUN + SHADE GARDEN

The sunken courtyard of an early twentieth century estate is re-worked into sweeping, immersive views of planting beds rich in color, structure and seasonal variation. A meandering crushed stone walk-way leads to private spaces for sitting in the sun as well as beneath the shade of a redbud and surrounding mature trees, relics of the site's exotic botanical history.

3 BEE + BUTTERFLY LAWN

A lawn between the courtyard and the wood's edge, both sunny and shaded, is interspersed with a diversity of native flowers, grasses and sedges, all crucial pollen, nectar and host plants — and all of which are tolerant of occasional mowing and/or able to bloom at a height between 4 and 12 inches.

4 WOODLAND EDGE

A full sun to part-shade transition area between lawn and woods, here shrubs of diverse size, structure and bloom time are arranged to maximize ecosystem services in what was once an area lacking in understory vegetation. Private sitting areas for scattered picnic benches and a hammock are also created.

5 MEADOW

A sunlit lawn once dominated by invasive Japanese stiltgrass is re-imagined as a biodiverse native meadow traversed by an 8 foot wide mowed path.

6 POND + STREAM CROSSING

A diverse array of wetland plants surround both sides of the trail that leads from the courtyard through the woods and emerges into sunlight to cross a stream at the northernmost edge of green acre lane pond. Woody shrubs, forbs and sedges growing along the shore of the pond are passed before the trail disappears beneath the surrounding forest.

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Entry
Understory
HASKINS PRESERVE

SITE CONDITIONS

MEDIUM SOILS
PART-SHADE TO SHADE
HEAVY FOOT TRAFFIC

PLANT SCHEDULE

GRASSES	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Carex blanda	Eastern Woodland Sedge	21	2` wide spacing
	Carex pensylvanica	Pennsylvania Sedge	52	1` wide spacing

PERENNIALS	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Eurybia macrophylla	Large-leaved Wood-aster	21	2` wide spacing
	Geranium maculatum	Spotted Crane`s-bill	35	1` wide spacing
	Solidago caesia	Blue-stemmed Goldenrod	25	1.5` wide spacing
	Solidago flexicaulis	Zigzag Goldenrod	12	1` wide spacing
	Solidago puberula	Downy Goldenrod	8	1` wide spacing
	Symphyotrichum cordifolium	Heart-leaved Aster	12	1` wide spacing
	Symphyotrichum lateriflorum	Calico Aster	12	2` wide spacing
	Symphyotrichum novi-belgii	New York Aster	19	2` wide spacing
	Viola pubescens	Smooth Yellow Violet	27	.5` wide spacing
	Viola sororia	Common Violet	24	.5` wide spacing

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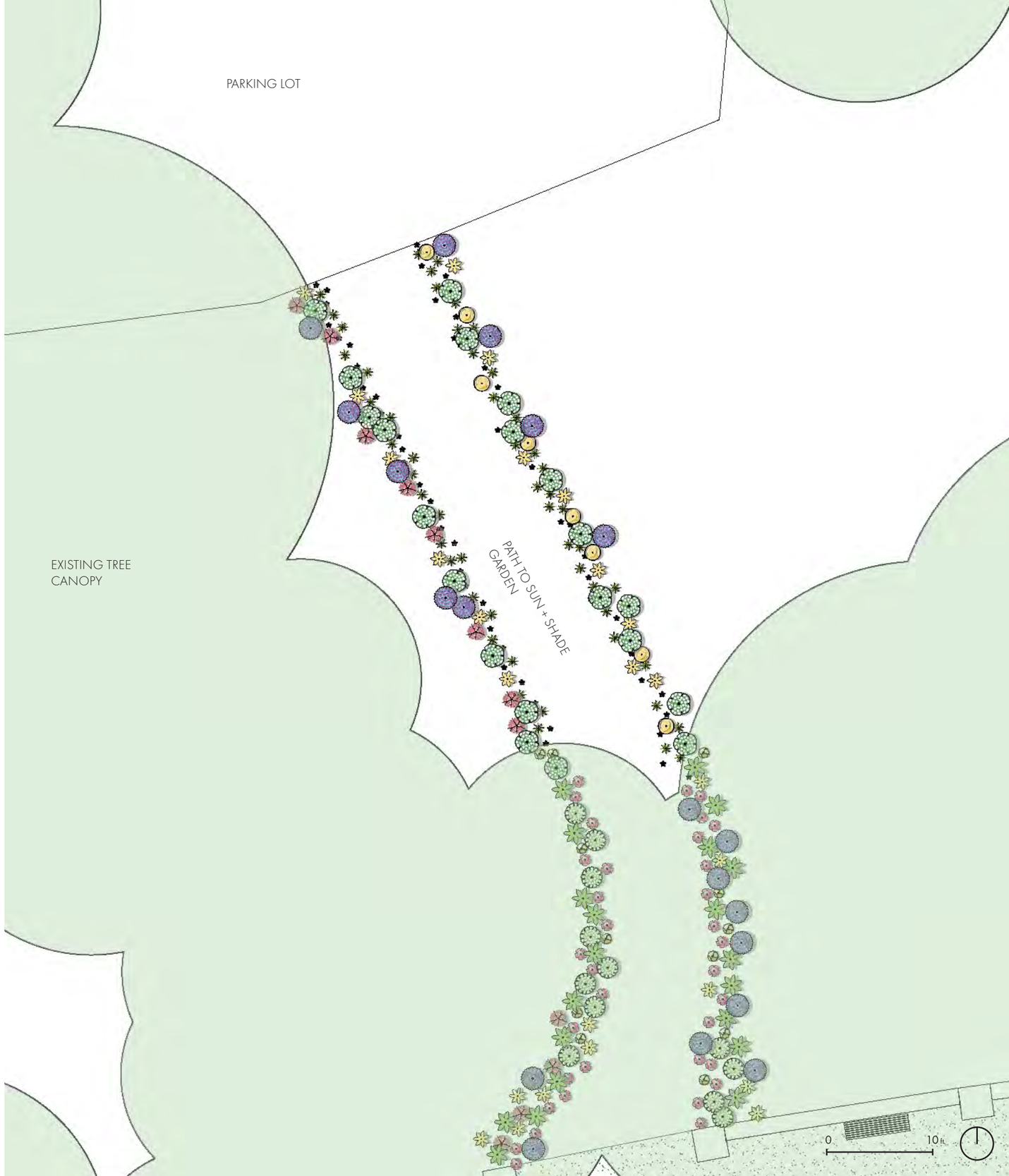

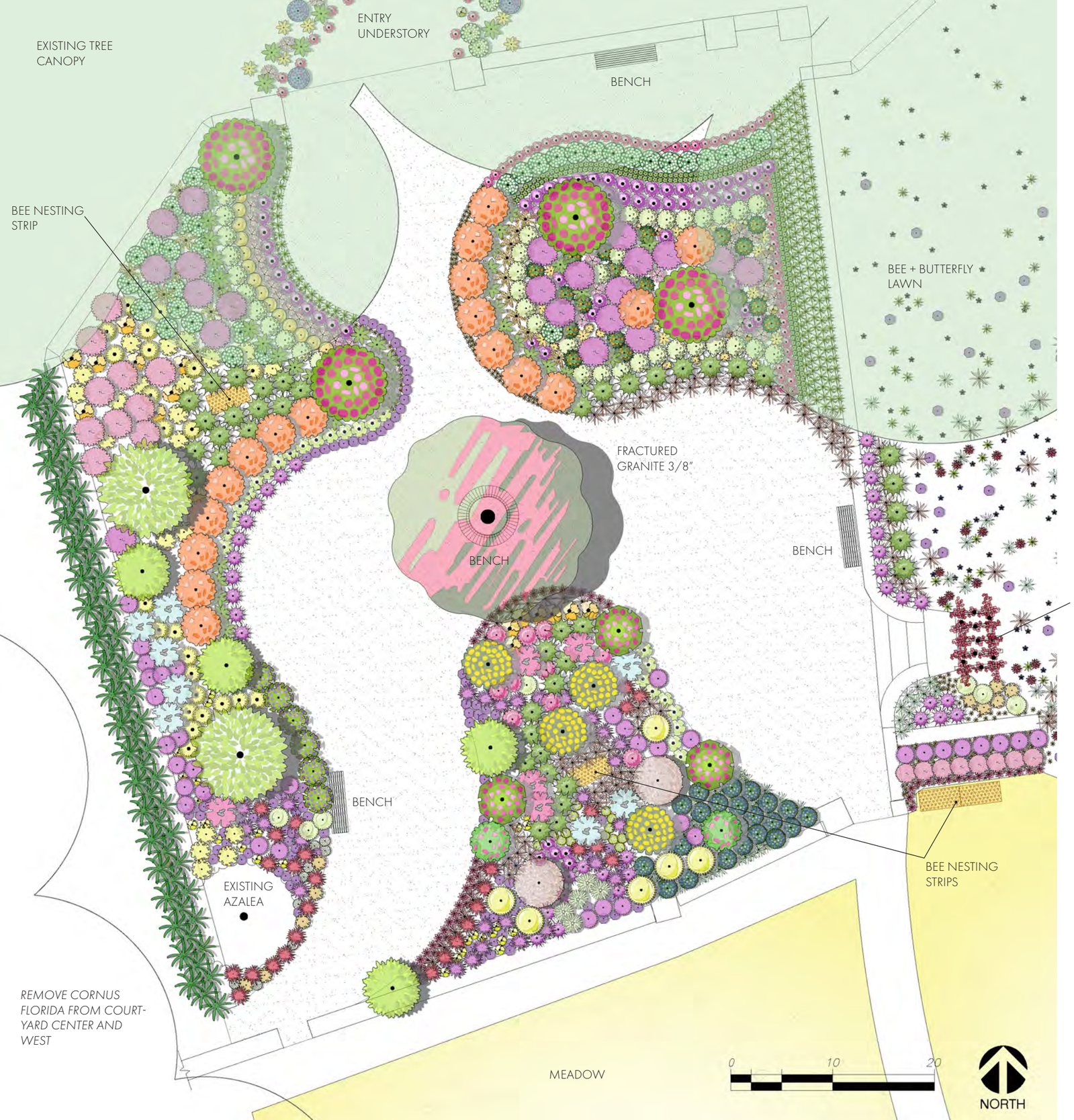

Sun + Shade Garden

HASKINS PRESERVE

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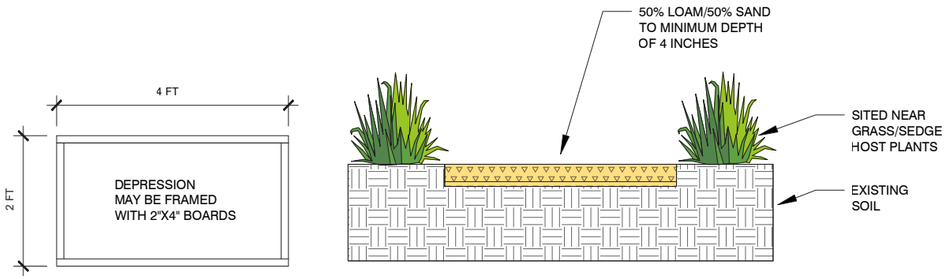
SITE CONDITIONS

DRY, POOR SOILS (GRAVEL AND FILL)
FULL SUN TO PART-SHADE
GATHERING SPACE
HIGH DEER BROWSE PRESSURE

BEE NESTING STRIP DETAIL



Sun + Shade Garden

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PLANT SCHEDULE

TREES	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Cercis canadensis	Eastern Redbud	1	20` wide spacing
	Salix humilis	Prairie Willow	4	6` wide spacing
	Salix occidentalis	Dwarf Prairie Willow	2	5` wide spacing
	Salix petiolaris	Meadow Willow	2	10` wide spacing

SHRUBS	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Baptisia tinctoria	Yellow Wild Indigo	6	3` wide spacing
	Diervilla lonicera	Northern Bush-honeysuckle	17	4` wide spacing
	Hypericum prolificum	Shrubby St. John`s-wort	4	5` wide spacing
	Rosa carolina	Carolina Rose	2	4` wide spacing
	Rosa virginiana	Virginia Rose	3	5` wide spacing
	Rubus odoratus	Purple-flowering Raspberry	4	7` wide spacing
	Spiraea alba	Meadowsweet	8	3` wide spacing
	Spiraea tomentosa	Steeplebush	5	3` wide spacing
	Vaccinium angustifolium	Lowbush Blueberry	6	3` wide spacing
	Vaccinium pallidum	Hillside Blueberry	22	2` wide spacing

ANNUALS	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Impatiens capensis	Spotted Jewelweed	18	2` wide spacing

GRASSES	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Andropogon gerardii	Big Bluestem	66	3` wide spacing
	Bromus pubescens	Hairy Wood Brome	17	1.5` wide spacing
	Carex blanda	Eastern Woodland Sedge	44	2` wide spacing
	Carex brevior	Short-beaked Sedge	262	.5` wide spacing
	Carex pensylvanica	Pennsylvania Sedge	186	1` wide spacing
	Danthonia spicata	Poverty Oat-Grass	51	1` wide spacing
	Eragrostis spectabilis	Purple Love Grass	37	1-2` wide spacing
	Panicum virgatum	Switchgrass	42	3` wide spacing
	Schizachyrium scoparium	Little Bluestem	96	2` wide spacing

PERENNIALS	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Agastache scrophulariifolia	Purple Giant Hyssop	36	2` wide spacing
	Asclepias exaltata	Poke Milkweed	42	2` wide spacing
	Asclepias syriaca	Common Milkweed	10	2` wide spacing
	Cardamine concatenata	Cut-leaved toothwort	203	.5` wide spacing
	Doellingeria umbellata	Flat-topped Aster	24	2` wide spacing
	Eurybia macrophylla	Large-leaved Wood-aster	35	2` wide spacing
	Eutrochium dubium	Coastal Plain Joe-Pye Weed	8	2` wide spacing
	Eutrochium fistulosum	Hollow Joe-Pye Weed	10	3` wide spacing
	Eutrochium purpureum	Purple Joe-Pye Weed	21	3` wide spacing
	Geranium maculatum	Spotted Crane`s-bill	57	1` wide spacing
	Liatris novae-angliae	Northern Blazing Star	60	1` wide spacing
	Monarda didyma	Scarlet Bee Balm	28	2` wide spacing
	Monarda fistulosa	Wild Bergamot	27	2` wide spacing
	Penstemon digitalis	Foxglove Beardtongue	25	1.5` wide spacing
	Penstemon hirsutus	Northeastern Beardtongue	59	1.5` wide spacing
	Prunella vulgaris	Selfheal	93	1` wide spacing
	Solidago caesia	Blue-stemmed Goldenrod	12	1.5` wide spacing
	Solidago flexicaulis	Zigzag Goldenrod	11	1` wide spacing
	Solidago juncea	Early Goldenrod	8	1` wide spacing
	Solidago nemoralis	Gray Goldenrod	27	1` wide spacing
	Solidago odora	Sweet Goldenrod	21	1-2` wide spacing
	Solidago puberula	Downy Goldenrod	14	1` wide spacing
	Solidago sempervirens	Seaside Goldenrod	10	1` wide spacing
	Solidago speciosa	Showy Goldenrod	16	2` wide spacing
	Symphyotrichum cordifolium	Heart-leaved Aster	28	1` wide spacing
	Symphyotrichum ericoides	Heath Aster	9	1` wide spacing
	Symphyotrichum pilosum	Awl Aster	7	2` wide spacing
	Symphyotrichum puniceum	Purple-stemmed Aster	5	2` wide spacing
	Zizia aurea	Golden Alexanders	14	1` wide spacing

VINE/ESPALIER	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Lonicera sempervirens	Trumpet Honeysuckle	9	Will climb 15-20`

Conceptual rendering of the Sun + Shade Garden landscape design from the southeast portion of the courtyard looking southeast.

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Bee + Butterfly Lawn

HASKINS PRESERVE

PLANT SCHEDULE

GRASSES	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Carex pensylvanica	Pennsylvania Sedge	120	1` wide spacing
	Danthonia spicata	Poverty Oat-Grass	62	1` wide spacing
	Schizachyrium scoparium	Little Bluestem	68	2` wide spacing
PERENNIALS	**BOTANICAL NAME**	**COMMON NAME**	**QTY**	**REMARKS**
	Pedicularis canadensis	Canadian Wood Betony	66	1` wide spacing
	Prunella vulgaris	Selfheal	99	1` wide spacing
	Viola pedata	Bird`s-foot Violet	57	.5` wide spacing
	Viola pedatifida	Prairie Violet	87	.5` wide spacing
	Viola sororia	Common Violet	64	.5` wide spacing
	Viola striata	Cream Violet	61	.5` wide spacing

SITE CONDITIONS

MEDIUM SOILS
FULL SUN TO PART-SHADE
HEAVY FOOT TRAFFIC
MAINTAINED BY MOWING
STILTGRASS IS DOMINANT

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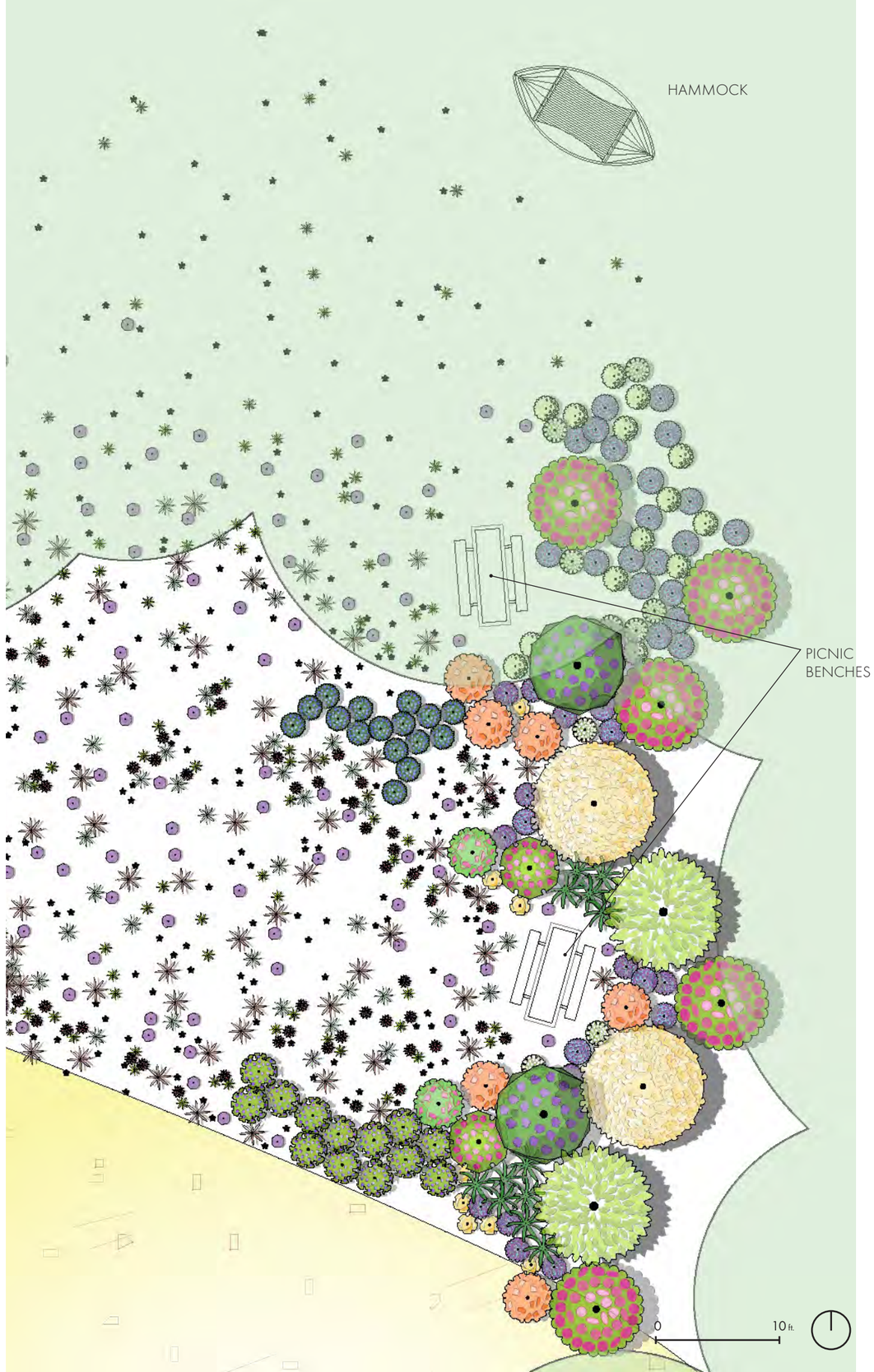

SITE CONDITIONS

MEDIUM SOILS
FULL SUN TO PART-SHADE
HIGH DEER BROWSE PRESSURE
WINEBERRY IS DOMINANT

Woodland Edge

HASKINS PRESERVE

PLANT SCHEDULE

TREES	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Salix lucida	Shining Willow	2	10` wide spacing
	Salix petiolaris	Meadow Willow	2	10` wide spacing
SHRUBS	**BOTANICAL NAME**	**COMMON NAME**	**QTY**	**REMARKS**
	Diervilla lonicera	Northern Bush-honeysuckle	6	4` wide spacing
	Rosa carolina	Carolina Rose	2	4` wide spacing
	Rosa virginiana	Virginia Rose	2	5` wide spacing
	Rubus odoratus	Purple-flowering Raspberry	5	7` wide spacing
	Vaccinium angustifolium	Lowbush Blueberry	13	3` wide spacing
	Vaccinium corymbosum	Highbush Blueberry	2	8` wide spacing
	Vaccinium pallidum	Hillside Blueberry	16	2` wide spacing
GRASSES	**BOTANICAL NAME**	**COMMON NAME**	**QTY**	**REMARKS**
	Andropogon gerardii	Big Bluestem	12	3` wide spacing
PERENNIALS	**BOTANICAL NAME**	**COMMON NAME**	**QTY**	**REMARKS**
	Asclepias exaltata	Poke Milkweed	14	2` wide spacing
	Hypericum punctatum	Spotted St. John`s-wort	8	1` wide spacing
	Symphyotrichum laeve	Smooth Aster	12	1.5` wide spacing
	Symphyotrichum lateriflorum	Calico Aster	9	2` wide spacing
	Symphyotrichum novi-belgii	New York Aster	28	2` wide spacing

Meadow Trail

HASKINS PRESERVE

SITE CONDITIONS

DRY TO MEDIUM SOILS
FULL SUN TO PART-SHADE
HEAVY FOOT TRAFFIC
STILTGRASS IS DOMINANT

HASKINS MEADOW SEED MIX

Shrubs	
Spiraea alba	Meadowsweet
Spiraea tomentosa	Steeplebush
Forbs	
Agastache scrophulariifolia	Purple giant hyssop
Asclepias syriaca	Common milkweed
Doellingeria umbellata	Tall white aster
Euthamia graminifolia	Grass-leaved goldenrod
Eutrochium purpureum	Purple Joe-Pye weed
Geranium carolinianum	Carolina crane's-bill
Geranium maculatum	Spotted crane's-bill
Impatiens capensis	Spotted touch-me-not
Monarda fistulosa	Wild bergamot
Monarda punctata	Spotted beebalm
Pedicularis canadensis	Canadian lousewort
Penstemon digitalis	Foxglove beardtongue
Penstemon hirsutus	Northeastern beardtongue
Solidago juncea	Early goldenrod
Solidago odora	Sweet goldenrod
Solidago speciosa	Showy goldenrod
Symphyotrichum cordifolium	Heart-leaved American-aster
Symphyotrichum ericoides	Heath American-aster
Symphyotrichum laeve	Smooth American-aster
Symphyotrichum lateriflorum	Calico American-aster
Symphyotrichum novae-angliae	New England American-aster
Symphyotrichum pilosum	Awl American-aster
Symphyotrichum prenanthoides	Crooked-stemmed American-aster
Zizia aptera	Heart-leaved golden Alexanders
Zizia aurea	Golden Alexanders
Graminoids	
Andropogon gerardii	Big bluestem
Eragrostis spectabilis	Purple lovegrass
Panicum virgatum	Switchgrass
Schizachyrium scoparium	Little bluestem

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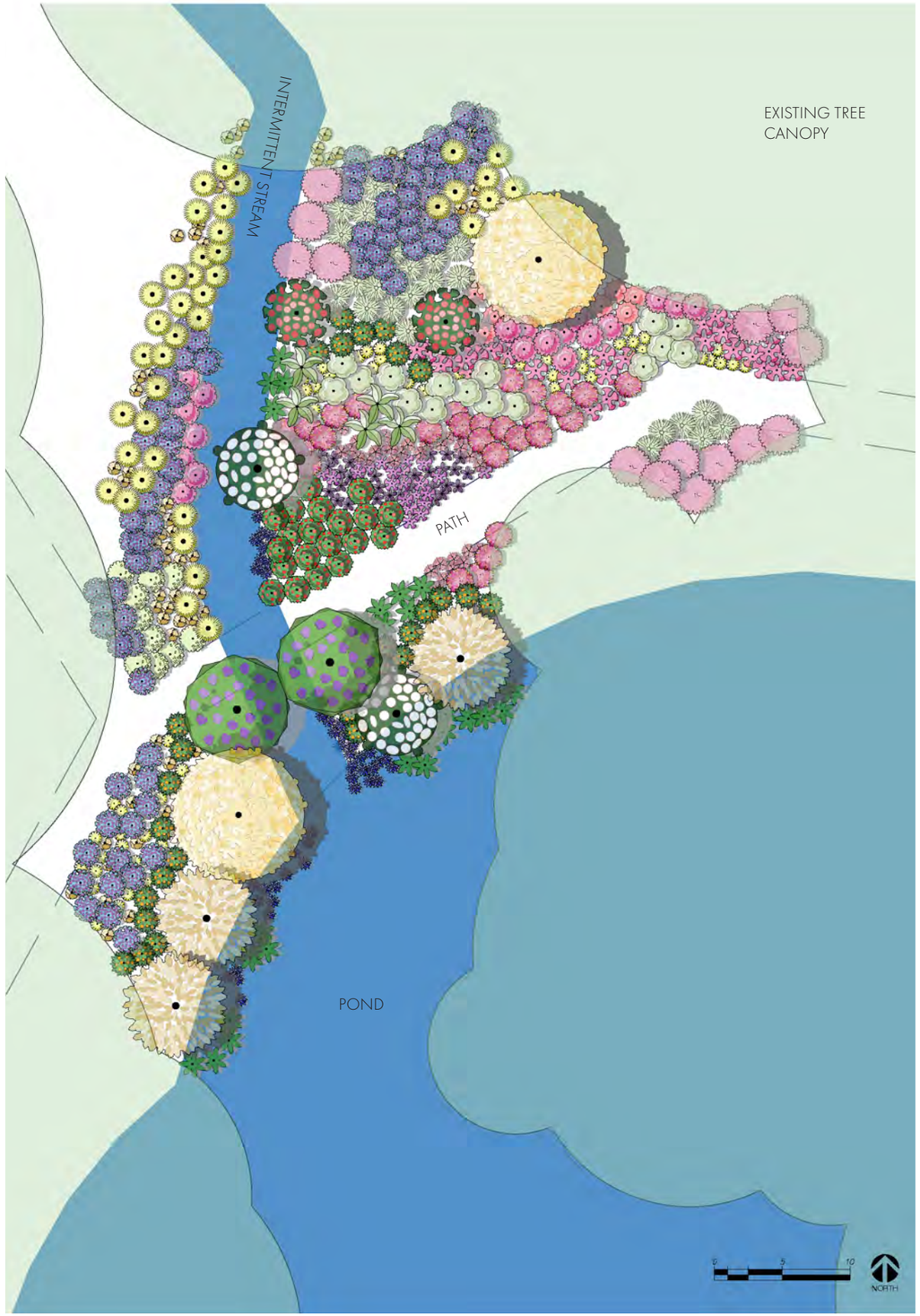
Pond + Stream Crossing

HASKINS PRESERVE

SITE CONDITIONS

MOIST TO WET SOILS
FULL SUN
HIGH DEER BROWSE PRESSURE
AGING AQUATIC INFRASTRUCTURE



PLANT SCHEDULE

TREES	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Salix discolor	Pussy Willow	3	8` wide spacing
	Salix lucida	Shining Willow	2	10` wide spacing
SHRUBS	**BOTANICAL NAME**	**COMMON NAME**	**QTY**	**REMARKS**
	Cephalanthus occidentalis	Buttonbush	2	6` wide spacing
	Rosa palustris	Swamp Rose	2	5` wide spacing
	Vaccinium corymbosum	Highbush Blueberry	2	8` wide spacing
	Vaccinium macrocarpon	American Cranberry	20	2` wide spacing
ANNUALS	**BOTANICAL NAME**	**COMMON NAME**	**QTY**	**REMARKS**
	Impatiens capensis	Spotted Jewelweed	28	2` wide spacing
BIENNIAL	**BOTANICAL NAME**	**COMMON NAME**	**QTY**	**REMARKS**
	Cirsium muticum	Swamp Thistle	7	2` wide spacing
GRASSES	**BOTANICAL NAME**	**COMMON NAME**	**QTY**	**REMARKS**
	Carex stricta	Tussock Sedge	26	2` wide spacing
PERENNIALS	**BOTANICAL NAME**	**COMMON NAME**	**QTY**	**REMARKS**
	Asclepias exaltata	Poke Milkweed	10	2` wide spacing
	Asclepias incarnata	Swamp Milkweed	27	2` wide spacing
	Doellingeria umbellata	Flat-topped Aster	40	2` wide spacing
	Eupatorium perfoliatum	Boneset	16	1-2` wide spacing
	Euthamia graminifolia	Grass-leaved Goldenrod	55	1` wide spacing
	Eutrochium fistulosum	Hollow Joe-Pye Weed	14	3` wide spacing
	Eutrochium maculatum	Spotted Joe Pye Weed	19	2` wide spacing
	Lobelia siphilitica	Blue Lobelia	32	1` wide spacing
	Mimulus ringens	Monkeyflower	30	1` wide spacing
	Physostegia virginiana	Obedient Plant	34	1.5` wide spacing
	Pontederia cordata	Pickerelweed	45	1` wide spacing
	Rumex altissimus	Pale Dock	5	2` wide spacing
	Scutellaria lateriflora	Mad-dog Skullcap	21	1` wide spacing
	Solidago flexicaulis	Zigzag Goldenrod	63	1` wide spacing
	Symphyotrichum novae-angliae	New England Aster	76	2` wide spacing
	Symphyotrichum puniceum	Purple-stemmed Aster	23	2` wide spacing

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BEST MANAGEMENT PRACTICES

1. NO CHEMICALS

Eliminate pesticide use, particularly those containing neonicotinoids. Herbicides and chemical lawn treatments can also be highly damaging to pollinators.

Avoid planting in areas previously contaminated by pesticides or without a spatial buffer from areas where pesticides are applied (at least 100 ft. wide forested buffer is recommended).

Ensure plants and seeds come from a clean, pesticide-free source. Many commercial nurseries treat their plants and seeds, oftentimes before retailers receive them. Some pesticides and most neonicotinoids persist in plants and soil for months to years.

2. DIVERSE NATIVE PLANTS

Plant straight native plant species. Cultivars and exotic plants largely do not support the pollen and nectar preferences of threatened pollinators and tend to be visited by common pollinator species whose populations are stable.

Include a range of plant types (trees, shrubs, forbs, grasses, sedges) with varying bloom times, to ensure pollen, nectar and host plants are available across the entire growing season.

3. CREATE NESTING OPPORTUNITIES

Seventy percent of native bee species are ground nesting. Mulch using compost or natural materials (e.g. chopped leaves, seed-free hay, composted wood chips) and leave bare areas of well-drained soil in sunny locations.

Thirty percent of native bees are cavity nesting. Allow dead trees, snags and pithy stemmed plants such as raspberries to remain standing.

To benefit bumblebees, maintain small brush piles. This will provide cover for rodents that will in turn create nesting habitat for bumblebees. Where possible, leave leaf litter in gardens and allow it to build up over time. This provides cover for overwintering queens. Barns with unbaled hay or a dry, protected cavity containing hay, straw, clumps of moss or grass located above or below ground are also ideal.

As with other ground nesting bees, limiting or eliminating tillage practices will limit the potential of harming bumblebees.

4. BE MESSY

Skip the fall clean up, allowing dead stems, leaves and seed heads to stand over winter, and wait until evening temperatures consistently reach 50 degrees before raking in the spring.

Don't be overzealous when it comes to tidying up. Some weeds act as host plants for caterpillars, such as lambsquarters *(Chenopodium album)* for Common Sootywing *(Pholisora catullus)* and Queen Anne's lace *(Daucus carota)* for Black Swallowtail *(Papilio polyxenes)*.

5. IT DOESN'T STOP WITH PLANTING

That being said, with new plantings, water and weed regularly for the first two years.

To deter deer and rodents until plants fully establish, it may be helpful to construct temporary fencing or set up netting. Natural repellent sprays such as *Plantskydd* can be effective when applied regularly. Thorny plants such as roses can also deter deer browse and function as natural fences for more vulnerable plants.

6. LAST BUT NOT LEAST

Put something in place to catch rainwater, with a dirt base to simulate a puddle, providing pollinators necessary minerals. Make it last between rainy days.

Keep night skies dark for moths and other nocturnal insects: motion-detecting lights or lamps facing down instead of spotlights on all night.

Some plant species establish best by direct seeding: while late fall or early winter is the best time to sow, early spring seeding is also possible, although some species may not germinate until the following year.

Lawn containing Prunella vulgaris (Common selfheal). Photograph by Matt Lavin.

TURN YOUR LAWN INTO HABITAT

Maintaining a manicured lawn can not only be expensive, it also often requires high water and chemical usage. Many turf lawns are habitat dead zones, as they are comprised primarily of non-native sod-forming grasses that spread by rhizome, outcompeting native vegetation and offering little opportunities for ground-nesting bees by carpeting the soil.

Lawns can be converted into diverse habitat in a number of ways:

METHOD 1: DIVERSIFY A TRADITIONAL LAWN

STEP 1: Mow your lawn at one inch or less. Remove grass clippings to expose as much soil as possible.

STEP 2: Rake, scrape, score, weed whack or use a spading fork to break up the lawn surface. This helps create good conditions for plant establishment and healthy seed growth through seed to soil contact.

STEP 3: Spread native seed and plant plugs. Here are the recommended rates based on the Bee + Butterfly Lawn Toolkit:

Carex pensylvanica (Pennsylvania sedge) at 1 plug per sq. ft of exposed ground
Danthonia spicata (Poverty oat-grass) at 40 seeds or 1 plug per sq. ft of exposed ground
Schizachyrium scoparium (Little bluestem) at 40 seeds or 1 plug per sq. ft of exposed ground
Pedicularis canadenis (Canadian wood betony) at 1 plug per sq. ft of exposed ground
Prunella vulgaris ssp. lanceolata (Common selfheal) at 60 seeds or 1 plug per sq. ft of exposed ground
Viola spp. (Violets) at 2 plugs per sq. ft of exposed ground

Thoroughly mix the seed into a filler material such as slightly moistened sand or sawdust before applying. Use 4 gallons of filler per 1,000 sq. ft area and hand broadcast the seed mix, leaving it on soil or snow surface.

WHEN TO DO IT

Late fall or winter are the best times to direct seed most native plant species, although early spring is also possible. If there is not adequate rainfall, areas recently seeded or planted should be watered.

METHOD 2: CREATE A BLANK SLATE

STEP 1: To start you must first remove existing grass. Plan accordingly: large areas of bare soil are easily eroded by runoff and provide fertile ground for weeds to establish. Chemical herbicides are not recommended because of their negative impacts to pollinators and ecosystems as a whole. Below are several alternatives to chemical removal.

- SOD CUTTING is the quickest way to remove grass. Equipment rental companies and hardware stores rent walk behind sod cutters for $100-$150/day. In a few hours several thousand square feet of grass can be cut, rolled up and carted away. A lot of topsoil is lost in the process.
- SHEET MULCHING uses cardboard or newspaper to smother grass. It is best started several months before you want to use the planting area. Fall is an excellent time to sheet mulch as the material breaks down slowly over the winter and is ready for planting in the spring. The basic technique involves smothering grass and building organic matter in place by placing alternate layers of carbon materials and nitrogen materials directly on top of each other. Layers should be fairly equal to allow for even decomposition, approximately 1" thick.
- SMOTHERING/SOLARIZIATION is a method of site preparation that involves covering the planting area with black or clear plastic and allowing the sun and lack of water to kill unwanted vegetation. This takes a full growing season at a minimum, requires that the plastic is firmly secured in place all along the edges at all times, and may be best performed in sections rather than on a large scale.

STEP 2: Follow the previous directions to direct seed and plant plugs (seeding rates can be doubled if starting with a blank slate). For blank slate seedings a cover crop should also be included: winter wheat for fall or winter seedings, and wild oats for spring seedings, 100 lbs/acre.

MAINTENANCE

If you mow, keep your blades at least 6 inches off the ground; allow newly seeded and planted vegetation to fully establish before cutting. Once vegetation is established, mow no more than every four to six weeks. Taller lawns are beneficial in that they shade the ground, preventing moisture from evaporating while also discouraging weed seeds from sprouting. Refrain from mowing while flowers are blooming to increase the amount of forage available for pollinators and to allow plants to more fully establish by setting seed.

The Meadow area at Haskins Preserve before and after sod removal. Center and right photographs by Mary Ellen Lemay, Landowner Engagement Director, Aspetuck Land Trust. Left photograph by Evan Abramson.

MEADOW ESTABLISHMENT AND MANAGEMENT

SITE PREPARATION

The Meadow at Haskins Preserve was installed by first removing existing turf grass using a walk behind gas-powered sod cutter. An 8' wide strip of grass was left to mark a walking path which will be maintained through the center and around the perimeter of the meadow.

After all of the sod was rolled up and loaded to be composted off-site, the meadow seed mix listed on page 16 was hand broadcast equally across all areas of exposed soil. The seeds were mixed in a 5 gallon bucket with slightly dampened coarse sand. Four gallons of sand should be used for every 1,000 sq. ft to be seeded (sawdust may also be used instead of sand).

Late fall or winter are the best times to direct seed most native plant species, although early spring is also possible. If there is not adequate precipitation, areas recently seeded or planted should be watered. For direct seedings a cover crop should also be included: winter wheat *(Triticum aestivum)* for fall or winter seedings, and wild oats *(Avena sativa)* for spring seedings, either one at 100 lbs/acre.

Alternatively, small to medium-sized areas may be smothered with black plastic or sheet mulched in lieu of sod cutting as a method of vegetation removal. Refer to page 19 for a more detailed description of each of these methods.

MOWING REGIME

For the first growing season following seeding (2021), all seeded areas should be closely monitored for growth. When the average height of vegetation is approximately 12 inches, the area should be brush hogged or weed whacked or to a height of no less than 8 inches. This schedule should continue throughout the first, and possibly second growing season.

In the second growing season (2022), the seeded areas should be periodically assessed by a botanist or other individual with vetted plant identification skills. **If the majority of vegetation in a given area is native species from the seed mixes**, then the mowing schedule for that area should transition to a once-a-year mow. This should always occur during the dormant season (between November 15 and April 1), after plants have gone to seed or before they begin next season's growth. Ideally, the site would be broken up into 2 or 3 sections, with each section cut once a year on a rotational basis. During this annual mow, vegetation should be cut to a height of 6-8 inches.

If during the second growing season, **the majority of vegetation in a given area appears to remain non-native grasses and/or weeds**, then continue mowing to keep the overall height of plants between 8-12 inches. This regime should be followed until the third growing season.

By the third growing season (2023), the site should be ready for transition to an annual mow on a rotational basis as described above. Invasive species and early successional trees should be closely monitored throughout the 3-5 year establishment period, and either manually grubbed using a weed wrench; mechanically grubbed using a brush grubber mounted on a tractor, ATV or truck; or applied with natural or chemical herbicides.

References

WHY POLLINATORS?

Garibaldi, L. A. et al. Wild Pollinators Enhance Fruit Set of Crops Regardless of Honey Bee Abundance. Science 339, 1608 (2013).

John E. Losey, Mace Vaughan, The Economic Value of Ecological Services Provided by Insects, BioScience, Volume 56, Issue 4, April 2006, Pages 311–323.

Russo, L., DeBarros, N., Yang, S., Shea, K. & Mortensen, D. Supporting crop pollinators with floral resources: network-based phenological matching. Ecology and Evolution 3, 3125–3140 (2013).

Mathiasson, M. E. & Rehan, S. M. Wild bee declines linked to plant-pollinator network changes and plant species introductions. Insect Conservation and Diversity 13, 595–605 (2020).

Fowler, Jarrod. (2016). Specialist Bees of the Northeast: Host Plants and Habitat Conservation. Northeastern Naturalist. 23. 305-320. 10.1656/045.023.0210.

PROJECT CONTEXT

Zemba, Anthony J. Conservation and Management Plan for the Caryl and Edna Haskins Preserve. Fitzgerald and Halliday (2018).

TURN YOUR LAWN INTO HABITAT

Blue Thumb. Turf Alternatives. Retrieved January 23, 2021, from www.bluethumb.org/turf-alternatives