

Using GIS to model bike routes in Waterville and bike storage facilities at Colby College

Corin Balan '18, Environmental Studies Program, Colby College, Waterville, Maine

Introduction

This project analyzes possible locations for indoor and outdoor bike racks and establishes a bike route in compliance with the U.S Green Building Council (USGBC) and the LEED v4 certification¹. The USGBC bicycle facilities certification requires campuses and other institutions to provide a bike network that includes the following:

- At least 10 diverse locations on the route where bikers can engage with the community, shop or engage in recreational activities.
- All destinations must be within a 3-mile bicycling distance of the project boundary.
- A dedicated bike path that extends to at least the edge of the institution's property.
- The usage of public roads must be limited to areas where the posted speed limit is 25 mph or less.

Furthermore, in order to provide adequate bicycle storage, institutions seeking the LEED v4 certification must provide a minimum number of bike racks for both short-term (outdoors) and long-term (indoors or covered) storage. The minimum number of short-term bike racks must provide for at least 2.5% of all peak visitors and, the minimum number of long-term bike racks must provide storage for at least 5% of all regular building occupants. A minimum of 8 racks (4 short-term and 4 long-term) must be provided for each building. Both the long-term and short-term bike racks must be within 100-feet (30 meters) walking distance of any main entrance. If implemented successfully, this project will promote bicycling and transportation efficiency, creating a link between the Mayflower Hill campus and the city of Waterville. This project aims to identify the best bike routes and bike storage positioning options and is particularly relevant now as Colby has expanded downtown with the building of the new dormitory.

Methods

I used ArcGIS 10.4.1 (ESRI) software to solve for best route and bike rack placement. The data used in this project to depict and analyze roads in the city of Waterville were retrieved from the Maine Office of GIS². Specifically, a state-wide road layer and a parcel layer for the City of Waterville were downloaded and clipped to the city of Waterville to minimize processing time. The data pertaining to Colby College buildings and pathways were retrieved from the Colby College GIS database. This project partially built upon a previous campus entrance and path survey conducted by Tommaso Montagni '17, Fen Bowen '17, Ian Liphart '18, Wes Zebrowski '18 and Jiaqui Wu '17³.

I performed an initial road speed analysis to determine the posted road speed of roads around Colby. I performed a ground distance measurement to determine the exact distance travelled from campus to downtown Waterville. I dissolved and transposed data to ensure a uniform attribute distribution and to aid continuity. I created a network layer from the dissolved data. A network analyst was then run for various routes, ensuring that at least 10 diverse locations are covered and the 3-mile distance was not exceeded.

The bike rack placement on campus was partially developed by surveying current functional bike racks and partially calculated mathematically. By using statistical data provided by PPD I calculated the size of the regular campus population to be 2669 (sum of all students, faculty and staff). I approximated the daily peak visitor count by analyzing Colby College Museum visitor data and extrapolating a value of 100 daily peak visitors. As per USGBC criteria, I calculated the minimum bike capacity per rack to be 5 spots for short-term storage and 10 bikes for long term storage.

Results

The results of the bike network analysis yield one bike path (Purple trail) that can be used immediately and one bike path (Blue trail) (Figure 1) that requires a change in the speed limit on a 0.5 mile portion of the road stretching from the bridge area of Mayflower Hill to the intersection of Eustice Parkway and North Street. The portion of road that is not suitable for the bike path network has a posted limit of 35 mph, 10 mph higher than the criteria imposed by USGBC. The Blue trail (Figure 1) includes an alternate route depicted in green (Figure 1) which follows the North Street Recreational Trail. Both trails are within the imposed 3-mile distance limit and include at least 10 diverse locations. The locations along the bike paths that were in accordance with the USGBC criteria were depicted on the map using grey pentagons and were further detailed in Figure 2 and Table 1.

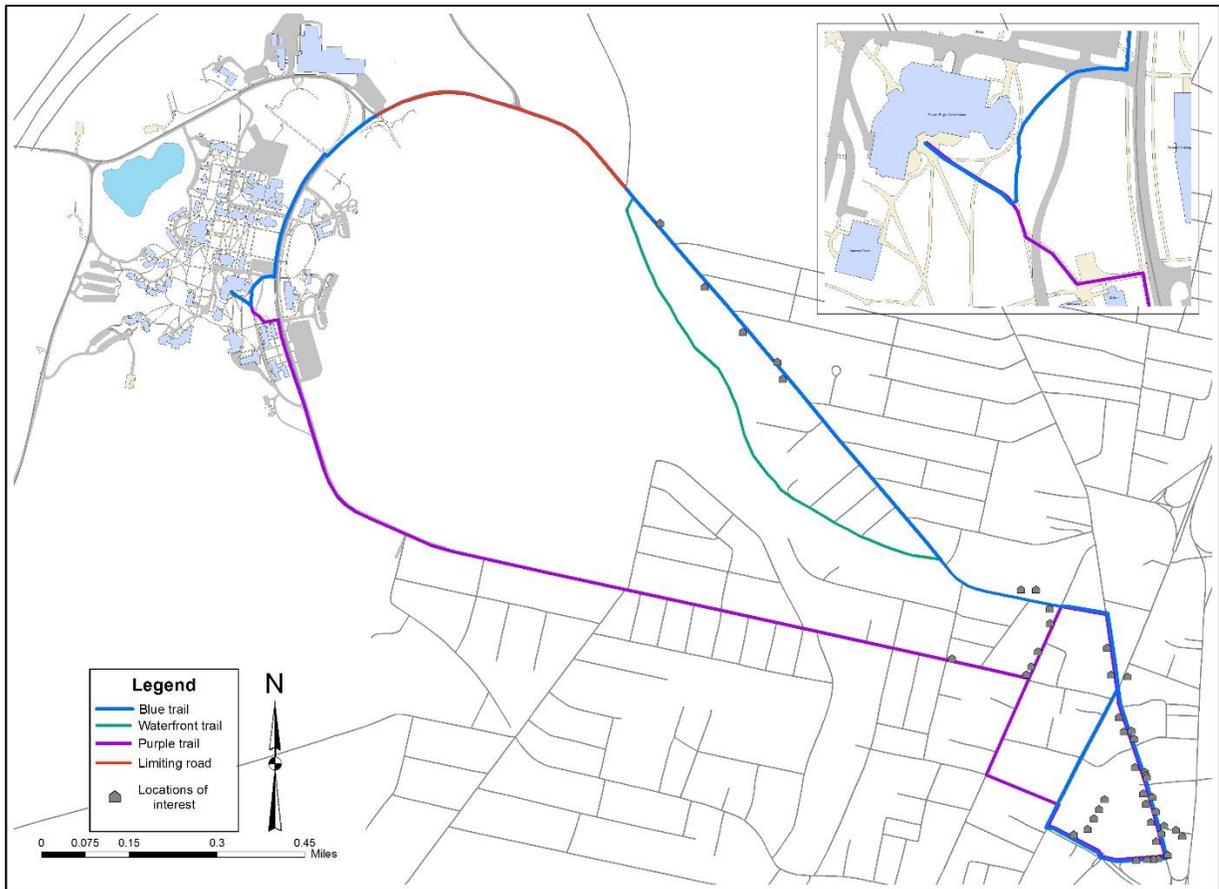


Figure 1. Campus trail network extending from Cotter Union (magnified in the top-right corner) to Main Street Waterville. The four color choices indicate routes, alternate routes and limiting roads discussed in the conclusion section. The red section depicts the portion of North Street that does not comply with the necessary maximum posted speed limit, while the green line shows an alternate route from the Blue trail that runs along the Messalonskee Stream (not depicted). The grey pentagon symbols represent locations where cyclists can shop, recreate and access facilities.

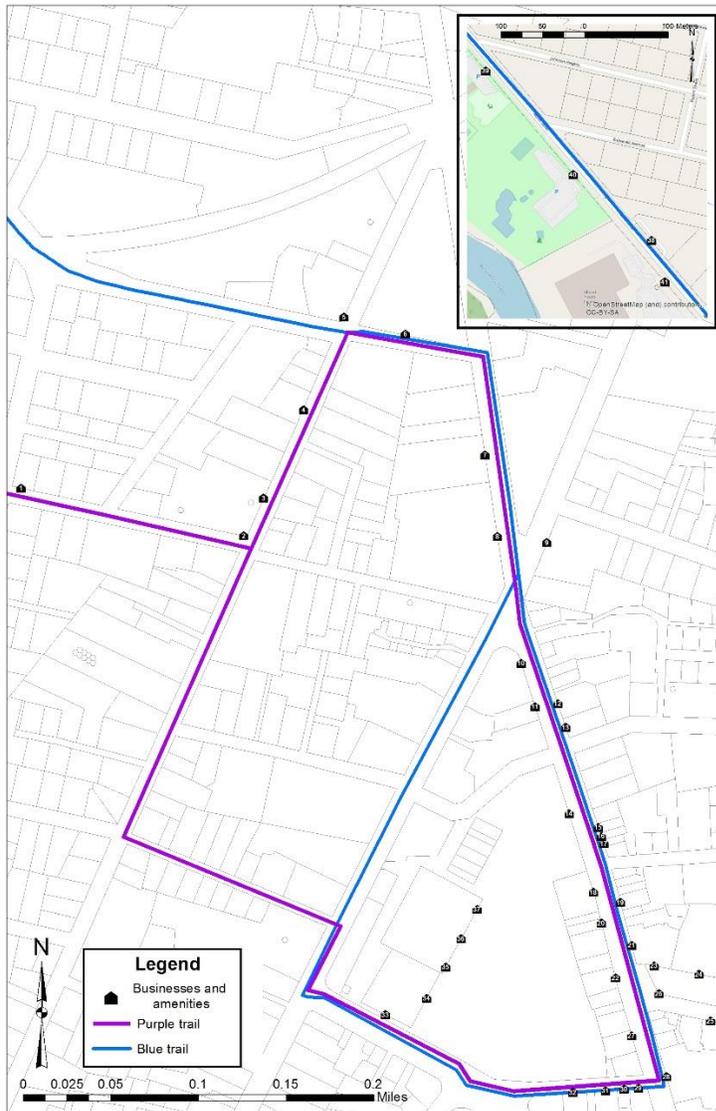


Table 1. List of amenities and businesses included on the Blue and Purple trails. The numbers in the table correspond with the labeled symbols in Figure 2.

Number	Business/ Amenity
1	Gilman Street Basketball Club
2	Sacred Heart Church
3	Sacred Heart Soup Kitchen
4	Pleasant Street Inn
5	Mobil 1 Gas Station
6	Kennebec Savings Bank
7	Kennebec Eye Care
8	Rite Aid Pharmacy
9	Waterville Fire Station
10	Mainly Brews Restaurant
11	TD Bank
12	DK Nail Salon
13	Seilah Tea Café
14	Colby College Alford Dorm
15	Thai Bistro
16	Waterville House of Pizza
17	Amici's Cucina
18	Key Bank
19	Jorgensen's Café
20	Jewel of India Restaurant
21	Maine Made & More
22	Holy Cannoli Café
23	Waterville Creative Center
24	Waterville Operahouse and City Hall
25	The Proper Pig Restaurant
26	Waterville Farmer's Market (Seasonal)
27	Children's Book Cellar
28	Camden Bank
29	Silver Street Tavern
30	Cancun Mexican Restaurant
31	The Last Unicorn Restaurant
32	Habitat for Humanity
33	Goodwill
34	Famili Dorllar
35	SaveAlot
36	Chapter 11
37	Dollar Tree
38	Dairy Cone
39	North Street Recreation Center
40	Municipal Pool
41	Waterville YMCA

Figure 2. Amenities and businesses alongside the trails in accordance with the USGBC criteria. A minimum of 10 are required for the certification. A total of 41 were mapped for diversity and ease of accessibility.

The position of the campus bike racks was determined using the physical campus survey and the USGBC criteria (Figure 3). 74 short-term storage racks concentrated around academic and administrative buildings were determined to be necessary, adding up to a short-term storage capacity of 370 bikes. 23 long-term storage racks were deemed necessary to provide adequate storage for residential buildings, adding to a total of 230 long-term bike spots. A full campus survey is necessary to assess existing and required bike racks. This project aimed to determine the best placement for bike racks and bike trails as well as meet the USGBC requirements for the LEED v4 sustainability certification. The analyses performed using ArcGIS serve as a foundation for the project and a starting point for further research and surveys.

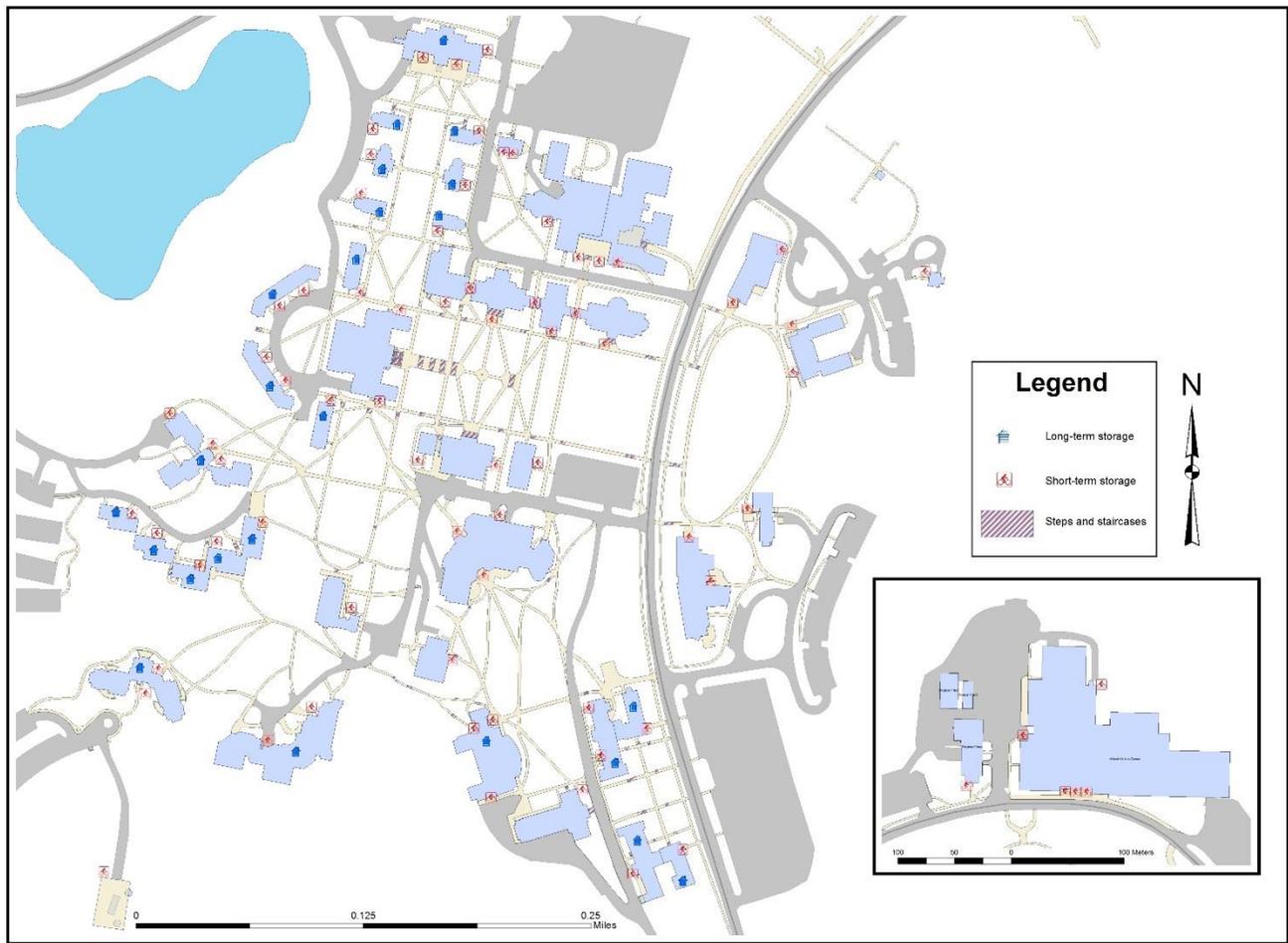


Figure 3. Proposed bike storage facility position and density on the Colby College campus. The long term storage facilities which are proposed as being indoors for this project are represented by the blue “house” symbol and are not necessarily positioned where the storage facilities should be but rather, in which building they should be. The red cyclist symbol represents the short-term storage facilities are located in the accurate position in rapport to the building entrance. The hashed blocks represent stairwells and staircases that are inaccessible to cyclists.

References

1. "Bicycle Facilities | U.S. Green Building Council." USGBC Homepage USGBC.. <https://www.usgbc.org/credits/commercial-interiors-hospitality-commercial-interiors/v4-draft/ltc4>.
2. "Maine Office of GIS." Maine.gov. <http://www.maine.gov/megis/catalog/>.
3. Zebrowski, Wesley M.; Bowen, Fen; Liphart, Ian R.; Wu, Jiaqi; and Montagni, Tommaso "GIS Campus Transportation Survey: Colby Campus Map," *Atlas of Maine*: Vol. 2016: No. 2, Article 7. Available at: https://digitalcommons.colby.edu/atlas_docs/vol2016/iss2/7

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