Salem State University Green Space Report

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In the ever-growing urban world, considering greenspaces has become more important than ever in planning, development and execution. Examples of urban green spaces include trees that line streets, landscaping (both private and commercial), parks, woodlands and marshes. (Biasotti, 2022) Greenspace helps to reduce exposure to harmful environmental factors such as heat, air pollution, and to a lesser extent, noise pollution and light pollution. In urban areas, these factors can become much stronger (noise pollution and air pollution from traffic, large amounts of heat reflecting off pavement, etc.), and urban areas tend to have a much higher population than others, meaning that these spaces can serve more people. (Browning et al., 2022) By adding greenspace to campuses, colleges can help serve the greater community, especially in urban campuses where the infrastructure of the school may be mixed in with that of the host town or city. While results can vary immensely by geographic context and environmental factors, there is a host of professional academic literature that points to a positive relationship between greenspace and the academic success of students. (Browning et al, 2019)

Drones can be used in a variety of ways to measure green space health and progress: from using multispectral sensors to measure general vegetation health and "greenness," all the way to using high end sensors to measure millimeter-level plant growth. (Matsuura, Y. et al. 2023) Although this study will not be using such "high end" sensors, it is noteworthy to understand the progress of drone technology in relation to measuring these areas. The objective of this study is to use drone technology to map and measure green spaces on Salem State University's campus. For this study, true-color orthomosaic imagery will be used to show the extent of Salem State's new "low-mow zone" greenspaces. Low mow zones are areas that will be mowed sparingly during the summer season to encourage water retention and wildlife habitat. (salemstate.edu, 2024)

Methodology

Using a DJI Phantom 4 Pro Multispectral drone, imagery was taken at a height of 120 meters (394 feet) for each area: The O'Keefe Complex, North Campus, and Central Campus. Table 1 shows some, but not all of the recorded flight data: air quality, pressure, and humidity, as well as information about crew members, permission and other legal and safety standards are also recorded in a flight log.

Table 1

Timestamp	Location	Date:	Time	Number of permanent GCPs:	Cloud Cover (please estimate a %)	Wind Speed (please select 1)	Wind Direction	Temperature (F)
8/1/2024 15:57:41	North campus	8/1/2024	3:20 PM	6	40 - 60%	0 - 10 mph	West	93
8/8/2024 14:55:14	Central campus	8/8/2024	2:16 PM	6	80 - 100%	0 - 10 mph	South	74
8/8/2024 15:49:40	O’Keefe Area	8/8/2024	3:06 PM	4	80 - 100%	0 - 10 mph	South	74

The overlap of each image was 70 percent horizontal and 80 percent forward. Flights were processed using between 4 to 6 ground control points, all of them permanent points such as tile stone corners, parking space indicators, manhole covers and similar permanent infrastructure (Fig.1).The imagery was processed together using “Drone2Map” from ESRI. This was a semi-automated process that often took up to two hours or more. (Fig. 2) Low-mow zones were then digitized by creating polygon shapefiles in ArcGIS, which were then modified for easier viewing in the resulting maps. (Fig. 3)

Figure 1: The permanent ground control point is colored in blue. Ground control points must be determined carefully: In this particular case, these parking indicators were scraped and repainted, so this one was not used.

Table 2

These lines meeting up in a tennis court create a useful point for a GCP.	
The point where this path meets a patch of grass creates a very permanent GCP point.	
These turf field indicators make a good semi-permanent GCP, but it’s important to note that this line could be re-painted for maintenance purposes, making it less effective for long term use.	

Figure 2: Each blue mark represents a photo taken, totalling at 229 photos for this flight location, Central Campus. Drone2Map is able to automatically align UAV imagery according to the placement of ground control points, shown with green crosses. (GCPs).

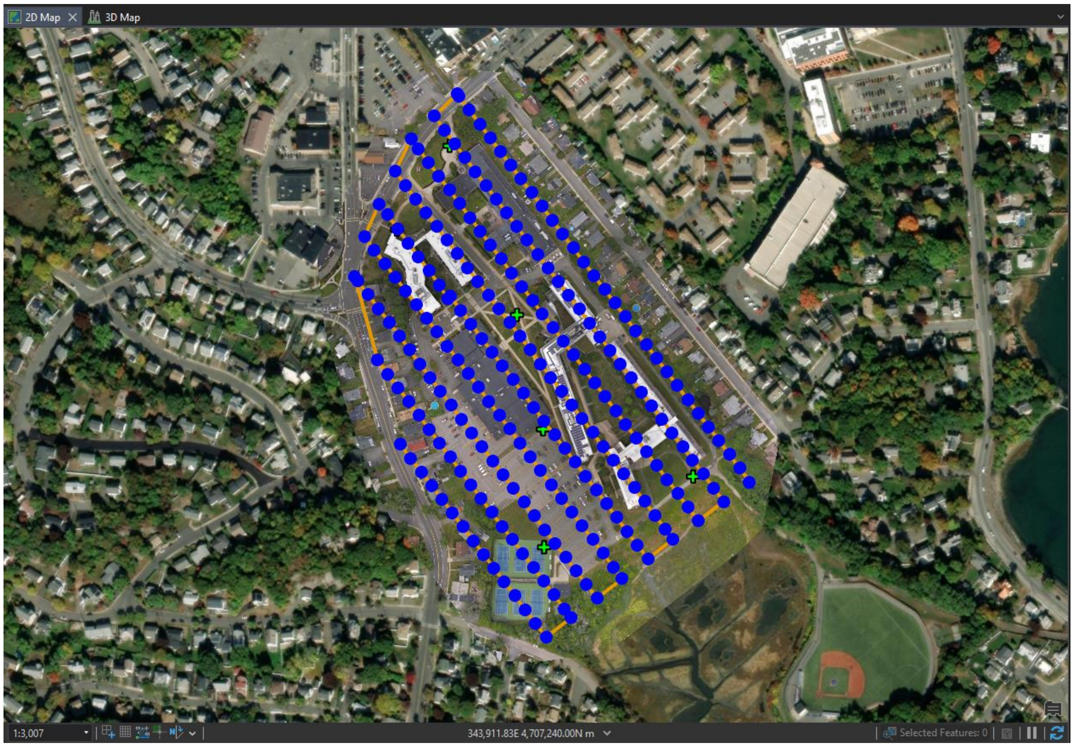
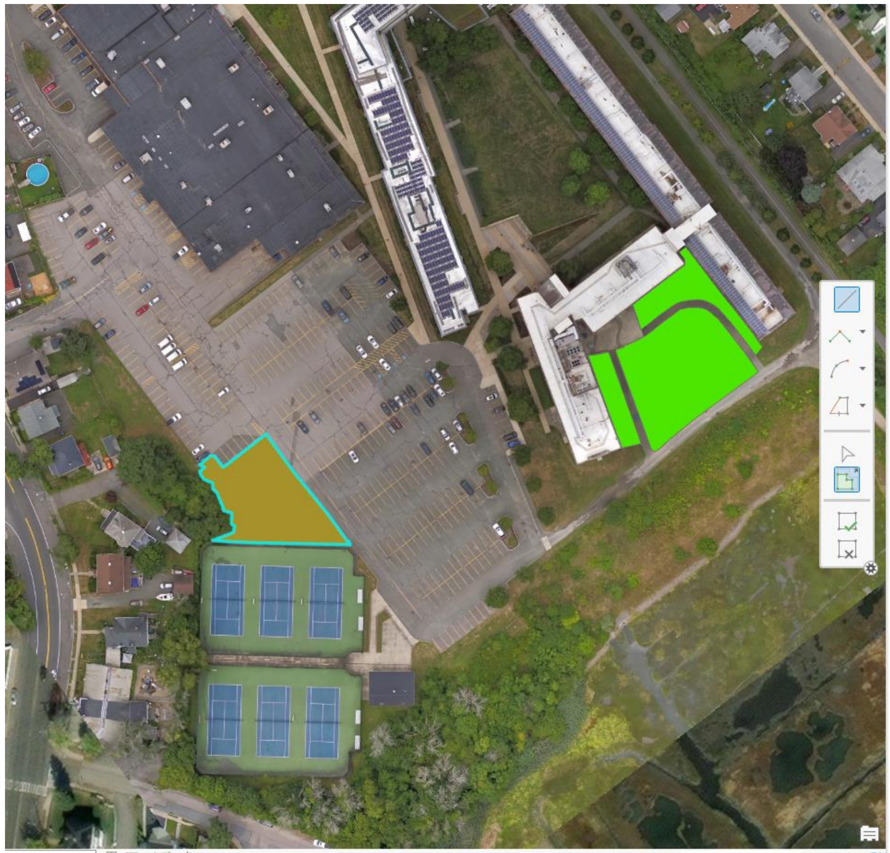
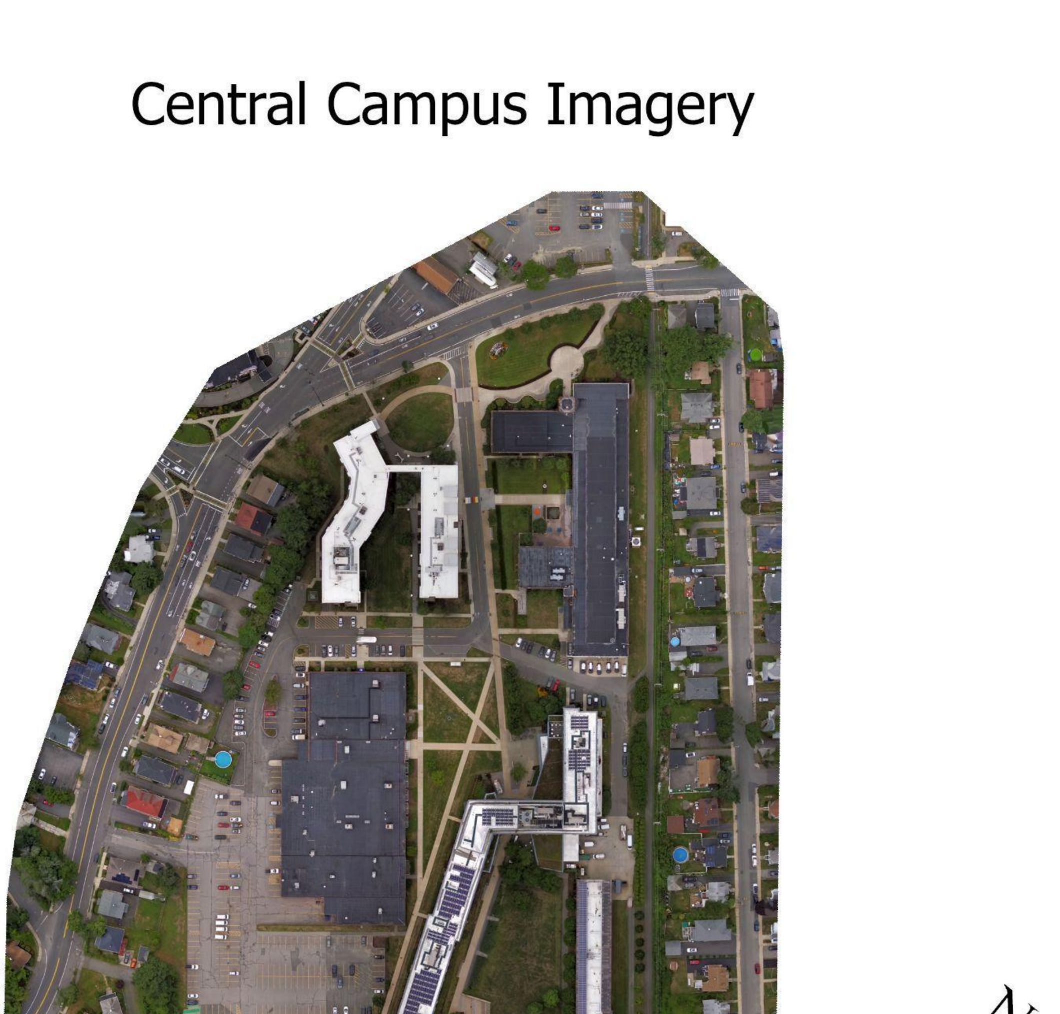


Figure 3: Low-mow zones are drawn with ArcGIS as polygon shapefiles according to real-world observations

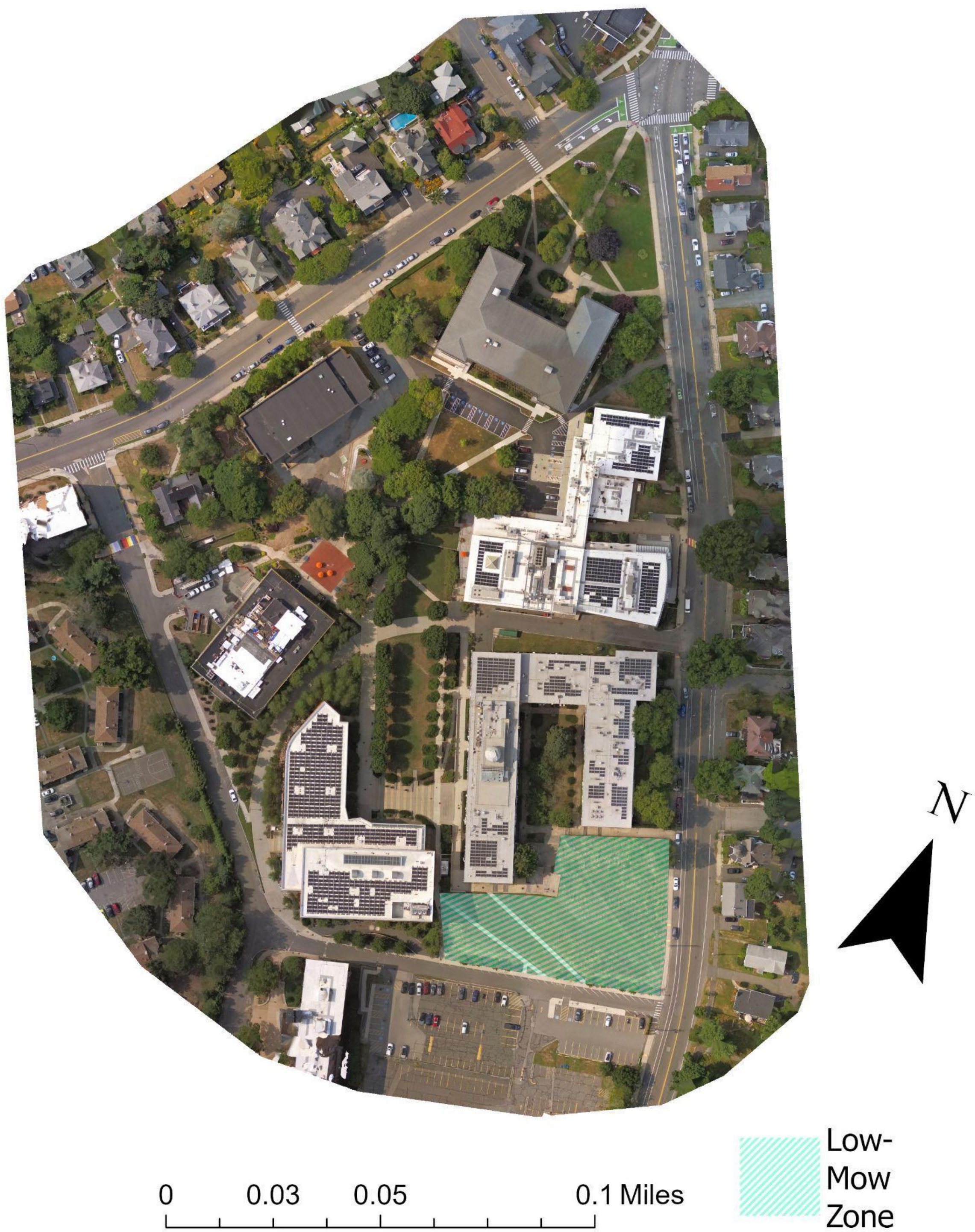


Imagery:

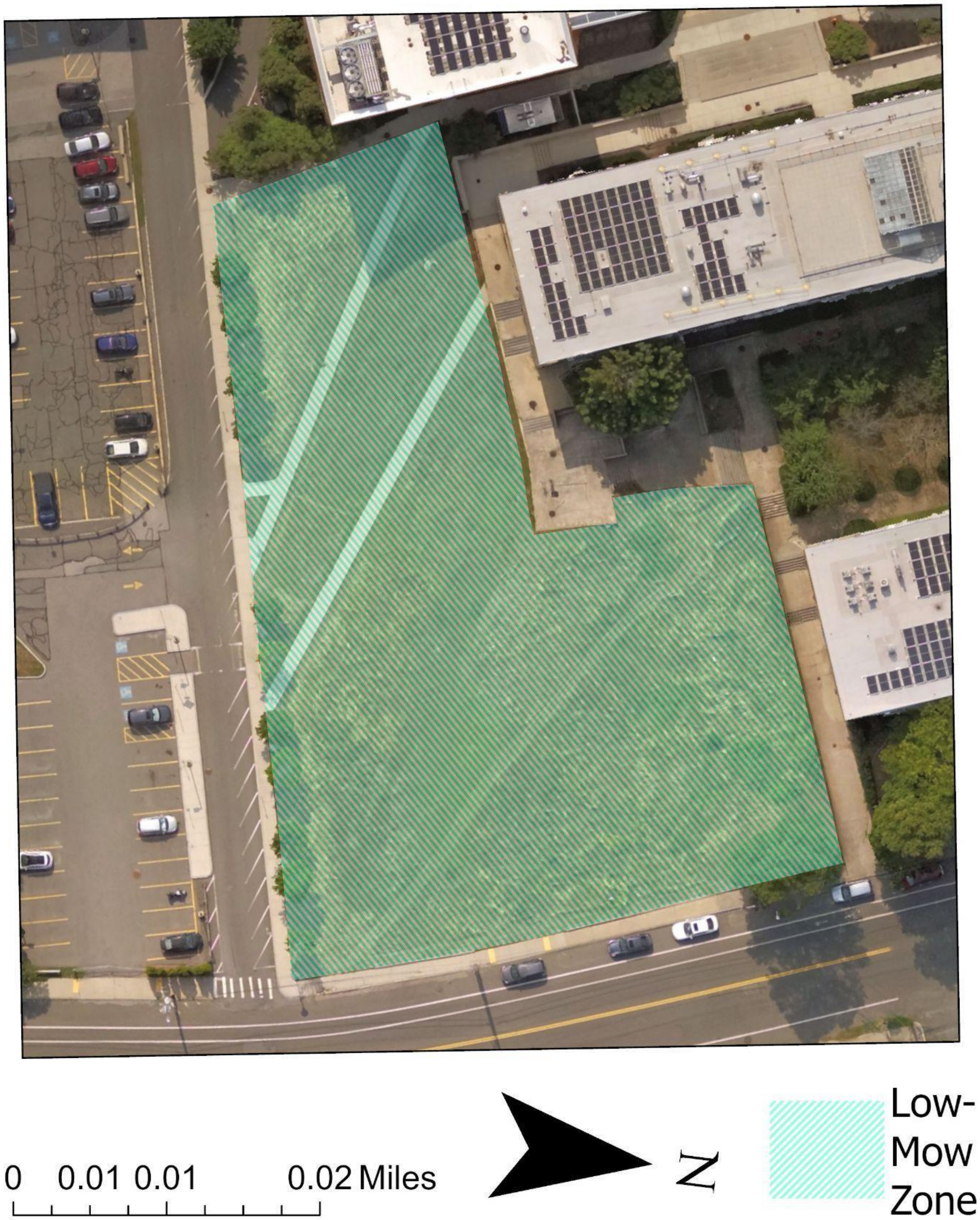


Central Campus Green Spaces

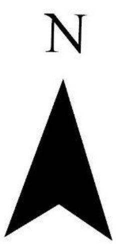
North Campus Imagery

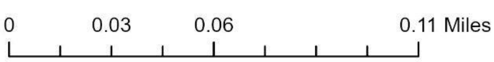


North Campus Green Spaces



O'Keefe Area Imagery





Source: Airbus,USGS,NGA,NASA,CGIAR,NLS,OS,NMA,Geodatastyrelsen,GSA,GSI and the GIS User Community

Discussion:

Looking at "Central Campus" green spaces and "North Campus" green spaces, a significant portion of unused land is now allowed to grow unmowed behind dorm halls, classroom buildings and bordering parking areas. This is outlined in translucent green striping on both maps. Overall, the maps show relatively recently taken imagery in good detail and during the mid summer season, when most vegetation is still quite active, or "leafy."

Looking at the "Central Campus Imagery" map, it becomes clear that parking areas and treeless spaces dominate this area, with greenery being in the form of lawns and grasses. While not barren, these greener areas are likely to be less conductive to pollinators and native plants that might be aesthetically unattractive but still ecologically important, than the low-mow zones. This area could potentially be better served by vegetation such as trees, shrubs and other perennials that could become permanent fixtures, giving shade and habitats to important pollinators and other animals. The marsh is considered "greenspace" as well, but is not accounted for in this project.

In comparison to the central campus imagery, north campus shows far more trees planted, according to the "North Campus Imagery" map. Notably, even where there are buildings and no green spaces, there is a significant amount of solar panel coverage. Looking at Table 3, even the acreage of low-mow zone areas is larger than that of central campus. North campus appears to be more "sustainably concise," with visibly more trees, green vegetation and more solar panel coverage than central campus, packed into a much smaller study area.

The O'Keefe area is unique in that although it looks green, the field is artificial turf. This part of Salem State's campus is also heavily intertwined with the city itself, but is spread out quite far. Looking at Table 3, the study area is quite similar in size to the "Central Campus Imagery" map. Most of the "true" green vegetation here is in small pockets bordering buildings and parking areas. Much of the tree coverage is along the bike path in the form of small trees that have yet to grow, and are difficult to see on the map.

Area Of Study	Acreage of Low-Mow Zone (US Survey Acres)	Approximate Reported Total Acreage of Study Area
North Campus	0.87	11.58
Central Campus	0.47	18.80
O'Keefe Area	N/A	17.18

Table 3

References

Biasotti, A. 2022. 6 examples of green spaces in cities. *ACB Consulting Services*. https://www.acbconsultingservices.com/sustainable-construction-project-management/6-examples-of-green-spaces-in-cities/ (last accessed 12 September 2024).

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