IF YOU BUILD IT, THEY WILL COME:

RANKING SEGMENTS TO BE BUILT

ALONG THE PROPOSED

NORTHERN STRAND COMMUNITY TRAIL

Final Project
Advanced Spatial Analysis
GIS 3130, Northeastern University
Winter 2008
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INTRODUCTION

The Rails-to-Trails movement to convert abandoned rail lines into multi-use trails for use by surrounding communities has steadily increased in support and popularity since its inception with the Rails-to-Trails Conservancy in 1986. Converted trails offer "a new kind of public space" (Flink et al., 2007, p. 2) by connecting neighborhoods to each other and to natural landscapes such as parks, vistas, and streams. More than providing opportunities for recreation and transportation, "trails and their associated greenway corridors are increasingly viewed as vital infrastructure…and will enhance the urban landscapes of the new century" (Flink et al., 2007, p. 3).

The Northern Strand Community Trail is a proposed rail-trail project in the greater Boston area. It will run along the abandoned Saugus Branch rail line, a 9.5 mile route beginning along the Malden river in Everett and ending a half mile from the Lynn waterfront. The MBTA is the current owner of the abandoned Saugus Branch rail line.

Bike To The Sea is a non-profit 501(c)(3) corporation founded in 1993 that promotes the development of the trail. In 2007, after many years of bureaucratic hurdles at the state and federal level, Bike To The Sea celebrated two huge successes with the cities of Everett and Malden as they signed lease agreements with the MBTA for permission to develop the trail within their city boundaries. In July 2007, the first 1000 feet of the trail was built in Everett by 35 volunteers spreading 35 tons of stone dust. Although Bike To the Sea hopes to obtain federal highway funds for much of this project,

> this first 1,000' is representative of the fact that this is a project that will be built neighborhood by neighborhood. It is not something being imposed from above but inspired by people who live along the length of the trail and think it is a good idea. Each block will have it's (sic) own issues to resolve: access paths, illegal dumping, parking wetlands etc. A lot of the work on the first 1,000' of the trail in Everett was building an access path from the Madeline English School to a new 7-acre park on some reclaimed industrial land that is now a beautiful park. (Bike To The Sea, 2007, para. 2)

The aim of this GIS project is to analyze which sections of the proposed Northern Strand Community Trail should be built first, based on areas of population density and community-oriented land parcels that lie within a ½-mile radius (a 10-minute walking buffer) of the trail. In addition, in response to a request by Steve Winslow, president of Bike To The Sea, this analysis includes low-income neighborhoods along the path to see if the project can be eligible for Community Development Block Grant (CDBG) funding. This analysis will combine these data layers together for the five cities and towns through which the trail runs, producing a ranking of six groups of trail segments to be built. All of the necessary data for the analysis is available though the Massachusetts Office of Geographic and Environmental Information (MassGIS).

Ideally this analysis and subsequent ranking will contribute to the overall development of the trail by spurring development of the sections that have the most potential for community use. The more that the sections are used, the more visibility the trail will gain, resulting in more advocates working for its completion.

DATA SETS

The data layers for this project, obtained from MassGIS, are as follows:

1. **Bicycle Trails –** This arc layer contains existing and potential trails which permit bicycle use. The linework was originally adapted from abandoned rail lines with potential for conversion. Consequently, the "Bike To The Sea" line appeares in the data layer as a single entity (i.e., no manual digitizing of the line was necessary.)
2. **Block Groups –** This polygon layer provides the necessary boundaries to display U. S. Census 2000 demographics. The attribute table contains "TOTAL_POP" data for each block group that was used to display population density.
3. **Income by Household –** Originally from the U.S. Census 2000 SF3 table, MassGIS provides this demographic as a standalone .dbf table for ease of display with the Block Group layer.
4. **Land Use –** This polygon layer contains 37 classifications of land use on a town-wide basis interpreted from 1:25,000 aerial photography.
5. **1:5,000 Black & White Orthophoto Images (1990's) –** In addition to being used as a base layer for this project, these orthophotos provide sufficient enough ground detail from which to digitize segments of the Northern Strand Community Trail into new data layers used in the analysis.

Manually digitized layers based on information from Bike To The Sea are as follows:

1. **Developed Trail Segment –** This arc layer represents the first 1000' development of the trail in Everett that runs alongside a newly developed 7-acre park next to the Mystic River.
2. **Next Phase Trail Segment –** This arc layer represents the "approved for development" segment of the trail in Malden. It begins at the Malden-Everett city boundary and ends at the intersection of the trail with Main St. in Malden.
3. **Underutilized Urban Public Space –** This polygon layer is the digitized boundary of a parking lot in Malden located directly upon the proposed trail. It is labeled "underutilized urban public space" since it is representative of similar sections of land inhibiting the path's construction while the land itself is not used to its fullest potential.

Underutilized Urban Public Space

The scope of the project is the entire length of the trail, passing through five cities and towns – Everett, Malden, Revere, Saugus and Lynn. Therefore, it was necessary to download the Land Use and Orthophoto layers for each of these towns. However, since Community Boundaries -Towns (another base layer obtained from MassGIS) and the Block Groups layer contain state-wide data, the data for the Northern Strand communities was selected from these layers for use in this analysis (**Figure 1**).

ANALYSIS CRITERIA: LAND USE & DEMOGRAPHICS

Because the crux of the analysis is to find sections of the trail that have the most potential for community use, "potential community use" needs to be clearly defined in order to get the "best fit" from the data layers driving the analysis. Since trying to define "community use" within the context of a city is an exercise in tautology (cities are structured communities), it makes more sense to define "community use" specifically by how it relates to the trail. To this end, two approaches were used to clarify the definition from the many possible data layers originally considered for analysis: 1) sampling by precedent and 2) using a 300-ft buffer around the trail. A brief explanation of each approach follows.

Sampling by Precedent

In sampling by precedent, the aim is to look at the data attributes underlying the trail segments already developed (Everett) or approved for development (Malden), and at the area of "underutilized urban public space" that was labeled valuable to the trail (Malden). The assumption is that these areas contain the optimal characteristics to both community and trail since they have already been developed or tagged for development.

The first step in this process was to digitize these sections based upon the information provided in the Bike To The Sea newsletters (**Figure 2**). It is worthwhile to note that while the location of these segments was provided in the newsletters, reasons for development of these locations were not. Consequently, for the purposes of this analysis, it is assumed that these segments have been selected for their locational value rather than for bureaucratic reasons.

1000-ft developed segment

Figure 3 displays the land use types that intersect the trail development segments and were subsequently chosen for this analysis: Participation Recreation, Commercial, and Urban Public. While there was a significant amount of Industrial and bits of High Density Residential and Salt Water Wetland along the trail development segments, these land use types didn't embrace the same "community-oriented" characteristic as the ones chosen. Also, the parking lot in Malden is situated on Urban Public land use. Since this parking lot is an example of a "problem area" where valuable trail land is underutilized, it begs the question: are other parcels of Urban Public land underutilized as well?

The 300-ft Trail Buffer

When sampling by precedent, the land use types chosen for analysis all fell within a 300-ft buffer around the trail. This buffer introduces a human scale into the analysis, since 300 feet is the common measurement for one walkable block. "Community-oriented" land use types that lie directly on the trail or one block away from it are more relevant to the analysis (and to the final rankings) than the same land use types that fall within the 10-minute buffer. The ½-mile trail buffer (a 10-minute walkability buffer) mentioned in the Introduction is still used as a criterion in the final ranking of trail segments, but as a secondary criterion. **Figure 4** displays both buffer areas together with the "Pro-Community" land use types of the Northern Strand Community cities and towns.

Points and Open Spaces

Additional data layers that could indicate potential areas for community use near the path were not used in this analysis since they were often redundant with the land use layer. The primary example of this is the Open Spaces data layer from MassGIS that demarcates baseball parks, cemeteries, transportation areas, conservation lands, etc. The baseball parks that fell within the 300-ft trail buffer and seemed the most likely of "community-oriented" land types were already identified by the Participation Recreation classification of the land use layer. Community infrastructure points such as ice skating rinks, libraries and schools also fell redundantly upon Urban Public and Commercial land use classifications. It is beyond the scope of this analysis to provide degrees other than the two classes of 1st-, 2nd-, and 3rd-order priorities for building the path.

Community Demographics

Population density and median household income density at the block group level for the five cities and towns were essential for locating the concentrations of people and low income in areas along the trail. For the final analysis, density values were consolidated into Boolean values for block groups above or below the median value for each demographic. **Figure 5** shows block groups that are above the median population and **Figure 6** shows block groups that are below the median household income among the Northern Strand Communities.

ANALYSIS & RESULTS

Prior to evaluating the "pro-community" land use and demographic data, the 300-ft and the ½-mile buffers were overlaid separately onto the land use layer to extract the land use areas within these buffers. The ½-mile buffer excluded the 300-ft buffer range. The final analysis consisted of adding together the four layers (300-ft land use, ½-mile land use, above median population, below median household income) through Raster Calculator on the ArcGIS Spatial Analyst toolbar, and ranking the resulting totals. **Table 1** displays the ranking matrix used for the output totals of these layers. Since land use was given the most weight to the analysis, every rank included land use in its total.

Table 1

Trail Segments Ranking Matrix

300-ft Buffer		½-Mile Buffer	
RANK 1	Land Use + Population + Income	**RANK 4**	Land Use + Population + Income
2	Land Use + Population or Land Use + Income	**5**	Land Use + Population or Land Use + Income
3	Land Use	**6**	Land Use

The totals produced through Raster Calculator were assigned to three color categories according to their ranking; darker colors differentiated the 300-ft buffer totals from the ½-mile buffer totals. The color-coded raster polygons produced by the Raster Calculator were then manually digitized as separate segment layers over the Northern Strand Community Trail. **Figure 7** is the final result of these ranked segments, with higher-ranked segments displayed over the lower ones. Attention must be paid to the "developed" and "approved for development" segments of the trail that overlap all underlying rankings, since these segments have been pre-qualified for development and are therefore excluded from the ranking process of undeveloped segments. Only a few sections of the trail are colored red (1st priority sections) signifying the presence of all three "pro-community" layers – land use, population and income. The majority of the trail is dark or light green, indicating that "pro-community" land use accompanies either population or income. The sections of the trail that remain black are segments where none of the "pro-community" criteria were present.

C O N C L U S I O N

The Northern Strand Community Trail rankings, though not objective by any standard and perhaps irrelevant in the face of real-world application, nonetheless present the newcomer with a reference map for understanding the more "community-oriented" segments of the 9.5 mile route. A future analysis might serve the project more directly by keeping the layers separate for specialized purposes, like the income layer for displaying impoverished areas in order to gain community-based funding. Low income areas were not displayed very well in this analysis by consolidating the "household median income" ranges into Boolean values for above or below the median income. It would have been more effective to display "impoverished areas" by face income values instead by relation to the median value. Also, this analysis did not seem to shed any light on the presence of additional problem areas of "underutilized urban public areas" like the parking lot in Malden. In fact, the parking lot's segment was ranked "3rd priority" (purple), when empirically it has been valued as a top priority area. However, the red "1st priority" segments in Everett and Lynn are in accordance with the present Bike To The Sea development priorities. Bike To

The Sea is this month holding a community forum in Lynn to solicit input how to develop the last 0.5 miles from the end of the trail to the waterfront. Also, the segment underneath the yellow "developed" segment is in fact red, which corresponds to the original premise of this analysis that the red segments should be developed first. Let us hope that the Northern Strand Community Trail continues to see more development in the future.

REFERENCES

Bike To The Sea. (2007). Retrieved March 24, 2008, from <http://www.biketothesea.com>.

Massachusetts Geographic Information System. (2008) Massachusetts Office of Geographic and Environmental Information (MassGIS). Retrieved Februsary 24, 2008. <http://www.mass.gov/mgis/massgis.htm>.

Flink, C., Olka, K., and Searns, R. (2001). *Trails for the Twenty-First Century: Planning, Design, and Management Manual for Multi-Use Trails.* Washington D.C.: Island Press.

Cities and Towns
of the
Northern Strand Community Trail

Legend

- Northern Strand Community Trail
- City of Everett
- City of Malden
- City of Revere
- Town of Saugus
- City of Lynn

Scale 1:63,360

1 inch equals 1 miles

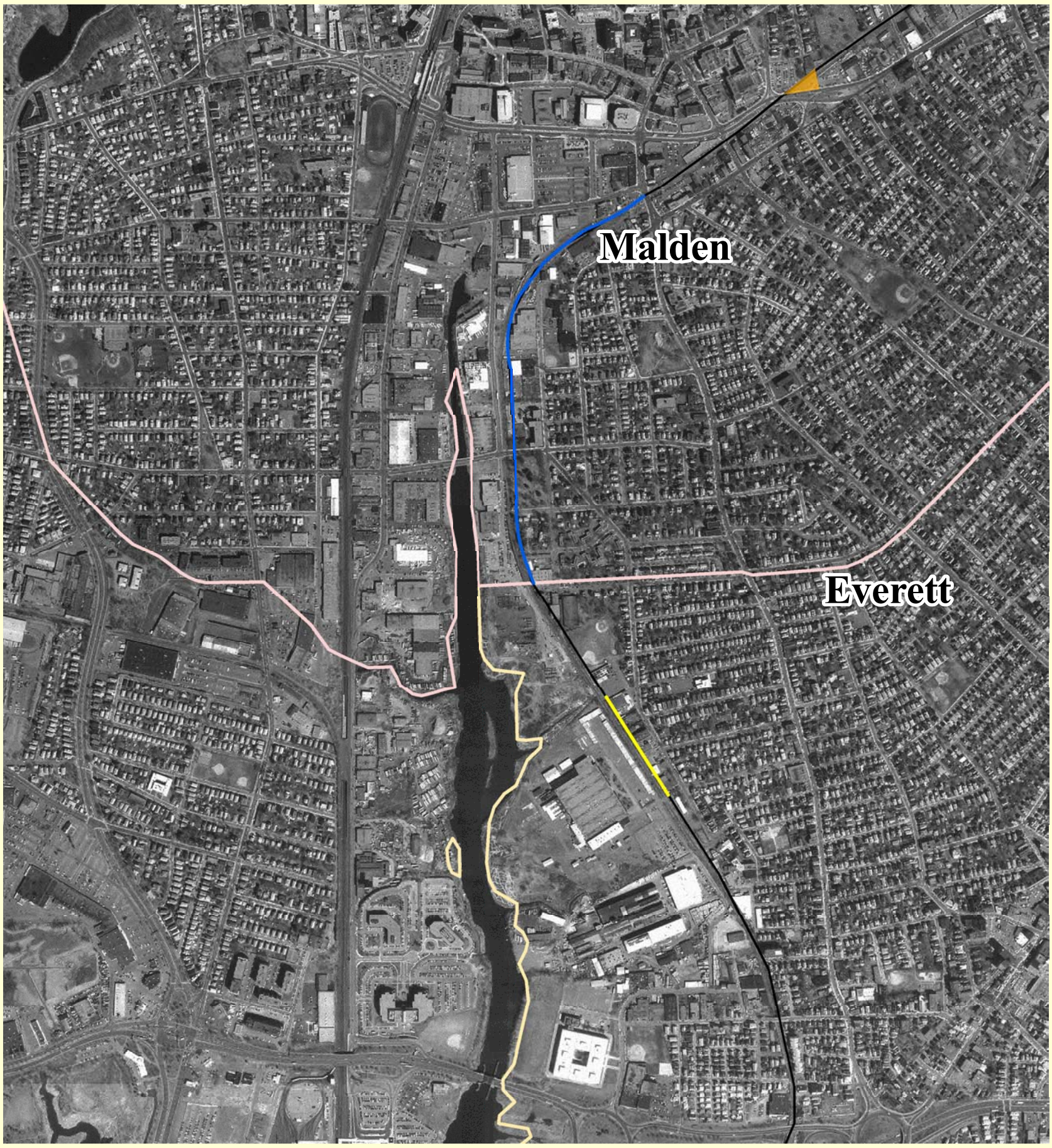
0 0.5 1 2 3 4 Miles

N
W E
S

Data Courtesty of MassGIS

Figure 1

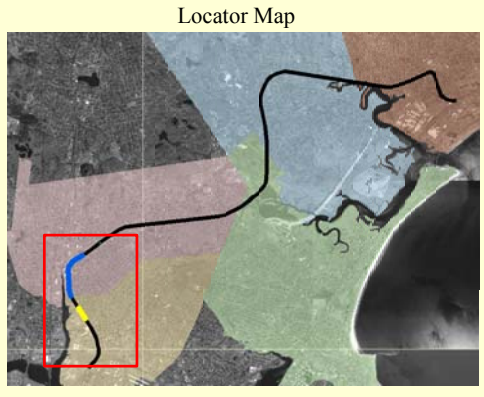
Development Segments
of the
Northern Strand Community Trail



Legend

- Northern Strand Community Trail
- Trail - Developed
- Trail - Approved for Development
- Underutilized Urban Public Space
- City of Malden
- City of Everett

Locator Map



Scale 1:12,000

1 inch equals 1,000 feet

0 500 1,000 2,000 3,000 4,000 Feet

N W E S

Data Courtesty of MassGIS
and Bike To The Sea, Inc.

Figure 2

"Pro-Community" Land Use
in
Malden and Everett
Along the development segments of the Northern Strand Community Trail

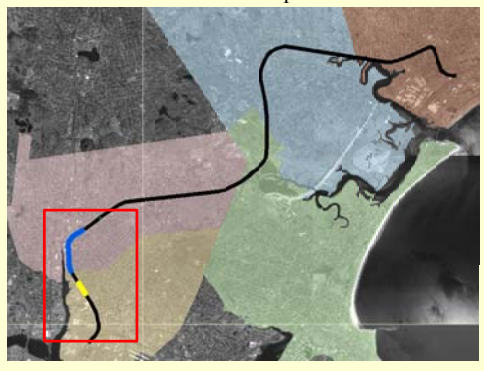
Legend

- Northern Strand Community Trail
- Trail - Developed
- Trail - Approved for Development
- City of Malden
- City of Everett
- Underutilized Urban Public Space

"Pro-Community" Land Use

- Participation Recreation
- Commercial
- Urban Public

Locator Map



Scale 1:12,000

1 inch equals 1,000 feet

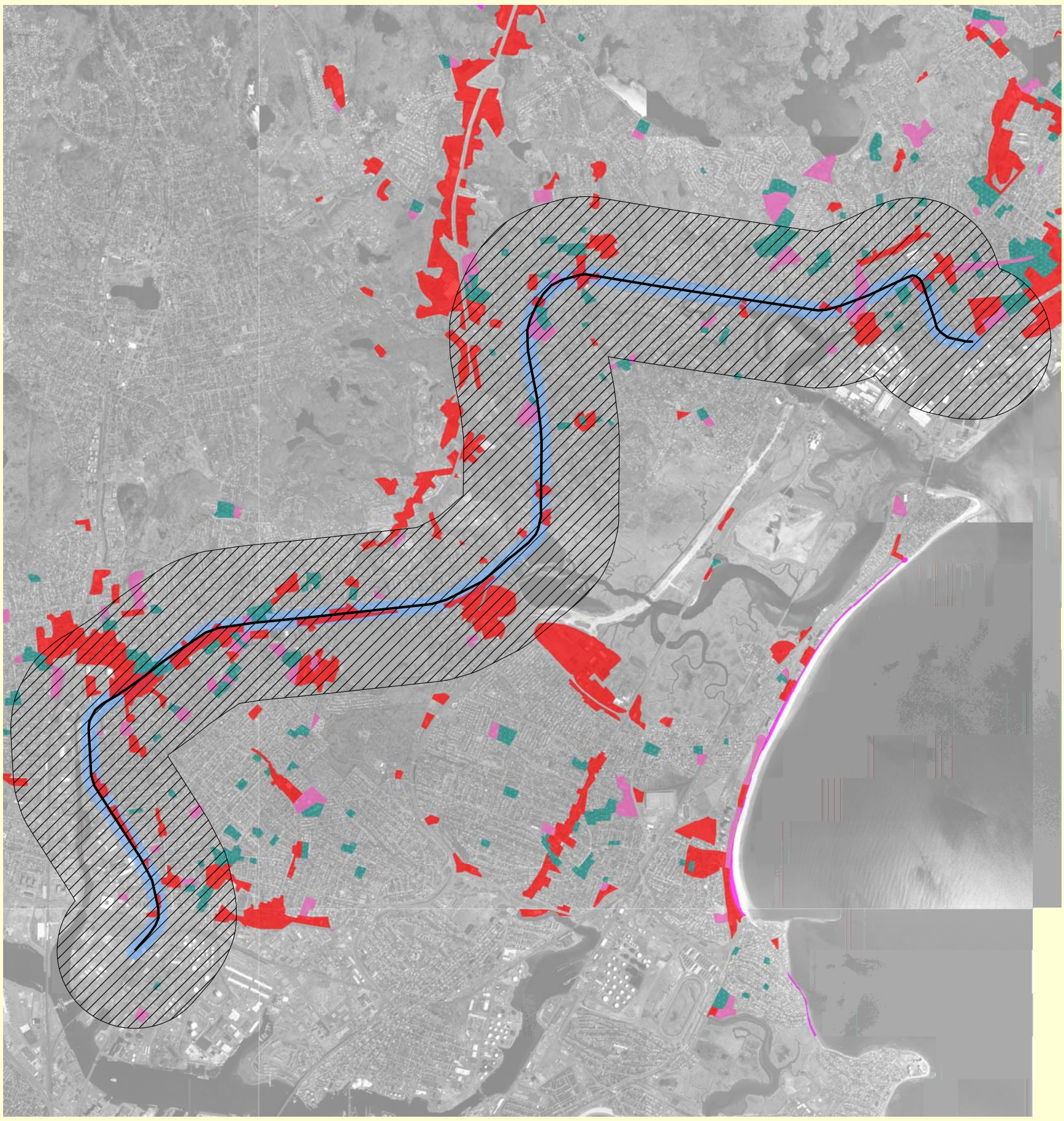
0 500 1,000 2,000 3,000 4,000 Feet

N W E S

Data Courtesty of MassGIS and Bike To The Sea, Inc.

Figure 3

"Pro-Community" Land Use
intersecting the
Northern Strand Community Trail



Legend

- Northern Strand Community Trail
- Trail - Buffer 300 ft
- Trail - Buffer 1/2 Mile

"Pro-Community" Land Use

- Commercial
- Urban Public
- Participation Recreation

Scale 1:48,000

1 inch equals 4,000 feet

0 2,000 4,000 8,000 12,000 16,000 Feet

N W E S

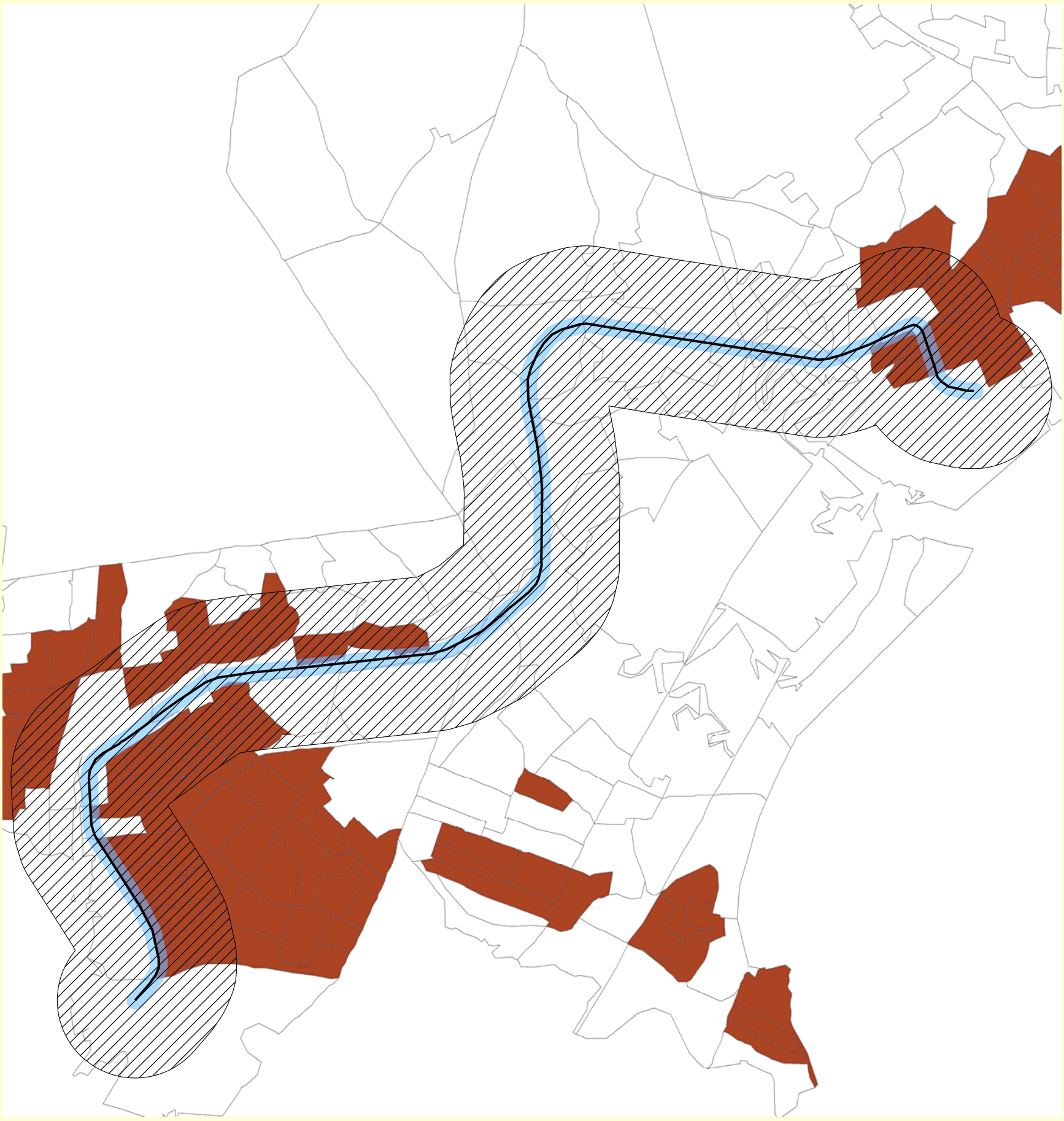
Data Courtesty of MassGIS

Figure 4

Above Median Population

Block Groups of the Cities and Towns of the

Northern Strand Community Trail



Legend

- Northern Strand Community Trail
- Trail - Buffer 300 ft
- Trail - Buffer 1/2 Mile

Above Median Population - Block Groups

- More than 13,580 people per sq. mile

Scale 1:48,000

1 inch equals 4,000 feet

0 2,000 4,000 8,000 12,000 16,000 Feet

N W E S

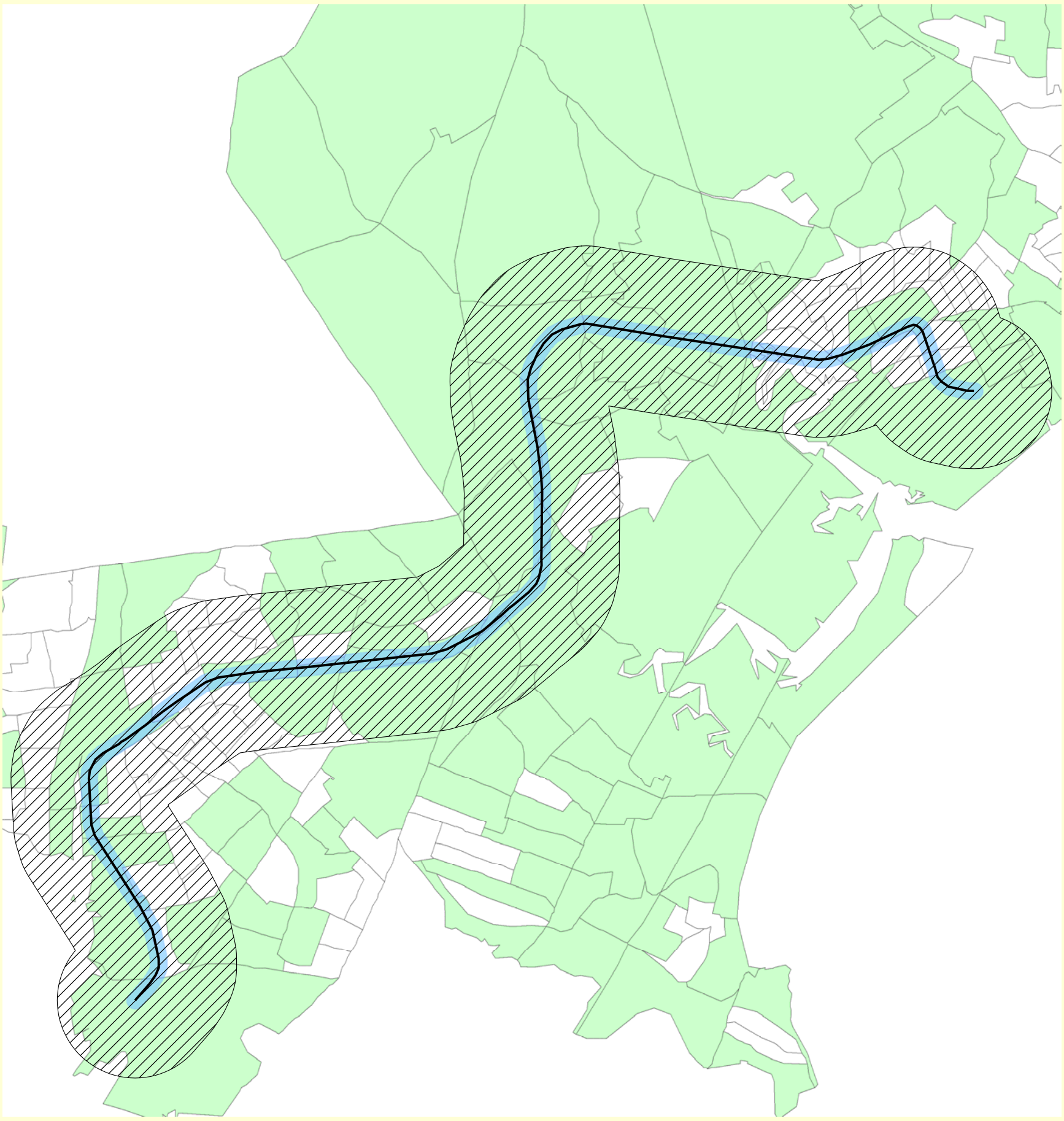
Data Courtesty of MassGIS

Figure 5

Below Median Household Income

Block Groups of the Cities and Towns of the

Northern Strand Community Trail



Legend

- Northern Strand Community Trail
- Trail - Buffer 300 ft
- Trail - Buffer 1/2 Mile

Below Median Income - Block Groups

- Households earning less than $468,000 per year

Scale 1:48,000

1 inch equals 4,000 feet

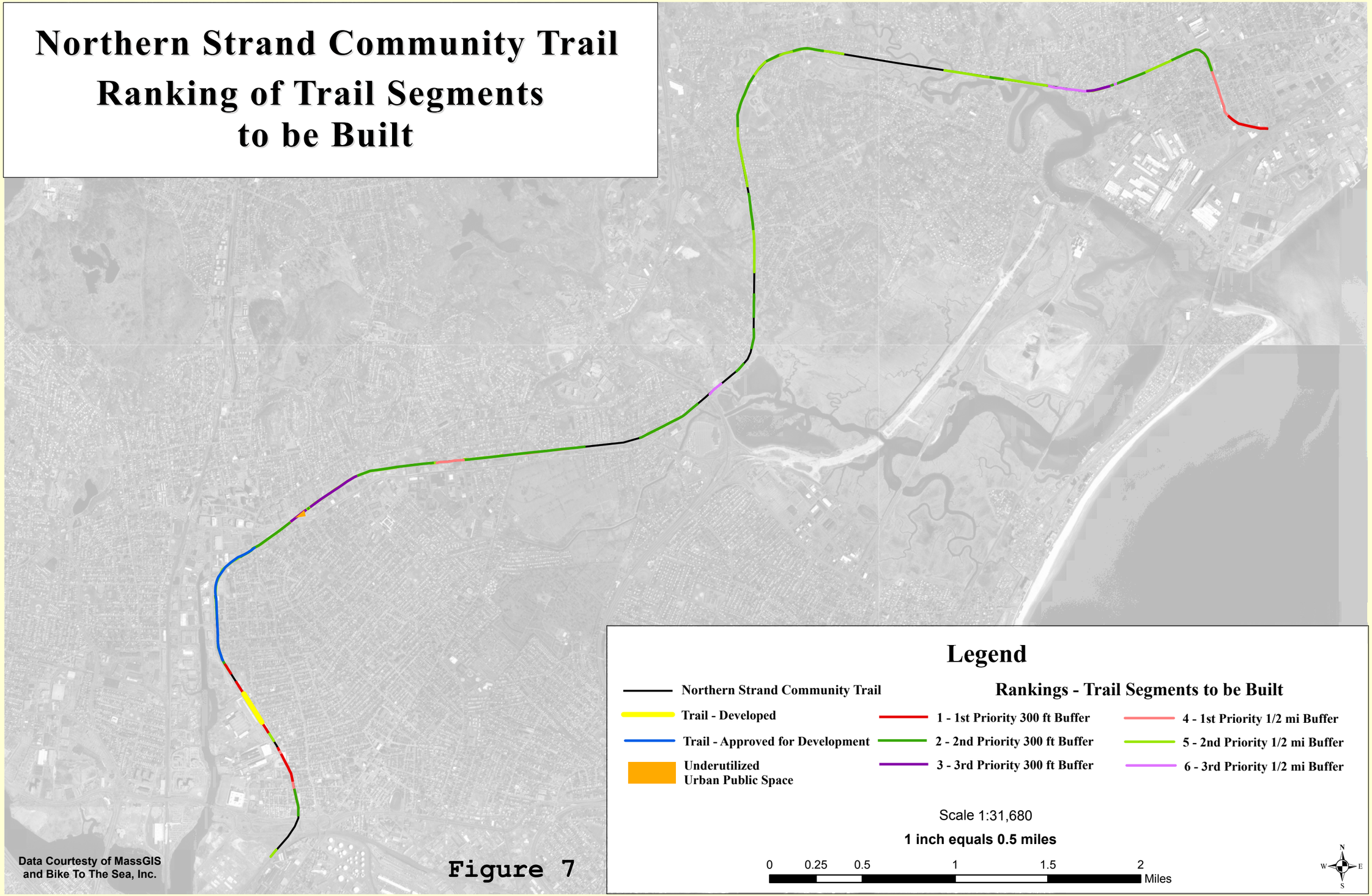
0 2,000 4,000 8,000 12,000 16,000 Feet

N W E S

Data Courtesty of MassGIS

Figure 6

Northern Strand Community Trail
Ranking of Trail Segments to be Built



Legend

- Northern Strand Community Trail
- Trail - Developed
- Trail - Approved for Development
- Underutilized Urban Public Space

Rankings - Trail Segments to be Built

- 1 - 1st Priority 300 ft Buffer
- 2 - 2nd Priority 300 ft Buffer
- 3 - 3rd Priority 300 ft Buffer
- 4 - 1st Priority 1/2 mi Buffer
- 5 - 2nd Priority 1/2 mi Buffer
- 6 - 3rd Priority 1/2 mi Buffer

Scale 1:31,680

1 inch equals 0.5 miles

0 0.25 0.5 1 1.5 2 Miles

N W E S

Data Courtesy of MassGIS and Bike To The Sea, Inc.

Figure 7

IF YOU BUILD IT, THEY WILL COME:

RANKING SEGMENTS TO BE BUILT
ALONG THE PROPOSED
NORTHERN STAND COMMUNITY TRAIL

Final Project
Advanced Spatial Analysis
GIS 3130, Northeastern University
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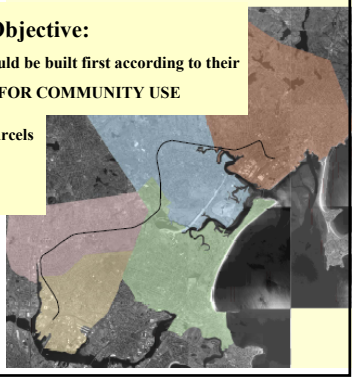
Cities and Towns
of the
Northern Strand Community Trail

Objective:

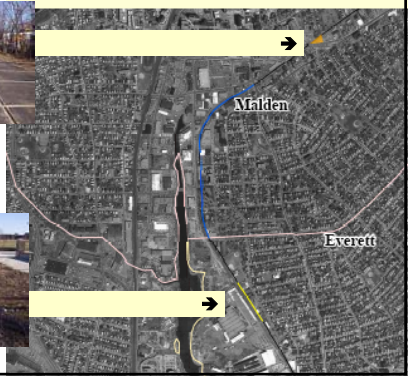
Analyze which sections should be built first according to their

POTENTIAL FOR COMMUNITY USE

- **community-oriented land parcels**
- **population density of area**
- **low income area**



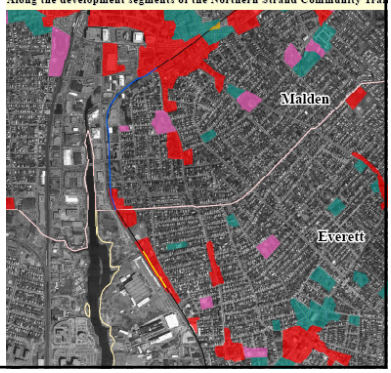
Development Segments
of the
Northern Strand Community Trail



"Pro-Community" Land Use
in
Malden and Everett
Along the development segments of the Northern Strand Community Trail

"Pro-Community" Land Use

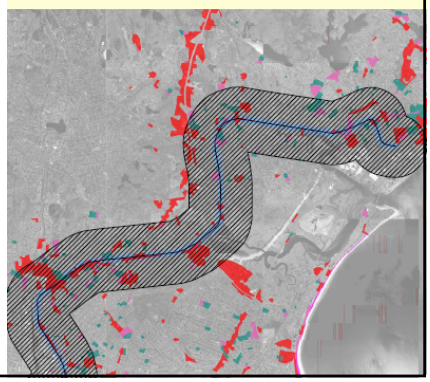
- **Participation Recreation**
- **Commercial**
- **Urban Public**



"Pro-Community" Land Use
intersecting the
Northern Strand Community Trail

Ranking Buffers

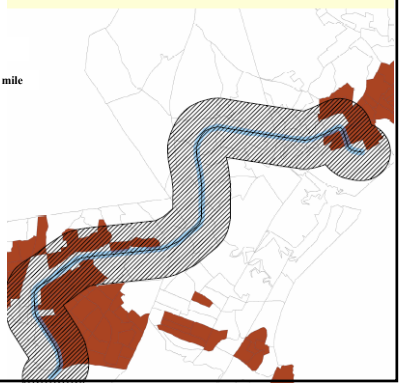
- **300 ft**
- **½ mile**

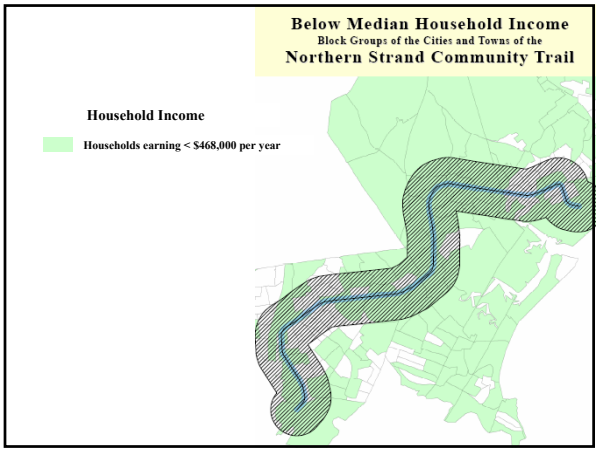


Above Median Population
Block Groups of the Cities and Towns of the
Northern Strand Community Trail

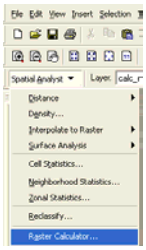
Population

- **> 13,580 people per sq. mile**





Raster Calculator



LandUse (1) + POP (2) + INCOMEBELOW (4) =
1 -- LU
3 -- LU + POP
5 -- LU + INCOME
6 -- POP + INCOME
7 -- LU + POP + INCOME