



Committee Members

Mary Knittle, Chair
Stefanie Covino, Vice Chair
Ted Conna
Nathan Fournier
Evelyn Herwitz
Deirdra Murphy
Mary Leovich

Contacting the Committee

Department of Sustainability and Resilience
Address: 455 Main Street, Room 108,
Worcester, MA 01608 (by appointment)
Email: GreenWorcester@worcesterma.gov
Website:
WWW.WorcesterMA.gov/GreenWorcester

Department of Sustainability and Resilience

Our Mission:

To implement the ambitious and urgent goals of the Green Worcester Sustainability and Resilience Strategic Plan (GWP), a roadmap for making Worcester the greenest mid-size city in the country.

Our Staff:

John Odell, *Chief*
Jacquelyn Burmeister, *Lakes & Ponds Program Coordinator*
Jessica Davis, *Project Manager*
Robert DeFosse, *Energy Services*
Nick Pagan, *Senior Environmental Analyst*
Sarah Mount, *Energy Analyst*
Luba Zhaurova, *Director of Projects*

Accessibility:

The GWAC is committed to ensuring that its public meetings are accessible to all. Should you require interpretation, auxiliary aids, services, translations, written materials in other formats, or reasonable modifications in policies and procedures, please contact the DSR a minimum of 48 hours in advance of the scheduled meeting.

Translations:

Hay disponibles servicios de interpretación y otras adaptaciones con solicitud previa.
Avisanos por
greenworcester@worcesterma.gov

CITY OF WORCESTER

Meeting Minutes

Green Worcester Advisory Committee

Monday, December 12, 2022 at 5:30 p.m.

Location: Esther Howland Room, City Hall

This meeting will be held in-person at the date, time and location listed above. Meeting attendees will additionally have options to participate remotely by joining online or by phone. To attend this meeting virtually, see the bottom of the agenda for details.

Attendance:

Present:

District 1: Mary Knittle, Chair

District 1: Evelyn Herwitz

District 2: Nathan Fournier

District 3: Mary Leovich (online)

District 4: Ted Conna

District 4: Deirdra Murphy (online)

Absent:

District 5: Stefanie Covino, Vice Chair - Absent

Staff:

John Odell

Luba Zhaurova

Bob DeFosse

Sarah Mount (online)

Call to Order at 5:38 by Mary Knittle, Committee Chair

1. **Welcome.** The Chair introduced new committee member, Mary Leovich. Mr. Odell introduced new DSR staff: Bob DeFosse, Senior Manager of Energy Services, and Sarah Mount, Energy Analyst.

2. **Approval of Minutes – September 19th and October 24, 2022**
The Committee voted 6-0 to approve the September 19th meeting minutes (**Exhibit A**).

October 24th minutes were not ready for review and therefore were postponed to the next meeting.

3. New Business

a. Presentations by Community Groups / Groups of Interest:

- i. Evan Abramson of Landscape Interactions presented “Native Pollinator – Plan Interactions. Designing Landscapes and Corridors to Support Regional Biodiversity” (**Exhibit B**). Working on creating pollinator corridors at a town as well as watershed scale. Insects are critical for ecosystems and are in danger. He discussed the benefits of biodiversity, ecological resilience and the role of pollinators. He recommended that Worcester bans neonicotinoid insecticides if not used at an agricultural scale, as they are contribute heavily to the decline of bees, birds, butterflies and freshwater invertebrates.

He described his company’s projects in Lincoln, Northampton, Martha’s Vineyard and others.

- Member Murphy thanked Mr. Abramson for his presentation and asked for a recommendation on how to incentivize local businesses to use pollinator friendly landscaping in their vegetative buffers. Mr. Abramson suggested looking at the best management practices in the back of the case reports on his company’s website. He stated that his company could also provide a guidance documents for the City and add training or a certification. Organic Landcare Provider Certification is also offered by NOFA, which is holding a conference in Worcester in January.
- Member Fournier commended Mr. Abramson for working on these issues and providing a sound scientific basis for this work, which is often lacking. He felt that these landscapes are more attractive than conventional landscapes, and have many more benefits. He stated support for doing this work in the City at a larger scale.
- Member Herwitz asked about the time frame for designing the program and measuring its effectiveness. Mr. Abramson stated that designing, mapping, writing and publishing a plan (e.g. Lincoln Plan – 100 pgs) – takes about 12-15 months. Measuring success needs to take place after the plants have been installed and established (1-2 growing seasons).
- Mr. Odell asked about the maintenance and whose responsibility it is. Mr. Abramson noted that the maintenance is usually the responsibility of the homeowner – a town or private owners committed to the project, usually via an MOU. Maintenance can be done by Parks or Conservation Commission if there is budget line item. But it is also great to appeal to local people – sidewalk design or a small front yard, using those as model sites for others to visit and learn from.
 - Maintenance costs include site preparation. If currently grass – need to remove it by: a) smothering with thick black plastic May-Sept (during growing season); no labor - \$400 for 5,000 SF of thick 6 mm reusable tarp; or 2) sod-cutting or removing using a mini-excavator to scrape off the top 2-3” of soil. Planting plugs and shrubs costs about 45-50 cents/SF. If seed mixes – \$1500/acre. Maintenance on a meadow from seeds involves mowing the first growing season (from 12” to 5-6”, weed whacking or brush hogging, once/month). Second season – 1-2 cuts in the spring; in June forward – let it grow in. From then on - cut once every 2-3 years. A lot less maintenance than a standard lawn. If a garden – weeding is key; needs to be done once every 1-2 weeks or 1-month at a minimum, use mulch as well (not dyed).
- Member Herwitz asked about application in a more congested city and attitudes toward bees. Mr. Abramson mentioned that public education is required to get buy-in, and that most native bees don’t sting (unlike honey bees or wasps). Pollinator gardens do not attract more wasps. His company’s projects in downtowns or urban areas include Northampton project, New York state and Brooklyn.
- Erica Holmes, Mass Audubon Urban Ecologist, was interested in a connection between urban forestry and pollinator species. Mr. Abramson stated that pollinator canopy surveys are relatively new to the northeast area. Walnut, hickory, oak trees’ wind carried pollen is gathered by bees too. He could make plant recommendations for trees. Anecdotally – native oaks, native maples, native willows, native laurel, poplars, redbud are great pollen and nectar plants.
- Member Conna stated that pilot projects have great symbolic and educational value. He stated that if they can be scalable – they would be even more impactful; and while vast

expanses of grass in the city can be used for food production, alternative application, and more affordable, may be to convert them to pollinator gardens. He asked how to address the problem of invasives. Mr. Abramson listed several methods: herbicide in selected area for specific plants such as knotweed or stump treatment of bittersweet; pulling (e.g. burning bush); tarping, and more. Approaches vary depending on present invasive species, past land use, and land owner's preference.

- Mr. Abramson suggested a couple of avenues for the City to consider pursuing:
 - Develop a list of potential sites, with different characteristics, and plant pollinator gardens. Use them as example of different applications – a menu.
 - Do one site (landscape design and planting) that work well, with a plan, maps and education materials.
 - Develop an interactive map where people can navigate to their property and find recommendations for which type of pollinator garden application may suit their property best.
- Mr. Conna mentioned that from his personal experience, sumac is extremely invasive, even though it is considered a good pollinator tree. Mr. Abramson mentioned that sumac is a host for solitary bees and is good to plant along field edges, while is not a good plant for small lots.
- Mr. Conna brought up an idea of developer incentives for planting pollinator friendly environments. Mr. Abramson liked the idea, said that it would be unprecedented for the state, and that a model list of plants can be designed for developers to choose from for each growing season.
- Mr. Abramson recommended considering restricting or even banning the pesticide neonicotinoid (not pesticide) for commercial landscape applications in the city – as it is not necessary and very harmful to the pollinators.

4. Unfinished Business

- a. Update on pocket forest pilot (10 minutes)
 - i. Member Herwitz stated that she walked a potential site on West Boylston Drive with Carl Gomes, but found it was not a good fit for the pocket forest pilot.
 - ii. She plans to review with Ms. Zhaurova tax titled properties and public school properties as potential pilot sites for the pocket forest pilot.
 - iii. She debriefed the Committee about meeting with Alan Manoian, Director of Community and Economic Development, town of Ayer, which received an MVP grant to develop Miyawaki Forest pilot sites in Ayer and Devens. Ayer emphasized the importance of engaging the community when making the location decisions and that these are very small plots of land. The pilot in Ayer will be just 30 ft in diameter.
 - iv. She has reached out to Cambridge to learn about a similar pilot they started.
- b. Final update: GWAC's letter - City Manager's leadership on sustainability & resilience
 - i. Member Conna stated that while the original letter in the fall did not follow anticipated path, given that the new City Manager is officially on board, he wanted the Committee to submit the revised letter to him, encouraging the support of the Green Worcester Plan. Member Leovich suggested removing reference to the previous city manager's vision in the 5th paragraph, so that the letter reads forward looking. The Committee approved unanimously the proposed revision and submission of the letter to the City Manager Eric Batista.

5. DSR Updates

- a. Sustainability Performance Measures:
 - i. Inclusion in: Application Scoring Guidance for Affordable Housing Trust Fund Applications: "Consistency with the City's Green Worcester Sustainability and Resilience Strategic Plan (Maximum score of 10)"
 - 1. Mr. Odell described the new sustainability criteria for the affordable housing trust fund applications. The new criteria will represent 10 points for a building's sustainability measures in the application total score (maximum 150).

- ii. Inclusion in: Comparative Evaluation Criteria for “Worcester Redevelopment Authority Request for Proposals Property Sale and Development: Former “Denholm” Property 484-500 Main Street, Worcester, Massachusetts”
- b. Interdepartmental collaboration:
 - i. Monthly interdepartmental meetings – DSR, HHS, ED, DPW&P, DTM, City Manager – Innovation Division. Opportunities for collaboration and cross-pollination
 - ii. Mobility - Endicott/Bigelow Street Redesign: DSR, DTM, ED, DPW&P.
 - iii. Mobility Master Plan: DTM, DPRS, DSR.
 - iv. Resilience – MVP: DPW&P, DSR.

6. Standing Items

- a. Community outreach
 - Possible DSR public event in partnership with Arts Worcester Impact Show. The show is already planned and will focus on human impact in February-March. Member Conna recommended considering DSR doing a presentation; and for GWAC members to sit on a panel with artists to develop sustainability ideas and community discussion.
- b. Upcoming events
 - i. Northeast Organic Farming Association (NOFA) Winter Conference 1/14-1/15
 - Member Fournier will be a speaker at the upcoming NOFA Winter Conference at Worcester State University. The theme of the event is co-operative food waste. He will highlight the work that GWAC is doing. Ms. Zhaurova will add the event to Green Worcester’s upcoming mailer.
- c. Community feedback
 - i. None.
- d. Other:
 - Member Conna stated that the new Urban Forestry Tree Commission is looking to fill a vacancy for district 3.
 - Member Conna asked the committee to revisit his previously made request about a policy that strives to balance protection and numerous benefits of the street trees with the renewable energy (solar) production that may be negatively impacted by tree shading. While he drafted a proposed policy at the previous meeting, since then he has been advised that GWAC is not supposed to make policy but can recommend and react to a policy developed by administration. Therefore, he recommended that DSR considers working with DPW-Parks, to consider the potential impact of street trees’ shading on solar panels and develop a policy accordingly. To summarize a high-level impact, he stated that there are roughly 2500 solar systems on people’s homes in the city. If a quarter of them is facing the street to the south, and one third of those have a street tree nearby, that would make a few hundred places where shading may be an issue.
 - Member Fournier stated that he thought that the new street tree plantings would not be very tall tree species, so that they wouldn’t interfere with powerlines, and at the same time, wouldn’t be tall enough to cast shade over solar panels.
 - Mr. Odell suggested that Member Conna bring this policy concept to the newly formed Urban Forestry Tree Commission. He also stated that most of the current solar installers use software that considers the location, height, age and species of nearby trees when designing successful solar systems. Mr. Odell stated that he will consider Member Conna’s recommendation, but he cannot make promises that the policy will be developed or will be considered high enough priority item to pursue, when set against other departmental and city-wide priorities.
 - Chair Knittle decided that more research should be done on the idea of policy, from other communities, before the Committee should taking a vote. Member Conna stated that he was satisfied with Mr. Odell response.

7. Received Communications

- a. Worcester Now | Next Citywide Plan - Priority Goals Questionnaire
 - i. The city’s comprehensive plan survey is now available online, seeking public comments on setting priorities for the previously selected goals.

Adjournment: 7:38 pm

The Committee voted unanimously to adjourn the meeting.

2023 Upcoming Meetings

Green Worcester Advisory Committee meetings begin Mondays at 5:30pm.

<i>January 23</i>	<i>Esther Howland</i>
<i>March 13</i>	<i>Esther Howland</i>
<i>April 3</i>	<i>Levi Lincoln</i>
<i>May 15</i>	<i>Esther Howland</i>
<i>June 26</i>	<i>Esther Howland</i>
<i>July 31</i>	<i>Levi Lincoln</i>
<i>September 18</i>	<i>Esther Howland</i>
<i>October 16</i>	<i>Esther Howland</i>
<i>November 27</i>	<i>Esther Howland</i>

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Green Worcester Advisory Committee

Monday, September 19, 2022 at 5:30 p.m.

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Attendance

Present

District 1: Mary Knittle, Chair
District 1: Evelyn Herwitz
District 2: Nathan Fournier
District 4: Ted Conna
District 5: Stefanie Covino, Vice Chair (online)

Absent:

District 4: Deirdra Murphy (absent, excused)

Staff:

John Odell
Luba Zhaurova
Jessica Davis

Call To Order at 5:40 pm by Mary Knittle, Committee Chair

1. Welcome. The Chair read out the rules of meeting conduct.

2. Approval of Minutes – July 25, 2022 (Attachment A)

The Committee voted unanimously to approve the July 25, 2022 meeting minutes with Member Conna's edit on 3.a.v: "A non-quorum group cannot take substantive action or speak for the committee as a whole".

3. New Business

- a. Presentations by Community Groups:
- ii. Jeuji Diamondstone, NAACP Environmental and Climate Justice Committee & the Worcester HEART Partnership (*Attachment B*)

- iii. Karin Valentine Goins, Walk Bike Worcester (*Attachment C*)
- iv. Ms. Davis shared that the pdfs of the slides and the recordings of the presentations by community groups are posted on the DSR's Green Worcester website (www.worcesterma.gov/sustainability-resilience/green-worcester) under the title "Speaker Series". She also said that October meeting presenters are Mary Knittle, the Chair of the Green Worcester Advisory Committee (GWAC) and the Director of Energy Resources at the Worcester Community Action Council and Deb Carey, the Community Advocacy and Engagement Manager for Mass Audubon.

b. Discussion on pocket forest pilot

- i. Member Herwitz shared a document (*Attachment D*) with her research and an overview of her project idea. She proposed that DSR work with the City's Parks Department along with other relevant city agencies to look into planting a pocket forest in one of Worcester's heat island neighborhoods. This would be a pilot project and would need to involve local community organizations such as the Greater Worcester Land Trust and neighbors in planning and planting. The committee agreed with this proposed idea. Member Fournier suggested using a variety of trees and plants including fruit and nut trees.
- ii. Member Conna said pocket forests could be encouraged as part of larger developments, or for educational benefit at city schools.
- iii. Member Covino said the Conservation Commission has a lot of conservation land but no maintenance budget, and might welcome a funded pilot project for restoration of a city-owned parcel they control.
- iv. Chair Knittle suggested a partnership with New England Botanic Garden at Tower Hill.
- v. Member Herwitz stressed the importance of the Urban Forest Master Plan currently being developed, and the hope that the Urban Forestry Tree Commission confirmed by the City Council will meet soon.
- vi. Mr. Odell said that DSR is interested in exploring this idea and will report back at the next meeting.

c. Moving Toward Net-Zero – Status Update

- i. Mr. Odell explained that the state enacted a law "An Act Driving Clean Energy and Offshore Wind" which included a provision to allow for 10 municipalities to participate in a pilot project where they restrict or eliminate the use of fossil fuels in new construction and/or significant renovations. Worcester will not participate in this pilot because the City believes there is a different path toward net-zero that will work better for the City as a whole considering the impacts on stakeholders and vulnerable populations. This does not completely rule out passing a Home Rule Petition related to this topic in the future but the City won't be pursuing that option currently. The Green Worcester Plan outlines the City's goals and demonstrates the City's commitment to decarbonization. Instead of applying to participate in the pilot, the City will pursue adopting the state's new opt-in specialized stretch energy code this upcoming winter. Two barriers to full electrification to consider are National Grid's electrical grid capacity and not wanting to burden vulnerable populations that may end up staying on gas longer and having to pay more. National Grid is not just an electric company, it's a gas company too and they have a high level plan to reach net zero by 2050. Mr. Odell emphasized that the City will need to work with National Grid and developers as well as working on communication and education for the community on this topic.
- ii. Member Fournier said that he agreed with this approach to avoid economic barriers and resistance from developers. He also said that energy efficiency is key.
- iii. Member Herwitz: questioned how much new electrical demand National Grid can handle. Mr. Odell said there's no easy answer, but National Grid plans to spend at least \$5 billion to get to net zero by 2050.
- iv. Member Conna said that a net zero policy should avoid unwittingly encouraging more electric resistance heating which is cheap to install but inefficient and costly to operate. He said that to meet GWP goals, electrification of 2,000-2,500 units per year will be needed, and the 2,300 new housing

units currently in the development pipeline are low-hanging fruit because they are new construction with no pre-existing obstacles to correct. He said that information and education of builders and developers will be needed, that the City could offer subsidies for new developers to achieve net zero, and that the City should use whatever leverage it has through the permitting process. Additionally, he said that the DSR should have a voice at the City's Pre-Development Consultations (<http://www.worcesterma.gov/planning-regulatory>) and promote energy efficiency and electrification.

- v. Mr. Odell said there is no formal plan yet to achieve the GWP electrification goal, but the program will require 1) collaboration with National Grid, 2) collaboration with development community (Chamber, WBDC, WRA) and 3) effective public communication/education. He also stressed that it is important to consider not just the cost of change, but also the cost of not changing.
- vi. Member Conna said all this will require collaboration among city departments. He referred to several Early and Short Term Actions in the GWP (pp.38-43) and asked if the City is requiring sustainability performance outcomes in exchange for new development tax incentives. Mr. Odell said not yet. Member Conna then asked for October and periodic updates on progress to net zero and Mr. Odell said that was already planned. Finally, Member Conna suggested that volunteers or GWAC members could help investigate sustainability initiatives of other mid-sized cities.
- vii. Chair Knittle shared that this winter, the average home will have to pay an extra \$110 per month due to energy price increases so there should be a focus on energy efficiency as well.

4. Unfinished Business

- a. GWAC's letter for requested qualifications for new City Manager including status
 - i. Chair Knittle reported that she met with the Acting City Manager and will be meeting with the Mayor in the next week or two. She will get his advice to determine next steps. She will provide an update at the next meeting.
 - ii. Mr. Odell said that there haven't been many consultants replying to the RFP for a firm to lead the search for a new City Manager so there isn't a clear timeline for the search at this time.
 - iii. Member Conna expressed concern that the selection process timeline could change unpredictably and that the City Council may never hear the Committee's input, and frustration that GWAC's letter is still stuck in bureaucratic limbo after 2.5 months.

5. DSR Updates

- a. Mr. Odell shared an event announcement. National Grid is hosting an Energy Fair on October 25 from 4-7pm at the library. Residents can go to speak with experts about their energy bills and learn how they can save money during the price increases this winter. They will also have the opportunity to apply for fuel assistance at that event.
- b. Vacancy recruitment progress
 - i. Mr. Odell shared that there is an applicant who is going to be vetted by the CAC and he will report back on that status next month.
- c. Greenhouse Gas Emissions Inventory Final Report (*Attachment E*)
 - i. Mr. Odell said that the report has been finalized and is now available on the DSR website. DSR will also conduct outreach to share the results with the public.
- d. Upcoming GWAC Tours
 - i. Ms. Davis shared that there will be a tour of the Upper Blackstone Wastewater Treatment Plant on October 24 at 3:30pm for GWAC members and more details will be sent out with the calendar invite. Also, DSR had to cancel the solar farm tour due to weather so it will be rescheduled soon.

6. Standing Items

- a. Upcoming events

- i. Member Herwitz shared that there will be two public meetings for residents to give input on the City's Urban Forestry Master Plan, one on September 21 and the other is on September 22 (*Attachment F*).
- ii. Member Covino shared information about an event on integrated water planning on September 22 and a tour of the Worcester CSO on September 29. Information about these events can be found here: www.blackstonecollaborative.org/events.

b. Community Outreach

- i. Art Exhibit – no updates.
- ii. Sustainability Contest – no updates.

c. Community Feedback

- i. Member Herwitz shared a citizen concern about AstroTurf fields and their impact on their environment and their contribution to heat islands. The resident requested a moratorium on them. Member Covino suggested this may be an issue for DPW and the Conservation Commission. Members Conna and Fournier agreed that Astroturf has many negative environmental impacts and the city should not be installing it. Mr. Odell replied that DSR will look into this and respond at the next meeting.
- ii. Member Fournier met with Joseph Corazzini, Vice President of Government and Community Affairs from Clark University, who wants to establish another community garden/ orchard and he may be a good partner for the pocket forest pilot project.

7. Received Communications

- a. None.

Adjournment: 7:56 pm

The Committee voted unanimously to adjourn the meeting at 7:56 pm. **Attachments**

Attachment A: July 25, 2022 GWAC Meeting Minutes

Attachment B: HEART Partnership Presentation

Attachment C: WalkBike Worcester Presentation

Attachment D: Pocket Forest Proposal

Attachment E: Greenhouse Gas Emission Inventory Report

Attachment F: Urban Forestry Master Plan Public Meetings Flyer

Upcoming Meetings

<i>Date</i>	<i>Location</i>
October 24	Esther Howland, Worcester City Hall
December 12	Esther Howland, Worcester City Hall

Meeting Minutes

Green Worcester Advisory Committee

Monday, October 24, 2022 at 5:30 p.m.



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7th member TBD

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Meeting Agenda

Green Worcester Advisory Committee

Monday, October 24, 2022 at 5:30 p.m.

Location: Esther Howland Room, City Hall

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1. Site visit of Upper Blackstone Wastewater Treatment Plant, 7 Nippnapp Trail, Worcester

Meeting Call to Order: 5:30PM

2. Welcome
3. Approval of Minutes – September 19, 2022
4. Approval of 2023 Meeting Calendar
5. New Business
 - a. District 3 Vacancy Filled – Mary Leovich (starts 12/12/2022)
 - b. Presentations by Community Groups:
Deb Cary, Mass Audubon (30 minutes)
 - c. Introduction to City Budgeting Process (10 minutes)
6. Unfinished Business (15 minutes)
 - a. Update on pocket forest (Miyawaki) pilot
 - b. GWAC's letter for requested qualifications for new City Manager update

7. DSR Updates (30 minutes)
 - a. DSR staff hiring update
 - b. Upcoming GWAC tours - spring
 - c. Departmental Goals – moving toward net-zero (energy efficiency, renewables, electrification)
 - i. New municipal aggregation contract – increasing renewable energy content
 - ii. EV Charging Stations – 25 Meade St., public garages and feasibility study
 - iii. GreenWorcester ElectriCITY branding
 - d. Departmental Goals – Climate Change Resilience
 - i. Municipal Vulnerability Preparedness (MVP) Grant project update
 - ii. Urban Heat Mapping update
8. Standing Items (10 minutes)
 - a. Upcoming events
 - i. National Grid Energy Savings Event, October 25, 4-7pm at Worcester Public Library
 - b. Community feedback
 - i. Discussion of solar access issues
 - c. Community outreach
9. Received Communications
10. Adjournment

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Upcoming Meetings

Date	Location
December 12	Esther Howland, Worcester City Hall

Attendance:

Present

District 1: Evelyn Herwitz

District 2: Nathan Fournier

District 4: Ted Conna

District 4: Deirdra Murphy (online)

District 5: Stefanie Covino, Vice Chair

Absent:

District 1: Mary Knittle, Chair

Staff:

John Odell

Jessica Davis

Luba Zhaurova

Call To Order at 5:37pm by Stefanie Covino, Committee Vice Chair

2. Welcome. The Vice Chair read out the rules of meeting conduct.

3. Approval of Minutes – September 19, 2022

- a. Member Conna confirmed that committee minutes are not uploaded online until the committee approves them.
- b. Member Conna asked that the committee approve the minutes and add additional details at the next meeting to not delay the minutes going online. Vice Chair Covino responded that once minutes are approved, they cannot be edited, and reminded Member Conna that the public can watch the recording online if they would like more details. Member Conna motioned to continue this item to the next meeting. Evelyn Herwitz seconded. The Committee voted 5-0 to continue approval of the September 19, 2022, meeting minutes to the next meeting to allow Member Conna opportunity to revise the minutes.

4. Approval of 2023 Meeting Calendar

- a. Vice Chair Covino confirmed that GWAC will meet once per month in 2023, except for February, August, and December when there will be no meeting.
- b. Ms. Zhaurova noted that DSR staff did take Jewish and Christian holidays and school vacation weeks into consideration when drafting the calendar.
- c. The Committee voted unanimously to approve the 2023 meeting calendar as is.

5. New Business

- a. District 3 Vacancy Filled – Mary Leovich (starts 12/12/2022)
- b. Presentations by Community Groups:
 - i. Mass Audubon. Deb Cary, Community Advocacy and Engagement Manager, Jennifer Madison, Regional Director, and Martha Gach, Education Manager and Conservation Coordinator presented on the organization's work. (Attachment A)
 1. Deb Cary commended the committee's work and asked how they bring all active sustainability groups in the city together. Member Conna stated the feeling and question was mutual. Deb Cary recommended having a conference of sorts for all the sustainability groups to get a chance to talk with each other. Member Covino invited

the Mass Audubon group to participate in the Blackstone Watershed Collaborative Committee meetings. Mr. Odell recommended putting the discussion of creating a conference on the agenda to a later meeting. Member Herwitz remarked that a conference to connect different groups in the city is a great idea and asked what a group like Mass Audubon would want to get out of a conference like this. Jennifer Madison mentioned she would like to see a map of all Worcester's sustainability groups' work that can be used to create a story for the public.

2. Member Conna suggested that the Mass Audubon use their outreach to help spread the word about the work that DSR and GWAC are doing and asked how the Mass Audubon gets every 7th grader to come and visit the Broad Meadow Brook Sanctuary. Deb Cary stated that the Worcester Educational Foundation pays for the program.

ii. Introduction to City Budgeting Process

1. Mr. Odell explained the basics of the budgeting process and timeline.
2. Member Herwitz asked how the committee should play a role in the budgeting process. Mr. Odell responded that committee's main priority should be helping with implementation of the Green Worcester Plan, and there is little assistance GWAC can provide in terms of DSR's budget development process.

6. Unfinished Business

a. Update on Pocket (Miyawaki) Forest Pilot

- i. Member Herwitz recommended putting the pilot within the city's "heat island" and relayed that the City of Worcester planning department staff recommended avoiding previously conserved land as it likely already has vegetation, but instead considering tax title properties. She also communicated that during the winter months, she and Member Fournier will scope out the best sites and DSR staff will begin looking for funding sources.
- ii. Member Covino mentioned a study by a student at Clark University that had tax title data and focused on reducing flooding in city owned properties.
- iii. Member Conna asked if Member Herwitz has a parcel size minimum. Member Herwitz did not have a minimum or maximum lot size. Member Fournier reiterated that this project is scalable, and that many different sizes could work.
- iv. Member Herwitz affirmed that this project is still in the research stages and as she finds the answers to these questions she will report back to the committee.
- v. Member Murphy recommended reaching out to the Worcester Native Plant Initiative (WNPI) who have been working to plant more native species in the city. Member Fournier had recently had lunch with a leader of WNPI and they show interest in partnering once the committee is out of the planning stages. Jennifer Madison, on behalf of Mass Audubon, expressed support and interest in collaborating.

b. GWAC's letter for requested qualifications for new City Manager update

- i. Mr. Odell stated that staff is very close to resolving the process for getting the letter to the City Council. He will update the committee again at the next meeting.

7. DSR Updates

a. DSR Staff hiring update

- i. Mr. Odell stated that DSR is in the final stages of hiring two new DSR positions, a Senior Energy Manager who will oversee the city's energy performance contract, and an Energy Analyst who will help DSR analyze municipal energy usage.

b. Upcoming GWAC Tours – Spring 2023

- i. Ms. Zhaurova stated that the tour for the Upper Blackstone water treatment plant will be rescheduled for the Spring when the weather is better and that DSR Staff will help the committee find tours for other locations, if there is still interest.
- c. Departmental Goals – moving towards net zero
 - i. New Municipal Aggregation contract – increasing the renewable energy content
 - 1. Mr. Odell stated that the city has an electric aggregation program whereby the City of Worcester bundles electricity supply of its residents to get a more favorable rate and term through a third-party vendor. He explained that the city's former contract with Direct Energy expires in December 2022, and a new contract will start in January 2023. He noted under the new contract electricity prices will increase, due to global energy crises, but still will be better than the National Grid's basic service price for the first 6 months; and that the people in the program will be receiving 52% of their energy from renewable local sources.
 - 2. Vice Chair Covino highlighted that there is a pamphlet available to learn more about the city's aggregation program. She additionally reminded the committee and the public that National Grid has instituted a Winter Customer's Saving Initiative to help residents pay their winter electricity bills. Mr. Odell added that participating in the National Grid's programs doesn't preclude one from being on the aggregation program as well. (Attachment B)
 - 3. Member Herwitz stated that the Telegram & Gazette did a story highlighting the electricity price hikes.
 - 4. Vice Chair Covino noted that the aggregation program is an opt-out program meaning residents are automatically enrolled. Mr. Odell clarified that new residents may see National Grid as their supplier initially, but that they will automatically be enrolled in the program by default. He also emphasized that residents may leave the program at any time.
 - ii. EV Charging stations – 25 Meade Street, public garages, and feasibility study
 - 1. Ms. Zhaurova stated that two electric vehicle charging stations have been installed at 25 Meade Street. These charging stations have the capability to charge four vehicles, including inspectional services' two current electric vehicles. These vehicle charging stations are not open to the public, but they mark an opportunity to continue to electrify the city's fleet.
 - 2. Ms. Zhaurova stated that DSR has installed, but not yet activated, charging stations at three public garages: Federal Plaza Garage, Pearl Elm Garage, and Worcester Common Garage. Once activated each garage will have the capability to charge six electric vehicles simultaneously.
 - 3. Ms. Zhaurova stated that the city is launching a feasibility study for adding new electric vehicles to the city's fleet. While installing the new electric charging stations, the city found that the primary obstacle isn't purchasing the vehicles but installing charging stations due to constraints on the current electrical grid. The study will encompass five municipal locations, and integrate the city's current vehicle electrification plan. She stated that she expects the study to take at least 6 months and plans to apply for additional grant funding.
 - iii. Green Worcester ElectriCITY branding
 - 1. Mr. Odell commended Member Herwitz on the new ElectriCITY branding and explained that a designer has put together a media packet for the city that will be used for all outreach. Ms. Zhaurova clarified that "ElectriCITY" is umbrella branding. DSR expects there to be subdivisions in the future for different programs.

2. Member Herwitz commended the department on creating this branding inexpensively and efficiently. She continued discussing that the largest challenge of the project is how to effectively explain what an aggregation plan is.

d. Departmental Goals – Climate Change Resilience

i. Municipal Vulnerability Preparedness (MVP) Grant Project Update

1. Ms. Zhaurova stated that DSR and DPW won an interdepartmental MVP grant to map the City of Worcester's stormwater system to identify bottlenecks and opportunities for later green infrastructure projects. The MVP grant received is for 1.2 million dollars and will cover approximately 75% of project costs. The city's consultant, Weston & Sampson, has begun the project and has teams driving around Worcester measuring the depths of the stormwater drains from manhole to the bottom of the pipes. These measurements will allow the city to identify: which direction the water is flowing in our system, if any pipes have collapsed, and insufficient capacities within any pipes. The Weston & Sampson team is gathering data from approximately 6,500 manholes and culverts city wide. The collected data will be fed into a GIS layer and a modelling software. The next step will be testing the accuracy of the model by comparing its predictions to observed flooding patterns. If the model data does not match observed local flood data, Weston & Sampson will survey more manholes. The surveying component is estimated to be complete before the ground becomes completely frozen.
2. Vice Chair Covino suggested that this project may be a good opportunity to inform the public about storm water systems and how to take care of them.
3. Member Conna asked if this field work is meant to verify the records the city already has. Mr. Odell replied that though the city has records of the sewage systems, much of the data is out-of-date and there are gaps where new infrastructure has been implemented. He continued that the gaps and outdated data prevent the city from modelling the storm water system. Modelling is key for the city to address storm water problems pro-actively. Mr. Odell stressed that many of the paper maps and data the city currently has is derived from the "as designed" schematics as opposed to the "as built" reality and emphasized that many older infrastructure projects may have been tweaked over time when newer projects were put into place. Vice Chair Covino expressed support for the project, reiterating that having data in a variety of places including people's heads does not allow the city to model our systems, and this project will bring all the data sets together and fill in the gaps to allow for accurate modeling.

ii. Urban Heat Mapping update

1. Mr. Odell stated he expects the project to finish in the next few weeks, and that when completed the city will have heat maps for eight different climate scenarios. This data will tie in well with the new Urban Forestry Tree Commission's recommendations.
2. Member Herwitz asked if a pocket forest can contribute to the city's greening scenario. Mr. Odell confirmed that it can.
3. Ms. Zhaurova emphasizes that the project also has a great environmental justice and equity focus. Environmental Justice communities generally have less access to air conditions, those areas are hotter, and residents are often outside more waiting for buses or walking. The heat map study provides an argument for targeting tree planting in areas that need it the most.

8. Standing Items

a. Upcoming events

- i. National Grid Energy Savings Event, October 25, 4-7pm at Worcester Public Library (Attachment C)
- b. Community feedback
 - i. Discussion of solar access issues
 - 1. Member Conna discussed a potential proposal for helping residents maintain their “Right of Solar Access.” He relayed a citizen complaint that trees are growing too tall in front of their solar arrays limiting the array’s production. He worries that residents are building solar arrays based on the current landscapes, not accounting for the growth of nearby trees or the potential for new taller buildings in the future. The DSR website says there were 1500 new solar panel projects installed in Worcester in the past 10 years. He argued that many of these panels face the street, and there is a large potential for decreased solar productivity. He introduced a draft proposal (Attachment D) that would have owners of solar collectors register with the city, and the city would then work with these residents to protect solar access to their homes from shading by city owned landscaping. Under the proposal, the City would avoid planting trees that would grow large enough to shade existing solar arrays.
 - 2. Vice Chair Covino commented that this is an interesting topic as we are dealing with competing interests.
 - 3. Member Herwitz reacted that this is a valid policy question but believes that the Urban Forestry Tree Commission should be included in this discussion. She also emphasized that a policy would have to be very clear about what types of solar projects would qualify.
 - 4. Member Covino suggested that research is needed on other communities that have similar policies.
 - 5. Member Conna established that he does not want to see trees removed, and that when weighing one environmental value against another, objective criteria are needed to avoid decisions based on political clout and favor. He would like to see the city develop a solar access policy, and offered the draft proposal as a starting point for discussion.
 - 6. Vice Chair Covino mentioned that the Mass Audubon Society has a policy team that may be able to conduct research.
 - 7. Jessica Madison commented that there are existing GIS maps of trees, and a layer could be created with the city’s solar data. These two layers, when combined, could offer insight into the problem’s potential extent.
 - 8. Vice Chair Covino contributed that this could be a great mapping project for students she works with at Clark.
 - 9. Member Conna asked for the committee to make a motion to go on record requesting that such a policy be considered. Vice Chair Covino felt a motion was not needed and Mr. Odell offered to have staff investigate the issue and report back to the Committee. Vice Chair Covino suggested the Committee return to the topic once more research can be done, and Member Conna agreed.
- c. Community outreach
 - i. Member Conna asked the committee to support partnering with ArtsWorcester (AW) for their IMPACT art show in collaboration with the Fitchburg Art Museum in late February through April. The AW director approves of potentially having a panel on sustainability. Vice Chair Covino asked for clarification on what supporting the project would look like. Member Conna stated that AW is willing to do outreach, but GWAC would need to plan a

sustainability panel. Mr. Odell asked Member Conna to send the contact information for the director of the event to DSR staff and noted that DSR will be short staffed in the coming months. Member Conna recommended having DSR present on all the City's accomplishments at the event and not creating something new for this event. Vice Chair Covino also offered to help with this.

9. Received Communications

- a. None.

10. Other

- a. Member Conna asked for an update on interdepartmental collaboration. Mr. Odell reported on a preliminary meeting with representatives from DPW, Planning, Health & Human Services, Transportation & Mobility, and Economic Development to discuss anticipated projects and foster collaboration between departments. These meetings will continue, approximately quarterly beginning in January. Mr. Odell also said the Inflation Reduction Act tax incentives take effect in January, and staff will be researching how they can be used to prioritize and fund sustainability projects.

Adjournment

The Committee voted unanimously to adjourn the meeting at 7:45pm.



Native Pollinator-Plant Interactions

DESIGNING LANDSCAPES + CORRIDORS
TO SUPPORT REGIONAL BIODIVERSITY

EVAN ABRAMSON, M.Sc.
Principal

LANDSCAPE | INTERACTIONS



“THE ESSENTIAL, INTERCONNECTED WEB OF LIFE ON EARTH IS GETTING SMALLER AND INCREASINGLY FRAYED. THIS LOSS IS A DIRECT RESULT OF HUMAN ACTIVITY.”

*Professor Josef Settele, Co-Chair,
2019 IPBES Global Assessment on
Biodiversity and Ecosystem Services*



Playing with Fire

Humanity’s impact on the Earth is now so profound that a new geological epoch has been declared.

The Age of the Anthropocene is defined by a striking acceleration of carbon dioxide emissions and sea level rise, the global mass extinction of species, and the transformation of land by deforestation and development.

As many as **30 to 50% of all species on the planet are heading toward extinction** by mid-century.

*Ibid. and Thomas, et al. 2004. Extinction risk from climate change. Nature 427: 145–148.
World is ‘on notice’ as major UN report shows one million species face extinction. UN News. (2019, May 6).
Hance, J. “The Great Insect Dying.” Mongabay Environmental News. (2019, July 18).*

Collapse of Nature

One million species are threatened with extinction globally, including **over half the native bee species** in North America.

Insects essential for all ecosystems, as pollinators, food for other creatures and recyclers of nutrients.

Most insects could vanish within a century at the current rate of decline.

Habitat loss cited as the most pressing problem. New classes of insecticides introduced in the last 20 years have also been especially damaging, particularly **neonicotinoids**.

“We are sleepwalking towards the edge of a cliff.”

Carrington, D. 'Insect apocalypse' poses risk to all life on Earth, conservationists warn. *Guardian News and Media*. (2019, November 13).
Carrington, D. Humanity has wiped out 60% of animal populations since 1970, report finds. *Guardian News and Media*. (2018, October 29).
Sánchez-Bayo, F., Wyckhuys, K.A.G., Worldwide decline of the entomofauna: A review of its drivers, *Biological Conservation*. 232, 2019, 8–27.
Carrington, D. Plummeting Insect Numbers 'Threaten Collapse of Nature.' *Guardian News and Media* (2019, February 10).
J.-M. Bonmatin et al., Environmental fate and exposure; neonicotinoids and fipronil. *Environ. Sci. Pollut. Res. Int.* 22,35–67 (2015).



Crisis in North America

North America has lost 3 billion birds since 1970.

Over 1 in 4 birds in the past 50 years.

Habitat loss is the most direct cause.

Rosenberg, Kenneth V., et al. "Decline of the North American Avifauna." Science, American Association for the Advancement of Science, 19 Sept. 2019.

Five Biggest Threats to Biodiversity

According to the UN's Convention on Biological Diversity there are five main threats to global biodiversity:

1. Changes in Land and Sea Use
2. Exploitation of Natural Resources
3. Climate Change
4. Pollution
5. Invasive Species

IPBES (2019): *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages.

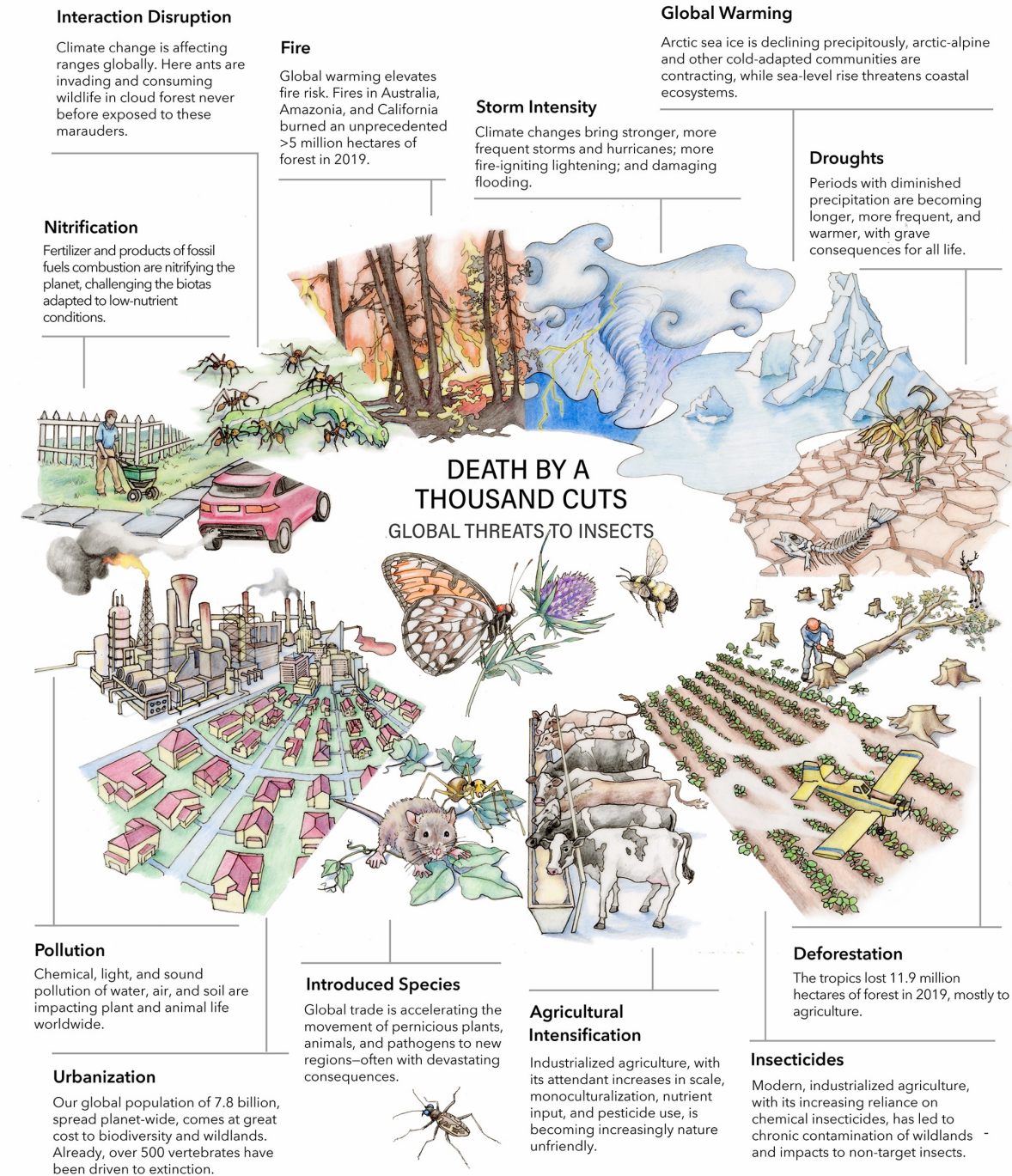


Illustration by Virginia Wagner

Climate + Biodiversity: Solve Both or Solve Neither

It's not just about climate change impacting biodiversity: it's about the loss of biodiversity deepening the climate crisis.

Connected, diverse and extensive ecosystems can help stabilize the climate and will have a better chance of thriving in a world permanently altered by rising emissions.

"Rather than being framed as a victim of climate change, biodiversity can be seen as a key ally in dealing with climate change."

Pettorelli, N., Graham, N. A. J., Seddon, N., Maria da Cunha Bustamante, M., Lowton, M. J., Sutherland, W. J., Koldewey, H. J., Prentice, H. C., & Barlow, J. (2021). Time to integrate global climate change and biodiversity science-policy agendas. *Journal of Applied Ecology*, 00, 1– 10.

Malhi, Y., Franklin, J., Seddon, N., Solan, M., Turner, M. G., Field, C. B., & Knowlton, N. (2020). Climate change and ecosystems: Threats, opportunities and solutions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 375(1794), 20190104.



Illustration by Charlotte Ager/The Guardian

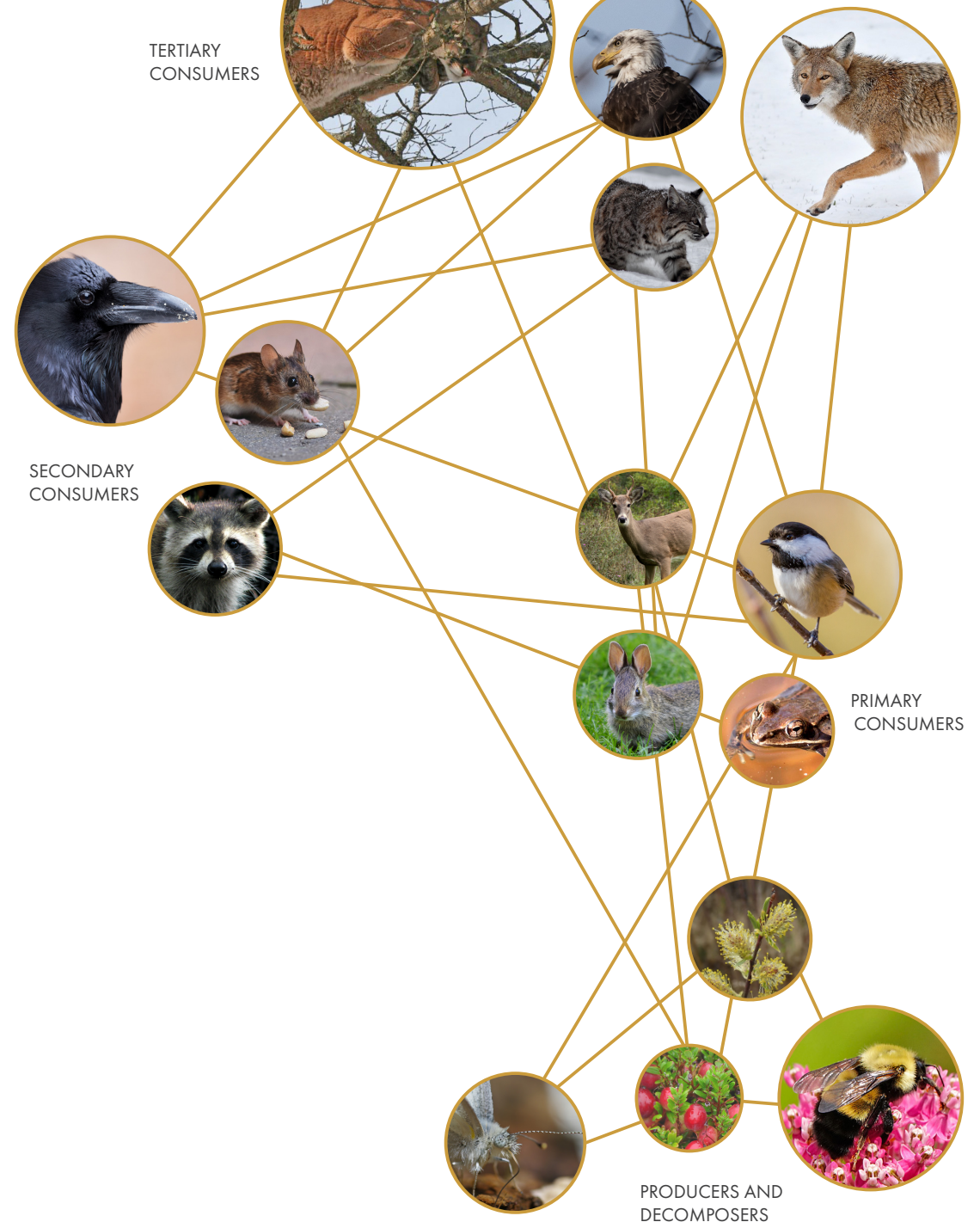
Designing Nature in the Anthropocene

Farms, conservation lands, urban and suburban greenways, rural communities and largescale solar arrays provide a wealth of opportunities for expanding regional biodiversity, climate change resilience, ecological health and food security through the implementation of native pollination systems corridors.

What happens at the pollination scale has repercussions all the way up the food chain to the largest predators and humans.

“Ecological resilience may be the most important attribute for any natural system, especially in the face of rapid climate change, continuing loss and degradation of habitat, encroaching invasive species and other threats.”

Helzer, C. Should We Manage for Rare Species or Species Diversity? The Prairie Ecologist. (2017, March 14). Retrieved January 18, 2021.



Why Pollinators?

Pollinators are primarily insects that fertilize plants, culminating in the production of seeds and fruit.

Pollinators are responsible for assisting over **80%** of the world's flowering plants.

Bees alone pollinate **45%** of the food crops grown in Massachusetts, and one-third of food grown in U.S.

Pollinators are vital to creating and maintaining the habitats and ecosystems that most animals rely on for food and shelter.

Some plants have a small guild of pollinators which coevolved with them to ensure their pollination.

Approximately 15% of northeastern native bee species are pollen specialists.

Jarrod Fowler "Specialist Bees of the Northeast: Host Plants and Habitat Conservation," *Northeastern Naturalist* 23(2), 305-320, (1 June 2016).



Bombus fervidus foraging on *Monarda didyma* (Scarlet bee balm). One of the most abundant bumblebee species in Massachusetts a few decades ago, it is now the second rarest bumblebee species in the state. Photograph by Norm Levey.

A Bee's Needs

Over 400 of the 4,000 native bee species in the U.S. live in the Northeast.

Native bees do the vast majority of pollination. In a global study of 41 crops in 600 fields across every populated continent, **wild pollinators were twice as effective as honeybees** in producing seeds and fruit.

The average native bee foraging range is 200 - 1800 ft.

70% of bees are ground nesting.

Most are solitary.

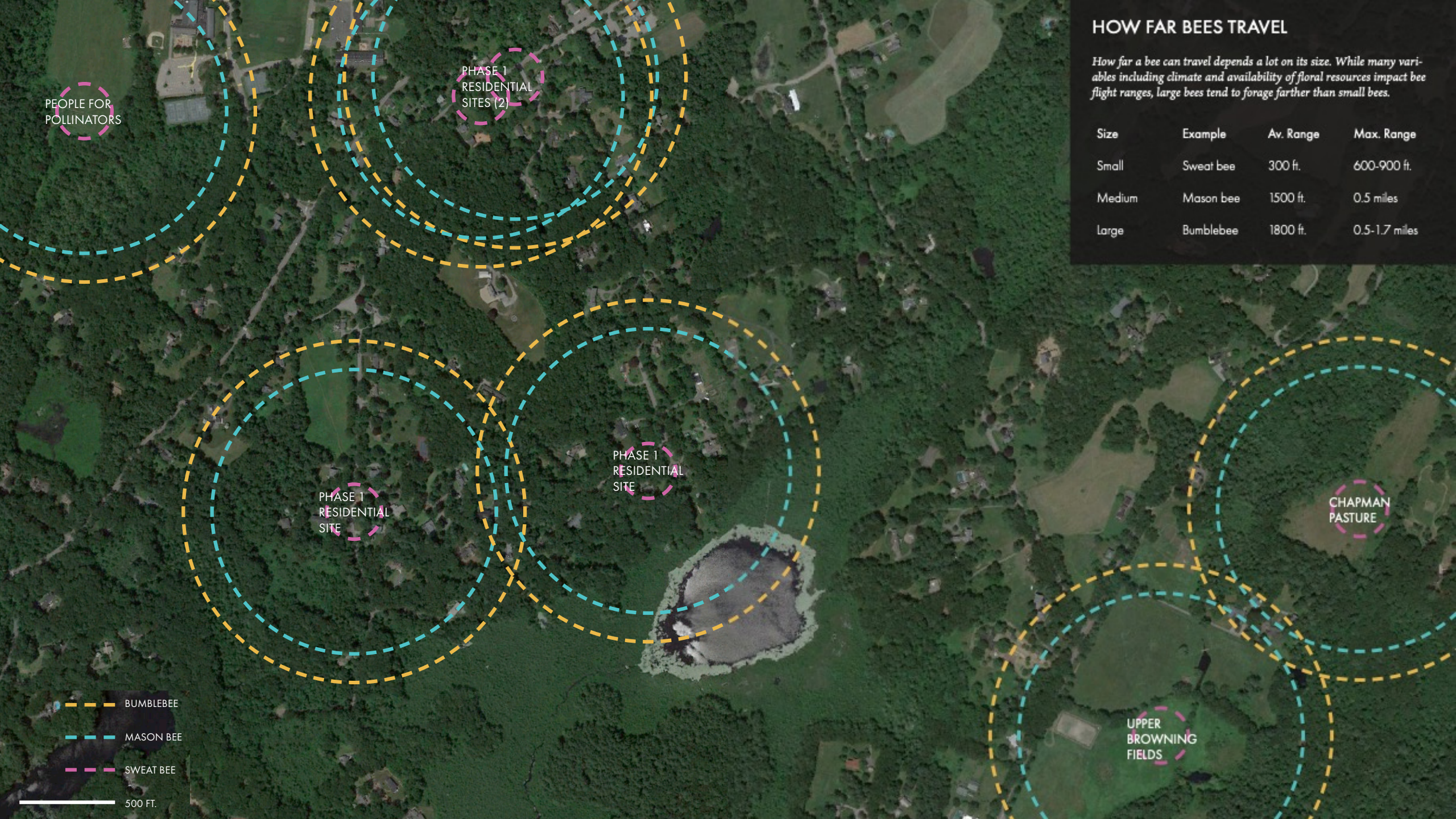
Habitats Include:

- Bare ground
- Soft-pithed twigs
- Abandoned rodent burrows
- Dead trees and snags

Garibaldi, Lucas A., et al. "Wild Pollinators Enhance Fruit Set of Crops Regardless of Honey Bee Abundance." Science, American Association for the Advancement of Science, 29 Mar. 2013.



*Osmia calla (Mason bee) and
Scutellaria elliptica (Hairy skullcap).
Photographs courtesy USGS.*



PEOPLE FOR
POLLINATORS

PHASE 1
RESIDENTIAL
SITES (2)

PHASE 1
RESIDENTIAL
SITE

PHASE 1
RESIDENTIAL
SITE

CHAPMAN
PASTURE

UPPER
BROWNING
FIELDS

HOW FAR BEES TRAVEL

How far a bee can travel depends a lot on its size. While many variables including climate and availability of floral resources impact bee flight ranges, large bees tend to forage farther than small bees.

Size	Example	Av. Range	Max. Range
Small	Sweat bee	300 ft.	600-900 ft.
Medium	Mason bee	1500 ft.	0.5 miles
Large	Bumblebee	1800 ft.	0.5-1.7 miles

BUMBLEBEE

MASON BEE

SWEAT BEE

500 FT.

4,500,000 Honeybee
Colonies (1980)

Pollinators in Peril

*Not just honeybees are dying.
Pollinators worldwide are in decline due to:*

Habitat Loss

Pesticides

Pathogens

Climate Change

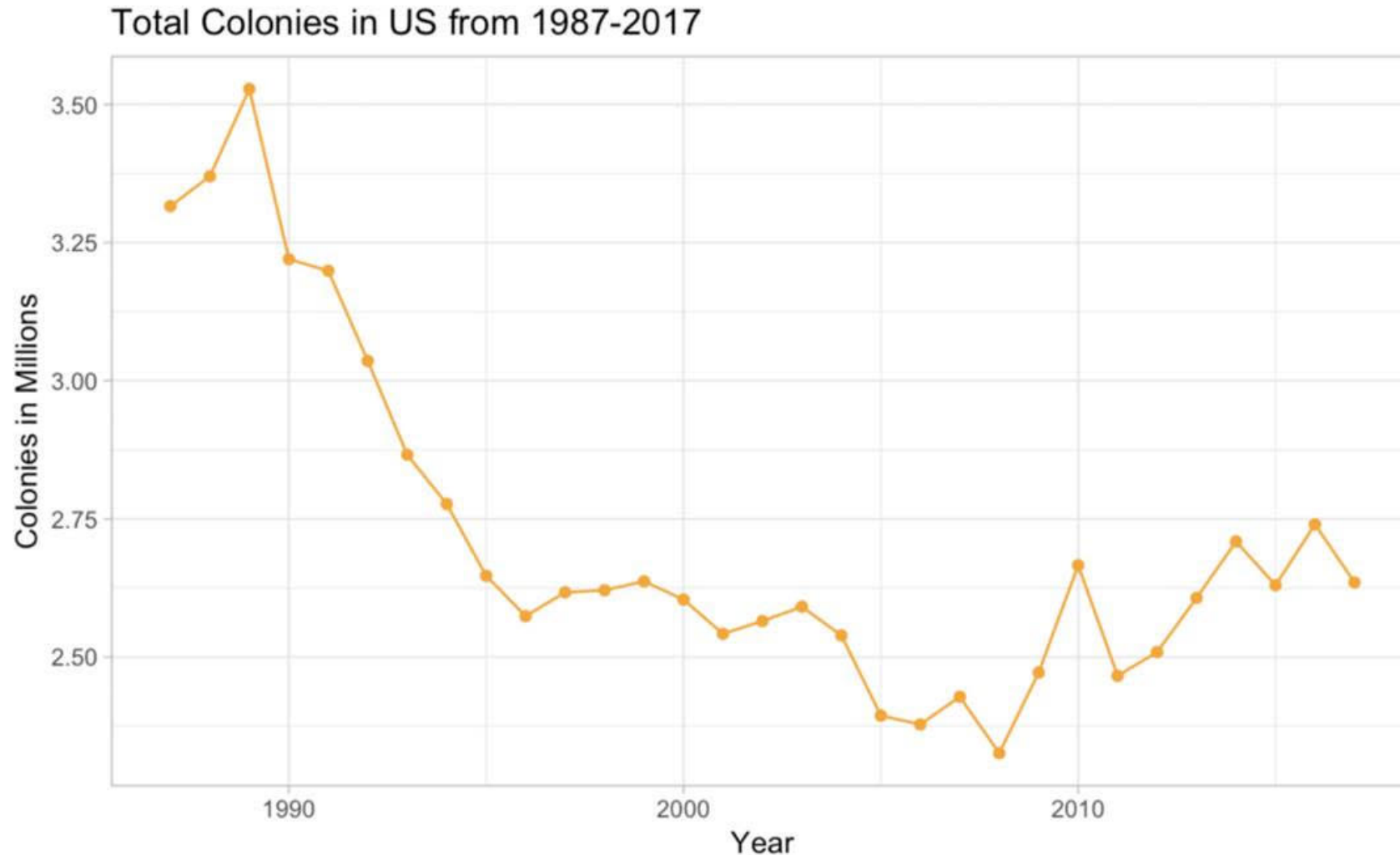
3,250,000 Honeybee
Colonies (1990)

2,250,000 Honeybee
Colonies (2005)



Honeybee Trend Reversing

Since 2005, beehive populations in the U.S. have been relatively stable — and even increasing.



Graphic:
Abhi Motgi. "What's Buzzing with the Bees?" Medium,
Towards Data Science, 24 June 2019.

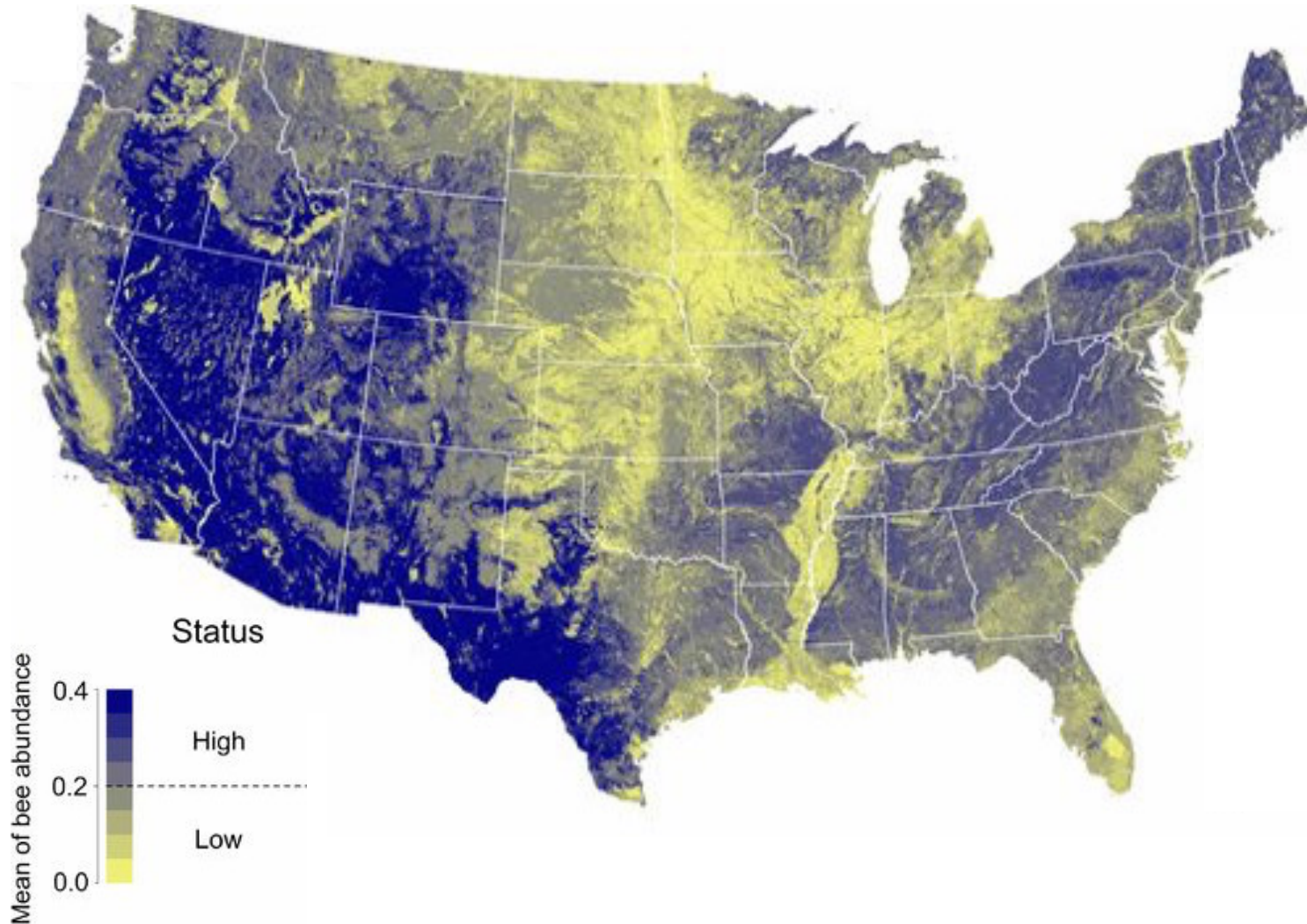
Data:
Kaggle: Bee Colony Statistics
FRED: CPI data
NASA: Temperature anomalies from 1880-present

Wild Bees ↓ 23%

In the United States, wild bee abundance dropped by 23% in just five years.

In New England, 22% of native plants are considered rare, in decline, endangered or extinct.

“A heterogeneous community of native species can help buffer against the decline of managed species.”



Koh, Insu, et al. "Modeling the Status, Trends, and Impacts of Wild Bee Abundance in the United States." *Proceedings of the National Academy of Sciences*, vol. 113, no. 1, 2015, pp. 140–145.

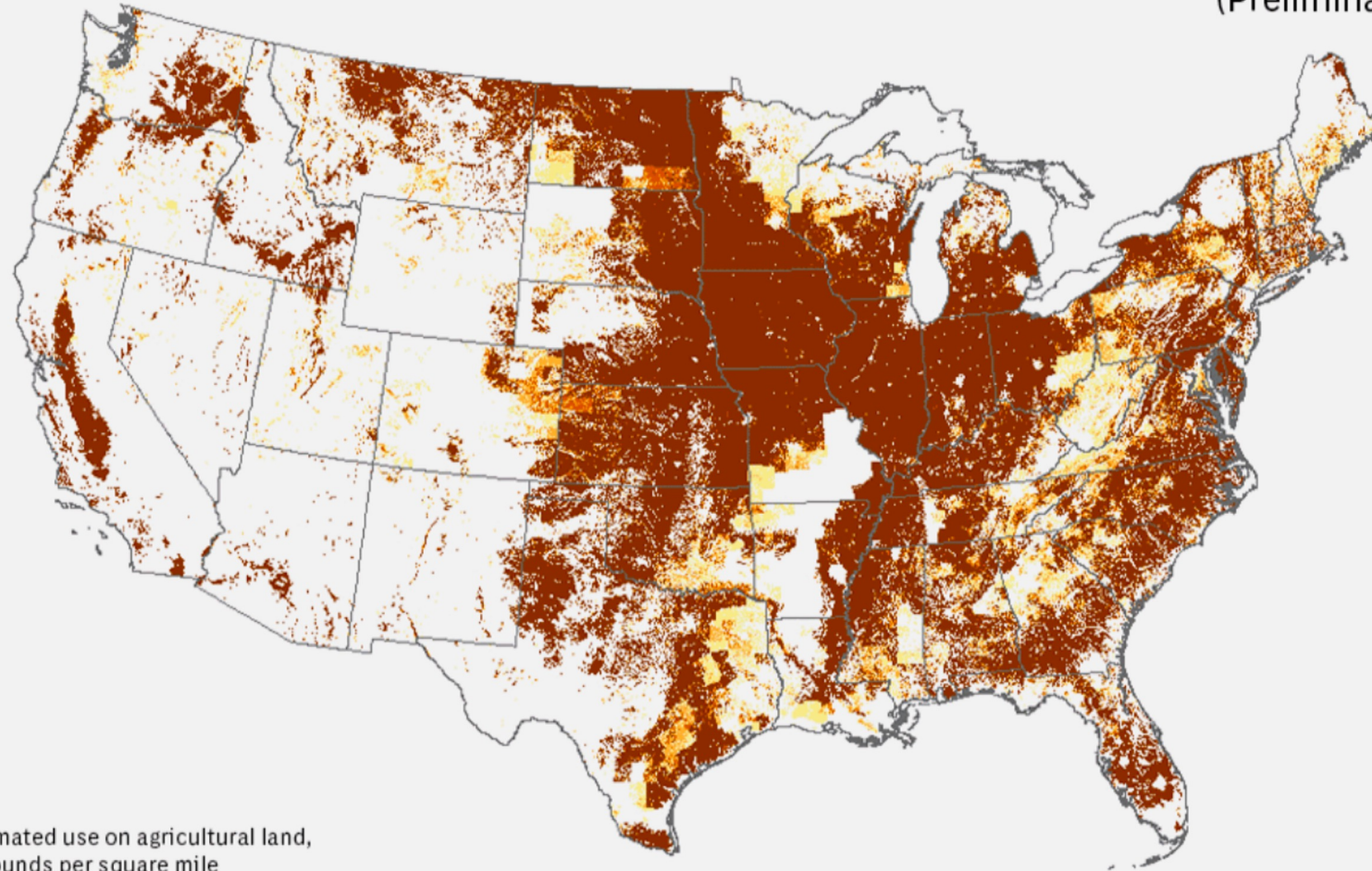
Kremen C, Williams NM, Thorp RW. Crop pollination from native bees at risk from agricultural intensification. *Proc Natl Acad Sci USA*. 2002;99:16812–16816.

Farnsworth, Elizabeth. *State of the Plants: Challenges and Opportunities for Conserving New England's Native Flora*. Native Plant Trust, 2015.

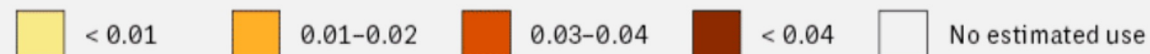
Estimated Agricultural Use of Imidacloprid

EPest-Low

2014
(Preliminary)



Estimated use on agricultural land,
in pounds per square mile



In June 2022, the EPA confirmed that three widely used neonicotinoid insecticides (clothianidin, imidacloprid, thiamethoxam) likely harm roughly three-fourths of all endangered plants and animals.

Neonicotinoids, which are banned in the European Union, are the most popular insecticides in the United States.

Hundreds of studies have shown they play a major role in population-level declines of bees, birds, butterflies and freshwater invertebrates. More recent studies show significant harm to mammals.

Imidacloprid is also sold as a flea and tick prevention for pets.

Burd, Lori Ann. Center for Biological Diversity. June 16, 2022. Web.

Map: USGS National Water-Quality Assessment, The Intercept

Native Bee Visitation to Fruit and Vegetable Crops



APPLE

BLUEBERRY

TOMATO

EGGPLANT

MELON

GENUS

BOMBUS

PEPONAPIS

ANDRENA

OSMIA

LASIOGLOSSUM

HALICTUS



Beyond Pollinator-Friendly

Most efforts to restore pollination systems to date have focused on increasing the numbers of a few bee species based on their crop pollination abilities, rather than on the range of wild pollinator species needed for ecosystem health and resiliency.

A delicate balance exists between native plants and their pollinators, relationships that co-evolved over millions of years. For many species, once their “partner” is missing from the landscape, they cannot reproduce.

A major misconception about pollinator decline is that all species are declining at the same rate. “Seeing lots of bees” does not mean that your area is necessarily pollinator-friendly.



Bombus vagans with bottle gentian (*Gentiana andrewsii*). Video by Tom Lautzenheiser.

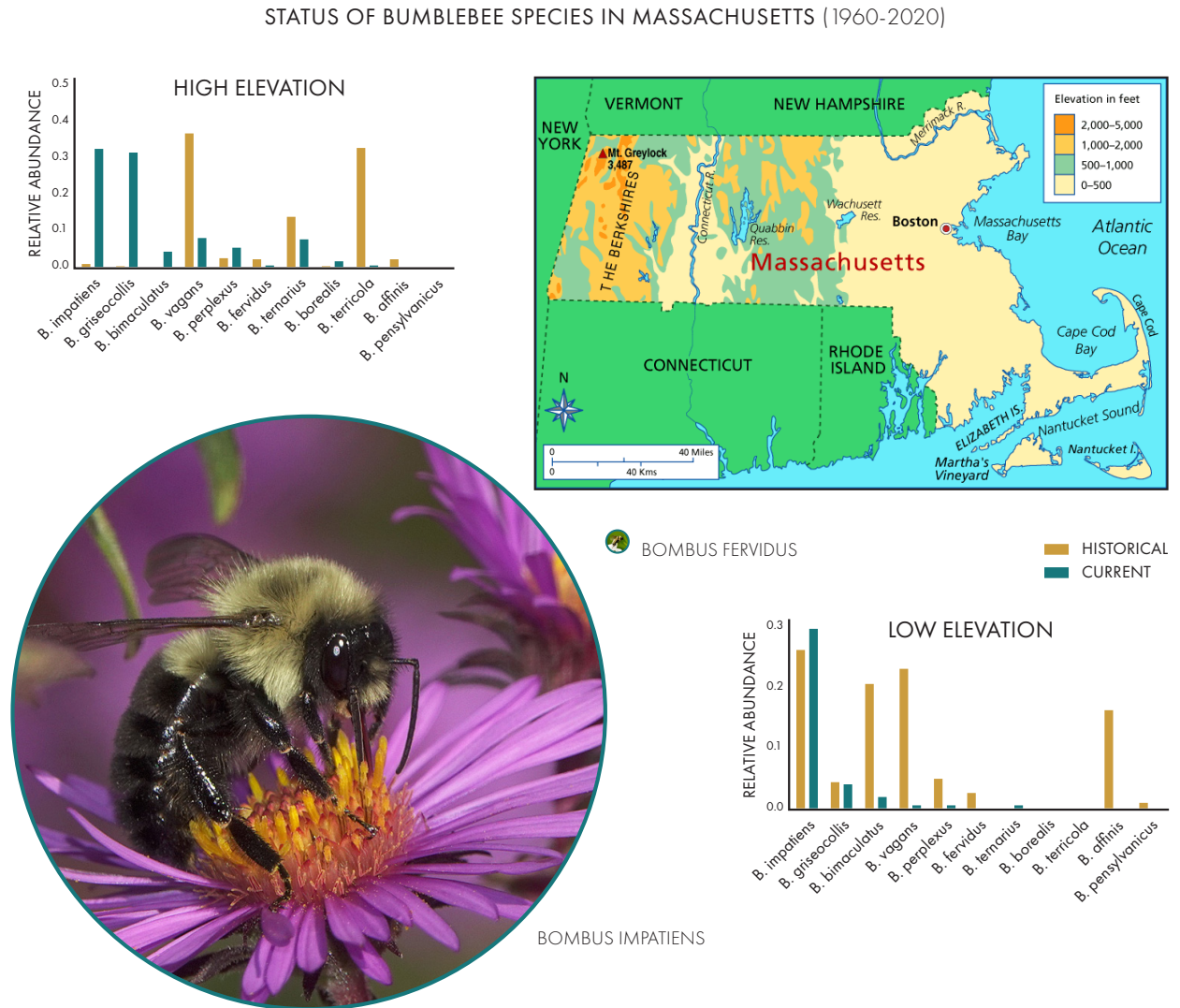
Diversity vs. Abundance

In Massachusetts, two out of 11 bumblebee species are extirpated, and two others are expected to be gone within the next decade.

The recent Empire State Native Pollinator Survey found 24% of native bee species surveyed to be at risk and 11% extirpated, as well as between 38% and 60% of native bees, flies, beetles and moths.

Lots of bees isn't always a good thing: While some species are declining or no longer present, others are more abundant now than historically. This pattern is common throughout the Northeast.

What one species wants or needs — be it for pollen, nectar or nesting — is not the same for every other species. MA lists five bees and 44 butterflies and moths as Species of Greatest Conservation Need.



Contemporary data courtesy Dr. Robert Gegear. Historical records from Yale Peabody Museum. Photos by Norm Levey.

White, E.L., M. D. Schlesinger, and T.G. Howard. 2022. The Empire State Native Pollinator Survey (2017-2021). New York Natural Heritage Program, Albany, NY.

CASE STUDIES



Lincoln Pollinator Action Plan

PLANTING FOR BIODIVERSITY
AND CLIMATE RESILIENCE

Evan Abramson

The Lincoln Pollinator Action Plan is a comprehensive field guide for creating and maintaining habitat on a wide range of landscapes, to support threatened and at-risk pollinator species in the Northeast. While the designs, plant lists and management recommendations contained herein are based on the prevalent landscape conditions in Lincoln, Massachusetts, their applicability stretches far beyond town boundaries. The product of a year-and-a-half-long collaboration between scientists, designers, planners, conservation professionals and citizens, this Plan endeavors to make pollinator habitat conversion easy, exciting and aesthetically pleasing — and inspire landowners to view their properties as integral parts of a network of ecosystems that stretches into surrounding communities and across the wider region.

Commissioned by
the Lincoln Land Conservation Trust

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

a project of **LANDSCAPE|INTERACTIONS**



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 for each Toolkit in this plan. 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.

People for Pollinators, Chapman Pasture and Upper Browning Fields are being surveyed for pollinator species diversity and change over a three-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 sites before any planting or landscape modifications took place. Years Two and Three (2021 and 2022) will document changes in species presence and interactions after the recommended plants, designs and management guidelines from the

Toolkits have been implemented. **The Toolkits have been created to specifically target and support bee and butterfly species which are threatened or at risk in Northeastern Massachusetts.** 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 Plan will not only be observed, but sustained on each site in Years Two, Three and beyond.

After kicking off Lincoln's Pollinator Action Plan programming with a public presentation in January 2020, Dr. Gegear offered workshops in Lincoln during the spring and summer, as well as an online tutorial, in order to recruit citizens to collect data on bumblebee species distributions in Lincoln using the **Beecology** app he created (<https://beecology.wpi.edu>). Videos and photographs of bumblebees on plants are taken on a smartphone or tablet and uploaded through the app. Dr. Gegear and members of his lab verify every bumblebee and plant ID before they are added to the database.

Another highly valuable visual resource for aspiring citizen scientists emerged in the summer of 2020,

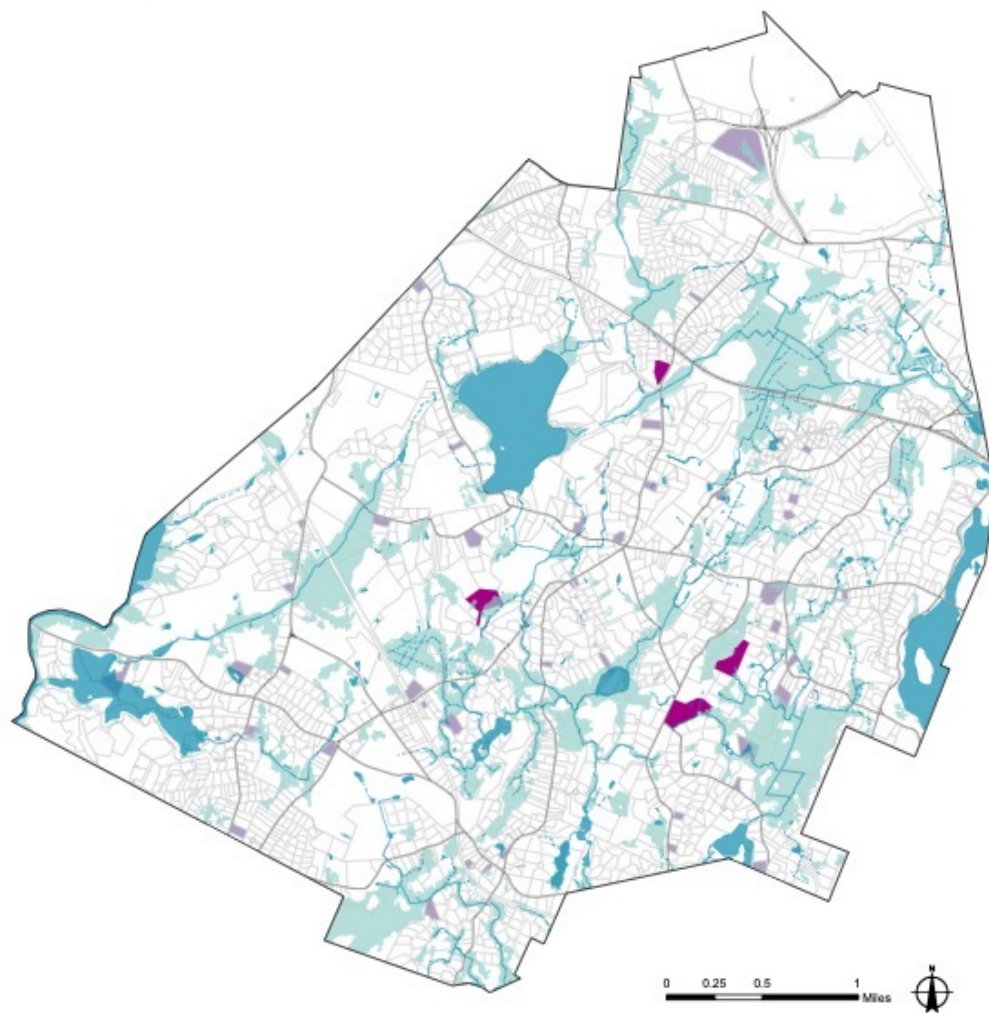
when renowned photographer, wildlife observer and Lincoln resident Norm Levey released **Bombus: The Bumblebees of Lincoln**, a bee ID video published in collaboration with Beecology and the Lincoln Land Conservation Trust. Billed as "a virtual walk in the People for Pollinators meadow and other locations in the town to meet the local bumblebees," the 13 minute video is an excellent tool for learning how to differentiate between seven different species of bumblebee presently abiding in Lincoln.

To become a Beecologist you can get started at: <https://beecologywpi.edu/website/participate#apps>



This page: video stills from *Bombus: The Bumblebees of Lincoln* filmed and produced by Norm Levey/*The Natural World* in Lincoln. <https://theindwellingspider.wordpress.com/video/bombus-the-bumblebees-of-lincoln/> Opposite: Beecology workshop hosted by Dr. Gegear. Photographs by Bryn Gingrich, Outreach Director, Lincoln Land Conservation Trust.

Toolkit sites seen in correlation to the 43 properties in Lincoln that installed plant kits based on the Birches School landscape design, which were sold through a plant sale by LLCT. The plants were selected to support at-risk bumblebee and butterfly species in Eastern Massachusetts specifically, rather than species whose populations are stable. A buffer of 500 feet was added to each property, representing the average foraging range of a native bee, in an attempt to depict opportunities for habitat connectivity across the town-wide landscape. While many solitary bee species forage limited distances from their nests, bumblebee species are known to forage much farther than 500 feet, as are many butterfly species.



POLLINATOR CORRIDOR PHASE 1 SITES

Toolkit sites and properties in Lincoln with pollinator habitat installed





Recommended Plants for Northeastern Massachusetts*

Latin Name	Common Name
<i>Agastache scrophulariifolia</i>	Purple giant hyssop
<i>Andropogon gerardii</i>	Big bluestem
<i>Asclepias incarnata</i>	Swamp milkweed
<i>Asclepias syriaca</i>	Common milkweed
<i>Asclepias tuberosa</i>	Butterfly milkweed
<i>Baptisia tinctoria</i>	Yellow wild indigo
<i>Carex spp.</i>	Sedges
<i>Cephalanthus occidentalis</i>	Buttonbush
<i>Cercis canadensis</i>	Redbud
<i>Chamaecyparis thyoides</i>	Atlantic white cedar
<i>Cirsium discolor</i>	Field thistle
<i>Cirsium pumilum</i>	Pasture thistle
<i>Desmodium canadense</i>	Showy tick-trefoil
<i>Dieruilla lonicera</i>	Northern bush honeysuckle
<i>Doellingeria umbellata</i>	Tall white aster
<i>Eutrochium dubium</i>	Coastal plain Joe-Pye weed
<i>Eutrochium fistulosum</i>	Hollow Joe-Pye weed
<i>Eutrochium maculatum</i>	Spotted Joe-Pye weed
<i>Eutrochium purpureum</i>	Purple Joe-Pye weed
<i>Geranium maculatum</i>	Spotted crane's-bill
<i>Hypericum ascyron</i>	Great St. John's-wort
<i>Hypericum prolificum</i>	Shrubby St. John's-wort
<i>Hypericum punctatum</i>	Spotted St. John's-wort
<i>Impatiens capensis</i>	Spotted touch-me-not
<i>Juniperus virginiana</i>	Eastern red cedar
<i>Lupinus perennis</i>	Wild lupine
<i>Mimulus alatus</i>	Winged monkey flower
<i>Mimulus ringens</i>	Allegheny monkey flower

Latin Name	Common Name
<i>Monarda didyma</i>	Scarlet bee balm
<i>Monarda fistulosa</i>	Wild bergamot
<i>Panicum virgatum</i>	Switchgrass
<i>Pedicularis canadensis</i>	Canadian lousewort
<i>Penstemon digitalis</i>	Foxglove beardtongue
<i>Penstemon hirsutus</i>	Northeastern beardtongue
<i>Prunella vulgaris ssp. lanceolata</i>	Common selfheal
<i>Prunus maritima</i>	Beach plum
<i>Quercus ilicifolia</i>	Scrub oak
<i>Quercus spp.</i>	Oaks
<i>Rosa carolina</i>	Carolina rose
<i>Rosa palustris</i>	Swamp rose
<i>Rosa virginiana</i>	Virginia rose
<i>Rubus allegheniensis</i>	Common blackberry
<i>Rubus odoratus</i>	Purple-flowering raspberry
<i>Rubus pensilvanicus</i>	Pennsylvania blackberry
<i>Rubus vermontanus</i>	Vermont blackberry
<i>Rumex altissimus</i>	Pale dock
<i>Rumex spp.</i>	Water dock (native)
<i>Salix bebbiana</i>	Bebb's willow (male)
<i>Salix discolor</i>	Pussy willow (male)
<i>Salix humilis</i>	Prairie willow (male)
<i>Salix lucida</i>	Shining willow (male)
<i>Salix petiolaris</i>	Meadow willow (male)
<i>Schizachyrium scoparium</i>	Little bluestem
<i>Scutellaria galericulata</i>	Hooded skullcap
<i>Scutellaria lateriflora</i>	Mad dog skullcap
<i>Solidago caesia</i>	Axillary goldenrod

*Plant recommendations are site-specific and based on landscape conditions at the Toolkit sites, however, the sites chosen represent a wide range of habitat types, land use, soils and hydrological conditions.

Opposite page, clockwise from bottom: *Zizia aurea*; *Vaccinium angustifolium*; *Rubus odoratus*; *Ribes rubrum*; *Penstemon hirsutus*; *Bombus ternarius* on *Salix discolor*; *Spirea alba*. This page, from top: *Baptisia tinctoria*; *Carex stricta*; *Prunus maritima*; *Vaccinium macrocarpon*; *Schizachyrium scoparium*; *Scutellaria galericulata*; *Lupinus perennis*.

Latin Name	Common Name
<i>Solidago flexicaulis</i>	Zig-zag goldenrod
<i>Solidago juncea</i>	Early goldenrod
<i>Solidago odora</i>	Sweet goldenrod
<i>Solidago puberula</i>	Downy goldenrod
<i>Solidago sempervirens</i>	Seaside goldenrod
<i>Solidago speciosa</i>	Showy goldenrod
<i>Spirea alba</i>	White meadowsweet
<i>Spirea tomentosa</i>	Steeplebush
<i>Symphotrichum laterifolium</i>	Calico American-aster

Latin Name	Common Name
<i>Vaccinium angustifolium</i>	Lowbush blueberry
<i>Vaccinium corymbosum</i>	Highbush blueberry
<i>Vaccinium macrocarpon</i>	Large cranberry
<i>Vaccinium oxycoccos</i>	Small cranberry
<i>Vaccinium pallidum</i>	Hillside blueberry
<i>Viola spp.</i>	Violets (native)
<i>Zizia aptera</i>	Heart-leaved golden Alexanders
<i>Zizia aurea</i>	Common golden Alexanders
































Toolkit Sites

1. MEADOW & WOODLAND
PEOPLE FOR POLLINATORS
2. OLD FIELD
CHAPMAN PASTURE
3. WET MEADOW
UPPER BROWNING FIELDS
4. GARDEN & LAWN
BIRCHES SCHOOL

SITE CONDITIONS

MEDIUM TO MOIST SOILS
FULL SUN TO PART-SHADE
MODERATE FOOT TRAFFIC
FORMER HAY FIELD

PLANT SCHEDULE

TREES	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Cercis canadensis	Eastern Redbud	2	20' wide spacing
	Chamaecyparis thyoides	Atlantic White Cedar	2	20' wide spacing
	Quercus bicifolia	Scrub Oak	3	15' wide spacing
	Salix discolor	Pussy Willow	5	8' wide spacing
	Salix humilis	Prairie Willow	10	6' wide spacing
	Salix lucida	Shining Willow	5	10' wide spacing
	Salix petiolaris	Meadow Willow	10	10' wide spacing
SHRUBS	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Cephalanthus occidentalis	Butterbush	4	6' wide spacing
	Diervilla lonicera	Northern Bush-honeysuckle	36	4' wide spacing
	Hypericum prolificum	Shrubby St. John's-wort	10	5' wide spacing
	Rosa carolina	Carolina Rose	7	4' wide spacing
	Rosa palustris	Swamp Rose	5	5' wide spacing
	Rosa virginiana	Virginia Rose	9	5' wide spacing
	Rubus odoratus	Purple-flowering Raspberry	8	7' wide spacing
	Rubus pensilvanicus	Pennsylvania Blackberry	4	6' wide spacing
	Rubus vermontanus	Vermont Blackberry	10	4' wide spacing
	Spiraea alba	Meadowsweet	10	3' wide spacing
	Spiraea tomentosa	Steeplebush	10	3' wide spacing
	Vaccinium macrocarpon	American Cranberry	7	2' wide spacing
	Vaccinium oxycoccos	Small Cranberry	7	2' wide spacing
	Vaccinium pallidum	Hitside Blueberry	30	2' wide spacing
GRASSES	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Andropogon gerardi	Big Bluestem	75	3' wide spacing
	Carex pensylvanica	Pennsylvania Sedge	125	1' wide spacing
	Chasmanthium latifolium	River Oats	40	2' wide spacing
	Panicum virgatum	Switchgrass	70	3' wide spacing
	Schizachyrium scoparium	Little Bluestem	100	2' wide spacing
PERENNIALS	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Cirsium pumilum	Pasture Thistle	50	1' wide spacing
	Eutrochium dubium	Coastal Plain Joe-Pye Weed	36	2' wide spacing
	Hypericum ascyron	Giant St. John's-wort	26	2' wide spacing
	Pedicularis canadensis	Canadian Wood Betony	80	1' wide spacing
	Prunella vulgaris	Selfheal	116	1' wide spacing
	Rumex crispus	Pale Dock	12	2' wide spacing
	Viola pedata	Bird's-foot Violet	40	.5' wide spacing
GROUND COVERS	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Dry Mix	Upland Meadow Seed Mix	8,714 sf	Seed 35% of total area

EXISTING
FOREST
CANOPY

EXISTING
PLANTS

SHED WITH
RAIN BARRELS

BEE NESTING
STRIPS

BEECOLOGY
RESEARCH
GARDEN

BEE NESTING
STRIPS

MOWED PATH

EXISTING
MEADOW
(35% TO BE
RESEED)

EXISTING
MOWED
PATH

Meadow & Woodland Toolkit

PEOPLE FOR POLLINATORS

LANDSCAPE|INTERACTIONS

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



Refer to the
following page for
more information
on the plants in
the design.

Old Field Toolkit

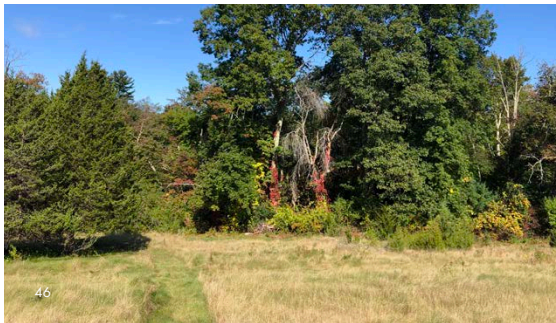
CHAPMAN PASTURE

Chapman Pasture is a rolling 8-acre grassland that was grazed with sheep for over forty years. The property is unique in that its vegetation is relatively consistent: upland areas of the site are almost all non-native grasses that reach a mature height of less than 3 feet. The property forms part of a contiguous 95-acre corridor of protected land owned and managed by LLCT.

Forested wetlands border the site on both northwest and southeast sides, with an intermittent stream running northward through the center of the field from the southeast corner of the property. This stream, combined with the topography of the site, creates a low point in the center of the field, a wet swale which is comprised predominantly of native vegetation.

Whereas the upland two-thirds of the site are dominated by non-native grasses with small patches of early successional *Pinus strobus* (White pine) and *Juniperus virginiana* (Eastern red cedar), this wet swale contains a somewhat limited range of plants that support threatened pollinator species, including *Carex vulpinoidea* (Common fox sedge), *Asclepias incarnata* (Swamp milkweed), *Symphotrichum nove-belgii* (New York American-aster) and *Solidago gigantea* (Smooth goldenrod). Field borders and forest edges contain significant portions of invasive *Celastrus orbiculatus* (Oriental bittersweet) as well as *Rosa multiflora* (Multiflora rose).

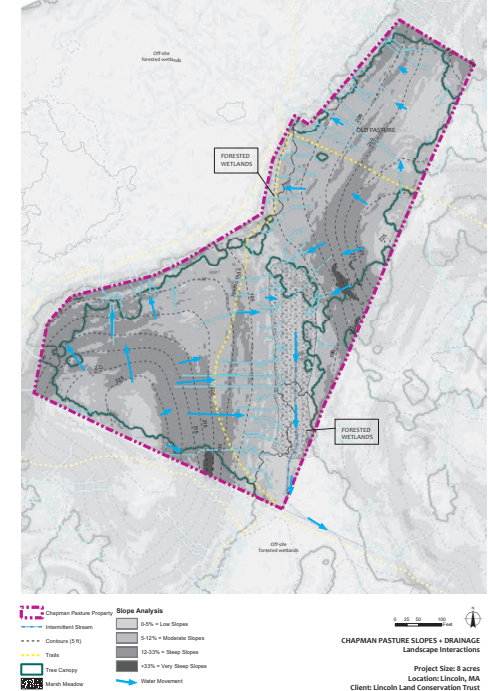
While Chapman Pasture is somewhat secluded, the site is open to the public and one point of access



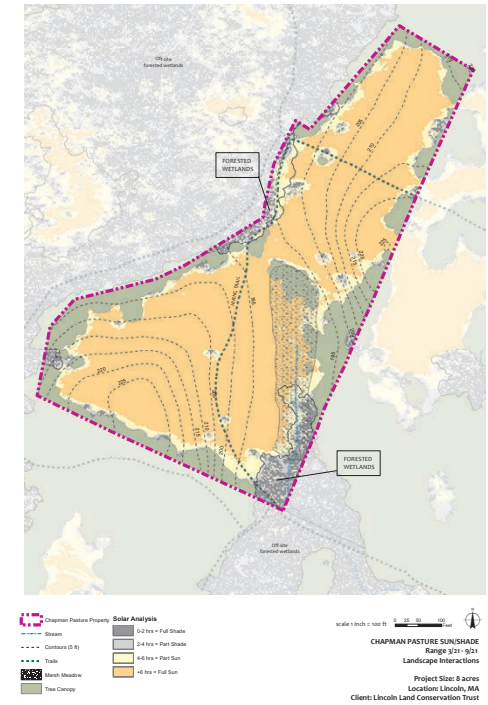
EXISTING CONDITIONS

originates from another Toolkit site, Upper Brown-ing Fields. LLCT is committed to converting the low habitat value of the grasses at Chapman Pasture to a diverse pollinator meadow with shrub areas. Seven bird boxes at Chapman Pasture are monitored for Eastern Bluebirds and Tree Swallows by a dedicated LLCT volunteer. Enhancements to the site will benefit these birds and wildlife at other trophic levels.

Due in large part to the dominance of the non-native grasses on the site, as well as the large scale of the property, Landscape Interactions proposed that prescribed fire be used to clear the site of existing vegetation and expose the soil for seeding. A proposal was prepared by LLCT and Landscape Interactions and sent to U.S. Fish & Wildlife Service. After visiting the site and learning more about LLCT's town-wide effort to target threatened pollinator species, USFWS agreed to fund a burn plan for the site, and to help find a team to execute the burn. USFWS will clear approximately one acre of field edges in preparation for the burn, which is scheduled for early spring 2021.



Above and right: some of the site analyses created to interpret the Chapman Pasture site and develop recommendations for habitat conversion and design. Clockwise from top left: Basemap, Slopes and Drainage, Sun and Shade.



Old Field Toolkit

CHAPMAN PASTURE

MANAGEMENT GUIDELINES

SITE ESTABLISHMENT

As mentioned, Chapman Pasture will be subject to prescribed fire in April 2021 as the initial method of site preparation for seeding. The burn will knock back non-native cool season grasses which dominate the site, expose the soil and encourage remnant native plant communities. As soon as 1 week following the burn, the wet swale can be planted with the recommended species depicted in the design. Additionally, exposed rocks and boulders on the site will be planted with the recommended arrangements of plants. Prescribed burns should continue on the site every 3-5 years as a primary method of vegetation management.

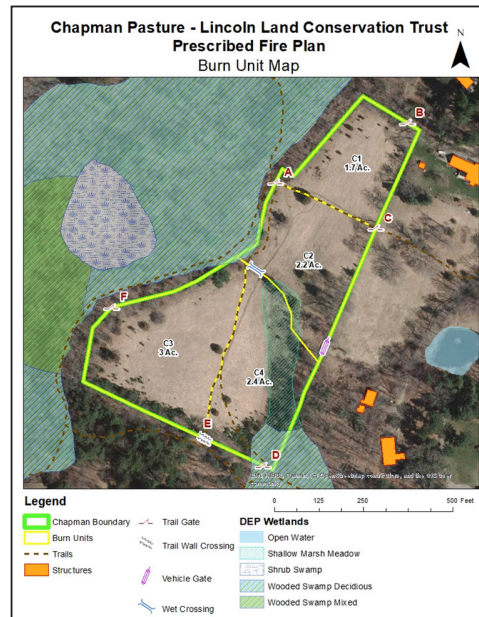
In late October or November 2021, the entire site should be mowed as close to the ground as possible, with the exception of those areas planted in the wet swale and in/around boulders in the field. If any emergent trees or invasives are found in the meadow during the 2021 growing season, they should be grubbed or pulled.

In November or December 2021, the wet and dry mixes should be seed drilled across the site, according to the areas outlined on the preceding page. If a seed drill is not available, the seed mixes may be broadcast; a harrow raking across the site may be required beforehand to ensure sufficient seed to soil contact (if drilling, no harrow raking is required). 100 lbs./acre of winter wheat cover crop should be added when fall seeding (if spring seeding, wild oats

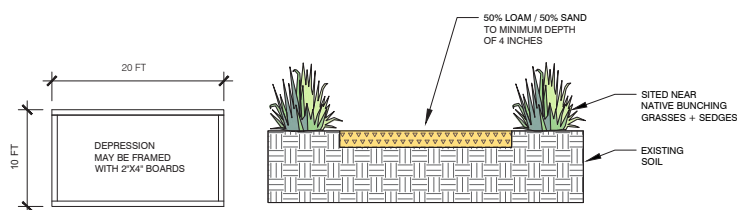
should be used instead). The plant lists for each seed mix are on the opposite page.

MOWING REGIMES

For the first growing season following seeding (2022), the entire site should be closely monitored for growth of vegetation. When the average height



BEE NESTING STRIP DETAIL



Above: Map of burn unit areas from Chapman Pasture Prescribed Fire Plan courtesy Alex Entrup of Entrup Consulting. Left: Due in part to the scale and accessibility of the Chapman Pasture site, rather than having multiple 2'x4' nesting strips, it is recommended to create a single 10'x20' nesting location. Remove all vegetation and at least 4 inches of soil. 50% of the soil can be added back in mixed with 50% sand. The area should be well draining, in full sun and kept clear of weeds, grasses or other vegetation. Do not mulch.

CHAPMAN PASTURE UPLAND MEADOW SEED MIX

Shrubs	
<i>Spiraea alba</i>	Meadowsweet
<i>Spiraea tomentosa</i>	Steeplebush
Forbs	
<i>Agastache scrophulariifolia</i>	Purple giant hyssop
<i>Asclepias syriaca</i>	Common milkweed
<i>Asclepias tuberosa</i>	Butterfly weed
<i>Baptisia tinctoria</i>	Yellow wild indigo
<i>Cirsium discolor</i>	Field thistle
<i>Geranium maculatum</i>	Spotted crane's-bill
<i>Hypericum punctatum</i>	Spotted St. John's-wort
<i>Lupinus perennis</i>	Wild lupine
<i>Monarda fistulosa</i>	Wild bergamot
<i>Pedicularis canadensis</i>	Canadian lousewort
<i>Penstemon digitalis</i>	Foxglove beardtongue
<i>Penstemon hirsutus</i>	Northeastern beardtongue
<i>Prunella vulgaris ssp. lanceolata</i>	Common selfheal
<i>Solidago odora</i>	Sweet goldenrod
<i>Solidago speciosa</i>	Showy goldenrod
<i>Symphyotrichum lateriflorum</i>	Calico American-aster
<i>Zizia aptera</i>	Heart-leaf golden Alexanders
<i>Zizia aurea</i>	Golden Alexanders
Graminoids	
<i>Andropogon gerardii</i>	Big bluestem
<i>Carex blanda</i>	Common wood sedge
<i>Carex brevior</i>	Plains oval sedge
<i>Panicum virgatum</i>	Switchgrass
<i>Schizachyrium scoparium</i>	Little bluestem

of vegetation in a given area is approximately 12 inches, the area should be brush hogged to a height of no less than 8 inches. This schedule should be continued throughout the first, and possibly second growing season.

In the second growing season (2023), the site should be periodically assessed by a botanist or other individual with vetted plant identification skills. If the majority of vegetation on the site or in a given area is native species from the mixes which were seeded, then the mowing schedule for the site or that area may be transitioned to a once-a-year mow. This should always occur during the dormant season (after November 15 or before 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 being mowed once a year on a rotational basis. During this annual mow, vegetation should be cut to a height of 4-6 inches.

If during the second growing season, the majority of vegetation on the site or in a given area appears to

CHAPMAN PASTURE WET MEADOW SEED MIX

Forbs	
<i>Asclepias incarnata</i>	Swamp milkweed
<i>Doellingeria umbellata</i>	Tall white aster
<i>Eutrochium fistulosum</i>	Hollow Joe-Pye weed
<i>Eutrochium maculatum</i>	Spotted Joe-Pye weed
<i>Eutrochium purpureum</i>	Purple Joe-Pye weed
<i>Impatiens capensis</i>	Spotted touch-me-not
<i>Mimulus alatus</i>	Winged monkey flower
<i>Mimulus ringens</i>	Allegheny monkey flower
<i>Rumex orbiculatus</i>	Great Water Dock
<i>Scutellaria galericulata</i>	Hooded skullcap
<i>Scutellaria lateriflora</i>	Mad dog skullcap
Graminoids	
<i>Andropogon gerardii</i>	Big bluestem
<i>Carex blanda</i>	Common wood sedge
<i>Carex brevior</i>	Plains oval sedge
<i>Panicum virgatum</i>	Switchgrass



remain non-native grasses, then continue mowing to keep the overall height of plants between 8-12 inches. This regime should be followed until the third growing season.

No-till seed drills such as the Flex by Truax pictured above are ideally suited for largescale native seeding without the need for raking. Sites should never be tilled before seeding native species, as doing so brings dormant weed seeds to the surface, increasing competition.

By the end of the third growing season (2024), the site should be ready for transition to an annual mow on a rotational basis. Invasive species and early successional trees in the open portions of the site should be closely monitored throughout, and either manually grubbed using a weed wrench ("Puller-bear" brand) or mechanically grubbed using a brush grubber ("Brush Grubber" brand) mounted on a tractor, ATV or pickup truck.

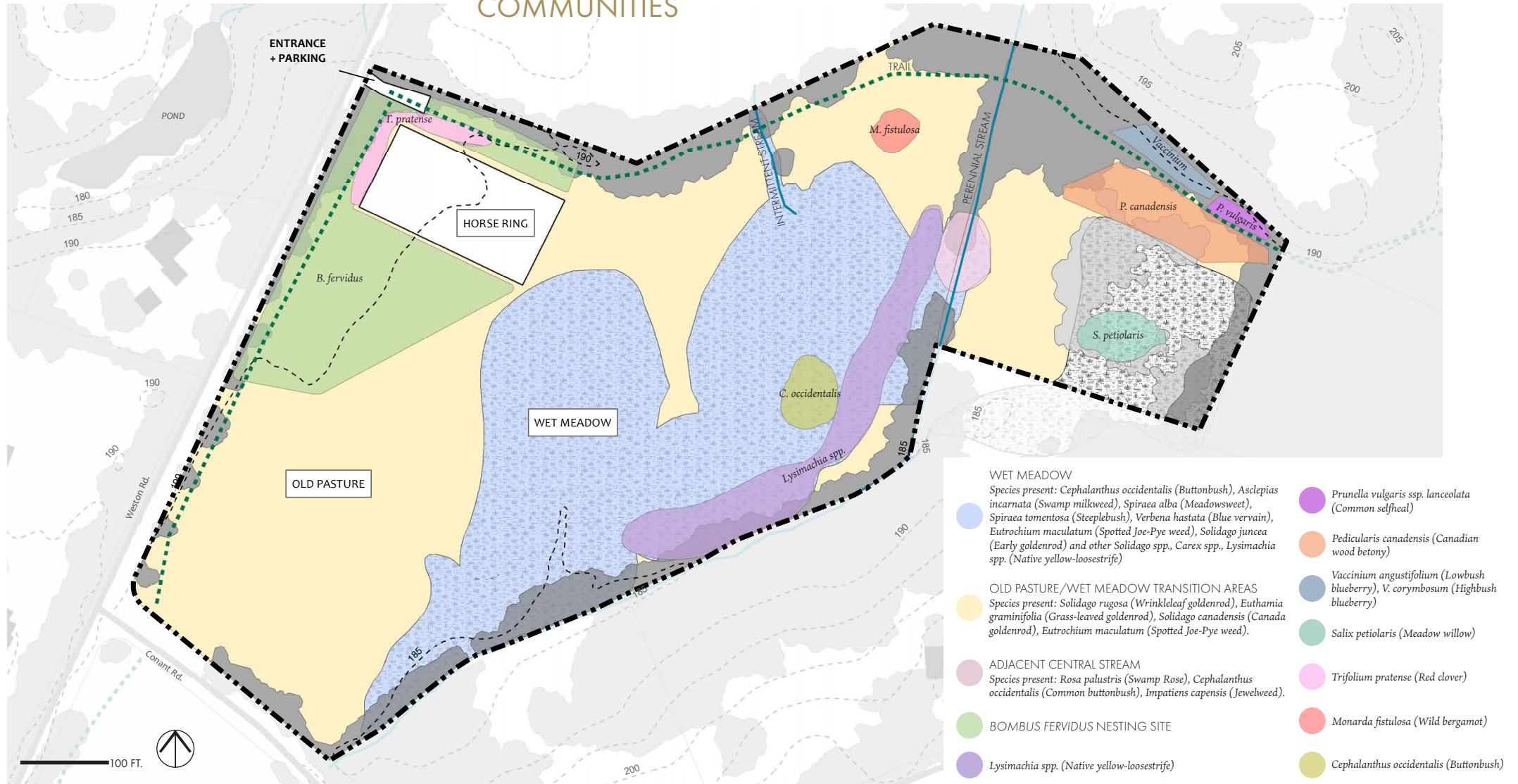


Wet Meadow Toolkit

UPPER BROWNING FIELDS

ECOLOGICAL COMMUNITIES

This map of plant species locations on Upper Browning Fields and the mowing/management guidelines presented in the map on the following pages were provided to Lincoln Conservation Department staff and LLCT in the early fall of 2020, to help interpret the varying ecosystems and plant communities present on the site, and understand the diverse management methods each unique area requires in order to better steward the landscape for at-risk pollinators.



Wet Meadow Toolkit

UPPER BROWNING FIELDS

LANDSCAPE|INTERACTIONS

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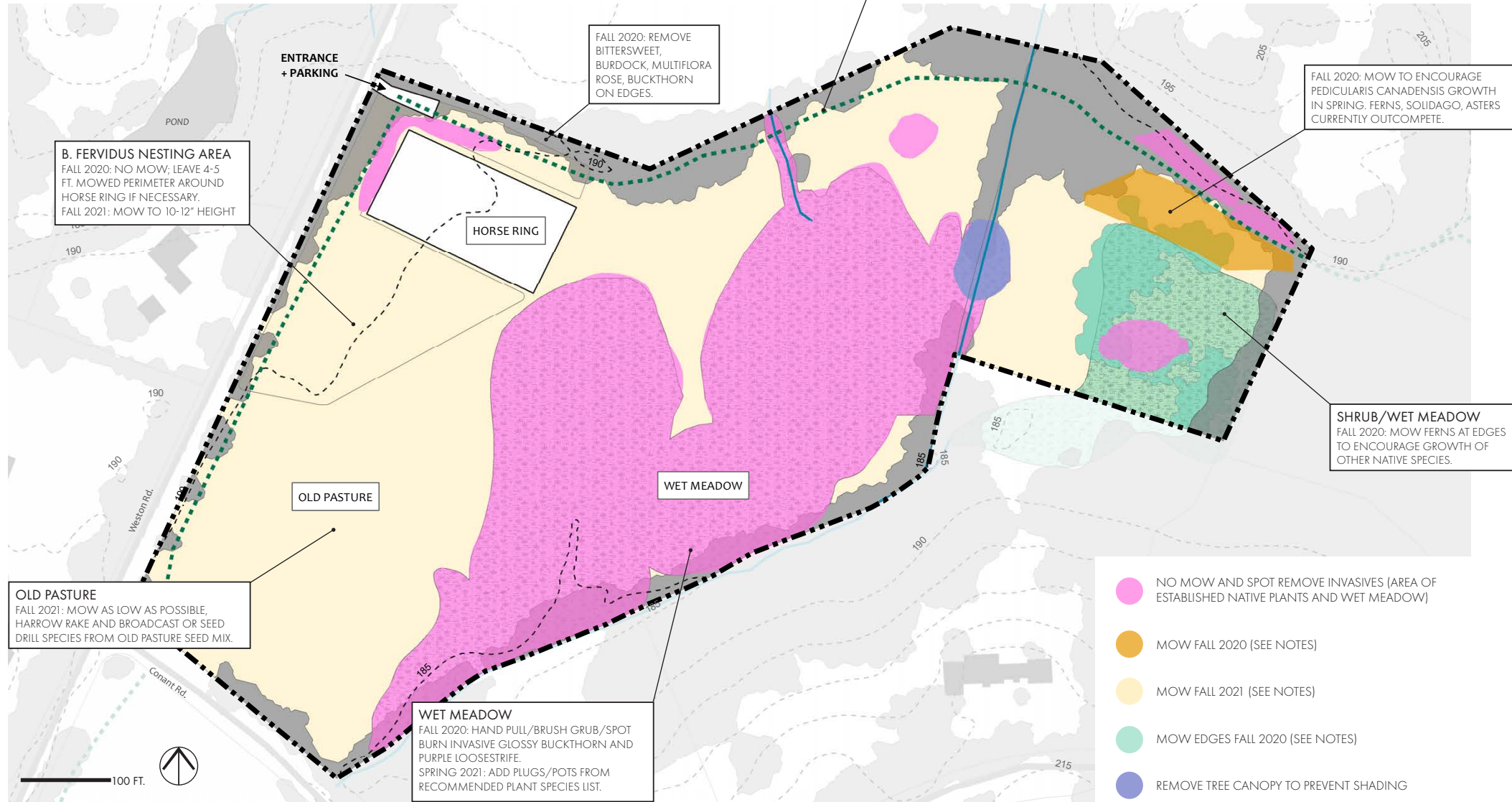
SITE CONDITIONS

MEDIUM SOILS & WET SOILS

FULL SUN & PART SHADE

CONSERVATION HABITAT

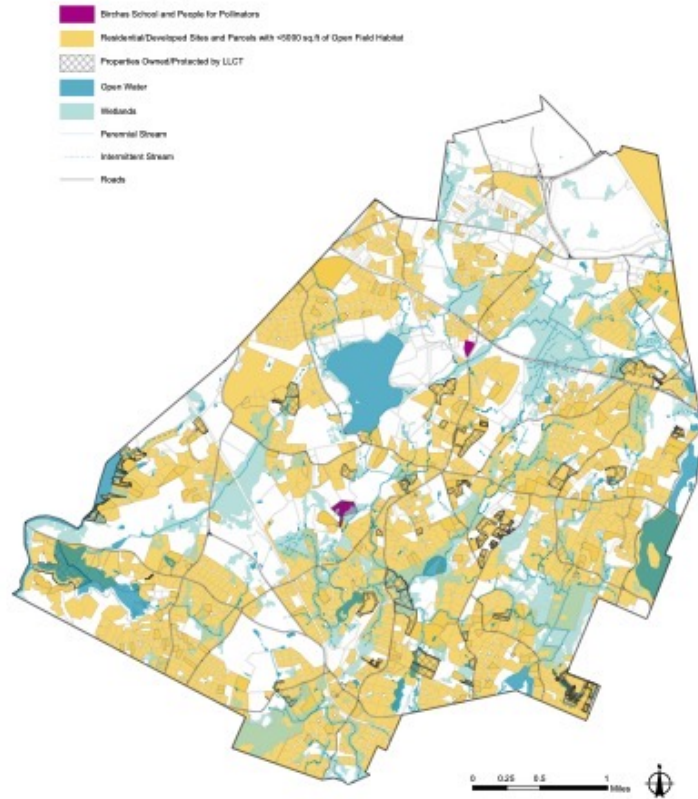
WET MEADOW



Opportunities for Connectivity

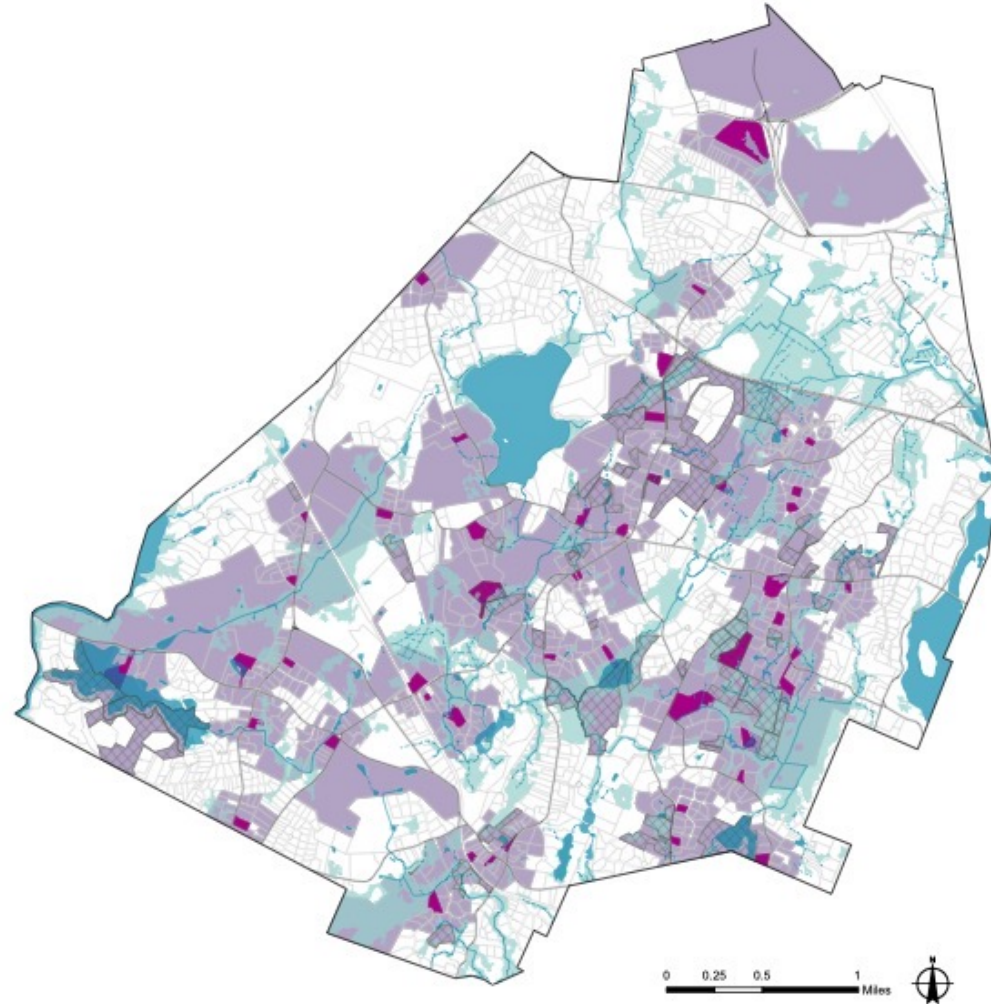
OPPORTUNITIES FOR BIRCHES SCHOOL AND PEOPLE FOR POLLINATORS TOOLKIT REPLICATION

Residential and developed properties in Lincoln and parcels
with under 5000 sq.ft of open field habitat



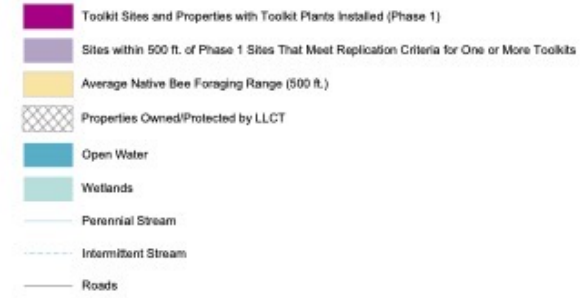
Opportunities for replication of the Toolkit designs in Lincoln. Left: properties in yellow are zoned as residential or developed, or contain open field areas measuring less than 5000 sq.ft, similar conditions to the context in which the People for Pollinators and Birches School designs were created; center: properties in brown contain large areas of open grassland habitat, comparable to the Chapman Pasture site; right: properties in dark green contain wetlands, wet meadows or priority/estimated habitat of rare species, conditions which are analogous to the Upper Browning Fields site.

Properties that meet the replication criteria for one or more of the Toolkit designs based on their existing landscape typologies are seen in correlation to the Phase 1 Toolkit sites and properties with planting kits installed. All properties in lavender are within 500 feet of one or more of the Pollinator Corridor Phase 1 sites, and contain land use conditions or habitat features which are similar to one or more of the Toolkit sites. Right: with a 500 ft. buffer on every potential Phase 2 property, representing the average foraging range of a native bee species, a town-wide pollinator corridor in Lincoln is demonstrated, with overlapping flight ranges allowing for redundancy and further strengthening of the life stages of the target threatened species.



POLLINATOR CORRIDOR PHASE 2 SITES

Properties in Lincoln suitable for replication of Toolkit designs with maximum connectivity





Pollinate Northampton

REPLICABLE AND SCALABLE
LANDSCAPE DESIGN TOOLKITS
TO SUPPORT POLLINATOR SPECIES AT RISK
IN THE CONNECTICUT RIVER VALLEY
OF MASSACHUSETTS

Evan Abramson, *Principal*
LANDSCAPE | INTERACTIONS



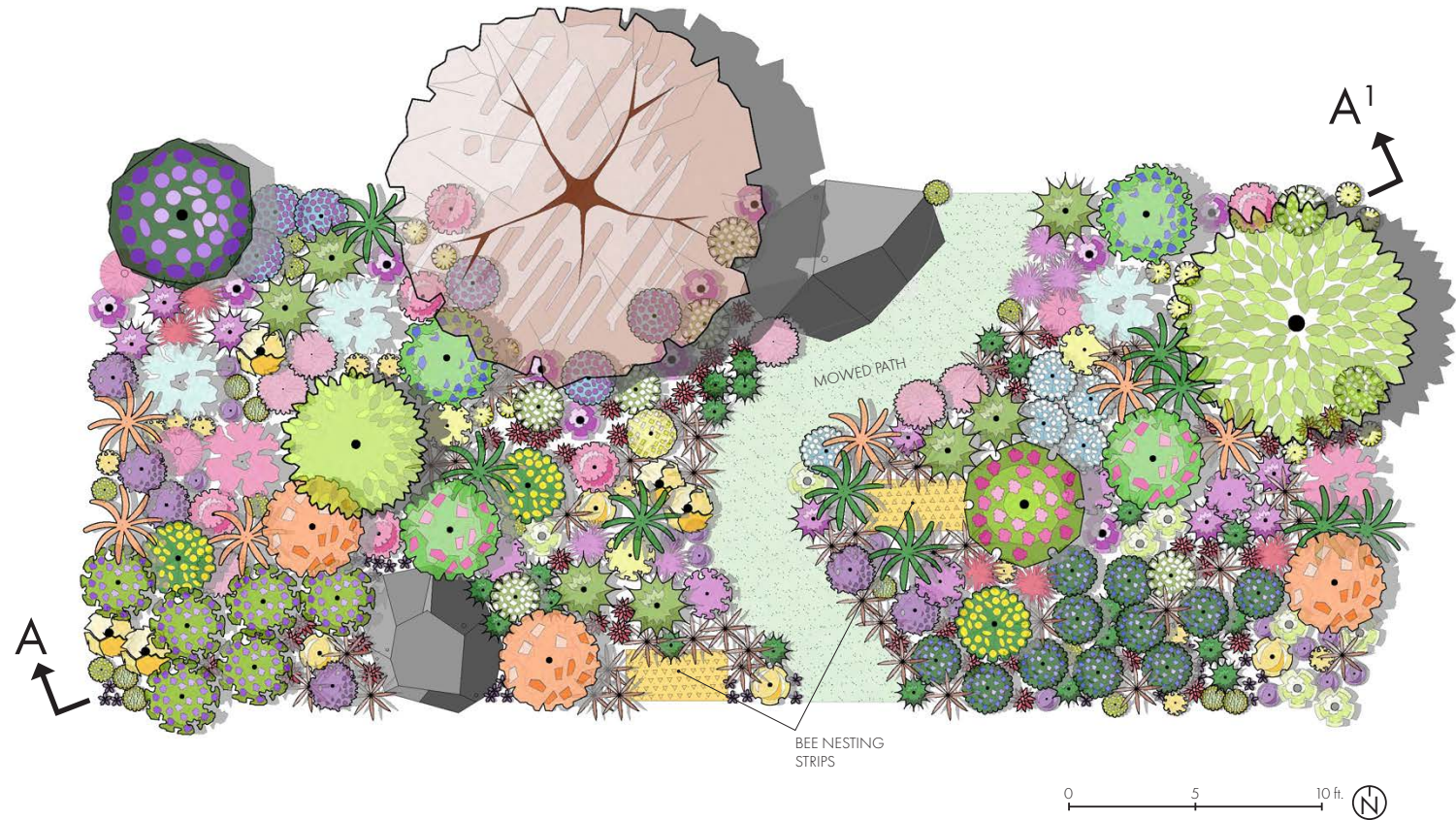
Sun Garden Toolkit

NORTHAMPTON

LANDSCAPE|INTERACTIONS

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

The plants in this design were selected for their propensity to thrive in full sun. Plants that are located north or beneath the canopy of taller plants are tolerant of part-shade. This design can easily be reworked to fit a range of layouts or conditions, including interspersing smaller groupings of plants within existing gardens and landscapes. Bee nesting strips can be created anywhere there is full sun and well-draining soils: remove at least 4 inches of existing vegetation and soil, and put back half the soil mixed with sand. Keep the area clear of plants at all times to allow ground nesting bees to access bare soil surface.



SITE CONDITIONS

DRY TO MEDIUM SOILS
FULL SUN
1000 SQ.FT

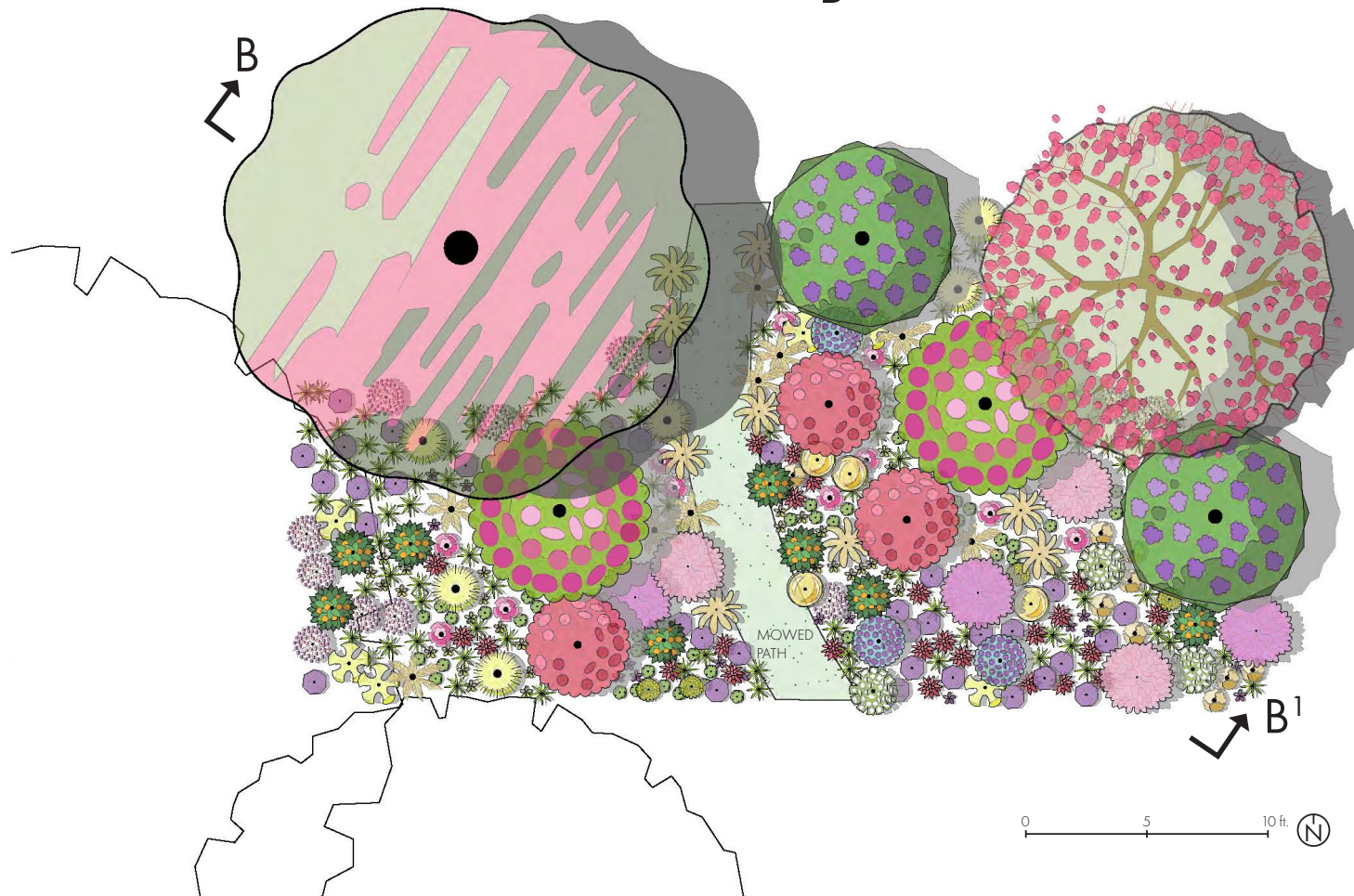


Shade Garden Toolkit

NORTHAMPTON

LANDSCAPE|INTERACTIONS

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



In this imagined scenario, two large mature trees are located south and southwest of the design space, casting shade and allowing for a mix of shade and light to move across the garden area throughout the day. All of the plants here are tolerant of part-shade to full shade conditions. Species located beneath the canopy of taller plants, or directly north of the adjacent mature trees, are tolerant of the deepest shade. Soils here are medium to moist, insofar as direct solar exposure to the garden is limited throughout the day.

SITE CONDITIONS

MEDIUM TO MOIST SOILS

PART-SHADE

800 SQ.FT

Bee + Butterfly Lawn Toolkit

NORTHAMPTON

LANDSCAPE | INTERACTIONS

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Northampton, MA 01060
landscapeinteractions.com

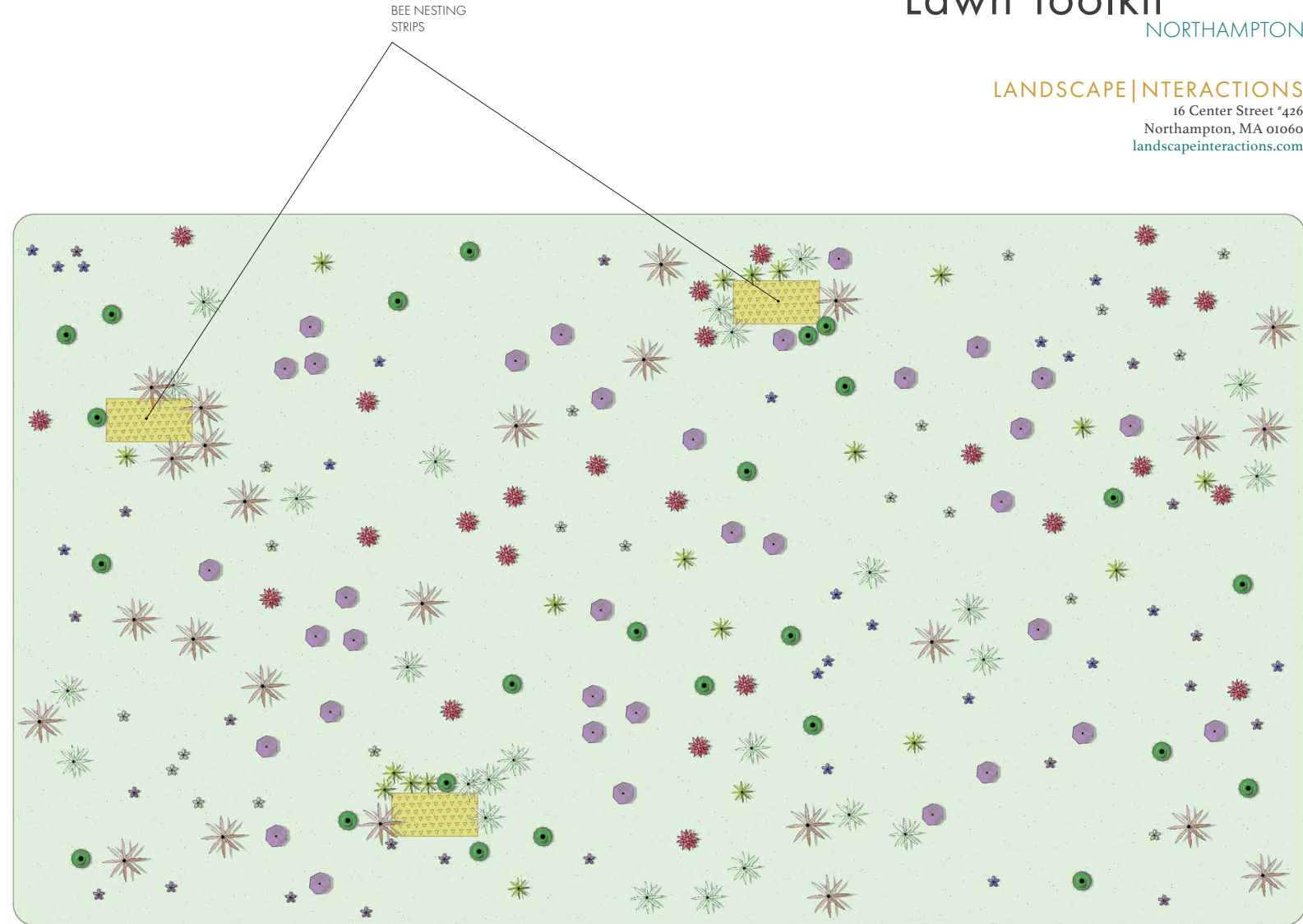
SITE CONDITIONS

MEDIUM TO DRY SOILS
FULL SUN TO PART-SHADE
2000 SQ.FT

Lawns are a personal choice and make sense in many situations; not everyone has the space or desire for a 4-8 ft. high meadow. The bee and butterfly lawn was designed to be installed in existing turf grass by scoring, scraping or otherwise removing small patches of vegetation, inserting plugs and/or seeds into the landscape and adjusting mowing regimes to allow the new plants to flower and seed. The less often you mow, and the higher you adjust your mowing blades, the more these native flowers, grasses and sedges will support bees and lepidoptera, and spread across the landscape. Mowing around flowers is a practice that we should all get used to if we are to expand the diversity and resilience of our properties, communities and regions.

All of the flowers selected for this design bloom at a height of 6-12 inches; the grasses and sedges are all tolerant of somewhat regular mowing. Try to delay mowing as much as possible the first growing season as it will stress the newly installed plants. Bee nesting strips can be created anywhere there is full sun and well-draining soils: remove at least 4 inches of existing vegetation and soil, and put back half the soil mixed with sand. Keep the area clear of plants at all times to allow ground nesting bees to access bare soil surface.

This design can also be installed to replace a traditional lawn. Clear all vegetation using a sod cutter; smothering with black tarp or plastic for one full growing season; or by sheet mulching. Rake away or dig out any remaining remnants of plants. Install 1 plug per sqft or mix plugs with seeds at a rate of 60-100 seeds per sqft, sown between November and early February. Violets and *Carex pensylvanica* must be installed by plug, as they are very difficult to establish by direct seeding.



Sidewalk Strip Toolkit

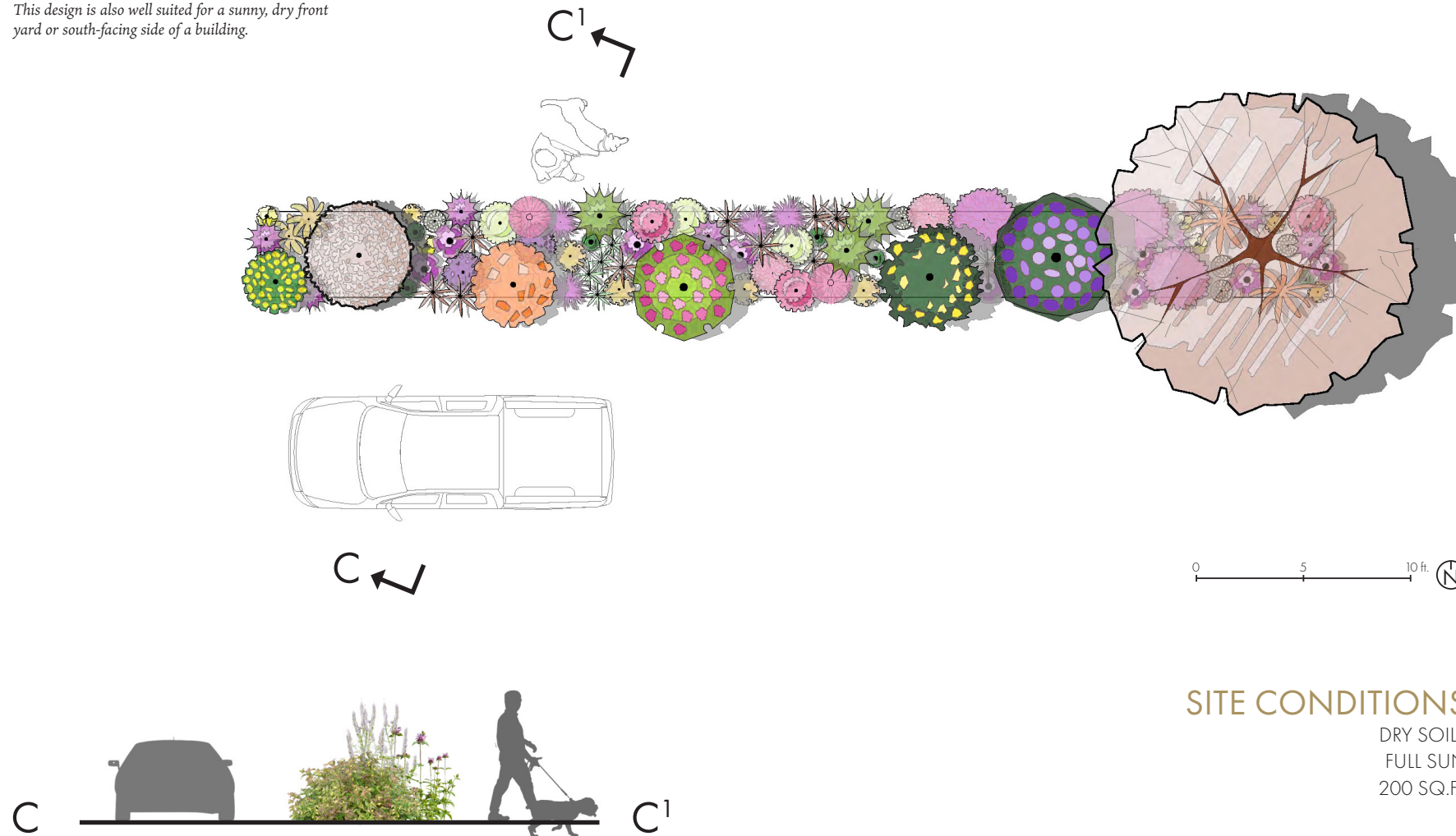
NORTHAMPTON

LANDSCAPE | INTERACTIONS

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

This assembly of hardy, salt and drought-tolerant plants survive the roughest of conditions. Many are less than 4' height or tolerate repeated cutting. The scrub oak and dwarf prairie willow are much shorter than most urban street trees and would fare well beneath power lines.

This design is also well suited for a sunny, dry front yard or south-facing side of a building.



SITE CONDITIONS

DRY SOILS
FULL SUN
200 SQ.FT

Sidewalk Strip Toolkit












NORTHAMPTON

LANDSCAPE | INTERACTIONS

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

PLANT SCHEDULE

TREES	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Quercus ilicifolia	Scrub Oak	1	15' wide spacing
	Salix occidentalis	Dwarf Prairie Willow	1	5' wide spacing
SHRUBS	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Baptisia tinctoria	Yellow Wild Indigo	1	3' wide spacing
	Diervilla lonicera	Northern Bush-honeysuckle	1	4' wide spacing
	Hypericum prolificum	Shrubby St. John's-wort	1	5' wide spacing
	Rosa virginiana	Virginia Rose	1	5' wide spacing
	Rubus pensilvanicus	Pennsylvania Blackberry	1	6' wide spacing
BIENNIAL	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Cirsium pumilum	Pasture Thistle	2	2' wide spacing
GRASSES	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Agrostis perennans	Autumn Bentgrass	6	1' wide spacing
	Chasmanthium latifolium	River Oats	2	2' wide spacing
	Danthonia spicata	Poverty Oat-Grass	5	1' wide spacing
	Eragrostis spectabilis	Purple Love Grass	7	1-2' wide spacing
	Panicum virgatum	Switchgrass	3	3' wide spacing
	Schizachyrium scoparium	Little Bluestem	11	2' wide spacing
	Sorghastrum nutans	Indian Grass	2	2' wide spacing

PERENNIALS	BOTANICAL NAME	COMMON NAME	QTY	REMARKS
	Agastache scrophulariifolia	Purple Giant Hyssop	2	2' wide spacing
	Asclepias syriaca	Common Milkweed	3	2' wide spacing
	Eutrochium dubium	Coastal Plain Joe-Pye Weed	2	2' wide spacing
	Eutrochium purpureum	Purple Joe-Pye Weed	3	3' wide spacing
	Monarda fistulosa	Wild Bergamot	4	2' wide spacing
	Penstemon hirsutus	Northeastern Beardtongue	9	1.5' wide spacing
	Solidago juncea	Early Goldenrod	5	1' wide spacing
	Solidago nemoralis	Gray Goldenrod	4	1' wide spacing
	Solidago sempervirens	Seaside Goldenrod	4	1' wide spacing
	Symphyotrichum ericoides	Heath Aster	5	1' wide spacing
	Symphyotrichum pilosum	Awl Aster	3	2' wide spacing

Farming for Biodiversity at Island Grown Farm

TOOLKIT OF SCALABLE + REPLICABLE
FARMSCAPE HABITAT DESIGNS
TO SUPPORT POLLINATION SYSTEMS
AT RISK ON MARTHA'S VINEYARD

EVAN ABRAMSON

a project of

LANDSCAPE | INTERACTIONS



ISLAND
GROWN
INITIATIVE





Above (left to right): Glasses clear the field at Island Grown Farm following the commercial vegetable harvest. IGI shares gleaned food with schools, senior centers and community support programs including the Island Food Pantry and the Wampanoag Safe Harbors Program. Aerial view of the no-till vegetable fields at Island Grown Farm. Education Director Emily Armstrong plants with a visiting school group in IGI's community garden. All photographs courtesy Rauldi Baird and Island Grown Initiative.

Project Context

The Island Grown Farm is a 42-acre farm located in the center of the island of Martha's Vineyard. IGI was gifted this farm in 2012, and we are committed to restoring soil health and biodiversity on the land while producing abundant healthy, delicious food for our community.

This island is the home of the Wampanoag people, who have been here for many thousands of years and who are still here today. In considering the farm's past, it is important to recognize that the vast majority of the land care and food production history of this farmland and this island have been in the hands of the Wampanoag people, who developed complex systems to support a flourishing environment, bountiful food, and a thriving human community.

As we seek to implement a regenerative land care ethic now on this farm, we recognize that we are looking to restore some of the vibrancy that was created by many, many generations of skilled, attentive, and successful Wampanoag land stewards. Regenerative practices are not new or novel or recently invented — they are a current manifestation that seeks to learn from the traditional way of approaching food production and relationship to land, water, and place that was honed by the Wampanoag people.

—Noli Taylor, Senior Director of Programs, Island Grown Initiative

In the fall of 2021, Evan Abramson of Landscape Interactions was contracted by IGI to create a series of design and habitat management strategies at Island Grown Farm to support pollinator species at risk, and serve as a model for other farms on Martha's Vineyard as well as the greater island community. By demonstrating a range of design interventions and approaches to landscape conversion, the vision is for IGI Farm to serve as a standard for biodiverse, climate resilient design and land management across the region.

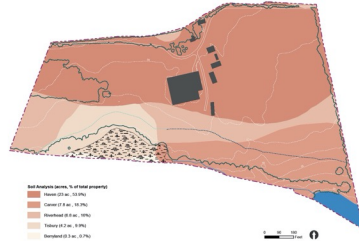
During an initial site visit in September of that year, it was observed that the vast majority of the farm is comprised of non-native vegetation. Annual vegetable crops dominate the open fields, in combination with cool season grasses, common agricultural weeds and clover. A small planted orchard has been installed in the southeastern portion of the farm, which in reality is a sandplain grassland suppressed by non-native grasses and forbs. While native vegetation in this area consists of less than 30% of the land cover, notable native plant species found in this area include Rosa vir-

giniana (Virginia rose), Symphyotrichum ericoides (heath aster), Eurybia spectabilis (showy aster), Ionactis linariaefolia (stiff aster), Asclepias tuberosa (butterfly weed), Solidago juncea (early goldenrod), Asclepias syriaca (common milkweed), Solidago nemoralis (gray goldenrod), Eragrostis spectabilis (purple love grass), Schizachyrium scoparium (little bluestem), Andropogon virginicus (broomsedge bluestem), Achillea millefolium (common yarrow), Pityopsis falcata (golden sickle leaf aster), Baptisia tinctoria (yellow wild indigo), Rhus copallinum (winged sumac), Lespedeza capitata (round-headed bush-clover) and Eupatorium hyssopifolium (hyssop-leaf boneset).

While the orchard contains a few rows of woody perennial flowering vegetation in the form of cultivated Morus sp. (mulberry), Castanea sp. (chestnut), Prunus tomentosa (Nanking cherry), Aronia sp. (hybridized black chokeberry) as well as native Prunus maritima (beach plum), and a small section of cultivated blueberries also exists, nearly 90% of the farm's open fields are characterized by herbaceous, non-native vegetation, thus providing very limited foraging opportunities for native pollinators, particularly in the early portion of the growing season, when pollen is crucial to the reproduction of many species of native bees.

The areas of the farm with the richest habitat consist of forested margins and, in particular, a forested wetland and perennial stream corridor in the southernmost portion of the site. This diverse area is connected to a kettle pond and a beathland located just across the property line, on the Little Duarte's Pond Preserve owned by the Land Bank, where Quercus ilicifolia (scrub oak), Carex pensylvanica (Pennsylvania sedge), Baptisia tinctoria (yellow wild indigo), Lespedeza hirta (hairy bush-clover), Eupatorium hyssopifolium (hyssop-leaf boneset), Arctostaphylos uva-ursi (bearberry), Schizachyrium scoparium (little bluestem), Juniperus virginiana (eastern red cedar), Hudsonia ericoides (pine-barren false heather), Pinus rigida (pitch pine) and Deschampsia flexuosa (wavy hair grass) are encountered.

An emergent wet meadow is found along the fenceline southwest of the greenhouse, where Prenella vulgaris (common selfheal) and Eutrochium dubium (coastal plain Joe-pye weed) are growing among non-native grasses and weeds adjacent to an area seeded with grains for seasonal sheep grazing. Moving west, typical non-native species continue, with some remnants of native grassland habitat found in limited populations of Solidago juncea (early goldenrod), Solidago sp. (likely S. rugosa ssp. aspera), Asclepias syriaca (common milkweed) and Asclepias tuberosa (butterfly weed).



Various ecological site analyses were conducted for Island Grown Farm in order to better inform the design process. Nearly the entire property is listed by MassWildlife's Natural Heritage and Endangered Species Program (NHESP) as BioMap2 Core Habitat (right), likely due in large part to the farm's proximity to several intact natural areas, including the Manuel F. Corvillius State Forest (bottom right). The dominant soil types on the farm are Haven very fine sandy loam, Carter heavy coarse sand and Riverhead sandy loam, which together comprise over 80% of the property (left). These three soils are representative of much of the farmland on the island: all are among the five most common soil types on Martha's Vineyard, with Carter covering nearly 34% of the island.



After walking the site for two days with IGI's Regenerative Landscape Manager Mary Sage Napolitan, Senior Director of Programs Noli Taylor and Education Director Emily Armstrong, as well as meeting on site with Senior Director of Island Grown Farm Matthew Dix, Regenerative Agriculture Consultant Andrew Woodruff and Field Manager Tim Connelly, it was determined that the best approach for improving and expanding the biodiversity and resilience of the farm would be multifaceted, responsive to the unique ecological and social conditions of the site and sensitive to the many constraints that define a working landscape.

First, numerous narrow stretches of land that criss-crossed the farm upon existing tractor roads and footpaths were identified to be redundant, and it was agreed that these could be converted into permanent hedgerows and field borders comprised of a mix of woody and herbaceous perennial vegetation, including early season pollen sources, host plants and native warm season grasses and forbs. Second, several marginal or unproductive portions of field would be turned over to permanent grassland/meadow installations, including the emergent wet meadow area along the southern fenceline which was consistently difficult to access with equipment. Third, the lower, less productive half of the orchard, which was already partially comprised of native sandplain grassland vegetation, would be restored into an oak savannah community, with the remaining fruit and nut trees transplanted to the western, more successful portion of the existing orchard site. Fourth, the understorey areas in between existing orchard tree plantings would be filled in with shade tolerant native shrubs and forbs. Fifth, in addition to the various custom seed mixes which would be created for the diverse grassland/meadow and oak savannah areas, a graze-tolerant seed mix would be created for livestock so that permanent grazing areas on the farm could be established, comprised entirely of native vegetation.

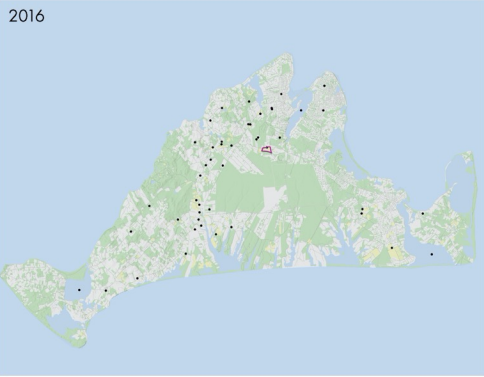
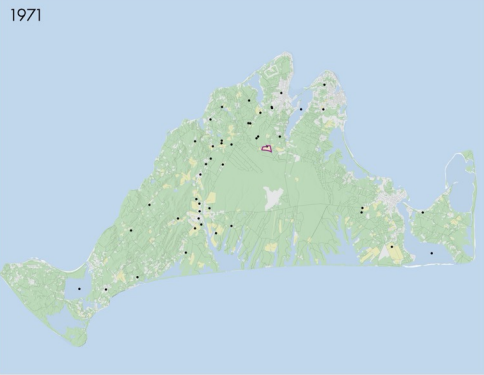
Most importantly, all proposed habitat areas would be mapped out in draft form and reviewed by the farmers and land managers before any final decisions were to take place. The habitat areas would be phased in over a 3+ year process developed in coordination with Mary Sage Napolitan, who would be responsible for the implementation and maintenance of these areas on the farmscape for the foreseeable future.

Land Use Threatens Biodiversity

Insects are the cornerstone of all terrestrial ecosystems — as pollinators, food for other creatures, and recyclers of nutrients. Without them, a bottom-up trophic cascade occurs: in essence, a domino effect that surges up through the food chain, wiping out higher animals (Carrington 2019a). Forty percent of the one million known species of insect are presently facing extinction (Carrington 2019b), including over half of the native bee species in North America (Marshman & Knezevic 2021). At the current rate of decline, most insect species on the planet could vanish within less than a century (Sánchez-Bayo, et al.; Carrington 2019c). Habitat loss and widespread pesticide use — in particular through industrial agriculture — are understood to be the main drivers of the declines, in addition to climate change.

By some measures, the biodiversity crisis is even more serious than that of climate change. Since the dawn of civilization, humanity has caused the loss of 83% of all wild mammals. In the last 50 years alone, the populations of all mammals, birds, reptiles and fish on the planet have fallen by an average of 60%. In a study published in late 2019, it was reported that in North America over 1 in 4 birds, or 3 billion birds, have disappeared since 1970 (Rosenberg et al. 2019). Habitat loss was again cited as the most direct cause.

Connected, diverse and extensive ecosystems can help stabilize the climate and will have a better chance of thriving in a world permanently altered by rising emissions (Petorelli et al. 2021). One of the most important components of any healthy and viable ecosystem is diversity. Diversity is strongly linked to the resilience of natural communities (Helzer 2010). A diverse combination of plant and animal species in a community increases the likelihood that the loss of one species can be somewhat compensated by other species that might play a similar role in the ecosystem. **Ecological resilience may be the most important attribute for any natural system, especially in the face of rapid climate change, continuing loss and degradation of habitat, encroaching invasive species and other threats** (Helzer 2017).



Right: Between 1971 and 2016, developed land on Martha's Vineyard nearly quadrupled from 11 to 40% of the island's total area. During the same period, agricultural land use shrank from 4 to 2%. Data obtained from MunsGIS Land Use datasets (1971, 2016) and MunsGIS OpenSpace by Ownership. 1971 data categorized by 11-21 Land Use Code system; 2016 data categorized by combining General Use Codes with Land Cover Codes and excluding permanently protected land or agricultural land from developed category.

FIVE MAIN THREATS TO GLOBAL BIODIVERSITY

1. CHANGES IN LAND + SEA USE
2. EXPLOITATION OF NATURAL RESOURCES
3. CLIMATE CHANGE
4. POLLUTION
5. INVASIVE SPECIES

UN CONVENTION ON BIOLOGICAL DIVERSITY (IPBES 2019)

Image: Matt Dorfman



Above (left to right): Regenerative Landscape Manager Mary Sage Neapolitan checks on native plant seedlings that overwintered in the unheated portion of Island Crown Farm's greenhouse. Working off the plant list in this Toolkit, she has been collecting seeds from wild populations of native plants on Martha's Vineyard along with a core group of volunteers. EGI hopes to eventually grow most of the plants they need for future phases of the Farming for Biodiversity installation. Below: working farms, and in particular those with organic practices, are very well suited to the incorporation of native plants into active production areas as well as marginal spaces. This rendering shows the wide range of opportunities that working farms present, including orchards and pick-your-own/fruit comprised of native pollen, nectar and host plants.

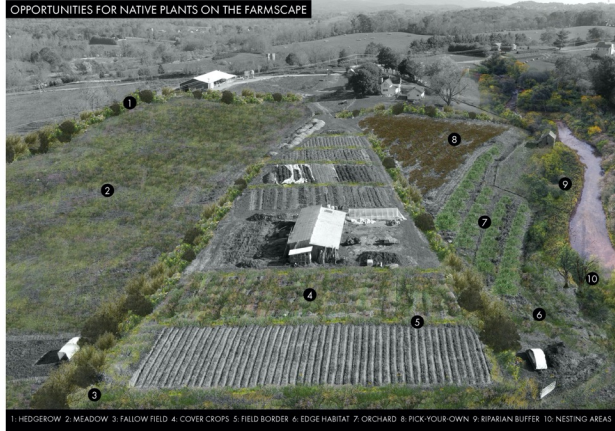
Native Plant Agriculture

Working farms provide a wealth of opportunities for expanding regional biodiversity, climate change resilience, ecological health and food security through the implementation of native pollination systems. While landscape conversion to intensive agriculture is understood to be the main driver of insect declines globally (Sánchez-Bayo, et al. 2019), diversified organic farms often provide refugia for a wide range of wildlife, including pollinator species. Yet if the majority of a farm's landscape consists of annual crops and fields are regularly plowed or otherwise disturbed (even by no-till practices such as tarping), limited opportunities may exist for many pollinator species to meet their life cycle requirements, especially species at risk whose habitat needs are often more specialized.

WHAT DOES REGENERATIVE MEAN?

"Regenerative agriculture takes a more systems-based, holistic look at the land being stewarded and applies various principles with the goal of making the land more productive and biodiverse over time. In most situations, improving soil health and function is the key to improving productivity and biodiversity." (Kiss the Ground 2022). While it is clear that soil health is important, particularly with regards to the productivity of food systems, biodiversity is difficult to achieve if significant portions of the farmscape are not allocated to uses other than human. Wild spaces on or adjacent to productive lands, untouched by pesticides and not managed for food production, are critical for wildlife survival. On Martha's Vineyard, this might look like a combination of open meadows, fallow fields, hedgerows, forest edges, riparian areas, heathland, field borders or other forms of edge habitat; all comprised primarily of functionally diverse, native plant communities.

Soil health, improved water retention, beneficial insect populations, increased carbon sequestration and fall crop pollination services are all byproducts of natural habitat areas (Vong et al. 2019; Kremen et al. 2002). But in order for a farm to truly be biodiverse — and thus, regenerative by definition — intentional planting and management of areas for a diversity of native pollinator-plant interactions is vital.



1. HEDGEROW 2. MEADOW 3. FALLOW FIELD 4. COVER CROPS 5. FIELD BORDER 6. EDGE HABITAT 7. ORCHARD 8. PICK-YOUR-OWN 9. RIPARIAN BUFFER 10. NESTING AREAS

Design Overview

ISLAND GROWN FARM

Island Grown Farm has been divided into eight scalable and replicable habitat types. Each represents a distinct landscape typology commonly found on working farms on Martha's Vineyard. For each habitat type, a selection of plants and/or seed mixes have been designed, appropriate for the ecological conditions of the site as well as the aesthetics and constraints of the particular space, its present land use on the farm, and the surrounding landscape.

1 FIELD BORDERS

Running north to south as well as east to west along field edges, narrow roadsides and walking paths across the farm, 5-6' wide field borders improve water infiltration and nutrient flow of soils and sub-soils with deep-rooted native graminoids and flowers; expand biodiversity, improve crop pollination, and reduce pest pressure by attracting and sustaining a wide range of native bee, butterfly and moth species as well as beneficial insects throughout the growing season.

2 HEDGEROWS

Running east to west along existing tractor roads throughout the farm, 10-12' wide hedgerows are comprised of compact trees and shrubs, herbaceous forbs, bunching grasses and mow-tolerant ground-covers. By providing diverse horizontal and vertical structure, wind is slowed, bird habitat is created, and pollinator life across the farm-scape is greatly expanded through the addition of numerous early season pollen sources and host plants.

3 WET MEADOW

Biodiversity on the farmscape is greatly expanded by adding a whole suite of wetland plants that would otherwise be difficult to establish on site, as other areas of the farm are much drier. This wetland buffer area will be restored to a native wet meadow environment through a combination of tarping, direct seeding and planting.

4 GRAZING AREAS

Two marginal areas on the farm have been identified for conversion to permanent grazing lands for sheep. As a future phase of the project, they will be tarped and seeded with mixes comprised entirely of native warm season grasses and forbs suitable for forage, all of which are host plants, pollen and nectar sources.

5 ORCHARD

Existing fruit and nut trees will be interplanted with native understory vegetation on contour, creating a corridor that connects a restored oak savannah to the farm's main artery. Wide paths allow animals to graze between rows, which provide much needed shade.

6 OAK SAVANNAH

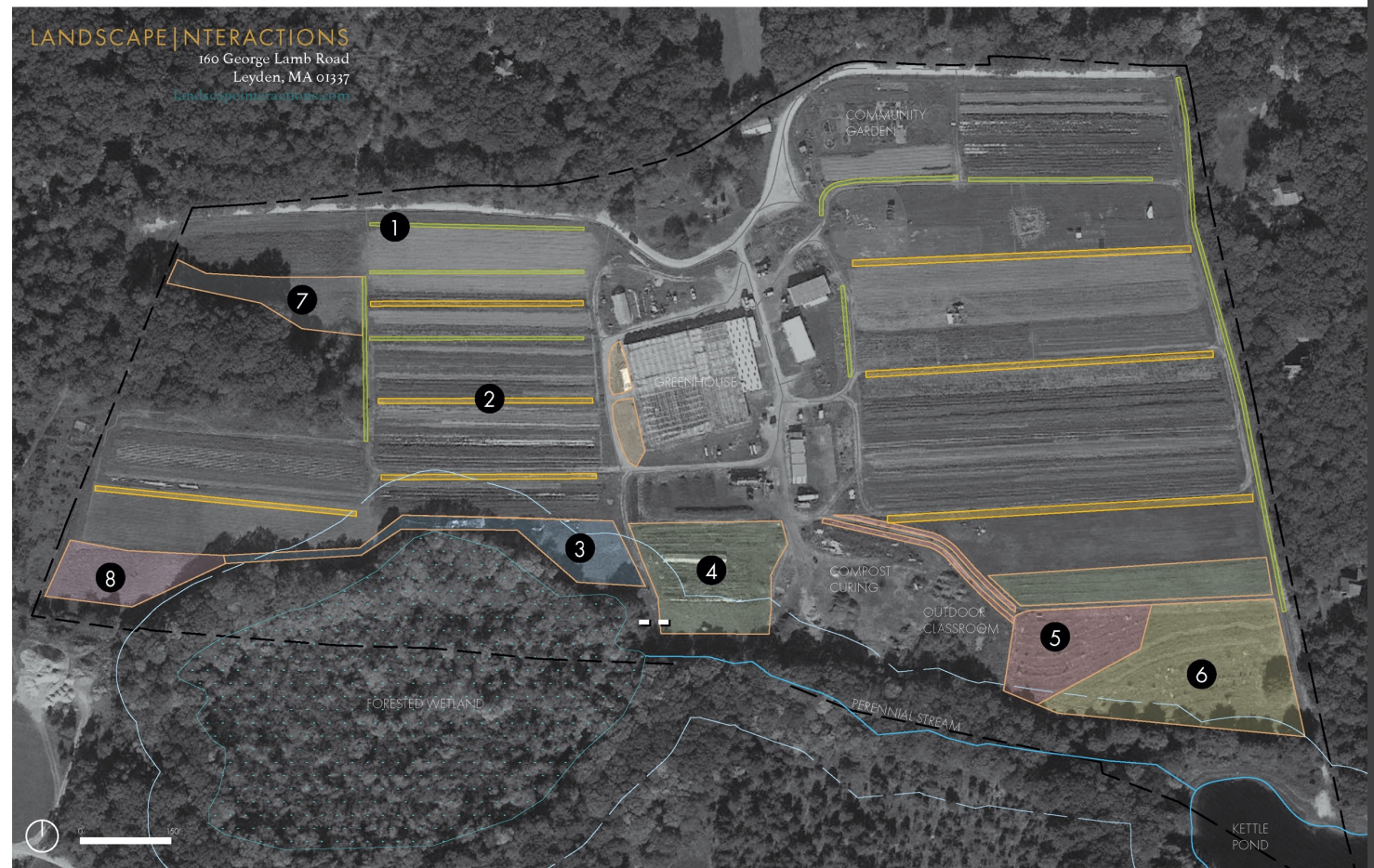
Characterized by excessively well-draining soils, this sandplain grassland remnant is converting back into a native landscape on its own. It will be helped along by removing non-native grasses, invasives and weeds through a combination of hand pulling and tarping; filling in the gaps that are created with a diverse seed mix of sandplain grassland species, as well as widely spaced plantings of trees and heathland shrubs.

7 WOODLAND EDGE

North of a forested section of the farm, this marginal area is not often utilized for production due to the fact that it is shaded. This offers the opportunity to create a unique habitat feature. After tarping to remove the predominantly non-native vegetation, this area will be seeded with a shade-tolerant mix and planted with a structurally diverse combination of shade-tolerant shrubs, sedges, flowers and a redbud tree.

8 MESIC MEADOW

This fallow field corner, dominated by about 70% non-native grasses, invasives and weeds, is significantly drier than the wet meadow area to the east. It will be restored as a rich, upland meadow by tarping and seeding with a custom mix appropriate for full sun and mesic soil conditions.





Photographs (clockwise from top left): *Bombus fervidus* on *Monarda didyma* (scarlet beebalm) by Norm Levey; *Cucullia speyeri* caterpillar by Jackie Elmore; *Andrena crataegi* on *Malus* sp. (apple) by Angus MacLean; *Juniper Hairstreak* on *Prunus maritima* (beach plum); *Lithophane lemmeri* by Bernie Knaupp.

At-Risk Pollinators Supported by this Toolkit

BEES:

- » *Andrena carlini*
- » *Andrena crataegi*
- » *Andrena distans*
- » *Andrena forbesii*
- » *Andrena miserabilis*
- » *Andrena nubecula*
- » *Andrena placata*
- » *Andrena vicina*
- » *Bombus vagans*
- » *Bombus fervidus*
- » *Coelioxys rufitarsis*
- » *Colletes compactus*
- » *Colletes validus*
- » *Epeolus scutellaris*
- » *Halictus rubicundus*
- » *Lasioglossum cinctipes*
- » *Lasioglossum heterognathum*
- » *Lasioglossum imitatum*
- » *Lasioglossum leucocomum*
- » *Lasioglossum pilosum*
- » *Lasioglossum quebecense*
- » *Megachile brevis*
- » *Megachile latimanus*
- » *Melissodes druriella*
- » *Osmia atriventris*
- » *Peponapis pruinosa*
- Carlinville Miner Bee
- Hawthorn Miner Bee
- Distant Miner Bee
- Forbes's Miner Bee
- Smooth-faced Miner Bee
- Cloudy-winged Miner Bee
- Peaceful Miner Bee
- Neighbouring Miner Bee
- Half-black Bumblebee
- Golden Northern Bumblebee
- Red-legged Cuckoo Leafcutter Bee
- Aster Cellophane Bee
- Blueberry Cellophane Bee
- Red-chested Cuckoo Nomad Bee
- Polymorphic Sweat Bee
- Band-footed Sweat Bee
- Wide-mouthed Sweat Bee
- Bristle Sweat Bee
- White-haired Golden Sweat Bee
- Hairy Sweat Bee
- Quebec Sweat Bee
- Short Leafcutter Bee
- Broad-handed Leafcutter Bee
- Drury's Long-horned Bee
- Maine Blueberry Bee
- Squash Bee

BUTTERFLIES:

- » *Callophrys gryneus*
- » *Callophrys irus*
- » *Callophrys polios*
- » *Erynnis horatius*
- » *Erynnis icelus*
- » *Euphydryas phaeton*
- » *Hesperia leonardus*
- » *Lethe appalachia*
- » *Parrhasius m-album*
- » *Pholisora catullus*
- » *Satyrrium favionus*
- » *Thorybes bathyllus*
- » *Thorybes pylades*
- Juniper Hairstreak
- Frosted Elfin
- Hoary Elfin
- Horace's Duskywing
- Dreamy Duskywing
- Baltimore Checkerspot
- Leonard's Skipper
- Appalachian Brown
- White-m Hairstreak
- Common Sootywing
- Oak Hairstreak
- Southern Cloudywing
- Northern Cloudywing

MOTHS:

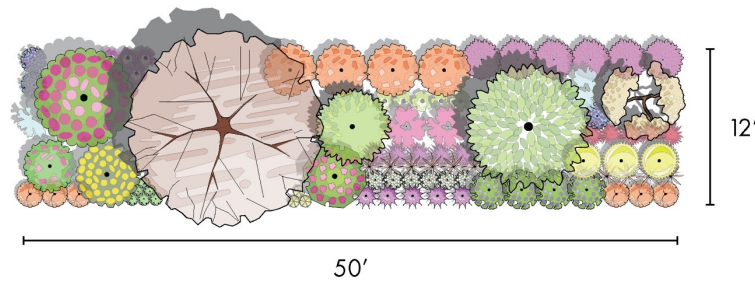
- » *Abagrotis benjamini*
- » *Abagrotis magnicipida*
- » *Agrotis stigmosa*
- » *Chaetagnaea cerata*
- » *Cucullia speyeri*
- » *Digrammia equivocata*
- » *Euxoa perpolita*
- » *Euxoa pleuritica*
- » *Euxoa violaris*
- » *Hemaris gracilis*
- » *Leucania extincta*
- » *Lithophane lemmeri*
- » *Schinia gracilentia*
- » *Schinia septentrionalis*
- » *Schinia spinosae*
- » *Zanclognatha theralis*
- Coastal Heathland Cutworm
- One-Dotted Dart
- Spotted Dart Moth
- Waxed Sallow Moth
- Speyer's Paint
- Equivocal Looper
- Polished Dart
- Fawn Brown Dart
- Violet Dart Moth
- Slender Clearwing Moth
- No Common Name
- Lemmer's Noctuid Moth
- Slender Flower Moth
- Northern Flower Moth
- Spinose Flower Moth
- No Common Name

BIGGEST THREATS FACING POLLINATORS

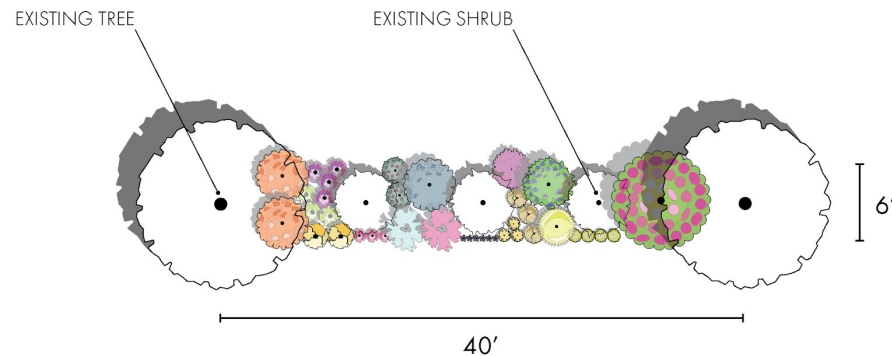
- » HABITAT LOSS
(AGRICULTURE + DEVELOPMENT)
- » PESTICIDES
- » CLIMATE CHANGE

Farming for Biodiversity at Island Grown Farm

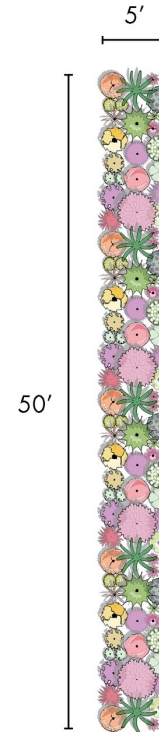
SCALABLE + REPLICABLE
FARMSCAPE HABITAT DESIGNS
TO SUPPORT POLLINATION SYSTEMS
AT RISK ON MARTHA'S VINEYARD



HEDGEROW
(12 FT. X 50 FT.)

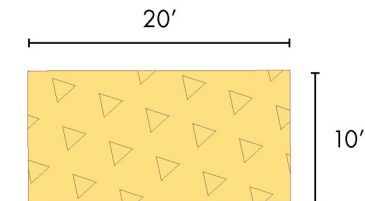
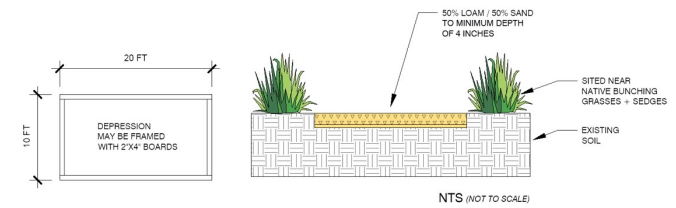


ORCHARD UNDERSTORY
(6 FT. X 40 FT.)



FIELD BORDER
(5 FT. X 50 FT.)

BEE NESTING STRIP DETAIL



BEE NESTING STRIP*
(10 FT. X 20 FT.)

*Bee nesting strips can be installed as a break among hedgerows or field borders, in meadows, or anywhere with sunny, well draining soil.

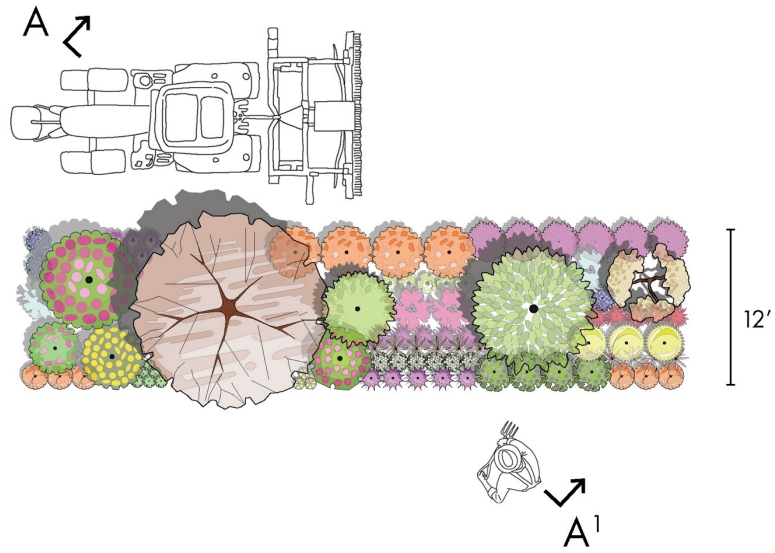


LAYOUT CONCEPT



Farming for Biodiversity at Island Grown Farm

SCALABLE + REPLICABLE
FARMSCAPE HABITAT DESIGNS
TO SUPPORT POLLINATION SYSTEMS
AT RISK ON MARTHA'S VINEYARD



Section A - A1 of the hedgerow facing northeast. Scale of section below is three times the scale of design above.



Conceptual rendering of field border between farm fields and walking path, with biodiverse grazing area on the right. Rendering by Evan Abramson based on original photograph by Randi Baird.





SITE PREPARATION

Adequate site preparation is crucial before attempting to seed or plant native vegetation. Successfully establishing a meadow can be a three-year process, with the first growing season devoted to site preparation. Eliminating competitive weeds or invasive species before planting is essential to long-term success. At Island Grown Farm, we chose to employ two distinct, chemical-free methods of site preparation: smothering with black silage tarp and repeated shallow soil disturbance using pigs.

SMOTHERING

All meadow areas which are to be direct seeded in the fall were smothered with 6-millimeter black plastic silage tarp for 4-5 months beginning in May. This ensures that non-native cool season grasses and perennial weeds are eliminated before seeding. Native flowers and grasses tend to stay small and low to the ground their first year of growth as they develop root systems. This is why a full season of site preparation is critical to success.

Areas to be tarped should be mowed as short as possible beforehand. Any excessive organic matter can be raked off to create a smooth surface. **DO NOT TILL THE SOIL**, as this will only bring more weed seeds to the surface. Leaving a light layer of clippings is okay.

Lay thick (5- or 6-mil) black plastic over the entire area, overlapping the edges by about a foot if you use more than one roll or piece of plastic. All edges must be weighed down with sandbags, rocks, cinderblocks or other materials, every 3 to 6 feet. By excluding light from the vegetation below the plastic, those plants are unable to photosynthesize and will eventually die. Any seeds that germinate under the plastic are likewise unable to survive for long.

Dark tarps, landscape cloth or thick layers of wood chips can also be used instead of plastic. If wood chips are used, it's best to lay down a layer of cardboard underneath so that plants can't grow up through the wood chips. Watering the cardboard first is recommended. All material should be removed before seeding, to avoid enriching soil nutrient levels.

Leave the soil covered from mid-May until late September or October. When you remove the plastic or other materials, you will have bare soil on which to plant. Avoid disturbing this clean seed bed; do not till the prepared area as it will stimulate more weed growth. Do not apply compost or other nitrogen-rich material: native forbs do best in low nutrient soil. If needed, rake lightly to remove dead grasses and surface debris just before spreading the seed mix or planting.

PIGS

Hedgerow and field border areas were cleared of existing vegetation by running a pair of young pigs across the extent of the spaces to be planted. This has the added benefit of providing a product in the form of meat.

In order for this method to be effective, the pigs must stay in each area long enough to root around and consume weed seeds and roots below the surface of the soil. Ideally, the pigs would visit each area twice in the same growing season, with at least 6 weeks between each visit. This would allow any potential regrowth to also be eliminated.

The hedgerow and field border areas are to be installed in the fall using plants in the form of plugs and 1-2 gallon pots, with cardboard squares around each plant and wood chips across the expanse of the planted space in order to ensure establishment is successful. Irrigation drip lines will also be laid down. Weeding will be necessary throughout the first and second growing seasons following planting. In the case of the hedgerows, occasional winter pruning every 2-5 years may also be employed in order to prevent unwanted shading.

SOD CUTTING

In smaller grass-dominated areas you can remove the top layer of vegetation with a sod cutter and plant directly. It is recommended to mow short and wait until soils are dry before cutting, as the weight of the material is a lot less. This method has the benefit of requiring very little time to prepare for planting.

STALE SEED BEDDING

Stale bedding is another chemical-free method that is best suited for a large scale. The process involves repeated shallow tillage every 2-3 weeks from April or May until planting will occur, for a minimum of 60 days. This keeps bringing up new weed seeds and terminating them. Soils should only be disturbed to a depth of 2-3". Seeds or plants can then be installed directly.

Stale bedding is a desirable option for site preparation if soil disturbance is not a barrier and access to equipment is possible. While only two months of this process may be necessary, it is recommended to wait until after mid-October for direct seeding native plant species.



MEADOW SEEDING + MAINTENANCE

It is highly recommended to install native seed mixes in the dormant season, mid-October through January. This is because most native flowering species require between one and three months of cold stratification in order to germinate. Fall and winter naturally provide this opportunity in the Northeast, and are usually followed by rainfall in the spring. It is also possible to sow seeds in the early spring, but many species may not germinate until the following year, and watering may be necessary.

Due to the relatively small scale of the areas at Island Grown Farm that are to be seeded directly (a combined total of 4 acres), it is possible to install all seeds manually by broadcasting the mixes. The process is fairly straightforward: after seed mixes are created and purchased for each area, the mixes are weighed with a food scale and divided into 1/4-acre parts. Each 1/4-acre part is then mixed with a 5 gallon bucket of moistened sand or parboiled rice hulls (PBH) as a carrying agent. The physical areas to be seeded are divided into 1/4 acre sections, and each section is distributed evenly with buckets containing the seed mixes and their carrying agent.

A cover crop should always be included when direct seeding: winter wheat (*Triticum aestivum*) for fall or winter installations, and wild oats (*Avena sativa*) for spring installations, at 100 lbs/acre. When broadcasting, cover crops can be installed separately following the seed mixes.

To give a concrete example, let's say we're seeding the Wet Meadow area at IGI Farm (see page 15). This area will have a unique seed mix, as it's the only wet area on the farm. The total wet meadow area to be seeded is 0.5 acres. When the seed mix arrives, it will be divided in half using a food scale. Each half will be mixed evenly with a 5 gallon bucket of moistened sand or parboiled rice hulls.

The wet meadow area at the farm will then be divided in half with a string. Each half of the wet meadow area will be broadcast evenly with a 5 gallon bucketful of seed mix and sand, followed by 25 lbs of winter wheat cover crop. It is best to walk back-and-forth across the area in two directions (West to East and North to South for example) in order to guarantee even coverage. Refer to the diagram to the right for an example of how to evenly broadcast seeds across a site.

For the first growing season following seeding, at least 1 inch of rain per week is necessary. If there is not adequate precipitation, areas recently seeded should be watered 1-2 times per week.

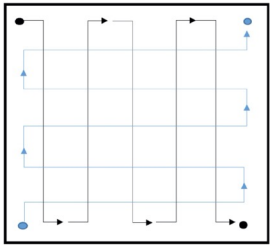
MOWING REGIME

For the first growing season following seeding, all recently seeded areas should be closely monitored for growth. When the average height of vegetation is around 12 inches, the area should be brush hogged or weed whacked down to a height of no less than 5-6 inches. This schedule should continue throughout the first growing season, as most native plants are focusing their energy on establishing root systems, and can easily become outcompeted and shaded out by weeds and non-native cool season grasses.

In the second year, 1-2 mows will be necessary between April and May depending on growth, down to the same height (5-6 inches) as cool season grasses take hold at the beginning of the season. After June 1, the seeded areas should be assessed by a botanist or individual with vetted plant identification skills. **If the majority of vegetation in a given area is native species from the seed mixes**, then mowing for that area can be paused until the end of the season (mid-October), after which all vegetation can be mowed down to 6 inches. **If the majority of vegetation in a given area still appears to remain non-native grasses or weeds**, then continue mowing as described above to keep the overall height of plants consistently between 6 and 12 inches. This regime should be followed until the third growing season.

By the third growing season, the site should transition to one mow every 1-3 years. This should always occur during the dormant season (mid-October to mid-April), after plants have gone to seed or before next season's growth. Doing so allows native pollinators to overwinter safely, and native plants to naturally scatter their seeds. Ideally, the site would be broken up into 2 or 3 sections, with each section cut on a rotational basis. During this dormant season mow, vegetation should be cut to a height of no less than 6 inches.

Invasive species and early successional trees should always be closely monitored and, after mowing becomes less frequent, either manually pulled, cut or mechanically grubbed.



This diagram from the University of New Hampshire illustrates the two directions that should be walked when broadcasting seeds, in order to ensure even coverage.

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, nectar and host plant 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 bee species 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.

References

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Pelikan, M. (2022) Martha's Vineyard Pollinator Pathways: Promoting Pollinators on Island Farms (Betsy and Jesse Fink Family Foundation), 1-15.

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Bee Specimen Databases Accessed through Discoverlife.org:

American Museum of Natural History, Bee Specimen Record database
Bee Biology and Systematics Laboratory database
Cornell University Insect Collection database
Rutgers University Arthropod Collection database
University of California, Riverside, Entomology Research Museum database
University of Connecticut Insect Collection database

Clockwise from top left: *Vaccinium angustifolium*; *Prunus maritima*; *Rubus odoratus*; *Penstemon hirsutus*; *Cercis canadensis*; *Bombus terrestris* on *Salix discolor*; *Spiraea alba*; *Corex striata*; *Schizachyrium scoparium*; *Baptisia tinctoria*; *Zizia aurea*; *Vaccinium macrocarpon*; *Scutellaria galericulata*.



Plants + Seeds

SOURCES FOR NATIVE PLANTS AND SEEDS:

Archewild - Quakertown, PA - <https://archewild.com/nursery/>
Bigelow Nurseries - Northboro, MA - <https://bigelownurseries.com/>
Blue Stem Natives - Norwell, MA - <https://www.bluestemnatives.com/>
Earth Tones Native Plants - Woodbury, CT - <http://www.earthtonenatives.com/>
Ernst Seeds - Meadville, PA - <https://www.ernstseed.com/>
Long Island Native Plant Initiative - Hampton Bays, NY - <https://linpi.org/>
Native Plant Trust - Framingham and Whately, MA - <http://www.nativeplanttrust.org/>
New England Wetland Plants - South Hadley, MA - <https://newp.com/>
New Moon Nursery - Bridgton, NJ - <http://www.newmoonnursery.com/>
North Creek Nurseries - Oxford, PA - <https://www.northcreeknurseries.com/>
Northeast Pollinator Plants - Fairfax, VT - <https://www.northeastpollinator.com/>
Pierson Nurseries - Biddeford, ME - <https://www.piersonnurseries.com/>
Pinelands Nursery & Supply - Columbus, NJ - <https://www.pinelandsnursery.com/>
Polly Hill Arboretum - West Tisbury, MA - <https://www.pollyhillarboretum.org/plants/plant-sale/>
Prairie Moon - Winona, MN - <https://www.prairiemoon.com/>
Toadshade Wildflower Farm - Frenchtown, NJ - <https://toadshade.com/>
Vermont Willow Nursery - Fairfield, VT - <https://vermontwillownursery.com/>
Wild Seed Project - Portland, ME - <https://wildseedproject.net/>
Wing and a Prayer Nursery - Cummington, MA - <https://aliceskitchenathoneyhill.com/amys-nursery/>

NATIVE PLANT PROPAGATION GUIDELINES:

Wild Seed Project - How to Grow Natives from Seed:
<https://wildseedproject.net/how-to-grow-natives-from-seed/>

Prairie Moon - How to Germinate Native Seeds
<https://www.prairiemoon.com/blog/how-to-germinate-native-seeds>

Native Plant Network Propagation Protocol Database:
<https://npn.mgr.net/propagation>

Indigenous Landscapes - Native Plant Propagation Guide and Nursery Model:
<https://indigescapecom/nativepropguide>

Pollinate Now

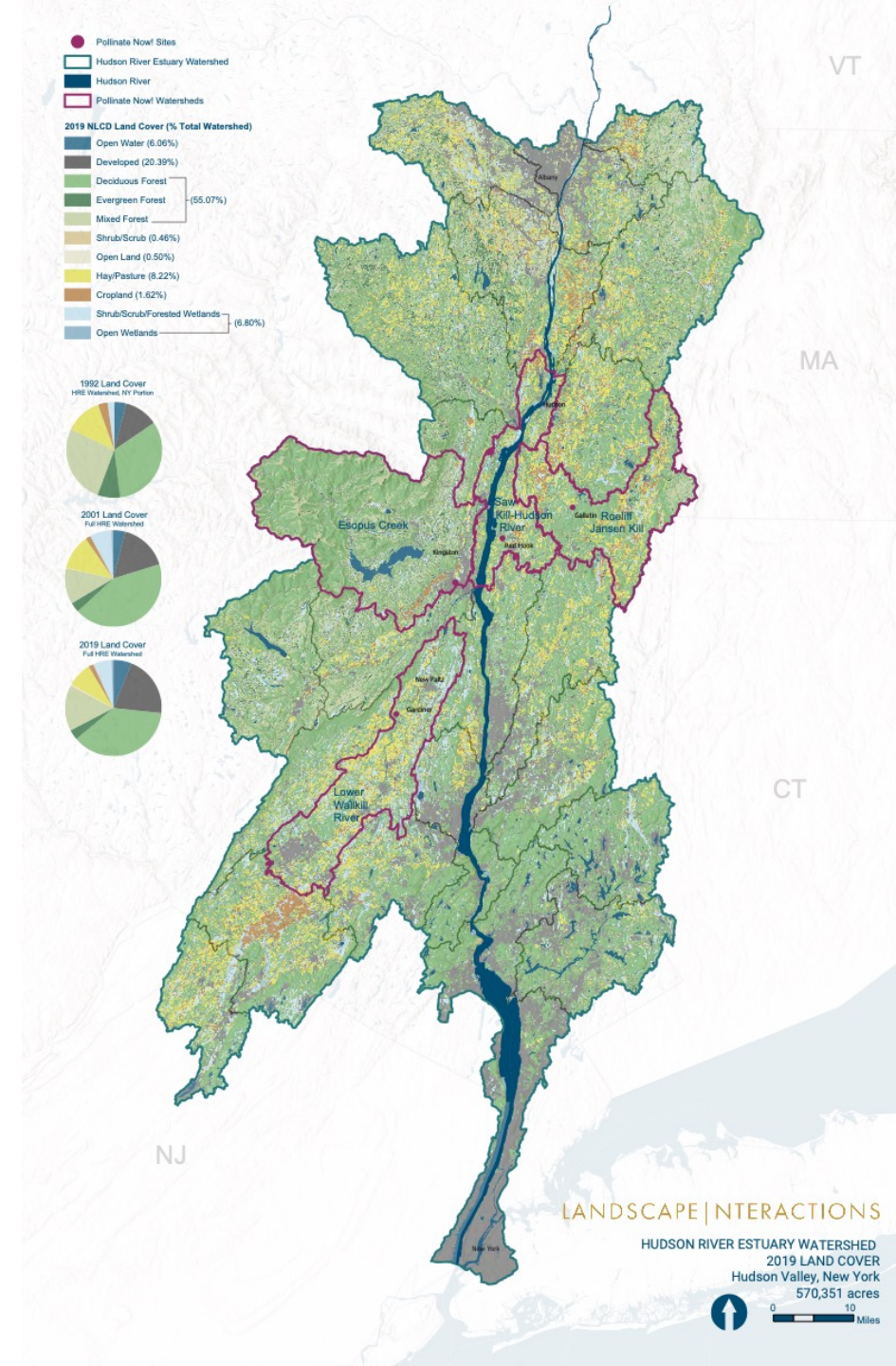
BIOREGIONAL STRATEGY FOR HABITAT RESTORATION IN THE HUDSON RIVER ESTUARY WATERSHED

Landscape Interactions in collaboration with Partners for Climate Action Hudson Valley, a local non-profit.

Regional pollinator action plan as well as four site-specific landscape designs, all created specifically to target native pollinators in decline.

Over 50 towns and cities involved, including Kingston, Hudson, Red Hook and New Paltz.

In terms of land area and population size, likely the largest pollinator corridor project in the United States.



Pollinate Now

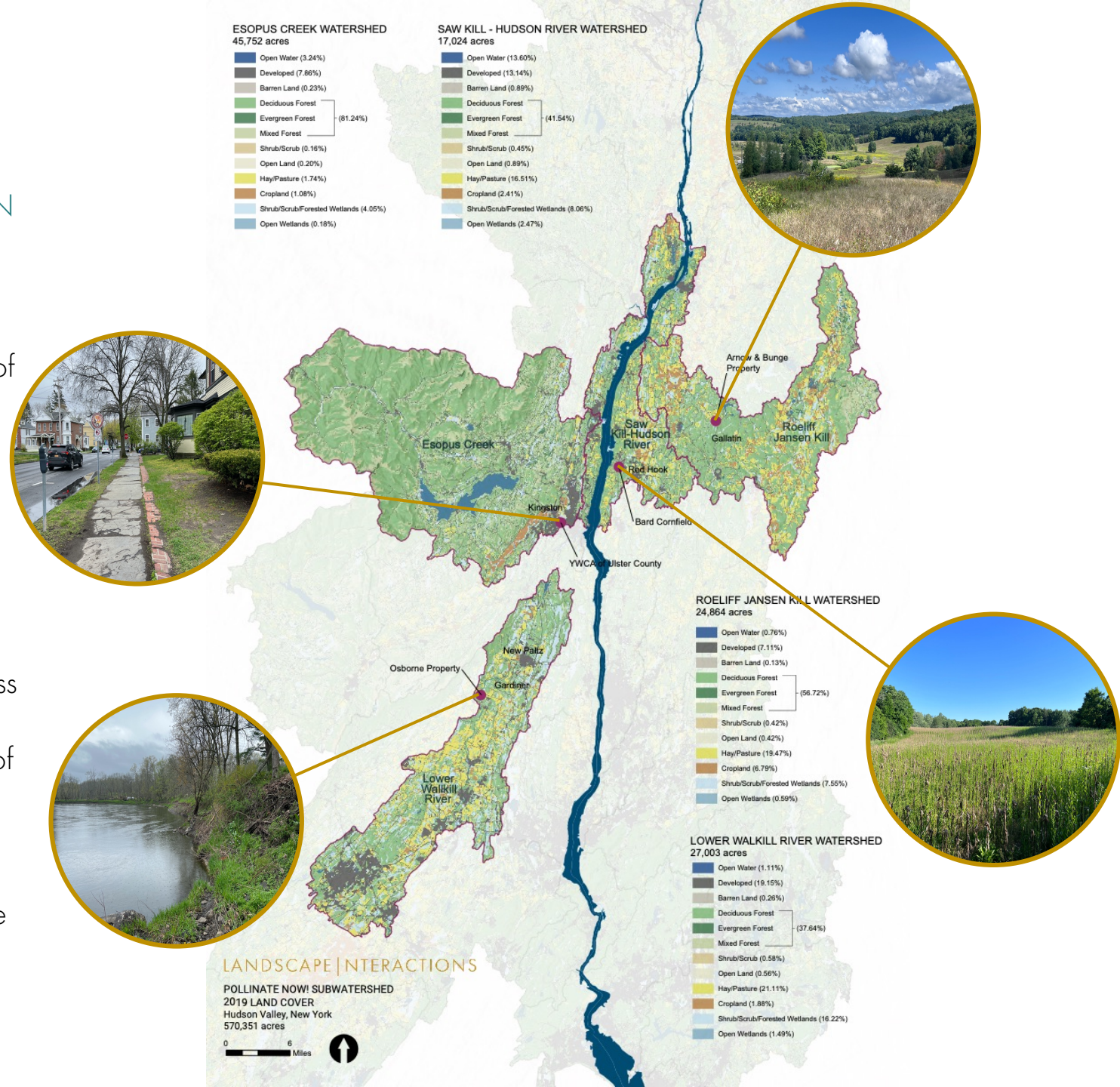
BIOREGIONAL STRATEGY FOR HABITAT RESTORATION IN THE HUDSON RIVER ESTUARY WATERSHED

Four case study sites across four HUC-10 subwatersheds of the Hudson River, representing common landscape typologies found in the Mid-Hudson region: farmland, conservation land, urban-residential and riparian.

Each case study site design created to be scalable and replicable on other similar sites across the region.

All sites surveyed for native bee and butterfly species across the 2022 growing season; follow-up surveys will occur to compare differences two years following implementation of the site designs and management plans.

All landscape designs, plant lists, seed mixes, landscape establishment and management guidelines will be scalable and replicable on other similar sites across the watershed and beyond.



Pollinate Now

BIOREGIONAL STRATEGY FOR HABITAT RESTORATION IN THE HUDSON RIVER ESTUARY WATERSHED

Target species for the project include all genera of native bee, butterfly and flower-visiting moths that are at risk of local extinction from the Hudson Valley region.

Historical records (pre-2000) for all NY counties within or adjacent to the Hudson River Estuary Watershed compared to contemporary records (2000 to present), including the 2022 Empire State Native Pollinator Survey.

Target species include 49 bees, 31 butterflies and 13 moths.

Comprehensive plant list for the project for all major landscape typologies, including host plants, pollen and nectar plants that support the widest network of species interactions and every individual species' life cycle needs.



Pollinator-Friendly Solar

In 2020, the Massachusetts Department of Energy Resources (DOER) launched a pollinator habitat adder for solar projects:

Credits \$0.0025/kWh (\$3,500/MW) per year.

Applies only to projects awarded pollinator certification by UMass Amherst Clean Energy Extension.

Existing and new projects may apply.



Certification Requirements

All projects require a multi-year habitat establishment and maintenance plan.

Sites must be surveyed by botanist or other ecological professional.

At least 33% plants in seed mixes/planting schedule support pollen specialist bees or lepidoptera of conservation concern.

- All vetted as neonicotinoid and pesticide-free
- Native to county level
- No rare or endemic species from out of state

Comprehensive invasive species strategy.



The Statewide Landscape

34 solar projects have been certified as pollinator-friendly in Massachusetts to date, totaling 143 MW DC.

These projects will provide over 600 acres of native pollinator habitat across the state.

Landscape Interactions has designed 28 of these projects.



Measuring Success

Functional diversity improved over time.

Native bumblebee and butterfly species diversity as a metric of success (or failure).

Plant selection supports species richness across functional traits, trophic levels and animal groups (bee, butterfly, moth, bird).

Three-year study period.

Science informs the design process, plant selection and measures the results.

Every project has a maintenance plan and management regimes.



Clockwise from top left: *Bombus vagans*, *B. perplexus*, *B. fervidus*, *B. ternarius*. Photographs by Norm Levey.



Landscape Interactions

Biodiversity through Pollination Science

We specialize in designing landscapes and planning corridors that build biodiversity and strengthen ecological resilience to a changing climate at the ecosystems level.



landscapeinteractions.com/projects

To: City Manager Eric Batista

From: Green Worcester Advisory Committee

Date: December 12, 2022

Dear Mr. Batista:

First of all, we congratulate you on your appointment as Worcester's new City Manager. As you know, the Green Worcester Advisory Committee is tasked with helping the City of Worcester implement the ambitious goals of the Green Worcester Plan by serving as the liaison between the community and city government. We applaud the city's vision in adopting the Plan in April 2021, and we write to you now because it is clear to us that successful implementation of the Plan will require the commitment, participation, and collaboration of many different city departments and agencies. For that to happen, your leadership is essential.

Under the leadership of John Odell, Luba Zhaurova, and their excellent staff, the Department of Sustainability and Resilience has made considerable progress as they begin to implement key aspects of the Plan. But no single department can do this alone—in order to succeed, implementing the Green Worcester Plan must become a city-wide effort. That means educating and engaging many other city employees for whom sustainability is currently neither their first priority, nor part of their job description. Such an effort cannot fully succeed without strong leadership and commitment from your office, and we respectfully request that you make the city-wide sustainability transition a top priority.

Climate change is already affecting our City and our most vulnerable citizens will experience its impacts hardest – through flooding, extreme heat, increasing drought, and the many ways that the changing climate will increase the cost of living. Understanding these challenges and finding cost-effective, equitable, data-driven, and common-sense solutions will be a critical element of leading our City into its next phase, as will communicating the City's progress to the public.

Ed Augustus had the vision to support and promote the Green Worcester Plan and its goal to make Worcester one of the most sustainable and climate-resilient mid-sized cities in America by 2050. It's a smart strategy that will position Worcester well, both economically and environmentally. But for that goal to be realized, your administration will need to take it to the next level. Sustainability must be woven into the fabric of everything our City does—from improving energy efficiency in buildings and incorporating climate resilience into school programming, to increasing tree retention and enforcing floodplain regulations. The Green Worcester Plan outlines an ambitious strategy to bring diverse voices together to address the complicated challenge of climate change, and we believe your intimate knowledge of the city gives you an important advantage in making that happen. We look forward to working with you to ensure that Worcester continues to lead the way in our transition to a more sustainable future.

Respectfully submitted,

Green Worcester Advisory Committee
Mary Knittle, Chair