Comprehensive Access & Mobility Plan

City of Rochester, NY
Lovely A. Warren, Mayor
Rochester City Council

NELSON
NYGAARD

STATE OF THE CITY
TRANSPORTATION SYSTEM

FACTBOOK

Believe.

200 Years of Douglass
1818
2018
CITY OF ROCHESTER, N.Y.

Lovely A. Warren, Mayor
Rochester City Council

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PREFACE

A safe, reliable transportation system that serves all users regardless of age, income, or ability is critical to quality of life and economic development. Identifying improvements to the transportation system requires a thorough understanding of the infrastructure and services that comprise it, and how well they provide access to jobs, schools, medical facilities, shopping, and other vital community functions.

The Rochester Comprehensive Access and Mobility Plan Factbook presents a clear, concise, and comprehendible picture of transportation in the city. This document serves as the foundation for working with stakeholders to determine what projects and programs will continue the transformation of the city's transportation network to a better-balanced, more equitable one.

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REGIONAL RELATIONSHIP

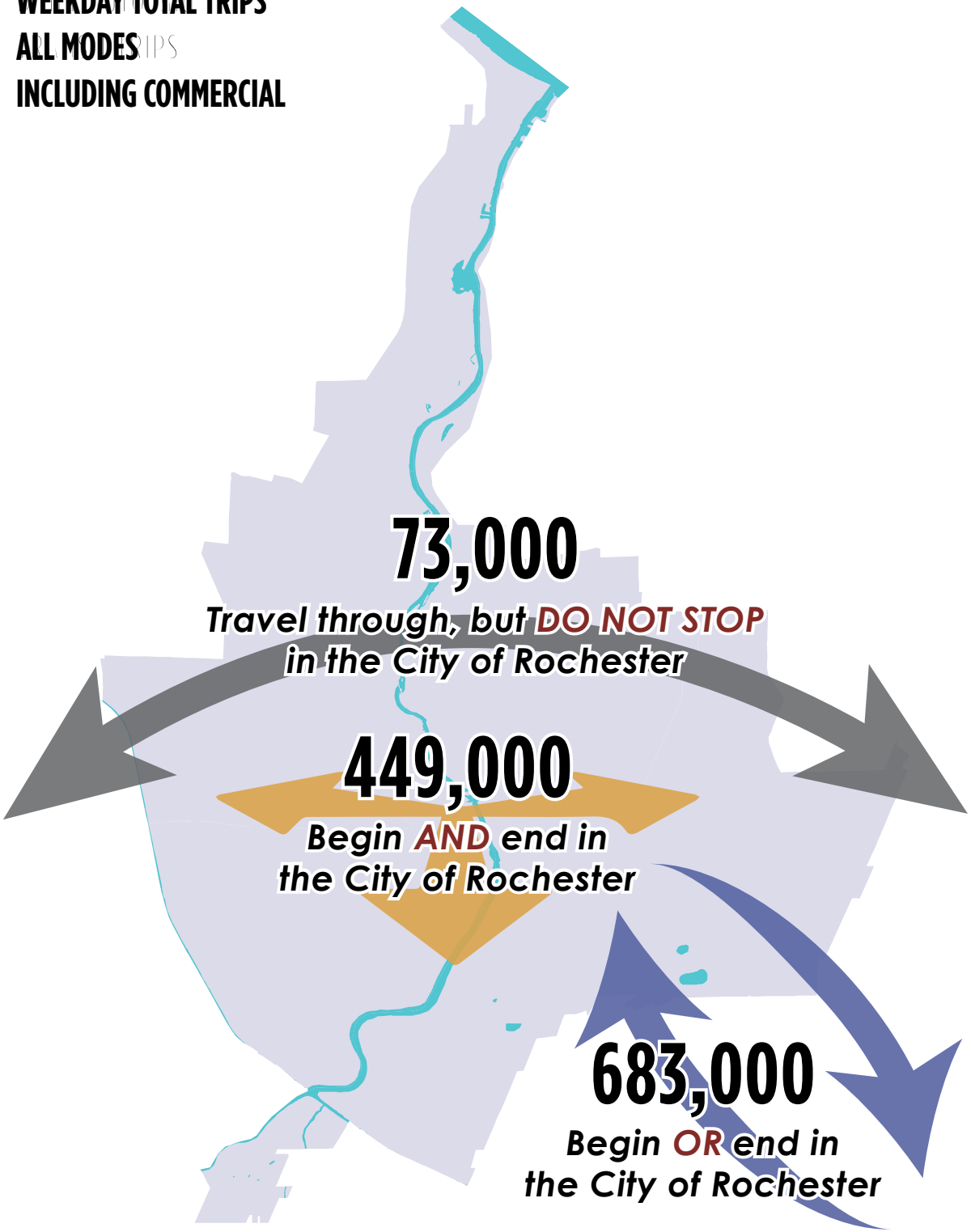
As the primary urban center of the Genesee-Finger Lakes Region, Rochester's transportation system is used extensively by residents and non-residents. Significant numbers of trips start in Rochester but end outside of the City, and vice versa. At the same time, many trips stay within the city.

As in many metropolitan areas, the majority of Rochester residents work far enough from home to make walking impractical. As the regional climate places limitations on cycling, the majority of residents rely on other modes to make their daily commute. Still, commute trips only make up one-sixth of daily travel–other trips are typically shorter than commutes–making walking and biking potentially more attractive and viable options.

ROCHESTER'S PLACE IN THE REGION

Rochester plays a vital role in the regional, state, and national economy. By population, it is the largest municipality in the Genesee-Finger Lakes Region, third largest city in New York State, and the Census-defined metropolitan area is the 51st largest in the country.

City-based businesses employ 25 percent of all workers in the region and represent 30 percent of employers with 500 or more employees in region. Rochester and the region are home to emerging industries including photonics, biotechnology, food and beverage processing, and green technologies.



Source: GTC Regional Travel Demand Model v3.4, 2010

DAILY TRIPS TO, FROM, AND THROUGH ROCHESTER

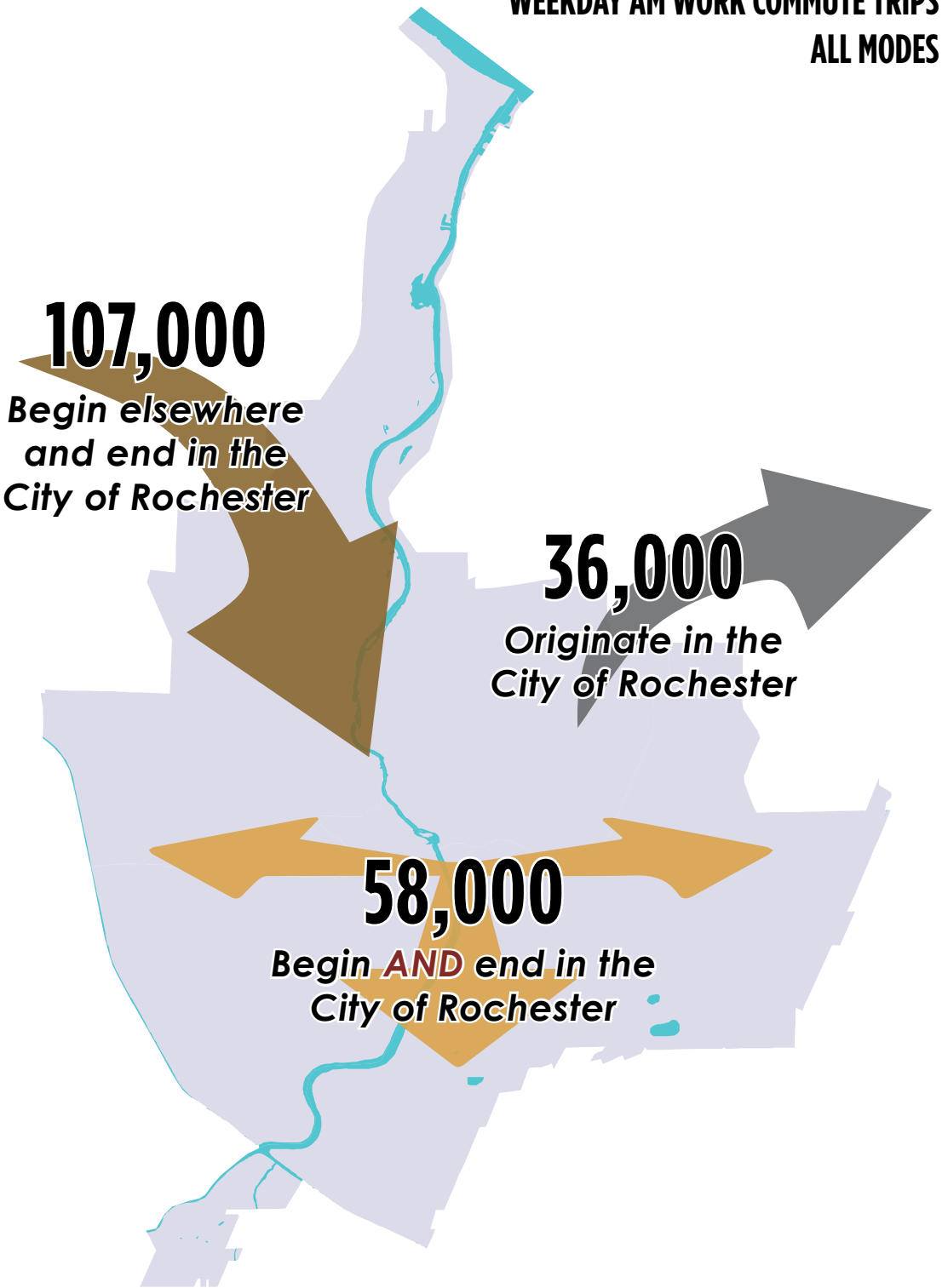
Over 1,200,000 daily trips are made each day in the City of Rochester including people coming to the City, leaving the City, passing through, and those traveling from one part of the city to another.

According to the Genesee Transportation Council's 2011 Household Travel Survey, the most common trip purposes are work-related commutes (37%) and family/personal business (32%).

WORK-RELATED COMMUTE

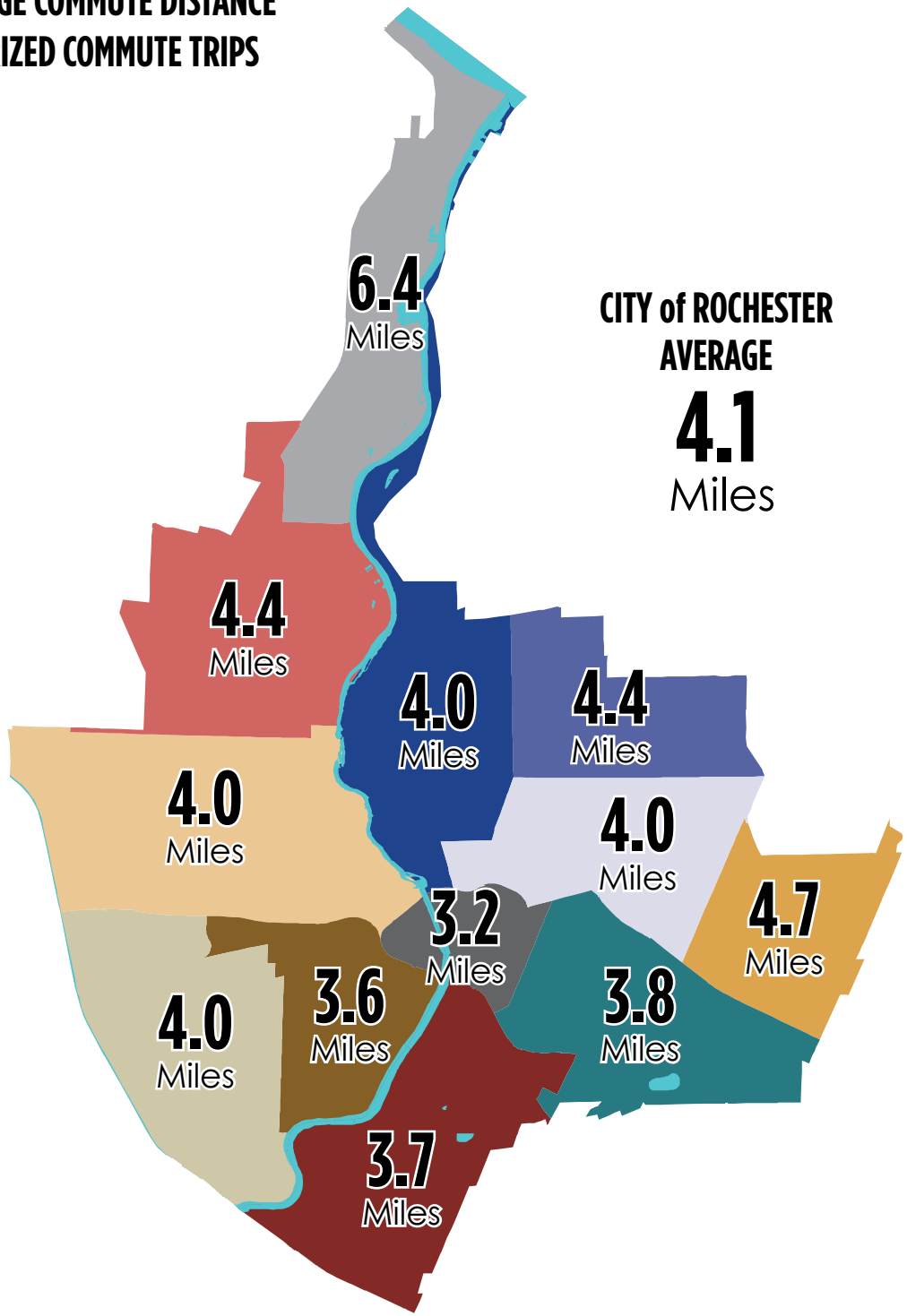
Over 100,000 people commute into Rochester every day, demonstrating the importance of the City's transportation system to the regional economy.

Despite Rochester's role as a regional economic center, 38% of residents' commute trips end outside of the City, demonstrating the existence of a substantial reverse commute pattern.



Source: GTC Regional Travel Demand Model v3.4, 2010

AVERAGE COMMUTE DISTANCE MOTORIZED COMMUTE TRIPS



CITY of ROCHESTER AVERAGE

4.1
Miles

CITY RESIDENT COMMUTE DISTANCES

The average commute to work for a city resident who drives or takes transit to work is over four miles, a distance too long for most practical walking commutes, but viable for a bike commute if the network is safe and attractive.

Source: GTC Regional Travel Demand Model v3.4, 2010

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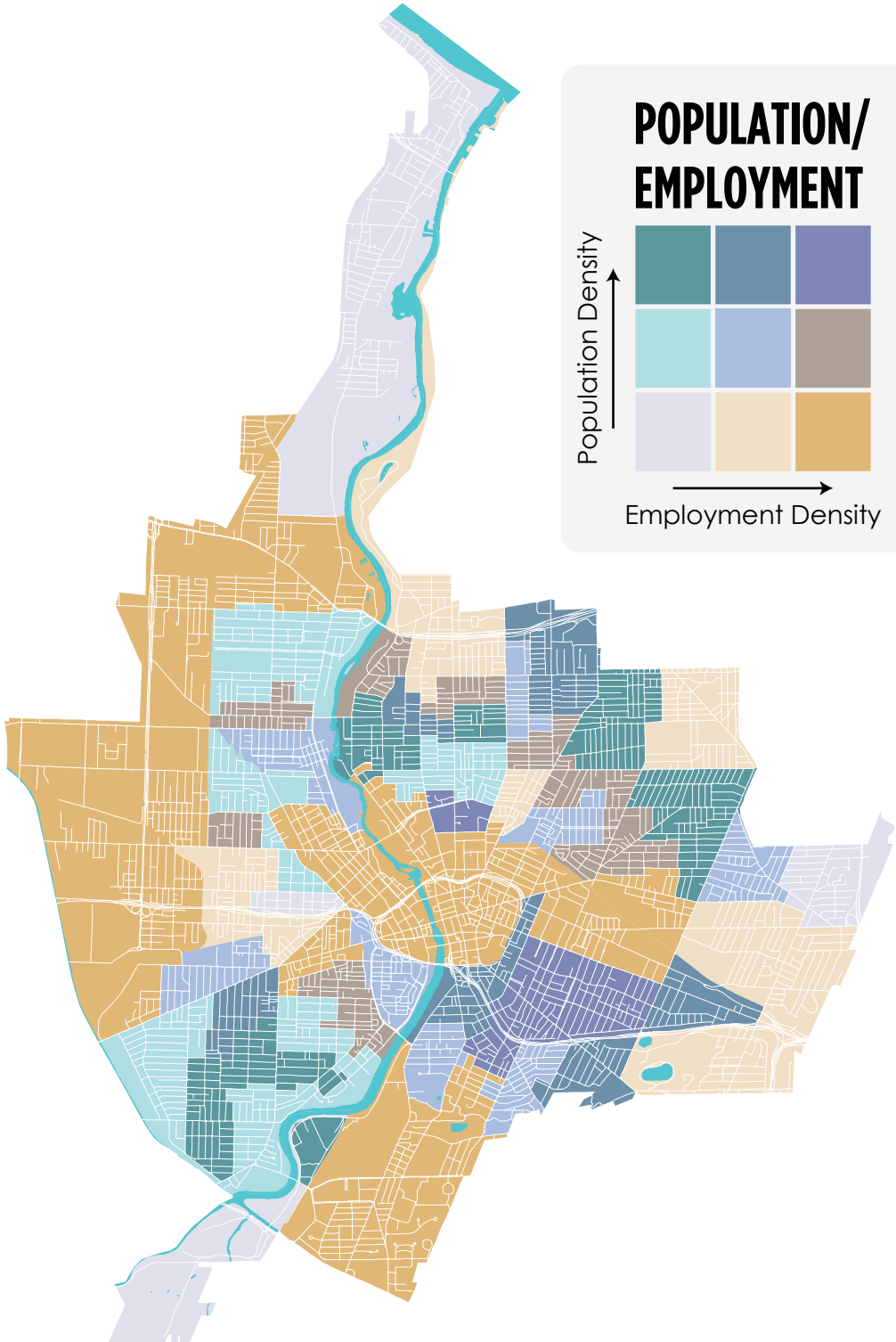
DEMOGRAPHICS

Rochester is home to over 200,000 people and approximately 150,000 jobs. Residents of the city are relatively young. The Millennial generation represents a larger percentage of the City's population than the national average. Residents are primarily low to middle income, highlighting the socioeconomic disparity between the City and other parts of the region. The City's median income is less than half of that of the surrounding county. Most people travel by car, although a sizeable minority of residents rely on other modes of transportation. Over one-quarter of households do not have access to a private vehicle.

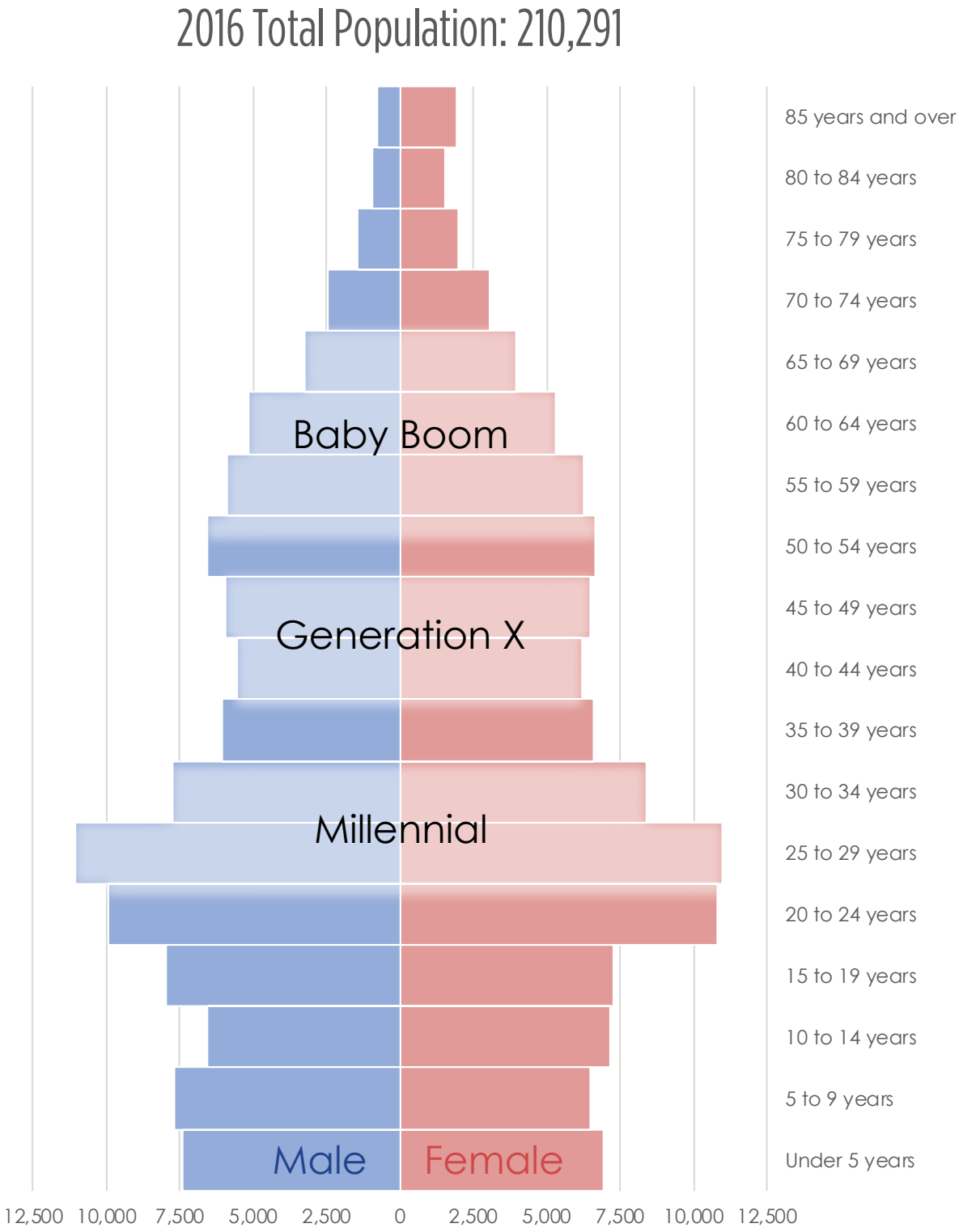
POPULATION AND EMPLOYMENT DENSITY

Large areas of Rochester consist of high employment or population densities, though few areas exhibit a strong mix that simplifies primary transportation needs.

Exceptions include the Park Avenue, Monroe Avenue, and South Clinton Avenue Corridors as well as Upper Falls Boulevard.



Sources: American Community Survey Dataset B01003, 2016, LEHD 2015



Source: American Community Survey Dataset B01001, 2016

AGE, GENDER, AND GENERATIONS

Rochester is a young community. 24% of residents are between 22 and 34 years old compared to the 18% national average.

Residents aged 40 to 69 make up 32% of the city population compared to 37% nationally.

Women outnumber men by approximately 5,400 citywide.

COMMUTE MODE SHARE

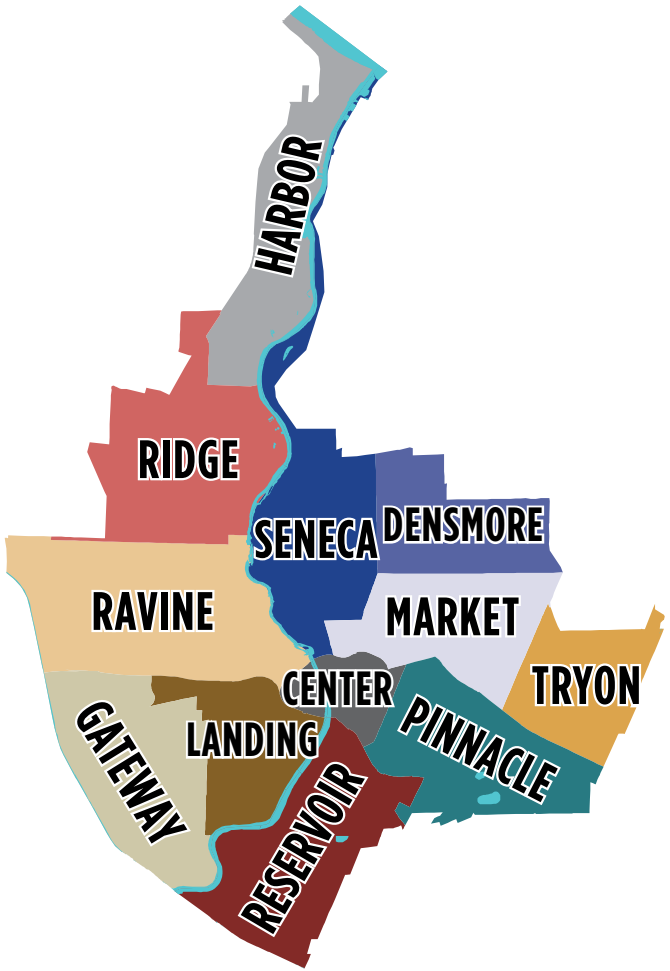
More than 15% of city residents commute via an active transportation mode.

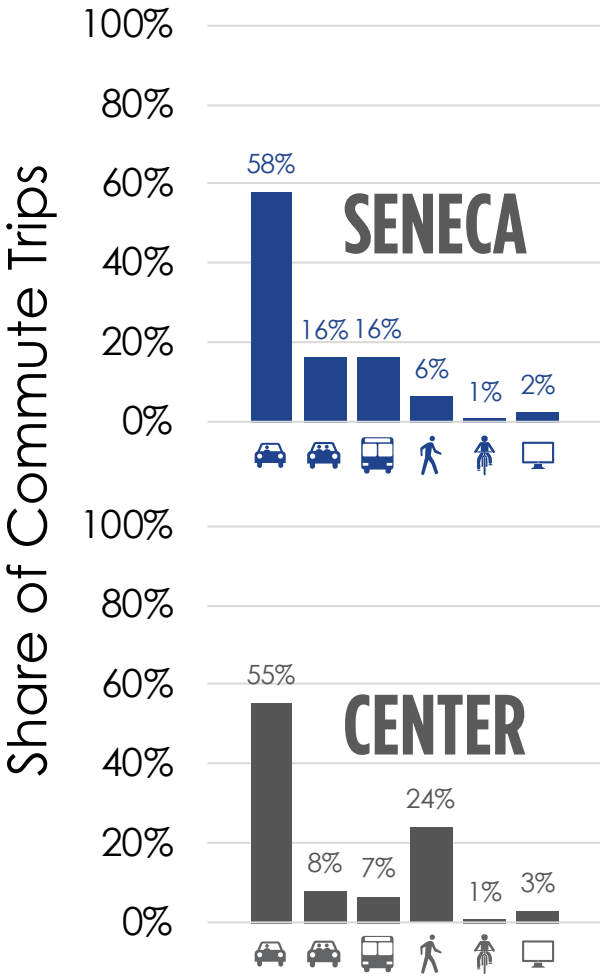
Almost one-quarter of residents who live within divisions that contain the Downtown and University of Rochester Medical Campus employment centers walk to work.

CITY of ROCHESTER

70% DRIVE ALONE

10% CARPOOL



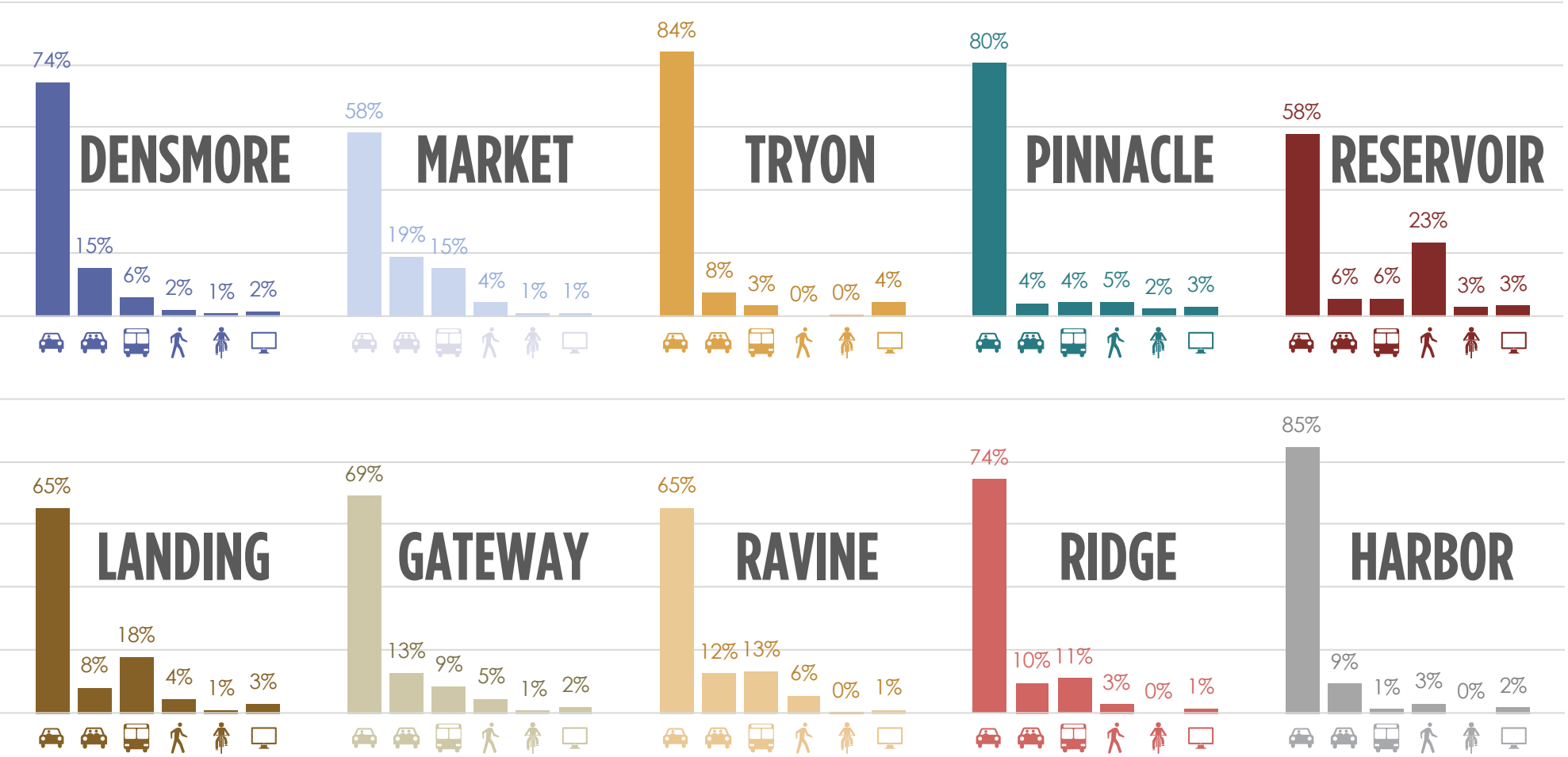


9% BUS

7% WALK

1% BIKE

2% WORK FROM HOME

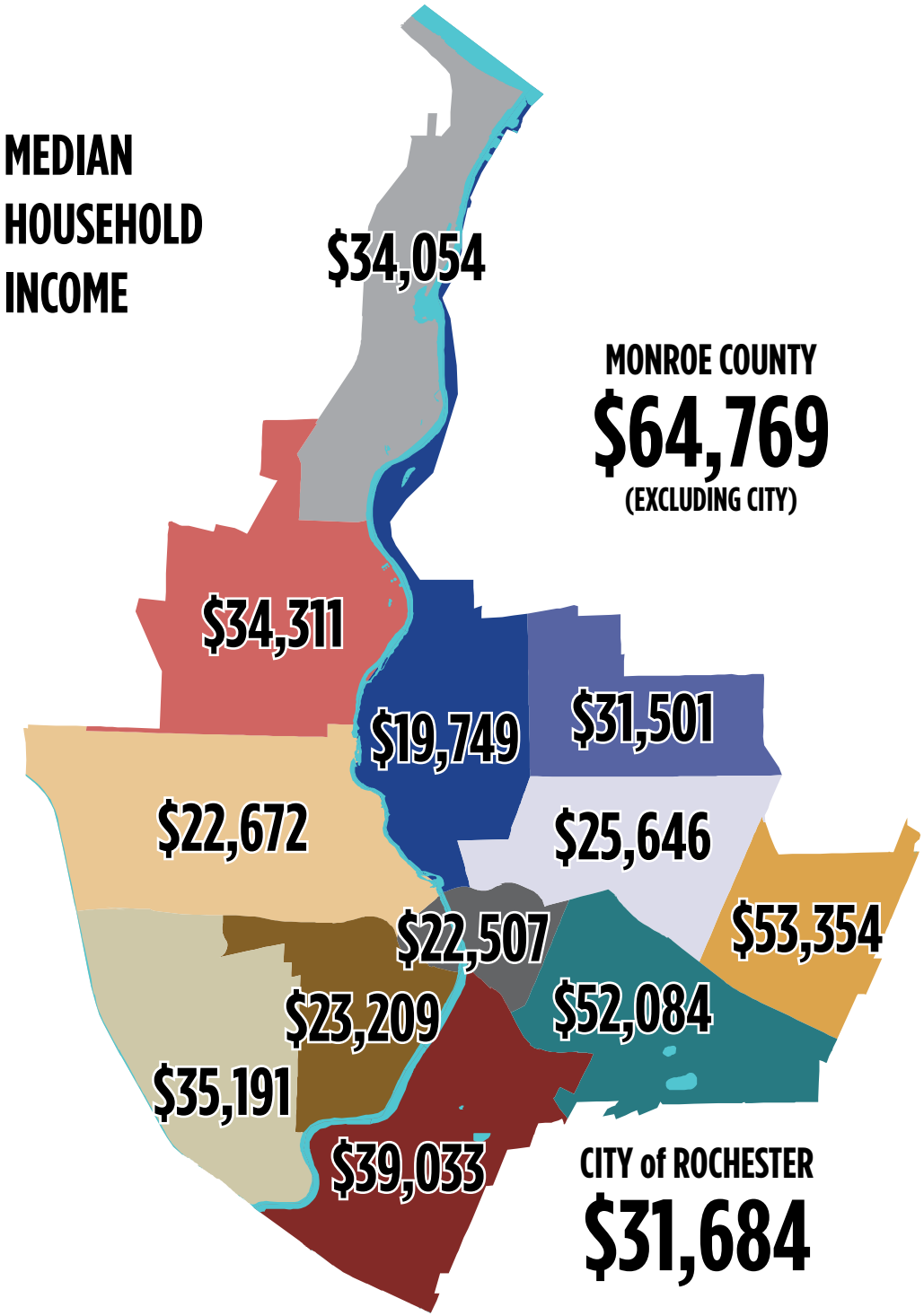


Source: American Community Survey Dataset B08301, 2016

HOUSEHOLD INCOME

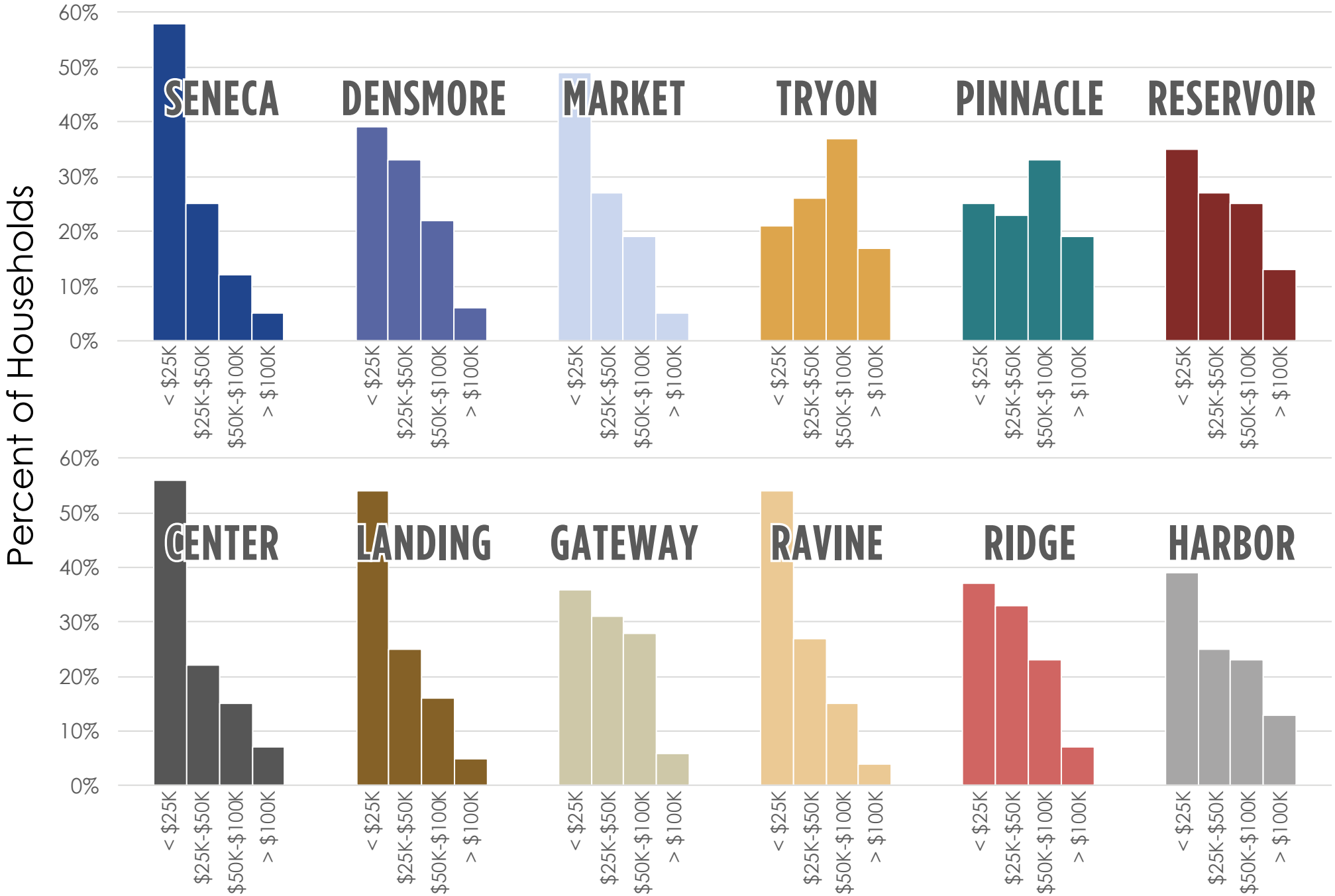
Rochester exhibits lower household incomes than the surrounding suburbs. Transportation directly affects household budgets as the most convenient transportation options often are the most expensive.

Income in the southeast divisions exceeds that of the city as a whole. Downtown and adjacent neighborhoods to the north and west lag far behind the median.



Source: American Community Survey Dataset B01001, 2016

Household Income

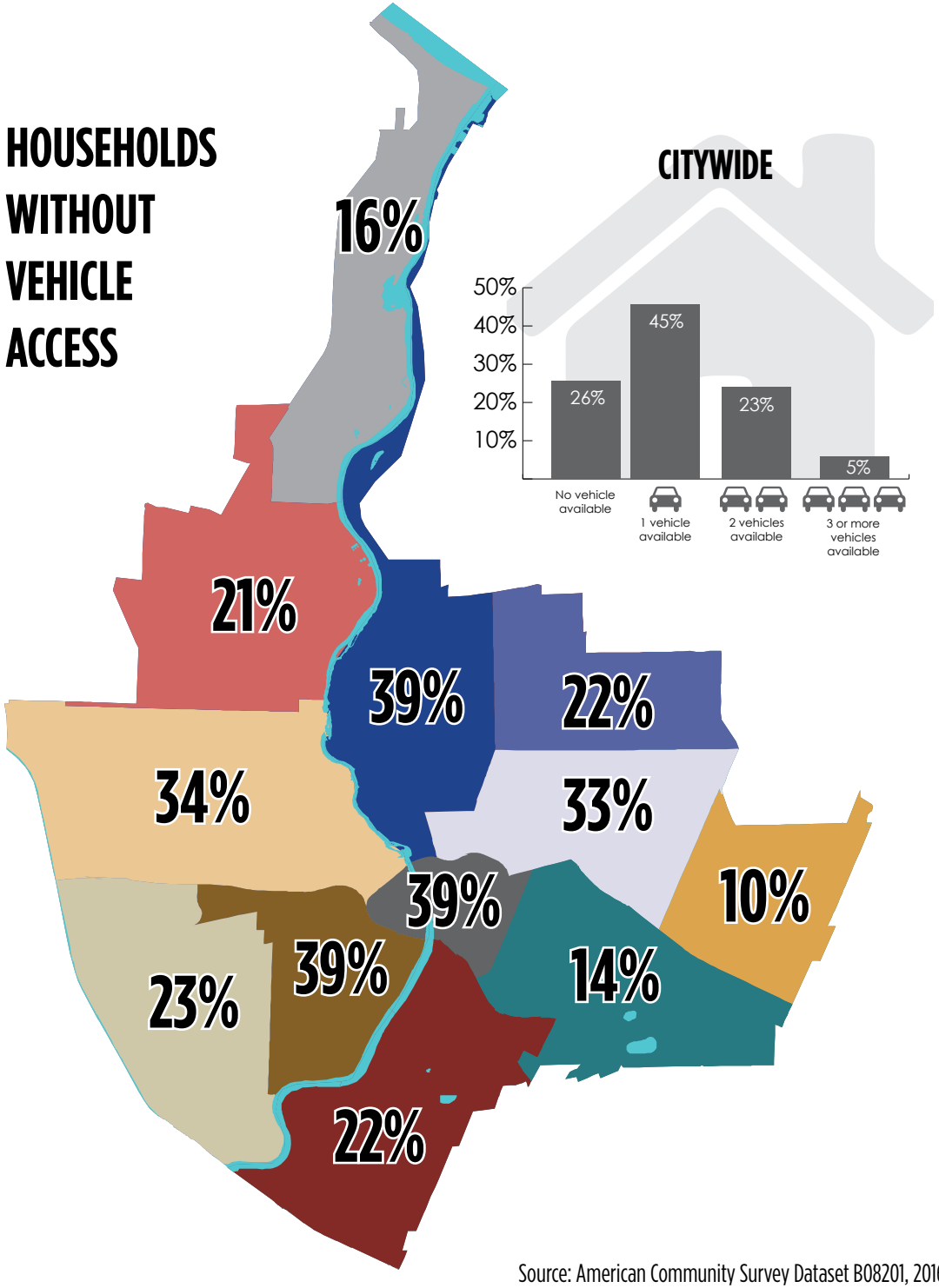


Source: American Community Survey Dataset B19001, 2016

PRIVATE VEHICLE ACCESS

Over one-quarter of all city households, approximately 22,000, as well as over one-third of households in Downtown and most downtown-adjacent neighborhoods do not have access to a private vehicle.

Whether out of choice or necessity, these households rely on transit, walking, biking, and other means to meet their daily needs.



Source: American Community Survey Dataset B08201, 2016

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TRANSPORTATION NETWORK

Rochester's transportation system is arranged around a network of streets of varying types that support commercial corridors and employment centers. Automobile traffic is greater on north-south major streets as expressways carry the highest east-west volumes. Motorized transportation activity accounts for almost one-quarter of the City's greenhouse gas emissions.

A burgeoning bicycle network, implemented mostly within this decade, attempts to increase the overall level of cycling in the city by providing lower stress routes for cyclists. Additionally, a bikeshare system was launched in the summer of 2017 and expanded in 2018.

Rochester features a robust transit system within city limits, with core routes operating more than 18 hours per day. However, certain corridors within the City are underserved from a frequency standpoint. School transportation policies result in further use of the transit network.

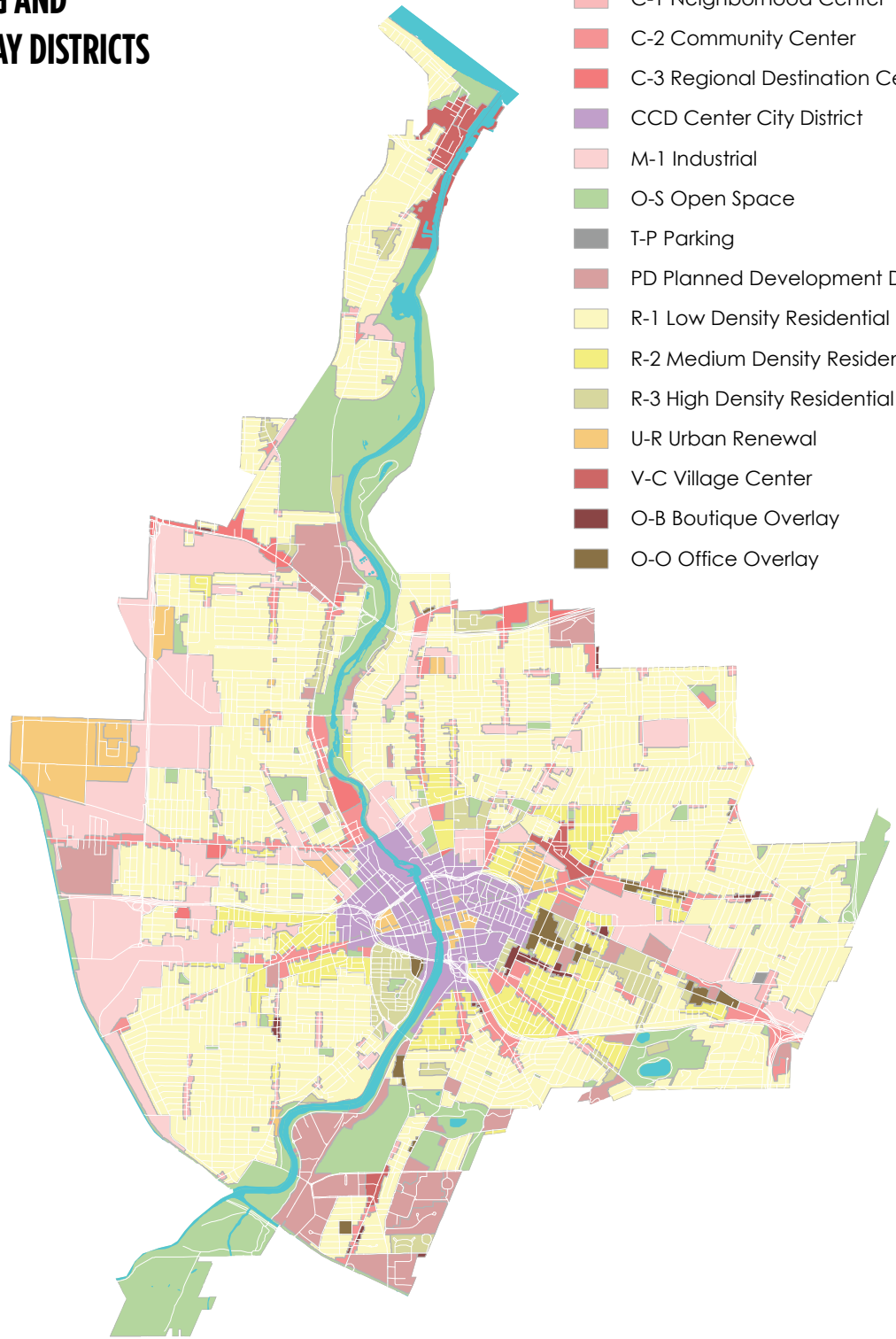
As a regional center, Rochester is the focus of a high amount of freight transport activity both on the street network as well as via rail.

ZONING/LAND USE

Most of Rochester is zoned for low density residential development. Areas along major corridors are zoned for commercial and higher density residential use. Industrial zoning is located along existing and former rail corridors.

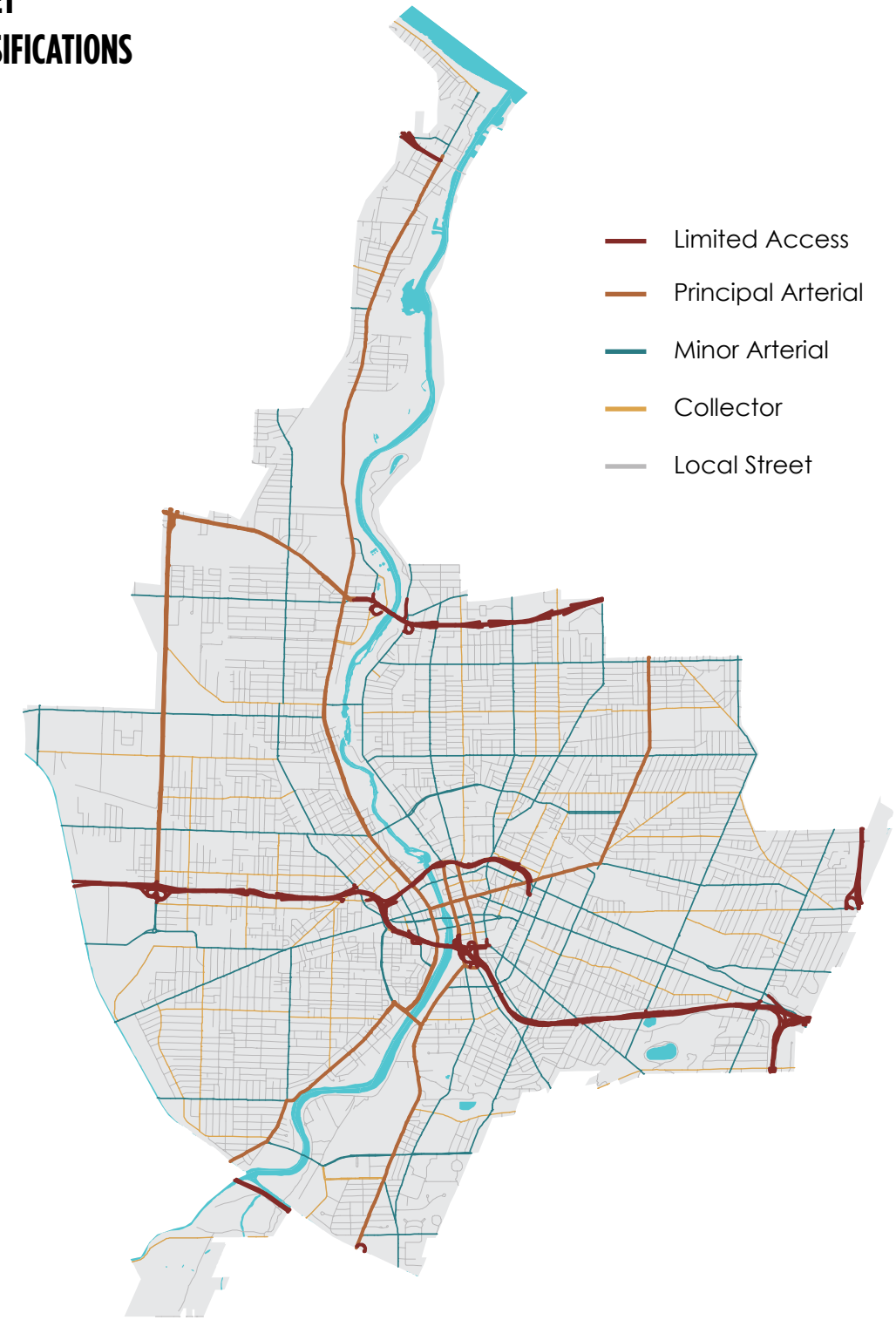
Zoning designations encourage and preserve office and higher-density residential development downtown and in many neighborhood centers.

ZONING AND OVERLAY DISTRICTS



Source: City of Rochester

STREET CLASSIFICATIONS



Source: City of Rochester

ROADWAY CLASSIFICATION

Functional classification groups streets and roadways into the roles they are expected to play within the motorized transportation network.

The streets that make up Rochester's roadway network have been recently reclassified.

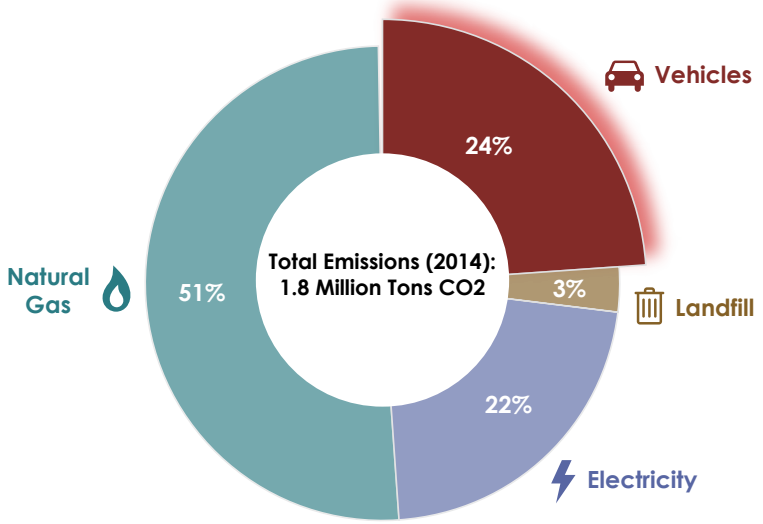
Further consideration should be given to other transportation modes and to the character of the corridor.

GREENHOUSE GAS EMISSIONS

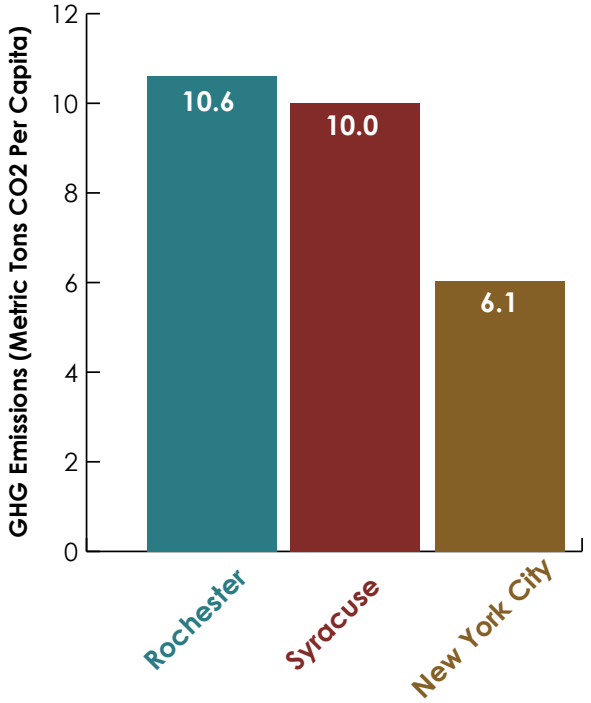
On-road vehicles generate around a quarter of annual emissions in Rochester, which has a higher per-capita carbon footprint than other cities in New York.

While emissions associated with ground transportation may fluctuate due to changes in vehicular travel and improved vehicle efficiency, climate change continues to pose a serious threat to the integrity of the transportation system in Rochester.

GREENHOUSE GAS EMISSION SOURCES

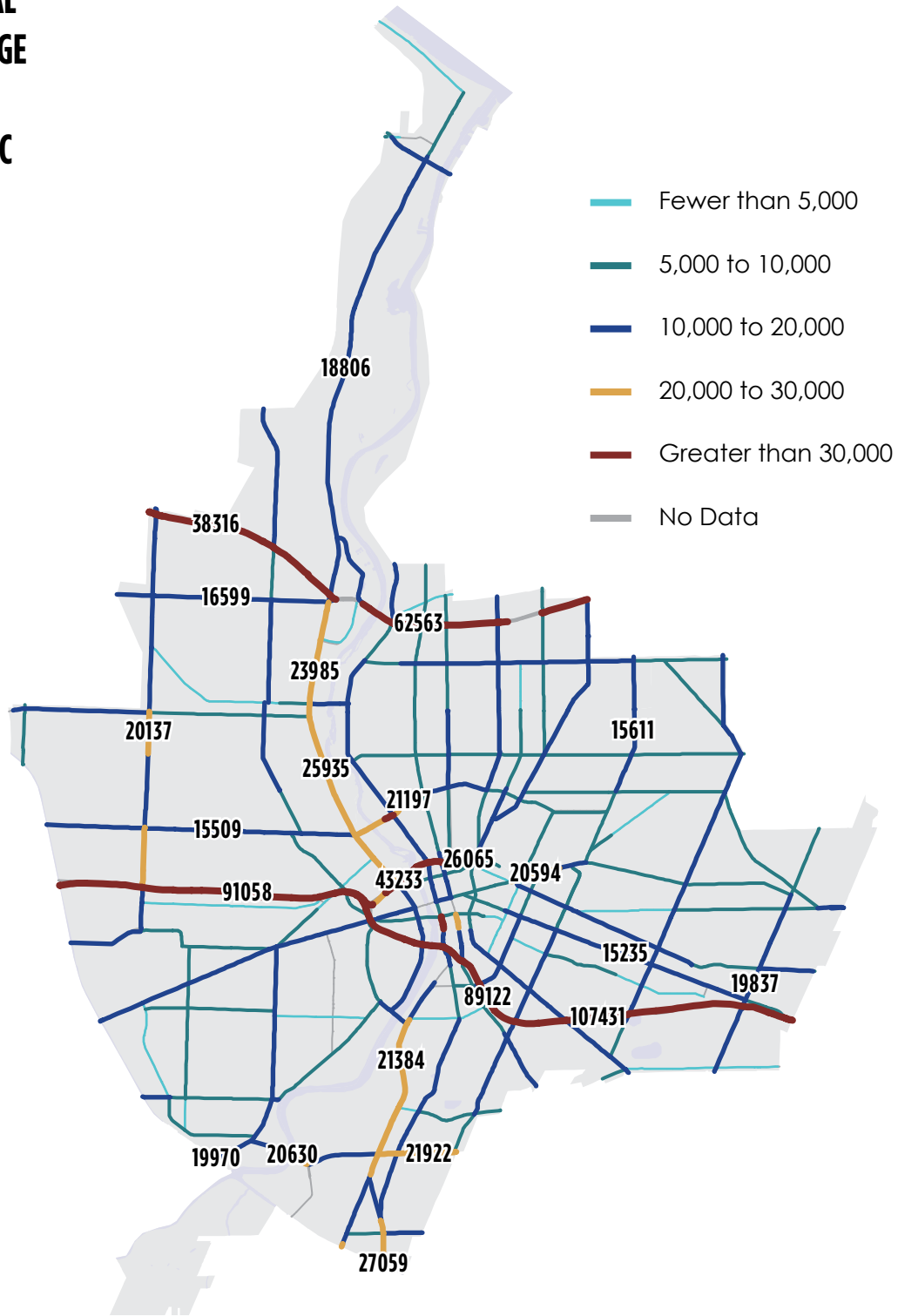


GREENHOUSE GAS EMISSIONS BY CITY



Source: Rochester Climate Action Plan, 2015 Energy Master Plan

ANNUAL AVERAGE DAILY TRAFFIC (2015)



Source: New York State Department of Transportation

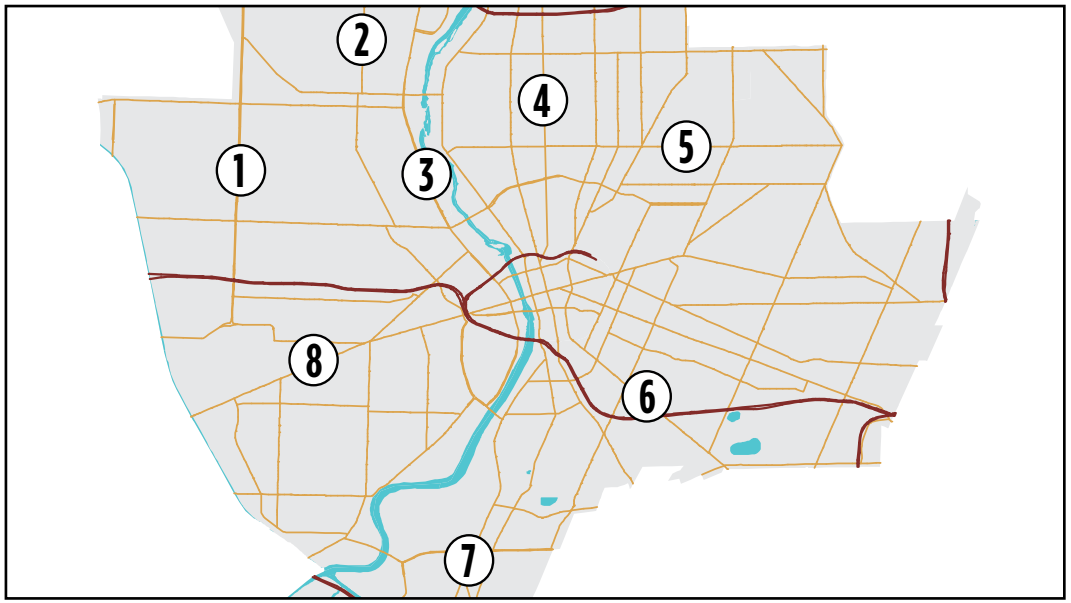
VEHICLE VOLUMES

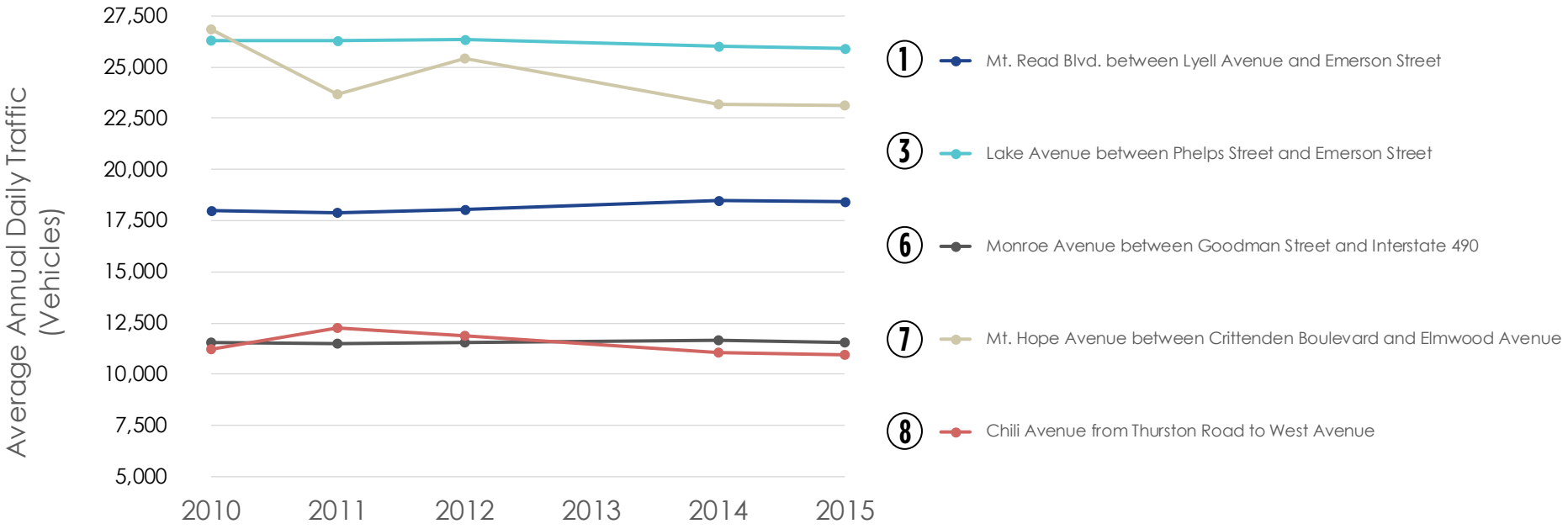
Traffic volume is significantly higher on north-south arterials than other surface streets due to the alignment of limited access expressways.

The highest volumes are seen along Ridge Road, Lake Avenue, Mt. Hope Avenue, Upper Falls Boulevard, Mt. Read Boulevard, and Elmwood Avenue; most of these are four lane roads for their entirety.

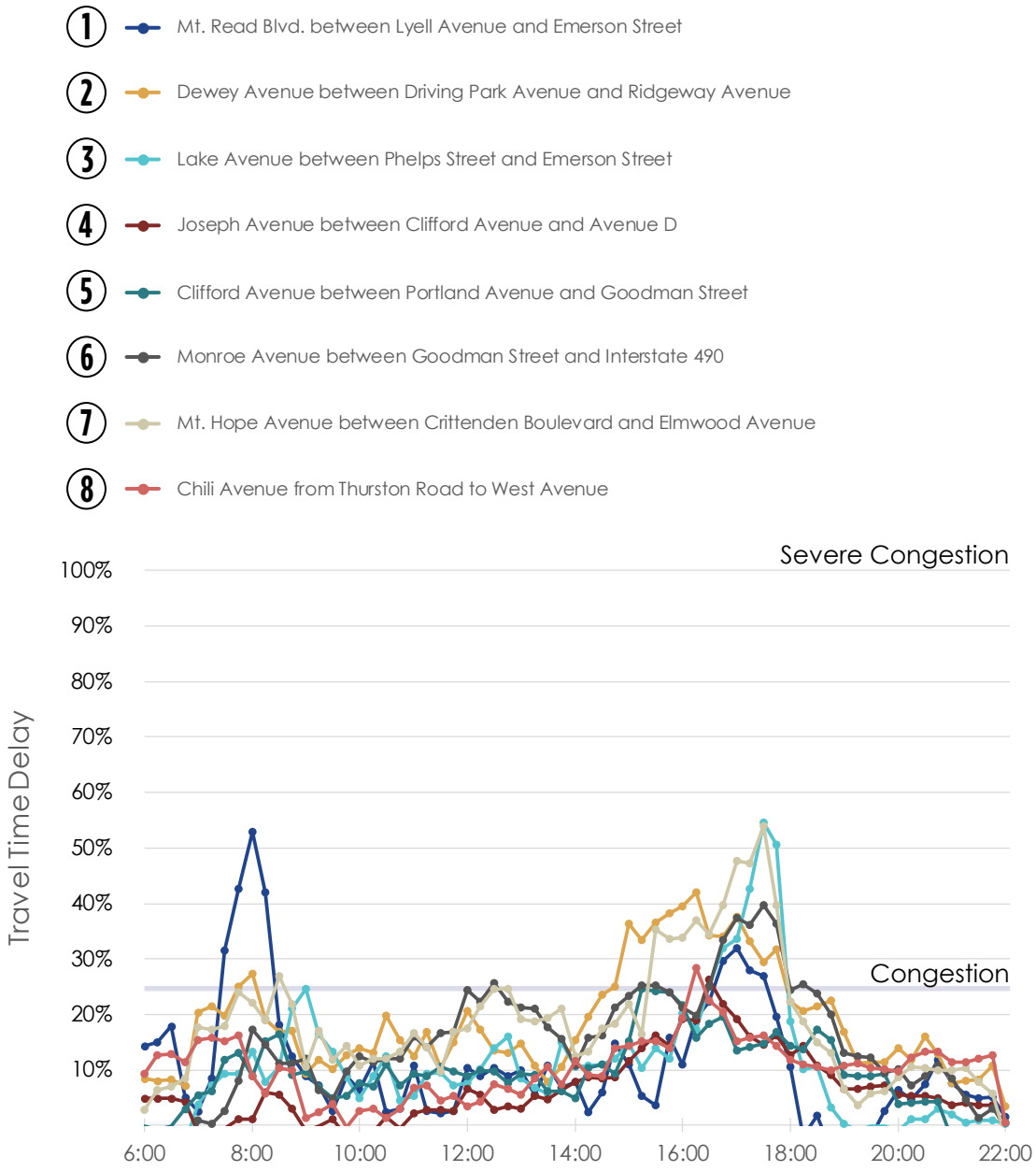
VEHICULAR TRAFFIC TRENDS

Daily vehicular traffic on city arterials has remained relatively stable year over year.





Source: New York State Department of Transportation



Source: INRIX, September 2017

DAILY TRAFFIC TRENDS

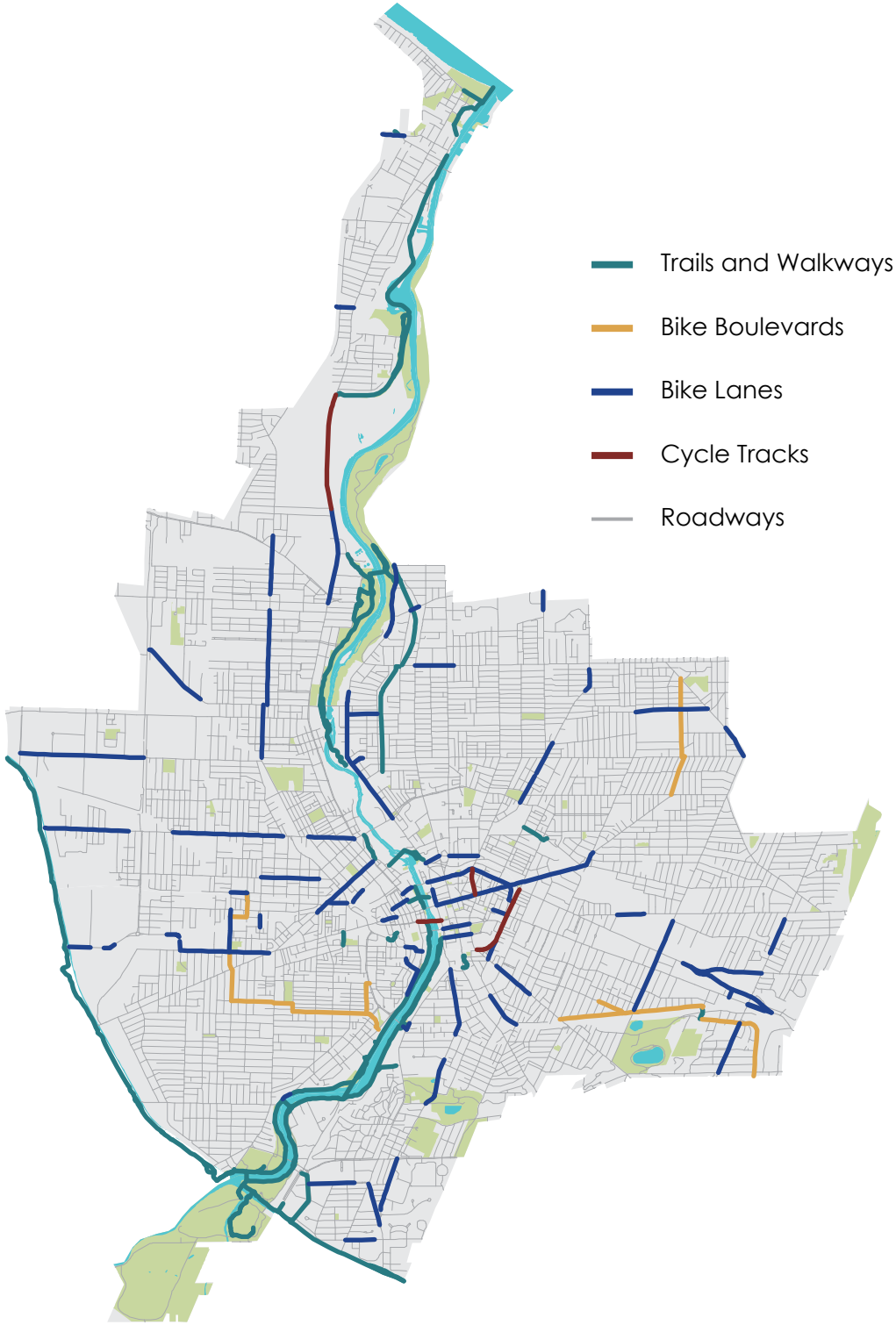
The Genesee Transportation Council's Congestion Management Process defines congestion where a trip would take one-quarter longer than it would under uncongested conditions. Severe congestion is defined as a trip that takes twice as long.

Certain Rochester arterials experience short periods of congestion during peak travel times, but do not approach severly congested conditions.

NON-MOTORIZED NETWORK

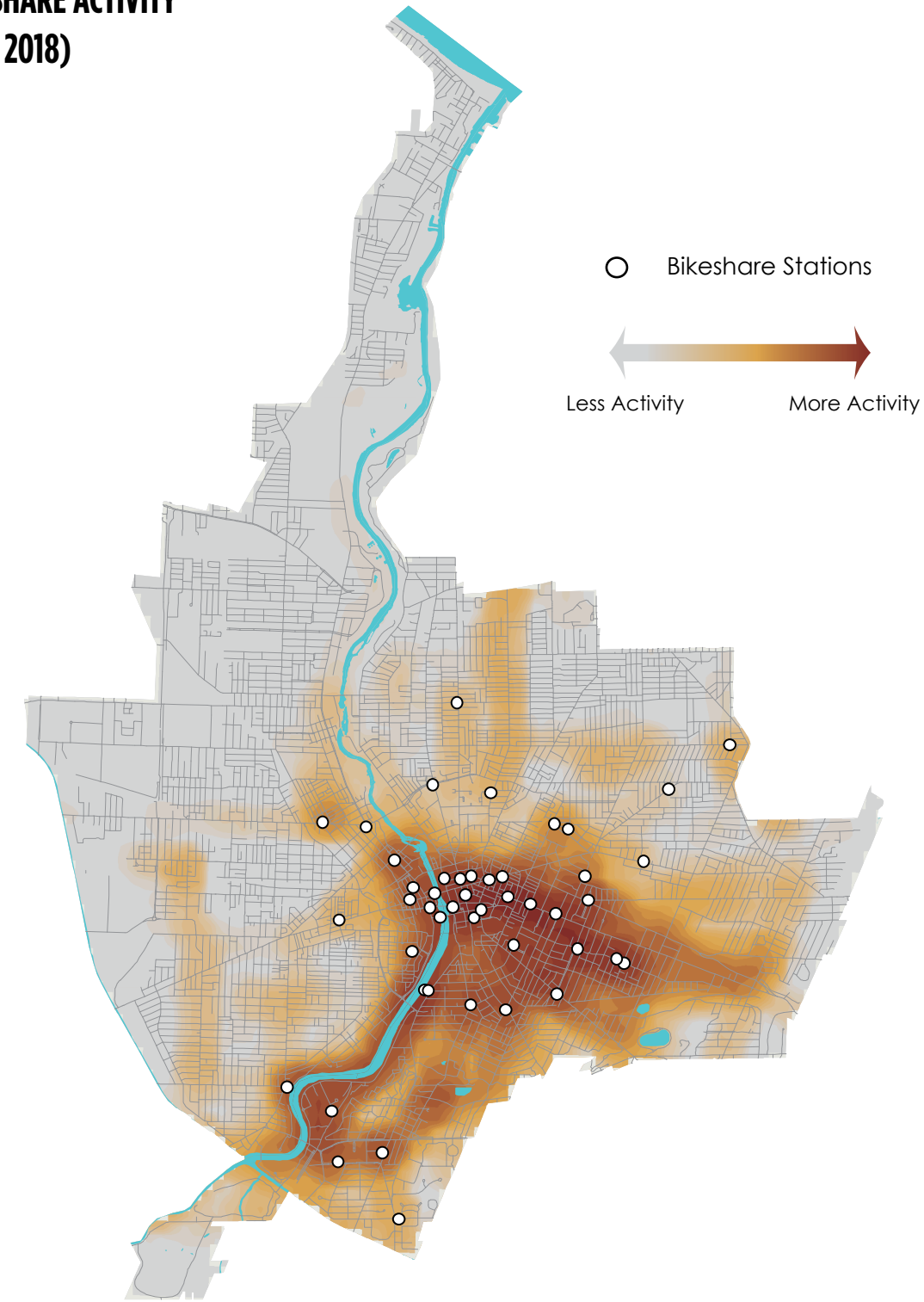
The El Camino and Rochester Riverway Trails allow pedestrians and cyclists to travel easily along most of the Genesee River corridor. The Erie Canalway Trail provides an important non-motorized link along the city's edge.

Meanwhile, Rochester's streets are home to over 50 miles of bike lanes and cycle tracks, all of which have been implemented since November 2011.



Sources: Genesee Transportation Council, City of Rochester

BIKESHARE ACTIVITY (MAY 2018)



Sources: City of Rochester, Zagster

BICYCLE TRAVEL

In July 2017, the City launched a new bicycle sharing service.

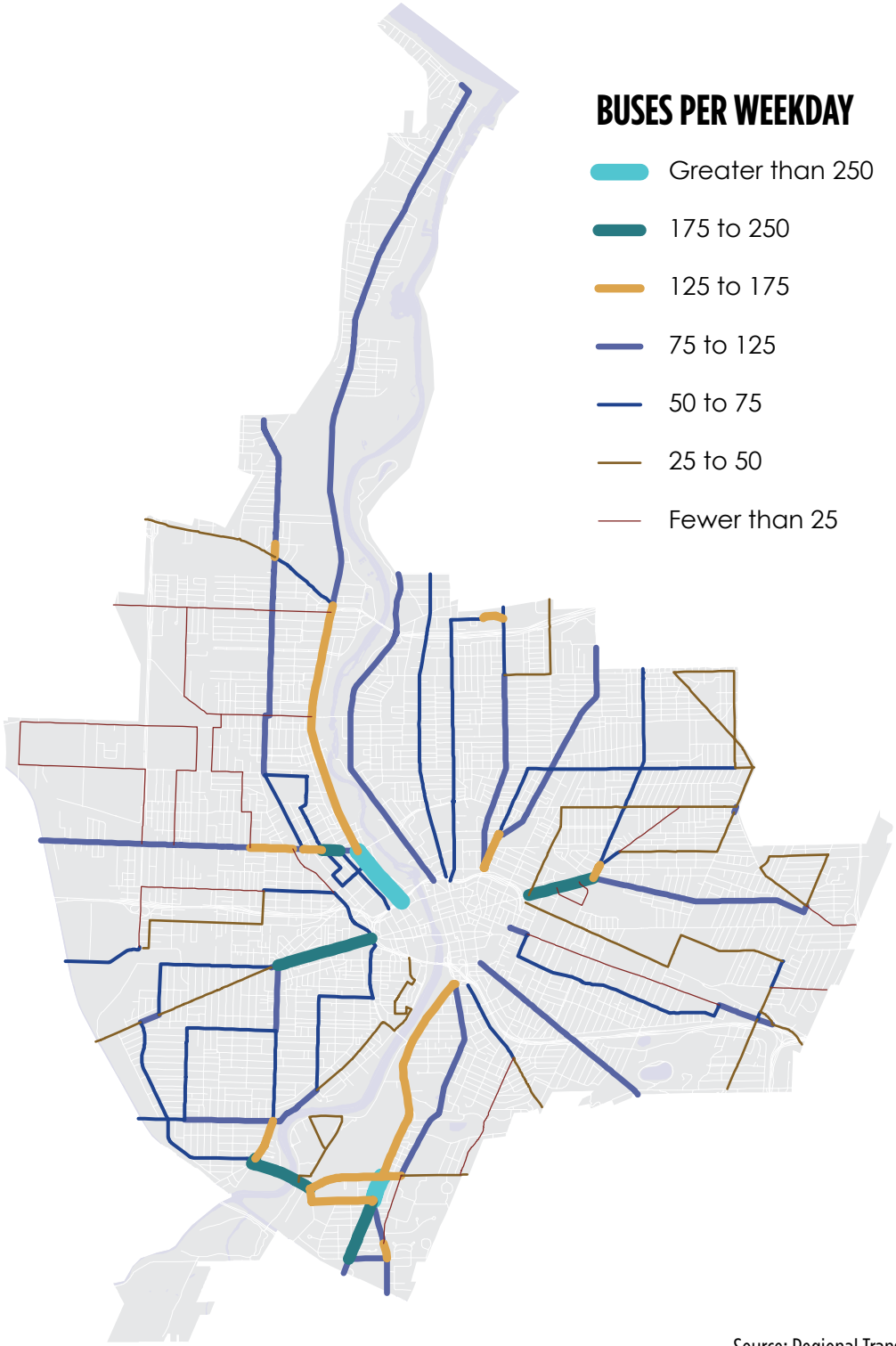
The average trip length during the first operating year was just over 2.5 miles and most activity remained near station locations.

A change in the service model for 2018 that allows users to lock bikes in any location without incurring a penalty has already resulted in greater levels of activity in areas not yet served by stations.

TRANSIT COVERAGE

Certain corridors in Rochester, such as Lake and Mount Hope Avenues, are served by over 125 transit buses each weekday.

Other corridors, such as Plymouth and University Avenues, see fewer than 50 buses each day.

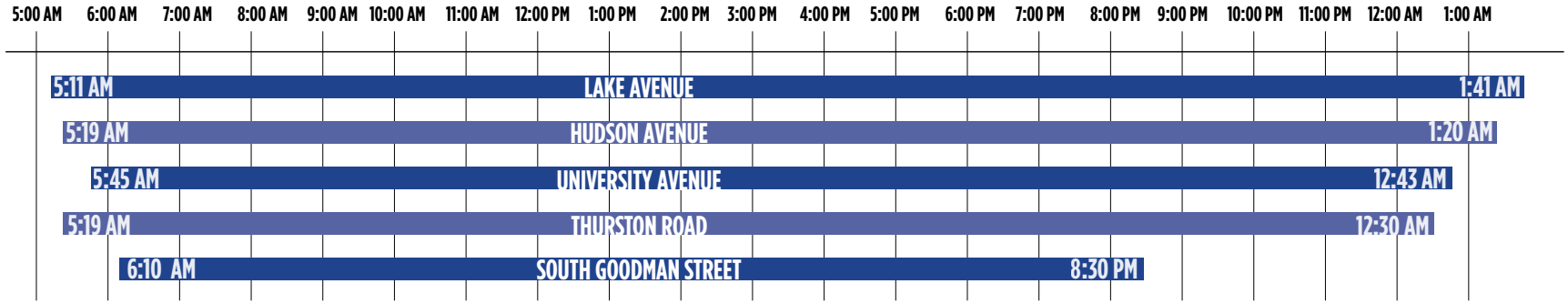


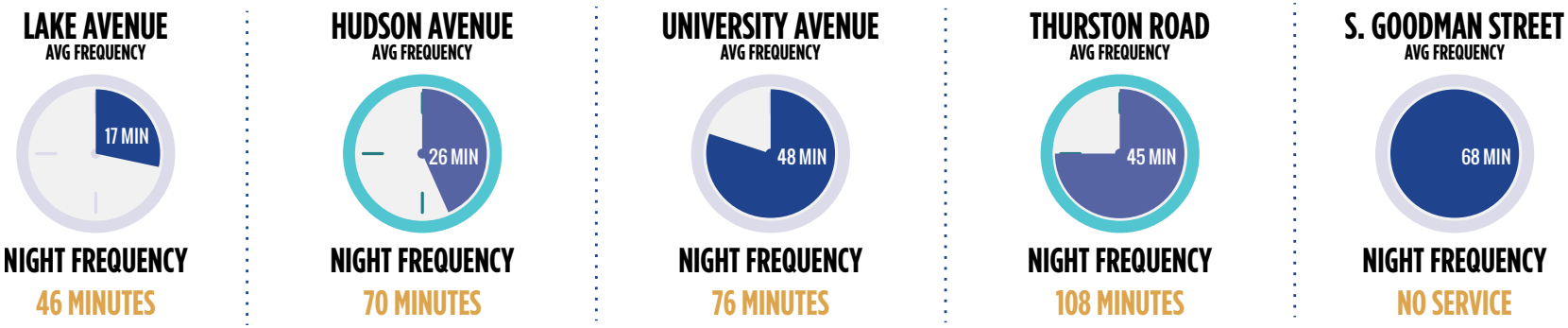
Source: Regional Transit Service

TRANSIT SERVICE DAY AND FREQUENCY

The time of day that transit service is available varies between routes, though most city corridors are served continuously from prior to 6:00 a.m. until later than midnight.

Corridors without augmented express service often see long average wait times throughout the service day. Waits can be especially long after 7:30 p.m and on weekends.





Source: Regional Transit Service

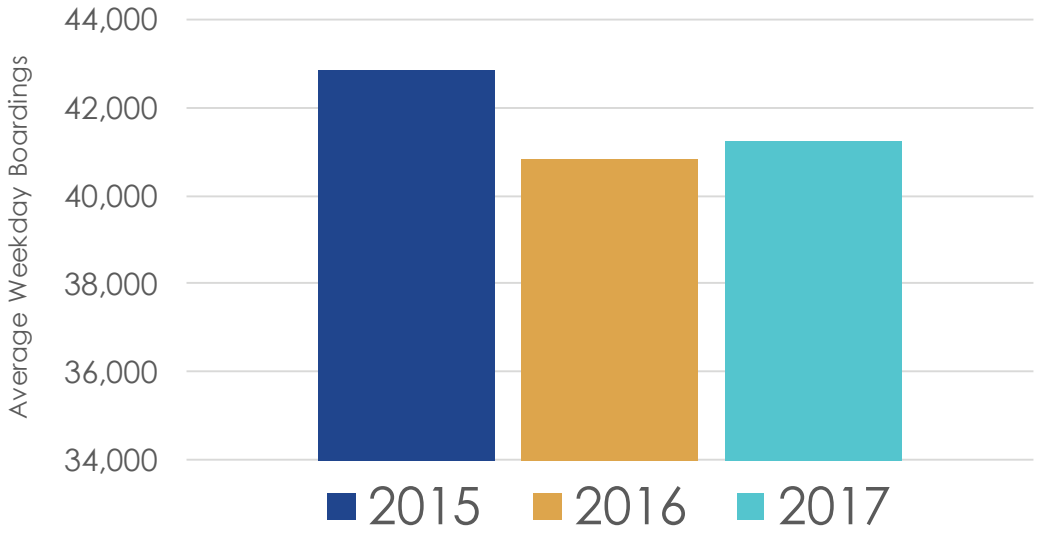
TRANSIT RIDERSHIP

The transit system in Rochester serves over 40,000 trips per day.

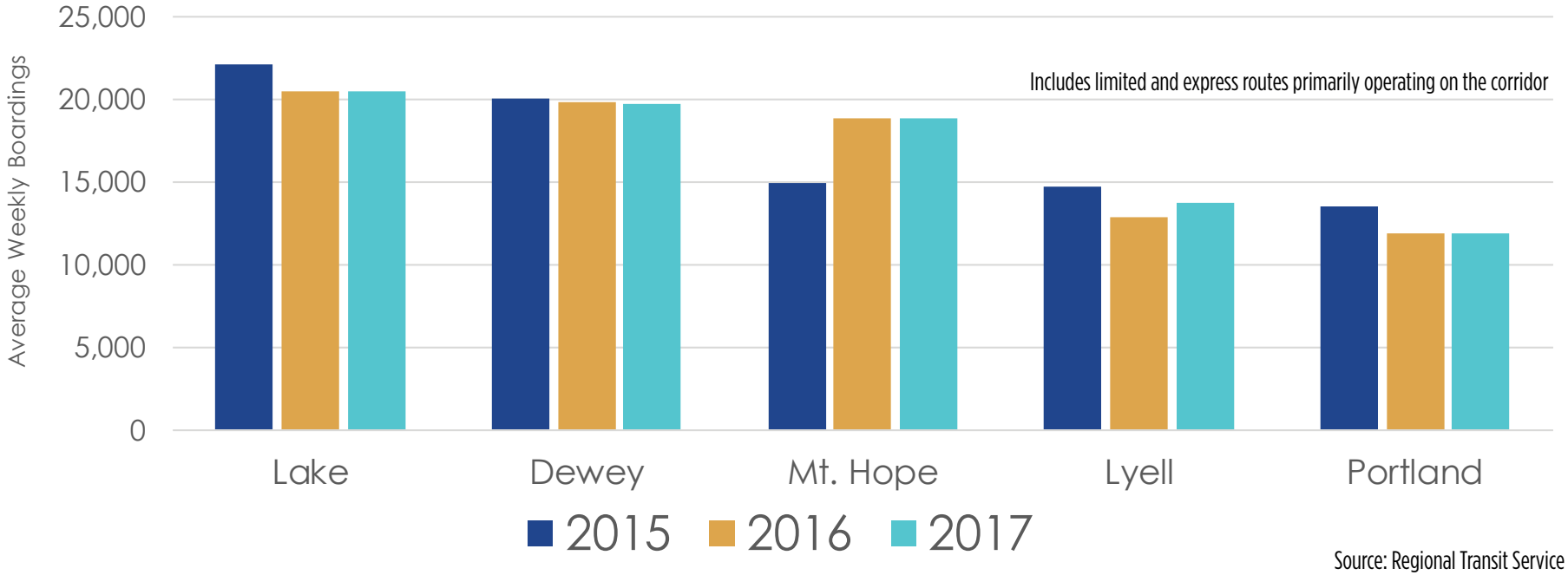
Consistent with nationwide trends, total ridership has decreased since 2015. However, ridership for routes serving the City is increasing due to the introduction of express ROC-it routes to popular destinations.

Rochester's buses are carrying more people than its peers in New York State.

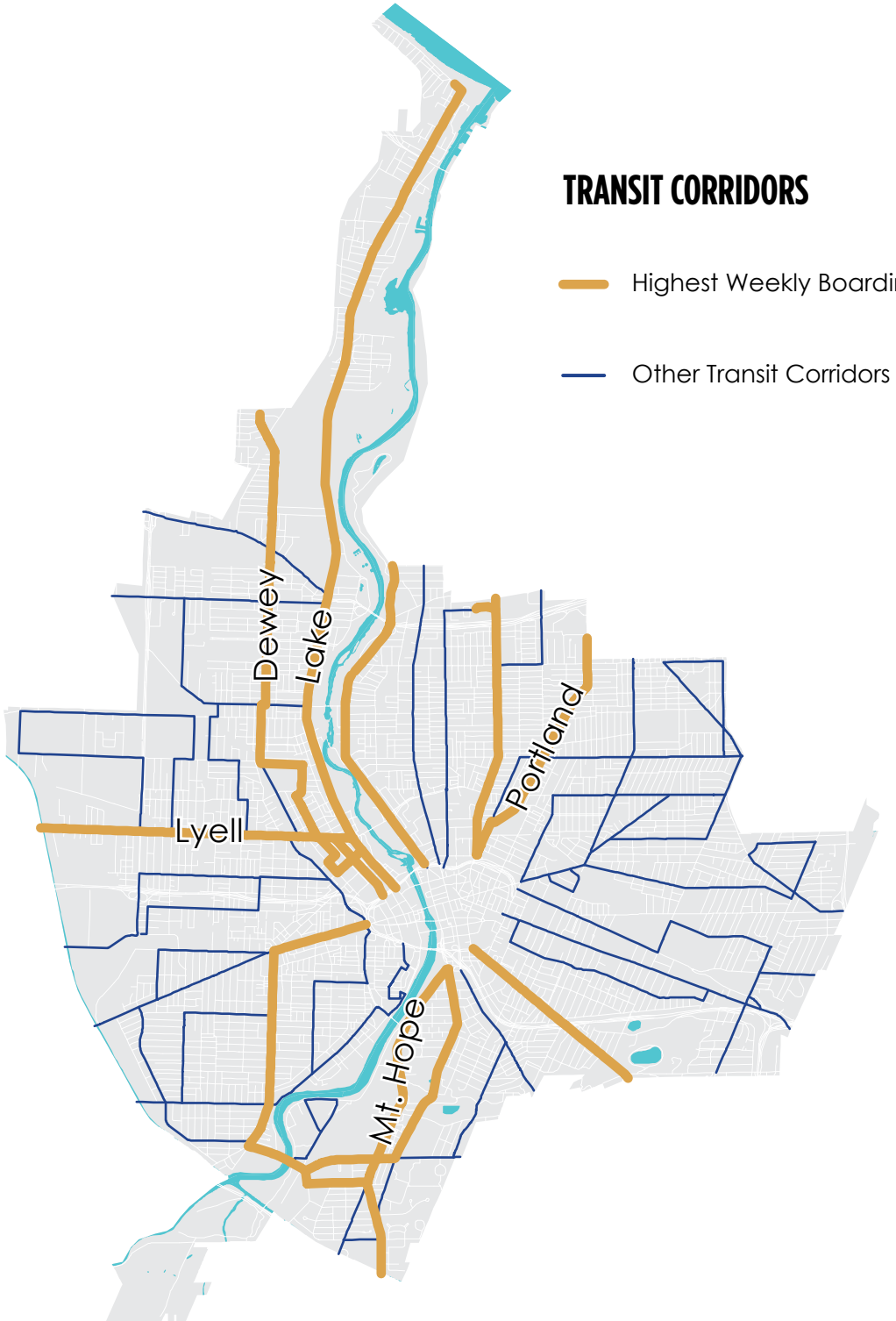
ALL ROUTES EXCLUDING SUBURBAN EXPRESS



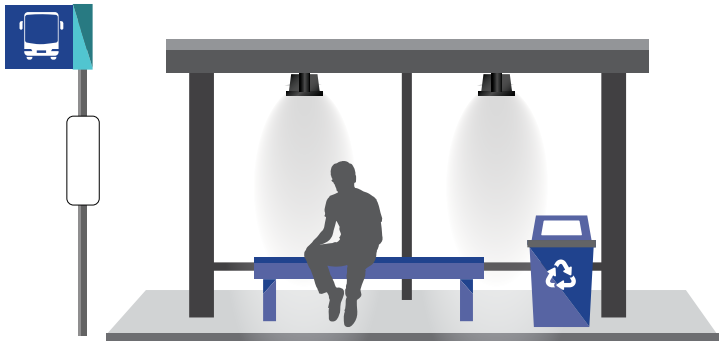
HIGHEST RIDERSHIP CORRIDORS

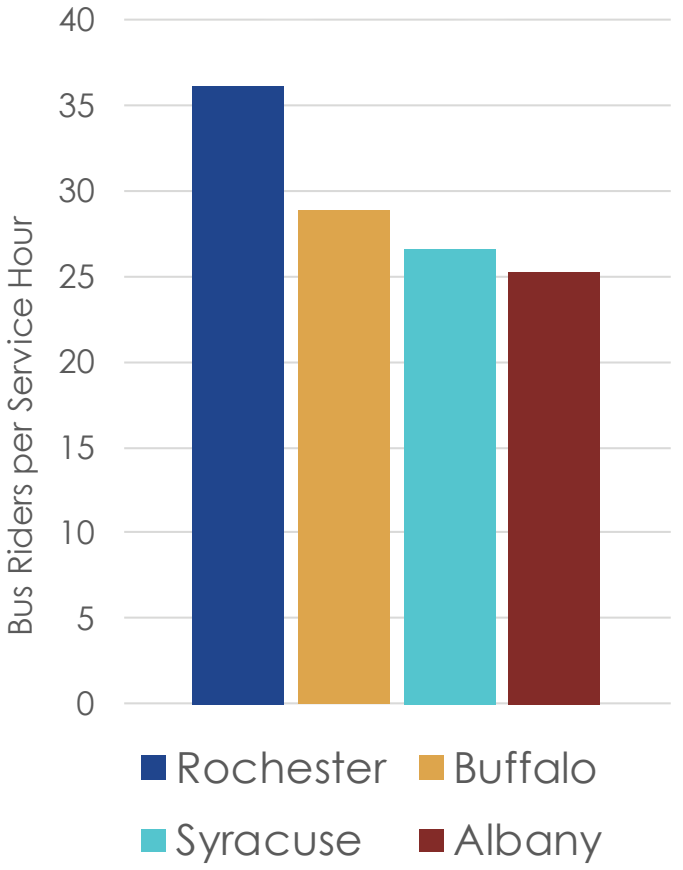


Source: Regional Transit Service



Source: Regional Transit Service, 2017





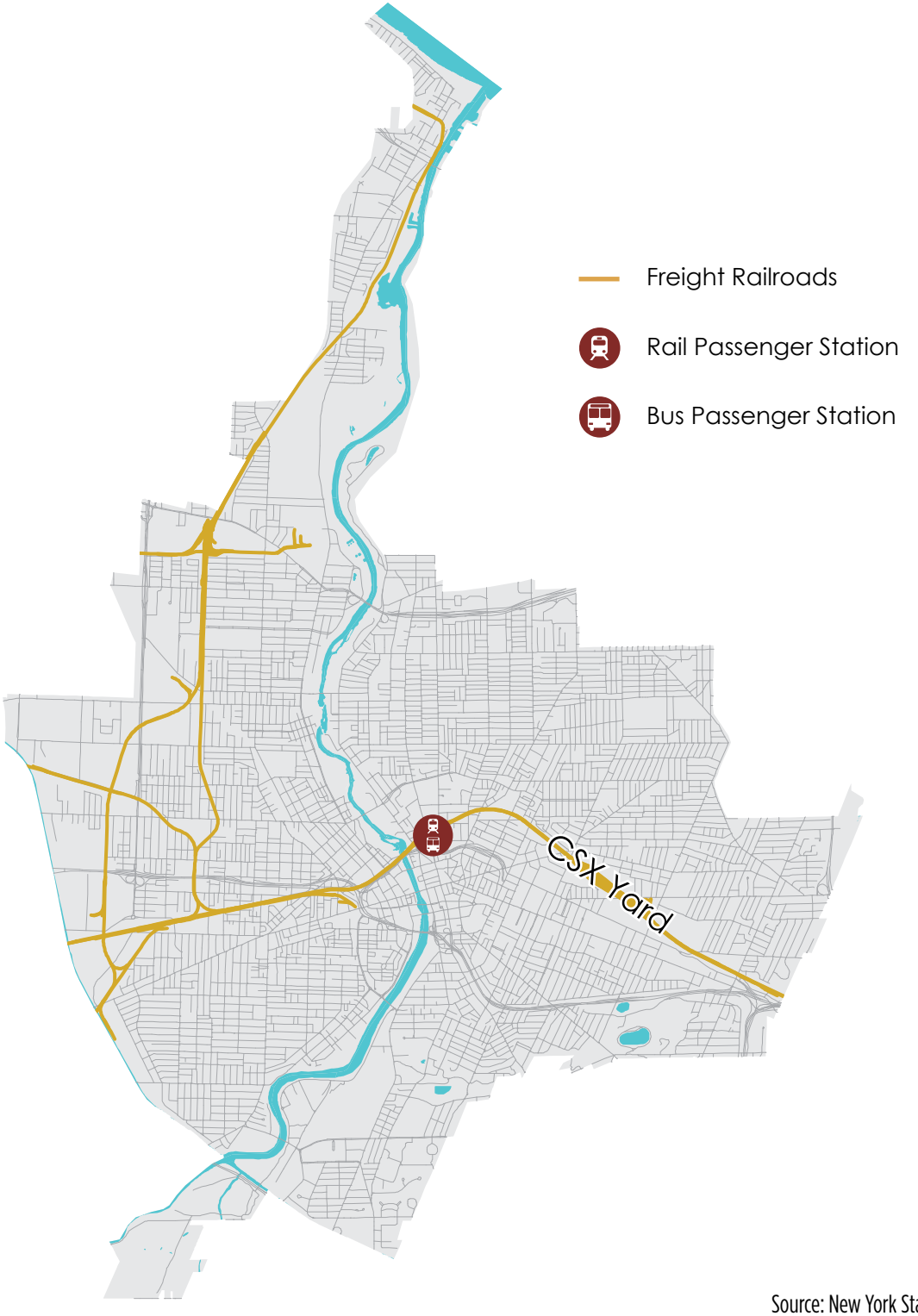
Source: National Transit Database, Federal Transit Administration, 2016

INTERCITY GROUND TRANSPORTATION AND FREIGHT RAILROADS

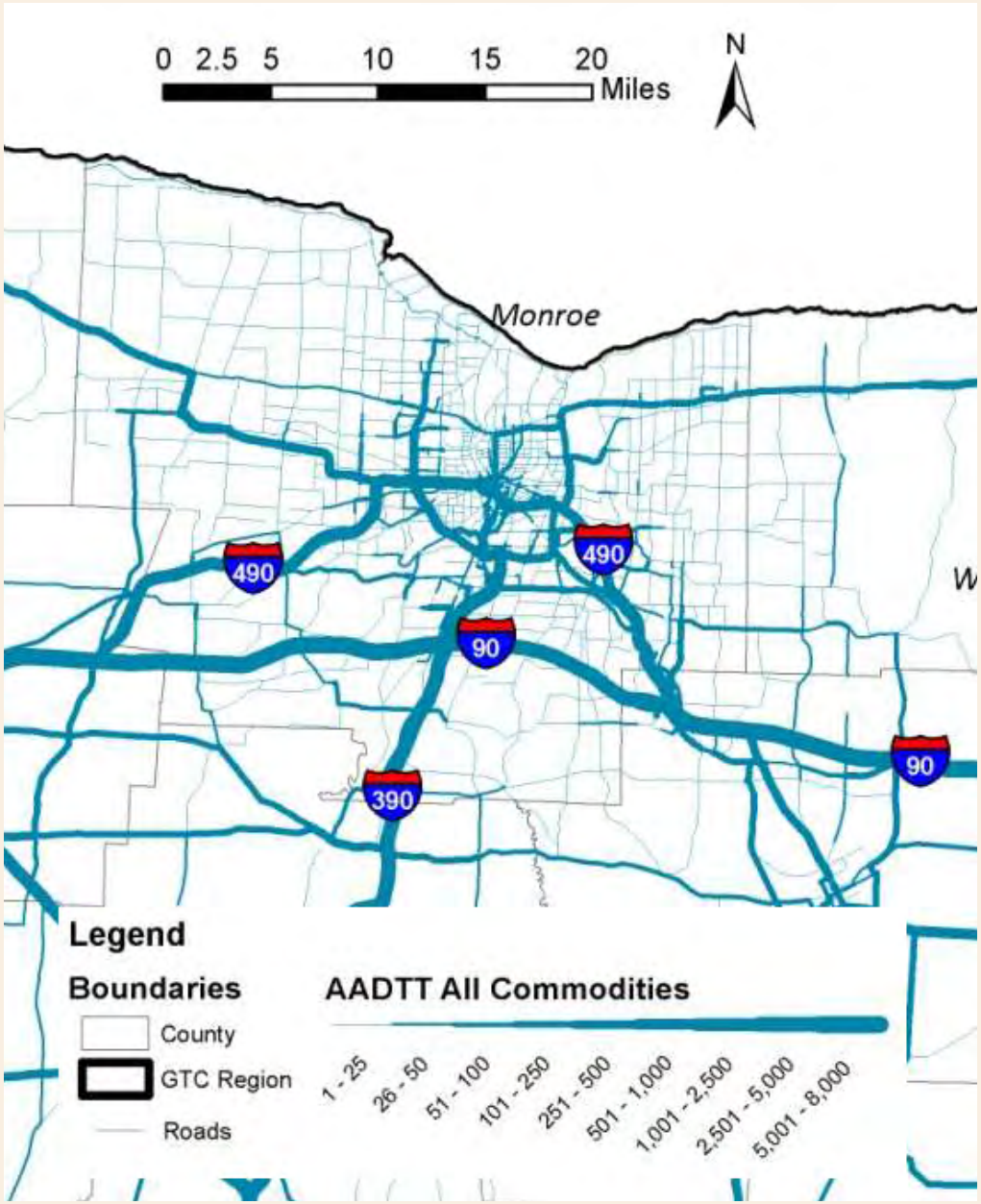
Rochester is linked to New York City, Toronto, Chicago, Boston, Cleveland, Buffalo, and Niagara Falls by 8 daily trains and 12 daily intercity buses.

The rail network is owned by freight rail companies and primarily transports bulk shipments of industrial materials. Many of these shipments are sorted in CSX's Rochester Yard.

Over 1.5 million tons of freight are handled on mainline tracks at the western edge of the city, linked to sites in the industrial northwest as well as Eastman Business Park's internal rail system.



Source: New York State



FREIGHT TRUCKING PATTERNS

The interstates and other expressways generally carry the largest truck volumes.

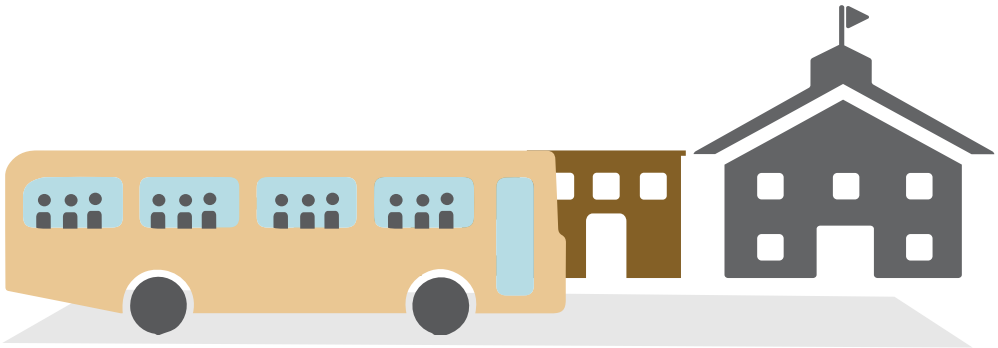
The highest truck volumes are seen on major roads such as I-490, Mt. Hope, and Mt. Read. Approximately $1 trillion worth of goods move into, out of, within, and through the Genesee-Finger Lakes Region annually.

Source: Transportation Strategies for Freight and Goods Movement in the Genesee-Finger Lakes Region. Genesee Transportation Council, 2012

STUDENT TRAVEL TO SCHOOL

Rochester City School District policies result in bus transportation for over 15,000 elementary school students, many of whom live within 1.5 miles of their school.

The scale of student transportation activity is even greater when public middle schools, high schools, private schools, and charter schools are considered.



560 Bus Routes

Transport 86% of RCSD Elementary Students

Source: Rochester City School District

4

SAFETY

While few exceptions exist to the citywide 30 miles per hour speed limit, roadway design can encourage excessive speeds, increasing the risk of collision with other vehicles, pedestrians, and cyclists.

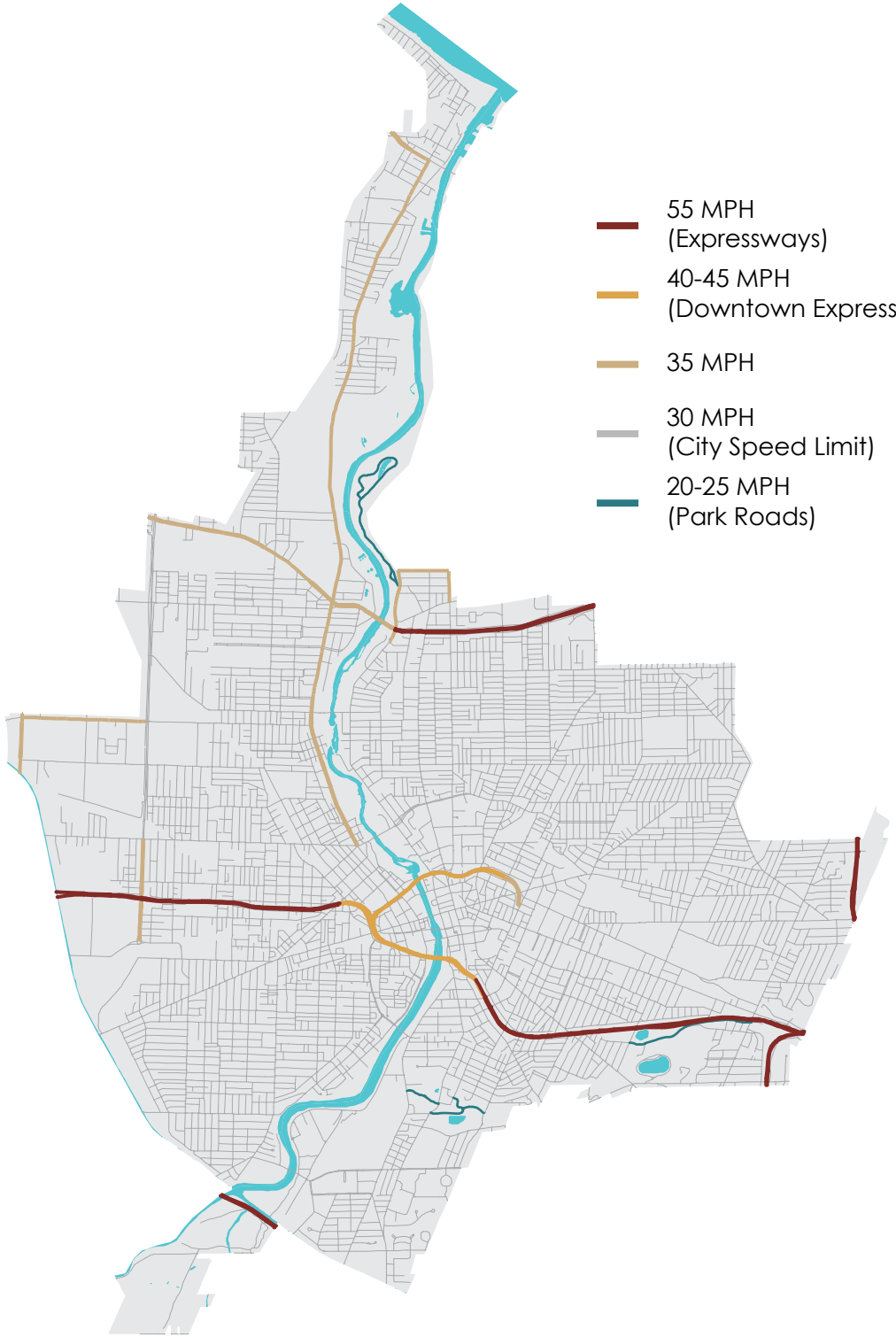
Those using non-motorized transportation as a primary mode choice face physical barriers and uncomfortable travel enviroments at conflict points with limited access freeways and multiple lane arterials.

SPEED LIMITS

There are few exceptions to the City's default 30 miles per hour speed limit.

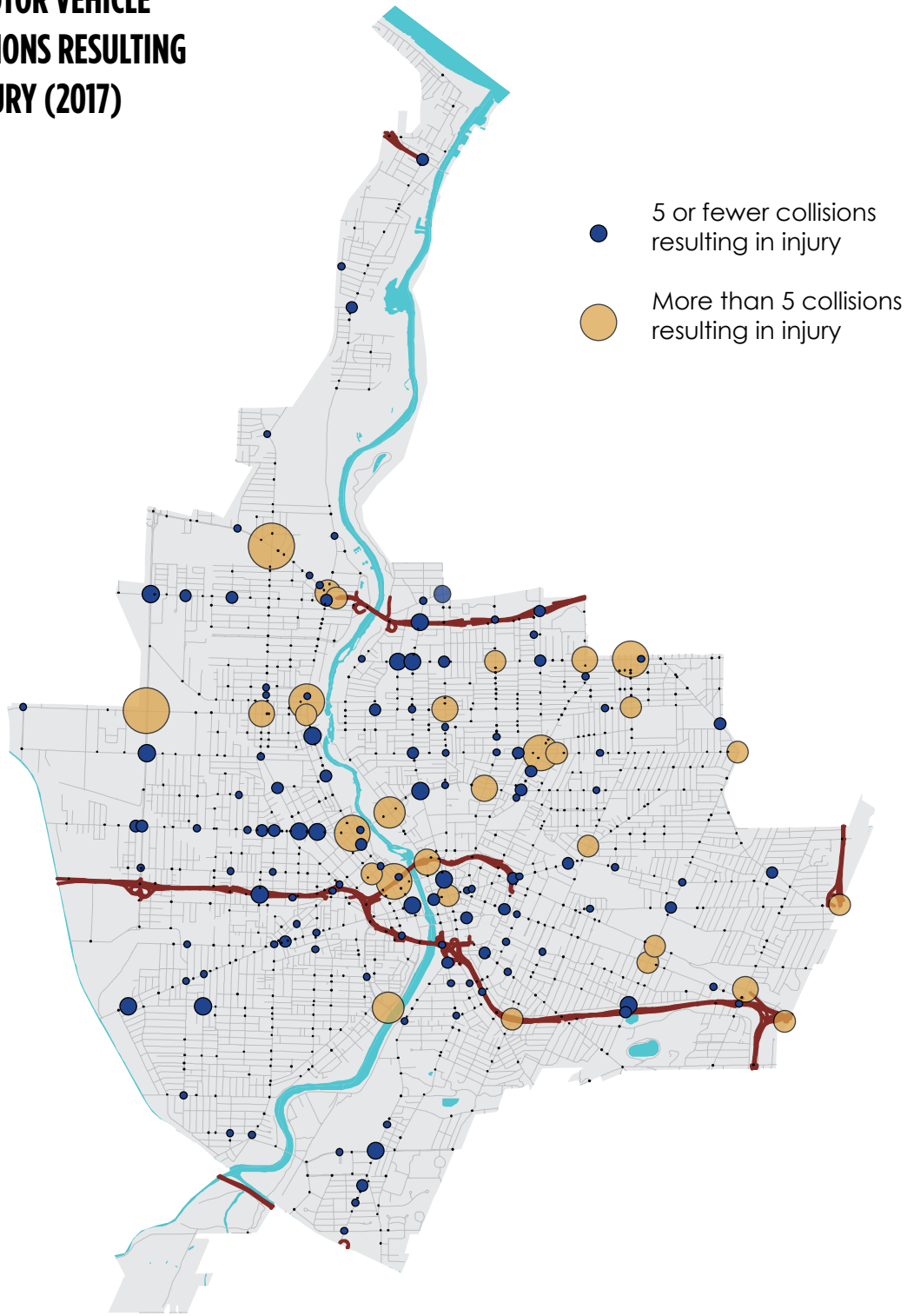
Permanent exceptions include park roads in Seneca and Highland Parks.

The speed limit is reduced to 20 mph near certain schools.



Source: City of Rochester

ALL MOTOR VEHICLE COLLISIONS RESULTING IN INJURY (2017)



Source: NYSDOT Accident Location Information System, 2017

TRAFFIC COLLISIONS

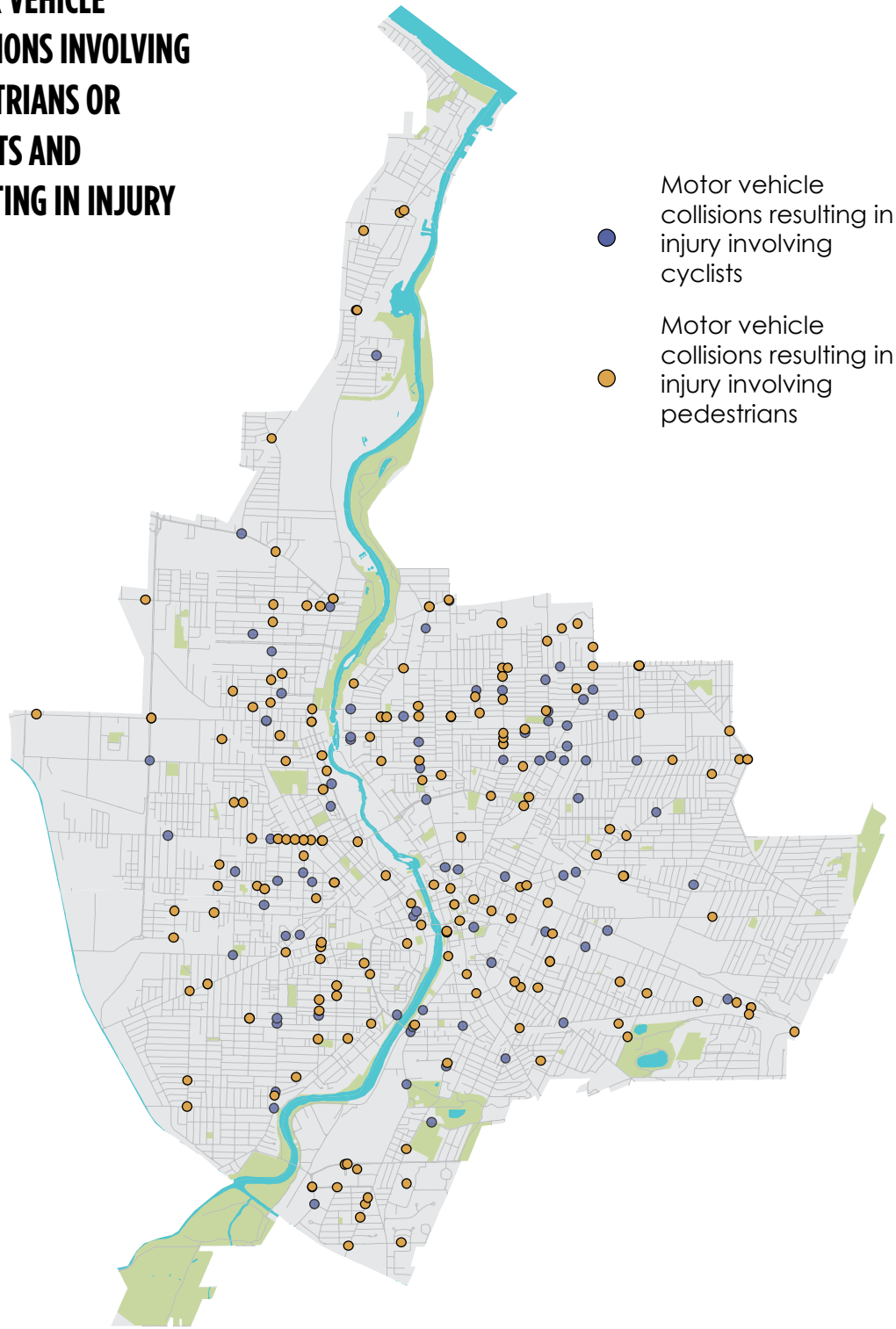
Collisions involving motor vehicles are far more likely to result in injuries on wider and higher speed roadways such as Ridge Road, Lake Avenue, Mt. Read Boulevard, Norton Street, Upper Falls Boulevard, and the Inner Loop.

COLLISIONS INVOLVING PEDESTRIANS AND CYCLISTS

Over 15 percent of motor vehicle collisions resulting in injury within the City involve a cyclist or a pedestrian, the most vulnerable users of the transportation system.

The speed of the vehicle is the single largest determinant of the severity of injury and likelihood of fatality. Approximately 95 percent of pedestrians struck by a vehicle moving at 20 miles per hour will survive the collision. Only 15 percent will do so at 40 miles per hour.

MOTOR VEHICLE COLLISIONS INVOLVING PEDESTRIANS OR CYCLISTS AND RESULTING IN INJURY (2017)



Source: NYSDOT Accident Location Information System, 2017

BARRIERS TO NON-MOTORIZED TRAVEL

Even if the non-motorized travel network is well-connected, certain environmental conditions can discourage walking and cycling as a primary mode of transportation.

Examples include:

- Large expressway interchanges that complicate and degrade the pedestrian experience while completely rerouting bicycle traffic.
- Frontage roads and one-way flows restricting pedestrian access to Amtrak and Greyhound/Trailways stations.
- Wide, high-speed urban arterials, such as Lake Avenue or Upper Falls Boulevard, that limit access to daily needs.

5
ACCESS

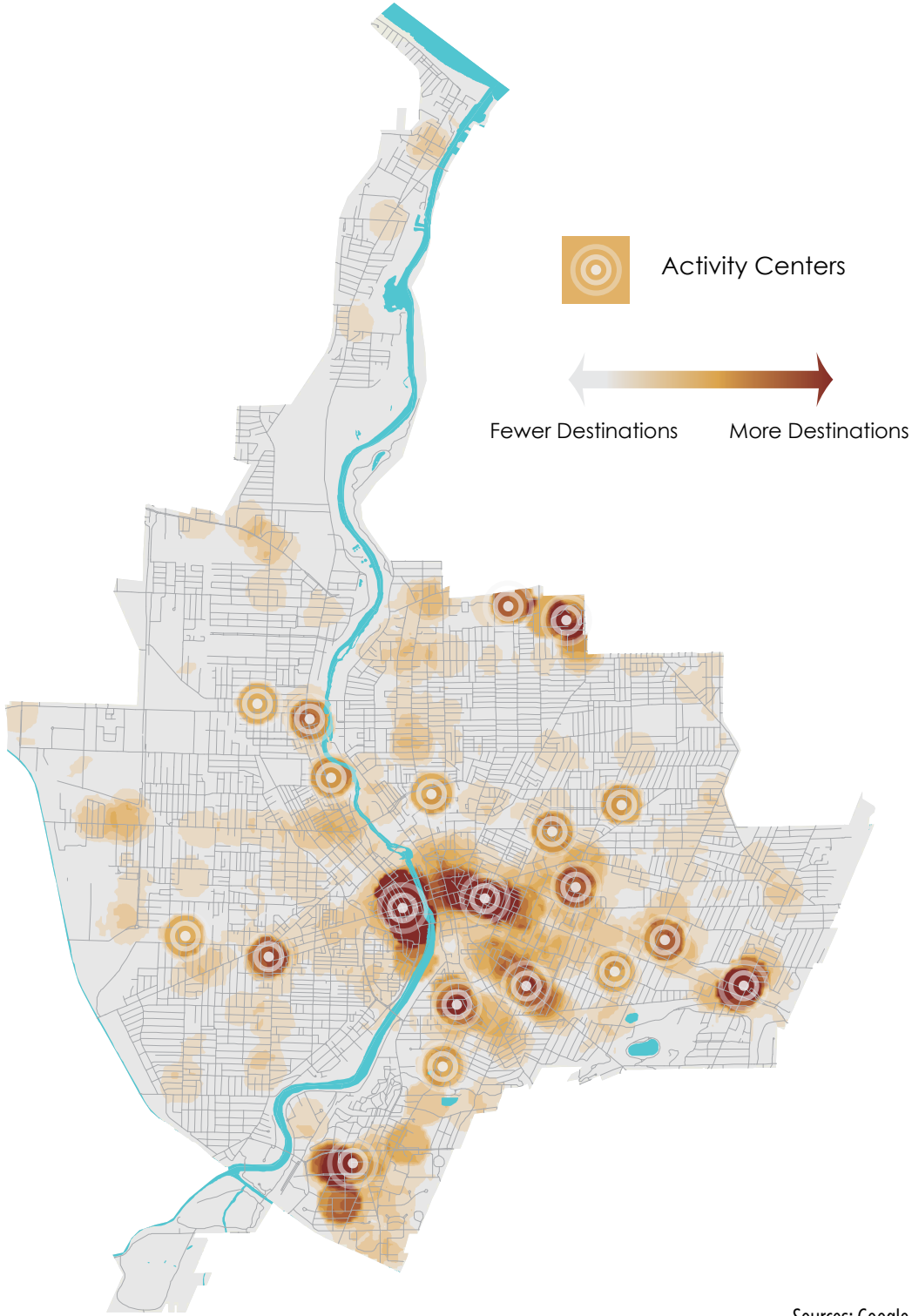
Rochester's transportation system faces great challenges due to the relationship between where residents live and where they can fulfill various basic needs. Relatively few are able to walk to obtain high quality groceries, though an improving bicycle network puts many within reach of most services. The location mismatch extends to the region, forcing the lowest income workers to spend more of their time commuting.

Transit coverage is extensive within city limits though residents wishing to connect to intercity transportation options face delays due to uncoordinated transfers.

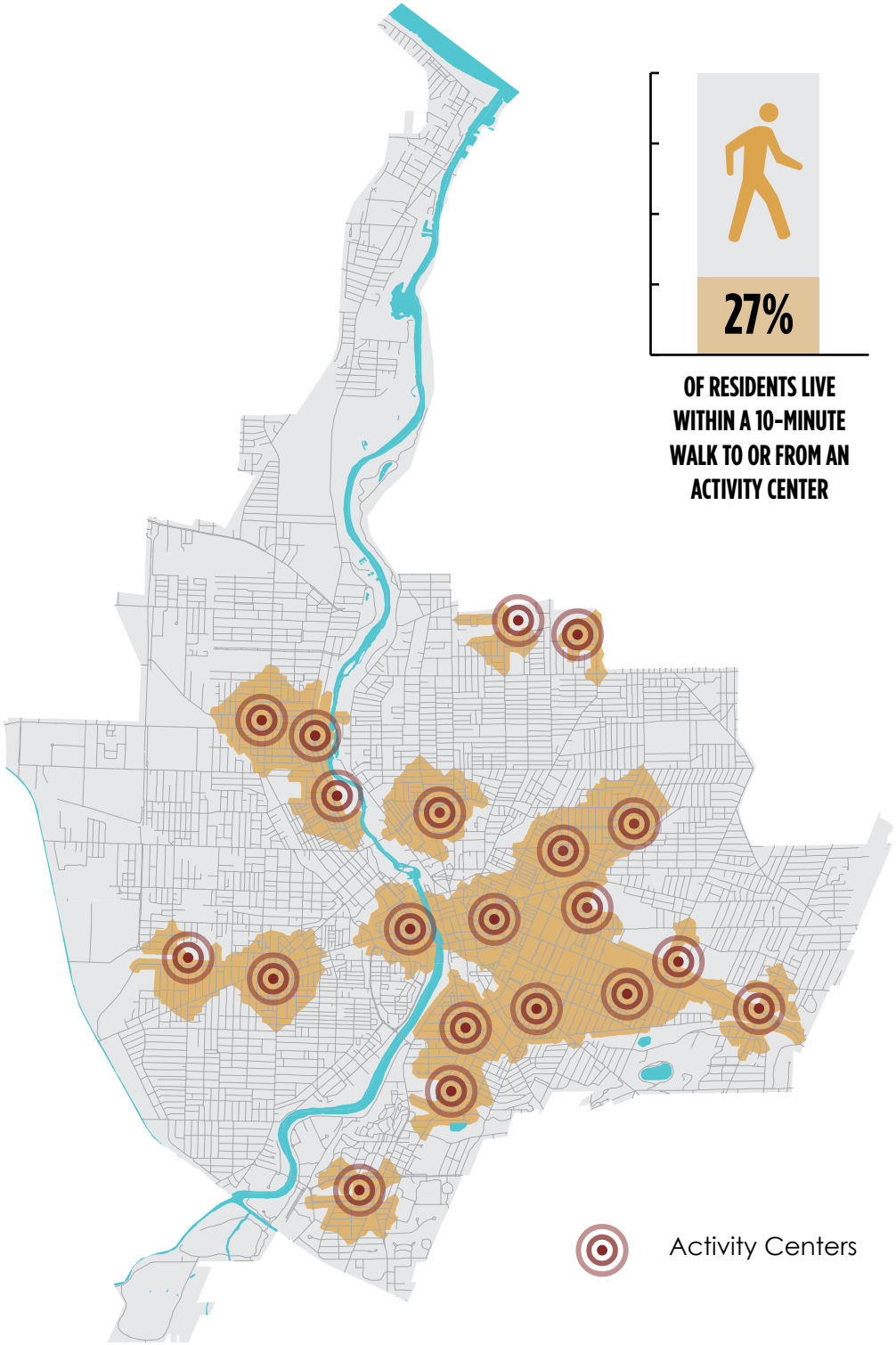
An expanding trail system paired with a large number of public parks ensure that a large majority of residents are able to walk to natural environments. Some gaps remain, however.

ACTIVITY CENTERS

20 activity centers were identified using the location of various daily and weekly needs such as grocery stores, pharmacies, medical offices, and social services.



Sources: Google API



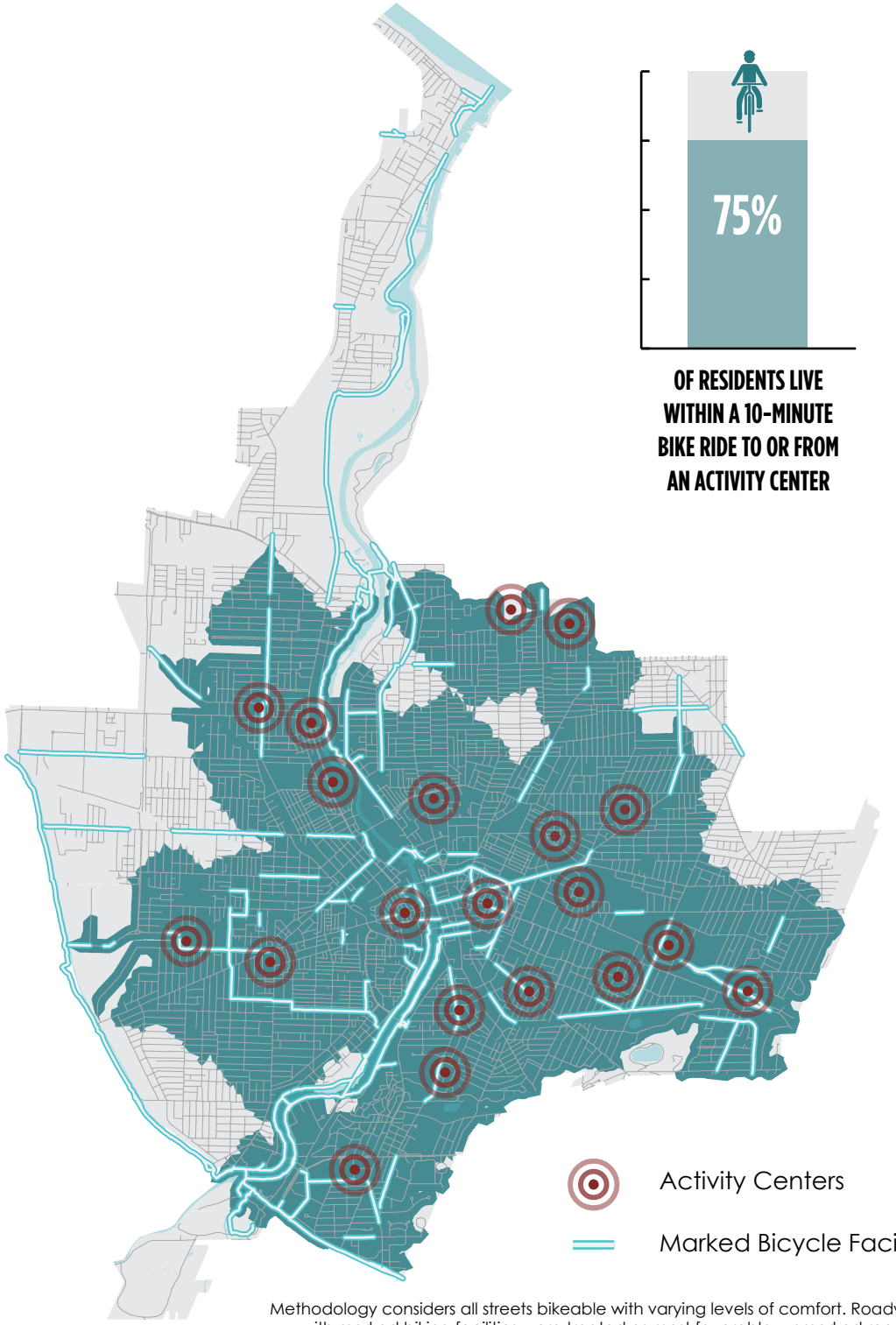
PEDESTRIAN ACCESS TO ACTIVITY CENTERS

Almost three-quarters of city residents are unable to walk a short distance to a supermarket or medical appointment.

BICYCLE ACCESS TO ACTIVITY CENTERS

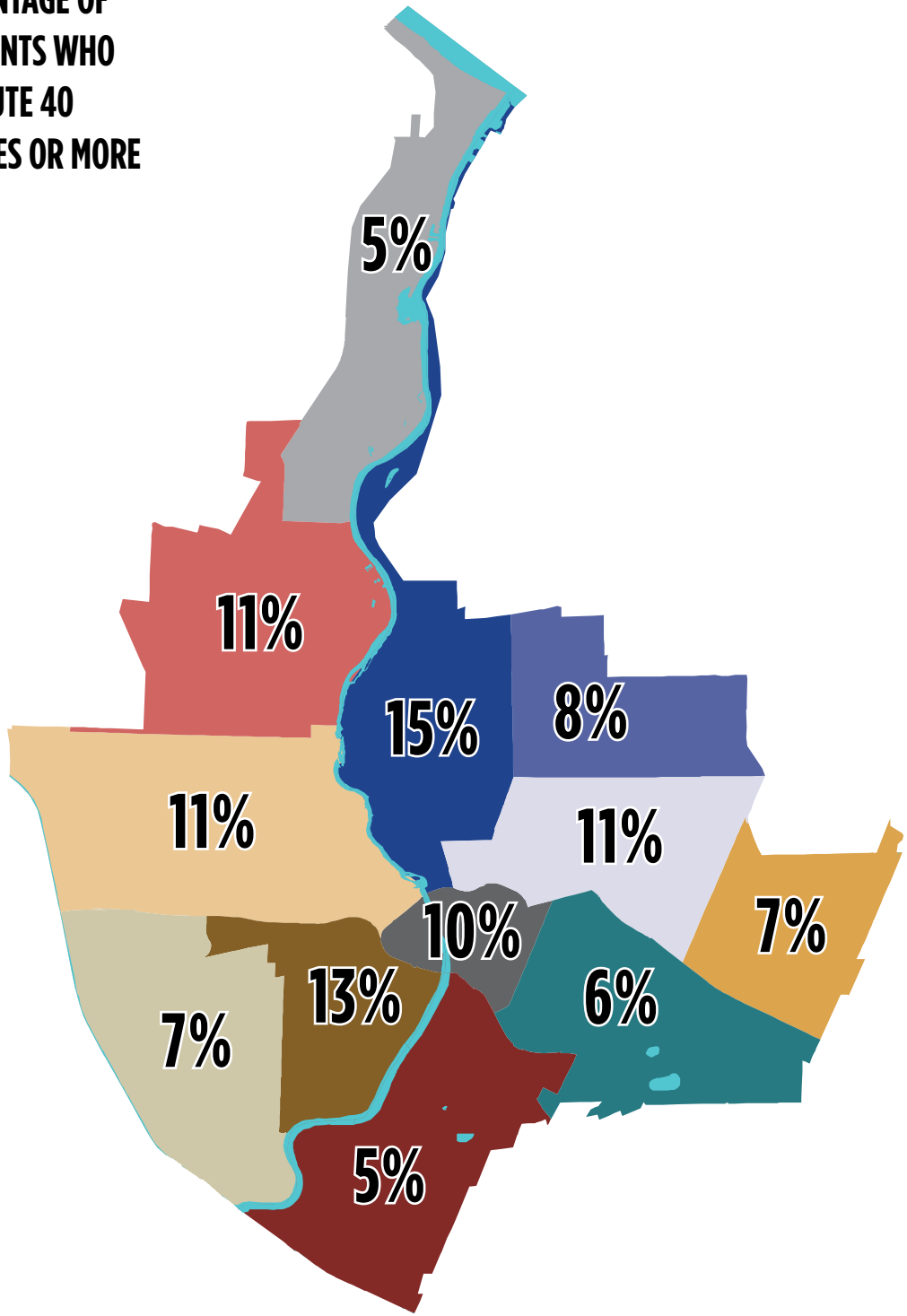
Almost all city residents, with the exception of those living north of Eastman Business Park, are able to access an activity center by bicycle within 10 minutes using a combination of roadways and the marked bicycle network.

Note that not all activity centers are directly connected to the non-motorized network. Dedicated bicycle infrastructure remains missing from many of the most direct travel routes.



Methodology considers all streets bikeable with varying levels of comfort. Roadways with marked biking facilities were treated as most favorable, unmarked roads as moderately favorable, and unmarked roads with high levels of traffic as least favorable.

PERCENTAGE OF RESIDENTS WHO COMMUTE 40 MINUTES OR MORE



ACCESS TO EMPLOYMENT

The lowest income city residents are more likely to experience the longest commute times due to low-wage employers locating in suburban areas.

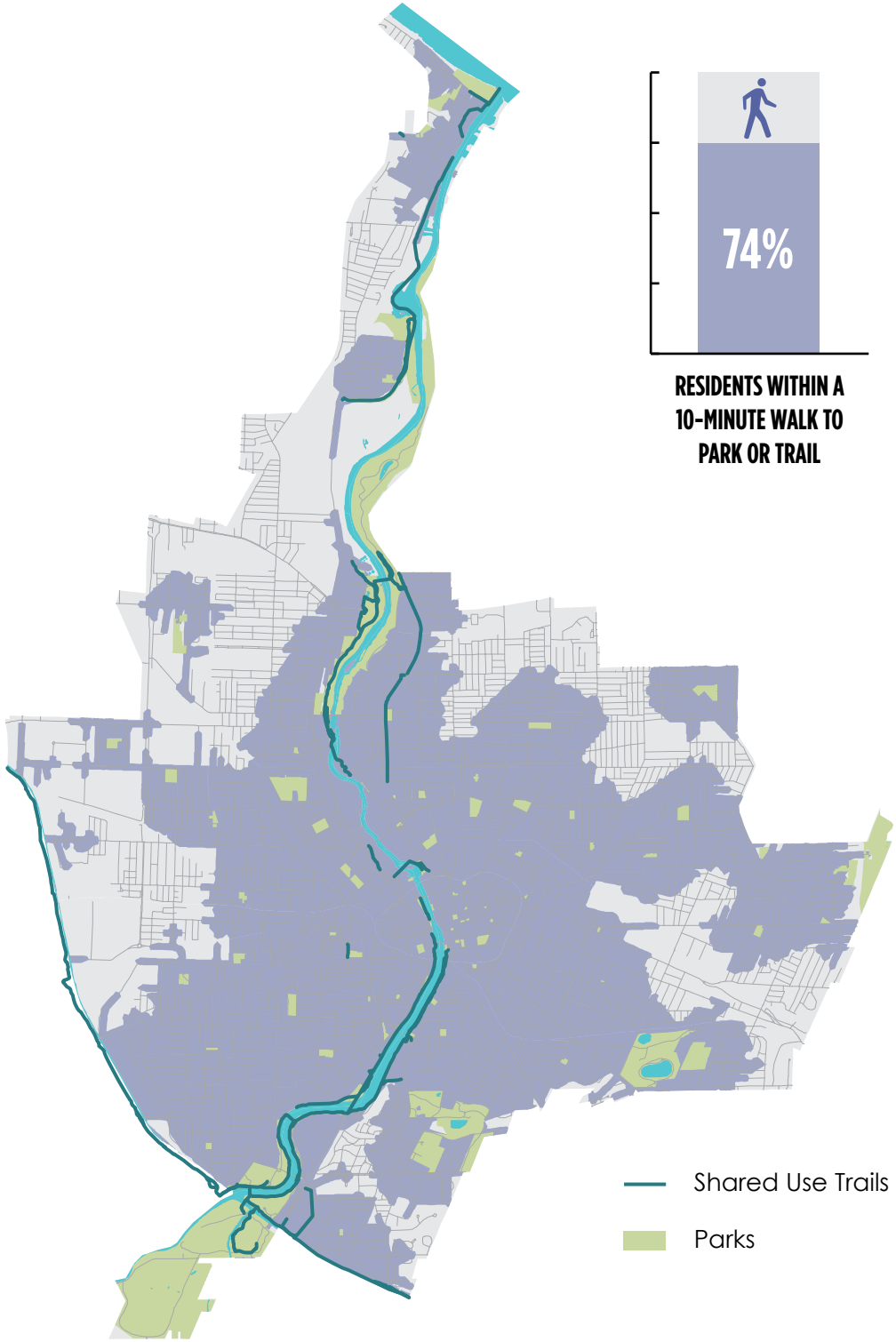
Low income jobseekers are forced to address a disproportionate travel burden in order to obtain and maintain employment.

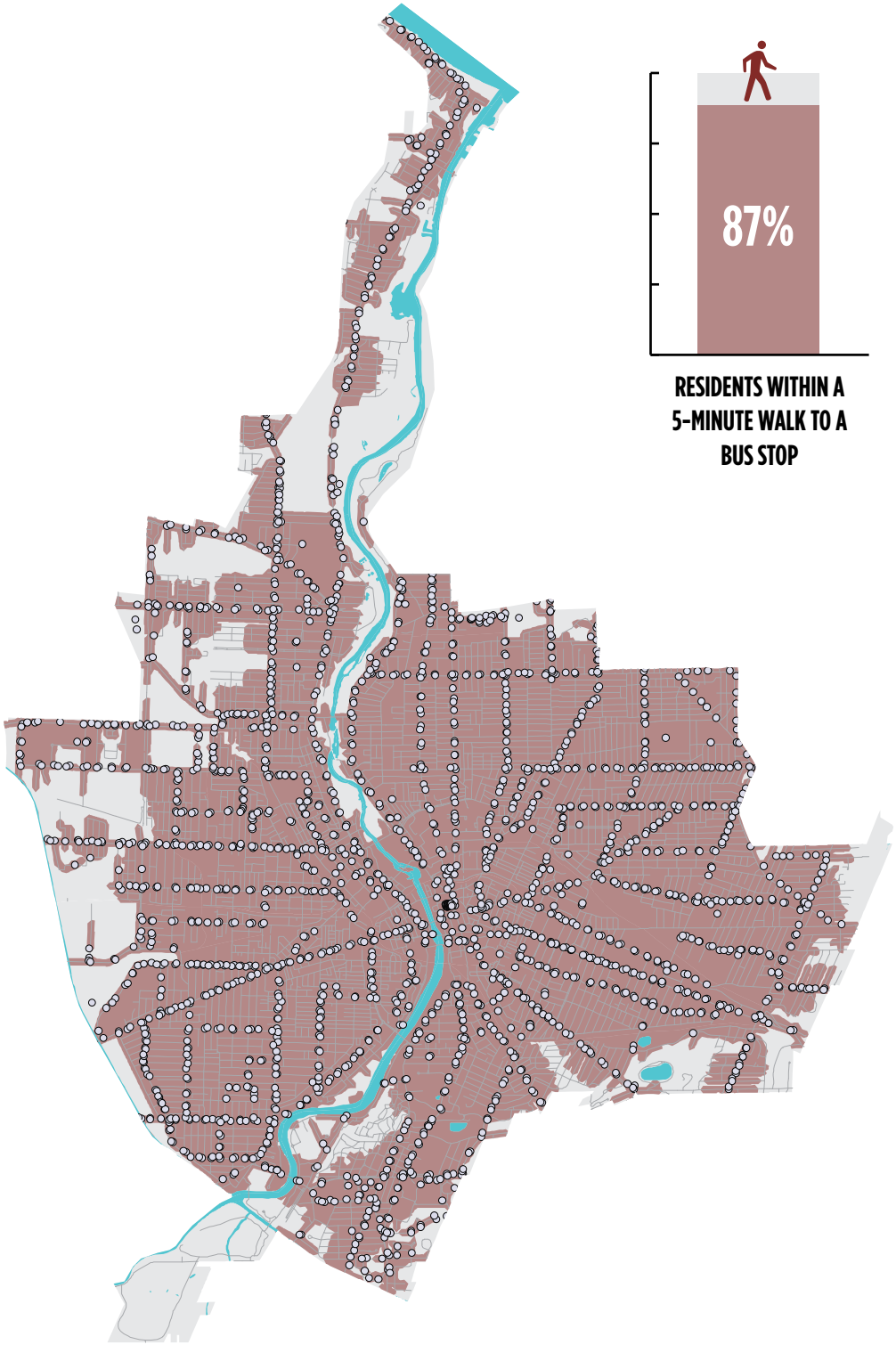
Source: American Community Survey Dataset B08303, 2016

PEDESTRIAN ACCESS TO PARKS AND TRAILS

Almost three-quarters of Rochester residents reside within a 10-minute walk of a park or trail.

Significant gaps in the park and trail system are found near heavily industrial areas on both the west and east sides of the City.





RESIDENTS WITHIN A 5-MINUTE WALK TO A BUS STOP

PEDESTRIAN ACCESS TO TRANSIT

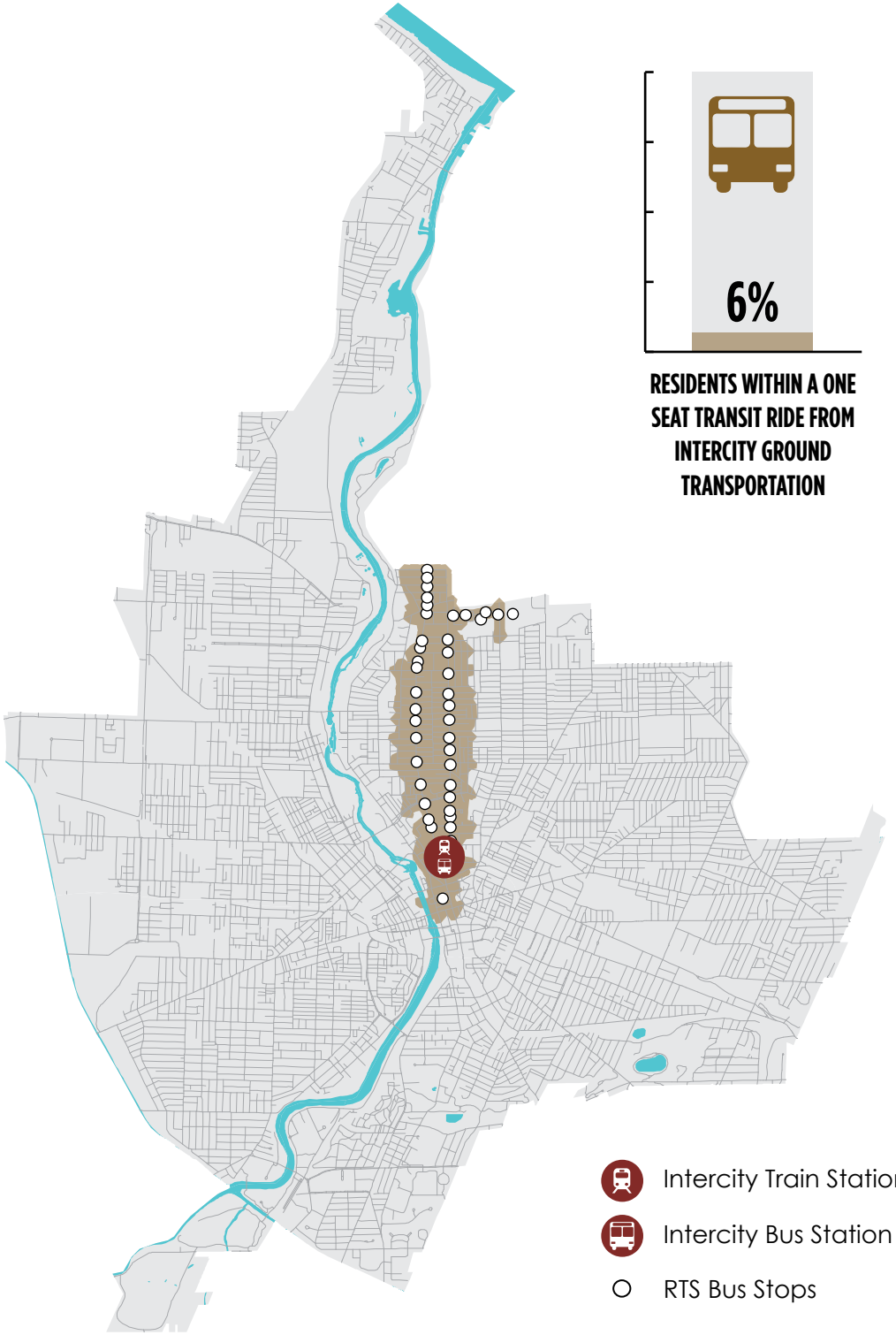
A large majority of Rochester residents live within a 5-minute walk of a bus stop.

Proximity is not the only factor that determines the viability of public transportation for many users. The frequency of service and overall travel times are also important considerations.

TRANSIT ACCESS TO INTERCITY GROUND TRANSPORTATION

Relatively few Rochester residents are able to access intercity transportation options via a single transit trip.

Most trips to intercity transportation facilities by transit require a transfer, which usually adds additional time for travelers. Walking and bicycling are limited as options when considering luggage and the potential of inclement weather.



6

PLANNED IMPROVEMENTS

Rochester is expanding people's mobility options through transformative transportation projects. Reimagine RTS has the potential to significantly boost riders' access to frequent, all-day transit service. ROC the Riverway street and trail upgrades position the Genesee River as the city's premier public space.

The Inner Loop North project will further reconnect Rochester's Downtown with nearby neighborhoods and leverage key land parcels for redevelopment. The City's Capital Improvement Program also knits together neighborhoods through street improvements that prioritize safety for people walking and biking.

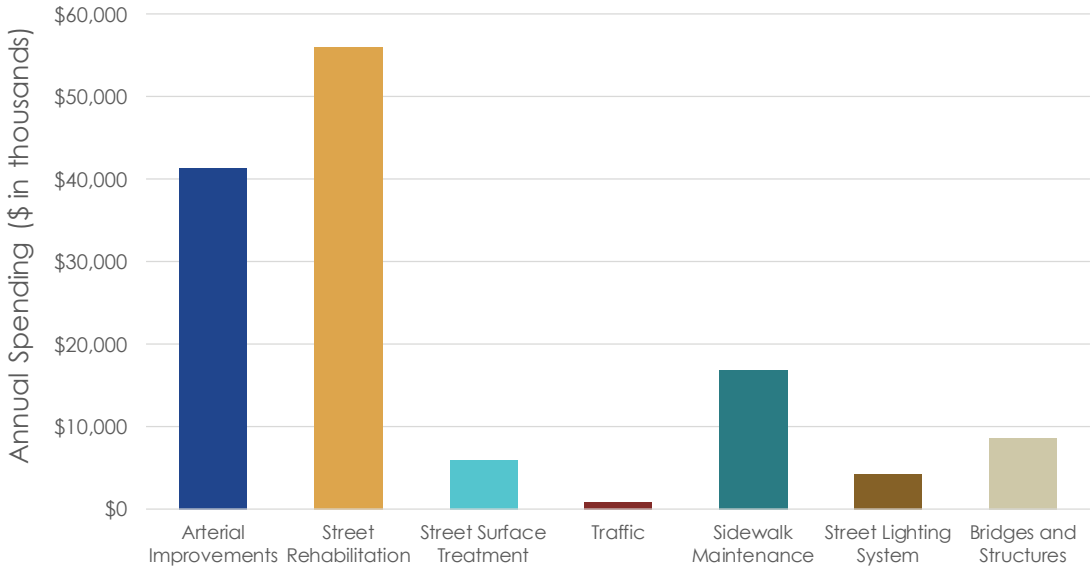
CAPITAL IMPROVEMENT PROGRAM

The City's 2017-18 to 2021-22 Capital Improvement Program (CIP) provides $134 million, 30% of expenditures listed in the program, for the reconstruction and rehabilitation of transportation facilities.

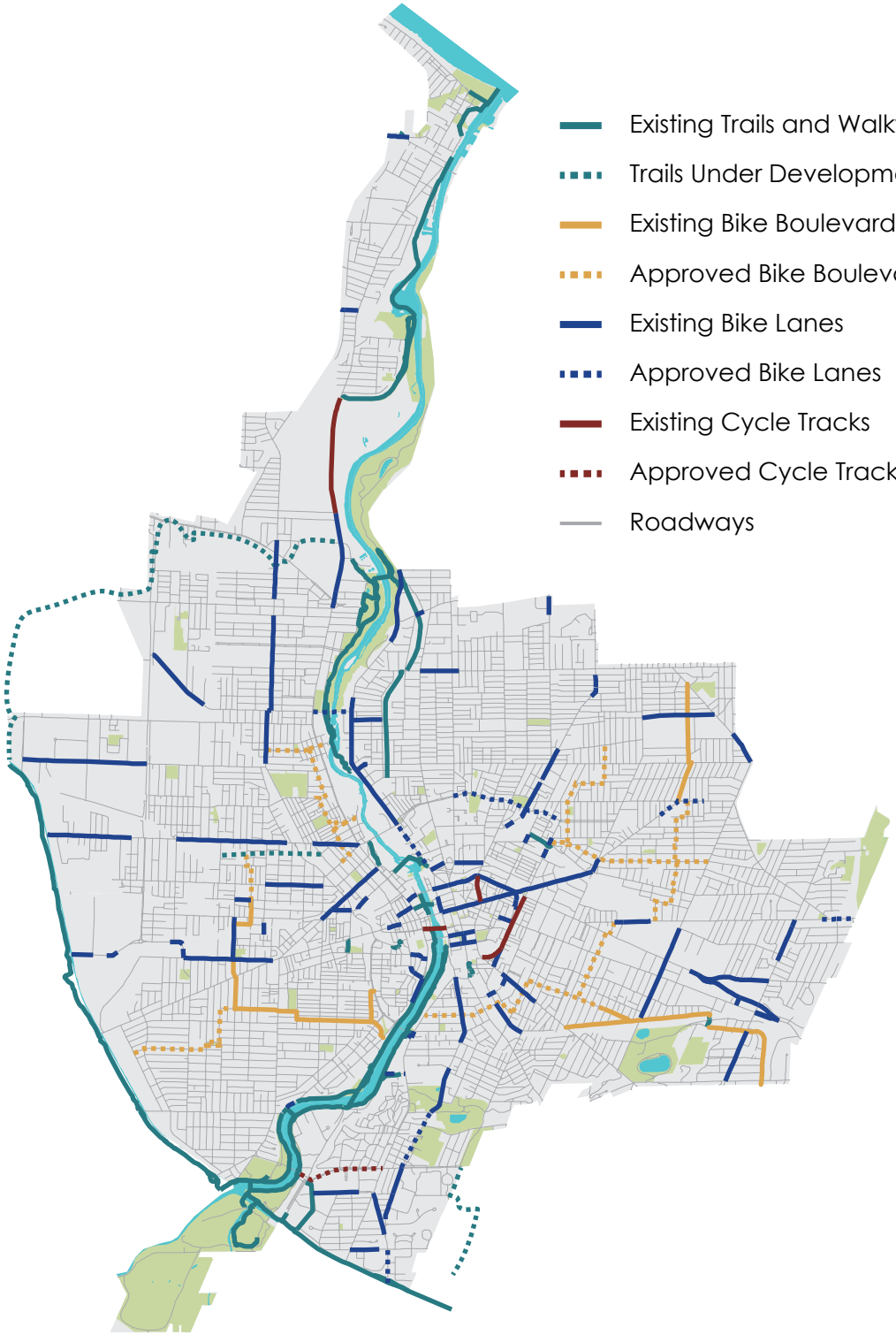
Street projects improve and create safer conditions for people who walk and bike.

Corridors such as Broadway, South Avenue, Dewey Avenue, Mount Hope Avenue, and Seneca Avenue will be reconstructed as part of the CIP.

Transportation Spending in the Capital Improvement Program 2017-2018 to 2021-2022



East Main / Goodman Pedestrian Safety Improvements, financed by the Capital Improvement Program



Sources: Genesee Transportation Council, City of Rochester

NON-MOTORIZED NETWORK IMPROVEMENTS

Planned expansions to the non-motorized transportation network continue to be advanced. These include multi-use trails that separate bicycles and pedestrians from vehicles, on-street bicycle facilities (including dedicated bike lanes, bike boulevards on lower volume roads, and protected cycle tracks), and sidewalk replacements.

REIMAGINE RTS

Reimagine RTS refocuses the transit system around a comprehensive network of frequent, all-day core service routes and simplified local routes.

May 2018 draft recommendations, subject to revision, focus on growing ridership through more frequent and direct service along with the introduction of mobility hubs to increase the diversity of services available for last-mile connections.

ROC THE RIVERWAY TRANSPORTATION IMPROVEMENTS

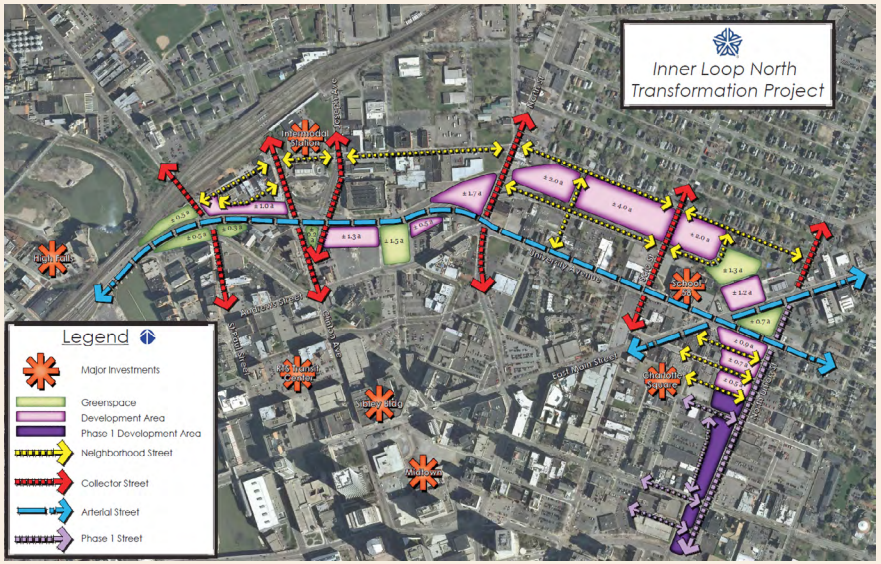
ROC the Riverway establishes the Genesee River as the centerpiece of Downtown Rochester by implementing multimodal access improvements on both sides of the riverfront.

Its key investments include a bike/pedestrian bridge over the Genesee at Byron Street and a road diet of Main Street between Broad Street and East Avenue.

INNER LOOP NORTH

Rochester recently converted the Inner Loop between Chestnut Street and East Main Street into a boulevard, reconnecting the street grid and city neighborhoods, and opening up land for development.

Stakeholders are now planning the removal of the Inner Loop's northern segment. The City will initiate the scoping phase in 2018-2019.



DATA SOURCES AND METHODOLOGY

The Factbook uses a variety of data sources to create representations of individual aspects of the transportation network. The following section describes those data sources, assumptions, and methods used to produce new data sets.

Genesee Transportation Council Regional Travel Demand Model: Pages 1-3, 1-4, 1-5

The Model estimates the movement of people and vehicles during an average weekday in September, 2010 within the Rochester Transportation Management Area, an area that includes all of Monroe County plus adjacent areas in Livingston, Ontario, and Wayne counties.

Model data is aggregated across 577 Transportation Analysis Zones (TAZ). 131 TAZs are located within the City of Rochester. TAZs comprise a subset of census tracts.

American Community Survey: Pages 2-2, 2-3, 2-4, 2-5, 2-6, 2-7, 2-8, 5-5

The American Community Survey (ACS) is an ongoing survey by the U.S. Census Bureau. It regularly gathers information previously contained only in the long form of the decennial census, such as demographic, economic, employment, and htransportation characteristics. ACS data is aggregated in the factbook from data corresponding to each county census tract. There are 79 census tracts within the City of Rochester.

Employment and population density is displayed via color code on Page 2-2. The lowest population density grouping corresponds to lower densities than 7,071 persons per square mile while the highest corresponds to densities greater than 10,164 persons per square mile. The lowest employment

density grouping corresponds to lower densities than 789 jobs per square mile while the highest corresponds to densities greater than 3,038 jobs per square mile.

Longitudinal Employer-Household Dynamics (LEHD): Page 2-2

Part of the U.S. Census Bureau, the LEHD program combines federal, state, and Census Bureau data on employers and employees under the Local Employment Dynamics (LED) Partnership. From the data, the program creates statistics on employment, earnings, and job flows at detailed levels of geography and industry and for different demographic groups. LEHD data is spatially joined into census tracts for Factbook deliverables.

INRIX: Page 3-7

A subscription service, INRIX collects information about roadway speeds and vehicle counts from real-time anonymous mobile phones, connected cars, trucks, delivery vans, and other fleet vehicles equipped with GPS locator devices. The data collected is processed in real-time, creating traffic speed information and traffic predictions for roadways across North America.

INRIX data for streets in the City of Rochester is presented in 15 minute intervals for all days in September, 2017. Data displayed represents 15 minute averages across all Tuesdays, Wednesdays, and Thursdays.

Zagster: Page 3-9

Zagster, who operates the City's Pace bikeshare system, tracks activity of all bikes in operation. GPS points are logged at regular intervals to determine trip start and stop points as well as trip routes. Trip route information labeled 'Background' and 'Foreground' is analyzed using ArcGIS Spatial Anaylst to create the actitivty heat map found in the Factbook.

Regional Transit Service: Pages 3-10, 3-11, 3-12

Regional Transit Service (RTS) is the public-facing name of transit service provided in Monroe County by the Rochester-Genesee Regional Transportation Authority.

Average daily boarding by bus route was provided for calendar years 2015, 2016, and 2017. Corridor ridership was created by combining route ridership for route operating primarily along the same corridor. Eg. The Mt. Hope Avenue corridor includes routes 23, 24, 55, and 124.

Frequency figures were calculated from publicly available schedules, with night frequency representing the operating period after 7:30 p.m.

Federal Transit Administration: Page 3-13

The Federal Transit Administration's National Transit Database (NTD) records the financial, operating and asset condition of transit systems. The NTD includes agency profiles that

standardize efficiency and effectiveness metrics such as Unlinked Trips per Vehicle Revenue Hour representing the number of boardings per hour of bus service.

IHS/Global Insight TRANSEARCH Database: Page 3-15

The TRANSEARCH database combines information from public sources and data obtained from major freight carriers to develop a repository of county-level freight-movement data by commodity group and mode of transportation. The data informs Figure 3.32 of the Genesee Transportation Council's 2012 Transportation Strategies for Freight and Goods Movement in the Genesee-Finger Lakes Region.

Rochester City School District (RCSD): Page 3-16

The RCSD has made available a table listing all elementary schools, associated school bus routes, the number of students who make daily use of school transportation, and the total enrollment at each school.

New York State Department of Transportation (NYSDOT) Accident Location Information System: Pages 4-3, 4-4

Crash location information and crash statistics are retrieved by NYSDOT using the Accident Location Information System (ALIS). The ALIS application uses crash data stored in the Safety Information Management System database in conjunction with location information produced by location coders at the Department of Motor Vehicles.

Data is provided in point format including geographic information along with other collision details such as the involvement of pedestrians or cyclists.

Google Application Programming Interface (API): Page 5-2

The Google Places API allows for large scale commercial and service location queries. The following use types were included to locate activity centers providing daily and weekly needs:

- Goods Retail, including bicycle, book, clothing, furniture, hardware, and shoe stores
- Food Retail, including bakeries, restaurants, and supermarkets
- Services, including banks and laundromats
- Medical, including hospitals, pharmacies, and doctor/ dentist offices
- Government, including courts and local offices
- Institutional, including libraries and churches
- Intercity Transportation

Full-service supermarkets are weighted to be equivalent to ten times the other trip attractors to emphasize their importance in the community.

Access Metrics: Pages 5-3, 5-4, 5-6, 5-7, 5-8

Using ArcGIS Network Analyst, the non-motorized network is defined. Each segment of the network is assigned an associated travel time for walking and biking. The travel time assumes a walking speed of 3 miles per hour. Bicycle speed of 10 miles per hour is used for the marked bike lane and trail network while a 'penalty' is assessed on unmarked facilities dependent on the average daily traffic (effective 7mph on unmarked roads with less than 4,000 vehicles per day. effective 5 mph on unmarked roads with more than 4,000 vpd).

Activity centers, transit stops, trail access locations, and park entryways are defined by points. Network access is then simulated based on a ten-minute travel time to/from access points.

Population coverage figures are based on geographic coverage at the census tract level.

City of Rochester
Comprehensive Access and Mobility Plan

Bikeable City Report

NELSON
NYGAARD

Cover photo from patrickashley via wikimedia

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1 Biking in Rochester: Snapshot

The Bicycle Network Today

The vast majority of Rochester residents (75%) live within a 10-minute bike ride of a commercial activity center. Accordingly, development of quality bike facilities could make short trips like these more attractive to take by bike. In the past decade, Rochester has conducted multiple studies to create a more welcoming bicycling network, including the 2011 Rochester Bicycle Master Plan, which identified a key network for on-street biking connectivity and the 2015 Bicycle Boulevard Master Plan, which outlines a network of low-volume, low-stress streets where bicycle travel can be prioritized.

Since the Bicycle Master Plan was completed in 2011, the City has installed over 60 miles of bike lanes and cycle tracks and has added bike boxes at six signalized intersections. Rochester's extensive trail system offers bicyclists access to 35 miles of recreational trails connecting all corners of the city. The City also offers a range of end-of-trip amenities for bicyclists, including indoor bike lockers and sheltered bike racks at six City-owned parking garages,[1] four bicycle repair stations in city parks,[2] and hundreds of curbside bike racks throughout the city.[3] The City recently opened its first bike corral, a type of bike rack installed in place of a single on-street parking space to provide bicycle parking where existing sidewalk space cannot accommodate it.

The Bicycle Boulevard Master Plan found that 65% of Rochester's streets carry less than 5,000 cars a day, which makes much of Rochester's street network a great candidate for the development of a lower-stress biking network, which would build on the City's momentum to make Rochester a city more welcoming to people of all ages, incomes and abilities. The City has installed X miles of Bicycle Boulevards to-date. See Page 5-8 of the State of the City Transportation System Factbook.

In 2016, the City received the a Bicycle Friendly Community Bronze level award from the League of American Bicyclists for its commitment to improving cycling conditions through investments in cycling promotion, education programs, infrastructure, and

[1] These garages include the High Falls Garage, Sister Cites Garage, Court Street Garage, South Avenue Garage, Washington Square Garage and East End Garage.

[2] Bicycle repair station locations include Sister Cities Parking Garage, Genesee Valley Sports Complex, Maplewood Park, and High Falls.

[3] Over 100 new bike racks were installed in 2011 and 2012, according to the City. http://www.cityofrochester.gov/bikerochester/

pro-bicycling policies. To achieve a Silver level award, the City would need to make the following changes:[4]

- Increase the percentage of high-speed roads with bike facilities
- Increase the bicycle network mileage as a percentage of overall roadway network mileage.
- Increase the share of the City's transportation budget spent on bicycling
- Specify mode share and safety goals.
- Create an official Bicycle & Pedestrian Advisory Committee (BPAC) to create a systematic method of gathering public feedback into the development of important policies, plans, and projects.
- Create a comprehensive safety plan or broader Vision Zero policy to support engineering, education, and enforcement strategies that reduce traffic crashes and fatalities.
- Conduct a Level of Traffic Stress analysis to better understand the ability of the bicycle network to connect traveler origins and destinations.
- Ensure that the Pace bikeshare system is complemented by strategic infrastructure and wayfinding improvements.

In 2018, the City was ranked 2.8 stars out of 5 by Places for Bikes, a national active transportation advocacy group. This rating aggregates mobility indicators such as safety, demographic and gender gaps in biking, bike ridership, bike network completeness, and the growth in bike facilities and events.[5] The City's best score (3.7 out of 5) was in its growth in bike facilities and events, while its worst score was in overall ridership (1.6 out of 5). Overall, Rochester ranks 22nd out of the 484 cities that Places for Bikes evaluated, within the top 5% alongside peers such as Atlanta, GA, and Alexandria, VA.

The City launched a partnership with Zagster to provide bicycle sharing services in July 2017. With 340 bikes spread across 46 stations, the average ride lasted 25 minutes during its first season of implementation (the service runs from April to November). Nearly 52,000 rides were taken during the first year of operation. Now known as Pace, the system was modified and expanded in 2018. Early trials of the

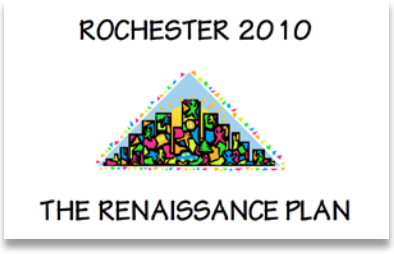
[4] League of American Bicyclists. 2016. Rochester, NY Rankings. https://bikeleague.org/sites/default/files/bfareportcards/BFC_Fall_2016_ReportCard_Rochester_NY.pdf

[5] Places for Bikes. 2018. "Rochester, NY | City Scorecard." https://cityratings.peopleforbikes.org/wp-content/uploads/2018/04/rochesterNY.pdf

new system, which combines dock-based and dockless bikes, showed 6-7 times the ridership of other Zagster programs in other mid-sized cities.[6]

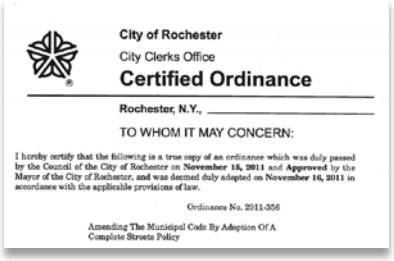
Policy and Planning Context

Previous land use, transportation, and corridor planning efforts In Rochester help set the stage for the Bikeable City Report. The report builds on past work to direct Rochester toward a more bikeable future. The following excerpts provide brief descriptions of select city plans and policies, focused on the ways each addresses biking or connecting to the biking network.



Rochester 2010: The Renaissance Plan (2000)

- Outlines the City's goals, principles, and implementation actions related to subject areas including economic development, environmental management, infrastructure, land use/zoning, and mobility/transportation, among others
- Outlines that Rochester is not an especially safe city for people walking and biking, with relatively few on-street bike lanes, or off-street paths connecting major destinations.
- Outlines a Vital Urban Village concept containing a network of accessible bicycle paths connecting major open spaces and parks, and streetscape amenities, including bicycle racks


City of Rochester
City Clerks Office
Certified Ordinance

Rochester, N.Y., _____

TO WHOM IT MAY CONCERN:

I hereby certify that the following is a true copy of an ordinance which was duly passed by the Council of the City of Rochester on **November 15, 2011** and **Approved** by the Mayor of the City of Rochester, and was deemed duly adopted on **November 16, 2011** in accordance with the applicable provisions of law.

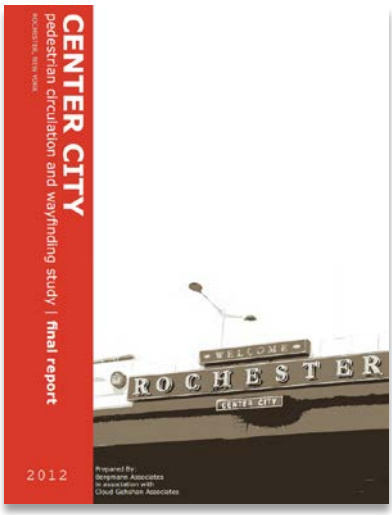
Ordinance No. 2011-356

Amending The Municipal Code By Adoption Of A Complete Streets Policy

Complete Streets Policy – Adopted 2011

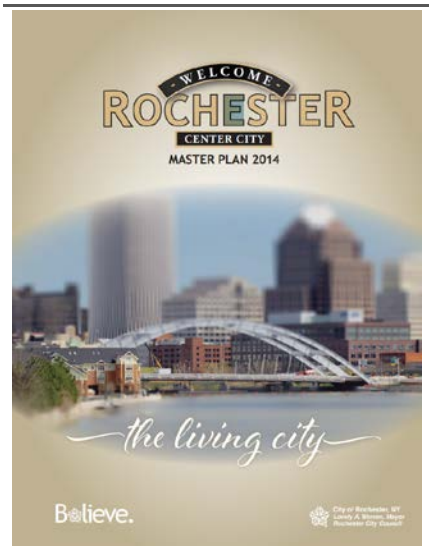
- Ensures that all future street design efforts will fully consider the needs of pedestrians, bicyclists, transit users and persons with disabilities.
- Helps to improve public safety by installing bike lanes, as well as lowering motor vehicle travel speeds and improving sight distances.

[6] Sisson, Patrick. 2017. "New Bike-Share System Promises 'dockless without the Drawbacks.'" Curbed. November 30, 2017. https://www.curbed.com/2017/11/30/16720066/bike-share-dockless-pace-cities-cycling.



Center City Pedestrian Circulation and Wayfinding Study – 2012

- Attempts to improve the visitor wayfinding experience within Rochester's Center City
- Recommends enhancement and connection of existing wayfinding systems
- Puts forth an organizing system and style recommendations for cyclist wayfinding



Center City Master Plan Update (2014)

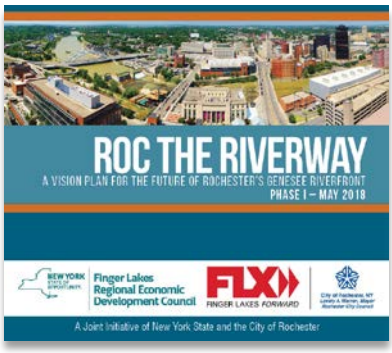
- Helps the City measure progress on key mobility indicators, identify further research and analysis, prioritize multimodal transportation projects, and secure funding for implementation.
- Prioritizes key Center City projects such as street and sidewalk improvements, redevelopment of vacant lots and surface parking, and enhancements to trails and off-street paths.

Bicycle Master Plan (2011)

Rochester Bicycle Master Plan

- The plan's recommendations serve as a framework for the city's future investment in bicycle infrastructure.
- The network-wide bicycle facility recommendations were divided into four priority groups, based on required implementation effort. Additional bicycle facilities and treatments such as sharrows and bike boulevards were also included.

Roc the Riverway (2018)



- Produces seamless and accessible pedestrian and bicycle connections along both sides of the river via the Genesee Riverway Trail and neighborhood linkages to the trail
- Will reinvest in pedestrian and bicycle bridges, separate pedestrian and bicycle traffic as a part of trail upgrades, and create improved streetscape experiences where streets bisect the river

Bicycle Boulevard Master Plan (2015)

- Outlines a network of low-volume, low-stress streets where bicycle travel is prioritized. The ideal bike boulevards have low traffic volumes (under 3,000 AADT), complete gaps in the bike network, connect key destinations, and have low speed limits (25 mph or less).
- Proposes a 50-mile-long network, to be implemented over several years.
- Recommends street enhancements to corridors selected as bicycle boulevards, including signs and pavement markings, traffic calming strategies, intersection treatments, and marketing.

2 Vision and Goals

Rochester's transportation system improves quality of life for Rochesterians by enabling safe, convenient, and comfortable access to work, life, and play, and enabling connectivity between neighborhoods. The system works for users of all ages and abilities whether they walk, bike, drive or take public transportation, and supports Rochester businesses by enabling the movement of goods and personnel. The system activates transit and pedestrian oriented design to create a city of short distances, and is clear and user-friendly, with the highest standards of sustainability, design, and maintenance. The system works proactively and strategically to advance mobility improvements for all road users, rather than a piecemeal approach that prioritizes projects around the needs of roadway maintenance.

Make Cycling More Attractive to a Wider Demographic

The 2012 GTC Rochester Area Transportation Study (Household Travel Survey) found that men are twice as likely as women to travel by bike in the Rochester Transportation Management Area, which consists of Monroe County and adjacent portions of Livingston, Ontario, and Wayne Counties. This survey also indicated that residents with incomes less than $50,000 a year are more likely to choose options other than driving to get to work and that people of color account for 17% of all walking and biking trips in the Rochester region, despite comprising only 8% of the region's population. Providing expanded, well-connected bike infrastructure – particularly protected facilities – will be paramount to transforming Rochester into a safer and more welcoming bicycling city for riders of all ages, backgrounds, and abilities. The City should continue to track demographic trends as they relate to cycling to measure success in making Rochester more bikeable for people of all backgrounds.

Reduce Greenhouse Gas Footprint by Inviting More Multimodal Trips

The 2016 Rochester Climate Action Plan cites a goal of reducing greenhouse gas emissions by 20 percent from its 2010 levels by 2020 and by 40 percent from its 2010 levels by 2040. Among other actions, the Plan calls for a 1 percent annual reduction in VMT through 2040. To achieve this, the plan promotes increasing multimodal trips through the development of complete streets and implementation of the Bicycle Master Plan as key ways to reduce the transportation impact of emissions and improving first-last mile connections. Bicycling alone can help the City achieve significant greenhouse gas reductions. A study by the Institute for Transportation and Development Policy (ITDP) found that by increasing bicycling mode share to 11% by

2030 14% by 2050 - both ambitious targets – would alone reduce transportation-related greenhouse gas emissions by 11%.[7]

Expand the Low-Stress Bike Network

Rochester aspires to complement its extensive off-street path system with growth in its on-street network, especially in the development of low-stress bicycle facilities such as protected lanes and bicycle boulevards. Streets with vehicular travel volumes below 3,000 cars a day and speeds below 25 miles per hour present the ideal conditions for bicycle travel. These streets should continue to be prioritized in the proposed network to build connected bicycle boulevards, provided they connect with key employment centers and other regional destinations. Implementing the neighborhood traffic calming proposed in the 2011 Bicycle Master Plan will also serve to reduce cycling stress on Rochester streets.

[7] Institute for Transportation & Development Policy. 2015. A Global High Shift Cycling Scenario: The Potential for Dramatically Increasing Bicycle and E-bike Use in Cities Around the World, with Estimated Energy, CO2, and Cost Impacts. https://www.itdp.org/2015/11/12/a-global-high-shift-cycling-scenario/

3 Needs Assessment

Connecting Demand to Destinations

Rochester is located within a region well-known for its off-street paths but is less known for its on-street facilities. While trails provide excellent public health and recreational opportunities, they do not typically provide adequate direct transportation connections that might cause a casual cyclist to choose biking as a commute or personal business option. 2016 American Community Survey data presented in the State of the City Transportation System Factbook (pages 1-5, 2-4, and 2-5) shows that only 1% of Rochester commutes by bike, despite an average commute length of 4.1 miles, a distance that is considered conducive to bike commuting, as well as favorable topography. Rochester possesses little terrain variation aside from some steep areas along the river north of Downtown and a series of hills near its south-east border.

Since the completion of the 2011 Bicycle Master Plan, the City has installed over 60 lane miles of on-street bicycle facilities and an additional 140 miles are planned. However, gaps remain in the network and the nature of some existing bike facilities still make it challenging for certain prospective cyclists to bike around the city.

Areas of Rochester that would be expected to have high levels of pedestrian activity are opportunities for more efficient trip-making through cycling. Spatial representations of this active transportation trip demand and the location of activity centers and parks show where important bicycle facility gaps remain.

While motorized and transit network users take for granted that their networks are continuous and can focus on other aspects to improve them, such as the speeds or headways, the main focus for cyclists continues to be user safety. Users perceive discontinuous non-motorized networks to be unsafe and unattractive. Therefore, priority for bicycle network improvements should be to fill-in gaps along the most frequent routes between already existing bicycle facilities. Subsequently, the network should be completed using key links that create more direct access to key destinations as well as the trail system.

Analysis

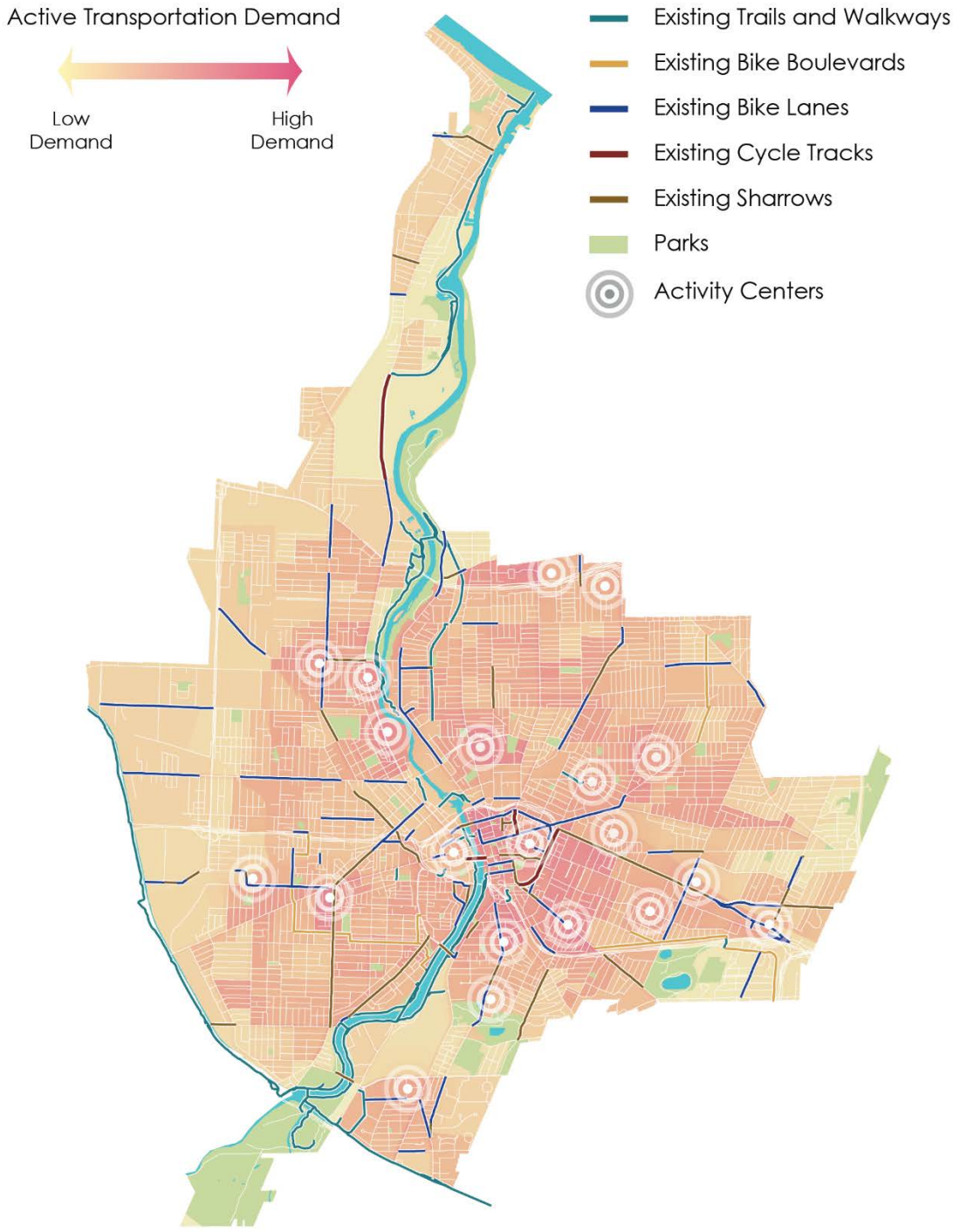
Active transportation demand in Rochester, as measured by population density, zero-vehicle households, low-income households, employment density, transit ridership, and proximity to activity centers, is shown in Figure 1. This map is a broad indicator of where people are most likely to walk and bike under current network conditions, overlaid with existing bike facilities. The following figures, Figure 2 and Figure 3, use this analysis as the basis for a gap assessment that evaluates which streets have the greatest potential to facilitate the greatest number of bike trips on street segments that currently have no bike facilities. This gap assessment is this

study's primary means of prioritizing bike facility investments that serve the greatest number of potential bike trips.

This analysis uses the RTC's Regional Travel Demand Model to estimate which street segments would see the highest bike volumes under the assumption that all short trips under five miles in length were made by bike. While not all short trips are expected to be made by bike outside of this exercise, short vehicle trips are more likely to shift to bike trips than trips longer than five miles because short bike trips typically feature travel times more competitive with vehicular trips of the same distance. Figure 2 spatially displays the assigned short trips, representing the desire lines of potential cyclists in an effort to identify network segments with high potential bike demand that do not currently feature bicycle-only facilities.

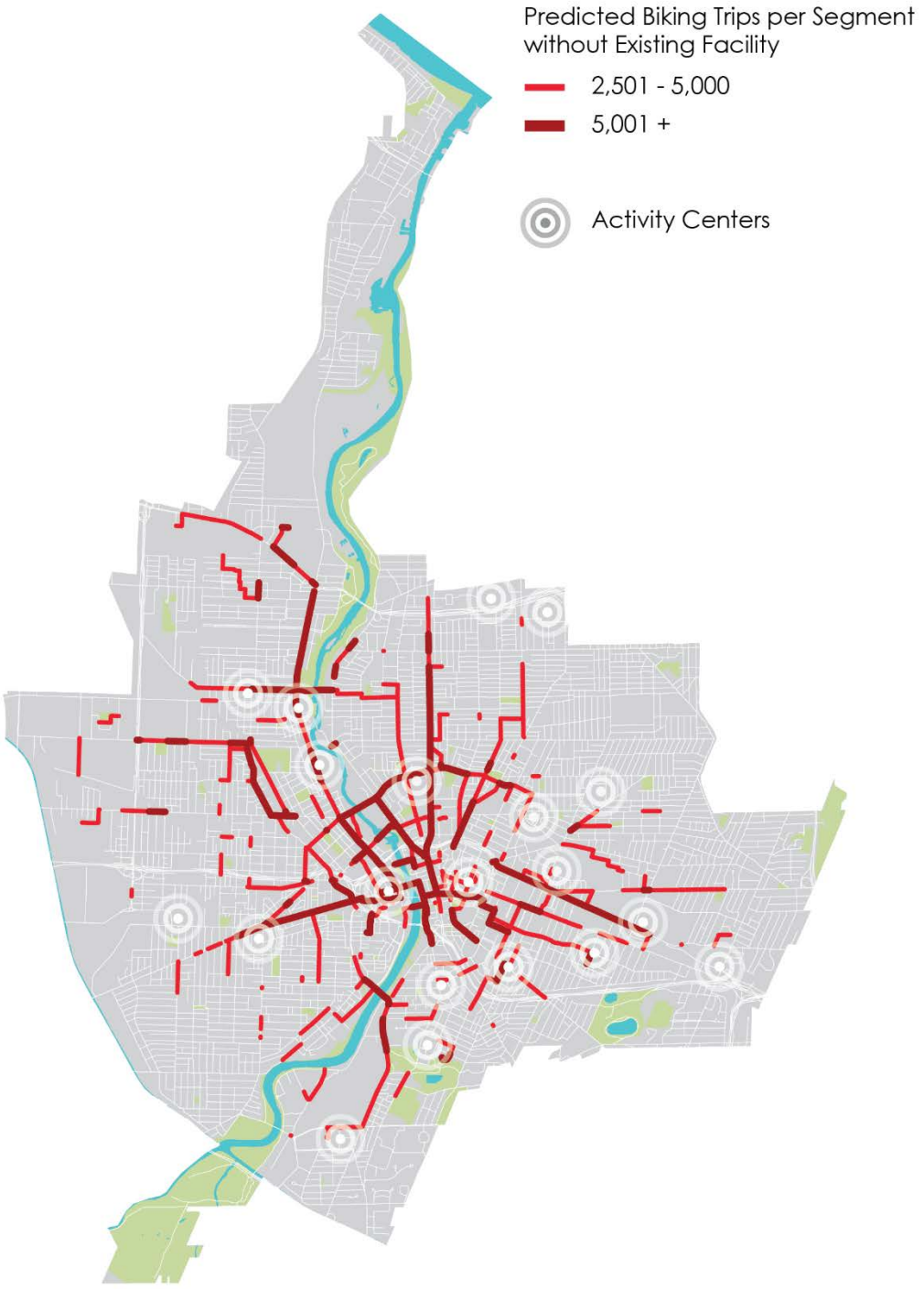
Segments colored in red show lack of bike facility, and the bike demand is represented with the segment thickness. Thicker dark red segments are those that would serve a higher number of potential bicycle trips, but where there is no existing bike facility. These corridors are considered the highest priority for bike improvements in general. Segments shown in blue already have a bike facility, although the thickest lines shown in blue are forecast to carry the highest bike volumes and may therefore be good candidates for protected lanes. Bike facilities are defined as existing trails, walkways, bike boulevards, bike lanes, and cycle tracks. Note that sharrows are not included as part of the bike network, and thus streets such as University Ave are colored in red.

Figure 1 Active Transportation Demand and Existing Bicycle Facilities



Sources: American Community Survey 2016, LEHD 2015, Google API, Genesee Transportation Council, City of Rochester

Figure 2 Predicted Bicycle Trip Flows and Activity Centers



Sources: Genesee Transportation Council, City of Rochester, Google API

A bike network designed to accommodate all-purpose trips shorter than 5 miles has been estimated at 636 miles. 11% of this network already has some type of facility (excluding sharrows), as shown in Figure 2. Using the Regional Travel Demand Model,[8] these shorter trips were assigned to the shortest possible paths in the non-motorized network defined as all streets and trails excluding limited access expressways. This assignment indicates locations that would attract increases in cyclist volumes related to potential mode share shifts.

Figure 3 lists links without dedicated bicycle facilities where expected demand would be highest if all trips under five miles were made by bicycle. On Lyell Avenue, adding 0.6 miles of bicycle facilities to what already exists would extend the network for almost 7,000 potential trips. Likewise, conversion of 1.5 miles of sharrows on University Avenue to bike lanes could more comfortably accommodate an even greater number of potential short trips.

Figure 3 Road Segment with Highest Potential Bicycle Demand

	Miles – No Bike Facility	Miles – with Bike Facility	Average Assigned Trips
State Street	1.1		10,322
Bausch Street	0.0		9,982
Andrews Street	0.1	0.5	9,726
University Avenue	1.5	1.1	9,293
West Main Street	1.1	0.2	8,242
East Broad Street	0.6	0.2	7,866
Genesee River Ped Bridge (Plymouth)		0.6	7,518
St Paul Street	1.4	2.0	7,284
Driving Park Avenue	1.2	0.6	7,259
Bittner Street	0.1		7,240
Avenue E	0.4		7,201
Lyell Avenue	0.6	2.1	6,867

The existing trail network plays a key role in handling potential biking trips, as trails provide an alternate route for some higher vehicular traffic routes without bicycle facilities. As an example, the Genesee Riverway Trail compensates for gaps on Lake

[8] The Regional Travel Demand Model is maintained by the GTC and consists of a four-step model that includes trip generation, trip distribution, mode choice, and vehicle assignment. More details about the model's data sources, structure, validation process, and outputs are available here: https://www.gtcmpo.org/sites/default/files/pdf/2010/GTCModelDocumentation.pdf

Avenue, but it should be recognized that the sections of the Riverway Trail that follow the river gorge feature significant elevation changes and can be daunting for non-advanced cyclists.

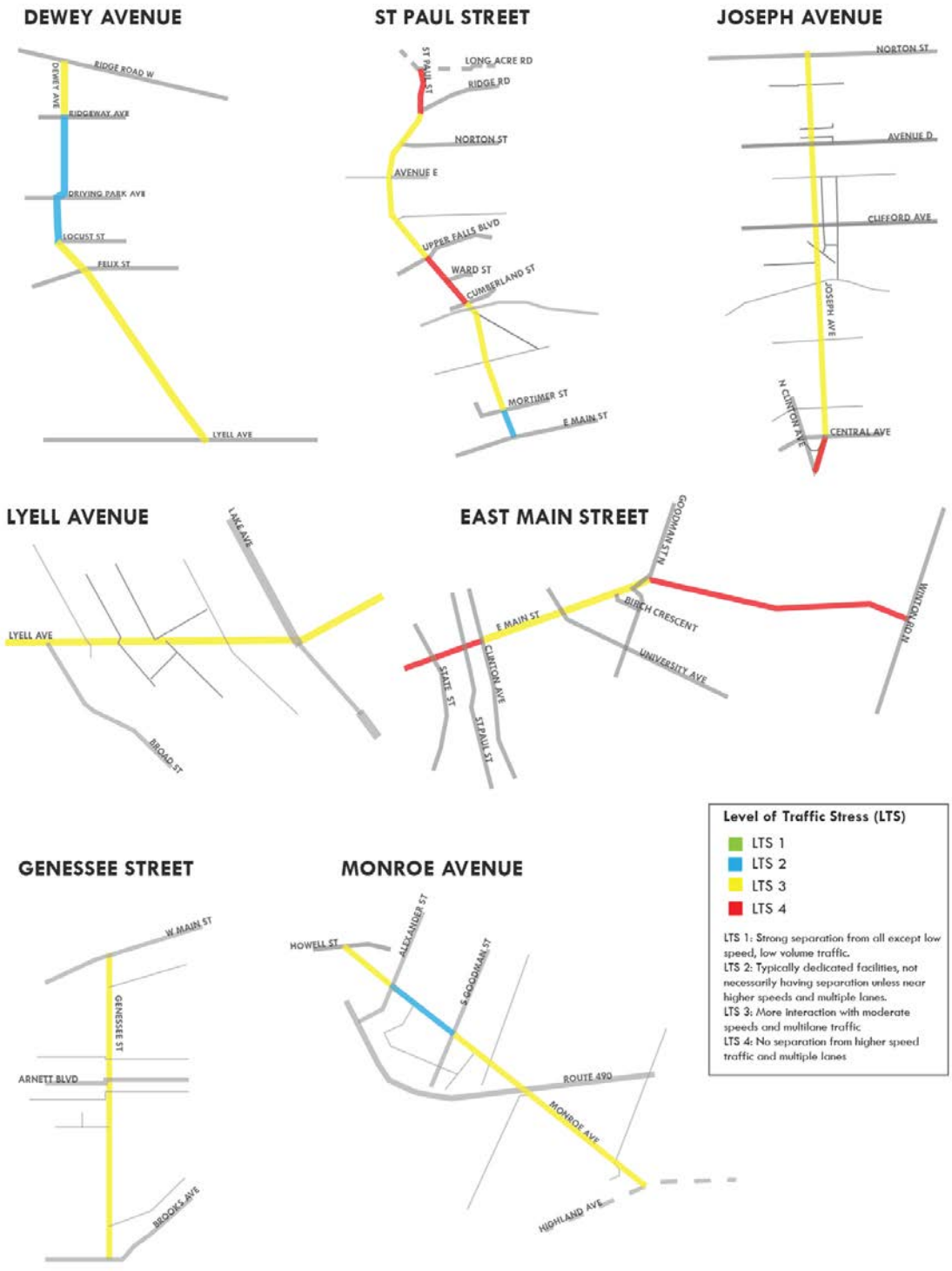
As indicated in Figure 3, the streets connecting downtown with the rest of the city generally accumulate the highest demand of potential bike trips, including State Street, University Avenue, West Main Street, and St. Paul Street. East-west connections such as Driving Park Avenue, Avenue E, and Lyell Avenue would act as useful feeders to this radial network and would help create a continuous and more attractive network.

Network Quality

Bike Level of Stress

The study team modeled the relative comfort of cyclists, identified in terms of "Level of Stress," for some of the city's most important direct transportation corridors (Figure 4). In general, low traffic and low speed local streets are more comfortable for people of all ages and abilities to ride a bicycle. Low stress routes show up as green on the map to indicate the higher level of comfort perceived while cycling. Red and orange streets do not feel comfortable for the majority of bicycle users. These streets typically have higher traffic speeds and/or little physical distance separating bicyclists from motorized traffic. Traffic volumes, number of lanes, the presence and nature of bike facilities all go into the perceived stress and comfort of using any bicycle facility. Appendix A includes the methodology used to calculate the bicycle Level of Stress.

Figure 4 Bicycle Level of Stress – Select Corridors



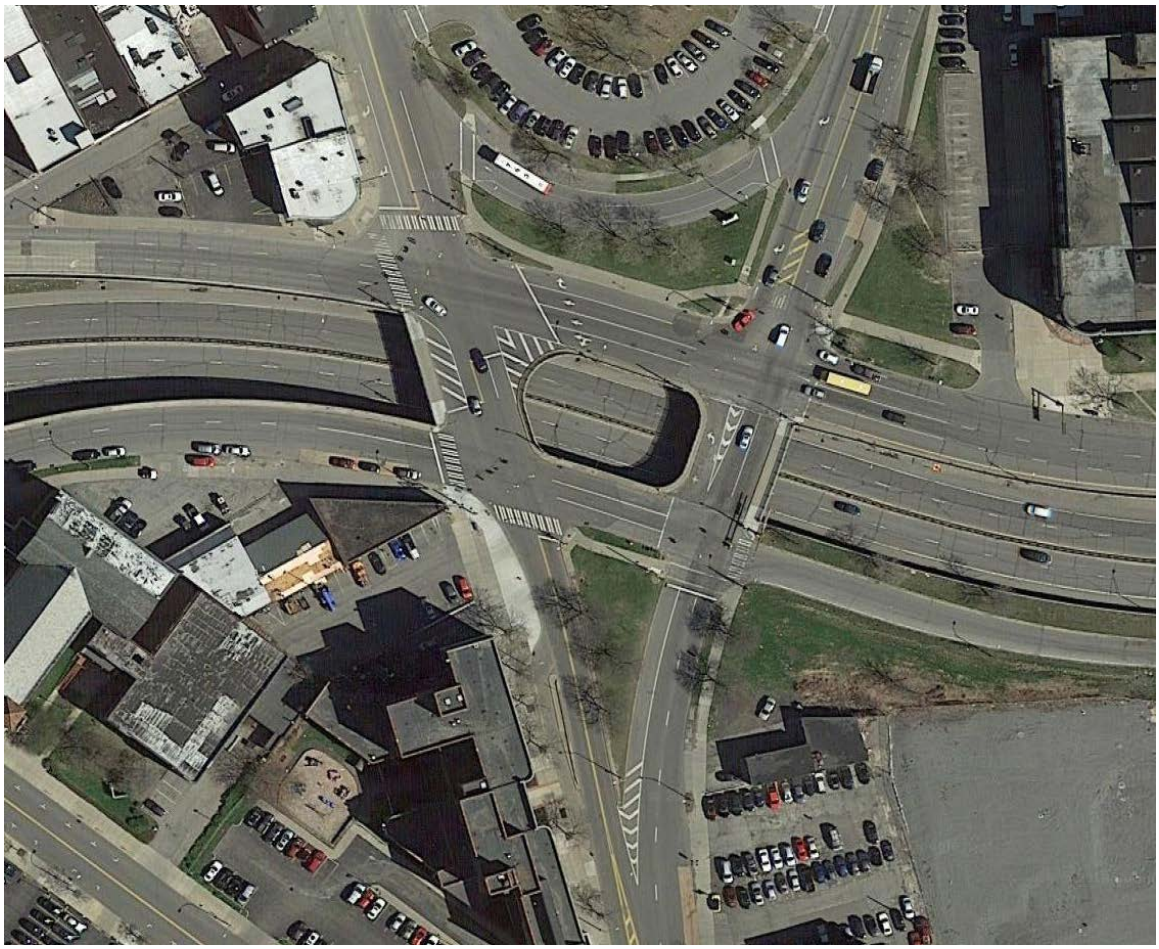
Key Conflict Areas

Bicyclists in Rochester encounter the following major conflicts:

- Intersections with multiple lanes of traffic in each direction, particularly with high traffic volumes
- Lack of safe bicycle crossings or bike-friendly intersection treatments, particularly on high-volume, high-speed streets.
- Narrow railroad underpasses with poor lighting and lane striping, particularly connecting Downtown and the north side neighborhoods
- Gaps in the existing network
- Wide, high-speed arterials with non-existing or unprotected bike lanes
- Sharrow-designated network segments with high traffic volumes (Figure 6)

Figure 5 displays an intersection that should be a gateway into and from downtown, especially due to its proximity to intercity transportation stations, but that exhibits a low level of cycling comfort due to high volumes, multiple crossings, and lack of bike infrastructure.

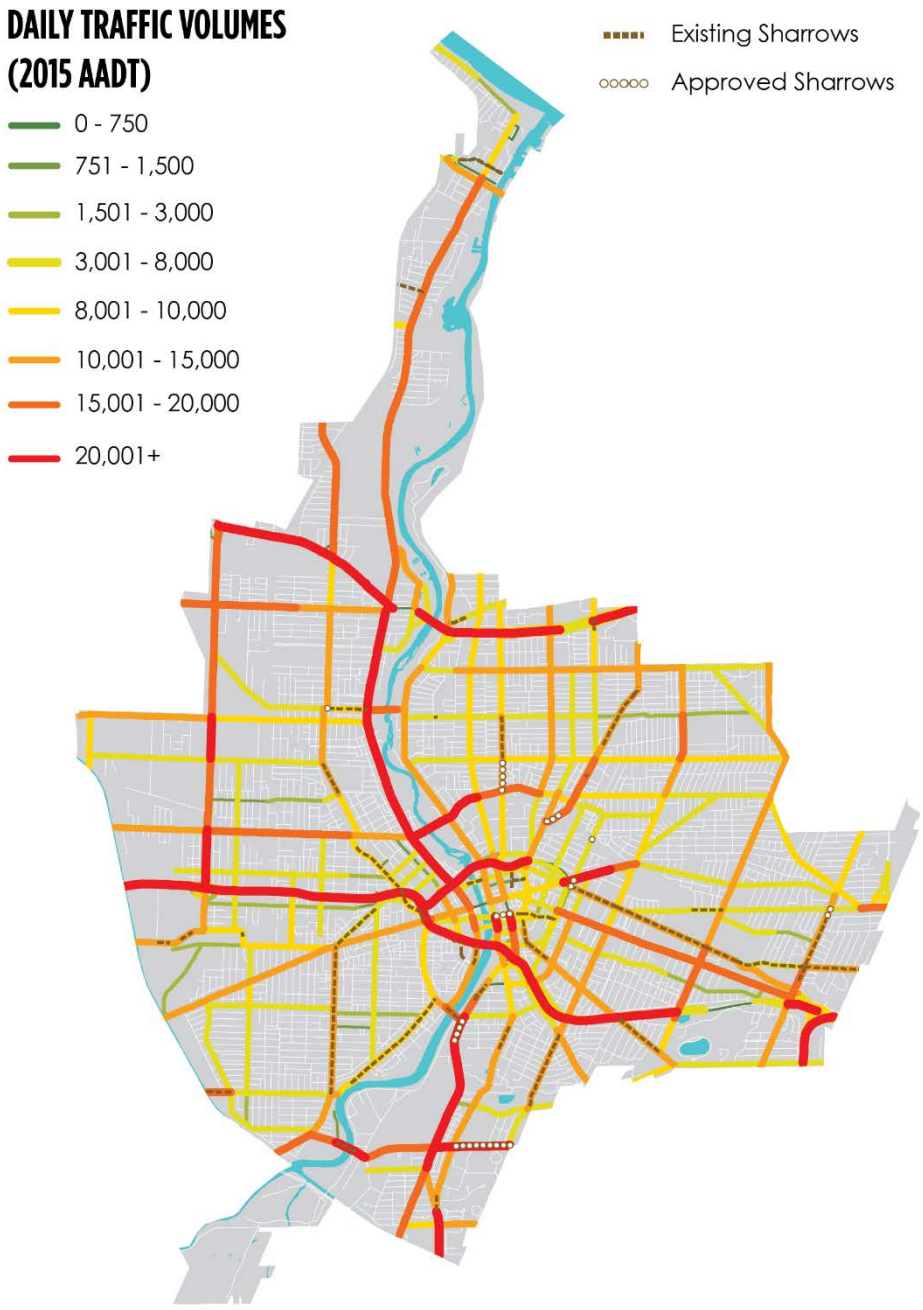
Figure 5 Cumberland St-Joseph Ave-Clinton Ave intersection



Source: Google

Figure 6 shows how most designated sharrows are found in road segments with greater average daily traffic than 8,000 vehicles per day, far higher than the 4,000-6,000 vehicle range, which is the recommended level of vehicle traffic for implementing this type of bicycle facility. In addition, sharrows are recommended in locations that experience lower vehicular traffic speed. Examples of where sharrows currently exist in Rochester include portions of University Avenue and Genesee Street, which both carry over 10,000 vehicles per day.

Figure 6 Conflict Areas: Sharrows on High Vehicular Traffic Streets



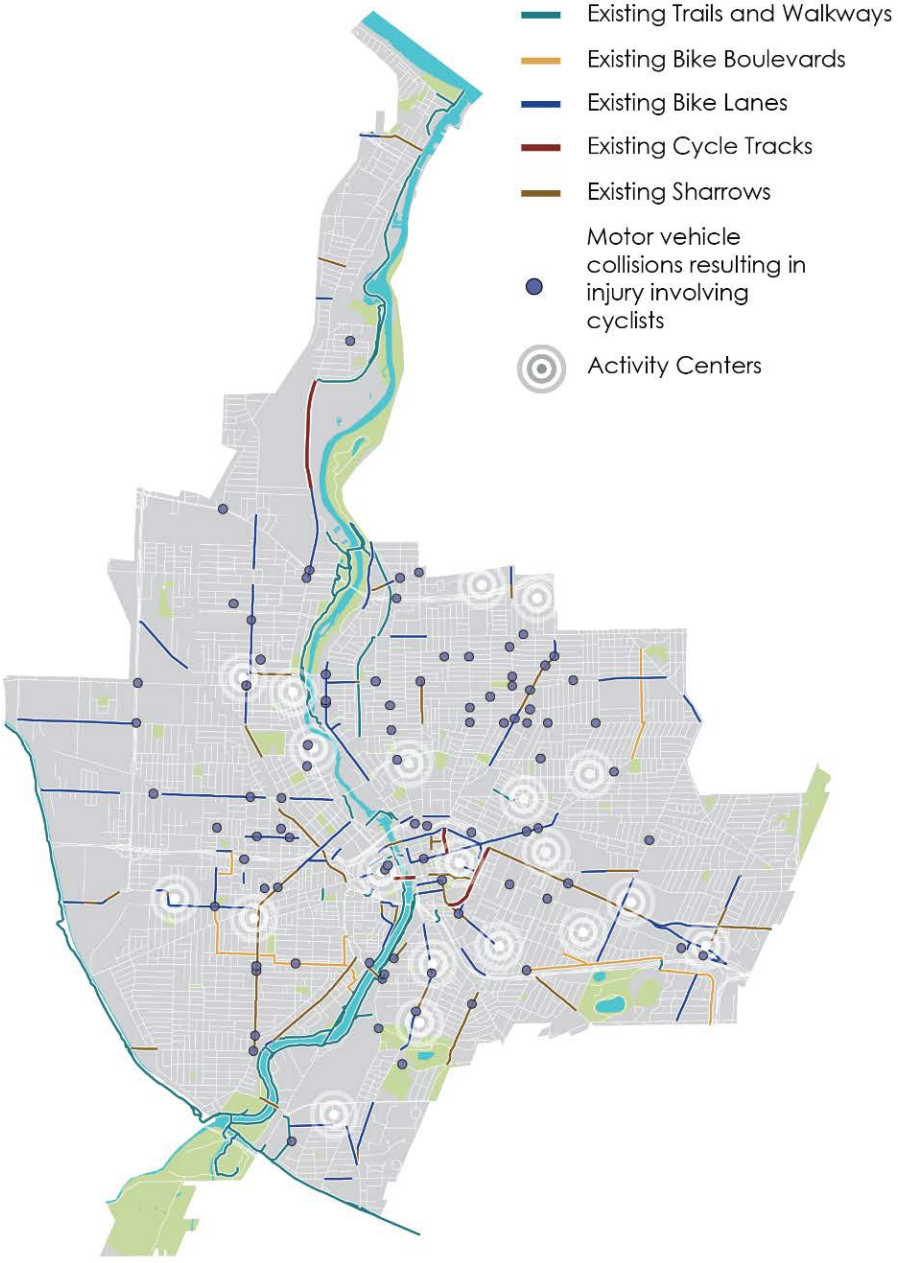
Sources: New York State Department of Transportation, City of Rochester

Vehicle-Bicycle Collision Location

There is a noticeable trend of crashes involving bicyclists occurring on the major roadways in Rochester, including all types of arterials, but other lower speed local

streets also experience bicycle-related collisions. Bicycle crashes occur on streets with and without dedicated bicycle facilities, though more often on the latter. While few exceptions exist to the citywide 30 miles per hour speed limit, roadway design can encourage excessive speeds, increasing the risk of collision with other vehicles.

Figure 7 Motor Vehicle Collisions Involving Cyclists (2017)



Sources: Genesee Transportation Council, City of Rochester, NYSDOT Accident Location Information System, 2017

4 Community Survey

The public engagement events provided residents an opportunity to provide feedback and to participate in an online survey to better understand conditions, travel patterns, and the community's interest in biking.

The online survey was accessible through the project website. In total 339 people provided input on existing and desired bicycle conditions. Although this survey represents only a small portion of the Rochester population, the responses identify some common trends in travel behavior, issues and challenges, and future priorities for biking around the city.

The balance of gender and age of people responding to the survey may be an indication that people of all ages and abilities ride in Rochester. Typically, a community that has more women and older people identifying as bicycle riders, has a network where people feel safe and comfortable.

Key Findings from the survey indicate that bicycling is a popular mode choice among these survey respondents to go around the city (10%), close to transit and over walking (7%). Safety is a major concern for bicycling. While the majority of participants stated they felt biking in Rochester was moderately safe, there is still room for improvement.

Safety and Perception

There is an overwhelming desire to bike more and to prioritize bicycle facilities within the city. For the 36% of respondents who said they would like to bike more, the most frequent cited obstacle was "safety concerns" which was cited by 46% of respondents. The next most frequent obstacles cited were "lack of bike infrastructure" at 26%, "hostile/uneducated drivers" at 18%, "disconnected bike Infrastructure" at 13%, and "heavy traffic" also at 13%.

The results indicate that perceived lack of safety was a key obstacle to respondents' biking more than they do now. Respondents indicated they want more bike infrastructure to increase their safety, but also indicated that sharing space with cars is dangerous, not only because of speeds and volume, but also due to perceived dangerous driving behavior. The responses suggest that separating bikes and cars with a physical barrier is likely to be supported by this population.

Aside from safety, respondents choose not to bike due to the weather, travel distances, a lack of places to store their bike, not having the time to bike, a need to transport people and things, no place to shower at work, and snow plowed into bike lanes.

Big Ideas for Rochester

At pop-up events and in a survey, respondents were asked about what their big idea would be to make the following vision come to reality, *"Rochester's transportation system…works for users of all ages and abilities whether they walk, bike, drive or take public transportation"*. Regarding biking in Rochester, people want to be able to bike comfortably. Some suggested the city focus more on people who bike and walk when they develop roads. Many of the respondents' suggestions focused on the right of way, suggesting widening sidewalks, reducing parking, and adding bike lanes, cycle tracks, seating, bus lanes, speed bumps, traffic-calming measures, more stop signs, and fixing and adding pedestrian signals. Trails, road diets and the elimination of parking requirements, better pedestrian connectivity, and more frequent bus service were also proposed.

5 Challenges and Opportunities

Building on preliminary research, stakeholder input, and data analysis, there are three key challenge topics that impact bikeability in Rochester (see Figure 8). Each challenge presents an opportunity for the City to build on what's working well and to learn from the efforts of others. The opportunities are further explored in the Recommendations section, which presents the types of solutions that can be applied to the challenges facing Rochester.

This section lays out problem statements and matches them with potential solutions that have been used effectively in cities across the nation. These leading practices are meant to inspire and expand the tools available to make Rochester more bikeable. Many key activity centers are located along arterial corridors with high speeds and traffic volumes. Often these corridors are disconnected from residential trip origins, and the lack of a coherent street grid makes connecting these origins and destinations challenging. Rochester can prioritize adding new and upgrading existing bike facilities that connect key activity centers with adjacent residential corridors, particularly to existing and planned bike boulevards. Add intersection improvements for bikes along key arterial corridors (such as those shown in Figure 2) to facilitate riders' transitions from lower-volume/speed corridors to higher-volume/speed corridors.

The most appropriate bicycle facilities to implement on any given street depend highly on the local roadway context, such as the posted speed limit, motor vehicle volumes and roadway configuration (see Figure 9). Because very few streets in Rochester have posted speed limits below 30 mph, the range of bicycle facilities appropriate for all ages and abilities is limited in most cases: reducing speed limits through signage and traffic calming, shrinking multi-lane roadways to a single lane in each direction, or protected bicycle lanes. As shown in Figure 9, any implementation of bicycle boulevards, or of conventional or buffered bicycle lanes, requires first reducing vehicle speeds to 25 mph or less to be safe for all ages and abilities.

Figure 8 Key Challenges and Opportunities for Rochester

Topic	Challenge	Opportunity
Bicycling Environment	Three-quarters of Rochester residents are within a 10-minute ride to an activity center. However, public outreach results indicate that residents define the environment as hostile with uneducated drivers and high traffic.	Rochester can **add more traffic calming features along the bike network** as they add protected facilities, increase driver awareness regarding the presence of cyclists and their rights, and design bicycle facilities to improve the overall cyclist experience.
Connections and Modal Conflict	While the City has built many facilities, future priorities need to be focused on connecting infrastructure between home locations and activity centers to create a more useable network.	**Fill in the gaps** with high biking demand and in corridors where there are some existing bike facilities, prioritizing areas with low income, youth and zero-vehicle households.
Safety and Maintenance	Even portions of the bicycle network experience collisions resulting in injury. Bikers are discouraged from biking where they feel unsafe or where facilities are too narrow and/or unprotected near heavy and fast vehicular traffic flows.	Design bike facilities for all ages and abilities (Figure 9). **Upgrade current bike facilities to protected bike lanes** in high traffic volumes locations. **Extend the bike network across intersections.** Employ traffic calming within bike facility design.
Understanding Facility Comfort Level	While existing and expected facility type and location are included in GIS databases, a direct link to traffic volumes and roadway geometry is not yet part of the City's dataset. Comfort levels on existing streets, as well as the perceived comfort level and likelihood of use of a proposed on-street facility, are unknown.	Rochester can perform a citywide Level of Traffic Stress analysis to further help pinpoint priority investments in the network that ensure future facilities respond to the needs of all levels of cyclists.

Figure 9 Contextual Guidance for Selecting All Ages & Abilities Bikeways

Roadway Context				All Ages & Abilities Bicycle Facility
Target Motor Vehicle Speed[9]	**Target Max. Motor Vehicle Volume**	**Motor Vehicle Lanes**	**Key Operational Considerations**[10]	
Any		Any	*Any of the following:* high curbside loading activity, frequent buses, motor vehicle congestion, or turning conflicts	**Protected Bicycle Lane**
< 25 mph	<500 – 1,500	No centerline, or single lane one-way	<50 motor vehicles per hour in peak direction at peak hour	**Bicycle Boulevard**
	<1,500 – 3,000	Single lane each direction, or single lane one-way	Low curbside activity, or low congestion pressure	**Conventional or Buffered Bicycle Lane, or Protected Bicycle Lane**
	<3,000 – 6,000			**Buffered or Protected Bicycle Lane**
	Greater than 6,000			**Protected Bicycle Lane**
	Any	Multiple lanes per direction		
Greater than 26 mph[11]	<6,000	Single lane each direction	Low curbside activity, or low congestion pressure	**Protected Bicycle Lane, or Reduce Speed**
		Multiple lanes per direction		**Protected Bicycle Lane, or Reduce to Single Lane & Reduce Speed**
	Greater than 6,000	Any	Any	**Protected Bicycle Lane, or Bicycle Path**
High-speed, limited-access roadways, natural corridors, or geographic edge conditions with limited conflicts		Any	High pedestrian volume	**Bike Path with Separate Walkway or Protected Bicycle Lane**
			Low pedestrian volume	**Shared-Use Path or Protected Bicycle Lane**

Source: NACTO

[9] While posted or 85th percentile motor vehicle speed are commonly used design speed targets, 95th percentile speed captures high-end speeding, which causes greater stress to bicyclists and more frequent passing events. Setting target speed based on this threshold results in a higher level of bicycling comfort for the full range of riders.

[10] Operational factors that lead to bikeway conflicts are reasons to provide protected bike lanes regardless of motor vehicle speeds and volumes.

[11] Setting 25 mph as a motor vehicle speed threshold for providing protected bikeways is consistent with many cities' traffic safety and Vision Zero policies. However, some cities use a 30 mph posted speed limit as a threshold for protected bikeways, consistent with providing Level of Traffic Streest level 2 (LTS 2) that can effectively reduce stress and accommodate more types of riders.

6 Bikeable City Peer Review

As mentioned above, it is important for the City of Rochester to build on the success of what peer cities have been able to accomplish. The table below tabulates the recent progress made by Rochester's peer cities. The City's Bicycle Master Plan also includes a peer review with additional statistics that supplement those provided here.

Figure 10 Bikeable City Peer Review

	Pittsburgh, PA	Buffalo, NY	Richmond, VA	Salt Lake City, UT	Grand Rapids, MI	Akron, OH	Rochester NY
Bicycle Mode Share (Commute Trips)	2.9%	1.4%	2.4%	3.2%	1.3% bike	0.1% bike	1.3%
Miles of Bike Lanes	77	Approx. 25	20	150 including trails	111.6	25 current 16 planned	50 miles of bike lanes and cycle tracks 31 miles of trails 10 miles of bike boulevards
Protected Bike Lanes	2.2 Miles	Yes	13 Miles	Yes	25 Miles	-	4.6 Miles
Bike Education or Incentive Programs	Bike PGH provides education videos and live classes and promote biking through events.	GoBike Buffalo leads workshops and social bike promotion events.	Bikewalk RVA provides education and incentive programs.	BikeUtah leads educational workshops and programs to promote bicycling in Utah.	-	Akron MPO's "Switching Gears" program promotes biking and provides education and incentives.	The New York Bicycling Coalition now has an education coordinator in Rochester responsible for coordinating safe cycling classes and presentations.
Use of Traffic Calming Measures	High visibility crossings, Various traffic calming devices	Road Diets, Various traffic calming devices	Road Diets, various traffic calming devices	Bumpouts	Speed humps, Traffic calming pavement markings	Road Diets	Neighborhood Traffic Calming Program includes bumpouts, diverters, and neighborhood traffic circles.

7 Recommendations

Performance Measures

A successful Rochester bicycle network should be measured by:

- An increase in bicycle mode share
- A decrease in per capita injury severity
- An overall improvement to public health

Connect Network Gaps

The City should prioritize connecting infrastructure, expanding facilities between home locations and activity centers to create a more useable network. The City should identify ways to incrementally implement previously performed trail linkage planning in tandem with upgrading the on-street network. While the Genesee Riverway Trail serves most north-south trips, the current bike network lacks some of the east-west connections to feed it. See Figure 3.

Starting from a principle that streets are public spaces for people, street design must consider the needs of people walking, driving, cycling, and taking transit, all in a constrained space. Rochester should reassess streets currently marked with sharrows for conversion into protected bike lanes where average daily traffic volumes are greater than 6,000 vehicles per day and 85th percentile speeds are higher than 26 miles per hour.

The assessment needs to take into consideration curb-to-curb widths as a primary constraint, but also elements meant to promote pedestrian safety, transit loading, and other corridor access such as curb extensions and parking lanes. Figure 11 shows a minimum 36 feet wide cross-section to accommodate protected bike lanes. Unprotected bike lanes require a 32 feet wide cross-section.

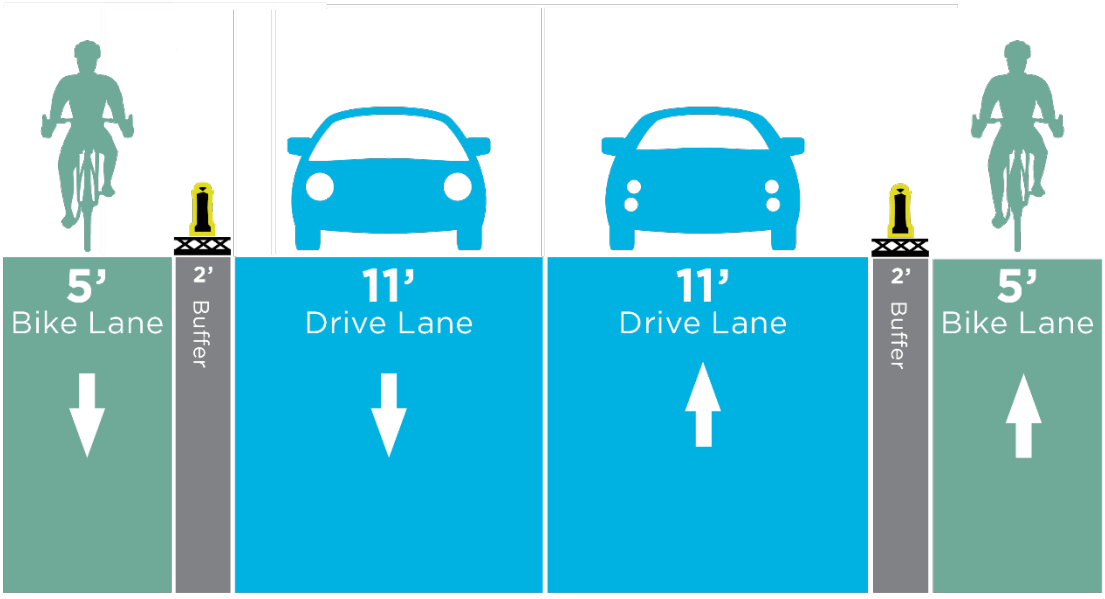
Vehicle travel lanes should be 11' wide where significant heavy vehicles and/or transit occurs. Curbside lanes can accommodate several uses: parking lanes should be 7' side, while bike lanes should have a minimum width of 5' per direction and a buffer of a minimum of 1' to 3', depending on the adjacent traffic volumes, with physical protection if possible. A standard parking lane should be able to be converted into a bike lane and buffer wide enough to allow the installation of bollards.

Following these guidelines, there are a number of potential conversion locations within the City of Rochester. Referring to Figure 2 to identify locations of high potential demand, and comparing to vehicular volumes and existing facility locations, protected bike lane installation locations can be prescribed. Examples include:

- University Avenue
- Plymouth Avenue
- Brown Street
- Broad Street between Smith and Allen Streets
- Genesee Street south of Melrose Street
- Portland Avenue between North Street and Central Park
- Monroe Avenue between Howell and Alexander Streets
- Monroe Avenue east of Goodman Street

Examples where curb extensions preclude full sharrow conversion include University Avenue, Plymouth Avenue, and Brown Street, all 28 feet wide from curb extension to opposite curb. The portion of Broad Street cited does not have enough room to accommodate protected bike lanes. Unprotected bike lanes are possible, but require the repurposing of the on-street parking on one side of the street. Prioritization is required based on the emphasis for this or any constrained corridor that physically cannot provide facilities for all modes. Highlighted portions of Genesee Street, Portland Avenue, and Monroe Avenue meet physical requirements that may allow for the preservation on one parking lane while providing protected on-street bicycle facilities.

Figure 11 Street Design Guidelines – Protected Bike Lanes



Design Context-Suited Facilities

Proper bicycle facility design is rooted in context. Streets with fast, heavy traffic require greater separation between bike riders and traffic lanes. Streets with very low

traffic speeds and volumes allow cars and bikes to share the same space. If Rochester is typical of national data, only about 1% of its residents would feel comfortable riding on typical city streets. Meanwhile, about 60% of residents would be interested in riding a bike, but only feel comfortable on separated bikeways or very low speed, low traffic volume streets (another 32% are not interested in cycling at all[12]).

Rochester should choose bicycle facilities that are suited to unique roadway and traffic conditions. Figure 9 provides identification guidelines. For more detail, see the NACTO Urban Bikeway Design Guide at www.nacto.org.

Fully Integrate the Network

To fully integrate bicycling as a mode of transportation into the existing street network, bike facilities need to take people to places they want to go in a direct way that is separated as much as possible from motor vehicle traffic.

The City should ensure that facilities also have crossing applications at intersections and driveways through stamped/colored applications, reinforcing the safety and visibility of the system in these areas. For several years, the City has experimented with different types of green markings to draw attention to bike facilities, particularly at intersections or where vehicles and bicycles have to cross travel lanes, such as a right-turn lane. The green markings are used either to highlight conventional or protected bicycle lanes that run through intersections or to create "bike boxes," recessed stop areas at intersections where bicyclists can get a head start ahead of motor vehicles when stopped at red lights. The green markings contribute to cyclist comfort and keep them well-positioned in the bike lane through the intersection, while also reducing confusion for drivers. Below is a selection of intersections where the City has implemented green markings to improve safety and create a lower-stress bike network:

- Court Street & Clinton Avenue/Square
- Court Street & Chestnut Street
- Ford Street & Mount Hope Avenue
- University Avenue & East Main Street
- Monroe Avenue & Goodman Street
- Ames Street & West Avenue

[12] Roger Geller, 2006

Figure 12 High Visibility Bicycle Facility Intersection Treatments

Source: NACTO

Provide Best Practice Bike Parking

Figure 13 U-Shaped Bike Rack

Source: Nelson\Nygaard – Grand Rapids Vital Streets

Bicycle Parking is a critical component of a bicycle network. It can take the form of bicycle racks on sidewalks, indoor-secure bike parking in parking garages, and/or parking "swaps" where bicycle parking takes the place of one or two car parking spaces. One other important feature in promoting bicycle commuting is secure indoor bicycle parking at major places of employment. The League of American Bicyclists and LEED ND both provide guidance on the supply of bike parking that should be provided by use. Many communities also look to the zoning code of Cambridge, MA as a best practice model of how much and what type of bike parking to require. Furthermore, the Association of Pedestrian and Bicycle Professionals (APBP) provides a comprehensive guide on what type of racks work best for securing bicycles in an efficient manner, with additional guidance on how they should be sited near buildings (https://www.apbp.org/page/Publications).

Currently, the City requires new development to provide off-street bicycle parking equal to 10% of the vehicle parking requirements for the property (minimum two bicycle spaces), for all multifamily housing (over 10 units) as well as commercial and industrial uses. Additionally, the City allows applicants to petition for reductions in off-street motor vehicle parking if the proposed development provides bicycle parking or makes special accommodations for bicyclists.[13] Special accommodations may include bicycle lockers and employee shower and changing facilities.

Support Winter Maintenance Requirements

To sustain a functioning bike system year-round in a climate like Rochester's, the City should plan for winter maintenance of bike facilities and for summer re-painting and repairs. The City should coordinate snow storage with other corridor needs to ensure snow is not stored within any bicycles facilities that are present.

As Rochester continues to build out its protected network, the City should procure and deploy adequate snow-clearing equipment capable of plowing cycletracks and paved trails. Priority should be given to plowing bike facilities on street segments that carry the highest potential bike volumes, such as segments shown in blue in Figure 2.

Given the wear and tear that comes with salt, snow, and plowing, some cities seek grant funding to re-paint their bike infrastructure every 1 – 2 years (example: Somerville, MA) and NACTO provides guidance on selecting and maintaining more durable materials.[14] Re-painting costs range from $1.20-1.60/square foot for paint, $8-11/square foot for durable liquid pavement markings, and $10-14/square foot for thermoplastic. ().

Enforce Misuse of Bike Lanes

In order to ensure adequate safety of bike travel where dedicated facilities exist, the City should educate the public regarding bicycle-only facilities and engage in active enforcement against parking and loading in those facilities. Cities like Portland, OR and Chicago, IL provide postcards and resources online that educate drivers on the preferred method of interaction with new facilities like protected lanes and bike boxes.

Rochester should consider deploying a system piloted by the Boston Department of New Urban Mechanics for enforcing illegal stopping and standing in curbside bike lanes as well as measuring the effectiveness of the pilot system. This system uses a

[13] City of Rochester Municipal Code. § 120-173 C. (3) | Off Street Parking. https://ecode360.com/8682809

[14] NACTO. 2013. Urban Bikeway Design Guide. https://nacto.org/publication/urban-bikeway-design-guide/bikeway-signing-marking/colored-pavement-material-guidance/

bicycle police detail to flag illegally parked vehicles with a first-time warning notice, followed by a parking violation if the vehicle remains illegally parked on second inspection. Such issues are becoming an increasingly important priority with the increase in curbside pickup and drop-off of users of private Transportation Network Companies like Uber and Lyft.

Expand Cyclist Focused Wayfinding

Knowing where you are going by bike is essential. Good wayfinding helps to combine a network of discrete bicycle facilities into a single continuous route that can connect people to destinations. Directional wayfinding signage accomplishes this by helping residents and visitors navigate the bikeway network by providing cues at key decision points. Wayfinding highlights key destinations and indicates the best bike routes to get people to their destinations. People traveling by bicycle who follow wayfinding signs and pavement markings benefit from riding on the designated bicycle facilities and experience the most comfortable crossings of major roadways.

Rochester should use a combination of MUTCD compliant signs, pavement markings, colors, and other symbols to differentiate bike routes from other streets. This "branding" of the bikeway network improves user's ease of use and celebrates the act of bicycling. Wayfinding on the trail network, especially the Genesee Riverway Trail, is comprehensive. The on-street bike network would benefit from more frequent wayfinding signage and pavement markings.

Figure 14 MUTCD Compliant Bicycle Boulevard Wayfinding

8 Priority Projects

1. Design the bike network so that it is bikeable for all ages and abilities
    a. Convert sharrows on streets with AADT higher than 4,000 into bike lanes or protected bike lanes where speeds are higher than 26 mph and AADT higher than 6,000. Considerations included.
        i. Broad St between Smith and Allen – 32 feet wide, on-street parking present
        ii. Genesee St south of Melrose – 43 feet wide, on-street parking present
        iii. Portland Ave between North and Central Park – 43 feet wide, on-street parking present
        iv. Monroe Ave between Howell and Alexander – 43 feet wide, on-street parking present
        v. Monroe Avenue east of Goodman Street – 46 feet wide, on-street parking present
    b. Convert bike lanes into protected bike lanes where speeds are higher than 26 mph and AADT higher than 6,000.
2. Prioritize corridors with few gaps, where providing new miles of bike facilities will provide a continuous network connecting key destinations. See Figure 2.
    a. South Ave
    b. Lyell Ave
    c. Dewey Ave
    d. Broad St
    e. W Main St
    f. Driving Park Ave-Ave E
    g. Webster Ave
    h. Chestnut St
    i. Joseph Ave
    j. Elmwood Ave
3. Prioritize the projects listed in points 1 and 2 when located in low income communities with low car ownership, a high youth or senior population percentage, and near activity centers.

9 Appendix

Bicycle Level of Stress Methodology

Low-stress bicycle facilities are those that are specifically designed to provide a comfortable experience for bicyclists of all ages and abilities. Often this means dedicated space on- or off-street, with some kind of separation from vehicular traffic. However, facilities such as bicycle boulevards, which are simply low-speed, low-volume streets with markings for bicyclists can also be considered low-stress facilities, and can often provide critical links between other facilities in the overall network.

A 2012 study conducted by the Mineta Transportation Institute identified four different levels of traffic stress to help classify the comfort levels experienced using different bicycle facility types.

Level 1

Level 1 is a suitable environment for bicyclists of all ages and abilities, providing a relaxing experience with little traffic stress. Level 1 environments are often separated from vehicular traffic or on a street with slow speeds (25 mph or less) and low traffic volumes.

Level 2

Level 2 is a suitable environment for most adult bicyclists, but is slightly more stressful than level 1. Level 2 environments may include some separation from vehicular traffic, but often are directly adjacent to a slow speed (30 mph or less) travel lane.

Level 3

Level 3 is a suitable environment for experienced bicyclists, but is not up to the level of stress experienced riding in multi-lane traffic. Level 3 environments may offer dedicated space for bicycles adjacent to moderate speed (35 mph or less) vehicular traffic, but more often are simply shared spaces with vehicles on moderate speed streets.

Level 4

Level 4 is not a desirable environment for bicyclists, exhibiting high speeds (35 mph or more) and high volumes of traffic with no protection for bicyclists.

Figure 15 Level of Stress Assessment for Bicycle Facilities

	MORE COMFORTABLE		LESS COMFORTABLE	
	1	2	3	4
SHARED ON-STREET FACILITIES				
SPEED LIMIT *residential*	25 MPH or less	30 MPH	30 MPH	35+ MPH
SPEED LIMIT *non-residential*		25 MPH or less	30 MPH	35+ MPH
NUMBER OF LANES	2 Lanes	2-3 Lanes	2-3 Lanes	4+ Lanes
INTERSECTING STREETS	Narrow and Calm	Calm	Busy	Wide and Busy
DEDICATED BIKE LANES				
SPEED LIMIT	30 MPH or less	30 MPH	35 MPH	40+ MPH
LANES EACH DIRECTION *without median*	1 Lane	1 Lane	2+ Lanes	2+ Lanes
LANES EACH DIRECTION *with median*	1-2 Lanes	2 Lanes	3+ Lanes	3+ Lanes
BIKE LANE WIDTH	6 Feet	5-6 Feet	5 Feet	<5 Feet
INTERSECTION TREATMENTS	Continuous	Shared	Shared	Non-Continuous
SEPARATION	Separation moves a facility one comfort level to the left			
OFF-STREET FACILITIES				
CROSSING FREQUENCY	Rare	Infrequent	Moderate	Frequent
TYPE OF CROSSINGS	Narrow and Calm, or Controlled	Uncontrolled, but Narrow	Uncontrolled, Wide, or Fast	Uncontrolled, Wide, and Fast

Figure 16 Level of Traffic Stress (LTS) Analysis

CORRIDOR 1: ST PAUL STREET

TDV_ROUTE	BEGINDESC	ENDDESC	AADT	AADT_TYPE	AADT_YEAR	Shape_Le_1	#_Lanes	City_SpeedLimit	Prevailing_Speed	Bike_Ln_Width	Has_Parking	LTS SCORE
ST PAUL ST	RIDGE RD E	N CITY LINE	11,863	ACTUAL	2015	739.6	4	30	50	6ft	No	4
ST PAUL ST	NORTON ST	RIDGE RD E	8,850	ACTUAL	2015	739.6	2	30	35	N/A	Yes	3
ST PAUL ST	AVE E	NORTON ST	13,651	FORECAST	2015	723.5	3	30	35	6ft	Yes, NB only	3
ST PAUL ST	UPPER FALLS BLVD	AVE E	14,903	FORECAST	2015	1,721.3	3	30	35	6ft	Yes, NB only	3
ST PAUL ST	N L WARD ST	UPPER FALLS BLVD	13,880	FORECAST	2015	529.0	4	30	35	N/A	No	4
ST PAUL ST	CUMBERLAND ST EB	N L WARD ST	12,704	FORECAST	2015	370.6	2	30	35	N/A	No	4
ST PAUL ST	MAIN ST E	CUMBERLAND ST EB	14,256	FORECAST	2015	482.4	3	30	35	N/A	Yes	3
ST PAUL ST	MAIN ST E	CUMBERLAND ST EB	14,256	FORECAST	2015	482.4	3	30	35	6ft	No	2

CORRIDOR 2: LYELL AVE

TDV_ROUTE	BEGINDESC	ENDDESC	AADT	AADT_TYPE	AADT_YEAR	Shape_Le_1	#_Lanes	City_SpeedLimit	Prevailing_Speed	Bike_Ln_Width	Has_Parking	LTS SCORE
LYELL AVE	BROAD ST & LYELL AVE	LAKE AVE	12,254	FORECAST	2015	900.6	2	30	35	6ft	Yes	3

CORRIDOR 3: EAST MAIN STREET

TDV_ROUTE	BEGINDESC	ENDDESC	AADT	AADT_TYPE	AADT_YEAR	Shape_Le_1	#_Lanes	City_SpeedLimit	Prevailing_Speed	Bike_Ln_Width	Has_Parking	LTS SCORE
MAIN ST WEST	MAIN ST	STATE ST	11318	FORECAST	2015	541.1	3	30	35	N/A	Yes	4
MAIN ST EAST	STATE ST	ST PAUL ST	0	NO DATA	2015	305.8	5	30	35	N/A	No	4
MAIN ST EAST	ST PAUL ST	CLINTON AVE	13282	FORECAST	2015	225.5	4	30	35	N/A	No	4
MAIN ST EAST	CLINTON AVE	UNIVERSITY AVE	8474	FORECAST	2015	869.1	4	30	35	6ft	Yes, EB only	3
MAIN ST EAST	UNIVERSITY AVE	BIRCH CRESCENT	20594	FORECAST	2015	692.1	5	30	35	6ft	Yes, EB only	3
MAIN ST EAST	BIRCH CRESCENT	GOODMAN ST N	17853	FORECAST	2015	386.4	5	30	35	N/A	No	4
MAIN ST EAST	GOODMAN ST N	WINTON RD N	7246	FORECAST	2015	2,929.5	3	30	35	N/A	Yes	4
MAIN ST EAST	GOODMAN ST N	WINTON RD N	7246	FORECAST	2015	2,929.5	2	30	35	N/A	Yes	4

CORRIDOR 4: MONROE AVENUE

TDV_ROUTE	BEGINDESC	ENDDESC	AADT	AADT_TYPE	AADT_YEAR	Shape_Le_1	#_Lanes	City_SpeedLimit	Prevailing_Speed	Bike_Ln_Width	Has_Parking	LTS SCORE
31, MONROE AVE	ACC INNER LOOP MONROE AVE	RT 490I UNDER	11548	FORECAST	2015	1739.4	2	30	35	N/A	Yes	3

31, MONROE AVE	ACC INNER LOOP MONROE AVE	RT 490I UNDER	11549	FORECAST	2015	1739.4	2	30	35	5ft	Yes, NB only	2
31, MONROE AVE	ACC INNER LOOP MONROE AVE	RT 490I UNDER	11548	FORECAST	2015	1739.4	2	30	35	N/A	Yes	3
31, MONROE AVE	RT 490I UNDER	ROCHESTER CL	10398	FORECAST	2015	1079.0	2	30	35	N/A	Yes	3

CORRIDOR 5: DEWEY AVENUE

TDV_ROUTE	BEGINDESC	ENDDESC	AADT	AADT_TYPE	AADT_YEAR	Shape_Le_1	#_Lanes	City_SpeedLimit	Prevailing_Speed	Bike_Ln_Width	Has_Parking	LTS SCORE
DEWEY AVE	RIDGEWAY AVE	RIDGE RD W	9,833	FORECAST	2015	699.2	3	30	35	N/A	Yes	3
DEWEY AVE	DRIVING PK AVE	RIDGEWAY AVE	14,505	FORECAST	2015	1447.2	3	30	35	6ft	Yes	2
DEWEY AVE	FELIX ST	DRIVING PK AVE	10,025	FORECAST	2015	1284.6	2	30	35	6ft	Yes	2
DEWEY AVE	FELIX ST	DRIVING PK AVE	10,025	FORECAST	2015	1284.6	2	30	35	N/A	No	3
DEWEY AVE	LYELL AVE	FELIX ST	9,126	ACTUAL	2015	666.6	2	30	35	N/A	Yes	3

CORRIDOR 6: GENESSEE ST

TDV_ROUTE	BEGINDESC	ENDDESC	AADT	AADT_TYPE	AADT_YEAR	Shape_Le_1	#_Lanes	City_SpeedLimit	Prevailing_Speed	Bike_Ln_Width	Has_Parking	LTS SCORE
GENESEE ST	BROOKS AVE	190S ARNETT BL	10645	FORECAST	2015	1206.1	2	30	35	N/A	Yes	3
GENESEE ST	190S ARNETT BL	MAIN ST WEST	13487	ACTUAL	2015	912.7	2	30	35	N/A	Yes	3

CORRIDOR 7: JOSEPH ST

TDV_ROUTE	BEGINDESC	ENDDESC	AADT	AADT_TYPE	AADT_YEAR	Shape_Le_1	#_Lanes	City_SpeedLimit	Prevailing_Speed	Bike_Ln_Width	Has_Parking	LTS SCORE
JOSEPH AVE	S L AVE D	NORTON ST	9,868	ACTUAL	2015	658.9	2	30	35	N/A	Yes	3
JOSEPH AVE	S L CLIFFORD A	S L AVE D	10,791	FORECAST	2015	610.7	2	30	35	N/A	Yes	3
JOSEPH AVE	N HERMAN ST	S L CLIFFORD A	11,103	FORECAST	2015	433.8	2	30	35	N/A	Yes	3
JOSEPH AVE	CENTRAL AVE	N HERMAN ST	8,514	FORECAST	2015	932.1	2	30	35	N/A	Yes	3
JOSEPH AVE	CLINTON AVE NO	CENTRAL AVE	9,312	FORECAST	2015	305.4	4	30	35	N/A	No	4

City of Rochester
Comprehensive Access and Mobility Plan

Walkable City Report

NELSON
NYGAARD

Cover photo from patrickashley via wikimedia

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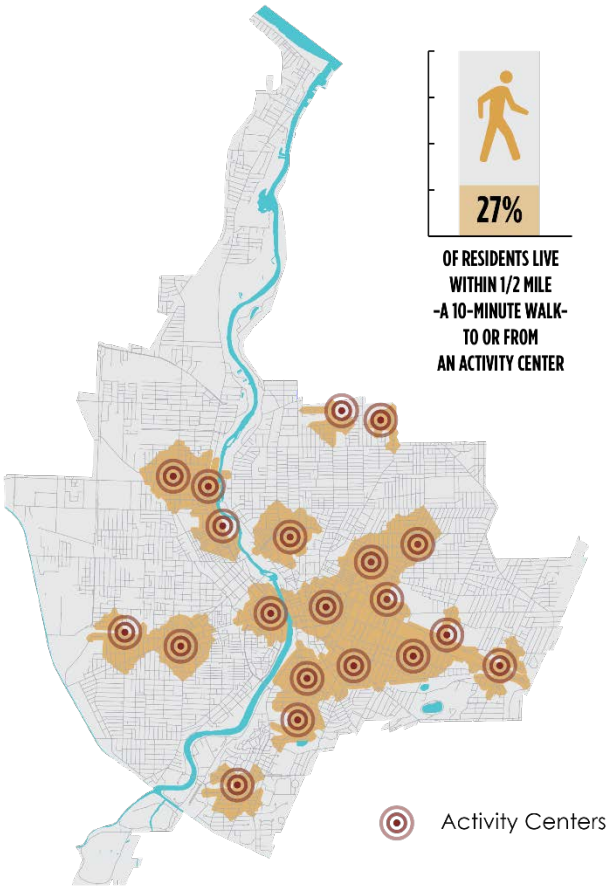
1 Walking in Rochester: A Snapshot

Approximately 7% of commuters in the City of Rochester travel to work by foot, and almost one-quarter of residents that live near Downtown or the University of Rochester Medical Campus walk to work. While sidewalks exist on almost all streets within the City, infrequent crossing opportunities and overly large or complicated interchanges, like those at I-490 or around the Inner Loop, present significant barriers to pedestrian mobility in the city. Sidewalks and ramps in poor condition, narrow buffers between the sidewalk and the roadway, curb cuts, and physical barriers such as highways and rail crossings are additional factors that affect the walking experience. These conditions are also present in neighborhoods that have land use characteristics that are conducive to increased walking as a part of daily mobility.

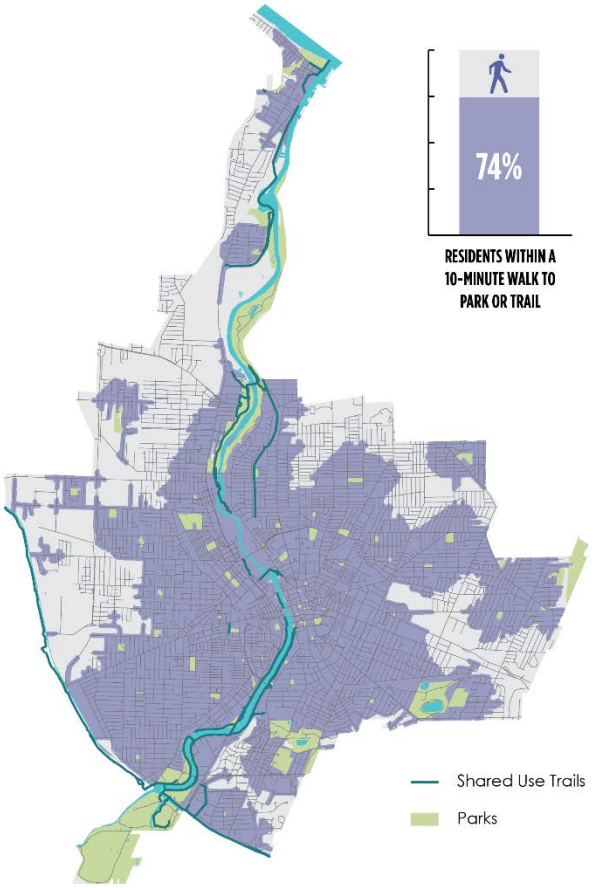
According to walkshed data displayed in the State of the City Transportation System Factbook, over one-quarter of Rochester residents live within a half mile, or a 10-minute walk, of a supermarket or other essential services. Two-thirds live within one mile, and are able to reach these activities in 20 minutes on foot.

Figure 1 Pedestrian Access to Services



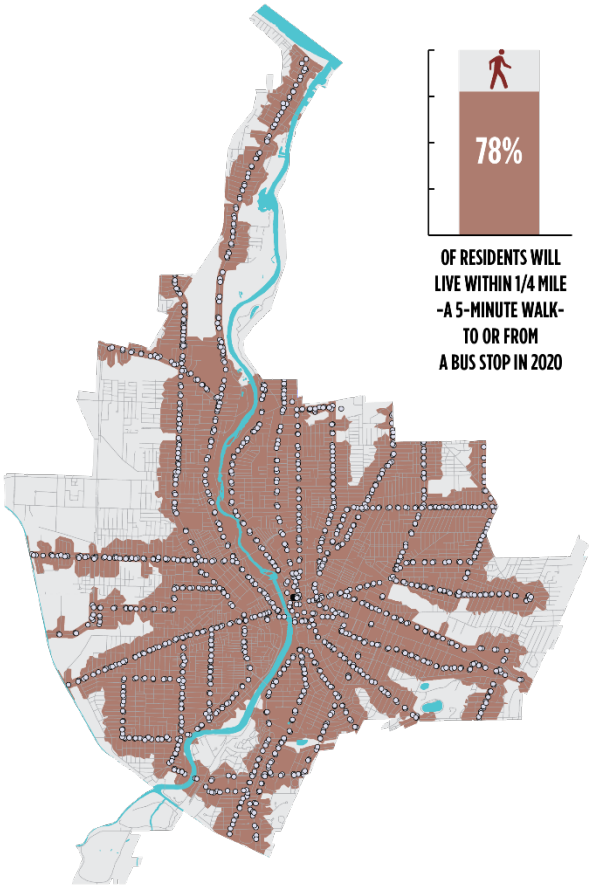
Almost three-quarters of residents live within a 10-minute walk to a park or trail, which provides recreational walking opportunities. Despite this proximity, conditions such as complicated expressway and multi-lane roadway crossings exist between residential areas and these greenspaces, precluding safe and comfortable pedestrian connections.

Figure 2 Pedestrian Access to Greenspace



Every transit trip begins with a walking trip and 87% of City residents currently live within ¼ mile of a bus stop. As the Reimagine RTS plan, which calls for a reduction in the number of fixed bus routes, is implemented in summer 2020, the number of Rochesterians who can walk to a bus stop within five minutes will drop to 78%. Therefore, high quality pedestrian infrastructure near transit stops (and other transit hubs) is essential to support transit ridership and provide safe mobility options for Rochester residents. This means ensuring that safe crossings exist near stops, especially on wide streets with long distances between signalized intersections.

Figure 3 Pedestrian Access to Transit – Reimagine RTS Realignment



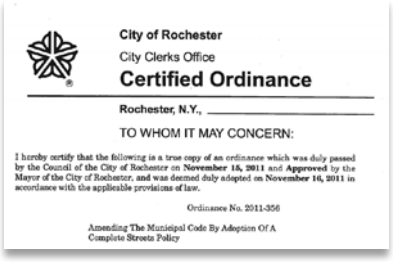
Similarly, since everyone who parks their vehicle or uses the bike-share system also walks at the beginning and end of their trip, quality pedestrian facilities improve the public realm experience for both residents and visitors, regardless of their primary means of transportation. The City has previously recognized the intersection of interesting architectural and natural resources with the promotion of physical activity in transportation with their *Rochester Walks!* Initiative. The program published suggested walking routes online that cover many corners of the city, lists health benefits, and provides safety tips to potential walkers. While the program is no longer active, its helpful materials remain an online resource.

Policy and Planning Context

Previous land use, transportation, and corridor planning efforts In Rochester help set the stage for the Walkable City Report. The report builds on past work to direct Rochester toward a more walkable future. The following excerpts provide brief descriptions of select city plans and policies, focused on the ways each addresses walking or connecting to the walking network.

Rochester 2010: The Renaissance Plan (2000)

- Outlines the City's goals, principles, and implementation actions related to subject areas including economic development, environmental management, infrastructure, land use/zoning, and mobility/transportation, among others
- Outlines a Vital Urban Village concept containing landscaped pedestrian "human scale" streetscapes where public sidewalk minimum widths of 5' in residential areas and 8' in mixed use cores are established


City of Rochester
City Clerks Office
Certified Ordinance

Rochester, N.Y., _____

TO WHOM IT MAY CONCERN:

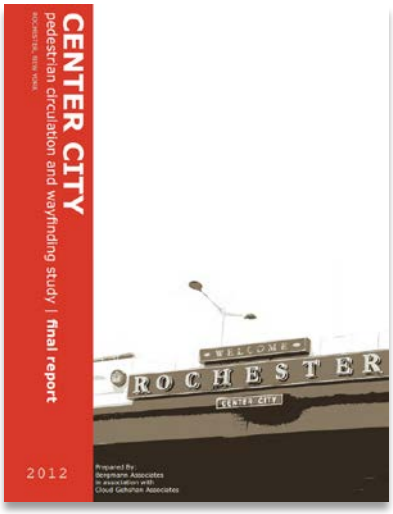
I hereby certify that the following is a true copy of an ordinance which was duly passed by the Council of the City of Rochester on November 16, 2011 and Approved by the Mayor of the City of Rochester, and was deemed duly adopted on November 16, 2011 in accordance with the applicable provisions of law.

Ordinance No. 2011-356

Amending The Municipal Code By Adoption Of A Complete Streets Policy

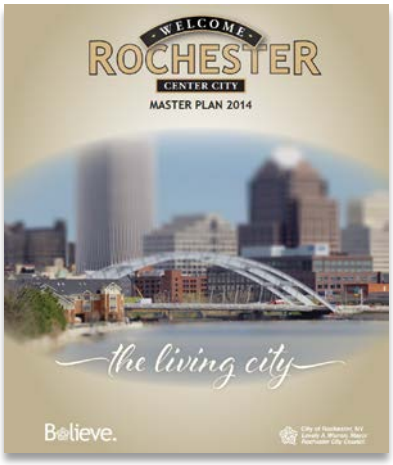
Complete Streets Policy (2011)

- Ensures that all future street design efforts will fully consider the needs of pedestrians, bicyclists, transit users and persons with disabilities by requiring Traffic Control Board review and an annual report from the City Engineer regarding consistency with the policy by all street construction, reconstruction, rehabilitation, and pavement maintenance projects
- Helps to improve public safety by installing and maintaining sidewalks, crosswalks, ADA-compliant ramps and bike lanes, as well as reducing crossing distances, lowering motor vehicle travel speeds and improving sight distances



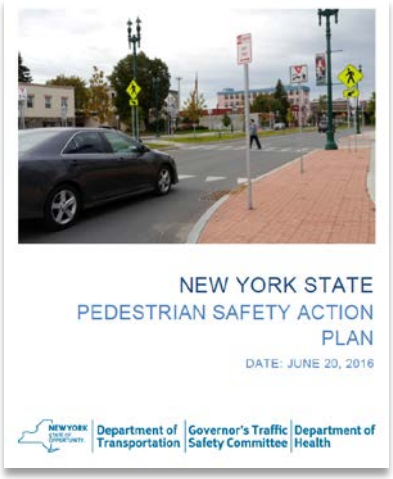
Center City Pedestrian Circulation and Wayfinding Study (2012)

- Attempts to improve the visitor wayfinding experience within Rochester's Center City by providing clear and direct orientation and connections, reducing the effort required to navigate Center City
- Recommends enhancement and connection of existing pedestrian wayfinding systems such as the Genesee Riverway Trail, High Falls Walking Tour, and Erie Canalway Heritage Trail sign systems
- Puts forth an organizing system and style recommendations for major kiosks, minor kiosks, and direction signs that builds off of the quadrant colors of the existing vehicular wayfinding system, but is modified for pedestrian focused wayfinding



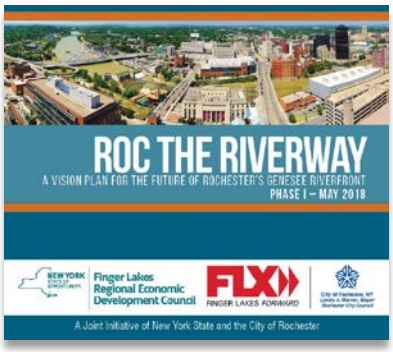
Center City Master Plan (2014)

- Identifies a fundamental vision of lively streets, highlights the importance of the Genesee River and Main Street, places downtown in the geographical context of the City and region, and identifies several key leverage points
- Draws a connection between active uses, attractive streetscape, and lively streets
- Recognizes obstacles to mobility in expressway/railroad corridors, superblocks, perception of safety, and walkway maintenance



New York State Pedestrian Safety Action Plan (2016)

- Recommends a distinct set of engineering, education, and enforcement countermeasures that can be accomplished over the next 5 years to improve pedestrian safety
- Names Monroe County a focus county and Rochester a focus community
- Creates systemic treatment packages for uncontrolled crossings on state roads in urban areas



Roc the Riverway (2018)

- Produces seamless and accessible pedestrian and bicycle connections along both sides of the river via the Genesee Riverway Trail and neighborhood linkages to the trail
- Will reinvest in pedestrian bridges, separate pedestrian traffic as a part of trail upgrades, and create improved streetscape experiences where streets bisect the river

2 Vision and Goals

In recent years, Rochester has built high-class pedestrian environments downtown, in many neighborhood centers, and along its trail system. These investments in walking infrastructure have made it possible for many residents to walk more and live more active lifestyles.

However, walking remains a small minority of transportation activity compared to private personal vehicles. To make Rochester a walkable city, all neighborhoods should be walkable. In reality, Rochester must prioritize limited funds and target pedestrian improvements in the places of greatest need. The Walkable City Report will set Rochester on a path to meet residents' most critical needs by presenting areas of improvement and assessment, identification, and implementation processes for those improvements.

Based on feedback from community outreach, stakeholder input, and conversations with city staff, the following vision and goals make an aspirational statement about the walkable city Rochester wants to become by 2034. Achieving these outcomes will require steadfast commitment from the city's leaders, staff, and residents as well as significant additional resources to support capital and program investments.

Comprehensive Access and Mobility Plan Vision

Rochester's transportation system improves quality of life for Rochesterians by enabling safe, convenient, and comfortable access to work, life, and play, and enabling connectivity between neighborhoods. The system works for users of all ages and abilities whether they walk, bike, drive or take public transportation, and supports Rochester businesses by enabling the movement of goods and personnel. The system activates transit and pedestrian oriented design to create a city of short distances, and is clear and user-friendly, with the highest standards of sustainability, design, and maintenance.

Goal 1: Create Connected and Complete Communities

- Complete the city-wide pedestrian network and enhance the walking environment
- Make connections to the places people need and want to go
- Provide seamless connections to transit and ensure access to community assets
- Enhance streetscapes to create vibrant public spaces
- Extend nature into the street network with trees and landscaping

Goal 2: Make the Experience Safe

- Reduce the number of motor vehicle crashes involving pedestrians, ultimately eliminating traffic-related injuries and fatalities
- Protect vulnerable populations and account for pedestrian needs first in planning and design
- Institute a culture of safety, educating walkers and drivers alike, to encourage more walking trips
- Teach and reinforce safe driving and walking behavior

Goal 3: Build Comfortable Walkable Places for All

- Prioritize improvement projects to aide residents on foot in meeting their regular transportation needs
- Make investments that promote equity in the transportation system for those unable to drive
- Assess and improve pedestrian environment quality citywide
- Design facilities for people of all ages and abilities
- Excite the public about walking through neighborhood activities and demonstration projects
- Make walking a part of everyday life in Rochester

Goal 4: Prioritize for Implementation

- Identify and prioritize a list of pedestrian facility improvement projects through the participation of key stakeholders in focus groups
- Note budgetary considerations, constraints, and outside funding opportunities

3 Needs Assessment

Connecting Demand to Destinations

While the pedestrian network in Rochester is nearly complete, the range of pedestrian demand generated by Rochester neighborhoods does not always conveniently reach destinations that serve residents' regular needs. Distance and convenience are reasons commonly cited for Rochester's lack of everyday practical walking activity, pointing to a need to improve the quality of the pedestrian environment such that either destinations are found in closer proximity to residences or that longer walks are considered a positive experience.

Pedestrian Demand Index

Using a combination of factors that generate or attract walking trips, the Pedestrian Demand Index highlights areas of Rochester that would be expected to have high levels of pedestrian activity. These factors include population density, employment density, density of households without a vehicle, household income, proximity to activity centers and frequency in bus stops.

The Pedestrian Demand Index weights normalized factors for each characteristic.

Figure 4 Weights of the Pedestrian Demand Factors

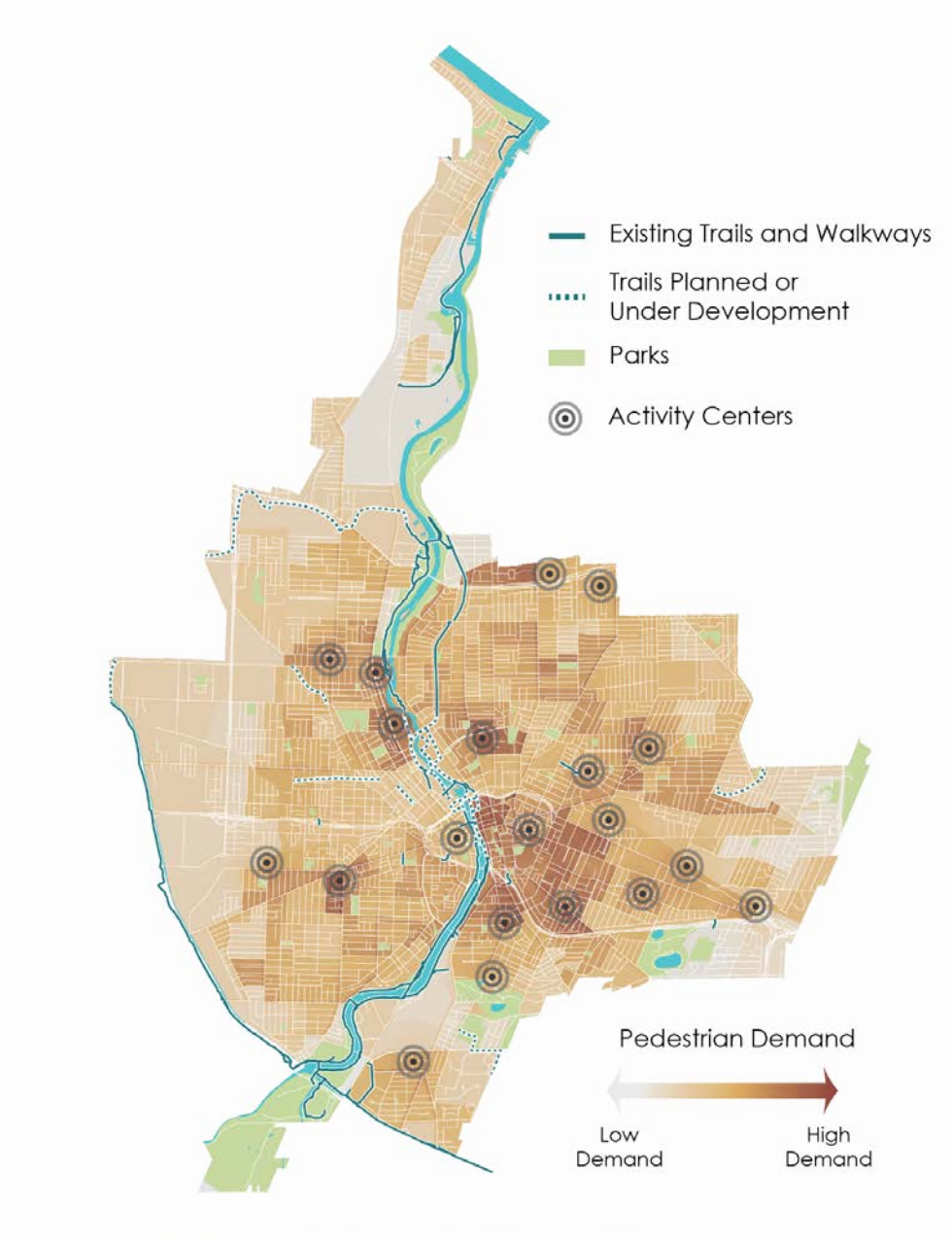
Factor	Weight
Population Density	2
Employment Density	2
Density of Households with Access to a Vehicle	1.5
Household Income	1.5
Activity Centers	1
Transit Frequency	1

Activity Centers were defined in the State of the City Transportation System Factbook through identification of the following use types that serve daily and weekly needs:

- Retail, including bicycle, book, clothing, furniture, hardware, and shoe stores
- Food Retail, including bakeries, restaurants, and supermarkets
- Services, including banks and laundromats
- Medical, including hospitals, pharmacies, and doctor/dentist offices
- Government, including courts and local offices
- Institutional, including libraries and churches
- Intercity Transportation

When mapped in Figure 3, the index shows that the "center of gravity" for expected pedestrian activity is located in downtown and downtown-adjacent neighborhoods to the south and east. Secondary pockets of high expected demand are found in the Bull's Head area, along Upper Falls Boulevard, along Lake Avenue between Driving Park and Lyell Avenues, near the intersection of Goodman Street and Webster Avenue, and at the northern end of Hudson Avenue.

Figure 5 Pedestrian Demand and Destinations



Sources: American Community Survey 2016, LEHD 2015, Google API, Genesee Transportation Council, City of Rochester

Factors Limiting Demand

Online survey and in-person public outreach participants were asked to indicate a transportation mode that they would prefer to use more often. Of the 26% of respondents who said they would like to walk more, the most frequently cited obstacle to doing so was distance, noted by 36% of respondents. The next most frequently cited obstacle, lack of destinations (14%), and another common reason, convenience (10%) are directly related to distance. These factors inhibiting walking align with the analysis in the State of the City Transportation System Factbook, which notes a smaller number of households are proximate to activity centers.

Key Conflict Areas

Even where pedestrian demand and destinations might be proximate, significant barriers exist that discourage walking. Expressway interchanges complicate and degrade the pedestrian environment along the edges of Downtown. General characteristics of these locations that confuse and dissuade people from walking through include:

- High vehicle speeds and multiple conflict points due to channelized turning movements
- One-way frontage roads creating multiple crossings, some without crosswalks
- Sidewalks routed through areas with many blind entryways or along high speed access ramps
- Termination of expressway operation or lane reductions
- Crossings that do not lead directly into continuing sidewalks
- An unclear sense of the direction of the pedestrian pathway versus diverging access ramps

Figure 6 Example Key Pedestrian Conflict Areas

West Broad Street at Allen Street, Joseph Avenue at Cumberland Street Source: Nelson\Nygaard

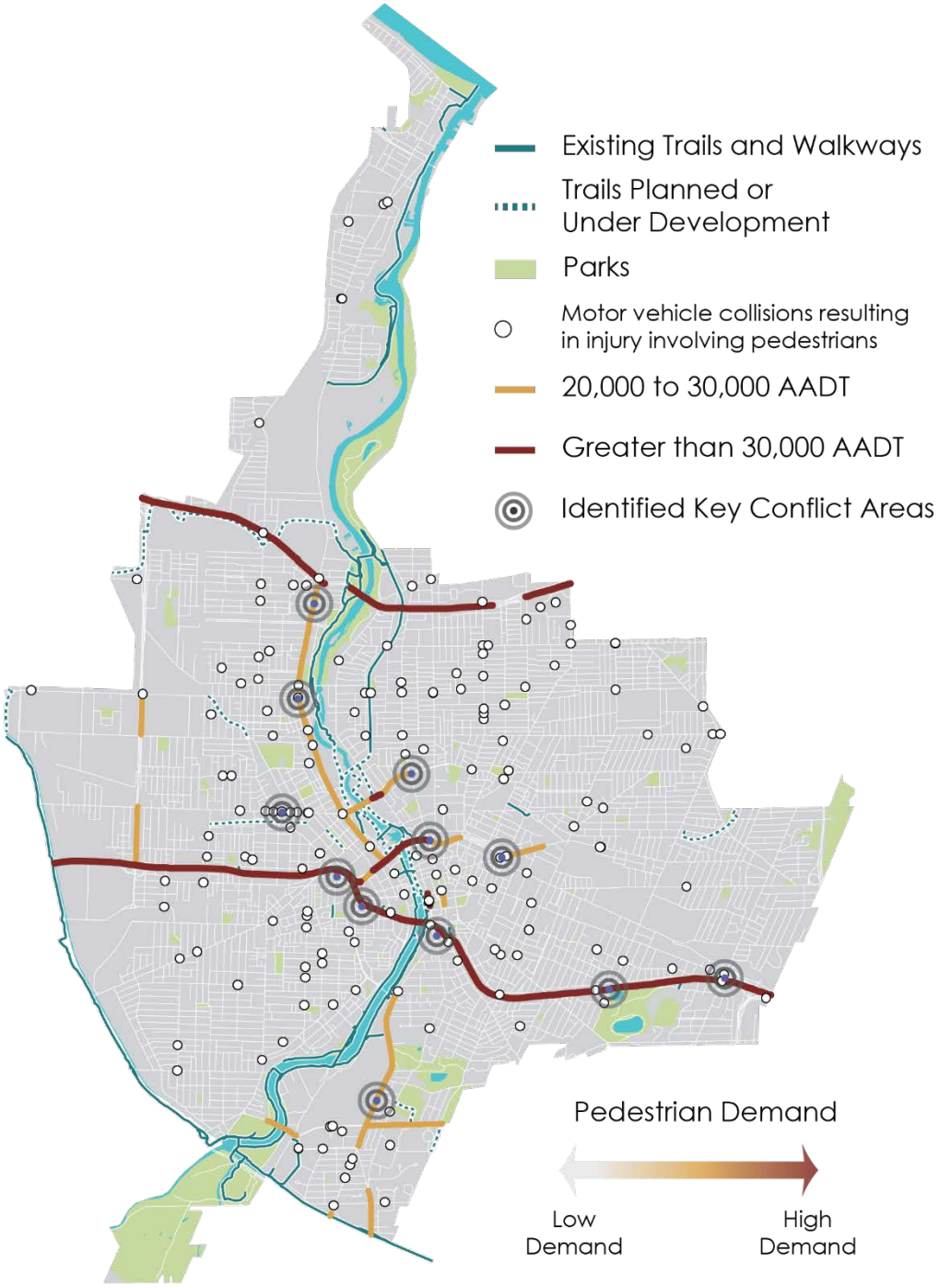
High-speed, and high volume urban arterials with multiple lanes, such as Lake Avenue, Upper Falls Boulevard, and Mt. Hope Avenue limit access to residents' regular needs. Pedestrian delay is long waiting to cross at intersections immediately bordering top destinations within activity centers such as supermarkets. These sites

are primarily oriented for vehicle access. Additionally, these high volume routes proceed for long distances between signalized intersections. Distances between traffic signals along Lake Avenue from Flower City Park to Driving Park Avenue range from 800 to 1,300 feet. The four-lane stretch of Upper Falls Boulevard from Joseph Avenue to Hudson Avenue measures 1,800 between signals. Mt. Hope Avenue, which carries over 20,000 vehicles per day between Elmwood and Highland Avenues is uninterrupted by traffic control devices on the entire 2,300 foot long stretch of roadway.

Figure 7 spatially displays key conflict areas. Highlighted areas were chosen that most closely correspond to the following conditions:

- Crossing safety compromised or complicated by high-volume expressway interchanges
- High traffic volume and/or large number of lanes on surface streets where the interval between signalized intersections exceeds 1,000 feet
- Low crossing level of service coupled with multiple collisions involving pedestrians in 2017
- Complex intersection geometry and dominant movements (Eg. Broad/Lyell/Dewey) coupled with multiple collisions involving pedestrians in 2017

Figure 7 Identified Key Conflict Areas



Sources: New York State Department of Transportation, NYSDOT Accident Location Information System

Network Quality

Pedestrian Level of Service

The quality of a transportation facility can be measured in a number of different ways depending of the point of view from which considerations are made. Transportation Research Board's Highway Capacity Manual 2010 (HCM2010) presents level of service concepts for multiple modes to describe facility performance from the traveler's perspective in a useful way to planners and decision makers as well as the users themselves.

HCM2010 defines pedestrian level of service (PLOS) as an approach to assess quality of operations of pedestrian facilities at intersections, as intersections generally experience the highest amount of modal conflict. At busy intersections, motorists, cyclists, and pedestrians often have to deal with complex situations and be aware of the position, movement, and intent of other users.

HCM2010 further defines PLOS at signalized intersections as a function of pedestrian time delay, which is calculated based on the contribution and proportion of 'walk' and 'don't walk' time within the overall signal cycle.

Analysis

Three intersections were chosen for an example PLOS calculation. Choices were made at activity centers or other areas of high pedestrian demand that demonstrated high levels of modal conflict due to high speeds, volumes, and/or turning movements. Figure 4 shows how these focus intersections relate to 2017 vehicle-pedestrian collisions resulting in injury as well as the Pedestrian Demand Index.

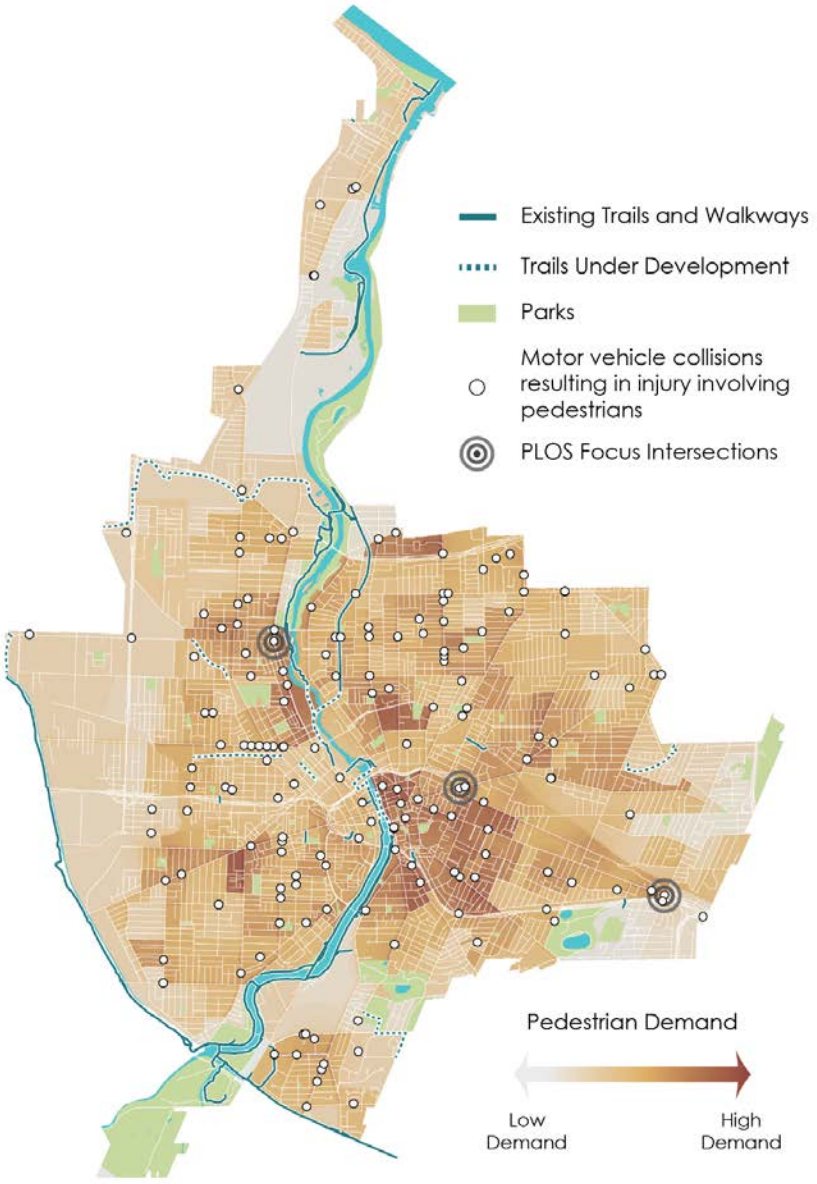
PLOS Grades as a function of expected travel delay are based on traveler perception research performed by the authors of HCM2010. While A represents the best quality of service, and F the worst, best and worst are undefined and subjectively based on traveling experience and perception of quality.

The grading table included in the Appendix uses a natural logarithmic scale linked to travel research that designates an 'A' grade to intersection legs whose expected pedestrian delay is 4 seconds or less. Note that this figure is an expected, rather than maximum value, which at any intersection is dependent on the signal cycle. For example, while the average person walking along Lake Avenue who attempts to cross Lexington Avenue will wait 10.4 seconds, someone who arrives just as the don't walk cycle begins will be forced to wait 54 seconds.

Conversely, an 'F' is assigned to crosswalks where expected pedestrian delay exceeds 81 seconds. A 'D' grade is assigned to crossings whose expected individual delay falls between 19 and 38 seconds. Behavioral studies have shown that delay exceeding 30 seconds leads to a dramatic decrease in pedestrian signal

compliance.[1] Further research links non-compliance to elevated relative risk of collision with a motor vehicle.[2] Even when actuated, the expected delay at major crossings of each intersection analyzed all exceed 30 seconds.

Figure 8 Motor Vehicle Collisions Involving Pedestrians and Resulting in Injury



Source: NYSDOT Accident Location Information System

[1] Zheng, Y. et al. *Pedestrian Traffic Operations in Urban Networks.* Transportation Research Procedia. Volume 15, 2016.

[2] King, M.J. et al. *Relative Risk of Illegal Pedestrian Behaviours.* 2008 Australasian Road Safety Research, Policing and Education Conference. 2008.

All signal cycle values included in Figure 7 represent PM peak cycle length and split times. Other times of day will have shorter cycle lengths and thus shorter walk interval times in the primary travel direction. The complex intersection at University Avenue and East Main Street is made of components of three intersections, allowing for analysis of North-South crossing of Main Street. It should be noted that the Western crossing requires the pedestrian to walk 300 feet west and make an extra crossing of Pitkin Street. This additional time is not included in the analysis.

Figure 9 Pedestrian Level of Service Selected Intersection Analysis

Intersection	Approach	Walk Cycle Length (s)	Full Cycle Length (s)	Pedestrian Delay (s)	Level of Service
East Avenue & Winton Road	North	44	120	21.6	D
	East	19	120	39.2	E
	West	19	120	39.2	E
	South	44	120	21.6	D
University Avenue & East Main Street @ Inner Loop	North	34	100	19.2	D
Union Street & East Main Street	West	32	125	31.7	D
University Avenue & East Main Street @ Pitkin Street	West	21	125	40.0	E
University Avenue & East Main Street @ Inner Loop	South	34	100	19.2	D
Lexington Avenue & Lake Avenue	North	29	120	31.5	D
	East	49	120	10.4	C
	West	49	120	10.4	C
	South	29	120	31.5	D

More advanced intersection PLOS calculations consider crosswalk crossing distance. Minimizing these distances minimizes pedestrian exposure to modal conflict and forms the basis of intersection reconfiguration best practices.

Safety and Perception

Safety concerns were cited by 12% of survey respondents who expressed a desire to walk more often. Respondents who provided specific reasons describe feeling unsafe walking due to roadways with heavy and/or fast vehicular traffic and feeling uncomfortable at intersections because they do not feel seen by drivers. Respondents were concerned about the quality of the pedestrian network, noting insufficient pedestrian infrastructure, narrow sidewalks, missing sidewalks, and sidewalks in disrepair.

Outreach participants were also asked to provide a Big Idea to make the Rochester Comprehensive Access and Mobility Plan's vision become reality. Many walkers Rochester simply want to be able to walk and bike comfortably. Some suggested the City focus more on people who walk during roadway development. Many suggestions focused on the right-of-way itself, suggesting widened sidewalks, reduced parking, added speed humps, and added traffic control devices such as stop signs. Additional suggestions requested the fixing and adding of pedestrian signals, further development of the trail network to promote low-stress pedestrian connectivity, and a wider implementation of road diets.

Street Design Preferences

Survey and outreach participants were asked whether they would prefer more landscaping, more seating, or more space to walk on a widened sidewalk along a neighborhood street where they spend time working, shopping, or meeting friends. A majority (50%) chose landscaping, followed by seating (30%), and finally more space to walk (20%).

Those who shared their Big Ideas were also concerned with the environment and sense of place, suggesting improved tree canopy along streets, more separation between the sidewalk and roadway, and landscaped public places with seating along pedestrian routes throughout the city. Noting significant gaps in the tree canopy in public rights-of-way, participants also suggested Investments in green pedestrian infrastructure in Downtown Rochester and in mixed-use neighborhoods, where interruptions related to automobile parking would be more dispersed throughout the district or neighborhood.

4 Challenges and Opportunities

Building on preliminary research, stakeholder input, and data analysis, there are four key challenge topics that impact walkability in Rochester (see Figure 8). These challenges influence pedestrian project delivery, pedestrian and driver behavior, walking comfort and safety, and access and mobility. Each challenge presents an opportunity for the City to build on what's working well and to learn from the efforts of others. The opportunities are further explored in the Recommendations and Best Practices sections, which present the types of solutions that can be applied to the challenges facing Rochester.

This section lays out problem statements and matches them with potential solutions that have been used effectively in cities across the nation. These leading practices are meant to inspire and expand the tools available to make Rochester more walkable.

Figure 10 Key Challenges and Opportunities for Rochester

Topic	Challenge	Opportunity
Pedestrian Environment, Distance, and Convenience	Only one-quarter of Rochester residents are able to walk to essential services in 10 minutes or less. Demand analysis shows expected areas of high pedestrian exist further from activity centers while public outreach indicates that factors related to distance are the most common obstacles to greater practical walking activity.	Fully two-thirds of residents live within a 20-minute walk of those same activity centers. Rochester can encourage walkers to go the literal 'extra mile' by improving the pedestrian environment, making walking a more rewarding experience and changing the perception of time spent in transit. Rochester can also help to coordinate future infill development to increase the percentage of residents who can reach destinations via shorter walks.
Connections and Modal Conflict	Connectivity is decreased through delay where large vehicle volumes intersect pedestrian movements. Intersections close to top destinations experience pedestrian delay and compromised pedestrian	Many Rochester intersections can be reconfigured to reduce crossing distances without disrupting traffic patterns. A reconsideration of signal timing could give pedestrians priority

Topic	Challenge	Opportunity
	safety due to wide crossing widths, long signal cycle times, and high vehicle speeds.	when they are most likely to be seen by drivers.
Safety and Maintenance	Even well-connected portions of the pedestrian network experience collisions resulting in injury. Citizens are confused by pedestrian routes and discouraged from walking where they feel unsafe or where facilities are too narrow or in disrepair.	Rochester can take advantage of new state crosswalk design standards and improvements delivered via the state Pedestrian Safety Action Plan (PSAP). Connecting sidewalks can be upgraded citywide to meet state standards. Introducing new pedestrian crossings to shorten the distance between controlled intersections and adding streetscape elements to better define the roadway edge can act to calm traffic on wide and high volume roadways.
Programmatic Approach	Rochester does not have a visible pedestrian program. Pedestrian supportive projects and programs like *Rochester Walks!* are implemented on an opportunistic basis, resulting in less impact than desired and a low level of recognition of available programs by the public.	Rochester can create an Active Transportation Program to house pedestrian projects and programs. Putting all existing and future work under a single recognizable umbrella demonstrates a commitment to a walkable Rochester. Using partnerships with stakeholders, and expanding best practice wayfinding initiatives, the City can further expand its education and encouragement programs.

5 Recommendations

Design for Safety and Connectivity

Reconfigure Key Crossings

In order to identify the worst pedestrian delays due to signalization, the City should perform a Pedestrian Level of Service analysis comparable to that in Section 3. Required inputs are walk signal duration, flashing don't walk signal duration, and the overall intersection cycle time in seconds. Formulae and the grading scale are included in the Appendix to this document.

Subsequently, the City should conduct pedestrian counts at intersections where PLOS is poor and compare to collision data to identify priority locations for reconfiguration of the surrounding pedestrian infrastructure. Fundamentally, reconfigurations should shorten and make crossings more direct while certain elements may bring with them additional traffic calming benefits.

The intersection of Lake and Lexington Avenues, a State DOT controlled intersection, sits immediately between a full-service supermarket and a low income neighborhood while where over one-third of households have no access to a vehicle. This intersection was identified by stakeholders and verified by analysis as a key conflict point where high demand and low PLOS coupled with high vehicle speeds creates an unsafe pedestrian environment.

Shown in Figure 9, the corner of Lake and Lexington presents a number of common opportunities to reduce crossing distance and conflict risk. A curb extension may be added without compromising the required length and function of bus turnout further south. The width of the eastbound lane on the eastern approach may be reduced by roughly half, not only reducing the eastern crossing distance, but also changing the interaction of the curb radius with the southern crossing. Medians already in place can be extended further into the intersection, slowing down left turn movements without violating the required turning radius for a DL-23 design vehicle. Larger vehicles such as a WB-50 tractor trailer should access the site via Glenwood Avenue to simplify back up movements and unloading.

As with all intersections examined, lane-to-lane outer turn radius and curb radii should be verified for the design vehicle and design context. In locations where on-street bicycle facilities are also present, to avoid bicycle queuing in the crosswalk and allow cyclists a safe place to queue, the advanced stop bar should be located at least 8 feet in advance of the crosswalk and a bike box utilized between the crosswalk and the advanced stop bar.

Figure 11 Example Crossing Improvements at Lake and Lexington Avenues

Crosswalk Design

Continental and bar pair crosswalks are more noticeable and visible crosswalk marking styles, improving roadway safety for both drivers and pedestrians. The crosswalks keep people visible while crossing the street and set clear limits to drivers. Studies have shown that continental and bar pair striping is safer than traditional pedestrian crossings marked by two parallel lines connecting the corners of an intersection. A Federal Highway Administration study completed in 2010 found that the continental and bar pair markings were detected at about twice the distance upstream as the transverse marking during daytime conditions.[3] This increase in distance reflects 8 seconds of increased awareness of the crossing for a 30 miles per hour operating speed. Cities such as San Diego and San Francisco are gradually replacing all traditional crosswalk markings with this style and codifying design standards.[4]

The study team has identified that bar pair striping is present in Downtown Rochester, though not consistently across all intersection approaches. New York State DOT Traffic Safety & Mobility Instruction 16-05 updates statewide policy on the use of high-

[3] Federal Highway Administration. Publication No.: FHWA-HRT-10-067

[4] City of San Diego. City Standard Drawing SDM-116

visibility crosswalk markings and will inform PSAP implemented improvements on state roads in the coming years. The PSAP also encourages local municipalities to implement systemic safety programs on locally owned roads. The City should prioritize the implementation of continental or bar pair striping (where special paving materials are not already in place) at:

- Intersections experiencing high levels of pedestrian volume
- Intersections and midblock crossings already slated to be painted
- Crosswalk locations near parks, libraries, and schools

Pay special attention to odd intersection geometries created by legacy shifts in the street grid. Lyell Avenue, which carries over 15,000 vehicles per day, and its many oblique intersections with Broad Street, Dewey Avenue, Saratoga Avenue and others, are the location of a series of vehicle-pedestrian collisions causing injury. Per state Engineering Instruction 18-008, the longitudinal lines of high visibility crosswalks should be drawn parallel to the direction of vehicle travel. The crosswalk itself should be no less than 10 feet in width, with limit lines installed no closer than 4 feet in advance of the transverse markings.

Leading Pedestrian Interval (LPI)

A Leading Pedestrian Interval (LPI) typically gives pedestrians a 3–7 second head start when entering an intersection with a corresponding green signal in the same direction of travel, enhancing the visibility of pedestrians in the intersection and reinforcing their right-of-way over turning vehicles, especially in locations with a history of conflict.

The City of Rochester should inventory existing LPI implementations, as well as those anticipated as part of the State PSAP, and compare to intersections where heavy turning traffic comes into conflict with crossing pedestrians, especially where pedestrian volumes are also high. This may require additional vehicular and pedestrian traffic counts. The City may then request additional LPI implementation from the Monroe County Department of Transportation to improve both safety and connectivity at a relatively low cost. The effectiveness of LPI further enhanced when paired with a curb extension.

Rectangular Rapid Flashing Beacon

Rectangular Rapid Flashing Beacons (RRFBs) are devices using LED flashing beacons in combination with pedestrian warning signs to provide a high-visibility strobe-like warning to drivers when pedestrians and bicyclists use a crosswalk. A push button is used to activate the beacon, or another activation method used by the person to signal the intent to cross. The push button and other components of the crosswalk must meet all other accessibility requirements. RRFBs can be used when a traffic signal is not warranted at an unsignalized crossing.

New York State will be installing additional RRFBs, such as one recently installed across Mt. Hope Avenue near Robinson Drive, as part of their PSAP. DOT guidelines in TSMI 18-02 cite the following criteria for the appropriateness of RRFB implementation while noting that not all criteria need to be met in order for an RRFB to be considered an appropriate solution at a previously uncontrolled location.

- Marked Crosswalk
- Minimum Vehicular Volumes: 1500 VPD or 150 VPH
- Minimum Pedestrian Volume Thresholds
  - 20 pedestrians or 10 school aged, elderly, or disabled pedestrians in any one hour
  - 18 pedestrians or 9 school aged, elderly, or disabled pedestrians per hour in any two hours
  - 15 pedestrians or 8 school aged, elderly, or disabled pedestrians per hour in any three hours
- Stopping Sight Distance (SSD) ≥ 8 times the Speed Limit
- Minimum 300 feet to the nearest protected crossing
  - 200 ft. in urban areas based on engineering judgment
- Posted Speed Limit of 30 to 45 MPH
- Maximum # of lanes crossed: 4 lanes
  - with a raised median: 5 lanes

RRFB installation should be considered for locations not on the State implementation list that experience with high vehicular volumes, greatly exceed established minimum distance to a controlled crossing guidance, and where pedestrian demand is likely to exceed minimum thresholds.

Provide a Quality Pedestrian Environment

At its core, a walkable city is one where transportation on foot is convenient, safe, and enjoyable. Quality pedestrian environments help to reduce the risk of motor vehicle collisions and increase physical activity and social cohesion with direct physical health benefits as well as stress reduction and mental health improvements that promote individual and community health.

Complementary Land Use

A quality pedestrian environment relies on land use diversity and density not just pedestrian design. The citation of distance as factor inhibiting walking activity includes some underlying context regarding useful locations for infill development. The City should develop criteria regarding the coordination of land use policy, development approval, and transportation infrastructure. This will require integration between city departments and key partners, including departments of

transportation, regional economic development councils, developers, lenders, local foundations, social service providers, healthcare agencies, and other key players.

Pedestrian Environmental Quality Assessment

Systems have been devised to aid in the qualitative assessment of pedestrian environmental quality. One such system is described in the case study below. Rochester has previously conducted a walkability audit in the Merchants-Culver neighborhood and should expand the scope of this type of assessment along all connecting corridors to further prioritize pedestrian environment improvements.

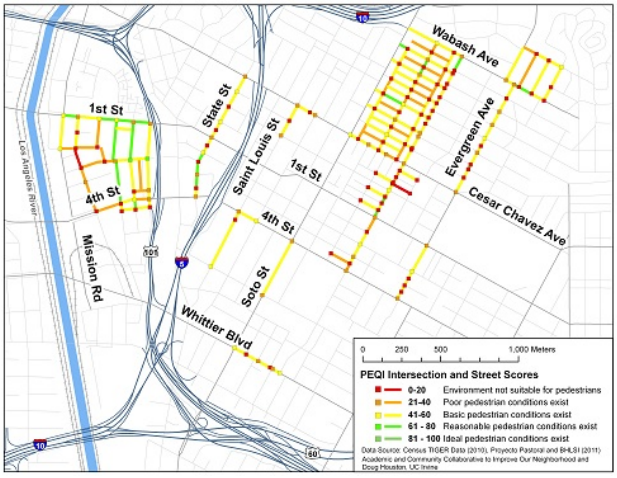
CASE STUDY

Pedestrian Environmental Quality Index

The Pedestrian Environmental Quality Index (PEQI) questionnaire was developed in 2008 by the San Francisco Department of Public Health Program on Health, Equity and Sustainability (SFPDH) to assess the quality and safety of the physical pedestrian environment and inform pedestrian planning needs. It evaluates the pedestrian environment in five categories:

- Intersection safety
- Traffic
- Street design
- Land use
- Perceptions of safety and walkability

Figure 12 Example PEQI Visual Representation



Source: UCLA Sustainable Technology and Policy Program

PEQI has since been adapted by the Sustainable Technology and Policy Program at UCLA,[5] translating the paper-survey form into a mobile phone application with automated scoring and web-based mapping.

Indicator scores for each indicator category were created based on a survey of national experts, including city and transportation planners and consultants, and pedestrian advocates, regarding their importance to pedestrian environmental quality. PEQI scores reflect the degree to which environmental factors supportive of walking and pedestrian safety have been incorporated into street segment and intersection design. PEQI differs from PLOS in that it relates more to a general

[5] University of California at Los Angeles. http://www.stpp.ucla.edu/node/496

perception of comfort level. With the exception of traffic volume, all indicative data is collected via an observational survey. PEQI is more comprehensive than PLOS as PEQI considers elements such as sidewalk impediments, presence of street trees and furniture, and even the presence of graffiti, litter, and abandoned buildings. PEQI can also act as a facility condition survey and a major component of a facility database that also includes PLOS and independent pedestrian counts.

The PEQI scores street segments and intersections separately, on a scale from 0 -100 where the following twenty point intervals represent:

- 100-81 = highest quality, many important pedestrian conditions present
- 80- 61 = high quality, some important pedestrian conditions present
- 60- 41 = average quality, pedestrian conditions present but room for improvement
- 40- 21 = low quality, minimal pedestrian conditions
- 20 and below = poor quality, pedestrian conditions absent

In addition to the score for a specific street or intersection, it is also informative to compare street and intersection scores across an area to see if there are notable areas with more or fewer physical environmental factors supportive of walking – and to see how the scores are spatially related to known pedestrian attractors such as schools, parks, or transit stops.

Design and Maintenance

When conducting walkability audits, facility quality and dimensions should also be inventoried with the intent of upgrading the entirety of the existing pedestrian network to meet minimum walkway and ramp standards set forth in Chapter 18 of the New York State Highway Design Manual. The city should work with volunteer organizations to develop an inventory of assets and develop a targeted upgrade program and maintenance cycle.

Rochester's significant average annual snowfall presents additional pedestrian network maintenance challenges. The effectiveness of the City's municipal sidewalk plowing program should be evaluated noting residual snow left below plow level or during snow events of less than four inches of accumulation and the impact of thaw and refreeze cycles on sidewalk walkability. If effectiveness is a function of snow storage capability, policies such as temporary no parking zones for snow storage, should also be evaluated.

Existing policies that place the onus on property owners to remove snow from the sidewalk immediately in front of their property should be presented on the City's website in an interactive manner that includes specific standards, fine information, violation reporting, and payment. Spot enforcement of existing policies should

augment reporting, not just intended to ensure cleared sidewalks, but also to educate property owners.

Streetscape Improvements

Noting challenges related to walking distances in Rochester, streetscape improvements can improve perception of the walking environment such that residents consider longer walks to be viable. Streetscape elements serve many important functions. The City's Main Street Strretscape and Wayfinding Project can be looked as an example of new streetscape designed to improve conditions for pedestrians and encourage multi-modal transportation.

Street Trees

Street trees provide many benefits to the street including identity, shade, visual narrowing, visual amenity, and street edge definition. Street trees should be planted within the sidewalk buffer or planting strip on every street, whenever possible. Plantings should be in compliance with Rochester's Urban Forest Policy, updated in 2012 by the Forestry Division of the Bureau of Operations and Parks. Larger trees are recommended to create greater canopy and to provide more variety along corridors.

Street Lighting

Lighting improves both safety and the sense of security. Lighting should be carefully designed to avoid light pollution and light cast into adjacent buildings. Lighting should be as energy efficient as possible, either utilizing LED technology or deriving their power from renewable energy sources. Lighting should illuminate the sidewalk as well as the roadway, crosswalks, and other conflict points. Lighting is appropriate and desirable on all street types other than alleys, which may or may not be lit.

Lighting should provide consistent lighting levels and avoid high contrasts of light and dark areas. Lighting spacing and design should accommodate growth of street trees and installation of other pedestrian infrastructure. Lighting fixture types should generally be limited to a small number of approved standards. This contributes to a cohesive public realm and more cost-effective maintenance.

Street Furniture

Public seating creates more accessible and inviting streetscapes for all users, especially those with mobility challenges, by providing places to rest and enjoy the street environment. They may include benches, chairs, seat-walls, and other fixed structures.

Public seating should be limited to areas with higher concentrations of pedestrian activity, public parks, plazas, transit stops, and places where there is other demonstrated need. Seating locations should be carefully evaluated to ensure that

they will be visible, regularly used, and maintain clearance with pedestrian movement, loading areas, fire hydrants, and/or other street fixtures.

Seating may be aligned parallel or perpendicular to the curb. Seating parallel to and along the curb should be oriented toward the sidewalk and away from vehicular traffic, except where provided at transit stops. Like light fixtures, street furnishings and public seating should be of a standard type that is consistent throughout the city or neighborhood and easily and reliably procured. Street furnishings should be constructed from long lasting and durable materials and finishes and should be regularly inspected for damage to ensure that it remains safe and comfortable for all users.

Supportive Zoning

Zoning policy can support the creation of aesthetically desirable and interesting places to walk through standards for infill development that include building setbacks, first floor fenestration and sidewalk entry access requirements, and parking lot location requirements. These measures reinforce the feeling of enclosure along a sidewalk and the perception of personal safety.

Railroad Underpasses

Streetscape improvement programs should consider the pedestrian environment within the large number of railroad underpasses in Rochester. These walkways should be well lit and kept clean. The City should coordinate with facility ownership, CSX Transportation, to achieve this goal.

Adopt an Effective Programmatic Approach

The implementation by the City of a recognizable Active Transportation Program would better equip Rochester to allocate funding to pedestrian projects as it becomes available and set clear parameters for the City to make improvements through creative partnerships. Any program should facilitate coordination among public and private stakeholders and develop new methods for involving communities in pedestrian projects.

An active transportation program may also choose to approach certain issues more specifically through planning efforts such as:

- Safe access to parks and trails plans promoting play and healthy living
- Transit supportive pedestrian improvement programs that provide safe routes to stops as well as location improvements through amenities, roadway geometry changes, and accessibility enhancements
- Creative public campaigns designed to draw attention to other pedestrian initiatives by encouraging active transportation over short vehicle trips

If any of these initiatives are currently being provided in some way by other city departments, Active Transportation Program management should lead internal coordination efforts to ensure that all pedestrian-oriented initiatives are well-publicized and information able to found in one convenient location.

Expand Pedestrian Focused Wayfinding

Good wayfinding simplifies navigation and efficiently relays important information, which adds to sense of place and makes a district more vibrant and enjoyable. The 2012 Center City Pedestrian Circulation and Wayfinding Study is an excellent plan for enhancing the pedestrian environment within Rochester's Center City. The City should continue implementation of the plan that began in 2017 as part of the Main Street Streetscape Project while developing a maintenance plan for wayfinding signage and structures that includes timely updates as new attractions are built or change names.

The fundamental wayfinding system within the plan should be expanded to neighborhoods outside of the Center City adding some longer distance non-motorized wayfinding principles to intra-neighborhood wayfinding. Distinct visual neighborhood identities should be a part of neighborhood wayfinding signage while maintaining a recognizable family of signs between neighborhoods and downtown.

Present Meaningful Information Using a Pedestrian Interface

Present destination-based, pedestrian-oriented information including walking times in minutes on directional signage and maps.

- Include 5- and 10-minute walk "rings" on "you are here" map installations.
- Install guidance plaques distance and direction of popular pedestrian destinations.
- Install all wayfinding signage and markings at a pedestrian level.

Emphasize Symbols over Text

Use internationally recognized symbols to convey information to the greatest number of people.

Emphasize Non-Motorized Routes in Maps

The City should ensure that official maps identify all pedestrian way-through options, including short pedestrian bridges over Interstate 490. The City should also engage partners who produce independent publications to further ensure that map standards involving non-motorized transportation modes are met in all publicly distributed literature.

Guide Users of Multiple Transportation Modes

As all residents and visitors become pedestrians at some part of their trip, use wayfinding signage to guide drivers to and from parking facilities, transit riders to bus routes and stations, and general visitors to riverfront access points and commercial/cultural/recreational destinations.

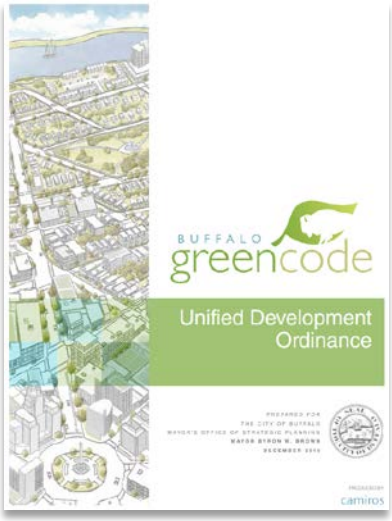
Ensure Consistency

Coordinate with all major generators of wayfinding signage to develop a seamless series of visual cues for pedestrian navigation.

Promote Walkability to Out-of-Town Visitors

Coordinate with hotels to promote area walkability and encourage the use of active transportation alternatives.

6 Best Practices

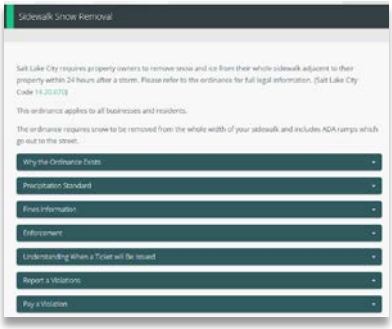


Crosswalk Design

Buffalo's recently adopted Unified Development Ordinance, or Green Code,[6] requires marked crosswalks where greater pedestrian visibility is desired, where two or more transit routes cross, where traffic volumes exceed 2,000 vehicles per day, and at crossings within certain zoning designations. High visibility striping, explicitly the continental pattern, is preferred. This has enabled neighborhood and other groups to install temporary high visibility crosswalks on non-state radoways.

Pedestrian Facility Quality Analysis

Over 2,300 miles of roadway corridors within the Richmond, VA Area MPO were analyzed for pedestrian level of service in order to identify nodes and corridors to guide regional pedestrian improvements. Additionally, individual facility and improvement selection criteria were created.[7]

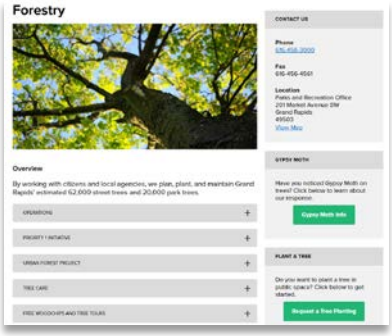


Snow Removal Policy

Salt Lake City describes their sidewalk snow removal ordinance on an interactive page within their city website. Citizens can clearly access precipitation standards and timing, fines information, report violations, and pay for received violations.

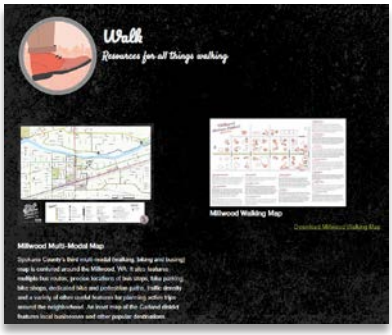
[6] City of Buffalo. Chapter 496, Unified Development Ordinance. Article 10 Section 2.4.B.3

[7] Virginia Department of Transportation. Richmond Regional Bicycle and Pedestrian Plan. Strategies A-2, B-3



Street Tree Canopy

The City of Grand Rapids has set a goal of a 40% tree canopy. By filling all available planting sites on City streets, they were able to raise canopy coverage to 34%. Grand Rapids is now endeavoring to plant on private property and in parks through their Urban Forest Project. This and other forestry initiatives, studies, and a tree planting request tool, are available on an easy-to-use web interface.



Active Transportation Program

The Spokane Region Health District, analogous to the Monroe County Health Department, encourages physical activity in everyday routines through its Walk Bike Bus Spokane program. The program offers residents individual support including information and products specific to walking, educational workshops and events, guidance from trained staff, incentives specific to program sign-on and tracking miles-traveled.

7 Priority Projects

- Create an active transportation program to streamline funding allocation to pedestrian projects.
- Conduct a pedestrian environmental quality and facility condition assessment as an initial input to a pedestrian network database.
- Conduct additional intersection PLOS analyses to identify worst pedestrian delays and highest likely exposure to collisions due to non-compliance.
  - Follow up with pedestrian counts to complete the pedestrian network database and to help identify specific improvement locations.
  - Work with MCDOT to implement LPI where not already implemented and where service level is Grade D or lower.
  - Reconfigure identified intersections to align crosswalks with state standards, reduce crossing distances, and reduce turning speeds by tightening curb radii.
- Install RRFBs to facilitate mid-block crossing along long intervals with no controlled intersections, and where appropriate criteria are met. Consider the following locations for appropriateness screening:
  - Mt. Hope Avenue between Highland and Elmwood Avenues
  - Lake Avenue between Flower City Park and Driving Park Avenue
  - Upper Falls Boulevard between Joseph and Hudson Avenues
  - Others as identified by Focus Group
- Expand the pedestrian wayfinding system to simplify navigation on foot within and between neighborhoods.

8 Appendix

Pedestrian LOS Calculation

The expected pedestrian delay while waiting to cross the street is computed with the equation below:

$$d_p = \frac{(C - g_{walk})^2}{2C}$$

Where d_p is pedestrian delay, g_{walk} is the sum of the duration of the walk and flashing don't walk signals, and C is the total signal cycle length.

The LOS Score for the crossing, given as I_p, is calculated as:

$$I_p = 0.5997 + \ln d_p$$

Figure 13 lists scores associated with each PLOS.

Figure 13 Pedestrian Level of Service Criteria

LOS	LOS Score
A	Less than or equal to 2.00
B	Greater than 2.00, less than or equal to 2.75
C	Greater than 2.75, less than or equal to 3.50
D	Greater than 3.50, less than or equal to 4.25
E	Greater than 4.25, less than or equal to 5.00
F	Greater than 5.00

City of Rochester
Comprehensive Access and Mobility Plan

Transit Ready City Report

NELSON
NYGAARD

Cover photo from patrickashley via wikimedia

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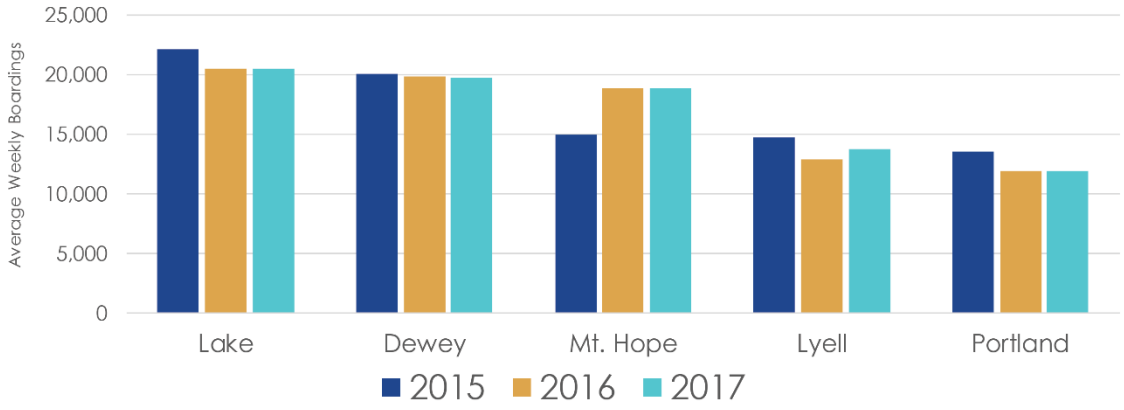
1 Introduction

Hundreds of bus transit trips carry tens of thousands of Rochester residents throughout the City every weekday. Service frequency and service day span are inconsistent, however, leading to a loss of personal time for users, a lack of competitiveness with other transportation modes, and decreasing ridership on non-express corridors. At most stops within the network, users must also wait for and board buses in spaces lacking urban programming, burdened by weather extremes during all seasons.

Figure 1 Average Weekly Boardings on Highest Ridership Corridors



Source: Regional Transit Service

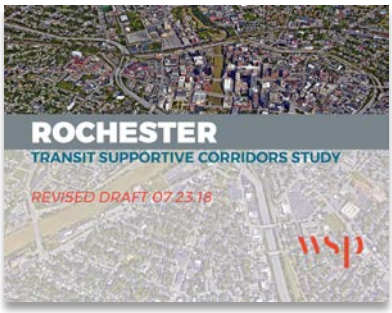
Efforts are underway by the local transit agency, Regional Transit Service (RTS), to fundamentally transform the transit network through reassignments of service to high priority corridors from those that are currently underperforming. This reallocation of resources that allows for more frequent transit service also creates an opportunity for the City to advance development policies and invest in additional infrastructure along these corridors.

The Transit Ready City Report endeavors to identify a standard inventory of transit-supportive streetscape enhancements for different stop typologies in order to prioritize supportive investments. A stop hierarchy based on intersection points of newly proposed crosstown routes and high frequency corridors is suggested while supportive right-of-way configurations are explored. Supportive technologies such as first/last mile connections and real time coordination are identified along with corresponding collaborative agencies. Finally, a peer review of best practices, coupled with a concurrent assessment of transit-supportive development potential, identifies priority investment locations for the deployment of supplemental transit-supportive infrastructure by the City of Rochester.Previous and Ongoing Studies

Studies currently in progress are supported by past work that attempts to create an environment that prioritizes the movement of transit users along and across city streets. The following excerpts provide brief descriptions of select plans and policies led by both the City and RGRTA, focused on the ways each impacts or creates a need for transit supportive infrastructure.

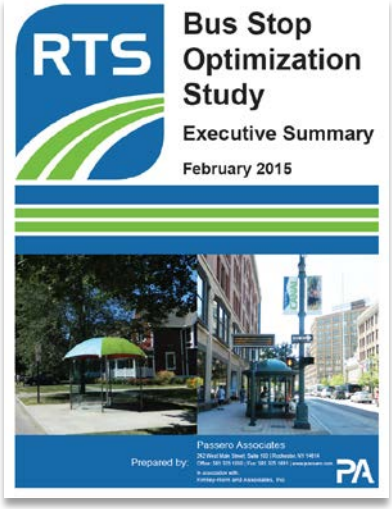
Reimagine RTS – 2018

- A refocusing of the transit system to deliver a comprehensive frequent transit network
- Alignment changes focused on creating a more connected network that reduces the need for customers to transfer at the Downtown Transit Center
- Areas that are not fixed-route transit supportive due to low densities, disconnected development patterns, or poor road network structure and have existing RTS service are proposed as Community Mobility Zones to pilot more cost-effective mobility solutions



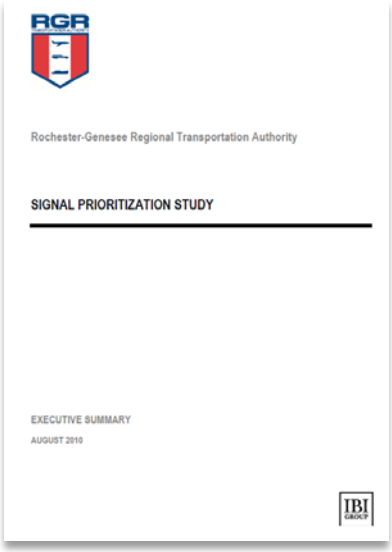
Transit Supportive Corridors Study – 2018

- Identifies corridors for transit supportive development where transportation, land use, development policy, planning, and decision-making are better coordinated, and where resulting development makes it easier for people to use transit, walk, or bike as their preferred method of local travel
- Identifies supportive land use, development, and zoning strategies for these corridors



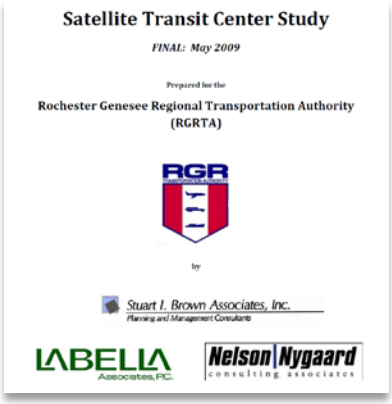
Bus Stop Optimization Study – 2015

- Evaluates approximately 3,400 bus stops in the RTS Monroe County service area
- Provides recommendations to improve the placement of stops



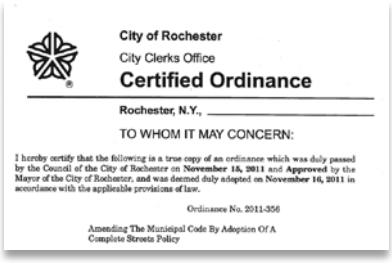
Signal Prioritization Study – 2010

- Identifies two corridors (Lake and Dewey Avenues) that would benefit most from transit priority implementation measures
- Assesses traffic signal control systems and provides a market comparison of alternative systems
- Examines the concept of applying a Center-to-Center approach to transit signal priority implementation



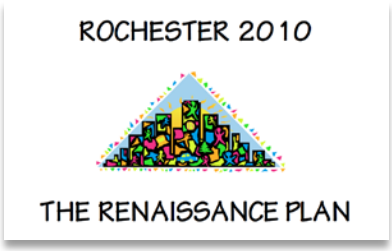
Satellite Transit Centers Study – 2009

- Evaluates the viability of 19 potential sites to serve as a satellite transit center
- Selects four sites for further consideration, one site for transit supportive development in conjunction with economic development, and six sites for enhancements


City of Rochester
City Clerks Office
Certified Ordinance
Rochester, N.Y., _____
TO WHOM IT MAY CONCERN:
I hereby certify that the following is a true copy of an ordinance which was duly passed by the Council of the City of Rochester on November 15, 2011 and Approved by the Mayor of the City of Rochester, and was deemed duly adopted on November 16, 2011 in accordance with the applicable provisions of law.
Ordinance No. 2011-356
Amending The Municipal Code By Adoption Of A Complete Streets Policy

Complete Streets Policy – Adopted 2011

- Ensures that all future street design efforts will fully consider the needs of pedestrians, bicyclists, transit users and persons with disabilities
- Helps to improve safe access for transit riders by installing and maintaining crosswalks and ADA-compliant ramps as well as reducing crossing distances for those making transit connections



Rochester 2010: The Renaissance Plan

- Outlines the City's goals, principles, and implementation actions related to areas including economic development, environmental management, infrastructure, land use/zoning, and mobility/transportation
- Outlines a Vital Urban Village concept, which includes providing infrastructure and streetscape amenities to facilitate increased transit use

2 Priority Corridors

The Reimagine RTS initiative represents the largest set of transit system changes in decades. The recommendations provided in draft reports at the time of this writing, are guiding all other studies related to supportive economic and infrastructure development. Central to priority corridor identification is the new frequent network proposed by RTS, consisting of 10 major corridors, and featuring 15-minute frequency from the AM peak through the PM peak. The frequent network allows transit to truly compete as an urban transportation mode, promoting less car-dependent lifestyles and denser development patterns.

Identification

Frequent network corridors make up ten of the twelve corridors considered and evaluated by the Transit Supportive Corridors study. These corridors represent a logical starting point for transit enhanced infrastructure and priority technology investment.

Figure 2 Recommended Future Frequent Network Corridors

Corridor	Start	Stop
Lake Avenue/State Street	Main Street	Eastman Avenue
Genesee Street/Elmwood Avenue	West Main Street	Mount Hope Avenue
West Main Street/Chili Avenue	Transit Center	City Limit
Dewey Avenue/Broad Street	West Main Street	Eastman Avenue
Hudson Avenue	North Street	City Limit
East Main Street	Transit Center	Winton Road
North Street/Portland Avenue	East Main Street	City Limit
Joseph Avenue	Transit Center	Hudson Avenue
Monroe Avenue	East Main Street	Highland Avenue
Lyell Avenue	Lake Avenue	City Limit

Figure 3 Reimagine RTS – Recommended Future Transit Network

Source: Rochester-Genesee Regional Transit Authority

Street Design and Public Realm

The priority corridors (Frequent Network) identified in Figure 3 are lined by a mix of neighborhood business districts, recreational facilities, schools, and family homes. Transit supportive enhancements within these corridors should be designed to contribute to and enhance corridor character while supporting typical corridor activities.

The following paragraphs describe the ideal characteristics of the building blocks of transit-supportive infrastructure installed adjacent to the roadway. While certain elements, such as bus stop sign design, are the responsibility of the transit authority, the City should use its relationship as well as its representatives on the Board of Commissioners to encourage the application of these practices.

Bus Stop Sign

Bus stops should all include consistently updated and attractive signage conveying essential information to increase customer satisfaction and understanding of the bus system. Basic information includes route numbers and names, stop ID number, the direction of the routes, a phone number and/or website for additional assistance, and often destination(s) and times served. A stop ID number is often used to access real-time schedule information via text message, web/app, or an automated phone system. These details help to reduce visitor confusion and increase rider comfort at stops. All bus stops should have a consistently maintained bus stop sign on the far side of the boarding area and be placed on a pole at a height that conforms to the Americans with Disabilities Act (ADA) and does not get in the way of pedestrian movement on the sidewalk.

Figure 4 Basic Bus Stop Sign

Source: Nelson\Nygaard

Shelter

Shelters offer a prominent and safe protective waiting area for bus passengers, traditionally including informational signage about the bus service and surrounding land uses. Shelters protect transit riders from the elements and help to identify stop locations by defining a sense of place along a roadway or at a transit center. Shelters should be placed at stops with higher ridership or those that serve as transfer points.

Figure 5 Shelter with Seating

Source: RTS

Numerous suppliers provide off-the-shelf bus stop shelter designs and the City of Rochester can choose to customize shelter designs to fit specific stop locations and needs. Shelters typically have at least two walls, a roof, seating, and a clear space for customers using a wheelchair. Bus shelters should provide a clear line of sight to approaching buses. Many shelter designs incorporate glass or plastic walls in order to provide multiple lines of sight.

Seating

Benches can be freestanding or part of a shelter design. They provide seating for passengers waiting for the bus, particularly at locations where service is less frequent (headways longer than 15 minutes) or near sites that attract riders who may have difficulty walking and standing. Seating should be provided at every stop where it would not compromise safety or obstruct sidewalk access or access to customer information. Benches should be fabricated of durable materials resistant to vandalism and weather conditions.

Figure 6 Basic Bus Stop Seating

Source: Nelson\Nygaard

Lighting

Adequate lighting at bus stop facilities allow bus drivers and approaching traffic to see waiting passengers at night. Lighting also provides added security for those waiting at the stop, in addition to illuminating route and schedule information for patrons. Lighting can be provided by a nearby streetlight, ambient light from the adjacent businesses, lighting installed within the shelter, or a standalone light pole. Transit stops without sheltered lighting should be located within 30 feet of an overhead light source. Where this is not possible, solar-powered actuated lights are available that not only light the waiting area for a timed duration, but also notify oncoming buses that a stop is requested. Light installed within the shelter should not be so bright as to create a spotlight effect that makes it difficult for waiting passengers to see outside.

Figure 7 Indirect and Direct Stop Lighting

Source: Nelson\Nygaard

Waste and Recycling

Bus stops, both those with and without shelters, can offer both trash and recycling receptacles to help keep the stop area free of debris, food scraps, or other refuse generated by waiting bus passengers on a daily basis. Receptacles should be durable, visible, and placed conveniently without blocking major pedestrian movements. Bus stops that have a problem with litter and those in proximity to fast food establishments should have trash receptacles. Receptacles should be of a standard type, closed at the top to prevent rain, snow, or other precipitation from entering, and easy for maintenance workers to access and empty. Maintenance can be completed through a private

Figure 8 Bus Stop with Waste and Recycling

Source: Nelson\Nygaard

maintenance agreement. Design should be consistent, but receptacles can be customized with artwork or advertising specific to stop locations.

Bicycle Parking

Permanently and individually installed bicycle racks bearing an "upside-down U" shape provide an opportunity for bus passengers arriving by bicycle to securely park their bike during the length of their bus trip. Groups of bicycle racks may be covered and secured in lockers or a shelter with gated access to provide an additional benefit to long-term bicycle parkers by protecting bicycles and related gear from weather or theft. Lockers should be clearly labeled as bicycle parking and signs should be posted with directions for use. Larger bicycle parking stations can have vertical hanging racks, typically require a unique maintenance plan, and are often operated as a concession or contract service.

Figure 9 Bicycle Parking at Bus Stop

Source: Nelson\Nygaard

Sufficient spacing between racks enables two bicycles to fit comfortably on each rack. Installations should be consistent with the Association of Pedestrian and Bicycle Professionals (APBP) Bicycle Parking Guidelines.

Real Time Information

An electronic display at bus stops showing the number of minutes until the next arrival of each operating bus route at that very stop can help improve the passenger experience. Knowledge of how long a passenger must wait until the next bus is important for rider comfort, especially at stops where the average waiting time is longer than every 10-15 minutes.

Figure 10 Real Time Information at Transfer Point

Source: Nelson\Nygaard

Fare Vending Equipment

At major bus stops and transfer stations, the installation of fare payment/purchase equipment can improve customer convenience and service reliability by reducing on-board cash transactions and bus stop dwell times. Off-board fare payment vending machines and associated instructional signage typically require a 10' by 10' footprint for two machines and should be semi-enclosed. The potential need for wired connections for power or communications can restrict the number of potential deployment sites.

Figure 11 Remote Fare Vending Equipment

Source: Nelson\Nygaard

3 Stations and Stops

Given limited resources, improvements made to passenger facilities across the system should be prioritized by both the type of improvement being made and locations most in need of that improvement. A set of well-defined bus stop typologies can help the City target the most appropriate locations. When deciding the desired typology of each bus stop, consider the total number of daily boardings at the location, the number of routes serving the corridor, and any special populations served by the stop. The City of Rochester should be directly involved in the stop improvement process as the easement providing entity in the public right-of-way.

Basic Bus Stops

The Basic Bus Stop represents the lowest level of service within the stop hierarchy. The bus stop sign is included as a matter of course in identifying the stop location while other amenities described in Figure 15 should be provided to improve the overall level of comfort of users interfacing with the system.

The boarding area at a basic stop should be made of concrete or other paving material. The stop should be well lit, potentially taking advantage of nearby street lighting. Simple seating on site is optional, but recommended.

Enhanced Bus Stops

Enhanced Bus Stops are ideal for locations along a corridor that experience a high number of boardings. All elements included at a basic stop should be present as well as a well-lit shelter with seating and waste/recycling receptacles.

Optional elements at enhanced bus stops include bicycle parking to promote last mile connections, a real-time information display listing anticipated bus arrival times, and a temporary heat source that can be actuated by waiting passengers in cold temperatures.

Transfer Points

In addition to recommending frequent network corridors, the Reimagine RTS initiative describes a number of crosstown routes, listed in Figure 13, that fundamentally change the nature of the network by filling in service gaps created by the geometry of Rochester's radial street grid. A route including the South Goodman Street corridor bridges a wide gap between the diverging South Clinton Avenue and East Main Street corridors. Likewise, crosstown service along Upper Falls Boulevard connects the heavily traveled, but divergent Hudson and Lake Avenue corridors.

Figure 12 Proposed Crosstown Corridors

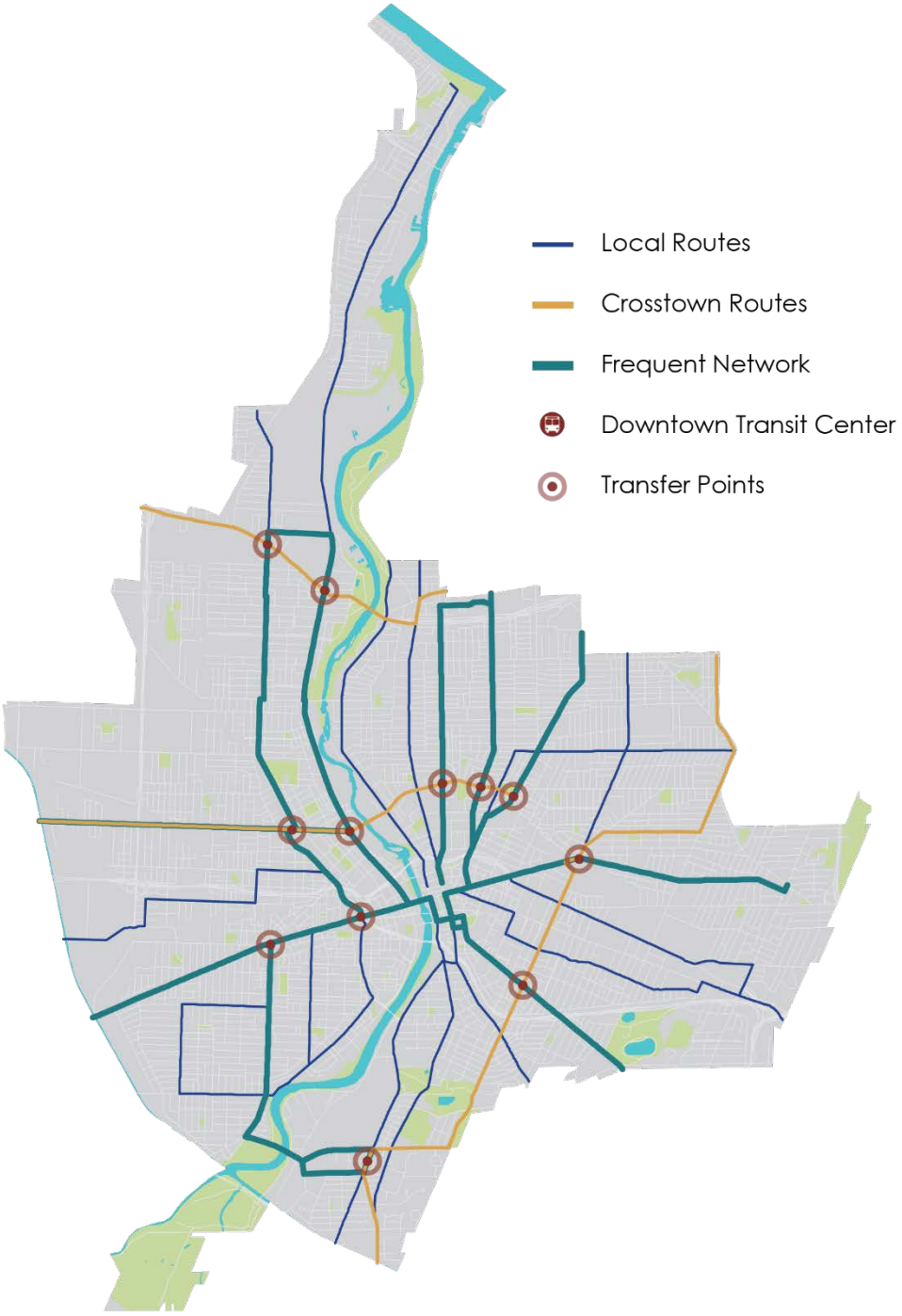
Corridor	Start	Stop
Ridge Road/NY-104	Elmridge Center, Greece	Skyview on the Ridge, Irondequoit
East Henrietta Road/Mount Hope Avenue/ Elmwood Avenue/South Goodman Street/ Parsells Avenue/Culver Road	Marketplace Mall, Henrietta	Skyview on the Ridge, Irondequoit
Lyell Avenue/Upper Falls Boulevard	Howard Road, Gates	Portland Avenue

A previous study conducted by RTS in 2009 identified candidate locations for Satellite Transit Centers. The preferred site for a large format transit center identified in the report was to be locatied along Mt. Hope Avenue between Crittenden Boulevard and Elmwod Avenue. While not constructed as part of the development of Collegetown, the location remains a point of emphasis in the Reimagine RTS plan. Connection Hubs are proposed throughout the revised service area at key network connection points, such as the University of Rochester Medical Campus, Eastman Business Park, and North Winton Village.

The Transit Ready City report revisits this concept with a scaled-back version by proposing a new bus stop typology. Transfer Points where either crosstown routes intersect the frequent network, or where multiple frequent network routes serve a single intersection before diverging, are primary candidates for the full suite of stop amenities. Transfer Points may feature multiple stop locations on intersecting streets surrounding an intersection.

Transfer Points should feature all compulsory and optional amenties at basic and enhanced stops in addition to fare vending equipment such as machines currently used at the Downtown Transit Center. While cognizant that RTS has no current plans to install fare vending machines at location other than the Transit Center, the City should encourage RTS to consider installation in appropriate remote locations as a long-term planning goal. Shelters should be larger and real-time fare information displays more robust. Bicycle parking should be immediately adjacent to the enhanced shelter.

Figure 13 Reimagine RTS – Recommended Crosstown Routes and Proposed Transfer Points



Source: Rochester-Genesee Regional Transit Authority

Figure 14 Proposed Transfer Point Locations

Frequent Network Corridor	Intersecting Corridor(s)
East Main Street	Goodman Street (Culver Road Crosstown)
Portland Avenue	Draper Street (Lyell/Upper Falls Crosstown)
Hudson Avenue	Upper Falls Boulevard (Lyell/Upper Falls Crosstown)
Joseph Avenue	Upper Falls Boulevard (Lyell/Upper Falls Crosstown)
Lake Avenue	Lyell Avenue (Lyell/Upper Falls Crosstown)
Lake Avenue	Ridge Road (Ridge Road Crosstown)
Dewey Avenue	Ridge Road (Ridge Road Crosstown)
Dewey Avenue	Lyell Avenue (Lyell/Upper Falls Crosstown)
West Main Street	Broad Street (Dewey Short and Long Lines, Jay/Maple, Plymouth)
West Main Street	Genesee Street (Genesee)
Mount Hope Avenue	Elmwood Avenue, East Henrietta Road (Genesee, Marketplace, Thurston/MCC, South, Culver Road Crosstown)
Monroe Avenue	Goodman Street (Culver Road Crosstown)

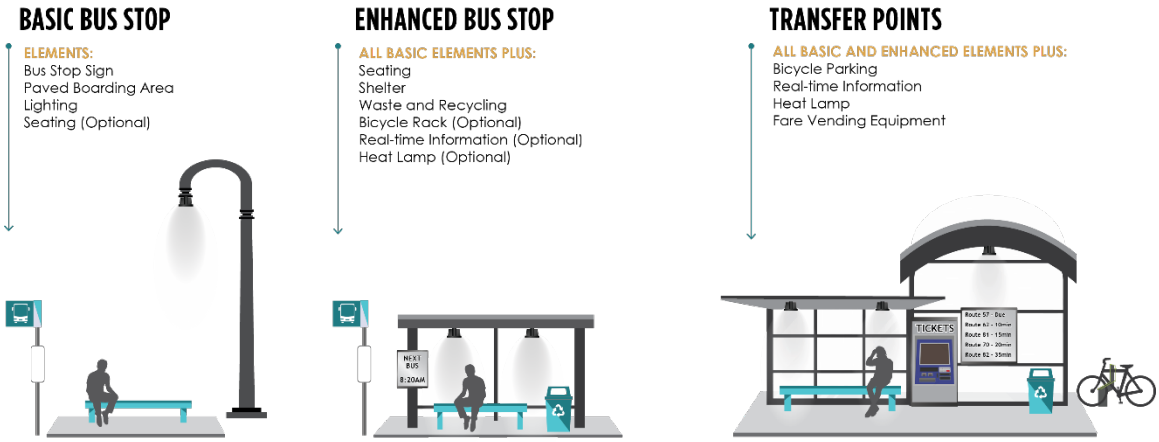
Stop Hierarchy and Requirements

The table and graphic below provide a guide for the inclusion of the streetscape and stop infrastructure elements described in Chapter 2 for each bus stop typology described in this chapter. While RTS maintains its own amerity placement criteria, the City may choose to maintain a set of guidelines in order to supplement those provided by RTS as opportunities arise. For all presented typologies, some features may be omitted where the primary observed stop activity is alighting passengers rather than boarding passengers.

Figure 15 Suggested Stop Hierarchy

Bus Stop Element	Basic Stop	Enhanced Stop	Transfer Points
Bus Stop Sign	Yes	Yes	Yes
Seating	Yes	Yes	Yes
Lighting	Yes	Yes	Yes
Shelter	No	Yes	Yes
Waste and Recycling	No	Yes	Yes
Bicycle Parking	No	Optional	Yes
Real-Time Information	No	Optional	Yes
Heat Lamp	No	Optional	Yes
Fare Vending Equipment	No	No	Yes

Figure 16 Stop Hierarchy Visual Representation



Source: Nelson\Nygaard

Supportive Right-of-Way Considerations

The City has a more direct level of control over transit network enhancements within non-state owned roadways. The physical interface between the bus and curb can be altered to support transit service objectives. On street bus stops like those described earlier may locate the bus loading area in a travel lane, a parking lane, or the shoulder depending on the characteristics of the roadway. While on-street bus stops are the most common and the easiest to establish, there are some site considerations in location evaluation. Parked cars must not block bus access to acceleration/deceleration areas or the curb, rendering the stop inaccessible to customers who use wheelchairs.

Intersection sight distance is an additional consideration whenever structures such as shleters with non-transparent walls housing information and fare equipment are

recommended for installation near an intersection. Closest allowable proximity to the curb and crosswalk should be computed in accordance with the latest revision of AASHTO's (American Association of State Highway and Transportation Officials) *A Policy on Geometric Design of Highways and Streets*. Alternately, intersections with insufficient visibility can be reconfigured to be more compact. Compact intersections reduce the size of the sight triangle, giving all users better view of potential conflicts.

The City may choose to implement one of a pair of roadway configurations, curb extensions and bus turnouts, to address some of these issues while accomplishing other service goals. Note that a public comment period and City Council approval are required to alter pavement widths on City-owned roadways.

Curb Extension

A curb extension, also known as a bulb out, is a widening of the sidewalk to extend the bus stop loading and waiting area into the parking lane which is directly adjacent to the travel lane. Curb extensions are most effective in denser environments with high pedestrian activity or areas where the sidewalk is too narrow to accommodate a bus stop. In these locations, curb extensions provide a larger bus stop footprint that can accommodate shelters, benches, and other transit customer improvements as well as reduce interference with pedestrian activity on the sidewalk. Curb extensions also reduce the need to displace parking spaces since a bus serving a stop on a curb extension will stop in the traffic lane instead of traveling into the parking lane as they do at curbside bus stops. Finally, curb extensions work well in conjunction with crosswalks by reducing the crossing distance for pedestrians.

Figure 17 Shelter at Curb Extension

Source: Nelson\Nygaard

Curb extensions should be considered at sites with the following characteristics:

- High pedestrian activity
- Crowded and/or narrow sidewalks
- A need to reduce pedestrian crossing distances
- Bus already stops in travel lane
- The need to minimize loss of street parking
- There are multiple travel lanes, enabling vehicles to bypass a stopped bus

Bus stops on curb extensions require different footprints than curbside bus stops. Since a bus serving a stop on a curb extension will stop in the traffic lane instead of traveling into the parking lane, the required length of the loading area is shorter.

Stops located along a curb extension should be designed to the following minimum dimensions:

- 30’ bus stop length (46’ bus stop length for stops served by articulated buses)
  - Based on 22’ (40’ bus) and 36’ (articulated) centerline front door to rear door distance
- 5’ by 8’ concrete landing pad
- 4’ by 10’ rear door clear zone

Bus Turnout

A bus turnout, or bus bay, is a stop with a pull-out for buses that is constructed as an inset into the curb. The bus bay allows buses to pull out of traffic for loading and unloading, allowing general traffic to pass the loading bus. Bus turnouts are most effective in areas where the impact of a bus blocking a travel lane creates significant traffic delays or where long dwell times are common. In these locations, bus turnouts allow buses to service the stop while minimizing traffic delays and conflicts with traffic. Bus turnouts also clearly define the bus stop and allow customer loading and unloading to be conducted in a more relaxed manner.

Figure 18 Bus Stop at Bus Turnout

Source: Nelson\Nygaard

However, bus turnouts can make it difficult for buses to re-enter traffic, which can increase bus delays, decrease service reliability, and increase average bus travel time. Bus turnouts may also require right-of-way acquisition. Additionally, bus turnouts may reduce sidewalk width and impact pedestrian traffic.

Bus turnouts should be considered where any of the following conditions exist:

- Average peak period dwell time exceeds 30 seconds per bus
- There is a high frequency of accidents involving buses and/or pedestrians
- Bus volumes exceed 10 or more buses per hour
- Where stops in the curb lane are prohibited
- Where sight distances prevent traffic from stopping safely behind a stopped bus
- At stops where there are frequent wheelchair boardings
- Where buses are expected to layover at the end of a trip

Bus stops located along bus turnouts require slightly different footprints than typical curbside bus stops. Since a bus serving a stop in a turnout will pull out of the general travel lane into a tapered pull-in area, a longer bus stop length (60') is required, as the bus will use the pull-in area for its approach as well as a similar tapered pull-out area to rejoin the travel lane.

Stops located in a bus turnout should be designed to the following minimum dimensions:

- 60' bus stop length (80' on corridors employing articulated buses)
- 5' by 8' concrete landing pad
- 4' by 10' rear door clear zone

Evolution of the Transit Center

As the frequent and crosstown networks change, operational demands on the Downtown Transit Center will change. While these changes are primarily the concern and responsibility of RTS, the City should be prepared to play a supportive role.

Current functional limitations of the Downtown Transit Center require the use of adjacent Mortimer Street to accommodate articulated buses and other select routes. Passengers must exit the transit center, cross an exit driveway and an additional city street to access that secondary boarding area, which is not climate controlled like the main Transit Center.

Currently, the City allows stops on Mortimer Street, across from the Transit Center building, as an extension of the Transit Center. A small number of shelters are built against the exterior wall of the Mortimer Street Garage while the public sidewalk and curbside are used as waiting and staging areas. At the time of this writing, the City had recently reached an agreement to sell the Mortimer Street Garage to a private

operator. The City should assess the terms of the sale, paying special attention to any surviving easements to better understand its ability to continue to support RTS' goal to convert a portion of the Mortimer Street Garage into an extension of the Transit Center that focuses on connections to non-fixed route mobility services.

Connections to Intercity Services

Transit service between the new Louise M. Slaughter Rochester Intermodal Station and the Downtown Transit Center is currently uncoordinated. The inclusion of the Joseph Avenue corridor in the frequent network creates an opportunity to integrate this transportation gateway into the regional transit system that would not require a special shuttle service or additional dedicated vehicle.

The Intermodal Center is currently owned by Amtrak, while New York State owns the current Greyhound/Trailways site immediately south. As such, the City should advocate for and provide any required roadway configuration support for a minor routing adjustment of the Joseph Avenue frequent corridor. Inbound buses would turn right from Joseph Avenue, travel the block of Central Avenue immediately in front of the Intermodal Center, then turn left onto Clinton Avenue while outbound buses would continue on Clinton Avenue beyond its split with Joseph Avenue, turn right onto Central Avenue, then turn left to join the Joseph Avenue corridor.

The City should reserve land for and work with RTS to create bus stops on each side of Central Avenue that are comparable to those appropriate for the Transfer Points described in Chapter 3. These stops would serve both the current intercity transportation setup, where Greyhound/Trailways is located across Central Avenue from the Intermodal Station, as well as the envisioned joining of the two facilities on the north side of Central Avenue.

Neither the recommended transit network nor proposed mobility hub extensions retain connections to the Greater Rochester International Airport. In addition to its role as a major intercity transportation facility, the airport site serves as the region's primary rental car center. Noting the airport's capacity to serve as an intermodal mobility hub, the City should encourage RTS to maintain a system connection to the airport, not necessarily direct to Downtown, but at minimum directly linked to the frequent network via alternative mobility options.

4 Facility Support

The City can further support the transit system through the configuration of other physical facilities. Travel lane and roadway treatments, strategic active transportation investments, expanding the geographical reach of curbside management policies, employing technology to increase efficiency, recognizing specialized operating needs, and attention to unique maintenance issues are ways the City can make the most of planned regional transit investments.

Operational Network Features

In addition to roadway improvements related to stops, there are roadway improvements that can be made to the transit system through management of travel lanes along identified transit corridors. These improvements attempt to prioritize transit as a more efficient way to move more people, rather than vehicles, through a transportation corridor.

Dedicated Transit Lanes

Dedicated transit lanes are used to speed up frequent bus services on busy streets, especially those corridors with frequent service. Owing to the high passenger capacity of transit, a dedicated transit lane can drastically increase the amount of people that can move along a street during congested times of day. Since dedicated transit lanes reduce traffic delay for transit users, they are an important part of encouraging transit use by making the service faster, more reliable, and more enjoyable. Pavement markings, signage, and enforcement are important to maintain the integrity of dedicated lanes.

Dedicated lanes can be:

- **Curbside** – Best on streets with no on-street parking at designated operating hours, few driveways and limited right-turning traffic
- **Offset** – On multi-lane roads next to a parking lane with bulb-outs
- **Median** – Operating in the center lanes separated from general traffic with median islands for boarding
- **Contraflow** - Transit operates bi-directionally on a one-way street for efficient connectivity

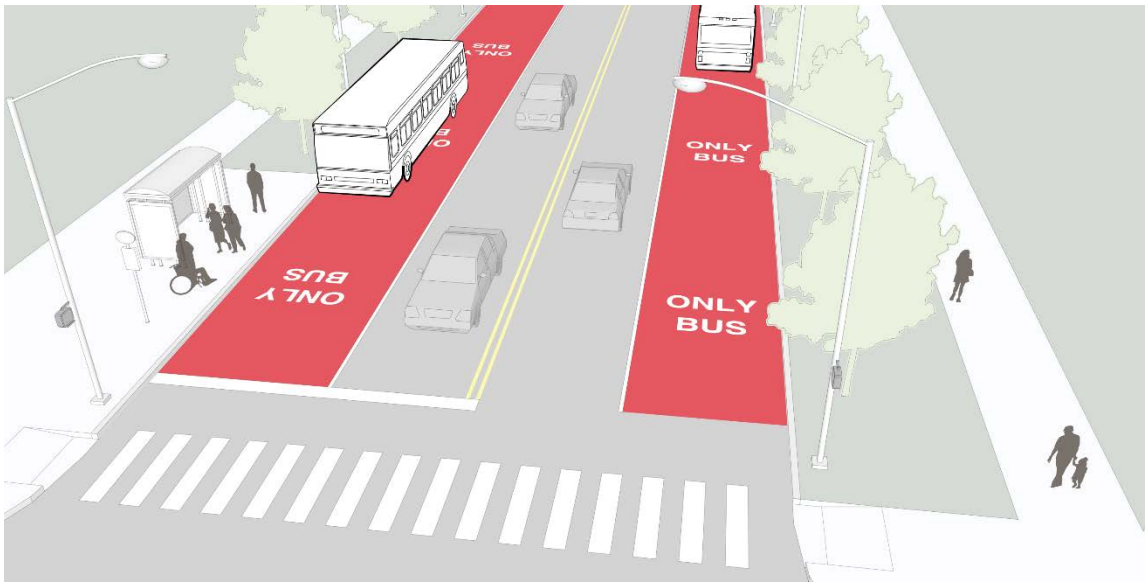
Transit lanes are used only on corridors where transit service is very frequent, ridership is high, and traffic congestion significantly and routinely impedes transit operations. Transit lanes may be permanent or time restricted—reserved for transit vehicles only at peak hours of the day and permitted for other uses at other times.

Transit lanes can be marked by red colored pavement as a visual cue to drivers to obey rules regarding bus lanes. This practice reduces unauthorized bus lane use,

especially illegal parking and/or standing. Currently, the use of red colored pavement to denote a bus lane requires approval from the FHWA's Office of Transportation Operations. Applicants should be able to demonstrate that increased public transit vehicle travel speeds and reduced overall corridor service time would be expected. Also, the application of the colored pavement to what was previously a general purpose lane should not adversely affect the traffic flow in the remaining general purpose lanes.[1]

Epoxy street paints on new asphalt are proven to last the longest of bus lane red paint treatments; three to five years without failing while wearing faster at bus stop locations.[2] The same epoxy street paints applied to existing asphalt typically fail in less than one year.

Figure 19 Dedicated Transit Lanes



Source: Nelson\Nygaard

Shared Transit Lanes

A shared lane reserved for transit vehicles and bicyclists can provide improved accommodation for both road users to maneuver together as transit vehicles start and stop along a corridor. Shared lanes are most appropriate on streets where bus volumes are high, but where headways exceed four minutes, where bicycle volumes and vehicular speeds are not very high (20 miles per hour or less), and where space constraints preclude exclusive facilities for each. Further, shared transit lanes are only

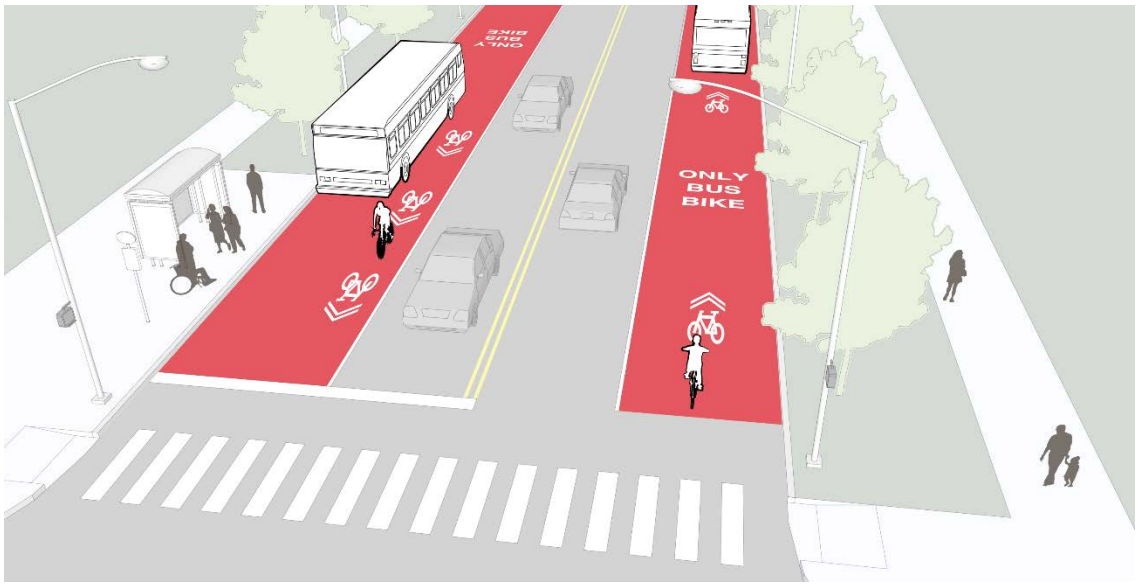
[1] Federal Highway Administration. MUTCD Interpretation Ltter 3(09)-24(I) – Application of Colored Pavement. https://mutcd.fhwa.dot.gov/resources/interpretations/3_09_24.htm

[2] New York City DOT. Red Bus Lane Treatment Evaluation. https://nacto.org/docs/usdg/red_bus_lane_evaluation_nycdot.pdf

recommended along corridors for which a bicycle facility cannot be provided on a nearby parallel street.

The shared lane is typically wider than a dedicated transit lane. They should be located in the outermost lane adjacent to a curb to reduce conflict.[3]

Figure 20 Shared Transit Lanes



Source: Nelson\Nygaard

Bus Queue Jump Lanes

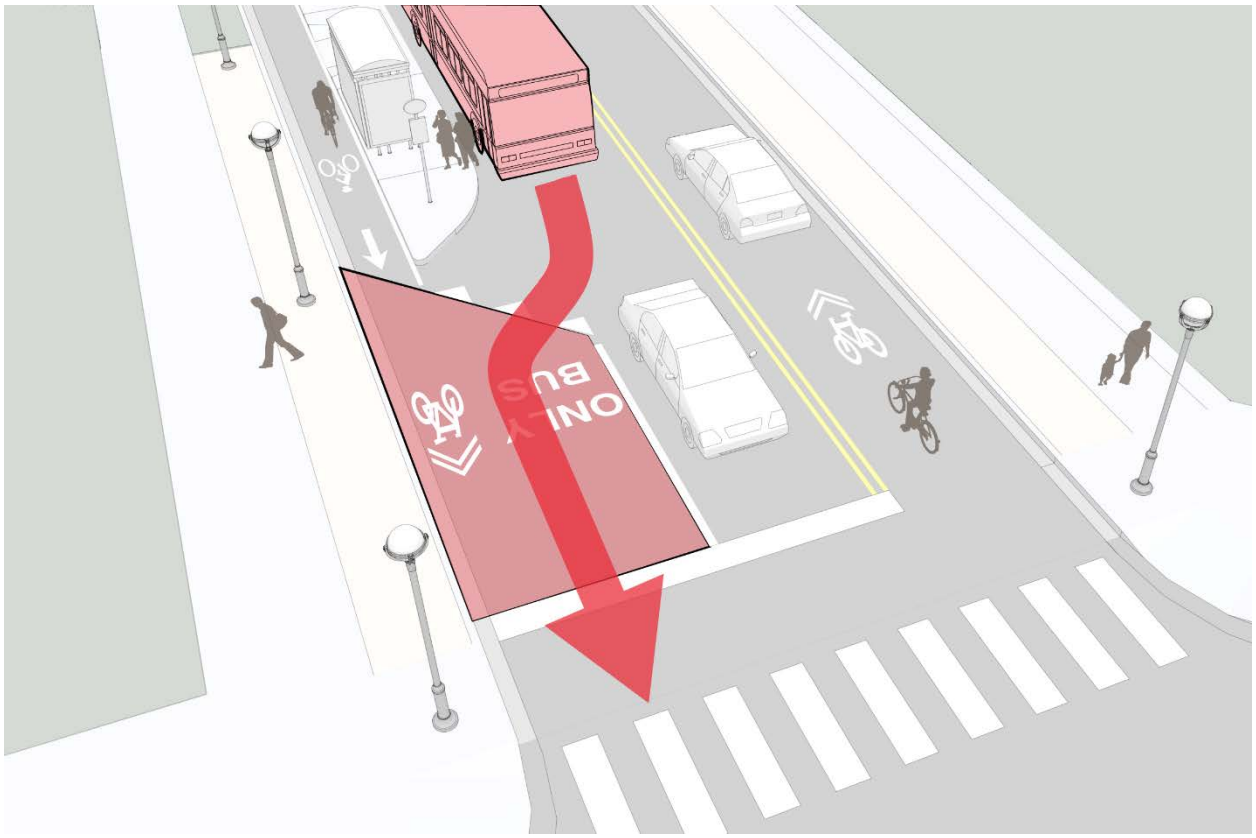
A short bus lane located at the approach to a traffic signal allows buses to bypass waiting traffic, significantly improving transit travel time. They are best used at congested intersections on primary transit routes and where stops can be placed at the far-side of an intersection. Space on the far side of an intersection should exist for the bus to reenter traffic. Bus queue jumps may be:

- **Transit Exemption for Right-Turn Lanes**: The bus queue jump lane shares space with a right-turn lane, but transit vehicles are allowed to proceed straight through the intersection.
- **Advanced Stop Bar**: The main stop bar is pushed back several car lengths and a transit-only or "right and transit" lane is placed along the curb at least two car lengths ahead of the stop line, so that a transit vehicle can pull ahead of other traffic.
- **Shared Right-Turn/Bus Lane**: The entire curbside lane is reserved for transit vehicles, but drivers are allowed to use it for right turns at intersections. An example of this configuration can be seen on Main Street between Plymouth Avenue and the Genesee River.

[3] NACTO Transit Street Design Guide 2016

RGRTA's 2010 Signal Prioritization study included queue jump locations on selected transit priority corridors. The City should update this work on a wider scale in coordination with RTS and the Monroe County DOT in order to create a priority table containing appropriate network locations at which to apply queue jump lanes.

Figure 21 Bus Queue Jump Lane



Source: Nelson\Nygaard

First/Last Mile Connections

Bikeshare

Bicycle sharing systems have been shown to extend the reach of public transportation across the country. According to the Bureau of Transportation Statistics, 77% of bikeshare stations in 2016 connected to another transportation mode within one block.

Once a stop hierarchy is identified and locations chosen, the City should work with Zagster/Pace to compare the locations of current bikeshare stations with the locations of enhanced stops and transfer points. Planned additions to the bikeshare station network should take mismatches between these intermodal connection points into account.

Curbside Management

As the demand for drop-off areas has increased due to private ride hailing activity, cities are seeing an imbalance in the amount of curbside space required to properly support these uses. An internet-based ride hailing service behaves differently than traditional quick pick-up taxi service. In the absence of available curbside space, rideshare vehicles are inclined to use bus loading zones, or to simply double park, creating impediments to traffic flow and safety.

The City of Rochester may choose to change the dynamics of on-street parking spaces immediately adjacent to Transfer Points and Enhanced Bus Stops. During certain times of day, typically the peak hours for ride hailing activity, these spaces would not allow private vehicle parking. Outside of these defined hours, these spaces would revert to their original general public parking use.

Pre-implementation steps would require an assessment of passenger pick-up/drop-off activity by time of day. Spaces chosen would ideally be following far-side bus stops and preceding near-side stops to allow drivers of both transit and private vehicles to easily pull in and out. In-place implementation would minimally require signage, but could include dynamic programming of parking meters associated with selected spaces.

Real Time Coordination

Transit Signal Priority (TSP) schemes allow for variable traffic signal timing at intersection to give priority to transit movements, thereby reducing rider delay and improving schedule reliability. No longer predicated on preemption of the signal cycle due to synchronization and pedestrian crossing safety issues, the practice has evolved to provide transit priority based on calculations performed from a systems perspective.

In contemporary "active" TSP implementations, buses communicate with the traffic signal system to provide a green signal indication to an approaching bus, reducing average corridor delay by up to 10%.[4] The feature is generally less effective when signals are operating at capacity. The City should partner with RTS and the Monroe County Department of Transportation to assess up-to-date technical and capital requirements of providing transit signal priority with interconnected traffic controllers and vehicle detection. A further implementation location assessment, referencing and updating the work done as part of the 2010 Signal Prioritization Study, should be performed to determine where TSP is needed along transit corridors to provide transit vehicles with precedence. Cross-street pedestrian and traffic demand should continue to be considered in location identification.

[4] TRB Transit Capacity Quality of Service Manual 2013

The following paragraphs describe the operational attributes of some common signal systems compatible with the the application of Transit Signal Priority.

Actuated-Uncoordinated "Free" Signal Timing: Each intersection in a corridor responds to its own need with no regard to traffic operations at adjacent intersections. The traffic signal controller adjusts the amount of time served to each phase of the intersection based on the number of vehicles detected by detector loops or video detection at that intersection.

Adaptive Signal Timing: Adaptive signal control systems continually refine the timings at every intersection within a corridor or network, cycle-by-cycle, as traffic conditions change. Adaptive systems monitor traffic conditions using vehicle detectors for all approaches, and often for all movements, of the intersections within the corridor. These systems adjust the signal timing based on the real-time traffic flow in the corridor.

Local Application

Transit priority has been explored locally. Monroe County has done preparatory work by purchasing and testing a limited number of compatible traffic signal controllers, and has explored the use of the existing fire preemption system for the detection of approaching buses. Primary obstacles to implementation include the need to equip the RTS bus fleet with on-board transceivers required to trigger compatible signals.

Layover and Staging Facilities

More efficient, high-frequency services depend heavily on layover locations for idle buses/operators that ensure reliable access to the route starting point. While non-moving buses create obstacles to other mobility modes, they are a very necessary part of transit operations. Bus layover should be accommodated in a way that meets urban design and mobility goals without locating them so far away from passenger activity areas that it increases operating costs or decreases reliability.

The recommended network of the Reimagine RTS initiative identifies the following locations where routes are planned to terminate inside city limits:

- Hudson at Walmart
- Eastman Business Park
- Main/Winton/Merchants
- East and Winton
- Monroe/Highland
- URMC/Collegetown

Accommodating quality layover locations will requires the City to revisit the authority

to use curbspace, or otherwise permit bus turnouts described in Chapter 3. Layover locations should be purposely designed to avoid conflict with bike facilities and on-street parking. Driver amenities, such as restrooms, should be considered, and if not constructed on-site, the City should help RTS to facilitate agreements with nearby property owners for use of those facilities where necessary. Layover locations co-located with the first stop of a return trip should feature all amenities associated with Enhanced Bus Stops.

Climate Considerations

Bus Stops

The landing zones at transit stops should be cleared of snow and ice and clear pathways provided to cleared sidewalks. A pathway from the landing zone to the cleared roadway space must be maintained at a width sufficient to enable deployment of wheelchair lifts. This can be particularly challenging as roadway plowing tends to pile snow up at the curb line. This berm of snow should be cut through to enable a clear path for passenger boarding and alighting. As mentioned in the bus stop hierarchy definitions of Chapter 3, user-actuated heat lamps should be installed in bus shelters where possible.

Loading Areas and Travel Lanes

Curb extensions and bus turnouts should not be used for snow storage and should have a maintenance plan for snow clearance. Likewise, transit lanes and bus queue jumps should not be used for snow storage. In winter, access to transit lanes should be kept clear for transit vehicles. Physically separated transit lanes may require special equipment for snow removal.

5 Benchmarks

A group of peer cities were identified for use in all Focus Area Reports. The cities were chosen based on ratios of city and urbanized populations, their role as regional centers as opposed to a satellite city in a larger metropolitan region, and their general timeline of establishment and growth in an attempt to include many with comparably designed transportation networks and regional considerations such as climate. Best practice examples from these and other Rochester-comparable locations are summarized below.

Bus Stop Hierarchy and Design Guidelines

The Planning and Transportation Divisions of the Community & Economic Development Department of Salt Lake City prepared a set of bus stop and bikeshare station design guidelines for their City Council in 2014.[5] The guidelines address stop location, a design element inventory, and minimum element provisions as well as bikeshare guidelines that emphasize location near transit access points.

Supportive Right-of-Way Considerations

Envision Downtown, a public/private partnership between the Mayor's Office and the Pittsburgh Downtown Partnership, has deployed a series of pilots along Liberty Avenue, including a dedicated red bus lane to prioritize outbound travel for buses and a rubber bus bumpout to reduce sidewalk congestion. The pilot is a result of findings from Envision Downtown's Public Space Public Life survey.

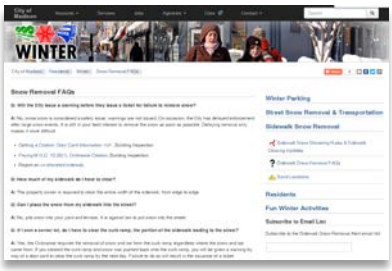
[5] Council Staff Report, City Council of Salt Lake City
http://slcdocs.com/council/agendas/2014agendas/November/Nov4/110414A5.pdf

Layover and Staging Support

The Seattle Departments of Construction & Inspections and Transportation are working with King County Metro on joint legislation that would define bus layover facilities in the land use code, provide a permitting process, and include standards for inclusion in non-downtown neighborhoods.

Real-time Coordination

The Niagara Frontier Transportation Authority's Niagara Street project in Buffalo included equipping part of the vehicle fleet with traffic signal prioritization equipment. The buses communicate with traffic lights, giving the buses a green light when necessary. Funding comes from a Federal Transportation Administration Livability grant, along with assistance from New York State.



Climate Considerations

The City of Madison, WI currently takes responsibility to clear bus stops as necessary. City crews clear bus stops with concrete pads as part of general plowing operations. Snow removal from other Madison Metro Bus stops begins when the priority snow removal is complete.

6 Summary

The City's direct opportunities to create a transit ready city may be limited to intervention within the roadway, but the City can be a leader in facility design standards and in facilitating partnerships. Locating and requesting targeted and coordinated investments by partners will reinforce the value of those and prior investments and result in a more coherent and usable transit network for residents of the City of Rochester.

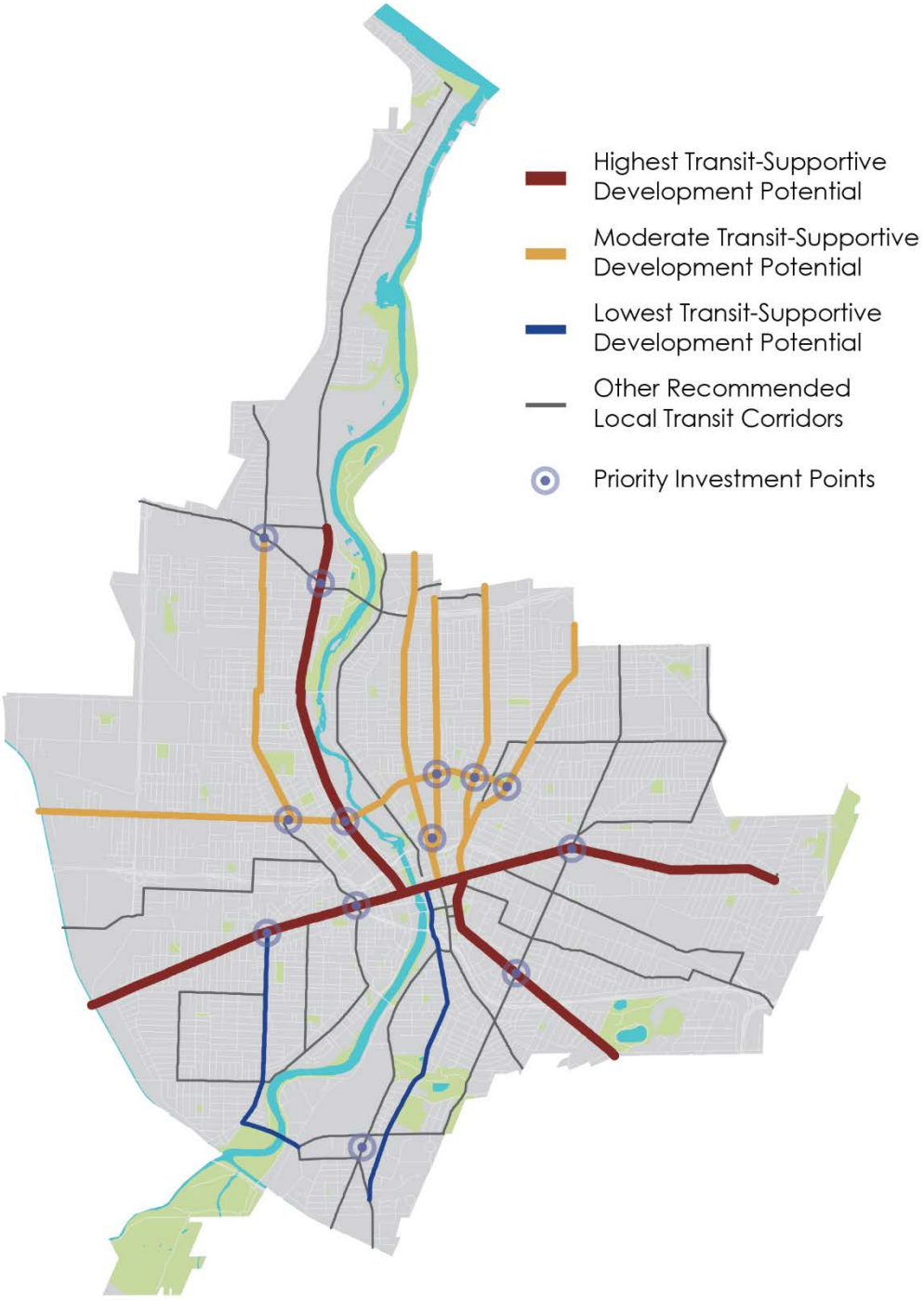
The following projects and programs represent steps forward that the City can take to begin building a more robust core of the regional transit system.

Priority Recommendations

- Working with RTS, develop a stop hierarchy including amenity inventory and inclusion standards
- In an effort to solidify the new transit network, and noting corridors where transit-supportive development potential is high (Figure 22), help RTS to identify options for Transfer Point installation at the following intersections:
  - East Main Street and North Goodman Street
  - Portland Avenue and Draper Street
  - Hudson Avenue and Upper Falls Boulevard
  - Joseph Avenue and Upper Falls Boulevard
  - Lake Avenue and Lyell Avenue
  - Lake Avenue and Ridge Road
  - Dewey Avenue and Ridge Road
  - Lyell Avenue and Dewey Avenue/Broad Street
  - West Main Street and Broad Street
  - West Main Street and Genesee Street
  - Mount Hope Avenue between Elmwood Avenue and Crittenden Boulevard
  - Monroe Avenue and South Goodman Street
- Assess locations along the frequent network where right-of-way treatments such as curb extensions, bus turn outs, transit lanes, and queue jumps would have the greatest positive effect for transit riders in terms of safety as well as travel delay.
- Continue to support RTS' goal to convert a portion of the Mortimer Street Garage into an improved extension of the Transit Center focusing on connections to non-fixed route mobility services.

- Work with RTS to create a pair of Transfer Point stops on Central Avenue between Clinton and Joseph Avenues to serve intercity ground transportation stations as part of the frequent transit network.
- Assess technical and capital requirements of providing transit signal priority with interconnected traffic controllers and vehicle detection. Work with RTS to determine locations where transit signal priority implementation has the greatest potential benefit for operations.
- Accommodate bus layover and staging areas by reallocating curbspace authority, permitting bus turnouts, and/or assisting with on-site driver and rider amenities near
  - Hudson Avenue Walmart
  - Eastman Business Park
  - Main Street, Winton Road, and Merchants Road
  - East Avenue and Winton Road
  - URMC/Collegetown
- Compare the locations of current bikeshare stations with the proposed locations of enhanced stops and transfer points. Subsequently add stations to the bikeshare network where mismatches between these intermodal connections occur.
- Assume responsibility for snow removal at bus stops within the city. Consider an adoption program similar to fire hydrant adoption to ensure that stops are kept clear of snow and remain accessible.

Figure 22 Supportive Development Potential and Priority Investment Locations



Source: City of Rochester, Rochester-Genesee Regional Transit Authority

City of Rochester
Comprehensive Access and Mobility Plan

Urban Goods Movement/ Emergency Service Report

T·Y·LIN INTERNATIONAL

NELSON NYGAARD

Cover photo from patrickashley via wikimedia

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1 Background

The efficient movement of goods and the ability to provide emergency services in a timely manner are vital components of a healthy, vibrant city. Interestingly, these topics are not often addressed thoroughly in urban transportation plans. Freight planning is typically done at the regional and statewide levels. The requirements of emergency vehicles and their impact on streetscapes barely receive mention in existing transportation plans of other cities. The *City of Rochester Comprehensive Access and Mobility Plan* recognizes that planning for these non-person trips is critical to the social and economic vitality of the community.

From a transportation perspective, goods movement and emergency services are unique in that they do not involve personal travel and use larger vehicles than most forms of personal travel (the exception being public transportation). Accordingly, the Urban Goods Movement/Emergency Service Report (the Report) addresses the needs of freight and emergency service providers in a holistic manner that integrates these types of non-person trips into the overall urban ecosystem of personal travel by various modes.

Urban Goods Movement

Cities will always be massive consumers of physical goods. One of the primary reasons that cities initially formed was to reduce transportation costs by bringing goods closer to a larger number of potential buyers. These goods include finished products that residents and visitors purchase to meet their basic needs as well as raw materials and intermediate inputs that businesses add value to before sending along to the next stage in the larger marketplace. Beyond the substantial network of physical infrastructure required to serve Rochester's goods movement needs there is a complex logistics framework. In their never-ending pursuit to reduce costs, shippers, carriers, and receivers are harnessing technology to maximize routing and scheduling for themselves and their customers. There are two important and overarching factors to consider in freight planning.

Global Nature of Freight

The vast majority of people do not have a full appreciation of how the things they own and use end up in their homes, their workplaces, their doctor's offices, and the restaurants they frequent. The Buy Local movement is a constructive effort that strengthens urban economies and has the potential to reduce the environmental impacts of production and consumption. While it continues to grow, the reality is that the movement of goods occurs on a global scale at each stage of development: production, transport, and delivery. This requires an interconnected network of the various modes of goods movement that generally begins and ends with trips by truck with transfers to railroads, marine vessels, and airplanes prior to delivery to

stores and residences. Figure 1 provides a flow chart of the supply chain for apparel once it enters the country as developed for National Cooperative Freight Research Program (note: "DC" stands for distribution center, which is a facility that receives and stores products for delivery to another location such as a store or directly to a customer).

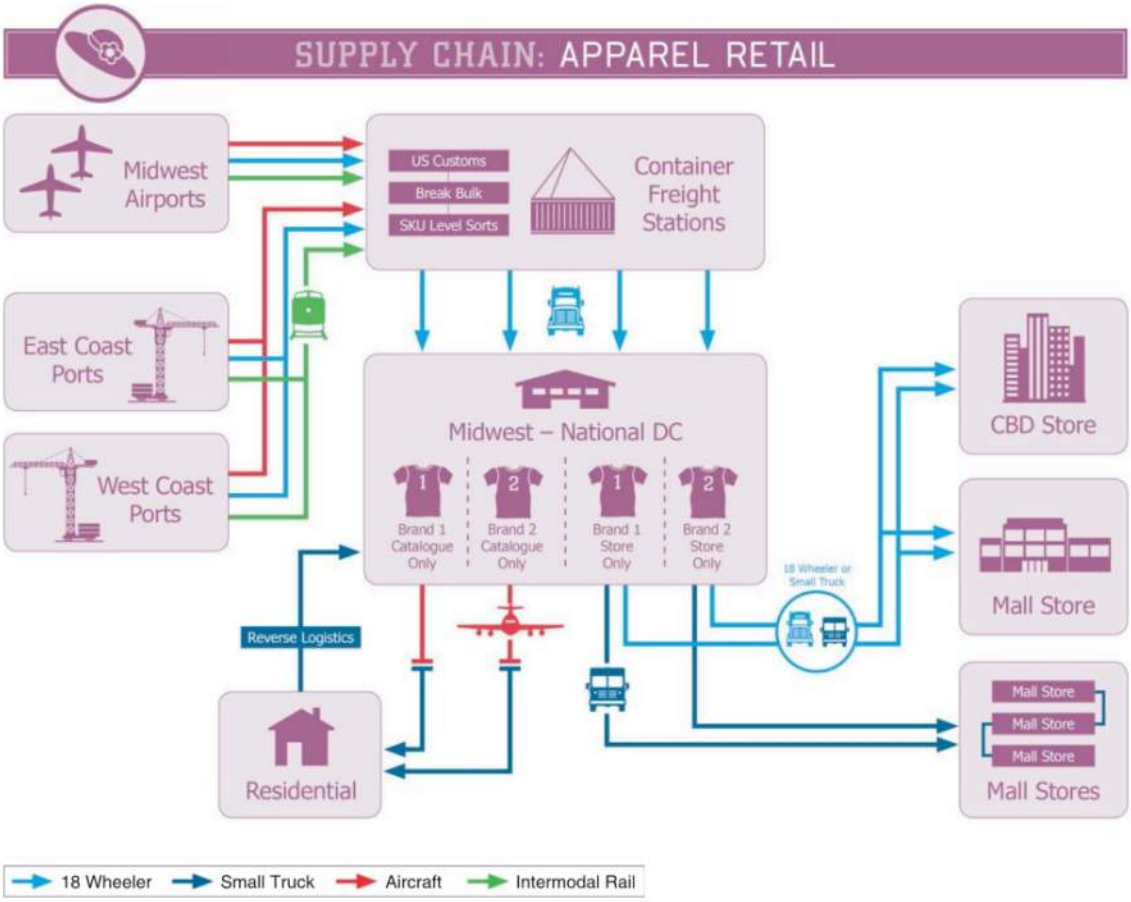


Figure 1. Apparel Flowchart
Source: Rhodes, S., M. Berndt, P. Bingham, J. Bryan, T. Cherrett, and P. Plumeau, National Cooperative Freight Research Program Report 14 *Guidebook for Understanding Urban Goods Movement,* Transportation Research Board, National Research Council, Washington D.C., 2012.

Future of Retail

The nature of retail (i.e., the sale of goods to the final consumer) continues to change at an accelerating rate as does the wholesale market (i.e., the sale of goods to businesses that resell goods in smaller quantities than they receive) along with the supply chains that serve them. Terms like the "Amazon Effect" and "Now Economy" capture the public's propensity to purchase a more diverse set of goods via the internet and expect delivery in hours not days, much less weeks (see Figure 2). There is no disputing that the numbers of direct deliveries to residences has and will continue to increase. However, the frequent reports of "bricks and mortar"

closings and the financial difficulties facing suburban malls paint a broad brushstroke of the retail sector that misses nuances affecting cities. Certain chains such as Dollar General and Dollar Tree continue to open new stores at a steady rate and higher end retail is becoming more experiential, offering cities the opportunity to meet both the needs of citizens with lesser financial means and to attract higher income shoppers to their downtown and neighborhoods.

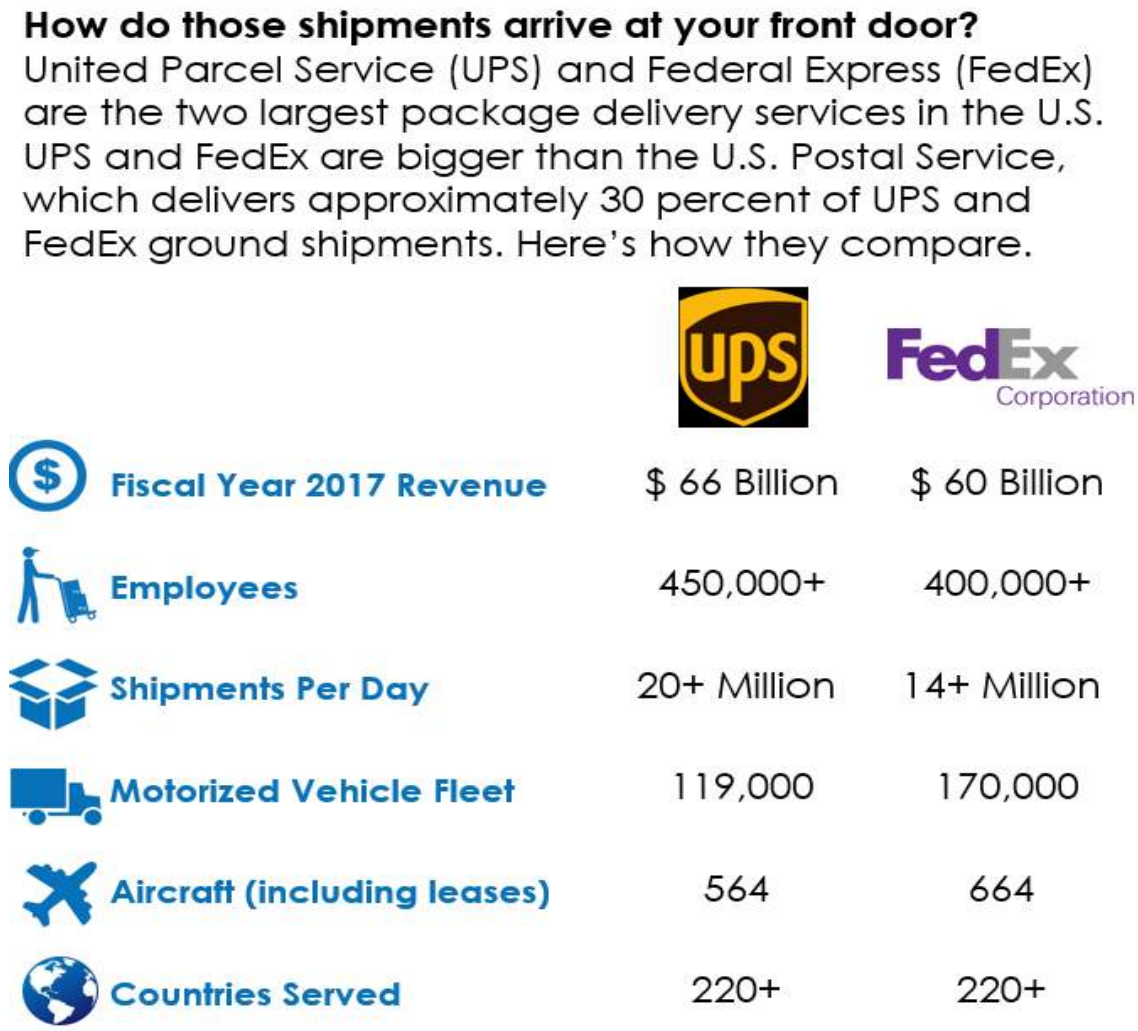


Figure 2. Comparison of United Parcel Service and Federal Express
Sources: FedEx Corporate Fact Sheet; UPS Fact Sheet; and Stevens, L., (2014, August 4). For FedEx and UPS, a Cheaper Route: the Post Office. *Wall Street Journal,* U.S. edition (https://www.wsj.com/articles/u-s-mail-does-the-trick-for-fedex-ups-1407182247 - retrieved May 17, 2018).

Emergency Service

Providing the necessary services to save lives and reduce property damage resulting from natural and human-created hazards is a critical function of all city governments. Regardless of the emergency, response time is key and reducing it is a top priority for all responders. This creates a conflict with the current goals and

objectives of urban transportation planners, public health professionals, and neighborhood associations who are seeking to increase the viability of streets for all users by making them friendlier for bicyclists and pedestrians. To accomplish this requires that the decades-long design of streets to accommodate as many automobiles as possible be reversed, resulting in narrower streets. This is viewed by emergency responders as creating the potential for not only increased response times but also a lack of space to deploy needed equipment to address incidents.

Fire Trucks

Often used interchangeably by the public, fire engines and fire trucks are not synonymous. They represent the largest vehicles employed by fire departments as part of their fleets (referred to as their "apparatus"). Fire engines have a pump, water tank, and hoses, allowing firefighters to begin responding while water supply from a hydrant is being established. They are called "pumpers." Fire trucks have an attached hydraulically operated aerial ladder in addition to ground ladders of varying sizes, which is why they are known as "ladder trucks." Fire trucks are also equipped with outriggers to stabilize the vehicle when the aerial ladder is in use. In addition, fire trucks also typically carry additional equipment, including saws, lights, ventilation fans, and other rescue and extrication tools. Fire trucks are larger than fire engines with a longer wheelbase (the distance between the front and rear axles), requiring a larger minimum inside turning radius. Figure 3 presents pictures of a Rochester Fire Department engine and truck.

Figure 3. Rochester Fire Department Engine and Truck

These are the big-picture factors that influence the movement of goods into, out of, and through the City of Rochester and the needs of emergency responders to quickly and reliably address incidents that compromise public safety. More local information – both quantitative and qualitative – informs the development of transportation policies, projects, and programs to improve economic development and emergency response.

2 Existing Conditions

Key to determining how transportation can improve the movement of freight and the delivery of emergency services is developing an understanding of the relevant circumstances that currently exist in the City of Rochester. In gathering information on the topics of goods movement and emergency services, it is recognized that data on these important considerations are limited compared to other modes and trip purposes. As such, the data that is available has been supplemented with input from local professionals who work in transportation, economic development, and emergency services.

Volumes by Mode

Approximately 300 million tons of freight worth $1.2 trillion[1] moved into, out of, and through the Genesee-Finger Lakes Region in 2017, and this amount is expected to increase to 420 tons valued at $2.0 trillion in 2035. By tonnage, two-thirds of these freight flows are through movements: they neither originate at nor are destined for a location within the region. The remaining amount is split equally between inbound and outbound movements. This distribution of movements is expected to continue into the future.

When assessing freight flows in Rochester, it is assumed that a larger proportion of the trips begin or end within City limits. This is because a large amount of the long haul truck trips through the region are made using the NYS Thruway (I-90) to bypass local traffic on I-490. Trains not serving the region are routed along the CSX Westshore Branch Line between Fairport and Churchville rather than the less direct CSX Chicago Line that traverses the City of Rochester.

Slightly more than 80 percent of the total tonnage in 2017 (approximately 245 tons) was transported by truck. As would be expected based on the predominant movement (through trips), I-490 carries the largest numbers of trucks within City limits. Mt. Hope Avenue and Mt. Read Boulevard carry the largest numbers of trucks on City of Rochester streets as these roadways service institutional and industrial land uses (see "Freight Generators"). Figure 4 presents the projected annual average daily truck traffic (AADTT) in Monroe County in 2035.

While the vast majority of goods move by truck that is not to say that other modes of freight transportation are not important. As noted above, Rochester is served by CSX, one of seven Class I railroads. Class I railroads are the largest freight rail operators with operating revenues of approximately $450 million in 2016. In addition to CSX, the City is also served by the Rochester & Southern Railroad (RSR), a Class III or "shortline"

[1] Calculated using IHS/Global Insight data, via the New York State Department of Transportation, as published in *Transportation Strategies for Freight and Goods Movement in the Genesee-Finger Lakes Region,* Genesee Transportation Council, 2012.

railroad. RSR is owned by Genesee & Wyoming, Inc., which owns or leases 122 freight railroads across the world, including 115 in North America. The RSR includes an

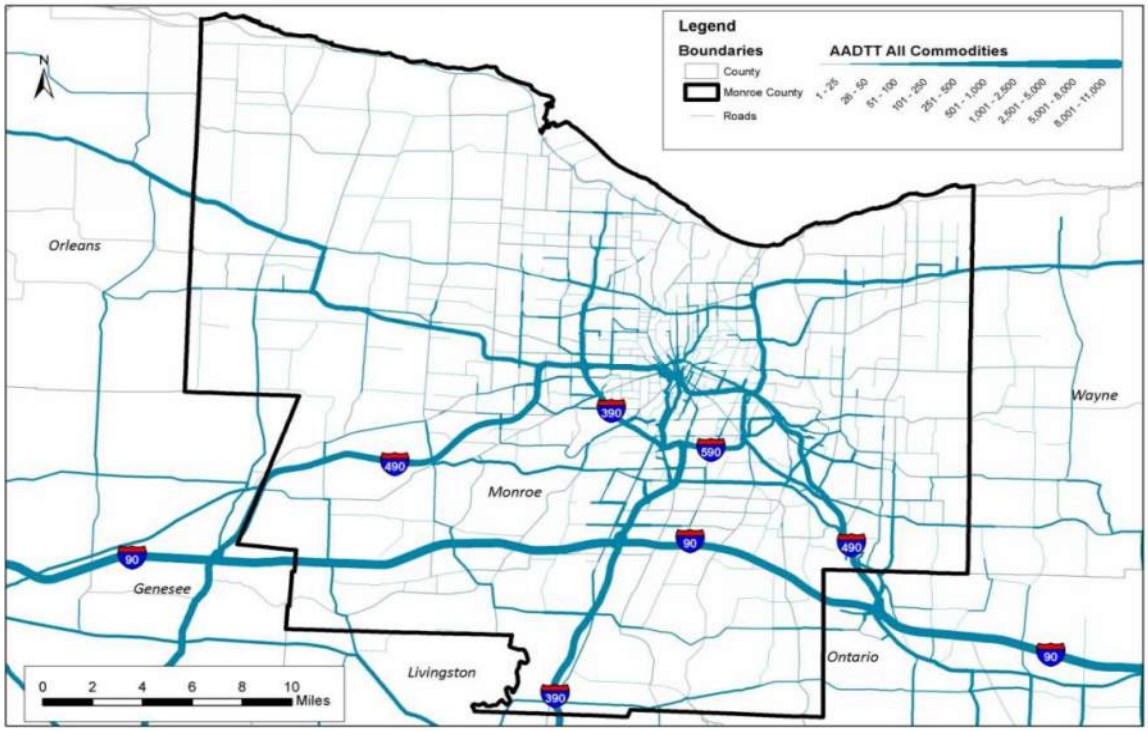


Figure 4. Total Commodity Truck Flows in Monroe County, 2035
Source: Genesee Transportation Council using IHS/Global Insight TRANSEARCH database, via the NYS Department of Transportation.

interchange with CSX on the west side of the City. In addition to directly serving customers, including Eastman Business Park, CSX and RSR also operate yards for switching purposes (disassembling and reassembling cars into new trainsets), repair of locomotives, and storage of unused rail cars. The largest of these is the CSX South Goodman Yard (also known as the Rochester Yard), which extends approximately one mile from East Main Street to Culver Road. Figure 5 displays the active freight rail lines in the City of Rochester along with the location of the CSX South Goodman Yard.

With no freight-appropriate highway network serving it, plans for the Port of Rochester in the Charlotte neighborhood call for its continued redevelopment as an mixed-use district that can attract visitors from across the Region and beyond. The primary marine freight activity in the City is the shipping of cement produced at the ESSROC Canada plant located along the Genesee River near Turning Point Park approximately two miles from Lake Ontario. The Stephen B. Roman transports cement produced at the plant to Toronto and Picton in Ontario, Canada.

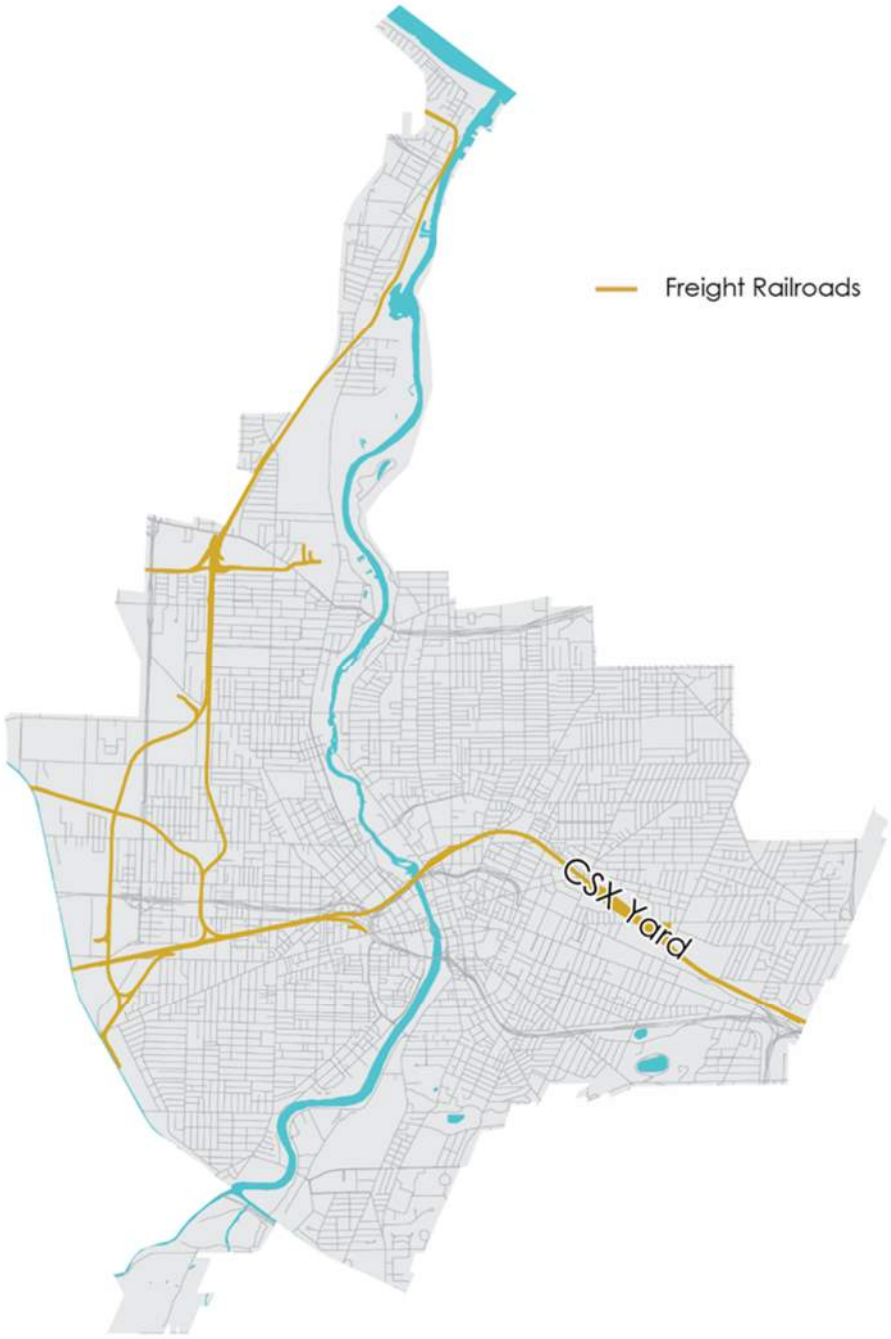


Figure 5. Active Freight Railroads
Source: NYS Department of Transportation.

Freight Generators

Certain land uses can generate a significant number of goods movement trips. These uses can serve as the origin for shipments, the destination for deliveries, or both (particularly, in the case of manufacturing and processing) as raw materials and intermediate inputs are further refined or finished products are created. To identify

these properties in the City of Rochester, freight generating land uses were identified and then classified as:

- Manufacturing & Processing: This includes light, industrial, and high technology operations, as well as businesses involved in salvage. Deliveries to these facilities can come from a variety of truck sizes as well as rail. Manufacturing and processing remain vital to the City's fiscal health, accounting for approximately 15 percent of the overall economy. In addition, manufacturing and processing have a high multiplier effect, which supports other sectors of the economy through indirect and induced impacts.
- Storage & Distribution: This includes warehouses, distribution centers, lumberyards, and cold storage facilities for perishable items. These facilities typically have the most loading docks relative to the amount of square footage and are usually served by large trucks and rail.
- Retail: This includes regional, area, and neighborhood-level shopping centers, grocery stores, minimarts, and multiple use structures that currently house or are zoned to allow establishments that sell products to the general public. Depending on the industry, numerous shipments from multiple carriers can occur to and from each of these types of establishments daily.
- Hospitals: In addition to Strong Memorial Hospital, Highland Hospital, Rochester General Hospital, St. Mary's Campus, and Monroe Community Hospital, the Rochester Psychiatric Center and the Al Sigl Center are also included. These facilities require deliveries of equipment, food, cleaning supplies, and other materials on a large-scale.
- Lodging: This includes hotels and motels, which require deliveries of food, cleaning supplies, and new furnishings, linens, and equipment on a regular basis.
- Stadiums and Arenas: This includes the Blue Cross Arena at the War Memorial, Frontier Field, and Marina Auto Stadium. The large crowds that attend events at these venues require significant deliveries of food, cleaning supplies, and materials to maintain the performance surfaces, seating, and vending areas.

Over 2,800 properties in the City of Rochester can be defined as freight generators (see Figure 6). Certain land use patterns become apparent. According to the City of Rochester Department of Neighborhood & Business Development, 70 percent of industrial activity (manufacturing and processing and storage and distribution) is located in the City's northwest quadrant. Neighborhood retail (including stores located in multiple-use buildings) is located along multiple corridors. Larger retail outlets are present throughout the City and serve multiple neighborhoods. These include stand-alone stores such as supermarkets and the Walmart on Hudson Avenue and the Citygate development. There are hospitals located in all but the

Northwest Quadrant with the greatest concentration in the Southeast Quadrant, which includes Strong Memorial Hospital, Highland Hospital, and Monroe Community Hospital. As would be expected, the majority of lodging establishments and all of the stadiums and arenas are located in and adjacent to the Center City District.

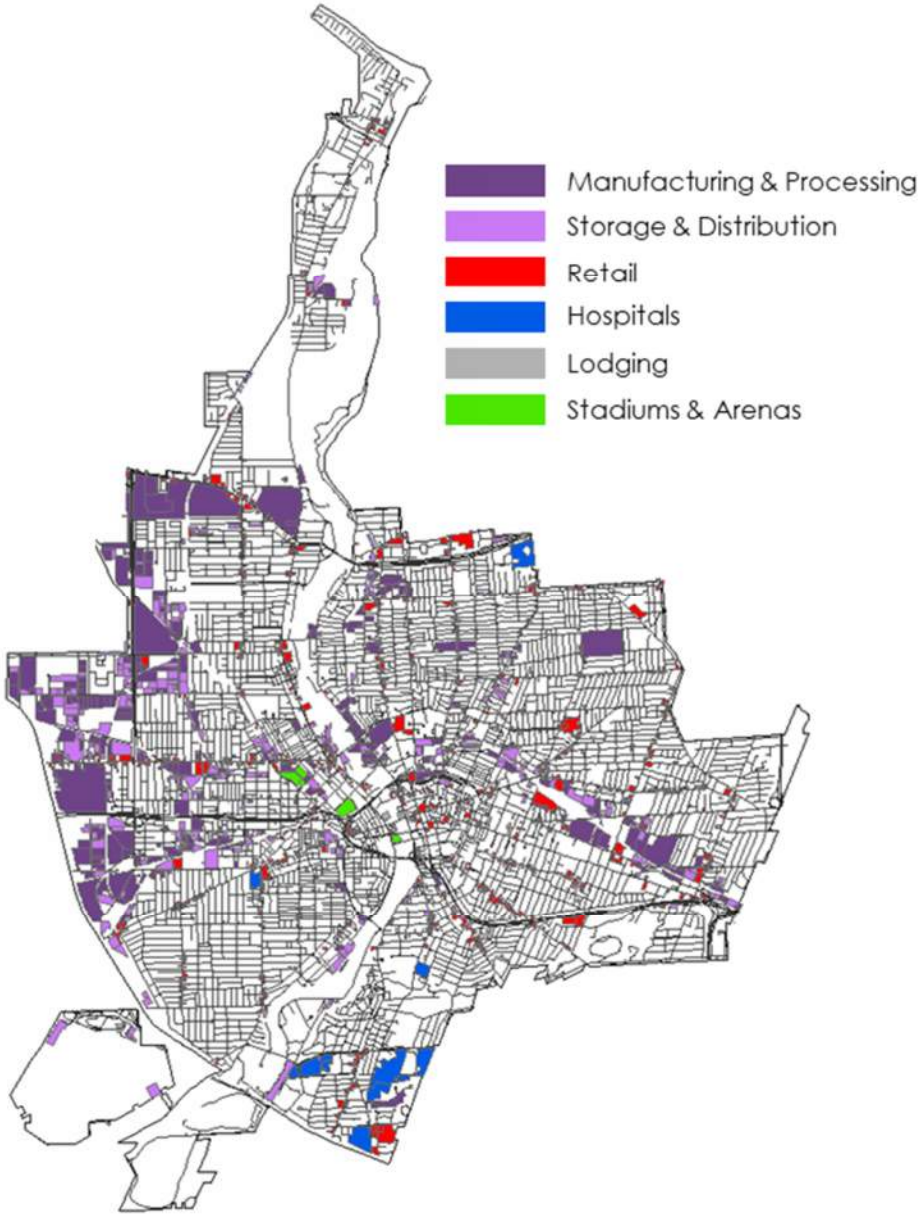


Figure 6. Freight Generators
Source: City of Rochester.

Firehouses

The location of firehouses and assignment of apparatus and staffing are key considerations in the emergency response planning process. In older, modest-growth urban areas like the City of Rochester, the location of the firehouses was determined decades ago and relocation of existing ones and construction of new ones are infrequent. Depending on the dimensions of the structures, there is some flexibility in the assignment of apparatus to ensure that fire trucks can respond when fire engines will not be sufficient for the respective alarm call or likely require support. The Rochester Fire Department (RFD) operates 16 firehouses: 15 within City limits and another on West Henrietta Road to provide fire protection and first responder emergency medical services as part of a contract with the West Brighton Fire Protection District. The location of the firehouses in the City of Rochester and the apparatus assigned to them is provide in Figure 7.

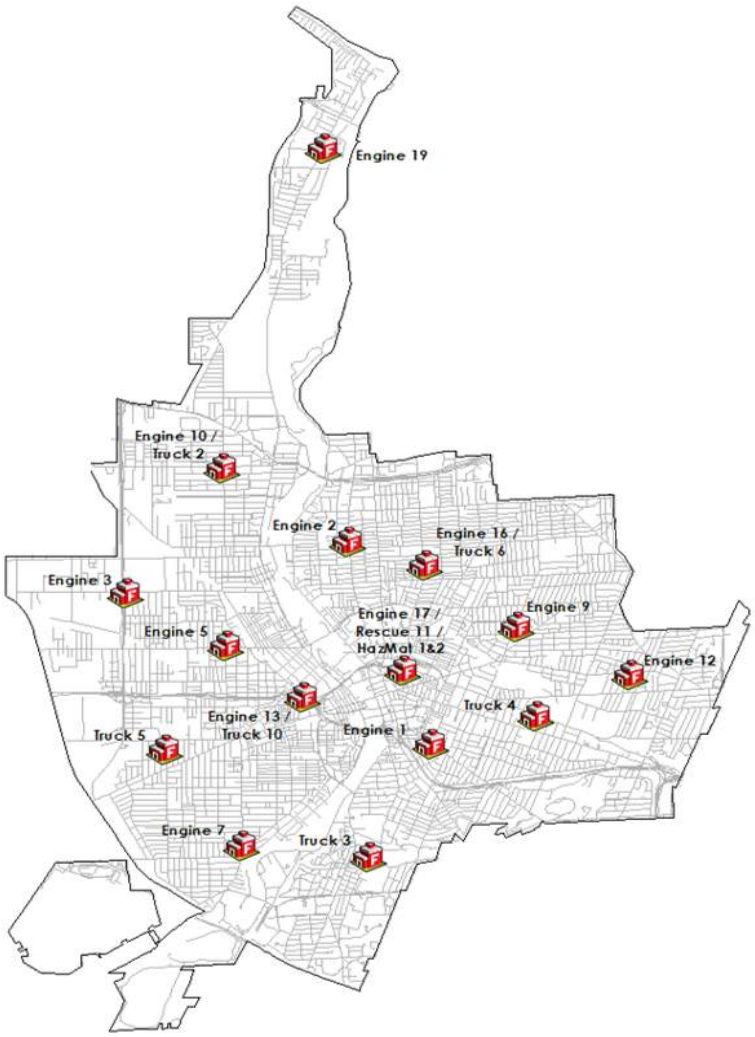


Figure 7. Rochester Fire Department Firehouses
Source: Rochester Fire Department.

Emergency Response Frequency

From January 1, 2013 to December 31, 2017, the RFD responded to nearly 168,000 incidents – an average of approximately 34,000 per year. Figure 8 displays these incidents by number and type over the five-year period using the National Fire Incident Reporting System (NFIRS) series. Over half of the incidents during this time period were medical assist and emergency medical service (EMS) incidents (part of the NFIRS Rescue and EMS Incidents series).

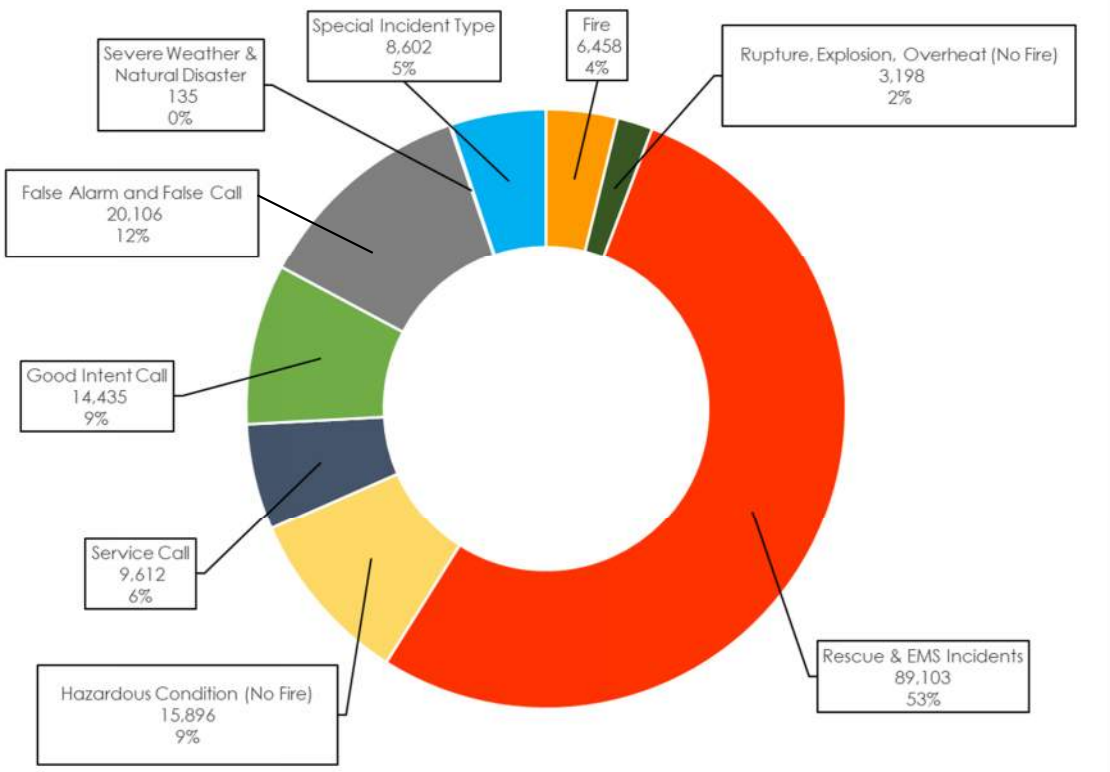


Figure 8. Rochester Fire Department Incident Response by NFIRS Series, CY 2013-2017
Source: Rochester Fire Department.

The number of incidents that are responded to is an important consideration but does not provide a complete picture. The RFD responded to an average of 2,153 fire incidents each year from 2013 through 2017. Approximately half of these were structure fires and nearly 30 percent were outside rubbish fires. The resources to address these fire incidents (in terms of both personnel and equipment) is, on average, greater than any of the other types of incident series. As a result, the average number of vehicles dispatched for fire incidents was 4.5. The only other incident series for which more than two vehicles were dispatched on average was for Rupture, Explosion, Overheat (No Fire) (2.5).

This information combined with additional discussions and analysis serve as the foundation for determining freight- and emergency service-related transportation needs in the City of Rochester.

3 Needs Assessment

Whether it be for personal travel, the movement of goods, or response by emergency vehicles, a city's transportation network must be safe, efficient, and reliable. Infrastructure that is in poor condition or is not operated properly can detract from quality of life, decrease economic opportunity, and jeopardize public safety. Determining current limitations of the transportation network as it relates to freight and emergency vehicle movements should be viewed as a baseline. The goal should be to identify ways to make the network a distinguishing factor that enhances economic development and social vitality.

Infrastructure

Conversations about the condition of the nation's highway, bridge, and transit infrastructure and their inability to meet the needs of a 21st century economy, as well as the lack of sufficient bicycle and pedestrian infrastructure, are increasing as the available funding falls continuously short of that needed to address identified deficiencies. While there is no denying the need for increased investment in infrastructure, the issue is more nuanced when evaluating local circumstances.

The American Transportation Infrastructure Institute, a part of the American Trucking Associations Federation, publishes an annual report entitled "Critical Issues in the Trucking Industry." The report includes a "Top Ten" list of issues affecting the trucking industry based on quantitative analysis and ranking of the difficulties faced by those in the industry. "Transportation Infrastructure/Congestion/Funding" ranked ninth in the 2017 edition of the report. The remaining issues were operational in nature with "Driver Shortage" ranking the highest. These results are consistent with what was found with respect to the needs in Rochester.

The primary infrastructure issue facing the trucking industry and emergency service providers is bridges that are in poor condition structurally. Narrowness and sight line/visibility issues are an inconvenience but these and other design issues associated with bridges built prior to current standards are not a major limitation. Bridges that are weight-restricted or height-restricted require rerouting of trucks carrying freight resulting in additional costs for businesses and, more importantly, increased response times for emergency vehicles attending to incidents.

Within City limits, there are no bridges that are not able to safely carry vehicles transporting legal weights. Legal weights of trucks are determined by the vehicle's wheelbase, number of axles, and the spacing of the axles. The legal weight of the heaviest truck is up to 80,000 pounds, enough to carry firetrucks which are typically a maximum of 70,000 pounds. Overweight permits can be applied for and granted to carry up to 102,000 pounds. The only bridge in Rochester that is "R-posted" and is not allowed to serve vehicles that have received an overweight permit is the bridge

carrying eastbound traffic on the Inner Loop over the Genesee River between the I-490 on-ramp and the St. Paul Street off-ramp.

In addition to bridges, roadways can also have weight limits imposed upon them. The City's Traffic Control Board regulates the setting of weight limits on streets. Nearly 150 streets currently have weight restrictions. Many of the weight-restricted segments are relatively short stretches on residential streets, which in some cases are the result of excessive cut through traffic over many years. However, there are some streets with weight restrictions that are not serving primarily residences. Notable street segments that provide access to and from freight generators include:

- Brooks Avenue from Genesee Street to Genesee Park Boulevard
- Browncroft Boulevard from Winton Road to the I-590 interchange
- Crittenden Boulevard from Lattimore Road to Mount Hope Avenue
- South Goodman Street from South Clinton Avenue to Elmwood Avenue
- Merchants Road from Winton Road to Browncroft Boulevard

There are railroad bridges in the City where the vertical clearance under them is less than the minimum of 14 feet and desired 14 feet 6 inches for non-National Highway System roadways. There are three notable examples of height-restricted bridges that have been identified as having impacts on freight. The CSX railroad bridge over St. Paul Street north of the Inner Loop between Cumberland Street and Ward Street has a clearance of 11 feet 3 inches. Two railroad bridges over Driving Park Avenue less than 250 feet apart – one carrying CSX tracks and the other carrying RSR tracks – also have clearances of 11 feet 4 inches. Clearances such as these do allow the highways below them to accommodate some trucks (see Figure 9) but can represent impediments to efficient operation of the highway network. In the event of a bridge strike, extrication of the vehicle that struck the bridge and an inspection to affirm its structural integrity can result in rerouting of all traffic potentially causing backups and delay in the vicinity of the incident and beyond.

CSX Railroad over St. Paul Street looking Northwest

Figure 9. Low Bridge Clearance at St. Paul Street North of the Inner Loop in Rochester, New York

Highway and bridge projects currently underway and planned that have the potential to impact goods movement and emergency service trips in Rochester include:

- Mt. Read Boulevard Highway Project – Lyell Avenue to Buffalo Road: Construction is expected to begin in fall 2018 on this pavement condition improvement project that will also include the replacement of an existing traffic circle with a roundabout, reconfiguration of traffic lanes, and replacement of traffic signals.
- NYS Route 33A Over Erie Canal Superstructure Replacement: This bridge crosses the Erie Canal, connecting Rochester and the Town of Gates. On May 6, 2014, it was closed for emergency repairs, requiring 16,000 vehicles per day to divert to other routes. Construction of a new redundant steel or concrete multi-girder design is expected to begin in spring 2020 and be completed in fall 2021.
- Inner Loop North Transformation: The City has secured $1 million in funding to assess the feasibility of transforming the Inner Loop from East Main Street to State Street into an at-grade, complete street. This is a distance twice that of the Inner Loop East Transformation project and will require a similar analysis of traffic redistribution and associated impacts to surrounding facilities.
- NYS Route 390/I-490/Lyell Avenue Interchange: This project is located on the City's western boundary in the Town of Gates and addresses the Region's largest bottleneck, which directly affects the viability of the manufacturing, processing, and distribution establishments located in the Northwest and Southwest Quadrants of the City. The project has a price tag of approximately $150 million and includes four phases, the last two of which will be constructed using a design-build procurement that began in July 2018.

Economic & Community Development

Overall, there is sufficient capacity for current and projected freight volumes as congestion in Rochester is primarily limited to morning and evening peak periods on weekdays. This delay is lower in terms of intensity and duration than similar-sized cities. The roadways that experience it are commuter corridors heading into and out of the Center City District. This is not to say that there will not be areas of localized congestion for commercial trucks making local pickups and deliveries that will need to be addressed as the location of freight generators changes over time. Figure 10 presents the congested links in the Rochester Metropolitan Planning Area during the morning and evening peak periods. (Note: a travel time index [TTI] of 1.25 to 1.99 means that a trip in the peak period takes 25-99 percent longer than under free-flow conditions and a TTI equal to or greater than 2.00 means that the trip takes twice as long or more in the peak period compared to free-flow conditions).

Employment levels in the manufacturing and processing industry do not correlate directly with the amount of goods created by these businesses. Increases in productivity generated by automation and improved processes mean that even if manufacturing and processing employment remains stable or declines slightly, the amount of goods and intermediate inputs developed in the City will increase, resulting in more trucks on the road. This increase will not necessarily result in more congestion on the City's and Region's roadways. The decision on when these shipments will begin their journey to the next destination can often be scheduled to coincide with lower traffic volumes in the evenings and overnight.

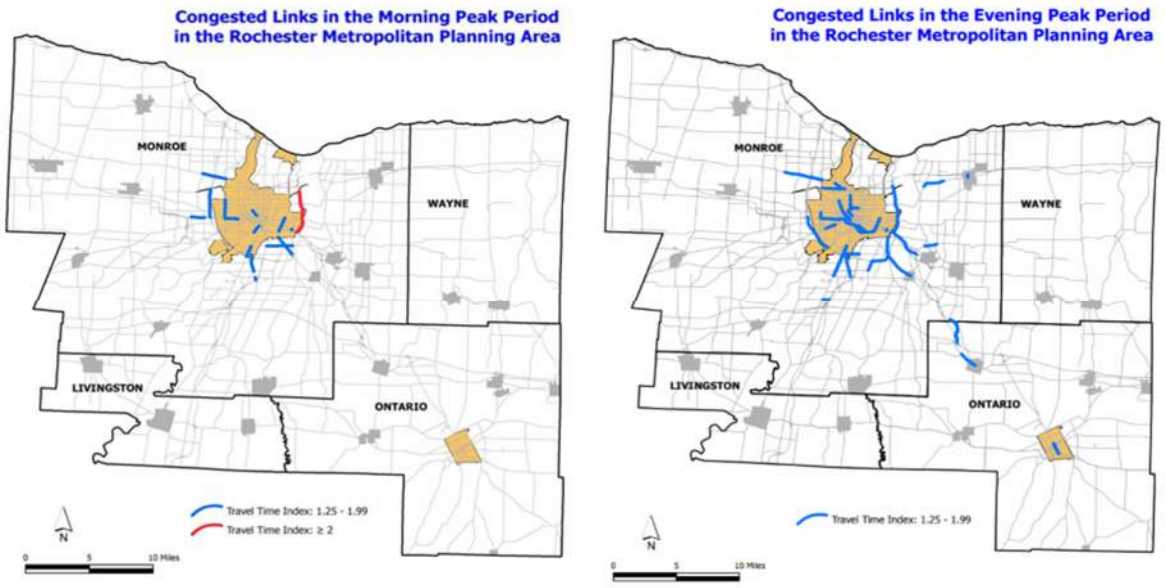


Figure 10. Congested Links in the Rochester Metropolitan Planning Area, 2015
Source: Genesee Transportation Council using INRIX data.

Opportunities to improve the transportation network for the purpose of generating additional economic activity (increased jobs in existing establishments and altogether new establishments) in the storage and distribution industry are limited. The Port of New York/New Jersey has an existing "inland port" (IP) established with CSX in Buffalo and another is being planned in the Town of DeWitt outside Syracuse to handle additional multimodal container distribution. The catchment area for the DeWitt IP is estimated to be 75-100 miles, which would mean that capacity in both Buffalo and Syracuse would need to be projected to be near fully utilized prior to considering another IP in Western or Central New York. If or when this occurs, a location in Rochester would be difficult to find. Expansion of the CSX South Goodman Yard is not viable. While it abuts some industrial land, it is surrounded by primarily residential areas.

Future development at Eastman Business Park (EBP) is still being determined. The existing facilities are better suited for research and development activities than manufacturing and processing or storage and distribution. Any construction of new

structures on vacant areas at EBP will need to address environmental issues and the related liability associated with development. These issues at EBP that complicate the addition of manufacturing and processing or storage and distribution combined with the locational advantages of sites to the east and west for major multimodal logistics hubs results in limited needs for additional freight rail capacity

Retail in the City is primarily locally-owned businesses, including smaller boutique-type stores. Recent non-locally-owned retail development has included discount chains (e.g., Dollar Tree, Dollar General, etc.) throughout the City and the addition of PriceRite supermarkets in the Northwest Quadrant and Southeast Quadrant. Overall, there is limited growth in retail projected citywide with most expected to occur in the Southeast Quadrant. Any additional demand for new retail is largely tied to continued residential development Downtown. If the required critical mass to attract new retail, dining, and entertainment establishments is met, additional deliveries will result. It is not anticipated that there will be much growth in retail of non-durable goods anywhere in the City as these are typically provided by big box chains that have permeated the inner ring suburbs and are also available through online ordering.

According to the U.S. Bureau of Transportation Statistics, the amount of freight generated per person annually is approximately 60 tons. As UPS, FedEx, USPS, and others increase their deliveries directly to residences rather than stores, the issue of smaller single-unit truck (box truck and van) and additional automobile traffic could become a quality of life issue in city neighborhoods. While deliveries to residences replace some person trips to stores, the majority of studies on this issue project there will be a net increase in the number of trips to residences. Two needs arise out of this scenario: 1) ensuring limited disruption to daily residential activities due to increased vehicle traffic and noise and 2) mitigating emissions from delivery vehicles.

A benefit of the sufficient capacity on existing roadways and lack of weight-restricted bridges is that large trucks are not required to reroute through residential areas as part of their through trips to other locations. The nature of cities, with mixed-use buildings in dense environments, means that there will always be interaction between residents and larger vehicles (see Figure 11). However, the presence of an excessive number of larger trucks in and near neighborhoods creates not only quality of life issues but also safety concerns as these vehicles have increased interaction with bicyclists and pedestrians on narrower streets. In addition, larger trucks in and near neighborhoods has the potential to result in environmental justice issues if the trucks are traveling through communities of concern, including those with concentrations of persons of color, low-income individuals, persons with disabilities, and individuals with limited English proficiency.

Public Safety

The ability to provide emergency response and ensure public safety requires predictability. This applies to not only certainty in personnel and equipment but also the transportation network. This is critical because, unlike freight carriers, emergency responders cannot choose when they travel and direct routing is more than an economic consideration. As discussed previously, RFD apparatus can travel over any bridge carrying a public roadway. Once on the scene of a fire, fire trucks and fire engines require a minimum amount of physical space to establish a safe distance for personnel and vehicles, access equipment, and stabilize their vehicles through the use of outriggers when utilizing aerial ladders.

Figure 11. Delivery on Park Avenue, June 2018
Source: T.Y. Lin International.

The 2015 International Fire Code (IFC), as amended by the 2017 NYS Supplement, became effective on October 3, 2016. The IFC is produced by the International Code Council and provides construction standards to ensure that the potential for fires, explosions, and the unsafe handling of hazardous materials is reduced to the greatest extent possible through the proper design and separation of incompatible uses within buildings. The City of Rochester Fire Marshal serves as the responsible "fire code official" (as referenced in the IFC) with the authority to require that the IFC is complied with. Section (§) FC 503 of the IFC provides the requirements for fire apparatus roads and §FCD 105 does so for aerial apparatus access roads. The NYS

Supplement does not alter the IFC for these selections (i.e., municipalities in New York State are subject to the same requirements as municipalities nationwide unless their respective state has amended these sections of the IFC).

Per the IFC, all streets must have a minimum, unobstructed width of at least 20 feet, not including shoulders. Streets with even a single building whose height exceeds 30 feet, as measured by the intersection of the roof with an exterior wall (including an eave on a pitched roof) or the top of a parapet wall (whichever is greater), must have a minimum width of 26 feet, not including shoulders. These streets must also run parallel to one entire side of the building and be no less than 15 feet and no more than 30 feet from it (see Figure 12.). Space dedicated to on-street parking cannot be considered in the minimum width of the streets under either requirement.

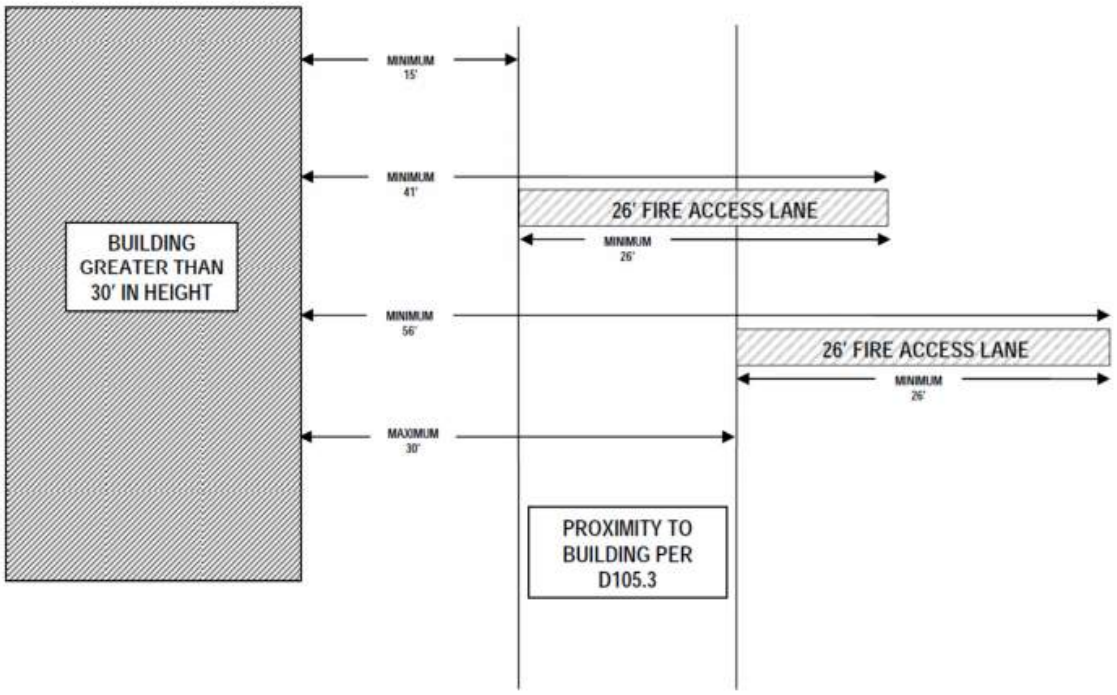


Figure 12. Standard Aerial Fire Apparatus Access Road for Buildings Greater than 30 Feet in Height.
Source: Town of Brighton, New York.

As a result, adherence to the IFC means that the construction of buildings four stories or more (which is desired in certain parts of the City to increase density and enhance the urban fabric) could require that the streets that serve them have unobstructed widths that exceed those typically designed to slow traffic and better provide for travel by bicyclists and pedestrians. Outside of alternate street design or variances from the New York State Regional Board of Review, the solution would be to construct roads that are either wholly dedicated to fire apparatus (including aerial) or restrict vehicles with access limited to non-motorized uses and fire apparatus.

Shared Requirements

Beyond commercial trucks and fire apparatus, other large vehicles travel along city streets. These include passenger buses (including Regional Transit Service, Greyhound/Trailways, Megabus, and tour bus operators) and refuse and recycling trucks. A significant difference between these types of vehicles and freight shipping and emergency service vehicles is related to their operation: they run on predictable schedules and defined routes. However, one commonality outweighs their differences. At times, all of these large vehicles compete for the same curb space in the City (albeit for typically shorter durations of time compared to passenger vehicles and fire engines and fire trucks). This reinforces the need for both designing roadways to transport users serving the myriad of functions that the city requires and managing curb space in terms of location, time of day, and duration.

4 Recommendations

While many cities grapple with infrastructure deficiencies that impair the movement of goods and/or emergency response vehicles, Rochester's highways and bridges have few structural issues and sufficient capacity to support efficient movements without excess delay. Citizen complaints about trucks creating noise and safety issues are infrequent. This provides the City the opportunity to address issues that are likely to emerge in a proactive manner with an eye on balancing economic, environmental, and equity issues. The recommendations provided herein reflect an emphasis on cost-effective solutions that will require coordination with the freight community and multiple City departments – most notably Environmental Services (DES), the RFD, and Neighborhood & Business Development (NBD). Many of the recommendations relate to each other and their advancement and ultimate success are interconnected.

Infrastructure

I.1. – Implement Context-Sensitive Improvements to Support Economic Development

To maintain and enhance the viability of City businesses that rely on the efficient movement of goods to and from their location(s), there are and will be smaller-scale capital improvements that will need to be made. In many cases, the requests from businesses will involve additional/realigned points of access and wider turning radii at intersections to accommodate trucks that ride over a portion of the curb when making right-hand turns.

Any improvements should consider all users within the context of the street on which the change(s) is being requested. Per the National Association of City Transportation Officials (NACTO), different "design vehicles" can be assigned to streets by their use so that items such as turning radii are designed for the largest vehicle that frequently uses a particular type of streets. This ensures that the surrounding land uses (i.e., the context) and the street work with rather than against each other.

Recommendation D.1. proposes that city streets be classified by the purpose they serve in moving goods. Associated design vehicles could be assigned to each freight roadway classification, with a process for determining required justifications for exceptions.

I.2. – Further Incorporate Freight & Emergency Services into Capital Programming Criteria

As noted earlier, the movement of goods and emergency vehicles are not standard considerations in city transportation planning locally and nationally. Not surprisingly, they receive scant attention in many capital improvement program project prioritization processes. The programming process yields the best results when the criteria for evaluating the universe of projects under

consideration are directly related to specific objectives. This is referred to as performance-based programming, tying investments to specific outcomes that matter to users.

In conjunction with the freight classifications created and assigned to specific City streets in recommendation D.1., criteria could be created to rank projects based on a variety of factors including:

- Does the project reduce crashes involving trucks (with additional emphasis given to crashes involving bicyclists and pedestrians)?
- Does the project increase efficiency and reliability for large vehicles on streets (including those that are currently weight-restricted) serving manufacturing and processing and storage and distribution establishments?
- Does the project mitigate the negative impacts of large vehicles (e.g., noise, emissions, etc.) to the environment and communities of concern?
- Does the project reduce response times for emergency service providers by improving street connectivity or improving egress from their facilities?
- Does the project provide designated loading/unloading zones to serve retail, dining, entertainment, and lodging establishments?

I.3. – Resolve Existing Bridge Clearance Issues

There are two ways to increase the clearance between the surface of a street and the underside of a bridge (e.g., slab, girders, etc.): lowering the profile of the street or raising the bridge. Neither of these options is cheap but lowering the roadway is almost always less expensive than raising the bridge. This is particularly true for railroad bridges. The benefits of resolving the current inefficiencies resulting from height-restricted bridges in Rochester would likely not exceed the costs of doing so when factoring the existing life left in the pavements. Therefore, it is recommended that when the streets that pass under these bridges require full-depth reconstruction, the project limits be expansive enough to allow for the lowering of the profile of the new street surface.

Design

D.1. – Create Freight Roadway and Emergency Response Classifications that are Incorporated into the *City of Rochester Street Design Guide*

As referred to in the Infrastructure recommendations, classifying streets in the City according to the role they serve in moving goods and providing mobility for emergency vehicles when responding to incidents can inform design and the prioritization of projects when allocating the limited funding available for

public works initiatives. These classifications can be based on multiple factors that vary for trucks and emergency response vehicles, reinforcing that accommodating large vehicles is necessary for the City to function properly.

The City of Portland, Oregon has developed hierarchal classifications for all forms of personal travel as well as freight and emergency response as part of its *2035 Transportation System Plan* (see Figures 13 and 14). Factors considered in developing freight classifications include land uses served, function, connections, and design. Specific classes include:

- Regional Truckways – Include all Interstates and major arterials. They serve industrial establishments and other large freight generators with the purpose of providing "safe and efficient continuous-flow operation for trucks." They connect to other streets that carry large numbers of trucks, such as Priority Truck Streets (see below), and are designed as limited access facilities that can accommodate all types of trucks.
- Priority Truck Streets – Provide access and circulation within designated Freight Districts and also connect them to Regional Truckways. They are designed to accommodate all types of trucks (including oversized loads) and include buffers to reduce noise in adjacent neghborhoods.
- Major Truck Streets – Serve as the principal routes for non-industrial freight-generating establishments, such as retail, connecting them to Regional Truckways. Trucks that do not make a stop along Major Truck Streets (i.e., through trips) are discouraged from using them. Their design accommodates trucks of all types "as practicable."

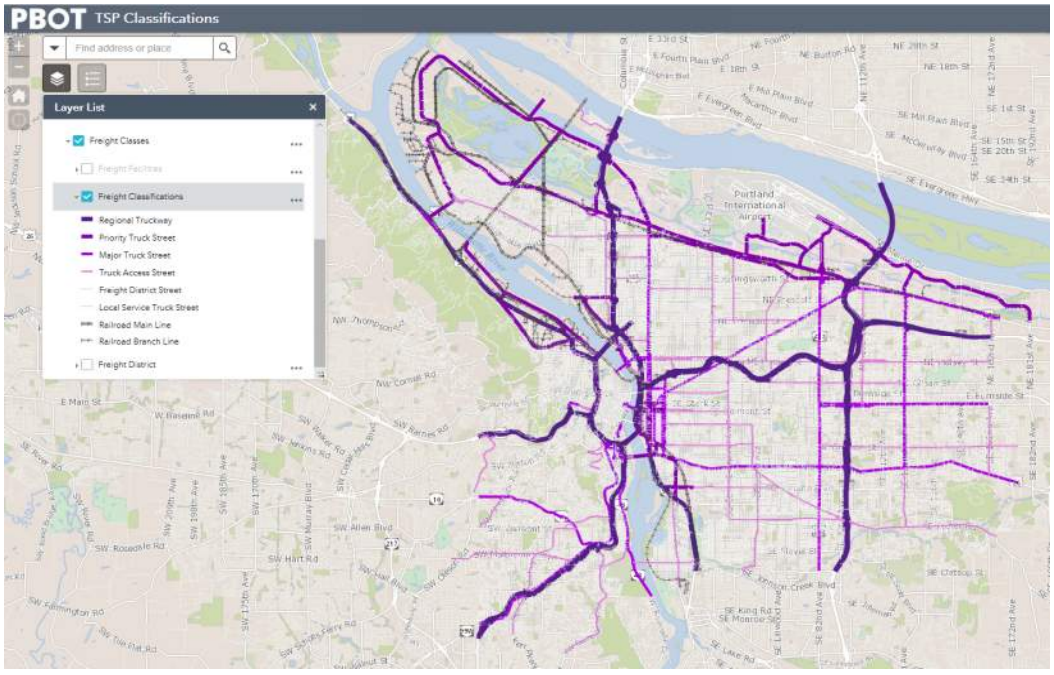


Figure 13. Portland, Oregon Freight Street Classifications
Source: City of Portland.

- Truck Access Streets – Provide access to establishments in neighborhoods by trucks coming from Major Truck Streets. Non-local truck trips are discouraged from using these streets. They are designed to balance trucks' needs with the context of the neighborhoods they serve.
- Local Service Truck Streets – Serve the delivery needs of individual establishments and residences. "Use of restrictive signage" to deter non-local truck trips is appropriate on these streets.

Emergency Response Streets are intended to create an interconnected network. They are classified based on the type of design improvements that should be made and traffic slowing measures that should be avoided. Specific classes include:

- Major Emergency Response Streets – Design changes should improve the mobility of emergency vehicles and traffic slowing measures (where allowed based on the Traffic Classification) can only be added per the approval of the Portland Fire and Rescue Bureau.

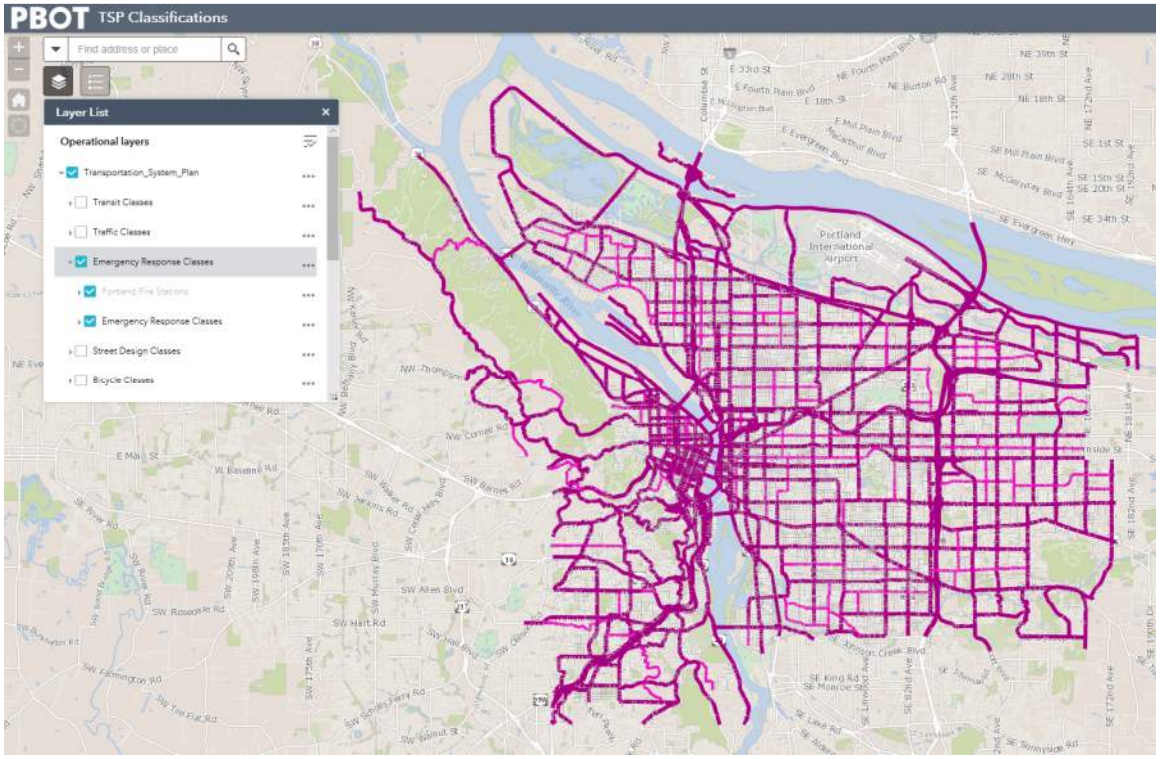


Figure 14. Portland, Oregon Emergency Response Classifications
Source: City of Portland.

- Secondary Emergency Response Streets – Design changes should improve the mobility of emergency vehicles with limited traffic slowing measures allowed "to enhance safety and livability."
- Minor Emergency Response Streets – These are all streets not classified as Major Emergency Response Streets or Secondary Emergency Response Streets. The emphasis on these streets is the provision of access to individual properties while enhancing safety and maintaining livability.

D.2. – Identify Opportunities that Meet Both City Street Design Principles & the IFC

There is a mismatch between the widths of streets required by the IFC to allow for the use of fire apparatus compared to those desired by citizens, public health advocates, and others that recognize the direct correlation between narrower streets and reduced numbers and severity of crashes. One of the City's most preferred street components can also help to meet IFC requirements: bicycle lanes. Bicycle lanes expand the width of streets, providing space for fire apparatus and creating wider turning radii for their turns.

Pavement that is colored, for bicycle lanes and other purposes, can serve as traffic calming measures. Other traffic calming measures that can assist in meeting IFC requirements include inset parking and speed cushions. Inset parking can provide needed on-street parking and maintain limited lane widths (see Figure 15). Speed cushions are speed humps or speed tables with cuts that are spaced for tires of fire engines and fire trucks, allowing unencumbered mobility for the largest emergency vehicles (see Figure 16).

To address the IFC requirements for buildings whose height exceeds 30 feet and requires a minimum pavement width of 26 feet, the City should consider separate fire aerial apparatus access roads in site design to the greatest extent possible. This would alleviate the need for wider public streets. Where possible, the inclusion of bicycle lanes on the streets parallel to the side of a building and mountable curbs should be a primary consideration.

D.3. – Eliminate Potential Conflicts with Bicycle Lanes & Transit Stops

A number of uses compete for street space outside of automobile travel lanes. With the City's current emphasis on promoting transit and bicycling as alternatives to automobile travel, the need for more actively managing curb space becomes imperative to ensure there are adequate spaces for loading and unloading of freight in mixed-use districts where all users are present (see Figure 17).

The decision to manage curb space as dedicated for certain uses or be flexible for multiple uses will need to be carefully considered going forward

depending on the projected demand for different uses. Looking to the future, the introduction of automated passenger vehicles and delivery trucks adds the consideration of revenue to the use of limited space. How limited curb space will not only be defined but also charged for becomes a factor.

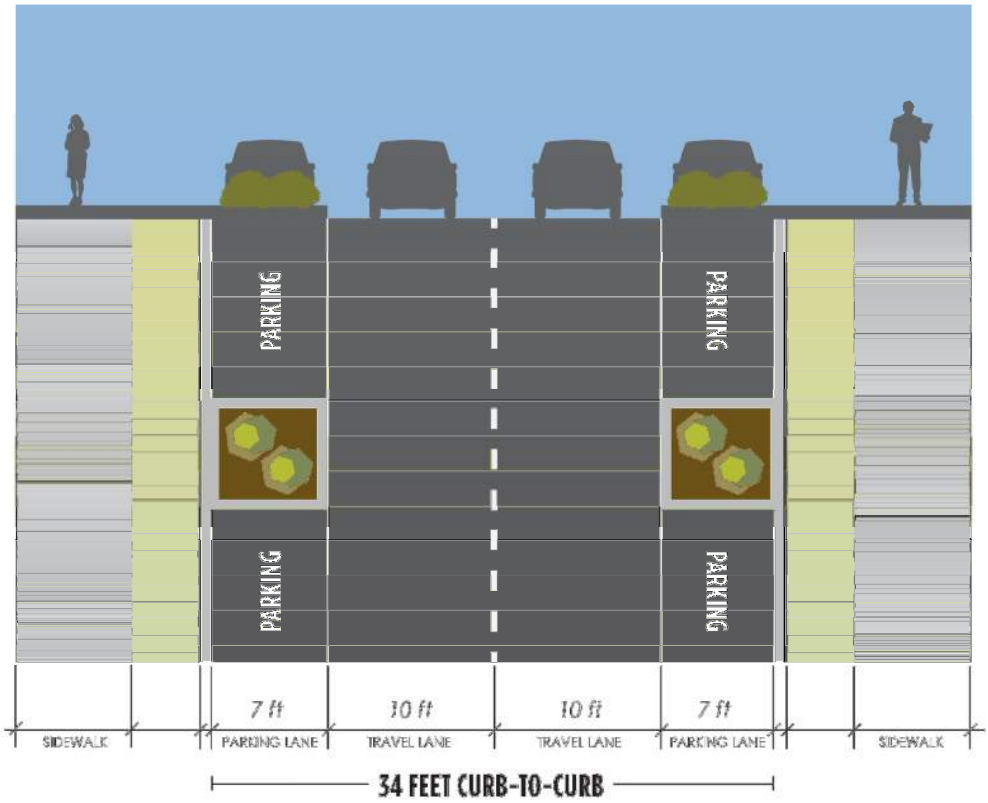


Figure 15. Inset Parking Layout and Dimensions
Source: Nelson\Nygaard.

Figure 16. Speed Cushions
Sources: NACTO and Seattle Department of Transportation.

Figure 17. Curb Space Usage on Main Street in front of Powers Building, July 2018
Source: T.Y. Lin International.

Operations

O.1. – Track Traffic Patterns to Determine Need for Delivery Windows/Restrictions

Larger cities across the country and the world have implemented specific hours for deliveries. These can limit negative impacts to traffic operations by eliminating double parking and other activities that reduce roadway capacity. They should be part of a comprehensive curb space management policy and include not only location but also duration. These can include off-hour deliveries in neighborhoods and mixed-use districts that must include outreach to and input from residents and merchants.

In New York City, the implementation of the off-hour delivery program included recruitment of establishments, which incorporated information on benefits to them. Figure 18 presents delivery window spaces designated on Church Street in Brooklyn, New York. If issues were to arise in Rochester around delivery of goods, it would likely be in the Downtown/Center City District. Implementation of delivery windows would require modifications to and expansion of City Code "§ 111-70 Vehicles prohibited in Central Traffic District"

Figure 18. Delivery Windows on Church Avenue in Brooklyn, New York
Sources: New York City Department of Transportation.

O.2. – Track Citywide Truck Movements to Determine Need for Designated Truck Routes

Cities can manage freight from a time perspective (see recommendation O.1.) and a location perspective. If the volume of trucks increases as predicted, it may be necessary for the City to manage both. In the event that designated truck routes are deemed necessary, they should be guided by the classification of streets conducted as part of recommendation D.1. to ensure consistency between the intended purpose of streets with respect to freight and their design.

Another important factor in selecting the routes is discouraging disproportionate designation of streets that run through communities of concern. The key to designated routes being effective is education and enforcement. Designated truck routes should be signed as such and affected vehicle operators should be made aware of their introduction and any changes to them. The New York City Department of Transportation (NYCDOT) not only posts its designated truck route map on its website but also distributes approximately 80,000 hard copies annually. Integrating the truck routes into commercial GPS services is also advised. Once established, enforcement via warnings and/or fines to violators that use non-designated streets for through trips is required.

O.3. – Monitor Complaints to Determine Need for Designated Truck Parking Facilities

Commercial vehicles such as trucks (as well as recreational vehicles) are not allowed to park on any city street for more than six consecutive hours per City Code "§ 111-17 Parking of certain vehicles for more than six hours." The lack of formal complaints to the City and comments as such received via the public involvement activities of the CAMP indicate that illegal truck parking is not currently an issue in neighborhoods in Rochester.

Opportunities for the City to harness truck parking as an economic development initiative are limited. While long haul trucks and larger fleet operators purchase fuels at travel centers, these purchases tend to be limited

to centers that are located near an interstate. The lack of job creation potential indicates that mitigating and eliminating truck parking that disrupts the quality of life in City neighborhoods should be identified and addressed early if it occurs.

Vehicles

V.1. – Assist Shippers & Carriers in Transitioning to Cleaner Vehicle Fleets

According to the U.S. Environmental Protection Agency (EPA), medium and heavy-duty vehicles comprise 10 percent of the overall fleet in the country but produce 20 percent of greenhouse gas (GHG) emissions. EPA and New York State both have programs that offer resources to shippers, carriers, and logistics companies to reduce emissions. The EPA SmartWay program is intended to advance sustainable transportation supply chains through performance measurement, benchmarking, and sharing of best practices among participating companies.

The New York Truck – Voucher Incentive Program includes the New York State Electric Vehicle Voucher Incentive Fund, which provides $9 million to cover the incremental cost (the difference in price between a traditional vehicle and electric vehicle) of purchasing any truck with a gross vehicle weight rating greater than 10,000 pounds. The City can encourage companies to participate in these and other programs to help reduce emissions resulting from the movement of goods into, out of, and within the city.

V.2. – Assess Opportunities for the RFD to Utilize Smaller, Safer Fire Engines & Fire Trucks

Above all else, fire engines and fire trucks must be able to address fire incidents (structural or otherwise). The smaller apparatus employed in Europe and elsewhere are a function of needing to navigate narrow streets that were originally built several centuries ago and are insufficient for American cities. Cities such as San Francisco, Hamilton, Ontario, and others are beginning to transition the fire apparatus component of their fleets to smaller vehicles. A reduction of 10 inches in the length of the vehicle can reduce the turning radius by eight feet. Doors that roll up rather than open outward and shorter outriggers can also make fire trucks more city-friendly without compromising firefighting capabilities.

Safety features such as no tint windows so firefighters can make eye contact and more easily communicate with pedestrians and bicyclists and the addition of cameras that provide a 360-degree view outside the vehicle to the driver can increase safety during responses. Beyond the actual vehicles, departments (including the Portland Fire and Rescue Bureau) are beginning to implement processes to more efficiently respond to medical assist and emergency medical service calls.

V.3. – Support Pick Ups & Deliveries by Bicycles

Shipments to many neighborhood-level retail establishments and residences in the City are of lower volume and do not require delivery by truck or car. The same is true for restaurants and stores that make deliveries (such as grocery stores and pharmacies). Cargo bicycles, fully human powered or with electric assist (as pictured in Figure 19), provide many benefits. They offer reduced monetary costs compared to cars and trucks in terms of initial capital outlay, for purchase of the bicycle, and ongoing maintenance and fuel. The lack of emissions of localized pollutants and GHGs improves public health. Cargo bicycles for pick ups and delivery would also leverage the City's growing number of bicycle facilities and further promote cycling as a mainstream form of travel in addition to automobiles.

Figure 19. Cargo Bicycles in New York City and Portland, Oregon

Safety

S.1. – Develop Informational Resources to Increase Safe Operation of Large Vehicles and Other Modes

When most people hear "Share the Road", they immediately think of drivers of passenger cars and trucks being reminded that they are required to adhere to laws aimed at protecting bicyclists and motorcyclists. "Share the Road" is an initiative of the National Highway Traffic Safety Administration, a part of the U.S. Department of Transportation (USDOT), responsible for reducing injuries and fatalities on roadways.

The Federal Motor Carrier Safety Administration (FMCSA) – also part of the USDOT – has a similar responsibility with its emphasis on commercial motor vehicles (large trucks and buses). FMCSA administers its program "Our Roads, Our Safety" to educate drivers of both passenger cars and trucks, commercial drivers, and bicyclists and pedestrians on how they can better coexist, which is of particular importance in urban settings. An emphasis of "Our Roads, Our Safety" and similar programs at the state and local level, including the NYCDOT's "Truck's Eye View", (see Figure 20) is to increase awareness about the substantial blind spots operators of large trucks must contend with as they drive. The City could utilize the "Our Roads, Our Safety" toolkit and emulate the

"Truck's Eye View" program to promote a better understanding among motorists, bicyclists, and pedestrians of how to interact with large vehicles.

Figure 20. FMCSA and NYSDOT Educational Materials on Commercial Vehicles

S.2. – Identify Areas in Need of Increased Enforcement of Speed Limit, Parking, & Idling Laws

NHTSA reports that in 2016 (the latest year for which data is available), over 10,000 people died as a result of motor vehicles being operated at excessive speeds. This accounted for more than one in four traffic fatalities that year. The increase in pedestrian mortality rates as vehicle speed increases is well documented. The results of crashes between trucks and pedestrians are even more dire than when a passenger automobile is involved. Many parking regulations are intended to provide adequate sightlines for motorists, bicyclists, and pedestrians, as well as ensure needed access to fire hydrants. Trucks create larger safety concerns than passenger automobiles when they park illegally due to their size. The New York State Environmental Conservation Law prohibits commercial trucks and buses from idling more than five minutes at a time with fines of up to $18,000 for the first violation. Trucks engaging in any of these activities – speeding, parking illegally, or idling in excess of the law – compromise safety and public health. Addressing these issues is critical to protecting and improving quality of life, especially in residential neighborhoods.

S.3. – Inventory and Monitor Maintenance of At-Grade Rail Crossings

There are 26 at-grade railroad crossings in the City of Rochester. There is equipment (e.g., gates, signage, lights, etc.) at these crossings to prohibit movement across them when a train nears, is present, and as it passes by. Ensuring that the safety devices at these crossings are maintained in a state of good repair is imperative as train collisions with vehicles and passengers, while rare, have a high potential to be tragic. In the best-case scenario, an equipment failure results in a closed crossing that creates delays for motorists. Congressional members representing Rochester have identified and continue to raise local grade crossing safety as a priority at the federal level. Local elected officials, neighborhood advocates, and other stakeholders can support these efforts to have repairs made in a timely manner and for maintenance records be provided for public inspection.

Partnerships

P.1. – Establish A Freight Advisory Committee

Freight advisory committees provide a forum for cities to engage freight-related businesses, neighborhood organizations, real estate management and development companies, and regional and state transportation agencies. The primary role of the committee is to consider, deliberate, and advise the City on issues related to all facets of urban goods movement. Including a diverse array of stakeholders is vital and allows a freight advisory committee to be a well-rounded forum for discussion and knowledge transfer, as well as advocate for policy changes and resources that will benefit the City at the state and federal levels. By-laws that define purpose, membership, roles, and processes should be created as a framework to set expectations and guide decision making.

P.2. – Work with Employers, Shippers, and Carriers on Routing Options

Even if the thresholds required to designate truck routes as discussed in recommendation O.2. are not realized, the City will still have occasion to work with employers, shippers, and carriers to ensure that truck traffic does not interfere with City activities of varying duration (e.g., street construction, community events, etc.) nor is excessively hindered by city policies. Members of the freight advisory committee established by recommendation P.1. can provide outreach to other employers, shippers, and carriers to gain their input and involvement when truck traffic needs to be routed around specific locations.

P.3. – Participate in Regional Freight Planning Efforts

The current federal surface transportation legislation includes enhanced provisions for freight planning and funding compared to previous versions. The current regional freight plan produced by the Genesee Transportation Council (GTC) was completed in June 2012. When the GTC updates this plan or undertakes other regional goods movement related activities, the City should fully participate. Providing review of materials from and input to these processes could be a key function of the freight advisory committee from recommendation P.1. (if formed).

The recommendations discussed above are intended to be cost-effective, proactive and address issues related to the economy, the environment, and equity for all citizens. Implementation of the recommendations will ensure that goods movement and emergency response capabilities in the City will be maintained and improved.

City of Rochester
Comprehensive Access and Mobility Plan

Transportation Demand Management Report

NELSON
NYGAARD

Cover photo from patrickashley via wikimedia

Table of Contents

Table of Figures

1 Background

Transportation Demand Management (TDM) strategies are cost-effective solutions that aim to reduce drive-alone trips; increase active trips such as public transit, walking, biking, carpooling, and vanpooling; and shift driving trips away from the most congested times. Supporting bicycling, walking, using transit, and carpooling makes it easier for all users to reduce reliance on driving alone, and provides larger environmental benefits through lower emissions, health benefits through increased safety and physical activity, and community benefits through active public spaces and streets.

TDM offers a solution to the problems that plague many cities and their residents including traffic congestion, long commutes, and reduced quality of life. The programs work within the existing transportation system to expand and support mobility options that accommodate future growth while meeting larger local and regional goals.

TDM Concepts

Transportation Demand Management (TDM) refers to policies, physical amenities, programs, tools, and services that support the use of sustainable modes of travel. TDM programs collectively work together to change how, when, where, and why residents and employees travel.

- Employer- or worksite-based strategies are programs and incentives to help diversify commute options and create lower-cost options for how people get to and from work. These strategies are designed to be implemented by employers; however, experience around the country suggests that employers will need support, encouragement and technical advice to be easily initiated by employers.
- Regional TDM strategies are programs and services that are best implemented on a larger scale, such as a neighborhood (e.g., Upper Mount Hope) or a large employment center (e.g., Downtown Rochester). In some cases, regional strategies may be implemented on a much broader scale, such as throughout the Finger Lakes Region. Some regional TDM strategies require policy initiatives and coordination across multiple government entities, while others may be initiated or managed at a regional level but implemented locally.

TDM Benefits

Across the country, more and more people are beginning to identify walkable neighborhoods and convenient public transit as a priority. Communities, regions, and employers (particularly those with large campuses such as academic institutions and

hospitals, etc.) are leveraging this trend, using TDM is to help manage growth, alleviate congestion, and improve the environment.

TDM programs are used by academic and business campuses to promote and provide a diverse mix of transportation choices as part of efforts to attract and retain talented students and employees. Mixed-use areas use a variety of transportation options to make places more accessible to residents and employees and, as a result, emerge as vibrant, walkable neighborhoods with desirable amenities which, in turn, increases the profitability of local businesses. Environmental reviews may also benefit from TDM programs or measures as mitigations for air quality and/or transportation impacts.

TDM Programs can have significant financial benefits as well. As a rule of thumb, a single surface parking space costs about $3,000 to build, plus annual maintenance, taxes, and opportunity costs. A space in a covered parking structure costs a minimum of $20,000 per space to build and at least another $150/year to maintain. By incorporating TDM programs into planning decisions in place of parking minimums, developers and owners are able to forgo the financial burdens of providing and maintaining parking. Similarly, effective use of TDM programs can reduce existing parking demand, which could allow for excess existing spaces to be reallocated for more active and profitable uses.

TDM programs are also supportive of equity goals. Generally, people who cannot or don't drive often pay high costs to get to work – either in terms of time-consuming transit trips, high transit fares and/or long or uncomfortable bike or walk trips. TDM strategies work to level this playing field by creating options that make it less expensive for people to ride the bus, safer for people to walk or ride their bikes, and easier to create carpools or take advantage of ridesharing and vanpools.

2 Existing TDM Programs

The City of Rochester does not currently have any implemented TDM policies and does not have any TDM requirements in the city's municipal code. The city code does include some TDM-supportive policies; namely, exemptions for parking minimums in certain districts and bike parking requirements for certain land uses.

Bikeshare and Carshare

A partnership with Zagster brought a bikeshare program to Rochester in 2017, which was updated to a dockless program in 2018. The program, now called Pace, currently provides over 300 smart bikes. Pace bikes are initially located at stations within the central city, but bikes can be parked anywhere once they are checked out. Because bikes are fitted with GPS technology, the Pace mobile app allows users to locate the bikes that are nearest to them even if they are not parked at a station.

As of 2018, Zipcar is operating in a few select locations, namely on the city's college campuses. A citywide car sharing program is in development, but has not yet launched.

Vanpools

The City helped to pilot a vanpool program in 2016, and later secured a NY State Congestion Mitigation Air Quality grant to expand the program. The vanpool program is now currently being operated through a partnership between Regional Transit Service (RTS) and Enterprise Rideshare, and is currently being used by a small number of employers in the city. RTS plans to expand the program to 30 vans serving 450 users by the end of 2020.

Commute-Assistance Programs

ROCEASYRIDE

While there are no Transportation Management Associations serving Rochester exclusively, the city is the catalyst and focal point of the Metropolitan Planning Area of the Genesee Transportation Council (GTC), the Metropolitan Planning Organization (MPO) that which covers the nine-county area of the Genesee Finger Lakes Region. The MPO operates ROCEASYRIDE, a free online service that allows users who register to take advantage of trip planning assistance tools, including:

- Commute Trip Profiles – Users can create profiles for individual and/or frequent commutes patterns which will then show the user ideal routes for driving, walking, or riding a bicycle, and allows the user to set up a search for potential carpool, walk, or bicycling partners who are following along a similar pattern.

- Commuting Information – Each user's home portal provides links to the latest Greater Rochester Bicycling Map, current traffic conditions in the greater Rochester area, and public transportation services in the Finger Lakes Region.
- Commuting Statistics – Users who log their daily commutes, and modes used for each commute, can create reports showing estimates of money saved, gas saved, calories burned, and environmental pollution reduced through their use of non-driving modes. Since 2011, over 1500 commutes have been logged.

ROCREASYRIDE also allows employers and organizations to register for the service and create organizational profile pages with their own logo, information for employees/members, and event information. The service also provides a way for administrators of employers and organizations to list their worksites/destinations and to run reports specific to their organization. Users who identify themselves on the service as employees/members of an organization can also then limit their matches to co-workers and other members of the organization.

Employer Assisted Housing Initiative

The city currently offers The Employer Assisted Housing Initiative, a program designed to encourage employers to provide home-buying assistance programs for employees who purchase new homes within the city, which can be used for down payment and closing costs. The program provides a dollar-for-dollar match of employer contributions up to $3000. Employers must provide employees purchasing an eligible home at least $1000 to be eligible for the matching grant. Employees must also meet eligibility requirements including:

- Meeting employer qualifications
- Not currently owning a home in the City of Rochester
- Living in the property for at least five years
- Contributing at least $1,500 of their own funds
- Qualifying for a conventional mortgage
- Attending pre-purchase home buyer training (if a first-time home buyer)

The Employer Assisted Housing Initiative does not, however, require that employees live within a particular range of their primary employment location, a critical determinant for non-driving modes.

Employer-Based TDM Programs

There are also some TDM programs in the Rochester area that are provided by private employers, notably including the University of Rochester and the Rochester Institute of Technology.

University of Rochester

The University of Rochester is the largest employer in the city, and is one of the city's most prominent providers of TDM programs. The university's TDM program (branded as UR Connect) features a menu of mobility opportunities most of which are available to all faculty, staff, and students in the campus community (Figure 1).

Figure 1 TDM Programs Available at University of Rochester

Program	Program Details
Campus Shuttles	▪ Free With Campus ID ▪ Campus shuttles are all equipped with real-time tracking equipment ▪ Shuttles are bicycle friendly
Transit Passes	▪ University employees can purchases passes with a pre-tax payroll deduction ▪ Operated by RTS
Carpool	▪ Carpoolers are eligible for a discounted Parking Permit ▪ 2 people carpool – 50% of rate ▪ 3 people carpool – 25% of rate ▪ 4 people carpool – no charge
Rideshare	▪ Operated by Zimride
Park & Stride	▪ Certain parking spaces are labeled "Park here to walk farther and be healthier". ▪ Signs display calories burned walking between parking lots and building entrances
Bicycling	▪ Free bike registration ▪ Covered bike cage rental ▪ Bike locker rental ▪ Bike rack, shower, and repair station locations ▪ Bicycle maintenance & riding safety seminar

The University's "Occasional Parking Program "further encourages the use of TDM offerings among campus affiliates who own a car but do not use it for regular trips to campus. Campus users who register their vehicle in this program are eligible for a "bundle" of further benefits based on their preferred transportation mode. All of the "bundles" include:

- 26 free one-day parking passes
- Use of a Guaranteed Ride Home program

Additional mode-specific benefits available to participants in the Occasional Parking Program can be found in Figure 2.

Figure 2 UR Connect "Bundle" Benefits

Walking Bundle	Biking Bundle	Carpool Bundle	Public Transportation Bundle
▪ Coordination with WELL-U programs	▪ Coordination with WELL-U Programs ▪ Cage/Locker Permit with Fee ▪ Free Access to all Bike Racks	▪ Discounted Parking Permit ▪ Prime Parking Space	▪ Payroll Deduction Yearly Bus Pass

Rochester Institute of Technology

The Rochester Institute of Technology (RIT), although not located within the City of Rochester limits, is another top-5 employer in the Rochester Metropolitan Area, and, recognizing the importance and potential of providing, and encouraging the use of, multiple mobility options, has begun expanding their TDM program. Currently, RIT provides the following services:

- Campus Shuttles – RIT shuttles make scheduled stops at all RIT apartment complexes, Residence Halls, and other key on-campus and nearby off-campus locations during the academic year.
- Walking Escorts - the Public Safety Department will provide an escort for those walking on campus during the hours of darkness, any day of the week, upon request
- Intercity Bus Transportation – the "My Bus Home" program encourages students to leave their personal vehicles at home by providing transportation for all academic breaks in private, fully insured motor coach buses with restrooms, DVD and Wi-Fi. Buses travel between campus and to/from central locations in the following regional centers:
  - Plymouth Meeting and Easton, PA, Bridgewater, NJ
  - NYC (Penn Station) and Jericho, Long Island
  - White Plains and Albany, NY
  - Mechanicsburg, PA, Baltimore, MD and Arlington, VA
  - Ludlow and Newton, MA and Londonderry, NH

RIT plans to expand its TDM offerings in the Fall of 2018 with Rideshare and Bicycle programs.

3 Lessons from TDM

Following is a review of a selection of Rochester's peer cities. The peers selected for this review were selected by the City of Rochester, and are as follows:

- Pittsburgh, PA
- Buffalo, NY
- Richmond, VA
- Spokane, WA
- Birmingham, AL
- Salt Lake City, UT
- Grand Rapids, MI
- Akron, OH

The city of Rochester's benchmarking peers were selected to reflect a mid-sized city with similar population and economic profiles that houses a major university campus environment and a large medical facility or hospital.

In terms of TDM policy and program availability, the City of Rochester falls behind several of its peers. In fact, outside of employer based plans, Rochester was found to have limited comprehensive TDM policies, plans, or programs that are provided and/or operated by the city, a TMA, or a transit organization; while most peers benefit from at least some policy and/or a selection of TDM-options provided by the city, a TMA, or a transit organization. (Figure 3)

Figure 3 Population and TDM Context of Peer Cities

City	Population (2016)	Municipal TDM Policy/Plan	TDM-Specific Zoning Ordinance	Municipal, TMA ,or Transit Provided TDM Programs
Pittsburgh, PA	303,625	✗	✗	✓
Buffalo, NY	256,902	✓	✓	✓
Richmond, VA	223,170	✗	✗	✓
Spokane, WA	215,973	✓	✓	✗
Birmingham, AL	212,157	✗	✗	✓
Salt Lake City, UT	193,744	✗	✓	✗
Grand Rapids, MI	196,445	✓	✗	✗
Akron, OH	197,633	✗	✗	✗
Rochester	**208,880**	✗	✗	✓

Peer Review

Pittsburgh, PA

The Pittsburgh Municipal Code does not contain any stipulations that requires new developments or existing employers to provide TDM programs. The code does, however, have language that encourages the use of several types of TDM or TDM supportive programs by allowing parking requirements to be reduced if certain TDM programs are provided.

The City itself does not operate or manage any TDM programs, but some are provided through the semi-coordinated efforts of three major Transportation Management Associations (TMA):

- Oakland Transportation Management Association (Oakland TMA), which focuses primarily on Oakland, a large Pittsburgh neighborhood located just east of Downtown.
- Pittsburgh Downtown Partnership (PDP), which focuses primarily on the downtown area.
- Airport Corridor Transportation Association (ACTA), which focuses on suburban areas of western Pittsburgh that are located south of the Ohio River.

Most notably, these TMA's collaborated to create the Walk Pittsburgh initiative. Details of this and other TDM programs provided by these TMA's can be found in Figure 4.

Figure 4 TDM Programs of Pittsburgh TMA's

Provider	Program(s)	Program Details
Oakland TMA, PDP, ACTA	Walk Pittsburgh	Through a website and smartphone app, the program provides resources and support to encourage walking. Participants log their daily steps, and can view how their steps affects the environment and their personal health.
Oakland TMA	Oakland Smart Commute	Encourages small business owners in Oakland to promote the use of alternative commuting to their employees for commuting to work, and provides TDM information to individuals.
PDP	Bicycling Initiatives	In collaboration with Bike Pittsburgh and the community, PDP designed, manufactured and installed bike racks, and is working with the Bike Share program to identify locations for bike stations.
	Wayfinding	Currently working to develop and implement a wayfinding system the North Side/North Shore, Oakland, and Downtown areas
ACTA	Ride ACTA	RideACTA is an on demand, last mile commuter shuttle that runs along Campbell Road at the Airport Corridor, and provides nearly 80,000 rides per year.

Buffalo, NY

In January of 2017 the City of Buffalo enacted the Buffalo Green Code, a place-based development strategy that builds upon the city's existing 20-year Comprehensive Plan. The Buffalo Green Code eliminated minimum parking requirements citywide, making Buffalo the first major US city to do so, and instead replaced parking minimums with a TDM process that also takes into account multimodal access. A TDM Policy Guide was adopted in March of 2017 to provide guidance for compliance of the requirements set forth in the Buffalo Green Code. The policy guide requires projects within certain zones, and any within ¼ mile (1,320 feet) of a Metro Rail Station, to reduce anticipated vehicle trips by 20%, and requires all other projects to reduce vehicle trips by 10%. Notable, the Green Code also requires that the city's Planning Board provide a written report ensuring that any approved development meets the required TDM standards.

The Green Code requires certain developments to prepare a TDM Plan that is consistent with the requirements set forth in the TDM Policy Guide. The must be prepared by a qualified professional, and must determine anticipated travel demand and determine how anticipated travel demand will be met. This includes:

- The number of on-street, off-street, or shared vehicle parking spaces
- The number of short-term and long-term bicycle parking spaces; accommodations for pedestrians, bicycle riders, drivers, transit riders, and the mobility-impaired
- TDM strategies that will be employed to reduce vehicle trips and vehicle miles travelled, and to promote driving alternatives
- Mode share objectives that will be sought from the implementation of the TDM strategies

The TDM Policy Guide also provides a scoring metric and requirements for TDM strategies in order for said strategies to be applied towards a development's trip-reduction requirements. (Figure 5)

Figure 5 Buffalo Green Code Vehicle Trip Reduction Credits, by TDM Strategy

Category	Strategy	Trip Reduction Credit
Share Programs	Car Share Stations	2 trips per car share space
	Car Share Membership	1 trip per car share membership
	Bike Share Stations	1 trips per 5 bike share spaces
	Bike Share Membership	1 trip per 5 bike share memberships
Promotion and Outreach	Promotion and Education	Up to 2%
Employee Incentives and Programs	Alternative/Flexible Work Schedules	Up to 2%
	Transit Pass	Trips = number of passes multiplied by % of subsidy
	"Live Near Your Work" Programs	1 trip for each employee that utilizes program
	Guaranteed Ride Home (GRH)	Up to 2%
Enhanced Design Amenities	Roadway Improvements	Up to 4%
	Bike Parking	1 trips per 5 bike spaces
	Shower Facilities and Lockers	Up to 4%
	Bike Repair Station	1%
	Transit Facilities	Up to 4%
High Occupancy	Shuttles (Buspool)	Up to 10%
	Vanpool	Up to 5%
	Carpool	2%
Parking Management	Shared Parking	Up to 10%
	Parking Cash Out	Up to 10%
	Unbundled Parking	Up to 10%

Richmond, VA

In the greater Richmond area, RideFinders is the regional non-profit TDM and rideshare agency. RideFinders is a division of the Greater Richmond Transit Company (GRTC) Transit System whose stated mission is to foster increased efficiency of the transportation system by influencing travel behavior by mode, time, frequency, trip length, or route. TDM programs and services provided by RideFinders to employers and commuters include the following:

- Transit Information and Transit Media
- Vanpool Formation Services
- Carpool Matching
- Telework Consulting
- Clean Air Program
- Downtown Commuter Guide
- Emergency Ride Home Program
- Transportation Planning
- Employer-Based Marketing
- Employer Relocation and Site Analysis Services
- Commuter Choice Program Development
- Bike and Pedestrian Commuter Service
- Park and Ride Lot Information

Spokane, WA

The 2006 Washington State Commute Trip Reduction (CTR) Efficiency Act requires local governments in urban areas with traffic congestion to develop programs that reduce drive-alone trips and vehicle miles traveled per capita. In Spokane, the CTR Act requirements have been inserted into the city's municipal code. The code requires affected employers[1] to make a "good faith effort" to develop and implement a CTR program. A good faith effort, as defined by the stipulations of the Spokane city code, requires a minimum of the following actions:

- Designating an Employee Transportation Coordinator (ETC)
- Displaying the ETC's name and contact information where employees are likely to see it
- Distributing information to employees about commute alternatives to driving alone
- Implementing a set of measures geared toward achieving the CTR goals
- Surveying employees about their commuting habits every two years
- Reporting annually about progress toward meeting CTR goals
- Meeting any additional local requirements that may apply

The city itself does not provide any TDM services, nor does the regional TMA.

[1] Affected employers include an employer that employs 100 or more full-time employees at a single worksite who are scheduled to begin their regular workday between 6am-9am on two or more weekdays for at least twelve continuous months. Construction worksites, when the expected duration of the construction is less than two years, are excluded from this definition.

Birmingham, AL

The Regional Planning Commission of Greater Birmingham established the CommuteSmart program to work with employers and commuters in the greater Birmingham metro area to help reduce motor vehicle trips and improve air quality. Registered users, or employees of registered employers, can log into CommuteSmart to gain access to CommuteSmart services or programs including matching services for rideshares, carpools, and vanpools, and emergency ride home, among others.

CommuteSmart users are eligible for incentive programs. The GETGREEN Incentive Program is a one-time program that offers $1 per day for every day a non-driving alternative is taken in the first 90 days of participating in CommuteSmart, with a minimum of 20 non-driving days required to qualify for a payout. Participants are eligible for $20-$70 during the 90-day period. Upon completing the GETGREEN Incentive Program, users are automatically enrolled in the COMMUTERCLUB Incentive Program, which provides a $25 gift card for commuters that log at least 20 non-driving commutes each quarter.

Salt Lake City, UT

Salt Lake City does not have any specific TDM policies, but does include some TDM supportive requirements in the city's municipal code. In general, these elements of the city code apply to any buildings constructed after April 12, 1995 that employ 100 or more people, and include the following:

- Bicycle Parking Requirements – developments are required to provide parking spaces at a number equivalent to 5% of the minimum parking requirement, and provided spaces must meet bike parking design standards.
- Carpool Parking Incentive – developments must devote 10% of the total number of employee parking spaces for vehicles participating in a car pool program, and spaces must be located to provide superior convenience.

The municipal code also allows special minimum and maximum parking requirements for developments in certain districts where alternative forms of transportation exist. These requirements are intended to reduce traffic volumes in effected zoning districts by reducing the number of parking spaces required, and in some cases, limiting the maximum number of parking spaces permitted.

Grand Rapids, MI

Grand Rapids released a TDM Plan for its Michigan Street corridor in 2013. Citywide, however, Grand Rapids currently has no municipal TDM plans, policies, or programs, nor are there any TMA-related plans, policies, or programs for TDM.

Akron, OH

There are currently no municipal TDM plans, policies, or programs in Akron, nor are there any TMA-related plans, policies, or programs for TDM.

Peer Best Practices – Lessons Learned

Dedication to Systemic TDM

The most ambitious peer cities do not approach TDM only from a position of promoting or providing individual commuters with programs or improved mobility options; they also approach TDM from a systemic level, in hopes of managing demand before it gets to the user level. This includes:

- **Clear, Specific, TDM Policy and Goals** – including city or area-specific TDM plans
- **TDM-Related Development Requirements** – including requiring site-specific TDM plans for each new development that meets certain criteria, trip mitigation fees and plans, TDM measurement and reporting
- **TDM Supportive Development Priorities** – including promotion of increased density, transit-oriented development, and mixed-use development

TDM Coordination and Management

Peer cities have more, and more useful and effective, TDM offerings when they are coordinated through a central agency following a unified strategy than when they are being provided piecemeal by various agencies, often without any overarching strategy at all. In particular, Transportation Management Associations (TMA) appear to be notably effective at providing and managing programs, as they are creations made up of, and often funded by, the very stakeholders they serve. A point person for managing programs, whether within a TMA or designated by some other means, is also integral to ensuring that an overarching strategy is being followed.

Strategic Commute-Trip Reduction Programs

Commuters in several peer cities have access to a menu of complementary TDM offerings. Many of the most effective and/or popular offerings are those which carry with them some kind of incentive for use, or those that help alleviate an existing barrier to a preferred mode of travel.

4 Recommendations

Systemic TDM Policy

Citywide or Area-Specific TDM Plans

Rochester does not currently have a citywide TDM Plan or policy in place, but previous planning efforts recommend and are supportive of TDM program usage in the city. A citywide policy, and citywide and area-specific plans, could be particularly useful to provide clear policy directives and/or guidance in the downtown, or in other areas with constrained parking or anticipated development.

TDM-Specific or Supportive Development Requirements

The municipal zoning code should be revised and updated to promote increased density as well as transit-oriented and mixed-use development. Other zoning code updates could include revising parking requirements to include parking maximums, and encourage or require shared parking and unbundled parking where appropriate. These changes could be coupled with TDM and traffic mitigation requirements in the code.

TDM Coordination and Management

Transportation Management Association (TMA)

Regional or local governments, chambers of commerce, and/or the management of major facilities (such as malls, hospitals, or universities) can help create a TMA and provide seed funding. A variety of services can be provided by Transportation Management Associations to encourage more efficient transportation and parking resource usage. These services include:

- ***Access management:*** TMA's can be involved in land use planning, active-transportation planning processes, transit improvement plans, and roadway design practices to encourage smart growth development and create people-friendly streetscapes.
- ***Commuter programs:*** TMA's can provide various programs that allow employers to incentivize their employees to reduce their automobile trips including commuter financial incentives such as parking cash-out and transit allowances, rideshare matching, alternative scheduling, telecommuting options, Guaranteed Ride Home programs, and walking and cycling encouragement facilities and programs, among others.
- ***Coordination between employers and facilitation with public agencies:*** TMA's can serve to provide effective coordination of programs and projects with and between employers and the various public sector entities. A TMA Coordinator can help administer TDM programs at particular businesses or developments.

- ***Parking management and brokerage:*** TMA's can provide parking brokerage services, allowing businesses to share, trade, lease, rent and sell parking facilities.
- ***Direct service provision:*** TMA's can directly provide some services to employers such as shuttles, special event planning and transit services, public and community relations programs, etc.
- ***Standard and guidelines development:*** TMA's can aid in the development of contextually appropriate strategic TDM standards and guidelines for employers, such as the allocation and design of bike parking.
- ***Wayfinding and multimodal navigation tools:*** TMA's may facilitate the implementation of multimodal navigation tools such as signs, maps, guidebooks, internet resources, and mobile applications that provide useful travel option and destination information to consumers.
- ***Marketing and promotion:*** TMA's can help determine the needs and preferences of consumers through a variety of means including surveying, creating contextually appropriate targeted products, and providing information and promotional materials about products to consumers.

Applicability to Rochester

The Genesee Transportation Council (GTC) is currently performing many of the duties that could be performed by a TMA, including providing some TDM programs. A Rochester-specific TMA made up of key local stakeholders, however, may be better suited to develop and manage the TDM needs and responsibilities facing the city, including developing, implementing, and managing programs; collecting, analyzing, and reporting data on TDM performance; and advising on new and updated TDM policy, including zoning recommendations. The downtown area and the University of Rochester/Collegetown/Upper Mt Hope would most likely form the most effective boundaries for TMA's in Rochester

Potential stakeholder-partners for Rochester-focused TMA's include, but are not limited to:

- City of Rochester
- Monroe County
- Greater Rochester Chamber of Commerce
- Genesee Transportation Council
- Regional Transit Service
- University of Rochester
- Rochester Regional Health (including Rochester General Hospital/Unity Hospital)
- Eastman Business Park
- Bausch & Lomb
- Wegmans Food Markets (corporate)
- Paychex (corporate)

- Rochester Institute of Technology
- Xerox Corporation (corporate)

TDM/Mobility Coordinators

A TDM or Mobility Coordinator provides a single point of contact that oversees the creation and day-to-day administration of all of the various programs and initiatives intended to promote non-driving modes of transportation and manage parking demand in the city.

Coordinators can be effective at various levels, and are increasingly commonplace at TMA's, large university campuses, and municipal transportation departments. In settings where there is not a designated person to oversee transportation and TDM programs, they are typically managed by various employees over various departments without overall guidance on how they are, or should be, impacting each other, or reflecting the overall transportation goals. A Coordinator, on the other hand, ensures that programs are being planned and managed in unison to effectively complement each other in pursuit of these overall goals.

A coordinator is most successful if employed full time as a stand-alone position focused solely on TDM projects, programs, and initiatives, but can have success as a part-time employee if there is a strong support network of involved employers and stakeholders.

Applicability to Rochester

Rochester is home to several large campuses and employers, several of which have employees or visitor numbering in the thousands. A coordinator could be beneficial to each of these organizations, but would particularly benefit the college/university campuses, hospital/health campuses, and local and county government campus areas. A coordinator could also be crucial to the efficacy of a TMA, or for the management and implementation of any citywide TDM policies.

A Coordinator should have specialist knowledge of TDM programs and services. Some typical duties of a successful TDM or Mobility Coordinator include:

- Development and day-to-day management of existing TDM programs
- Organizing and participating in promotional events and orientations
- Providing marketing, promotions, and education/training at new employee on-boarding/orientations (or during new student orientation during start-of-school activities)
- Coordination with local and regional transit operators
- Providing personalized commuter counseling.
- Serving and representing TDM interests on travel and construction advisories
- Developing, documenting, and reporting program metrics

- Collecting, managing, and analyzing various transportation and other related data
- Consulting and assisting new and existing developments on compliance with TDM and traffic mitigation related policies

Program Finance

A critical question in moving forward with TDM strategies is potential funding. TDM programs tend to be very low-cost as compared to other transportation projects and programs, and offer relatively cost-effective solutions to regional transportation issues. In most cases, TDM expenditures equal or can reduce the investments employers are already making in parking. However, implementation still requires at least an initial investment in time, resources, and money.

Many of the strategies outlined above are employer-based strategies, and as such they could be initiated and led by employers, and in most cases, employers may also be required to invest in these programs. There are some strategies, such as transit and vanpool fare subsidies, where investments made by employers are tax deductible, helping to reduce or minimize the financial impacts. Actual costs will vary based on employment size and the number of employees who participate in the program.

There are other strategies, such as development of park-and-ride lots, and improvements to pedestrian and bicycle facilities, that are typically funded by the public sector. Moreover, other strategies, such as ridesharing or vanpool programs or a guaranteed ride home program, are of a scale on which the public sector can typically take the lead in developing and managing supporting infrastructure or systems. The public sector may also take responsibility for marketing and encouraging participation in any implemented programs.

TDM programs are eligible for funding under some of the traditional federal transportation programs, including those administered by the Federal Transit Administration (FTA) and the Federal Highways Administration (FHWA). Because TDM strategies typically reduce drive-alone commuting, many regions fund their programs with Congestion Mitigation Air Quality (CMAQ) funds. Fixing America's Surface Transportation (FAST) Act funds are also eligible for projects that increase vehicle occupancy rates (i.e. carpooling, etc.) or otherwise reduce demand for peak period travel, some expanded use for transit operations and workforce development, training, and education activities.

Transportation Management Associations are uniquely suited to provide or manage funding for TDM programs, as they can leverage both private and public funding sources. Initial TMA funding normally comes from local governments, highway or planning authorities, major private businesses, etc. Federal funds, such as the Congestion Mitigation Air Quality (CMAQ) program can be used to support TMA

start-up costs and up to three years of operating assistance[2]. Later, TMAs are typically funded by dues paying member businesses, as well as government grants. Some funding can also be obtained by charging certain fees for services they provide, such as shuttles, parking management, etc.

Many TMAs rely on public, government-controlled funding mechanisms, such as the CMAQ program or local city or county sources, to fund their organization. City Business Improvement Districts (CBID) can provide funding for businesses to implement tailored TDM strategies. Foundation funding is also sometimes available to fund specific projects and programs. TMA's can respond to foundation opportunities individually, or they can coordinate with area partners on a joint application.

Commute Reduction Programs

Parking Cash-Out

The cost of providing parking is often hidden from the user, but a Parking Cash-Out program remedies this by revealing or prescribing the value of parking spaces to their users. In a Parking Cash-Out program, employers continue to offer parking, but offer the cash value (full or partial) of the parking subsidy to any employee who chooses not to use it.

Applicability to Rochester

Many of Rochester's employers offer parking to employees and affiliates free of charge. This contributes to problematic inducing of parking demand, particularly in places where parking is limited. By offering a cash-out program, employers and the city can help curb demand by allowing users to choose between a parking space or receiving a rebate on the value of the space for not using it.

Carpooling, Rideshare, and Ride-Matching Services

Carpooling arrangements and schemes involve varying degrees of formality and regularity. Carpools may be formal - arranged through an employer, public website, etc. - or casual, where the driver and passenger might not know each other or have agreed upon arrangements.

Applicability to Rochester

These services are in use at several employers in the city, and are a key component of ROCEASYRIDE. Tighter coordination of these services, both at individual employers and citywide, could help to increase their use. Employers could also provide

[2] http://www.fhwa.dot.gov/fastact/factsheets/cmaqfs.cfm

incentives to help incentivize the use of these carpooling and ridesharing, such as preferred reserved premium parking spaces.

Vanpools

Vanpools are a type of ride-sharing, similar to carpooling, but typically involving more people and a shared, provided vehicle. In most cases, vans are owned or leased by a sponsoring organization and riders share the cost of operating the vehicle to and from work. Vanpools have had the most success where employees travel longer distances along corridors with limited or no existing transit service.

Applicability to Rochester

As noted in the previous chapter, Enterprise Rideshare is currently operating in Rochester under a partnership with RTS. The City continues to provide federal and state grant funding to help subsidize the service. Plans to expand the program should be continued.

Guaranteed Ride Home Program

Guaranteed Ride Home (GRH) programs can be the key to making many other TDM programs run effectively. This initiative recognizes that for workers to commute without their own private vehicle, there will be times when they will need a reliable travel alternative. Whether a commute is made by bike, transit or vanpool, there will be an occasional need to work late, make unplanned trips home, or have an alternate plan due to inclement weather. The Guaranteed Ride Home program allows for a taxi or other ride home under these circumstances, making the use of alternative travel arrangements on a daily basis more palatable and feasible.

Applicability to Rochester

Guaranteed Ride Home programs are crucial to the efficacy of strategic TDM programming, and as such should be included as a key element of any TDM program at any level in the city. Currently the University of Rochester offers GRH to its affiliates, and a GRH program is provided by RTS to eligible employees of organizations that form partnerships with RTS.

Live-Near-Your-Work/Homebuyer Programs

Live-near-your work programs are home-buying assistance designed to encourage employees to purchase homes within a minimum distance of their place of work, thereby reducing or altogether eliminating the need to use an automobile to commute to work. The programs are typically provided by major employers such as universities, hospitals, and city and state agencies, and typically funded through public-private partnerships and grants.

Private-public partnerships between major local or regional employers and the city, state, or regional governments wherein the employment centers are located utilize live-near-your-work programs as a tool to combat traffic congestion and sprawl. Through these partnerships, employers can offer financial incentives to participating employees in a number of ways, including:

- Grants are provided to employees and paid by the employer, the participating public agency, or a combination of the two through a fund matching program
- Payment of down payments and/or closing costs
- Forgivable and/or no-interest, low-interest, or fixed-interest loans

Applicability to Rochester

The Employer Assisted Housing Initiative provides an opportunity to promote housing choices that are more favorable to non-driving modes. The current program could be redesigned to provide a scaled incentive based on the range of distance from the primary working location, based on likely commuting distances. The top tier of such a structure could fall into a typical walking range (up to 15 minute walking distance, or half-mile); the next tier within a typical bicycling range (about one-half mile to two miles); and the third tier within a typical transit range (about 30 minutes ride). The effectiveness of this program could be further enhanced with strategic parking policies and fee structures at major employers.

The University of Rochester and Rochester Regional Health (including Rochester General Hospital/Unity Hospital) are the most likely candidates for effective Live-Near-Your-Work programs in Rochester. However, more employees in other areas of the city could be eligible with a strategic expansion or restructuring of the Employer Assisted Housing Initiative, or if further programs were operated through a TMA.

Employer Shuttles

Employer-specific or site-specific shuttles connect high-employment areas with important transit stations or centers. Shuttles often connect to a major transit service, potentially providing employees with a solution to the important first-mile/last-mile challenge of getting from a transit station or stop that may be near, but not within walking distance to, their job. Employer shuttles usually operate at work-shift times and can be operated by a TMA, an employer or group of employers, or as a partnership with a transit agency. Shuttle services typically serve a well-defined area, or specific route, and provide convenient and direct service to desired destinations. If the service receives public funding, then it must be open to the general public, but routes and schedules can be customized to the needs of the employer.

Shuttles serving a single employer are typically managed and operated by said employer. If a shuttle serves employment centers or corridors, TMA's can coordinate

groups of employers to operate the service. TMA's can also provide effective third party design and cost allocation for the service, and balance needs among multiple stakeholders. Alternatively, TMA's can operate the service themselves, or facilitate a contract with a public or private service provider. Most employer shuttles operate "fare-free" as riders are typically associated with the employer or institution.

Applicability to Rochester

The University of Rochester and Rochester Institute of Technology currently offer free shuttle services to campus affiliates.

The Rochester Regional Health System (including Rochester General Hospital/Unity Hospital) is another ideal candidates for employer shuttles in Rochester.

Pre-Tax Transit/Vanpool Passes

Federal tax law allows employers to offer tax-free benefits for the purposes of taking transit, vanpooling, and paying for parking. These benefits are deducted from corporate gross income for taxes paid by the employer, allowing both employers and employees to save on taxes because neither pays federal income or payroll taxes on these benefits.

As of 2018, up to $270 per month is excludable for vanpooling and transit

Applicability to Rochester

Any employer can offer this benefit to its employees, and many employers are able to manage their own program internally. Some employers, though, particularly those with very high numbers of employees, have success using third-party vendors to help manage their program.

Pedestrian and Bicycle Facilities and Programming

Walking and riding a bicycle to work are becoming more popular as cost-effective, environmentally friendly, and healthy ways to commute. The expansion of related infrastructure opens up walking or riding a bicycle to more commuters.

Infrastructure is only one part of encouraging walking or riding a bicycle, as walkers and bicycle riders also need to be supported once they reach their destination. This is especially true of bicycle riders, who are more likely to have come from greater distances, and have equipment that may need to be tended to and stored. In many places, employers are providing on-site bicycle amenities for use by employees and visitors. Bicycle facilities are included as part of new construction, but can also easily be retrofitted into existing buildings and employer campuses.

Types of End-of-Trip Facilities

Bicycle Parking

Bicycles can cost anywhere from a hundred to several thousand dollars, but all bicyclists seek safe, secure, weather-protected, bicycle parking for their bicycles. Parking could be located inside the building, in a parking garage, or in a weather-protected facility in a parking lot. Bicycle parking should be located near a convenient, desirable employee entry point.

Shower and Changing Facilities

Shower, changing, and locker facilities promote bicycle commuting by providing a convenient place for commuters to deal with the occasional effects of active transportation and weather elements, and/or a secure place to store clothing and other necessities. Existing locker rooms can serve this purpose, or simple, secure facilities are can be an easy addition to many buildings.

Bicycle Repair Facilities

A simple, do-it-yourself bicycle stand is an inexpensive investment that provides essential support for cyclists, especially when tire gauges, air pumps, and wrenches and other tools for minor repairs are also provided. A bicycle stand can fit in a small space in the building or co-located with bicycle parking.

Additional Considerations

Developing bicycle facilities is all about understanding the needs of people who wish to ride a bicycle and removing barriers that conflict with said needs. Considerations to be reviewed/applied on a site-specific basis should include:

- **Wayfinding Signage** – Prominently placed, easily readable signs directing pedestrians to key areas, and directing bicycle riders to/from parking areas.
- **Lighting** – All walking and bicycle paths should be well lit to provide added visibility and protection, as should bicycle parking areas.
- **On-site connections** – Once past the entry gate, facilities should have paved, accessible paths to building entries and/or bicycle parking.
- **Off-site connections to regional facilities/transit stops** – The "last mile" between an employer's front door and key bicycle or transit connections can be the most difficult, and should be reviewed and improved on as needed
- **Low-cost design improvements** – Walking and riding a bicycle can be encouraged and improved through simple design changes, some of which can be implemented at little additional cost, including:
  - Providing access from residential neighborhoods to regional facilities
  - Adding pedestrian gateways to employment complexes at strategic locations (near bus stops, crossings)
  - Creating continuous sidewalks and crosswalks at intersections

- Accessible curb ramp design
- Highly visible pavement markings
- Designing tight curb radii

Applicability to Rochester

According to public outreach, aside from safety, Rochester residents choose not to bike due to the weather, travel distances, a lack of places to store their bike, not having the time to bike, a need to transport people and things, no place to shower at work, and snow plowed into bike lanes. Many of these issues, including safety, could be addressed through improved facilities and programming. Further analysis of walking and riding a bicycle in Rochester, as well as walking and bicycle riding recommendations, can be found in the respective companion reports for walking and biking in Rochester.

PRIORITY PROJECTS

ROCHESTER COMPREHENSIVE ACCESS AND MOBILITY PLAN

200 Years of Douglass
1818
2018
CITY OF ROCHESTER, N.Y.

NELSON NYGAARD

HIGHLAND PLANNING

T·Y·LIN INTERNATIONAL

EXPAND THE DEDICATED BICYCLE NETWORK

Bikeable City

OVERVIEW

The Bikeable City Report described a priority project to upgrade shared lane markings to dedicated bike lanes or protected bike lanes. Additionally gaps in the existing on-street dedicated bicycle network should be connected, starting where the fewest miles of new facility would provide the most continuous connectivity.

A methodology was presented in the report that forecasted likely bicycle trips using current vehicle trips under five miles in length. These trips were aggregated in travel flows and rated by volume in order to prioritize dedicated bicycle facility investment.

Maps created in the report, when overlayed with existing and approved bike lanes and cycle tracks, help to identify facility investment priorities.

INTEGRATION

Upgrading the on-street network is a critical component of creating a network for cyclists of all ages and abilities. Low-stress bicycle networks are proven to increase cycling adoption in cities worldwide.

ROC The Riverway

Priority connections may be better achieved through the use of trails and connectors.

Elmwood Avenue Cycle Track

Announced in 2014, the City will construct a physically separated cycle track between Wilson Boulevard and Mt. Hope Avenue, an identified secondary priority link.

Union Street Cycle Track
Source: Arian Horbovetz

EXPAND THE DEDICATED BICYCLE NETWORK

Bikeable City

SELECTION

The diagram below displays the location of existing and planned bike lanes, protected facilities, and existing shared lane markings.

The first set of high impact network improvements would be upgrading sharrows to dedicated lanes in locations that would link existing portions of the network. This may require curb relocation to achieve the desired roadway width. Highest priority upgrades should occur at:

- Driving Park between Dewey and Lake
- Monroe/Chestnut between Broad and Priem Streets
- Broad Street between Clinton and Union
- Broad Street between Main and Allen

A second set of high impact network improvements would fill in short gaps between existing facilities. Highest priority implementations should occur at the following locations:

- St. Paul Street between Upper Falls and the Inner Loop
- Dewey Avenue between Flower City Park and Knickerbocker Avenue
- Lyell Avenue between Oak and Sherman, Glide and Belknap

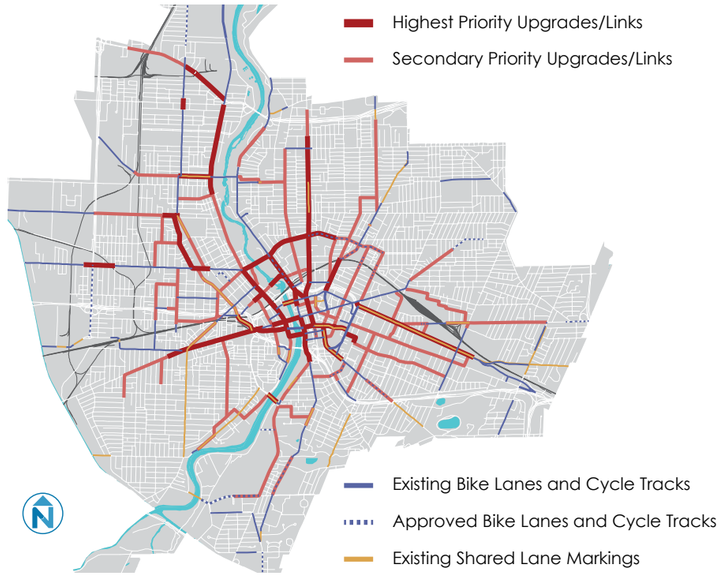
Planned facility locations that do not overlap highest or secondary priority implementation locations should be reconsidered in favor of other highest priority upgrades.

IMPLEMENTATION

Facility implementation costs may be relatively low when implemented in conjunction with planned roadway resurfacing projects or targeted restriping, but high when requiring curb relocation.

Decidated bicycle facilities may not be an option for high-traffic corridors. Cycle tracks may require land acquisition and/or easements.

Further study, selection, and implementation would be an ongoing short-to-medium-term (1-5 years) project.



ESTABLISH A CITYWIDE MODE SHIFT POLICY

Transportation Demand Managment

OVERVIEW

The TDM Focus Area Report noted how a citywide single occupancy vehicle trip reduction policy, as well as area-specific plans, could be useful to provide clear guidance to areas experiencing constrained parking resources or those anticipating development. Focus Group and Public Meeting refinement of this concept yielded support for a policy that may offer incentives for building on bus lines or in walkable areas or may institute requirements that reduce the amount of car traffic development creates.

Policy initiatives would be overseen by a mobility coordinator who would also administer City pedestrian and cycling programs.

INTEGRATION

Regional Efforts

A citywide TDM policy would build on a proposed feasibility study for forming a regional Transportation Management Association (TMA). This organization would be focused on connecting low-income residents with currently inaccessible job opportunities.

City Programs

The City currently struggles with the visbility of active transportation initiatives such as *bikeROCHESTER* and *Rochester Walks!* A mobility coordinator can restart these initiatives through a managed, programmatic approach.

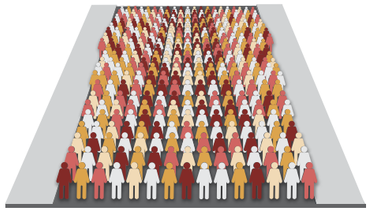
MOVING CARS

27.8 people
typical per block

MOVING TRANSIT

240 people
maximum per block

MOVING PEOPLE



1,000 people
maximum per block

Sources: *Evaluating Transportation Land Use Impacts*, Victoria Transport Policy Institute (2018). National Household Travel Survey, FHWA (2017). City Block assumed 40' curb to curb and 300' long.

ESTABLISH A CITYWIDE MODE SHIFT POLICY

Transportation Demand Management

POLICY OPTIONS

A citywide mode shift policy that aims to reduce per-capita vehicle trips requires support to be measurable and enforcable.

A revision of the municipal zoning code that promotes increased density as well as transit-oriented and mixed-use development supports TDM policy from the built environment side of the equation. Other zoning code updates could include revising parking requirements to include parking maximums and remove statutory caps on shared parking agreements where appropriate. These changes may be able to be linked to any traffic mitigation requirements already found in the code.

Additional policy levers for directing development site selection and thus, reducing car trips include licensing and tax incentives.

IMPLEMENTATION

TDM policies are very low-cost compared to other transportation projects and offer relatively cost-effective solutions versus additional investments in vehicle parking.

However, implementation still requires at least an initial investment in staffing. Additionally, policies must not conflict with other City programs.

Adding a TDM coordinator and developing a comprehensive trip reduction policy can be a short-term project, accomplished within one year.

TDM POLICY BENEFITS

Larger Pool of Workers

Transportation options that connect to employment centers and the regional transit system help employers recruit and retain employees from across the City and region.

Faster Freight

Rochester's economy is dependent on an efficient transportation system that moves freight quickly and reliably. Investing in mobility options reduces congestion, allowing freight to arrive on schedule.

Saves Employers Money

Structured parking costs between $25,000 and $40,000 per parking space, plus operations and maintenance costs. By comparison, employers can encourage alternative commutes by supporting a last mile shuttle to seamessly connect their employees to the job site.

$25k to $40k per space

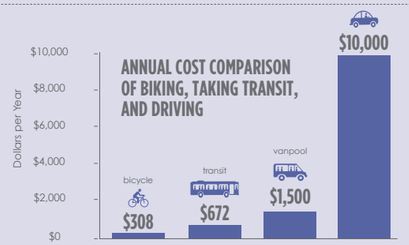
Healthier Workers

Employees that lead an active lifestyle take up to six fewer sick days from work per year.

Transit users walk an average of 19 minutes to and from transit stops each day.

Saves Employees Money

On average, Americans spend more than $10,000 per year owning and operating a personal vehicle. By comparison, a full price annual adult transit pass costs under $700.



EAST/WEST PRIMARY MULTI-USE TRAIL ROUTE

Walkable/Bikeable City

OVERVIEW

The focus group convened to evaluate the Bikeable City report suggested a study to determine the optimal routing of an east-west shared-use trail to complement currently emphasized north-south infrastructure. The new trail should be a link comparable to the Genesee Riverway or El Camino Trails.

No natural features exist that span the City from East to West. A new off-street facility may take the form of a cycle track parallel to a sidewalk in places, and/or make use of existing and proposed bicycle boulevards in order to assemble an east-west low-stress cycling and pedestrian network spine.

INTEGRATION

An east-west shared-use trail would build on and integrate with the following projects:

ROC The Riverway

Any east-trail will require use of existing or proposed new Riverway Trail connections and/or bridges to cross the Genesee River.

JOSANA Rail to Trail

Conversion of the right-of-way parallel to Lyell Avenue between Oak and Hague Streets could represent a significant first link in an east-west active transportation corridor.

East Avenue Road Diet

Restriping street space to calm traffic and provide bicycle space has proven to be a success. The City can make permanent these improvements while reserving space for protected bicycle facilities.

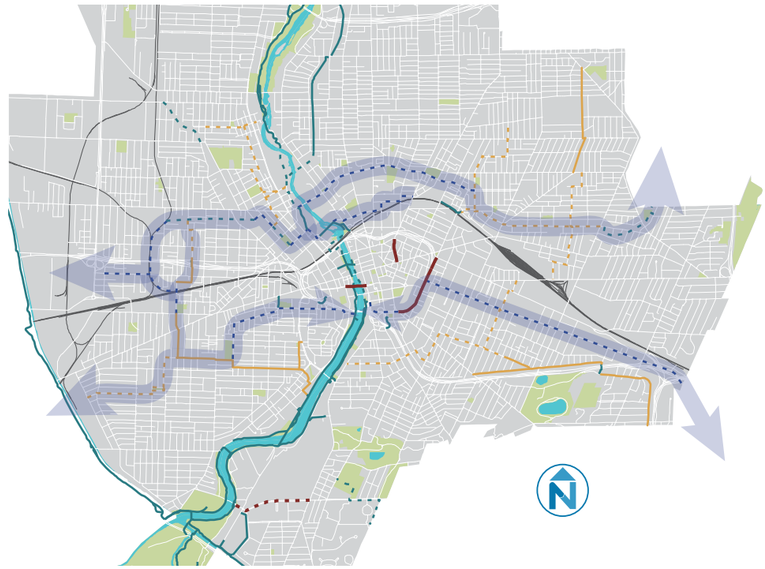
Source: Discover El Camino

EAST/WEST PRIMARY MULTI-USE TRAIL ROUTE

Walkable/Bikeable City

ALTERNATIVES

Three example alternatives for a primary east-west bicycle trail have been explored. All would require some travel along roadway corridors. Certain City corridors, such as East Avenue and Upper Falls Boulevard, can accomodate cycle tracks to create long stretches of the potential corridor. Lands immediately adjacent to railroad corridors represent another, but highly unlikely, option for long, uninterrupted trail segments. In other locations, while unprotected, the City's existing and proposed bicycle boulevards are the best low-stress option. The proposed bicycle boulevard on Garson Avenue could act as a significant eastern portion of the route. Difficulty remains connecting corridors through Downtown.



IMPLEMENTATION

Costs associated with a new trail are high due to facility construction costs as well as land acquisition factors.

Trails along active railroad rights-of-way require extensive negotiations. An alternative may exist on city-owned property immediately adjacent to the rail corridor (Eg. Ward Street Ext. to Ormond).

Selection and implementation requires a long-term (5-10 years) effort. Short-term initial actions include performing a formal planning study.

- Potential Trails/Cycle Tracks
- Existing Trails and Walkways
- Trails Under Development
- Existing Bike Boulevards
- Approved Bike Boulevards
- Existing Cycle Tracks
- Approved Cycle Tracks

MODIFY STREET DESIGN STANDARDS

Walkable/Bikeable City

OVERVIEW

Stakeholders groups focused on active transportation modes requested that design speeds of reconstructed streets not exceed their posted speed. Principles cited include that speed plays a critical role the severity of collisions between motor vehicles and other street users.

On many connecting corridors in Rochester, narrower travel lanes and the presence of highly visible facilities for other modes would help to promote slower driving speeds. According to the NACTO Urban Street Design Guide, lane widths of 10 feet are appropriate in urban areas (11 feet where transit is emphasized) and have a positive impact on user safety without impacting traffic operations. This forms the basis for reapportioning the roadway to achieve a lower traffic speed without the use of discrete calming elements that hinder desired uses.

INTEGRATION

New street design standards would build on the following City plans and policies:

Complete Streets Policy

Adopted in 2011, the policy ensures that all future street design efforts will fully consider the needs of pedestrians, bicyclists, transit users and persons with disabilities by requiring review for all street construction projects.

Bicycle Master Plan

The plan's recommendations serve as a framework for the city's future investment in bicycle infrastructure based on implementation effort.

MODIFY STREET DESIGN STANDARDS

Walkable/Bikeable City

EXAMPLE

Joseph Avenue between Clifford Avenue and Avenue D, a corridor similar in context to many others across the City, sees traffic speeds consistently closer to or exceeding free flow speeds for a large part of the day.

Joseph Avenue features on-street parking on each side of the street, protected by curb extensions. Because these spaces are underutilized, they do not adequately perform a traffic calming function. Restricting this parking to a single side of the street frees up roadway width for other purposes.

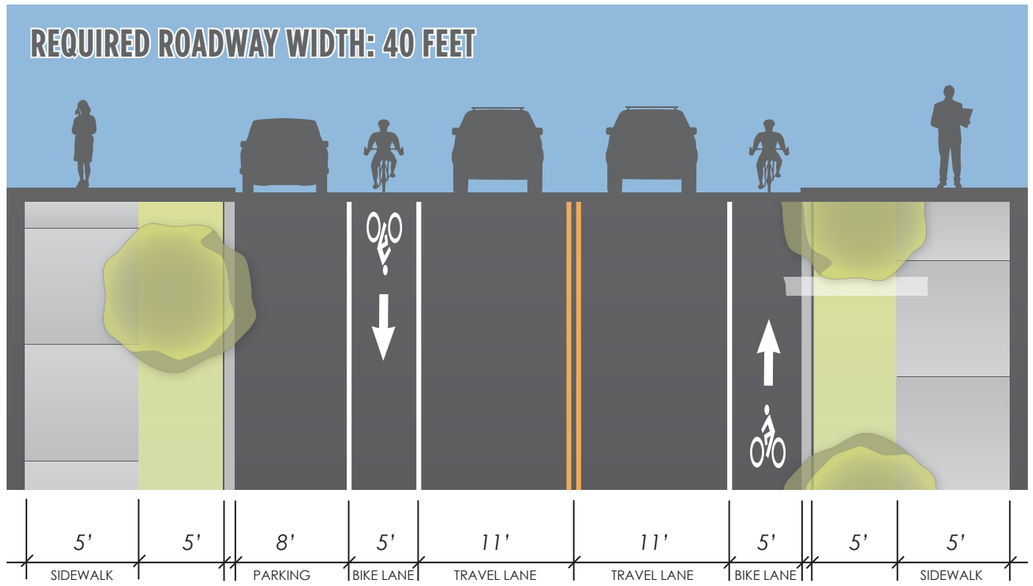
To properly accomodate transit vehicles and upgrade sharrows to bi-directional dedicated bicycle facilities, 40 feet is required from curb to curb as seen below.

IMPLEMENTATION

Standards themselves are low cost to implement. Improvement realization and potential higher costs depend on the ability to work within existing hard constraints.

City Architecture & Engineering must allow for review and comment by the Operations Bureau on street design plans.

Adoption of new street design standards can be a short-term project (one year) and can be assisted by the forthcoming Rochester Street Design Guide.



Rochester Comprehensive Access and Mobility Plan

Priority Projects | March 2019

Project Information and Contact

http://www.cityofrochester.gov/camp/

CREATE A TRANSPORTATION DATA WAREHOUSE AND BUSINESS INTELLIGENCE PLATFORM

Making More Informed Decisions

OVERVIEW

Strong, vibrant cities are built on safe, efficient, and reliable transportation infrastructure and services. Ensuring limited resources are programmed to those projects and programs that provide the greatest benefit relative to cost is essential to enhancing urban mobility. As the amount and types of transportation data continue to rapidly expand, the City should invest in developing a repository of data collected internally and by partner agencies. This data would be easily accessed and its contents manipulated using tools that query the diverse datasets to provide improved insights regarding the needs of residents, businesses, and community institutions. Collectively the repository and the infrastructure and services improvement/introduction methodology is referred to as data warehousing and business intelligence (BI).

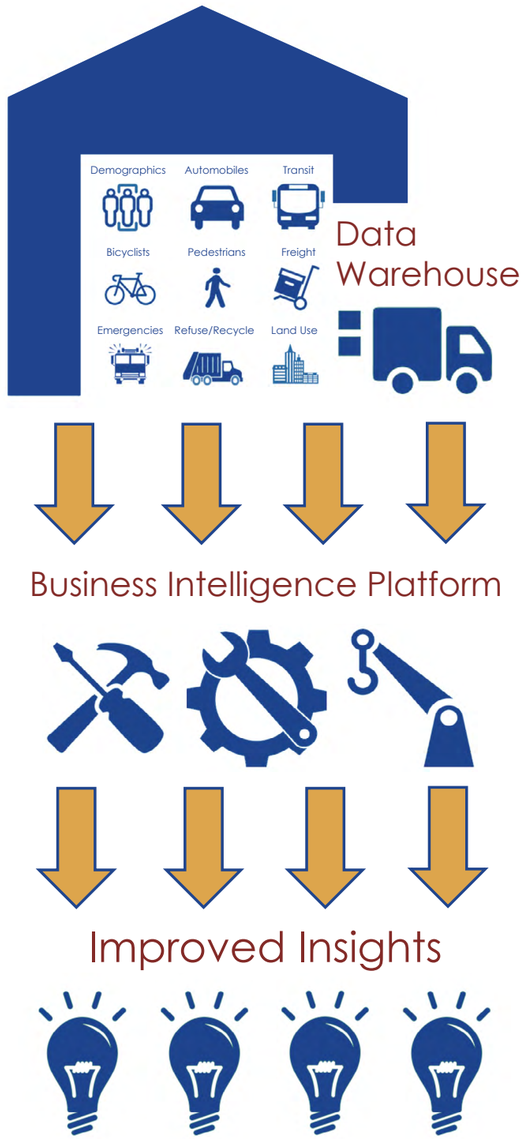
INTEGRATION

Protected Bicycle Facilities

Bicycle volume counts on City streets and multi-use trails, bikeshare origins and destinations, collisions involving bicyclists, and other data sets can be monitored to prioritize protected bicycle facilities.

City Street Repairs

Better knowledge of where bicycle and pedestrian volumes, transit boardings and alightings, and transportation network company pickups and drop-offs overlap is critical to capital programming and appropriate multimodal street design.



POLICY OPTIONS

Developing a transportation data warehouse and BI platform can be part of a larger smart city initiative that includes non-transportation components with strong connections to transportation considerations beyond project and program prioritization. In the case of transportation, this would include dynamic traffic signal timings, optimized refuse collection routes and schedules during extreme weather events, and signal prioritization for transit to improve on-time performance. Changes in performance over time and in real-time can also be monitored with a BI platform, allowing an accelerated feedback loop between decisions and impacts to users of the transportation system. Beyond changes in observed system performance, BI platforms are also capable of assessing public opinion and serving customer relationship management functions.

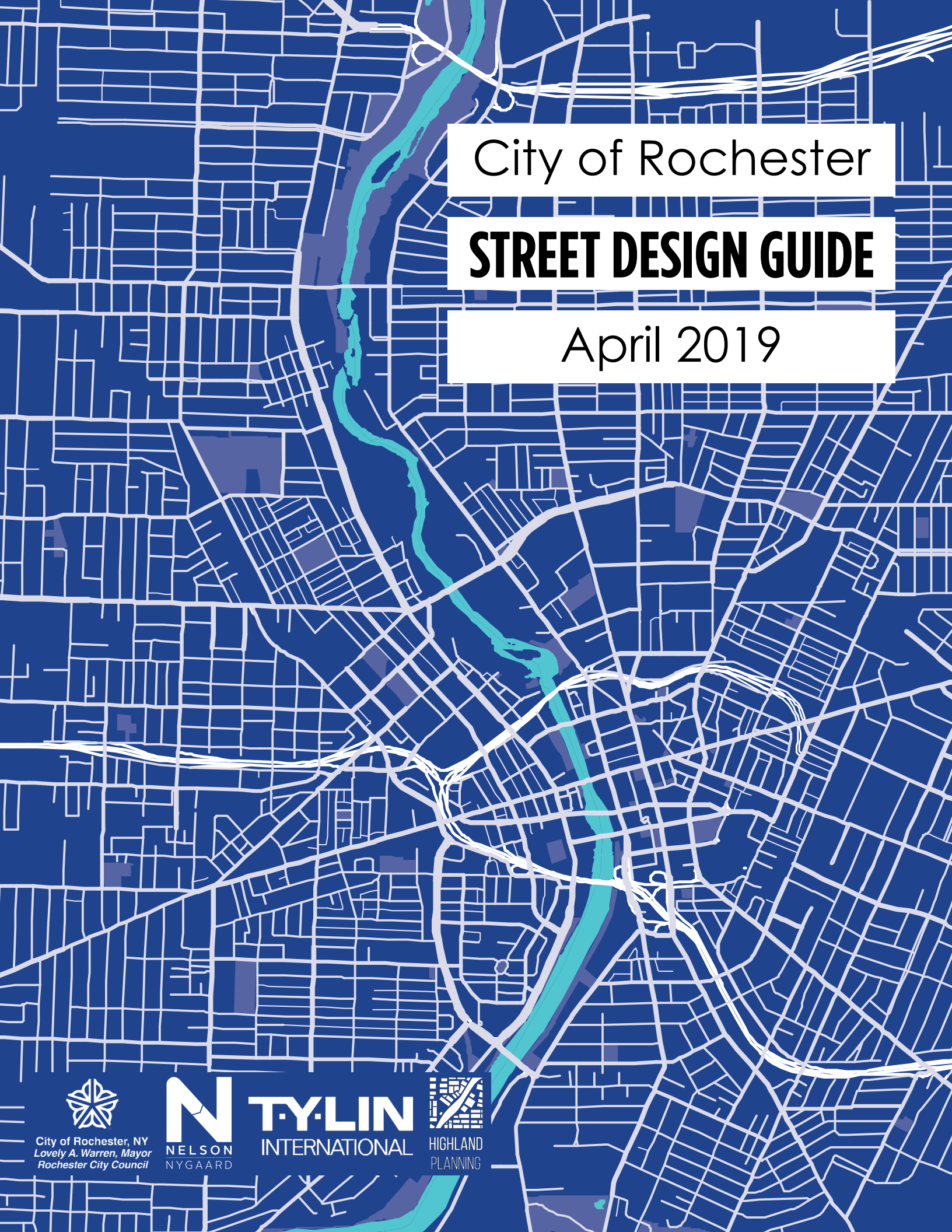
Street improvement project locations and change in crashes - New York
Source: DataKind

IMPLEMENTATION

Data compilation costs vary from free for public sector data sources that may have lag times of months or years to proprietary providers that offer real-time data via paid subscription services. The costs of BI tools include not only initial development costs but also those for maintenance as data sources revise their contents and format.

Significant data resources are available from governmental agencies but full coverage of the elements necessary to provide a robust data warehouse and useful BI platform require additional information points. Beyond private sector data providers, the City can also negotiate the provision of datasets from its licensed transportation network companies and bikeshare companies.

The initiation of a transportation data warehouse and BI platform should be a near-term project. Whether the platform is transportation-specific or incorporates other quality of life and economic development considerations, the Mayor's Office of Innovation and Strategic Initiatives should have an active role.



City of Rochester

STREET DESIGN GUIDE

April 2019

City of Rochester, NY
Lovely A. Warren, Mayor
Rochester City Council

NELSON NYGAARD

T·Y·LIN INTERNATIONAL

HIGHLAND PLANNING

TABLE OF CONTENTS

OVERVIEW

The Rochester Comprehensive Access and Mobility Plan envisions a transportation system that improves the quality of life of Rochesterians by enabling access and connectivity between destinations and neighborhoods. The system should work for users of all ages and abilities whether they walk, bike, drive, or take public transportation, and should support businesses by enabling the movement of goods and employees.

The City of Rochester Complete Streets policy seeks to create an interconnected network of transportation facilities that accommodate all modes of travel in a manner that is consistent with neighborhood context and supportive of community goals by incorporating active transportation modes into the planning, design, and operation of all future City street projects. The policy defines Complete Streets as streets that are planned, designed, operated, and maintained to enable safe access for all users, and upon which pedestrians, bicyclists, transit users, persons with disabilities, and motorists of all ages and abilities are able to safely move along and across.

The City of Rochester's Bureau of Architecture & Engineering, within the Department of Environmental Services, utilizes a pavement management system to assess the relative condition of city streets and rank them to determine maintenance priorities. This data is used in the Capital Improvement Program (CIP) development process to allocate limited available resources to the streets with the greatest needs as well as to align the street improvement program with other City goals and priorities. Once a street is selected for inclusion in the CIP, it proceeds to the engineering and design phases before going to construction.

The City of Rochester Street Design Guide provides detailed information on street design considerations to assist street designers and engineers, City

planning and zoning, and members of the public in ensuring that updates and additions to the City's street network meet Rochester's goals. The Guide covers four primary topics:

STREET TYPOLOGY DEFINITION

Street types are outcome-oriented, driven by an overall vision for the intended future state—both localized and network wide. All types of streets must be complete streets that support a safe transportation environment and network connectivity for users of all modes. However, since each street has a finite amount of space, some streets may emphasize one or more modes over others by design while still recognizing that all modes will occasionally make use of the street.

The City of Rochester Street Design Guide assigns a street typology to all City streets based on a street's aspirational land use characteristics and transportation function. Typology assignment has been based on the synthesis of suggestions received from multiple stakeholder groups during a street design guide workshop.

SELF-ENFORCING DESIGN AND CONTROLS

Self-enforcing design is the overarching objective of the Street Design Guide. Self-enforcing design provides environmental cues to street users to enable them to naturally and intuitively comply with speed and other operating expectations. Design controls reflect the character and context of the street (intended users) as well as the desired and expected behavior of all street users.

OPERATIONAL PERFORMANCE METRICS

The goals of different street users often conflict. Contemporary performance measures should take a multidisciplinary approach, looking at urban streets and traffic at the macro and the micro scale, through the lens of safety, economy, and design, and inclusive of the goals and behaviors of everyone using the street.

DESIGN ELEMENTS

A street's right-of-way is divided into different zones, each with its own design elements, operational goals, and users. The Street Design Guide provides detailed recommendations for the use, design, operations, and maintenance of the component parts of a street.

Source: Keith Ewing (CC BY-NC 2.0)

TYPOLOGY DEFINITION

The Rochester Street Design Guide assigns a street type to all City streets based on a street's aspirational land use characteristics and transportation function. A street may not have the same typology for its entire length. For example, a street may travel through a low-density residential neighborhood to a neighborhood business district (South Avenue)or between industrial and commercial districts (Lyell Avenue).

Street types are outcome-oriented, driven by an overall vision for the intended future state—both localized and network wide. All types of streets must be complete streets that support a safe transportation environment and network connectivity for users of all modes. However, since each street has a finite amount of space, some streets may emphasize one or a set of modes over other modes by design while still recognizing that all modes will occasionally make use of the street. Certain areas along a corridor, such as school zones, may attempt to include elements beyond those required or typically desired for that typology. Designers should also consider how to incorporate green stormwater management best practices on all streets.

DEFINITION PROCESS

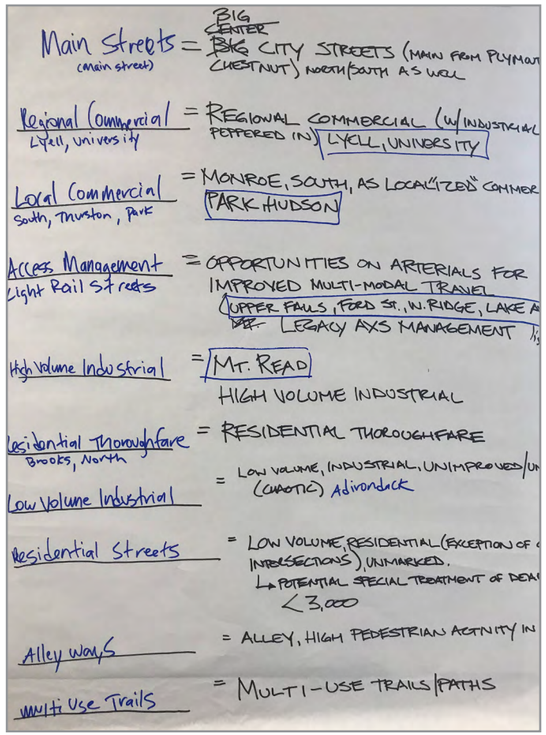
On December 3, 2018, City staff representing Planning, Zoning, Engineering, and Environmental Services as well as representatives of the Rochester-Genesee Regional Transportation Authority, the Monroe County Department of Transporation, and the Genesee Transportational Council participated in a street design workshop intended to develop a set of street typologies.

Comprehensive Access and Mobility Plan project background was presented to attendees, prefacing a longer presentation meant to familiarize workshop participants with street design principles, street design guides in

general, the concept of assigning street typologies rather than relying on functional classifications, and best practices in street design guides as embodied by national (NACTO, ITE Manuals) and city-specific (Ann Arbor, Columbus, etc.) examples. An initial set of potential street typologies for Rochester as a starting point for workshop activities.

Workshop participants were split into groups, each responsible to develop a street typology set for Rochester. In many cases, naming of the typologies took a backseat to a focus on present day and aspirational corridor context. Each team designed and presented a suite of up to ten typologies to the larger group. The work of all groups was collectively synthesized into the typologies presented in this street design guide. The harmonized hierarchy of street types features orders of streets (Activity, Link, Local) grouped by context (Regional, Downtown, Neighborhood, Industrial).

Key characteristics, examples, priority users, and design objectives are described on the following pages for each typology. Required, recommended, and optional street design elements for each street type are also listed. Street typology assignments are mapped in aggregate at the end of this section and individually by type in the Appendix of this document.



REGIONAL ACTIVITY

Image Capture: June 2017 © 2019 Google

Regional Activity streets serve a larger purpose in the regional transportation network. Often serving auto-oriented commercial uses as well as institutional and industrial land uses, the street environment tends to lack distinctive character.

In addition to the high volume of motor vehicle traffic, including a significant number of commercial vehicles traveling at higher speeds, these streets act as primary transit routes. Pedestian and bicycle activity is present. Travel speeds should be kept low to encourage better land use practices on current nearby low-density or undeveloped parcels along these corridors.

Regional Activity streets are important beyond the City's transportation network as they often act as a City gateway, an urban-suburban transition that connects points within the City to travel corridors that continue further into the region.

EXAMPLE STREETS

- West Ridge Road
- Upper Falls Boulevard (pictured)
- Lake Avenue
- Elmwood Avenue

PRIORITY USERS

Regional Activity streets should emphasize through vehicle travel while cognizant of providing safe through travel for all modes. Access for workers and customers must be prioritized.

DESIGN OBJECTIVES AND TYPICAL FEATURES

Redesigned Regional Activity streets should improve street character and support current and planned land uses while maintaining critical connectivity for through travel. While challenging, pedestrian mobility is imperative. Due to the high traffic volumes and higher speeds, non-motorized users should be well protected from moving traffic.

- **Sidewalks (5 feet minimum width)** are required on both sides of the street. Streetscape elements, especially trees, are recommended.
- **Travel lanes should be 11 feet wide** to allow for transit and goods movement activity. Transit-only lanes and median protected center turning lanes may be considered.
- It is recommended that bicycle facilities are **physically separated from traffic by a buffer**.
- On-street parking is **optional.**

DOWNTOWN ACTIVITY

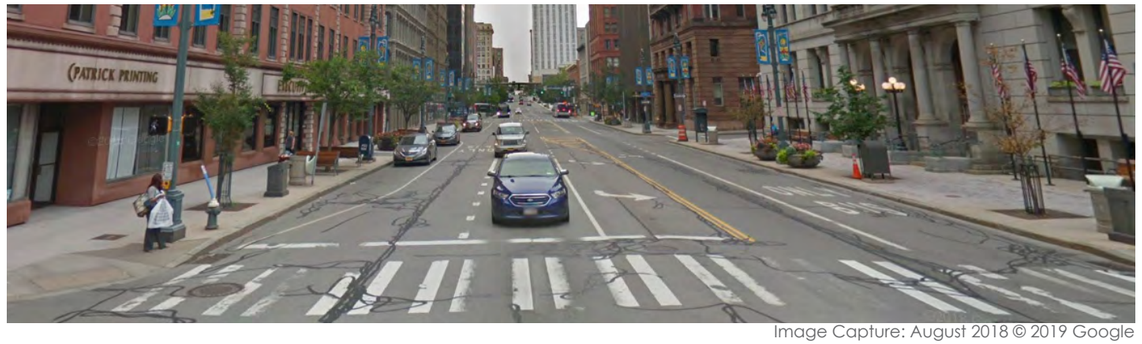


Image Capture: August 2018 © 2019 Google

Downtown Activity streets are Rochester's principal employment and entertainment streets. The streets also support a number of residents, institutions, students, and workers at the highest densities. These streets have specific design requirements to provide a high quality public realm that contributes to the City's sense of place.

Downtown Activity streets are important links in the local and regional transportation network. Travel demands are intense, with high volumes of travelers using personal vehicles, arriving and departing via transit, bicycling, and reaching final destinations on foot.

Parking is important, though is not always provided on street. The supply of off-street parking downtown generally dwarfs the on-street supply. Despite high volumes, vehicular traffic speeds should be kept generally slow to allow for a more comfortable street environment.

EXAMPLE STREETS

- Main Street (pictured)
- Clinton Avenue
- Chestnut Street

PRIORITY USERS

Downtown Activity streets should emphasize the pedestrian mode first and foremost. Pedestrians are present for a variety of reasons and each becomes an active user of the public space.

DESIGN OBJECTIVES AND TYPICAL FEATURES

Downtown Activity streets should create a distinctive sense of place while promoting access to downtown destinations via multiple modes. Movement should be smooth and efficient with minimal circling and congestion.

- **Sidewalks (8 feet minimum width)** on both sides of the street are required.
- **Lane widths of 11 feet** reflect expected transit operations. Transit-only lanes are an option where need and physical space allow. **Medians should be used to shorten crossing distances** and protect center turning lanes.
- Due to high vehicular volume, **protected bicycle facilities are recommended**. Consider frequent vehicle turning movements in design.
- On-street parking, protected by bump outs is **recommended**.

DOWNTOWN LINK

Image Capture: August 2018 © 2019 Google

Downtown Link streets are connections that carry local downtown traffic between Downtown Activity streets. Like Downtown Activity Streets, these streets serve the highest downtown densities and mixed uses.

Unlike Downtown Activity, these streets may have lower traffic volumes and travel speeds should be kept low by design to respect the relatively high pedestrian traffic volume while allowing for reliable vehicular traffic flow.

Downtown Link streets are traveled by all modes, but primarily pedestrians. Where alleys and off-loading facilities do not exist, Downtown Link streets are likely to serve the majority of downtown curbside deliveries. These links may feature transit service as buses depart from and return to the RTS Transit Center. Downtown Link streets are often more attractive options for bicycle routing versus Downtown Activity streets.

EXAMPLE STREETS

- Fitzhugh Street (pictured)
- Pleasant Street
- Scio Street

PRIORITY USERS

As with Downtown Activity Streets, Downtown Link streets should emphasize pedestrians first. Workers, customers, students, and visitors arriving via any mode all become pedestrians and active users of downtown public space.

DESIGN OBJECTIVES AND TYPICAL FEATURES

Downtown Link streets should continue to create a sense of place on less-traveled downtown streets and accommodate all modes. Transit and goods delivery activity may be less prevalent.

- **Sidewalks (8 feet minimum width)** on both sides of the street and street trees are required.
- Travel lanes should be scaled appropriately to the common users of the street, **most often 10 feet in width**. Where there will be transit operations, lanes should be **11 feet wide**.
- **Dedicated bicycle lanes are recommended**. Protected facilities are only recommended to link together the off-street network where physical constraints and opportunities allow.
- On-street parking protected by bump outs **should be provided on both sides of the street**.

NEIGHBORHOOD ACTIVITY

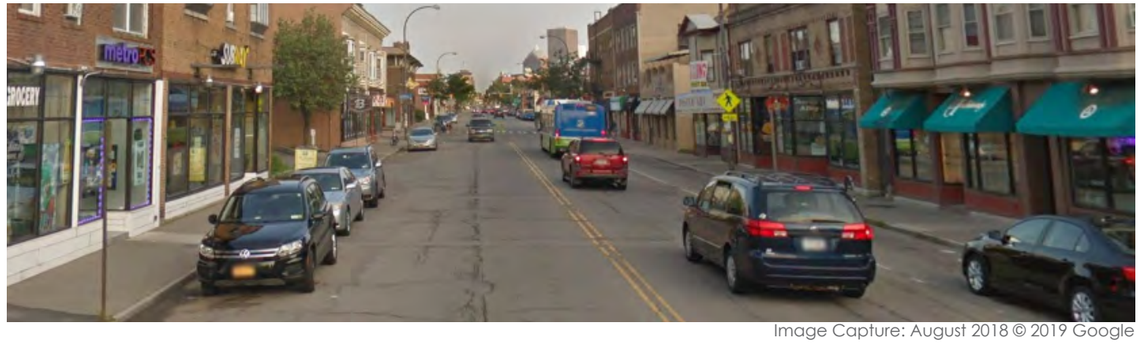


Image Capture: August 2018 © 2019 Google

Neighborhood Activity streets are primarily commercial corridors that also serve a critical roles in the larger transportation network. Neighborhood Activity streets are unique areas within Rochester neighborhoods that serve medium intensity mixed uses, including newer flexible mixed uses and are defined as prime areas to accommodate infill development.

Neighborhood Activity streets are moderate to high volume multimodal streets. While typically oriented along a corridor, they can be arranged as a grouping of streets to create mixed-use neighborhoods within or near development sites.

Neighborhood Activity streets accommodate travel demands to and through the business district and must provide safe access for all modes of travel, although they may be prioritized for one or more modal emphases (High-frequency transit is most likely to operate on this street typology).

EXAMPLE STREETS

- Monroe Avenue (pictured)
- North Clinton Avenue
- University Avenue
- West Main Street

PRIORITY USERS

Commercial customers and employees arriving on foot, bike, via transit, and by personal vehicle. Delivery vehicles must also be accommodated.

DESIGN OBJECTIVES AND TYPICAL FEATURES

Neighborhood Activity streets should support economic productivity of the corridor and enhance multimodal access and through travel while enabling unobstructive goods delivery.

- **Sidewalks (8 feet minimum width)** on both sides of the street, large canopy trees, and pedestrian seating are required.
- Travel lane width is variable dependent on modal emphasis. Lanes should be **11 feet wide on transit corridors**, 10 feet wide elsewhere.
- Noting difficulty due to right-of-way constraints, **dedicated bicycle lanes are recommended**. Protected facilities may be considered where daily traffic exceeds 6,000 vehicles per day.
- On-street parking on one or both sides of the street along with sufficient and convenient bicycle parking is **recommended**. Any parking lane **should be protected by bump outs**.

DRAFT
TYPOLOGY DEFINITION

NEIGHBORHOOD LINK

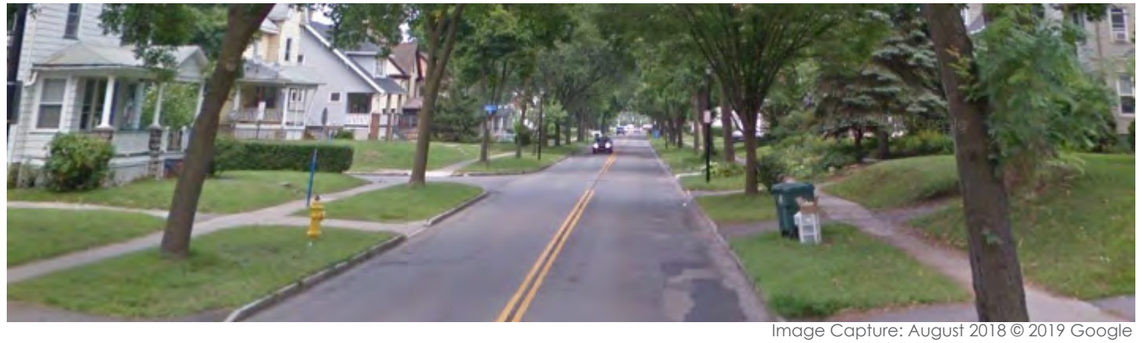


Image Capture: August 2018 © 2019 Google

Neighborhood Link streets are predominantly residential corridors that serve a similar role to that of Neighborhood Activity streets in the transportation network. Community facilities such as parks or recreation centers, schools, or places of worship are common on these streets and may be interspersed with some limited commercial use.

These streets may have moderate to higher volumes of traffic—particularly during peak travel hours. Vehicle travel must be maintained at modest speeds to respect the more residential character of this street type and/or likelihood of children crossing the roadway.

Neighborhood Link streets are primary streets for all modes of travel including pedestrians, bicyclists, private vehicles, transit, and delivery trucks. They often have some level of transit service and some may feature frequent transit service. Neighborhood Link streets may also serve as critical backbones of the on-street bicycle network.

EXAMPLE STREETS

- Brooks Avenue (pictured)
- Bay Street
- Jay Street

PRIORITY USERS

Neighborhood Link streets are complete streets and must provide safe accommodation for all users. Some streets may be recognized as key links in a certain modal network and thus slightly prioritize the efficient travel of that mode.

DESIGN OBJECTIVES AND TYPICAL FEATURES

Neighborhood Link streets should protect residential quality of life while accommodating crosstown connectivity via a variety of modes.

- **Sidewalks (5 feet minimum width)** on both sides of the street and street trees are required.
- Travel lane width is variable dependent on modal emphasis. Lanes should be **11 feet wide on transit corridors**, 10 feet wide elsewhere.
- **Dedicated bicycle lanes are recommended**. Protected facilities may be considered where daily traffic exceeds 6,000 vehicles per day.
- On-street parking on one or both sides of the street is **optional**. Where present, on-street parking **should be protected by bump outs**.

NEIGHBORHOOD LOCAL

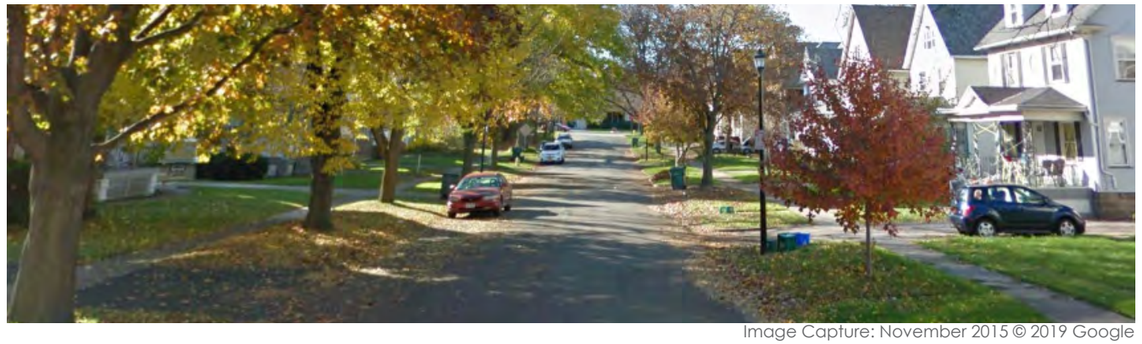


Image Capture: November 2015 © 2019 Google

Neighborhood Local streets provide access to local residents while inviting those residents to use the streets as public linear recreational space. Neighborhood Local streets generally correlate to low and medium density residential areas as defined by the City's Placemaking Plan where building types are primarily single family houses, divided houses, or smaller apartment buildings.

Neighborhood Local streets are not principal streets in the citywide vehicular network, but serve as an important link for pedestrians and cyclists who generally travel at lower speeds. Neighborhood local streets are primary candidates for bicycle boulevard implementation rather than dedicated bicycle lanes and generally do not feature transit service. Additionally, truck traffic may be restricted on these streets.

EXAMPLE STREETS

- Gorsline Street (pictured)
- Linden Street
- Post Avenue
- Grand Avenue
- Evergreen Street

PRIORITY USERS

Residents of Neighborhood Local streets, pedestrians and cyclists of all types and abilities, and especially vulnerable users including young children, seniors, and persons with disabilities.

DESIGN OBJECTIVES AND TYPICAL FEATURES

In an effort to design streets that maintain low vehicle volumes and travel speeds, emphasize green infrastructure and open space, and continue to provide access to residences, the following features are employed:

- **Sidewalks (5 feet minimum width)** on both sides of the street are required. A tree lawn should be provided between the sidewalk and street.
- **Narrower travel lanes (10 feet)** and limited network connectivity generally manage speeds and deter non-local traffic. Traffic calming elements are appropriate as a supplemental implementation.
- Separate bicycle facilities are generally not provided. Safe and low-stress bicycle accommodation is **provided within the street**.
- On-street parking is **generally provided** on one or both sides of the street.

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TYPOLOGY DEFINITION

INDUSTRIAL LINK

Image Capture: August 2018 © 2019 Google

Industrial Link streets are regional connections that primarily serve large-scale industry, often isolated manufacturing, warehousing, and distribution uses. Industrial Links are rarely found in close proximity to residential or commercial uses, may be relatively isolated from other streets, may occur in small pockets among other street types, or may comprise an entire distinct district.

Industrial Link streets often experience a more pronounced difference between peak and non-peak hour traffic volumes because they are located near employment centers. Access via a variety of modes including transit, bicycle, and by foot remains important.

These streets serve industrial corridors and are built to accommodate commercial trucks. While there may be fewer pedestrians and bicyclists here, these streets may also serve as through-routes for these users to adjacent land uses.

EXAMPLE STREETS

- Buffalo Road
- Lexington Avenue (pictured)
- Driving Park Avenue
- Portions of Lyell Avenue

PRIORITY USERS

Industrial Link streets should prioritize freight and service vehicles, but are are still complete streets and should retain multimodal access for workers, proprietors, customers, and clients.

DESIGN OBJECTIVES AND TYPICAL FEATURES

The primary function of Industrial Link streets is to support and strengthen economic activity by enabling efficient commercial activities. Safety is emphasized through reducing conflict opportunity.

- **Sidewalks (5 feet minimum width)** remain required. Streetscape elements are optional.
- **Travel lanes should be 11 feet wide** to allow for unimpeded goods movement and supporting transit activity. Median protected center turning lanes may be considered.
- Because of the blind spots often present in large vehicles, which may comprise more than 10% of total vehicle volumes, **physically separated bicycle facilities are recommended**.
- **On-street parking is an option**, though curbside space may be best used for transit and short-term delivery loading activity.

INDUSTRIAL LOCAL

Image Capture: August 2016 © 2019 Google

A secondary industrial street type is the **Industrial Local** street, which typically serves smaller pockets of industry across the City. Industrial Local streets are generally smaller streets that connect to larger network link streets, but may also serve as access points to larger industrial properties.

Volumes are lower in general on Industrial Local streets, though they may experience a surge of employee traffic at peak hour.

While these streets serve industrial uses and must accomodate commercial truck traffic, required travel lane width and travel speeds are lower, allowing for unprotected pedestrian and bicycle facilities where a need is identified. For example, an industrial office park street or street with obvious function in the transportation network should include complete street treatment.

EXAMPLE STREETS

- Adirondack Street (pictured)
- Nassau Street
- Cairn Street
- Science Parkway
- Mt. Read Boulevard Frontage Roads

PRIORITY USERS

As with Industrial Link streets, Industrial Local streets should prioritize freight and service vehicles. Depending on context, multimodal access for employees may be enhanced.

DESIGN OBJECTIVES AND TYPICAL FEATURES

As the primary objective of Industrial Local streets is to provide local access to industrial sites, most design elements are optional dependent on surrounding land uses and desired network connectivity.

- The sole requirement for Industrial Local streets is **11 feet wide travel lanes**. **Sidewalks are optional** and context dependent.
- Also optional are on-street curbside parking, streetscape elements, and bicycle facilities.
- Depending on network connectivity, Industrial Local streets may be candidates for shared lane markings and integration into the bicycle boulevard network, though vertical traffic calming elements should not be employed.

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TYPOLOGY DEFINITION

ALLEY

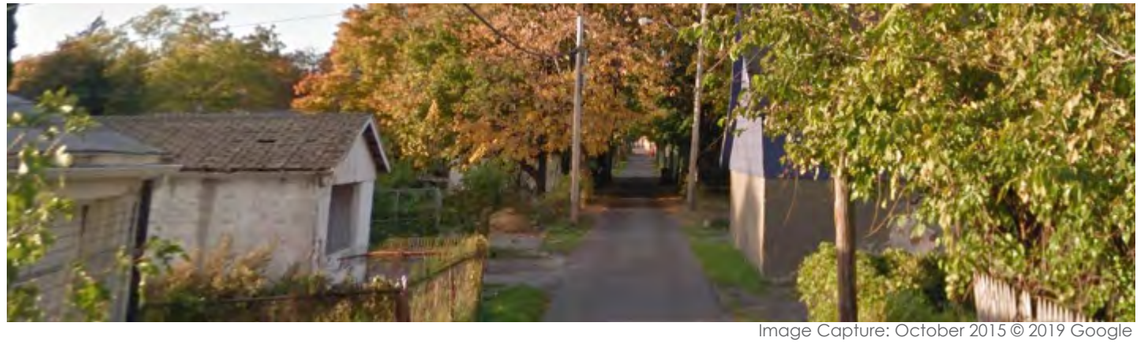


Image Capture: October 2015 © 2019 Google

Alleys can be designed to play an important role in the street networks of commercial districts as well as residential areas. Both types of alleys serve a utilitarian purpose, allowing for off-street loading and unloading, garage access, and refuse removal. Alleys provide direct property access and eliminate the need for driveways, which improves the walking and biking environment on primary streets.

Alleys generally have very low traffic volume. Potholes and puddling are common. Alleys represent an opportunity to install porous pavements for more effective drainage while not degrading the alley's operation or function.

Alleys operate largely as shared streets, with no regulating striping or curb separation. Dependent on context and need, the City may choose to include alleys as links in pedestrian and bicycle networks. Commercial alleys can be restricted to non-motorized traffic during non-delivery hours.

EXAMPLE STREETS

- Pindle Alley
- Ruff Alley
- Daus Alley (pictured)

PRIORITY USERS

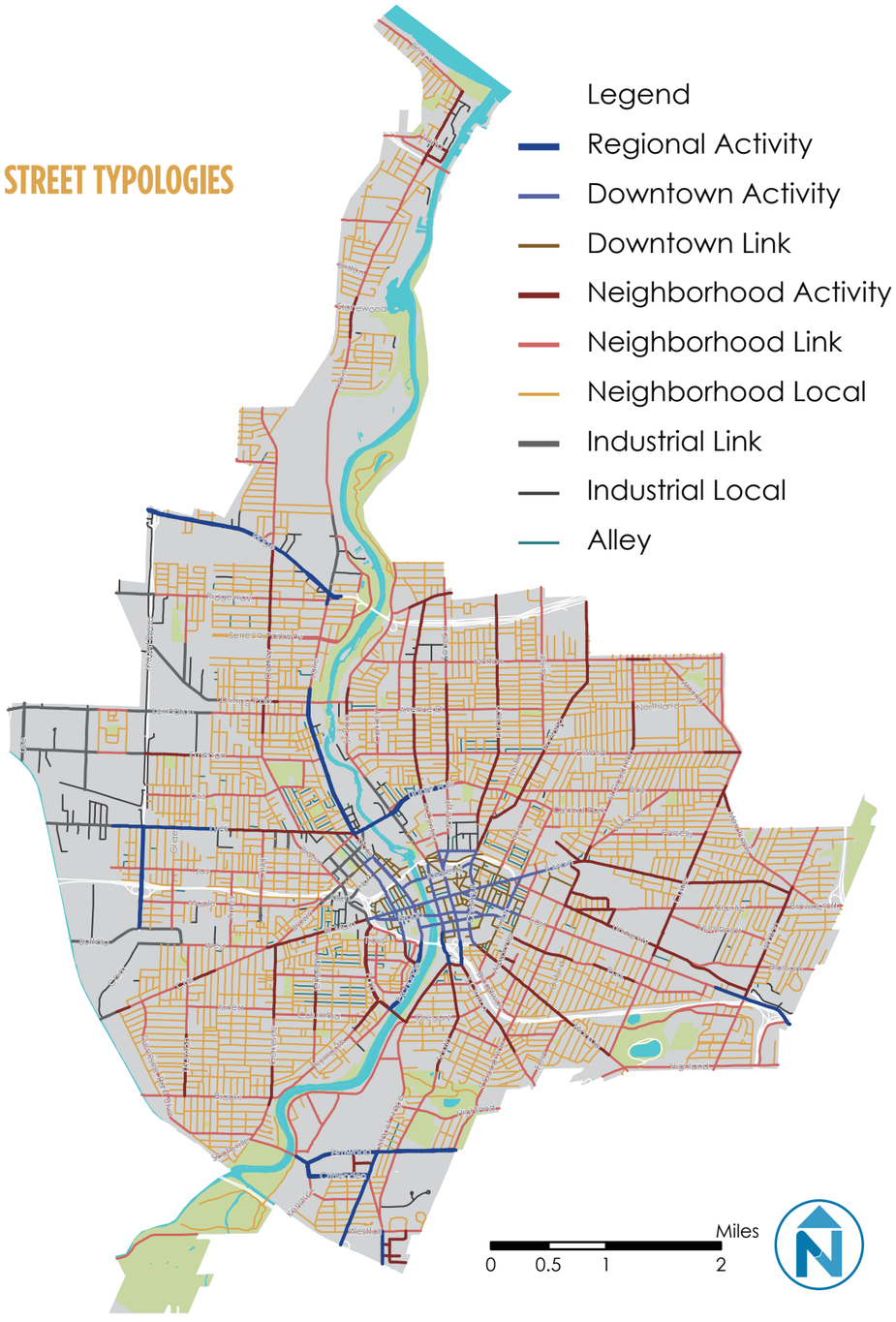
Access is reserved for property owners as well as delivery and utility vehicles. Pedestrians and cyclist should feel comfortable using alleys as shortcuts between streets.

DESIGN OBJECTIVES AND TYPICAL FEATURES

The primary function of alleys is to reduce loading and utility activity on the local street. Alleys have the added benefit of reducing curb cuts, which in turn increases the on-street parking supply and the quality of the tree canopy while reducing the number of conflict points on the parallel street.

- **Pavement or another hardscape treatment are required** in alley design. Depending on the volume of activity, consider porous pavements with high sunlight reflectivity to improve drainage and reduce heat island effects. Where garbage trucks operate, pavements must meet AASHTO H-20 Loading ratings.
- **Lighting is required** in alleys for safety reasons.
- A single lane width limits vehicle traffic while a lack of painted markings or curbing reinforces that space is shared between all modes.

ASSIGNED STREET TYPOLOGIES



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TYPOLOGY DEFINITION

RIGHT-OF-WAY ZONES

The elements that make up city streets, from sidewalks to travel lanes to transit stops, all vie for space within a limited right of way. To make clear the tradeoffs between different design choices and optimize the benefits the community receives from its streets, the Rochester Street Design Guide identifies three conceptual 'zones' that can make up the right of way of the street.

PEDESTRIAN ZONE

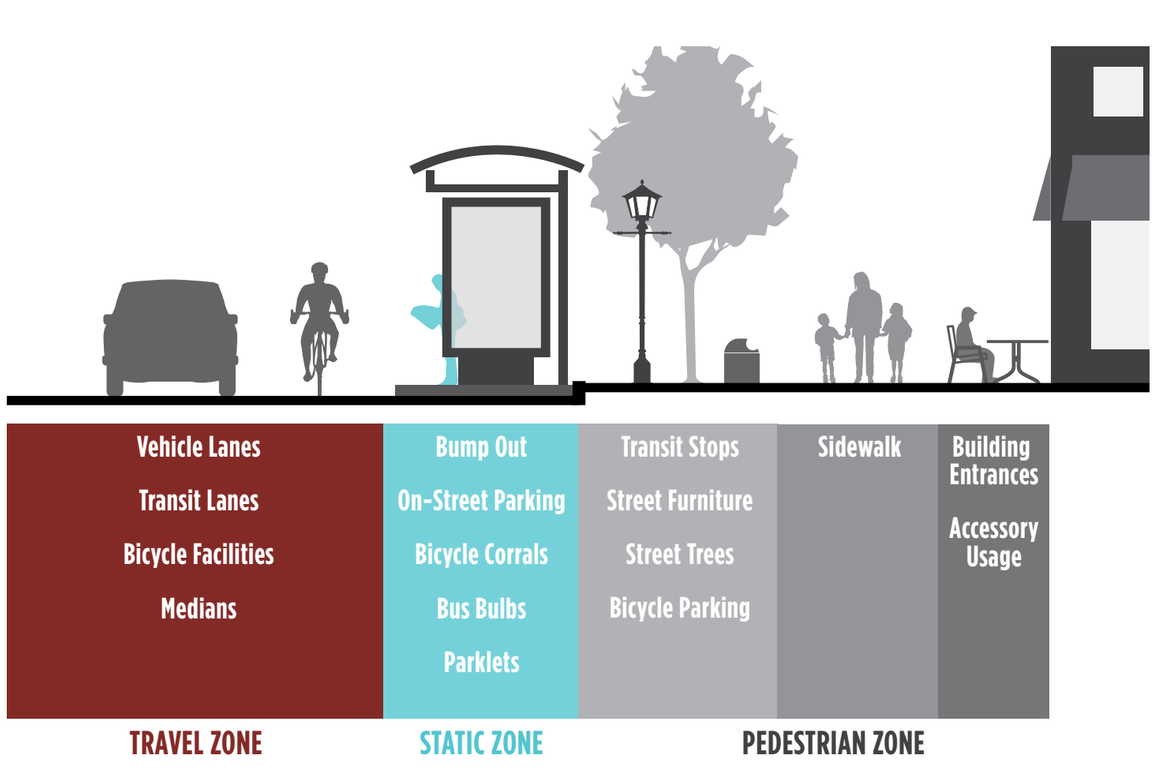
Defined as the portion of the street between the curb line and the property line, the Pedestrian Zone transitions from buildings to the public realm while providing adequate space for pedestrians to travel. The portion of this zone nearest the roadway buffers pedestrians from vehicular travel and provides space for streetscaping and amenities. The portion of this zone closest to the building entrance may accomodate temporary seasonal programming such as private sidewalk café seating on higher order street types. In certain situations, protected bicycle facilities may be located at curb level in the pedestrian zone.

STATIC ZONE

The Static Zone includes elements directly adjacent to the curb on the street side, such as parking spaces and parklets. This zone serves stationary uses and makes up part of the buffer area.

TRAVEL ZONE

The Travel Zone provides facilities for movement of people, including space for motor vehicles, bicycles, and transit vehicles.



ZONE DIMENSION AND FACILITY SELECTION

The target dimensions for each zone of the street are based on the street typology, the mode emphasis (if any), and the available right-of-way. Common street dimensions for various elements are shown here. Some of the design elements may not be present or appropriate for all street typologies.

Within the zones of the street, designers have the ability to select and combine different street elements to achieve the goals and design objectives for the street type. Facility selection is the process of weighing tradeoffs and prioritizing users and uses in the available right of way. Designers should use best engineering judgment to carefully balance modes, while ensuring that all users are safely accommodated. Typical dimensions are to be used as applicable and feasible, but may need to increase or decrease to improve user comfort and/or when used in conjunction with other elements. Note that certain dimensions provided may exceed state minimum requirements and represent an ideal implementation of that element.

		Regional Activity	Downtown Activity	Downtown Link	Neighborhood Activity	Neighborhood Link	Neighborhood Local	Industrial Link	Industrial Local	Alley
PED. ZONE	Walkway (Sidewalk)	5'	8'	8'	8'	5'	5'	5'	5'	
	Landscape strip (trees and/or grass)	6'	6'	6'	6'	6'	6'			
	Temporary programming area		10'	10'	10'					
	Bus shelter	4.5'	4.5'	4.5'	4.5'	4.5'		4.5'		
STATIC ZONE	On-street parking and loading	8'	8'	8'	8'	8'	8'	8'		
	Parklets		6'	6'	6'					
	Bicycle corral		6'	6'	6'					
	Bump out		6'	6'	6'	6'		6'		
TRAVEL ZONE	Vehicle lanes	11'	11'	11'	11'	11'	10'	11'	11'	
	Turning lanes	10'	10'	10'	10'	10'		10'		
	One-way dedicated bicycle lane		5'	5'	5'	5'		5'		
	One-way protected bicycle lane	8'	8'	8'	8'	8'		8'		
	Two-way cycle track	13'	13'	13'	13'	13'		13'		
	Dedicated transit lane	12'	12'							
	Median	10'	10'					10'		

ELEMENT INCLUSION GUIDANCE

The typology definition process groups streets while also defining required, recommended, and optional street treatments. The table below summarizes that guidance per street type for quick reference. Streetscape refers to any combination of street trees, lighting, seating, waste containers, and/or bicycle furnishings. Note that all requirements are subject to site limitations and constraints. The City should strive to satisfy requirements whenever possible.

	Minimum Sidewalk Width	Travel Lane Width	Bicycle Facility	Transit Lanes	On-Street Parking	Protected Center Turning Lanes	Streetscape
REGIONAL ACTIVITY	5'	11'	Recommended Protected	Optional	Optional Protected	Optional	Recommended
DOWNTOWN ACTIVITY	8'	11'	Recommended Protected	Optional	Recommended Protected	Optional	Required
DOWNTOWN LINK	8'	11' (Transit) 10' (Non-Transit)	Recommended Dedicated		Recommended Protected		Required
NEIGHBORHOOD ACTIVITY	8'	11' (Transit) 10' (Non-Transit)	Recommended Dedicated Optional Protected (AADT > 6,000)		Recommended Protected		Required
NEIGHBORHOOD LINK	5'	11' (Transit) 10' (Non-Transit)	Recommended Dedicated Optional Protected (AADT > 6,000)		Optional Unprotected		Required
NEIGHBORHOOD LOCAL	5'	10'	Optional Shared Lane Markings		Recommended Unprotected		Required Optional Discrete Traffic Calming
INDUSTRIAL LINK	5'	11'	Recommended Protected		Optional Unprotected	Optional	Optional
INDUSTRIAL LOCAL	Optional 5'	11'	Optional Shared Lane Markings		Optional Unprotected		Optional

SELF-ENFORCING DESIGN

Self-enforcing design is a key objective of the Rochester Street Design Guide. Self-enforcing design provides environmental cues to street users to enable them to naturally and intuitively comply with speed and other operating expectations. Self-enforcing design is substantially more effective than simply providing signage or relying on enforcement by police because the design uses environmental cues to guide travelers to drive, bicycle, and walk carefully when using the street. This improves safety for all users and helps to achieve the objectives and desired outcomes of the Rochester Comprehensive Access and Mobility Plan.

Street design outcomes are governed by a number of design controls. These controls reflect the character and context of the street as well as the desired and expected behavior of street users. On a very wide road with few buildings, trees, or activities along the street edge, a driver can easily underestimate the speed they are traveling and inadvertently exceed the speed limit. On such streets, the driver's attention focuses on points further ahead and their peripheral awareness diminishes. On a narrow street with buildings and trees providing a sense of enclosure and many active uses along the street edge, drivers have a better sense of the speed they are traveling relative to other users on the street. The slower speed, in turn, increases their perception of activities on the periphery.

The majority of drivers are cautious, prudent, and drive at speeds that are reasonable and proper, regardless of the posted speed limit. It is therefore incumbent upon the street designer to consider every aspect of street design and its components. The Rochester Street Design Guide delivers street designs that allow drivers to intuitively understand the reasonable and proper travel speed. It also supports the larger objectives of street operation without over-reliance on active enforcement measures.

One of the benefits of self-regulating design is that it minimizes the need for active police enforcement. This delivers street safety while at the same time minimizing the need for interaction between travelers and law enforcement personnel. Self-regulating street design equitably communicates safe operational behavior to all drivers at all times.

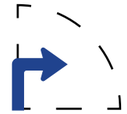
DESIGN SPEED

Vehicle speed has a profound effect on the use and enjoyment of urban streets and is perhaps the single most important factor in safety outcomes. Vehicle speed affects a driver's peripheral awareness, the stopping distance required to avoid a crash, and survival and injury rates should a crash occur.

At slow rates of speed, drivers can stop more quickly and have more time to react to objects or incidents further down the road. Drivers can focus on a wider perspective of the street and pay more attention to activities occuring along the street edge, such as crossing pedestrians or school children playing in front yards. This allows a higher margin of error for drivers of all ages and abilities. At even moderately higher rates of speed on major roads, drivers must focus more attention on activities in the street further ahead of them that pose the most obvious potential threat. This narrowing of focus means drivers are less aware of and less able to respond to unanticipated incidents that may spring from the street edge, such as a pedestrian crossing the street or a driver emerging from a vehicle parked at the curb.

The most effective techniques employed in creating self-enforcing streets are:

TRAVEL LANE WIDTHS



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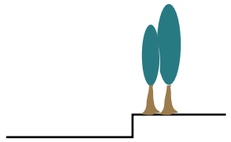


STREET EDGE FEATURES

LINE OF SIGHT

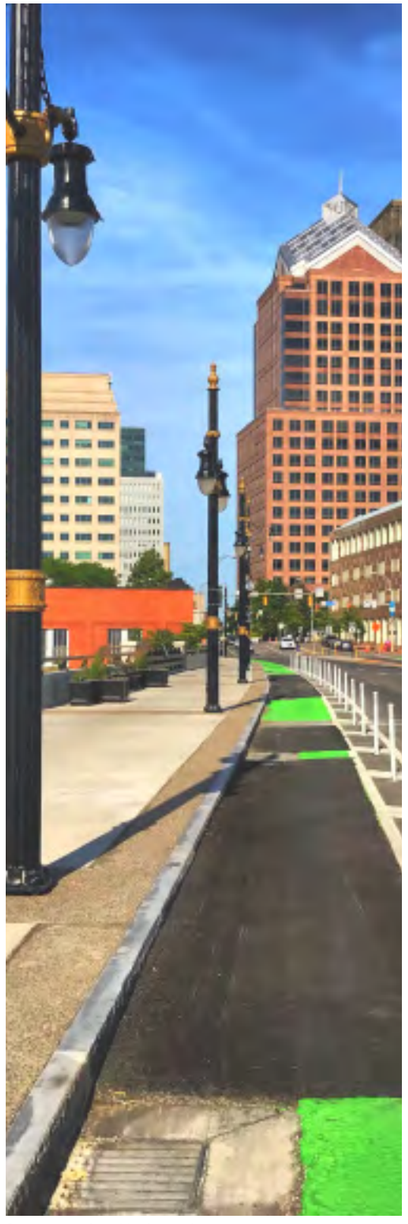
SPEED MANAGEMENT, SUCH AS HORIZONTAL OR VERTICAL DEFLECTION FEATURES

PRESENCE OF MULTIPLE MODES OF TRANSPORTATION

SIGNALS

NUMBER OF LANES

DRAFT
SELF-ENFORCING DESIGN



Source: Arian Horbovetz

DEFINTION

Speed in street design can be referred to in a number of ways:

- The **Speed Limit** is also referred to as the posted speed. It is the maximum legal speed permitted on a segment of roadway. The standard speed limit on non-limited access expressways in the City of Rochester is 30 miles per hour except as indicated in Schedule A on file with the City's Traffic Control Board.
- The **Target Speed** is the desired speed at which motor vehicles travel on a street, determined by policy and design.
- The **Operating Speed** is the speed at which 50% of all vehicles travel under free flow conditions.
- The **Design Speed** is the maximum safe speed that one may generally travel on a segment of roadway, weather permitting and depending on geometric characteristics of the segment.
- The **Inferred Speed** is the speed most motorists sense is the appropriate speed on a street based on the general design of the street.
- The **85th Percentile Speed** is the speed at which 85 percent of all vehicles travel under free flow conditions. The 85th percentile speed is higher than the average operating speed of the majority of drivers.

In conventional street design, the design speed used for the street may be 5 to 10 MPH above the legal speed limit. This conservative approach to design results in an environment that conveys an even greater inferred speed to the driver. Drivers feel they are penalized for traveling at a speed that feels natural and intended.

Effectively managing speed cannot rely solely on the posting of regulatory signs. The design of the street should naturally compel drivers to drive at the desired and appropriate speed.

Rather than focusing on the maximum legal speed permitted, street designers should instead focus on the target speed and **deliver a street that produces an identical operating speed**. This requires a street to be designed in such a way that drivers can infer the proper speed from the cues they receive from the street environment.

A measure of success in street design is when operating speed matches target speed. To accomplish this, design speed and inferred speed should converge to produce an identical

operating speed at the minimum legal speed limit which will capture 85 percent of all vehicles traveling under free-flowing traffic conditions.

STOPPING DISTANCE

Motor vehicles, transit buses, and delivery trucks traveling at even moderate rates of speed possess tremendous momentum and can exert exponentially greater force compared to smaller, slower objects, such as bicycles, operating in the same space.

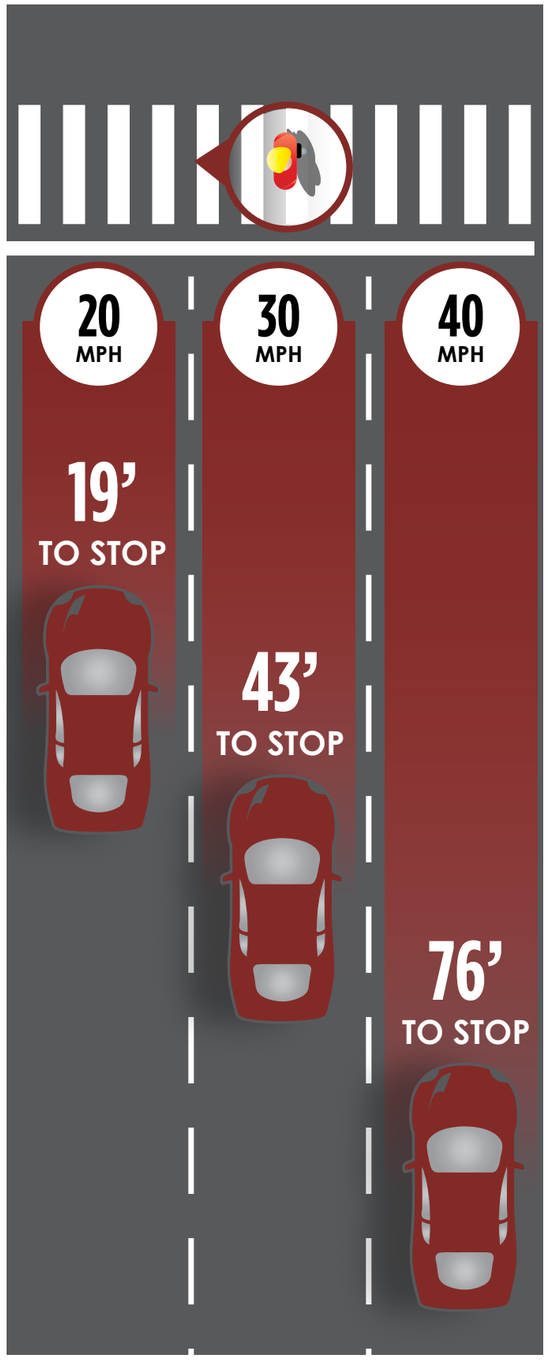
In addition, while pedestrians and even bicyclists can react and stop or adjust very quickly to unanticipated conflicts in the street, automobiles cannot due to their size and weight. The faster an automobile is traveling, the more time and distance is required to avoid a potential collision.

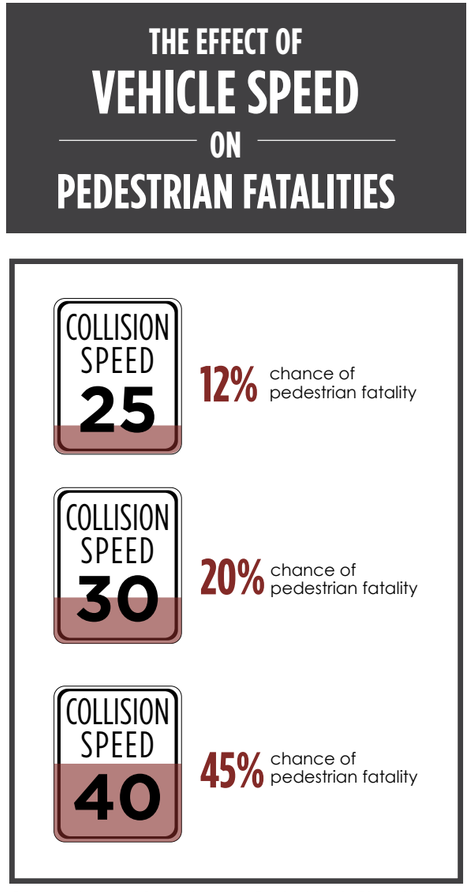
In addition to the required stopping distance in the figure at right, a driver's recognition and response to perceived danger takes time, during which the vehicle continues to travel at the original speed. Even if the driver reacts in 1.5 seconds, the vehicle travelling 20 mph requires 44 additional feet to stop. At 30 miles per hour, the driver requires 109 feet in total to assess, react, and stop the vehicle. At 40 miles per hour, that number is 164 feet.

Thus, if a pedestrian, suddenly appears 75 feet in front of a driver, at 20 MPH the driver will be able to react and stop before striking them. In contrast, vehicles operating at even moderately higher speeds may not be able to stop in time, drastically increasing the risk of death and severe injury.

SAFETY IMPACT

Street designers can anticipate and plan for known occasions that require a vehicle to stop, such as at intersections or crossings. However, they must also be cognizant of the potential consequences of unanticipated events when adequate stopping distance cannot always be provided. In these instances, vehicles traveling at higher rates of speed will strike with greater force, possibly resulting in death or serious injury. As seen in the graphic on the following page, risk of pedestrian fatality is





Source: *Impact Speed and a Pedestrian's Risk of Severe Injury or Death*, AAA Foundation for Traffic Safety, September 2011

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SELF-ENFORCING DESIGN

correlated to speed of the colliding motor vehicle. At low speeds, risks are low: at impact speeds below 15 mph, 91% percent of pedestrian who are struck do not sustain serious injuries and very few die. As speeds increase, small changes in speed significantly increase pedestrian fatality risk. Risks are even higher for older pedestrians. The average risk of death for a 70-year-old pedestrian is equal to the average risk for a 30-year-old pedestrian struck by a vehicle traveling 10 mph faster. Street design that intrinsically guides drivers to operate at speeds consistent with desired safety outcomes can reduce not only traffic fatalities, but also the number and severity of serious injuries among pedestrians.

SELF-REGULATED SPEED MANAGEMENT TECHNIQUES

Three features of street design significantly contribute to the driver's perception of speed: lane widths, turning radii, and activities along the street edge.

LANE WIDTHS

A 2000 study published in the Transportation Research Record entitled, *Design Factors That Affect Driver Speed on Suburban Streets* found that while many factors influence driver speed, wider lanes correlate with higher travel speeds, while narrower lanes contribute to slower driving speeds. Narrow travel lanes have a positive effect on the safety of the street by reducing vehicle crash rates.

In addition, research presented by the Midwest Research Institute at the 2007 Transportation Research Board Annual Meeting concluded that narrower, 10- or 11-foot travel lanes led to no increases in collision frequency compared to 12-foot lanes. Findings further stated that the use of narrower lanes may provide benefits in traffic operations, pedestrian safety, and/or reduced interference with surrounding development.

10-foot wide travel lanes accommodate the majority of vehicles using City streets while maintaining a street profile that supports speed management objectives. Streets with frequent transit services or significant volumes of truck traffic require an 11-foot lane to accommodate those vehicles. On streets with multiple lanes of travel in one direction, this lane should be closest to the curb. All other lanes should measure the minimum width.

It is important that the determination of travel lane width be made within the overall assemblage of the street. While 10-foot travel lanes are generally preferred, utilizing the narrowest acceptable dimension for all street features such as bike facilities and parking lanes may result in friction between users and decreased safety. Facilities adjacent to a travel lane should be increased to at least the preferred dimension while maintaining the narrowest acceptable marked space for the travel lane.

TURNING AND CORNER RADII

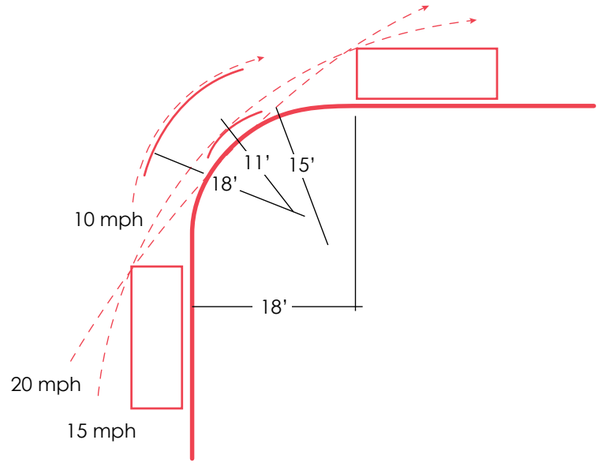
Turning and corner radii affect the speed of turning vehicles, the alignment and length of crosswalks, and, consequently, the risk and exposure of crossing pedestrians. A smaller turning radius lowers the speed of vehicles in the intersection, improving safety for pedestrians.

The turning radius is often thought of as one measure, but in fact there are two measures to consider:

- Effective corner radius
- Actual corner radius

The effective corner radius is the turning radius a vehicle can track without encroaching on the curb. Curbside parking or bicycle facilities along the edge of the street increase the effective corner radius of an intersection. Bump outs decrease the effective corner radius. A smaller turning radius results in a lower vehicle turning speed and better pedestrian visibility. In general, effective corner radii are larger than actual corner radii.

Street designers should use the smallest practical actual corner radius that preserves an effective curb radius appropriate to the design vehicle and the overall objectives of the street. Effective corner radii are configured to the needs of design vehicles and the mode emphasis of the street. Control vehicles that rarely use the street, such as fire trucks, may encroach into oncoming lanes if and when required to slowly navigate a turn. Smaller radii should be the default where there is an expectation of high levels of use by persons with disabilities.



NOTES:

- A 15-foot corner radius yields a 20 mph passenger vehicle turning speed if parked vehicles are no closer than 18 feet from the intersection.
- An 11-ft corner radius yields a 15 mph turning speed.
- A 6-ft wide curb extension with an 18-foot radius yields a 10 mph turning speed if the vehicle travels as close as possible to the corner.

Source: American Association of State Highway and Transportation Officials. *A Policy on Geometric Design of Highways and Streets.* Washington D.C.: 2011; Formula 3-8.

DESIGN ELEMENTS ALONG THE STREET EDGE

Vertical elements such as street trees have positive implications for safety performance. Planted medians and curbside objects not only narrow the visual appearance of the roadway, but also bring street edge elements closer to the driver on both sides, providing the driver with a more intuitive sense of their travel speed and causing them to slow to target travel speeds. These buffers also increase pedestrian comfort walking across and adjacent to the roadway. Note that Federal Highway Administration requirements maintain an 18 inch minimum horizontal clearance to vertical obstructions unless a design exception is approved to provide adequate clearance for heavy duty vehicle mirrors and for opening curbside doors.

Unlike an arrangement that alters the street context to provide a clear zone to compensate for driver error, and inadvertently encourages more dangerous driving habits, self-regulating design creates a lively street environment that supports drivers in intuitively traveling at speeds appropriate to the street context.

DESIGN VEHICLE

In conventional street design, the design vehicle is the largest motor vehicle that uses a street with considerable frequency. However, motor vehicles are not the only frequent users of an urban street. Geometric and operational design decisions made to accommodate motor vehicles significantly affect the ability of non-vehicular users to navigate the street safely and intuitively. Not all streets should be designed to accommodate all types of vehicles.

In order to provide safe and navigable streets for all users, Rochester street designers should **design for vehicles that comprise 10% or more of the typical volume of peak hour traffic.** An equally important consideration should be designing for the pedestrian.

For Neighborhood Local streets, the motorized design vehicle will be a passenger car. On higher order streets, the motorized design vehicle may be a school bus, municipal bus, or single unit delivery truck. Some streets with routinely high proportions of heavy vehicles may require the use of even larger motorized design vehicles, such as tractor trailers. Streets should be designed so that the motorized design vehicle may operate in the designated travel way at the desired design speed without impeding operation in other lanes or encroaching into the pedestrian zone at intersections and corners.

Regardless of the motorized design vehicle, streets must also allow pedestrians of all ages and abilities to navigate the City safely. This can be done by considering the pedestrian as a second priority user, representative of other likely street users. Using a child or senior on foot as the design vehicle is one way to evaluate if street design and operation is sufficiently logical and safe to navigate. Streets reasonably navigable by this less experienced and more vulnerable user will be safe and accessible to the majority of other non-motorized users.

The selection of a design vehicle impacts the characteristics of that street. Before selecting a design vehicle, consider the overall context of the roadway and how a larger control vehicle, such as a fire truck or tractor-trailer, might operate within the proposed design.

- Curb radii designed to accommodate the larger vehicles operating at higher speeds degrade the pedestrian environment and result in longer crossing distances.
- Emergency vehicles are permitted full use of the right-of-way in both directions, especially where tight curb radii may necessitate use of the opposite lane during a turn.
- Transit vehicles, such as articulated buses, benefit from the use of a larger effective turning radius.
- Oversized trucks and other large vehicles may be restricted from certain corridors based on existing context, vulnerable street users, or impractical operational impacts.
- Where operation is allowed, large vehicles may experience infrequent operating challenges.

HIGH-PRIORITY CONSIDERATIONS

The design vehicle is a frequent user of a given street and dictates the minimum required turning radius and lane width. A control vehicle is a larger more infrequent user that can complete turns using additional space within the intersection. Adopt both a design vehicle and a control vehicle standard based on context-specific street types.

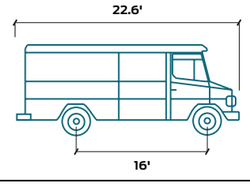
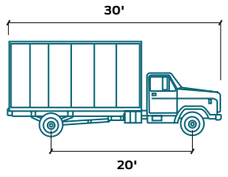
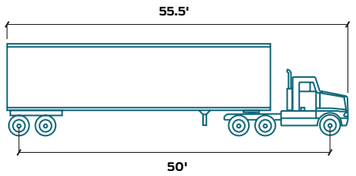
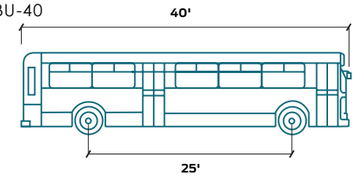
A transit bus may be a design vehicle on street where transit is emphasized and where buses turn. Buses must be able to turn without reversing. Consider removing parking near the intersection or recessing the stop line on the receiving street.

Consider slower design speeds when determining local street geometries. Vehicles traveling at slower speeds can make difficult turns that may be challenging or unsafe at higher speeds.

RECOMMENDED CONSIDERATIONS

Adopt a default design vehicle that is a frequent user of urban streets—the delivery truck (DL-23). Package delivery trucks commonly travel on city streets, and have an inside turning radius of 22.5 feet.

Designation of freight routes should be considered in coordination with primary bicycle, transit, and pedestrian corridors, as well as through analysis of key access routes, bridge hazards, and land uses.

STREET TYPE	DESIGN VEHICLE
Activity, Link, and Local Streets	DL-23 
Certain Activity Streets	SU-30 
Freight Emphasis Streets Note: Trucks are permitted to use the full intersection when making turns onto a receiving street.	WB-50 
Transit Emphasis Streets Note: Buses are permitted to use the full intersection when making turns onto a receiving street, but this is not preferable.	BU-40 

OPERATIONAL PERFORMANCE METRICS

Measuring the performance of a given street or network is an imperfect process. A street that works extremely well for one set of users may be difficult to use for another, just as a corridor with no delay at one point may experience significant delay at an intersection or elsewhere along the corridor. Performance measures must take a multidisciplinary approach, looking at urban streets and traffic at the macro and the micro scale, through the lens of safety, economy, and design, and inclusive of the goals and behaviors of everyone using the street.

The goals of different street users often conflict. For pedestrians, public safety, adequate sidewalk width, protection from rain, and shade from the sun together make a successful street. Bicyclists desire connectivity and minimal detour or delay in addition to feeling safe and protected from moving traffic. Transit service may be measured by its speed, convenience, reliability, and frequency of service. Motorists want to arrive at their destination as quickly and safely as possible with limited delay. Drivers feel safest when buffered from other moving vehicles, bicyclists, and crossing pedestrians. Freight operators want to move goods from their origin to their destination as easily and quickly as possible. Emergency responders are responsible for attending to events as quickly as possible and benefit from predictability along their routes. Urban street design must strive to balance these goals, making strategic tradeoffs in search of an optimal scenario.

The development of holistic performance measures requires a clarification of the problems that a designer is trying to solve. While a multi-modal performance metric such as person delay may improve upon auto-based level of service (LOS), delay alone fails to capture the success of a street outside of its ability to move people through it. A street with low person delay is not necessarily a great street, especially if it has no economic activity or shade trees to improve the public realm.

VEHICLE LEVEL OF SERVICE (LOS)

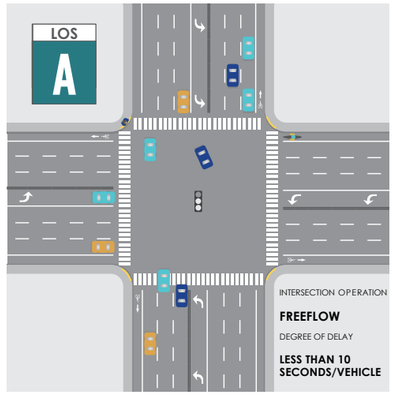
Vehicle Level of Service is among the most commonly used metrics of street and intersection operational performance. LOS is a measure of vehicle congestion at intersections reflected by letter grades that range from A to F. LOS as a measure of street performance has a number of limitations.

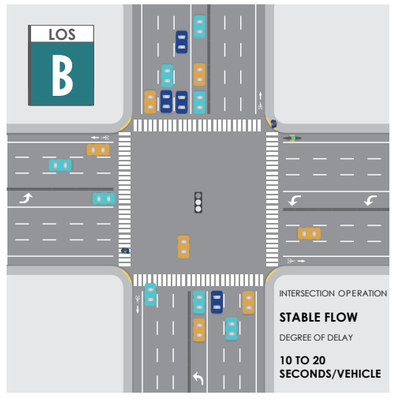
While congested roadways affect the efficiency of transit operations and the safety of pedestrian crossings, LOS is primarily an evaluation of the free movement of motor vehicles. Conversely, stopped transit vehicles or pedestrians in crosswalks can degrade vehicle level of service but are precisely the kinds of activities and users the Comprehensive Access and Mobility Plan seeks to support and encourage. LOS does not accurately reflect the street's performance for non-drivers.

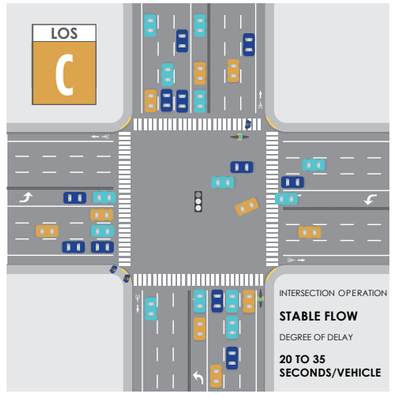
In vehicle LOS, the same importance is assigned to a single-occupant vehicle as a full transit bus. LOS can also incompletely capture the impact of a street enhancement. LOS is commonly calculated for each intersection. While intersection improvements may decrease the vehicle delay at that intersection, travel time through a series of street segments may remain unchanged.

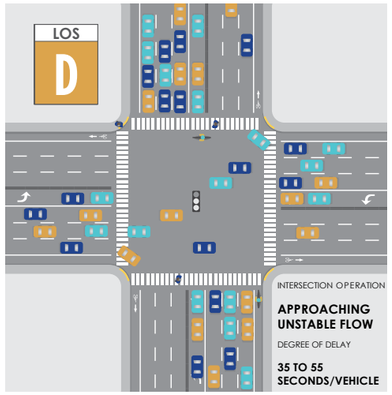
LOS generally describes conditions during the height of daily congestion—the peak hour or even peak 15 minutes of the busiest day. Seeking to achieve a higher LOS grade based on a level of congestion during a short period of the day results in increasing the number of travel lanes, increasing speeds, and wider rights of way—extra capacity that could be used for development, public space, or other productive uses. Instead, the goal should be to seek alternative ways to satisfy this travel need either via a different mode, along an alternative route, or at another period of the day.

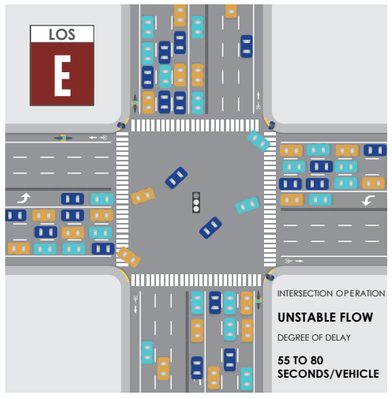
Vehicle LOS often has an inverse relationship to economic vitality, quality of life, community health. High LOS grades are common in areas that attract few visitors and host limited activity while vibrant, dynamic areas that attract high numbers of visitors have lower vehicle levels of service. These considerations, along with mobility goals for Rochester transportation corridors, encourage the evaluation of replacement transportation system performance metrics. Cities and states across the continent have adopted alternative measures to supplement or replace vehicle LOS. These measures can be used to evaluate design alternatives and measure project and program performance for future street design efforts. No single measure is intended to be used alone, but when applied together they provide valuable insight for street design.

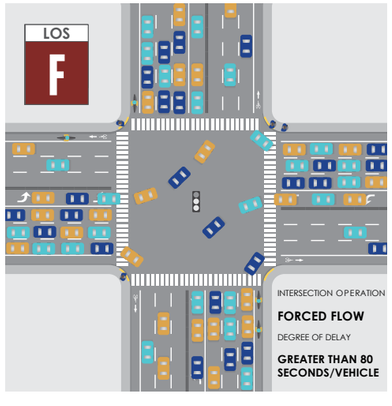












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OPERATIONAL PERFORMANCE METRICS

VEHICLE MILES TRAVELED (VMT)

VMT measures the amount and distance people drive, without taking the number of passengers within a vehicle into account. Typically, development at a greater distance from other land uses and in areas without transit generates more driving than development near other land uses with more robust transportation options. Currently, VMT information is used to help measure air quality impacts, especially in California where the state has replaced vehicular LOS with VMT in transportation analysis related to their Environmental Quality Act (CEQA).

VMT metrics define impact significance thresholds that require project impact and cumulative impact analyses. When a significant impact is identified, mitigation measures are considered to reduce that impact. Mitigation encourages infill development and can also deliver improved transit, bicycle, and pedestrian facilities. VMT is also useful in general plan or program-level analysis, helping to identify long-range transportation impacts.

The change from LOS to VMT analysis, already adopted by the cities of Pasadena, San Francisco, Oakland, and now San José, to measure and mitigate for the amount of induced vehicle travel, better aligns the desired effect of environmental policy with actual environmental impacts from traffic. Focusing on delays to vehicles ends up encouraging more driving, which leads to higher pollution and greenhouse gas emission levels. In contrast, measuring the amount of traffic a development produces gives a clearer picture of its potential environmental impacts.

PERSON THROUGHPUT

Person throughput is the number of all travelers, regardless of mode, accommodated through a particular point on a corridor. Unlike vehicle LOS, person throughput values all users equally and equally weighs the impacts to each.

Person throughput can be an evaluation measure when estimating the theoretical person capacity of a transportation alternative or a performance measure recording the actual throughput of users. Person-capacity reflects that non-drive-alone alternatives such as mass transit, bicycling, and walking can move many more people in the same area of roadway space as single occupant vehicles, optimizing the available right-of-way for the greatest number of travelers.

PEDESTRIAN/BICYCLE ENVIRONMENTAL QUALITY INDEX (PEQI/BEQI)

The Pedestrian Environmental Quality Index and associated Bicycle Environmental Quality Index were developed by the San Francisco Department of Public Health in 2008 to evaluate and prioritize investments in infrastructure. The index measures thirty indicators of pedestrian and bicycle environmental quality at both the segment and intersection levels, including vehicular conflict, street design, land use, and perceived personal safety. The department has made the index available for use and provides technical assistance in its application. While valuable measures, the indices are best suited to smaller geographic areas rather than city-wide application due to the time consuming nature of data collection.

For example, in the Boyle Heights neighborhood of Los Angeles, community members chose a smaller geographic area of about nine square blocks and 26 intersections for evaluation. Following training and surveys, street and intersection scores were calculated based on contributions to pedestrian safety and walkability. Scores helped community members focus initial improvements. An implementation of PEQI or BEQI in Rochester would first require identification of a focus area through analysis of another metric that is more conducive to a citywide application such as MMLOS.

MODE SHARE

Mode share is the percentage distribution of the modes people use to commute to and from work. It is a benchmark that can be used to evaluate the number of travelers relative to the capacity of the street, assess the City's right-of-way allocation and use, and measure progress towards sustainability goals such as a citywide policy to reduce single occupancy vehicle (SOV) trips.

Peer cities, for example Grand Rapids, Michigan, have adopted mode share targets for 2035 and longer term goals to reduce the mode share of SOV commute trips from 95% in 2013 to 70% in 2035 and ultimately to 45%. This is accomplished through sizable increases in commuting by foot, by transit, and by bicycle, which require that streets provide connected, accessible, and inviting pedestrian facilities; efficient, safe, and logical bicycle infrastructure; and regular, rapid, and reliable transit services.

While mode share can be calculated after an improvement project through travel surveys or direct observations, forecasting mode share—or bicycle or pedestrian demands—is difficult.

Source: UCLA Center for Occupational and Environmental Health

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OPERATIONAL PERFORMANCE METRICS

MULTIMODAL LEVEL OF SERVICE MEASURES (MMLOS)

In late 2013, the City of Ottawa completed a full update to their Transportation Master Plan (TMP). The TMP includes recommendations and actions that support the development of Complete Streets to provide safe and efficient roads. One of the tools identified to support the process was the development of an MMLOS framework, which is intended for use in the assessment of road design and the allocation of street right-of-way.

Draft guidelines were released in 2015 to build upon the high level direction of the TMP and to provide a detailed overview of how the service indicators are to be used and interpreted for each mode–pedestrians, cycling, transit, freight trucks, and motor vehicles–as part of the transportation impact assessment process.

The MMLOS tools should be applied to a variety of projects whenever detailed analysis of transportation impacts is required. The MMLOS criteria allows for comparison of modes in order to evaluate trade-offs by assessing the relative attractiveness and comfort of any particular mode along a corridor. An overview of these varying factors are described in the table below.

The Pedestrian Level of Service (PLOS) tool is intended to evaluate pedestrian comfort, safety and convenience. The segment analysis component is based on pedestrian facility quality and adjacent traffic impact while the intersection analysis component considers two factors–pedestrian delay, and pedestrian exposure to traffic at signalized intersections.

The bicycle level of service tool evaluates both roadway segments and signalized intersections for the level of traffic stress (LTS) experienced by cyclists using the corridor. Results are mapped to level of service A-F in order to allow comparison with other modes.

MODE	ELEMENT	LEVEL OF SERVICE	
		←	→
Pedestrians (PLOS)	Segments	High level of comfort	Low level of comfort
	Intersections	Short delay, high level of comfort, low risk	Long delay, low level of comfort, high risk
Bicycles (Mapped BLTS)	Segments	High level of comfort	Low level of comfort
	Intersections	Low level of risk/stress	High level of risk/stress
Trucks (TkLOS)	Segments	Unimpeded movement	Impeded movement
	Intersections	Unimpeded movement/short delay	Impeded movement/long delay
Transit (TLOS)	Segments	High level of reliability	Low level of reliability
	Intersections	Short delay	Long delay
Vehicles (LOS)	Intersections	Low lane utilization	High lane utilization

Source: *City of Ottawa Multi-Modal Level of Service Guidelines*
Note vehicular level of service is evaluated only at intersections per City transportation impact assessment guidelines

Transit level of service evaluates the relative attractiveness of transit based on transit travel time, transit priority provided to transit vehicles on varying facilities, and cross-conflicts such as driveways.

While traditional LOS accounts for heavy vehicles by considering the percentage of trucks and buses in the traffic volume, some elements of roadway segments and intersections clearly affect the operational ability of freight vehicles. Truck level of service (TkLOS) attempts to complement LOS by considering the physical space available for trucks to negotiate corners and operate safely within travel lanes. The objective of evaluating TkLOS is to facilitate goods movement. The evaluation of TkLOS is not necessary for all streets and should be limited to key delivery access routes.

The ultimate objective of developing a MMLOS program is to enable designers and the public to evaluate transportation choices. All MMLOS tools should be used and presented in relation to each other. Different streets with different associated land-use contexts will experience varying levels of service for each mode.

Any city implementing a MMLOS program should develop modal level of service targets. In order to introduce local context, these targets should be based on the City's Placemaking Plan Character Area designations and street typologies. The character area designations provide a sense of the surrounding land use, density, and desired level of commercial activity while street typologies represent approximate vehicular volume capacity and speed. The target-setting process provides an understanding of how trade-offs can be made to support the goals and policies laid out in the Placemaking Plan. There are two important potential outcomes to consider:

- Targets are not intended to create wide corridors that achieve high LOS grades for all modes along new or relatively unconstrained rights-of-way. The implementation of MMLOS should also be considered in relation to other factors influencing street design, including urban design and built form characteristics.
- In constrained environments, an MMLOS framework is intended to facilitate modal prioritization decisions. The framework guides and supports decisions to provide high quality facilities for certain modes, even at the expense of others.

Source: Keith Ewing (CC BY-NC 2.0)

DESIGN ELEMENTS

Design elements are the buildng blocks of street design. Grouped according to right-of-way zone definitions and common applications, elements are catalogued along with clear definitions and detailed guidance on the use, design, operations, and maintenance of these building blocks.

- **Pedestrian Zone Elements**
- **Static Zone Elements**
- **Travel Zone Elements**
- **Intersection Design Elements**
- **Traffic Calming Elements**
- **Green Infrastructure Elements**

PEDESTRIAN ZONE

The Pedestrian Zone of the street is one of the most dynamic and economically vital portions of the overall street right-of-way. The pedestrian zone is generally defined as the portion of the street between the curb line and the property line, although this zone may also extend into the street in the form of bump outs or crosswalks.

The Pedestrian Zone consists of many of the fixed features of the street including street trees, street lighting, bus shelters, bicycle racks, and public seating. The pedestrian zone must provide space for people to walk through as well as places for people to gather and wait. The Pedestrian Zone is an intermodal space as people shift from transit, a personal vehicle, or bicycle to pedestrian travel.

The Pedestrian Zone consists of three distinct subareas:

Frontage Area: Running parallel to and abutting the property line, the frontage area is the transitional area between the private realm and the public realm. The frontage area is generally not a zone of through travel and is excluded from sidewalk width calculations.

Clear Area: The clear area is the portion of the street that allows pedestrian travel. The Federal Highway Administration (FHWA) refers to this as the effective sidewalk width and it is generally the only area that is included in sidewalk width calculations.

Landscape and Amenity Area: This area is located between the pedestrian clear area and the curb. In low intensity areas, this zone is mostly grass and/or trees. In higher intensity areas, such as downtown and other commercial districts, this zone is generally paved hardscape with trees in pits or planters. Most street features are located in this zone, including street lighting, traffic signal poles, seating, and others.

SIDEWALK

The sidewalk is the paved portion of the right-of-way intended for pedestrian travel. It is important to note that the entire pedestrian zone, which is sometimes referred to as the sidewalk, includes area that accomodates street furniture and fixtures in addition to the pedestrian walkway. Access and movement for people of all ages and abilities is critical in sidewalk design. Sidewalks contribute to the social environment of the city.

USE

- Sidewalks are needed on most streets in the City. Exceptions include Industrial Local streets, alleys, and specifically designed and managed shared streets with low volumes of vehicle traffic where pedestrians may safely and comfortably mix with all other street users.
- Sidewalks are appropriate for, and should be provided on both sides of the street.

DESIGN

- Sidewalks must permit the unimpeded travel of individuals walking and those using mobility assistance devices year round.
- Sidewalks should have a minimum clear width of five (5) feet exclusive of the curb. Along Downtown and Neighborhood Activity corridors, eight (8) feet is preferred to accommodate two people walking abreast while still permitting the passing of one pedestrian or wheelchair user in the opposite direction.
- Sidewalks should be continuous and connected across streets with crosswalks. ADA-compliant accessible curb ramps must be provided at every designated crossing.
- Sidewalks must have adequate cross slope to facilitate stormwater runoff. The surface must be stable, slip-resistant, and free of tripping hazards.

OPERATIONS AND MAINTENANCE

- The pedestrian clear area of the sidewalk must be kept clear of snow and ice and should never be used for snow storage.
- While the City is responsible for general sidewalk maintenance and construction, ground floor occupants and building owners are respsonible to keep the adjoining sidewalk free and clear from obstructions including snow and ice.
- Safe, and accessible pedestrian walkways should be maintained in construction areas.

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PEDESTRIAN ZONE

STREET TREES

Street trees contribute to the character of both residential and commercial streets. They provide shade and reduce heat in summer, mitigate air pollution, dampen street noise, and help manage stormwater.

Mature trees provide significant stormwater management benefits through soil storage, interception, and evapotranspiration. Larger trees decrease runoff exponentially more than smaller trees.

USE

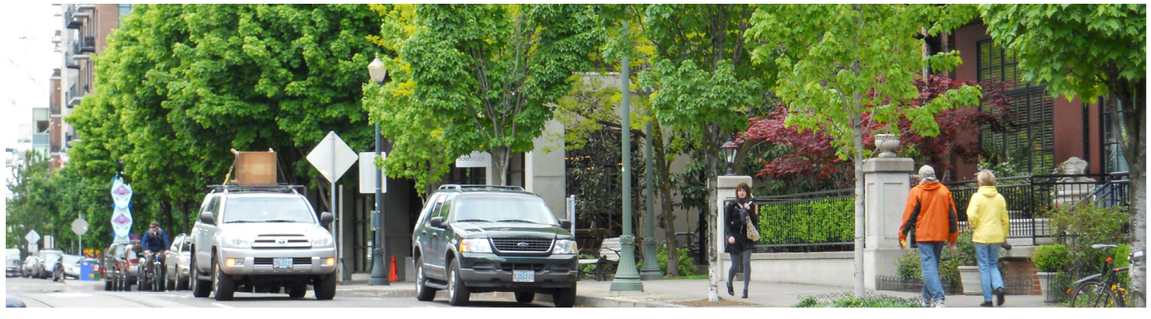
- Street trees should be included on every street, where possible, but are particularly important on Downtown and Neighborhood street types.
- Trees are required on all street projects unless not permitted by technical constraints such as inadequate planting strip width or soil volume.
- Trees are important in helping to define a consistent edge of the street.
- Street trees are important in high pedestrian traffic areas and in areas with large amounts of impervious surfaces.
- Street trees can be incorporated into the Static Zone of the street in green infrastructure facilities such as bioretention areas and planters.

DESIGN

- Trees should be selected from the City's Urban Forest Master Plan. Proper selection considers:
  - Size of growing area, soil, and drainage.
  - Width of the tree relative to the distance between trees and adjacent structures.
  - Presence of elements that would adversely impact or be adversely impacted by trees.
  - Deep root structure to minimize impacts on underground utilities and paved areas.
- Trees should be protected from substantial pedestrian traffic that may compact their roots.
- Trees should not compromise the visibility of traffic signs or signals or the sight distance of pedestrians, cyclists, and drivers at intersections.

OPERATIONS AND MAINTENANCE

- Trees require routine maintenance including tree trimming and health assessments.
- Planted street trees should have a maintenance contract providing tree care for the first two years following installation.
- New plantings require immediate and consistent watering.



STREET LIGHTING

Street lighting generally takes the form of either lighting over the roadway or sidewalk – although some lighting serves both purposes. Pedestrian lighting fixtures are generally installed lower with closer spacing while roadway lighting is placed higher with larger spacing. Lighting improves both safety and the sense of security.

USE

- Street lighting is desirable on all street types and is a priority along Downtown and Neighborhood street types. Alleys may not have street lighting.
- Pedestrian-oriented street lighting may be difficult in areas with above ground utilities.

DESIGN

- Street light spacing should prioritize even illumination and clear sense of the street edge.
- Street lighting should illuminate the roadway and pedestrian zone as well as crosswalks. Wider streets may require unique fixtures to light both the pedestrian and travel zones.
- Street lighting should provide consistent lighting levels and avoid contrasts of light and dark areas. In some cases, low lighting is preferable.
- Light poles should be set back two feet from the face of curb in a straight line along the street edge. Lighting may be provided on bump outs.
- Pedestrian zone lighting is generally spaced 20 to 40 feet apart. Travel Zone lighting may be spaced 60 to 120 feet apart depending on the lighting element.
- Street lights in the pedestrian zone may alternate with street trees spaced 10 to 20 feet apart.
- Full cut off or shielded lighting should be used to avoid light pollution and light cast into private residences and adjacent buildings.
- Street lighting should take advantage of timers, daylight sensors, and motion detection to reduce energy use and increase efficiency.

OPERATIONS AND MAINTENANCE

- The City should pursue more energy efficient lighting strategies such as LED lighting and/or street lights powered by renewable energy.
- Lighting fixtures should generally be limited to a small number of approved standards. This contributes to a cohesive public realm and more cost-effective maintenance. Unique street light fixtures may be approved with a confirmed maintenance agreement.

CURB CUTS

Curb cuts provide vehicular access from the public right-of-way through the pedestrian zone to private property. While driveways and curb cuts provide essential access, they introduce conflict with pedestrian, bicycle, and through vehicle travel, and reduce the efficiency of vehicular travel corridors. Cities are working to encourage shared access points and restore or reintroduce alley networks to reduce the need for curb cuts.

USE

- Driveways and curb cuts should be used only when access from alleys or shared access facilities is not available.
- Driveways and curb cuts should be located on the lowest order street abutting a property.
- Limit properties to one vehicular curb cut on each street frontage whenever practical.
- Driveways should be discouraged, minimized, or prohibited on streets with a high concentration of pedestrian activity such as Downtown and Neighborhood Activity streets.
- Existing curb cuts should be consolidated or eliminated whenever possible reduce conflict.

DESIGN

- The maximum width for residential, one-way commercial, and two-way commercial driveways are 15', 16', and 24', respectively. (Construction Details Section S608)
- Curb cuts that serve designated fire lanes must be a minimum of 20' wide and have appropriate turning radii for fire apparatus.
- Sidewalks should proceed straight and at grade across driveways and curb cuts as required by the ADA. Sidewalk materials should also extend across the driveway providing clear visual reference that pedestrians have priority.
- Driveway width and turn radii should be minimized to the extent practical to slow vehicles crossing the pedestrian clear zone.
- Driveways need to be spaced far enough from intersections to ensure that traffic entering or exiting a driveway does not conflict with traffic queueing at the intersection.

OPERATIONS AND MAINTENANCE

- Parking and loading activities must not be permitted where the driveway crosses the sidewalk or at the curb cut.

TRANSIT STOPS

Transit stops are designated places where riders board and disembark from transit vehicles. Stops may be a sidewalk with a paved connection to the curb adjacent to a transit stop signpost, or may include a range of amenities such as a shelter, seating, waste receptacles, dynamic information displays, and/or public art. A well-designed stop calls attention to transit service, explains how it works, and makes transit an appealing travel option.

USE

- Transit stops are located along corridors with transit services. A transit stop is required for fixed-route transit service.

DESIGN

- Every transit stop should be identified with a transit sign, located at the front of the bus stop, two feet behind the curb, that indicates the transit services provided at that stop and assists drivers in aligning doors with loading areas.
- Far-side in-lane stops located on a bus bulb confer the highest priority to transit at most signalized intersections while reducing conflict.
- Pull-out stops for 40-foot buses are typically 90 feet long when located near-side, and 100 feet when located far-side (NACTO). Stops for articulated buses require an additional 20 feet.
- Near side transit stops should be set back at least 15 feet from crosswalks (NACTO).
- Each stop should be illuminated by streetlights and feature a paved landing area at each bus door connected to a continuous sidewalk that meets the accessibility requirements of the ADA.

OPERATIONS AND MAINTENANCE

- Regulatory signs are required indicating the limits of the transit stop zone. Parking and loading should be prohibited within the stop area.
- Currently, RGRTA is responsible for shelter maintenance and repair along RTS fixed route transit corridors. The City or other entities can contribute to the construction, operations, and maintenance of future bus shelters.
- Bus shelters require quick repair if panels are broken or damaged. The shelter must also be regularly washed and cleaned of debris/litter.
- Landing zones and pathways must be cleared of snow and ice, at a width sufficient to enable deployment of wheelchair lifts.

PARKING METERS

Meters are one means to manage parking utilization and ensure there is adequate availability of on-street parking at any time. Parking meters permit payment for the use of curbside space. Parking meters may control only one space or multiple spaces. More advanced meters can communicate payment and occupancy status to a central control center enabling real time information-sharing and management.

USE

- Metered parking is generally implemented in commercial or mixed-use districts where there is significant competition for curbside space.
- Parking meters are unnecessary in areas where parking demand is low.
- Metering should be in effect during hours that curbside occupancy routinely exceeds 85%.

DESIGN

- Multi-space meters typically govern 10 parking spaces per kiosk. Multi-space meters should be conveniently located not more than 150 feet from any space that they serve.
- Smart single-space meters govern only a single space. No more than two meters are mounted on each post. Single space meters are placed immediately to the front or rear of the spot they are to serve.
- All parking meters must be accessible to persons with disabilities providing a smooth level pathway of at least 36" in width to access the meter.
- Meters should be located a minimum of 18" from the curb. A clear path should provide access to and from parked cars to the main sidewalk.
- Signage should indicate the location of multi-space meters, days and hours of parking meter operation, and any parking duration limitations.

OPERATIONS AND MAINTENANCE

- Parking meters and pathways leading to them should be kept clear of snow to facilitate use.
- Parking meters require regular collection of cash payments and regular maintenance of parts and operations.

WAYFINDING

Wayfinding clearly defines pedestrian, bicycle, and vehicle networks to guide travelers to destinations of interest or connecting facilities. Wayfinding is typically provided via signage and may orient a user, inform travelers of areas of interest or local offerings, or reassure a user that they are still on the same route.

The 2012 Center City Pedestrian Circulation and Wayfinding Study has created an excellent foundation for enhancing the Downtown pedestrian environment. The system should be expanded to areas beyond Downtown, adding long distance non-motorized wayfinding principles.

USE

- Wayfinding is typically located on higher order streets (e.g. Downtown Activity, Downtown Link, Neighborhood Activity) but may be placed on lower order streets for programmed routes such as bicycle boulevards.

DESIGN

- Wayfinding should follow a consistent design palette to aid in identification and legibility.
- Wayfinding may provide estimated travel time or distance information to destinations of interest (e.g. 5-minute walk to Arena).
- Signage should be located in the pedestrian zone, but must not impede movement.
- Pedestrian and bicycle wayfinding should be located at eye level. Vehicle signage should be at a location and scale consistent with driver's line of sight and speed of travel.
- Wayfinding oriented to one user should be inconspicuous to other users to avoid confusion.
- Signage should be compliant with the MUTCD and should not conflict with traffic signs.
- Signage should use reflective materials in low light conditions to improve legibility.

OPERATIONS AND MAINTENANCE

- Keeping wayfinding updated can be a challenge. Responsibility for updating signs should be established prior to installation.
- Wayfinding signs are often subject to abuse and theft. Similarly, wayfinding signs are often removed and stored during construction. Responsibility for storage, reinstallation, replacement, and maintenance must be clarified prior to installation.

PUBLIC SEATING

Public seating creates more accessible and inviting streetscapes for all users, especially those with mobility challenges, by providing places to rest. Structures may include benches, chairs, and seat-walls.

USE

- Public seating, aside from that associated with transit stops, is generally limited to areas with higher concentrations of pedestrian activity and/or where there is other demonstrated need.
- Seating locations should be carefully evaluated to ensure that they will be visible and regularly used to enhance the user's sense of security.

DESIGN

- Public seating is generally located on the street side of the pedestrian zone, but may be located closer to the building line, facing the sidewalk.
- Seating may take any number of forms, including bench-type seating, chair or stool type seating, or unique artistic seating.
- Seating parallel to and along the curb should maintain two feet of clearance from the curb and be oriented away from traffic, with the exception of seating provided at transit stops.
- When public seating is provided perpendicular to the curb, it is recommended that at least two seats be provided facing one another.
- Seating must not impede or encroach upon the pedestrian walkway. It should be placed in such a way that does not block building entries, loading zones, or other street functions.
- A 3-foot minimum clear zone shall be provided to the sides and front of the seat to provide ADA accessibility and clearance for wheelchairs
- Seating should not be located within five (5) feet of fire hydrants, should maintain four (4) feet of clearance from other fixtures, and should not block signage visibility or driver sight distance.

OPERATIONS AND MAINTENANCE

- Street furnishings and public seating should be of a standard type that is easily and reliably procured. Non-standard seating should only be used under a maintenance agreement.
- Street furnishings should be constructed from long lasting and durable materials and finishes.
- Seating should be regularly inspected for damage to ensure it is safe for use.
- Snow should be cleared from seating as part of routine pedestrian zone winter maintenance.

WASTE AND RECYCLING

Waste and recycling receptacles help keep the city clean and beautiful, reducing the likelihood of loose trash and refuse.

USE

- Waste and recycling receptacles are welcome in all areas, but are generally concentrated in areas with a high quantity of pedestrians such as transit stops, commercial areas, and/or near institutions such as schools or recreation centers.

DESIGN

- Waste and recycling receptacles must be placed so they do not block major pedestrian movements, building entries, loading zones, or other street functions.
- Do not locate waste receptacles where transit passengers board or disembark.
- Receptacles should be covered such that rain, snow, and other precipitation does not enter the receptacles and mix with refuse.
- Receptacles should be secured to the ground and be designed with an inner container that can be removed to facilitate collection of refuse.
- Receptacles should be standard manufactured designs, constructed out of durable materials, that are common throughout a district. Custom designs and other special order receptacles are generally discouraged.
- Do not place receptacles directly on top of utility covers or vaults.
- Place receptacles in locations accessible to curbside pickup and maintenance crews.
- Coordinate location and design of waste receptacles with the Solid Waste Management Division to ensure it meets their needs for easy emptying and maintenance.

OPERATIONS AND MAINTENANCE

- The City is responsible for waste or recycling receptacles and their waste removal.
- Private development projects of substantial scale should provide public waste and recycling receptacles. These may be conveyed to the City provided they are the standard design.
- Snow should be cleared from around receptacles to facilitate waste removal. Snow should not be piled or stored on top of receptacles to prevent damage as well as to keep receptacles accessible year-round.

BICYCLE PARKING

Bicycle parking is vital in an urban environment. Bicycle parking, like vehicle parking, provides easy access to City destinations. It is essential in making bicycling a convenient mode of travel. Insufficient provision of bicycle racks can lead people traveling by bicycle to lock bicycles to other street fixtures, which may damage these elements, compromise their intended use, or impede pedestrian travel.

USE

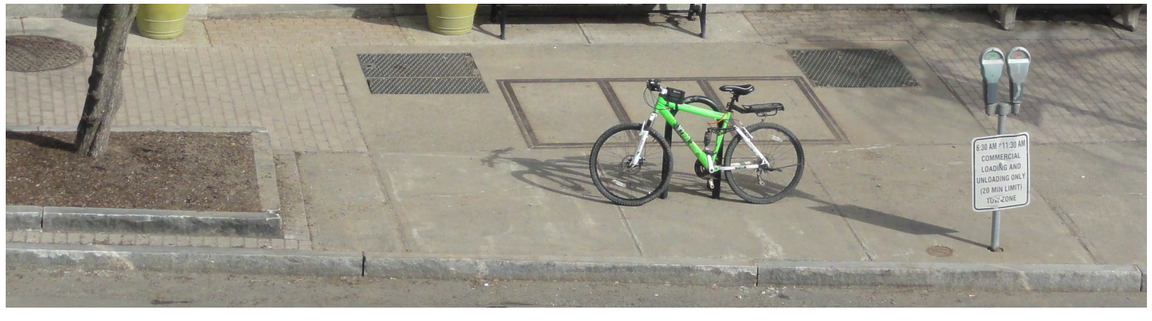
- Bicycle parking is appropriate on all but the lowest order street types and should be encouraged to facilitate bicycle use
- Bicycle parking is generally unnecessary on Neighborhood Local streets and may be less common on Neightborhood Link streets except near or at community destinations.

DESIGN

- Bicycle parking racks should allow the user to lock both the frame and at least one wheel.
- Bicycle racks should be affixed firmly into the sidewalk or street surface and made of a material type and shape to resist cutting/rusting.
- The common inverted U rack or bicycle loop are recommended rack design types. Wave and schoolyard style racks are not recommended.
- Bicycle racks should be placed in the sidewalk space aligned parallel and at least two feet from the curb.
- Bicycle racks should be placed in locations with high visibility to make them easy to find and use, and to provide passive security.
- Bicycle racks should be placed at least five (5) feet from fire hydrants, crosswalks, or midblock crossing ramps. Racks should be three to four (3-4) feet from loading zones, street furniture, or bus stops/shelters. Racks should not interfere with parked car doors and must not impede pedestrian traffic.

OPERATIONS AND MAINTENANCE

- Bicycles left at bicycle racks for an extended period of time should be removed.
- Bicycle racks may need to be replaced when they show signs of wear that may damage bicycles. Loose anchors may need to be repaired to ensure the rack remains secure.
- Monitoring bicycle rack occupancy can help determine when additional racks are needed.



BICYCLE REPAIR

Bicycle repair stations provide a place for bicyclists to make minor repairs on their bicycles such as repairing a flat tire, fixing a chain, or tightening loose parts. Repair stations make bicycling more convenient and reliable by enabling cyclists to make common repairs while away from home. Bicycle repair stations typically consist of an upright fixture to allow the bicycle to be lifted and hung while it is being worked on. A number of basic tools are affixed to the stand.

USE

- Bicycle repair stations are commonly located along major bicycle facilities such as heavily used cycle tracks or trails.
- They are generally co-located with significant bicycle parking.

DESIGN

- A variety of bicycle repair stations are commercially available and can be simply affixed to the street or sidewalk area.
- Repair stations should include an air pump, screwdrivers, crescent wrenches, allen wrenches, tire levers, and may include torque wrenches. Use cables to attach tools to the bicycle stand to prevent theft.
- Bicycle repair stations should be located near to bicycle parking, but should not impede the easy use of bicycle racks for bicycle parking.
- Bicycle repair stations should be located at least four feet from the curb and all other objects to enable easy use and to prevent the bicycle rack from impeding any other use or travel flow.
- Bicycle repair stations are typically located in the Pedestrian Zone of the street but may be located in the Static Zone near bicycle corrals.
- All publicly available bike repair stations should also be included on bike-oriented wayfinding.

OPERATIONS AND MAINTENANCE

- Bicycle repair stations must be checked routinely to ensure all tools are present and in working order, and to make repairs/replacements. Replacements should be kept on hand.
- Repair stations may be sponsored by local bicycle friendly businesses. Sponsors should have a maintenance agreement in place.

DRAFT
PEDESTRIAN ZONE

BIKE SHARE STATION

Bike share stations are locations where people can rent and return bicycles for typically short trips from the shared system. Bike share stations may be as simple as groups of bicycle racks that provide a space to lock "smart" bike share bicycles using integrated locks, or smart docking stations for shared bicycles.

USE

- Bike share stations should be located to encourage bicycle trips for commuting, shopping, running errands, social outings, exercise, and sightseeing.
- Bike share stations may be a wide range of sizes depending on the intensity of bicycle demand. However, they typically range from 10 to 30 bicycle docking or parking spaces.

DESIGN

- Stations should be located in areas with popular destinations and in high density areas.
- Bike share stations are highly desirable near transit stops and intermodal facilities. Locating bike share stations near these facilities encourages trips by multiple modes.
- Bike share stations are commonly located in the pedestrian zone of the street, but may also be located in the static zone or in public spaces. Stations may also be placed on private property with appropriate approvals and ensured access.
- Parked bicycles, and the space required to get bicycles in and out, must not impede use of the pedestrian zone or adjacent travel lanes.
- Bike share stations must avoid obstructing utilities, fire hydrants, other street furniture, or the sight distance of pedestrians, cyclists, and drivers at intersections.

OPERATIONS AND MAINTENANCE

- Newer modular or dockless bike share stations may be easier to move and accommodate construction or changing user demand.
- The placement of a bike share station should maximize convenience for bike share users, yet minimize conflicts with pedestrians and discourage bicycle riding on the sidewalk.
- Van access for station maintenance and bicycle rebalancing should also be considered.

STATIC ZONE

The Static Zone of the street is located adjacent to the curb line of the street. It is so named because this is typically not a zone of through movement, but rather the zone used for parking, loading, and other uses.

The curb line may deviate from a straight line to include bump outs, bus bulbs and other features. For this reason, there is some overlap between the Static Zone of the street and the Pedestrian Zone.

The Static Zone is a transitional space that serves a number of functions. It provides an important buffer and protection between people on the sidewalk and vehicles moving in the Travel Zone of the street. The static zone is also a space of exchange and transfer as people get in and out of cars parked at the curbside or buses as they stop for boarding and disembarking passengers. The Static Zone is where freight loading often occurs. It also plays a critical role in stormwater management, as this is an area where storm sewers and/or green infrastructure are commonly located.

Design and management of the Static Zone is important to pedestrians, bicyclists, motorists, transit riders, and area businesses and residents. Poor management can lead to congested parking or loading spaces which, in turn, can degrade the operations and safety of the adjacent Travel Zone.

ON-STREET PARKING

On-street parking provides support to local commercial businesses, offices, and residents by providing a convenient location for short-term parking. On-street parking in commercial areas not only provides access to adjacent businesses, but also buffers pedestrians from adjacent traffic, which can be critical to providing a comfortable walking environment on fast-moving, heavily-trafficked streets. In residential areas, on-street parking provides residents and visitors with short-term and overnight parking spaces.

USE

- On-street parking is appropriate on most street types; less common on Industrial street types.
- While valuable, right-of-way space should only be used for on-street parking after the mobility needs of all travelers are met.
- On-street parking may be removed to meet minimum recommended sidewalk widths.

DESIGN

- Typically, on-street parking is curbside parking parallel to the curb. While perpendicular or angled parking are also acceptable configurations, they are only appropriate on wider streets without bicycle facilities.
- Parking spaces may be marked with T and L pavement markings at their outside edge or defined with a solid white line to discourage encroachment into adjoining travel lanes.
- Parallel curbside parking spaces should be 8 feet wide by 21 feet long. A minimum of 7 feet of width and 18 feet of length is required.

OPERATIONS

- On-street parking must be effectively managed such that spaces are typically available on each blockface to prevent added traffic volumes while motorists search for parking.
- Particularly on active commercial streets, the parking lane may be used for flexible uses such as café seating on a semi-permanent basis.
- Bicycle parking may also be provided in the parking lane where there is not enough room to park a car, such as between driveways.
- Snow removal from on street parking spaces is completed by the city using time restrictions. When necessary, on-street parking spaces may be used for temporary snow storage.

DRAFT
STATIC ZONE

LOADING ZONES

A loading zone is a dedicated space at the curbside intended for short-term use to directly service nearby properties. There are typically two users of loading zones – freight trucks for the receipt or delivery of goods and automobiles for passenger pick up/drop off. Appropriately located loading zones can improve the operation of a street. Locating loading zones adjacent to commercial uses may reduce the incidence of double-parked delivery trucks. Loading zones also take up space that could otherwise be used for parking, pedestrian, or transit space and should be well managed.

USE

- Loading zones are generally shared by a number of businesses or properties on a block. There is typically one loading zone per block.
- Loading zones are intended for short duration parking of 20 minutes or less. In business activity areas, off-peak loading hours are encouraged.
- Loading zones may be designated for private vehicle passenger pick-up/drop off and/or for use by taxis and other ride-hailing services.
- Alleys should be used for loading when possible.

DESIGN

- Loading zones for deliveries should be designed to house a single-unit 30-foot delivery vehicle.
- Loading zones should be located near the far side of intersections to facilitate access to and from the rear of trucks via sidewalk ramps.
- Freight loading zones should be 40 feet long and 8 feet wide. Per ADA, passenger loading zones must be 20 feet long and 8 feet wide.
- Zones should be well-marked to indicate no parking allowed during loading hours.
- Loading zones must not impede the use of adjacent crosswalks.

OPERATIONS AND MAINTENANCE

- Regular enforcement is required to ensure that loading zones are not used for parking.
- Delivery dwell time should be restricted in the loading zone to ensure turnover.
- If multiple businesses are sharing the loading zone, they should be encouraged to coordinate delivery times to discourage double-parking.
- Loading zones may be used for other purposes during non-delivery hours. Typical uses include curbside parking or valet parking operations.

BUMP OUTS

Bump outs visually and physically narrow the street by extending the sidewalk, reducing pedestrian crossing distance, and increasing pedestrian visibility and line of sight. At signalized intersections, reduced crossing distances enable shorter walk phases. The narrower street profile encourages slower driving, increasing safety for all roadway users.

USE

- Bump outs are appropriate on all streets, but especially encouraged on higher volume streets such as Downtown and Neighborhood Activity.
- Bump outs should only be used where a curb lane is present that is not used for travel.
- Bump outs are particularly beneficial in commercial frontage contexts where pedestrian volumes are concentrated and streets are wide.
- The most common type of bump outs are located at intersection corners.
- Midblock bump outs can be used to narrow a street for traffic calming or be used in conjunction with a midblock crossing.

DESIGN

- Bump outs should not narrow any bicycle or general traffic lanes to an unsafe width. One (1) to two (2) feet should remain between the curb and the first travel or bicycle lane.
- Corner or midblock bump outs with crosswalks should be as wide as the crosswalk, and ideally extend to the stop bar.
- At corners with turn restrictions, use a bump out to make the turn more difficult, while ensuring that transit vehicles are not delayed.
- The decision to place bump outs on streets that accommodate transit vehicles should carefully consider bus turning radii requirements.

OPERATIONS AND MAINTENANCE

- Bump outs can be a temporary trial installation, using bollards and planters. Temporary extensions should be removed in winter months to facilitate snow removal.
- Green infrastructure applications should have maintenance plans prior to installation.
- Special snow removal equipment should not be necessary if bump outs are designed with turn radii adequate for the current fleet.

DRAFT
STATIC ZONE

BUS BULBS

Bus bulbs are a bump out that facilitates in-lane transit stops on streets with on-street parking. Bus bulbs improve transit operations, speed, and reliability by eliminating the need for buses to merge in and out of traffic at stops. Like bump outs, bus bulbs benefit pedestrians by shortening the crossing distance. Bus bulbs also can provide additional space for enhanced transit passenger amenities.

USE

- Bus bulbs can be used in any location where on-street parking is present. Bus bulbs may not be used on streets where curbside uses vary throughout the day.
- Bus bulbs may be used on streets with bicycle facilities with an accommodating design at stops. In this instance, bus bulbs are commonly called side boarding islands.
- Bus bulbs are most appropriate on streets with moderate to high transit ridership volumes and/or streets where transit vehicles may be delayed by merging in and out of traffic.
- They may be used at near-side, far side, or mid-block bus stops, though far side and mid-block stops are preferred.

DESIGN

- The length parallel to the roadway must allow all bus doors to open directly onto the bus bulb.
- Bus bulbs extend from the curb edge to within two feet of the outside of the travel lane.
- Bus bulbs should have a return angle of 45 degrees and 15 foot radii to facilitate vehicle turns, snow clearance and/or street sweeping.
- Bus bulbs will generally be designed at a curb height consistent with the rest of the street and join level with the adjacent sidewalk.
- On streets with bicycle facilities, provide cut-through for bicycle lanes behind bus bulbs.
- Transit amenities, such as shelters and seating, should be located on bus bulbs, provided adequate clearance requirements are met for landing zones and maintaining clearance with pedestrian walkways or bicycle facilities.
- Near side bus bulbs with a right turn restriction should be designed with the curb to self-enforce the restriction.

OPERATIONS AND MAINTENANCE

- Bus bulbs should not be used for snow storage and should have a plan for snow clearance.

Source: NACTO (CC BY-NC 2.0)

PARKLETS

Parklets are seasonal mini plazas located in the parking lane. Parklets convert curbside parking spaces into a public seating platform, including landscaping. Often the product of a partnership between a city and local businesses or neighborhood associations, these amenities have a distinctive design and accommodate unmet demand for public space, particularly on thriving neighborhood retail streets or commercial areas.

USE

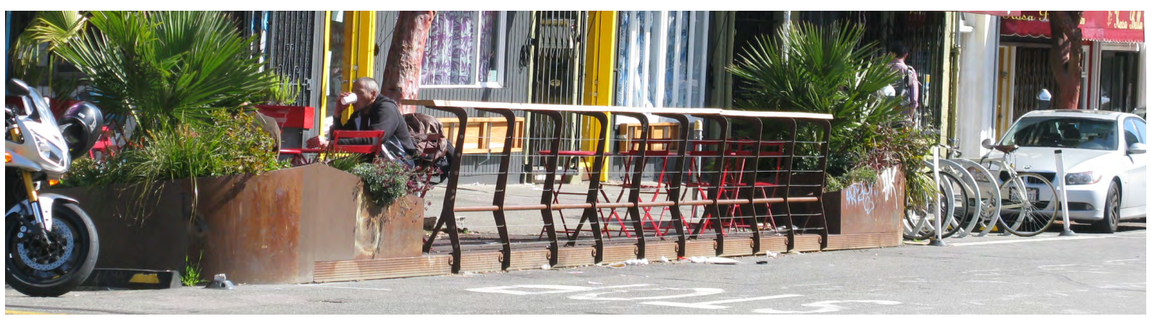
- Parklets are typically applied where narrow or congested sidewalks prevent the installation of traditional sidewalk cafés or where local property owners or residents see a need to expand the public space along their street.
- While parklets are principally intended as community assets, their presence can increase revenues for adjacent businesses.

DESIGN

- To ensure increased protection from moving traffic and parking cars, parklets must be buffered using a reflective wheel stop at a distance of three to four feet from the parklet and include vertical elements such as reflective flexible posts or bollards.
- The maximum width of parklets should be one foot less than the width of the parking lane.
- Parklets should have a flush transition at the curb to permit easy access.
- Parklets are best placed at least one parking space away from the intersection corner. Where a parklet is considered for a site near an intersection, volumes of turning traffic, sightlines, and visibility should be taken into account.
- The parklet substructure must accommodate the crown of the road and provide a level surface for the parklet.

OPERATIONS AND MAINTENANCE

- Parklets are typically administered through partnerships with adjacent businesses and/or surrounding residents. Design and installation costs are typically borne by nearby residents or businesses and these partners maintain and program the parklet, keeping it free of debris.
- Parklets should be removed during the winter to prevent conflicts with snow removal equipment and street cleaning vehicles.



BICYCLE CORRALS

Bicycle parking corrals are bicycle racks installed in the curb lane of the street where automobiles typically park. One vehicle parking space can usually accommodate 10 bicycle parking spaces.

USE

- Bicycle parking corrals are most often used in areas of high bicycle parking demand and/or in areas where sidewalks are narrow and bicycle racks would impede pedestrian flow.

DESIGN

- Bicycle corrals typically consist of groups of six, nine, or 12 inverted U or hoop style bicycle racks or a single rack unit with parking for eight to 12 bicycles installed in the parking strip.
- Bicycle parking corrals should provide adequate clearance for bicycles from the adjacent travel lane. Racks should be placed perpendicular to the curb in wider streets where at least 96 inches is available and angled on narrower streets where a minimum 80 inches is available. Racks should be spaced at least 36 inches apart; 48 inches is recommended.
- The corral should be demarcated using paint, bollards, rubber curb, or planters. Any hard deflector should be four feet from the corral.
- Bicycle parking racks should allow the user to lock both the frame and at least one wheel. Rack design should prevent the bicycle from tipping over.
- Bicycle racks must be durable and securely anchored to prevent theft.
- Corrals should be located as close as possible to the main entrances to buildings.

OPERATIONS AND MAINTENANCE

- Racks and any barriers surrounding the corral need to be replaced or removed in a timely manner if they have been damaged.
- Bicycle racks should be replaced when they show signs of wear that may damage bicycles.
- Proposed bicycle corrals need to be reviewed by the City for traffic safety and operations issues as well as for adherance to City code.
- Some designs for bike parking corrals include large planter pots, which can be maintained by local businesses, community groups, or individual volunteers.

TRAVEL ZONE

The Travel Zone of the street is typically located along the centerline of the street and extends to the Static Zone. The Travel Zone may extend from curb to curb on streets where on-street parking is prohibited. As it implies, the Travel Zone of the street is where moving vehicles and bicycles operate. Occasionally, as in the case of shared streets, pedestrians may also use the Travel Zone other than at a marked crossing.

While we typically think of cars, buses, and trucks as the principal operators in the Travel Zone of the street, this is also typically the zone of bicycle travel. Even where off-street trail facilities are provided, bicycles are still legal users of the Travel Zone. The Travel Zone must be designed to provide safe facilities and safe operation to protect all users.

Speed is a critical factor in safety. Most city streets should be designed to produce an operating speed that does not exceed the posted speed, generally 30 miles per hour. Shared streets should be designed to encourage speeds no greater than 15 mph. The posted speed limit is the maximum permitted speed, and the street must be safe to travel on at this speed. However in some street types—such as Neighborhood Local and Downtown Link—and in areas such as school zones, the desired speed may actually be lower than the maximum permitted speed.

The dimensions, type, and location of facilities in the Travel Zone should create "self-regulating streets" in which the design of the street encourages users to travel at an appropriate speed for that street type. In general, self-regulating streets should have a posted speed limit that is the same as the design speed and the target operating speed.

LANE WIDTHS

Travel lane width is a significant factor in how drivers interpret the appropriate speed of travel on a street and is a key element to self-regulating street design. Travel lanes also tend to be the largest street element in the total cross section. As such, reducing travel lane widths directly reduces the street crossing distance. Minimizing travel lane widths can also provide space for facilities for the safe movement of other users, such as bus bulbs, wider sidewalks, street trees, or bicycle facilities.

The application of 12-foot travel lanes is due to a belief that they improve safety by reducing the probability of side swipe crashes and increased vehicle throughput. However, the Transportation Research Board's publication *Relationship of Lane width to Safety for Urban and Suburban Arterials* indicates that in most cases, travel lane widths between 10 feet and 11 feet on urban arterials do not negatively impact overall motor vehicle safety, operations, or capacity.

AASHTO's *Policy on Geometric Design of Highways and Streets* states that the use of the narrowest appropriate lane width results in lower speeds, increased safety, less severe crashes, and more space for other critical uses of the right of way. While some streets in Rochester have 12-foot travel lanes, 10-foot travel lanes are more appropriate on lower speed roads such as those posted 30 miles per hour within the City of Rochester.

On streets that often host higher volumes of heavy vehicles, such as transit buses, large trucks, and emergency response vehicles, one 11-foot wide travel lane should be provided in each direction.

Lane widths should examine interactions between the design of adjacent elements, their users, and the overall assemblage of the street. It is sometimes inadvisable to choose the narrowest dimension for all elements within the Static and Travel Zones of the street. Examples include:

- The inclusion of gutter pan width in the total dimension of vehicle travel lanes, but not as a component of bicycle lane width.
- Using the minimum dimension for a parking lane, bicycle lane, and travel lane simultaneously, leaving little room for vehicle doors to open and for cyclists to maneuver around them.

Where streets have a designated modal emphasis, the preferred dimension for the selected modal facility should be used.

Lane widths may be marked or unmarked, depending on the street type. Unmarked streets, such as yield streets, do not have separately defined lanes, but rather a shared space that provides the necessary lane width while requiring that vehicles yield to one another as they pass. Yield streets are generally two-way low volume streets with on-street parking.

TRAVEL LANE TYPE	RECOMMENDED WIDTH
Typical general purpose travel lane	10'
Travel lane - transit, freight, or emergency emphasis	11'
Turning lane	10'
Dedicated bicycle lane	5'
One-way protected bicycle lane	8'
Dedicated transit lane	12'
Shared or yield street	16'
Raised median	10'

DRAFT
TRAVEL ZONE

VEHICLE TRAVEL LANE

Travel lanes are the typical lanes of a vehicular street. Travel lanes are typically designed for general purpose use—meaning they are appropriate for passenger vehicles, delivery vehicles, and transit vehicles or heavy truck. Bicycles are generally permitted in the general purpose lane, especially when designated bicycle facilities are not provided on the street.

The appropriate number of travel lanes on a street depends on the desired volume of vehicle travel on the street, the desired operating environment on the street, and the remaining right-of-way space available after accommodating all users, as well as green infrastructure elements.

USE

- Travel lanes are present features in all street types, although the number and width varies by type. Lower order streets typically features two travel lanes—one operating in each direction. Because desired operating speed is low, lane widths are generally narrow. Higher order streets (Regional Activity, Downtown Activity) may have a greater number of travel lanes; albeit narrow to promote self-regulation.

DESIGN

- When determining the number and width of travel lanes, designers should consider how the street is used throughout the entire day and not just simply during peak periods. Excess travel lanes coupled with lower vehicle volumes can lead to excessive speeding and work against the objectives of self-enforcing street design.
- Travel lanes should be assembled together with other roadway elements including turning lanes, parking lanes, bicycle facilities, bump outs, and other horizontal calming elements.
- Corridors with certain modal priority emphasis—such as transit emphasis or vehicle/truck emphasis—may require wider travel lanes.
- General purpose travel lanes are typically demarcated with yellow center lane markings for vehicles traveling in opposite directions and white dashed lane markings for vehicles traveling in the same direction.

OPERATIONS AND MAINTENANCE

- Travel lanes must be kept clear of snow and ice. They should be designed to facilitate rapid drainage following heavy rainfall.

VEHICLE TURN LANE

Turn lanes provide a space for vehicles to move out of the general flow of traffic into a dedicated space to wait for a gap in pedestrian or vehicle traffic in order to complete a turn. The assemblage of travel lanes together with turn lanes can have a substantial effect on the experience of pedestrians. Turn lanes, particularly center turn lanes, can dramatically improve the throughput of vehicular corridors. However, turn lanes can introduce additional conflict and uncertainty in their interaction with other modes. Additionally, the inclusion of right- and/or left-turn lanes at intersections can dramatically increase the total roadway width and pedestrian crossing distance.

USE

- Turn lanes should only be used where necessary and after evaluation of their safety and operational impact on other modes.
- Turn lanes are generally only required on higher order streets such as Regional Activity, Downtown Activity, and Neighborhood Activity. Downtown, Neighborhood, and Industrial Link streets may also benefit from turn lanes given the proportion of heavy vehicles expected on these streets.

DESIGN

- Turn lanes are generally 10 feet wide. Center turn lanes may require slightly more width.
- Turn lanes should be designed with appropriate length to accommodate reasonably expected queuing demand. Turn queue bays should not be longer than is required.
- Turn lanes may be managed via separate signal phases depending on the volume and other intersection operations.
- For streets where the addition of turn lanes requires pedestrians to cross four or more lanes of traffic, look for ways to install pedestrian crossing islands to provide a safe haven for pedestrians crossing the corridor.

OPERATIONS AND MAINTENANCE

- Like through travel lanes, turn lanes must drain properly following heavy rain and be kept clear of snow and ice.

PEAK HOUR TRAVEL LANE

Peak hour travel lanes are curbside parking lanes that are converted to other uses during peak or rush hour times. Traditionally, this is done to convert parking lanes to general purpose travel lanes. However, time restricted parking lanes can also be temporarily converted to other purposes, including transit and bicycle lanes.

Peak hour travel lanes can increase the capacity of the roadway for general traffic. Depending on conditions, an additional travel lane can improve capacity by 600 to 1,000 vehicles per hour.

USE

- Time restricted lanes may be considered on roadways where additional capacity is needed during peak hours.
- Restricting parking, stopping, and standing at curbside during peak hours can improve traffic capacity and flow. However, the decision to restrict parking should be carefully weighed against the other demands on curbside use, such as loading and deliveries, access for persons with disabilities, and the need to create a buffer for sidewalk users.

DESIGN

- Peak hour travel lanes should be a minimum of 10 feet wide to serve as a travel lane. If designed wider, these lanes can accommodate both parked cars and bicycles in off-peak times.
- Peak hour travel lanes are not compatible with bump outs.
- Converting parking lanes to general purpose travel lanes at peak times can make it difficult to install dedicated bicycle lanes due to safety concerns associated with having moving traffic on both sides of the bicycle lane.
- Right hand turn lanes should be evaluated for conversion to time restricted parking lanes during roadway reconstruction projects to reduce pedestrian crossing distances during off-peak hours.

OPERATIONS AND MAINTENANCE

- Temporary use of the curbside space for vehicular travel requires rigorous enforcement to realize the envisioned circulation benefits.

TRANSIT LANE

Dedicated transit lanes are used to reduce delay for transit services on busy streets, especially those corridors with frequent service. Owing to the high passenger capacity of transit, a dedicated transit lane can help to dramatically increase the amount of people that can move along a high-ridership transit corridor. Dedicated transit lanes reduce traffic delays and increase the reliability of transit service.

USE

- Transit lanes are used only on corridors where transit service is very frequent and traffic congestion routinely impedes transit operations.
- Transit lanes may be time restricted and permitted for other uses at other times.
- Curbside lanes are immediately adjacent to the curb and work best on streets with few driveways and limited right turning traffic.
- Offset lanes operate outside of a parking lane. Offset lanes may be compromised by vehicles entering and exiting curbside parking.
- Median lanes occupy the center of the street. Transit may operate within a wide median or adjacent to a median boarding platform.

DESIGN

- The preferred width for a dedicated transit lane is 12 feet. Gutters may be included in the calculated dimension of a curbside transit lane.
- The street should be clear for a vertical distance of 12 feet above the street surface. Banners or trees overhanging a curbside used for bus travel shall be maintained above this height.
- Fixtures or plantings should maintain a 2 foot clear zone from the curb where buses or other vehicles travel in the curb lane.
- If the lane is permanently reserved for bus only use, apply BUS ONLY pavement markings.
- At intersections, bus lanes may become right-turn only lanes. Use a dotted line to denote where other vehicles may enter the bus lane.

OPERATIONS AND MAINTENANCE

- Dedicated transit lanes may require additional enforcement.
- Create a plan to prevent significant disruption of transit service when utility work requires occupying part or all of a transit lane.
- In winter, keep access to transit lanes and transit stops clear for both the vehicles and riders.

DRAFT
TRAVEL ZONE

SHARED TRANSIT LANE

Under certain circumstances, a shared lane reserved for transit vehicles and bicyclists can provide improved accommodation for both groups. Shared transit lanes are specifically designed to provide room for the two users to maneuver together as buses start and stop along a corridor.

USE

- Shared transit lanes are appropriate on streets where space constraints preclude the ability to provide separate facilities and where bus headways and speeds are moderate. Shared transit lanes typically require less total right-of-way space than separate facilities for each user.
- This lane type should not be considered on high frequency transit corridors or on corridors where bicycle volumes are high enough to adversely affect transit operations.
- Shared transit lanes are not an appropriate treatment on desired low-stress bicycle corridors.
- Shared transit lanes are not appropriate on time restricted streets where the parking lane converts to a travel lane during peak hours.

DESIGN

- Shared transit lanes should be located in the outermost lane, ideally adjacent to the curb.
- Shared transit lanes typically are not physically separated from adjacent travel lanes and thus, should have sufficient width for dual bicycle/transit use. The minimum adequate width is twelve (12) feet.
- Appropriate markings and signage must be provided to ensure that all users of the street are aware of the lane configuration and permitted lane users.
- Shared transit lanes should be for the exclusive use of buses and cyclists, except at intersections, where other vehicles may use them as right turning lanes.

OPERATIONS AND MAINTENANCE

- Shared transit lanes generally require a higher level of observation and enforcement.
- Transit operators should be trained in interaction with cyclists in shared bicycle/transit lanes.
- Lanes should be kept clear of snow and debris.
- Pavement markings will require maintenance and replacement.

BUS QUEUE JUMP LANE

A bus queue jump lane, also known as a bus bypass lane, is a truncated bus lane located at the approach to a traffic signal. Buses use the lane to bypass waiting traffic, significantly improving transit travel time. Bus queue jumps may take many forms.

USE

- Transit exempt right turn lanes allow buses to proceed straight through the intersection from a right turn lane.
- The main stop bar may be pushed back and a transit-only lane placed along the curb ahead of the stop line so that the transit vehicle can pull ahead to an advanced stop bar.
- A shared right turn/bus lane reserves the curbside lane for transit vehicles with the exception of right turns by general traffic. This gives buses priority for a longer distance, but requires the removal of parking or travel lanes.
- Queue jump lanes are best used on overlapping transit routes at intersections where buses are likely to experience more significant delays.
- Place bus stops at the far-side of the intersection to allow buses to take advantage of the bus queue jump lane located on the near-side.

DESIGN

- Design bus queue jump lanes long enough so that buses can bypass stopped vehicles.
- Special pavement markings and/or signage may be needed to indicate the space is exclusively for transit vehicles.
- Place an advanced stop bar at least two car lengths ahead of the main traffic stop bar .
- Provide space on the other side of the intersection for the bus to reenter traffic.
- Modify traffic signal timing to allow right-turning drivers to clear the bus queue jump lane in order for transit vehicles to use it. Shorter traffic phases may help to reduce backups.
- To be fully effective, use transit signal priority alongside a bus queue jump lane.
- Exercise caution when placing bicycle lanes next to bus queue jump lanes due to conflicts with buses and right turning drivers. Identify the conflict zone with colored pavement markings.

OPERATIONS AND MAINTENANCE

- Bus queue jump lanes can be cleared of snow using regular snow removal equipment and should never be used for snow storage.

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TRAVEL ZONE

MEDIAN

A median divides lanes of traffic. Medians are generally in the center of the right-of-way, dividing opposing directions of traffic. They may also separate local access or special purpose lanes. Medians increase safety and enhance roadway operations by reducing vehicular movement conflicts, limiting turning movements, and potentially (but not necessarily) providing a refuge for pedestrians crossing the street. Medians can improve environmental quality and incorporate stormwater source control when planted.

USE

- Medians are generally applied to high volume streets to reduce turning movement conflicts while providing an attractive streetscape.
- Medians may be used as an access management tool, a means to limit vehicle conflicts, and/or traffic calming on a corridor.
- For the purpose of slowing traffic, medians are generally used in conjunction with other traffic calming measures, such as lane narrowing.

DESIGN

- Striped or painted medians may precede more permanent improvements, providing an opportunity to test travel behavior before making a significant capital investment.
- Raised medians within the travel zone provide opportunities for landscaping, street trees, and two-stage pedestrian crossings.
- Medians should be a minimum of six feet wide. Those protecting turning lanes or accommodating pedestrian refuge areas should be at least 10 feet wide.

OPERATIONS AND MAINTENANCE

- Medians should be designed with snow removal in mind. Medians can be used for snow storage when necessary, although this may negatively impact planted materials and can block sight lines along the roadway.
- Medians should allow adequate width in the adjacent travel lane as well as turn radii that accommodate snow removal vehicles.
- Medians should also be designed for maintenance of the plantings and vegetation. Installed water infrastructure may be required.

DEDICATED BICYCLE LANE

Dedicated bicycle lanes are on-street bicycle facilities delineated by lane markings as well as bicycle symbol and arrow pavement markings. Bicycle lanes are typically located on the right side of the street immediately adjacent to a vehicle travel lane travelling in the same direction as vehicle traffic. Conventional bicycle lanes alert motorists to the presence of a bike route, allow cyclists to use the street with less interference, and increase comfort and predictability for all roadway users. The provision of bicycle lanes may reduce the incidence of cyclists riding on sidewalks.

USE

- The installation of bicycle lanes may require a reallocation of roadway width and may include modifications to travel, parking and turn lanes.
- Bicycle lanes are typically not used on Neighborhood Local streets.

DESIGN

- Conventional bicycle lanes should be at least five feet wide. Those lanes adjacent to the curb should be six feet wide including the gutter pan.
- When the bicycle lane is between the travel lane and parking lane, a minimum combined width of 13 feet is recommended eight (8) foot parking lane plus a five (5) foot bicycle lane).
- Preferred bicycle and parking lane combined width is 14 feet to minimize vehicle door conflict.
- A solid white line must be used to differentiate the bicycle lane from the general travel lane.

OPERATIONS AND MAINTENANCE

- Bicycle lanes should be kept free of debris, which represents a hazard to bicyclists.
- Avoid locating manholes and drainage grates in bicycle lanes. Ensure that utility covers are flush with the roadway.
- Bicycle lane striping and associated signs and symbols are additional markings that will require maintenance and replacement.
- If colored pavement is used, maintenance plans should keep the markings clear and legible.
- Additional enforcement may be required to ensure that bicycle lanes remain free of parked and stopped vehicles, including delivery trucks.
- Snow should be cleared from bicycle lanes as with any other roadway facility. Bicycle lanes should not be used for snow storage.

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TRAVEL ZONE

CONTRAFLOW BICYCLE LANE

Contraflow bicycle lanes are a dedicated bicycle lane on one-way streets that permit bicyclists to lawfully travel in the opposite direction of motorized traffic. They effectively make the street two-way for cyclists while maintaining one-way operations for vehicles.

USE

- Contraflow bicycle lanes typically address unique conditions where one-way vehicular operations result in inefficient bicycle connections. They may reduce the incidence of wrong-way cycling and cycling on sidewalks.
- Contraflow bicycle lanes are tools to bridge short interruptions in desired bicycle travel paths.
- Contraflow lanes are often employed on single blocks in the areas of highest demand.
- Contraflow lanes should only be used where there is an observed need for the connection.

DESIGN

- Marked contraflow bicycle lanes are located on the left side of travel lanes, based on the direction of vehicular travel.
- Contraflow lanes are separated from traffic by a double yellow line, indicating to motorists that cyclists are traveling in the opposite direction.
- The contraflow lane may be separated by a buffer, median, or other barrier.
- Contraflow bicycle lanes should be a minimum of five feet wide between the striping and curb.
- Orient stop signs and traffic signals along the street to face cyclists in the contraflow lane.
- Extend contraflow lane markings across the intersection to signal the presence of two-way traffic to motorists on cross streets.
- Colored pavement or pavement markings may be used to identify the contraflow lane.
- Bicycle travel in the same direction as vehicular traffic should be accommodated via facilities on the right side of vehicular travel lanes.

OPERATIONS AND MAINTENANCE

- Contraflow lanes should be kept free of debris.
- Pavement markings will require periodic maintenance and replacement.
- Contraflow lanes should be designed to permit snow clearance using existing equipment.
- Lanes should not be used for snow storage.

PROTECTED BICYCLE LANE

Protected bicycle lanes facilities with physical separation from vehicular travel lanes. Protected bicycle lanes can increase the sense of safety and comfort for bicyclists, especially those that are less experienced riders. Protected bicycle lanes correlate positively with increased bicycling activity as they improve comfort for cyclists while reducing the risk of bicycle/vehicle conflict.

USE

- There are two types of protected bicycle lanes
  - A one-way on-street bicycle lanes protected by a physical buffer
  - A two-way cycle track either located in the Travel Zone and protected by a physical barrier or located at curb level and set back from the roadway in the Pedestrian Zone.
- Protected bicycle lanes are the preferred bicycle facility on any corridor emphasizing bicycle use that experiences vehicle volumes in excess of 10,000 per day.
- Protected bicycle lanes are ideal for corridors with vehicle speeds higher than 35 mph, high collision rates, or high numbers of cyclists.

DESIGN

- Protected bicycle lanes shall have a minimum width of five (5) feet exclusive of the buffer for a one-directional facility and eight (8) feet minimum for a two-way facility.
- The minimum desired width of the buffer space is three (3) feet. This space can accomodate planters, raised medians, or flexible posts.
- Parked cars may be used as a barrier between the bicycle lane and travel lanes, but requires an additional three (3) foot buffer to allow for passenger loading and prevent door collisions.

OPERATIONS AND MAINTENANCE

- Bicycle facilities should be kept free of debris.
- Facilities should always be cleared following snow events, may require special equipment, and should never be used to store snow.
- Avoid locating manholes in lanes. Ensure that utility covers are flush with the lane surface.
- If colored pavement is used, maintenance plans should keep the markings clear and legible.
- Maintenance plans should prevent a significant disruption of the bicycle network when utility work requires occupying a bicycle lane.

SHARED LANE MARKINGS

Shared lane markings for bicycles, often referred to as “sharrows”, are pavement markings that indicate a lane explicitly intended to be shared by motor vehicles and bicyclists. Shared lane markings alert motorists to expect bicyclists, remind motorists of the legitimacy of bicyclists to use the roadway, and orient bicyclists to the preferred line of travel. Shared lane markings should not be considered a dedicated bicycle facility and should be used sparingly.

USE

- Shared lane markings may be used on all street types. However their use should be limited to locations where no other solution is possible.
- Shared lane markings are often used as wayfinding for bicycle boulevards, but otherwise not used on low volume local streets.
- The City limits their use of shared lane markings to situations where the street segment is a bicycle boulevard or designated trail connection; to fill gaps between bike lane sections; or to guide bicyclists through an intersection where bike lanes cannot be accommodated.
- Because bicyclists remain in mixed traffic, shared lane markings generally do little to enhance comfort for the most vulnerable or risk-intolerant bicyclists and are not appropriate on streets with high vehicle volumes and speeds.

DESIGN

- Shared lane markings are two chevron symbols positioned above a bicycle symbol. The chevrons should guide cyclists away from parked vehicles and point cyclists in the direction of travel.
- If the travel lane is adjacent to the curb, shared lane markings must be positioned in the center of the lane per State policy. If the travel lane is adjacent to a parking lane, markings are placed at least 14 feet from the curb face.
- Shared lane markings on non-local streets should be supplemented by signage.

OPERATIONS AND MAINTENANCE

- Shared lane markings require maintenance to ensure they remain highly visible.
- Placing shared lane markings toward the center of the travel lane, between the primary wheel tracks of vehicles, may reduce wear and fading.

BICYCLE BOULEVARD

Bicycle boulevards utilize local streets with less vehicle traffic to create a lower stress network for people walking and bicycling while still maintaining local vehicular access. Bicycle boulevards typically feature shared lane markings and bike route signage. These streets can also feature traffic calming design elements to slow traffic and limit cut-through traffic.

The City of Rochester completed a Bicycle Boulevard Plan in 2015 to identify parallel bicycle-friendly streets along key arterial corridors characterized by high automobile traffic volumes, high parking demand, and/or constrained rights of way.

USE

- Bicycle boulevards are typically only used on lower order streets such as Neighborhood Local or Industrial Local, although they may be applied on other streets where vehicle volumes are low and can be effectively managed.
- Bicycle boulevards typically experience traffic volumes of 1,500 vehicles per day or lower. Travel speeds should not be higher than 25 mph.
- Bicycle boulevards should be long enough to provide an attractive stretch of travel and should connect to a complete bicycle network.

DESIGN

- Bicycle boulevards typically employ a range of speed and traffic calming treatments such as chicanes, bulb-outs, diverters, and others.
- Clear signage and directional pavement markings are encouraged as bicycle boulevard corridors may follow somewhat indirect routes.
- Bicycle boulevards are sometimes referred to as neighborhood greenways as they represent opportunities to integrate green infrastructure into traffic speed and volume management.
- Traffic signals may be considered where bicycle boulevards cross high vehicular volume streets.

OPERATIONS AND MAINTENANCE

- Traffic conditions should be monitored before and after implementation. If conditions do not meet desired targets, additional management treatments should be implemented.
- Local streets that are designated bicycle boulevards should receive higher priority street maintenance services throughout the year.

DRAFT
TRAVEL ZONE

SHARED STREET

Depending on a street's volume and role in the traffic network, it has the potential to be redesigned and enhanced as a shared street. Shared streets can meet the desires of adjacent land uses while functioning as public space. Low speed vehicle access is maintained while permitting loading activity at designated hours. Shared streets are designed to slow traffic speeds using pedestrian volumes, design elements, and other implicit cues to slow or divert traffic.

USE

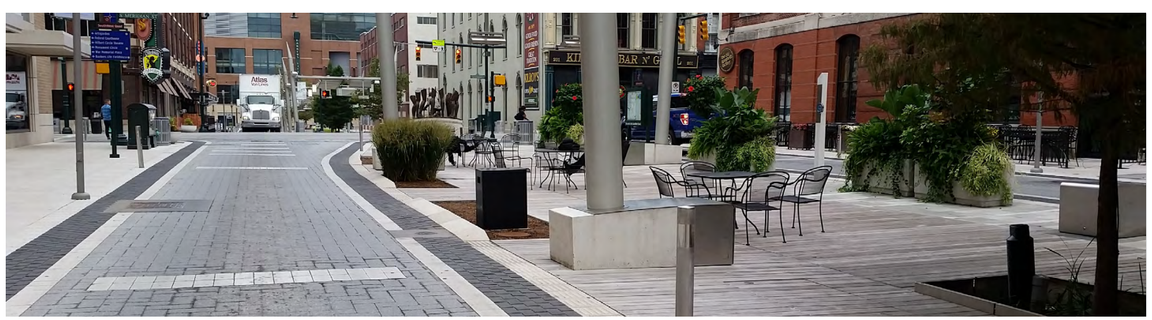
- Shared streets may be appropriate for business streets where sidewalk congestion forces pedestrians to walk in the street.
- They may also be appropriate where delivery vehicles obstruct non-motorized traffic, forcing pedestrians and cyclists to mix with motorists.
- Shared streets are generally not appropriate for streets that emphasize transit activity.

DESIGN

- Textured pavements that are flush with the curb reinforce the shared operation of the street and delineate a non-linear or narrow path of travel.
- Depending on the overall street width, designers may consider providing a clear path protected from traffic. Street furniture may be placed to provide definition for a pedestrian-only area.
- Commercial shared streets should be accessible by single-unit delivery trucks where necessary. Where alleys do not exist, shared streets may be designed to accommodate large trucks. Loading zones may be defined through pavement patterns, striping, and/or signage.
- Shared street space should be designed to facilitiate snow removal as well as drainage. Drainage channels should be provided either at the center of the street or along the flush curb and are often used to differentiate the shared area from the clear path.

OPERATIONS AND MAINTENANCE

- Special pavements may be subject to additional maintenance costs and should be selected based on long-term durability. Materials should be compatible with snow removal equipment.
- Prior to the permanent application of a shared street, car-free hours or temporary materials may be used to test a conversion and evaluate the potential impact on traffic operations.



INTERSECTION DESIGN

Intersections are where different users and uses of the street combine and intersect. Intersections can be the most challenging street element to design as they are the location of a majority of conflicts and crashes. Therefore, a focus on quality design is important to ensure the safety of all users. Just as street segments can be designed to be self-regulating, designers should strive to make complex movements at intersections safe, self-evident, and predictable to all users.

Intersections should be designed as a component of a corridor and the larger street network. Trade-offs can often be made between design decisions at one intersection and the impact on the network in terms of traffic volume and capacity. For example, a traffic signalization project can increase vehicle throughput and reduce delay at an intersection, but benefits will be greater if signals are coordinated along a corridor.

Intersections can range from simple crossings that are relatively straightforward to complex junctions that require careful planning and design. Regardless of the level of complexity, intersections should be designed to be as compact as possible, minimizing crossing distances, complexity, and delay for all modes. Wherever possible, dedicated turn lanes should be limited in order to improve pedestrian and bicycle safety.

Intersection design configurations should reflect the surrounding land uses and built environment. Designs should convert skewed intersections to right angles and reallocate unnecessary lanes to public space. Designers should align lanes so that the number of approach and departure lanes are equal at intersections and limit opportunities for people traveling through intersections to make unexpected or sudden movements.

CROSSWALK

Crosswalks are critical components of the street that facilitate a connected and continuous pedestrian network. Crosswalks are marked facilities that carry pedestrians across vehicular and bicycle travel ways.

USE

- Marked crosswalks should be provided at all signalized intersections and near schools, parks, community facilities, or other pedestrian generators.
- Marked crosswalks may be located at unsignalized crossings (e.g. stop controlled, uncontrolled, or roundabout) at intersections or mid-block.

DESIGN

- Crosswalks should be as wide as the sidewalks they connect; at least five (5) feet wide while eght (8) feet or wider is preferred in areas of higher foot traffic.
- Crosswalks should encompass the desired line of travel observed at a particular location. Sidewalk ramps should be provided to serve all marked crosswalks.
- Crosswalk markings shall be clear and legible.
- High visibility markings, such as the City's Ladder Bar Type L design, are advised in areas of high pedestrian volume or where more vulnerable users are concentrated.
- Crossings should be optimally aligned and as short as possible to minimize exposure time/risk.
- Designers should avoid the use of crosswalk segments longer than the width of four (4) travel lanes. For longer crossings, consider the use of pedestrian refuge islands.
- Crosswalk surface may be asphalt, concrete or non-slip pavers providing a level surface, but should also minimize vibrations for persons using wheeled moblity aids.

OPERATIONS AND MAINTENANCE

- Crosswalk markings should be installed in a slightly staggered pattern to avoid the typical vehicle wheel track and minimize maintenance requirements. Markings may also be inset into the pavement to prevent snow plow damage.
- Visibility of crosswalks is essential. Crosswalk markings should be refreshed at regular intervals.
- Crosswalks must be cleared of snow and ice and remain visible even in wintery conditions. Crosswalks must not be blocked by snow, ice, or pools of water, especially near sidewalk ramps.

SIDEWALK RAMP

Sidewalk ramps are short ramps cutting through a curb or built up to it that provide the transition from the sidewalk to the street, most often located at intersections. Sidewalk ramps are essential in providing mobility to persons with disabilities. They also contribute to overall utility and livability for a wide range of users, including people pushing or pulling strollers, delivery carts, luggage, or utility carts as well as people walking with a cane, crutches, or a bicycle.

USE

- Per ADA Title II, newly constructed or altered street level pedestrian walkways must contain curb ramps or other sloped areas to street level at any intersection having curbs or other barriers.
- Sidewalk ramps are used with both sidewalks and shared use paths.
- Sidewalk ramps may be used to provide access to accessible curbside parking spaces or passenger loading areas.
- Temporary sidewalk ramps should be provided when a pedestrian detour is needed to maintain access during sidewalk closures.

DESIGN

- Ramp dimensions should comply with PROWAG R304.2 and R304.5, a minimum of four (4) feet wide, though six (6) feet is preferred. Areas with high concentrations of pedestrian traffic may require wider sidewalk ramp openings.
- Sidewalk ramps should be oriented perpendicular to the natural curb line and oriented to the desired line of travel. Separate ramps should be provided for each crossing wherever feasible.
- Detectable warning strips that contrast with the surrounding pavement are required.

OPERATIONS AND MAINTENANCE

- As part of the sidewalk, adjacent property owners are responsible for snow clearance from sidewalk ramps. All parts of the path must be cleared, particularly after a snowplow has cleared the street.
- Detectable warning strips are particularly vulnerable to damage from snow removal operations. FHWA guidance recommends complete replacement of damaged curb ramp elements as a long term repair solution.

PEDESTRIAN SIGNAL

Pedestrian signals, like vehicle signals, inform pedestrians when it is appropriate to cross the street and when to stop and wait. Pedestrian signals consist of a white WALK symbol, a flashing and/or steady DON'T WALK symbol, and a countdown timer.

Basic pedestrian signals may be enhanced with audible signals. Pedestrian countdowns provide visual information on the time remaining in a pedestrian cycle. Accessible pedestrian signals are an integrated device that communicate cycle information to pedestrians with visual impairments.

MUTCD permits pedestrian signals to operate on fixed timing or actuation. Pre-timed signals provide a pedestrian walk phase for each leg of an intersection during every cycle, regardless of whether pedestrians are present. Actuated signals provide a walk phase only when pedestrians make a request.

USE

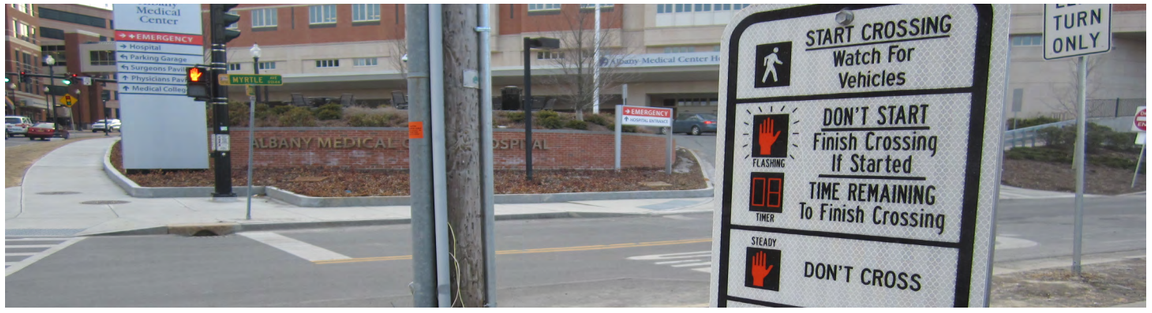
- Pedestrian signals should be installed at all signalized intersections with crosswalks.
- Fixed-time signals should be used where high pedestrian activity is expected on all crosswalks to ensure adequate crossing time. At intersections that experience less foot traffic, actuated signals are more appropriate.

DESIGN

- Provision of pedestrian countdown information is desired at all intersections with pedestrian signals. If the pedestrian crossing width exceeds 90 feet, increase the height of the numerical display to ensure visibility and legibility.
- Pedestrian crossing time that meets the MUTCD standard is dependent on the crossing distance. Crossing distances, and therefore required crossing times, may be reduced through the use of bump outs.
- Signal actuators should be located adjacent to the landing of the desired crossing with a maximum reach of 18" to the signal push button.

OPERATIONS AND MAINTENANCE

- Snow clearance at curb ramps and sidewalks must provide clear access to push buttons.
- Adequacy of pedestrian crossing time should be routinely monitored and adjusted.



PEDESTRIAN REFUGE

Pedestrian refuge islands are raised or curbed sections within the roadway that provide a landing zone for pedestrians to use while crossing a street with multiple travel lanes. Refuge islands decrease pedestrian risk by breaking up longer crossings into two or more stages. Because the pedestrian is crossing fewer lanes of traffic per stage, pedestrians are more easily able to find time to cross at unsignalized crossings. Refuge islands can also function as traffic calming devices and opportunities to apply green infrastructure.

USE

- Pedestrian refuge islands are most often used on multilane roadways where a pedestrian must cross four (4) or more consecutive travel lanes.
- Pedestrian refuge islands may also be used as a traffic calming or traffic channelization device in concert with roundabouts or shallow right turns.

DESIGN

- Refuge islands should connect to sidewalks via marked crosswalks. The crosswalk should continue at street grade through the island, employing detectable warnings, such as raised bumps, while within the island.
- Refuge islands should be 10 feet wide in order to accommodate pedestrians with strollers, mobility assistance devices, or bicycles.
- Landscaped medians can be designed for stormwater bio-retention. Larger medians can include street trees and native plantings.
- Landscaping on pedestrian refuge islands must comply with MUTCD standards so as not to impede sightlines and visibility.

OPERATIONS AND MAINTENANCE

- Refuge islands may introduce additional costs to street repaving. Landscaped pedestrian refuge islands will require regular landscape maintenance and may need irrigation.
- Pedestrian refuge islands should accommodate the width and turn radii of snow clearance equipment and emergency response vehicles.
- Pedestrian refuge islands should not generally be used for snow storage. They should be regularly cleared of snow and debris.
- Walking surfaces should be designed to avoid the pooling and icing of water while wide enough to allow for snow removal equipment.

ROUNDABOUT

Roundabouts are a circular intersection control where the turning movements are physically separated by a central island, and traffic moves circularly around the island. Vehicles leave the intersection by turning right at the appropriate leg.

According to the AASHTO Highway Safety Manual, roundabouts have been proven safer than stop-controlled and signalized intersections. They enable continuous movement through the intersection when conflicting traffic is not present, but implementation is a challenge in urban environments due to space requirements.

USE

- New York State requires the evaluation of a roundabout before considering a traffic signal.
- Roundabouts can be designed to handle a range of vehicle volumes and can be applied to single-lane (preferred) or double-lane roadways.

DESIGN

- A mountable curb apron should be provided at roundabouts where large trucks or emergency vehicles require access in constrained spaces.
- Crosswalks should be marked and set back at least 20 feet from the entry of the roundabout.
- Sight distance for drivers entering the roundabout should be maintained to the left so that drivers are aware of vehicles and bicycles in the circle as well as to the right when exiting the roundabout through pedestrian crossings.
- Splitter islands are medians or pedestrian refuge islands that allow pedestrians to cross one direction of traffic at a time, and also guide traffic into and out of the roundabout.
- If a bicycle facility is present on an approach, the roundabout can have bicycle take-off and re-entry ramps to allow cyclists to either merge with traffic or move onto the sidewalk.

OPERATIONS AND MAINTENANCE

- Roundabouts should allow adequate width in the travel lane as well as a turn radius that accommodates snow removal vehicles.
- Roundabouts can be used for snow storage when necessary, although this may negatively impact planted materials and can block sight lines along the roadway.
- Pedestrian refuge islands at roundabouts require sweeping and snow removal.

BIKE BOX

A bike box is a dedicated area for cyclists at the front of a traffic lane at signalized intersections. Bike boxes make cyclists more visible to motorists by positioning them at the head of a queue during a stop cycle. They provide a space for cyclists to queue that does not conflict with crosswalks. Bike boxes also enable cyclists to safely position for a left turn during a stop cycle at an intersection. On corridors of high bicycle activity, bike boxes enable cyclists to progress forward at the onset of the green signal cycle, reducing conflicts with right turning vehicles.

USE

- Bike boxes are used only at signalized intersections.
- Bike boxes are most beneficial on streets with high bicycle traffic volumes, locations with significant left turn bicycle activity, and/or intersections where conflicts between bicycle and right turning vehicles are common.
- Bike boxes may also be desirable in high pedestrian use areas to protect crosswalks from encroachment by bicycles or vehicles.

DESIGN

- The bike box is formed by two parallel pavement marking lines at least six inches wide forming a box at least 10 feet or more in depth and extending from the outside of the bicycle lane across all travel lanes in the direction of travel.
- Bike boxes are located between the crosswalk and the vehicle stop bar.
- The vehicle stop bar shall be moved behind the bike box at least 2 feet to prevent motor vehicle encroachment into the bike box.
- Bike boxes shall be separate and distinct from the crosswalk and may be moved further back from the crosswalk to prevent bicyclists from blocking the crosswalk.
- Right turn on red restrictions must be employed to avoid conflicts with queued cyclists.

OPERATIONS AND MAINTENANCE

- Education and enforcement may be needed to ensure all users are aware of and comfortable using bike boxes.
- Bike boxes are additional pavement markings that will require maintenance.

TWO-STAGE TURN QUEUE

A two-stage turn queue provides a less stressful left-turn option for cyclists via a queue box or protected area where cyclists may move out of the through traffic lane on the right hand side of a street and wait for the green cycle of the intersecting road before completing the turn. The two separate stages for a bicyclist to complete a left turn increases travel time for bicyclists, although the benefit of comfort may outweigh the time penalty.

USE

- Two-stage turn queue boxes are generally used in conjunction with other bicycle facilities, such as bicycle lanes or protected bicycle lanes, but may be used on any corridor where safe and comfortable accommodation of left-turning bicycles is needed.
- Two-stage turn queue boxes are especially appropriate where there are significant volumes of turning cyclists along preferred travel routes and/or where accommodating less confident cyclists is necessary.
- Two-stage turn queue boxes are particularly beneficial on streets with more than one travel lane in any one direction including turn lanes.

DESIGN

- A two-stage turn queue shall consist of a first stage bicycle facility, usually a bicycle lane, and a second stage green painted queue box that accommodates the cyclist waiting for the signal prior to completing the turn. Appropriate signage per the MUTCD should also be posted.
- The two-stage turn queue box shall be at least 10 feet wide by 4 feet deep but may be made larger based on expected cyclist volume.
- The turn queue box for the second stage shall be in a location aligned with the rightmost travel lane or bicycle facility of the receiving street.
- Two-stage turn queue boxes should not be placed adjacent to transit stops to avoid conflict between transit passengers and cyclists.

OPERATIONS AND MAINTENANCE

- Two-stage turn queues require additional pavement markings and may add additional maintenance complexity (e.g. green markings).
- Placing markings between vehicle tire tracks may reduce wear and tear.
- Two-stage turn queues should be cleared of snow concurrent with other street snow removal.

TRAFFIC CALMING

Traffic calming refers to geometric strategies to reduce the volume or speed of vehicles traveling on a street. Traffic calming design elements can be implemented as part of street re-design projects as a component of a self-regulating design, or alongside other design features that also reduce speeds, such as street trees, pedestrian lighting, and landscaping.

Traffic calming measures may be used to retrofit existing streets experiencing volumes or speeds that are not in line with the form and function of the street network. In this way, they may function as pilot projects that demonstrate a proof of concept and educate drivers and the public on how the street could function with reduced vehicle speeds or traffic volumes. If the results are favorable, a future project could provide more permanent and integrated design solutions.

Traffic calming should be evaluated and possibly implemented on a neighborhood or scale as volume or speed changes on one street segment may adversely impact the surrounding streets. Traffic calming installations should not divert traffic to other Neighborhood Local streets, but may divert vehicles to higher order streets (Regional Activity, Downtown Activity, Neighborhood Activity, Neighborhood Link, and Industrial Link). The potential impacts of diverted traffic should be evaluated for all traffic calming projects.

With all traffic calming devices, accommodation of emergency response vehicles, snow plows, and garbage trucks should be a consideration. Delays to emergency response vehicles should be minimized by the appropriate placement and design of traffic calming devices. In some cases, certain traffic calming devices may not be appropriate. For example, vertical traffic calming devices should not be used on primary emergency response routes or on corridors where freight or transit are emphasized.

HORIZONTAL CONTROL

Horizontal speed controls reduce traffic speeds and reinforce safe, pedestrian-friendly neighborhood streets by forcing drivers around horizontal curves and blocking long views of the road ahead through horizontal shifts. Horizontal deflections include chicanes, bulb-outs, and center islands.

USE

- Bulb-outs narrow the street mid-block by expanding the sidewalk or planting strip.
- Bump outs are bulb-outs at intersections that reduce pedestrian crossing distance, increase visibility, and lower turning speeds.
- Chicanes are bulb-outs that alternate from one side of the street to the other. Vehicles slow their speeds to pass through the series of curves.
- Center islands are a small median or island located at the centerline of a street that causes traffic to shift its path to the right.
- Horizontal speed control elements should be applied on lower order streets, primarily Neighborhood Local streets, where traffic volumes are higher than desired and are frequently used as cut-through routes.

DESIGN

- Horizontal elements should not be used where cyclists would be forced into the traffic flow.
- Shifts in chicane alignment should be at least one lane in width with deflection angles of at least 45 degrees, and include center islands to prevent drivers from following a straight path.
- Center islands may be located at the approach to an intersection or midblock.
- Lateral shifts are one of the few calming measures that can be used on higher order streets, such as Neighborhood Link, where higher volumes preclude other calming measures.

OPERATIONS AND MAINTENANCE

- Monitor the impact of traffic calming treatments at the network or neighborhood level prior to and after installation.
- Horizontal control measures that result in added bulb-outs will require additional maintenance of trees, street furniture, or landscaping.
- Designs should consider snow removal operations. Visual cues should alert snow plow operators of the change in the roadway.
- Bulb-outs may offer snow storage space.

ROAD DIET

A street striping modification—sometimes called a road diet—is a change in roadway striping that typically reduces the number of motor vehicle travel lanes. This strategy can be applied broadly to a wide variety of street types where one or more travel lanes are repurposed in order to discourage speeding, improve sight distances for left-turning vehicles, and/or allocate space for other facilities (e.g. bicycle lanes, bus bulbs, curbside parking).

USE

- The most common configuration involves converting a four-lane road to two travel lanes and a center turning lane.
- Four lane streets with traffic volumes less than 15,000 vehicles per day are generally good candidates for four to three lane conversions. Directional volumes are also a consideration.
- A four lane street with volumes between 15,000 and 20,000 vehicles per day may also be a good conversion candidate. A traffic analysis examining speed, volume, and types of traffic is needed to determine feasibility.
- As left-turning vehicles are moved into a common lane, and delays between vehicles and bicycles are minimized, four to three lane conversions typically have minimal effects on the vehicular capacity of the roadway.

DESIGN

- Center turn lane minimum width is 10 feet.
- If considered during reconstruction, raised medians may be incorporated in between intersections to provide improved pedestrian crossings, incorporate landscape elements, and reduce travel speeds. Bump outs may also be added if reconstruction work is involved.
- The space gained for a center turn lane is often supplemented with painted, textured, or raised medians, with opportunities for green infrastructure such as bioswales.

OPERATIONS AND MAINTENANCE

- The design of street reconfigurations should consider signal placement and alignment, signal timing, intersection capacity, and turn movements with traffic shifts at major intersections
- Intersection design and operation should be monitored to determine project results.

VERTICAL CONTROL

Vertical controls reduce traffic speeds, may assist in managing volume, and reinforce pedestrian-friendly streets by using raised roadway features. Speed humps, speed tables, and rasied crosswalks are common vertical speed control measures.

USE

- Vertical control measures may be a temporary or short-term method for reducing speeds. Over the longer term, self-regulating designs are more desirable to manage traffic. Vertical measures are not required for any street typology.
- Speed humps are parabolic vertical traffic calming devices intended to slow traffic speeds.
- Speed tables are midblock traffic calming devices that raise the entire wheelbase of a vehicle to reduce its traffic speed.
- Raised crosswalks elevate the crosswalk above street level, improving pedestrian visibility.
- Vertical speed control elements are most appropriate on lower order streets where vehicle volumes are higher than desired and that are frequently used by cut-through traffic.
- Vertical control measures can be installed on a pilot basis to assess potential impacts.

DESIGN

- All vertical controls should be accompanied by signage and pavement markings warning drivers of the upcoming control device.
- Speed humps are three to four inches high and 12–14 feet wide, with a ramp length of three to six feet, depending on target speed.
- Speed tables are flat-topped, with a height of 3-3.5 inches and a length of 22 feet.
- Vertical elements should not be placed in front of driveways or other significant access areas.
- Designs should ensure proper drainage and should permit snow removal and accommodate street sweeping vehicles while not damaging the vertical speed control elements.

OPERATIONS AND MAINTENANCE

- Vertical speed control elements shall be accompanied by signage and pavement markings warning approaching drivers.
- Monitor the impact of traffic calming treatments at the network and neighborhood level prior to and after installation.
- Snow plow operators should be adequately warned and trained.

RAISED INTERSECTION

Raised intersections create a slow speed crossing at low volume intersections. They are created by raising the level of the roadway to the same level as the sidewalk. Raised intersections are a similar concept to speed tables but are applied to the entire intersection.

USE

- Raised intersections are appropriate in areas of high pedestrian demand, in school zones, and locations where pedestrian visibility and motorist yielding have been identified as concerns
- Raised intersections can be used as a gateway treatment that signals to drivers a transition to a slower speed environment.
- Raised intersections are generally not used in areas with high traffic volumes, along major transit or emergency services routes, and multilane streets.

DESIGN

- Care should be taken to maintain direct routes across intersections aligning pedestrian desire lines on either side of the sidewalk.
- Signage to indicate the raised intersection to drivers must be provided.
- Raised crossings and intersections also require detectable warnings at the curb line for persons with visual disabilities.
- Design speeds, transit routes, and emergency vehicle routes must be considered when designing approach ramps.
- High-visibility or textured paving materials can be used to enhance the contrast between the raised crossing or intersection and the surrounding roadway.
- Designs should ensure proper drainage. Raised intersections can simplify drainage inlet placement by directing water away from the intersection. If the intersecting streets are sloped, catch basins should be placed on the high side of the intersection at the base of the ramp.

OPERATIONS AND MAINTENANCE

- Installation of raised crossings and intersections may affect snow removal operations. Snow plow operators should be adequately warned and trained.

VOLUME CONTROL

While most traffic calming approaches have some effect on both volume and speed, some measures are primarily targeted at discouraging or eliminating opportunities for vehicles to pass through certain streets. Volume control devices can include full and half street closures, diverters, median barriers, and forced turn islands. They are generally more permanent traffic calming solutions and must be implemented as part of a network solution as the diverted traffic will likely be relocated to nearby streets.

USE

- Volume control elements are best suited to long, straight streets that experience higher than desired traffic volumes.
- Semi-diverters prevent vehicles from crossing an intersection in one direction while permitting traffic in the opposite direction to pass through.
- A somewhat less common volume control measure, diagonal diverters are barriers installed across an intersection blocking through movement. Like half closures, diagonal diverters are usually staggered to create circuitous routes through neighborhoods.
- Volume control elements limit connectivity and the functionality of the street grid.
- Volume control elements should only be applied to lower order streets and are inappropriate for use on emergency response routes, bus routes, or higher order typologies.

DESIGN

- Semi-diverters should be located at the end of a block to prevent vehicles from entering but allow exits.
- Volume control elements may divert traffic to other low-volume streets.
- Provisions should be made for the continuation of pedestrian and bicycle routing through or around volume control diversions.

OPERATIONS AND MAINTENANCE

- Operation of the street network should be monitored to ensure that traffic is diverted to higher level streets as intended.
- Designs may require modification to increase compliance. Drivers may be less likely to drive around diverters or barriers if they are extended or angled for right turns out of the neighborhood.

MINI ROUNDABOUT

Mini roundabouts are circular islands located at the center of intersections. They can be installed using simple raised islands, but also provide great opportunities to include stormwater management facilities, art and/or landscaping. Mini roundabouts can be used at existing intersections to replace two-way stop control, all-way stop control, or a traffic signal. Mini roundabouts can improve the operation of an intersection by reducing the dominance of the traffic flow from one direction over others, facilitating access and reducing delay to minor street movements, and improving overall intersection capacity.

USE

- Mini roundabouts should only be considered in space constrained intersections with low desired approach speeds.
- Mini roundabouts offer a low-speed, low-noise intersection option for residential environments.
- A mini roundabout can be an ideal application to reduce delay at stop-controlled intersections that do not meet signal warrants.

DESIGN

- The location of the central island should allow for all movements to be accommodated at the intersection with counterclockwise circulation.
- Designing the central island size and location to provide deflection through the roundabout will encourage proper circulation and reduced speeds through the intersection.
- Shared-lane markings or intersection crossing markings should guide bicyclists through the intersection.
- Where a bicycle boulevard turns at a minor intersection, use bicycle wayfinding route markings and reinforce route direction using shared-lane markings.

OPERATIONS AND MAINTENANCE

- Shrubs or trees in the roundabout further the traffic calming effect and beautify the street, but need to be properly maintained so they do not hinder visibility.

MID-BLOCK CROSSING

Midblock crossings are crossings that occur between intersections, facilitating crossings to desired pedestrian destinations that are not well served by the existing network.

USE

- Install where there is a significant pedestrian desire line. Frequent applications include midblock bus stops, transit stations, parks, building entrances, and midblock passageways.
- Midblock crossings should not be used when within 400 feet of a crosswalk at an intersection.

DESIGN

- High visibility crosswalk markings are advised at high volume pedestrian locations, areas of heightened safety concern, or areas with concentrations of more vulnerable pedestrians.
- Advance yield markings at midblock crossings should be set back 20–50 feet to ensure that a person crossing the street is visible to a second driver when the first driver is yielding.
- Continuous crossings in excess of four (4) consecutive travel lanes should be avoided. For longer crossings, consider the use of pedestrian refuge islands.
- Midblock crossings at uncontrolled locations may require special design attention, such as pedestrian crossing signs, and/or parking restrictions to ensure visibility of pedestrians about to enter the crosswalk.
- Raised crosswalks may be used where vehicle volumes and speeds are generally low. Raised crosswalks elevate the crosswalk above the typical grade of the street, improving visibility.
- Midblock crossings where trails cross the roadway, such as within parks, may require further enhancements such as raised crosswalks, rapid flashing beacons, or bump outs.
- Enhanced pedestrian treatments, such as actuated beacons, should be considered only after more traditional treatments are used.

OPERATIONS AND MAINTENANCE

- Crosswalk markings may be installed in a slightly staggered pattern, or inset into the pavement, to avoid the typical wheel track and/or damage from snow plows.
- Visibility of crosswalks is essential. Crosswalk markings should be refreshed at regular intervals. After street repaving, crosswalks should be remarked as soon as possible.

PEDESTRIAN YIELD CONTROL

Stop and yield control devices can make it easier for pedestrians and motorists to see one another, discouraging encroachment on the crosswalk, and preventing multiple-threat collisions. Multiple-threat collisions occur when there are multiple lanes of travel in the same direction and the vehicle in the near lane yields while the vehicle in the far lane does not yield because the pedestrian is blocked from view.

USE

- Advanced Yield Markings are coordinated signage used at uncontrolled mid-block locations and intersections to encourage drivers to stop further back from crosswalks.
- In-street YIELD TO PEDESTRIAN signs are placed in the roadway at uncontrolled crosswalk locations to remind drivers of the pedestrian right-of-way.
- Rectangular Rapid-Flash Beacons (RRFB) are pedestrian crossing signs combined with an intensely flashing beacon that is only activated by a pedestrian call button.
- Pedestrian Hybrid Beacons (PRB) are often used at midblock crossings to increase driver awareness of pedestrians. A red PRB beacon is illuminated when activated by a pedestrian.

DESIGN

- Advance yield markings and signs shall be placed 20 feet to 50 feet in advance of crosswalks on uncontrolled approaches, and parking should be prohibited in the area between the yield markings and the crosswalk.
- In-street signs should be placed in the roadway close to the crosswalk location on the center line, on a lane line, or on a median island. They should not obstruct the crosswalk.
- In-street signs should be designed to bend over and bounce back when struck.
- RRFBs should be installed on both sides of the roadway at the edge of the crosswalk; placed curbside below the pedestrian crossing sign and above the arrow indication.

OPERATIONS AND MAINTENANCE

- In-street yield signs may be permanent or temporary. They should be removed during winter to facilitate snow removal operations.
- In-street signs require regular monitoring and should be replaced when damaged.

GREEN INFRASTRUCTURE

Per the City of Rochester & Monroe County Green Infrastructure Retrofit Manual, Green infrastructure is a design strategy that applies a natural systems approach to managing stormwater and creating healthier, more sustainable environments. Rochester's green infrastructure includes green spaces and the links between them, such as community gardens, streetscapes, sidewalks, and trail areas.

Street designers must balance the needs of competing road users when designing within limited street right-of-way. They must carefully consider how best to incorporate green infrastructure elements. In many cases, green infrastructure elements can be incorporated into other street elements, such as medians or bulb-outs.

The objectives of green infrastructure in design are to:

- Reduce stormwater run-off that would normally flow directly into the sewer system.
- Improve water quality by filtering pollutants.
- Slow stormwater run-off velocity.
- Reduce local flooding and ponding.
- Provide a "traffic calming" element and pedestrian safety.

Text for these design elements was adapted from the Green Infrastructure Guidance Manual, prepared originally for the City of Grand Rapids by TetraTech and modified for the Grand Rapids Vital Streets Plan. For more complete information on green infrastructure designs and considerations, including typical plans, profiles, and sections for various elements, refer to the City of Rochester & Monroe County Green Infrastructure Retrofit Manual.

BIORETENTION

Bump outs can be designed as a space to manage stormwater through bioretention. When designed with an opening in the curb they can catch stormwater as it flows down the curb and/or collect water from adjacent sidewalks. Collected water is then trapped in a low planting area and is dispersed either through plant uptake or ground infiltration. The soil and other features help to filter pollutants from the water.

USE

- Use at intersections where bump outs are possible, including mid-block crossing locations.
- Use in locations where stormwater flows along the curb line, especially where there is a slight slope for direction into the bioretention area.
- Use in locations where stormwater overflows can be directed or connected to an appropriate outlet structure prevent localized flooding.

DESIGN

- Do not locate in places that impede necessary pedestrian movement, such as crosswalks, sidewalks, or access to street furnishings.
- Coordinate placement with bicycle lanes or routes to ensure the safe passage of bicycles.
- Avoid use in areas with less than 2 feet to the water table or bedrock and in areas of known soil/groundwater contamination.
- Bump out bioretention facilities should be designed to work with other green infrastructure practices to manage stormwater volumes.
- A stone reservoir area should be installed below the planting soil.
- The surface area should generally be between four and seven percent of the tributary area.
- In general, bump out bioretention areas narrower than 3-feet should be avoided.
- Infiltration planters should be curbed when adjacent to sidewalks or street furnishings.

OPERATIONS AND MAINTENANCE

- Clean inlets, outlets, and overflows.
- Remove weeds during the establishment period. Add mulch when needed.
- Use low-profile native plants for reduced maintenance and unimpeded line-of-sight.
- On slopes, check dams as needed to provide stepped, flat bottoms in the bioretention area.

MEDIAN BIOSWALE

Linear bioretention facilities are located between the curb/gutter or shoulder of the road and sidewalk. They can be designed with curb-cut opening that allows stormwater to enter the linear bioretention facility from the gutters or with a grass filter strip with roads without curbs. The stormwater runoff is then captured in a depressed planting area and then either infiltrates into the soil or flows through an underdrain to the storm drain network.

USE

- Median bioswales are designed and function in much the same way as those found at bump outs, but are located in the center portion of the roadway between the travel lanes.
- Use in locations where stormwater flows along curb line or where runoff flows from adjacent paved areas.
- Use in locations where overflow water can be directed or connected to an outlet point.
- Use in locations where the green space between the curb and sidewalk is at least 6 feet wide and not dominated by other public uses.

DESIGN

- Do not locate in places that impede pedestrian movement, such as crosswalks, sidewalks, or access to parking meters or street furnishings.
- Coordinate placement with bicycle lanes or routes to ensure the safe passage of bicycles adjacent to the curb line.
- The total surface area of the linear bioretention should be one percent of the drainage area.
- A stone reservoir area should be installed below the planting soil.
- Avoid conflicts with fire hydrants and other above ground utilities or underground utilities.
- Meet requirements for emergency vehicle access along the roadway.

OPERATIONS AND MAINTENANCE

- Clean inlets, outlets, and overflows.
- Remove weeds during the establishment period. Add mulch when needed.
- Use low-profile native plants for reduced maintenance and unimpeded line-of-sight.
- On slopes, check dams as needed to provide stepped, flat bottoms in the bioretention area.

STORMWATER PLANTER

A stormwater planter is a vegetated green infrastructure practice relying on specified soils and vegetation to treat and absorb stormwater. It is different from other vegetated best management practices as it typically has concrete vertical side walls allowing it to be incorporated into congested street corridors or attached to the perimeter of a building.

USE

- Most appropriate in locations where stormwater flows along a curb line and can be directed into the Stormwater Planter and/or where stormwater overflows can be directed or connected to an appropriate outlet structure.
- Can also be used adjacent to or in close proximity to a building to collect downspout discharge water.

DESIGN

- The surface area should be about 5 to 7 percent of the drainage area.
- Provide a stone reservoir area below the planting soil and separated by a geotextile fabric to provide maximal storage volume.
- Design the storage layer to drain within 24 to 48 hours by an underdrain or infiltration.
- Do not locate a stormwater planter downstream of sediment sources.
- Avoid installation where the water table is less than 2 feet below the storage layer.
- Where water is directed to the Stormwater Planter from adjacent sidewalk or pedestrian areas, provide breaks in the wall and/or metal inlet structures to allow water to pass through.
- Provide a perforated underdrain pipe that takes excess water to the storm sewer system. Keep the elevation of the top of the overflow lower than the adjacent sidewalk or road.
- Use deep-rooted native plants for reduced future maintenance.
- Ensure that ADA access is maintained if taking up sidewalk space.

OPERATIONS AND MAINTENANCE

- Clear debris from inlets and overflow grates.
- Remove accumulated sediment.
- Remove weeds during plant establishment and annually thereafter.
- Remove trash and debris weekly.

LEACHING BASIN

Leaching or inilitration basins collect roadway runoff and provide the opportunity for stormwater to infiltrate in lieu of an outlet to a storm sewer pipe. There are several types of leaching or infiltration basins, including basins that contain a porous bottom consisting of loose aggregate. This type of basin allows water to infiltrate into the ground underneath the basin. Another type of basin contains both a leaching bottom and orifice holes punched along the vertical walls of the catch basin to provide additional infiltration capacity.

USE

- Unless there is a technical or environmental concern, leaching basins should be used in place of standard catch basins where soils are well drained.
- Leaching catch basins are preferred in locations at the upstream points along a stormwater drainage system where volumes are smaller.
- Best suited at locations with no inlet pipes, i.e., offline with only an inlet grate.
- Not recommended where sediment loading is likely to result in clogging of infiltration surface.
- Leaching basins can be integrated with linear infiltration trenches and/or porous pavements.

DESIGN

- Soil infiltration and depth to ground water must be investigated to determine the feasibility of a leaching basin in a particular location.
- Use a pre-cast concrete basin structure with a deep sump, typically up to 10-feet deep and 3-feet in diameter, with 1" diameter perforations.
- The basin structure should be surrounded by 2-foot thick layer of coarse aggregate to function as a stone reservoir.
- Provide a minimum 3-foot separation between bottom of basin and the high groundwater level.
- Use an inlet grate structure that is bike-friendly.

OPERATIONS AND MAINTENANCE

- Inspect at least once every four years.
- Avoid compaction of soils in leaching basin infiltration area.
- Clean leaching basin grates where water enters the structure as needed.
- Remove accumulated debris in the sump to ensure drainage through structure.

POROUS PAVEMENT

Flexible porous pavement allows stormwater to pass through the pavement to a stone storage layer. The water then either infiltrates into the soil or flows through an underdrain to the storm drain network. There are a variety of flexible porous pavements including concrete pavers, paving grids, pervious concrete, porous asphalt, porous rubberized asphalt, and glass porous paving.

USE

- Roadway parking lanes.
- Low-volume roads, alleys and protected bicycle facilities.
- Plazas, paths, sidewalks, and tree pits.
- In areas where impervious space is highly utilized and paved space cannot be spared for vegetated green infrastructure practices.

DESIGN

- Design the system so that the storage layer drains within 24 to 48 hours.
- Ensure that the drainage area has no significant sediment sources that will clog pavement.
- Coordinate review by an arborist or forester for impacts to nearby trees.
- To reduce the amount of sediment that collects on the flexible porous pavement, the area that drains to the flexible porous pavement should be largely impervious.
- Cost of flexible porous pavement tends to be higher than traditional pavement. Costs vary with location and contractor familiarity of the installation.

OPERATIONS AND MAINTENANCE

- Allow porous concrete to cure for a minimum of three months before applying salt.
- Remove sediment and particulates from porous pavement void spaces with a high efficiency vacuum sweeper at least twice per year.
- Pressure washing porous pavement is not recommended; particulate can further embed.
- Stone between pavers will need to be replaced after vacuuming as needed.
- Use of sand and fine aggregate for winter road conditions should not be used.
- Use of porous pavements can provide cost savings by reducing the amount of other storm treatment systems required.

Source: Philadelphia Water Department (CC BY 2.0)

APPENDIX

Street Typology Assignment Maps

- Center City Zoom
- Regional Activity
- Downtown Activity
- Downtown Link
- Neighborhood Activity
- Neighborhood Link
- Neighborhood Local
- Industrial Link
- Industrial Local
- Alley

STREET TYPOLOGY ASSIGNMENT

CENTER CITY ZOOM

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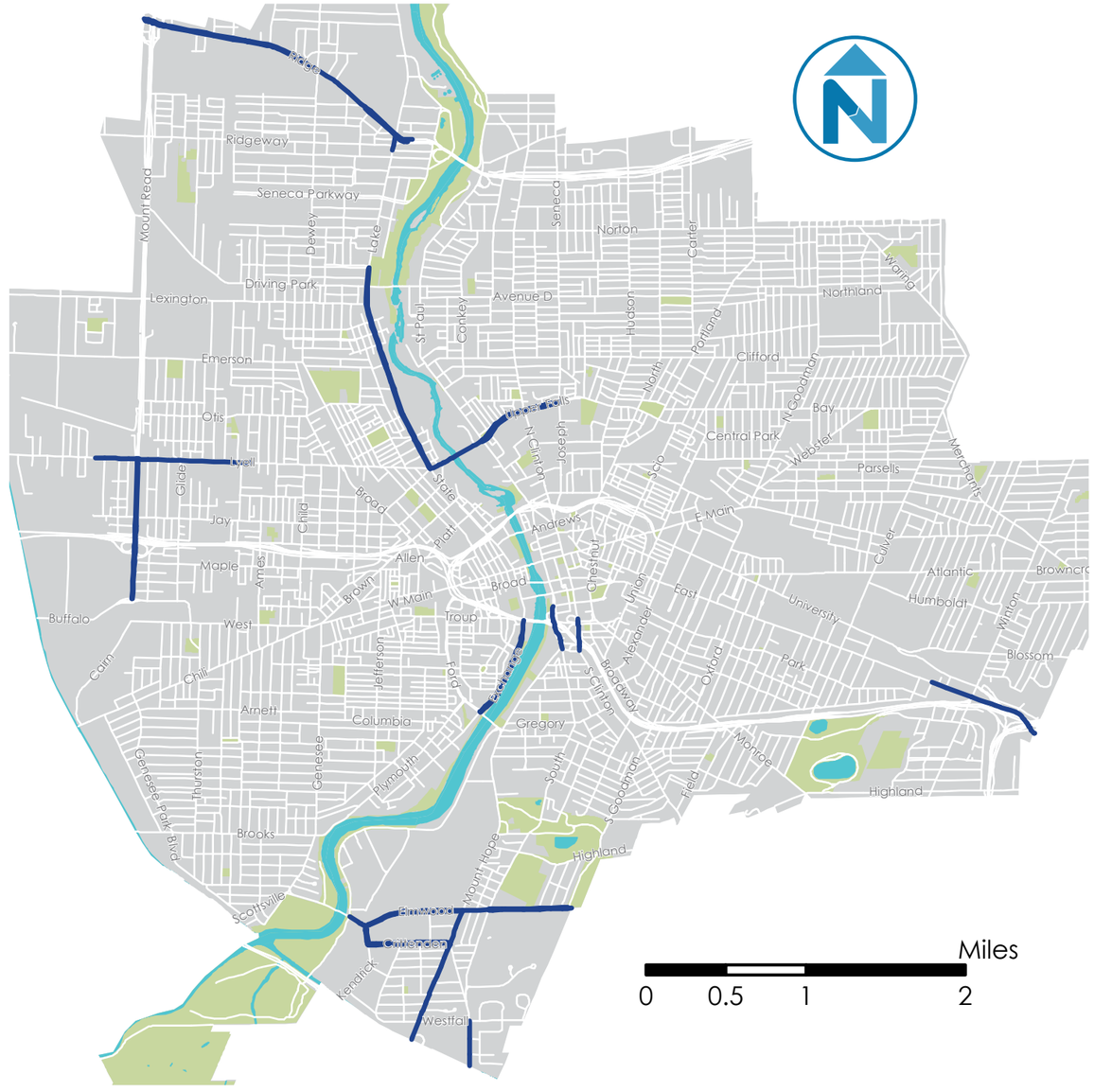
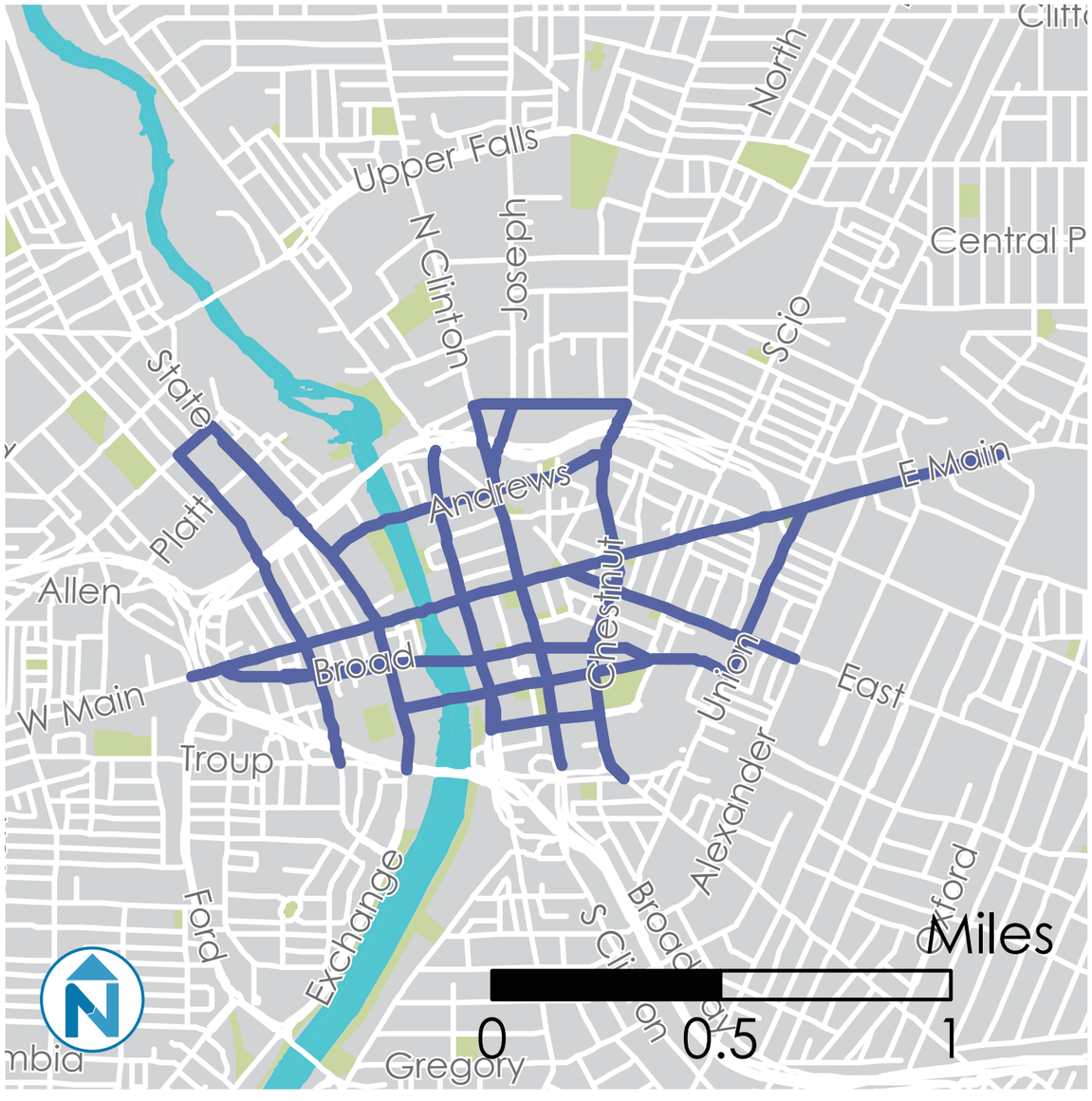
APPENDIX

STREET TYPOLOGY ASSIGNMENT

REGIONAL ACTIVITY



STREET TYPOLOGY ASSIGNMENT
DOWNTOWN ACTIVITY



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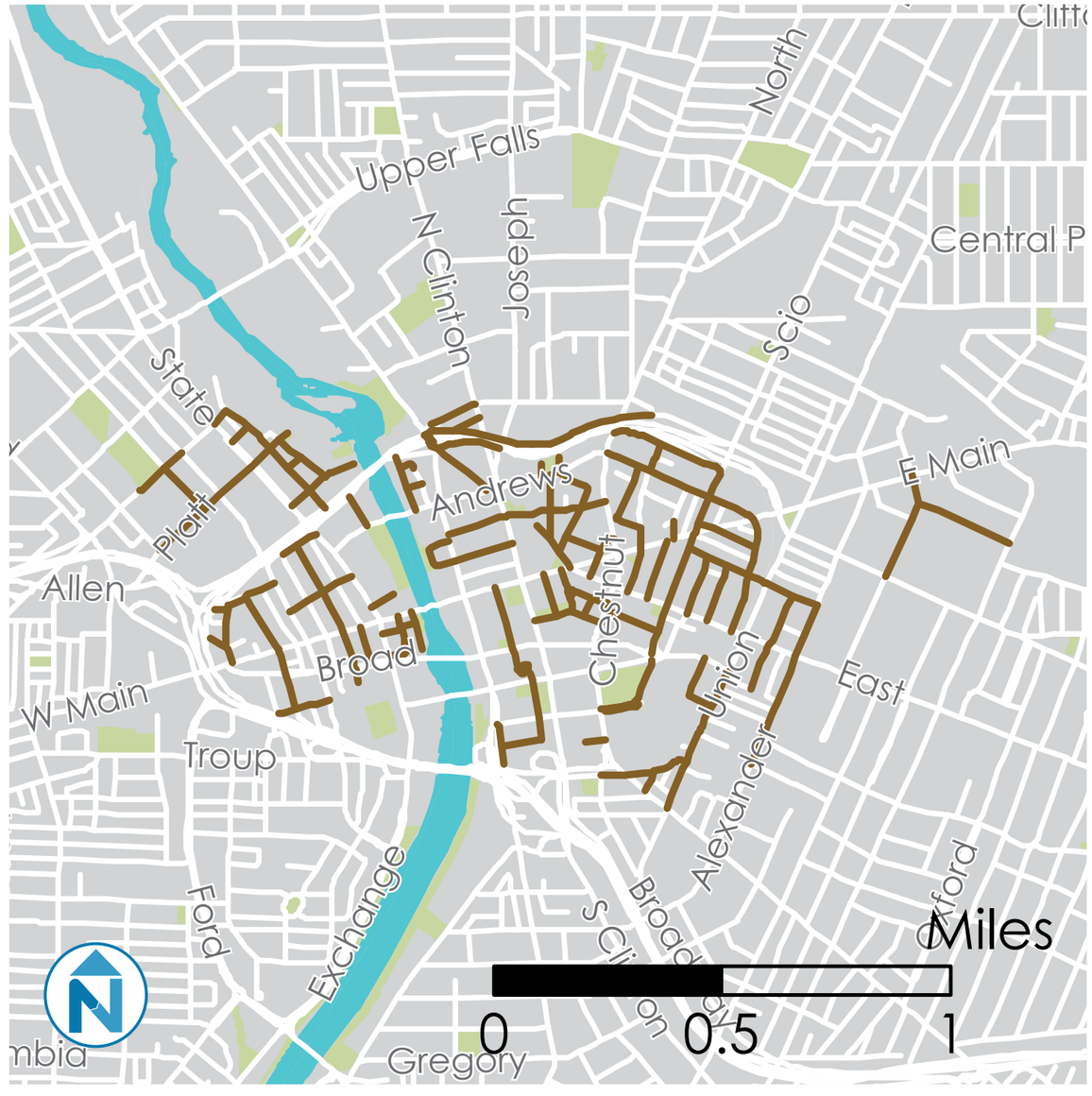
STREET TYPOLOGY ASSIGNMENT
DOWNTOWN LINK



STREET TYPOLOGY ASSIGNMENT
NEIGHBORHOOD ACTIVITY

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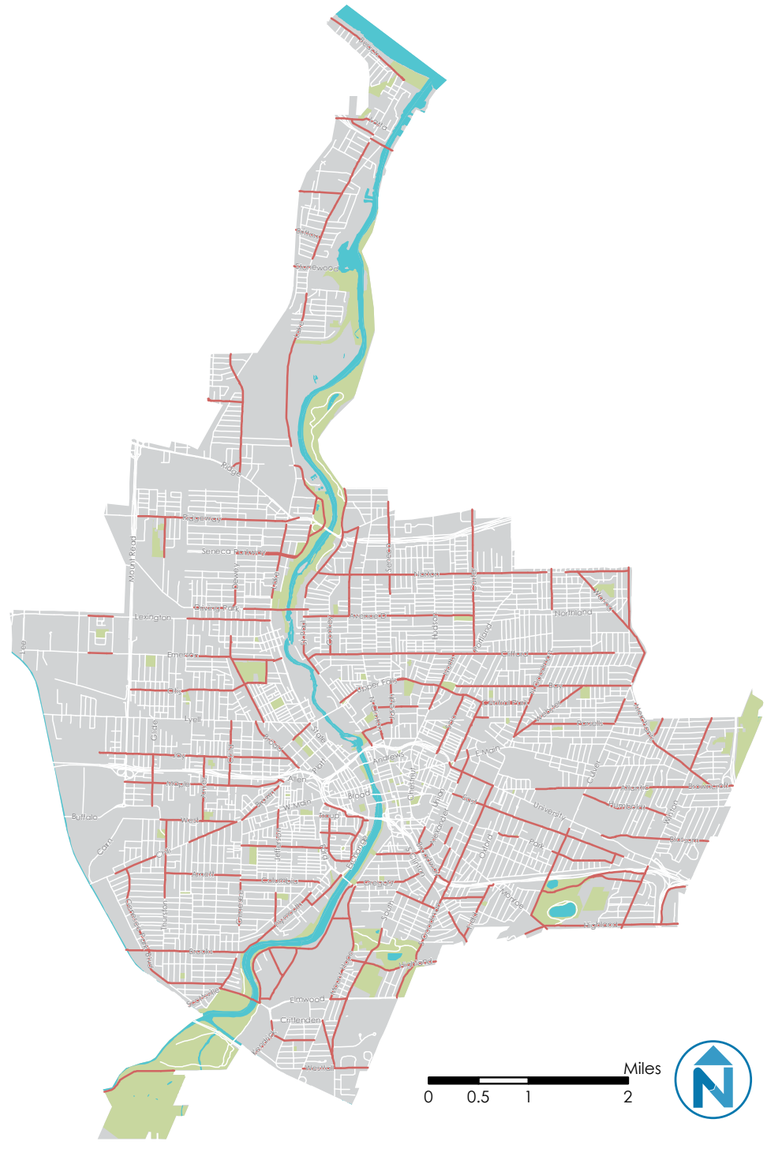
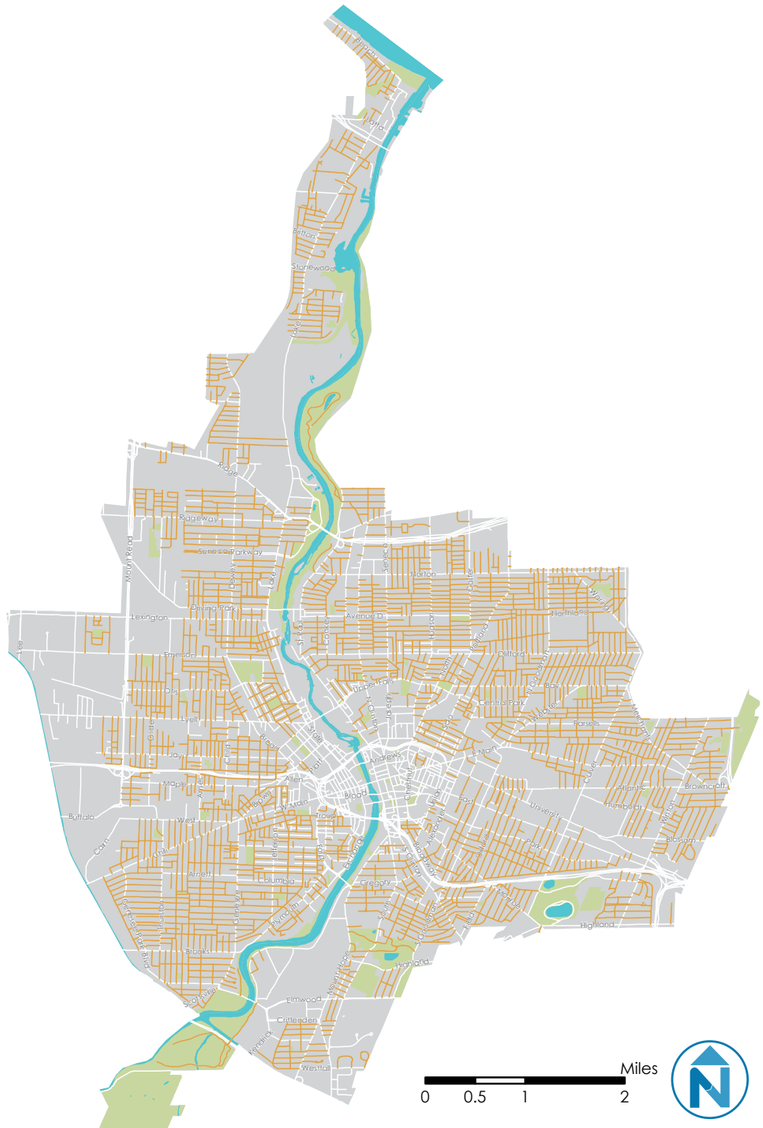
STREET TYPOLOGY ASSIGNMENT
NEIGHBORHOOD LINK



STREET TYPOLOGY ASSIGNMENT
NEIGHBORHOOD LOCAL



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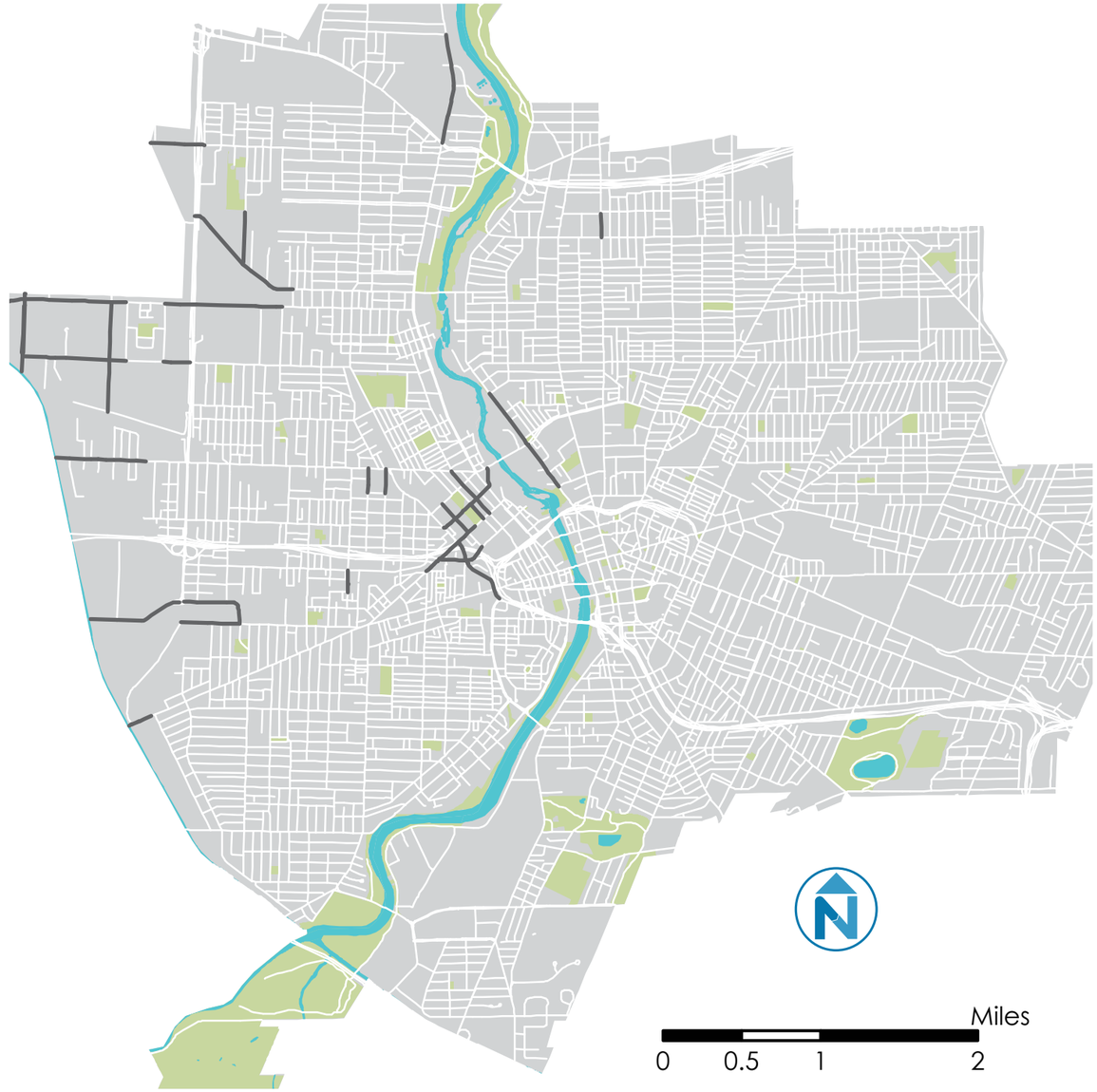
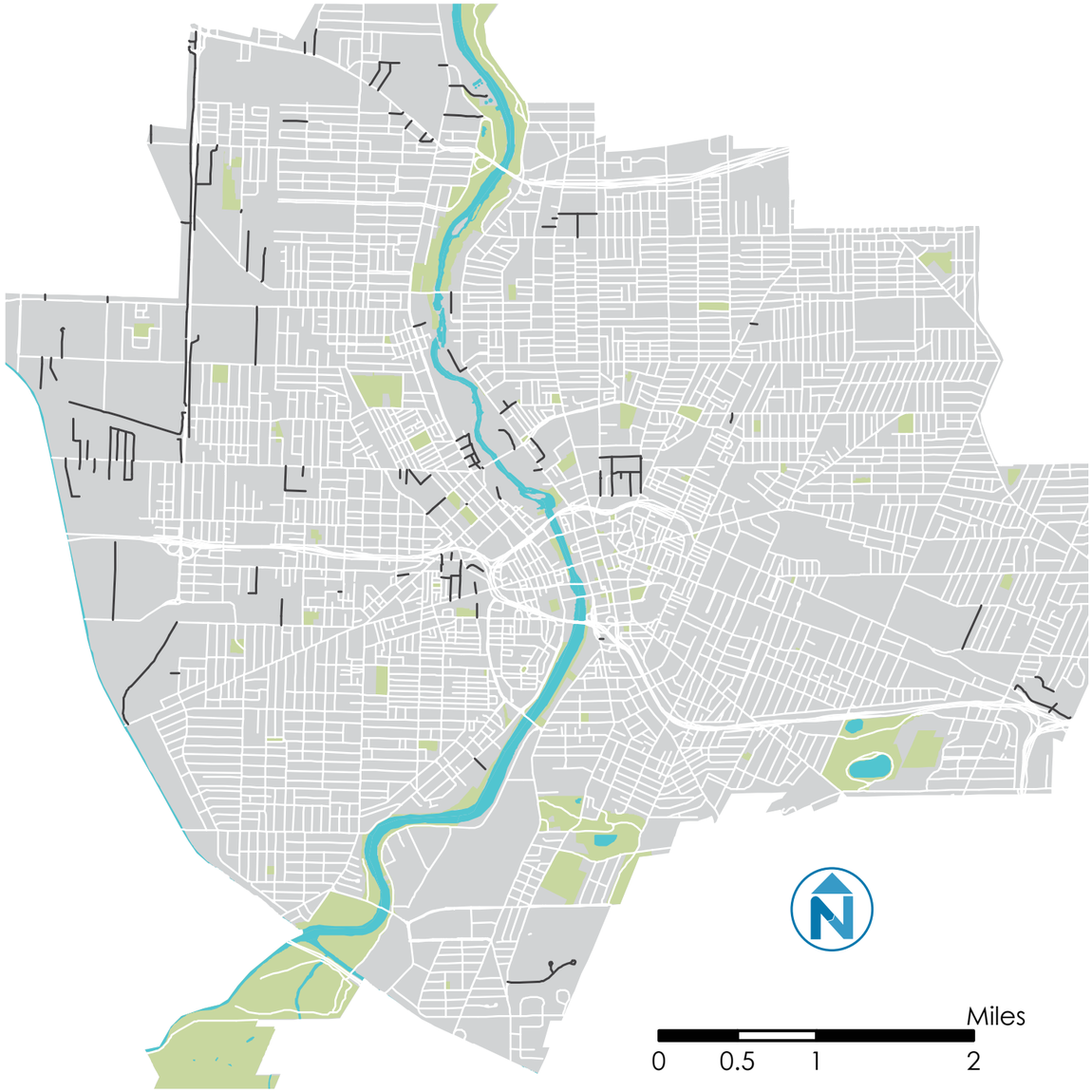
STREET TYPOLOGY ASSIGNMENT
INDUSTRIAL LINK

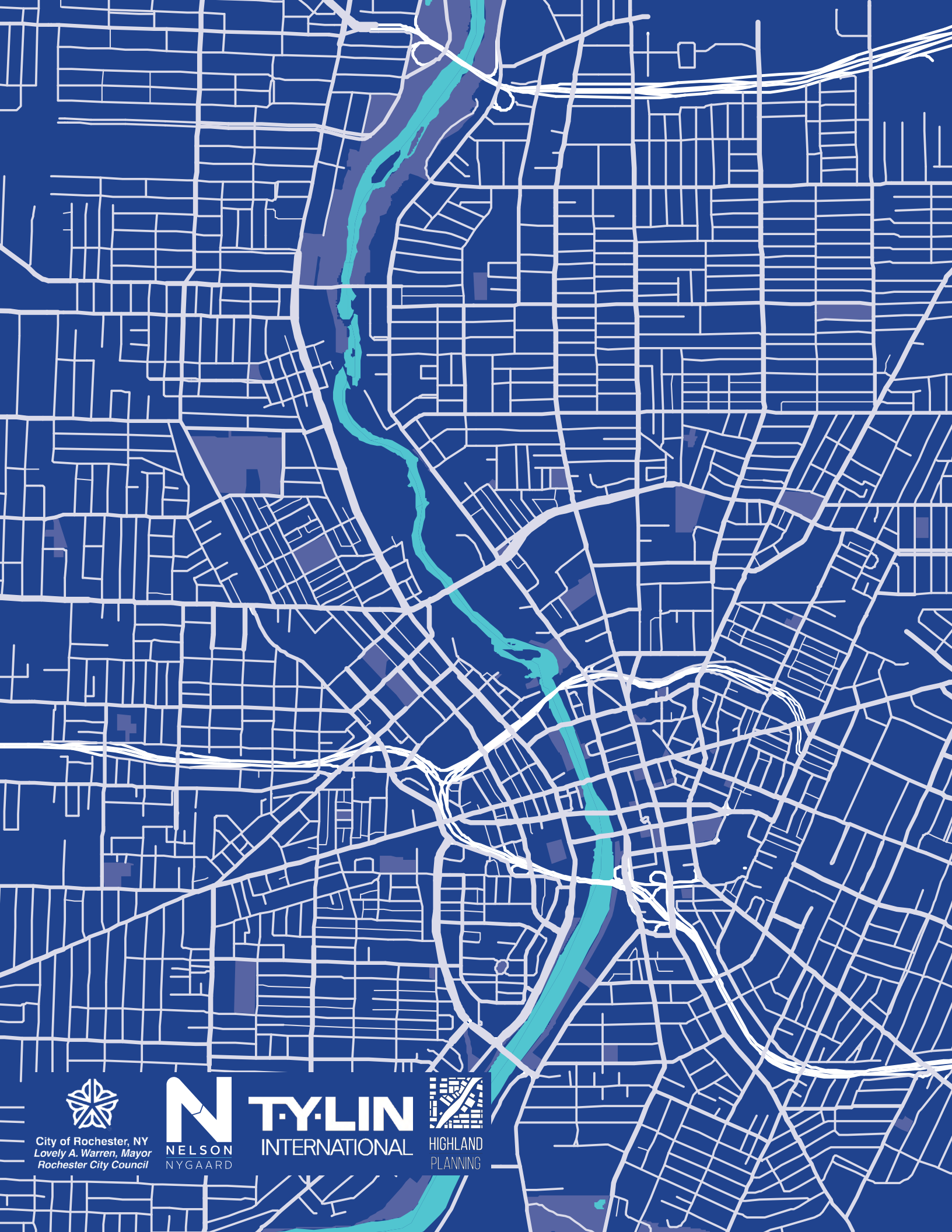


STREET TYPOLOGY ASSIGNMENT
INDUSTRIAL LOCAL



DRAFT
APPENDIX

STREET TYPOLOGY ASSIGNMENT
ALLEY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Rochester City Council
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