Rewilding and Restoration of Ecological Habitats on Middlebury College's Main Campus

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Abstract

Middlebury College's main academic campus in Middlebury, Vermont encompasses 350 acres (including athletic fields). Of those, 97 are mowed once a week for 24 weeks out of the year, resulting in 72,621 tons in harmful emissions annually and $10,696 spent on diesel fuel. This proposal calls for the implementation of reduced mowing zones and the restoration of ecological habitats on the main campus. This will be accomplished through multiple different habitat and management types, culminating in a 28% reduction in the amount of lawn the College currently mows.

The proposal designates mapped areas which aren't actively used by students and community members to be transformed into ecological restoration zones. The proposal goes on to explain the inefficiency of the extent to which the College currently mows its main campus, in terms of labor hours, CO_2 emitted, and dollars spent on fuel. It also explains how the implementation of this framework directly applies to the College's goal of Energy 2028 and objectives laid out in both the 2008 Master Plan and the 2017 update. Lastly, the proposal will address implementation and budgetary needs for this process in a 2 year pilot plan.

Mowed lawns are equivalent to ecological wastelands, providing little to no habitat or being outright hostile environments for birds, small mammals, insects, and pollinators.[1] A 2020 article from Princeton explains exactly how lawns and lawn maintenance are rapid contributors to climate change with gasoline powered lawn maintenance equipment across the U.S. demanding 800 million gallons of gasoline annually.[2] Middlebury College prides itself on being a guiding force in higher education towards sustainability and accountability. To mow less and to be intentionally kinder to the landscape that the college resides within through more intentional management of beautiful and natural habitats would not only serve this campus and education within it, but would also create a regenerative ecological model for the greater Middlebury and Vermont communities, as well as higher education as a whole.

[1] Tennessee Nature Scapes. "Negative Impacts of Lawns To Our Biodiversity." Tennessee Nature Scapes. September 24, 2021. https://www.tennesseenaturescapes.com/blog/2021/9/24/negative-impacts-of-lawns-to-our-biodiversity
[2] Jiahn Son. "Lawn Maintenance and Climate Change. PSCI Princeton. May 12, 2020. https://psci.princeton.edu/tips/2020/5/11/law-maintenance-and-climate-change

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I. General Proposal

We walked around campus using the ARCGIS Field Maps mapping app, determining which parts of campus should no longer be mowed and instead turned into intentional ecological habitats for emission and cost efficiency, as well as for educational opportunity. The map of existing lawns and proposed rewilding of those lawns can be found here. To have native perennial landscaping, pollinator habitats, rain gardens and other intentional landscape management would offer ideal experiential learning environments for Geography, Biology, Architecture, and Environmental Studies classes.

We have 7 main distinctions of habitat type and recommended management of the area. We delineate a 2-year proposed management plan along with budgetary needs, as well as longer term and more extensive 5 year mapping distinctions that create a 28% reduction in High Performance Lawns on campus. Below, we outline what these habitat types are and what their benefits are.

Middlebury is behind many college campuses in implementing more restrained mowing practices and intentional regenerative landscape planning. Since the idea of no-mow was first introduced in the Master Plan of 2008, 14 years ago, Middlebury has actually added almost 20 more acres to the area it mows. Among colleges who implement practices of this type are University of Arizona, Alleghany College (PA), Delta State University (MS), Black Hills State University (SD), Western Kentucky University (KY), University of Nevada, Las Vegas (NV), Green Mountain College (VT), University of Hawaii Manoa (HI), University of Minnesota Crookston (MN), Seattle University (WA).[3] Additionally UC Davis, Paul Smith College, SUNY ESF, SUNY Cortland, Williams College, Binghamton, and Cornell.[4] Beginning intentional regenerative management is not only a powerful educational opportunity, it is a logical, tangible step in line with Energy 2028 and Middlebury's sustainability goals as a pillar in sustainability in higher education through its many campuses both domestic and abroad.

[3] National Wildlife Federation. "Campus Landscaping for 'Wild.'" *The Campus Wild.* pg 13-26. National Wildlife Federation.
https://www.nwf.org/-/media/PDFs/Campus-Ecology/Resources/The-Campus-Wild/The-Campus-Wild_Campus-Landscaping-for-Wild.ashx?la=en&hash=DBAFA46CDBF90DF693A5A235B8F47474348E5BB2

[4] Cornell Campus Sustainability Office. "Grounds and Landscaping"
https://sustainablecampus.cornell.edu/campus-initiatives/land-water/grounds

II. Labeling and Designations

- **High Performance Lawn**
  - Heavily used areas that need consistent and regular maintenance similar to how we mow now, which is once a week during the season at 3-3.5."
- **Park Lawn**
  - This distinction is used for areas under trees which may have poor soil quality in which grass doesn't grow as fast. In these spaces it is important that they will still look like high performance lawns but should not be mowed every week as the grass will turn brown and begin to die. The hill under the chapel is an example.
- **Rough Lawn**
    - Existing No-Mow zones are areas on campus that are brush hogged twice a year, and otherwise left alone. They require even less maintenance than Rough Lawn.
  - Meadowy areas that may need to be mowed once a week in the beginning of the season leading up to Commencement but won't need to be mowed more than once a month through the rest of the season.
  - Multiple studies have found that mowing no lower than 3 inches, mowing every two weeks, and not using herbicides, increase flower abundance by "70-300 percent," providing pollinator habitat and supporting ground nesting bees as it reduces compaction.[5]
- **Clover Lawns**
  - Allowing large swaths of sunny area to become clover meadows, which enrich the soil through nitrogen fixing, and act as natural fertilizer for dry or erosion prone areas, as well as act as ideal habitats for bees. These can also aid in limiting nitrogen runoff into waterways.[6]
- **Native Fescue Area**
  - This is a stand of grass that is allowed to grow to its full height. It is treated first to remove weeds and then mowed once a year. It creates a prairie aesthetic with minimal input, minimizes the browning of grass that is cut too low, minimizes soil erosion, minimizes drought threat, keeps weeds at bay due to the high density of the grass, minimizes chemical pesticide use, and provides healthy pollinator and wildlife habitat.[7]
  - It will be the existing grass allowed to grow but first treated once to remove noxious weeds.
- **Clayplain Forest Plantings**

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[5] Sam Holmes and Aaron Stanton. "Williamstown Lawns to Meadows". Williams College Environmental Planning Workshop. December 18, 2021. https://ces.williams.edu/files/2022/01/Williamstown-Lawns-to-Meadows-1.pdf

[6] University of Maryland. "Lawns and MicroClover. University of Maryland. May 2022. https://extension.umd.edu/resource/lawns-and-microclover

[7] Jerry Schill. "The Top Seven Benefits to Commercial Landscaping with Ornamental Grasses." Schill Grounds Management. Feb 19, 2015. https://www.schilllandscaping.com/blog/benefits-to-commercial-landscaping-with-ornamental-grasses

        - This is the intentional planting of native trees and allowing the area over time to become a Clayplain forest, the native forest of Vermont. These are designated areas for reforestation, which will begin as Native Fescue Area that creates a great carbon source for the growing trees as it begins to die out under the shade of trees as they mature.
        - Can aid in flood control by planting water loving shrub species in particularly wet areas, can also prevent soil erosion and compete with invasive species or unwanted weeds. Can also provide shade and wildlife habitat.[8]
        - Characteristic species include "red maple, sugar maple, hemlock, white ash, white pine, swamp white oak, bur oak, red oak, white oak, shagbark hickory, American beech, and American elm." [9]
    - **Perennial Groundcovers / Wildflower Covers / Pollinator Gardens**
        - These three types are one mapping classification but will be developed differently based on site need.
            - Mulched perennial gardens are beautiful, protect soil from erosion, and can catch stormwater as needed. They also double as great habitats for pollinators and would be used around buildings for aesthetic landscaping.
            - Wildflower covers will likely need to be replanted every 3-4 years but are great alternative groundcover options that produce nitrogen fixation and protect soil from erosion.
            - Intentional Pollinator Gardens are rather time intensive for upkeep but would be great assets for outdoor learning. We think good spaces for pollinator gardens would be the bihall discovery court and the garden behind Hillcrest.

[8] Middlebury College ES Senior Seminar. "Champlain Valley Clayplain Forest Restoration" A Landowner's Guide. 2003. https://acrpc.org/wp-content/uploads/2021/11/Clayplain-Forest-Restoration.pdf
[9] Middlebury College. "2008 Master Plan."

III. Labor, Cost, and Energy Efficiency

This section will outline the cost of diesel fuel for the amount of mowing currently done on campus, and the difference if cut down by 28%. The following excel spreadsheet outlines the hours (based on calculators on the mowers) that Middlebury's landscaping team spends mowing annually. These numbers provide the basis for the following calculations.

Lawn Mowing Hours at Middlebury

80 hours of mowing per week x 24 weeks of the year = 1,920 hours of mowing annually

**Note: this number comes from surveying the hour meters on the equipment. This is a best estimate, but is on the low side, although highly variable from year to year depending on precipitation and temperature patterns.*

This is done with 6 lawnmowers. 4 of these have 5' decks, one has a 6' deck, and one has a 10' deck. Within the landscaping department there are 14 fulltime landscapers as well as 4-5 seasonal employees. This department manages 300 acres of grounds including the trees at Breadloaf.

Cost:

We used grasshoppermower.com's fuel calculator to gather the information surrounding the cost of mowing annually on Middlebury's campus. The calculator uses the national average for the cost of Diesel, and all of Middlebury's lawn mowers are diesel (one electric mower was purchased in 2022). **The annual diesel fuel expense of 1920 hours mowing a year is $10,696.** It is also important to recognize that this cost will inevitably increase over time as diesel prices increase as fossil fuel availability decreases.

2. Fuel Expense Per Year

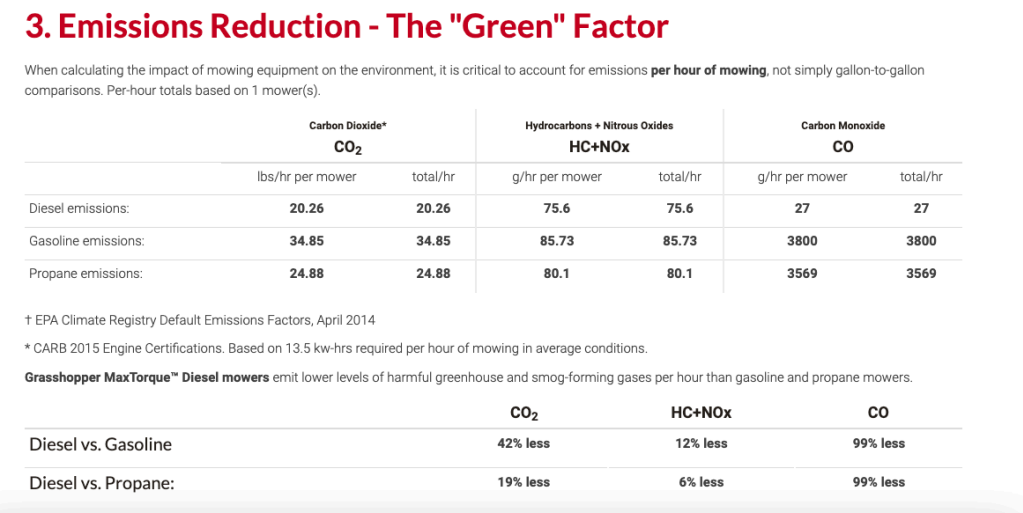
Here are the calculations for 1 commercial zero-turn mower(s).
(Professional pump/motor drive system; fuel-efficient horizontal shaft engine; 24-inch drive tires; commercial fabricated deck) Based on approximately equal engine displacement & horsepower (800 - 850 cc; 25 - 27 hp)

	Gasoline	Diesel	Propane**
Current Price ($/gal)	$5.006	$5.571	$2.983
Fuel Consumption (gal/hour)	1.65	1.00	1.80
Fuel Cost Per Hour of Mowing	$8.26	$5.57	$5.37
Total Hours Mowed per Year Annual hours mowed based on 1000 hours per mower (25 wks, 40 hrs)	1920	1920	1920
Annual Fuel Expense	$ 15,859.00	$ 10,696.00	$ 10,308.00

Energy Efficiency:

Using the same calculator, we were able to calculate the emissions of these diesel lawn mowers running for 1920 hours every year.

- CO_2
    - 38,899.2 lbs (19.4495 tons)
- Hydrocarbons + Nitrous Oxides
    - 145,152 lbs (72,576 tons)
- Carbon Monoxide
    - 51,840 lbs (25.92 tons)



3. Emissions Reduction - The "Green" Factor

When calculating the impact of mowing equipment on the environment, it is critical to account for emissions **per hour of mowing**, not simply gallon-to-gallon comparisons. Per-hour totals based on 1 mower(s).

	Carbon Dioxide* CO_2		Hydrocarbons + Nitrous Oxides HC+NOx		Carbon Monoxide CO	
	lbs/hr per mower	total/hr	g/hr per mower	total/hr	g/hr per mower	total/hr
Diesel emissions:	**20.26**	**20.26**	**75.6**	**75.6**	**27**	**27**
Gasoline emissions:	**34.85**	**34.85**	**85.73**	**85.73**	**3800**	**3800**
Propane emissions:	**24.88**	**24.88**	**80.1**	**80.1**	**3569**	**3569**

† EPA Climate Registry Default Emissions Factors, April 2014

* CARB 2015 Engine Certifications. Based on 13.5 kw-hrs required per hour of mowing in average conditions.

Grasshopper MaxTorque™ Diesel mowers emit lower levels of harmful greenhouse and smog-forming gases per hour than gasoline and propane mowers.

	CO_2	HC+NOx	CO
Diesel vs. Gasoline	**42% less**	**12% less**	**99% less**
Diesel vs. Propane:	**19% less**	**6% less**	**99% less**

No-Mow zones were first introduced in the 2008 Master Plan. In the 14 years since then, mowing on this campus has emitted:

- 280 tons of CO_2
- 1,016,064 tons of Hydrocarbons and Nitrous Oxides
- 362.88 tons of Carbon Monoxide

It is abundantly clear that for the College to continue mowing as much space as it does at the rate that it does is not only expensive but also leads to tons of emissions in greenhouse gasses, hindering the College's goals of Energy2028, contributing to climate change, and being a poor example for the greater community.

Other Environmental Considerations:

Beyond lawn mower emissions, the college is actively missing out on the potential power of its lawns as agents for carbon sequestration and habitat for wildlife and pollinators. Studies have shown that in mowed lawns with non-native plants compared to native plants, there were 68% fewer species of

caterpillars, 91% fewer numbers of caterpillars which led to 96% less food for birds and 96% less birds.[10] Further, this is an unusually dry summer with much of the college's current lawn turning brown due to hot days and a lack of rain. It would be beneficial even just for aesthetic purposes to consider alternative landscaping measures that would provide climate resiliency. This would include planting more trees and shrubs as they do well in areas with lack of water and provide shade for the understory. It may also include creating more rain gardens as storms may become more intense as they become rare.
The EPA estimates that "*a third* of all public water is used to water grass," and that in the US lawns use almost 9 billion gallons of water a day.[11] Additionally, they estimate that lawns and gardens are sprayed with "more than 90 million pounds of insecticides and herbicides a year." [12] While acknowledging that these numbers don't directly relate to Middlebury College's herbicide, pesticide, and water usage on lawns on campus, it is important to note the role that institutions of higher education play in establishing spoken and unspoken guidelines for sustainability within their respective communities. Lawns are commonplace in Vermont, with Middlebury setting a distinctive precedent with the way the campus directly borders town and is highly visible. A tangible and accomplishable step towards rethinking and exemplifying sustainable ways that people can relate and interact with their landscape in this community would be adopting the protocols outlined in this document and providing the support to amplify educational practices surrounding this topic.

[10] DWood. "Rewilding Our Home Lawns." Burlington Parks and Recreation. March 2020. https://enjoyburlington.com/rewilding-our-lawns/
[11] Ellen Paul. "Lawns May be Green but they're Terrible for the Environment." Greater Greater Washington. November 2021. https://ggwash.org/view/83168/lawns-may-be-green-but-theyre-terrible-for-the-environment
[12] Doreen Cubie. "A Farewell to Lawns." National Wildlife Federation. April 2019. https://www.nwf.org/Magazines/National-Wildlife/2019/April-May/Gardening/Turf-Lawns#:~:text=Native%20substitutes%20for%20turf%20lawns,choose%20plants%20that%20are%20indigenous

IV. Energy 2028 and Master Planning

Middlebury College has long acknowledged the necessity of implementing intentional landscape management in place of high performance lawn mowing. The 2008 Master Plan and the 2017 update both highlight the importance of creating no-mow zones and the unnecessary emissions, habitat destruction, and cost that the campus' current mowing protocol generates. These ideas are nothing new, but this proposal strives to make this process clear, constructive, and attainable. In this section we plan to reiterate the ways in which this proposal directly applies and satisfies the needs the College has expressed through the 2008 Master Plan, the 2017 update, and Energy2028. This proposal clearly aligns with the College's goals.

2008 Master Plan and 2017 Update:

The 2008 Master Plan remains an incredibly valuable document that calls for and outlines the possibility and feasibility of intentional landscape management that lies directly in line with College Sustainability Goals. In the 14 years since its publication, however, the College has actually expanded the amount of lawn it mows by 20 acres. This section delineates aspects of this plan which lie directly in line with the objectives of this proposal.

- Campus Overview:
    - "Of the 161 acres in the core academic campus, 123 acres are lawn, buildings, walks, and parking. Lawn—both open lawn and lawn with shade trees—predominates, at 76.5 Acres."[13]
    - *This number has actually increased by almost 20 acres to today's 97 acres*
- Policy #8: Landscape
    - "The College acknowledges the importance of the campus landscape as a resource, as an element of civic structure, as an ecological system, and as a teaching laboratory. The College will develop a proactive landscape development program that is resource-efficient and regionally consistent."[14]
        - The Landscape Plan Goals
            - Increase the "Connectivity" of Middlebury's landscape. This applies to habitats, species selection, hydrology, and campus spaces
            - Minimize the negative impact that the campus has on the environment—both regionally and globally
            - Make the campus landscape a more suitable environment for the recreational and ceremonial uses to which it is put
            - Enhance the campus landscape's ability to educate and inform[15]
    - "The predominance of open lawn and of parkland—lawn with shade trees—limits the suitability of campus as habitat for a variety of plant and animal species. Large expanses of lawn are akin to desert for many bird and insect species. The rich environment of

[13] Middlebury College. "2008 Master Plan." Pg 101.
[14] Ibid. Pg 137.
[15] Ibid. Pg 138.

ecological niches provided by the variety of plant types and sizes at the transitions between fields and woods are missing from most of campus. Trees and forested areas exist mostly as isolated patches, which limits the campus's contribution to the regional habitat of species that require larger territories."[16]

- "About half of the campus is currently lawn. This is the single most resource-intensive landscape cover type on campus. It requires twenty mowing cycles per year, which take more than **9,000 work hours and consume approximately 6,000 gallons of fuel,** contributing to Middlebury's carbon footprint."[17]
  - *These are not numbers that lie in line with our calculations and we are unsure where those discrepancies may be coming from.*

There are numerous valuable diagrams, proposed native plant species, and other ideas within the 2008 Campus Plan that certainly should not be forgotten. The 2017 update echoes many of the same sentiments as the 2008, but without distinguishing action.

Energy 2028:

From an Energy2028 perspective, this project would help Middlebury lead in addressing the climate crisis in higher education. According to the Energy2028 Homepage, "Energy2028 will fulfill Middlebury's mission at its deepest level: students learning how to engage their communities, think consequentially, and act creatively at this crucial time for our environment."[18] This is exactly how we have approached this project, as students working to make a difference in our campus community in a fresh, new way at a pivotal moment for our planet. This project focuses primarily on Energy2028's goals of Campus Energy Conservation and Commitment to Educational Opportunities.

Energy2028's second goal, Campus Energy Conservation "Intends to reduce energy consumption on its core campus by 25 percent by 2028"[19] If this plan is adopted beginning in 2023 and correctly implemented, it will reduce the amount of acres mowed by 25% by 2028, meeting the College's goals. This will decrease fuel use for lawn management by 25% or more. By cutting mowing hours by rewilding many campus spaces, less carbon will be output into the atmosphere from lawn mowers, and less energy will be required to care for our grounds through mowing. This Energy2028 goal also "...calls for improved energy-use monitoring across campus."[20] Through research conducted for this project, we have found another avenue for energy-use monitoring that has not been taken into account yet by Energy2028. As the focus is being both carbon conscious, as Middlebury already is, and now also energy conscious, this project is both. In addition, the landscaping and facilities department has invested in an electric mower. Throughout our pilot plan, the goal is to test how that mower works in efficiency, quality, and quantity. If it works well, once the pilot plan is over, our hope is that other gasoline-powered mowers will be replaced with electric ones as needed. This should be extended to all gasoline-powered, carbon-emitting landscaping machines Middlebury owns, such as leaf blowers and their trucks. As Middlebury introduces electric with our pilot plan, the carbon footprint of any remaining mowing will

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[16] Ibid. Pg 101.
[17] Ibid. Pg 101.
[18] Middlebury College. "Energy 2028." https://www.middlebury.edu/office/energy2028
[19] Ibid.
[20] Ibid.

significantly decrease. It is both more cost effective to cut the amount of mowers we have and mow less land.

- After reducing the acreage mowed on Middlebury's campus by 29 acres, or about 28%, 538 less labor hours would be spent mowing. Currently, 80 labor hours a week are dedicated to mowing, this would cut that number to only 57 labor hours per week during the season. For annual cost and emissions, this would total
    - $7,507 spent on diesel fuel
    - 27,999 lbs of CO2
    - 104,479 lbs Hydrocarbons + Nitrous Oxides
    - 37, 314 lbs of Carbon Monoxide

Energy 2028's fourth goal, Commitment to Educational Opportunities connects strongly to the goals of our project. We have created educational materials for not only the college community, but also the greater Middlebury one. College campuses act as both literal and symbolic examples for the communities they exist within, and the College has the opportunity to help rethink human relationship to the land within Vermont through landscape management and aesthetic alterations.

This project is easily a new pathway for experiential learning at Middlebury. Courses and their respective labs (as of Fall 2022 offerings) such as Ecology & Evolution, Natural Science & the Environment, Entomology, Plant Community Ecology, Conservation Biology, and many more, may use these areas to learn more about native plants and soils, regeneration, habitat spaces, and much more. As the Knoll currently lacks handicap accessibility, these rewilded spaces on the main part of campus can serve as an accessible option for lab classes to get outside. Outside of the classroom, these areas restored to their natural habitats will allow for students to interact with nature right outside their dorms. This goal has "...many roads to integration,"[21] at Middlebury. This project perfectly exemplifies that integration both in the classroom and out by leading by example. It will make these Energy2028 goals visible to the community, showing students, faculty, staff, and visitors that the College is committed to their goals, as well as student research and initiatives. These rewilded spaces also relate to behavioral and culture changes. By living more intertwined with nature, humans take more responsibility for the effect their actions have on the environment, breaking a wall in the duality our society has created. Living more in tune with nature, and seeing the impact humans make in our own backyards is valuable to behavioral change, so humans do not feel separated from the environment they are harming. In addition, "...exposure to nature has been linked to a host of benefits, including improved attention, lower stress, better mood, reduced risk of psychiatric disorders and even upticks in empathy and cooperation."[22] This project comes with benefits that have the opportunity to significantly improve physical and mental health on Middlebury's campus.

Communication to the Public

Within the Sustainability section of Middlebury's website, we plan to add a tab explaining this project and the pilot plan. It is intended to be a shorter version of this proposal for the public to read and understand. In addition, since this project is very visible, we will have signage in front of newly rewilded

[21] Ibid.
[22] Kirsten Weir. "Nurtured by Nature." American Psychological Association. April 2020. https://www.apa.org/monitor/2020/04/nurtured-nature

areas with a short blurb about what they are, why they are there, and a QR code that will take readers to the website page for more information. In addition, we will ask The Campus as well as the Addison Independent to publish articles in the beginning and updates on the continuation of this project.

V. Two Year Pilot Plan with GIS Mapping

At present, about 97 acres of land are cared for by Middlebury College's maintenance crew on the main academic campus. This is not including athletic fields. Currently, 4.6 acres exist as Rough Lawn, and 92.3 acres are mowed. In our 5 year plan, we propose 29.35 acres return to habitat spaces, rewilding about 28% of the acres cared for. All mowed areas, shown in gray, are considered High Performance Lawn and cut every other week. Areas shown in orange are the current no-mow zones as of August 2022, designated as Rough Lawn. At present High Performance Lawn is mowed to 3.5 inches, and 3 inches around commencement. It is required that at least a 12 foot circumference around all buildings be mowed for mice prevention[23]. All reduced mowing zones will also be mowed directly beside walkways for tick prevention. We have given a student perspective on what currently-mowed lawns are not necessary.

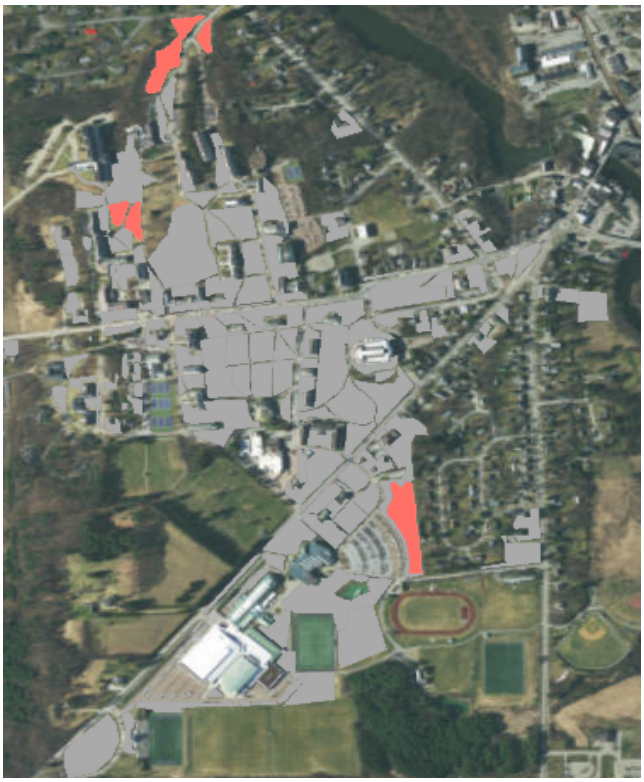

Figure 4. *Current campus mowing (gray) / No mow (orange)*

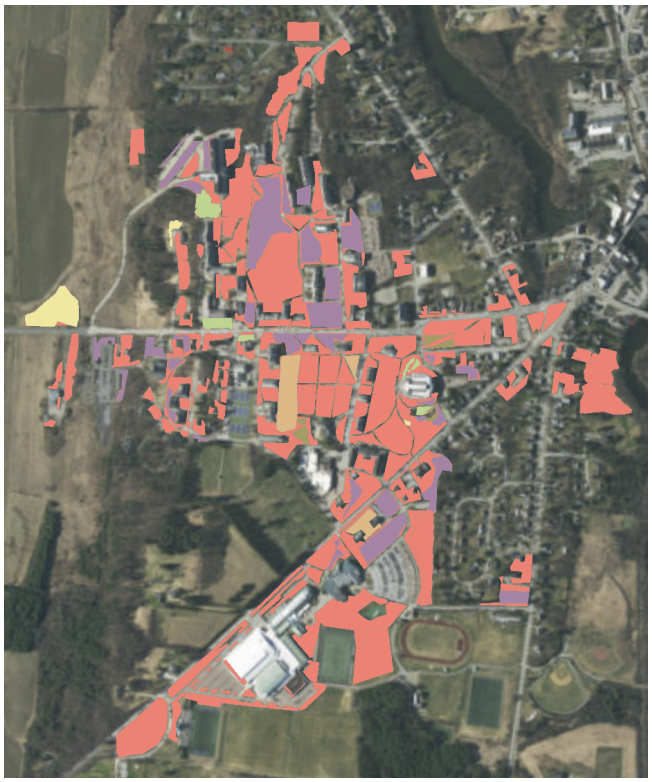

Figure 5. *Existing mowing (orange) / Proposed campus no mow (all other colors)*

The information seen in these ArcGIS Field Maps are also listed in this spreadsheet, Campus Lawns under the Proposed tab.

[23] Tim Parsons, Middlebury College's Landscape Horticulturist, 2022

Pilot Plan:

We are recommending a 2-year pilot program for this project. This will allow time for adjustment in budget, labor logistics, and community response. All proposed Rough Lawn areas will no longer be mowed right away for the easiest roll-out of this project. Any ground obstacles requiring access including but not limited to electric boxes, storm drains and water valves will be mowed around. We designated a few areas of different ground cover types to test this proposal over the next 2 years.

- Near the rain garden outside of Davis Family Library.
    - Clover Lawn *(light green)*
    - Pollinator Habitat *(yellow)*
    - Clayplain Forest Plantings *(olive green)*
    - Native Fescue Area *(purple)*

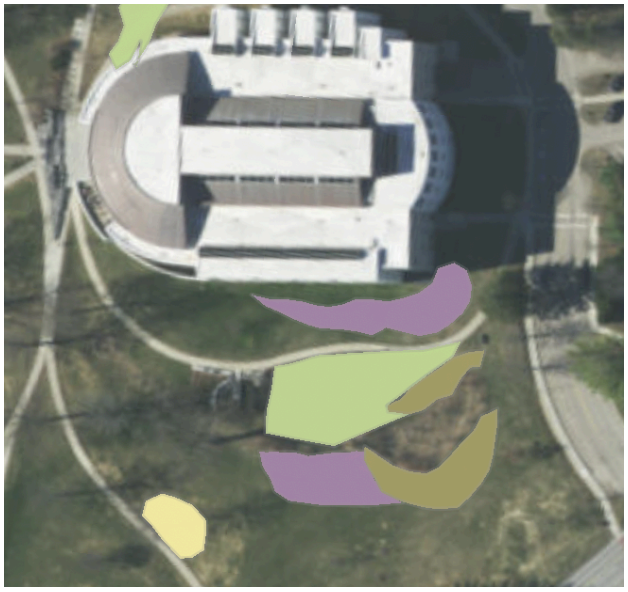

Figure 1. *GIS Field Map outtake of the lawn to the right of Davis Family Library.*

- Blinn Lane between the Center for Community Engagement and the Innovation Hub.
    - Clayplain Forest Plantings *(Green)*

Figure 2. *GIS Field Map outtake of Blinn Lane.*

- 20 Old Chapel Road and the Hebrew Language House
    - Native Fescue Area *(Purple)*

Figure 3. *GIS Field Map outtake of 20 Old Chapel Road lawn.*

Figure 4. *GIS Field Map outtake of Hewbrew House lawn*

As these locations begin to flourish over the next 2 years, the cost of implementation and care will become known. From there, the College can scale up to include our other proposed locations for changing High Performance Lawn to other ground cover types all listed here under the Proposed tab.

VI. Moving Forward and Initial Cost Estimates

Moving forward, Tim Parsons and the facilities team will have to adopt this project to implement its goals. The pilot plan we have laid out is reliable and effective, and will lead to the College doing better than what they are doing now without too much added effort. This project's progress will be included in the quarterly Energy2028 Updates sent to the entire Middlebury community. Our educational materials will also be available for access under the Sustainability page on Middlebury College's website and as signage in front of large restored areas. This budget covers the entire 5 year plan.

The transition to **Clover Lawn** will cost $33 per pound of seed with one pound of seed covering 1,000 square feet.[24] The designated areas will need to be seeded twice. In addition, starter fertilizer ($70 per 12,000 square feet) is necessary, and will be used three times for optimum growth. Sources listed below.[25]

- We propose 1.667 acres be turned to Clover Lawn. This will cost approximately $2,409.

The creation of **Pollinator Habitats** will cost $45 per square foot, including the labor necessary to create the space.

- We propose 0.166 acres be turned to Pollinator Habitats. This will cost approximately $1,201.

Creation of **Perennial Groundcover** areas will cost $196 per 3 lbs for a native seed mix. A half a pound of the seed mix will cover 1,000 square feet. In addition, any Pollinator Habitat larger than 1,000 feet will use a seed mix. This includes the Habitats in front of McCullough and in the BiHall parking lot.

- We propose 2.35 acres be turned to Perennial Groundcover. This will cost approximately $3,343.

The transition to **Native Fescue Areas** will cost $400 per acre. This includes spraying of an herbicide to get rid of weeds and a light organic fertilizer. Organic fertilizer is better for long term soil health, and will be used to make the grass grow.

- We propose 16 acres be turned to Native Fescue Area. This will cost approximately $6,400.

The planting of **Clayplain forest** areas will cost $100,000 per acre, including establishment and labor. There are about 300 trees per acre, and once planted and established it will take 5 to 10 years to become forest. In addition, any grass under the trees will turn into Native Fescue Area. It will act as a great carbon sink as it decomposes and turns into a food source for trees as it receives less and less access to sun as the trees grow.

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[24] DLF PickSeed." Technical Data: Microclover." https://www.dlfpickseed.com/Files/Files/DLF_Pickseed_USA/DLF_Pickseed_Tech_Sheets/Turf_Seed/Variety/Microclover_ts.pdf

[25] DLF Pickseed. "Microclover: Nature's Solution." https://www.dlfpickseed.com/Files/Files/DLF_Pickseed_USA/Brochures_Etc/Microclover_Brochure_2017_WEB.pdf

    - We propose 0.812 acres be turned to Clayplain Forest Plantings. This will cost approximately $80,000.

In order to transition all of the spaces in our 5 year plan, the total budget needed over the next 5 years is approximately $93,353. This is without taking into account how much money will be saved from mowing less acreage. Any up front additional labor costs will easily be made up in the decrease in mowing. More information on the budget and acreage can be found here under the Budget tab.

Potential contacts and community partners for future engagement with this work

- Tim Parsons - tparsons@middlebury.edu
- Sophia Calvi - scalvi@middlebury.edu
- Megan Brakeley - mbrakeley@middlebury.edu
- Jack Byrne - jmbyrne@middlebury.edu
- Natalia Schwein - nschwien@middlebury.edu
- Emily May - alumni involved with the Xerces Society - emily.a.may@gmail.com
- Brett Gilman - current student involved with the club ReWild Midd - bgilman@middlebury.edu
- Bee the Change Vermont - 802-349-2741

Concluding Thoughts

This proposal contains a lot of information, mainly targeted at how Middlebury College's current mowing protocols on its main campus are not only inefficient but also aimless. The standard in the U.S. is the lawn, although being an outdated colonial status symbol. As the College enters more and more pressing conversations surrounding climate change and emissions, mowing lawns may seem like an insignificant thing to focus on, both in terms of cost and emissions. This discussion, however, is targeted at something larger; the land itself and our relationship to it. Few would deny the beauty of Vermont's rolling hills, wildflowers, meadows, forests, and sunsets. This proposal strives, however, to get the reader to ask the question; does our current management detract from that beauty and our connection to it? The lawn standard is frankly an outdated landscaping aesthetic that actively detracts from the potential of the land we walk on both in aesthetic terms and ecological ones. The College can't just have the objective of lowering its emissions, it also must commit to questioning and reshaping the way we as students and lifelong learners interact with the land. Reducing mowing and rethinking what defines a picturesque and purposeful college landscape is an active, attainable, and integral first step.

By no means do we believe that fulfilling the five year plan of this proposal should be the end of this process. There are countless places on this campus that are not used but happen to be in highly visible areas that we chose not to include for fear of backlash. We do believe that as community mindset surrounding landscaping and mowing changes, any lawns that are not actively used (for study, hanging out, sports, etc.) be rethought and added as well. These places may include (but are certainly not limited to) small patches which are abundant in parking lots, the strips of lawns between the sidewalk and street, and the many small but unused lawns pocketed around campus that just happen to be in highly visible areas. We certainly encourage future reevaluation of the work done in this proposal as campus and community needs change.

We are grateful for the opportunity to have engaged with this work over the summer, we have learned a lot and are very excited to share this work. We also would like to take the opportunity to advocate for the continuation of student intern involvement on this project each summer if implementation of the proposal is allowed to begin. It would be an incredible learning opportunity to be actively involved with the process as it unfolds.

Aria Bowden '23 and SJ O'Connor '24