

# A Spatial Analysis of Lane Transit District in Springfield, Oregon

Winter and Spring 2012 • Geography

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## Acknowledgements

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## About SCI

The Sustainable Cities Initiative (SCI) is a cross-disciplinary organization at the University of Oregon that promotes education, service, public outreach, and research on the design and development of sustainable cities. We are redefining higher education for the public good and catalyzing community change toward sustainability. Our work addresses sustainability at multiple scales and emerges from the conviction that creating the sustainable city cannot happen within any single discipline. SCI is grounded in cross-disciplinary engagement as the key strategy for improving community sustainability. Our work connects student energy, faculty experience, and community needs to produce innovative, tangible solutions for the creation of a sustainable society.

## About SCYP

The Sustainable City Year Program (SCYP) is a year-long partnership between SCI and one city in Oregon, in which students and faculty in courses from across the university collaborate with the partner city on sustainability and livability projects. SCYP faculty and students work in collaboration with staff from the partner city through a variety of studio projects and service-learning courses to provide students with real-world projects to investigate. Students bring energy, enthusiasm, and innovative approaches to difficult, persistent problems. SCYP's primary value derives from collaborations resulting in on-the-ground impact and expanded conversations for a community ready to transition to a more sustainable and livable future. SCYP includes courses in Architecture; Arts and Administration; Business; Economics; Journalism; Landscape Architecture; Law; Oregon Leadership in Sustainability; and Planning, Public Policy, and Management.

## About Lane Transit District (LTD)

Since 1970, Lane Transit District has provided transportation services to Eugene-Springfield and the surrounding communities of Coburg, Junction City, Creswell, Cottage Grove, Veneta, and Lowell. Beginning with 20 vehicles, LTD today carries roughly 11.5 million customers annually with a fleet of 104 buses, which includes both standard and low-floor buses, in length of 30-foot, 40-foot, and 60-foot articulated buses for regular services. Among those 104 vehicles, 11 of those are 60-foot bus rapid transit (BRT) vehicles used for EmX service. All LTD buses have been wheelchair-accessible since 1985. The district currently operates 45 hybrid-electric buses. A board of directors, whose members are appointed by the Governor, governs LTD. A combination of passenger fares, payroll taxes, and state and federal monies fund the system.

## About Springfield, Oregon

The City of Springfield has been a leader in sustainable practices for more than 30 years, tackling local issues ranging from waste and stormwater management to urban and suburban redevelopment. It is the first and only jurisdiction in Oregon to create two separate Urban Renewal Districts by voter approval. Constrained by dramatic hillsides and rivers to the north and south, Springfield has worked tirelessly to develop efficiently and respectfully within its natural boundary as well as the current urban growth boundary. Springfield is proud of its relationships and ability to work with property owners and developers on difficult developments, reaching agreements that are to the benefit of both the project and the affected property owners. These relationships with citizens are what continue to allow Springfield to turn policy and planning into reality.

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# Executive Summary

This report documents the ideas, methodologies, and proposals produced by students of the Advanced Geographic Information Systems (GIS) class for Lane Transit District (LTD) and the City of Springfield. Project members were given the task of spatially displaying data and performing analyses about LTD system ridership and routes. The scope of the project was open-ended but students were expected to draw conclusions and make recommendations for further research. LTD is continually making efforts to improve the efficiency of the bus routes and the accessibility to the patrons of Lane County, Oregon.

Student research was primarily conducted using GIS, and the following projects include a moderate amount of technical information about the processes involved with analyzing the data. The majority of the projects were initially created as accessible web pages to be used for interaction and further data analysis, however due to limited subscription services, the generated maps are no longer accessible. Some of the host webpages still include project context but no longer actually house the maps. For more information about an individual project or data file it is recommended to get in touch with the Sustainable Cities Initiative and the individual student.

The 11 projects included in this report are categorized into three overarching themes. Each project description includes an introduction, methods and conclusion section. The report ends with a summary conclusions section which synthesizes overall recommendations generated by the projects. The structure of the report is as follows.

## Introduction and How to Use this Report

This section briefly explains more about the University of Oregon class and the project scope. It recognizes the City of Springfield's interest in improving their public transportation system. There is also a section about how to use the report is because of technical issues that appeared after the completion of the projects.

## Route and Ridership Analysis

This section analyzes the original data provided by the City of Springfield and LTD to make it easier to comprehend and useful for future planning. Projects in this section studied bus route efficiency by looking at data on bus stop locations, comparisons of expected arrival/departure time and actual arrival/departure times, and the number of people riding the bus. This section is useful for inspiring ideas about where to increase or remove stops on specific routes, and discusses future route expansion recommendations.

## **Socioeconomic Factors**

This section analyzes bus ridership and ways ridership could increase accessibility. It discusses reasons people ride the bus and ways public transportation could become more popular. Projects in this section look at surrounding facilities and attractors that increase ridership like access to food or work, while other projects look at the potential for new housing that would need access to bus stops and routes.

## **Social Media and Crowd Sourcing**

This section is an innovative look at current social media sources that could be used in conjunction with LTD's current communication and outreach methods to promote an increased use of public transportation. These projects use social media and existing attractors in Springfield, Oregon such as the local artwork around town as incentives to increase bus ridership.

## **Conclusion**

This section includes a final summary of students' GIS-derived recommendations for LTD and the City of Springfield.

## Introduction

The City of Springfield is working in conjunction with Lane Transit District (LTD) and the Sustainable Cities Initiative (SCI) to plan for future modifications to the existing public transit system. The corridor from east Springfield (the Thurston area) to the Lane Community College campus via downtown Springfield is the main route under consideration. The projects students developed in the Advanced GIS class were designed to be used as tools for city staff, project managers, public committees, and LTD to plan and accommodate for future needs of Springfield.

The purpose of this project is to analyze the City of Springfield's existing public transportation system and provide resources to further analyze and determine potential alternative scenarios for the development of the EmX line in the corridor. The students were given the option to analyze existing ridership, socioeconomic and environmental issues, existing and potential land uses, zoning, or a combination of variables. Students created online map services for LTD. These mapping websites solicit and enhance public participation regarding the planning process as well as provide a tool to analyze areas with potential for redevelopment within existing zoning and development regions. Although the initial scope of the project was very open-ended and did not expect nor require conclusive evidence, students were able to come up with recommendations for LTD to consider for future development.

### How to Use this Report

The Advanced Geographic Information Systems (Geog 491/591) course was structured as an application of GIS in public transportation planning and data management as well as introducing online publishing. GIS is a computer-based system that merges geographical locations with statistical analysis and database technology. GIS allows planners and researchers to combine and analyze statistical information with its geographical representation. In this course, it was also encouraged to make the generated maps be interactive and editable for further research and analysis. Project members spent the majority of their time in the University of Oregon's Social Science Institutional Labs (SSIL) analyzing Lane Transit District's bus routes and ridership based on shapefiles, data and GIS layers provided by city staff.

Under the heading of each project are the webpage links to the required final products of each student. For some projects students were required to submit a webpage as their final product that included the maps they created with explanations and any conclusions, discussions, or recommendations the student found. The majority of the webpages includes multiple maps that are interactive and in some cases time-enabled. The maps can be zoomed in/out and have many clickable features such as the bus routes or stops that includes additional data and information.



Each project presented in this report was intended to be accessible online to anyone without membership or fees as well as interactive and to some extent editable. However, due to technical issues, the maps generated are no longer accessible online. For more information about the data, it is recommended to contact the individual student(s) associated with the project as some of them have been able to retain the maps in other databases. The students' main objective was to create a tool for the general public and city staff to use so that they could develop more specific questions that could be answered with recommendations. Although the tools were not maintained as expected, this report intends to inspire further research on many of the ideas presented in the projects and offer visual explanations of the original datasets.

# Route and Ridership Analyses

## A Visualization of Lane Transit District Bus Ridership from 2006-2012 in Springfield, OR

*Brenda Freeman, Sage Limpp-Wagner, and Glenn Peterson*

- *Freeman: [blogs.uoregon.edu/freeman491/?p=19&preview=true](http://blogs.uoregon.edu/freeman491/?p=19&preview=true)*
- *Limpp-Wagner: <http://pages.uoregon.edu/sagel/sagel/ridership.html>*
- *Peterson: <http://blogs.uoregon.edu/gwpeterson/>*

When a bus doesn't arrive at the scheduled time, it may not actually be late; unaccounted changes in ridership could be one of the reasons the bus is not running on schedule. Perhaps the bus is not actually late and the schedule needs to be re-evaluated to accommodate the increase in ridership. Project members recognized this and constructed a time-enabled map to display the increase or decrease in ridership at each bus stop for the years 2006-2012. Riders have evolved from relying on public transit for single destination to work, into multi-destination use for things such as shopping or recreation. This map helps determine what factors are causing the changes in ridership, whether it is city zones, population density, or nearby facilities (see Figure 1).

### Information about the Data

These maps depict the temporal changes in total number of passengers getting on at each bus stop for one week from each year from 2006-2012. The time slider tool in the upper right hand corner displays proportionally how stops have increased or decreased in ridership for each year. Ridership is represented by "total ons" of each stop, which is the total amount of passengers getting on buses at each stop. However, one limitation is that not all of the "total ons" for each stop are taken from the same week every year. Half are taken from the month of May and half from the month of October. All the layers in the WebMap can be clicked on for further information.

### Methods

This map is designed for analytical use in determining where and why the bus has had changes in ridership. Springfield land development zones were aggregated into nine types of zoning from the original 18 categories. High, medium, and low density residential zones were maintained. All industrial zones fell into a single category, as did commercial zones. The zoning information was symbolized qualitatively (see Figure 1).

Points of interest included government buildings, schools, post offices, shopping centers, hospitals, LTD Park and Ride facilities along with their transit stations, fire stations, and public utility facilities. A shape file was created from these points. Addresses and images were collected for as many of points of interest as possible and joined with the attribute table. This enabled descriptive pop-ups

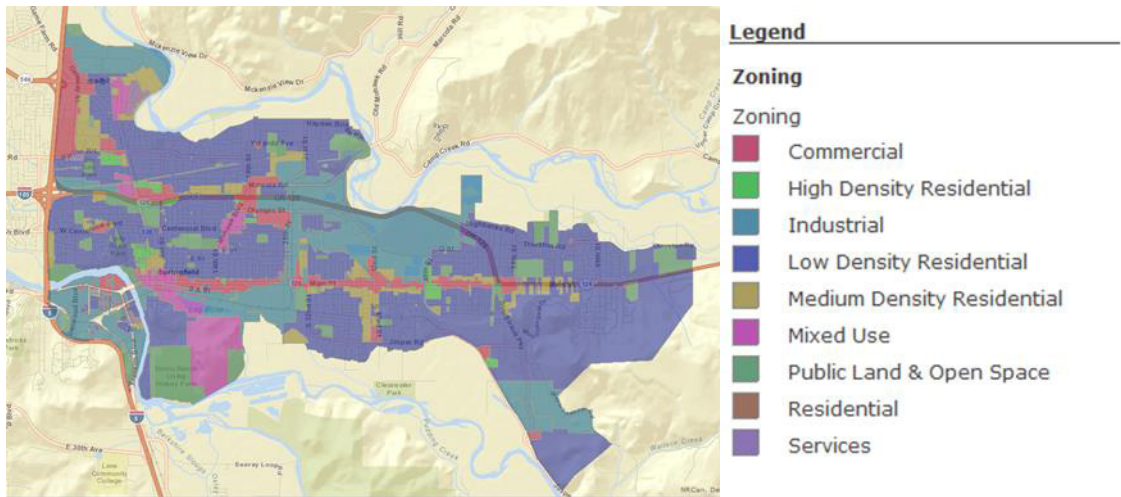


Figure 1: This map displays the nine different zones for Springfield, Oregon as categorized for this project. The legend demonstrates how the high, medium, and low density residential zones were maintained while industrial and commercial categories were grouped.

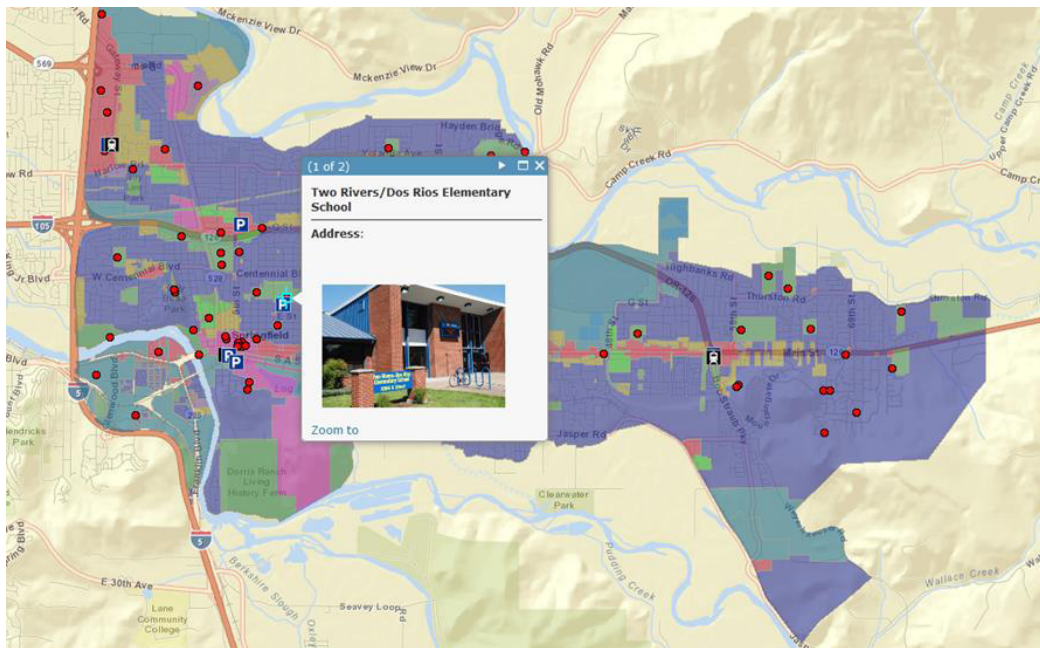


Figure 2: This image demonstrates the clickable features within the map and the additional data that can be displayed for the included facilities.

in the ArcGIS online map. Zoning and points of interests are highlighted in this map because of the idea that the bus has turned into a “multi-destination transit system”. This visualization gives us a better idea of which areas are seeing growth or decline as well as what factors draw people to that area.

The data from LTD was used to create a point shape file that had a temporal attributes. The category used to quantify bus ridership was “total ons,” meaning total number of people boarding the buses. This was symbolized with graduated symbols to represent how many people boarded the bus at each stop. Pop-ups were enabled on these symbols to display total boarding at this stop. Then the data from each year available, 2006, 2007, 2008, 2009, 2011, and 2012, were merged to create an attribute table that could be time enabled. This allowed the visualization of ridership changes on an annual basis (less 2010, data that wasn’t available). As the viewer analyzes the change in ridership, they can see what zones may be associated with an increase or decrease in ridership, as well as focusing on what points of interests are nearby these significant stops. The most significant results found were that there was a dramatic increase in stops and growth in areas of low-density residential zones that were near schools. This can be seen in the north section of the map (east of Gateway) where four stops were added between 2009 and 2011 as well as in the east, near the Thurston schools. There are more obvious growth areas such as the expansion of the Gateway area and the downtown area; however, those come from more obvious needs that were already addressed. There is also significant growth in commercial areas, perhaps leading to the idea that people use local transportation for work and recreation.

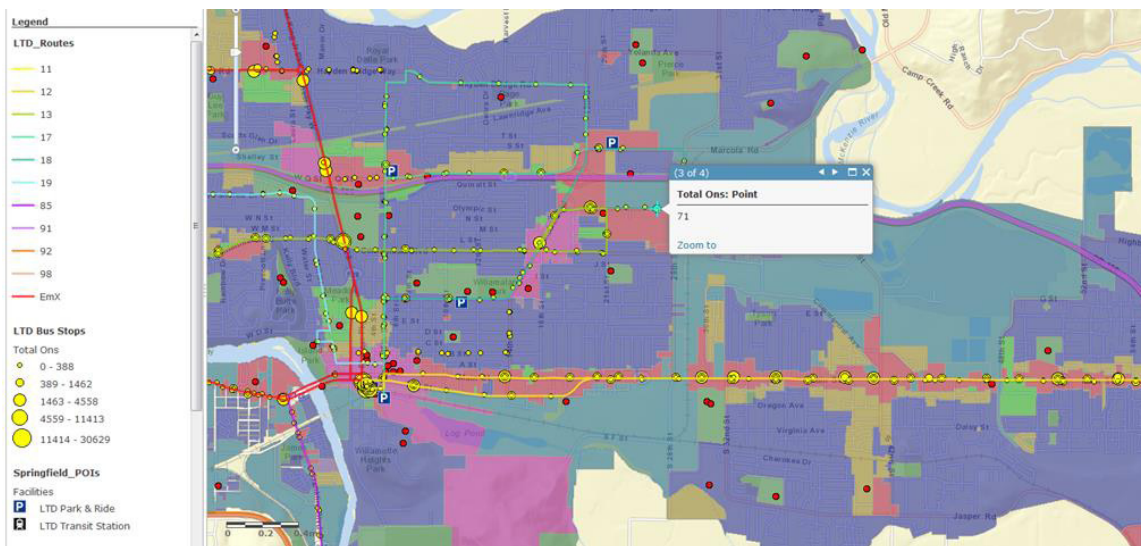


Figure 3: This map shows the ridership data that is associated with each stop on the map and how the different layers of the map can be interactive.

Utilizing ArcGIS Online, all of these layers were published as services for creating an online map that would allow the viewer to see the temporal change of ridership over the span of several years and within the Springfield urban growth boundary. The viewer can control what layers are visible, allowing them to see how bus stops correlate with population density or land development zones.

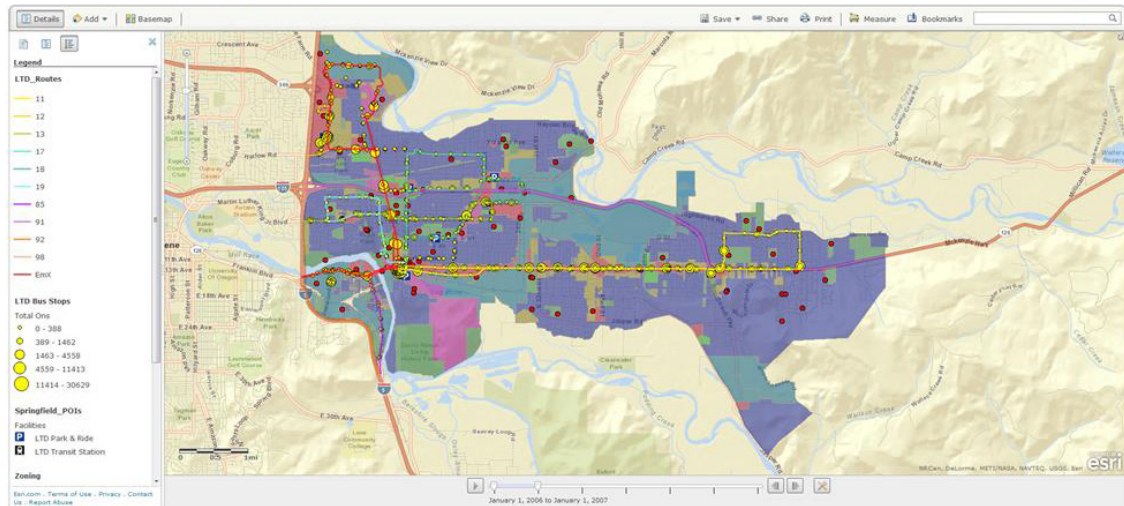


Figure 4: This map displays the changes in ridership by the size of the points at each bus stop, indicating increases or decreases for some routes, and no changes for other routes.

## Recommendations

The final analysis suggested a few possible routes that could be added to the existing bus system to improve efficiency and reach wider-spread areas of Springfield.

The suggested route would run on 42nd Street or 28th Street because it would pass through either a low density residential area or an industrial area, both of which have shown growth in population. Since ridership has developed into multi-destination usage, it is ideal if the east side of Springfield is more directly connected to the other routes and the northwest part of town. Route 91 is the only current route connecting both sides of town but when looked at more carefully on the map, it is evident that the route travels along the highway and therefore cannot connect to any of the other routes. Because of this, transit riders wanting to travel from the east to the northwest part of Springfield must first travel to the downtown area before then traveling north to the Gateway area, Sacred Heart Medical Center, or industrial areas. This suggested route would greatly increase connectivity across the city and could serve a lot of people.

## A Spatial Analysis of Bus Lateness

*Nathan Barone, Emily Nyholm, Benjamin Pontecorvo, and Blake Swanson*

- *Barone: <http://www.arcgis.com/apps/StorytellingTextLegend/index.html?appid=5ee4b06f91584415a4263b48e0309490>*
- *Nyholm: <http://www.arcgis.com/apps/StorytellingTextLegend/index.html?appid=da3fcf5e0ffb455999672db3a405f778>*
- *Pontecorvo: [http://www.arcgis.com/apps/Compare/storytelling\\_tabbed/index.html?appid=c7cb49a25a2e4a8da5c606b332d92141](http://www.arcgis.com/apps/Compare/storytelling_tabbed/index.html?appid=c7cb49a25a2e4a8da5c606b332d92141)*
- *Swanson: <http://www.arcgis.com/home/item.html?id=df9ad1de966e48ddbfa0b1123f6d506>*

This project's goal was to determine when the bus is late and use ArcGIS to map out where the bus is late and along which routes. The City of Springfield provided the students with data from the first two weeks of February 2013 that included all recorded data about bus ridership. Since the data provided such a short time frame it was essential that the student's keep in mind their analysis and the possibility for anomalies or unexplainable externalities. The team of students for this project developed a web-based mapping tool to help the City of Springfield and LTD staff interact with the map to see increase or decrease in delays during specific times of the day. The goal of this project is to give LTD the resources to further research what is causing the bus lateness, and pinpoint the most problematic areas.

### Method

Students began this project by organizing and cleaning the 116,000 pieces of data to sort it in a way that could be statistically analyzed and spatially displayed. Each row of data contained information about the route, with coordinates, the scheduled times of departure and arrival, as well as the actual times of departure and arrival. To show the lateness they calculated the difference between the actual arrival and scheduled arrivals of each instance the bus stopped. The data could then be sorted to show averages based on day of the week, time of the day, or both.

The group members for this project created multiple maps, displaying different variables that could affect whether the bus is late or not. These variables include ridership, location, time of day, day of the week, and weather.

From the maps, the students discovered that overall most buses are on average three minutes late or less. Next, the map reveals some patterns in the system, which tell the story of individual routes.

### Findings and Recommendations

Figure 5 shows the EmX (light green) arriving consistently two and a half minutes late, except for the last stop and two in between. This indicates that though the bus leaves the route slightly late, it does not get delayed further on.

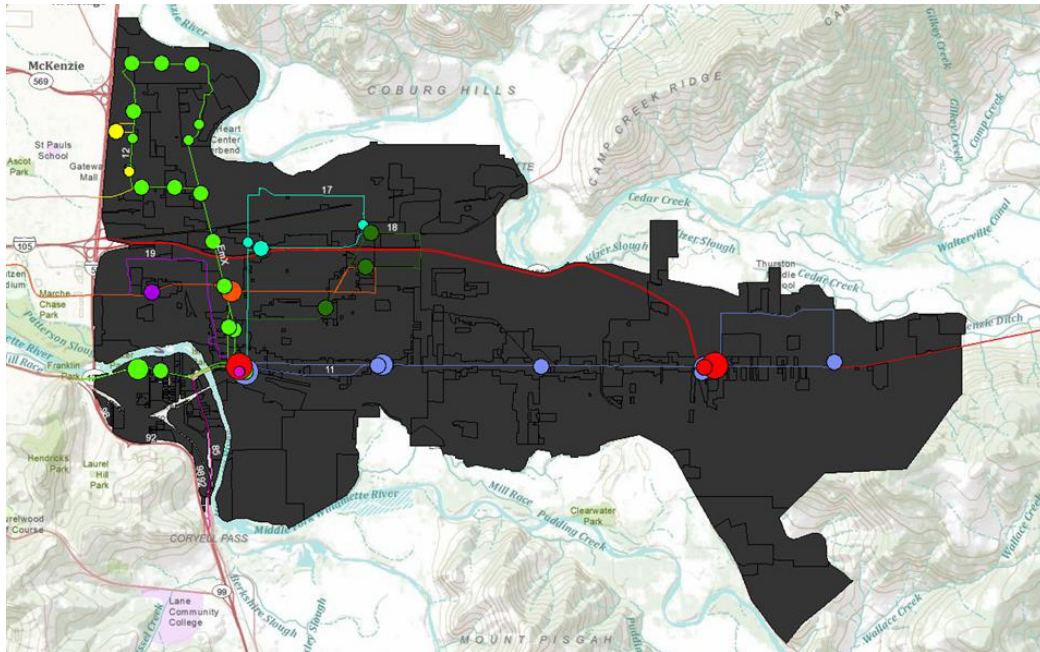


Figure 5: This map shows the different routes and stops organized by colors, and the circles of the stops representing ridership.

The next route that sticks out is the 91 (in red), which has the highest average delay of all the routes. Due to its exceptionally long route (going off the east edge of the map all the way to McKenzie Pass), it is logical that there are more frequent delays along the route. In addition, that route can experience bad weather, further delaying the bus. One case of the pass being closed, or requiring chains could really skew this data. The 91 is a unique route in that it travels far on highways and out of the city on potentially snowy roads.

Routes 17, 18, and 19 are all very urban routes which take passengers through the heart of Springfield. Unlike the EmX which also travels through the heart of Eugene and Springfield, these routes show more variation in their delay. For example, the 17 is on average one and a half minutes late to two of its bus stops, then more than three minutes late to its third.

Routes 11, 92, and 85 are similar to the 17, 18, and 19 in that they run through city centers, but are a different case because they run longer and are possibly more affected by congestion and other factors that are outside of Springfield, in Eugene or along I-5. To analyze these routes, it is a good idea to look at a larger geographic area to determine why these buses are arriving when they are arriving.

This map gives a snapshot of the lateness in the LTD system, and shows that the buses on average are not more than 3 minutes late. However, a more comprehensive analysis with more comprehensive data might reveal a different pattern of delay. With more research and data available, Lane Transit District can use this tool to determine where and potentially why the bus is late.

## LTD: Is it the Best Way to Connect?

Angela San Filippo

- Filippo: <http://blogs.uoregon.edu/asanfilippo/>

Many residents of Springfield rely on public transportation to get to and from work every day. This project analyzes how well LTD serves areas of higher population and employment. The assessment uses four main criteria: level of service, ridership, employment density and population density.

For this analysis four criteria were used to assess whether LTD's current level of service and ridership data are related to where people live and work. Bus route level of service was established by ranking bus stops based on bus frequency, days of week in operation, total hours in operation, and average spacing of bus stops. Current ridership was indicated by the average number of people boarding a stop per day based on data from May and October of 2012. Data from the United States Census Bureau was used to calculate the population density for each census block group. Employment density was inferred through research of similar studies across the United States and abroad, current zoning, and current land use classifications.

### Methods

A multiple criteria analysis was implemented using a weighted overlay to better understand the relationship between these four criteria. To combine these criteria into a single analysis, each cell for each criterion is reclassified into a common ranking system scale of 1 through 9, with 9 being the most favorable. The importance of each criterion was determined through background research of similar studies as well as by trial and visual analysis of different weighting scheme results based on knowledge of the local area. Employment density was determined to be the most important factor and was given a weighting of 40. Population density was the second most important factor and was given a weighting of 30. Level of service and ridership were given the same weighting of 15.

The level of service was evaluated based on the frequency of buses, days of the week the route is in operation, average distance between bus stops along the route, and total hours of operation. The routes that were given the highest level of service are those with the greatest frequency, greatest number of days in operation, highest total hours of operation, and lowest average distance between bus stops.

Level of service ranking is on a 1 to 9 scale with 1 having the highest level of service and 9 having the lowest level of service. In Figure 6, routes with the highest level of service are represented with the darkest blue lines. Bus routes with the lowest level of service ranking are indicated with the lightest color of blue. Ridership data is represented by the average number of people boarding each bus stop. Figure 6 represents greater bus stop ridership with larger circles.



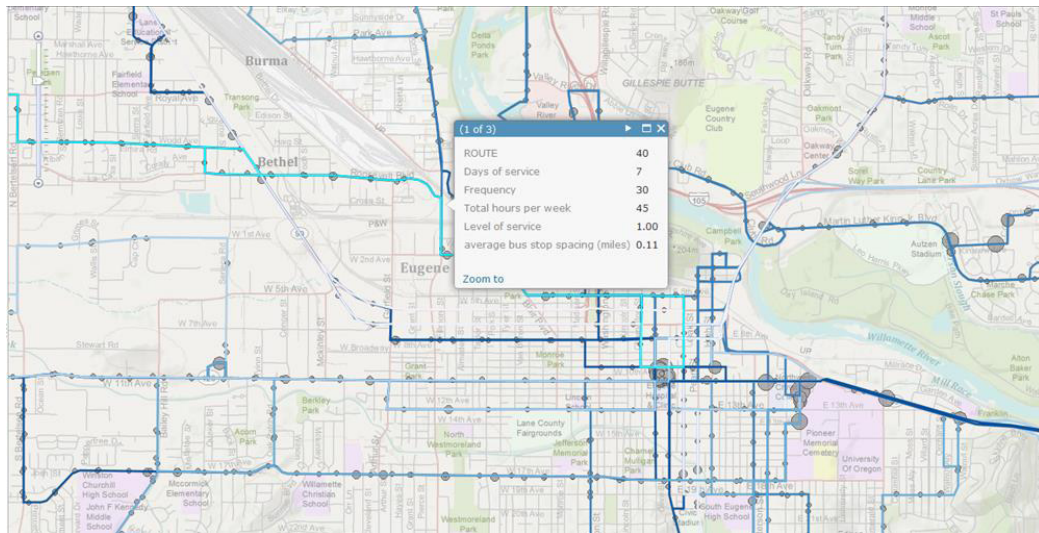


Figure 6: The clickable features in the map allow each route to be highlighted to provide more data about its usage.

In the web application, analysts can click on a bus route and the attributes related to level of service will display for each route.

The highest employment density is in areas that are mixed commercial and industrial areas. The lowest employment densities are in vacant and unbuildable areas as well as low density residential areas. The darker the shade of orange the higher the employment density is in the tax lot area. The densest employment exists in downtown Eugene, north of Eugene along Highway 99, west of Eugene along West 11th Avenue, downtown Springfield, along the Interstate-5 corridor, and just north of downtown Springfield, as shown in Figure 7.

A weighted overlay analysis of ridership, level of service, population density, and employment density is spatially represented on this map. In Figure 8, semi-transparent employment density and population density layers are represented as well as the result of the weighted overlay. The darkest grey sections represent bus stops along the current bus routes where there is the most direct relationship between ridership, level of service, employment density and population density.

## Recommendations

Based on the assessment of current ridership and level of service in relation to where people live and work (population density and employment density) there are a few areas that LTD may want to look at for future expansion or increases in level of service. West 11th Avenue has high employment density as well high population density. The multiple criteria analysis of this area indicates there are bus routes that correspond to the population density and employment density in the area but they are somewhat sporadic and not well connected.

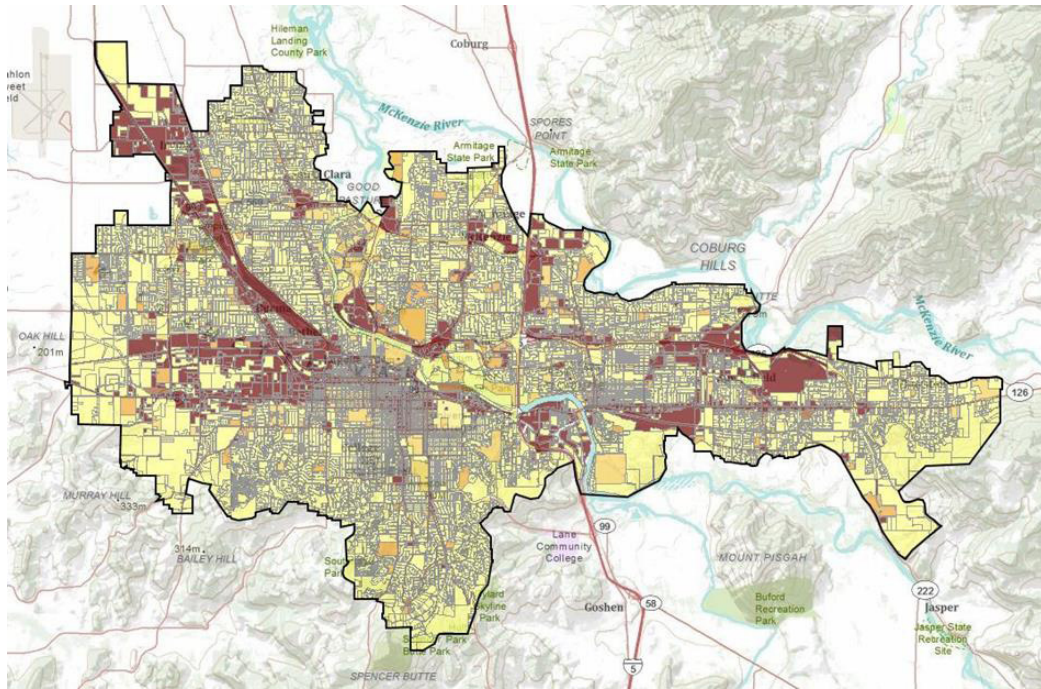


Figure 7: Employment density for Springfield, Oregon, by each tax lot.

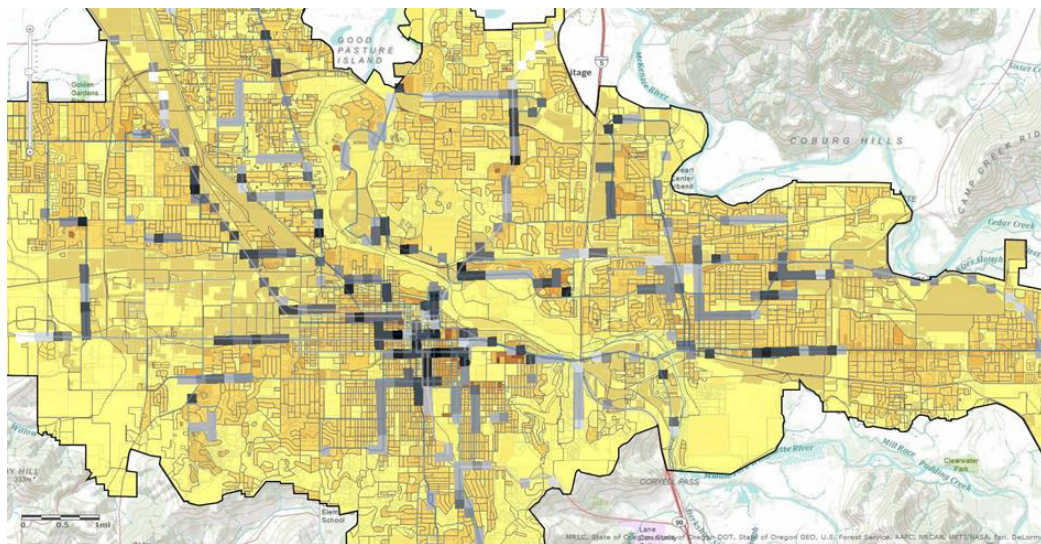


Figure 8: Map incorporates multiple variables. The darkest gray sections represent bus stops where there is the most direct relationship between ridership, level of service, employment density, and population density.

This analysis supports LTD's decision to move forward with the bus rapid transit expansion into this area. There are areas east and south of downtown Springfield where there looks like there is a gap in the level of service and ridership that correspond with employment density. Based on this analysis, the areas directly to the west, east, and north are well served but this area may warrant a more detailed evaluation. The area may be well served by more frequent bus stops or bus stops that are closer together.

This analysis did not go into depth about the relationship between the four criteria and whether the areas with a weak relationship are ripe for expansion of bus routes or for redevelopment and opportunity for business development. More intensive research would have to be undertaken to understand these relationships further. This analysis is really a starting point for where LTD may want to invest time and effort to explore for expansion or increased level of service.

Limitations of this analysis include not having access to actual employment density and inherent inaccuracies based the inferences that were made. Actual employment data would increase the level of accuracy. The level of service rankings may be reevaluated to reflect areas where the bus stops are less than a quarter mile apart as having a lower level of service. This would reflect the overall efficiency or lack of efficiency that comes with having bus stops so close together.

# Envision EmX: The Thurston Extension - Identifying Opportunities for Transit-Oriented Development Using a Multi-Criteria Weighted Overlay

Riley Champine

- Champine: <http://pages.uoregon.edu/rdc/110/GISFINAL/GISindex.html>  
(works best with Firefox not full-screen. Username: 110, Password: 225)

## Introduction

The purpose of this project is to determine the best potential location for stops along a new EmX line that would run between the Springfield downtown and Thurston bus stations. The busiest intersections on Main Street and the existing stations on Route 11 that have the highest average count for ridership were two of the main factors considered in the analysis. The student's project encourages transit-oriented development with the incorporation of existing infrastructure with room for growth or expansion.

## Methods

To perform a sustainability analysis this project weighted six different criteria: Zoning (30%), Land Use Variety (20%), Employment Density (20%), Housing Density (10%), Human Transport Facility Density (10%), and Proximity to Key Services (10%). The data for these criteria were location specific along the Main Street Corridor itself and not all of Springfield. The student created two interactive maps that are user-friendly and maneuverable.

## Findings and Recommendations

The student faced challenges with the accuracy of the network distances and the technical aspect of the map being created, but managed to maintain the focus of the project to the overall transit-oriented development plans for the EmX and still had reliable conclusions. The current Route 11 has bus stops that are in places of high population and employment density and high ridership rates, meaning a transit-oriented development plan is very feasible for any extension or adjustments of the routes.

# Socioeconomic Factors

## Affordable Housing and Low Income Access to Public Transportation

*Amy Cabbage*

- *Cabbage: <http://blogs.uoregon.edu/springfieldaffordablehousing2013/>*

The purpose of this project is to determine whether affordable rental housing developments in the City of Springfield are adequately serviced by Lane Transit District (LTD) bus stops and transportation routes. The focus of this report is on existing developments and ensuring LTD is being efficient and being used by people who would benefit from LTD service.

Accessibility to affordable housing is important to consider because it is a publicly supported resource for low-income individuals, families, older adults, and adults with disabilities. To ensure the needs of these people are met, it is important that affordable housing provide them with critical amenities, such as convenient and reliable public transportation, so individuals can commute to work, shop for food, visit family and friends, and access necessary services.

### Background

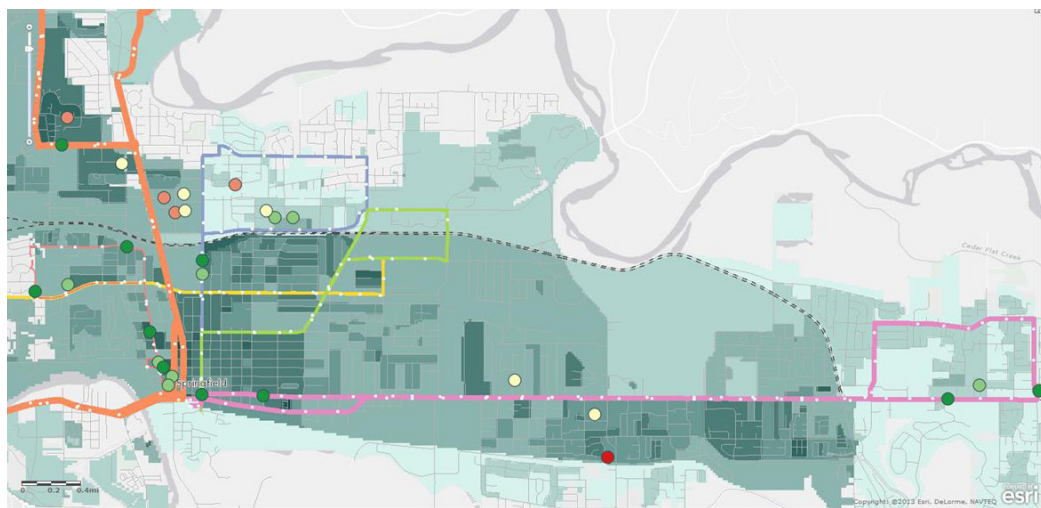
Affordable rental housing consists of rent regulated apartments in which rent cannot exceed market value and rent payments are calculated based on a resident's income or local income statistics. Occupants must meet low-income requirements and there is typically wait time involved before they can move into a new affordable unit due to high demand and limited supply. Eligible applicants may be required to wait from 6 to 12 months for a unit to become available, depending on the housing provider and the unit that they would like to rent.

### Methods

Using a web mapping tool the student created, she was able to come to some conclusions about accessibility. Access to public transportation is relatively good for those who reside in Springfield affordable rental housing units. All affordable rental developments are located within a 10 minute walk to a bus stop, and most units are within 3 minutes walking distance or less (see Figures 12 and 13). With some exceptions, developments are also located within close proximity to bus routes that offer a high frequency of service (for example, the EmX and Route 19). While this may have been the intent of the housing developers, LTD can also be credited with providing and maintaining this public transportation amenity.

The same, however, cannot be said for all low-income residents in Springfield. Based on an analysis of maps that display an index (2007-2011) of low income population density, not all low-income residents are located within the same convenient and easily walkable distance to public transportation bus stops and routes.

Based on this analysis of public transportation, affordable housing, population, and income data, a recommendation would be for LTD to expand its frequency of service along routes that are near areas of higher low-income population density. A second recommendation would be for developers of affordable housing to use mapping tools such as those developed for this project to help residents identify appropriate housing options and gauge the demand for future housing developments along existing transportation corridors.



**Legend**

Walking Time to Nearest Bus Stop (Minutes)	Springfield_Affordable_ LTD Bus Stops	Route 18 - 40 min freq.	Route 13 - 30 min freq.
0.12 - 1	EmX - 10 min freq.	Route 17 - 40 min freq.	Route 91 - 3 to 6 hr (limited) freq.
1 - 1.87	Route 11 - 15 min freq.	Route 19 - 2 hr (limited) freq.	Springfield Roads
1.87 - 3.01			
3.01 - 4.6			
4.6 - 8.21			

Figure 9: This map and legend show the housing units per development and which ones are not receiving enough options from public transit.

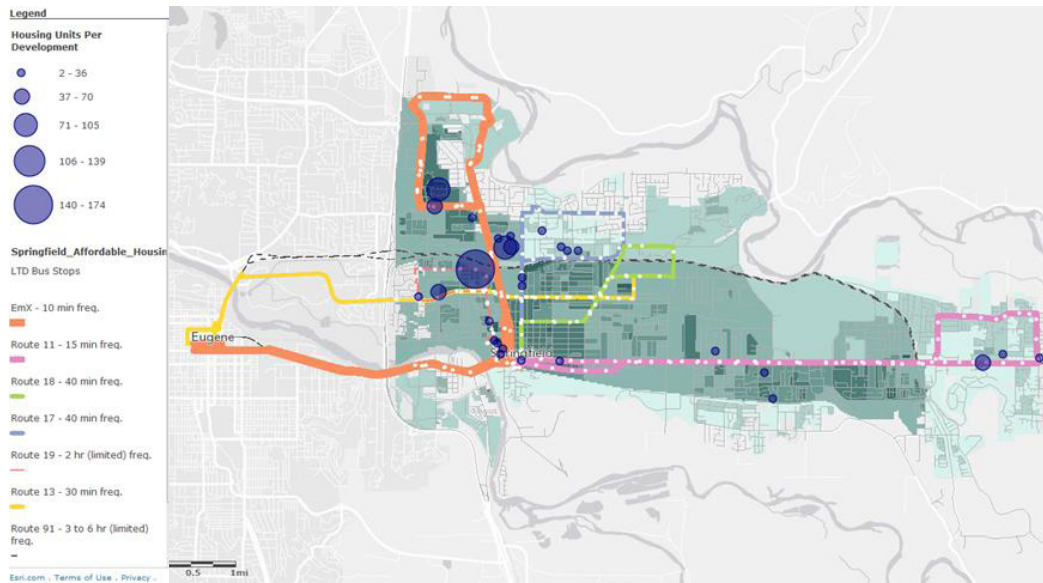


Figure 10: Shows the housing units per development and which ones are not receiving enough options from public transit.

# Tracking Land Value Changes Along LTD Transit Corridors in Springfield, OR 2006-2012

*Adams Bernhardt and Michael Varien*

## Introduction

The goals of this project were to determine the impact of transit infrastructure on assessed land values, discover if a relationship exists between changes in ridership and the assessed land values surrounding transit stations, and to see how transit infrastructure has impacted the value of residential and commercial properties. Lane County is expected to grow over 30 percent between 2007 and 2035 and we assume the City of Springfield would like to increase the number of housing developments, especially rentals, and make sure that they are built in collaboration with the developing transit routes.

## Methods

Station level ridership and changes in ridership from 2006-2012 were displayed over a map of 2011 tax lots using a color scale indicative of their total assessed value. The scale in all maps is consistent embodying 6 breaks (\$738K, \$2.5M, \$5.8M, \$10.9M, \$24.7M, \$295M).

Station level ridership and changes in ridership from 2006-2012 were displayed over a map of 2011 tax lots showing change (in percentage) of assessed valuation from 2007 to 2011. The scale consisted of 7 breaks (-50%, 0%, 25%, 75%, 125%, 250%, 1000%). Tax lots displaying null values for change (i.e. boundaries shifted between 2007 and 2011) were removed from the analysis.

In this analysis the students looked at the impact of the EmX line on the surrounding commercial and residential properties. EmX stations were displayed using station level ridership. Commercial and residential parcels were identified by clipping tax lot data to commercial, residential, and mixed use zones using tax lot centroids.

## Findings and Results

Figures 11, 12, and 13 depict a preliminary analysis of land values within  $\frac{1}{4}$  mile of LTD transit stops compared to land values outside this buffer area. Land values are higher within the LTD transit buffer/corridor and are often highest nearest the stop locations. The analysis shows the affect industrial and medical service tax parcels have on land values, which may account for the higher total land values outside the buffer areas. It also shows increased land values near transit stops, which are consistent with the research, although increased land values and development occur throughout the total land area.

Initial analysis suggests significant increases in land values outside the buffer were either related to larger industrial use, medical use, or real estate development. Additional analysis looks at the EmX route, ridership, total



assessed value and land use to show a relationship between residential and commercial use, without the direct influence of medical use and industrial use. If medical and industrial tax parcels were removed a very different result could occur. The students' findings support the research that shows land values are higher at or near stop locations and decrease further away from the stop location.

This analysis does not determine correlation of stop placement and land use versus stop location and change in land use, nor does it prove a correlation between the stop location, activity, and timing of the land value increases. Further analysis should be done to determine whether the stop or the development was built first. If increased land values are any indicator of the need for additional stops this analysis could show potential new routes and stops. Additionally research into the population distribution, future land use plans, and business activity should be considered.

The tax parcel data used were based on the total assessed values and it should be noted that this data is use for tax assessment and is constrained by legislation for tax rates. These findings are representative of the relationship between the transit corridor and the land use. They provide valuable insight on the affect public transit has on urban development. A more realistic value and analysis should use the Real Market Value data which reflect the real estate value of tax parcels and could provide a more plausible measure for analyzing the economic influence of LTD transit corridors in Springfield. A comparison of the various tax parcel values, total assessed value, land value, assessed value, and real market value could be useful for determining the best measure to use when analyzing future land use and transportation projects.

## **Conclusions**

### ***1. What is the impact of transit infrastructure on assessed land values?***

Land values in closer proximity and within transit corridors are higher per total area. This research supports the economic value of expanding public transit to underdeveloped areas, developing underdeveloped areas, and need to add stops or transit access to areas with higher economic value. This research does not address whether a stop or route spurs development or if development determines stops specifically, however it does show that land values are higher where LTD routes and stops occur.

### ***2. Is there a relationship between changes in ridership and assessed land values surrounding transit stations?***

In regards to displaying activity and change over time the students did not conduct an in-depth analysis to relate ridership to tax parcel data. Preliminary analysis shows that the increases in ridership match increases and changes in

tax parcel values. This analysis does not prove a correlation between ridership and tax parcel values.

### ***3. How has transit infrastructure impacted the value of residential and commercial properties?***

Impacts on commercial and residential values show an even greater relationship between proximity to LTD stops and routes along the EmX route. This analysis supports the first question and the research showing an increase in land values along public transit corridors.

This project shows that land values benefit from LTD stops and routes. The students suggest that the City of Springfield support and encourage projects and policies that enhance, expand or utilize public transit routes and options. The city is encouraged to support development on tax parcels currently underdeveloped. It would be beneficial to identify areas between stops with low total assessed value as potential locations for both new stops and redevelopment. Stops with lower total assessed value and low ridership have the greatest potential for redevelopment. The project would be more valuable with a closer look at the area outside the buffer and identify locations with high total assessed value as spots for future transit stops, as they are potential centers of economic activity, industrial or medical services and could benefit from LTD stops. It is important to consider land values when doing transportation planning for public transit.

After completing the project the students reviewed their work and made recommendations for someone interested in additional research. It would be more accurate to use Real Market Value instead of total assessed value, assessed value, or land value and compare with other tax parcel values data for appropriate analysis. Pedestrian and bicycle accessibility using  $\frac{1}{4}$  mile and  $\frac{1}{2}$  mile buffers could be a subject for additional analysis. Changing the priority in the weighted overlay for specific bus stop locations could also help the project be more accurate. Analyzing land values and rent/sale values by distance from stop for commercial and residential space is another topic for further analysis. Note that commercial rent and values are more reflective of market fluctuations and provide a better metric for analyzing the economic value of transit stations.

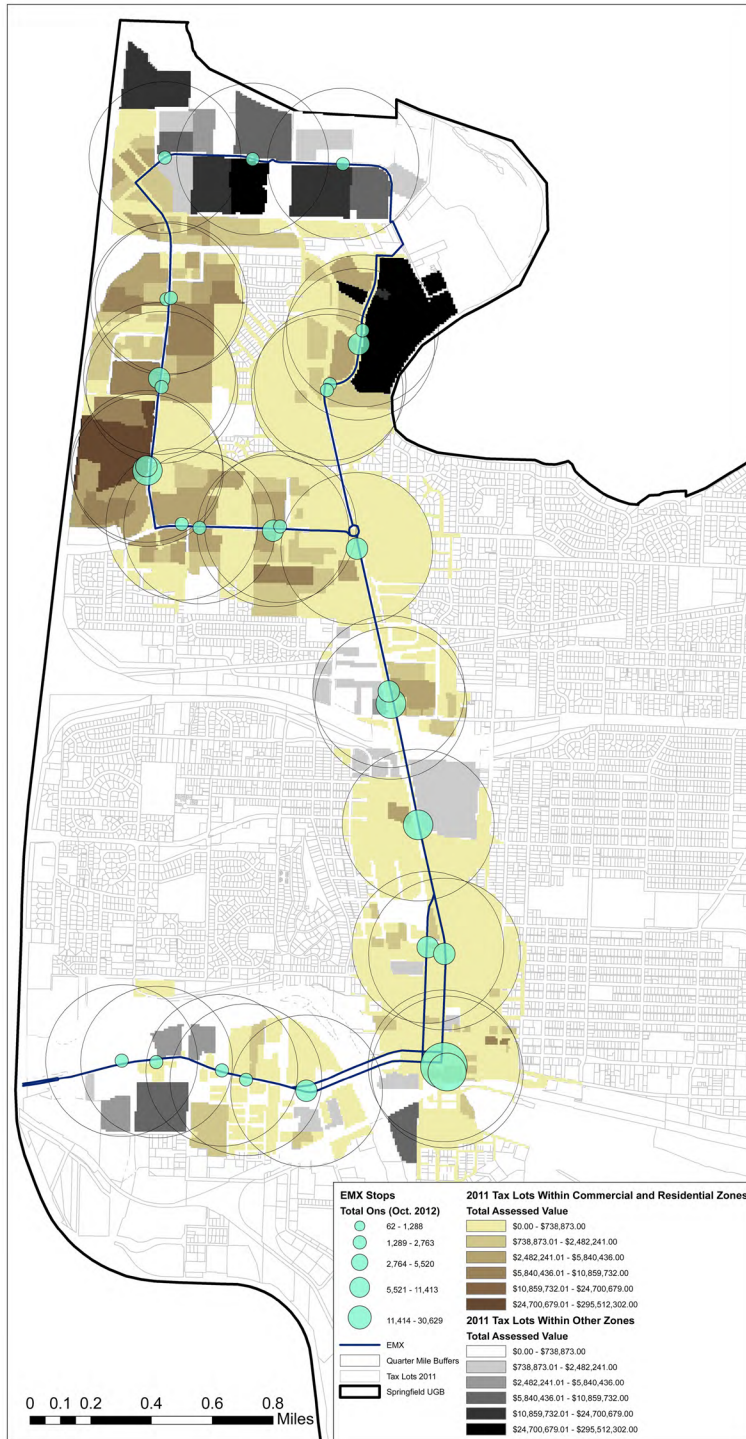


Figure 11: This map, along with Figures 12 and 13, shows the changes in land value along Lane Transit District Corridors.

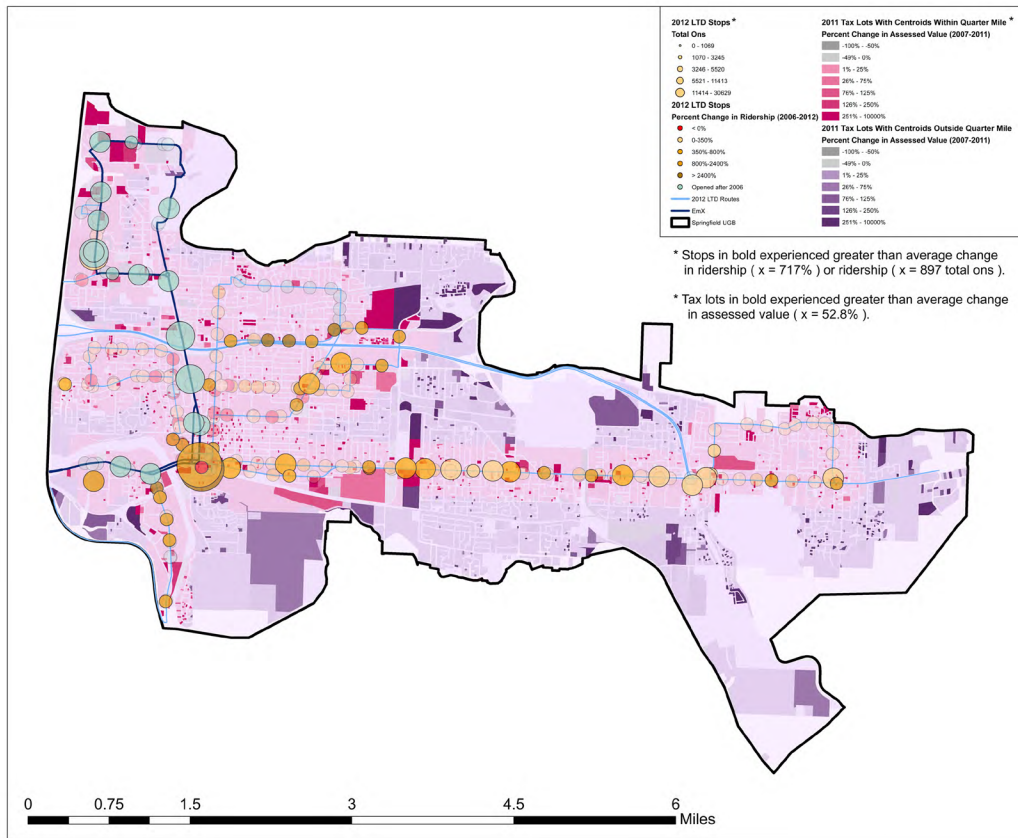


Figure 12: This map, along with Figures 11 and 13, shows the changes in land value along Lane Transit District Corridors.

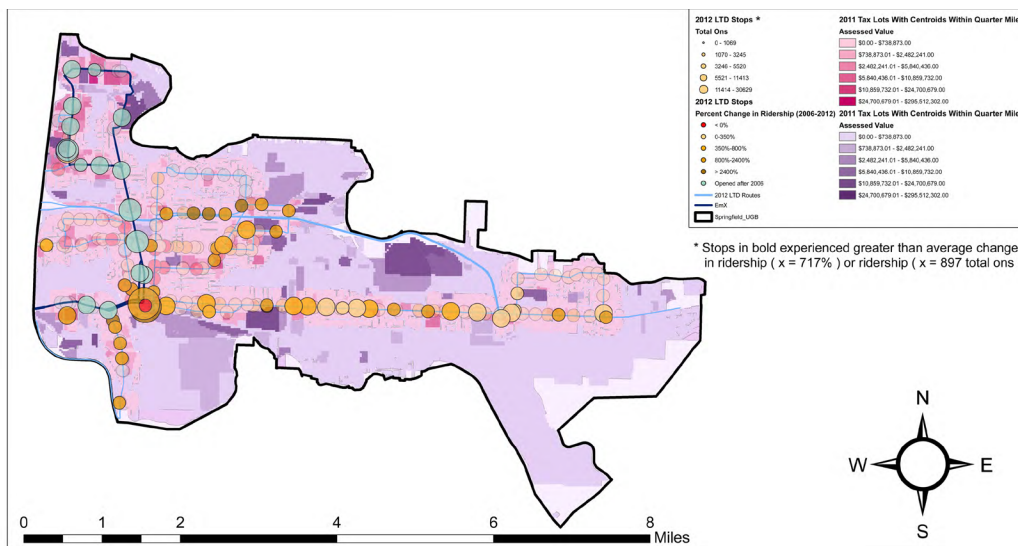


Figure 13: This map, along with Figures 11 and 12, shows the changes in land value along Lane Transit District Corridors.

## Access to Transit from Priority Development Sites

Kimberly Morley

- Morley: <http://blogs.uoregon.edu/kmorley/>

The urban growth boundaries prevent the City of Springfield from expanding outside its designated areas, so population density is increasing within the urban growth boundary. The question this project worked to answer is if there are any gaps in access to public transportation in Springfield in areas where future high-density residential and employment development will likely occur. The population of Springfield increased by 12% from 2000 to 2010; with continued growth the city will have to effectively plan for housing and transit accessibility.

To answer the research question, existing data that classifies tax parcels in Springfield was compiled and a scoring system was developed to identify priority sites. These priority sites were then compared to existing LTD transit infrastructure to identify gaps in service to help with LTD's future planning efforts.

### Methods

To answer this question the student began by compiling the tax parcels in the Springfield urban growth boundary that were classified as vacant industrial, commercial, and residential lands to focus the study on sites that are currently available to support the future employment and housing needs of the city.

Based on this approach, the parcels identified as potential development sites in Springfield are shown in Figure 14.

Once the study parcels were identified, the student added current zoning information and site designations from the METRO Plan to each parcel to further evaluate and score the parcels to determine priority sites. The criteria selected for the scoring methodology included: site acreage, improvement value of site, use consistency with the current zoning designation, and use consistency with the land use designation identified in the METRO Plan diagram, which indicates the city's preferred growth pattern in the future.

Site acreage was selected for ranking because the size of a site directly impacts the types of developments that are feasible on a site. Larger sites allow for more flexible development, and sites larger than 20 acres are considered important for attracting large businesses to an area (Parker, Goodman, and Perkins, 2009). Improvement value was evaluated to take into consideration existing improvements to a parcel that could make development of the property cheaper than if no infrastructure was in place. For example, although an existing building on a site may not be repurposed for a new development, existing utility lines on a site associated with existing buildings could make a site more development-ready. Finally, the current zoning and the METRO Plan land use designations

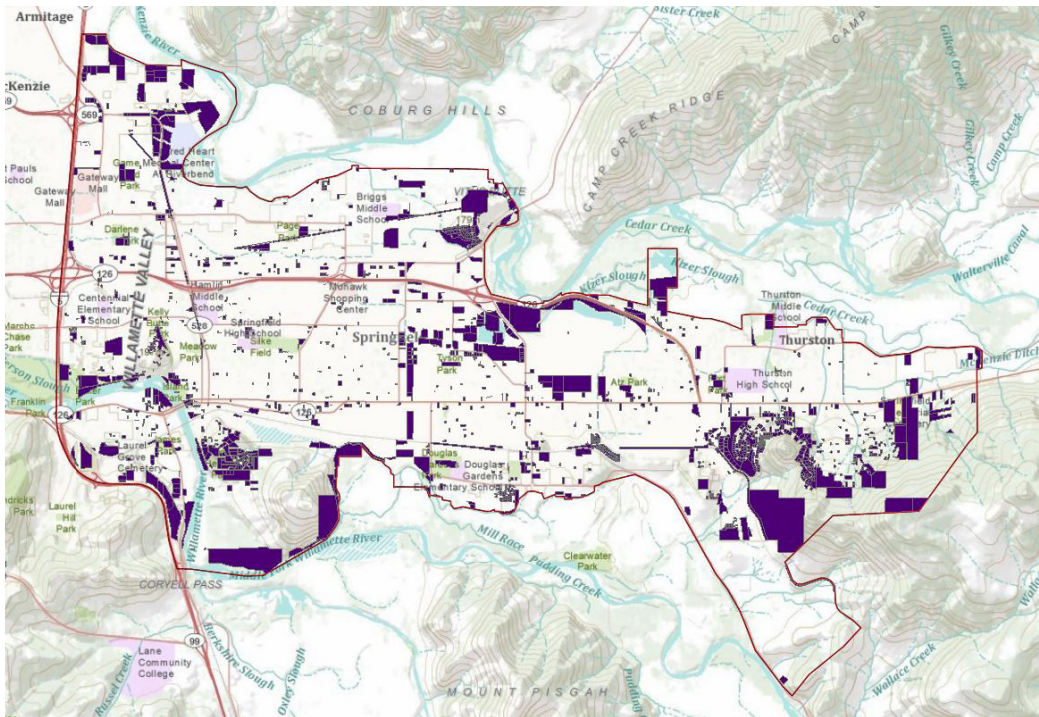


Figure 14: Areas in Springfield, Oregon which have been identified as potential development sites and would potentially need public transit.

were evaluated to assess whether the current property classification is consistent with either the zoning or preferred future land use, or both. Sites that are already zoned or used in a manner consistent with the comprehensive plan may be more suitable for development. For residential parcels, the student considered only high-density residential (HDR) designations (more than 20 units/acre) for her analysis, because a policy of the METRO Plan is to “promote higher residential density inside the UGB that utilizes existing infrastructure, improves the efficiency of public services and facilities, and conserves rural resource lands outside the UGB” (LCOG, 2004).

Based on these criteria, each parcel was scored according to the rubric shown in the table in Figure 15, and the total score of each site was used to identify priority sites for development.

Total scores ranged from four (4) to thirteen (13), and those with a score of eleven (11) or higher were considered priority sites for development. These 97 priority sites are shown in orange on Figure 16.

After identifying priority development sites, the student incorporated LTD’s 2012 bus route and bus stop data to evaluate where transit is currently located in Springfield. Figure 16 shows existing transit infrastructure in blue.

Next, the student created a ¼-mile buffer around the priority development sites to examine the proximity of existing infrastructure to these sites. A quarter-mile

buffer was selected because this is the average distance pedestrians are willing to travel on foot (“Planning Commission TOD”, n.d.). Figure 17 shows transit stops located within the buffer created around the priority development sites. The buffered area was used to determine where bus stops are located near the priority development sites to identify gaps in transit infrastructure.

By examining the availability of public transportation to areas of Springfield where employment and high-density residential growth could be possible in the short-term, the research identifies gaps in infrastructure and shows areas where LTD can work to improve access to public transportation in order to make these sites more viable for future use. Figure 18 shows transit stops located within ¼-mile of priority development sites in green.

In an analysis of Figure 18, there appears to be sufficient transit coverage from most of the priority sites located in the Glenwood and Gateway Mall areas, as well as sites located within ¼-mile of Main Street.

The primary gaps in transit infrastructure are located along Highway 126 (a major road where stop locations are infeasible), along 28th Street between Main Street and Highway 126, and along North 42nd Street between Main Street and Marcola Road. This general area contains a large cluster of priority development sites, and may be an area for LTD to explore further when planning for transit expansion to new areas.

## Recommendations

Transit successfully covers most of the priority sites located in the Glenwood and Gateway Mall areas, as well as the sites located within a ¼-mile of Main Street. The most noticeable gaps in transit infrastructure are located along Highway 126, along 28th Street between Main Street and Highway 126, and along North 42nd Street between Main Street and Marcola Road. It is infeasible along some of the routes to add stops because of the highways, but overall the routes recommended pass through areas with high potential for development.

Table 1: Criteria Scoring Method

Score	Acreage	Improvement Value	Zoning Consistency	METRO Plan Consistency
1	0 - <.1	\$0	Not HDR, C, or I	Not HDR, C, or I
2	.1 - <.23	< \$100,000	HDR, C, or I, but does not support current classification	HDR, C, or I, but does not support current classification
3	.23 - <1	\$100,000 - <\$1 mil	Zoning and classification match	Plan designation and classification match
4	1 - <10	\$1 million +		
5	10 - <20			
6	20+			

Figure 15: Table explaining the scoring method the student used to evaluate each site in order to determine priority sites for development.

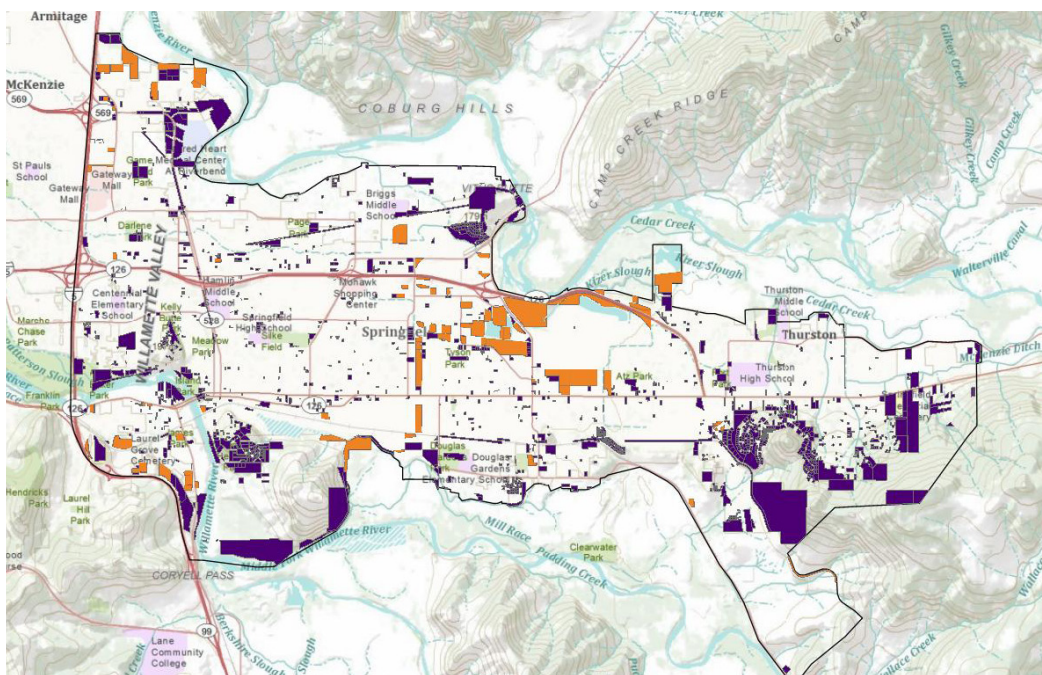


Figure 16: Different priority sites as determined by the student's scoring system.

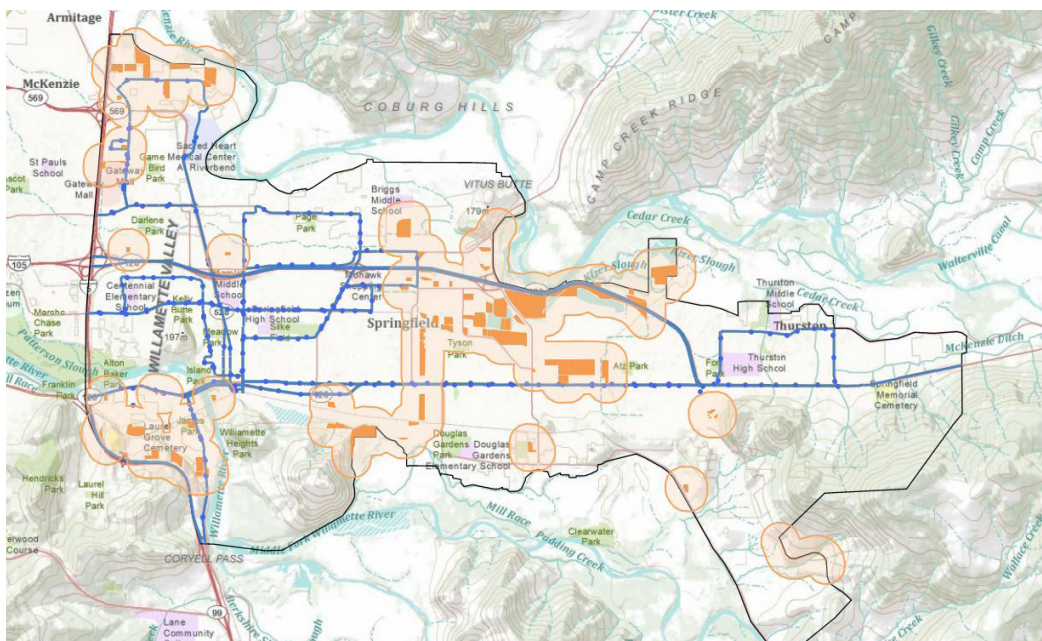


Figure 17: Shows a 1/4 mile buffer around the priority sites which is used to determine where there are gaps in transit infrastructure.



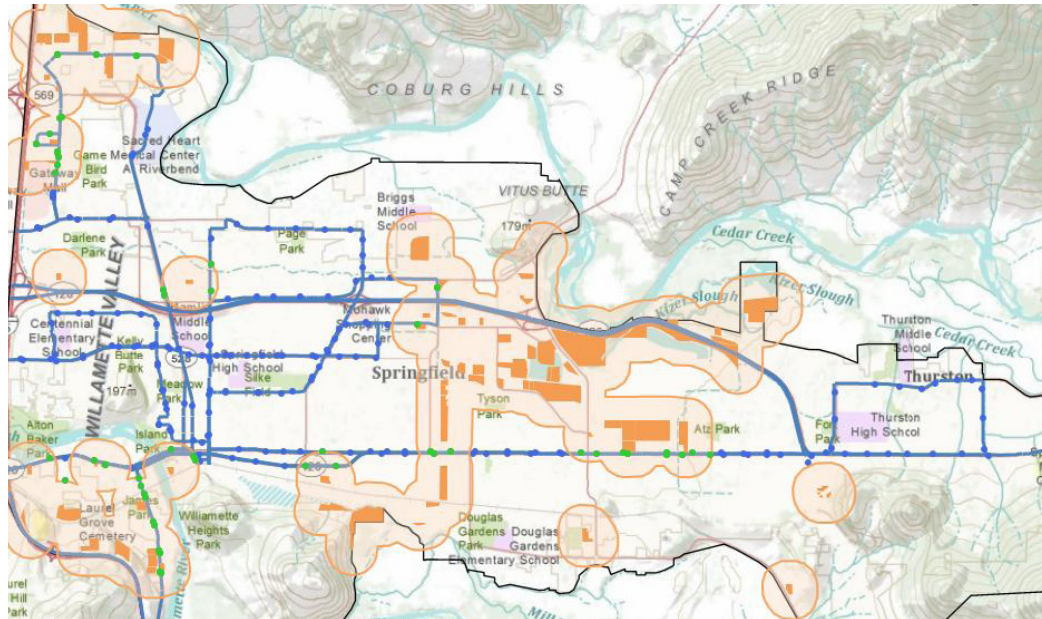
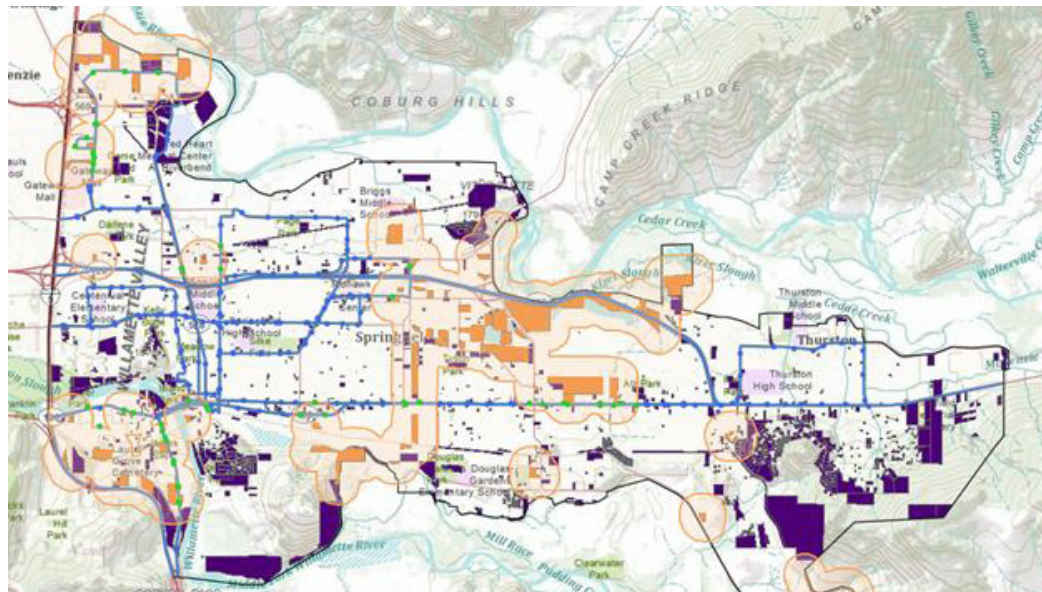


Figure 18: Shows the transit stops located in a 1/4 mile distance of the priority development sites in green.



Legend



Figure 19: Image of the web application the student created that has interactive features and can be used to inspire further research about the transit accessibility and its efficiency.

## Linking Public Transit and Food Access

Rebecca Harbage

- <https://blogs.uoregon.edu/rharbage/>

This project aimed to use geographic information systems (GIS) to further analyze public transit and food accessibility in the City of Springfield. In doing so, the project looked at current bus routes and stops, food store locations, as well as various socioeconomic factors. The purpose was to identify the existing level of accessibility across the city and pinpoint potential areas in need of improved transit to diminish food deserts.

### Background

A food desert is defined by the United States Department of Agriculture (USDA), along with a working group of staff from the Departments of the Treasury and Health and Human Services as “a low-income census tract where either a substantial number or share of residents has low access to a supermarket or large grocery store.” The USDA further defines these stores as “food stores with at least \$2 million in [annual] sales that contain all the major food departments found in a traditional supermarket.” For the purpose of this project, food stores are differentiated between two general categories, supermarkets and grocery stores (large and small) selling fresh produce, and convenience stores. Small, corner market-type grocery stores are also included if they sell a variety of fresh produce because they are often located in areas that lack large box-type stores.

Several reports published by the USDA identify key demographic and socioeconomic characteristics that often constitute constraints on a person or area’s ability to access healthy food options. For example, the USDA found that “[o]wnership of, or easy access to, a motorized vehicle may be the best marker of access regardless of whether someone lives in a poor area or not” (USDA “Food Deserts”). They also found that “[t]hose with low incomes are less likely to own a vehicle” (USDA “Food Deserts”). In addition to census data collected on vehicle availability by household, several socioeconomic factors may also be indicators of vehicle ownership. For example, elderly populations are less likely to drive for a variety of reasons. Having to depend on a neighbor, friend, or family member’s availability to access a grocery store is an inconvenience that may potentially present a barrier to consistent access to healthy food choices. On a related note, access to mass transit may also be a component that affects access to food stores (USDA “Food Deserts”). Other characteristics associated with income, including unemployment and poverty rates, may be indicators of an area’s need for low-cost transportation options for accessing healthy food. This study intends to analyze these characteristics to make recommendations to the Lane Transit District and the City of Springfield about future transit and food store development.

## Methods

This project sought to analyze public transportation in Springfield as it relates to access to food. Actual locations of food stores and transit services were analyzed first, followed by areas where improved access to food stores and transit may be needed. The best way to perform these analyses is to compare them spatially using ArcGIS software. The student had to create the main layer with the locations of food retail stores in Springfield using latitude and longitude coordinate found through Google Maps and the websites of stores themselves. For each store on the map there is also a table of attributes including the address, phone number, and website of the food store.

The stores to be included in the study were up to the discretion of the student. She chose to focus on grocery and convenience stores. Local and regional stores were also included, but it was more difficult to find reliable information for them. Since part of the focus of the project is determining access to healthy food options the student distinguished the stores as either convenience stores or grocery stores. Although not typically included in the USDA's food desert analysis, small neighborhood markets are included in the grocery store category if they sell a variety of fresh produce. To ensure accuracy and consistency the student made phone calls to the local stores included in the study discovering that the majority of the small corner market-type stores are convenience stores that sell a few apples and bananas. These stores were not included as grocery stores. Although the River View Market near Hayden Bridge, just outside the urban growth boundary sells carrots and a few other vegetables, it was not categorized as a grocery store because it relied on local produce that was not always available. Farmers markets, both seasonal and year-round were not included in this study but represent a potential area for future expansion of the project.

In the process of performing this analysis, the student learned that one store, Save-A-Lot on Main Street in central Springfield, actually went out of business a few months before the project began. She chose to leave the store on the maps and explain in the analysis that it was closed because it really calls attention to the dearth of food stores in that area.

Two other key pieces of data were vital to the project. Transit data was provided by the Lane Transit District (LTD) and included bus routes, bus stops, and more detailed information about ridership at each stop, of these, the student used only stop and route data in this study. She also used socioeconomic data downloaded from the United States Census Bureau. All of the Census data used in this study came from the American Community Survey 2006-2011 5-Year Estimates. The specific variables used in the study were (1) the percentage of occupied housing units without an available vehicle, (2) the percentage of the population over the age of 75, (3) the percentage of the population below the poverty line in the last twelve months, (4) the unemployment rate, and (5) population density. All but the last were downloaded by Census Tract while population density was by Census Block.

An overlay was created of the points (bus stops and food stores) and lines (bus routes) on top of the tracts. By combining census tracts with population density by block the student was better able to see where populations are within each tract in regards to the location of transit and food stores. In addition, she wanted to find out what share of Springfield's population resides near a food store. The student chose to define "near" as walking distance, which further defined is 1/4 mile, or about 400 meters. Current research generally uses this measure to define walkability.

For the sake of simplicity in this study, the student looked at a circular buffer around food stores with a 1/4 mile radius. This is estimation since people will walk along streets and cannot cut across blocks to walk a straight line to a food store. Further analysis of this data could include mapping a more realistic catchment area that follows walkable streets. Using this buffer, the student was able to approximate the population living within walking distance of food stores and bus stops, as well as the number of bus stops within walking distance of a food store. She expects the population estimate to be an overestimate approximation because it includes the entire population figure for blocks that are only partially within the buffer. In future analyses, blocks with only parcels that are a majority of the block located within the buffer could be removed from the calculation.

## **Analyses**

### ***Food Retail and Transit Location Analysis***

Looking at the map in Figure 20 the student identified several focal points of population density. As expected, there is a cluster of density near downtown. Other areas include:

- (1) the neighborhood east of the Gateway Center and north of Harlow Road,
- (2) the area just east of I-5 between I-105 and Centennial Blvd,
- (3) a corridor along the north and south of I-105 between 15th Street and Mohawk Boulevard,
- (4) a large residential area north of Main Street to the east of downtown,
- (5) the area to the north and south of Main Street between 28th Street and 42nd Street,
- (6) similarly, two pockets north and south of Main Street just west of the intersection of Main Street and I-105, and
- (7) the residential neighborhoods in Thurston.

Looking at the map in Figure 20, it is clear that some of the density pockets are better served by transit than others. For example, the downtown core and areas to the north are serviced by multiple bus routes that travel along major corridors and through some of the residential neighborhoods. That said, some of the

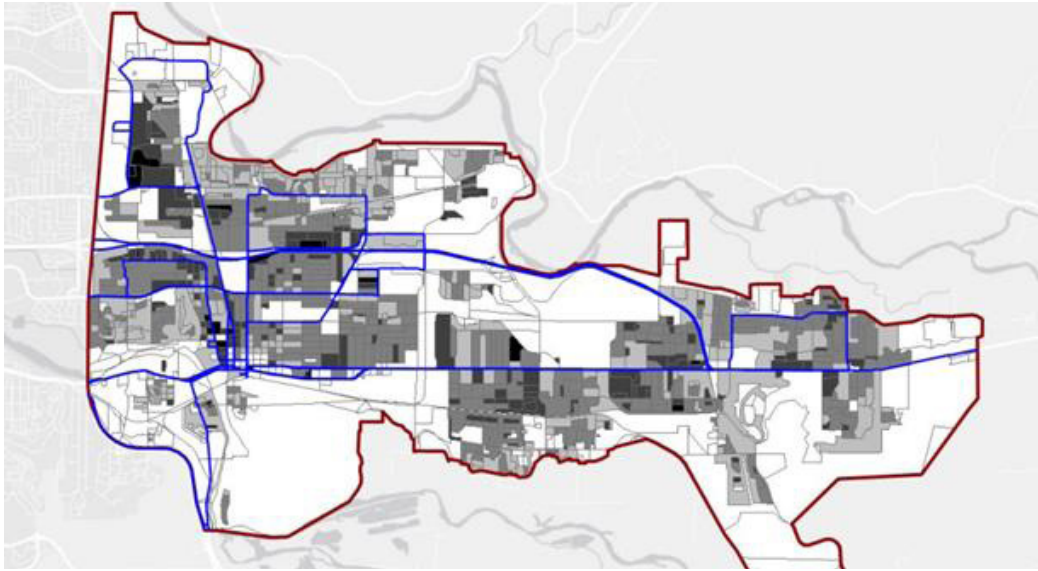


Figure 20: Population density map, by census block, used to identify where increased ridership should be accounted.

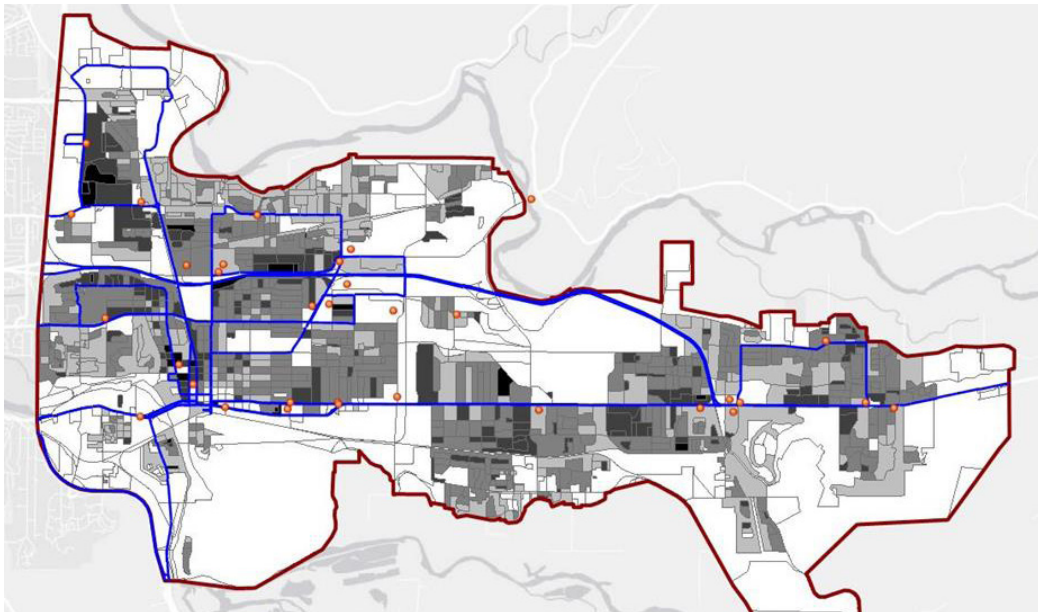


Figure 21: Map of the food retail stores in Springfield, Oregon.

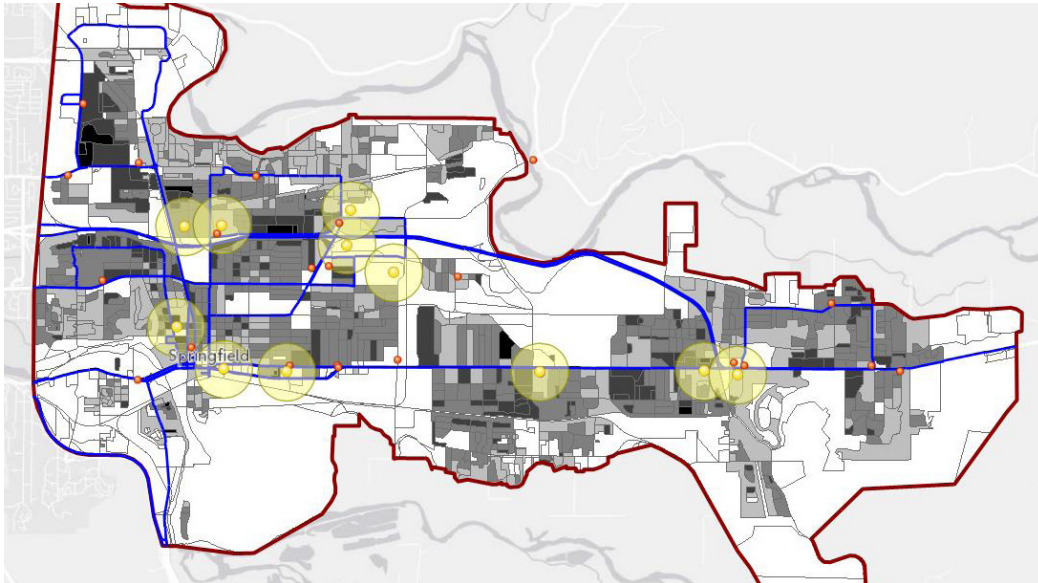


Figure 22: Map of the grocery stores in Springfield, Oregon.

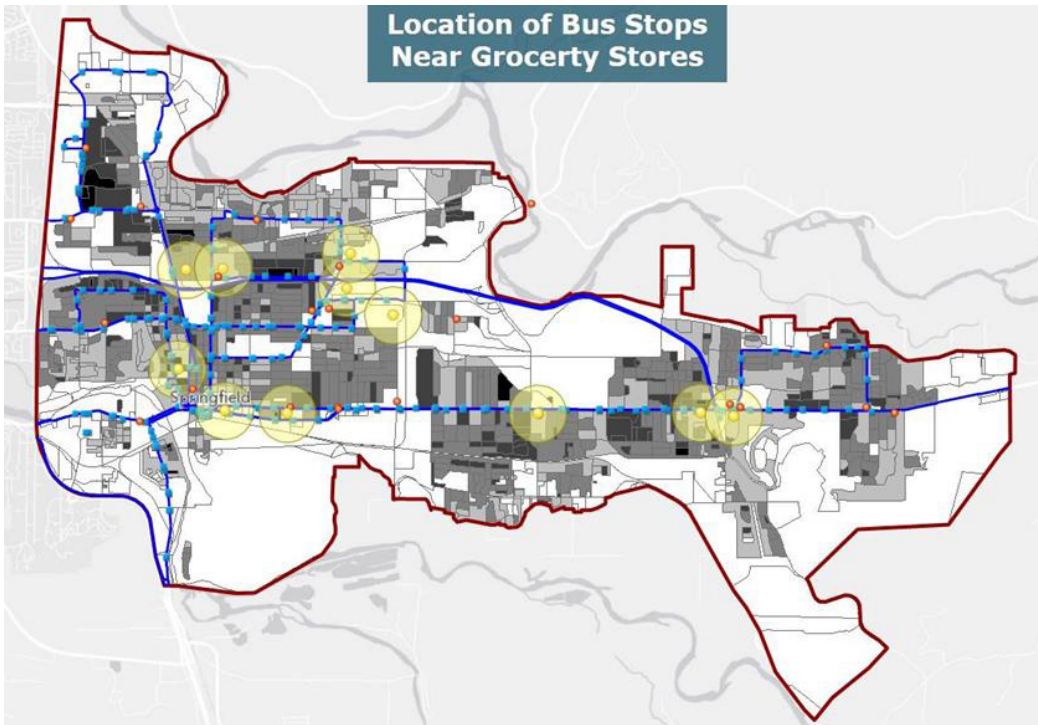


Figure 23: Displays the location of the bus stops near grocery stores in Springfield, Oregon.

pockets may be located farther than walking distance from bus stops. Traveling east, the service, especially south of Main Street, becomes spottier. The map is slightly deceptive in showing a bus route running along I-105 in north-central Springfield – there are no stops located along the highway.

Based only on this preliminary analysis of population density in Springfield, it is possible to pinpoint areas where food stores should be located based on the notion that they should be near population and transit hubs to give residents easy access for their grocery shopping. The map in Figure 21 displays the existing food retail locations in Springfield. These are displayed as orange pins.

In Figure 22, the yellow pins are supermarkets and large grocery stores, with the exception of the Bungalow Market in downtown that sells a variety of fresh produce. In this map, it is more noticeable that some densely populated areas of Springfield are quite far from the nearest grocery store. There are several key areas to note in this analysis, including but not limited to the Gateway area, south-central Springfield, and Thurston.

The yellow circles around grocery stores represent a quarter-mile buffer, or the distance pedestrians are usually willing to travel. Analysis of census block population estimates that about 22% of the population within the UGB lives within a quarter-mile of a grocery store. If a similar analysis is done for all food retail locations the share increases to 54% of the population. Also note that a quarter-mile buffer is only useful for residents who may choose to walk to the grocery store. For the 78% of the population not within walking distance, the question remains as to how they access grocery stores.

Figure 23 shows 2012 bus stops along the routes. Using this data, we can get a sense of whether existing grocery stores are adequately serviced by buses. As previously discussed, most of the stores are located along transit corridors and therefore have several nearby bus stops. However, several stores are located in areas that might be convenient to higher density neighborhoods if bus access was increased.

## Findings

- Not all neighborhoods with relatively high population density have access to bus service. Key areas include the neighborhood to the northeast of downtown, north central Springfield, and the neighborhoods along Main Street between downtown and the intersection with I-105.
- Food retail stores are generally located along existing transit routes, which is both good and bad. Those areas with access to transit can access food retail locations; however, those without access to transit often also lack access to food stores.
- In general, food retail stores are dispersed across the city, but the location of grocery stores leaves out several neighborhoods with relatively high population density. Most notable are west Springfield, north-central

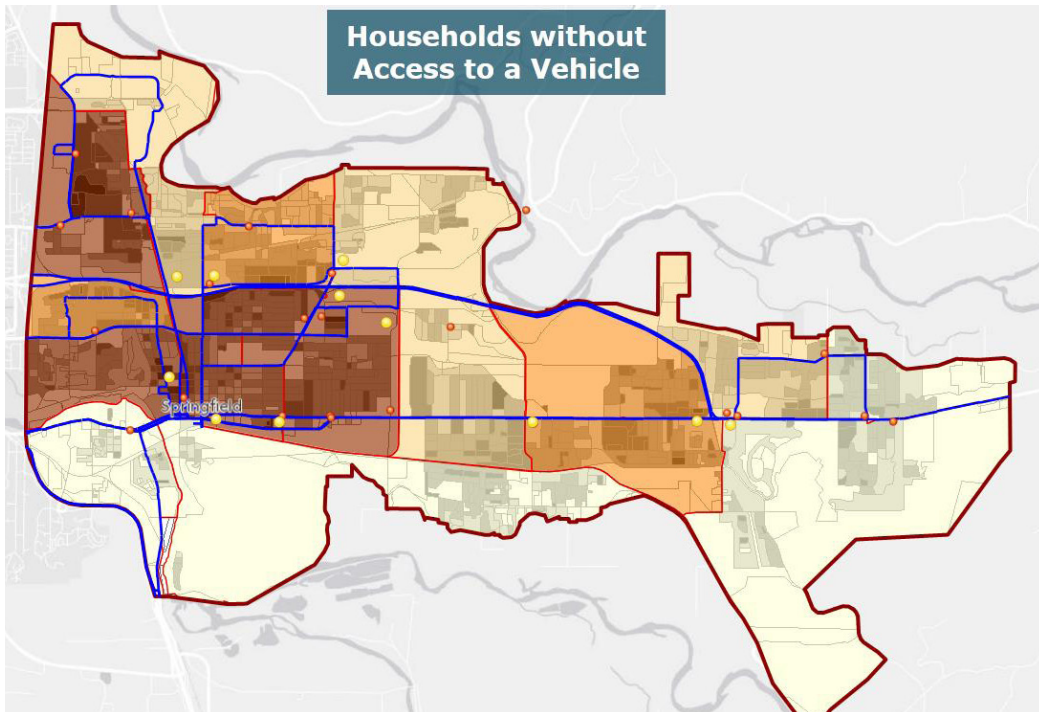


Figure 24: Map depicting where households don't have vehicles.

Springfield, the areas to the northwest and southeast of the intersection of Mohawk and Centennial, the area south of Main Street and west of its junction with I-105, and east Thurston.

- Some neighborhoods lack transit access to nearby grocery stores. For example, the area in central Springfield south of Main Street has no bus service through the neighborhood by which to access stores located on Main Street (although, with the Save-A-Lot closed, this area is also quite far from a grocery store).
- One store, the Wal-Mart on Olympic Street, has limited transit access within walking distance. This is especially true regarding access from the neighborhood to the southwest.

In addition to the location of transit stops and food retail stores, there are socioeconomic factors that may indicate greater dependence on transit for access to groceries. For this project, the four factors selected were age, poverty rate, unemployment, and availability of a vehicle. Mapping these factors by census tract can help one visualize the concentration of socioeconomic characteristics in different parts of the city. This series of static maps can be used to analyze whether concentrations of these factors overlap in any parts of the city. This analysis will suggest whether there are particular areas that, due to socioeconomic factors, may be more reliant on transit for accessing food stores. When combined with the previous analysis of the location of food and transit it



becomes more evident of the areas in need of more transit, more stores, or a combination of both.

Figure 24 shows the percentage of occupied housing units without any available vehicles. Nationally, about 9% of occupied housing units have no vehicle available. The darker shades in the map indicate a higher percentage of housing units with no vehicle. Notable compared to the national standard are the Gateway tract, with 13.4% of units with no vehicle, downtown (18.3%), the tracts to the west, north, and east of downtown (11.6%, 11.6%, and 12.7% respectively), and the tract to the west of I-105 as it turns south (10.4%).

In addition to the data on vehicle availability, there are other ways to look at an area's potential dependence on public transit for getting around. First is age. Areas with a concentration of elderly residents may drive less, even if vehicles are available. Figure 25 shows the percentage of the population in each tract that is 65 year of age or older. Most notable here are north Springfield (with tracts ranging from 16.5-25% 65 and over), the Glenwood area (16.4%), and the neighborhood southwest of the junction of Main Street and I-105 (13.6%).

The next socioeconomic characteristic analyzed was the poverty rate by census tract. This is displayed in Figure 26 with a notable concentration around downtown Springfield. Between 27-37% of the population in the three tracts comprising this area was below the poverty line in the last twelve months. Interesting and perhaps not entirely surprising is the fact that these three tracts overlap with some of the lowest rates of vehicle availability, as discussed above. It is also noticed that Gateway area not only has low vehicle availability, but also has a relatively high rate of poverty and an older population. The same can be said for the neighborhood southwest of the Main Street/I-105 junction.

Finally, unemployment rates by census tract were analyzed and some of the same tracts demonstrate high unemployment. The notable ones are: Gateway and northwest Springfield again (18.8% and 15.3% unemployment), downtown (17.5%), and the area southwest of Main Street and I-105 (11%). A tract in central Springfield also stands out with 14% unemployment. Compared with the other maps, there is also a relatively high rate of poverty, but low age and high vehicle availability.

## **Conclusion**

The above analysis should be taken together with the analysis of food retail and transit locations to determine whether there are particular areas that are more in need of expanded transit or grocery store access. Combining the analyses, some key findings for the Lane Transit District and the City of Springfield include:

- Northwest Springfield and the Gateway area have relatively high concentrations of the socioeconomic indicators discussed above, suggesting a greater reliance on public transit. The Gateway area also has relatively high population density. While these areas are serviced by existing

bus routes, no grocery stores are located nearby. Further analysis may help determine whether the situation can be improved by increasing food availability at existing stores (Dari Mart), by encouraging development of a supermarket or corner markets, or by improving the efficiency of transit access to existing grocery stores in other areas.

- North-central Springfield is in a similar situation, but also lacks the same level of transit service. This area has a significant portion of the population that is 65 or older, which suggests a potential increase in reliance on transit as residents continue to age.
- The neighborhood southwest of the Main Street/I-105 intersection stood out in all of the above categories. This area was also noted in the location analysis based on the fact that no transit service runs through the neighborhood south of the Main Street corridor. This means that anyone living within walking distance of Main Street can access the grocery stores located nearby (only Safeway, since the closure of the closest store, Save-A-Lot), but access to these stores is limited for residents to the south.
- Wal-Mart is known as a discount grocer but there is almost no transit access to the store from a high poverty, high unemployment tract to the east or from the high poverty, less mobile population center directly to the south.

Further analysis of the above and additional data is recommended. A few potential areas of improvement were discussed in the project methodology. These and others are listed below:

- Farmers markets could be included in future analysis.
- Population estimates could be adjusted to more accurately reflect the actual share of the population living within a 1/4 mile of a grocery store.
- Further study could include an analysis of cost. Not everyone chooses to shop at the grocery store nearest to them; decisions are often based on availability of a certain product or, more frequently, on cost. It would be possible to use the existing data, add a field representing cost of food at each store (perhaps the price of a common item), and display the stores on the map with symbols showing relative cost.
- Age data could be adjusted to better reflect the age at which people stop driving. Feedback on the maps suggested that people are continuing to be active and drive their vehicles long past the age of 65. Instead, future analysis could use the share of the population over 75 or over 85, both readily available from the Census. This may change the relative density displayed by tract.
- Finally, future analysis could broaden the scope of the socioeconomic analysis to include other factors that may affect need or demand for public transit. Research by the USDA may be a good starting point for identifying additional factors for research.

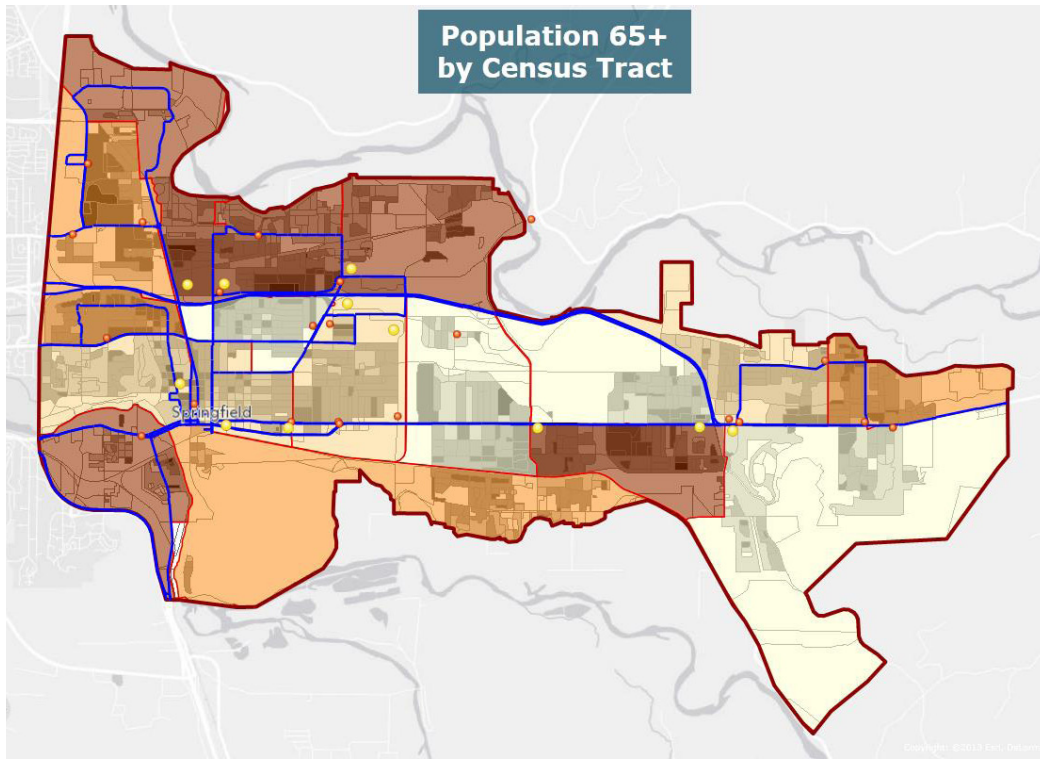


Figure 25: Map of the population of Springfield over 65 years old.

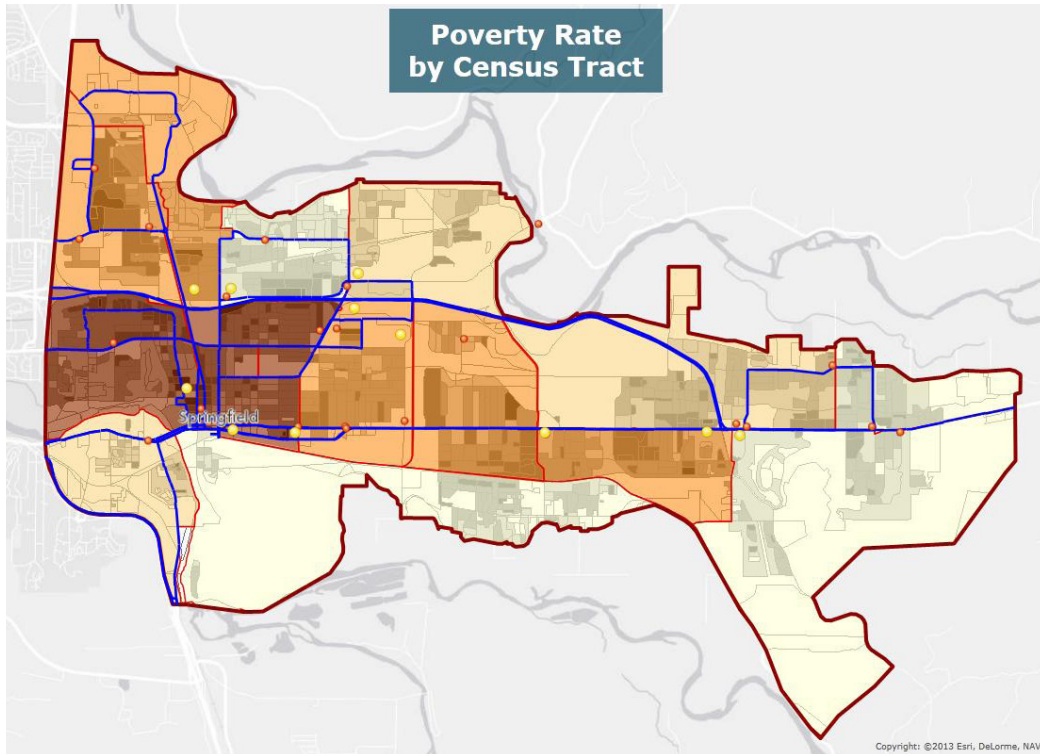


Figure 26: Map of the poverty rate by census tract in Springfield, Oregon.

# Social Media and Crowd-Sourcing

## The Evolution of Bus Ridership in Springfield, Oregon

*Ben Protzman*

- <http://blogs.uoregon.edu/lanetransitdistrict/>

This project aims to determine if a user-contributed data collection method is feasible for Lane Transit District in regards to the collection of ridership data in Springfield. The student created multiple maps, all accessible online to demonstrate how changes in public transportation ridership in Springfield can be planned for in a more effective way. The first two static maps are used to explain ridership change over time as well as provide context for the interactive map. The interactive map is intended to fill a gap in data collection methods currently used by the Lane Transit District for gathering boarding, exiting, and destination data. This map would rely on crowdsourcing or volunteered geographic information (VGI) to help expand the dataset. There are many potential limitations of user contributed spatial information, but if an information conveyance method is established properly, then they can offer many benefits as well.

### Background

This project focuses on trying to predict change in ridership based on input from public transportation users. To predict future change it is important to try to understand how ridership change has occurred in the past. The maps in Figures 27 and 28 show the change in bus ridership in Springfield, Oregon by comparing the number of people who boarded and exited a bus from 2006 to 2012 at each bus stop in the city. Difference in ridership is shown using graduated symbols with the smallest circles representing the lowest ridership counts and the largest circles representing the highest. Graduated symbols were evenly classified between the two dates shown on the map – meaning that the symbol sizes shown represent the same value range. Boarding rates are shown in purple in Figure 27 and exiting rates are shown in blue in Figure 28. In an effort to better demonstrate the ridership change from 2006 to 2012, a temporal component has been added and can be manipulated via a time slider, which can be accessed by selecting the “Time” option at the top of both maps.

Ridership numbers for each year are based on data collected over one week intervals. However, data for 2012 was only available on a monthly basis. In the case of the 2012 data, ridership numbers were normalized to represent a one-week interval to more precisely show the data in relation to years 2006 to 2011.

Zoning classifications within the city were included on the maps in Figures 27 and 28 to help determine the reasons for ridership changes in some areas compared to others. Zoning classification was reduced to the categories seen in the legend to minimize clutter and allow for more effective visual analysis. In

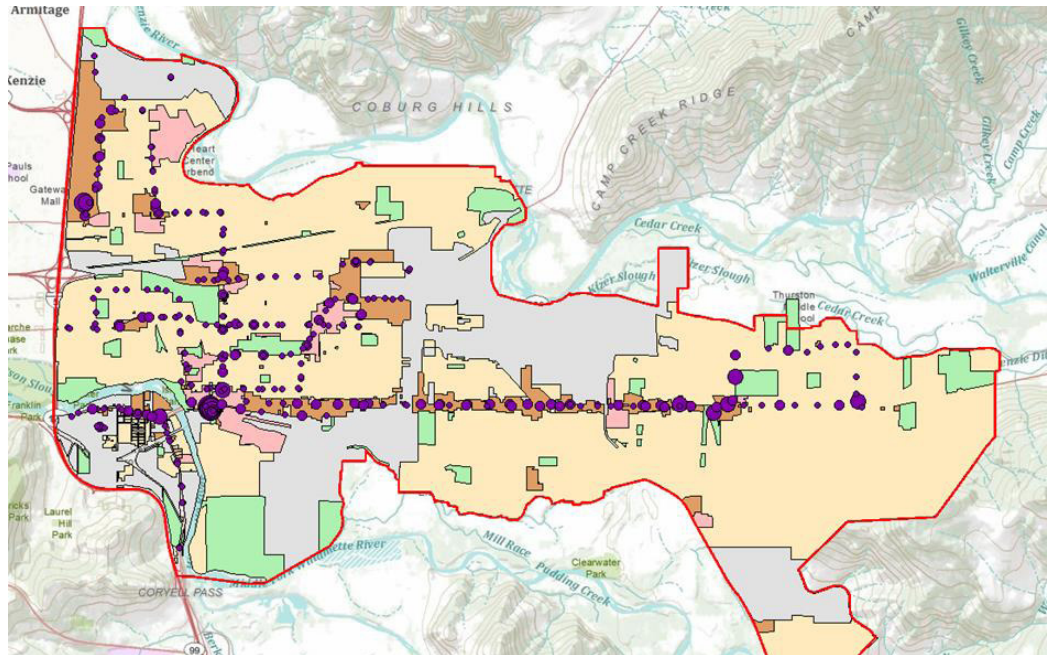


Figure 27: Map of Springfield, Oregon depicting boarding rates at each bus stop.

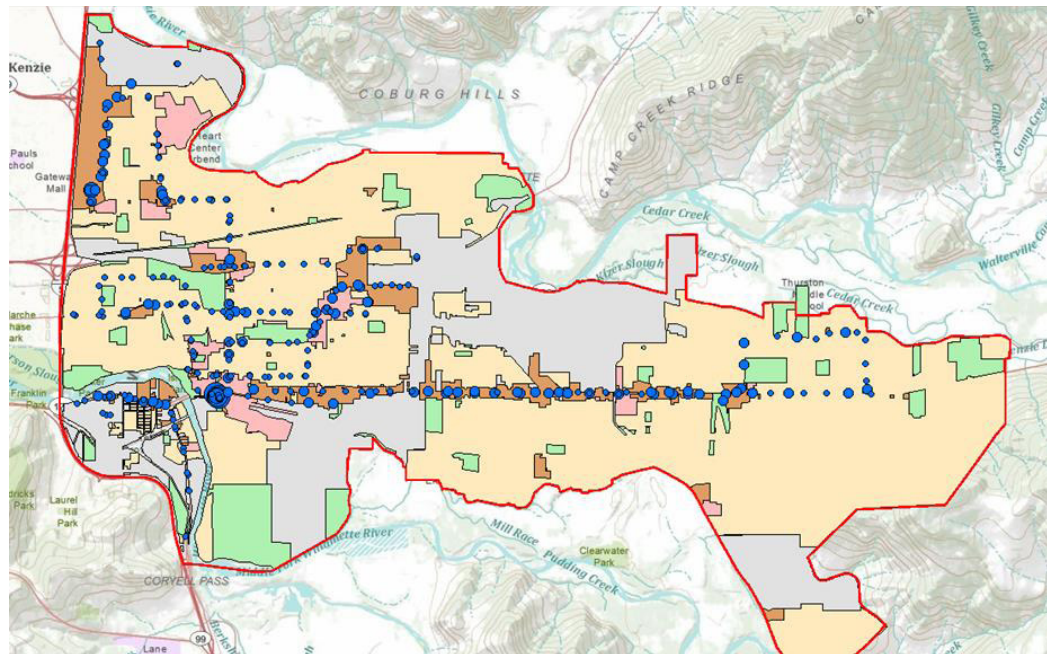


Figure 28: Depicts the number of exits at each bus stop.

theory, the type of zoning classification will impact ridership rates in a positive or negative manner. For instance, residential areas are likely to have a lesser impact on public transportation rates compared to commercial or mixed use areas because the attraction of public transportation users to residential areas is not as great.

Figure 27, depicting boarding rates, indicates that downtown Springfield remained the center of public transportation ridership over the seven year period. The popularity of downtown can largely be attributed to the presence of the transit hub. The public transit corridor that overlays commercial development to the east of the downtown area has experienced relatively stable boarding rates, with a slight decline as public transit routes enter Thurston. Stable ridership rates in the east may be a result of more development activity occurring in western Springfield where more commercial and mixed use zoning is located. Boarding rates have increased to the north and northwest of the downtown area, likely due to the concentrated location of mixed use and commercial zoning -- specifically, the Riverbend and Gateway mall developments respectively.

Figure 28 depicts exits for the same bus stops mentioned in the map shown in Figure 27. Exit rates largely mimic boarding rates in that the downtown transit hub contains, by far, the most transit activity. Furthermore, exit rates along the commercial corridor to the east of the downtown hub stayed relatively stagnant, with a slight decrease in ridership rates near Thurston. Bus stops in northwest Springfield experienced the most drastic change with a noticeable increase in the number of exits near Riverbend and Gateway mall.

## Methods

Figure 29 allows users to contribute data in the form of boarding, exiting, and destination features, which will, in theory, allow LTD to plan future routes and stops more effectively. Current LTD bus stop data is limited in its capacity to determine where individual public transit users are boarding and where they are exiting on the same trip. Information is only available for total boarding and exits at each bus stop, not individual trips. Furthermore, the destinations of individual users on any given trip remain largely unknown. LTD can assume that if an individual exits at a bus stop that is located near a shopping mall then that will be the destination of the individual, but there is no easy way to confirm or deny this assumption. It is therefore unclear whether all public transit users are adequately served by the current LTD bus system, especially if one considers the average distance that a public transit user will walk to reach a bus stop is only about a quarter of a mile. Given the simplicity of the data currently available, along with the average distance that a public transit user is willing to walk to get to a bus stop, it is questionable if more specific data about trips made by individual public transit users aid in determining where future bus stops and routes should be located.

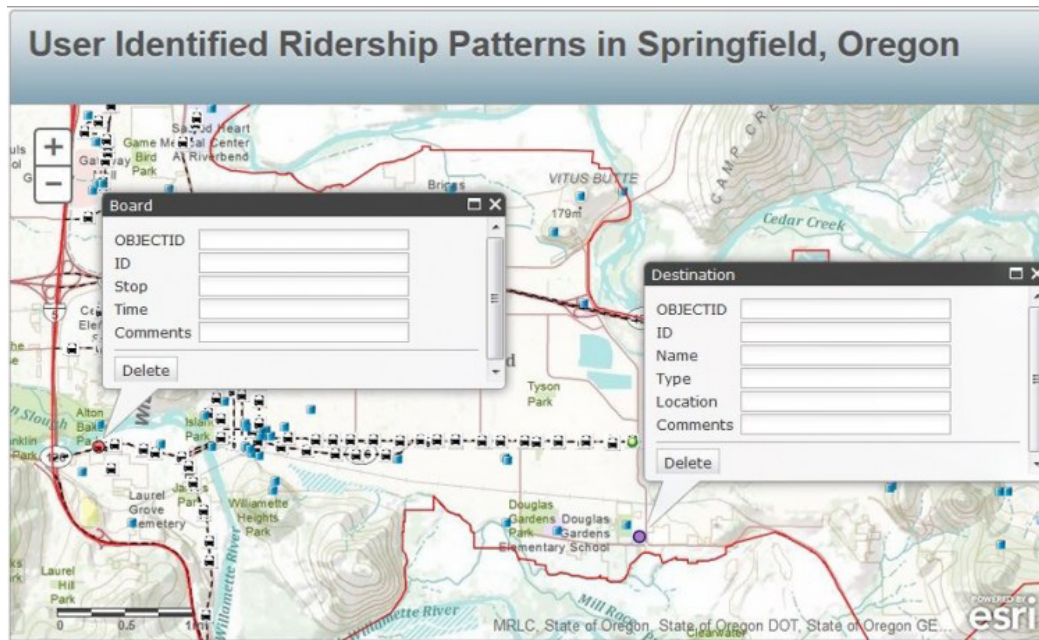


Figure 29: Demonstrates how some of the features in the web application are modifiable attributes that users can update.



Figure 30: Demonstrates the capability for changes to the map by bus riders and community members.

Figure 30 is rather simplistic on its face, but its usefulness stems from the ability of individuals to add geographic information to the map, which in the online application will be shown in real time. The map currently displays the bus stops, bus routes, and numerous facilities within Springfield. Bus stops and bus routes can be identified by clicking on the appropriate feature. Facility locations give users additional reference when adding features to the map.

Public transportation users can add data to the map by clicking on the link listed underneath. The link leads to another page where boarding, exiting, and destination features can be added. The boarding feature is meant to be placed at a bus stop where an individual user starts their trip. The exiting feature is placed at the bus stop at which they get off the bus and begin walking or biking to their destination. A destination point can then be added to the map to show the location that the user ultimately wants to reach. Each feature contains an attribute table that allows an individual to give a description to the feature. The modifiable attributes for the boarding and exiting features includes the ID of an individual user, the stop number, the time that they board or exit the bus and any comments that they wish to leave. The destination feature can include information about the name, type, and location of the destination, as well as any comments that the user wishes to leave. The ID field is perhaps the most important attribute because it allows anyone who uses the data to identify individual ridership patterns. Anyone who contributes data to the map can remain anonymous so long as the ID attribute that they choose to use is the same for all three of the features.

The ability of public transportation users to contribute data is known as volunteered geographic information (VGI), or crowdsourcing, depending on how an agency attains user participation. Volunteered geographic information is obtained from citizens who, on their own accord, contribute spatial information to a particular cause. Crowdsourcing involves a commitment on behalf of the agency to actively pursue citizen participation regarding a particular issue. Crowdsourcing not only allows for greater involvement from the public, but it allows those who might not normally participate in the planning process to do so fairly easily, especially if participation can be accomplished online. Lane Transit District can likely make greater use of crowdsourcing techniques over VGI because crowdsourcing allows the agency to guide the public in providing information that would be most useful to them.

## Findings

User-contributed ridership data can be a valuable source of information for LTD. If enough public transportation users contribute to a map, LTD can potentially tailor their future planning efforts to meet the needs of a target population. For instance, if user-contributed data shows that a significant number of public transportation users are exiting a bus and walking a half-mile to reach a similar destination, a new bus stop or route is likely needed. The data can also be used to examine general ridership patterns throughout the city, which can help



determine the future ebb and flow of public transit use. There are, however, some limitations associated with the potential usefulness of user-contributed data.

Using the proposed method, there is no way to verify that the features being added to a map are done so by Springfield public transit users. Also, even if the features are being added by Springfield public transit users, there is no way to ensure if the information is accurate. This represents a potentially significant flaw in the data collection method, one that could be rectified by assigning ID's to public transit users, thereby allowing for more accuracy while negating anonymity. Another potential limitation is the number of individuals who choose to contribute. For the data to be valuable, a sizable portion of public transportation users in Springfield need to input information. The creation of a more user-friendly data collection system, such as a smart phone app, may help to solve the contribution problem, at least partially.

## **Conclusion**

Planning for public transportation is vital to the growth of a city. As neighborhoods grow and development patterns change public transit opportunities will need to grow and change with them. An often underutilized source of information regarding the development of public transportation infrastructure is the citizens who rely on that infrastructure. Users of public transportation systems have some of the most valuable insight into where service is most needed and where it will be needed in the future. Through the use of crowdsourcing methods, LTD and other transportation agencies can draw on the knowledge and needs of local individuals to plan for future bus stops and bus routes. The use of web-based contribution techniques, like the one that proposed in this project, allows a wide range of users to contribute information and to take part in the growth of their city.

## LTD, Social Media, and Web Maps: Tweeting the Story of LTD Ridership

*Michael Duncan*

- <http://blogs.uoregon.edu/nugeography/about/>

This project looks at the intricacies of transit planning with Lane Transit District's growing transit network and specifically, the proposed EmX extensions, in accordance with social media feeds. Accessibility, congestion, and current land use are all issues that can be improved with the help of GIS software and user-generated data. To elevate GIS beyond a simple operational function, planners can leverage more complex spatial analyses to capture a portrait of environmental factors driving ridership. What sets this approach apart is the ability to process unique social phenomena otherwise too complex to understand outside of a dynamic spatial context. The emergence of geotagged Flickr and Twitter feeds offer a diverse and evolving source of user-generated data. These datasets are unique in that they offer unfettered public sentiment. Planners can assume a more active role in both harvesting and interpreting these new forms of data. This augmented element of public engagement may help communities better design from the human perspective, proactively, to construct transit networks fostering a sense of place as much as an increase in ridership.

Figure 31 represents dynamic geographically tagged social media feeds in relation to zoning type, various nearby facilities, and LTD ridership changes. Twitter and Flickr feeds will appear within a 1/2 mile radius at the center of the map extent.

The main component of this project is a map that was created in ArcGIS Desktop and published to a server which hosted the desktop map document. This map contains information on land zoning, nearby facilities that may explain attractors or detractors in ridership, and the ridership at each stop. Lane Transit District provided the ridership data which was symbolized to depict the percent change in average daily ridership from 2006 to 2012.

Figure 32 shows additional interactive and dynamic ArcGIS layers. LTD provided the ridership data, which was symbolized to depict the percent change in average daily ridership from 2006 to 2012. LTD also provided a list of nearby facilities. While these layers were part of the original context map published in ArcGIS Desktop, these layers were also added to the WebMap through an interface on ArcGIS Online. Social media is routed to the WebMap using an Application Programming Interface (API). Twitter's API captures a defined number of tweets within the last seven days for a given map extent. The Flickr API is similar, but allows a greater capture period. Due to the open source nature of the Twitter and Flickr feeds, we are able to modify the JavaScript and HTML scripts to attach these feeds to specific 1/2 mile geography as well as several other formatting alterations. This 1/2 mile geography is important

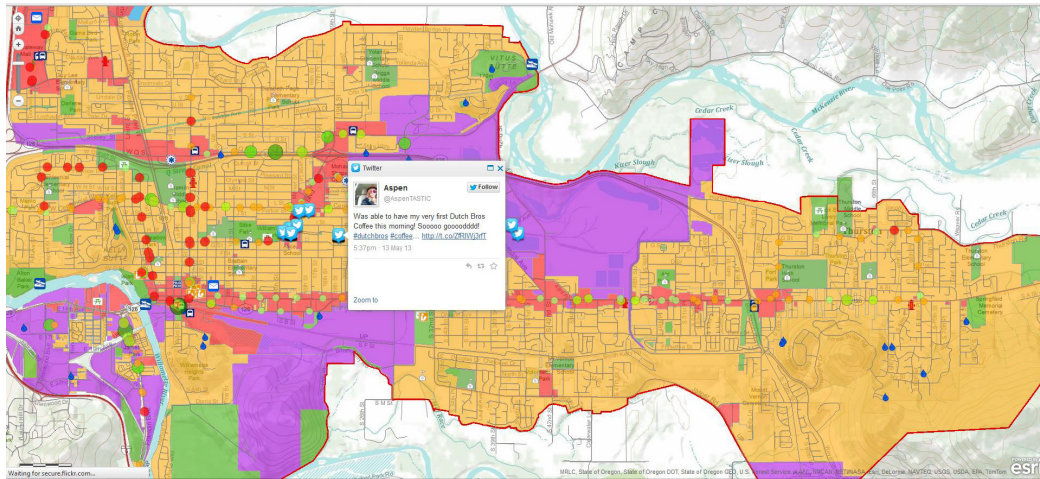


Figure 31: Demonstrates the clickable features of the map and how social media sites like twitter can be applied using geospatial data.

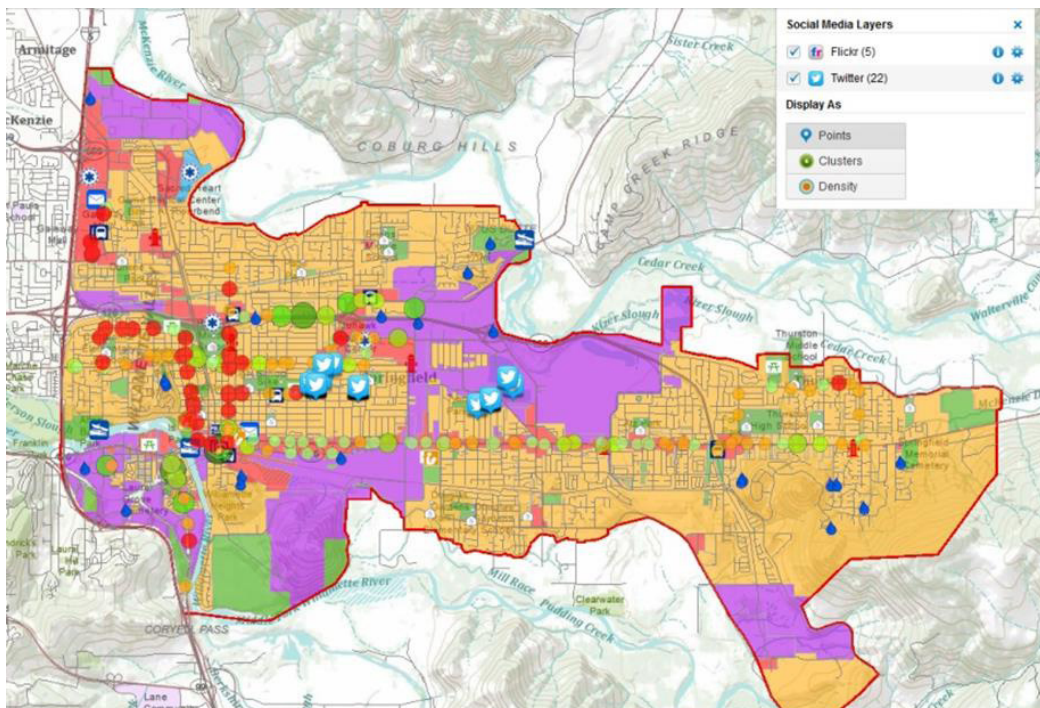


Figure 32: Shows how the layers can constantly be updated and that the data collected can be used to further analyze efficiency in the transit system.

for the Twitter API, because it allows us to channel the maximum tweets from their seven-day capture period. It also allows users to access tweets within the typified paragon of walkability, the 1/2 mile radius.

## Findings

### ***The Inseparable Relationship between Transit, Land Use, and Human Experience***

Planners don't only associate transit projects as a problem of mode choice; they also incorporate indicators from the built environment. Attributes surrounding transit stops often capture the type of land use, facilities, and transportation infrastructure. Models that rely on these factors attempt to illustrate patterns in transit usage that speak to both characteristics of the rider as well as why and where the rider is going.

A cursory analysis of Springfield's Twitter feeds indicate a number of non-related sentiments tweets that do not contain sentiment relating to attributes surrounding transit locations. A similar geography in Portland returned a wealth of public sentiment specific to experiences within that built environment. This contrast may suggest diverging measures of social media competency, both in the ability to access technology and the level of comfort expressing sentiment through that medium. Additionally, Twitter users within the Springfield area appeared to be younger (<18yrs) overall than the communities of Portland or Eugene. However, trends indicate that social media use is growing in communities like Springfield, and by attaching social media feeds to a specific geography, planners now have access to public sentiment in a way that was not previously available. Unrestrained and dynamic, this information provides context to how individuals are using this space, and it illustrates how our communities experience and perceive that space. While planners may query the resulting geotagged social media for transit-related sentiment, the primary benefit of a dataset like this is to inform planning and policies that shape the land use supporting transit. This leaves planners to craft transit systems that embrace the increasingly complex and diverse socio-environmental needs of transit riders. More so, this should be thought of as a pivotal step in how planners define the next evolutionary set of ridership indicators and how they relate to the human experience.

## **Accessing Public Art in Springfield, Oregon**

*Adburazak Hussen and Kevin Levy*

### **Introduction**

The goal of this project was to create an interactive map of the City of Springfield where public art was the main focus, inspired from another class project that had compiled data on the public artworks around the city. This project is unique in that it focuses on more than the Lane Transit District bus lines, and it also serves as a way to better connect the culture and community of Springfield with local art piece locations and ways to get there.

An online interactive map application was designed that integrated LTD bus stations, routes and stops with locations of local artwork. The map features descriptions of local murals and sculptures with links to online imagery from Flickr which can be searched by location.

### **Findings/Conclusions**

The students created a base map of the urban growth boundary within Springfield so that the list they compiled of public artworks could be geocoded to it. Each of the points on the map is clickable and links to information gathered online for a brief summary of the art and the best way to get there. This project did not analyze something specific; rather it made information more easily accessible for the Springfield community. A limitation of the project was the difficulty in determining exact addresses or locations for the artworks, as well as not having a complete or up-to-date list of all the local art. It was concluded though that the majority of the artwork is located in downtown Springfield.

## Conclusion

The students in the Advanced Geographic Information Systems course at the University of Oregon generated innovative ideas and recommended strategies to put these ideas into action and inspire further research. Listed below is a summary of the recommendations from these projects which are categorized by section.

### Route and Ridership Analysis

GIS tools were used to display the time attributes associated with the bus stops, allowing the students to discover some areas that were consistently late. Route 91 had the most variability in actual arrival time and estimated arrival time, but it is the longest of all the routes and has a lot to do with road and weather conditions, especially in winter. It was also suggested to add a route on 42nd Street or 28th Street that would pass through low-density residential areas that have the potential for growth in population. There is also only one main way to travel from downtown to the far-east side of Springfield; half loops along the main route would help connect more people in the northern and southern parts of town to downtown Springfield.

### Socioeconomic Factors

The projects in this section recommend areas of low-income be specifically targeted for new route additions because of their potential for growth and their need for public transportation. Furthermore, instead of implementing new routes, these projects suggest LTD convert an existing route to EmX. The project focusing land values found land value increased near LTD stops and routes which may be important for future planning.

### Social Media and Crowd Sourcing

This section suggests users of the public transportation system know best about where there needs to be more service. Geotagging information from the actual riders could help benefit the overall performance of the bus system. The information the riders of the bus give is important for future planning because the riders can express what areas have need for better access to transportation, leading to an overall increase in ridership.

## References

- Benn, Howard P. Bus Route Evaluation Standards: A Synthesis of Transit Practice. Research Report, Washington, D.C.: Transportation Research Board National Research Council, 1995.
- Dutko, Paula, Michele Ver Ploeg, and Tracey Farrigan. Characteristics and Influential Factors of Food Deserts. ERR-140, U.S. Department of Agriculture, Economic Research Service, August 2012.
- Eisenhauer, Elizabeth "In poor health: Supermarket redlining and urban nutrition." *GeoJournal* 53 (2001): 125-133.
- ESRI. "ArcGIS Desktop: Release 10.1." Redlands: Environmental Research Institute, March 13, 2012.
- Kolko, Jed, Marisol Cuellar Mejia, David Reed, and Eric Schiff. Making the Most of Transit Density, Employment Growth and Ridership around New Stations. Study Report, Chicago: Public Policy Institute of California, 2011.
- Lane Council of Governments, (2004). METRO Plan: Eugene-Springfield metropolitan area general plan. Eugene, OR: Lane Council of Governments.
- Metropolitan Planning Council. Bus Rapid Transit: Chicago's New Route to Opportunity. Study Report, Chicago: Metropolitan Planning Council, 2011.
- Metropolitan Planning Council. Integrating Livability Principles Into Transit Planning: An Assessment of Bus Rapid Transit Opportunities in Chicago. Research Report, Chicago: Metropolitan Planning Council, 2011.
- The Natelson Company. Employment Density Report. Research Summary, Yorba Linda: Southern California Association of Governments, 2001.
- Neckerman, K.M., "Measuring Food Access in Urban Areas," National Poverty Center Working Paper, <http://www.npc.umich.edu/news/events/food-access/index.php>.
- Parker, R., Goodman, B., & Perkins, W. (2009). City of Springfield: Commercial and industrial buildable lands inventory and economic opportunities analysis – Draft report. Eugene, OR: ECONorthwest.
- Planning Commission TOD Committee: Walking distance research. (n.d.). Retrieved from [http://www.fairfaxcounty.gov/planning/tod\\_docs/walking\\_distance\\_abstracts.pdf](http://www.fairfaxcounty.gov/planning/tod_docs/walking_distance_abstracts.pdf).
- Schmitt, Angie. "In Defense of the Corner Market." (5/10/2011) <http://dc.streetsblog.org/2011/05/10/in-defense-of-the-corner-market/>.
- Seeger, Christopher J. *GeoJournal*, Vol. 72, No. 3/4, Volunteered geographic information: key questions, concepts and methods to guide emerging research and practice (2008), pp. 199-213

Seltzer, Ethan, and Dillon Mahmoudi. "Citizen Participation, Open Innovation, and Crowdsourcing Challenges and Opportunities for Planning." *Journal of Planning Literature* 28, no. 1 (February 21, 2013): 3-18.

United States Census Bureau. "American FactFinder." Total Population P1: Summary File 1. 2010. [http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC\\_10\\_SF1\\_P1&prodType=table](http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_P1&prodType=table) (accessed March 13, 2013).

United States Department of Agriculture. "Food Deserts." (accessed 3/11/2013) <http://apps.ams.usda.gov/fooddeserts/foodDeserts.aspx>.

Ver Ploeg, Michele, et al. Access to Affordable and Nutritious Food: Measuring and Understanding Food Deserts and Their Consequences. AP-036, United States Department of Agriculture, June 2009.