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# Using GIS to Identify Barriers to Access on the RTD W Line in Denver, Colorado

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## Abstract

Denver, Colorado has a long history of public transportation usage beginning with horse-drawn streetcars in 1871. As the automobile began to flourish however, the use of public transportation has languished. In 2013, the W light rail line opened serving the West Denver area. As Denver has moved toward a more transit-oriented growth model, this rail line can create a more vibrant future. Using GIS, a better understanding of the barriers to access for light rail travel is obtained and considering key variables outputs are created to assist policy makers in utilizing the W line. By using GIS to address population increase, crime, accessibility, walkability, and traveler satisfaction, barriers to access on the RTD W Line are identified.



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# Using GIS to Identify Barriers to Access on the RTD W Line in Denver, Colorado

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Department of Geography & the Environment

Capstone Project

for

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## Abstract

Denver, Colorado has a long history of public transportation usage beginning with horse-drawn streetcars in 1871. As the automobile began to flourish however, the use of public transportation has languished. In 2013, the W light rail line opened serving the West Denver area. As Denver has moved toward a more transit-oriented growth model, this rail line can create a more vibrant future. Using GIS, a better understanding of the barriers to access for light rail travel is obtained and considering key variables outputs are created to assist policy makers in utilizing the W line. By using GIS to address population increase, crime, accessibility, walkability, and traveler satisfaction, barriers to access on the RTD W Line are identified.

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## Use of Acronyms and Abbreviations

CI - Comfortability Index

DRCOG - Denver Regional Council of Governments

DU - University of Denver

ESRI - Environmental Systems Research Institute

GIS - Geographic Information Systems

RTD - Regional Transportation District

W Line - Westbound Regional Transportation District Light Rail Line, Union Station to Sheridan Station.

## Introduction

In many parts of the world, using light rail is a comfortable and effective means of moving people. There are many benefits to light rail travel such as decreased carbon emissions, less opportunity for car accidents, the cost savings of not needing a personal vehicle, and the freedom to visit destinations without the need to pay for parking or be anchored to a personal vehicle. Denver has been reliant on automobiles for many years and a move toward alternative modes of transportation has been slow. Denverites have valid reasons for choosing not to use the W line and quantifying that data allows us to support positive change. If access limitations are mitigated, the W Line has the potential to be a world class public transportation method. As the West Denver area becomes more densely populated the ability to efficiently move people will become an ever more pressing need (Makarewicz and Nemeth 2018). There is significant information related to light rail in the United States and the issues that cause it to lag European and Asian systems. Additionally, there are sources which provide background on the limiting factors for rail travel within the neighborhoods in which W line stations are located. This information includes population statistics, crime statistics, sidewalk information, elevation change information, and other data regarding accessing stations. The central thesis of the project is that using GIS to identify barriers to access on the RTD W line will provide the outputs necessary to support stakeholders in increasing the number of people who may utilize the line.

## Problem Statement

The excitement of the W line being introduced to West Denver nearly ten years ago has faded and ridership has not been able to meet its potential. Low population density near stations, concerns around crime, difficulties accessing stations, and overall desirability have led many to

use other forms of transportation. Using GIS to locate areas where barriers to access exist, improvements can be made regarding the effectiveness of the W line in Denver. Significant research exists regarding light rail ridership although limited research has been undertaken for barriers to access on the W line. A robust transit line can improve the overall health of the neighborhoods served if limiting factors are identified.

## Literature Review

Before the automobile, many Denverites used public transit as a means of movement. However, automobiles gradually took over as the primary transportation conveyance culminating with the post-World War II freeway era (Muller n.d.). With the return of light rail to West Denver in 2013, there are many who have been able to utilize the benefits, but the system has been unable to successfully capture the ridership of many it is designed to support (Staeger 2019). To increase potential ridership, there has been relatively little research on the accessibility of using light rail as a transit mode (Mavoa, et al. 2012). Makarewicz & Nemeth explain that there is a correlation between multimodal transportation options and a higher standard of living (Makarewicz and Nemeth 2018). This is especially true for low-income individuals. Makarewicz & Nemeth make the case for providing better transit as a method to not only reduce residents' vehicle emissions and guarantee them safe and affordable access to work and other destinations, but also the opportunity to help improve quality of life and wellbeing (Makarewicz and Nemeth 2018). Lower income individuals may suffer due to lack of quality sidewalks, unsafe biking conditions, and displacement from the most transit accessible places due to high housing costs (Makarewicz and Nemeth 2018).

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Smart growth near light rail stations has been highlighted as a method to maximize the effectiveness of light rail in Denver. Dr Andrew Goetz argues that Denver is actively working to offer a different alternative to its sprawling past (Goetz, 2013). Although increasing automobile traffic and increasing urban land cover point to continued suburbanization in the Denver metro area, there has been a surge of interest in sustainable growth. Goetz adds that there is broader recognition across the public-private spectrum of the significant economic, social, and environmental costs of low-density suburban sprawl (Goetz, 2013). This has led to a desire to create more sustainable urban design alternatives. American cities have consistently been plagued by high energy consumption and high carbon emissions per capita. Denver is attempting to change that pattern with the advent of more sustainable growth. The Denver metropolitan area has grown significantly since 1950 from 564,000 people to 2,963,821 as of 2020 (U.S. Census Bureau 2020). The most ambitious plan to address the extreme growth Denver has experienced was the RTD FasTracks program (Goetz, 2013). The FasTracks program has resulted in the creation of light rail in all directions of the Denver metro area including the W line to West Denver in 2013 (Ellebracht 2019). GIS can be leveraged to implement the smart growth model overlaying building footprints and other land use data to visualize where changes can be made. The literature on smart growth in Denver was created just as the W line was coming online. As nearly ten years have passed and residents have had the opportunity to use the line, updated information is important to find gaps in improving the existing line. The smart growth initiative which suggests a paradigm shift away from low density urban sprawl to a mixed-use higher density development utilizing light rail has yet to be fully realized for the W line. A GIS study which considers smart growth will help identify barriers on the W line.

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Considering the history of Sprawl in the Denver metro area, achieving walkability regarding accessing light rail stations is a substantial challenge. As explained by Nawrocki, Nakagawa, Matsunaka, and Oba Japanese cities are generally more walkable than American cities and station walkability has a measurable impact on light rail usage (Nawrocki, et al. 2014). Sprawl can cause significant issues including higher danger of traffic fatalities (Ewing, Schieber and Zegeer 2003). Cities across the globe are coming to terms with the need to reduce dependence on automobiles and increasing public transportation and Denver is no exception. Factors influencing walkability include area perceptions, aesthetics, safety/crime, road network design characteristics such as intersection density and block length, as well as land-use diversity and population density. Aesthetic measures of urban environment such as squares, commercial buildings, and trees act positively on pedestrian frequency (Nawrocki, et al. 2014). Nawrocki, Nakagawa, Matsunaka and Oba conclude that walkability as measured by street connectivity has a limited but measurable effect on light rail ridership in the USA (Nawrocki, et al. 2014). Using GIS, we can quantify the walkability of the areas surrounding the W line. Using secondary sources of the infrastructure as well as primary data of W line served locations, we can map areas which need improvement for pedestrians. The literature considers walkability at a large scale and when targeting the W line stations, we can use existing approaches to understand walkability for W line users. Improving walkability factors has the potential to increase ridership on the W line and using GIS to locate areas of concern is the most useful approach to do so.

As explained by Chris Zuppa, accessibility is the most important concept in transportation planning because it describes the ease of travel to opportunities vital for everyday needs (Zuppa 2014). Theoretically, people will live closer to transit corridors if accessibility is improved

(Zuppa 2014). To capture population growth, denser land use patterns are desirable near light rail stations. Planners in Denver have changed zoning codes to allow for transit-oriented development. In the same vein as walkability, accessibility can be improved with the use of GIS. The idea is to minimize road centric land use policies and the subsequent sprawl. Suburbanization can in large part explain the lack of accessibility for W line stations. Many have viewed life in the suburbs as a better substitute to life in cities despite the longer commute times (Zuppa 2014). Additionally, there are those who argue that suburbanization is not a negative for the growth of cities (Gordon and Richardson 1997). Alternatively, transit dependent populations have limited accessibility to opportunities and rely more heavily on public transportation (Zuppa 2014). By showing the positive impacts of transit-oriented development through the use of GIS we can help to change the mindset that suburbanization is the answer to growth.

The Portland, Oregon LRT system (MAX) shows many similarities to the RTD light rail lines in Denver, Colorado. Francis Ellis Loettrele has performed GIS analysis on the MAX system, this information is also useful for the W line although each line has unique characteristics. Based on surveys of the MAX system, ninety seven percent of people need to be within one mile of a station (Loetterle 1999). For those who do not drive, nearly fifty percent do not have access to a car (Loetterle 1999). Low-income residents are less likely to have access to a personal vehicle (Makarewicz and Nemeth 2018). With this is mind, low-income individuals could benefit greatly from the ability to access the W line. Due to the convenience of light rail, housing prices increase near stations and low-income residents may be pushed out (Makarewicz and Nemeth 2018). However, seventy four percent of people who use MAX do so by choice. Considering that

choice is a large factor in ridership, improving comfortability for potential riders would encourage ridership. Understanding why individuals use light rail transit allows us to understand the weight of data points entered into the GIS.

As Loettrele discovered, the overwhelming majority of transit riders need to be in close proximity of light rail stations in order to use them. García-Palomares, Ribeiro Gutierrez and Marques studied the street systems to discover which are most likely to support walking to light rail (García-Palomares, et al. 2018). They found that a station-oriented street network significantly reduces walking distance to stations (García-Palomares, et al. 2018). Using GIS, we can locate current walking routes which will indicate walking accessibility for those wishing to use the W line. Much of the land around W line stations was not designed with transit in mind and is focused on individual vehicle use. Developing the land in close proximity to rail stations is important to ensure a high enough population density to support transit ridership. Hyungun, Keechoo, Lee and Cheon performed regression analysis on distance to transit and they found that five hundred meters was the ideal distance for transit-oriented development (Hyungun, et al. 2014). Land use is statistically significant for transit use and increasing density increases the number of transit riders (Hyungun, et al. 2014). Using buffers, we can create new data for potential locations of land use changes. The buffers in the GIS will provide distances up to one thousand meters around stations to highlight the study area for the W line. Interior buffers of two hundred fifty meters, five hundred meters and seven hundred fifty meters will designate where land use changes would be most appropriate.

There is a significant portion of the population who oppose light rail due to the perceived increase in crime near light rail stations. Billings, Leland and Swindell have shown that property

crime decreases around newly created light rail stations (Billings, Leland and Swindell 2016). Much of the work on crime and the presence of rail transit has focused on the perceptions of crime as opposed to crime statistics (Billings, Leland and Swindell 2016). Some argue that crime around light rail is related to criminals being able access suburban areas to prey on targets (Billings, Leland and Swindell 2016). Additionally, individuals using the light rail may be less familiar with the surroundings of light rail stops leading them to be easy targets for criminals (Billings, Leland and Swindell 2016). However, statistically most criminals act within a mile or two of their residence which lends credence to the theory that rail stations attract criminals from the local area (Billings, Leland and Swindell 2016). There are several reasons residents perceive light rail stations as being high crime areas. First, rail transit stops provide cover for potential offenders because riders appear to loiter, and this is not thought of as suspicious activity. Second, stations provide easy exit and entry for criminals. Finally, potential targets of criminals typically live away from the area and may not be familiar with surroundings (Billings, Leland and Swindell 2016). Development near light rail stations such as lights and buildings prevent crime as there are less places for criminals to hide. Using GIS to display crime data from the Denver police department and infrastructure data will allow us to locate areas near the W line stations which may need additional police presence or lighting to prevent crime. Controlling for overall crime trends it has been discovered that the addition of light rail in Charlotte led to less crime (Billings, Leland and Swindell 2016). This may be the result of public and private investment near light rails stations leading to gentrification which may have decreased criminal activity (Billings, Leland and Swindell 2016). Crime varies at individual light rail stations in Denver and higher crime rates can significantly impact an individual's

transportation mode choice (Mooney 2015). Crime concerns for the light rail system in St louis has led to changes in the way individuals access light rail stations (Kim, Ulfarsson and Hennessy 2007). Many female transit riders have opted to be picked up by private vehicles upon arriving at light rail stations as opposed to walking to their final destination due to crime issues (Kim, Ulfarsson and Hennessy 2007). A higher number of crimes reported at stations has led to a reduction in individuals using those stations (Kim, Ulfarsson and Hennessy 2007). Fear of crime may be the largest factor in discouraging light rail ridership (Kim, Ulfarsson and Hennessy 2007). Light rail security in Denver includes advanced video technology with this fear of crime in mind (Segal 2017). This allows for a more proactive approach to crime mitigation (Segal 2017). In addition, mobile apps allow for the reporting of suspicious activity which can further reduce crime (Segal 2017). Ultimately, for a light rail system to be successful it needs to be well used. As safety and security are key factors influencing ridership the focus on minimizing crime is essential (Segal 2017).

## Study Area

To focus the research efforts on the W line, a study area was chosen with Hyungun's 2014 regression analysis in mind (Hyungun, et al. 2014). The study area encompasses a one-kilometer buffer around each W line station in Denver as seen in figure 1. This includes Union Station, Pepsi Center/Elitch Gardens Station, Empower Field at Mile High Station, Decatur-Federal Station, Knox Station, Perry Station, and Sheridan Station. These stations are located in the Denver neighborhoods of West Colfax, Villa Park, Sun Valley, Auraria, and Union Station. GIS was used to overlay quantitative data affecting light rail access within the buffered boundaries. Individuals in areas outside the buffer are less likely to utilize the W line as the majority of users

need to be within one kilometer of stations. The W line was chosen specifically due to the proximity to the central business district of Denver, the unique zoning, infrastructure, and potential for quality-of-life improvement. These neighborhoods are also part of exciting new development which has taken place in part to accompany the light rail line. The study area contains several unique land-uses which help to explain which features are best suited for light rail use. These land uses include high rise commercial districts, large parks, sports venues, university campuses, industrial areas, and suburban neighborhoods all of which affected the data results of the project.

# Study Area, One-Kilometer Buffer around W Line Stations in Denver

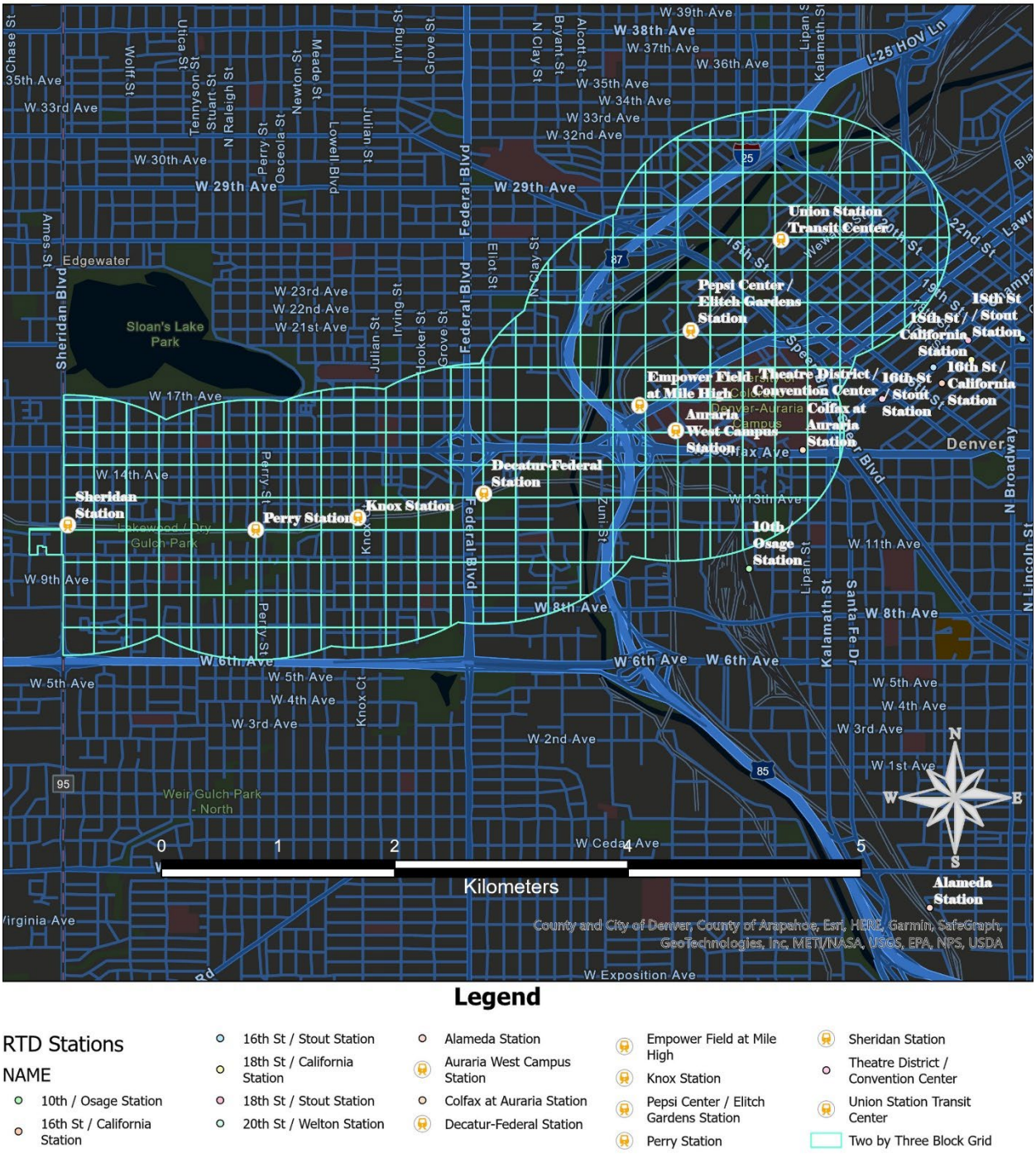


Figure 1: One-Kilometer Buffer Around W Line Stations in Denver

## Data Resources

Data for the project was compiled from several secondary sources and primary sources. The data was converted to the WGS84 datum and coordinate system. The building footprint data was obtained from the Denver Regional Council of Governments (DRCOG). The crime data was acquired from the Denver Police Department and the Denver Police crime map (Denver Police Department 2022). The station location and attributes were obtained from the RTD Open GIS website. Population data was acquired from Census TIGER files US Census, American Community Survey Tracts (2006-2010) and American Community Survey Tracts (2014-2018). Infrastructure data including sidewalks was obtained from DRCOG. Contour line data for elevation change was obtained from DRCOG. Additionally, ground truthing the data was required, and on-site research was performed to verify the accuracy of secondary sources. A survey was not required as much information currently exists regarding viewpoints on using light rail transit and a quantitative look into improving W the line was the desired output. An IRB was not required as there was no research involving human subjects.

## Design and Implementation

In order to best understand the barriers to ridership on the RTD W Line within the study area, three main research methods were employed. The first method focused on population statistics and used multiple regression to explain whether the addition of light rail and subsequent population growth near stations has had an effect on specific demographics. The second method involved analyzing violent crime with ArcGIS Pro tools to understand if W line station proximity was correlated to an increase in violent crime. Finally, the comfortability index was created to visualize where improvements could be made and to quantify barriers to light rail

ridership. The combined outputs were created to understand the limitations to access on the W line as seen in figure 2. The flow chart identifies inputs in blue, secondary data in green, initial outputs in yellow, and final output results in orange.

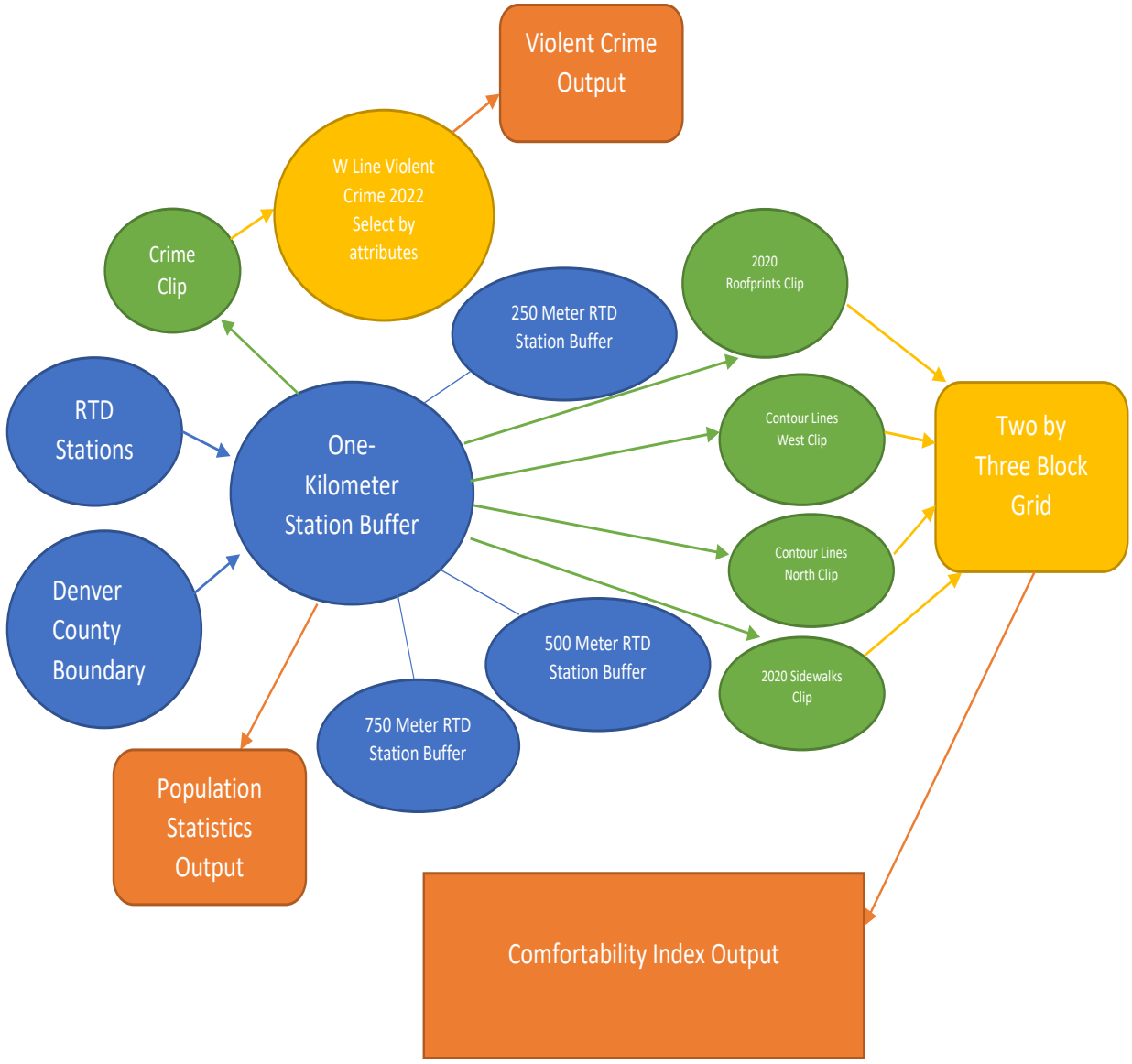


Figure 2: Flow Chart

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## Statistical Analysis of Population Changes

Using American Community Survey Census Tract data located within the one Kilometer buffered areas around W line stations in Denver, analysis was performed indicating whether the addition of light rail and subsequent population growth near stations has had an effect on average household income, percent poverty, and commute times. This information may inform changes to support quality of life outcomes near W line stations and provides for policy makers to better utilize resources to improve neighborhoods. In order to analyze the change which has taken place due to the introduction of the W line, data related to before the W line opened and after the W line opened were required. This included the use of US Census, American Community Survey Tracts (2006-2010) and American Community Survey Tracts (2014-2018). The census tracts from the American Community Survey were intersected with the one-kilometer W line station buffers. Fifteen census tracts of the one hundred forty-four census tracts in Denver intersected the W line buffer. The data for these census tracts include values relating to the total population of each tract before and after the W line was placed into service. This allowed for the creation of the dependent variable, total population numerical increase, TTLPOPULANUMINC, which is the numerical increase in population from the 2006-2010 community survey to the 2014-2018 community survey. To see how population increase accompanying the opening of the W line has affected the poverty rate, household income, and the number of individuals whose total commute times are less than fifteen minutes, the numerical increase of those values in each census tract were created as independent variables. Values of transformed independent variables were also created. Additionally, dummy variable W Line_DUMMY was created to distinguish between the fifteen census tracts intersecting the

one-kilometer buffer around W line stations and the non-W line intersecting census tracts located throughout the rest of the Denver County area, viewable in table 1. The hypothesis tested is that higher population growth in census tracts intersecting W line station buffers in Denver has resulted in higher household income, lower poverty rates, and lower commute times. The goal of the analysis was firstly to discover if population growth near W line stations has led to higher household income as many of those moving in are presumably taking advantage of the new transportation network to commute to work thus reducing barriers to employment. Secondly, it was expected that the growth in total population would result in lower poverty rates as many of the new residents were moving into new and often expensive units and potentially displacing lower income individuals. Finally, I expected to find that areas of higher population growth would show an increase in the number of individuals with commute times less than fifteen minutes. This was based on the prediction that the new residents were utilizing transit for trips to the city center which takes fifteen minutes or less from the W line stations under test. Multivariate regression was run using the dependent and independent variables. To reduce variance, the independent variable data was transformed using y' = y1/2 as the transformation formula. This transformation was chosen as the spread of residuals was increasing with Y. The transformed independent variables were then entered into a multiple regression to test, which helped stabilize the variance. The final variable, W Line_DUMMY, was used to highlight the difference in results between the entirety of Denver County and the census tracts intersecting the W line buffer. Using the dummy variable, the expectation was that areas within the buffer would have statistically significant relationships between dependent and independent variables and census tracts outside the buffered area would not.

Using multiple regression with a dummy variable was chosen for the dataset as the data is from the US Census and contains more than one predictor variable with all variables being metric with the exception of the dummy variable. With this in mind the data is best suited to the multiple regression analysis method.

## Violent Crime Analysis

A large factor which dissuades individuals from using the W line is the concern of violent crime near stations. By analyzing violent crime data from the Denver Police Department, areas of clustering are located. Using spatial autocorrelation, kernel density, and hot spot analysis tools in ArcGIS Pro the significance of clustering is analyzed and presented spatially. By providing maps to stakeholders such as RTD transit security or the Denver Police Department, safety initiatives near W line stations can be promoted and ridership outcomes can be improved. Using violent crime data within one-kilometer buffers of RTD W line stations it was expected that more violent crime occurs near W line stations than areas further from W line stations and that light rail stations are a primary factor for violent crimes occurring in West Denver. The violent crime data includes aggravated assaults, burglary, and murder from January 1, 2017, to May 20, 2022. This time period was chosen to provide a significantly large dataset to accurately portray crime committed since the opening of the W line.

## Comfortability Index Creation

By overlaying layers related to W line ridership barriers in a GIS, the goal was to understand where improvements could be made within the study area. The expectation was to visualize barriers by creating grid areas and symbolizing them with colors based on the values of data

findings. By adding data for each potential barrier and classifying each data point with a score, a comfortability score was created. Building footprints provided the land use information for each grid area. Utilizing data from the Denver Regional Council of Governments, sidewalk data was added. This information was ground-truthed for accuracy. Road information was utilized from satellite imagery and the world street map within ArcGIS Pro and ground truthed. A contour line overlay was added to show areas with large elevation changes and a score was given to each grid area with higher gradients receiving higher scores and low contour line grid areas receiving lower elevation change scores. Regarding distance, creating buffers of two hundred fifty meters, five hundred meters, seven hundred fifty meters, and one thousand meters around W line stations was performed to allow an understanding of areas most likely to benefit from increased density based on distance from stations. The five-hundred-meter and below distances being the ideal zones for high density land use (Hyungun, et al. 2014). Euclidian buffers were used due to overall distance carrying the highest weight for a score. Network buffers were not used as the walking paths and roads were addressed individually in the study. Crime data from the Denver Police Department was used for each grid area. Splitting the number of crimes into five classifications. Combining the primary and secondary data into the GIS and designating areas with a number value provided the comfortability index output, allowing users an overall view of areas with the greatest need for change. Providing a color value allows a clear spatial representation of the state of W line comfortability in West Denver. Utilizing the comfortability index, we see where improvements can be made in each grid area.

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## Grid

A Grid of cells was created within the buffered area to create individual locations for study in order to obtain scores for the comfortability index. These areas are 192 meters east to west and 250 Meters North to South. This creates grid areas of two blocks by three blocks. The grid size was chosen to minimize the reliance one cell would have on another. Due to the size of the features under analysis the two by three block area provided the best opportunity to create like grid areas (Moeckel and Donnelly 2015). A smaller grid causes one or two features to dominate the area under test and limits the effectiveness of the research method. Cells larger would not have had the accuracy to provide a successful comfortability index. The grid size led to a total of 291 unique grid areas within a one-kilometer area of W line stations. Each grid was evaluated for all potential barriers to ridership. To provide insight into the scoring system for the comfortability index, figure 3 provides a visual representation of the grid cells as research was performed. The grid area pictured includes grid item FID 75, the area with the lowest comfortability index value indicating the least barriers to access the W line and the highest overall comfortability. The grid area in figure 3 shows only one crime committed, more than four buildings, a strong network of sidewalks, no public roads, only moderate elevation change, and a distance of only 250 meters to a light rail station.

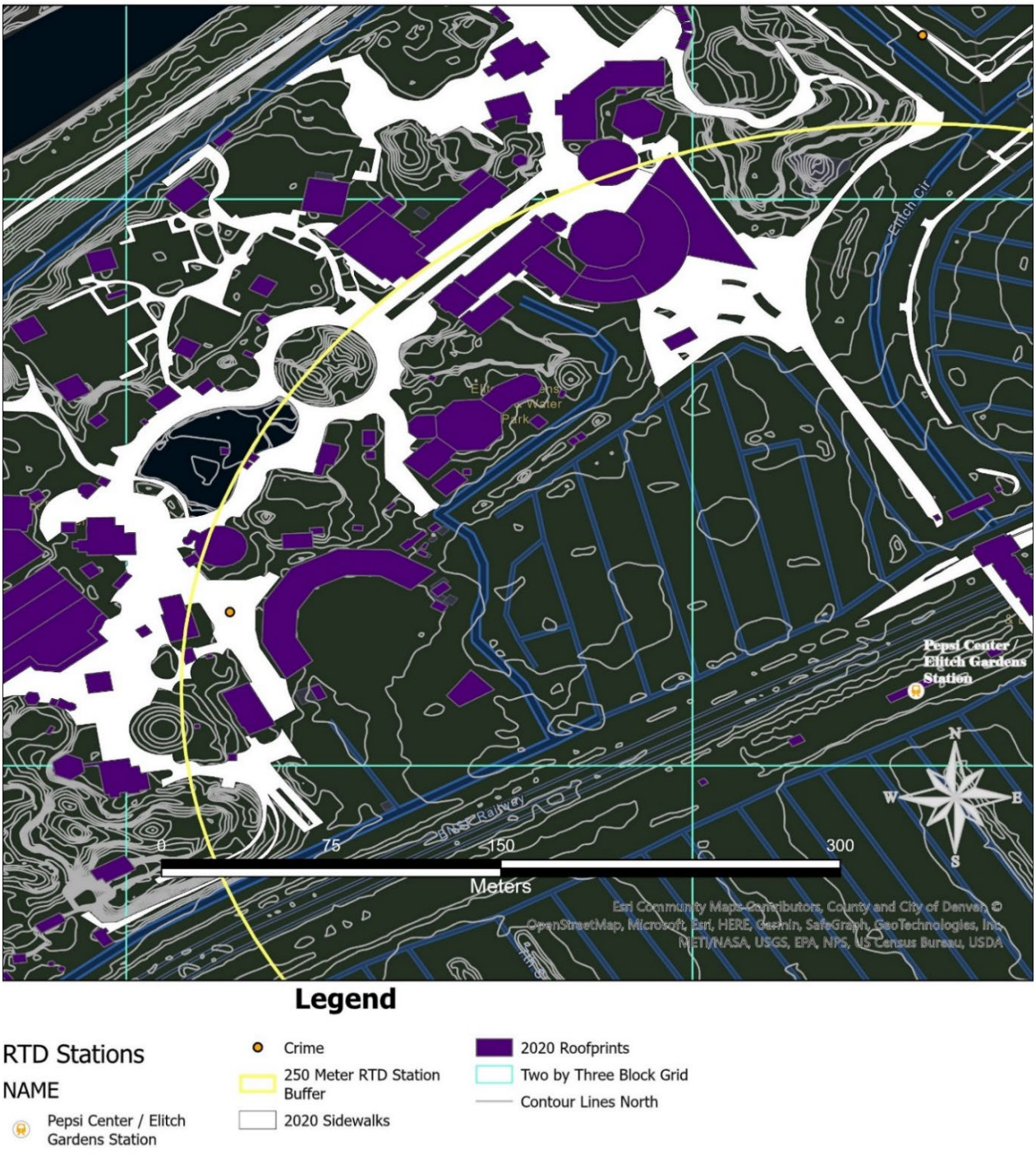


Figure 3: Selected Grid Cells

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# Results

## Statistical Analysis of Population Changes

By running an initial correlation for the full Denver County data between dependent and transformed independent variables, it was discovered that there were small but significant correlations. The initial correlation resulted in the dependent variable, total population numerical increase, having significance at a one tail test with the independent variable, average household income numerical increase with a score of .173. The correlation between total population numerical increase and the independent variable commute time numerical increase was .502 and is significant for a two tailed test. Finally, total population numerical increase and the independent variable percent poverty numerical increase was not significant at .023. This data suggests that on a county wide scale for Denver, there is not a significant correlation between the increase in the total population and the change in percent poverty. It also indicates that there has been an increase in the number of individuals commuting less than fifteen minutes on a county wide basis and that has increased with the overall growth in population. The data further suggests that there is a mild correlation between an increase in total population and household income on a county wide level. To discover if the W line had an effect on these correlations, multiple regression was run using a dummy variable exclusive to census tracts within commuting distance of the W line.

The multiple regression equation for data within the W Line buffer is TTLPOPULANUMINC = 533.932 + .036 AVGHHINCNUMINCTRA + 70.537 PCTPOVERTNUMINCTRA + 8.527 COMNUMINCTRA

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The multiple regression equation for data including all of Denver County is TTLPOPULANUMINC = 792.580 + .020 AVGHHINCNUMINCTRA + 46.968 PCTPOVERTNUMINCTRA + 4.374 COMNUMINCTRA

Using the dummy variable, the findings show that the independent variables are responsible for a significant amount of variance in the dependent variable. The R square using the dummy variable was strong at .828, and much weaker when running the regression without the dummy variable at .189. This indicates that areas within the W line buffer have been much more affected by the increase in population than the county as a whole. The beta figures for the dummy regression included a mild but significant .199 for average household numerical increase, a stronger .249 for percent poverty numerical increase, and a very significant .971 for commute time less than 15 minutes numerical increase. This indicates are relatively strong degree of change in total population numerical increase with a change in the independent variables. The tolerance levels of .415 for average household income numerical increase, .380 for percent poverty numerical increase, and .813 for commute time less than 15 minutes numerical increase are high enough to reduce concerns of multicollinearity in the data. The residual plot included one significant outlier for selected W line cases and two additional outliers for Denver County as a whole using the transformed independent variables. Despite the outliers, the plot was relatively uniformly dispersed adding to the confidence of the model. With this data in mind, we can convey with confidence that there is a significantly stronger correlation between dependent and independent variables within the W line buffer than for all of Denver County.

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# Violent Crime Analysis

## Spatial Autocorrelation

In order to understand if violent crime was clustered, spatial auto correlation was performed on a 500 ft/one block grid within the light rail station buffer. Violent crime data from, January 1, 2022, to May 20, 2022, was used to perform the analysis. The values for violent crime committed in 2022 indicated a statistically significant degree of clustering with a z-score of 1.87. We find the highest number of crimes are committed near Union Station with the lowest in proximity to Auraria West Stations and Empower Field at Mile High Station.

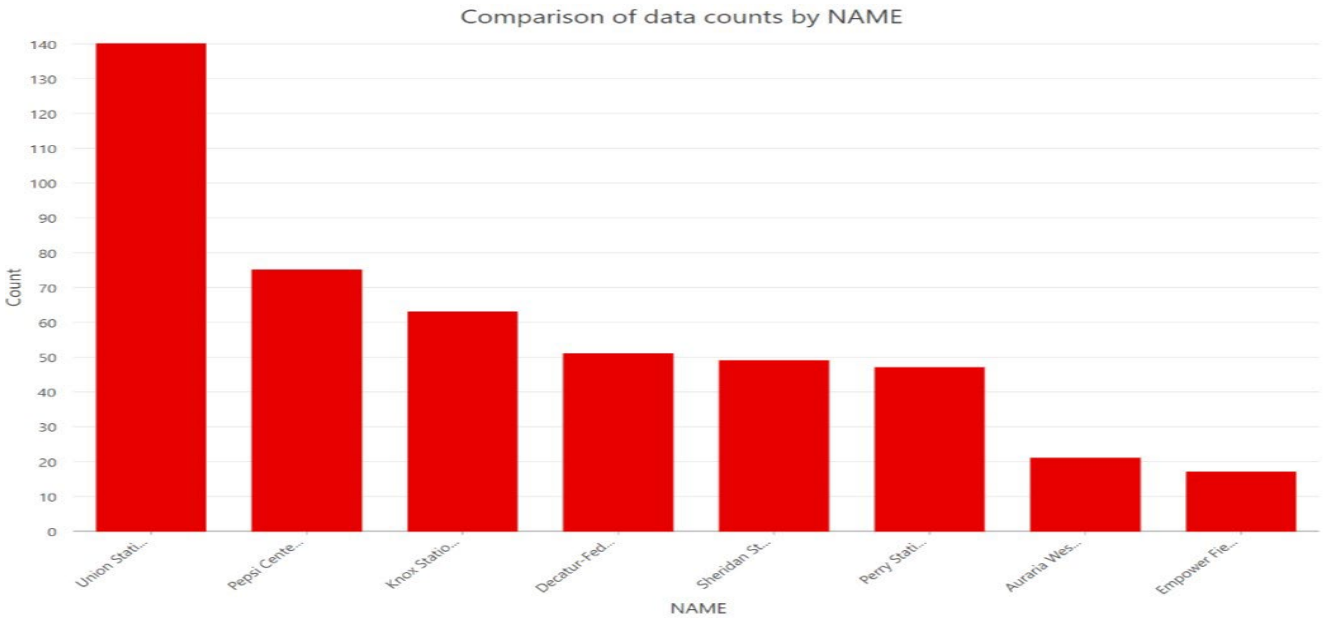



Figure 4: Comparison of Violent Crime by Station

# Spatial Autocorrelation for Violent Crime Within One Kilometer of the RTD W Line Denver

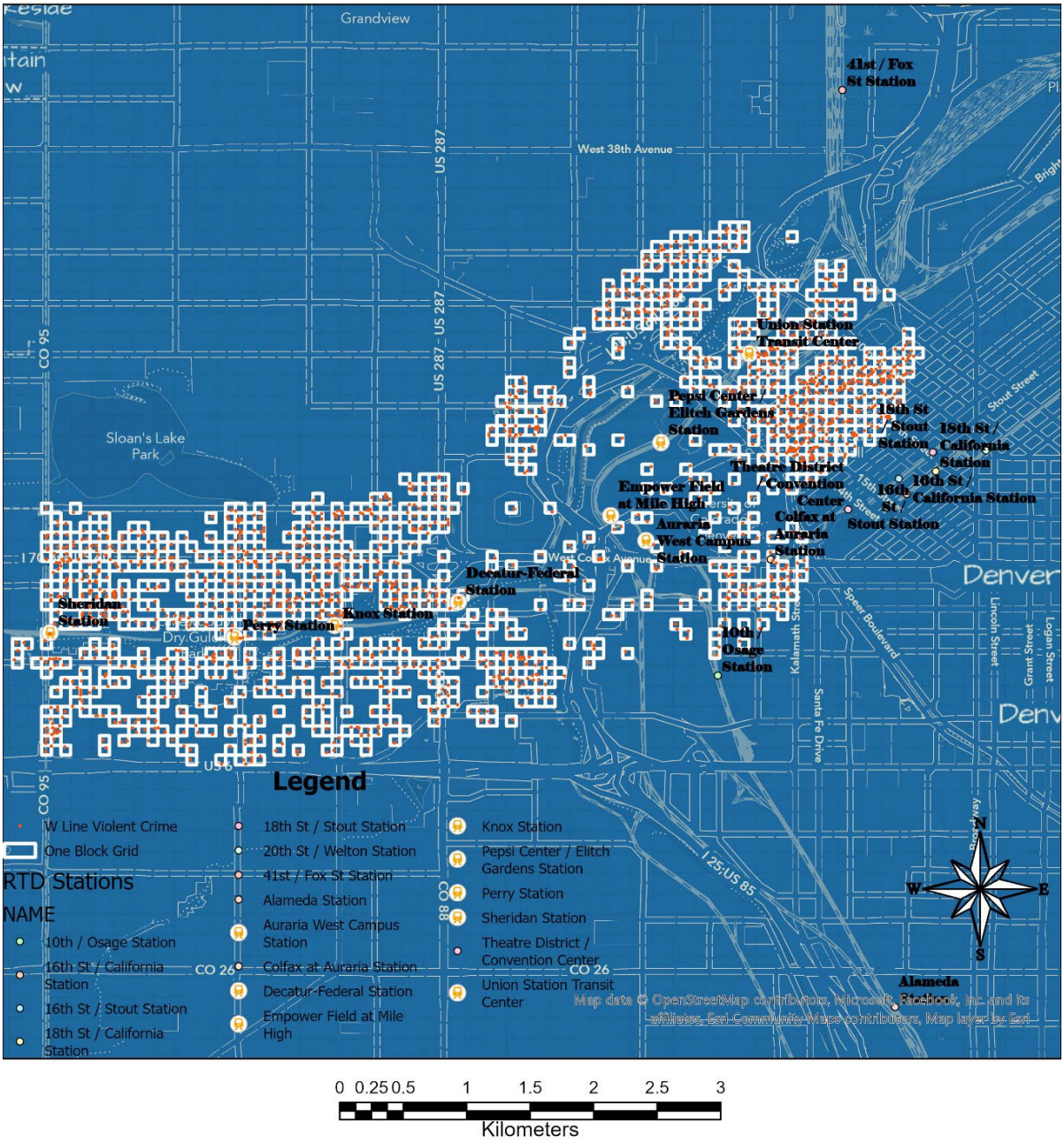
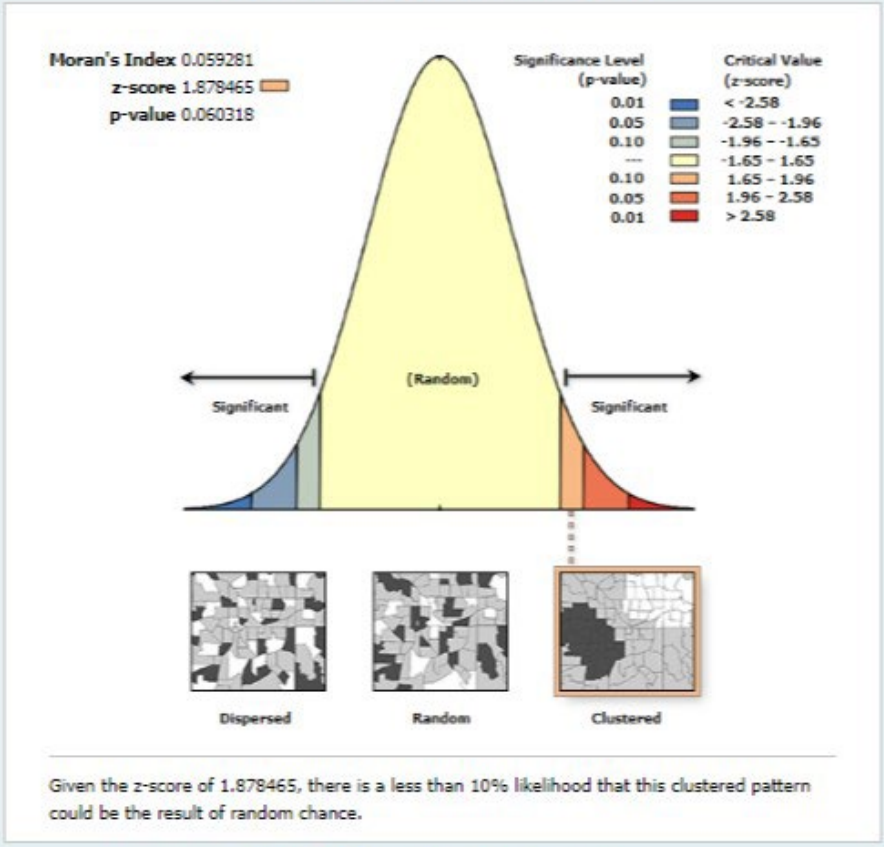



Figure 5: Spatial Autocorrelation Map

## Spatial Autocorrelation Report




Given the z-score of 1.878465, there is a less than 10% likelihood that this clustered pattern could be the result of random chance.

### Global Moran's I Summary

| | |
|---|---|
| **Moran's Index** | 0.059281 |
| **Expected Index** | -0.005291 |
| **Variance** | 0.001182 |
| **z-score** | 1.878465 |
| **p-value** | 0.060318 |

### Dataset Information

| | |
|---|---|
| **Input Feature Class:** | OneKilometerStationBufferOneBlockGrid_SummarizeWithin2 |
| **Input Field:** | POINT_COUNT |
| **Conceptualization:** | ZONE_OF_INDIFFERENCE |
| **Distance Method:** | EUCLIDEAN |
| **Row Standardization:** | False |
| **Distance Threshold:** | 304.8000 Meters |
| **Weights Matrix File:** | None |
| **Selection Set:** | False |

Figure 6: Spatial Autocorrelation Results

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## Kernel Density

The next analysis performed was kernel density. Using five classes and a geometric interval allowed for a clear visualization of where clustering occurred within the W line light rail boundaries. The time period of data from January 1, 2017, and May 20, 2022, was used for the analysis and patterns of significant clustering were visible near Union Station, Knox Station, and Decatur Federal Station. Additional high crime areas along the West Colfax corridor were apparent as well. The map shows signs of clustering in areas of high population density and lower crime in areas with low population density. We do not see indications that the clustering is focused specifically near W lines stations which does not support the hypothesis that the W line has led to an increase in violent crime.

Capstone

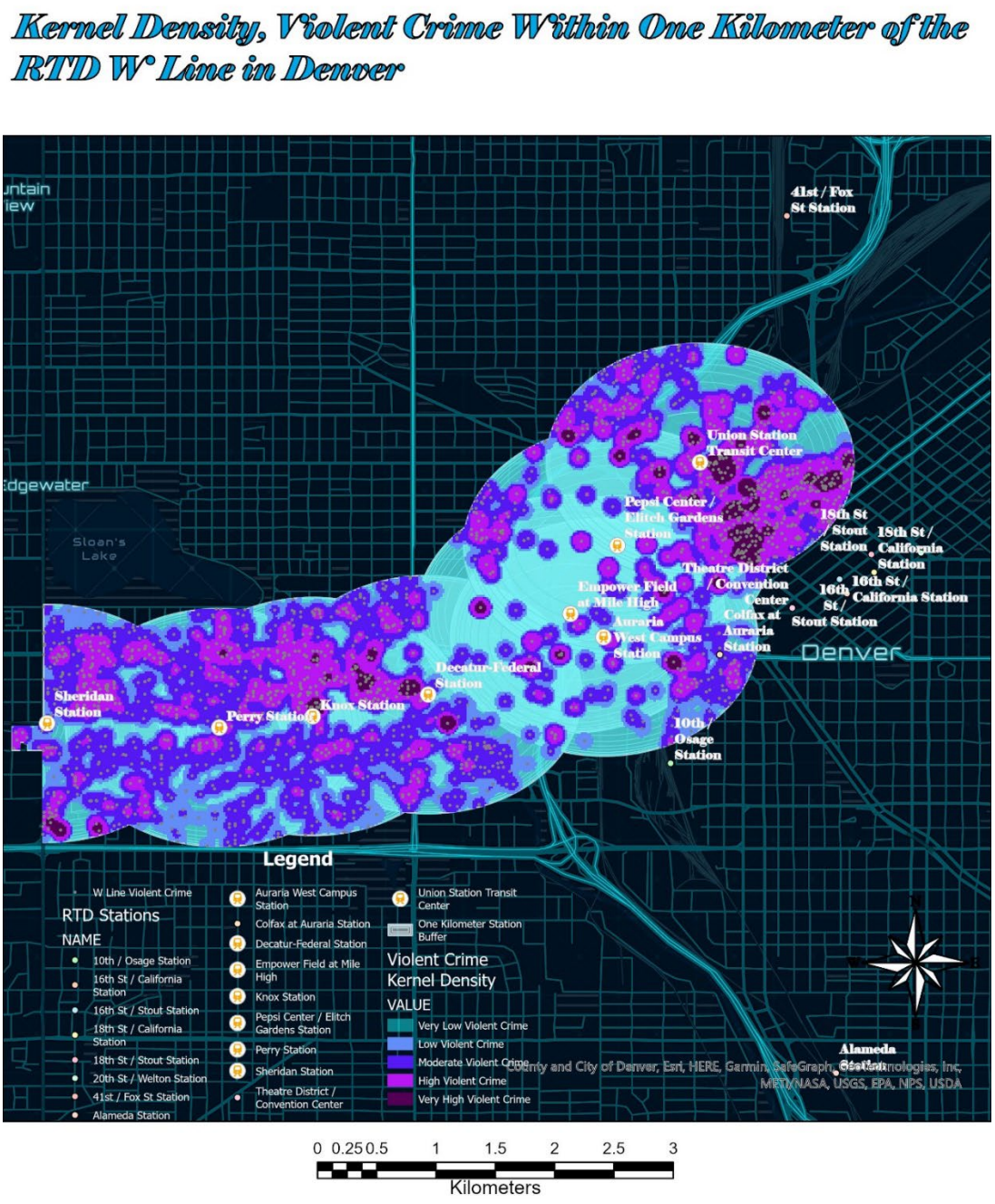



Figure 7: Kernel Density Map

Capstone

## Hot Spot

The final method used for analysis of violent crime near RTD W line stations was hot spot analysis. This was performed on the violent crime data from January 1, 2017, and May 20, 2022, using a one block or 500-foot grid to measure the number of crimes per grid area. A fixed distance band of 250 meters or 820 feet was selected to understand if clustering occurred in close proximity to W line stations. The analysis indicated strong confidence for hot spots near Union Station and Knox station while Decatur-Federal station shows hot spots to the West of the station and cold spots to the East of the station. Cold spots also exist near Pepsi Center/Elitch Gardens station, Empower Field at Mile High station, and Auraria West station. Hot Spot analysis indicated that clustering of crime has occurred near some light rail stations while other light rail stations have cold spots which does not support the hypothesis that violent crime would be concentrated near W line stations.

# Hot Spots for Violent Crime Within One Kilometer of the RTD W Line in Denver

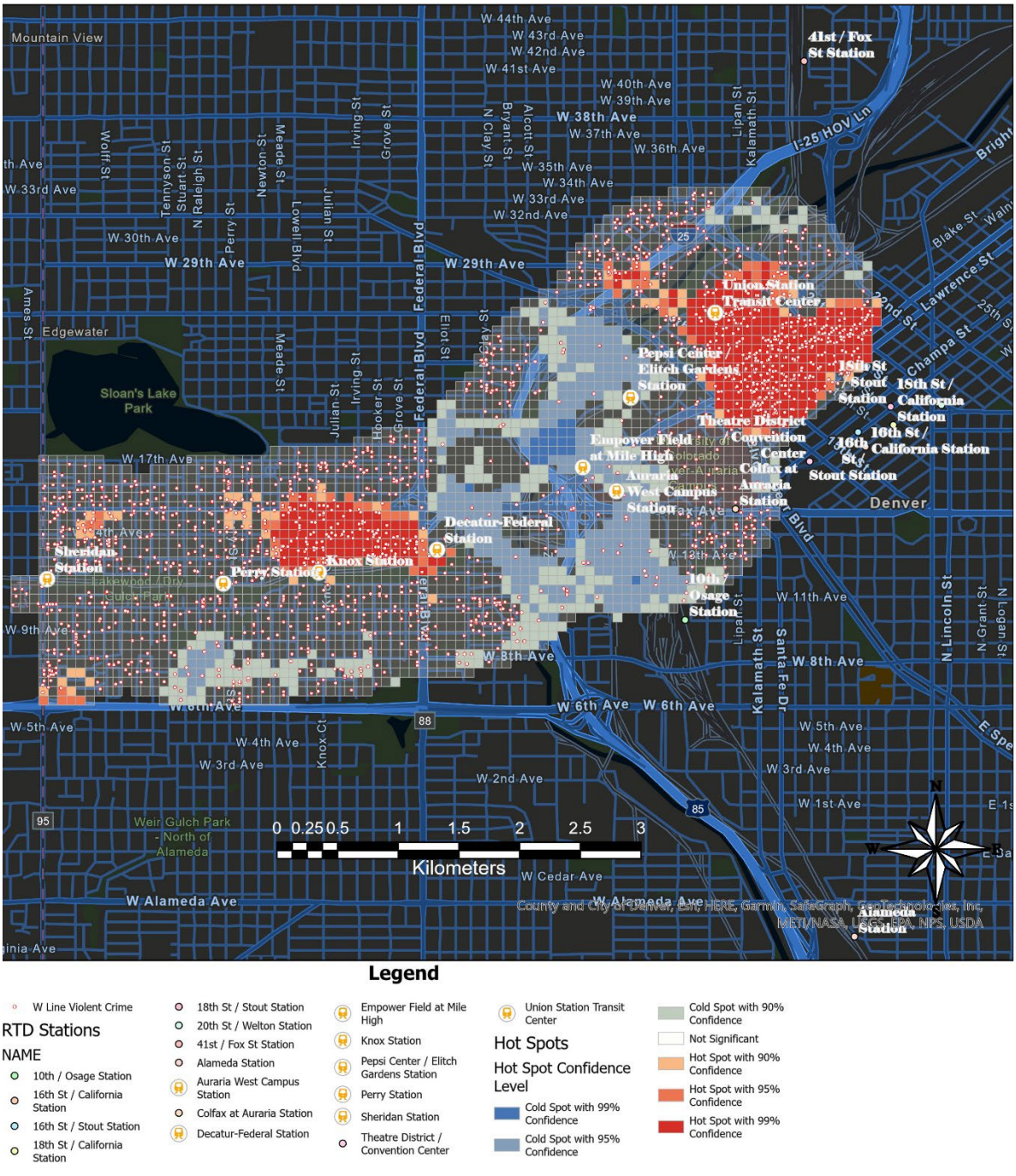



Figure 8: Hot Spot Map

By analyzing violent crime data occurring within a one-kilometer buffer of RTD W line stations in Denver, Colorado it was expected that clustering would be found, indicating a higher crime rate near light rail stations. Using spatial autocorrelation, it was discovered that significant clustering did occur for violent crime within the buffered areas of the light rail stations. A z-score of 1.87 and a p-value of .06 indicated that there was a 90% probability that clustering occurred. This was based on a 304.8 Meter/1000 ft distance band and violent crime data from January 1, 2022, to May 20, 2022. In order to visualize where clustering of violent crime was focused, kernel density analysis was performed. Using violent crime data from January 1, 2017, and May 20, 2022, and a 5-class geometric interval, a clear pattern emerged. Significant high violent crime areas were visible near Union Station, Knox Station, Decatur-Federal station, and along the West Colfax corridor. Low and very low violent crime areas are also visible using kernel density analysis and these areas appear to be focused where population is low. The final analysis method used was hot spot analysis. To locate statistically significant hot spots a 500 ft grid and the total violent crime data were used with a fixed distance band of 250 meters, or 820 feet. Hot spots were found around Union Station and Knox station and cold spots were located near Pepsi Center/Elitch Gardens station, Empower Field at Mile High station, and Auraria West station. Decatur-Federal station showed hot spots to the West of the station and cold spots to the East of the station.

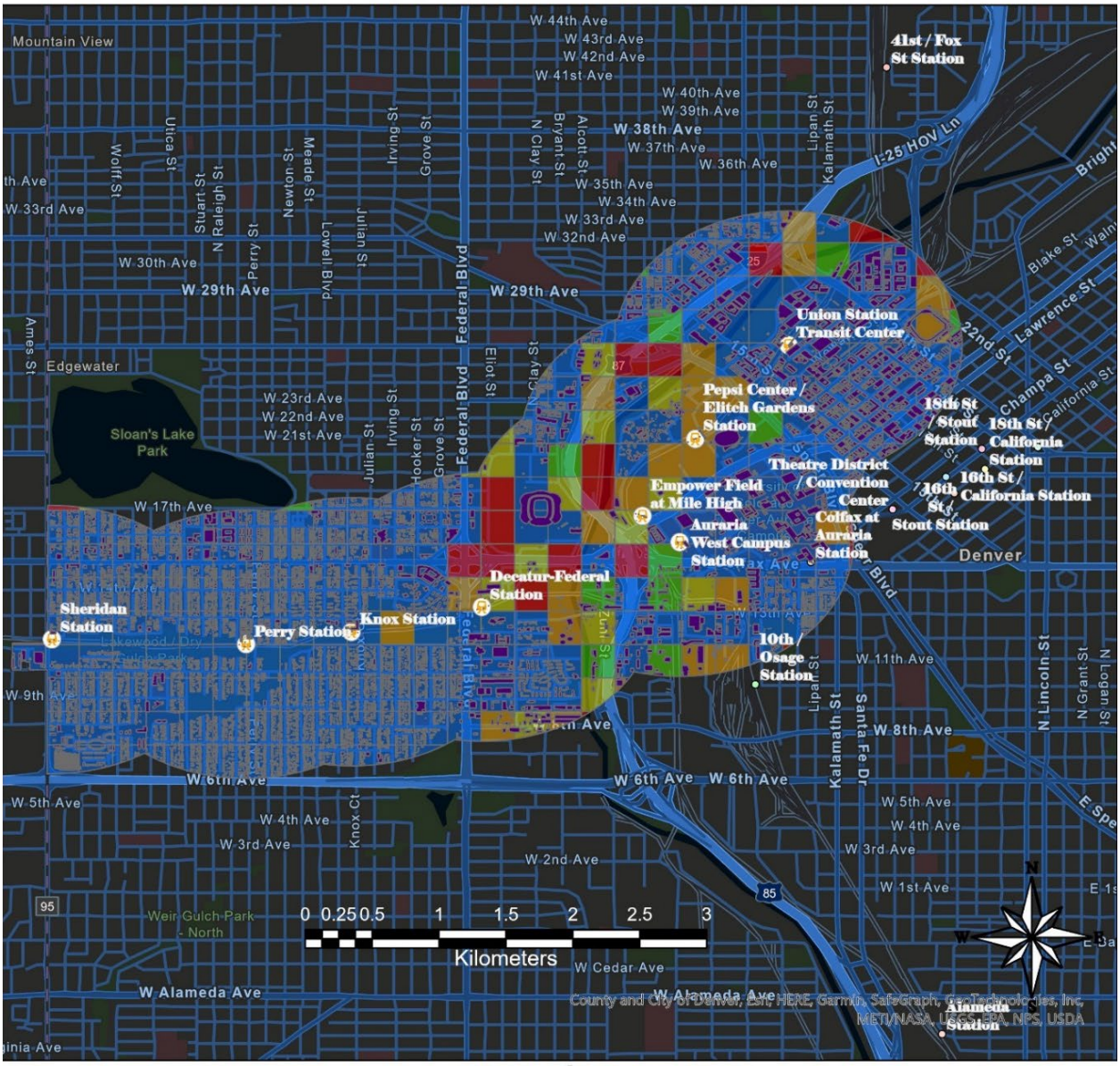
## Comfortability Index Findings

### Buildings

In order to maximize the effectiveness of light rail a relatively high population density is desirable to provide opportunities for ridership (Hyungun, et al. 2014). With this in mind the

building footprints layer was added to the GIS to visualize where housing, apartment buildings, and other structures were located. The building footprints were obtained from the Denver Regional Council of Governments. These footprints were delineated from 2020 aerial imagery and were spot-checked by ground truthing to verify accuracy as the data is nearly three years old. Small changes were located including a new apartment building near the Decatur/Federal station, new townhomes near the Perry Station, and new townhomes near the Knox Station which improved overall scores in their respective grid areas. Each grid area was scored on a one to five basis depending on the number of buildings present. One point was deducted from a maximum of five for each building. Large buildings such as schools, sports venues, museums, and apartment buildings were given a four-point deduction. Although housing near light rail stations is ideal, other building types are included as people also need employment destinations near light rail stations to make light rail travel useful (Currie, Ahern and Delbose 2010). The ideal score of one was given to areas built up enough to support the use of the W line. The results indicated that a majority of areas near the W line have the number of buildings required to support light rail ridership. Many of the poor scores were in industrial areas, parking lots, and areas used for large roads.  Areas encompassing or near interstate highway 25 have some of the highest scores due to the lack of buildings. Interesting modern land use patterns such as the Meow Wolf art installation have been able to utilize space near interstate 25 although additional future growth near this corridor could lower scores and provide more options for light rail usage as seen in figure 9.

# Building Scores Within One Kilometer of the RTD W Line in Denver




**Legend**

RTD Stations

NAME

- 10th / Osage Station
- 16th St / California Station
- 16th St / Stout Station
- 18th St / California Station
- 18th St / Stout Station
- 20th St / Welton Station
- 41st / Fox St Station
- Alameda Station
- Auraria West Campus Station
- Colfax at Auraria Station
- Decatur-Federal Station
- Empower Field at Mile High
- Knox Station
- Pepsi Center / Elitch Gardens Station
- Perry Station
- Sheridan Station
- Theatre District / Convention Center
- Union Station Transit Center
- 2020 Roofprints

Buildings

- 1
- 2
- 3
- 4
- 5

Figure 9: Building Scores Map

Capstone

## Sidewalks

Sidewalks are necessary for street connectivity supporting those accessing transit lines (Nawrocki, et al. 2014). Given the measurable gains in transit usage afforded by sidewalks an overlay of sidewalks accessed from the Denver Regional Council of Governments was included. The sidewalk data vintage is from 2020 and includes sidewalks and paved trails with a width of greater than three feet. The sidewalks conform to the Americans with disabilities act minimum sidewalk size of 36 inches. The sidewalk feature does not include private sidewalks which are not designed for public use in access to the W line. Spot checking of sidewalks at all stations was performed to verify accuracy and the sidewalks layer was found to have no specific errors. Sidewalks were scored with a one, three, or five score. Areas with sidewalks allowing transit in all four cardinal directions were given a one. Areas where direction in one to three directions was given a score of three. Areas with no sidewalks were given a score of five. Most neighborhoods of single-family homes and apartment buildings were found to have satisfactory sidewalks, and many received scores of one with notable exceptions. Significant areas within 250 Meters of the W line stations had missing sidewalks which affect access for the greatest number potential riders. There were numerous areas with no sidewalks especially near the interstate 25 corridor and in industrial areas. Missing sidewalks led to lower overall comfortability in areas affecting all stations. Areas missing sidewalks cause a noteworthy difficulty for travel to light rail stations in the W line buffer and minimizing the necessity of movement in streets or in unpaved areas would provide the ability to support additional transit users.

# Sidewalk Scores Within One Kilometer of the RTD W Line in Denver

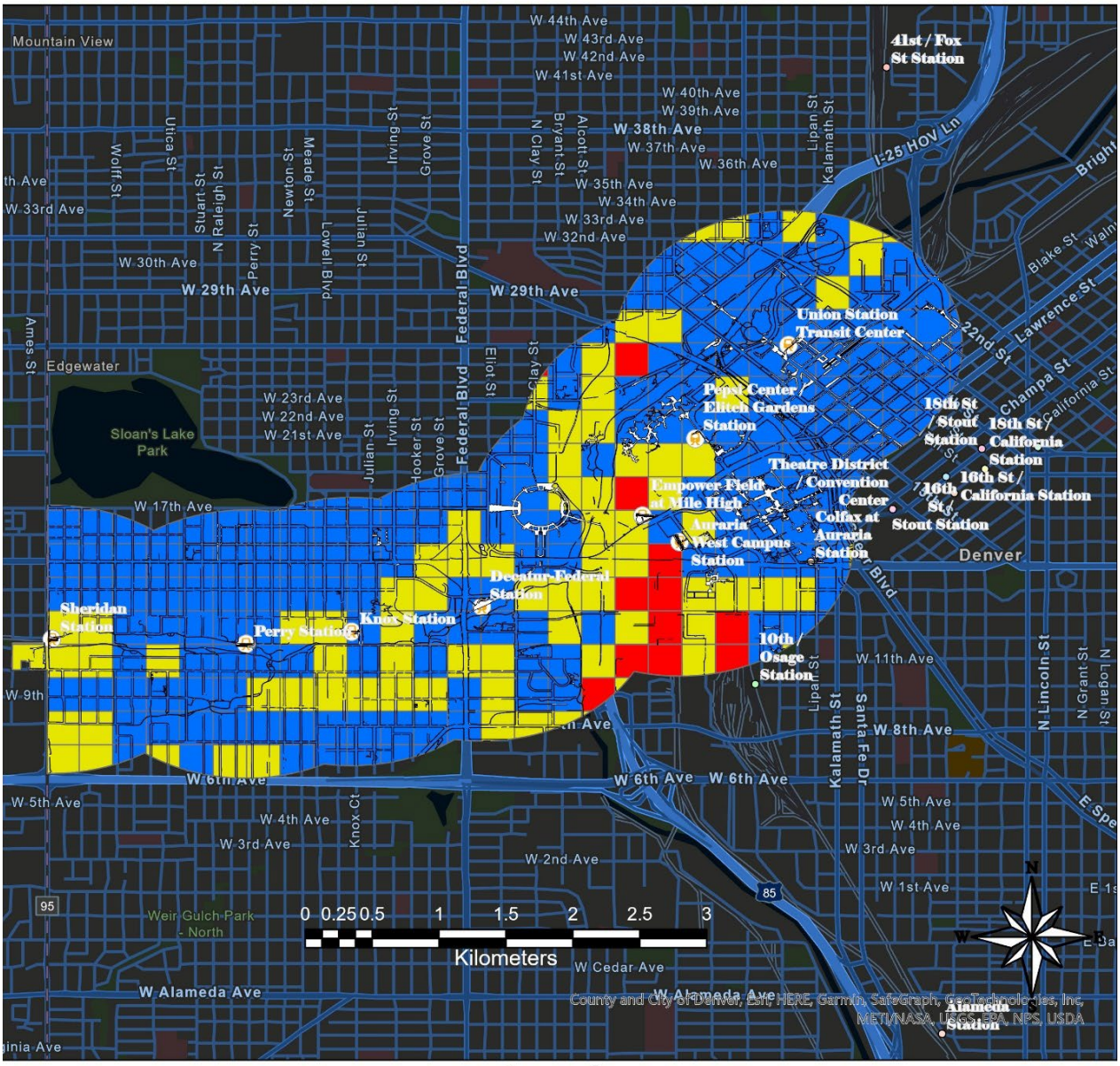


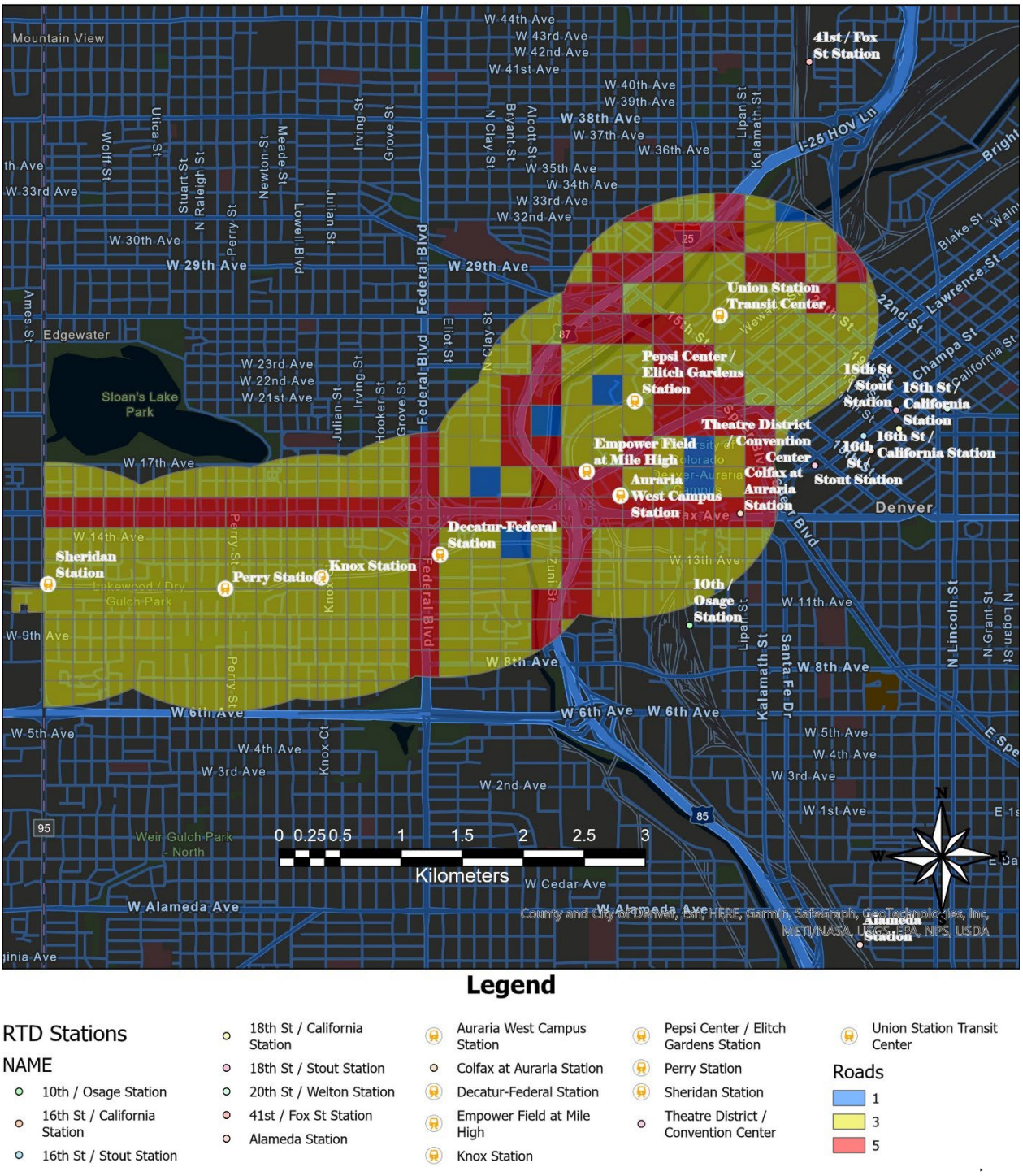

Figure 10: Sidewalk Scores Map

Capstone

## Roads

Roads are necessary for the movement of personal vehicles but can create barriers for accessing public transit. To quantify the barriers a road causes on potential light rail users, a one, three, or five score was utilized. Road data from publicly available sources within ArcGIS Pro was utilized along with ground truthing for accuracy. An area with no roads received a score of one, this included a very limited number of areas, notably parts of the Auraria Campus. Areas with roads of one lane in each direction were given a score of three. These roads may cause mild to moderate difficulty in crossing but can be traversed safely for most transit users. A majority of the areas within one kilometer of the W line fell within the moderate roads category. A score of five indicates areas where roads cause a significant barrier to cross. Notable roads in the number five category include Highway 40/Colfax Avenue, Highway 287/Federal Boulevard, Auraria Parkway, Speer Boulevard, and Interstate 25. These main throughfares create substantial barriers to those on foot or bicycle. Infrastructure improvements such as the Highland Bridge, which connects the Highland neighborhood with the Union Station neighborhood, allow pedestrians the ability to cross above or below these high traffic roads to improve access but are limited in scope. In many areas within the W line buffer, roads create barriers which greatly limit accessibility and comfortability to access light rail.

# Road Scores Within One Kilometer of the RTD W Line in Denver




## Legend

**RTD Stations**

NAME

- 10th / Osage Station
- 16th St / California Station
- 16th St / Stout Station
- 18th St / California Station
- 18th St / Stout Station
- 20th St / Welton Station
- 41st / Fox St Station
- Alameda Station
- Auraria West Campus Station
- Colfax at Auraria Station
- Decatur-Federal Station
- Empower Field at Mile High
- Knox Station
- Pepsi Center / Elitch Gardens Station
- Perry Station
- Sheridan Station
- Theatre District / Convention Center
- Union Station Transit Center

**Roads**

- 1
- 3
- 5

Figure 11: Road Scores Map

Capstone

## Elevation Change Scores

For individuals travelling to light rail stations, elevation change can cause difficulty and reduce the comfortability of access. By including contour lines with one-foot intervals in the GIS, we gain a better understanding of the difficulties faced by those accessing W line stations by analyzing where elevation change occurs. The contour line data was obtained from the Denver Regional Council of Governments and was obtained in the Fall of 2013. The ten-year-old vintage of the data is acceptable as elevation change is relatively static and ground truthing was performed for accuracy. To score elevation change a one, three, or five score was used. Areas with no tightly spaced contour lines indicating low elevation change allow for ease of movement and were provided with a score of one. If areas contained less than half tightly spaced contour lines than a score of three was given. If an area contained more than half tightly spaced contour lines and therefore high elevation change a score of five was applied. No specific elevation change was used to score but rather how the elevation change would affect potential light rail users. Using contour lines allowed for a manual visual review of the change in elevation in grid areas. A one, three, or five score was sufficient to capture the hinderance of movement within a grid area. With contour lines it was discovered that much of the downtown Denver area has relatively minimal elevation change. This kept scores low near Union Station, Pepsi Center/Elitch Gardens Station, Empower Field at Mile High Station, and Auraria West Campus Station. The stations west of downtown suffer from high elevation change in many locations which led to higher scores.

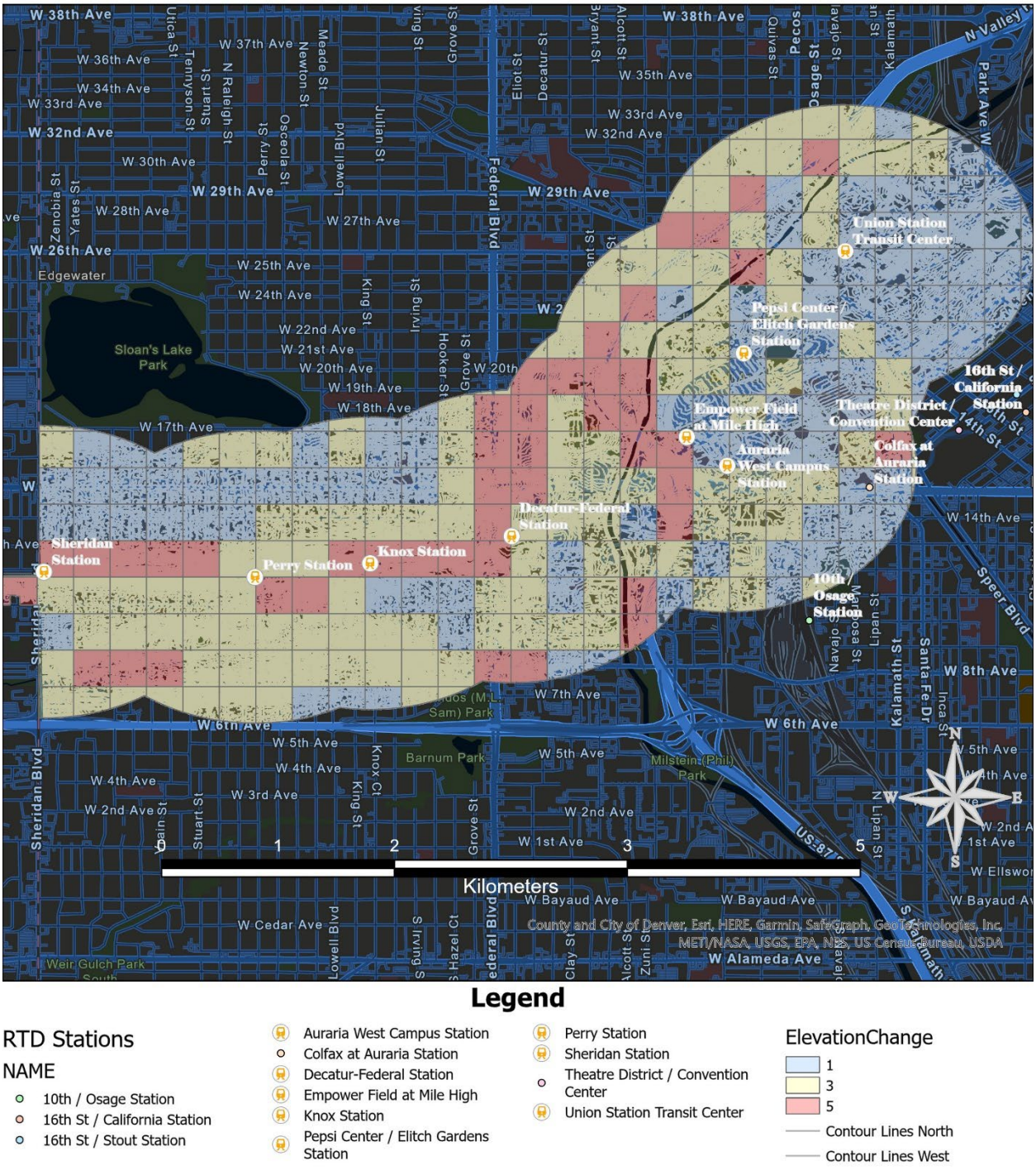



Figure 12: Elevation Change Scores Map

Capstone

## Distance

Based on survey data ninety seven percent of people need to be within one mile of a station in order to use it (Loetterle 1999). Regression analysis on distance to transit indicated that five hundred meters was the ideal distance for transit-oriented development (Hyungun, et al. 2014). Because of the sprawling design in much of Denver, distance plays a largely negative role in transit ridership for the W line. Distance scores were created based on distance from a W line station. To establish distance in each area, buffers were created for four different distances from each W line station. Grid areas which contain distances of two hundred fifty meters or less received a score of one, five hundred meters or less received a score of two, seven hundred fifty meters or less received a three, and under a thousand meters received a four. The distance results are provided visually in figure 13 and help to highlight the areas which are best suited to light rail access based on distance from each station. Distance is a barrier to access which affects areas differently and is exacerbated by the other barriers tested. Ground truthing helped to highlight that elevation change and sidewalks work in conjunction with distance to increase or decrease the comfortability of accessing light rail. Areas with distances within five hundred meters which are low on the overall comfortability index such as near Decatur-Federal Station are prime locations for stakeholders to identify when working to improve access to the W line.

# Distance Scores Within One Kilometer of the RTD W Line in Denver

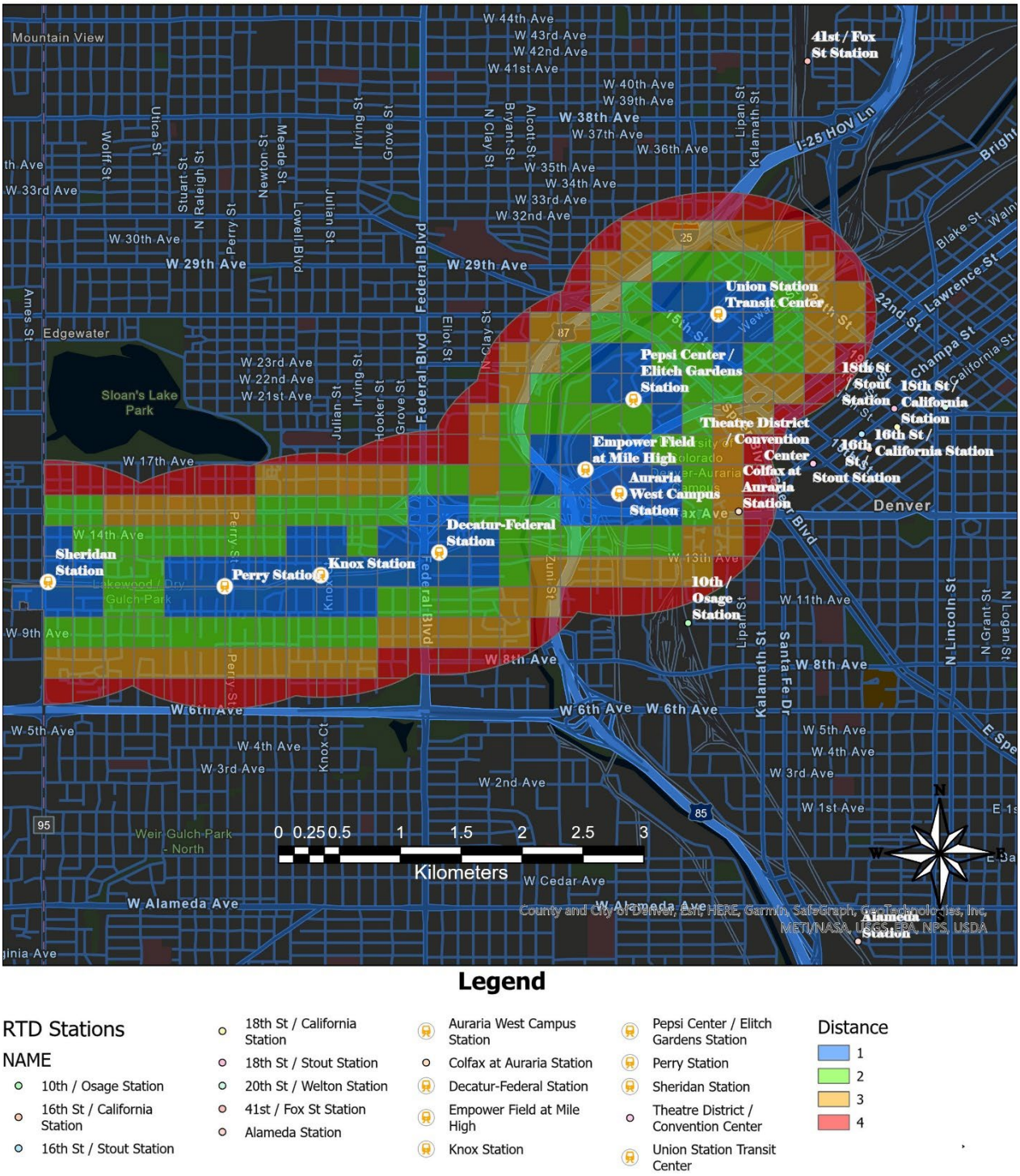


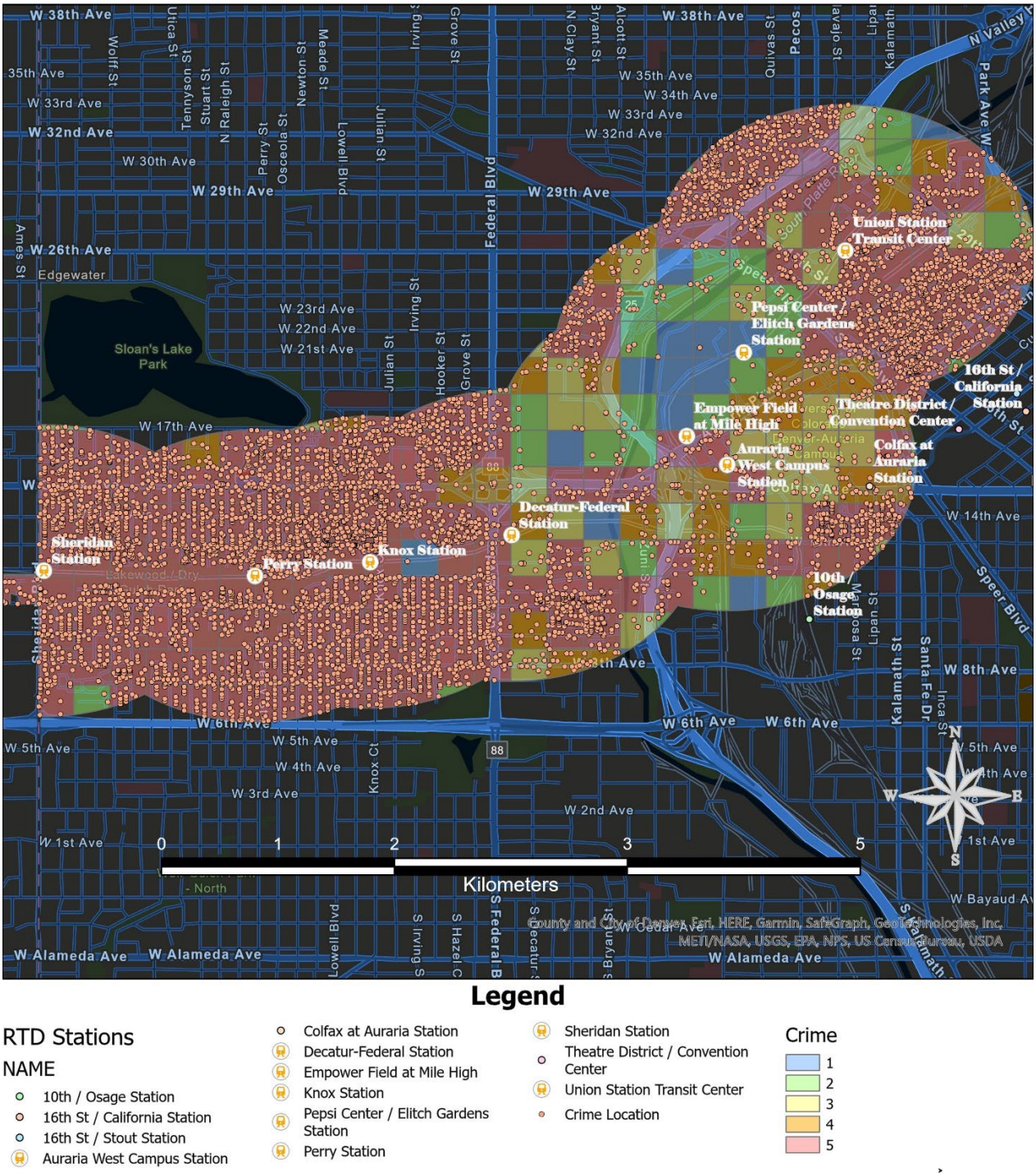

Figure 13: Distance Scores Map

Capstone

## Overall Crime

As part of the comfortability index an overall crime score layer was included. As violent crime was discovered to not be correlated with distance from W line light rail stations, overall crime was used as a low weight of the final comfortability index. It was important to include a crime layer in the comfortability index as crime is a large factor which dissuades potential light rail users from accessing the system. The crime data used for the comfortability index includes all crimes in the Denver police database from January 1, 2017, and May 20, 2022. This time period was chosen to provide a significantly large dataset to accurately portray crime committed since the opening of the W line. A total of 87,063 crimes were committed in the one-kilometer W line buffer during the time period. The grid areas were scored with a one to five score for crimes committed.  A grid area with zero crime or one crime received a score of one. A grid area with two or three crimes received a score of two. A grid area with four or five crimes was given a score of three. An area with six or seven crimes was given a score of four and areas with scores higher than seven received a five. We see in figure 14 that the majority of populated areas received a score of five and areas with small numbers of housing units most frequently received lower scores. Although crime is not focused on light rail stations, those accessing stations frequently need to transit through locations of high crime which lowers the comfortability of using the W line.

# Overall Crime Scores Within One-Kilometer Buffer around W Line Stations in Denver




## Legend

### RTD Stations

NAME

- 10th / Osage Station
- 16th St / California Station
- 16th St / Stout Station
- Auraria West Campus Station
- Colfax at Auraria Station
- Decatur-Federal Station
- Empower Field at Mile High
- Knox Station
- Pepsi Center / Elitch Gardens Station
- Perry Station
- Sheridan Station
- Theatre District / Convention Center
- Union Station Transit Center
- Crime Location

### Crime

- 1
- 2
- 3
- 4
- 5

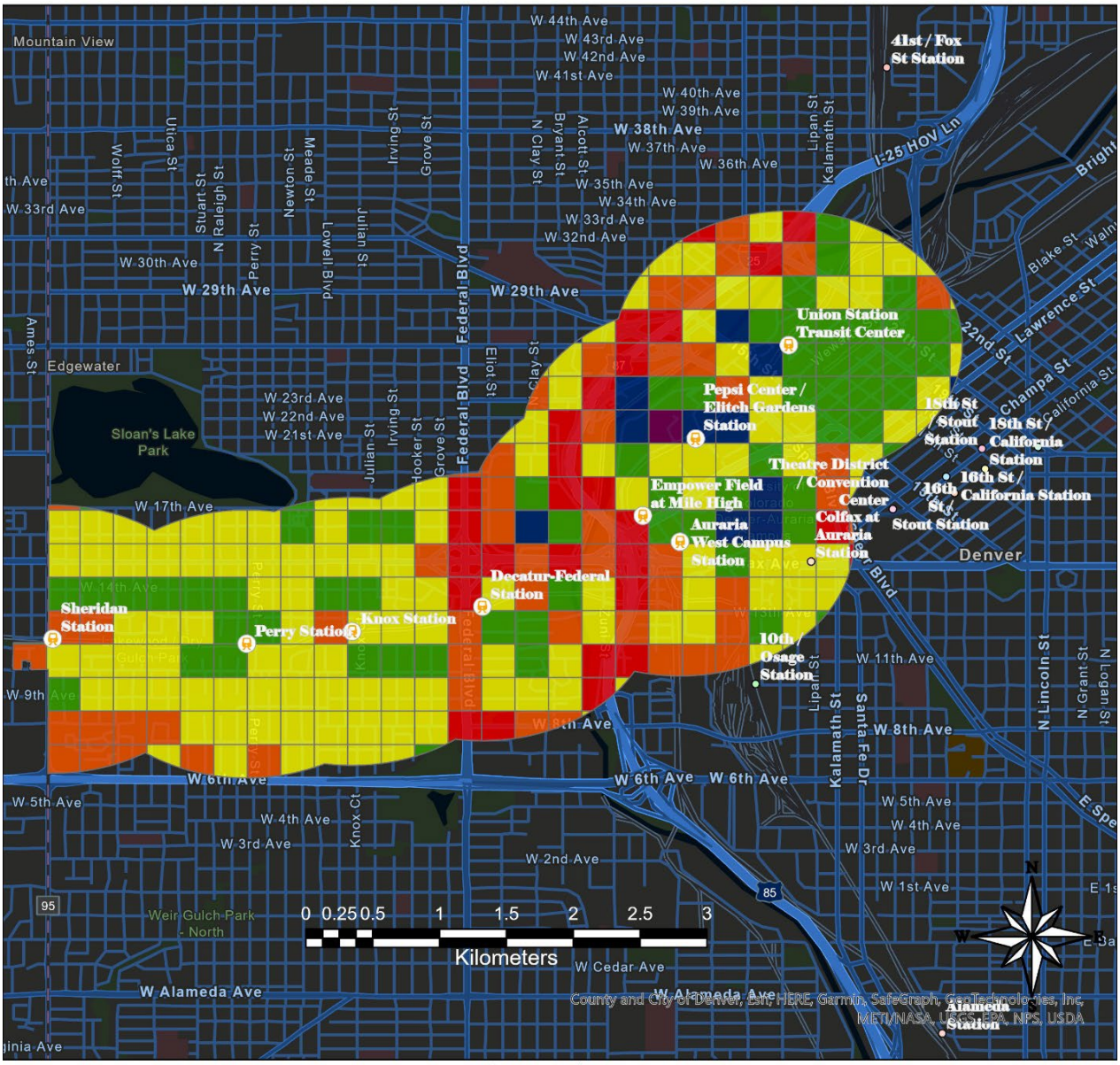
Figure 14: Overall Crime Scores Map

Capstone

## Comfortability Index

Once all data sets were brought into the GIS and the scoring system defined, the scores were added for each grid area and a final comfortability score was created. The comfortability index in figure 15 indicates each locations ease of access for potential W line users. We find a mean comfortability index value of 16.09 and a standard deviation of 2.93 with a relatively normally distributed outcome. By creating five geometric classes for the results, clear patterns emerge regarding the best comfortability scores. Areas in downtown near Union Station have some of the best comfortability for use of the W line. A Combination of low elevation changes, relatively low distances to Union Station or Pepsi Center/Elitch Gardens Station, relatively maneuverable streets, plenty of buildings, and a pedestrian friendly sidewalk system led to low scores in much of the downtown area. Many of the areas of lowest comfortability are found along main roads namely near Interstate 25 and Federal Boulevard. These areas suffered due to the high road scores, low building scores, often high elevation change scores, and many missing sidewalks. Empower Field at Mile High Station and Auraria West Station are very accessible from the East however areas to the West of those stations suffer from overall low comfortability. Decatur-Federal station suffers from its adjacency to Federal Boulevard and has an overall low comfortability. Knox station, Perry Station, and Sheridan station have moderate comfortability scores although some areas suffer from missing sidewalks and high elevation changes which kept many areas from having high comfortability.

# Rider Comfortability Within One Kilometer of the RTD W Line in Denver




## Legend

**RTD Stations**

NAME

- 10th / Osage Station
- 16th St / California Station
- 16th St / Stout Station
- 18th St / California Station
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- Alameda Station
- Auraria West Campus Station
- Colfax at Auraria Station
- Decatur-Federal Station
- Empower Field at Mile High
- Knox Station
- Pepsi Center / Elitch Gardens Station
- Perry Station
- Sheridan Station
- Theatre District / Convention Center
- Union Station Transit Center

**Comfort**

- Highest Comfort
- Very High Comfort
- High Comfort
- Medium Comfort
- Low Comfort
- Very Low Comfort

Figure 15: Comfortability Index Map

## Discussion

Regarding population changes, multivariate regression was performed on census data which was updated in ArcGIS Pro to separate areas near the RTD W line and Denver County as a whole. The desired goal was to highlight differences between census tracts intersecting W line buffers and areas outside of W line buffers throughout the rest of Denver County. The hypothesis that higher population growth in census tracts intersecting W line station buffers in Denver has resulted in higher household income, lower poverty rates, and lower commute times cannot be rejected based on the data. It was shown that a strong correlation exists between the dependent and independent variables near the W line. The use of a dummy variable pointed to a stronger relationship between variables within W line buffers than Denver County as a whole. A null hypothesis stating that areas within the W line buffers are not statistically different from the entirety of Denver County can be rejected. We can state that the inclusion of light rail and subsequent population growth near W line stations has had a positive effect on average household income, resulted in reduced poverty, and increased the number of individuals with commute times less than fifteen minutes. The data does not indicate how the changes came about. We cannot say definitively if longtime residents have experienced better outcomes or if higher income individuals have displaced former residents to result in the changes. Considering violent crime, we find that within one-kilometer buffers of RTD W line stations in Denver there is significant clustering. This is evident based on the spatial autocorrelation, kernel density, and hot spot analysis performed. This clustering occurs near several light rail stations including Union Station, Knox Station, and Decatur-Federal station. Violent crime is lower than expected at other W line stations including Pepsi Center/Elitch

Gardens station, Empower Field at Mile High station, and Auraria West station. These results make it apparent that light rail stations alone do not dictate violent crime and there are additional factors which need to be considered. Additionally, including household income data or drug crime data may provide a better understanding of why violent crime exists in specific locations. Using spatial analysis tools to locate where crime is clustered may help law enforcement reduce crime and increase ridership. Ultimately, we must reject the hypothesis that locations near W line light rail stations contain more violent crime than areas further from stations but using the data to locate where crime exists will help decision makers ensure light rail stations are safe and this will lead to a more successful light rail system. The final analysis was the creation of the comfortability index. The goal of the comfortability index was to provide any easily digestible resource explaining the comfortability of access on the RTD W line. Figure 15 provides an accurate representation of comfort based on the input parameters used. Perspective RTD W line users may access this map to identify ideal locations to live or work. Stakeholders such as RTD district representatives or city council representatives may use this map to inform decisions on where resources are most appropriate. The results indicate a mean comfortability value of 16.09 with the lowest score being 8 leaving significant areas capable of improvement. Breaking the data down into individual input parameters we can use the maps for buildings, sidewalks, roads, elevation change, distance, and overall crime to delve into resolving individual issues. Additionally, the comfortability index highlights that there are many locations within one kilometer of RTD W line stations which are highly comfortable for access, and this may help persuade potential transit users of the benefit of accessing the line.

## Areas for Further Research

The analysis executed clearly identifies barriers to access on the RTD W Line. The research was performed on a limited number of stations to provide significantly detailed analysis while limiting the scope of the project due to time constraints. The lessons learned may be used on future projects to identify barriers for the entirety of the RTD system or other transit systems. Performing statistical analysis on population changes provided a valuable insight into changes that have occurred with the opening of the W line. For a more thorough understanding of the population changes brought on by the inclusion of the W line, updated data may be included as additional housing units are brought online within the buffered areas. Further research may also consider changes in demographics such as race or age groups to identify if the increase in population is displacing former residents and leading to gentrification or if longtime residents are able to benefit from light rail as a transportation option. Regarding crime data, the analysis performed made it possible to visualize where violent crime is located which allows for stakeholders such as transit security and the Denver police to focus their efforts. It is not possible however to verify why additional violent crime is occurring near some light rail stations and not others. Further analysis normalizing for population may provide a more accurate understanding of violent crime. The comfortability index provided a clear representation of data sets using a one to five score. This provided an easily digestible outcome. Future iterations of a comfortability index may use more in-depth criteria to delve deeper into the scores in each area. Future criteria may include street light locations, land use types, noise levels, or other parameters which may influence comfortability for light rail ridership. Overall, future iterations of the techniques employed would be best suited to those interested in understanding barriers

to movement without a personal vehicle. American cities tend to be focused on personal vehicles and understanding how this affects those wishing to use alternative transportation methods empowers stakeholders to improve quality of life by removing barriers to access.

Capstone

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Capstone

# Appendix

Population Correlations

| | | TTLPOPULANUMINC | AVGHHINCNUMINCTRA | PCTPOVERTNUMINCTRA |
|---|---|---|---|---|
| TTLPOPULANUMINC | Pearson Correlation | 1 | .173* | .023 |
| | Sig. (2-tailed) | | .039 | .783 |
| | N | 143 | 143 | 143 |
| AVGHHINCNUMINCTRA | Pearson Correlation | .173* | 1 | -.322** |
| | Sig. (2-tailed) | .039 | | <.001 |
| | N | 143 | 143 | 143 |
| PCTPOVERTNUMINCTRA | Pearson Correlation | .023 | -.322** | 1 |
| | Sig. (2-tailed) | .783 | <.001 | |
| | N | 143 | 143 | 143 |
| COMNUMINCTRA | Pearson Correlation | .502** | .181* | -.142 |
| | Sig. (2-tailed) | <.001 | .031 | .090 |
| | N | 143 | 143 | 143 |

Population Correlations Continued

| | | COMNUMINCTRA |
|---|---|---|
| TTLPOPULANUMINC | Pearson Correlation | .502** |
| | Sig. (2-tailed) | <.001 |
| | N | 143 |
| AVGHHINCNUMINCTRA | Pearson Correlation | .181* |
| | Sig. (2-tailed) | .031 |
| | N | 143 |
| PCTPOVERTNUMINCTRA | Pearson Correlation | -.142 |
| | Sig. (2-tailed) | .090 |
| | N | 143 |
| COMNUMINCTRA | Pearson Correlation | 1 |
| | Sig. (2-tailed) | |
| | N | 143 |

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Capstone

Population Regression Using Data Within W Line Buffer

**Variables Entered/Removed[a,b]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | COMNUMINCTRA, AVGHHINCNUMINCTRA, PCTPOVERTNUMINCTRA[c] | . | Enter |

a. Dependent Variable: TTLPOPULANUMINC

b. Models are based only on cases for which W Line_DUMMY = 1

c. All requested variables entered.

**Model Summary[b,c]**

| Model | R | | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|---|
| | W Line_DUMMY = 1 (Selected) | W Line_DUMMY ~= 1 (Unselected) | | | |
| 1 | .910[a] | .434 | .828 | .781 | 660.532 |

a. Predictors: (Constant), COMNUMINCTRA, AVGHHINCNUMINCTRA, PCTPOVERTNUMINCTRA

b. Unless noted otherwise, statistics are based only on cases for which W Line_DUMMY = 1.

c. Dependent Variable: TTLPOPULANUMINC

**ANOVA[a,b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 23121508.892 | 3 | 7707169.631 | 17.665 | <.001[c] |
| | Residual | 4799324.842 | 11 | 436302.258 | | |
| | Total | 27920833.733 | 14 | | | |

a. Dependent Variable: TTLPOPULANUMINC

b. Selecting only cases for which W Line_DUMMY = 1

c. Predictors: (Constant), COMNUMINCTRA, AVGHHINCNUMINCTRA, PCTPOVERTNUMINCTRA

Population Coefficients[a,b] Using Data Within W Line Buffer

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 533.932 | 220.346 | | 2.423 | .034 |
| | AVGHHINCNUMINCTRA | .036 | .035 | .199 | 1.025 | .327 |
| | PCTPOVERTNUMINCTRA | 70.537 | 57.353 | .249 | 1.230 | .244 |
| | COMNUMINCTRA | 8.527 | 1.218 | .971 | 7.000 | <.001 |

**Coefficients[a,b]**

| Model | | Correlations | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|
| | | Zero-order | Partial | Part | Tolerance | VIF |
| 1 | (Constant) | | | | | |
| | AVGHHINCNUMINCTRA | .010 | .295 | .128 | .415 | 2.411 |
| | PCTPOVERTNUMINCTRA | -.178 | .348 | .154 | .380 | 2.634 |
| | COMNUMINCTRA | .897 | .904 | .875 | .813 | 1.231 |

a. Dependent Variable: TTLPOPULANUMINC

b. Selecting only cases for which W Line_DUMMY = 1

Population Collinearity Diagnostics[a,b] Using Data Within W Line Buffer

| Model | Dimension | Eigenvalue | Condition Index | Variance Proportions | | |
|---|---|---|---|---|---|---|
| | | | | (Constant) | AVGHHINCNUMINCTRA | PCTPOVERTNUMINCTRA |
| 1 | 1 | 2.527 | 1.000 | .06 | .03 | .03 |
| | 2 | .843 | 1.732 | .02 | .12 | .01 |
| | 3 | .484 | 2.285 | .88 | .04 | .02 |
| | 4 | .147 | 4.146 | .04 | .80 | .93 |

**Collinearity Diagnostics[a,b]**

| Model | Dimension | Variance Proportions |
|---|---|---|
| | | COMNUMINCTRA |
| 1 | 1 | .04 |
| | 2 | .48 |
| | 3 | .23 |

| | |
|---|---|
| 4 | .24 |

a. Dependent Variable: TTLPOPULANUMINC

b. Selecting only cases for which W Line_DUMMY = 1

Population Residuals Statistics[a,b] Using Data Within W Line Buffer

| | W Line_DUMMY = 1 (Selected) | | | | | W Line_DUMMY ~= 1 (Unselected) |
|---|---|---|---|---|---|---|
| | Minimum | Maximum | Mean | Std. Deviation | N | Minimum |
| Predicted Value | -259.87 | 5380.69 | 1059.87 | 1285.121 | 15 | -1762.91 |
| Residual | -830.653 | 1109.146 | .000 | 585.499 | 15 | -2731.134 |
| Std. Predicted Value | -1.027 | 3.362 | .000 | 1.000 | 15 | -2.197 |
| Std. Residual | -1.258 | 1.679 | .000 | .886 | 15 | -4.135 |

**Residuals Statistics[a,b]**

| | W Line_DUMMY ~= 1 (Unselected) | | | |
|---|---|---|---|---|
| | Maximum | Mean | Std. Deviation | N |
| Predicted Value | 3592.83 | 554.11 | 872.548 | 128 |
| Residual | 4952.170 | 222.705 | 1033.029 | 128 |
| Std. Predicted Value | 1.971 | -.394 | .679 | 128 |
| Std. Residual | 7.497 | .337 | 1.564 | 128 |

a. Dependent Variable: TTLPOPULANUMINC

b. Pooled Cases

Capstone

Population Regression Using Data for All of Denver County

**Variables Entered/Removed[a,b]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | COMNUMINCTRA, PCTPOVERTNUMINCTRA, AVGHHINCNUMINCTRA[c] | . | Enter |

a. Dependent Variable: TTLPOPULANUMINC

b. Models are based only on cases for which W Line_DUMMY = 0

c. All requested variables entered.

**Model Summary[b,c]**

| Model | R | | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|---|
| | W Line_DUMMY = 0 (Selected) | W Line_DUMMY ~= 0 (Unselected) | | | |
| 1 | .435[a] | .908 | .189 | .170 | 955.758 |

a. Predictors: (Constant), COMNUMINCTRA, PCTPOVERTNUMINCTRA, AVGHHINCNUMINCTRA

b. Unless noted otherwise, statistics are based only on cases for which W Line_DUMMY = 0.

c. Dependent Variable: TTLPOPULANUMINC

**ANOVA[a,b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 26459408.126 | 3 | 8819802.709 | 9.655 | <.001[c] |
| | Residual | 113270603.374 | 124 | 913472.608 | | |
| | Total | 139730011.500 | 127 | | | |

a. Dependent Variable: TTLPOPULANUMINC

b. Selecting only cases for which W Line_DUMMY = 0

c. Predictors: (Constant), COMNUMINCTRA, PCTPOVERTNUMINCTRA, AVGHHINCNUMINCTRA

Population Coefficients[a,b] Using Data for All of Denver County

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 792.580 | 107.968 | | 7.341 | <.001 |
| | AVGHHINCNUMINCTRA | .020 | .011 | .148 | 1.744 | .084 |
| | PCTPOVERTNUMINCTRA | 46.968 | 26.850 | .146 | 1.749 | .083 |
| | COMNUMINCTRA | 4.374 | .955 | .378 | 4.580 | <.001 |

**Coefficients[a,b]**

Capstone

| Model | | Correlations | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|
| | | Zero-order | Partial | Part | Tolerance | VIF |
| 1 | (Constant) | | | | | |
| | AVGHHINCNUMINCTRA | .188 | .155 | .141 | .906 | 1.104 |
| | PCTPOVERTNUMINCTRA | .080 | .155 | .141 | .938 | 1.066 |
| | COMNUMINCTRA | .396 | .380 | .370 | .959 | 1.043 |

a. Dependent Variable: TTLPOPULANUMINC

b. Selecting only cases for which W Line_DUMMY = 0

Population Collinearity Diagnostics[a,b] Using Data for All of Denver County

| Model | Dimension | Eigenvalue | Condition Index | Variance Proportions | | |
|---|---|---|---|---|---|---|
| | | | | (Constant) | AVGHHINCNUMINCTRA | PCTPOVERTNUMINCTRA |
| 1 | 1 | 1.824 | 1.000 | .12 | .05 | .13 |
| | 2 | 1.008 | 1.345 | .12 | .46 | .04 |
| | 3 | .803 | 1.507 | .00 | .36 | .04 |
| | 4 | .365 | 2.235 | .76 | .12 | .79 |

**Collinearity Diagnostics[a,b]**

| Model | Dimension | Variance Proportions |
|---|---|---|
| | | COMNUMINCTRA |
| 1 | 1 | .08 |
| | 2 | .20 |
| | 3 | .70 |
| | 4 | .02 |

Capstone

a. Dependent Variable: TTLPOPULANUMINC

b. Selecting only cases for which W Line_DUMMY = 0

Population Residuals Statistics[a,b] Using Data for All of Denver County

| | W Line_DUMMY = 0 (Selected) | | | | | W Line_DUMMY ~= 0 (Unselected) |
|---|---|---|---|---|---|---|
| | Minimum | Maximum | Mean | Std. Deviation | N | Minimum |
| Predicted Value | -450.84 | 2361.50 | 776.81 | 456.445 | 128 | 382.21 |
| Residual | -2473.208 | 6183.501 | .000 | 944.402 | 128 | -898.991 |
| Std. Predicted Value | -2.690 | 3.472 | .000 | 1.000 | 128 | -.865 |
| Std. Residual | -2.588 | 6.470 | .000 | .988 | 128 | -.941 |

**Residuals Statistics[a,b]**

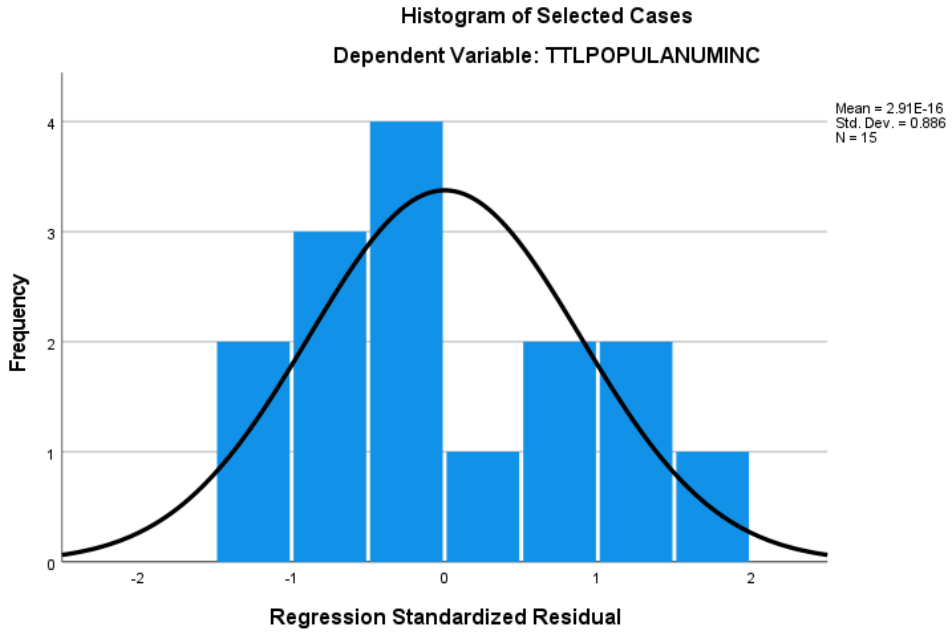
| | W Line_DUMMY ~= 0 (Unselected) | | | |
|---|---|---|---|---|
| | Maximum | Mean | Std. Deviation | N |
| Predicted Value | 3196.49 | 1026.41 | 650.524 | 15 |
| Residual | 2104.511 | 33.455 | 865.981 | 15 |
| Std. Predicted Value | 5.301 | .547 | 1.425 | 15 |
| Std. Residual | 2.202 | .035 | .906 | 15 |

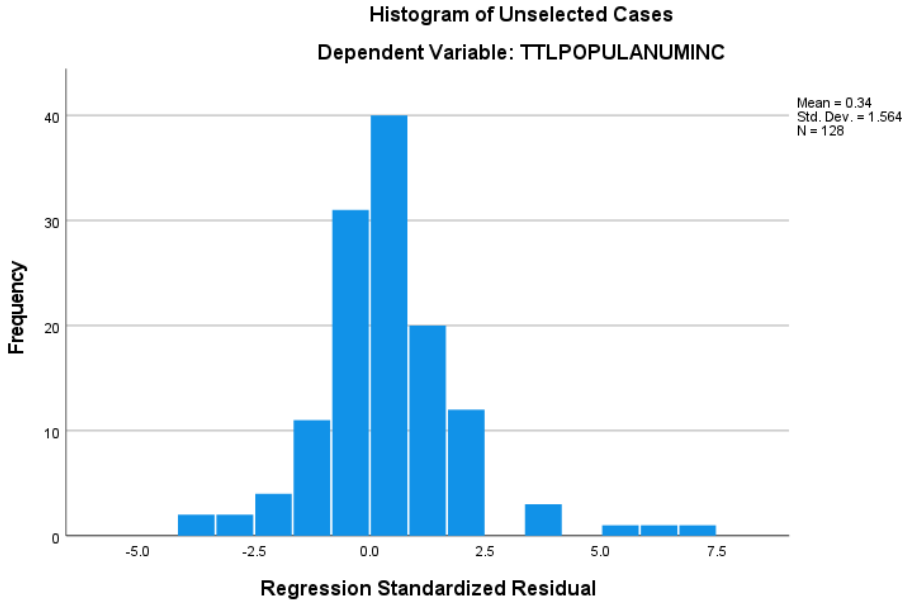
a. Dependent Variable: TTLPOPULANUMINC

b. Pooled Cases

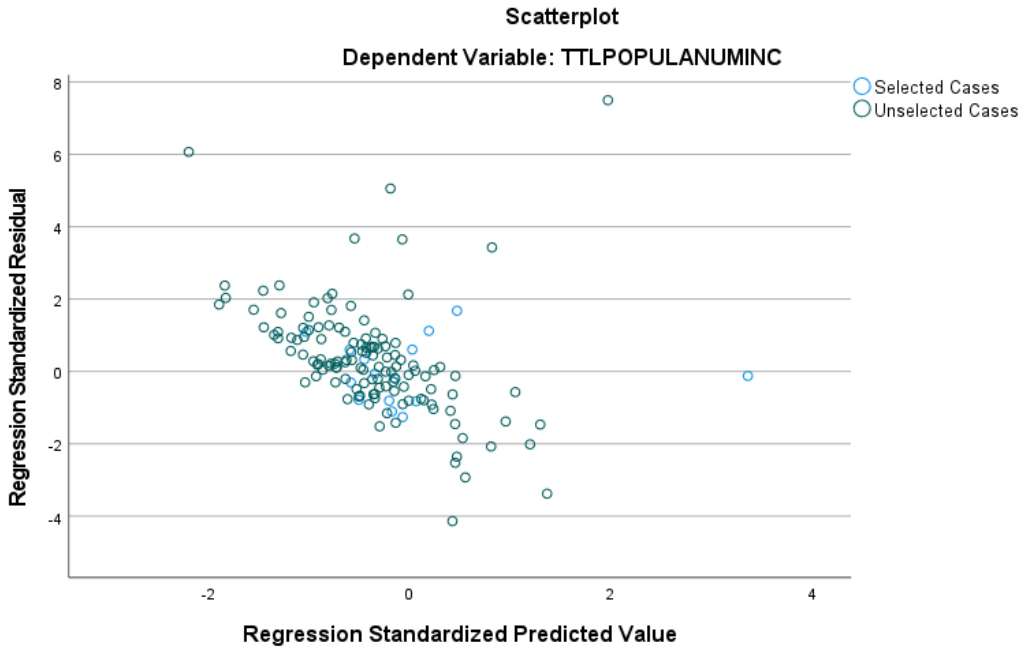
Capstone

Population Charts Using Data Within W Line Buffer

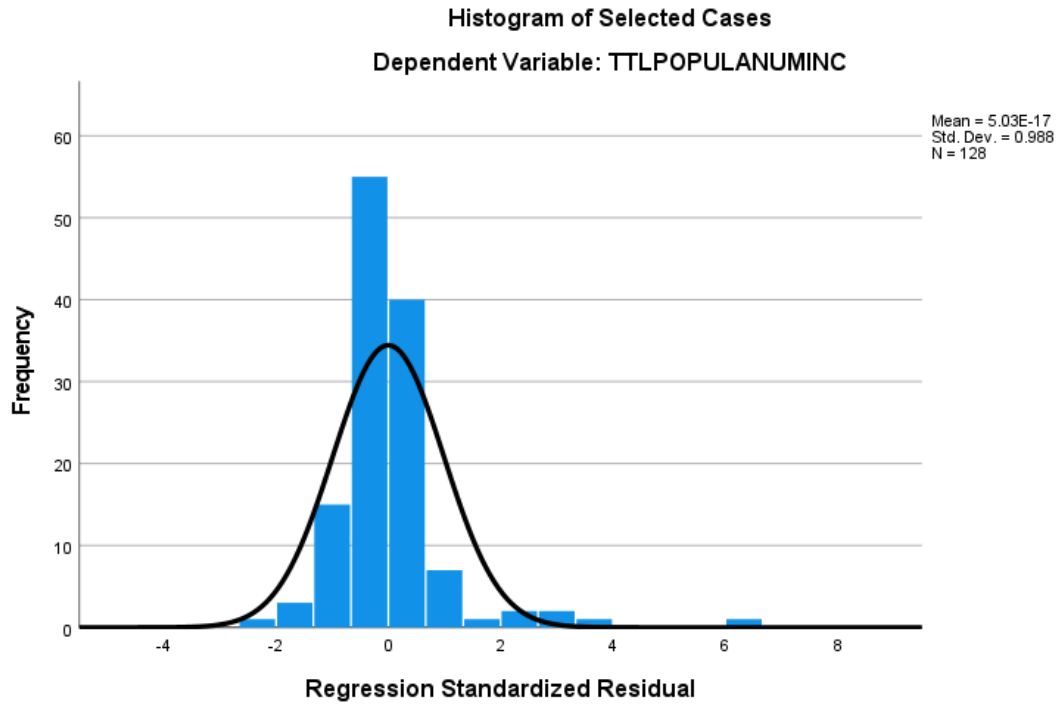


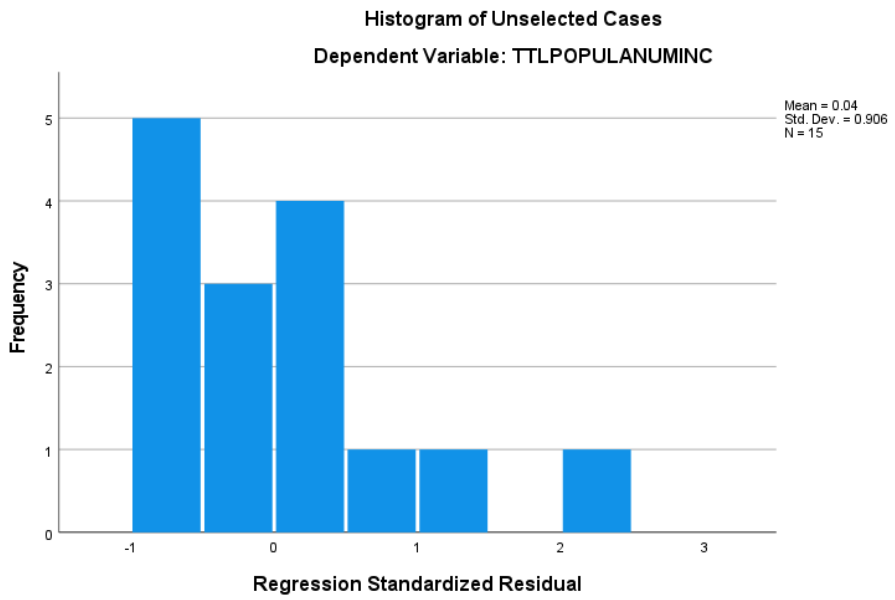
Capstone

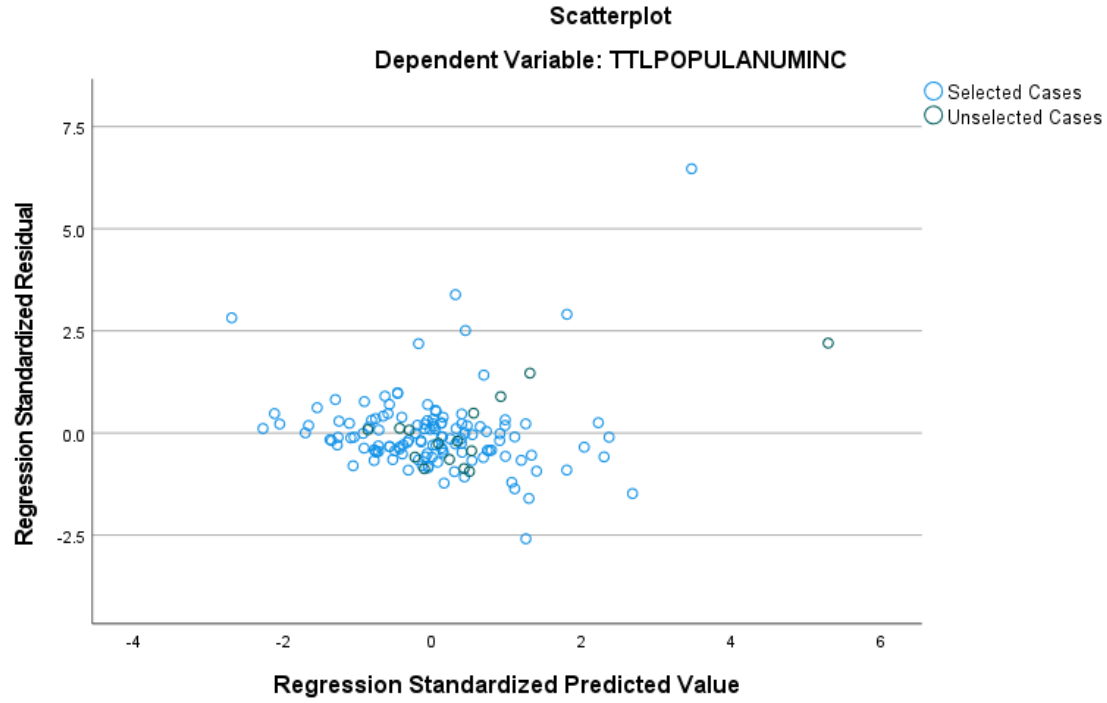



Population Charts Using Data for All of Denver County



Capstone


Histogram of Unselected Cases
Dependent Variable: TTLPOPULANUMINC
Mean = 0.04
Std. Dev. = 0.906
N = 15
Frequency
0
1
2
3
4
5
-1
0
1
2
3
Regression Standardized Residual


Scatterplot
Dependent Variable: TTLPOPULANUMINC
Selected Cases
Unselected Cases
Regression Standardized Residual
7.5
5.0
2.5
0.0
-2.5
-4
-2
0
2
4
6
Regression Standardized Predicted Value

Capstone

# Figures and Tables

Table 1: Data for Population Multiple Regression (Created by Tristan Johnson)

| TRACTCE10 | POPPCTINC | POVPCTINC | AVGHHINCPCTINC | COMPCTINC | W Line_DUMMY | TTLPOPULANUMINC | AVGHHINCNUMINC | PCTPOVERTNUMINC | COMNUMINC | TTLPOPULANUMINCTRA | AVGHHINCNUMINCTRA | PCTPOVERTNUMINCTRA | COMNUMINCTRA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 000102 | 17.88 | 53.85 | 35.50 | -2.30 | 0 | 516 | 23002 | 3.64 | -7 | 258.00 | 11501.00 | 1.82 | -3.50 |
| 000201 | -10.96 | -65.50 | -4.94 | -13.76 | 0 | -474 | -2887 | -15.57 | -49 | -237.00 | -1443.50 | -7.79 | -24.50 |
| 000202 | 3.31 | -19.75 | 5.06 | 14.37 | 0 | 128 | 2752 | -5.02 | 49 | 64.00 | 1376.00 | -2.51 | 24.50 |
| 000301 | 24.84 | -28.50 | 12.39 | 14.08 | 0 | 1174 | 7954 | -2.67 | 68 | 587.00 | 3977.00 | -1.34 | 34.00 |
| 000302 | 21.76 | 14.82 | 16.43 | 1.56 | 0 | 820 | 13358 | 0.71 | 6 | 410.00 | 6679.00 | 0.36 | 3.00 |
| 000303 | 3.06 | 21.83 | 8.46 | -33.33 | 0 | 132 | 7183 | 1.81 | -164 | 66.00 | 3591.50 | 0.91 | -82.00 |
| 000401 | -0.43 | -39.87 | 35.16 | -55.56 | 0 | -15 | 17206 | -8.95 | -270 | -7.50 | 8603.00 | -4.48 | -135.00 |
| 000402 | 2.77 | -58.00 | 38.14 | 13.93 | 1 | 140 | 24204 | -10.91 | 90 | 70.00 | 12102.00 | -5.46 | 45.00 |
| 000501 | 27.17 | -55.45 | 37.79 | -65.02 | 1 | 461 | 31511 | -3.61 | -290 | 230.50 | 15755.50 | -1.81 | -145.00 |
| 000502 | 15.15 | 25.24 | 25.71 | -40.72 | 0 | 769 | 14289 | 3.91 | -272 | 384.50 | 7144.50 | 1.96 | -136.00 |
| 000600 | 28.66 | -60.10 | 54.54 | 32.94 | 1 | 705 | 22116 | -26.36 | 112 | 352.50 | 11058.00 | -13.18 | 56.00 |
| 000701 | 14.35 | -15.16 | -13.85 | 17.91 | 1 | 575 | -5950 | -3.36 | 72 | 287.50 | -2975.00 | -1.68 | 36.00 |
| 000702 | 1.90 | 39.99 | -15.82 | 1.15 | 1 | 104 | -6120 | 11.14 | 4 | 52.00 | -3060.00 | 5.57 | 2.00 |
| 000800 | -6.82 | -0.14 | -19.71 | -32.73 | 1 | -107 | -2398 | -0.11 | -18 | -53.50 | -1199.00 | -0.05 | -9.00 |
| 000902 | 31.13 | 5.49 | 16.13 | -33.26 | 0 | 1490 | 7782 | 0.88 | -149 | 745.00 | 3891.00 | 0.44 | -74.50 |
| 000903 | 17.00 | -15.80 | 0.62 | -39.28 | 0 | 967 | 269 | -4.73 | -229 | 483.50 | 134.50 | -2.37 | -114.50 |
| 000904 | 2.09 | -0.63 | -28.71 | -1.85 | 1 | 108 | -10675 | -0.21 | -6 | 54.00 | -5337.50 | -0.11 | -3.00 |
| 000905 | 16.47 | -58.57 | 50.80 | 85.71 | 1 | 600 | 20294 | -18.52 | 210 | 300.00 | 10147.00 | -9.26 | 105.00 |
| 001000 | 12.20 | -52.26 | 12.05 | -16.21 | 0 | 496 | 4617 | -18.17 | -65 | 248.00 | 2308.50 | -9.09 | -32.50 |
| 001101 | -10.89 | -16.13 | 36.41 | 2.33 | 0 | -324 | 14833 | -4.77 | 10 | -162.00 | 7416.50 | -2.39 | 5.00 |
| 001102 | 51.29 | -61.31 | 33.20 | 24.06 | 1 | 1494 | 21914 | -11.57 | 134 | 747.00 | 10957.00 | -5.79 | 67.00 |
| 001301 | 14.88 | -33.56 | -8.98 | -9.87 | 0 | 703 | -5248 | -10.71 | -39 | 351.50 | -2624.00 | -5.36 | -19.50 |
| 001302 | 2.52 | 3.62 | -13.86 | -40.00 | 0 | 100 | -6833 | 0.71 | -248 | 50.00 | -3416.50 | 0.36 | -124.00 |
| 001401 | 17.16 | -59.37 | 24.59 | 6.85 | 0 | 959 | 8544 | -18.41 | 28 | 479.50 | 4272.00 | -9.21 | 14.00 |
| 001402 | 40.01 | -15.46 | -6.23 | 6.76 | 0 | 1413 | -3046 | -2.89 | 24 | 706.50 | -1523.00 | -1.45 | 12.00 |
| 001403 | 70.35 | -33.03 | 21.45 | -26.74 | 0 | 1350 | 10348 | -8.04 | -100 | 675.00 | 5174.00 | -4.02 | -50.00 |
| 001500 | 25.90 | -9.73 | 19.49 | -6.21 | 0 | 936 | 8184 | -3.46 | -28 | 468.00 | 4092.00 | -1.73 | -14.00 |
| 001600 | 86.06 | -55.44 | 25.40 | 117.33 | 1 | 5301 | 16915 | -16.92 | 1205 | 2650.50 | 8457.50 | -8.46 | 602.50 |
| 001701 | 73.99 | 10.57 | -12.45 | 48.82 | 1 | 2774 | -13318 | 1.3 | 311 | 1387.00 | -6659.00 | 0.65 | 155.50 |
| 001702 | 92.88 | 9.23 | -10.43 | 26.02 | 1 | 2048 | -7613 | 1.85 | 198 | 1024.00 | -3806.50 | 0.92 | 99.00 |
| 001800 | 8.27 | -24.04 | 6.52 | 29.18 | 1 | 264 | 2920 | -9.02 | 124 | 132.00 | 1460.00 | -4.51 | 62.00 |
| 001901 | 31.68 | -10.51 | -3.81 | 52.92 | 1 | 741 | -1053 | -5.53 | 127 | 370.50 | -526.50 | -2.77 | 63.50 |
| 001902 | 539.06 | -100.00 | 24.56 | 0.00 | 1 | 690 | 24768 | -19.53 | 0 | 345.00 | 12384.00 | -9.77 | 0.00 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 002000 | 75.04 | 13.18 | -0.04 | -4.52 | 0 | 944 | -36 | 1.56 | -19 | 472.00 | -18.00 | 0.78 | -9.50 |
| 002100 | 29.51 | -72.16 | 20.35 | 12.56 | 0 | 1507 | 12183 | -22.29 | 80 | 753.50 | 6091.50 | -11.15 | 40.00 |
| 002300 | 28.61 | -39.44 | 63.97 | 117.48 | 0 | 1269 | 32849 | -7.88 | 410 | 634.50 | 16424.50 | -3.94 | 205.00 |
| 002402 | 31.82 | -51.50 | 27.37 | 54.63 | 0 | 485 | 15713 | -15.29 | 112 | 242.50 | 7856.50 | -7.65 | 56.00 |
| 002403 | 38.58 | 20.67 | -2.67 | 25.09 | 0 | 1174 | -1285 | 4.59 | 138 | 587.00 | -642.50 | 2.30 | 69.00 |
| 002601 | 37.53 | -33.33 | 26.10 | -5.45 | 0 | 960 | 10525 | -10.15 | -31 | 480.00 | 5262.50 | -5.08 | -15.50 |
| 002602 | 33.18 | -62.95 | 15.82 | 42.21 | 0 | 708 | 10965 | -14.1 | 176 | 354.00 | 5482.50 | -7.05 | 88.00 |
| 002701 | 11.88 | -27.56 | 0.10 | 3.15 | 0 | 499 | 43 | -6.24 | 28 | 249.50 | 21.50 | -3.12 | 14.00 |
| 002702 | 16.07 | -16.44 | 10.88 | -4.60 | 0 | 868 | 6047 | -2.44 | -50 | 434.00 | 3023.50 | -1.22 | -25.00 |
| 002703 | 4.08 | -30.33 | 12.75 | -9.01 | 0 | 201 | 5209 | -6.53 | -80 | 100.50 | 2604.50 | -3.27 | -40.00 |
| 002801 | 0.18 | 0.31 | -12.33 | -23.93 | 0 | 5 | -9300 | 0.02 | -157 | 2.50 | -4650.00 | 0.01 | -78.50 |
| 002802 | 6.13 | 8.90 | -4.29 | -12.34 | 0 | 246 | -2538 | 0.94 | -98 | 123.00 | -1269.00 | 0.47 | -49.00 |
| 002803 | 23.07 | -40.88 | 3.72 | 9.04 | 0 | 885 | 2170 | -5.67 | 51 | 442.50 | 1085.00 | -2.84 | 25.50 |
| 002901 | 24.06 | -56.34 | 19.07 | 26.77 | 0 | 662 | 13095 | -8.26 | 87 | 331.00 | 6547.50 | -4.13 | 43.50 |
| 002902 | 12.53 | -41.88 | 10.46 | -14.11 | 0 | 462 | 11405 | -4.18 | -80 | 231.00 | 5702.50 | -2.09 | -40.00 |
| 003001 | 10.16 | -3.43 | 10.55 | 36.60 | 0 | 522 | 9763 | -0.27 | 243 | 261.00 | 4881.50 | -0.14 | 121.50 |
| 003002 | 1.15 | -56.32 | 19.42 | -39.30 | 0 | 30 | 14802 | -9.54 | -134 | 15.00 | 7401.00 | -4.77 | -67.00 |
| 003003 | -0.57 | -36.10 | 14.42 | -14.85 | 0 | -19 | 7305 | -11.64 | -72 | -9.50 | 3652.50 | -5.82 | -36.00 |
| 003004 | 23.23 | -49.67 | 2.10 | 59.08 | 0 | 1190 | 1339 | -11.94 | 345 | 595.00 | 669.50 | -5.97 | 172.50 |
| 003101 | 22.49 | 21.68 | -10.01 | -23.05 | 0 | 322 | -7150 | 2.12 | -80 | 161.00 | -3575.00 | 1.06 | -40.00 |
| 003102 | 26.91 | -34.03 | -7.63 | 109.25 | 0 | 738 | -3572 | -12.38 | 307 | 369.00 | -1786.00 | -6.19 | 153.50 |
| 003201 | 23.30 | -22.45 | -8.69 | 10.31 | 0 | 1073 | -6037 | -3.3 | 81 | 536.50 | -3018.50 | -1.65 | 40.50 |
| 003202 | 6.24 | -16.51 | -27.28 | -31.27 | 0 | 195 | -21806 | -1.76 | -237 | 97.50 | -10903.00 | -0.88 | -118.50 |
| 003203 | -1.83 | 30.72 | -0.73 | 18.86 | 0 | -55 | -1302 | 0.47 | 83 | -27.50 | -651.00 | 0.24 | 41.50 |
| 003300 | 5.09 | -23.52 | 0.02 | -35.10 | 0 | 164 | 27 | -1.63 | -218 | 82.00 | 13.50 | -0.82 | -109.00 |
| 003401 | 2.14 | 127.27 | -37.73 | -34.78 | 0 | 54 | -59468 | 3.08 | -201 | 27.00 | -29734.00 | 1.54 | -100.50 |
| 003402 | 12.74 | 213.25 | 2.69 | -15.31 | 0 | 531 | 4033 | 3.54 | -96 | 265.50 | 2016.50 | 1.77 | -48.00 |
| 003500 | 2.76 | -46.65 | 38.51 | 16.13 | 0 | 178 | 15182 | -18.1 | 100 | 89.00 | 7591.00 | -9.05 | 50.00 |
| 003601 | -3.40 | -34.67 | 34.10 | 94.40 | 0 | -162 | 13271 | -12.47 | 337 | -81.00 | 6635.50 | -6.24 | 168.50 |
| 003602 | 3.26 | -21.15 | -4.52 | -17.24 | 0 | 146 | -2208 | -5.9 | -85 | 73.00 | -1104.00 | -2.95 | -42.50 |
| 003603 | -0.09 | -25.89 | 12.07 | -41.16 | 0 | -3 | 6952 | -5.1 | -270 | -1.50 | 3476.00 | -2.55 | -135.00 |
| 003701 | 48.84 | -11.89 | -15.93 | 51.56 | 0 | 1159 | -12878 | -1.62 | 165 | 579.50 | -6439.00 | -0.81 | 82.50 |
| 003702 | 18.70 | -22.98 | -12.00 | 4.95 | 0 | 827 | -7278 | -3.58 | 42 | 413.50 | -3639.00 | -1.79 | 21.00 |
| 003703 | 13.49 | -26.88 | 6.01 | 10.28 | 0 | 376 | 3555 | -4.08 | 51 | 188.00 | 1777.50 | -2.04 | 25.50 |
| 003800 | 47.32 | -64.26 | -17.52 | -38.30 | 0 | 2245 | -22843 | -9.89 | -360 | 1122.50 | -11421.50 | -4.95 | -180.00 |
| 003901 | 1.46 | 49.04 | -30.58 | 40.38 | 0 | 61 | -55938 | 1.02 | 193 | 30.50 | -27969.00 | 0.51 | 96.50 |
| 003902 | 17.80 | -39.43 | -7.99 | 45.63 | 0 | 707 | -10104 | -3.58 | 230 | 353.50 | -5052.00 | -1.79 | 115.00 |
| 004002 | 12.18 | -4.07 | 2.83 | 29.64 | 0 | 375 | 3041 | -0.14 | 91 | 187.50 | 1520.50 | -0.07 | 45.50 |
| 004003 | 4.94 | -25.32 | 1.43 | -14.55 | 0 | 202 | 1108 | -1.56 | -87 | 101.00 | 554.00 | -0.78 | -43.50 |
| 004004 | -0.86 | 101.06 | -10.90 | -8.33 | 0 | -17 | -9511 | 3.82 | -17 | -8.50 | -4755.50 | 1.91 | -8.50 |
| 004005 | 25.91 | 2.93 | 4.54 | 52.65 | 0 | 679 | 2498 | 0.61 | 179 | 339.50 | 1249.00 | 0.31 | 89.50 |
| 004006 | -3.03 | -29.94 | -47.27 | -13.58 | 0 | -153 | -71977 | -6.58 | -88 | -76.50 | -35988.50 | -3.29 | -44.00 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 004101 | 17.46 | -17.09 | -17.50 | 130.05 | 0 | 715 | -7913 | -4.72 | 238 | 357.50 | -3956.50 | -2.36 | 119.00 |
| 004102 | 33.69 | -43.51 | 31.15 | 48.86 | 0 | 1308 | 12342 | -16.87 | 129 | 654.00 | 6171.00 | -8.44 | 64.50 |
| 004103 | 6.73 | -49.93 | -0.16 | -33.33 | 0 | 344 | -184 | -3.39 | -164 | 172.00 | -92.00 | -1.70 | -82.00 |
| 004104 | 12.22 | -65.95 | 80.59 | -8.43 | 0 | 516 | 40759 | -14.14 | -28 | 258.00 | 20379.50 | -7.07 | -14.00 |
| 004106 | 51.00 | -15.61 | 1.63 | 74.09 | 0 | 4377 | 2390 | -0.74 | 366 | 2188.50 | 1195.00 | -0.37 | 183.00 |
| 004107 | 296.19 | -30.61 | 23.88 | 322.73 | 0 | 8545 | 22881 | -2.25 | 639 | 4272.50 | 11440.50 | -1.13 | 319.50 |
| 004201 | 5.86 | -25.22 | -35.24 | -32.31 | 0 | 266 | -58583 | -1.72 | -168 | 133.00 | -29291.50 | -0.86 | -84.00 |
| 004202 | 27.28 | -32.66 | 0.90 | 50.86 | 0 | 1012 | 1089 | -2.91 | 207 | 506.00 | 544.50 | -1.46 | 103.50 |
| 004301 | 15.73 | 8.11 | -34.19 | 5.81 | 0 | 669 | -24350 | 1.17 | 42 | 334.50 | -12175.00 | 0.59 | 21.00 |
| 004302 | 4.28 | -60.40 | -0.40 | 2.33 | 0 | 104 | -362 | -9 | 7 | 52.00 | -181.00 | -4.50 | 3.50 |
| 004303 | 0.42 | 724.32 | -10.98 | -19.84 | 0 | 17 | -25771 | 5.36 | -100 | 8.50 | -12885.50 | 2.68 | -50.00 |
| 004304 | 9.85 | -42.31 | 6.86 | -27.85 | 0 | 526 | 6422 | -3.08 | -181 | 263.00 | 3211.00 | -1.54 | -90.50 |
| 004306 | 26.26 | -7.17 | 16.88 | -14.05 | 0 | 1104 | 15394 | -0.51 | -69 | 552.00 | 7697.00 | -0.26 | -34.50 |
| 004403 | -0.55 | -57.56 | 22.67 | 157.01 | 0 | -24 | 10944 | -16.14 | 347 | -12.00 | 5472.00 | -8.07 | 173.50 |
| 004404 | 21.43 | -32.95 | 1.91 | -12.83 | 0 | 1097 | 711 | -13.76 | -53 | 548.50 | 355.50 | -6.88 | -26.50 |
| 004405 | 20.79 | -44.15 | -10.46 | 48.44 | 0 | 1532 | -9911 | -6.56 | 311 | 766.00 | -4955.50 | -3.28 | 155.50 |
| 004503 | 0.07 | -45.66 | 6.06 | -90.23 | 0 | 3 | 2208 | -20.08 | -157 | 1.50 | 1104.00 | -10.04 | -78.50 |
| 004504 | 43.25 | -24.31 | 19.12 | 24.70 | 0 | 1327 | 7022 | -8.51 | 61 | 663.50 | 3511.00 | -4.26 | 30.50 |
| 004505 | 17.50 | -14.93 | -10.31 | 43.00 | 0 | 752 | -3873 | -5 | 89 | 376.00 | -1936.50 | -2.50 | 44.50 |
| 004506 | 15.70 | -13.86 | -9.46 | -31.71 | 0 | 522 | -3217 | -6.02 | -78 | 261.00 | -1608.50 | -3.01 | -39.00 |
| 004601 | 0.07 | -34.74 | -3.63 | -16.72 | 0 | 4 | -1879 | -5.11 | -103 | 2.00 | -939.50 | -2.56 | -51.50 |
| 004602 | 2.94 | -37.78 | -4.44 | 28.47 | 0 | 207 | -2070 | -10.99 | 119 | 103.50 | -1035.00 | -5.50 | 59.50 |
| 004603 | 8.06 | 35.51 | 8.17 | -10.80 | 0 | 441 | 4245 | 3.8 | -38 | 220.50 | 2122.50 | 1.90 | -19.00 |
| 004700 | 18.21 | 8.57 | 4.75 | 23.79 | 0 | 1144 | 2832 | 1.2 | 118 | 572.00 | 1416.00 | 0.60 | 59.00 |
| 004801 | 39.34 | -7.31 | 12.40 | 23.14 | 0 | 980 | 7931 | -0.41 | 53 | 490.00 | 3965.50 | -0.21 | 26.50 |
| 005001 | 18.00 | -34.78 | 16.33 | -28.32 | 0 | 405 | 9642 | -3.84 | -79 | 202.50 | 4821.00 | -1.92 | -39.50 |
| 005002 | 23.55 | -7.85 | -20.00 | 77.43 | 0 | 1563 | -10487 | -1.72 | 319 | 781.50 | -5243.50 | -0.86 | 159.50 |
| 005102 | -2.42 | -50.38 | 25.35 | -24.18 | 0 | -87 | 15393 | -9.24 | -88 | -43.50 | 7696.50 | -4.62 | -44.00 |
| 005104 | 30.92 | 48.34 | 11.45 | 60.57 | 0 | 864 | 4616 | 9.32 | 149 | 432.00 | 2308.00 | 4.66 | 74.50 |
| 005200 | 19.29 | 62.66 | 52.20 | 151.52 | 0 | 585 | 36997 | 3.39 | 350 | 292.50 | 18498.50 | 1.70 | 175.00 |
| 005300 | -3.17 | -20.57 | -23.60 | 33.33 | 0 | -47 | -13833 | -1.58 | 43 | -23.50 | -6916.50 | -0.79 | 21.50 |
| 005502 | -2.83 | -40.43 | 9.47 | 32.87 | 0 | -62 | 6667 | -8.96 | 47 | -31.00 | 3333.50 | -4.48 | 23.50 |
| 005503 | 0.19 | -14.67 | 17.82 | 3.78 | 0 | 9 | 11835 | -1.65 | 19 | 4.50 | 5917.50 | -0.83 | 9.50 |
| 006701 | 135.08 | 105.02 | 31.62 | 84.88 | 0 | 2033 | 18464 | 5.02 | 320 | 1016.50 | 9232.00 | 2.51 | 160.00 |
| 006804 | 55.18 | 33.74 | -11.60 | 14.51 | 0 | 1055 | -11414 | 1.11 | 56 | 527.50 | -5707.00 | 0.56 | 28.00 |
| 006809 | 9.69 | -62.23 | -16.09 | 51.47 | 0 | 682 | -13107 | -6.26 | 367 | 341.00 | -6553.50 | -3.13 | 183.50 |
| 006810 | 13.55 | -69.77 | 0.84 | -32.10 | 0 | 665 | 540 | -5.77 | -270 | 332.50 | 270.00 | -2.89 | -135.00 |
| 006811 | 8.43 | 50.07 | 6.75 | -8.24 | 0 | 498 | 4142 | 3.47 | -62 | 249.00 | 2071.00 | 1.74 | -31.00 |
| 006812 | 35.08 | 76.20 | -22.78 | 29.92 | 0 | 1027 | -19607 | 3.33 | 111 | 513.50 | -9803.50 | 1.67 | 55.50 |
| 006813 | 19.94 | -50.87 | 3.47 | 96.17 | 0 | 748 | 1632 | -15.43 | 201 | 374.00 | 816.00 | -7.72 | 100.50 |
| 006814 | 19.69 | -13.91 | -13.60 | 13.06 | 0 | 847 | -8703 | -2.02 | 47 | 423.50 | -4351.50 | -1.01 | 23.50 |
| 006901 | 20.68 | -49.01 | 23.08 | 23.90 | 0 | 1036 | 8553 | -14.13 | 92 | 518.00 | 4276.50 | -7.07 | 46.00 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 007006 | 29.62 | -43.81 | 35.01 | 31.18 | 0 | 1211 | 10925 | -12.32 | 106 | 605.50 | 5462.50 | -6.16 | 53.00 |
| 007013 | 23.67 | -66.79 | 7.79 | 93.10 | 0 | 750 | 4970 | -12.67 | 135 | 375.00 | 2485.00 | -6.34 | 67.50 |
| 007037 | 28.05 | -19.22 | -2.74 | 137.98 | 0 | 984 | -1115 | -6.4 | 178 | 492.00 | -557.50 | -3.20 | 89.00 |
| 007088 | 30.92 | -20.03 | -4.20 | 74.24 | 0 | 1219 | -2826 | -2.88 | 170 | 609.50 | -1413.00 | -1.44 | 85.00 |
| 007089 | 3.99 | -55.47 | -5.36 | 4.83 | 0 | 195 | -1842 | -12.33 | 13 | 97.50 | -921.00 | -6.17 | 6.50 |
| 008304 | 32.68 | -21.33 | 5.00 | 19.16 | 0 | 998 | 2353 | -5.34 | 41 | 499.00 | 1176.50 | -2.67 | 20.50 |
| 008305 | 41.93 | -12.58 | 16.63 | 71.96 | 0 | 1401 | 7392 | -3.31 | 77 | 700.50 | 3696.00 | -1.66 | 38.50 |
| 008306 | 19.88 | -22.65 | -8.87 | -7.90 | 0 | 1184 | -4504 | -6.18 | -41 | 592.00 | -2252.00 | -3.09 | -20.50 |
| 008312 | 26.26 | -42.50 | 42.30 | 176.53 | 0 | 1760 | 17405 | -13.08 | 549 | 880.00 | 8702.50 | -6.54 | 274.50 |
| 008386 | 33.45 | -13.48 | 20.89 | 76.21 | 0 | 1398 | 12187 | -1.48 | 157 | 699.00 | 6093.50 | -0.74 | 78.50 |
| 008387 | 22.49 | 8.39 | 19.40 | 139.60 | 0 | 1375 | 12171 | 1.27 | 349 | 687.50 | 6085.50 | 0.63 | 174.50 |
| 008388 | 55.03 | -63.65 | 26.32 | 14.51 | 0 | 3378 | 13102 | -7.88 | 111 | 1689.00 | 6551.00 | -3.94 | 55.50 |
| 008389 | 61.91 | -37.43 | -1.39 | 23.13 | 0 | 4155 | -1173 | -3.41 | 99 | 2077.50 | -586.50 | -1.71 | 49.50 |
| 008390 | 33.48 | 97.11 | -6.24 | 15.45 | 0 | 2447 | -4234 | 7.39 | 76 | 1223.50 | -2117.00 | 3.70 | 38.00 |
| 008391 | 7.77 | -18.88 | 9.38 | 19.12 | 0 | 508 | 6336 | -1.28 | 61 | 254.00 | 3168.00 | -0.64 | 30.50 |
| 011902 | -3.19 | -36.91 | 9.08 | -22.49 | 0 | -221 | 5174 | -5.91 | -130 | -110.50 | 2587.00 | -2.96 | -65.00 |
| 011903 | -3.20 | -70.61 | -1.40 | -32.08 | 0 | -84 | -876 | -16.34 | -94 | -42.00 | -438.00 | -8.17 | -47.00 |
| 012001 | -10.45 | -26.37 | -22.14 | 45.38 | 0 | -238 | -22378 | -2.65 | 54 | -119.00 | -11189.00 | -1.33 | 27.00 |
| 012010 | 3.96 | -51.52 | -12.92 | -25.77 | 0 | 201 | -10423 | -4.25 | -134 | 100.50 | -5211.50 | -2.13 | -67.00 |
| 012014 | 8.07 | -25.64 | 6.71 | -26.67 | 0 | 483 | 4194 | -3 | -255 | 241.50 | 2097.00 | -1.50 | -127.50 |
| 015300 | 22.52 | 7.79 | -10.98 | 105.21 | 0 | 732 | -5770 | 0.94 | 384 | 366.00 | -2885.00 | 0.47 | 192.00 |
| 015400 | 21.41 | -46.73 | 28.14 | -13.78 | 0 | 872 | 15416 | -12.28 | -82 | 436.00 | 7708.00 | -6.14 | -41.00 |
| 015500 | 2.84 | -64.96 | 53.78 | 147.41 | 0 | 108 | 18205 | -22.06 | 370 | 54.00 | 9102.50 | -11.03 | 185.00 |
| 015600 | 45.74 | -6.35 | 13.02 | -12.89 | 0 | 2784 | 5162 | -2.15 | -46 | 1392.00 | 2581.00 | -1.08 | -23.00 |
| 015700 | -15.93 | 9.12 | -16.54 | 79.25 | 0 | -1125 | -9307 | 1.93 | 275 | -562.50 | -4653.50 | 0.97 | 137.50 |
| 980000 | 21.42 | -40.02 | 26.09 | -20.95 | 0 | 268 | 11295 | -4.67 | -22 | 134.00 | 5647.50 | -2.34 | -11.00 |

Table 2: Scores for Comfortability Index (Created by Tristan Johnson)

| FID | Buildings | Sidewalks | Roads | Elevation Change | Distance | Crime | Comfortability Index |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 3 | 3 | 3 | 4 | 2 | 16 |
| 1 | 1 | 3 | 5 | 3 | 4 | 5 | 21 |
| 2 | 1 | 3 | 3 | 3 | 4 | 5 | 19 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 1 | 3 | 3 | 4 | 5 | 17 |
| 4 | 4 | 3 | 5 | 3 | 4 | 3 | 22 |
| 5 | 1 | 1 | 3 | 1 | 4 | 2 | 12 |
| 6 | 5 | 3 | 1 | 3 | 4 | 1 | 17 |
| 7 | 5 | 3 | 1 | 1 | 4 | 1 | 15 |
| 8 | 2 | 1 | 5 | 1 | 4 | 2 | 15 |
| 9 | 1 | 1 | 3 | 3 | 4 | 5 | 17 |
| 10 | 1 | 1 | 3 | 3 | 3 | 5 | 16 |
| 11 | 1 | 1 | 5 | 3 | 3 | 5 | 18 |
| 12 | 5 | 1 | 5 | 5 | 3 | 5 | 24 |
| 13 | 4 | 1 | 5 | 3 | 3 | 3 | 19 |
| 14 | 2 | 1 | 3 | 3 | 3 | 2 | 14 |
| 15 | 1 | 3 | 3 | 3 | 3 | 4 | 17 |
| 16 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 17 | 5 | 1 | 5 | 1 | 4 | 1 | 17 |
| 18 | 1 | 1 | 3 | 3 | 4 | 5 | 17 |
| 19 | 1 | 1 | 5 | 3 | 3 | 5 | 18 |
| 20 | 1 | 1 | 5 | 5 | 3 | 5 | 20 |
| 21 | 1 | 1 | 5 | 1 | 2 | 5 | 15 |
| 22 | 1 | 1 | 3 | 3 | 2 | 5 | 15 |
| 23 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 24 | 1 | 3 | 5 | 1 | 2 | 4 | 16 |
| 25 | 1 | 1 | 5 | 1 | 2 | 5 | 15 |
| 26 | 1 | 1 | 3 | 1 | 3 | 5 | 14 |
| 27 | 4 | 1 | 5 | 1 | 4 | 4 | 19 |
| 28 | 5 | 1 | 3 | 1 | 4 | 1 | 15 |
| 29 | 1 | 1 | 3 | 1 | 4 | 1 | 11 |
| 30 | 1 | 1 | 3 | 3 | 4 | 4 | 16 |
| 31 | 1 | 3 | 5 | 5 | 4 | 5 | 23 |
| 32 | 2 | 3 | 5 | 5 | 3 | 5 | 23 |
| 33 | 1 | 1 | 3 | 3 | 2 | 5 | 15 |
| 34 | 1 | 1 | 3 | 1 | 1 | 3 | 10 |
| 35 | 1 | 1 | 3 | 3 | 1 | 5 | 14 |
| 36 | 1 | 1 | 3 | 1 | 1 | 5 | 12 |
| 37 | 1 | 1 | 3 | 1 | 1 | 5 | 12 |
| 38 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
| 39 | 1 | 1 | 5 | 1 | 3 | 3 | 14 |
| 40 | 4 | 1 | 3 | 1 | 3 | 2 | 14 |
| 41 | 2 | 1 | 3 | 1 | 4 | 3 | 14 |
| 42 | 3 | 5 | 1 | 1 | 4 | 1 | 15 |
| 43 | 1 | 1 | 3 | 3 | 4 | 4 | 16 |
| 44 | 3 | 3 | 3 | 3 | 3 | 3 | 18 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 45 | 5 | 5 | 5 | 3 | 3 | 1 | 22 |
| 46 | 5 | 1 | 5 | 3 | 2 | 2 | 18 |
| 47 | 4 | 1 | 5 | 5 | 2 | 2 | 19 |
| 48 | 1 | 1 | 5 | 3 | 2 | 5 | 17 |
| 49 | 1 | 1 | 3 | 1 | 1 | 3 | 10 |
| 50 | 1 | 1 | 3 | 1 | 1 | 5 | 12 |
| 51 | 1 | 1 | 3 | 1 | 1 | 5 | 12 |
| 52 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
| 53 | 1 | 1 | 3 | 1 | 3 | 5 | 14 |
| 54 | 1 | 1 | 3 | 1 | 3 | 5 | 14 |
| 55 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 56 | 1 | 3 | 3 | 3 | 4 | 5 | 19 |
| 57 | 1 | 1 | 3 | 3 | 3 | 5 | 16 |
| 58 | 4 | 3 | 5 | 5 | 3 | 2 | 22 |
| 59 | 1 | 1 | 3 | 1 | 2 | 2 | 10 |
| 60 | 3 | 1 | 3 | 3 | 1 | 2 | 13 |
| 61 | 4 | 1 | 3 | 1 | 1 | 3 | 13 |
| 62 | 4 | 3 | 5 | 3 | 2 | 2 | 19 |
| 63 | 1 | 1 | 5 | 1 | 2 | 5 | 15 |
| 64 | 1 | 1 | 3 | 1 | 1 | 5 | 12 |
| 65 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 66 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
| 67 | 1 | 1 | 3 | 1 | 3 | 5 | 14 |
| 68 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 69 | 1 | 1 | 3 | 1 | 4 | 1 | 11 |
| 70 | 3 | 1 | 3 | 3 | 4 | 3 | 17 |
| 71 | 1 | 1 | 3 | 3 | 4 | 5 | 17 |
| 72 | 1 | 3 | 5 | 5 | 3 | 5 | 22 |
| 73 | 3 | 3 | 5 | 3 | 2 | 2 | 18 |
| 74 | 1 | 1 | 3 | 3 | 2 | 1 | 11 |
| 75 | 1 | 1 | 1 | 3 | 1 | 1 | 8 |
| 76 | 4 | 1 | 3 | 1 | 1 | 1 | 11 |
| 77 | 1 | 1 | 5 | 1 | 1 | 2 | 11 |
| 78 | 2 | 1 | 5 | 1 | 2 | 5 | 16 |
| 79 | 1 | 1 | 5 | 3 | 2 | 5 | 17 |
| 80 | 1 | 1 | 3 | 1 | 3 | 5 | 14 |
| 81 | 1 | 1 | 3 | 1 | 3 | 5 | 14 |
| 82 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 83 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 84 | 1 | 3 | 3 | 3 | 4 | 1 | 15 |
| 85 | 3 | 1 | 5 | 3 | 4 | 2 | 18 |
| 86 | 3 | 1 | 3 | 5 | 4 | 4 | 20 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 87 | 1 | 1 | 3 | 5 | 3 | 3 | 16 |
| 88 | 2 | 3 | 5 | 5 | 2 | 4 | 21 |
| 89 | 5 | 1 | 1 | 5 | 2 | 1 | 15 |
| 90 | 1 | 3 | 3 | 3 | 2 | 1 | 13 |
| 91 | 4 | 3 | 3 | 3 | 2 | 1 | 16 |
| 92 | 4 | 3 | 3 | 1 | 2 | 2 | 15 |
| 93 | 1 | 1 | 5 | 3 | 1 | 4 | 15 |
| 94 | 1 | 1 | 5 | 1 | 2 | 4 | 14 |
| 95 | 1 | 1 | 5 | 1 | 3 | 4 | 15 |
| 96 | 1 | 1 | 5 | 3 | 3 | 5 | 18 |
| 97 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 98 | 1 | 1 | 3 | 1 | 4 | 2 | 12 |
| 99 | 5 | 1 | 3 | 3 | 4 | 3 | 19 |
| 100 | 3 | 1 | 3 | 1 | 4 | 2 | 14 |
| 101 | 1 | 5 | 3 | 1 | 4 | 2 | 16 |
| 102 | 1 | 3 | 3 | 1 | 4 | 1 | 13 |
| 103 | 2 | 1 | 3 | 1 | 4 | 3 | 14 |
| 104 | 1 | 1 | 3 | 3 | 4 | 4 | 16 |
| 105 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 106 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 107 | 1 | 1 | 3 | 3 | 4 | 5 | 17 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 108 | 1 | 1 | 5 | 5 | 4 | 5 | 21 |
| 109 | 5 | 1 | 3 | 5 | 4 | 2 | 20 |
| 110 | 1 | 1 | 3 | 3 | 3 | 3 | 14 |
| 111 | 3 | 3 | 5 | 5 | 2 | 3 | 21 |
| 112 | 5 | 3 | 5 | 5 | 1 | 2 | 21 |
| 113 | 4 | 5 | 3 | 1 | 1 | 1 | 15 |
| 114 | 3 | 3 | 3 | 1 | 1 | 2 | 13 |
| 115 | 1 | 1 | 5 | 3 | 1 | 4 | 15 |
| 116 | 1 | 1 | 3 | 1 | 2 | 4 | 12 |
| 117 | 1 | 1 | 1 | 1 | 2 | 3 | 9 |
| 118 | 1 | 1 | 3 | 1 | 3 | 3 | 12 |
| 119 | 1 | 1 | 5 | 3 | 4 | 4 | 18 |
| 120 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 121 | 1 | 1 | 3 | 3 | 4 | 5 | 17 |
| 122 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 123 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 124 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 125 | 1 | 1 | 3 | 3 | 4 | 4 | 16 |
| 126 | 1 | 1 | 3 | 3 | 4 | 5 | 17 |
| 127 | 1 | 1 | 3 | 3 | 4 | 5 | 17 |
| 128 | 1 | 1 | 3 | 1 | 3 | 5 | 14 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 129 | 1 | 1 | 3 | 3 | 3 | 5 | 16 |
| 130 | 1 | 1 | 3 | 1 | 3 | 5 | 14 |
| 131 | 1 | 1 | 3 | 1 | 3 | 5 | 14 |
| 132 | 1 | 1 | 3 | 3 | 3 | 5 | 16 |
| 133 | 1 | 3 | 5 | 5 | 2 | 5 | 21 |
| 134 | 5 | 1 | 3 | 5 | 2 | 2 | 18 |
| 135 | 1 | 1 | 1 | 3 | 3 | 1 | 10 |
| 136 | 1 | 1 | 3 | 3 | 2 | 2 | 12 |
| 137 | 4 | 3 | 5 | 5 | 1 | 2 | 20 |
| 138 | 3 | 3 | 5 | 5 | 1 | 5 | 22 |
| 139 | 1 | 1 | 5 | 1 | 1 | 5 | 14 |
| 140 | 1 | 3 | 3 | 1 | 1 | 3 | 12 |
| 141 | 1 | 1 | 3 | 1 | 1 | 3 | 10 |
| 142 | 1 | 1 | 1 | 1 | 2 | 3 | 9 |
| 143 | 1 | 1 | 3 | 3 | 3 | 3 | 14 |
| 144 | 4 | 1 | 5 | 5 | 4 | 5 | 24 |
| 145 | 5 | 1 | 5 | 3 | 4 | 2 | 20 |
| 146 | 1 | 1 | 5 | 1 | 2 | 5 | 15 |
| 147 | 1 | 1 | 5 | 1 | 2 | 5 | 15 |
| 148 | 1 | 1 | 5 | 1 | 3 | 5 | 16 |
| 149 | 1 | 1 | 5 | 1 | 3 | 5 | 16 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 150 | 1 | 1 | 5 | 1 | 3 | 5 | 16 |
| 151 | 1 | 1 | 5 | 1 | 3 | 5 | 16 |
| 152 | 1 | 1 | 5 | 1 | 3 | 5 | 16 |
| 153 | 1 | 1 | 5 | 1 | 2 | 5 | 15 |
| 154 | 1 | 1 | 5 | 1 | 2 | 5 | 15 |
| 155 | 1 | 1 | 5 | 1 | 2 | 5 | 15 |
| 156 | 1 | 1 | 5 | 1 | 2 | 5 | 15 |
| 157 | 1 | 3 | 5 | 3 | 2 | 4 | 18 |
| 158 | 5 | 3 | 5 | 5 | 1 | 4 | 23 |
| 159 | 5 | 3 | 5 | 5 | 1 | 3 | 22 |
| 160 | 3 | 1 | 5 | 3 | 2 | 5 | 19 |
| 161 | 5 | 1 | 5 | 3 | 2 | 5 | 21 |
| 162 | 1 | 3 | 5 | 3 | 2 | 5 | 19 |
| 163 | 5 | 3 | 5 | 5 | 1 | 4 | 23 |
| 164 | 2 | 5 | 5 | 3 | 1 | 4 | 20 |
| 165 | 1 | 1 | 5 | 3 | 1 | 5 | 16 |
| 166 | 1 | 1 | 5 | 3 | 1 | 3 | 14 |
| 167 | 1 | 1 | 5 | 3 | 2 | 3 | 15 |
| 168 | 1 | 1 | 5 | 1 | 3 | 4 | 15 |
| 169 | 1 | 1 | 5 | 1 | 4 | 4 | 16 |
| 170 | 5 | 3 | 5 | 3 | 4 | 1 | 21 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 171 | 1 | 1 | 3 | 1 | 1 | 5 | 12 |
| 172 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
| 173 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
| 174 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
| 175 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
| 176 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
| 177 | 1 | 1 | 3 | 3 | 2 | 5 | 15 |
| 178 | 1 | 1 | 3 | 3 | 2 | 5 | 15 |
| 179 | 1 | 1 | 3 | 3 | 1 | 5 | 14 |
| 180 | 1 | 1 | 3 | 3 | 1 | 5 | 14 |
| 181 | 1 | 3 | 3 | 3 | 2 | 5 | 17 |
| 182 | 1 | 3 | 3 | 3 | 1 | 5 | 16 |
| 183 | 4 | 1 | 5 | 5 | 1 | 5 | 21 |
| 184 | 3 | 1 | 3 | 3 | 1 | 4 | 15 |
| 185 | 5 | 3 | 3 | 3 | 1 | 3 | 18 |
| 186 | 4 | 3 | 1 | 3 | 2 | 1 | 14 |
| 187 | 2 | 3 | 3 | 1 | 2 | 4 | 15 |
| 188 | 1 | 5 | 5 | 5 | 2 | 3 | 21 |
| 189 | 2 | 5 | 3 | 3 | 2 | 4 | 19 |
| 190 | 3 | 3 | 3 | 3 | 2 | 2 | 16 |
| 191 | 4 | 3 | 3 | 3 | 2 | 3 | 18 |

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| 192 | 1 | 3 | 3 | 1 | 3 | 5 | 16 |
| 193 | 1 | 3 | 3 | 1 | 3 | 5 | 16 |
| 194 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
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| 196 | 1 | 3 | 3 | 5 | 1 | 5 | 18 |
| 197 | 1 | 3 | 3 | 5 | 1 | 5 | 18 |
| 198 | 1 | 1 | 3 | 5 | 2 | 5 | 17 |
| 199 | 1 | 1 | 3 | 5 | 2 | 5 | 17 |
| 200 | 1 | 1 | 3 | 5 | 1 | 5 | 16 |
| 201 | 1 | 1 | 3 | 3 | 1 | 5 | 14 |
| 202 | 1 | 1 | 3 | 3 | 1 | 5 | 14 |
| 203 | 1 | 3 | 3 | 3 | 1 | 5 | 16 |
| 204 | 1 | 3 | 3 | 5 | 1 | 5 | 18 |
| 205 | 1 | 1 | 3 | 5 | 1 | 5 | 16 |
| 206 | 4 | 3 | 3 | 5 | 1 | 1 | 17 |
| 207 | 1 | 1 | 3 | 5 | 1 | 5 | 16 |
| 208 | 1 | 1 | 5 | 5 | 1 | 5 | 18 |
| 209 | 1 | 1 | 3 | 3 | 1 | 3 | 12 |
| 210 | 1 | 1 | 3 | 1 | 1 | 5 | 12 |
| 211 | 4 | 3 | 3 | 3 | 2 | 3 | 18 |
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| 213 | 1 | 3 | 5 | 3 | 3 | 5 | 20 |
| 214 | 1 | 5 | 3 | 1 | 3 | 4 | 17 |
| 215 | 1 | 3 | 3 | 3 | 3 | 4 | 17 |
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| 218 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
| 219 | 1 | 1 | 3 | 1 | 4 | 3 | 13 |
| 220 | 1 | 3 | 3 | 5 | 1 | 5 | 18 |
| 221 | 1 | 3 | 3 | 3 | 1 | 5 | 16 |
| 222 | 1 | 3 | 3 | 3 | 1 | 5 | 16 |
| 223 | 1 | 1 | 3 | 3 | 2 | 5 | 15 |
| 224 | 1 | 3 | 3 | 3 | 2 | 5 | 17 |
| 225 | 1 | 1 | 3 | 3 | 1 | 5 | 14 |
| 226 | 1 | 1 | 3 | 3 | 1 | 5 | 14 |
| 227 | 1 | 1 | 3 | 5 | 1 | 5 | 16 |
| 228 | 1 | 1 | 3 | 5 | 1 | 5 | 16 |
| 229 | 1 | 3 | 3 | 3 | 1 | 5 | 16 |
| 230 | 1 | 1 | 3 | 1 | 1 | 5 | 12 |
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| 232 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
| 233 | 1 | 3 | 5 | 3 | 2 | 5 | 19 |

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| 234 | 1 | 3 | 3 | 3 | 2 | 5 | 17 |
| 235 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
| 236 | 1 | 1 | 3 | 3 | 3 | 5 | 16 |
| 237 | 2 | 3 | 5 | 5 | 3 | 5 | 23 |
| 238 | 1 | 5 | 5 | 1 | 4 | 5 | 21 |
| 239 | 2 | 5 | 3 | 3 | 4 | 2 | 19 |
| 240 | 4 | 3 | 3 | 3 | 4 | 1 | 18 |
| 241 | 4 | 5 | 3 | 1 | 4 | 2 | 19 |
| 242 | 1 | 1 | 3 | 3 | 4 | 4 | 16 |
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| 244 | 1 | 1 | 3 | 1 | 2 | 5 | 13 |
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| 257 | 1 | 3 | 3 | 3 | 3 | 4 | 17 |
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| 260 | 3 | 5 | 5 | 5 | 4 | 3 | 25 |
| 261 | 4 | 3 | 3 | 1 | 4 | 2 | 17 |
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| 273 | 1 | 1 | 3 | 3 | 4 | 5 | 17 |
| 274 | 1 | 1 | 5 | 5 | 4 | 5 | 21 |
| 275 | 4 | 3 | 3 | 5 | 4 | 3 | 22 |

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| 276 | 3 | 3 | 3 | 1 | 4 | 4 | 18 |
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| 288 | 1 | 1 | 3 | 1 | 4 | 5 | 15 |
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| 290 | 1 | 1 | 3 | 3 | 4 | 2 | 14 |