

# Identifying Accessible Sites for Outdoor Science Education

## OVERVIEW

For towns needing improvement in their science education, the outdoors can be an important teaching tool. The Massachusetts State Educational Frameworks requires lessons for elementary students that benefit from outdoor activities and natural observation. These frameworks suggest particular lessons that could be enhanced by an outdoor setting and offer a chance to enrich students' learning by relating science to the world around them (DOE, 2006).

This project identifies environmentally immersive settings for learning opportunities by assessing schools' accessibility to open space sites in their towns. Through an analysis of proximity, land use type, ownership and road access, sites in four Essex County, MA cities have been identified and ranked according to their quality.

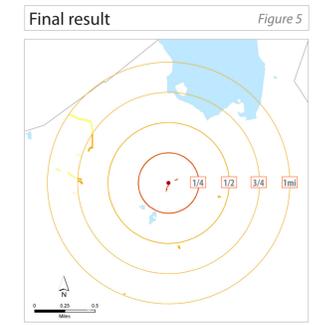
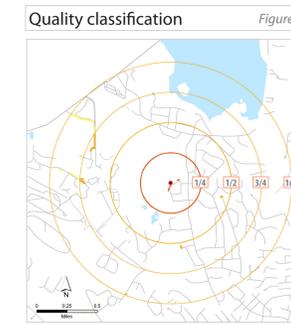
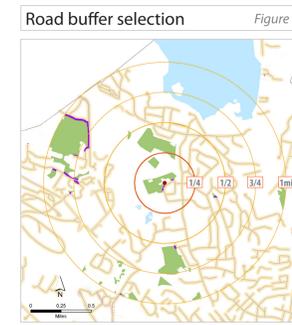
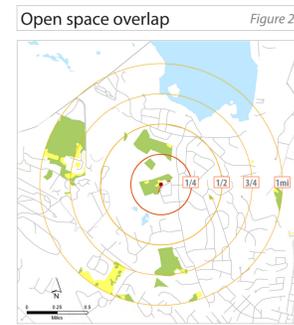
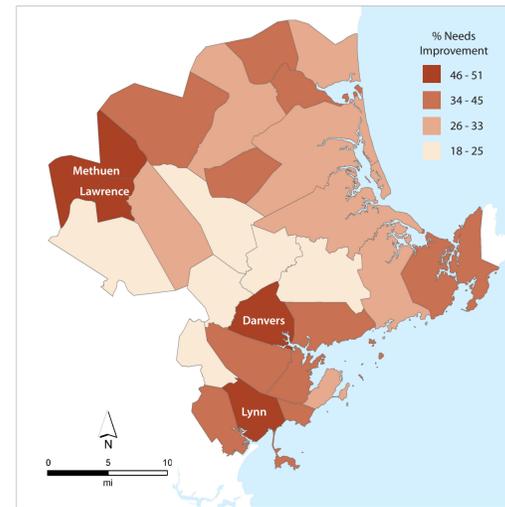
The fifth-grade education frameworks offer learning opportunities for the natural environment and are based on observational skills. Because of the simplicity of these lessons, they can be applied to many natural settings and offer a good relation to identifying open space in communities. Therefore, the schools chosen for the accessibility assessment were those containing public fifth-grade classrooms.

The cities of Danvers, Lawrence, Lynn, and Methuen were selected as areas for this GIS project because of their need for improvement in fifth-grade science testing scores. From the 2009 report of Essex County MCAS Science scores (MCAS, 2009), the percentage of students needing improvement was compared across all towns. A spreadsheet of % "Needs Improvement" was joined to a map of elementary school districts by their district name to produce a map showing classes of achievement (Figure 1). The four towns in this project were identified by this map as having the highest "Needs Improvement" rate in the

county at between 46% and 51%.

A detailed analysis was performed on these cities to produce a map showing the location of accessible public space. The quality of these spaces were ranked in classes as a function of proximity to schools, land use type, ownership and road access. These resulting maps can be viewed at the bottom of this poster (figures 6-9), and their accessibility ratings can be compared.

Essex County MCAS Scores by percent of students needing improvement Figure 1



## METHODS

To describe methodology, the figures referenced in the following passage focus on the location of open space around an individual school: The Ivan Smith Elementary School in Danvers. This methodology was applied to all schools citywide, per town, however for description clarity the figures will focus on one school.

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As an initial part of this analysis, the attributes of datalayers were edited to only include desired characteristics of accessible space. Datalayers were overlapped and extracted to eventually reveal accessible space. Following manipulations were conducted to datalayers from MassGIS. The datalayer 'Schools' was added and its attribute table was manipulated to only retain public schools that

included fifth grade classroom. Around these schools, concentric buffers of on-quarter mile were drawn. All subsequent manipulations were completed as an intersect with this buffer, ensuring that all resulting Accessible Space would be within one mile of a school. This ring buffer can be seen in Figures 2-5.

'Protected and Recreational Open Space [POS]' (polygon) - Only records marked as publicly accessible were retained. All other records were deleted. This ensured that any resulting space was available to the public. This layer also included attributes such as open space type, indicating whether the land was forested, parks, wetlands, recreation, or conservation lands. Because some of these uses may be closer to the natural state, records indicating forest, wetlands, and conservation were given (in a new field) a Class value of 1. Other records were given a Class value of 2.

'Land Use 2005 [LU05]' (polygon) - Any records under private ownership were deleted as were inappropriate land uses such as cemeteries and landfills.

The intersect of 'LU05' and 'POS' was found, resulting in a new layer, 'Public and Use' showing two classes of sites that were public and appropriate in Land Use. This

process is shown on a map in Figure 2.

The layer displaying roads 'OTR Roads' was added, and its attributes were manipulated to include only minor roads and arterials. This ensures that students would not have to walk from their school to the site along dangerous roadways such as highways. A buffer of 25m was calculated around the remaining roads, creating a new shape layer, 'Road Buffer'.

The intersect of 'Road Buffer' and 'Public and Use' was calculated, resulting in a new layer that showed public, appropriate sites that were accessible by the road. Many of these towns have open space between neighborhoods where the only access is through private property. Utilizing this road buffer ensures that the sites are accessible from the roads. The results of this process can be seen on the map in Figure 3.

The resulting 'Accessible Space' retains the classes constructed in 'POS'. A new field was added and joined with the data from the ring buffer distance, giving weight to the importance of being near the schools. By combining these classes, the resulting 'Accessible Space' layer is finally coded into three classes, of which '1' is the most ideal. These classes can be seen on the map with roads in Figure 4, and without roads in Figure 5.

As a final step, calculations were made to draw comparisons across the four cities. The total area of each class of 'Accessible Space' was calculated for each town (by selecting the attributes for each class and viewing the statistics). Each town's total accessible space was found and the subsequent class percentage for each town resulted. These comparisons can be seen in the pie charts below figures 6-9.

See the below for the city-wide results and cross-city comparisons.

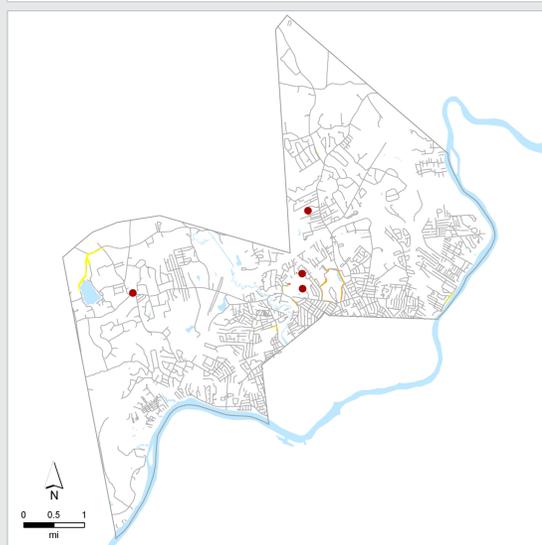
Two main limitations of this study are noted. First, the selection of classification criteria is mostly subjective on the author's part, and more information could be gathered about the nature of the open space and its quality. Second, a better consideration of road relations could be made: this could be done by analyzing walking distances along roads rather than radial distances from schools.

Further research could include a rating of high-scoring towns to compare with this study and to provide information as a resource to those communities.

See sources below for downloaded datalayers.

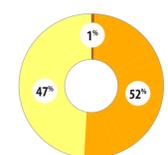
## FINAL RESULTS

Methuen Figure 8



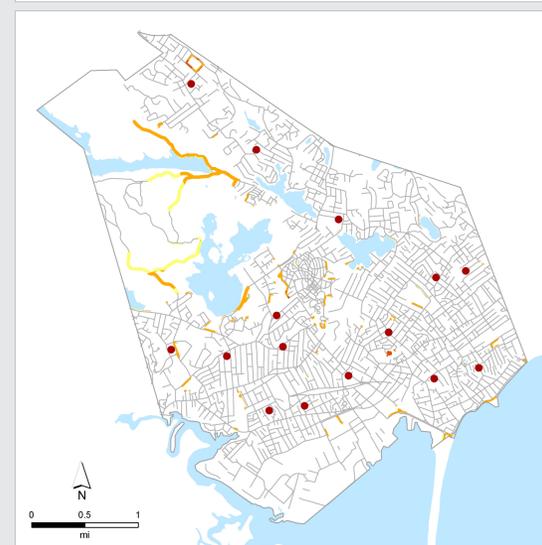
**1<sup>st</sup>** 4 Number of Schools  
63.5 Total Acres  
15.8 Acres per School

Quality of Space  
(each class as a percent of total acres)



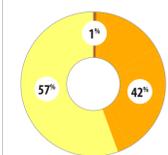
Methuen has the highest acreage per school, only 1% of this is Class 1 quality. 52% is class two, however, which is still a large supply of quality accessible space.

Lynn Figure 9



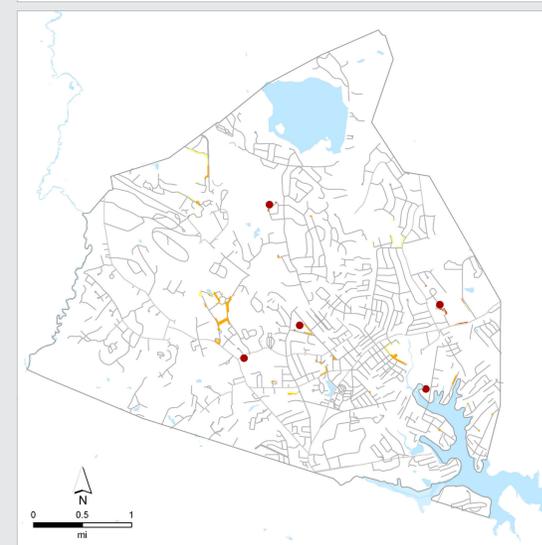
**2<sup>nd</sup>** 15 Number of Schools  
236 Total Acres  
15.7 Acres per School

Quality of Space  
(each class as a percent of total acres)



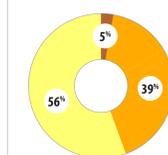
Lynn has the second-highest acreage per school, but offers very little Class 1. This is probably because most resides in the city woods which is distant from the schools.

Danvers Figure 6



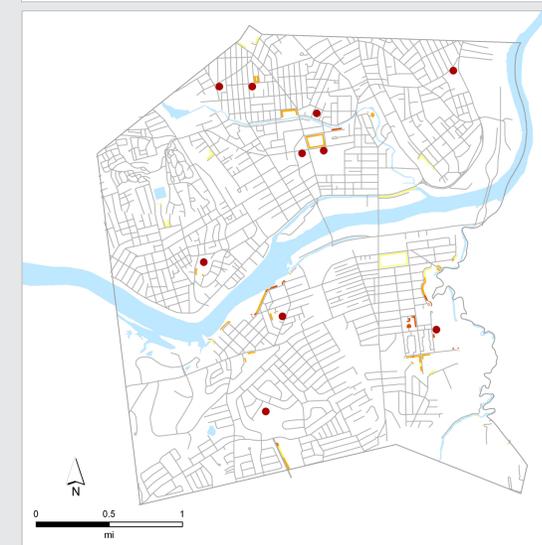
**3<sup>rd</sup>** 5 Number of Schools  
48 Total Acres  
9.6 Acres per School

Quality of Space  
(each class as a percent of total acres)



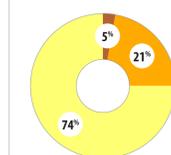
Danvers has the least number of acres total, but 5% of its area is Class 1 accessible space. Their area is limited, but of a higher quality than other cities.

Lawrence Figure 7



**4<sup>th</sup>** 10 Number of Schools  
91 Total Acres  
9.1 Acres per School

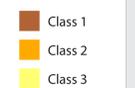
Quality of Space  
(each class as a percent of total acres)



Lawrence has the lowest acres per school, but its percentage of Class 1 area is higher than that of Methuen and Lynn.

## Legend

Accessibility Class:



Map Features:



Source:  
All datalayers for this project were downloaded from MassGIS. Datalayers are detailed below (MassGIS, 2009).

Quality of Space

Accessibility Class:

