Manhattan Area Transportation Strategy

A Long-Range Transportation Plan for the

Manhattan Urban Area

March 2015

Manhattan Area Transportation Strategy

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Executive Summary

This update of the Manhattan Area Transportation Strategy (MATS) is a multimodal document organized around a series of goals and objectives developed as part of the update of the Manhattan Urban Area Comprehensive Plan.

For each of these modes, MATS provides an overview of existing conditions – covering topics such as what infrastructure exists, how (or how well) it is used, how it performs, and what policies currently exist. MATS then presents a series of objectives for each mode, and develops a series of strategies for that mode going forward. The strategies are numerous and too lengthy to include in the Executive Summary, but they are tabulated at the end of each chapter and can be referred to there.

Perhaps the best way to summarize this document is to list the Goals and Objectives that the MATS strategies address. This list is included below.

Goal A: Provide a balanced, cohesive, integrated system of streets, sidewalks, bikeways and public transportation to meet the mobility needs of the Manhattan Area.

Objective A-1: Encourage equitable public and private investment in all modes of travel.

Objective A-2: Maximize the number of modes available for residents to access employment, recreation, shopping, education, and services.

Objective A-3*:* Enhance connection opportunities and safety between modes of travel.

Objective A-4: Promote a sustainable balance of all transportation modes.

Objective A-5: Enforce development approval requirements, and encourage development practices, consistent with Goal A.

Objective A-6**:** Support Goal A with agency policies, standards, design criteria, and best practices.

Goal B: Monitor and improve transportation system performance.

Objective B-1: Regularly measure and assess benchmarks and indicators of transportation system performance - all modes.

Objective B-2: Implement projects, plans, programs or policies to optimize system performance.

Goal C: Provide and maintain a safe, walkable, connected, and accessible transportation system for pedestrians - designed to maximize usage.

Objective C-1: Promote walking as a form of transportation.

Objective C-2: Provide and maintain a continuous system of sidewalks that promotes transportation safety and user comfort, and accommodates the community's range of user types.

Objective C-3: Where pedestrians share facilities with other modes (e.g., trails), provide for safe and comfortable pedestrian operations.

Objective C-4: Where pedestrians conflict with other modes (e.g. street crossings), minimize pedestrian exposure and design for pedestrian convenience and safety.

Objective C-5: Promote safe and accessible connections for pedestrians between different facility types and with other transportation modes.

Objective C-6: Maintain a Pedestrian Master Plan for planning, design, implementation and monitoring of the pedestrian system.

Goal D: Provide and maintain a safe, convenient, and connected transportation system for bicyclists - designed to maximize usage.

Objective D-1: Promote bicycling as a form of transportation.

Objective D-2: Provide and maintain a continuous system of bicycle infrastructure that provides needed connectivity, promotes safety, and accommodates the community's range of user types.

Objective D-3: Where bicycles share facilities with other modes (e.g., on-street bikeways, trails), provide for safe and comfortable bicycle operations.

Objective D-4: Where bicycles conflict with other modes (e.g. street crossings), design for bicyclist safety, visibility and comfort.

***Objective D*-5:** Promote safe and accessible connections for bicyclists between facilities and between modes.

***Objective D*-6:** Maintain a Bicycle Master Plan for planning, designing, implementing, and monitoring the bicycle system.

Goal E: Provide a safe, convenient, affordable, and accessible public transportation system - designed and operated to maximize usage.

Objective E-1: Promote transit as a form of transportation.

Objective E-2: Provide scheduled public transit that serves identified needs throughout the community.

Objective E-3: Provide paratransit or other public transportation alternatives for mobility-impaired persons for general public transportation purposes.

Objective E-4: Serve as a hub and provider for regional transit.

Objective E-5: Facilitate connections to and from other local transportation modes (pedestrians, bicycles, autos, airport).

Objective E-6: Support connections to intercity mass transportation modes (aviation, intercity bus).

Objective E-7: Maintain a Transit Master Plan for planning, implementing, operating and monitoring the transit system.

Goal F: Optimize/manage parking supply and internal connectivity for major activity centers.

Objective F-1: Systematically plan, implement and manage public parking (on-street and off-street).

Objective F-2: Regularly monitor parking conditions in Aggieville and implement improvements when necessary.

Objective F-3: Regularly monitor parking conditions in Downtown and implement improvements when necessary.

Objective F-4: Regularly monitor parking conditions around the Kansas State University campus and implement improvements when necessary.

Goal G: Provide and maintain local streets that promote safety, comfort and convenience, and that preserve a high quality of life.

Objective G-1: Implement neighborhood traffic control policies and practices, and adjust conditions when necessary to respond to community needs and national practices.

Objective G-2: Promote consistency and safety in residential street design while recognizing the variety of local street types and their relationship to the total street system.

Objective G-3: Minimize automobile/truck "through" traffic on residential streets, while maximizing connectivity for non-motorized modes.

Objective G-4: Maximize development access opportunities along local streets while maintaining safe conditions for all users.

Goal H: Provide and maintain a safe and effective network for users of arterial and collector streets.

Objective H-1: Maintain a master street classification system defining a hierarchical series of street classifications/typologies representative of function and context in the community.

Objective H-2: Design/maintain the roadway system to provide automobile continuity/connectivity, safety, and capacity.

Objective H-3**:** Consider all modes in the planning, design, improvement, and monitoring of arterial and collector streets and intersections.

Objective H-4: Regularly monitor crash data and develop strategies to remedy conditions where correctable accident patterns appear.

Objective H-5: Employ technology solutions to optimize arterial traffic flow, gather/disseminate traffic data, and address incidents.

Goal I: Leverage transportation and economic-development potential of the Manhattan Regional Airport (MHK)

Objective I-1: Provide convenient and economical commercial air service at MHK.

Objective I-2: Promote general aviation growth at MHK.

Objective I-3: Provide access and intermodal connections to MHK for all relevant passenger modes .

Objective I-4: Ensure compatible land use within 5 miles of the airport.

Objective I-5: Support use of MHK as Fort Riley's official Aerial Port of Embarkation (APOE).

Goal J: Participate in regional transportation planning and decision-making.

Objective J-1: Provide active, meaningful membership and leadership in the Flint Hills Metropolitan Planning Organization.

Objective J-2: Provide active, meaningful membership and leadership in the Flint Hills Regional Transit Administration.

Objective J-3: Coordinate Kansas State University transportation planning efforts with those of the City and County.

Objective J-4: Coordinate Fort Riley transportation planning efforts with those of the City and County.

Goal K: Facilitate freight movement while minimizing freight's impact on the transportation system.

Objective K-1: Delineate a preferred truck network and implement associated policies.

Objective K-2: Facilitate safe and efficient freight operations on the truck network, and between the truck network and freight-related land uses.

Objective K-3: Maintain safe conditions at rail crossings.

1.0 Purpose, Principles, Goals, Objectives

The *Manhattan Area Transportation Strategy 2035* (MATS) is the long-range transportation plan for the Urban Area and was developed in concert with the update of the Manhattan Urban Area Comprehensive Plan. This document is an update of the *Manhattan Area Transportation Strategy: Connecting to 2020 (February 2000)*, which was the first comprehensive transportation plan ever developed for the area. The Strategy includes the status of current transportation systems, revised strategies based on the most recent research and best practices to provide safe and effective transportation consistent with the values and desires of the community, and additional recommendations to help guide the strategy via proposed local policies, resolutions, and ordinances. **Figure 1-1** illustrates the study area.

MATS is intended for a diverse audience:

- *The general public* typically is interested in understanding the current transportation system and how it is performing; a vision for the system and how it will grow (which is funded in part by their tax dollars); and transparent methods to measure success.

- *Elected decision-makers* are interested in spending taxpayer dollars wisely, and ensuring successful, equitable, efficient outcomes for the community.

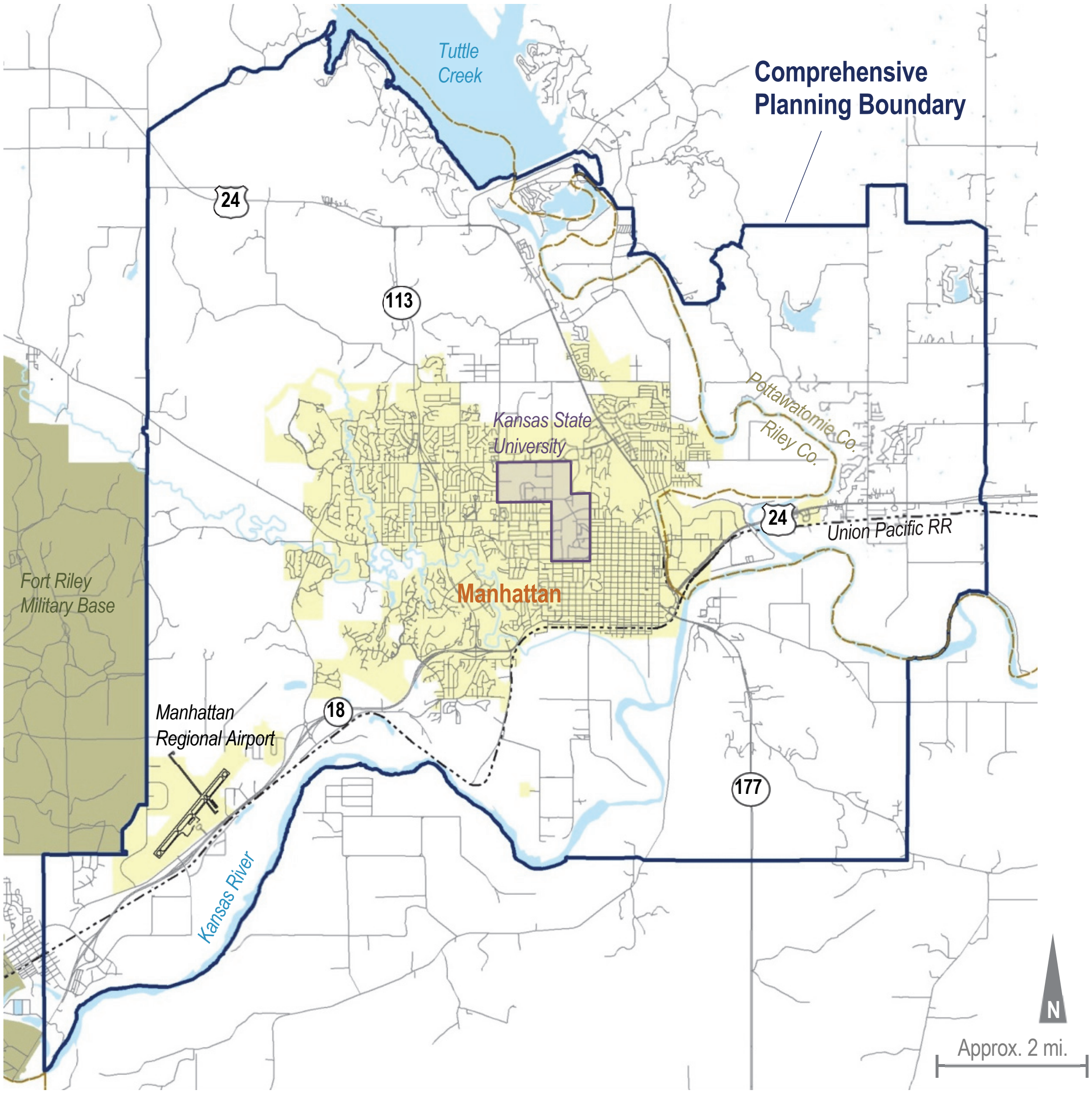
- *Agency staff* and *transportation service providers* are interested in the big-picture vision, but also have to implement regulations and serve as hands-on stewards of the system on a day-to-day basis – and thus need practical, implementable implementation steps.

- *The development community* is interested in understanding transportation-related requirements that may be included in development reviews and approvals.

Thus, MATS, while intended to be a fairly high-level strategic document, often intermingles broad policy statements with more specific detailed targets, standards, and guidance. This mixture is intentional, and necessary to fulfill the functions the document means to achieve.

The current MATS update has been developed in conjunction with the update of the Manhattan Urban Area Comprehensive Plan, known as “Manhattan Area 2035”. The land-use direction and community feedback arising from that process has informed the development of transportation solutions, and vice versa.

Figure 1-1: Study Area



Guiding Principles

The original MATS developed a set of six guiding principles, intended to "reflect the values and desires of the community with respect to transportation" and to guide the study process. For this update, the Guiding Principles were generally retained with generally minor modifications and one addition (Principle #5). The Guiding Principles are listed below.

Guiding Principles

1 The transportation system will be multimodal, i.e., emphasize all modes of transportation.

2 The transportation system must emphasize the needs of people rather than vehicles in assuring access to jobs, services, education, and recreational opportunities.

3 Transportation policies and investments should help conserve energy, protect environmental and aesthetic quality, strengthen the economy, promote social equality, and make the community and its neighborhoods more livable.

4 The two major institutions in the region – Kansas State University and Fort Riley – play vital roles in the community; transportation systems need to recognize the unique travel characteristics of these institutions. The MATS also needs to recognize the importance and uniqueness of major activity centers such as Downtown and Aggieville.

5 Transportation system planning and operation should embrace technology (such as Intelligent Transportation Systems) to increase efficiency.

6 The transportation plan is but one component of the community blueprint; it needs to be coordinated with the Comprehensive Plan elements and should be integrated with current City and County business practices and systems.

7 The transportation strategy must be safe, accessible and cost-effective.

Goals and Objectives

In light of these Guiding Principles, a series of eleven goals, each with its own subset of objectives, was developed. Eight of these goals refer to specific travel modes, while three of them (Goals A, B, and J) refer to system-wide or regional considerations. These three goals are addressed here in Chapter 1, while the remaining eight are addressed in the Chapters specific to their appropriate travel modes.

MATS Goal A: Provide a balanced, cohesive, integrated system of streets, sidewalks, bikeways, public transportation, and intercity transportation to meet the mobility needs of the Manhattan Urban Area.

Goal A emphasizes balance, and recognizes the importance of all travel modes. It is tied not only to **Guiding Principle #1** (multimodality), but also to **Guiding Principle #2** (people over vehicles), because it recognizes that transportation is a derived demand, a means to an end – connecting people with the places they need and want to be. **Goal A**'s objectives are largely borne out by recommendations in the rest of the plan, but are important as a unifying theme for the Urban Area's transportation system.

Objective A-1: *Encourage equitable public and private investment in all modes of transportation.*

The MATS document does not address funding sources comprehensively, but does emphasize a system that is multimodal. Identifying this system and its needs allows both the public and private sectors to individually and collectively plan for methods of funding to implement the system needs. The "equitable" component alludes to social equity, as funding from various sources should be distributed equitably among the various system needs and should consider the potential benefits to all members of the community.

Objective A-2: *Maximize the number of modes available for residents to access employment, recreation, shopping, education, and services.*

Chapters 2 through **6** focus on the ways to improve connectivity and quality of all the local transportation modes (walking, bicycling, riding transit, and driving). **Chapter 8** (along with portions of **Chapter 4**) examines ways to facilitate longer-distance travel.

Objective A-3: *Enhance connection opportunities and safety between modes of travel.*

Specifics regarding this Objective are provided in the remaining Chapters of the MATS document, but the key message of this objective is to ensure that as improvements are made to one mode, connections and conflicts with other relevant modes are considered in a systematic way. The Transportation Impact Study Guidelines presented in **Appendix B** are one way of implementing this principle, as they require consideration of all relevant modes of travel with the review of new development projects.

Objective A-4: *Promote a sustainable balance of all transportation modes.*

It is important to recognize that achieving transportation balance does not mean that all modes will be used equally. The automobile will continue to dominate as mode of choice for many/most trips taken in the urban area. A "sustainable" balance implies trade-offs on both sides of this equation. For automobiles, the basic network is well-defined and connectivity is high; for non-automobile modes, the networks have yet to be completed. There will be continued demand to address congestion "hot spots" in the automobile network, while the other networks will not reach their full potential until they achieve a basic level of connectivity. This balance will be promoted by the identification of system needs for each transportation mode and developing a plan for addressing all the needs in a sustainable way.

__Objective A-5:__ Enforce development approval requirements, and encourage development practices, consistent with __Goal A__.

MATS includes recommendations for an updated set of Transportation Impact Study Guidelines. These guidelines are intended to ensure that each new development in the Urban Area is appropriately considered in light of its effects on transportation demand (all modes), its internal provisions for all transportation modes, and the ways in which it can contribute toward the Urban Area's transportation system as a whole.

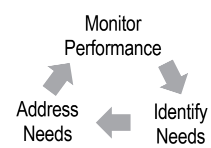
In addition, MATS includes modal-specific recommendations throughout the document that can also be incorporated into development approval guidelines.

__Objective A-6:__ Support __Goal A__ with agency policies, standards, design criteria, and best practices.

MATS includes a series of transportation policies, standards, design criteria, and recommended best practices to provide the Urban Area with a tool to implement the strategies in this document. This includes references to various national standards (some for potential adoption within the Urban Area), suggestions for upcoming design standard updates, and toolboxes for implementing/formalizing various approaches.

MATS Goal B: Monitor and improve transportation system performance.

The thrust of this goal is to set processes and measures in place that sustain a three-part feedback loop (shown at right). **Objective B-1** addresses the first and second parts of this continuous cycle; **Objective B-2** addresses the third part.



__Objective B-1:__ Regularly measure and assess benchmarks and indicators of transportation system performance – all modes.

Performance measures allow quantitative targets to be set that indicate the desirable performance of a system. Simply put, measuring outcomes will track the success of MATS implementation.

Because the Manhattan Urban Area plays a significant role in the Flint Hills Metropolitan Planning Organization (FHMPO), which is tasked with setting regional goals and performance measures, it is most logical for the Urban Area performance measures to be in harmony with those of the FHMPO. **Table 1-1** is a draft of performance measures being developed by FHMPO, and is included for reference. It is not the place of MATS to suggest changes to a regional process that is currently underway, but MATS does recommend that the Urban Area continue to contribute to regional transportation goal development consistent with the principles of MATS.

Most importantly, MATS recommends that **the Urban Area produce an annual report** that discusses the monitoring of MATS targets and goals, as well as whatever supplementary measures arise out of the FHMPO process. This report can be used as a MATS tracking tool, but can also be folded into FHMPO performance measurement reports.

Table 1-1: FHMPO Performance Measures (Draft, Currently Under Development By FHMPO, Reference Only)

Measures	Implementation Strategies
Goal 1. Safety and Security Provide a safe and secure multimodal transportation system.	
a) Number of serious injuries and fatalities, represented as a 5-year rolling average (required by MAP-21) b) Rate of serious injuries and fatalities per 100 million VMT, represented as a 5-year rolling average (required by MAP-21) c) Transit safety (anticipate additional MAP-21 guidance) d) Number of bicycle-related fatalities	Manage access along high-volume corridors to support safe travel. Implement multimodal engineering features to make interactions among users of different modes safer. Educate travelers across modes about safe travel behavior and techniques that are mode and age appropriate. Develop a strategy for regional emergency coordination and response to address inter-jurisdictional emergency events, including evacuation routes and procedures. Coordinate traffic system management and operations to respond to and recover from emergencies, including man-made threats and natural disasters.
Goal 2. Mobility and Accessibility Contribute to a high quality of life by providing comprehensive mobility and accessibility opportunities for all travelers.	
a) Traffic congestion (anticipate additional MAP-21 guidance) b) Employment within ½ mile of bus stop c) Population within ½ mile of bus stop	Preserve corridor capacity through access management. Improve transit route coverage and expand service hours of operation. Coordinate transportation investments to ensure compatibility with the transportation facilities of adjacent municipalities and counties. Explore policy direction to implement Complete Streets concepts. Implement inter-jurisdictional signal timing. Explore opportunities for strategic roadway redundancy and bypass routes. Leverage transportation funds with other funding sources to achieve shared interests (e.g., public health, elderly, disadvantaged populations). Work with area social service providers to eliminate barriers to travel.
Goal 3. Transportation System Integration Foster intra- and inter-modal connectivity, including connectivity across inter-jurisdictional boundaries.	
a) Percent of bus stops with a sidewalk presence b) Percent of bus fleet equipped with bicycle racks c) Number/description of existing gap resolved	Determine demand and feasibility of designated park-and-ride locations. Encourage municipal and regional coordination in support of the provision of transit and non-motorized travel facilities. Improve non-motorized facilities to ensure continuity and comfort for users. Coordinate Fort Riley transportation planning efforts with those of the planning area cities and counties. Outreach to area taxi companies to improve services for travelers.
Goal 4. Multimodal Choice Make available and promote the usage of alternative transportation options for area residents and workers.	
a) On-road mobile source emissions (Anticipate additional MAP-21 guidance) b) ATA transit ridership c) Change in miles of bicycle lanes (e.g., all or subsets like on-street/off-street/recreational trails) d) Percent of sidewalks that are Americans with Disabilities Act (ADA) compliant Change in vehicle miles traveled (VMT) per capita	Encourage Complete Street concepts in roadway engineering and design to accommodate the needs of all users (e.g., auto, transit, bike and pedestrian). Support public-private partnerships to fund transit service. Continue to provide demand response service to transportation disadvantaged populations. Invest in non-motorized facilities, amenities, and signage, especially those that link to activity centers and transit. Liaison with businesses to provide access on commercial properties for non-motorized users. Support maintenance and operating policies and procedures to enable year-round access to non-motorized facilities and transit stops. Provide adequate resources to expand the use of Transportation Demand Management (TDM) to help reduce the number of single occupancy vehicle trips within the region.

Measures	Implementation Strategies
Goal 5. Asset and System Management Preserve and maintain existing transportation assets and strategically manage roadway operations.	
a) Pavement condition. *(anticipate additional MAP-21 guidance)* b) Bridge condition *(anticipate additional MAP-21 guidance)* c) Transit state of good repair *(anticipate additional MAP-21 guidance)*	Evaluate existing preservation and maintenance programs to maintain and replace/rehabilitate transportation assets on a timely, systematic basis. Implement a region-wide Intelligent Transportation System (ITS) Architecture. Deploy ITS investments as appropriate to optimize traffic flow and support incident management consistent with the ITS Architecture. Utilize transportation system management (TSM) improvements when more cost effective than facility expansion.
Goal 6. Economic Vitality Support the economic health of the region through the provision of a reliable and accessible transportation system to move people and goods.	
a) Freight movement on the Interstate system *(anticipate additional MAP-21 guidance)* b) Performance of the non-Interstate National Highway System *(anticipate additional MAP-21 guidance)* c) Truck volumes on I-70 d) Manhattan Regional Airport enplanements *(split out by commercial and general aviation)*	Implement transportation investments to support designated growth areas, existing communities, and regional generators of economic activity. Coordinate with area economic development organizations to support business through strategic transportation investment. Preserve right-of-way to develop strategic corridors for future transportation systems. Develop a system of preferred or designated truck routes within the region.

A summary of the MATS-recommended performance measures to be monitored is included below. **Details of each measure are described in more detail in the relevant chapters.**

Pedestrians (Chapter 2)

- Overall miles of sidewalks and trails are basic measures of pedestrian infrastructure, but the Pedestrian Continuity Index is a better measure because it indexes sidewalk and trail mileage against roadway mileage. Since the City's sidewalks (and certain sidewalks elsewhere in the Urban Area) are now mapped with GIS, this index is now trackable on a regular basis. A continued increase in this index is desirable.
- The percent of commuters walking to work is tracked by the American Community Survey (ACS). This is not a performance measure that can currently be tracked annually, but is useful to monitor as it is updated – and can be benchmarked against peer cities.
- The annual number and severities of pedestrian crashes is a measure of pedestrian safety. A decline in this measure is a desirable target.

Bicycles (Chapter 3)

- As with pedestrian facilities, the overall mileage of bicycle facilities is a good, trackable measure of system growth. The ratio of miles of bicycle facility to miles of road (very minimal at present) is an excellent measure of the system's pervasiveness.
- As with walking, the ACS tracks the percent commuters biking to work, and this measure is a useful, periodic benchmarking index.
- As with pedestrians, declining bicycle crashes and zero bicyclist fatalities should be set as targets.

Transit (Chapter 4)

- System-wide transit ridership, included in FHMPO's performance measures, will certainly be an indicator of the system's health and growth. As a benchmark against other cities, and a target to aim for, transit ridership *per capita* is also a desirable measure.
- The National Transit Database contains several performance measures applicable to rural and small urban transit systems: Trips per mile, trips per hour, operating cost per mile, operating cost per trip, and farebox recovery ratio. FHATA's goal is to meet or exceed the average U.S. values for rural and small urban transit systems as monitored in the *Rural Transit Factbook,* and to adapt to new or modified measures as they are adopted by FTA.
- KDOT plans to enact performance standards related to transit providers throughout the state. The Urban Area will need to incorporate these into its future performance monitoring.

Parking (Chapter 5)

- MATS recommends periodic (at least every five years) monitoring of peak-period parking occupancy and turnover in the Downtown and Aggieville areas.
- Annual tracking of the total number of K-State parking permit-holders, broken out by students, faculty and staff, is recommended to develop a better understanding of the parking demand on and near the campus.

Roadway (Chapter 6)

- For pavement condition, MATS supports the current Urban Area target Pavement Condition Index (PCI) value of 70, and recommends that this value be monitored across the Urban Area jurisdictions by functional class.
- MATS recommends instituting an area-wide crash-tracking database that includes enough detail for meaningful trend analysis, and setting targets that reflect declining crashes and zero fatalities.
- New methods are emerging to monitor traffic congestion via GPS, cell phones, and other data. The Annual MATS report should include a congestion section that, at a minimum, analyzes the Top 20 most congested intersections and recommends steps to keep them performing at acceptable levels of service.
- MATS recommends that a measure(s) of ITS coverage, whether in miles of instrumented roadways or number of deployed devices, become part of performance-measure tracking.

Freight (Chapter 7)

- Annual crash totals at each of the 18 at-grade railroad crossings in the Urban Area (as reported by the FRA) should be tracked.
- Annual truck volumes on the region's major truck-carrying highways should be tracked (available through KDOT's traffic flow maps); from this, a rough truck-miles-traveled value can be calculated to provide an indicator of the region's freight activity.

Aviation (Chapter 8)

- In addition to commercial and general-aviation operations and enplanements as mentioned in the FHMPO performance measures, the number of commercial flights per day is a recommended measure to track.

Objective B-2: *Implement projects, plans, programs or policies to optimize system performance.*

The focus of this Objective is taking the information systematically tracked in **Objective B-1**, and using it to set transportation improvement and funding priorities. It is important that the Urban Area have a comprehensive, systematic means of improving the transportation system. FHMPO should be the central point for these common discussions, and has established (or is establishing) the means to identify and address regional transportation priorities.

In addition, MATS recommends that the MATS workgroup, established during this process, transition to a MATS implementation group, and meet regularly to evaluate area-wide progress on MATS objectives, develop/review annual reports, and suggest adjustments as necessary.

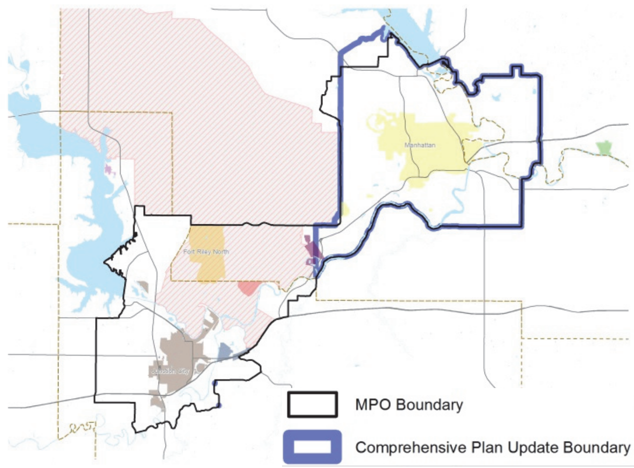
MATS Goal J: Participate in Regional Transportation Planning and Decision-Making

The Manhattan Urban Area is part of a larger region, and transportation decisions made in the Urban Area can have an effect on the region (and vice versa). Also, cooperation with regional partners can help leverage funding for needed transportation improvements.

Objective J-1: *Provide active, meaningful membership and leadership in the Flint Hills Metropolitan Planning Organization.*

The Flint Hills Metropolitan Planning Organization (FHMPO) encompasses parts of Geary, Pottawatomie, and Riley counties, as well as the cities of Junction City and Manhattan (See **Figure 1-2**). Federal law requires that when an Urbanized Area exceeds a population of 50,000 people, an MPO must be established to carry out the multimodal transportation planning for the metropolitan area. Per the 2010 U.S. Census, Manhattan exceeded 50,000 people and the population within the MPO boundary is currently estimated at approximately 87,000 people. Therefore, the FHMPO was designated by the state of Kansas in February 2013. The FHMPO is governed by a Policy Board made up of elected officials from the jurisdictions in the metropolitan area. In existence for less than two years, FHMPO represents an excellent opportunity for the Urban Area to collaborate to determine its transportation future.

Figure 1-2: FHMPO Boundaries



At a minimum, this coordination should include continued participation by FHMPO in the MATS implementation group.

Objective J-2: *Provide active, meaningful membership and leadership in the Flint Hills Regional Transit Administration.*

The Flint Hills Regional Transit Administration (FHRTA) is a multi-jurisdictional public entity created through an interlocal agreement between Geary, Pottawatomie, and Riley Counties, Junction City, and Kansas State University. It is housed within the Flint Hills Regional Council. FHRTA has been designated as the Direct Recipient of federal funds from the Federal Transit Administration (FTA) which can be used to support transit services within the Manhattan Urbanized Area or that start or end in the Manhattan Urbanized Area.

At a minimum, this coordination should include continued participation by FHRTA in the MATS implementation group.

Objective J-3: *Coordinate Kansas State University transportation planning efforts with those of the City and County.*

With nearly 25,000 students and almost 1,300 academic staff, K-State is a very large generator of transportation demand. The University and the local governments have partnered together over the years, and will need to continue to do so in order to ensure a successful transportation system. The University has an ambitious campus master plan including new buildings, relocated parking, and an expanded pedestrian zone. Much of the Urban Area's transit activity is centered on the University, and the campus is clearly a hot-spot for pedestrian and bicycle activity. In addition, the University is a repository of resources, both in collecting data and performing analysis, that can be of assistance in developing transportation solutions for the Urban Area. At a minimum, this coordination should include continued participation by K-State in the MATS implementation group.

Objective J-4: *Coordinate Fort Riley transportation planning efforts with those of the City and County.*

Although located southwest of the Urban Area as defined by MATS, Fort Riley certainly has a transportation impact on the Urban Area. A U.S. Army military installation, Fort Riley covers 100,656 acres in Geary and Riley counties and is utilized for heavy maneuver training, light maneuver training, other training, and cantonment. Within the installation are approximately 443 miles of paved and unpaved/dirt roads, tank trails and railroad tracks (to be used for deployment of soldiers and equipment). Military assets include tracked vehicles, wheeled vehicles, aircraft and unmanned aircraft. Fort Riley has a daytime population of approximately 25,000 people, with nearly 4,000 housing units and 6,200 barracks spaces. The post has historically served as a platform for the mobilization of forces for war, with approximately 16,000 soldiers expected to be assigned there in 2016.

Fort Riley is one of the largest economic drivers in Kansas and specifically in the Manhattan area. At the end of 2013, Fort Riley's economic impact on the Central Flint Hills Region was estimated at $1.77 billion. Even with an expected reduction in personnel assignments to Fort Riley (due to restructuring throughout the Army), a stable to slight decline in the economic impact of Fort Riley is anticipated, with an approximate economic impact of $1.6 billion per year through 2016.

Although many of Fort Riley's military personnel live on post, there are also many who live off-post, and there is a great deal of other demand for travel between the base and the Urban Area. The Urban Area offers community amenities that a military base cannot, and thus there is a need to connect travel needs of Fort Riley with those of the Urban Area to ensure the Urban Area's infrastructure is adequate.

At a minimum, it is recommended that a Fort Riley representative be added to the MATS implementation group.

Table 1-2: System-Level MATS Strategy Summary		
Strategy	**Responsible**	**Priority***
Monitoring		
Transition the MATS workgroup into the MATS implementation group	**Lead:** MATS implementation group **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	1
Track mode-specific performance measures described throughout the MATS document.	**Lead:** MATS implementation group, **Involve:** FHMPO	O
Produce an Annual Report discussing the monitoring of MATS performance measures.	**Lead:** MATS implementation group, **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	O
Use the information tracked in the MATS reports to set transportation improvement and funding priorities	**Lead:** MATS implementation group **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	O
Regional Transportation Collaboration		
Include FHMPO, FHRTA, K-State, and Fort Riley representatives in the MATS implementation groups	**Lead:** MATS implementation group **Involve:** FHMPO, FHRTA, K-State, Fort Riley	1

***1 = Immediate Priority,** to be implemented with MATS adoption or shortly thereafter; **2 = High Priority,** to be initiated as soon as possible and completed within one to two years after MATS adoption; **3 = Moderate Priority,** to be completed within three to five years after MATS adoption; **O = ongoing,** actions that occur continually.*

2.0 Pedestrian Facilities

MATS Goal C: Provide and maintain a safe, walkable, connected, and accessible transportation system for pedestrians – designed to maximize usage.

The importance of walking as a mode of travel has been increasingly emphasized in recent years, and MATS acknowledges its fundamental place in the transportation hierarchy by placing it first in this document. Walking is generally a part of every trip made and is the primary form of transportation for many students and residents. Walking provides health benefits, and can reduce traffic congestion (thereby also improving air quality), particularly around large activity centers such as the Kansas State University campus.

The fundamental infrastructure of pedestrian transportation is the sidewalk. Secondarily, trails can serve a transportation function but are often primarily recreational facilities due to their less direct nature. Crosswalks and pedestrian signalization are key elements of the system at locations where pedestrians and automobiles conflict.

2.1 Existing/Historical Conditions

Existing Infrastructure

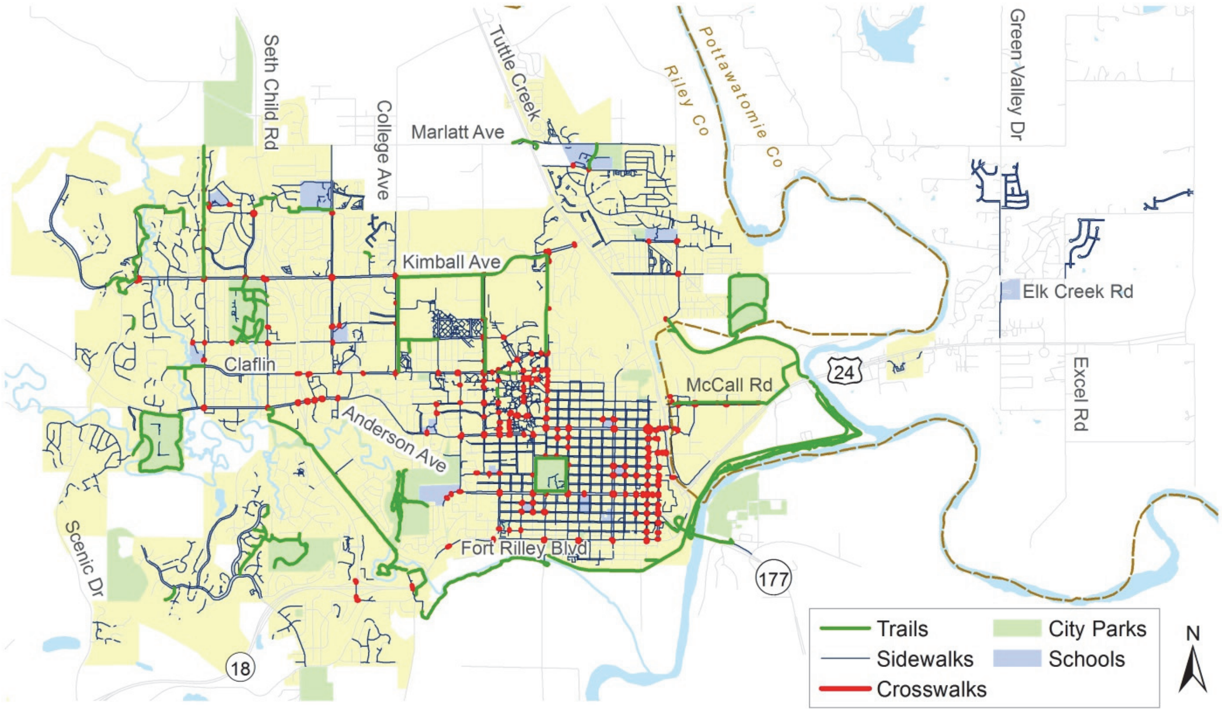
Figure 2-1 illustrates basic linear pedestrian infrastructure in the City of Manhattan: sidewalks (202 miles), trails (34 miles), and crosswalks (369 locations). Note that the figure indicates actual sidewalk locations; thus, roads with sidewalks on both sides can be identified. As the figure illustrates, the southeastern portion of the city, including Downtown, Aggieville, and K-State, has by far the densest pedestrian network in the city. The central portion of the city, especially the residential subdivisions which are some of the older areas of town, is notably lacking pedestrian infrastructure. At the fringes of the City (northwest, southwest, northeast), newer subdivisions include more sidewalks (albeit generally on only one side of the street).

Maintenance

Kansas statutes place the responsibility for sidewalk maintenance on the adjacent property owner. Additional information on maintenance practices within the Urban Area is included below:

- *City of Manhattan:* The City typically has a $50,000 line item in its CIP for sidewalks to fill in gaps in the sidewalk system along major pedestrian routes. Until the mid-1980s, the amount budgeted had been $100,000, but seemingly little interest in the program resulted in the budget reduction. This sidewalk program has not been actively promoted; rather, improvements typically stem from complaints or suggestions by citizens. State statutes place the responsibility for sidewalk maintenance on the property owner, and the City sends notification to property owners when inspectors determine repairs are necessary. In historic neighborhoods, the preservation and restoration of brick sidewalks is encouraged by the Historic Resources Board. Trail maintenance is the responsibility of the Parks and Recreation Department, except in the case of private trail systems.

Figure 2-1: Pedestrian Facilities



System Completeness

Continuity

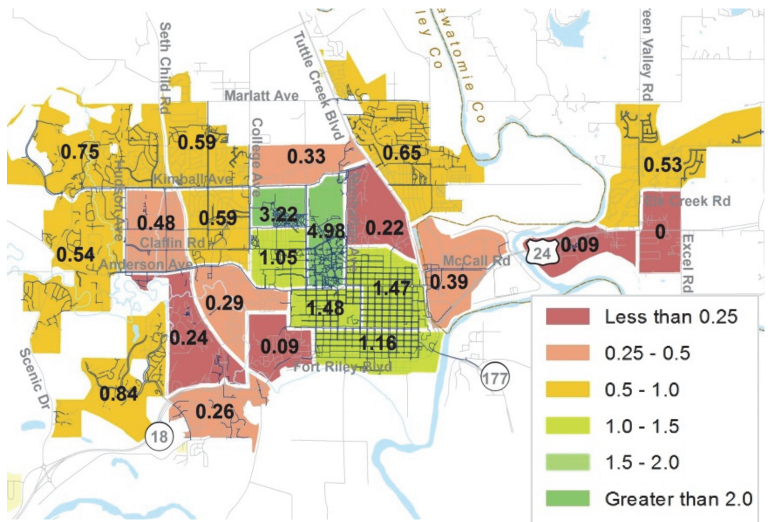
One measure of a pedestrian network is the extent to which it is, in fact, a network. A successful pedestrian network is continuous, without gaps. Whereas automobile networks are generally carefully planned to "connect the dots", pedestrian networks have traditionally often been an afterthought in planning and designing public infrastructure. Thus, where measures such as capacity and congestion are used for auto networks, the more basic measure of connectivity is often the focus in area-wide pedestrian planning. Benefits of continuity, all of which contribute to the attractiveness of walking versus the use of other modes:

- The ability of a pedestrian to make an uninterrupted trip.
- The ability of a pedestrian to make a safe trip, if the absence of sidewalks forces walking unsafely in the street.
- The ability of all users to even make a trip (e.g. mobility impaired, stroller users, etc.).

Gaps in continuity can come in the form of missing/broken sidewalk, missing or poorly identified crosswalks, lack of pedestrian signals (where warranted), overgrown vegetation, or physical barriers such as freeways, rivers, or fences. A visual scan of **Figure 2-1** reveals some of the gaps in the pedestrian network; analysis and strategies related to these gaps are included in **Section 2.2**.

Figure 2-2 characterizes different developed portions of the Urban Area by a Pedestrian Continuity index, which is the ratio of the length of pedestrian facilities in an area divided by the length of roadways. In a typical urban area, a value of 2.0 generally means that every roadway has sidewalk on both sides, indicating a high degree of continuity. **Figure 2-2** shows that K-State skews the typical meaning of this index because of its many off-street walking paths. The Downtown/Aggieville and west campus areas are the only other areas with ratios exceeding 1.0. Many of the older residential areas surrounding the urban core exhibit very low ratios, while the newer outlying residential subdivisions are notably better but still well below desirable values.

Figure 2-2: Pedestrian Continuity Index



Walkability

A broader pedestrian-related measure is walkability – broader because it looks beyond pedestrian infrastructure design to community design, which includes land uses and development patterns, among other things. One definition for walkability is: "The extent to which the built environment is friendly to the presence of people living, shopping, visiting, enjoying or spending time in an area".

- *City of Manhattan:* The City analyzed walkability (excluding the K-State campus) as shown in **Figure 2-3**. On a parcel-by-parcel basis, the analysis examined proximity of various destination types, assigning numerical points to each as below:

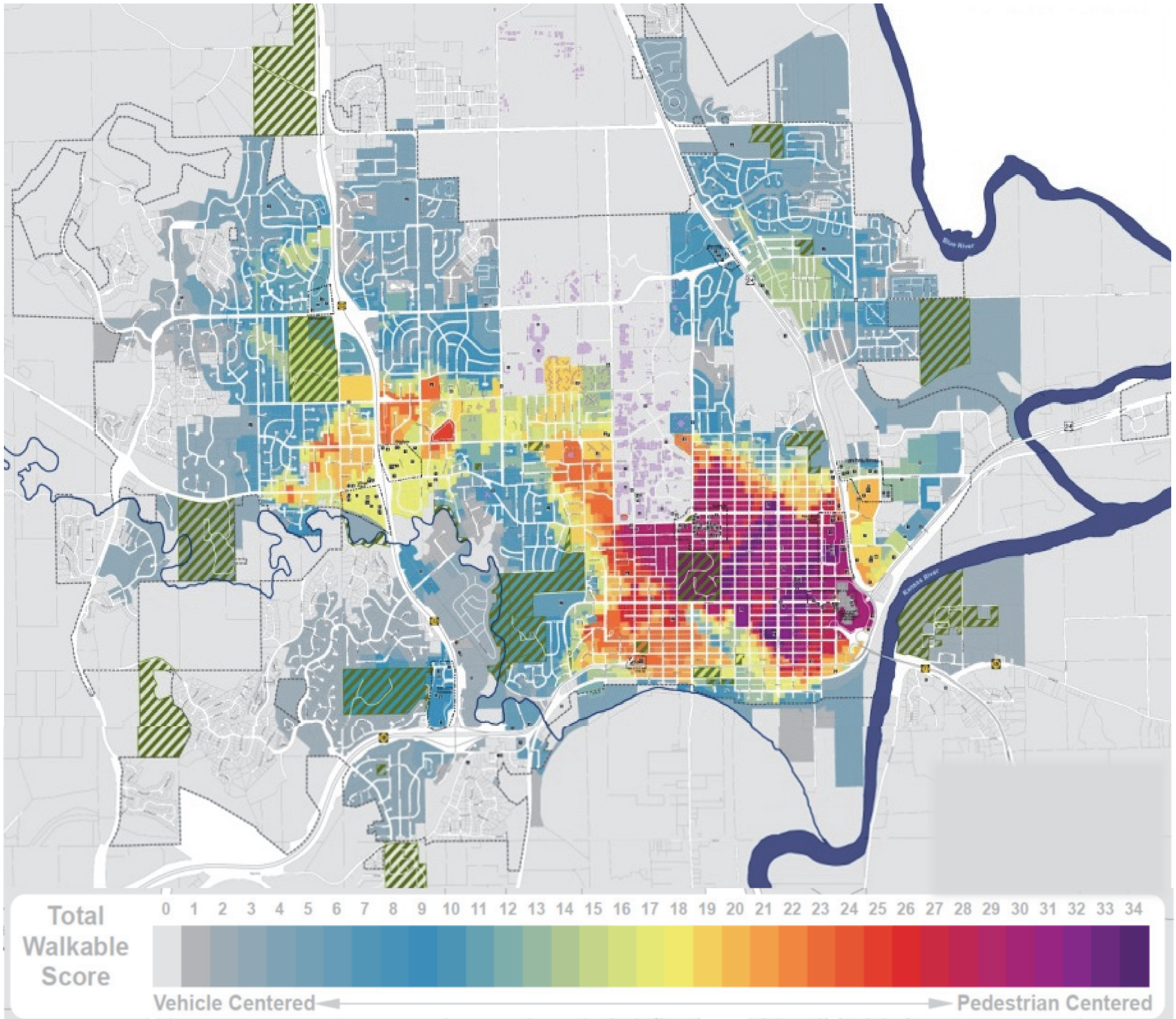
ATA Stops – 1	Retail – 1 to 3*	Grocery Store – 4
Historical Places – 1	Library – 3	Restaurants – 1 to 4*
Major Attractions (Zoo, FHDC) - 2	Park (Active) – 3)	Schools – 4
Museums – 2	Bar/Coffee Shop – 3	
Park (Passive) – 2	Gas Station/Convenience Store – 3	
	K-State Campus (Stadiums/McCain Auditorium) – 3	

**Dependent on type and intensity.*

  Each parcel was assigned points for each destination that was within a 10-minute walk (~3,000 feet) via sidewalk or trail. Where sidewalks were missing, non-arterial streets were used as fillers. On major roads, only intersections with pedestrian signals were used as crossing points. The assigned points were summed to create the walkability score shown in the figure. The result echoes **Figures 2-1** and **2-2**, in that it indicates that The Downtown and Aggieville areas are the most walkable and connected areas of the urban area. Many of the subdivisions in the remainder of the City have less diversity in their respective land-use mixes, and also have incomplete sidewalk systems as previously noted.

- Walkability analyses have not been performed for Riley County and Pottawatomie County, although by the standards of the analysis of **Figure 2-3** these areas would not be considered to be highly walkable because they are more spread out and rural in character.

Figure 2-3: Walkability (City of Manhattan, excluding K-State)



System Usage

Although comprehensive data on pedestrian travel throughout the urban area is not available, a series of pedestrian (and bicycle) counts were conducted in 2014 by FHMPO on fall weekdays (mid-day and p.m. peaks) and mid-day Saturdays. **Figures 2-4a and 2-4b** illustrate the mid-day and p.m. weekday peaks, and show that the heaviest pedestrian volumes are near the KSU campus. Saturday volumes are not shown, but were much lower.

Figure 2-4a: Selected Peak-Hour Pedestrian Volumes, Weekday – Mid-day

(Raw Data Source: Flint Hills MPO, Aggregated by HDR)

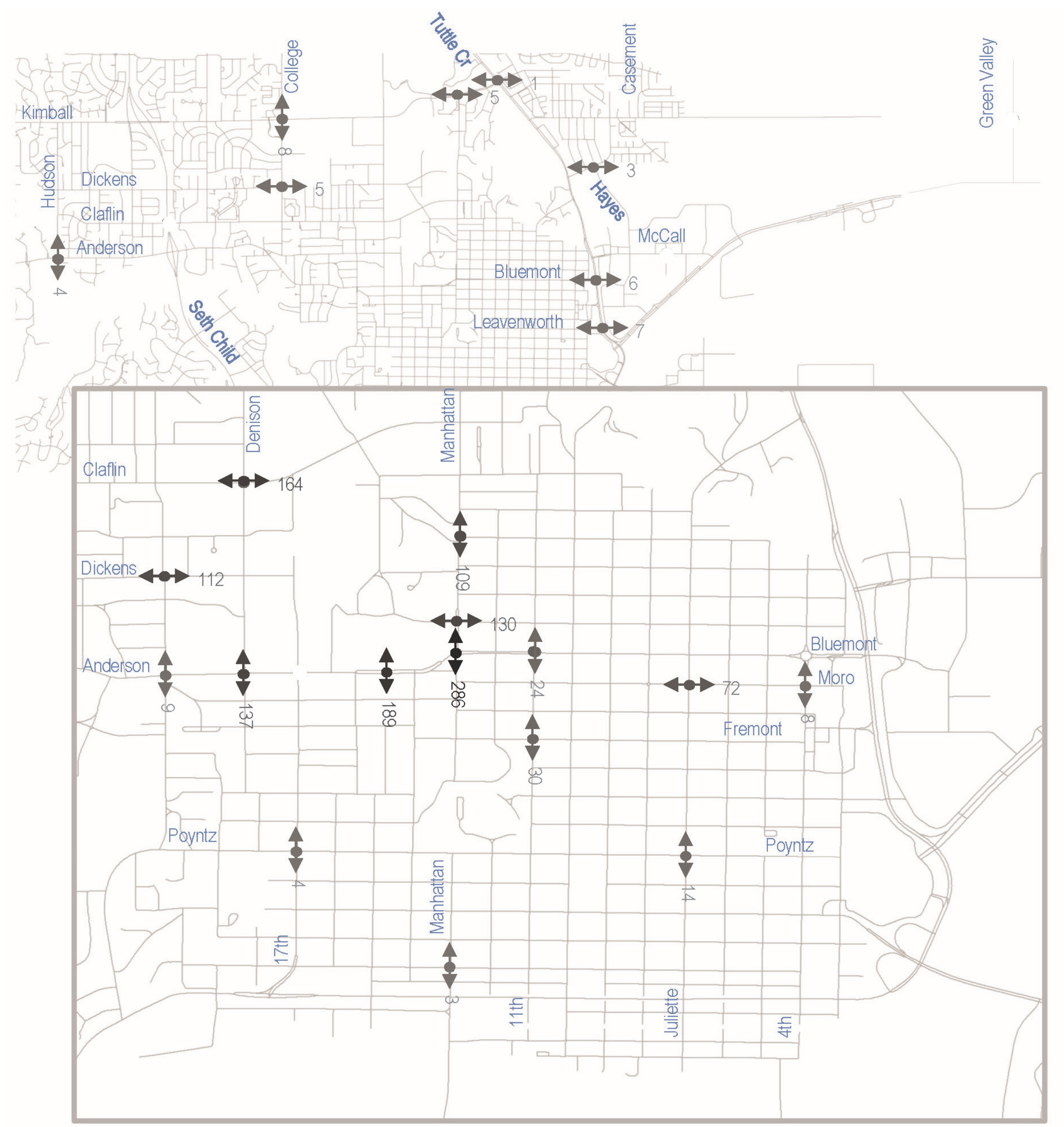
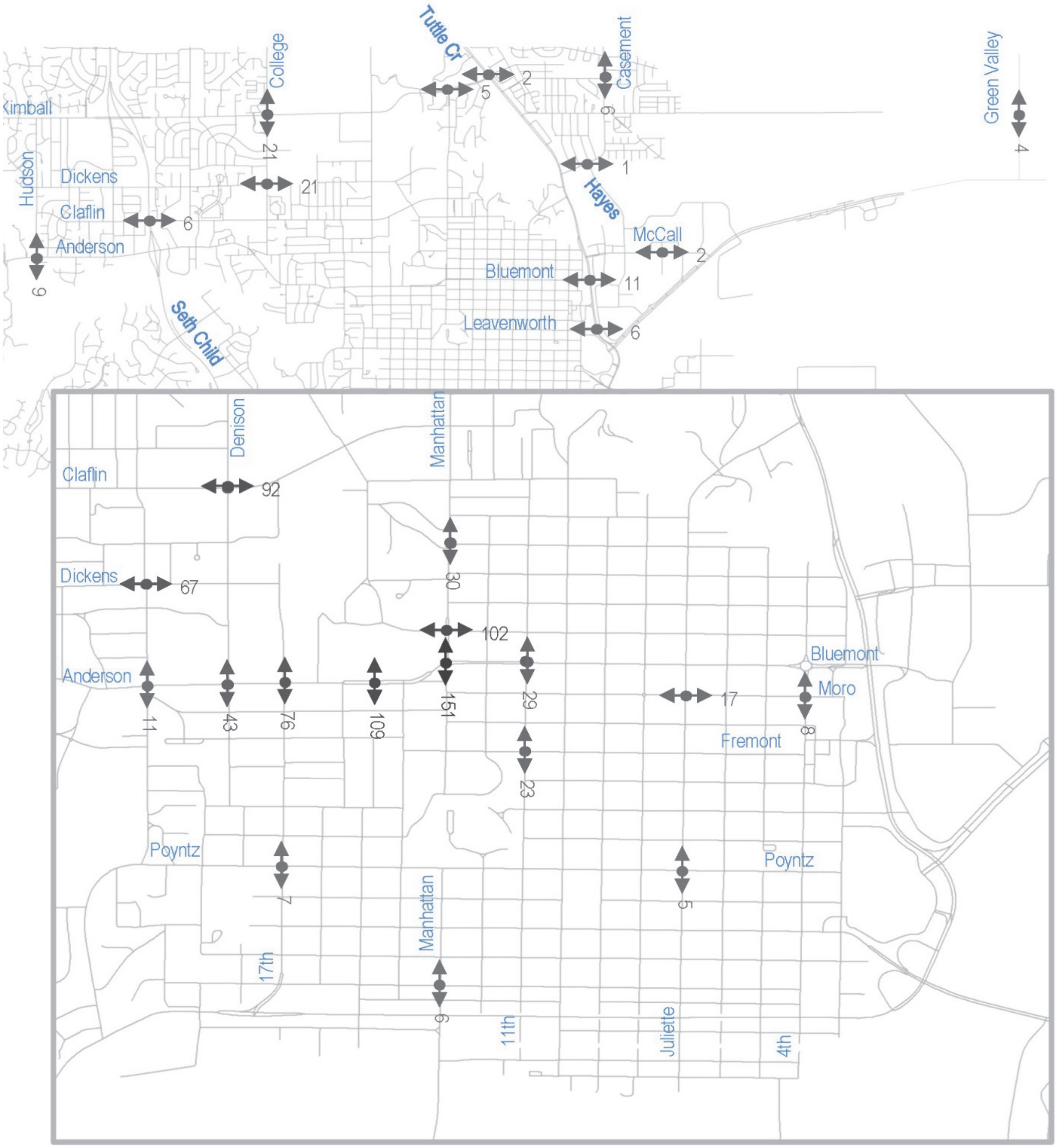


Figure 2-4b: Selected Peak-Hour Pedestrian Volumes, Weekday – p.m.

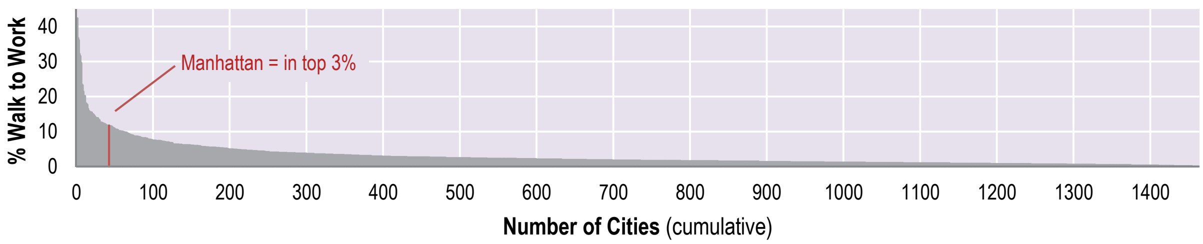
(Raw Data Source: Flint Hills MPO, Aggregated by HDR)



Census statistics also reveal on aspect of pedestrian activity in the Urban Area: walking to work. The American Community Survey (ACS) is a mandatory, ongoing statistical survey – conducted by the U.S. Census Bureau – that samples a small percentage of the U.S. population every year with the goal of giving communities information to support planning for investments and services. For areas the size of Manhattan, three years of data are used to achieve a reasonable sample size. Residents of homes and group quarters (such as dormitories) are included in the survey.

According to the most recent ACS five-year, 11.8 percent of journey-to-work trips within the City of Manhattan were by walking. (The 90-percent confidence range is 10.0 to 13.6 percent). As **Figure 2-5** indicates, this places Manhattan in the top 3 percent of the 1,463 communities surveyed. Almost three-fourths of the other communities in this same top 3 percent could be characterized as "college towns", so the presence of a University certainly affects these walking percentages.

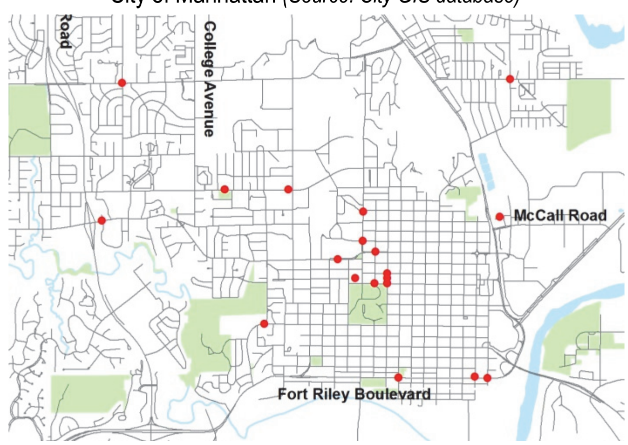
Figure 2-5: Percent of Commuters Walking to Work
Small U.S.Cities (pop = 20,000 - 99,999), 2008-2012



System Safety

Although pedestrian crash information has been collected and electronically tracked for several years, the database layout has changed in the past few years, and it is difficult to track pedestrian crashes before 2012. **Figure 2-6** illustrates locations of pedestrian-related crashes in Manhattan from 2012-2013. 20 crashes were reported during this period: 11 that were classified as "pedestrian", seven (7) that were recorded as including an injured pedestrian, and two (2) that met both classifications. The most prevalent crash clusters appear to be in the areas near the southeast corner of the K-State campus and Aggieville. Another pair occurred near the intersection of Fort Riley Boulevard and 3rd Street.

Figure 2-6: Pedestrian Crashes, 2012– 2013
City of Manhattan *(Source: City GIS database)*



The Riley County Police Department crash database is a more complete source of pedestrian-related crashes, but its data is not geocoded. **Table 2-1** summarizes the pedestrian crashes logged by this database from 2010 to 2014.

Table 2-1: Pedestrian-Related Crashes, 2010-2014
City of Manhattan *(Source: Riley Co PD)*

Year	Crashes
2010	20
2011	13
2012	19
2013	19
2014	18
Total	**89**
Annual Average	**17.8**

Relevant Policies

Development Regulations

- *City of Manhattan*: Sidewalks are mandated as part of new development. The City of Manhattan's Subdivision Regulations, Part 10, Section 10-1001 addresses sidewalk standards, and indicates that

  Sidewalks shall be required as part of the street improvements in the City and the Urban Service Areas in the following manners:

  (A) All sidewalks shall be constructed to standards set by the responsible Engineering Department. The MUAPB may require greater widths where pedestrian volumes dictate.

  (B) A median strip of grassed or landscaped area at least six (6) feet wide should separate all sidewalks from adjacent curbs.

  (C) Sidewalks shall be located within the dedicated non-pavement street right-of- way or within the companion easements.

  (D) Sidewalks shall be required on both sides of all arterial and collector streets and one side of all local streets.

  (E) When unique topographic, or other unique site conditions dictate, the subdivider may submit an alternative pedestrian and bicycle circulation system to the MUAPB for consideration, as a Variation of Section 10-203. The alternative circulation system must be consistent with the general requirements for adequate and functional pedestrian and bicycle circulation, and connectivity to adjacent areas, and shall demonstrate a well documented need for an alternative approach.

  (F) Sidewalks shall conform to accessibility standards.

  Item (D) represents a key improvement since the 2000 MATS document was published: Collectors previously only were required to have sidewalks on one side of the street, and not all local streets were required to include sidewalks.

- *Pottawatomie County*: The County's Unified Development Regulations indicate (emphases added):

  Article 4, Section 105.G.13

  All new developments, including residential, commercial and industrial, shall provide sidewalks or walking paths, or both…. All developments on one (1) acre lots or less shall provide, at a minimum, sidewalks/bicycle paths on both sides of the street.

  All new developments with lot sizes greater than one acre to a maximum of three acres shall provide a dedicated 10' strip of land, on one side of the street… for the future development of a sidewalk…. In addition, the Planning Commission will normally require a dedicated walking/bicycle trail that connects as many lots as possible to rights-of-way and other features in the subdivision.

  All new development with lot sizes greater than three acres are required to provide a walking/bicycle trail that connects as many lots as possible to rights-of-way and other features in the subdivision in a circular (looped) fashion….

Article 3, Section 109.A.2

> *All developments/facilities shall provide barrier-free pedestrian access on sidewalks (and walking trails), cross-overs and other facilities that are connected (or can be connected in the future) to adjoining properties….*

Thus, Pottawatomie County is aggressively pursuing robust sidewalk networks and trail connections in its new developments. One area not addressed by this policy is the status of key streets that may not ever be subject to subdivision regulations because they don't fall within a subdivision, such as arterials and collectors that support major traffic volumes. They might not fall within a subdivision, but it may be that the development is required to improve them. Thus, a statement(s) regarding sidewalks and/or paths along developer-improved streets might also be appropriate. The County's Roadway Design Standards do not mention sidewalks, and the typical roadway sections do not include a pedestrian component.

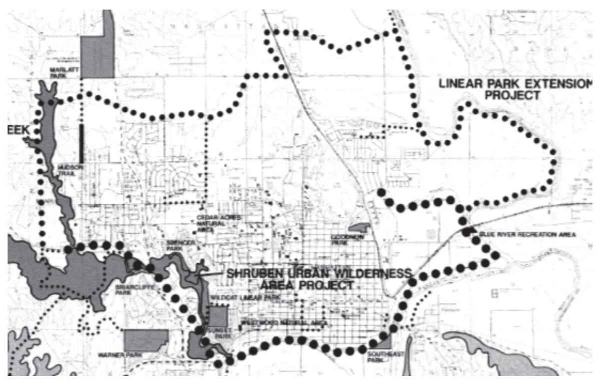
- *Riley County*: Riley County has jointly adopted the Urban Area Subdivision regulations. Outside the urban area, regulations regarding sidewalks are minimal.

Focused Issues

Linear Park Trail

The Linear Park Trail is envisioned to ultimately provide a continuous loop serving nearly the entire Urban Area. Many of the documents surrounding the completion of this loop are well over a decade old. **Figure 2-7** illustrates a version of this loop. The City of Manhattan's Parks and Recreation Department is currently developing a Strategic Facility Improvement Plan (SFIP). Although the scope of the SFIP does not the currently address the Linear Park Trail directly, any trail-related recommendations that may arise in the completed document (anticipated mid-2015) are considered MATS strategies as well.

Figure 2-7: Conceptual Linear Park Trail Buildout



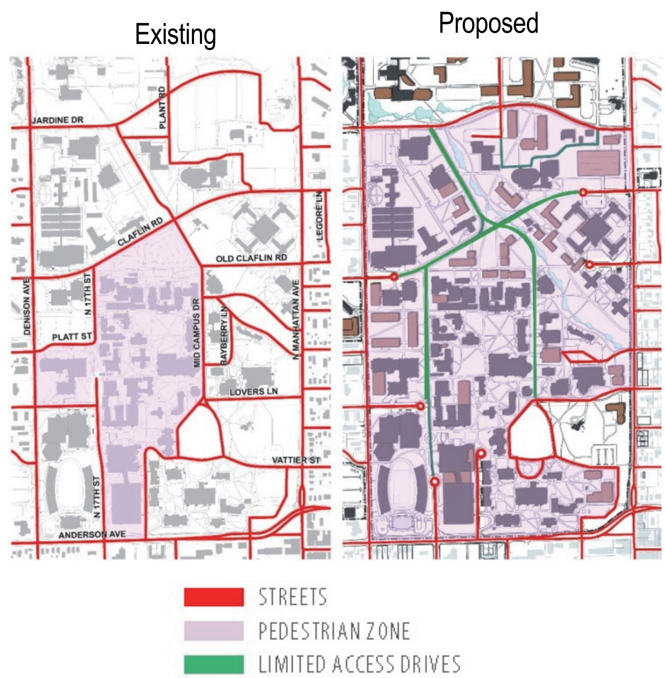
The southern portion of the trail, which represents most of the built portion, is generally on the fringes of the City of Manhattan and is typically isolated from the City's transportation by the Union Pacific Railroad tracks, and on the western portion, Wildcat Creek. Because it mostly skirts the edges of Manhattan, the Trail is much more of a recreational facility than it is a pedestrian transportation facility. However, maximizing access points to it from the City's transportation network will increase its attractiveness and thus, its usage. More discussion of the Trail related to bicycle transportation is included in **Chapter 3**.

K-State

As a result of the compact development of the core K-State campus, and its relatively flat terrain, the campus is considered to be very pedestrian-friendly. In general, most academic activities are located within a 10-minute walk of the Hale Library, which is considered to be the center of campus. Prioritizing pedestrian movements will remain a goal as the University grows. According to the K-State Master Plan, "Future development should replicate the density, spatial organization and park-like pedestrian quality of the historic core to the greatest extent feasible."

The campus currently includes a pedestrian zone, in which automobile travel is precluded because no streets exist. K-State's Master Plan aims to expand the concept, by limiting automobile traffic on 17th Street, Mid-Campus Drive, and Claflin Road, and eliminating or curtailing many other roads that currently enter campus. The goal is to relegate automobiles to the campus perimeter. **Figure 2-8** illustrates the existing pedestrian zone and its proposed expansion.

Figure 2-8: K-State Pedestrian Zone
(source: K-State Master Plan)



Pedestrian <u>access</u> to and from (as opposed to within) campus presents a few more challenges. Primary pedestrian access involves crossing one of three streets:

- Denison Avenue, on the west side, is a three-lane roadway with sidewalks on both sides that carries approximately 8,500 to 9,000 vehicles per day (vpd) between Anderson Avenue and Kimball Avenue. Denison Avenue does not include bike lanes, but does include sidewalks on both sides. Between the signalized intersections of Anderson Avenue and Claflin Road, Denison Avenue has three pedestrian-activated crossing beacons (one at Hunting Avenue, and two at different mid-block locations north of Platt Street. There is also a full traffic signal (including pedestrian signals and crosswalks) at the intersection of Denison Avenue and College Heights Road.

- Manhattan Avenue, on the east side, carries approximately 14,000 vpd between Anderson Avenue and Claflin Road. Manhattan Avenue carries sidewalks and narrow (approximately four-foot-wide) bike lanes on both sides; the 3,000-foot segment between the signalized intersections at Anderson Avenue and Claflin Road includes four intersections with pedestrian-activated flashing beacon installations.

- Anderson Avenue, on the south side, is a four-lane divided arterial that carries approximately 21,000 to 24,000 vpd. In the vicinity of campus, Anderson Avenue is missing sidewalk on both sides from Manhattan Avenue west to 14th Street. On the north side, the gap extends another 350 feet further west, past Thompson Hall – at which location there is a full pedestrian signal.

Manhattan Avenue and Anderson Avenue are operating very near their respective theoretical capacities, and all three roads have been cited as pedestrian crossing concerns in the K-State Master Plan. Pedestrian options for the campus perimeter are discussed further in **Section 2.2**.

2.2 Achieving Pedestrian System Objectives

Objective C-1: *Promote walking as a form of transportation.*

There are several ways the Manhattan Urban Area can promote walking:

- *Make the existing built environment more walkable* by filling gaps in the existing pedestrian network and encouraging active sidewalk maintenance. **Objective C-2** covers these items in more detail.

- *Design for future walkability and connectivity* through the design of new developments, new roadways, and new trails. With regard to development, the Manhattan Urban Area Subdivision Regulations currently say:

  > *Any type of street layout pattern may be used that best fits the topography. A curvilinear system, grid system, or modified grid system are acceptable alternatives. Cul-de-sac use should be carefully considered in the planning of a subdivision to ensure that all forms of vehicular and pedestrian traffic demands and other safety issues such as fire access have been adequately addressed.*

  The blanket statement "any type of street layout pattern" should be refined in light of current knowledge and national practice regarding subdivision layouts. Not every type of street layout pattern is pedestrian-friendly. Street layouts in residential subdivisions should discourage high traffic volumes and speeds. **Section 6.2** provides specific recommendations regarding modifying the language of the Regulations.

  Completing the Linear Park Trail will also promote walking, and is a recommended MATS strategy.

- *Market to citizens* through existing organizations and promotional materials. The Bicycle Advisory Committee (BAC) also addresses pedestrians, but its name may not reflect this. The committee should be renamed to reflect the fact that its goals center on both bicyclists and pedestrians. Other strategies concerning the BAC are included in **Chapter 3.**

Objective C-2: *Provide and maintain a continuous system of sidewalks that promotes transportation safety and user comfort, and accommodates the community's range of user types.*

This objective can be broken into three components: (1) continuity, (2) safety and comfort, and (3) user types. These are discussed in turn below.

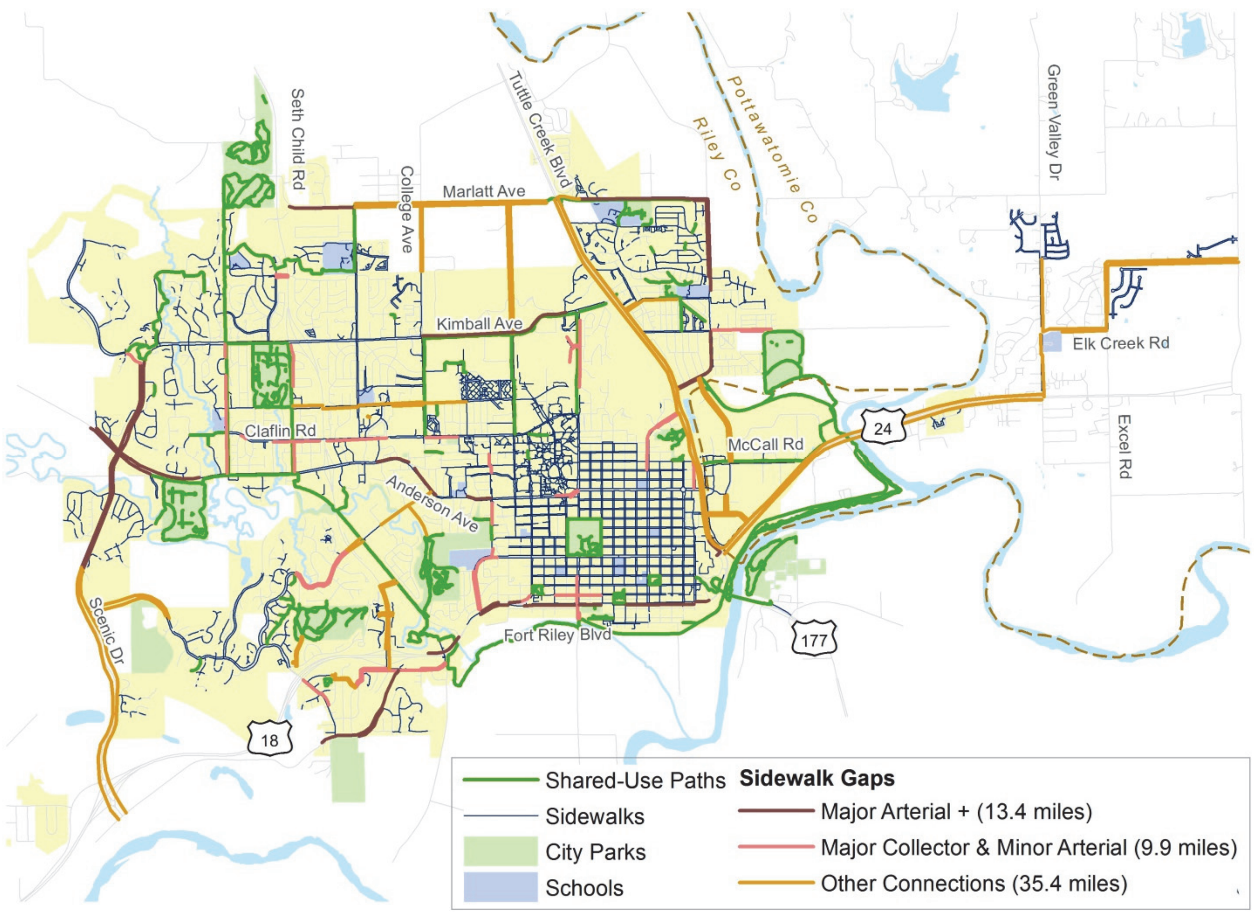
Continuity – Area-Wide

Figure 2-9 illustrates key gaps in the pedestrian network within the Urban Area, and is a mixture of quantitative and qualitative analysis. The City of Manhattan analyzed "policy gaps" for its collectors and arterials – facilities which, if the City's infrastructure matched its current subdivision regulations, would have sidewalks on both sides. MATS has further extended this by including a category called "Other Connections", which include facilities (1) on or along Manhattan's Minor Collectors and Local Roads, (2) on or along Principal Arterials, and (3) on or along facilities outside Manhattan but within the Urban Area. Together, the "policy gaps" and the "other connections" (52 miles in all) would knit a basic pedestrian network for the Urban Area, connecting to major destinations, schools, parks, and employment centers. **Appendix D** contains a prioritized list of these segments. **Table 2-2** summarizes the length of sidewalk in each priority category.

Table 2-2: Total Mileage – Pedestrian Continuity Projects

	Major Arterial	Major Collector/ Minor Arterial	Other Connections	Total
Near-Term (0-5 years)	1.9	4.5	3.8	**10.2**
Mid-Term (5-10 Years)	3.7	4.3	12.4	**20.3**
Long-Term (10-20 Years)	7.8	1.2	19.5	**28.4**

Figure 2-9: Pedestrian Continuity Projects



Continuity - Corridors

As mentioned elsewhere in this document, the unfinished portions of the Linear Park Trail represent a loop that needs to be closed. **Figure 2-9** includes the section of Marlatt Avenue from Tuttle Creek Boulevard to Browning Avenue as a continuity project, largely because it completes an important section of the Trail. The Figure also shows sidewalks along Denison Avenue and College Avenue connecting to the trail as longer-term improvements. The interior City pedestrian infrastructure should be connected with the trail wherever possible.

Other recent plans and documents also include pedestrian project recommendations, and these are incorporated into MATS by reference:

- The *Gateway to Manhattan (K-177 Corridor) Plan* included the recommendation to develop a sidewalk and multi-modal trail network map and work with KDOT to provide the necessary infrastructure improvements. It also included a more general recommendation to promote multi-modal connectivity along and across the Corridor.
- The *Eureka Valley – K-18 Corridor Plan* included a goal to establish an interconnected system of parks, trails, and open space, with several pedestrian-related objectives: (1) Develop a continuous trail system throughout the valley that connects Anneberg Park and the Miller Parkway Corridor with other park and open space areas in the valley and with the Linear Trail system; (2) Develop a trail along the Kansas River that connects to the Ogden river access.

Continuity - Local

Subdivision planning should also provide for pedestrian continuity. Pottawatomie County generally requires sidewalks on both sides of residential subdivision streets (where lot sizes are less than one acre). Manhattan and urban Riley County require sidewalks on just one side (collectors and arterials require sidewalks on both sides). These policies result in pedestrian connections on every street, but the City should not discourage developers from putting sidewalks on both sides of a local street.

Another issue that has arisen in subdivision design is the provision of pedestrian/bicycle connections between residential streets and longer, more connective parallel streets – and between adjoining cul-de-sacs. The City of Manhattan's subdivision regulations currently states:

> *Pedestrian easements not less than sixteen (16) feet in width shall be dedicated to the public through blocks where deemed beneficial by the MUAPB to provide for pedestrian access. These walkways shall be constructed in a manner approved by the City/County Engineer. (Section 10-301C)*

The Subdivision Regulations should be modified to include the following concepts, which should also be adopted by Pottawatomie County:

- Any proposed development that contains adjoining cul-de-sacs should include pedestrian/bicycle connections between them.
- Any new/proposed cul-de-sac that adjoins an undeveloped parcel should include right-of-way reserved for a future pedestrian/bicycle connection.
- In any proposed development, streets with properties that back onto collectors or arterials should provide direct bicycle/pedestrian access to these collectors/arterials, whether via connecting streets (as long as these streets meet the Access Management Guidelines) or dedicated bicycle/pedestrian facilities. The spacing between these connections should be no greater than 350 feet (consistent with the recommendations of **Objective G-3 in Section 6.2**.)

Safety and Comfort

The City of Manhattan is conducting a Safe Routes to School (SRTS) study, nearly complete at the time of this writing. Ultimately, the relevant recommendations of the SRTS will become MATS strategies.

Safety also includes safety at conflict points – addressed in **Objective C-4**. Comfort also includes consideration of facilities shared with other users – addressed in **Objective C-5**.

Pedestrian Level of Service (LOS) is primarily a measure of pedestrian perception of comfort and safety. It involves concepts such as sidewalk width and lateral separation from vehicular travel. Although at this stage of the evolution of the Urban Area's pedestrian transportation system, filling gaps is perhaps the most important priority, pedestrian LOS (defined in the Highway Capacity Manual) should be used to ensure that those gaps are filled by facilities providing adequate comfort and safety, especially in areas with higher pedestrian demand.

User Types

This aspect of **Objective C-2** encourages that pedestrian facilities be designed to accommodate users of all ages and mobility levels. The MATS strategy is to follow the U.S. Access Board's *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way* (historically known as PROWAG). PROWAG is expected to be formally adopted as a federal standard in the near future, and addresses the following elements:

- Pedestrian Access Routes (including sidewalks, street crossings, curb ramps/blended transitions)
- Detectable Warning Surfaces
- Medians and Traffic Islands
- Overpasses, Underpasses, and Bridges
- Pedestrian Signals
- Signs
- Roundabouts
- Toilet Facilities
- On-Street Parking and Passenger Loading Zones
- Transit Stops and Shelters
- Street Furniture and Other Elements

PROWAG should be incorporated, by reference at a minimum, into the pedestrian-facility design standards of the Urban Area Agencies.

Costs, Funding, Prioritization

Table 2-4 summarizes projects and funding sources listed in the City's Capital Improvement Program (CIP) from 2013 through 2015. Not all of the projects listed in the CIP are always funded or constructed, and thus the list has been at times more aspirational than concrete.

Many of the projects that have actually been built have been funded through the City-University Fund, consisting of monies transferred from the General Fund to support projects that are mutually beneficial to the City and the University. This is a strategy that will continue to work well in areas near the University, but is obviously not sufficient to build out needed pedestrian infrastructure area-wide.

In the past, several non-motorized projects within the City were funded by the Special Street and Highway Fund, derived from fuel taxes and distributed by the state of Kansas (the state has provided roughly $1.5 million per year in transportation funds to the City in recent years related to this fund). The City has shifted away from this practice in its

CIP processes for the past several years, and instituting a more formal allocation of this fund to non-motorized transportation projects (see later discussion) would be an important step to secure long-term growth of the pedestrian network through a more reliable funding stream.

Table 2-4: Pedestrian Facilities in the Capital Improvement Program (City of Manhattan)

Department/Division	Name	Funding Source	Cost (Budget Implications)
2013			
City-University	CU016P Sidewalk Construction at College Heights Rd.	City-University (100%)	$75,000 ($75,000)
City-University	CU017P Crosswalk Improvement Denison Ave North of Platt St.	City-University (100%)	$72,000 ($72,000)
City-University	CU750P KSU/City Sidewalk Bicycle and Lighting Improvements	City-University (100%)	$0 ($0)
2014			
City-University	CU025P Sidewalk Construction on Kimball between Denison and College Ave.	City-University (100%)	$80,000 ($80,000)
Citizen's Request	CR021P Pedestrian Cross-walk Signal at Anderson and Hudson	Grants (100%)	$20,000 ($0)
Citizen's Request	CR023P Sidewalk, South Side of Dickens Avenue Connecting to the Georgetown Apartments	City-University (50%) General Improvement (50%)	$50,500 ($50,500)
City Board & Committee Request	BR018P Annual Sidewalk Fund	General Improvement (100%) $	$50,000 ($50,000)
2015			
City-University	CU025P Sidewalk Construction on Kimball between Denison and College Ave.	City-University (100%)	$0 ($0)
City Board & Committee Request	BR018P Annual Sidewalk Fund	General Improvement (100%) $	$50,000 ($50,000)
Citizen's Request	Safe Pedestrian / Bicycle Path to the Northeast Park	Grants (64%) Other Sources (36%)	$260,000 ($0)
Citizen's Request	Extend Linear Trail	Other Sources (1%)	$0 ($0)
City Board & Committee	BR019P Bike and Pedestrian Improvements to the Intersection at Tuttle Creek Blvd and Kimball Ave.	Grants (100%)	$100,000 ($0)
City Board & Committee	BR020P Bike and Pedestrian Improvements to the Intersection at Tuttle Creek Blvd. and McCall Rd.	Grants (100%)	$180,000 ($0)
City Board & Committee	BR021P Bike and Pedestrian Path through City Park from the intersection at Manhattan Ave. and Central Park	Other Sources (100%)	$50,000 ($0)

The following additional strategies will support future funding and prioritization of pedestrian (and bicycle) infrastructure:

- Anticipate and provide for future pedestrian demand in the planning, design and construction of new transportation facilities – both in accordance with MATS recommendations and as reasonable expansion opportunities arise. Current lack of connectivity should not preclude the funding of projects. *For example, a bridge that is likely to* *remain in place for 50 years might be built with sufficient width for safe bicycle and pedestrian use in anticipation of those facilities availability at either end of the bridge, even if that is not currently the case.*

- Specifically dedicate Capital Improvement Project (CIP) funds to develop new non-motorized transportation projects. *The City and Urban Area must specifically dedicate funds as line items in capital budgets – a non-motorized transportation fund. A reasonable suggested starting point is a 2-percent allocation, which mirrors the federal Transportation Alternatives Program (TAP) allocation from the Highway Account of the Highway Trust Fund. For example, in Manhattan, this two percent could be computed against the total budget for the Special Street and Highway Fund. This approach would allow better planning of pedestrian infrastructure implementation and better tracking of non-motorized expenditures. The Public Works Department should systematically track the status of non-motorized transportation projects and expenditures.*

- Use the Bicycle Advisory Committee (BAC) as a sounding board for prioritization and pedestrian project integration. *One function of the BAC is to serve as a "watchdog" over implementation of the Urban Area's bicycle and pedestrian plans. As capital budgets are prepared, the BAC has been recommending projects, and should continue to do so. In addition, the BAC should be monitoring "non-pedestrian" capital projects to identify opportunities for pedestrian infrastructure integration and check that integration happens in keeping with MATS.*

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- Systematically identify and pursue non-local funding sources through a single point of contact. *As it continues to expand, the Urban Area needs a central, formalized process for pursuing and obtaining non-local or non-traditional funding for non-motorized projects. The most logical vehicle for this endeavor is the regional Bicycle/Pedestrian Coordinator recommended in **Chapter 3**. Potential funding sources (some of which have already been used in the Urban Area, and some of which have not) include:*

  - *Transportation Alternatives Program:* Federal funds awarded by KDOT for non-motorized projects (includes Transportation Enhancement (TE) Program and Safe Routes to School (SRTS) Program).
  - *Community Transformation Grants (CTG)*: Awarded by the Centers for Disease Control and Prevention (CDC) to state and local government agencies, tribes, and non-profits working to improve community health. Many of these projects are transportation-related.
  - *Community Development Block Grants (CDBG):* Provided by the Department of Housing and Urban Development (HUD) annually on a formula basis for community-based projects. The majority of funds must be used on activities that benefit low- and moderate-income persons. Examples of the types of projects funded include: sidewalk improvements; safe routes to school; and neighborhood-based bicycling and walking facilities that improve local transportation options or help revitalize neighborhoods.
  - *Recreational Trails Program (RTP):* Administered by Kansas Department of Wildlife, Parks and Tourism (KDWPT), this grant program provides eighty percent matching funds, on a reimbursement basis, for eligible recreational trail and trail-related projects. The program is not primarily for transportation purposes, but can fund the recreational portions of the system that also serve a transportation function.
  - *Land and Water Conservation Fund (LWC) Grants*: Administered by KDWPT in cooperation with the National Park Service, a 50/50 matching grant program. Qualifying projects include development and/or acquisition of outdoor facilities for the purpose of public recreation. Trails are one priority of this program.
  - Historic Preservation Fund (HPF): Administered by the Kansas State Historic Preservation Office (SHPO), this program funds up to 60 percent of the cost of eligible activities. The goal is to finance local preservation activities that will contribute to planning for the preservation of the built environment and archaeological resources. Many trail corridors contain structures, which are often of regional or national significance. The grant funds tangible products such as brochures, plans, or surveys.
  - *Urban and Community Forestry (UCF):* A federal program, sponsored in Kansas by the Kansas Forest Service, the primary focus of this program is "planting and sustaining healthy trees and vegetation wherever

people live and work in the State of Kansas." Mostly an education program, the UCF program "targets the need for tree planting and proper management of established trees within the city easement area, park areas as well as other naturalized areas" Trails and greenways are a key part of the program.

– *One-time Opportunities*: Other less programmatic grant opportunities arise from time to time, such as the federal TIGER program or FHWA's Non-Motorized Transportation Pilot Program. These grants can be sizeable – and in the case of TIGER, multi-modal projects are highly competitive. The Urban Area should track such opportunities through services such as grants.gov, and capitalize on them to improve bicycle infrastructure.

System Monitoring

As described more broadly in **Chapter 1** under **MATS Goal B**, monitoring the Urban Area's transportation system provides the feedback necessary to ensure it is performing as desired and to adjust plans as needed. Specific to bicycling, the following measures should be tracked:

- *Overall mileage of pedestrian facilities.* The Pedestrian Continuity Index, defined earlier in this Chapter, is a good measure indexing sidewalk and trail mileage against roadway mileage. The target for this index is 1.0 (or greater) over the lifetime of MATS, but a continual increase in this index is desirable. As more of the basic continuity projects are built out, the Urban Area should transition to a more robust index of network connectedness, one that more specifically penalizes gaps and discontinuities.

  The Urban Area should attempt to add at least two miles of pedestrian facilities per year – through new sidewalk projects, incorporation of pedestrian components into other roadway projects, and trail development – until the identified gaps are filled.
- *Percent commuters walking.* Track the American Community Survey (ACS) commute statistics (see **Figure 2-5**), with the goal (through the promotional activities described in **Objective C-1** and the network-expanding activities described in **Objective C-2**) of remaining in the top 3 percent of U.S. small cities with regard to commuting by foot.
- *Pedestrian crashes.* Systematically track pedestrian crash data across the Urban area (and annually reported) using a common database. Pedestrian crashes are relatively rare events, so setting a target rate is not a reasonable approach. Systematically tracking crashes annually, and setting a goal of declining crash rates, is a good strategy. A target of zero pedestrian fatalities is also part of this strategy.
- *Pedestrian counts.* Conduct pedestrian counts annually at key locations on weekdays and weekends to track trends and monitor high-volume locations. FHMPO has taken on this function.

Objective C-3: *Where pedestrians share facilities with other modes (e.g., shared-use paths and trails), provide for safe and comfortable pedestrian operations.*

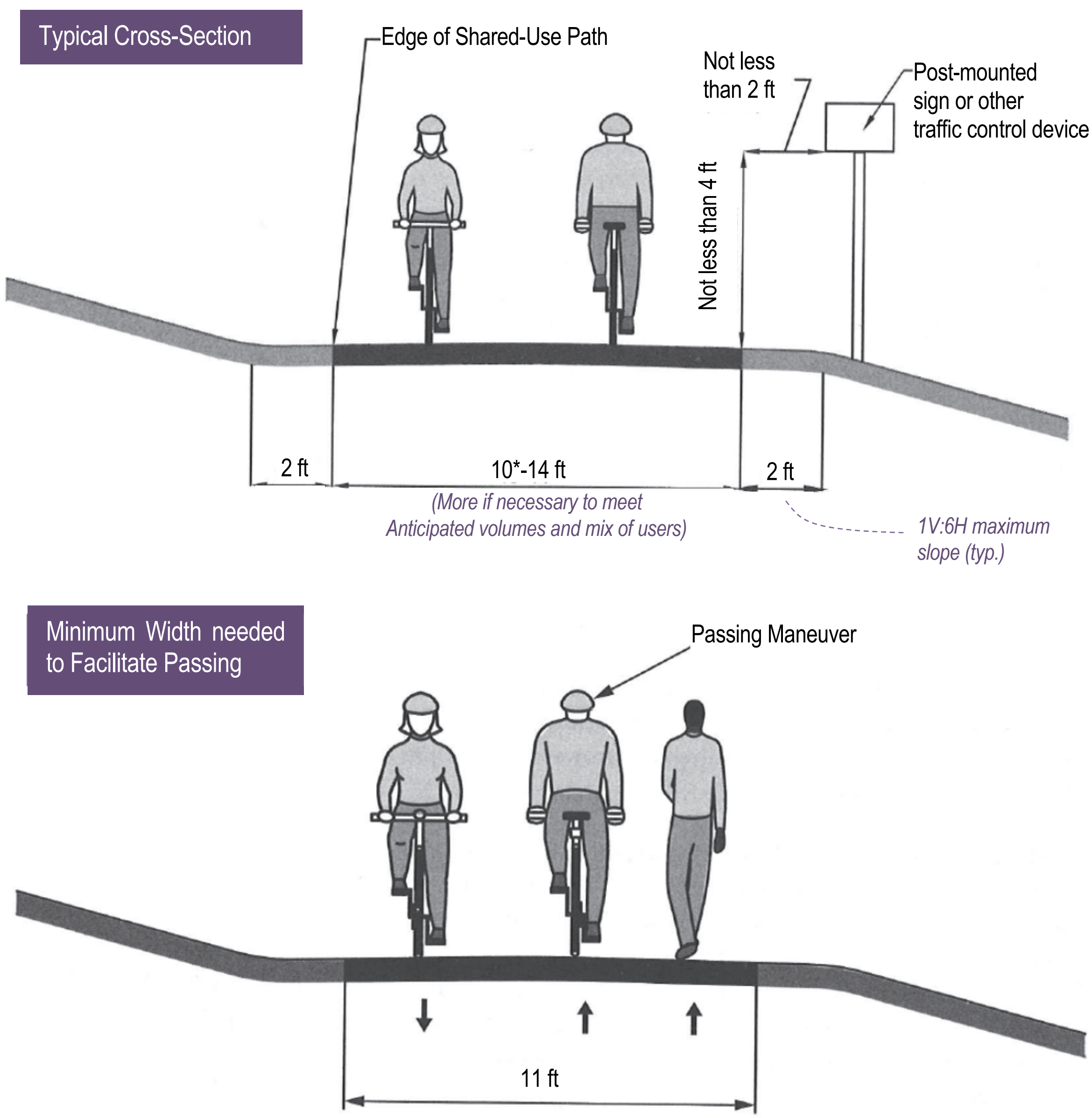
This objective largely relates to trails or shared-use paths, on which pedestrians, joggers, and cyclists all must coexist safely.

Due to the typical discrepancies in speeds between cyclists and pedestrians, trails and shared-use paths are usually designed to facilitate easy passing. When moderate to high user volumes exist or are anticipated, LOS as defined by the Highway Capacity Manual (HCM) should be checked to ensure adequate passing capacity.

None of the jurisdictions in the Urban Area currently has shared-use path or trail design standards. The MATS strategy is for the jurisdictions to adopt a uniform set of design standards. The design standards included in the *AASHTO Guide for the Development of Bicycle Facilities* should be the template. Key elements of shared-use path design in the guide include accessibility requirements, width/clearance, sidepath guidelines and concerns, design speed, horizontal alignment, cross slope, grade, stopping sight distance, surface structure, bridges/underpasses, drainage, lighting, intersection design, intersection treatments, crossing considerations, pavement markings, signs, and signals. **Figure 2-10** is adapted from the guide and shows shared-use path widths.

Figure 2-10: Shared-Use Path Widths

(adapted from AASHTO Guide for the Development of Bicycle Facilities)



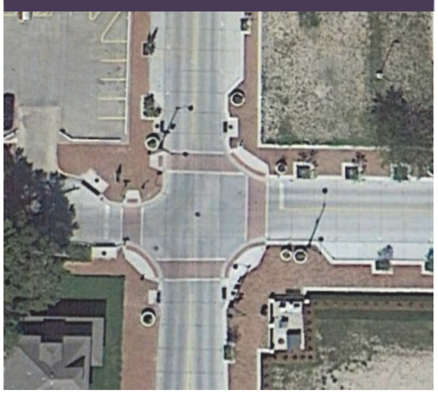
**An 8-foot minimum may be used as a last resort in situations where constraints dictate.*

> ***Objective C-4:*** *Where pedestrians conflict with other modes (e.g., street crossings), minimize pedestrian exposure and design for pedestrian convenience and safety.*

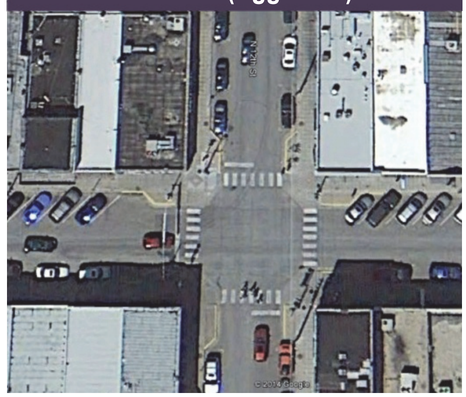
This objective primarily relates to intersections and mid-block crossings, at which pedestrians are exposed to automobile traffic. Minimizing pedestrian exposure generally translates to making crossing times as short as possible. In addition to minimizing street cross-sections to the extent possible, additional examples include:

- *Bulbouts:* On roads with parking, it is often possible to narrow the road at intersections. A recent example can be found on the 3rd and 4th Street corridors between Fort Riley Boulevard and Pierre Street.

4th/Colorado

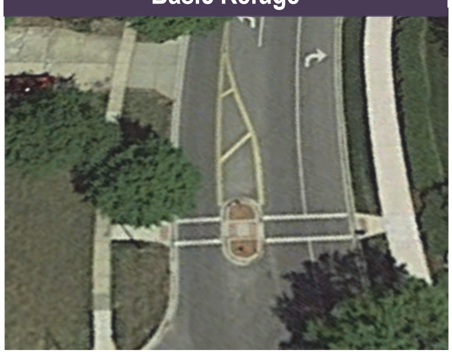


12th/Moro (Aggieville)

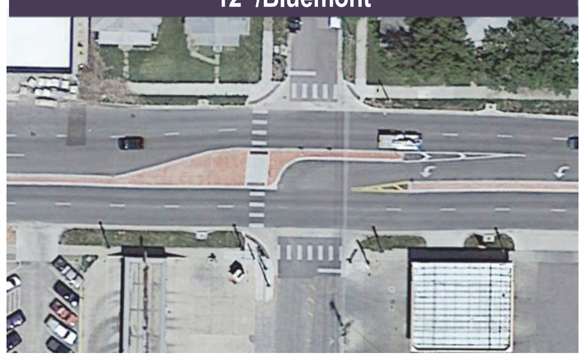


- *Median Refuges:* Installing an island in the center of a roadway, or making a pedestrian cut in an existing median, can convert a road crossing into a two-stage crossing, allowing pedestrians to have to concentrate on only one direction of conflicting traffic at a time.

Basic Refuge



12th/Bluemont



These types of treatments, in addition to high-visibility crosswalk markings (both zebra striping and color-contrast options) have been applied at key pedestrian-crossing areas throughout the Urban Area.

At signalized pedestrian crossings, **Objective C-4** includes providing adequate pedestrian crossing times and ensuring that pedestrian signal equipment – both design and location – meet national accessibility guidelines at a minimum. The

City requires that all new traffic signal installations comply with PROWAG. In addition to these accessibility considerations, the City installs countdown pedestrian signals at all new installations.

Secondarily, **Objective C-4** also relates to locations where trails intersect sidewalks. Because the Linear Park Trail runs largely at the edge of the city, and because there are limited sidewalks throughout the urban area, true intersections between sidewalk and trail are somewhat rare. But as the trail system and the sidewalk system both expand, it will be important to ensure that designs ensure maximum visibility between trail and sidewalk users, and appropriate signing and marking are included if necessary to indicate which users have the right-of-way – in conformance with national standards.

The following MATS strategies support the planning and design of pedestrian intersections/crossings:

- Follow PROWAG in the design of traffic signals/appurtenances, curb ramps, sidewalks, and crosswalks.
- Include pedestrian signals and pushbuttons on all legs of all signalized intersections. All pedestrian signals should be countdown signals.
- Minimize pedestrian crossing distances/times by minimizing road width wherever possible, while maintaining necessary vehicle turning radii. Use bulbouts at intersections along streets with on-street parking.
- Wherever crosswalks do not consist of decorative paving, use high-visibility longitudinal ("zebra") markings.
- If a crosswalk is made of decorative/contrasting pavement material, the edges should still be striped to enhance visibility (especially nighttime visibility).
- Where an unsignalized crossing exists at a transit stop, enhanced crossing treatments or actuated signals should be added. Transit stops should ideally be located so that pedestrians cross behind the bus or transit vehicle. Far-side stop placement is preferable to near side or midblock placement and increases the visibility of pedestrians crossing behind the bus.
- Install a midblock crosswalk where there is a significant pedestrian desire line to cross between intersections. Frequent applications include midblock bus stops, shared-use path crossings of roadways, parks, plazas, building entrances, and midblock passageways. Additional design guidelines include:
  - Use vertical elements such as trees, landscaping, and overhead signage help to identify mid-block crosswalks and islands to drivers.
  - Set stop lines at midblock crossings back 20–50 feet, to ensure that a person crossing the street is visible to the second driver when the first driver is stopped at the stop line.
  - On roadways with on-street parking, prohibit parking across mid-block crosswalks, and install curb extensions where possible to shorten walk times and increase pedestrian visibility.
  - Provide a refuge island (if no median is present) for any unsignalized mid-block crossing wider than 36 feet.
- Where pedestrian safety issues have become a concern at key access points to parks, schools, and at intersections with local streets, consider raised crossings to increase visibility and yielding behavior.
- At intersections between trails or multi-use paths and sidewalks, maximize visibility between users (design for bicycle speeds), and install appropriate signing and marking to indicate which approach(es) has the right-of-way.

K-State Perimeter

As mentioned in **Section 2.1**, pedestrian crossings of Anderson Avenue, Denison Avenue, and Manhattan Avenue to get to and from the K-State campus are a concern. As **Figure 2-6** illustrated, a few crashes involving pedestrians have been reported in the southeast perimeter of campus in recent years. Projected growth in student-oriented housing on the east and west side of campus will increase the amount of pedestrian (and bicycle traffic) crossing Denison Avenue and Manhattan Avenue.

Given the current conditions and future potential increases, additional crossing protection should be implemented on Denison Avenue and Manhattan Avenue. One logical upgrade might be to convert some of the pedestrian-activated flashing beacons on Denison Avenue/Todd Road, Denison Avenue/Hunting Avenue, and Manhattan Avenue/Lovers Lane to a more active form of signalization. Pedestrian Hybrid Beacons (also known as HAWK signals) or full signalization could be options at key locations. In addition, raised crosswalks or other pedestrian treatments could be implemented at one or more of the Denison mid-block crossings. MATS recommends that a detailed pedestrian crossing study be conducted on the campus perimeter to refine these conceptual ideas.

Objective C-5: *Promote safe and accessible connections for pedestrians between different facility types and with other transportation modes.*

Because the pedestrian scale is fairly small compared to other transportation modes, these connections are at a very focused level:

- *Sidewalk to bus:* Generally speaking, the City's fixed-route bus stops have been located with pedestrian access in mind, and most either provide sidewalk connections or are located within parking lots. As described in **Chapter 4** of this document, MATS recommends the provision of benches and shelters at fixed-route bus stops to improve pedestrian comfort and protection while waiting for public transportation.

- *Parking access:* MATS recommends that surface and structured parking lots in the Urban Area be designed to facilitate safe and efficient movement for pedestrians between their cars and their destinations. **Chapter 5** discusses best practices for parking lot design in more detail.

- *Bicycle racks:* **Chapter 3** points to a recommended bicycle parking design guideline, but with respect to pedestrian access, the key MATS strategies are to locate bike racks with visible and easy pedestrian access, and to locate them in such a way that they do not encroach on the pedestrian access route (as defined by PROWAG).

Objective C-6: *Maintain a Pedestrian Master Plan for planning, design, implementation and monitoring of the pedestrian system.*

At this time, MATS serves as the Pedestrian Master Plan. Going forward, a separate plan should be developed, and the MATS pedestrian chapter could become a more general set of strategies largely pointing to the Pedestrian Master Plan.

Table 2-5: MATS Pedestrian Strategies		
Strategy	**Responsible**	**Priority**
Promotion		
Rename the Bicycle Advisory Committee (BAC) to reflect the fact that it also addresses pedestrian issues	**Lead:** City Public Works, BAC **Involve:** City Commission, Pottawatomie Co. Public Works / Zoning / Board of County Commissioners	1
Network		
Build pedestrian continuity projects (see text)	**Lead:** Public Works – City and Counties, City Parks & Recreation **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
Complete the northern section of the Linear Park Trail	**Lead:** City Parks & Recreation **Involve:** Riley Co Public Works, City Public Works, Riley Co Planning & Development, City Community Development, City Parks and Recreation Advisory Board, K-State	3
Build a sidewalk and multi-modal trail network in the Gateway to Manhattan (K-177) Corridor	**Lead:** Riley Co Public Works **Involve:** Riley Co Planning & Development, KDOT, FHMPO, City Parks & Recreation	3
Develop a continuous trail system throughout the Eureka Valley (K-18) Corridor	**Lead:** Riley Co Public Works, City Public Works **Involve:** Riley Co Planning & Development, City Community Development, KDOT, FHMPO, City Parks & Recreation	3
Modify Subdiivision Regulations to include (1) pedestrian connections between cul-de-sacs and (2) connections to parallel collectors/arterials.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Pottawatomie Co. Public Works / Zoning / Board of County Commissioners	2
Incorporate relevant Safe Route to School (SRTS) recommendations as MATS strategies.	**Lead:** Public Works – City and Counties, USD 383 **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	2
Adopt HCM LOS to support design in areas with higher pedestrian demand.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	2
Follow PROWAG in the design of pedestrian facilities.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
Costs, Funding, Prioritization		
Anticipate and provide for future bicycle demand in the planning, design and construction of new transportation facilities.	**Lead:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works **Involve:** Flint Hills MPO	O
Consider alternative local means of funding non-motorized transportation (see text).	**Lead:** Regional Bicycle/Pedestrian Coordinator **Involve:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works, Flint Hills MPO	3
Systematically identify and pursue non-local funding sources through a single point of contact.	**Lead:** Regional Bicycle/Pedestrian Coordinator **Involve:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works, Flint Hills MPO	O
Specifically dedicate CIP funds to develop non-motorized transportation projects.	**Lead:** Public Works – City and Counties **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	2

***1 = Immediate Priority,** to be implemented with MATS adoption or shortly thereafter; **2 = High Priority,** to be initiated as soon as possible and completed within one to two years after MATS adoption; **3 = Moderate Priority,** to be completed within three to five years after MATS adoption; **O = ongoing,** actions that occur continually.*

Table 2-5: MATS Pedestrian Strategies (Cont'd)		
Strategy	**Responsible**	**Priority**
Monitoring		
Target a Pedestrian Continuity Index (see text) of 1.0, and add at least two miles a year until the future pedestrian network is built out.	**Lead:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works **Involve:** BAC, Flint Hills MPO	O
As pedestrian continuity projects begin to be built out, transition to a more robust network connectedness measure	**Lead:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works **Involve:** BAC, Flint Hills MPO	3
Track ACS bicycle commute statistics with the goal of remaining in the top 3% of U.S. small cities.	**Lead:** Regional Bicycle/Pedestrian Coordinator **Involve:** Flint Hills MPO, BAC	O
Systematically track pedestrian crash data across the Urban area (and annually report) using a common database - setting a goal of declining crash rates, and a target of zero pedestrian fatalities.	**Lead:** Public Works – City and Counties **Involve:** Flint Hills MPO, BAC	O
Conduct pedestrian counts annually at key locations on weekdays and weekends to track trends and monitor high-volume locations.	**Lead:** Flint Hills MPO **Involve:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works, BAC, K-State	O
Shared-Use Paths and Trails		
Adopt HCM LOS for shared-use paths where moderate to high user volumes exist or are anticipated	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	2
Adopt a uniform set of shared-use path / trail design standards, using AASHTO's *Guide for the Development of Bicycle Facilities* as a template.	**Lead:** Public Works – City and Counties **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners	2
Crossings/Intersections		
Follow PROWAG in the design of traffic signals/appurtenances, curb ramps, sidewalks, and crosswalks.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
Include countdown pedestrian signals and pushbuttons on all legs of all signalized intersections.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
Minimize pedestrian crossing distances/times by minimizing road width wherever possible. Use bulbouts at intersections along streets with on-street parking.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
Use high-visibility longitudinal ("zebra") crosswalk markings.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
If a crosswalk is made of decorative/contrasting pavement material, the edges should still be striped to enhance visibility	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O

****1 = Immediate Priority,** to be implemented with MATS adoption or shortly thereafter; **2 = High Priority,** to be initiated as soon as possible and completed within one to two years after MATS adoption; **3 = Moderate Priority,** to be completed within three to five years after MATS adoption; **O = ongoing,** actions that occur continually.*

Table 2-5: MATS Pedestrian Strategies (Cont'd)		
Strategy	**Responsible**	**Priority**
Crossings (Cont'd)		
Where an unsignalized crossing exists at a transit stop, enhanced crossing treatments or actuated signals should be added. Transit stops should ideally be located so that pedestrians cross behind the bus or transit vehicle.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
Install a midblock crosswalk where there is a significant pedestrian desire line to cross between intersections.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
Where pedestrian safety issues have become a concern at key access points (see text), consider raised crossings to increase visibility and yielding behavior.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
At intersections between trails or multi-use paths and sidewalks, maximize visibility and right-of-way clarity.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
Conduct a study of K-State campus perimeter crossings to determine the optimal crossing protection/enhancement strategies.	**Lead:** Public Works – City, K-State **Involve:** City Community Development	2
Intermodal Connections		
Provide benches and shelters at fixed-route bus stops to improve pedestrian comfort and protection while waiting for public transportation.	**Lead:** Transit Agency, City Public Works **Involve:** FHRTA, City Community Development, K-State	3
Design surface and structured parking lots to facilitate safe and efficient movement for pedestrians between their cars and their destinations.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
Locate bike racks with visible and easy pedestrian access, in such a way that they do not encroach on the pedestrian access route.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O

***1 = Immediate Priority,** to be implemented with MATS adoption or shortly thereafter; **2 = High Priority,** to be initiated as soon as possible and completed within one to two years after MATS adoption; **3 = Moderate Priority,** to be completed within three to five years after MATS adoption; **O = ongoing,** actions that occur continually.*

3.0 Bicycle Facilities

MATS Goal D: Provide and maintain a safe, convenient, and connected transportation system for bicyclists – designed to maximize usage.

Bicycles can serve both recreation and transportation purposes. Thus, the provision of bicycle facilities in urban areas is often divided between Public Works and Parks/Recreation departments. The Five-Year Strategic Plan for Bicycling (2011) conceives of an "interconnected web of bicycle facilities"; discussions during MATS development pointed toward the transportation and recreation functions being envisioned as a whole, and this document applies that philosophy area-wide.

The City assembled a Bicycle Advisory Committee and created a Bicycle Coordinator (intern) position in 2008. In 2012, Manhattan was named by the League of American Bicyclists as a Bronze Level Bicycle Friendly Community. These are very positive steps toward increasing the urban area's bicycle-friendliness.

3.1 Existing/Historical Conditions

Existing Infrastructure

Figure 3-1 illustrates bicycle facilities in the Manhattan Urban Area, which are generally restricted to the City of Manhattan. The Five-Year Plan refers to three categories of facilities:

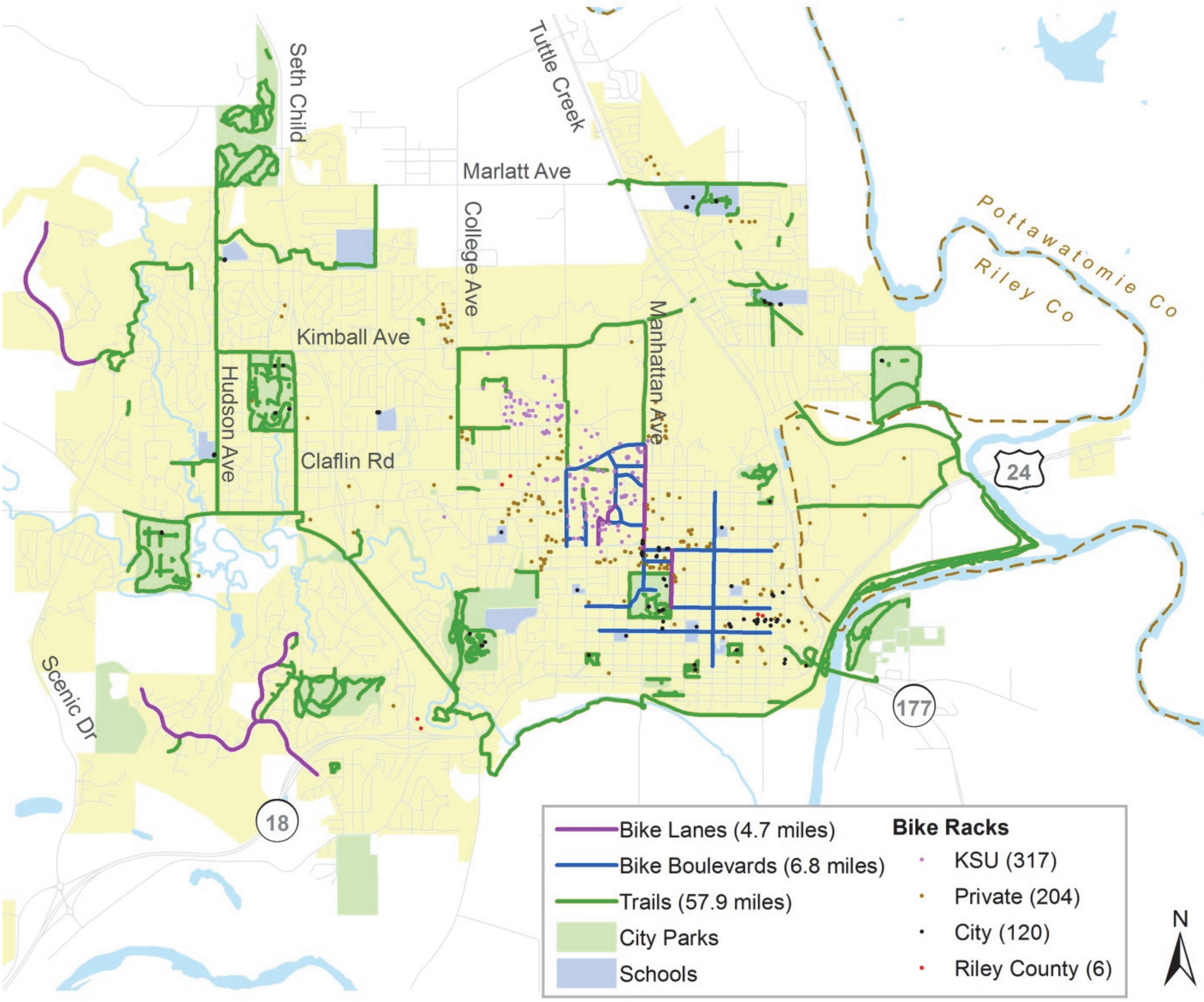
- *Bicycle Boulevards:* Shared roadways (bicycles and motor vehicles share the space without marked bicycle lanes) on which the through movement of bicycles may be given priority over motor vehicle travel. Traffic calming measures are used to control traffic speeds and discourage through trips by motor vehicles.
- *Bike Lanes:* Striped lanes for exclusive use by bicyclists, accompanied by signs and pavement markings.
- *Multi-Use Paths*: Off-street paths designated for bicycle and pedestrian usage and striped for two-way traffic. The Five-Year Plan makes a distinction between multi-use paths and trails, considering trails as recreational facilities not designed for transportation purposes. Off-street paths are called a "last resort to separate bicyclists on busy, multi-lane roadways (10,000 vehicles per day or more)."

As **Figure 3-1** shows, the bicycle transportation system in the Manhattan Urban Area is not particularly robust – however, it has begun to move forward in recent years as the Five-Year Plan has begun to be implemented. There are currently 4.7 miles of bike lanes and 6.8 miles of bike boulevards. The trails and paths shown in the figure, which were also shown in **Figure 2-1** as pedestrian facilities, do not meet the Five-Year Plan's definition of transportation facilities; however, they do offer connectivity of which bicyclists can avail themselves.

It should be noted that the City of Manhattan recently installed a barrier-separated contraflow bike lane on Manhattan Avenue just south of Anderson Avenue (at the west edge of Aggieville just south of K-State). In current parlance, this would be termed a *cycle track* or *protected bike lane.* More discussion of bicycle facility types and nomenclature can be found in **Section 3.2**.

Figure 3-1 also illustrates bicycle parking locations in the study area. There are 647 bicycle racks in the Manhattan Urban Area, representing well over 6,000 bicycle parking spots. As the figure shows, most bicycle parking clusters in and around the K-State campus and Aggieville. A fair amount is located Downtown, and other locations are scattered throughout the urban area. Bicycle racks continue to be added to the system; the City of Manhattan currently has a practice of requesting that bicycle racks be included in new development projects.

Figure 3-1: Existing Bicycle Facilities



Notes:

1. *Facilities shown as trails within parks may or may not qualify as bicycle facilities.*
2. *Areas identified as parks include City parks, parkland owned by K-State and Counties, and City cemeteries.*

System Usage

Although comprehensive data on bicycle travel throughout the urban area is not available, a series of bicycle (and pedestrian) counts were recently conducted by FHMPO on weekdays (mid-day and p.m. peaks) and Saturday mid-day peaks. **Figures 3-2a and 3-2b** illustrate weekday mid-day and p.m. bicycle volumes. Comparison to **Figures 2-5a and 2-5b** reveals that bicycle volumes are much lower than pedestrian volumes in the same areas. Bicycle volumes are highest in some areas near campus.

Figure 3-2a: Peak-Hour Bike Volumes - all, Weekday - mid-day

(Raw Data Source: Flint Hills MPO, Aggregated by HDR)

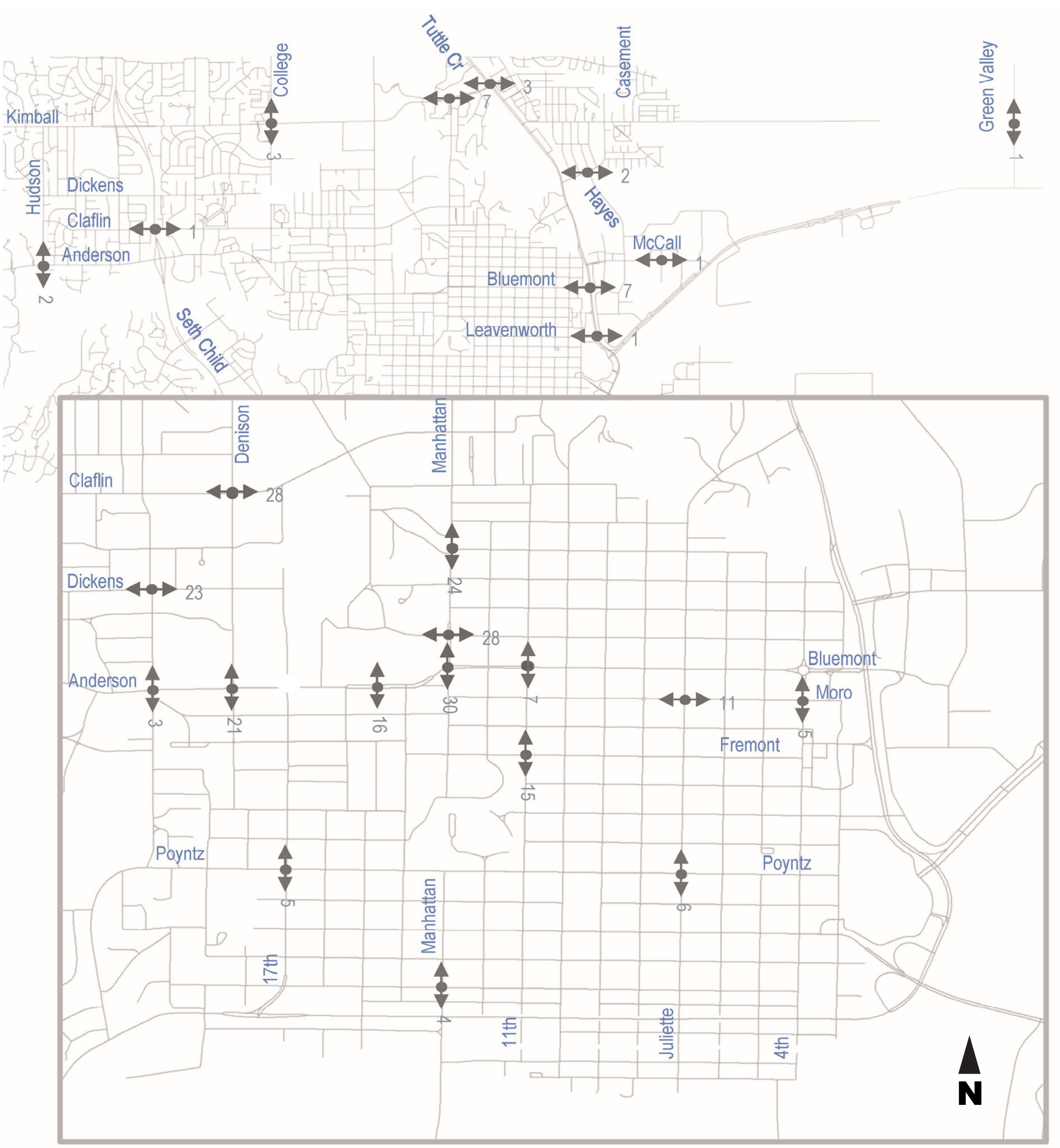
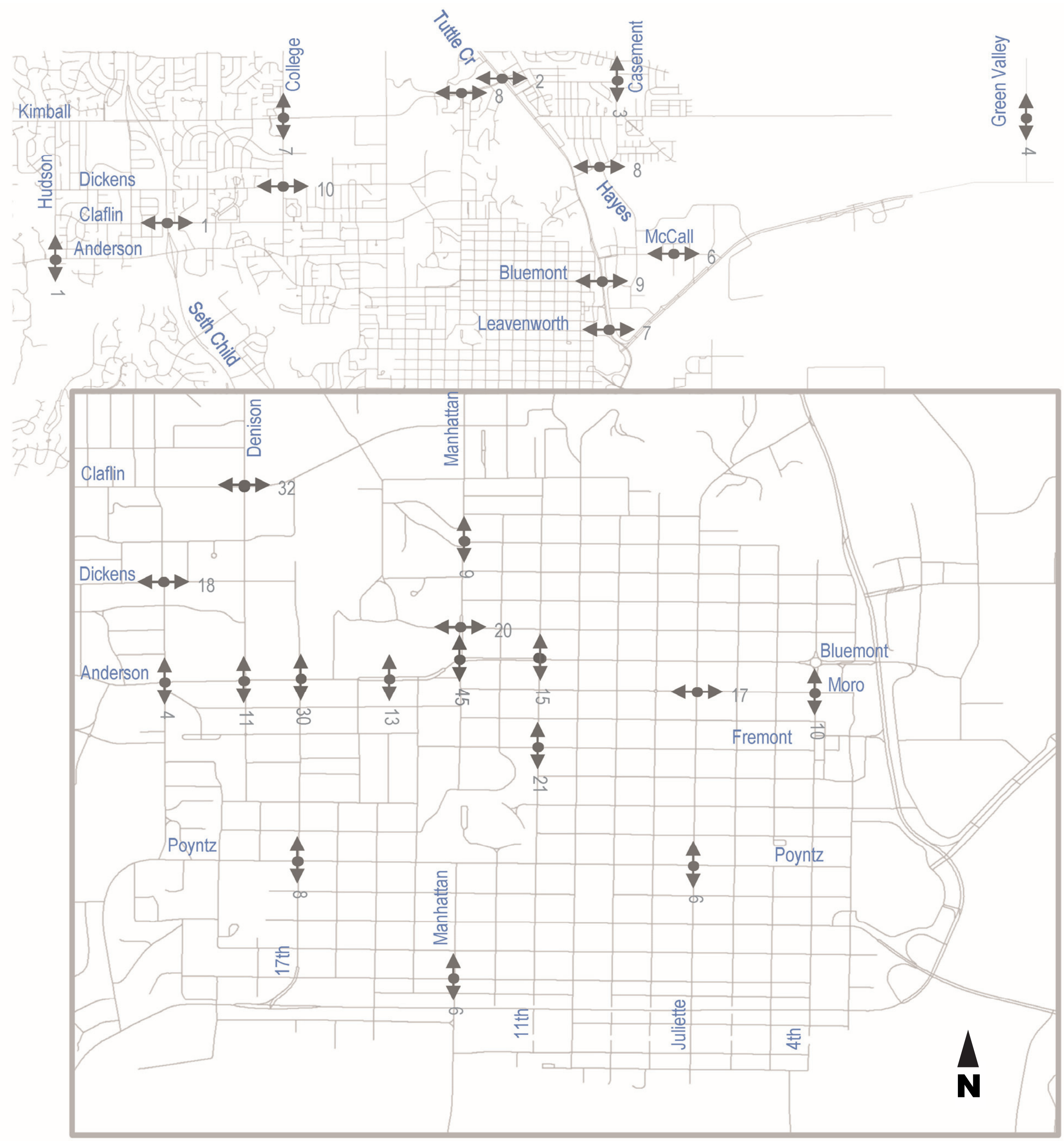


Figure 3-2b: Peak-Hour Bike Volumes - all, Weekday - p.m.

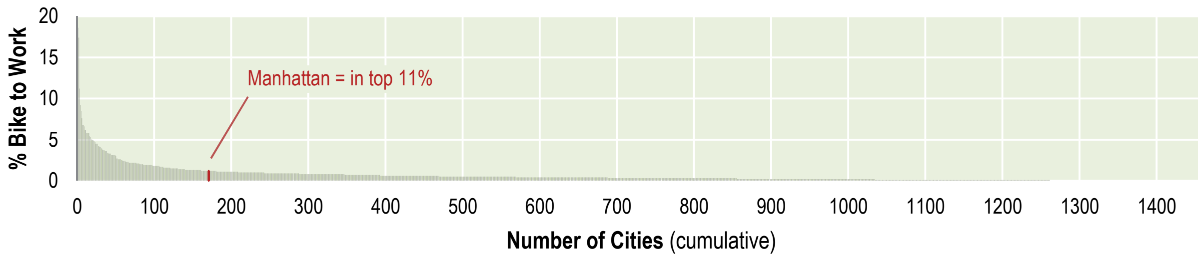
(Raw Data Source: Flint Hills MPO, Aggregated by HDR)



Census statistics can also shed light on bicycle usage in the urban area. The American Community Survey (ACS) is a mandatory, ongoing statistical survey – conducted by the U.S. Census Bureau – that samples a small percentage of the U.S. population every year with the goal of giving communities information to support planning for investments and services. For areas the size of Manhattan, three years of data are used to achieve a reasonable sample size. Residents of homes and group quarters (such as dormitories) are included in the survey.

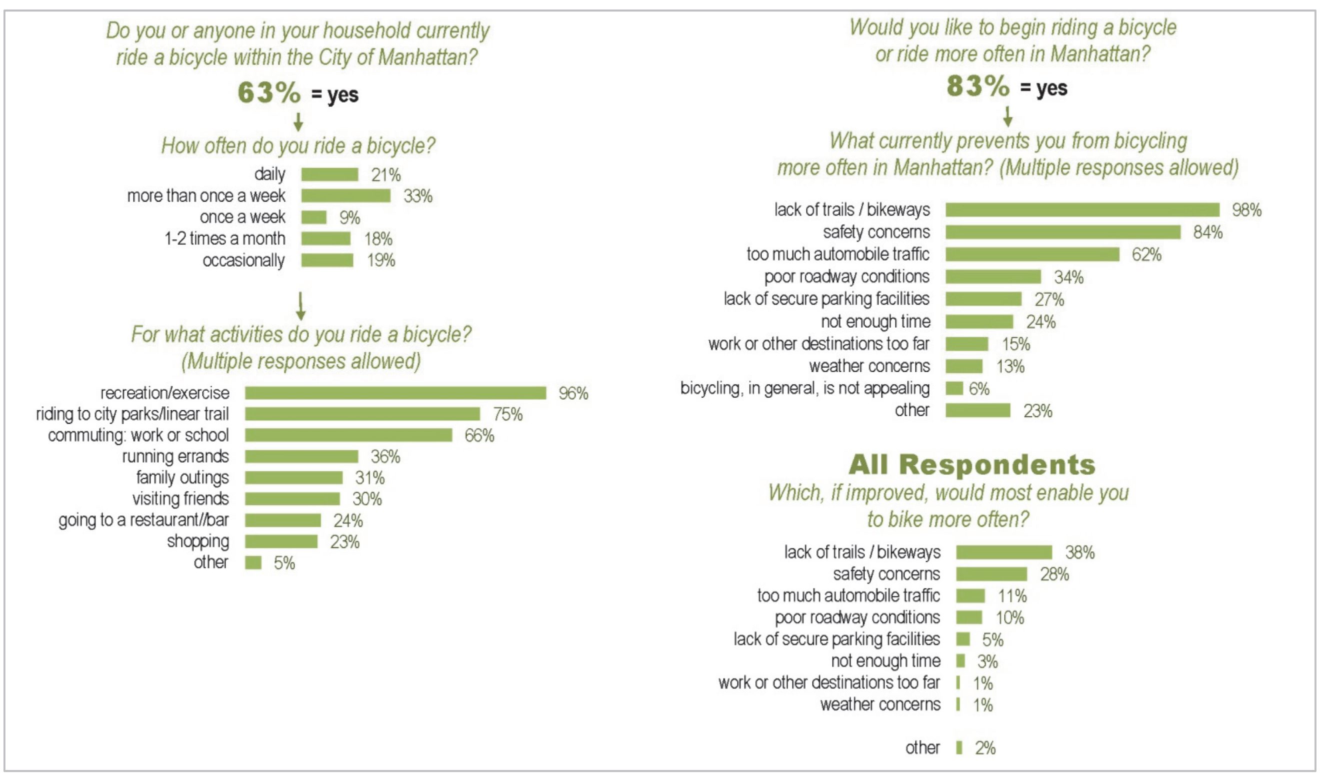
According to the most recent ACS five-year estimates, 1.2 percent of journey-to-work trips within the City of Manhattan were by bicycle. (The 90-percent confidence range is 0.7 to 1.7 percent.) As **Figure 3-3** indicates, this places Manhattan in the top 11 percent of the 1,465 communities surveyed.

Figure 3-3: Percent of Workers who Commute by Bicycle
Small U.S.Cities (pop = 20,000 - 99,999), 2012



Additional information on usage can be gleaned from a 2008 survey on bicycle use in Manhattan, as shown in **Figure 3-4**. Another survey specific to KSU students and employees was conducted in 2011, and nearly half of respondents indicated that they ride a bicycle at least once a week. Based on these surveys, it is clear that (1) the Urban Area has a sizeable amount of bike owners and riders, and (2) many of them would ride more often if a safe, continuous bicycle network were available.

Figure 3-4: Selected Bicycle Survey Results, 2008, City of Manhattan



System Safety

As with pedestrian-related crashes, the Riley County Police Department crash database includes bicycle-related crashes (although not geocoded). **Table 3-1** summarizes the bicycle-related crashes logged by this database from 2010 to 2014.

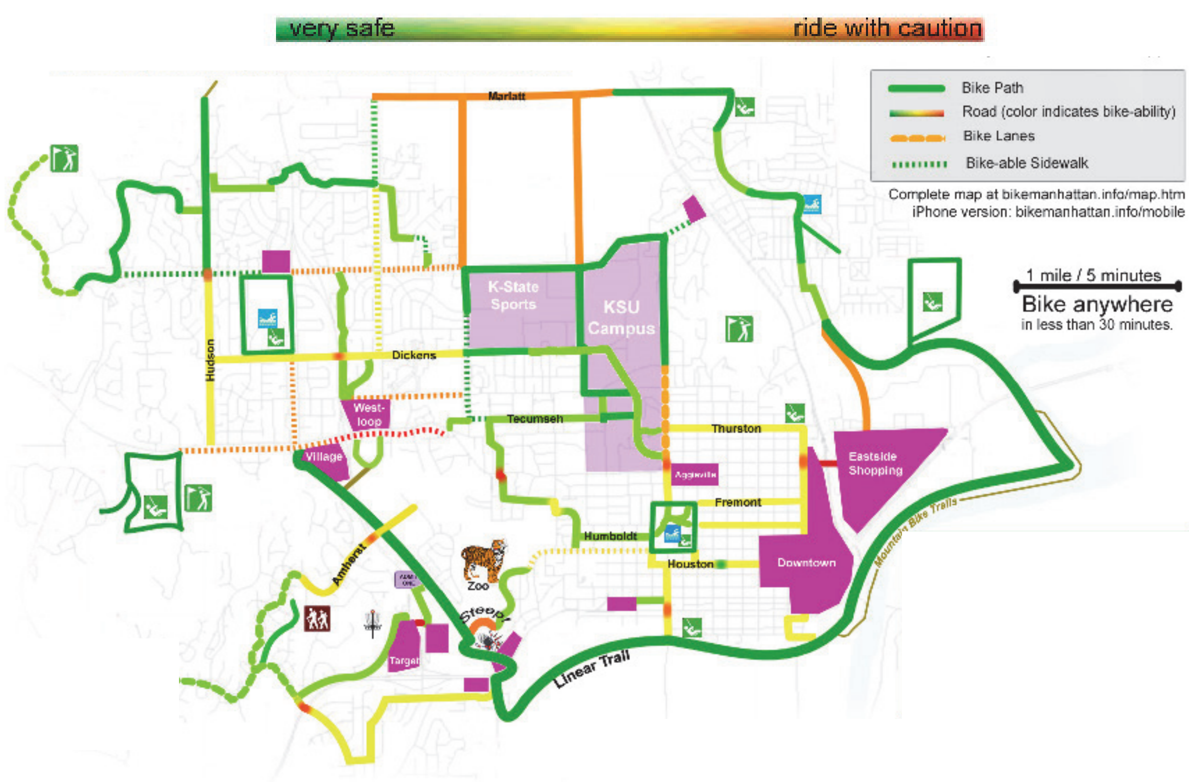
Another indication of areas with potential safety concerns is the "Bike Everywhere" map provided by Bike Manhattan, a local advocacy group (see **Figure 3-5**). The map is evidence, albeit non-statistical, that might warrant further investigation for safety improvements at several locations:

- Bluemont Ave – Downtown/Eastside connection
- Anderson Ave/Canfield Dr
- Miller Pkwy/K-18
- Amherst/Seth Child
- Dickens/Seth Child
- N. Manhattan Ave/Anderson Ave
- S. Manhattan Ave/Ft. Riley Blvd
- Hudson/Kimball

Table 3-1: Bicycle-Related Crashes, 2010-2014
City of Manhattan *(Source: Riley Co PD)*

Year	Crashes
2010	21
2011	19
2012	6
2013	8
2014	10
Total	64
Annual Average	12.8

Figure 3-5: Safety Indications on "Bike Everywhere" Map



3.2 Achieving Bicycle System Objectives

Many of the objectives described below are already supported by the 1998 Bicycle Master Plan. The Plan includes facilities mostly within the City, but also includes facilities outside the City limits in Riley and Pottawatomie Counties. In 2011, the Five-Year Strategic Plan for Bicycling was completed, clarifying near-term steps to implementation of the earlier plan. By incorporating most of the Five-Year Plan herein, MATS applies the principles and recommendations to the entire Manhattan Urban Area.

Objective D-1: *Promote bicycling as a form of transportation.*

Perhaps the best ways for the Manhattan Urban Area to promote bicycling as a form of transportation are:

- To continue to build out a comprehensive area-wide bicycle network, and to create policies that will facilitate that build-out. The details of this network are more appropriately described under **Objective D-2**.
- To plan future land-use growth that supports a bikeable community. The Manhattan Urban Area Comprehensive Plan (MUACP) policies guide land-use planning for the Urban Area, and promote a balanced mix of land uses – including some new higher-density areas near the K-State campus – that can help decrease the reliance on automobiles and thus support alternative transportation modes such as bicycling. For more details on specific policy recommendations, the reader is referred to the MUACP document.

However, there are many other specific steps that the Urban Area can take to promote bicycling; they are described below.

Community Activities

The City of Manhattan continues to increase its promotion of bicycle transportation. For example, the City officially proclaims Bike Month in May of every year. Bike Month activities are organized by an unofficial committee of interested citizens and stakeholders, with the City's Bicycle Coordinator as an informal liaison. The committee traditionally has representatives from the Riley County Police Department, Riley County Emergency Medical Services, Riley County Health Department, KSU Students for Environmental Action, City of Manhattan, local businesses, the City's two bike shops, non-affiliated community members, departments from KSU (kinesiology, business, community and regional planning), and others. For 2014, numerous events were organized, including:

- A commuter challenge for businesses, university departments, and other organizations, with prizes awarded to the group with the most trips per participant.
- A bicycling progressive dinner.
- Bike rides to the Kansas Sampler in Wamego, the Tall Grass Brewery, a ladies' ride around town, a ride with the Mayor around town, and other weekly rides. Many of these were tied in with, and/or sponsored by, local businesses.
- An open invitation to the public to attend that month's Bicycle Advisory Committee Meeting.
- Promotion of all these activities, along with a list of reasons to commute by bicycle, on the City's Web site.

This annual recognition is an excellent form of bicycle promotion. As an ongoing strategy, it should be enhanced by:

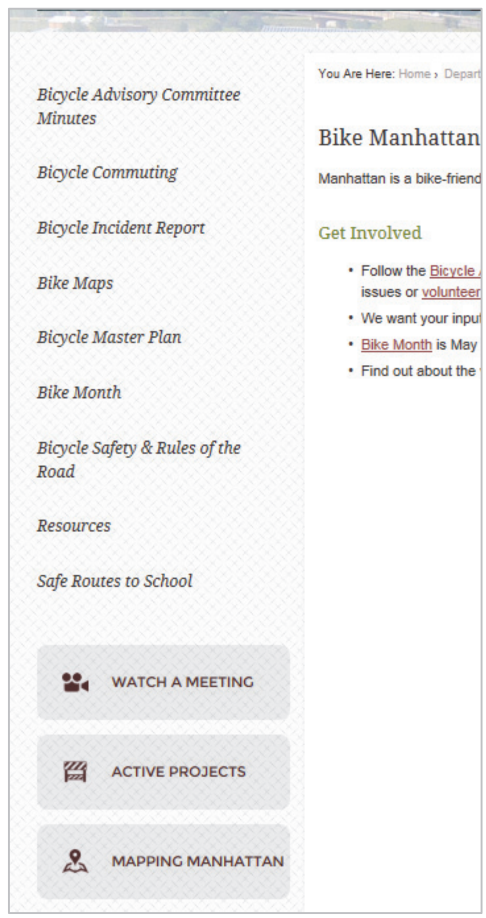
- Formalizing the Bike Month Committee, with financial and staff support from the City and two Counties.
- Including a large-scale draw such as a professional bike race.
- Adding more events, such as a bike fair / Cyclovia, a children's helmet fair (including helmet giveaways), or Adopt-a-Trail-type maintenance workdays.
- Encouraging funding support from other agencies: police, EMS, Health Department, Greater Manhattan Community Foundation, KDHE, etc.

Bike Month is certainly not the only forum for community activities to promote bicycle awareness, although it is certainly the biggest "stage" annually. The public agencies and stakeholders should continue to promote cycling throughout the year, and this should be a standing agenda item for the BAC.

Public Information

Neither Riley County nor Pottawatomie County has specific bicycle transportation pages on its respective Web site; it is recommended that, at a minimum, these sites provide links to the City's bike page.

The Bicycle page on the City's Web site is a useful resource. Its content is briefly described below, along with some suggestions for organization and additional content that could aid visitors.



- *Bicycle Advisory Committee Minutes:* This page includes PDFs of monthly minutes dating back to 2008. This archive is very helpful, but probably should not be the first link on the page as other topics may be more relevant to most visitors. Also, a brief description of the Committee and its governance would be helpful.
- *Bicycle Commuting:* This page provides a checklist of tips for bicycle commuters.
- *Bicycle Incident Report:* This page provides a form that allows individuals to report a bicycle-related crash or an area that is dangerous for bicycling. According to City staff, this form is used only rarely (one to two submissions per year). However, when used, it is good avenue for public feedback. It is recommended that this page be kept, and that its use be promoted in bicycle literature produced by Urban Area agencies.
- *Bike Maps:* This page links to both PDF and interactive bike maps of the City.
- *Bicycle Master Plan:* This page links to a scanned PDF of the 1998 Bicycle Master Plan as well as a PDF of the Five-Year Strategic Plan for bicycles. It would be useful for the page to provide a summary of the key elements of these plans, and to provide information on the types of bike facilities used and planned in Manhattan. Ultimately, the approved MATS document should be a primary reference.
- *Bike Month:* This page contains a list of the numerous Bike Month

Activities described previously, and is a good central source of information for this annual occurrence. It could add value to archive previous years' Bike Month pages (via links) on this page as well.

- *Bicycle Safety and Rules of the Road:* This page has safety tips for bicyclists, general road rules for bicyclists, and instructions to motorists for sharing the road with bicyclists. It is recommended that the rules of the road for motorists be listed separately on the main bike page, perhaps with a link entitled "Motorists' Responsibilities."
- *Resources:* This page contains links to local bike club sites and regional/national bicycle information. Links to the Bike Shops of the Manhattan area would be helpful.
- *Safe Routes to School (SRTS):* This page describes the federal SRTS program and its applicability to jurisdictions in Kansas (including Manhattan), and solicits input related to the City's application for SRTS funding.

Bicycle Advisory Committee and Bike/Ped Coordinator

The Bicycle Advisory Committee consists of nine people appointed to three-year terms by the mayor of Manhattan, with the advice and consent of the City Commission. Committee membership is currently delineated as follows:

- One representative of Kansas State University
- One representative of the Riley County Police Department
- One representative of Riley County
- One representative of USD 383
- One representative of the Riley County Health Department
- One representative of Manhattan's business community
- Three at-large members from the citizenry of Manhattan

The BAC bylaws should be adjusted to include membership from Pottawatomie County. Also, as mentioned in **Chapter 2**, the bylaws should be changed so that the Committee's name reflects its dual focus on bicycles and pedestrians.

In addition, MATS recommends that the Urban Area transition to a full-time Regional Bicycle/Pedestrian Coordinator. This could take the form of expanding the City's current part-time Bicycle Coordinator position (to full-time status and specific expansion to pedestrian duties), but the Urban Area should determine the best agency to ultimately house this function.

K-State Master Plan

The K-State Master Plan includes some on-campus recommendations regarding the promotion of bicycling:

- *Bike Sharing:* The feasibility of a bike sharing program has been considered over the years. One recent study recommended a "yellow bike" bike sharing program, whereby distinctly painted bikes would be located around campus for use. Ad hoc bike-share programs have sprung from student initiatives, but nothing permanent, large or formal has materialized. The University would need to take ownership of such a program, but a college campus is an excellent environment in which to deploy bike-sharing. Partnering with an established service/company such as Zagster could improve the chances for success.

- *Bicycle incentives:* The master plan also suggests a program in which students that commit to commuting by bicycle (and don't purchase a parking pass) could be provided parking vouchers for use on foul-weather days.

It is recommended that the Bicycle Advisory Committee keep the K-State recommendations as a standing agenda item, to keep these ideas in the forefront and to stimulate ideas on ways the community can support these initiatives.

Education

The Bicycle Advisory Committee has ongoing discussions regarding the education of bicyclists and motorists about the presence of bicyclists on the transportation system and the "rules of the road" for interactions. To supplement this ongoing strategy, education programs should be rolled out as the system continues to expand. The Urban Area should designate a government agency to take the lead on education programs – MATS recommends the City of Manhattan. The Regional Bike/Ped Coordinator position (described elsewhere in this Chapter) would be a good fit for such activities. The primary benefits of such programs would be increased awareness of bicyclists (thus improved safety) and increased promotion of bicycling as a form of transportation.

> ***Objective D-2:*** *Provide and maintain a continuous system of bicycle infrastructure that provides needed connectivity, promotes safety, and accommodates the community's range of user types.*

Bicycle Facility Types

The range of bicycle facility types in the planner's/designer's "toolkit" has both expanded and become more nationally uniform in recent years, most notably with the publication of the National Association of City Transportation Officials' (NACTO) *Urban Bikeway Design Guide*. Based on current best practices, MATS expands on the Urban Area's previous facility categorizations. The revised list is included below, with updated definitions:

- *Bicycle Boulevards:* Bicycle Boulevards are shared roadways (bicycles and motor vehicles share the space without marked bicycle lanes) on which the through movement of bicycles may be given priority over motor vehicle travel. Traffic calming measures may be used to control traffic speeds and discourage through trips by motor vehicles. In the Urban Area, Bicycle Boulevards must meet at least three of the five criteria in **Table 3-2.**

  As the Table shows, the various combinations of these three criteria create different types of environments for bicyclists. Bicycle Boulevards can be subdivided into two major categories, "Marked" and "Unmarked", depending on whether sharrows are included. Within each of these two categories, most combinations of criteria can be classified as "Preferential", meaning higher preference is given to bicycles, or "Destination", meaning more wayfinding guidance is given to bicyclists. Other subcategories are listed in **Table 3-2**, and two merit additional discussion:

  - Sharrow Streets have no specified speed control, but should not be implemented on a street with speeds exceeding 35 mph.
  - Emphasis Streets are marked and have slow speeds enforced by traffic calming. However, any Marked Bicycle Boulevard meeting more than three criteria is also considered an Emphasis Street.

Table 3-2:
Bicycle Boulevard Criteria and Applications

	Criteria				
	Decreased speed limit (20 mph)	Traffic-calming features.	A sharrow on every block in each direction	Right-of-way for bicycles at intersections	Wayfinding signs
Marked					
Emphasis	●	●	●		
Preferential		●	●	●	
Preferential - low vol	●		●	●	
Destination		●	●		●
Destination - low-vol	●		●		●
Sharrow Street (max 35 mph)			●	●	●
Unmarked					
Low-volume	●			●	●
Calmed		●		●	●
Destination	●	●			●
Preferential	●	●		●	

In deciding to implement a Bicycle Boulevard, the goals of the connection should be evaluated in light of **Table 3-1.** The desired major function of the facility should guide the implementation of the appropriate criteria.

- *Bike Routes:* Generally speaking, Bicycle Boulevards are the Manhattan Urban Area's preferred approach to shared roadways. However, certain stretches of roadway may not meet the minimum criteria for a Bike Boulevard while nevertheless being desirable connections from a bicycle network continuity standpoint. For such roadways, a Bike Route may be considered. Bike Routes should occur on streets with posted speeds no greater than 35 mph, and should generally include sharrows (in addition to standard Bike Route signs). On Bike Routes, vehicles and bicycles have roughly equal priority, or automobiles may have slightly higher priority – in contrast to Bicycle Boulevards, where priority slants more toward bicycles. Thus, it is important to carefully check Bicycle Level of Service (BLOS), as defined by the Highway Capacity Manual (HCM), before implementing a Bike Route. BLOS is an A-through-F scale describing bicyclist comfort riding on a street, and is a function of automobile speed, automobile volume, lateral clearances, and other items. A Bike Route should provide a minimum BLOS of D.

- *Bike Lanes:* Bike Lanes are striped lanes for exclusive use by bicyclists, accompanied by signs and pavement markings. A bike lane is distinguished from a cycle track in that it has no physical barrier (bollards, medians, raised curbs, etc.) to restrict the encroachment of motorized traffic. Conventional bike lanes run curbside when no parking is present, adjacent to parked cars on the right-hand side of the street or on the left-hand side of the street in specific situations. Bike lanes typically run in the same direction of traffic, though they may be configured in the contra-flow direction on low-traffic corridors necessary for the connectivity of a particular bicycle route. Where traffic speeds exceed 35 mph, or a bike lane runs adjacent to on-street parking, additional striped buffer space should be provided.

  Bike lanes should be a minimum of five feet wide. When adjacent to on-street parking, the buffer width should be a minimum of 3 feet wide. AASHTO's *Guide for the Development of Bicycle Facilities* should be used with regard to the layout of bike lanes.

- *Cycle Tracks:* Also known as Protected Bike Lanes, Cycle Tracks are exclusive bike facilities that combine the user experience of a separated path with the on-street infrastructure of a conventional bike lane. A cycle track is physically separated from motor traffic and distinct from the sidewalk. Cycle tracks have different forms but all share common elements—they provide space that is intended to be exclusively or primarily used for bicycles, and are separated from motor vehicle travel lanes, parking lanes, and sidewalks. In situations where on-street parking is allowed, cycle tracks should be located to the curb-side of the parking (in contrast to bike lanes). Cycle tracks may be one-way or two-way, and may be at street level, at sidewalk level, or at an intermediate level. If at sidewalk level, a curb or median separates them from motor traffic, while different pavement color/texture separates the cycle track from the sidewalk. If at street level, they can be separated from motor traffic by raised medians, on-street parking, or bollards. Maintenance needs such as snow plowing should be considered in the implementation of cycle tracks.

- *Multi-Use Paths*: Multi-Use Paths are designated for bicycle and pedestrian usage and striped for two-way traffic. They fall in two categories:

  - *Sidepaths*: Paths adjacent to a street (typically some buffered distance from the curb), serving the pedestrian-carrying functions of a typical sidewalk in addition to allowing two-way bicycle traffic.

  - *Trails:* Primarily recreational facilities that can also serve as connections in an overall bicycle transportation network.

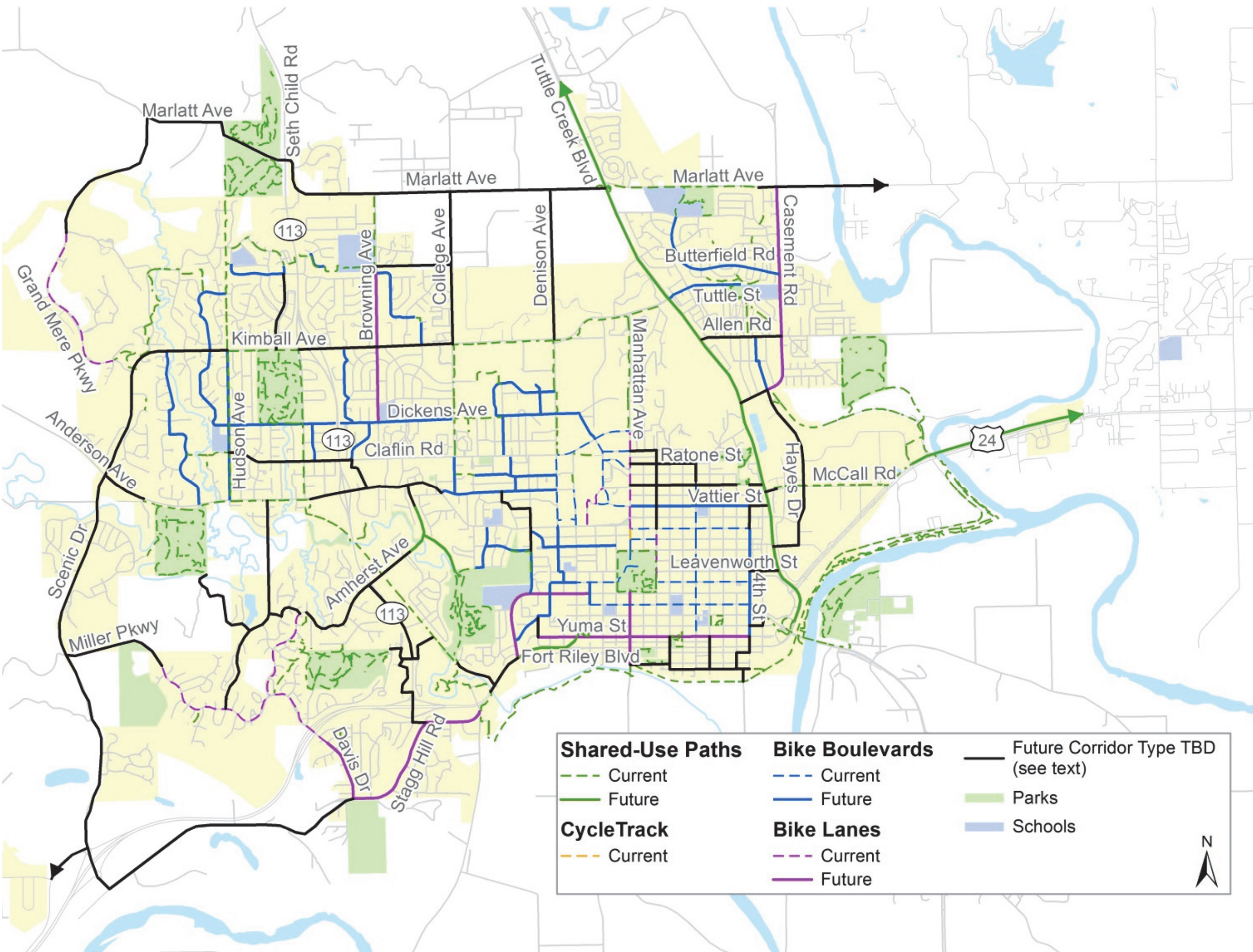
On-street facilities (Bike Lanes, Bike Boulevards, Bike Routes), if they can be accommodated safely and can be well-designed, are much preferred to multi-use paths. Where right-of-way, expense, high automobile traffic volumes/speeds, or other conditions prevent on-street facilities from being constructed or providing desired levels of service, multi-use paths may be considered in order to create the connections needed in the Urban Area's bicycle network.

Multi-Use Paths should be ten feet wide (an absolute minimum of eight feet if constraints dictate) and may include a solid yellow centerline separating directions of traffic.

Bicycle Network

Figure 3-6 is a map of the proposed long-term bicycle network for the Manhattan Urban Area. Many of the future facilities shown on the map are adapted from the 2011 Five-year Strategic Plan and its updates, but the map also shows many facilities beyond this horizon. At this point, the map leaves these facilities to be categorized in the future, but identifies the general corridors along which connections should be made. This does not rule out the potential for parallel facilities.

Figure 3-6: Future Bicycle Network



Some of the major connections needed in the longer term, shown on the map, include:

- *East-west connectivity on the west side of Manhattan:* While providing bicycle connections on or near the developed, higher-speed arterials (Kimball Avenue and Anderson Avenue) will be difficult and require creative solutions, the contributions of these connections to overall bicycle network continuity will be immense. Most likely they will need to be developed over time in conjunction with new construction or redevelopment, although the City should watch out for "lightning strike" funding opportunities that may arise. Marlatt Avenue presents more opportunity since much of the corridor is undeveloped. Finally, an Amherst Avenue connection across Wildcat Creek would provide a strong connection to the southwest part of the City and Urban Area. These four corridors also provide connections to four important parks (Marlatt Avenue to Marlatt Memorial Park, Kimball Avenue to Cico Park, Anderson Avenue to Anneberg Park, and Amherst Avenue to Warner Memorial Park.)

- *Tuttle Creek Boulevard (TCB):* This Principal Arterial, while an important automobile-carrying facility, is currently a lost opportunity for non-motorized travel options, in at least two ways:
  - *As an east-west barrier.* Currently, no designated bikeway crosses TCB, and thus it is currently divides the Urban Area from a bicycle connectivity standpoint. **Figure 3-6** shows several future east-west connections to rectify this situation.
  - *As a potential north-south connection.* In the southern portion of the Urban Area, TCB provides intermittent shoulders but is not a bicycle-friendly facility. However, given its centrality to the area, and the density of employment and destinations along the corridor, it is a natural candidate for a north-south bicycle spine. **Figure 3-6** shows the TCB corridor providing a multi-use path, which is the most likely choice given the speeds and traffic volumes on this facility.

    Further north, in unincorporated Riley County, an appreciable number of cyclists use TCB for recreational rides. TCB includes narrow paved shoulders adjacent to unpaved shoulders, a configuration not conducive to bicycle travel. Ultimately, well-designed shoulder bike lanes could provide an acceptable solution in the northern areas. If improvements are made to Tuttle Creek Boulevard as discussed elsewhere in this document (See **Chapter 6**), these provisions should be incorporated.

- *Linear Park Trail:* Although MATS is not a trails plan, multi-use paths undeniably form an important component of the bicycle transportation system. Thus, Figure 3-6 shows the completion of the initial Linear Park Trail loop along the Marlatt Avenue corridor, and shows connections to the trail in various places.
- *East of K-State Campus:* Figure 3-6 shows a denser network of bikeways east of the K-State campus, connecting residential areas both with the Campus and with Downtown/Aggieville.
- *Blue Township:* Figure 3-6 shows "regional" bicycle connections to Pottawatomie County via US-24 and an eastward extension of Marlatt Avenue. The US-24 connection is shown as an off-street path due to the high-speed, high-volume nature of US-24. The Marlatt Avenue extension offers an opportunity to integrate bicycle planning into the design of a new roadway, and thus bicycle facility type is yet to be determined. In addition, the MUACP discusses future growth in the Blue Township area, and recommends a robust grid roadway backbone that incorporates pedestrian and bicycle facilities on all key arterials and collectors – a recommendation that is incorporated into MATS by reference.

It should also be noted that the K-State Master Plan calls for "a clearly delineated grid of designated campus bike paths coordinated with planned city bike routes [that would] strengthen the bicycle network for KSU and the City of Manhattan." K-State's planned enhanced pedestrian zone (see **Chapter 2**) will also serve bicycle travel on and through campus. These features of K-State's planning are also considered part of the MATS bicycle network.

Bicycle Parking

The Association of Pedestrian and Bicycle Professionals' (APBP) *Bicycle Parking Guidelines* provides assistance with the selection and placement of appropriate bicycle racks for short-term bicycle parking, and MATS recommends that the Urban area use it as a guideline. Regarding bicycle parking provisions for new development – based on a review of other comparable U.S. Cities, the following should be incorporated into the subdivision regulations (and other relevant regulations, ordinances, and policies) of the City and two Counties:

- Multi-family residential: 1 space for every 2 dwelling units; minimum = 2 spaces
- Group (student) housing: 1 space for every 4 beds
- Commercial, Retail, Office: 1 space for every 20 automobile parking spaces; minimum = 3 spaces
- Industrial: 1 space for every 50 automobile parking spaces; minimum = 3 spaces

Costs, Funding, Prioritization

The 2011 Plan identified a series of short-term (5 years) and mid-term (10+ years) improvements (See **Table 3-3**), and many of the short-term improvements have been implemented on schedule. These improvements were prioritized using benefit-cost ratios, and are preserved in MATS as a reasonable near- and mid-term strategy.

Table 3-3: Cost Estimates, Prioritized Short- and Mid-Term Projects

Year	Project	Estimated Cost	
		Project	Year Subtotal
2015	Bike Boulevard on Vattier from North Manhattan Ave to 4th	$15,000	
	Bike Lanes on Yuma from 4th to Valley Dr.	$43,000	$58,000
2016	Bike Boulevard on Denison from Anderson to Humboldt	$10,000	
	Bike Boulevard on College Heights from Denison to Anderson	$18,000	
	Bike Lanes on South Manhattan Ave from Linear Trail to Poyntz	$22,000	
	Bike Boulevard on Hayes Dr from Casement to Allen Rd	$5,000	$55,000
2017	Bike Boulevard/Lanes on Dickens from Denison-Hudson	$80,000	$80,000
2018	Connection on Dickens across Seth Child	$75,000	$75,000
2019	Sidewalks on Sarber Ln connecting to Wal-Mart	$50,000	
	City Park Bike Connections	$15,000	$65,000
Short-Term Total			**$333,000**
2020	Multi-use Path on Hayes Dr from Casement-McCall Rd	$90,000	$90,000
2021	Connection improvements to the intersection at Bluemont and Tuttle Creek Blvd	$25,000	
	Bike Lanes on Browning from Dickens to Snowbird Dr	$18,000	
	Bike Boulevard the length of Garden Way	$10,000	
	Bike Boulevard on Tuttle St from Northview Elementary to Tuttle Creek Blvd	$10,000	
	Connect improvements to the intersection at Tuttle Creek Blvd and Kimball	$33,000	$96,000
2022	Bike Lane on Butterfield Rd from Casement to Mission Ave	$20,000	
	Bike Boulevard/Multi-use Path for Susan B Anthony Project	$20,000	
	Bike Boulevard/Multi-use Path for Yorgensen/Cemetery/Fremont Project	$50,000	$90,000
2023	Bike Boulevard/Multi-use Path for Zoo Project	$78,700	
	Bike Lanes on Stagg Hill Road from Fort Riley Blvd to Miller Pkwy	$15,000	$93,700
2024	Multi-use Path from Stagg Hill to Amherst around Target shopping district	$100,000	$100,000
2025	Bike Lanes on Stagg Hill Road from Fort Riley Blvd to Miller Pkwy	$15,000	
	Bike Lanes on Miller Pkwy from Davis to Amherst $15,000	$15,000	
	Bike Boulevard on Plymouth from Dickens to North Linear Trail	$14,000	
	Bike Boulevard on the length of Windsong Lane	$8,000	
	Bike Lanes on Stagg Hill Road from Fort Riley Blvd to Miller Pkwy	$15,000	$52,000
Mid-Term Total			**$521,700**

The remaining ("TBD") items from the long-term Bicycle Network Map (**Figure 3-6**) do not currently have a facility type associated with them. Thus, they will be prioritized in future updates of the plan, and costs are not developed at this time. They are listed in **Appendix D**, for completeness.

Most of the bicycle infrastructure in the Urban Area (excluding some trails) is in the City of Manhattan. **Table 3-4** summarizes projects and funding sources listed in the City's Capital Improvement Program (CIP) from 2011 through 2015. Note there is overlap with pedestrian projects listed in **Chapter 2**. Not all of the projects listed in these CIPs were funded or constructed, and thus the list has been at times more aspirational than concrete.

Table 3-4: Bicycle Facilities Listed in Annual Six-Year Capital Improvement Programs (City of Manhattan), 2011-2015

Department/ Division	Name	Funding Source	Cost (Budget Implications)
2011			
City-University	CU010P Campus Emergency Lighting / Bicycle Path Improvements	City-University (100%)	$27,500 ($27,500)
City-University	CU750P KSU/City Sidewalk Bicycle and Lighting Improvements	City-University (100%)	$118,000 ($118,000)
2012			
City-University	CU010P Campus Emergency Lighting / Bicycle Path Improvements	City-University (100%)	$20,000 ($20,000)
City Board & Committee	BR007P Moro Bicycle Boulevard Project	Special Street and Highway (100%)	$15,000 ($15,000)
City Board & Committee	BR008P Installment of Alternative Transportation Traffic Signs	Special Street and Highway (100%)	$5,000 ($5,000)
City Board & Committee	BR009P Installment of Bicycle Racks in Downtown	Special Street and Highway (100%)	$5,000 ($5,000)
2013			
City-University	CU010P Campus Emergency Lighting / Bicycle Path Improvements	City-University (100%)	$0 ($0)
City-University	CU750P KSU/City Sidewalk Bicycle and Lighting Improvements	City-University (100%)	$0 ($0)
2014			
City-University	CU024P Bike Racks on Campus	City-University (100%)	$18,000 ($18,000)
City Board & Committee	BR010P Bike Boulevard Project	STP (100%)	$31,500 ($0)
2015			
Citizen's Request	CR027P Safe Pedestrian / Bicycle Path to the Northeast Park	Grants (64%) Other Sources (36%)	$260,000 ($0)
City Board & Committee	BR010P Bike Boulevard Project	STP (100%)	$43,000 ($0)
City Board & Committee	BR019P Bike and Pedestrian Improvements to the Intersection at Tuttle Creek Blvd and Kimball Ave.	Grants (100%)	$100,000 ($0)
City Board & Committee	BR020P Bike and Pedestrian Improvements to the Intersection at Tuttle Creek Blvd. and McCall Rd.	Grants (100%)	$180,000 ($0)
City Board & Committee	BR021P Bike and Pedestrian Path through City Park from the intersection at Manhattan Ave. and Central Park	Other Sources (100%)	$50,000 ($0)

Many of the projects that have actually been built have been funded through the City-University Fund. As stated in **Chapter 2**, this is a strategy that will continue to work well in areas near the University, but is obviously not sufficient to build out needed bicycle infrastructure area-wide.

As stated in **Chapter 2**, the City has shifted away from using the Special Street and Highway Fund for non-motorized transportation projects over the past several years. Instituting a more formal allocation of this fund to bicycle transportation projects (see later discussion) would be an important step to secure long-term growth of the bicycle network through a more reliable funding stream.

The following additional strategies will support future funding and prioritization of bicycle infrastructure (most were discussed in **Chapter 2** as generalized non-motorized strategies and thus are abbreviated in this chapter):

- Anticipate and provide for future bicycle demand in the planning, design and construction of new transportation facilities – both in accordance with the future bicycle network map and as reasonable expansion opportunities arise. Current lack of connectivity should not preclude the funding of projects.

- Specifically dedicate Capital Improvement Project (CIP) funds to develop new bicycle and multi-use transportation projects. *Many of the Urban Area's "low-hanging fruit" bicycle capital projects – those that are fairly easy and inexpensive to implement – have been constructed. As projects become more complex and costly, the ability to fund them ad hoc with miscellaneous funds on hand will diminish. The City and Urban Area should specifically dedicate funds as line items in capital budgets – a non-motorized transportation fund. A reasonable suggested starting point is a 2-percent allocation of dedicated transportation funds. (This would be in addition to funds spent on non-motorized components incorporated into roadway or other capital projects.)*

- Use the Bicycle Advisory Committee (BAC) as a sounding board for prioritization and bicycle project integration.
.
- Consider alternative local means of funding bicycle transportation. *In addition to the dedicated CIP funding strategy discussed above, the Urban Area should consider other local means of funding bicycle infrastructure:*

  - Special bond issues
  - Dedications of a portion of local sales taxes
  - Voter-approved sales tax increase
  - Local-option transportation taxes
  - Bike licensing/registration fees (dedicated to building/maintaining bicycle infrastructure)

  In addition, ongoing partnerships with regional agencies (such as the Riley County Health Department), non-profits (the Greater Manhattan Community Foundation), and K-State could yield fruitful collaborative projects meeting multiple objectives.

- Systematically identify and pursue non-local funding sources through a single point of contact. *These items were described in more detail in **Chapter 2**.*

  - *Transportation Alternatives Program*
  - *Community Transformation Grants (CTG)*
  - *Community Development Block Grants (CDBG)*
  - *Recreational Trails Program (RTP)*
  - *Land and Water Conservation Fund (LWC) Grants*
  - *Historic Preservation Fund (HPF)*
  - *Urban and Community Forestry (UCF)*
  - *One-time Opportunities*

System Monitoring

As described more broadly in **Chapter 1** under **MATS Goal B**, monitoring the Urban Area's transportation system provides the feedback necessary to ensure it is performing as desired and to adjust plans as needed. Specific to bicycling, the following measures should be tracked:

- *Overall mileage of bicycle facilities.* MATS defines the *Bicycle Network Ratio* (BNR) as the following:

  BNR = [Bicycle Network Miles (excluding internal park trails)] ÷ [Collector + Minor Arterial Miles]

  The BNR target is 1.0 (or greater) over the lifetime of MATS. This policy will ultimately provide a reasonable level of bicycle infrastructure for the Urban Area. The current BNR for the Urban Area is approximately 0.09.

  The Urban Area should attempt to add at least three miles of bicycle facility per year – through restriping, dedicated bikeway projects, incorporation of bike components into other roadway projects, and trail development – until the future bicycle network is built out.

- *Percent commuters biking.* Track the American Community Survey (ACS) commute statistics (see **Figure 3-3**), with the goal (through the promotional activities described in **Objective D-1** and the network-expanding activities described in **Objective D-2**) of being in the top 5 percent of U.S. small cities with regard to bicycle commuting. Currently, Manhattan ranks in the top 11 percent; to achieve the goal of the top 5 percent, the Urban Area would need to roughly double its bicycle commute percentage, from 1.2 percent to 2.2 percent.

- *Bicycle crashes.* Systematically track bicycle crash data across the Urban area (and annually reported) using a common database. Like pedestrian crashes, bicycle crashes are relatively rare events, so systematically tracking crashes annually, and setting a goal of declining crash rates, is a good strategy. A target of zero bicycle fatalities is also part of this strategy.

- *Bicycle counts.* Conduct bicycle counts annually at key locations on weekdays and weekends to track trends and monitor high-volume locations. FHMPO has taken on this function.

- *Surface condition.* Visually inspect on- and off-street bicycle facilities annually (as a supplement to the Urban Area Pavement Management System discussed in **Chapter 6**) to identify, prioritize and fix surface irregularities that impede safe bicycle travel.

Objective D-3: *Where bicycles share facilities with other modes (e.g., on-street bikeways, trails), provide for safe and comfortable bicycle operations.*

This objective speaks specifically to the design aspects of the bicycle network. The City of Manhattan is in the process of updating its engineering standards and specifications. As part of the update cycles of the City and the two Counties, bicycle-specific standards/specifications should be adopted that specify and delineate widths, clearances, surface types, and other relevant engineering parameters. These design standards and specifications are supported by a set of policies:

General Design Considerations:

- Update subdivision regulations and other relevant regulations, codes, and policies to integrate MATS policies.
- Use universal design principles (with supporting operations and maintenance practices) to allow all users, including people with disabilities, to travel safely and independently on all bicycle facilities.
- Design and maintain path and bikeway pavement surfaces to be smooth, and uniform in width – avoiding wide cracks, joints, drop-offs, holes and bumps.

On-Street Facilities: The policies for street design are included in Chapter 6 under Objectives **G-3** and **H-3**. Highlights relevant to bicycles include:

- Use “Complete Streets” tools in designing new streets and upgrading existing streets. Even streets not on the Future Bicycle Network Map can be made more bicycle-friendly through these design principles.
- Include (or allow for) pedestrian/bicycle connections in new subdivisions between cul-de-sacs and between development streets and parallel arterials/collectors.
- With any planned improvement to an existing street, incorporate relevant connections from the Future Bicycle Network Map.
- Include paved shoulders on rural roadways used by more than 1,000 vehicles per day. Rumble strips, if used, must be designed to accommodate bicyclists safely.
- Focus on the implementation of a grid pattern of street connectivity.

Off-Street Facilities (Multi-Use Paths):

- Follow design guidelines and standards that are commonly used, such as the AASHTO *Guide for the Development of Bicycle Facilities*, AASHTO's *A Policy on Geometric Design of Highways and Streets*, and the Institution of Transportation Engineers (ITE) Recommended Practice "Design and Safety of Pedestrian Facilities."
- Use a path width of 10 feet, with an absolute minimum of 8 feet if constraints dictate.

Objective D-4: *Where bicycles conflict with other modes (e.g. street crossings), design for bicyclist safety, visibility and comfort.*

This objective primarily relates to on-street bicycles at roadway intersections, and off-street paths intersecting streets. The following strategies support this objective:

- *Intersection Design:* Follow MUTCD and AASHTO guidance related to bicycle accommodation at intersections. Include bicycle detection and bike signals at key locations. Where applicable, consider Bike Boxes, Protected Intersections, and other Complete Streets treatments to enhance bicycle safety and operation.

- *Arterial/Collector Intersections:* The design of intersections and interchanges along collectors and arterials should accommodate bicyclists in a manner that is safe, accessible, and convenient. Even if a corridor is not designated for (or commonly used by) bicyclists, allowing these users to cross that corridor safely and conveniently promotes more widespread bicycle use and increases the Urban Area's bicycle-friendliness.

- *Bike Lane Markings:* Dotted guidelines can be used where needed to assist bicyclists through the interior of particularly complex intersections or multi-lane roundabouts. Where such assistance is not needed, bike lane striping can stop at the near-side property line extended and then resume at the far-side property line.

- Mid-Block Crossings: Follow the pedestrian-related mid-block crossing guidelines described in **Chapter 2** under **Objective C-4**.

Objective D-5: *Promote safe and accessible connections for bicyclists between different facility types and with other transportation modes.*

The design standards discussed under previous Objectives in this chapter cover the facility aspect of this Objective. The primary intermodal connection that is relevant here is the connection from bicycle to bus, which is covered in **Section 4.2** under **Objective E-5**.

Objective D-6: *Maintain a Bicycle Master Plan for planning, designing, implementing, and monitoring the bicycle system.*

At this time, MATS serves as the Bicycle Master Plan. Going forward, a separate plan should be developed, and the MATS bicycle chapter could become a more general set of strategies largely pointing to the Bicycle Master Plan.

Table 3-5: MATS Bicycle Strategy Summary		
Strategy	**Responsible**	**Priority***
Promotion		
Continue to observe Bike Month, and enhance it in the following ways: (1) Formalize the Bike Month Committee, with financial and staff support; (2) Include a large-scale draw such as a professional bike race; (3) Add more events; (4) Encourage funding support from other agencies	**Lead:** Regional Bike/Ped Coordinator, BAC **Involve:** Riley Co. Planning and Development / Health / Public Works, Pottawatomie Co. Zoning / Public Works / Health, City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley Co. Planning Board, Pottawatomie Co. Planning Commission, City Parks and Recreation	O
Promote bicycling events throughout the year; include as a standing BAC agenda item.	**Lead:** Regional Bike/Ped Coordinator, BAC **Involve:** Riley Co. Planning and Development / Health / Public Works, Pottawatomie Co. Zoning / Public Works / Health, City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley Co. Planning Board, Pottawatomie Co. Planning Commission	O
At a minimum, provide links to the City's bike page on the County web pages.	**Lead:** Riley Co. IT/GIS, Pottawatomie Co. GIS	1
Modify the City's Web site to improve organization and add content (see text).	**Lead:** Regional Bike/Ped Coordinator **Involve:** City Information Systems, City Clerk	2
Adjust the bylaws of the Bicycle Advisory Committee (BAC) to include membership from Pottawatomie County.	**Lead:** City Public Works **Involve:** BAC, City Commission, Pottawatomie Co. Public Works / Zoning / Board of County Commissioners	1
Transition to a full-time Regional Bicycle/Pedestrian Coordinator. Determine the best agency to ultimately house this function.	**Lead:** FHMPO **Involve:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works,	2
Keep K-State Master Plan recommendations (bike sharing/incentives) as a standing BAC agenda item.	**Lead:** BAC **Involve:** K-State	O
Develop and implement an area-wide bicycle education program.	**Lead:** Regional Bike/Ped Coordinator **Involve:** Riley Co. Planning and Development / Health / Public Works, Pottawatomie Co. Zoning / Public Works / Health, Flint Hills MPO	3
Network		
Develop bikeways using the following classifications: Bike Boulevards, Bike Routes, Bike Lanes, Shared-Use Paths, Cycle Tracks	**Lead:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works **Involve:** Flint Hills MPO	O
Adopt Future Bicycle Network map and plan for priority projects while allowing for opportunistic projects	**Lead:** Public Works – City and Counties **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley Co. Planning Board, Pottawatomie Co. Planning Commission, City Parks and Recreation	1
Incorporate updated and current national design principles into the standards of the Urban Area jurisdictions.	**Lead:** Public Works – City and Counties **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	2
Use APBP Bicycle Parking Guidelines in the selection and placement of bicycle racks for bicycle parking.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	2
Adopt bicycle parking ratios for new development (see specific ratios in text) into zoning regulations and other appropriate documents.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	2

****1 = Immediate Priority,** to be implemented with MATS adoption or shortly thereafter; **2 = High Priority,** to be initiated as soon as possible and completed within one to two years after MATS adoption; **3 = Moderate Priority,** to be completed within three to five years after MATS adoption; **O = ongoing,** actions that occur continually.*

Table 3-5: MATS Bicycle Strategy Summary (Cont'd)		
Strategy	**Responsible**	**Priority***
Costs, Funding, Prioritization		
Anticipate and provide for future bicycle demand in the planning, design and construction of new transportation facilities.	**Lead:** City Public Works / Community Development / Parks and Recreation, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works **Involve:** Flint Hills MPO	O
Use the BAC as a sounding board for prioritization and bicycle project integration.	**Lead:** City Public Works / Community Development / Parks and Recreation, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works **Involve:** BAC, Flint Hills MPO	O
Consider alternative local means of funding bicycle transportation (see text).	**Lead:** Regional Bike/Ped Coordinator **Involve:** City Public Works / Community Development / Parks and Recreation, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works, Flint Hills MPO	3
Systematically identify and pursue non-local funding sources through a single point of contact.	**Lead:** Regional Bike/Ped Coordinator **Involve:** City Public Works / Community Development /Parks and Recreation , Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works, Flint Hills MPO	O
Specifically dedicate CIP funds to develop new bicycle and multi-use transportation projects.	**Lead:** Public Works – City and Counties **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	2
Update subdivision regulations and other relevant regulations, codes, and policies to integrate MATS bicycle policies.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	2
Performance Monitoring		
Target a Bicycle Network Ratio (see text) of 1.0, and add at least three miles a year until the future bicycle network is built out.	**Lead:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works **Involve:** BAC, Flint Hills MPO	O
Track ACS bicycle commute statistics with the goal of being in the top 5% of U.S. small cities.	**Lead:** Regional Bike/Ped Coordinator **Involve:** Flint Hills MPO	O
Systematically track bicycle crash data across the Urban area (and annually report) using a common database - setting a goal of declining crash rates, and a target of zero bicycle fatalities.	**Lead:** Public Works – City and Counties **Involve:** Flint Hills MPO, BAC	O
Conduct bicycle counts annually at key locations on weekdays and weekends to track trends and monitor high-volume locations.	**Lead:** Flint Hills MPO **Involve:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works, BAC, K-State	O
Visually inspect on-street and off-street bicycle facility surface conditions annually to identify, prioritize and fix surface irregularities that impede safe bicycle travel.	**Lead:** Public Works – City and Counties **Involve:** Flint Hills MPO	O

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Table 3-5: MATS Bicycle Strategy Summary (Cont'd)		
Strategy	**Responsible**	**Priority***
Design – General		
Use universal design principles (with supporting operations and maintenance practices) to allow all users to travel safely and independently on all bicycle facilities.	**Lead:** Public Works – City and Counties **Involve:** Flint Hills MPO	O
Design and maintain path and bikeway pavement surfaces to be smooth, and uniform in width – avoiding wide cracks, joints, drop-offs, holes and bumps.	**Lead:** Public Works – City and Counties **Involve:** Flint Hills MPO	O
Design – On-Street (see also Chapter 6)		
Use "Complete Streets" tools in designing new streets and upgrading existing streets.	**Lead:** Public Works – City and Counties **Involve:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works, BAC, FHMPO	O
Include (or allow for) pedestrian/bicycle connections in new subdivisions between cul-de-sacs and between development streets and parallel arterials/collectors.	**Lead:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	1
With any planned improvement to an existing street, incorporate relevant connections from the Future Bicycle Network Map.	**Lead:** City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works **Involve:** BAC, Flint Hills MPO	O
Include paved shoulders on rural roadways used by more than 1,000 vehicles per day. Rumble strips, if used, must be designed to accommodate bicyclists safely.	**Lead:** Public Works – City and Counties **Involve:** BAC, Flint Hills MPO	O
Focus on the implementation of a grid pattern of street connectivity.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** Public Works – City and Counties, BAC, Flint Hills MPO	O
Design – Off-Street		
Follow design guidelines and standards that are commonly used, (AASHTO, ITE, etc.)	**Lead:** Public Works – City and Counties, City Parks and Recreation **Involve:** Flint Hills MPO	O
Use a minimum path width of 10 feet, with an absolute minimum of 8 feet where constraints dictate.	**Lead:** Public Works – City and Counties, City Parks and Recreation **Involve:** Flint Hills MPO	O
Design – Intersections		
Follow MUTCD/AASHTO guidance related to bicycle accommodation at intersections. Include bike detection and bike signals at key locations. Consider Bike Boxes, Protected Intersections, and other Complete Streets treatments.	**Lead:** Public Works – City and Counties **Involve:** Flint Hills MPO	O
Design intersections/interchanges along collectors and arterials to accommodate bicyclists in a manner that is safe, accessible, and convenient.	**Lead:** Public Works – City and Counties **Involve:** Flint Hills MPO	O
Dotted guidelines can be used where needed to assist bicyclists through the interior of particularly complex intersections or multi-lane roundabouts.	**Lead:** Public Works – City and Counties **Involve:** Flint Hills MPO	O
Follow the pedestrian-related mid-block crossing guidelines described in **Chapter 2**.	**Lead:** Public Works – City and Counties **Involve:** Flint Hills MPO	O

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4.0 Public Transportation

MATS Goal E: Provide a safe, convenient, affordable, and accessible public transportation system – designed to maximize usage.

4.1 Existing/Historical Conditions

The majority of public transportation in the Manhattan Urban area is currently provided by the Flint Hills Area Transportation Agency (FHATA), which has been operational since 1976. Until recently, FHATA's primary service was demand-response transit, serving the citizens of Manhattan, Riley County, Blue Township, and St. George in Pottawatomie County, Fort Riley, and Junction City.

In 2012, FHATA initiated fixed-route service on four new routes, as well as complementary paratransit services for riders with mobility impairments. FHATA continues to offer demand-response services to areas outside the fixed-route service area. In addition to these services, FHATA provides shuttle services (Jardine, Park-and-Ride, Safe Ride, and SAC) focused around K-State. In 2013, FHATA completed a new Regional Transit Facility at 5815 Marlatt Avenue, housing operations and maintenance functions.

In addition to these FHATA services, the City of Manhattan also administers a taxi coupon program, as described later in this section.

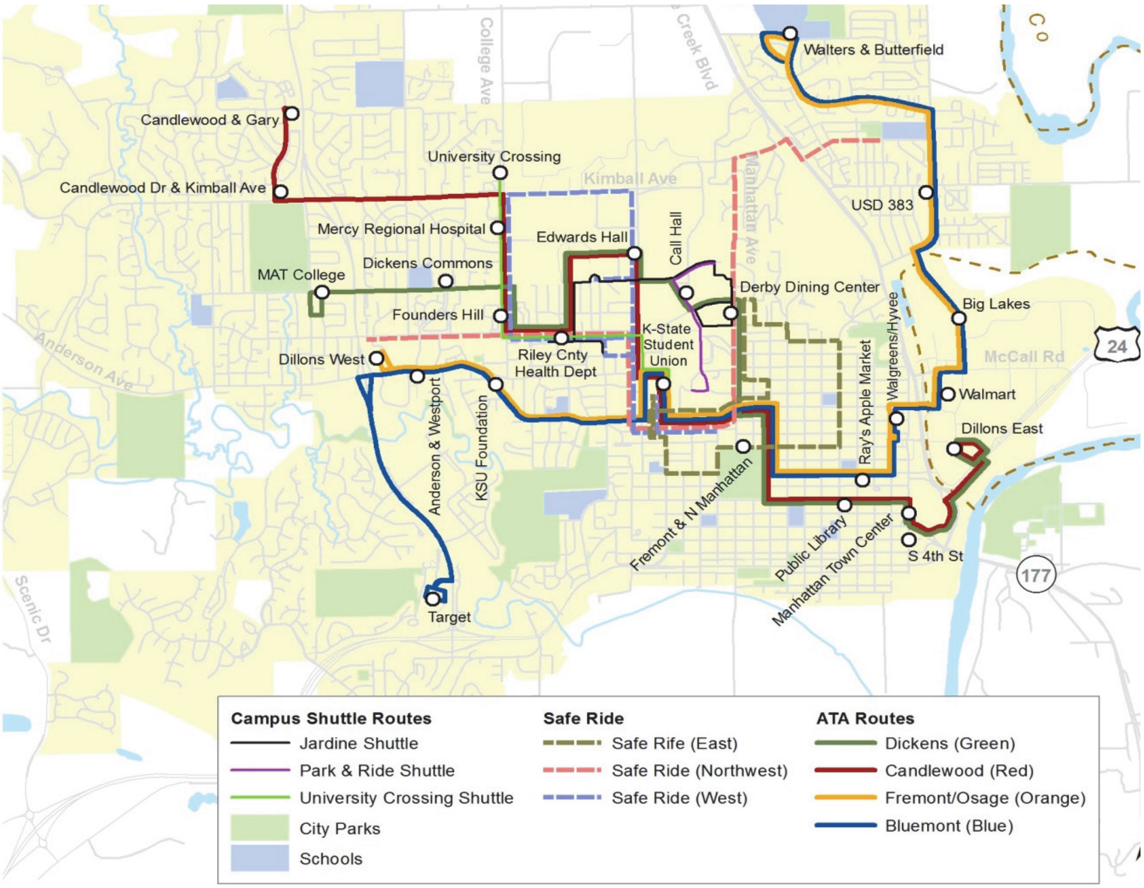
Table 4-1 summarizes key statistics for the public transportation options described in this section.

Table 4-1: Public Transportation Services in the Manhattan Urban Area

Route/Service	Days of Operation	Hours of Operation	Frequency (mins)	2013 Ridership	Basic Fare
Manhattan Fixed Routes				**55,649**	
Bluemont	MTuWThFSa	6:55a – 7:55p	60		$1.00
Candlewood	MTuWThFSa	6:55a – 7:55p	60		$1.00
Dickens	MTuWThF*	6:29a – 7:29p	60		$1.00
Fremont/Osage	MTuWThF*	6:25a – 7:25p	60		$1.00
K-State Shuttles					
Jardine	MTuWThFSa*	6:35a – 7:50p	40	138,794	free
	Su*	11:00a – 1:30p	40		
Shopping Shuttle	Sa*	9:00a – 1:40p	40		free
Park-and-Ride	MTuWThF*	6:30a – 12:30p	15		free
UC Apartments	MTuWThF*	7:00a – 5:00p	30-60		free (tenants), $1.00 (others)
Safe Ride				**14,492**	
East	ThFSa*	11:00p – 3:00a	20		free
Northwest	ThFSa*	11:00p – 3:00a	60		free
West	ThFSa*	11:00p – 3:00a	15		free
Manhattan-Riley Co Demand-Response			n.a.	**51,487**	$2.00
Inter-City Shuttle	MTuWThF	6:00a – 6:00p	n.a.	**13,497**	$2.00
SAC	MTuWThF	7:00a – 5:00p	n.a.		free
Taxi Coupon (City)	---whenever taxis run---		n.a.		$1.50

**Only when K-State is in session*

Figure 4-1: Existing Public Transit Routes



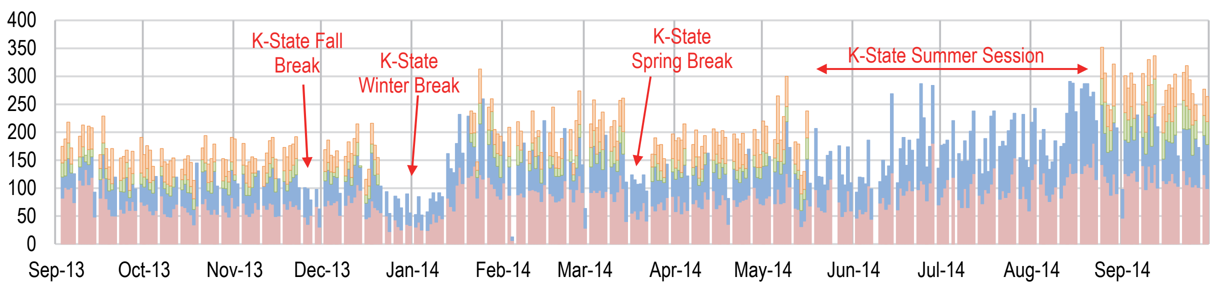
Citywide Fixed Routes (FHATA)

The Red and Blue routes provide year-round weekday and Saturday service. The Green and Orange routes only operate on weekdays when Kansas State University is in session. Therefore, since there is substantial geographic overlap between the Blue and Orange routes, as well as the Red and Green routes, the fixed routes effectively provide 30-minute headways on weekdays when KSU is in session (in the areas of overlap). **Figure 4-2** illustrates ridership trends on the Citywide fixed routes:

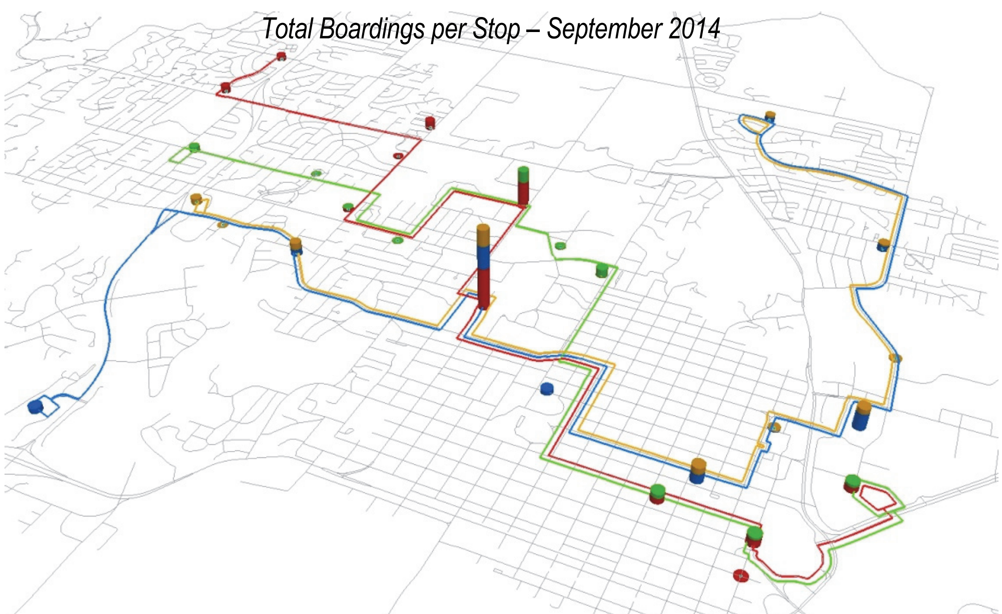
- Ridership increased in 2014; for example, in September 2014, system ridership raged from 250 to 300 riders per day, while a year earlier, the range was 150 to 200 riders per day. Ridership on the Red and Blue Routes (especially the Red Route) does take a noticeable dip when K-State is not in session, but the two routes together do still serve a noteworthy number of riders during those periods.
- The K-State Union is by far the busiest stop on the system, serving approximately 83 riders per day in September 2014.
- The Red route appears to be the most well-used, carrying approximately 114 riders per day during September 2014. The Green route is the least used (45 riders per day). The fact that the Green Route does not connect to the K-State Union may contribute to its lower ridership.

Figure 4-2: aTaBus Fixed-Route Ridership, 9/2013 - 9/2014

Daily Boardings per Route



Total Boardings per Stop – September 2014



Campus Shuttles (FHATA)

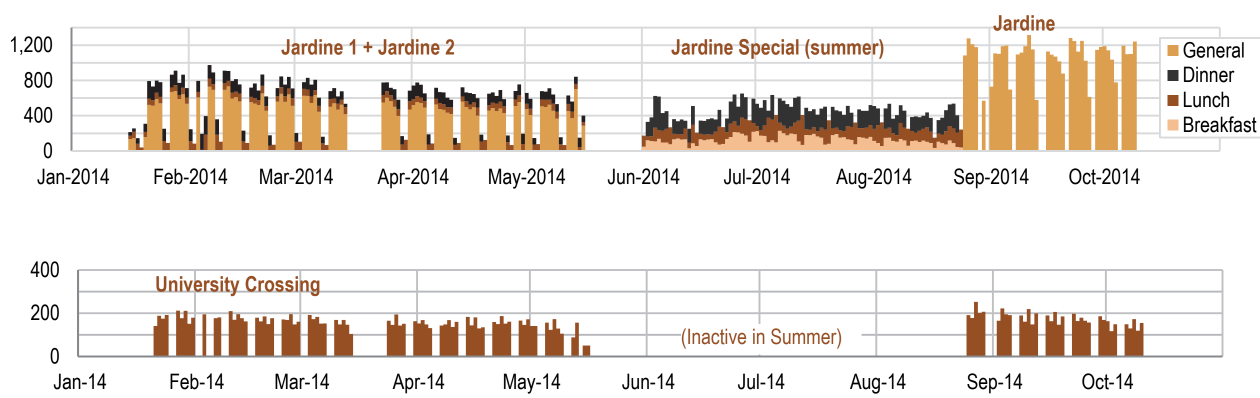
In addition to citywide fixed-route service, FHATA provides several shuttle services specifically oriented toward the K-State campus (shown in **Figure 4-1**). Ridership trends are shown in **Figure 4-2**.

Jardine Route: The primary purpose of this route is to connect the Claflin Community Apartments and the Jardine Apartments (primarily on-campus family living) with the Child Care Development center and Food Centers on campus. As the upper graph in **Figure 4-2** shows, this shuttle's service has undergone transformation throughout the 2014. Initially, the service included a "Jardine 1" and "Jardine 2" route, the latter running at lunch and dinner. Currently, the service is packaged as a single Jardine service running at 40-minute headways throughout the day. In summer of 2014, the "Jardine Special" ran every day at breakfast, lunch, and dinner only. As the graph illustrates, the Jardine routes typically served 600 to 800 riders per day in the spring of 2014 (with surges up to 1,000 per day in the early part of the year), typically served 400 to 600 riders per day during the summer, and is currently serving on the order of 1,200 riders per day. Gaps in service can be seen during spring and semester breaks.

Park-And-Ride Shuttle: Implemented in fall 2014, this route runs north-south through the K-State campus, from Parking Lot B-17(on Jardine Drive west of Manhattan Avenue) to McCain Auditorium near the south end of campus. Since this service has been recently implemented, no ridership trends are yet available.

University Crossing Apartment Shuttle: This deviated fixed-route shuttle serves the UC apartment residents with peak service to and from Manhattan Area Technical College and KSU. Funded by grant money, the shuttle has essentially become an overflow for the aTa Bus Red Route. Beginning in January 2015, the shuttle will be moved into the Red Route. As the lower graph in **Figure 4-2** indicates, this shuttle typically carries between 100 and 200 riders per day.

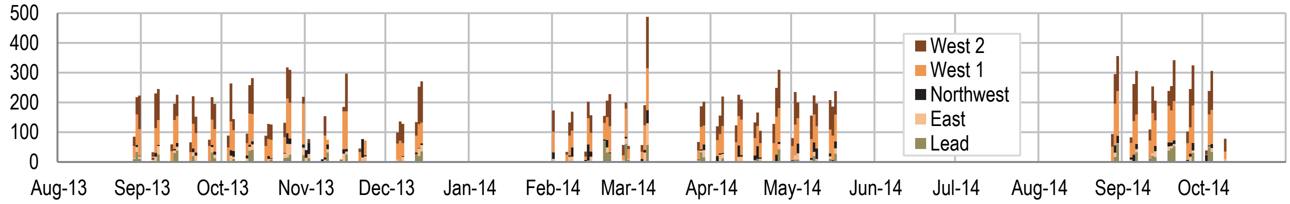
Figure 4-2: Daily Ridership on Campus Shuttles, 2014



Safe Ride (FHATA)

FHATA also operates SafeRide services, which provides fixed-route service on Thursday, Friday, and Saturday nights (11 p.m. to 3 a.m.) during the University school year. This service has three different routes (see **Figure 4-1**), and is intended to provide individuals a safe ride home after potentially becoming impaired by alcohol. Students with a valid student ID can ride for free, while others can ride for a $2.00 fare. **Figure 4-3** illustrates daily ridership for August 2013 through October 2014. As the figure indicates, the service is much more well-used on Friday and Saturday nights than on Thursday nights. On these nights, the service currently carries around 200 to 300 passengers, whereas on Thursdays, the service carries 100 or fewer passengers. The West routes carry the majority of the SafeRide riders.

Figure 4-3: Daily Ridership on SafeRide, Aug 2013 – Oct 2014



KSU Student Access Center (SAC)

A demand-response shuttle service is provided as a courtesy by the university (operated by FHATA) for eligible students with either a temporary injury or a permanent disability, to assist them in getting to their classes. Students arrange rides via an email form; the service operates Monday through Friday, 7:00 a.m. - 5:00 p.m., when classes are in session. The SAC routes are tracked as part of the demand-response services described below.

Demand-Response Services (FHATA)

Demand response service includes the Inter-City shuttle, internal Manhattan runs, Geary County – only services, and other coverage within the Urban Area. **Figure 4-4** illustrates daily demand-response ridership for the entire FHATA system for fiscal years 2012-13 and 2013-14. As the graph indicates, system-wide ridership is around 200 to 250 passengers per day, and has generally increased over the two-year period.

Figure 4-4: Daily Ridership, FHATA Demand-Response, July 2012 - May 2014

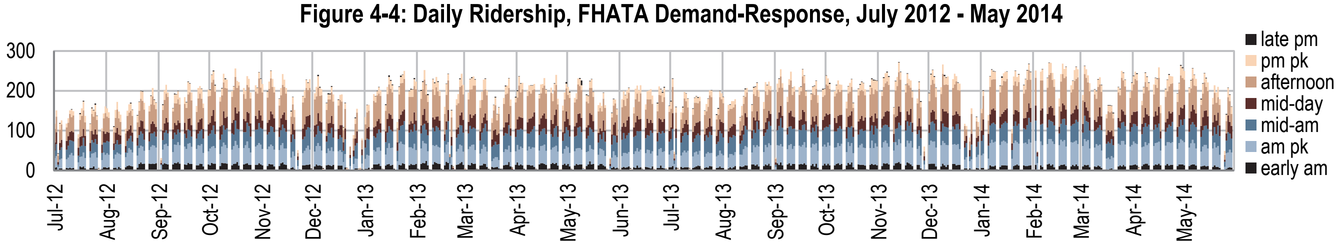
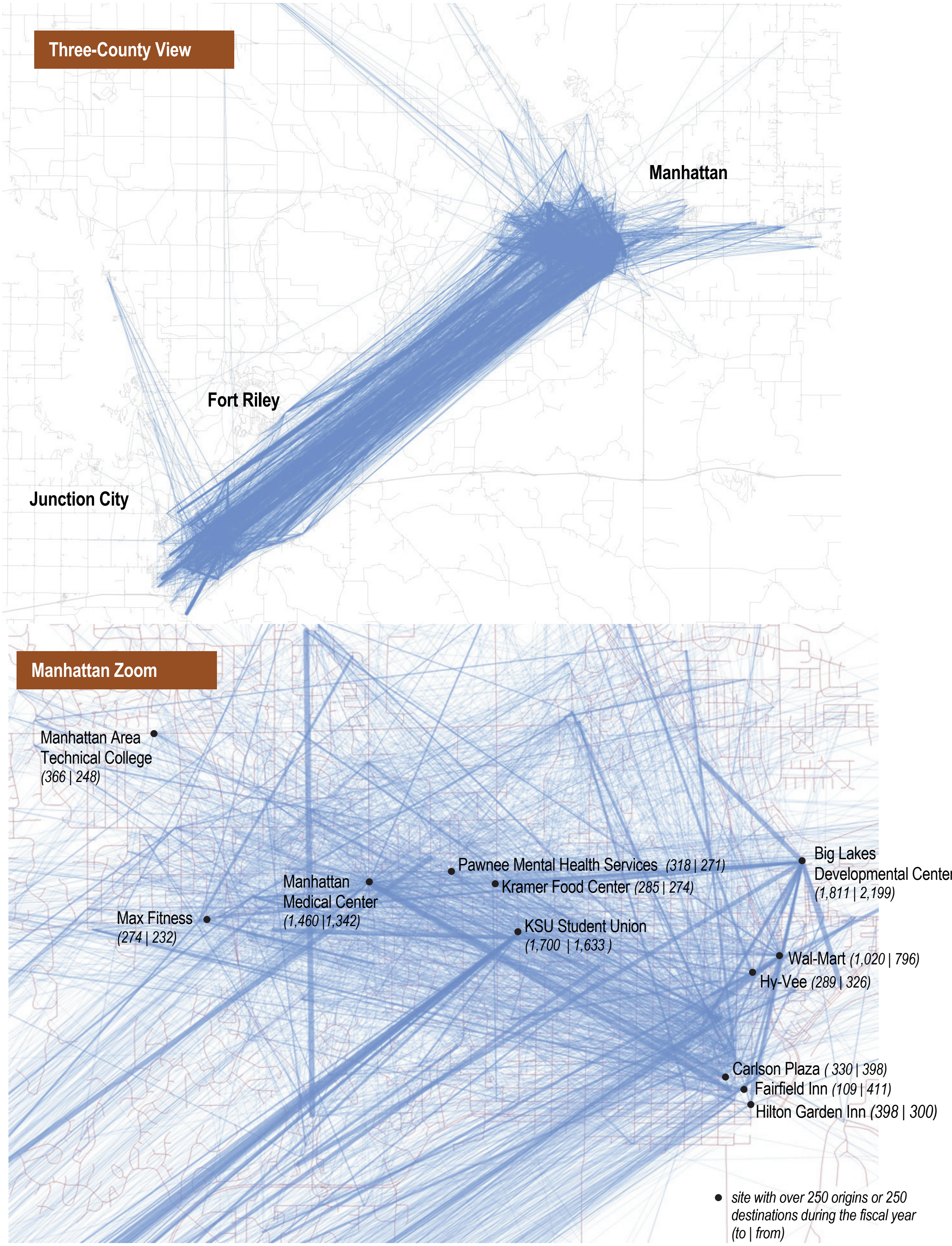


Figure 4-5 gives an indication of where demand-response trips travel to and from, based on the 2012-2013 ridership data. The "three-county view" shows that a noteworthy portion of the demand-response trips – approximately 21 percent – traveled between Manhattan and Junction City on the Inter-City Shuttle. (Note that another approximately 12 percent of the riders were purely within Junction City, and thus outside the Urban Area.)

Zooming in on the Manhattan area, **Figure 4-5** shows the large amount of origins and destinations within the city, and also annotates some of the more prevalent origins and destinations. As can be seen in the figure, the most prevalent sites are the Big Lakes Development Center, the KSU Student Union, the Manhattan Medical Center, and Wal-Mart. Other major destinations falling outside the map (and the Urban Area) include the Marshall County Senior Center in Marysville (1,102 to | 1,295 from), the Fort Riley PX (748 | 409), Junction City Wal-Mart (510 | 297), Junction City High School (494 | 338), Geary County Hospital (355 | 316), and Cloud County Community College (323 | 266). This data could further be explored to analyze the potential for additional fixed-route service in and near the Urban Area.

Figure 4-5: FHATA Demand-Response Trips, FY2012-2013

Trips with both ends in the Riley-Geary-Pottawatomie County Area (42,805 trips)



Taxi Coupon Program

The City of Manhattan operates a Taxi Coupon program that allows qualified residents (aged and disabled) to purchase coupons good for a one-way taxi ride anywhere within city limits. Key program features are listed at right. All taxi companies licensed with the City must accept the taxi coupons. **Figure 4-2** illustrates monthly coupon sales for 2000 through mid-2014. Program usage:

Age Requirement: Elderly 62+, Disabled 16+

Income Requirement: <$14,000

Cost: $2.50/coupon; $1.00 (to driver) for each additional passenger (aides/assistants exempt)

Valid: 2 years

Reimbursement to taxi company: $4/coupon

City Resolution No. 091713-B

- declined from 2000 to 2002 (from about 1,000/month to about 700/month),
- began rising slightly until 2004 (about 800/month),
- and decreased steeply until 2009 (around 300/month), when it leveled off.

The decline may be linked to usage of FHATA's demand-response and paratransit services in place of taxi coupons, but there is no hard evidence at this point to support that hypothesis.

Figure 4-2: Monthly Taxi Coupons Sold, 2000-2014 (stacked values are additive)

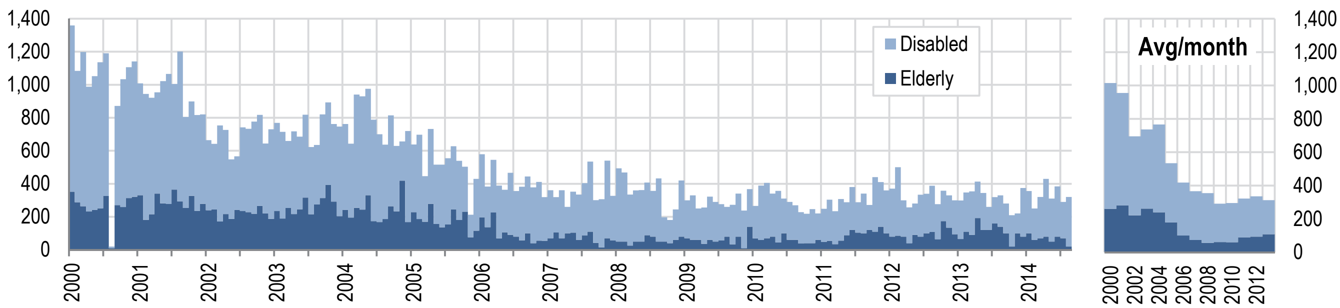
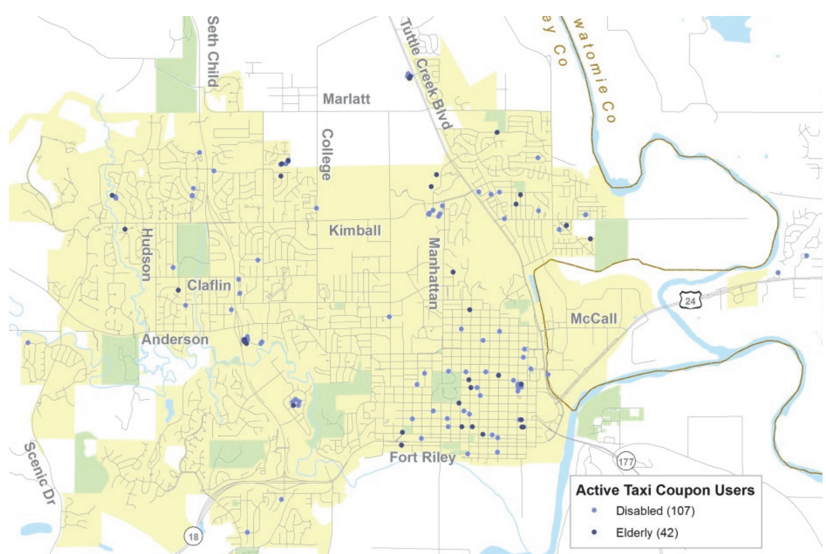


Figure 4-3: Geographical Distribution of Taxi Coupon Participants

Figure 4-3 indicates the geographical distribution of active Taxi Coupon participants. As the figure indicates, there are clusters in the Downtown area, northeast Manhattan, and northwest Manhattan. The Redbud Estates (K-113 corridor) and Colonial Gardens (Tuttle Creek Boulevard) manufactured home communities exhibit some clustering, as do the Manhattan Housing Authority Communities near Kimball Avenue/Manhattan Avenue and the Garden Grove Senior Apartments.



General Taxi Services

At the time of this writing, three taxi companies are licensed through the City of Manhattan:

- Taxi 4 Less (3 vehicles)
- Bell Taxi (7 vehicles)
- Wildcat Taxi (4 vehicles)

Current regulations regarding taxis in the City of Manhattan are shown in **Table 4-2**.

Table 4-2: City of Manhattan Taxi Regulations
(Resolution No. 091713-B, eff. 9/17/2013)

Initial flag drop (includes first one-fifth mile)	$2.75
Each additional one-eighth mile	$0.25
Waiting time, per minute	$0.40
Additional passenger to same destination	$1.00
Grocery sacks	
First two	Free
Each additional	$0.25
Package delivery, passenger fare plus	$0.25
Foot locker, duffel bag, and other large items	$0.25

Intercity Bus (ICB)

There is currently no ICB service provided in the Manhattan Urban Area, beyond the FHATA's Inter-City shuttle serving Manhattan, Fort Riley, and Junction City. At one time, Greyhound had a stop in Manhattan, but it was discontinued sometime between 1995 and 2006. A Greyhound route still runs east-west along I-70 for the entire length of the state of Kansas; however, the stop closest to Manhattan is in Junction City. Thus, riders can access Greyhound via FHATA's Inter-City Shuttle, but not directly in Manhattan.

A KDOT-funded project recently studied intercity bus services statewide. Due to its high ridership potential, Manhattan was identified as an important location in which to restore ICB service. The study recommended the extension of the Beeline Express Blue Line (which currently runs from Wichita to Salina) to include additional stops in Abilene, Junction City, and Manhattan. The Beeline Express is operated by Village Tours, LLC and is funded by KDOT.

Airport Shuttles

Shuttle service to the Kansas City International Airport (KCI) is provided by KCI RoadRunner. The service makes seven daily round-trips between Manhattan and KCI. The shuttle also stops in Junction City, Fort Riley, Topeka (three locations), and Lawrence (two locations).

Other Transit Providers

Several other entities provide (or will provide) transportation to, from, or within the Manhattan Urban Area:

- Pottawatomie County General Public Transportation provides services throughout the county for non-emergency medical, grocery, financial, social service, and recreation purposes. This includes trips twice a month into Manhattan from Wamego, Emmett/St. Marys/Belvue, Onaga/Havensville, Blaine/Whaton/Westmoreland, and Olsburg/Fostoria.
- Big Lakes Developmental Center provides employment-oriented deviated-fixed-route transportation services to disabled adults ($4 within Manhattan, $7 outside Manhattan). The service area includes Riley, Pottawatomie, Geary, and Clay Counties.
- Community HealthCare System, Inc. provides demand-response medical, shopping, and personal business transportation services. The service area includes Pottawatomie, Jackson, Marshall, Nemaha, Shawnee, and Riley Counties.
- Pawnee Mental Health Services provides demand-response and deviated route service for medical, shopping, personal business, education, and employment trips. The service area includes Riley, Geary, Marshall, Clay, and Pottawatomie Counties.
- Via Christi Village provides transportation service for the residents of Via Christi Village, health care, assisted living and independent living. Service is provided to various locations within Riley and Pottawatomie Counties.
- New service between Manhattan and Wamego will be starting in January 2015.

4.2 Achieving Transit System Objectives

***Objective E-1:** Promote transit as a form of transportation.*

The fact that FHATA now provides fixed-route service, and system ridership is growing, indicates that transit is being promoted successfully within the Manhattan Urban Area. Strategies going forward must continue to make transit more visible to area residents.

One way to make service more visible is through stop amenities. The fixed-route stops are currently solely marked with signs, and do not provide benches or shelters. Not only would such amenities increase public awareness of the service and its stop locations, but they would make the service more attractive to potential new riders by increasing comfort and convenience. New funding (including a local match component) would need to be identified for benches and shelters, and FHATA's right-of-way agreement with the City would have to be amended to allow for the placement of this additional street furniture.

Riley County features FHATA links prominently on its Web site home page; Pottawatomie has a "Public Transport" link on its home page that discusses the County's demand-response service as well as providing a link to the FHATA web site. The City of Manhattan's Web site home page does not have information or links regarding transit; a helpful improvement would be to add at least a link to FHATA under the "Community" tab (which also includes the airport, parks/recreation, and other community amenities).

The K-State Master Plan also recognizes the value of promoting transit, and recommends "promoting and utilizing the newly instituted ATA fixed routes to help reduce the demand on an increasingly strained parking system as the university grows." Certainly, KSU is working hand-in-hand with the FHATA to improve transit services. One small way that transit could be promoted further is to make transit information easier to find on the KSU web site – perhaps directly under the "Student Life" menu.

***Objective E-2:** Provide scheduled public transit that serves identified needs throughout the community.*

Service Hours

Most of the recommendations in the 2010 Transit Plan have been implemented with the institution of fixed-route services. The implemented plan is effectively a "starter system" for the City. The next steps will be to implement the following intermediate service improvements:

- Extend fixed routes later into the evening (ending at 10 p.m. instead of 7 p.m.)
- Add Sunday service

These service-hour extensions will need to be implemented as demand warrants and funding allows.

Routes

Once the intermediate service level is reached, the next recommendation is to add more routes until a full system is established. This could include additional routes within Manhattan, a route to the airport, or commuter service routes between Manhattan and Fort Riley/Junction City. Further studies will be needed to determine the best candidate extension routes.

The K-State Master Plan also identified, in conjunction with major campus changes (additional buildings, expanded pedestrian zone, shifted parking), the potential need for a frequent, convenient campus perimeter shuttle. The Master Plan also recommended continued coordination with the City of Manhattan regarding transit planning and funding. This will be important to avoid route duplication, improve service frequency and coverage, and simplify route confusion, thereby improving service convenience and increasing ridership.

Technology

Intelligent Transportation Systems (ITS) can be applied to public transportation in the form of items such as Computer-Aided Dispatch/Automatic Vehicle Location (CAD/AVL), traveler information, electronic fare payment, transit security systems, Automated Passenger Counters (APCs), vehicle fleet monitoring devices, traffic signal priority, and digital/mapping software applications. MATS recommends that the applicability of transit ITS in the Urban Area be explored in future transit planning efforts.

Other services

Given the historical decline of usage of the City's taxi coupon program, and the potential overlap with FHATA's demand-response service, MATS recommends that the City conduct a survey of its existing coupon users to explore their needs and usage patterns – with an eye toward potential efficiencies that could be gained by consolidating services.

Identified Needs

The 2010 Transit Update identified the following goals, which can also be considered needs:

Table 4-3: Transit Needs

Need (Goals from 2010 Transit Plan)	Status (MATS Evaluation)
Serve **KSU** student, faculty, and staff by connecting the campus with residential, commercial, and employment locations.	All fixed routes serve KSU; campus shuttles provide additional internal connectivity.
Serve **Fort Riley** commuters (civilians and military) and dependents with service locations off the post (such as Manhattan and Junction City) as well as general circulation on the post.	Demand-response (including Inter-City Shuttle) serves Fort Riley; future fixed-route service has been identified as an area for further study.
Serve **social service** needs of the area by addressing transportation needs of economically disadvantaged people, older people as well as persons with disabilities by providing access to social services, employment, and commercial areas.	In terms of economics of these demographics, FHATA offers discounts to low-income, disabled, and elderly riders. Paratransit additionally assists those with disabilities. The 2010 Transit Update explored the demographics of the region, including maps of social services, population and employment.
Support **businesses** of the area by providing access to employment for low- and moderate-wage earning employees, transportation access from the Manhattan Regional Airport, and to and from hotels in Manhattan.	*Employment:* The fixed-route services currently serve many key employment areas, and others can be reached with demand-response service. Potential future employment areas to consider for service include north downtown and the Fort Riley Boulevard corridor. *Airport:* Demand-response service currently connects to the airport, and future fixed-route service has been identified as an area for further study. *Hotels:* The fixed routes stop near several hotels within Manhattan and Pottawatomie County. The major corridor currently not served is the Fort Riley Boulevard corridor.

MATS recommends that connections to medical destinations also be considered a goal of the system. The fixed routes already provide access to Mercy Regional Hospital and the Riley County Health Department, and many medical trips are served by the demand-response operations, so this goal is in keeping with existing service.

Performance Measures

Table 4-4 summarizes Transit performance measures that are currently tracked by FHATA, compared with statewide and national averages from USDOT's *Rural Transit Factbook.* In the two years shown, the transit system's trip-based measures (trips/mile, trips/hour) have increased admirably, and operating cost indicators (cost/mile, cost per trip) have decreased – both indicating increasing efficiency. These measures are generally better than – and in many cases much better than – statewide and U.S. averages for rural agencies and small cities.

The farebox recovery ratio for the fixed routes is below national averages, but the demand-response service is well above average.

As stated in **Chapter 1**, MATS recommends that these statistics continue to be tracked (along with total ridership), but that total ridership per capita become another measure tracked in the Urban Area in order to continue to benchmark against peer cities.

MATS also recommends that ridership tracking be refined such that the daily ridership graphs and O-D maps presented in this document can be regularly and easily produced.

Table 4-4: Transit Performance Measures
(from FHATA 2013 Annual report)

	FHATA		RTFB* (2010)	
	2012	2013	U.S.	KS
Trips Per Mile				
Fixed-Route	0.42	0.75	0.56	0.34
Demand-Response	0.29	0.33	0.17	0.25
Regional	0.12	0.16	--	--
Subtotal	*0.25*	*0.48*	*0.22*	*0.26*
Trips per Hour				
Fixed-Route	8.1	10.0	7.8	5.5
Demand-Response	4.3	5.4	2.6	4.2
Regional	2.6	3.1	--	--
Subtotal	*4.3*	*7.4*	*3.8*	*4.3*
Operating Cost Per Mile				
Fixed-Route	$2.74	$2.16	$2.93	--
Demand-Response	$2.07	$2.08	$2.02	--
Regional	$2.05	$1.93	--	--
Subtotal	*$2.49*	*$2.08*	*$2.32*	*$1.69*
Operating Cost Per Trip				
Fixed-Route	$6.59	$2.90	$6.80	--
Demand-Response	$7.21	$6.25	$16.83	--
Regional	$16.99	$12.14	--	--
Subtotal	*$8.69*	*$4.36*	*$10.54*	*$6.47*
Farebox Recovery Ratio				
Citywide Fixed-Route	6%	4%	8%	--
Demand-Response	19%	18%	7%	13%
Regional	12%	17%	7%	--

**RTFB = Rural Transit Factbook 2013 (USDOT/NCTR)*

Objective E-3: *Provide paratransit or other public transportation alternatives for mobility-impaired persons for general public transportation purposes.*

With any of FHATA's shuttle or route services, origin-to-destination demand-response service is available for persons with mobility impairments who live within 3/4 mile of the services. Service must be requested a day in advance. Fares are comparable to the demand-response fares. In these key areas, among others, FHATA's service is structured to comply with 49 CFR 37.131. As scheduled service expands, paratransit will need to be expanded along with it.

Objective E-4: *Serve as a hub and provider for regional transit.*

FHATA's service area extends beyond the boundaries of the Manhattan Urban Area, encompassing Fort Riley, the Green Valley area of Pottawatomie County, all of Geary County, and all of Riley County (roughly 1,030 square miles).

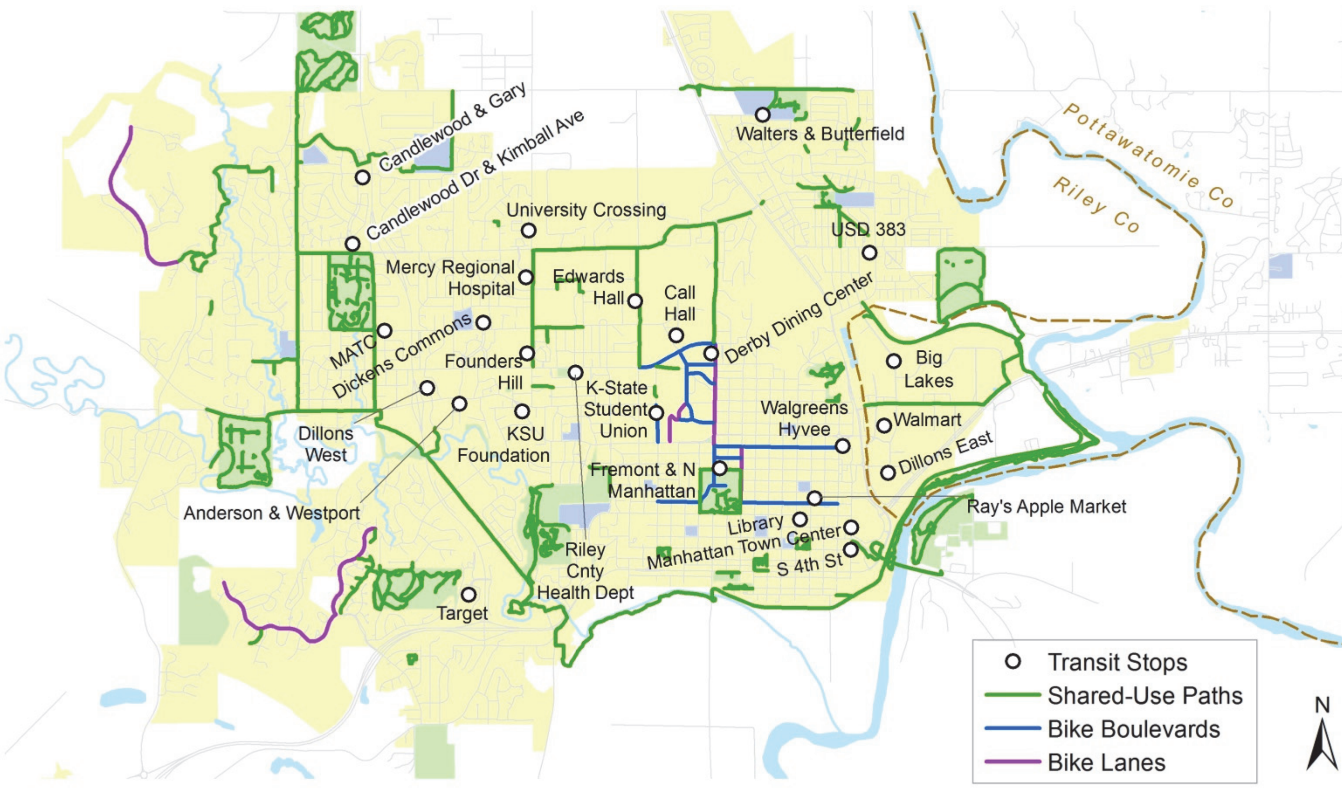
Thus, the agency, centered in the Manhattan Urban Area, already serves as a hub and provider for regional transit. A study expected to start in the fall of 2015 will also examine fixed-route transit in Junction City, and will be an important effort in continuing to expand the Manhattan Urban Area's regional transit role.

Objective E-5: *Facilitate connections to and from other local transportation modes (pedestrians, bicycles, autos, airport).*

Each mode is discussed in turn below:

- *Pedestrians:* FHATA stops have been located with pedestrian access in mind. As mentioned previously, these stops do not currently provide amenities, such as benches and shelters, that would increase pedestrian comfort and thereby enhance the service's attractiveness to pedestrians.
- *Bicycles:* FHATA fixed-route vehicles include bike racks, and demand-response drivers are generally willing to load bicycles in the backs of their vehicles (if they fit and are clean). Because of Manhattan's current limited bicycle route coverage, only six of the system's 26 stops are served by on-street bicycle routes, although several others are located near shared-use paths. **Figure 4-4** illustrates an overlay of the transit stops on the current bicycle facilities.
- *Automobiles:* Many of the FHATA fixed-route stops are located along roadways that allow automobiles to drop off or pick up passengers. Many are also located near parking lots, allowing for potential park-and-ride situations. The Park-and-Ride shuttle on the K-State campus is a new route created to distribute passengers from their cars to various locations on campus.

Figure 4-4: Relationship of Bicycle Facilities and Transit Stops



***Objective E-6:** Support connections to intercity mass transportation modes (aviation, intercity bus).*

Currently, FHATA's Inter-City Shuttle can connect the region's residents to both the Manhattan Regional Airport and the existing Greyhound stop in Junction City. Potential considerations for strengthening these connections in the future include:

- As previously mentioned, the 2010 Transit Plan suggested the airport be among future destinations considered in developing future routes.
- As also previously mentioned, KDOT's recent Statewide Intercity Bus Study recommended a stop in Manhattan connecting to an existing north-south route that ultimately connects to Wichita. It is recommended that the region continue to advocate for an intercity bus stop in Manhattan. Not only would this provide a connection into the national intercity bus network (via the I-70 stop in Junction City), but it would provide connections to Amtrak in Hutchinson and/or Newton.

***Objective E-7:** Maintain a Transit Master Plan for planning, implementing, operating and monitoring the transit system.*

The 2010 Transit Plan serves this function, and the conditions and strategies identified in MATS can be used to assist with updating it. Now that fixed-route transit is a reality in Manhattan, the Transit Plan should be revisited to identify the next wave of transit service growth.

Table 4-5: MATS Transit Strategies		
Strategy	**Responsible**	**Priority****
Promotion/Planning		
Provide benches and shelters at key transit stops.	**Lead:** Transit Agency* **Involve:** FHRTA, City Community Development, City Public Works, K-State, City Commission	3
Include a prominent link to the Transit Agency's web site on the City's web site.	**Lead:** City Information Systems **Involve:** Transit Agency*, City Community Development	1
Include a more prominent link to the Transit Agency's web site on K-State's web site.	**Lead:** K-State **Involve:** Transit Agency*	1
Maintain a Transit Master Plan.	**Lead:** Transit Agency* **Involve:** FHRTA, City Community Development	
Scheduled Service		
Extend fixed transit routes later into the evening (10 p.m.).	**Lead:** Transit Agency* **Involve:** FHRTA, City Community Development, K-State	3
Add Sunday service.	**Lead:** Transit Agency* **Involve:** FHRTA, City Community Development, K-State	3
Identify additional routes and expand service.	**Lead:** FHRTA, Transit Agency* **Involve:** FHRTA, City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works	3
Explore the applicability of transit ITS in the Urban Area in future transit planning efforts.	**Lead:** Transit Agency* **Involve:** FHRTA, City Public Works	
Establish K-State perimeter shuttle in conjunction with campus Master Plan changes.	**Lead:** Transit Agency*, K-State **Involve:** FHRTA, City Community Development, City Public Works	3
Survey taxi coupon users regarding needs and usage patterns – to determine whether an overlap exists with Transit Agency* demand-response service.	**Lead:** City Customer Service **Involve:** City Community Development	2
Target 2010 Transit Plan goals for regional service; add serving medical trips as a goal.	**Lead:** FHRTA, Transit Agency* **Involve:** FHMPO	1
In addition to standard FTA performance metrics, track ridership per capita and benchmark against peer cities.	**Lead:** Transit Agency* **Involve:** FHRTA, FHMPO	O
Refine ridership tracking to allow simpler presentation of data.	**Lead:** Transit Agency* **Involve:** FHRTA, FHMPO	1
Paratransit		
Expand paratransit to complement expanded fixed-route service.	**Lead:** FHRTA, Transit Agency* **Involve:** FHRTA, City Public Works / Community Development, Riley Co. Planning and Development / Public Works, Pottawatomie Co. Zoning / Public Works	3
Connections		
Design the bicycle system and transit system to mutually reinforce each other.	**Lead:** Public Works – City and County, FHRTA, Transit Agency* **Involve:** FHMPO	O
Advocate for an intercity bus stop in Manhattan.	**Lead:** FHRTA, FHMPO, City Community Development Support: City Public Works / Community Development, Riley Co. Planning and Development / Public Works **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners	2

*****1 = Immediate Priority,** to be implemented with MATS adoption or shortly thereafter; **2 = High Priority,** to be initiated as soon as possible and completed within one to two years after MATS adoption; **3 = Moderate Priority,** to be completed within three to five years after MATS adoption; **O = ongoing,** actions that occur continually.*

**At the time of this writing, it is known that the Flint Hills Regional Transit Administration (FHRTA), a relatively new agency designated as the region's Direct Recipient of federal transit funds, will be required to formally solicit for a transit operator. FHATA, the current transit agency, is not excluded from remaining as the operator, but as the outcome is subject to a process, the final decision is unknown. Therefore, in this table, the general term "Transit Agency" is used.*

5.0 Public Parking

MATS Goal F: Optimize/manage parking supply and internal connectivity for major activity centers.

5.1 Existing/Historical Conditions

Parking issues are most frequently associated with the most urbanized areas in a region; thus, this section generally focuses on issues within the City of Manhattan (as opposed to the outlying County areas).

Parking Supply

Figure 5-1 illustrates existing public off-street parking lots, as well as various on-street parking restrictions and loading areas, within the City of Manhattan. Parking for residential streets is generally not included in the figure..

Figure 5-1: Existing On- and Off-Street Parking

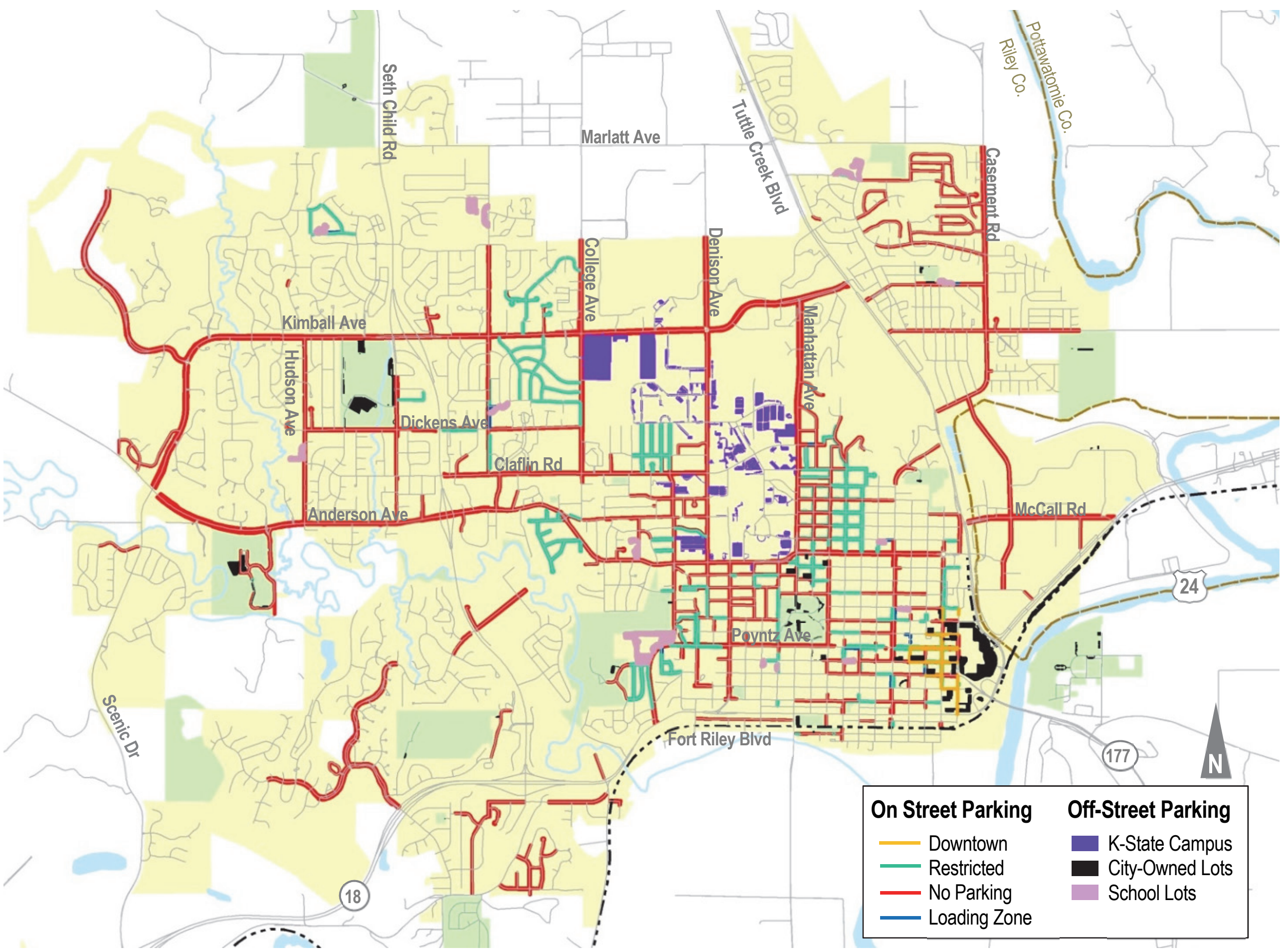


Table 5-1 summarizes the public parking inventory in Downtown and Aggieville. More detailed inventory maps are included in **Appendix E**. As the Table indicates, public parking in Aggieville is fairly evenly split between on-street and off-street, while Downtown offers approximately 4.5 times as many off-street spaces as on-street spaces. It should be noted that nearly half of Downtown's public parking is located at Manhattan Town Center, whose parking lot is publicly owned.

Table 5-1: Public Parking Supply, Downtown and Aggieville
(Source: City of Manhattan)

	Downtown	Aggieville
Off-Street		
Unlimited: Mall	1,555	--
Unlimited: Other	1,408	--
3-Hour Limit	--	261
Farmer's Market	255	--
Subtotal	**3,218**	**261**
On-Street		
Unlimited	354	148
2-Hour Limit	299	169
Restricted 8a – 5p	--	11
Permit (White Zone)	63	--
Subtotal	**716**	**328**
Grand Total	**3,934**	**589**

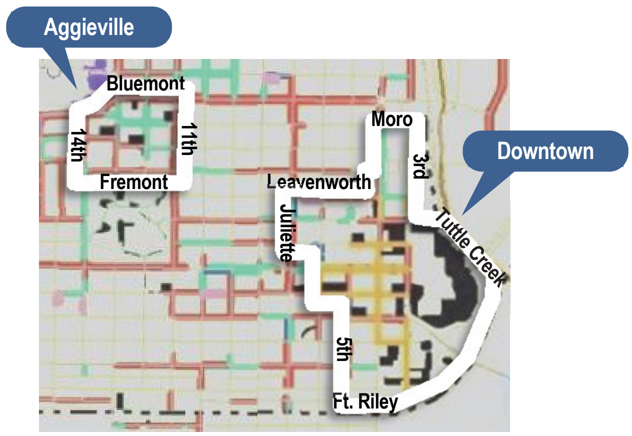
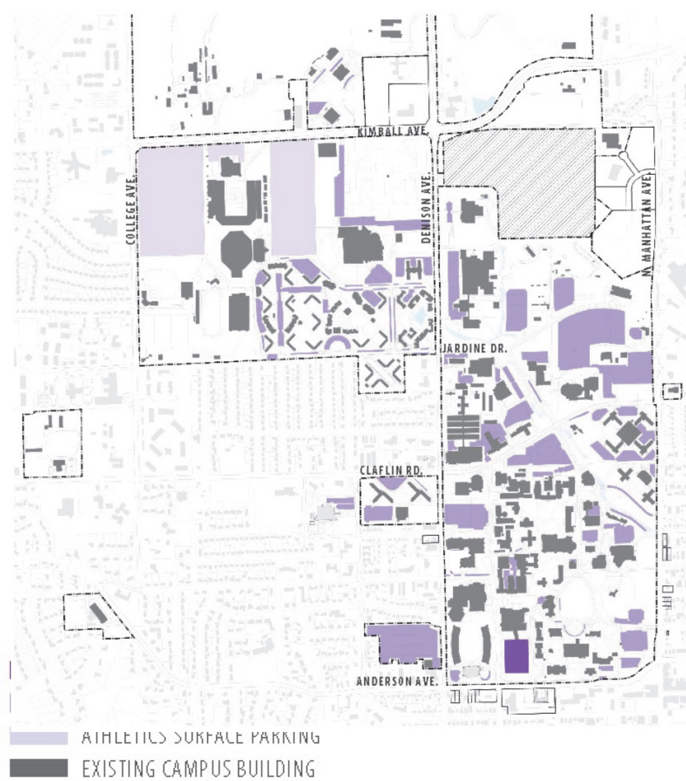


Figure 5-2 illustrates parking supply associated with the K-State campus. The K-State campus includes 125 acres of off-street parking (garage and surface lots), about 22 percent of the campus land.

According to the Parking and Transportation Element of the K-State Master Plan:

> *The university, through KSU Parking Services, maintains approximately 11,900 total parking spaces for commuter, visitor, resident, and service vehicle parking. There are an additional 1,800 spaces administered by the Athletics Department located east of Snyder Family Stadium which must be vacated by 6:00 pm. West of the stadium there are an additional 2,500 spaces, though these are not designated for campus parking use.*

Figure 5-2: K-State Parking



Parking Usage

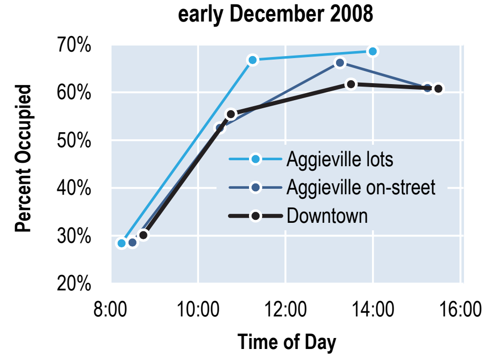
Downtown/Aggieville

The most recent parking usage data for Downtown and Aggieville was collected by the City on weekdays in late 2008. This data covered:

- The four public parking lots in Aggieville (Laramie/Manhattan, Moro/11th, Bluemont west of 12th, Laramie/12th)
- Aggieville on-street parking on North Manhattan Avenue (600-700 blocks), North 12th Street (600-700 blocks), Anderson Avenue (1300 block), and Moro Street (1100-1200 blocks).
- Two public parking lots downtown: Houston/3rd, Humboldt/3rd
- Downtown on-street parking on South 5th Street (100 block), North 4th Street (100 block), South 4th Street (100-200 blocks), Poyntz Avenue (300-500 blocks), and Houston Street (300-400 blocks).

Figure 5-3 illustrates the data for weekdays in the first half of December. According to this data, parking occupancies in Downtown and Aggieville showed similar trends throughout the days studied: occupancies peaked between 60 and 70 percent, and generally achieved these peaks by late morning – with the exception of Aggieville on-street parking, which apparently peaked closer to lunch time.

Figure 5-3: Weekday Parking Occupancies, early December 2008



Downtown has changed a great deal since 2008, and the City is planning to conduct new parking occupancy counts to better understand the current situation. The City is also conducting initial feasibility analyses regarding new parking structures in the Downtown area, but at this point the analyses are focused on physical feasibility, not potential demand.

K-State

According to the Parking and Transportation Element of the K-State Master Plan:

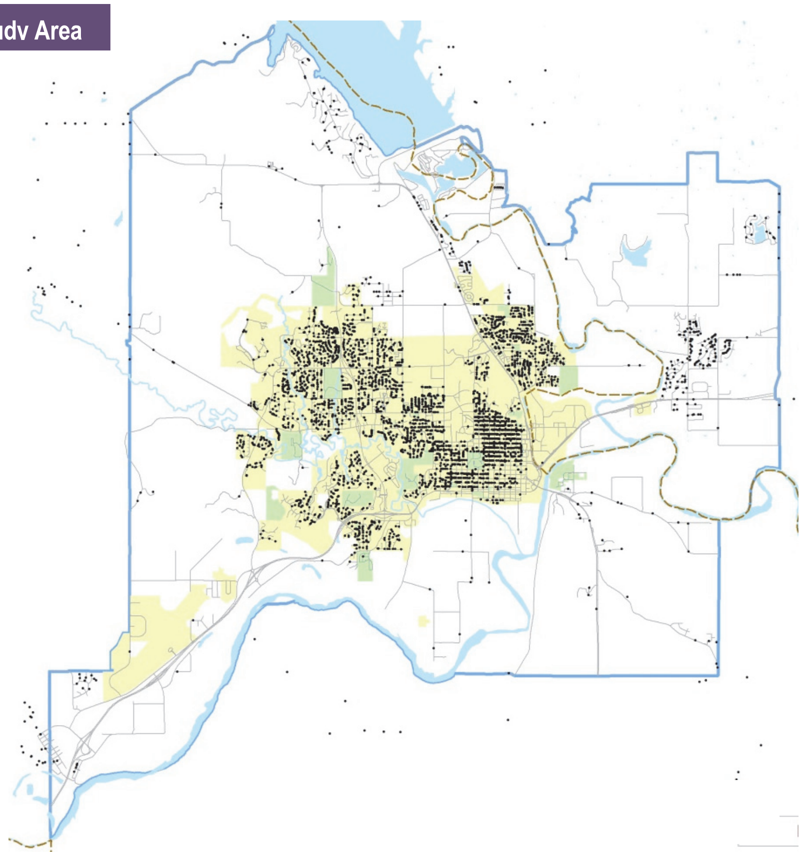
> *Overall, the parking supply appears to be adequate; however, access to convenient parking is strained. At the same time, there is a large amount of unused parking in lots adjacent to Snyder Family Stadium…*

K-State provided an anonymous address database of its parking permit holders, in which faculty, staff, and students were aggregated together. The database consists of 12,827 permit holders, of which about 7,700 have “home” addresses within the study area but not on campus (about 2,600 live on campus). **Figure 5-3** illustrates the geographical distribution of these permit holders within the study area. It is likely that most, if not all, of these 7,700 commute (in one form or another) to park on campus. It is noteworthy that 75 percent of these permit-holders (about 4,700) live within a quarter-mile of an FHATA bus stop, and 91 percent (about 7,000) live within a half-mile of a stop. This suggests that there may be a significant amount of potential additional transit riders within the study area.

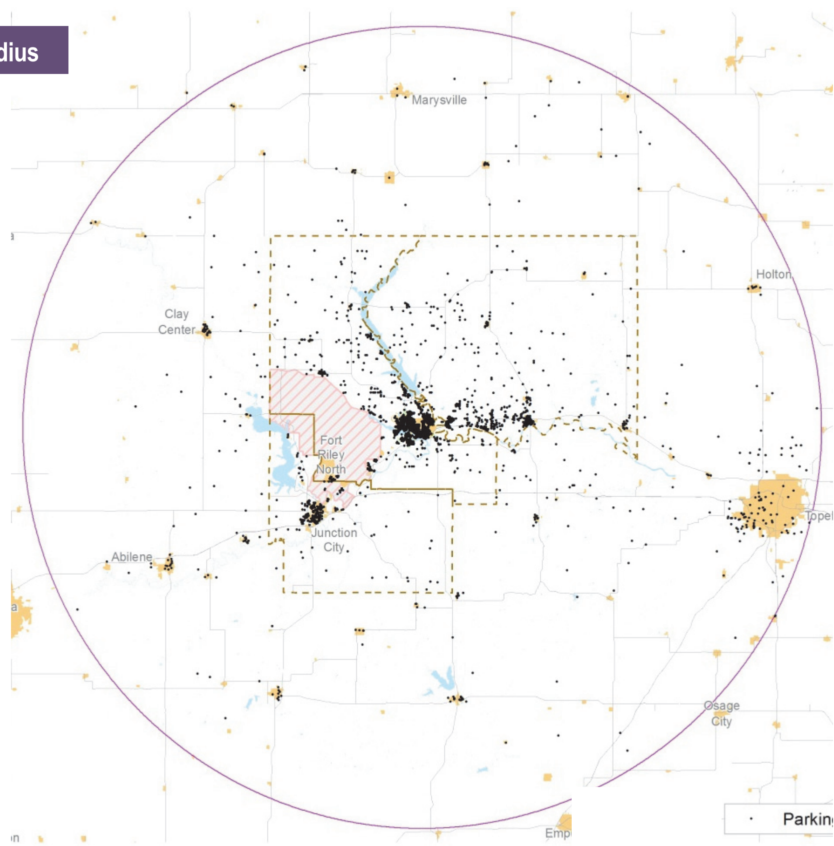
Figure 5-3 also illustrates the geographical distribution of permit-holder residences within a 54-mile radius of K-State (this radius was chosen because it includes Topeka). An additional 1,572 permit-holders have home addresses within this region, which is probably the furthest distance one is likely to commute to campus (although some of these home addresses may be students’ hometown addresses rather than their address while at school).

Figure 5-3: Geographical Distribution of KSU Parking Permit Holders, Fall 2014

Within Study Area



Within 54-Mile Radius



Parking Policies

The City of Manhattan sets required off-street parking ratios for 8 dwelling/lodging categories, 18 commercial categories, and 11 other categories. In addition, the City has parking lot configuration standards for both on-and off-street parking detailing stall and aisle dimensions. Off-street configurations are detailed for 45-, 60-, 75-, and 90-degree parking; on-street dimensions are provided for these same angles.

5.2 Achieving Parking Objectives

Objective F-1: *Systematically plan, implement and manage public parking (on-street and off-street).*

For this objective, a series of Best Practices are presented – some as recommendations, some as considerations.

Planning

- In considering future parking capacity expansions – especially the development of new parking structures – the Urban Area should explore the possibility of public/private partnerships.

- Zoning Regulations should reflect ADA requirements for accessible parking. This generally means:
  - For lots with 500 or fewer spaces: 1 accessible space for every 25 spaces (rounded up to the nearest space)
  - For lots with 501 to 1,000 spaces: 2 percent of all spaces should be accessible
  - For lots with more than 1,000 spaces: 20 accessible spaces, plus one for each 100 spaces over 1,000

  Of the accessible spaces:
  - For lots with 400 or fewer spaces: 1 accessible van space (and the rest accessible automobile spaces)
  - For lots with 401 to 500 spaces: 2 accessible van spaces (and the rest accessible automobile spaces)
  - For lots with more than 500 spaces: 1 out of every 8 spaces van accessible (and the rest automobile accessible)

  Accessible parking spaces must be located on the shortest accessible route of travel to an accessible facility entrance. Where buildings have multiple accessible entrances with adjacent parking, the accessible parking spaces must be dispersed and located closest to the accessible entrances.

  These standards should be applied both to new parking lots, and those that are being restriped, in order to conform to federal regulations.

- Shared parking should be encouraged wherever possible.
  - When adjacent parcels develop, strong consideration should be given to allowing cross-access between the parcels. This idea is addressed in the Access Management Guidelines (**Appendix A**) because it allows consolidation of access points, reducing impacts to the public road system – but it also has the benefit of building a contingency or cushion into the parking capacity, allowing for occasional overflows to be better accommodated and perhaps allowing reductions in parking requirements (see later discussion).
  - Because different land uses have parking peaks at different times of day (for example, office uses peak during the workday while hotels peak in the evening), time-of-day parking analysis should be analyzed in shared-parking situations. ITE's *Parking Generation* not only includes peak parking ratios, but in many cases also includes time-of-day distributions, and these can be used to overlay site uses to determine the true peak parking demand, rather than just adding the peaks for each use.

- Parking ratio discounts should be considered. The City's Zoning Regulations include a lengthy list of land uses and their associated parking ratios. It may be reasonable to discount these rates in certain situations. The Regulations already allow such discounts for Planned Unit Development (PUD) Districts, but don't specify positive criteria for implementing them. There may be cause to extend this allowance to non-PUD developments. For example, higher-density apartments, if not approved as a PUD, could benefit from reduced parking ratios. Reductions for residential density, employment density, land-use mix (using shared-use analysis procedures described above), transit accessibility, walkability, and demographics (e.g., senior or student-oriented housing).
- Another way to potentially reduce parking requirements, or to better match them to true demand, is to encourage "unbundling" of parking space costs from multi-family rent. This is particularly applicable to large multi-family residential developments. Giving residents the option to pay for a parking space separate from their rent could encourage consideration of not owning a vehicle, or could attract non-vehicle-owning residents. Studies have shown this approach could reduce parking needs 10 to 20 percent.
- When a use does not fit into the categories identified by the Zoning Regulations, or it is more specialized in a way that could affect parking ratios, ITE's *Parking Generation* should be consulted as a source to determine potential demand. If a use is not covered by *Parking Generation*, actual field studies of similar uses should be conducted to verify expected demand.

Design

- Parking design standards should include dimensions for accessible parking spaces, both on-street and off-street, for both cars and vans. Off-street, this generally translates to minimum dimensions of 8 feet for stall width, 5 feet for access aisle width for a car, and 8 feet of access aisle width for a van. On-street, this often translates (where space is not constrained) to a 5-foot buffer between the parking space and the curb, connecting to an accessible curb ramp. On- and off-street accessible spaces should be signed and marked appropriately. If and when ADA standards are updated, the agencies' standards should be updated as well.
- Use IES illuminance guidelines to determine lighting criteria for surface and structured parking lots.
- Parking design standards should discourage the use of wheel stops, as they present a tripping hazard for pedestrians.
- Parking lot design standards should encourage a clear, direct, unobstructed, minimum-conflict pedestrian path to the land-use(s) served by the parking lot. Standalone parking lots should provide clear, direct, unobstructed pedestrian connections to adjacent sidewalks fronted by the parking lot – connections that do not force pedestrians to use automobile driveways.
- Certain parking lot dimensions (e.g., aisle widths and stall depths in 90-degree layouts) may be able to be reduced to tighter minimums. In addition, a single width for all parking spaces is not consistent with typical practice – low-turnover spots (employee or student parking) may be able to use lower widths than the City's 8.5-foot standard, but higher-turnover spots may need higher widths (up to 9 feet). It is recommended that current editions of Urban Land Institute's (ULI's) publication *The Dimensions of Parking*, in addition to other national publications, be considered as standard dimensions for parking spaces are revised.
- Reverse angle (or back-in angle) parking is beginning to be adopted by a number of cities across the U.S. Instead of pulling head-first into their parking spot, cars back into their spots, allowing them to make eye contact with oncoming traffic when exiting the parking space.

  Advantages include:

  - Improved visibility and increased field of vision
  - Decreased number of collisions
  - Improved safety for children exiting the vehicle (guided toward the street)
  - Improved safety for bicyclists (motorists can see them when exiting the space)

– Improved loading/unloading (car trunk adjacent to sidewalk instead of street)

Potential concerns include:

– Driver misunderstanding, entering spaces head-in from opposite side of street (requires education, signing, and enforcement)
– Vehicles overhanging sidewalk (design and placement must be done with care)
– Vehicles backing into street furniture (design and placement must be done with care)
– Vehicle exhaust over sidewalks (may require idling regulations)
– Potential congestion (similar to parallel parking, backing in could cause congestion on heavy-traffic streets)

MATS recommends that the Urban Area consider a demonstration project for reverse-angle parking, identifying a candidate location where concerns exist relating to existing angle parking that may be resolved with this treatment.

Management

Information and management technologies related to parking continue to mature under the umbrella of Active Parking Management. Smartphone apps and new detection technologies are allowing cities and other entities to add efficiencies to the parking system by providing information on available spaces directly to the consumer, no matter where the consumer may be currently located. MATS recommends that the Urban Area investigate the applicability of Active Parking Management in the Downtown, Aggieville, and K-State areas.

One related concept that has so far not been implemented in the City of Manhattan's denser parking areas (with the exception of the K-State campus) is *parking pricing*. MATS is not suggesting a sweeping implementation of parking meters and priced garages throughout the City; however, the City may wish to explore the benefits (and potential drawbacks) of beginning to implement parking pricing. Pricing is one means to manage demand in problem areas as opposed to (or to postpone) major investments in capacity increases. One potential pilot project would be to implement convenient (credit-card or cell-phone-based) metering for a premium subset of parking spaces in some larger area (spaces closer to motorists' desired destinations). This could become a revenue-generating tool for the City, but could also begin to demonstrate whether pricing is a feasible parking management tool in the Urban Area.

MATS also recommends that the City evaluate its parking fine ordinances and structures to ensure that they reflect current best practices and local financial realities.

Objective F-2: *Regularly monitor parking conditions in Aggieville and implement improvements when necessary.*

Objective F-3: *Regularly monitor parking conditions in Downtown and implement improvements when necessary.*

Monitoring. It is recommended that peak parking demand in Aggieville and Downtown be counted at least every five years to determine occupancies, turnover times, and unserved demand. Portions of these areas have restricted parking; thus, average turnover times are of interest to determine if the restrictions are appropriately set (and complied with). Regularly monitoring these areas allows tracking of trends and provides a better understanding of changing conditions. MATS continues to recommend progressing toward the establishment of a parking management organization or organizations focused on these two areas of the City; such monitoring can help to determine the timing for the formation of such an organization.

Wayfinding. Because the Urban Area includes two major transient populations – K-State students and nearby Fort Riley military personnel, there are more new residents in the area at any given time than would be found in typical areas of this size. Many of these individuals are interested in visiting local destinations such as Downtown and Aggieville. As parking is an important function of a successful visit, it is recommended that the City consider additional emphasis on wayfinding in these two areas. The City currently has a Downtown wayfinding map) about four levels deep on its web site that primarily indicates parking (a portion of which is shown at right). This map could be much more powerful if it were broadened to include on-street parking restrictions, Downtown destinations (restaurants, hotels, Flint Hills Discovery Center, retailers, etc.), and pedestrian paths/sidewalks. Thus, this recommendation is larger than a parking strategy – it has economic development and walkability components – but a parking map is a good central organizing framework around which to build. It is recommended that such maps be built for both Downtown and Aggieville (on-line and paper versions are both recommended), and that they be prominently featured on the Web sites of the City, Riley County, the Aggieville Business Association, and Downtown Manhattan, Inc.

Objective F-4: *Regularly monitor parking conditions around the Kansas State University campus and implement improvements when necessary.*

The K-State Master Plan includes the following strategies regarding campus parking:

- A proposed structured parking facility at the corner of Claflin Road and Manhattan Ave would provide as many as 1,600 additional spaces.
- As a general goal/policy, the plan recommends shifting parking to the periphery from the core of campus – for example, the underutilized surface parking adjacent to Snyder Family Stadium, which would be more attractive with enhancements to bicycle and pedestrian infrastructure and transit service.
- New building construction is mainly proposed to be sited on existing surface parking lots, protecting the existing open space network on campus.
- Accessible (ADA) parking is to be maintained and provided at any new buildings or facilities.
- Screen parking with plant materials according to the landscape guidelines.

With the shifting of campus parking, some of it to more outlying areas, the question of impacts to parking in campus-adjacent neighborhoods has been raised. As **Figure 5-1** illustrates, there are a number of parking restrictions and prohibitions in effect for residential neighborhoods near campus. MATS recommends that this situation be monitored over time as the K-State Master Plan is implemented; it is possible that such restrictions may need to be extended to streets further from campus – perhaps as far west as College Avenue and as far east as 7th Street.

Table 5-2: MATS Parking Strategy Summary		
Strategy	**Responsible**	**Priority***
Planning		
Explore the possibility of public/private partnerships in the development of new parking structures.	**Lead:** City Manager, City Public Works, City Community Development **Involve:** City Commission	3
Adjust parking-related regulations to reflect ADA guidelines for provision and location of accessible parking.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	1
Encourage shared parking for adjacent parcels wherever possible through cross-access. Tailor parking ratios to the anticipated peak based on projected daily fluctuations of each use.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	2
Consider parking-ratio discounts for residential density, employment density, land-use mix, transit accessibility, walkability, and demographics.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	2
Consider encouraging the "unbundling" of parking spaces from multi-family rent.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	2
Use standard sources, or field studies, for parking ratios not found in the Zoning Regulations.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	1
Design		
Include dimensions for accessible parking spaces, both on- and off-street, in parking design standards	**Lead:** Public Works – City and Counties **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners	1
Use IES illuminance guidelines to determine lighting criteria for surface and structured parking lots.	**Lead:** Public Works – City and Counties	2
Discourage the use of wheel stops, as they present a tripping hazard for pedestrians.	**Lead:** Public Works – City and Counties	2
Encourage clear, direct, unobstructed, minimum-conflict pedestrian paths from parking lots to adjacent land-uses and sidewalks.	**Lead:** Public Works – City and Counties, City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners	2
Revise standard parking space dimensions to reflect current industry practices and to add flexibility (i.e. high vs. low turnover).	**Lead:** Public Works – City and Counties **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners	2
Consider a demonstration project for reverse-angle parking.	**Lead:** City Public Works, City Community Development **Involve:** City Commission	3

Table 5-2: MATS Parking Strategy Summary (Cont'd)		
Strategy	**Responsible**	**Priority***
Management		
Investigate the applicability of Active Parking Management in the Downtown, Aggieville, and K-State areas.	**Lead:** City Public Works **Involve:** FHMPO, K-State	3
Consider a small parking meter pilot project.	**Lead:** City Manager, City Public Works, City Community Development **Involve:** City Commission	3
Evaluate parking fine ordinances and structures to ensure that they reflect current best practices and local financial realities.	**Lead:** City Manager, City Commission **Involve:** Aggieville Business Association; Downtown Manhattan, Inc.	3
Downtown & Aggieville		
Count comprehensive peak parking occupancy and turnover rates in Downtown and Aggieville at least every five years.	**Lead:** City Public Works/Community Development **Involve:** Aggieville Business Association; Downtown Manhattan, Inc.	O
Progress toward the establishment of a parking management organization for Downtown and Aggieville, guided in part by the monitoring data collected above.	**Lead:** City Manager, City Public Works, City Community Development **Involve:** City Commission; Aggieville Business Association; Downtown Manhattan, Inc.	3
Expand the existing Downtown wayfinding map to include on-street parking restrictions, Downtown destinations, and pedestrian paths/sidewalks. Develop a similar (or bundled) map for Aggieville.	**Lead:** City Manager, City Public Works, City Community Development **Involve:** Aggieville Business Association; Downtown Manhattan, Inc.	2
K-State		
Implement the parking provisions of the K-State Master Plan	**Lead:** K-State **Involve:** City Public Works/Community Development	3
Monitor parking in campus-adjacent neighborhoods as the K-State Master Plan is implemented to determine if parking restrictions in residential areas need to be extended further east	**Lead:** City Public Works/Community Development **Involve:** K-State	3

****1 = Immediate Priority,** to be implemented with MATS adoption or shortly thereafter; **2 = High Priority,** to be initiated as soon as possible and completed within one to two years after MATS adoption; **3 = Moderate Priority,** to be completed within three to five years after MATS adoption; **O = ongoing,** actions that occur continually.*

6.0 Roadway Infrastructure and Management

Goal G: *Provide and maintain local streets that promote safety, comfort and convenience; that preserve a high quality of life; and that reflect the context of their surrounding areas.*

Goal H: *Provide and maintain a safe and effective roadway network for users of arterial and collector streets.*

MATS has two goals related to the automobile mode, as shown above. **Goal G** focuses on the "local" level, emphasizing neighborhood streets – both their traffic-carrying function and their quality-of-life features. These elements are addressed below in the "Neighborhood Traffic Control" section of this chapter and under the discussion of the objectives for **Goal G** in the second half of the Chapter. **Goal H** is at a broader level, considering the urban area's roadway network as a whole, and the hierarchy of streets necessary to move automobile traffic safely and efficiently throughout the Urban Area.

6.1 Existing/Historical Conditions

Functional Classification

Functional classification has been defined as "the process by which streets and highways are grouped into classes, or systems, according to the character of traffic service that they are intended to provide." One important reason to classify roads this way is that this classification provides important input into the apportionment of federal funds. Historically, the Manhattan Urban Area used four functional classifications: (1) Freeway and Expressway, (2) Arterial, (3) Collector, and (4) Local. However, in recent collaboration with KDOT and FHMPO, this classification has been broadened to seven categories (definitions per FHWA), as shown in **Table 6-1**.

With the passage of the most recent federal transportation authorization bill, MAP-21, all roads and streets classified as Principal Arterial routes (which include Freeways, Expressways and Other Principal Arterials), regardless of jurisdiction, were automatically added to the National Highway System (NHS) on October 1, 2012. None of the Manhattan Urban Area's Principal Arterials are interstates, meaning only state-owned facilities are on the NHS.

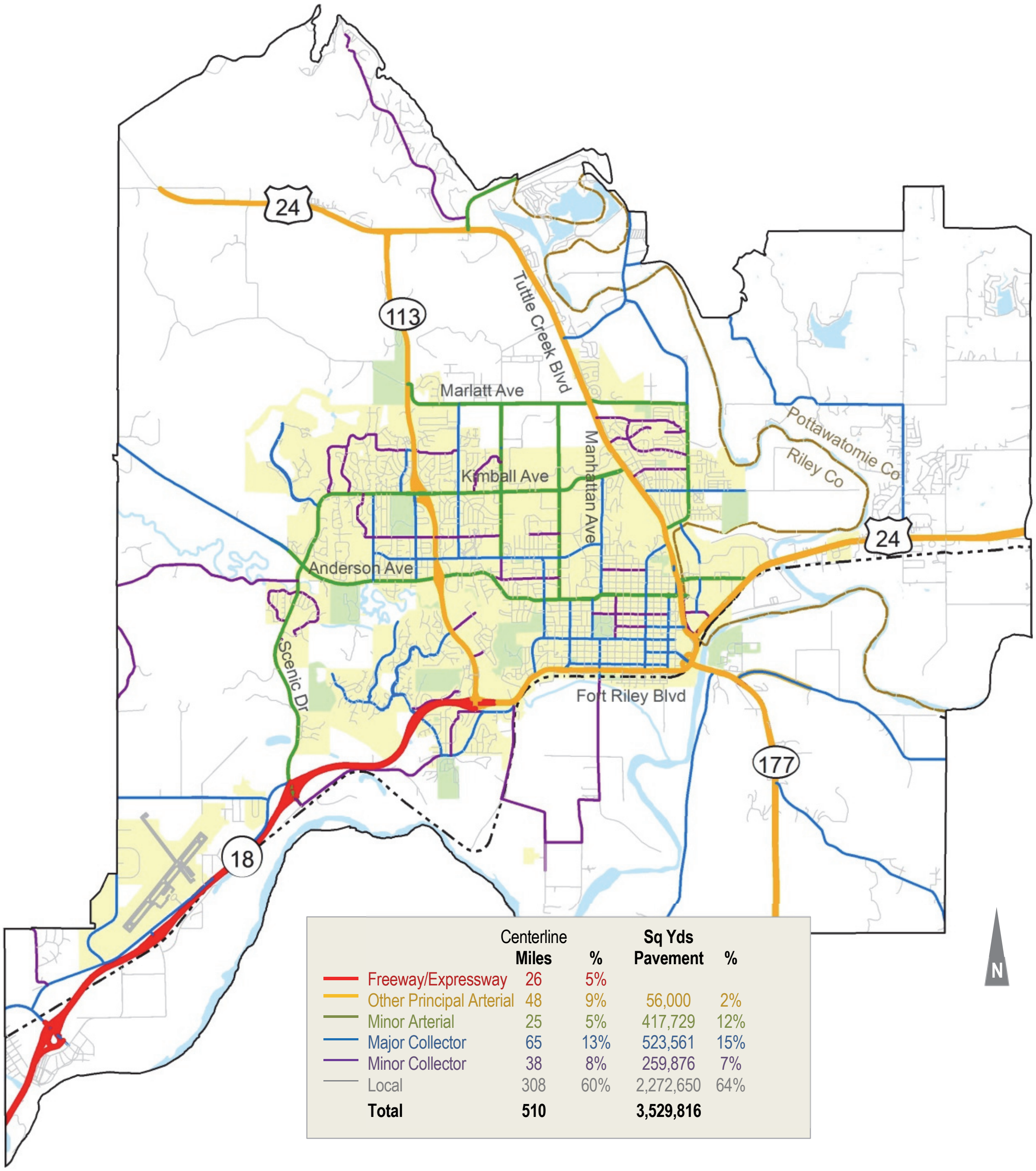
It should be noted that the NHS designation on Principal Arterials entails certain requirements, such as reporting on the status of pavement and bridges (and associated performance targets), outdoor advertising regulations, and requirements to use national (AASHTO) design criteria and standards for all new projects (regardless of funding source).

Figure 6-1 illustrates the current functional class system as applied to the study-area roadways, and provides mileage totals for each classification. As the figure indicates, there are 510 miles of roadways within the study area, and 60 percent of that mileage is classified as local roads.

Table 6-1: Functional Classifications in the Manhattan Urban Area

	Function	Access vs. Mobility
Interstate	*Not used in Manhattan Urban Area*	
Freeways and Expressways	Serve the major portion of trips entering and leaving the urban area, longer intra-city trips, as well as the majority of trips bypassing the central city; provide continuity for Arterials that intercept the urban area boundary. Directional travel lanes are usually separated by some type of physical barrier, and their access and egress points are limited to on- and off-ramp locations or a very limited number of at-grade intersections.	In the Manhattan Urban Area, facilities in this class have full access control (interchange access only). Like Interstates, these roadways are designed and constructed to maximize their mobility function, and abutting land uses are not directly served by them.
Other Principal Arterials	Serve major centers of metropolitan areas; provide a high degree of mobility.	Unlike on their access-controlled counterparts, abutting land uses can be served directly. Forms of access include driveways to specific parcels and at-grade intersections with other roadways.
Minor Arterials	Interconnect and augment with the higher-level Arterial system; provide intra-community continuity and serve intra-city trips of moderate length. May carry local bus routes.	Mostly signalized intersections.
Major Collectors	Distribute and channel trips between Local Streets and Arterials, usually over a distance of greater than three-quarters of a mile. Serve both land access and traffic circulation in higher density residential and commercial/ industrial areas.	Typically uncontrolled access (all driveways and cross streets have full access).
Minor Collectors	Distribute and channel trips between Local Roads and Arterials, usually over a distance of less than three-quarters of a mile. Serve both land access and traffic circulation in lower density residential and commercial/industrial areas.	Typically uncontrolled access, but with higher driveway densities than major collectors.
Local Streets	Serve short travel. Connect to higher functional classes. Often designed to discourage through traffic. Typically do not carry bus routes. Often classified by default; once all Arterial/Collector roadways have been identified, all remaining roadways are classified as Local.	Provide direct access to adjacent land.

Figure 6-1: Functional Classification of Manhattan Urban Area Roadways



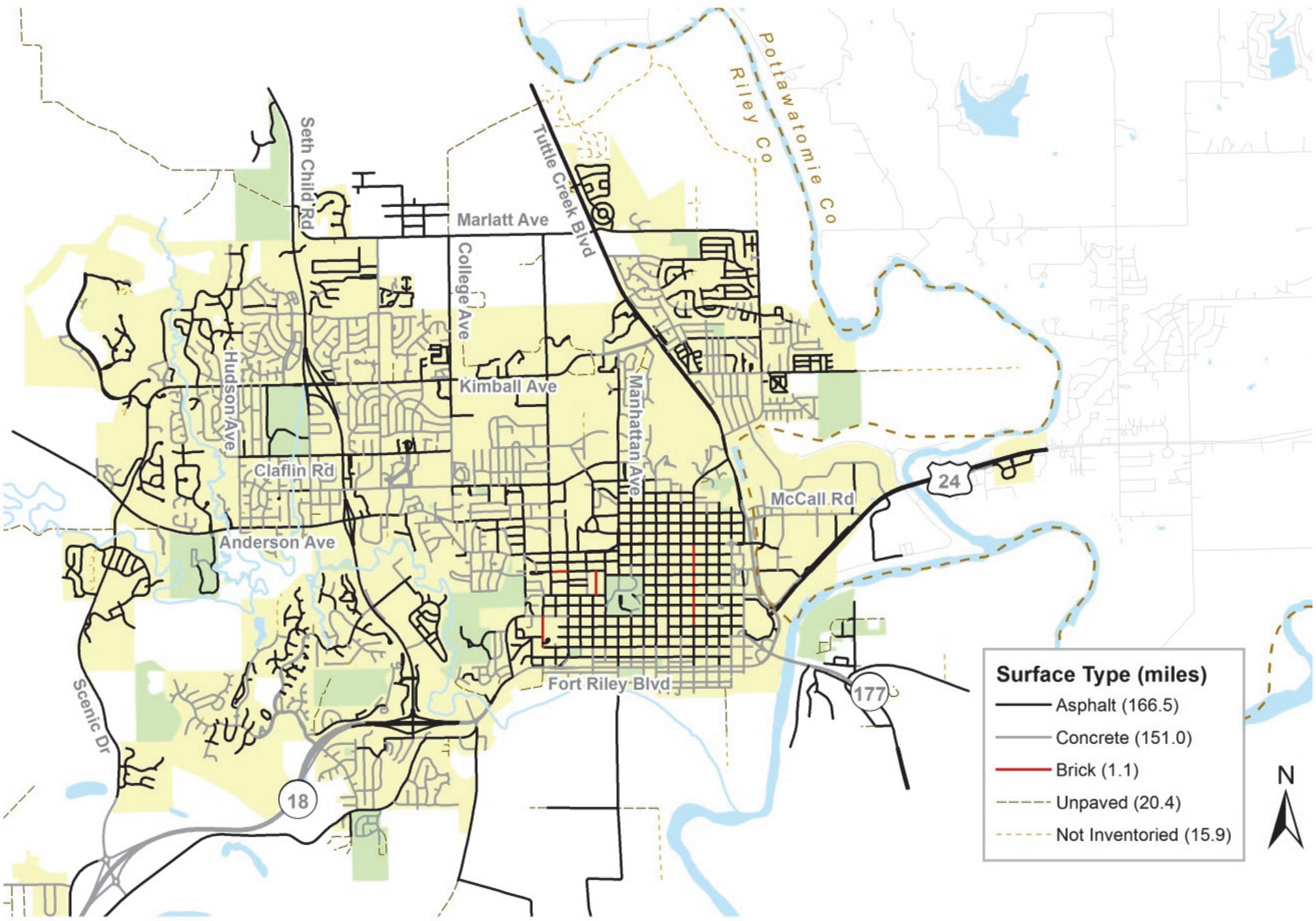
	Centerline Miles	%	Sq Yds Pavement	%
Freeway/Expressway	26	5%		
Other Principal Arterial	48	9%	56,000	2%
Minor Arterial	25	5%	417,729	12%
Major Collector	65	13%	523,561	15%
Minor Collector	38	8%	259,876	7%
Local	308	60%	2,272,650	64%
Total	**510**		**3,529,816**	

System Condition

The following describes how the two Counties and the City monitor and maintain their street systems with regard to pavement:

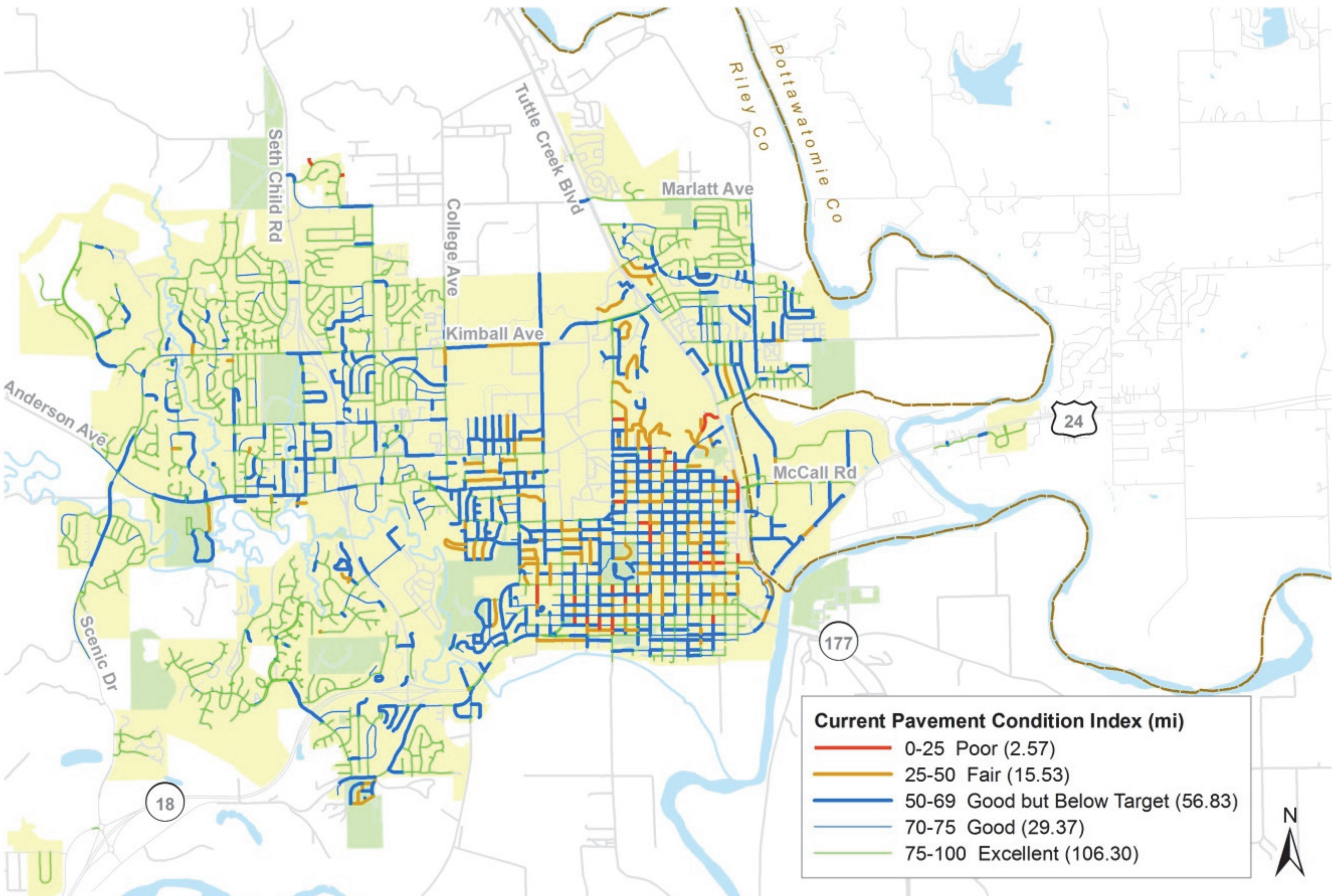
- *Riley County*: The County has a scheduled maintenance program, with each roadway on a 12-year cycle: overlays at the beginning of the cycle, and then chip seals after 6 years. In addition, the County crack-fills all roads on an annual basis. These procedures are used as a guide, but each road is also visually inspected annually to determine if alterations to the maintenance schedule are necessary.
- *Pottawatomie County:* The County monitors pavement condition, but does not use an electronic system.
- *City of Manhattan:* **Figure 6-2** illustrates the type of pavement used on roadways within the City. Out of the 339 miles inventoried, almost half are asphalt, and about 45 percent are concrete.

Figure 6-2: Pavement Surface Type, City of Manhattan Inventory



The City of Manhattan annually reviews the pavement conditions of Arterials and Collectors in the field to determine their condition and need for repair. For Local Streets, the City annually reviews the calculated Pavement Condition Index (PCI) using LUCITY software, which also includes degradation formulas based on the time elapsed since the most recent measurement. A PCI of 70 or above (on a scale of 1 to 100) is considered acceptable. **Figure 6-3** illustrates the PCI for Manhattan roadways as of October, 2014. As can be gleaned from the figure, approximately 136 miles of roadway are calculated at or above a PCI of 70, while 75 miles are below 70. (Note that the PCI in **Figure 6-3** is tracked for a smaller subset of roads than the inventory in **Figure 6-2**).

Figure 6-3: Pavement Condition Index, City of Manhattan (as of October 2014)



System Usage

Figure 6-4 illustrates Average Daily Traffic (ADT) volumes for streets and highways that have been counted within the study area.

Figure 6-4: Selected Daily Traffic Volumes *(Source: City, Riley County, KDOT)*

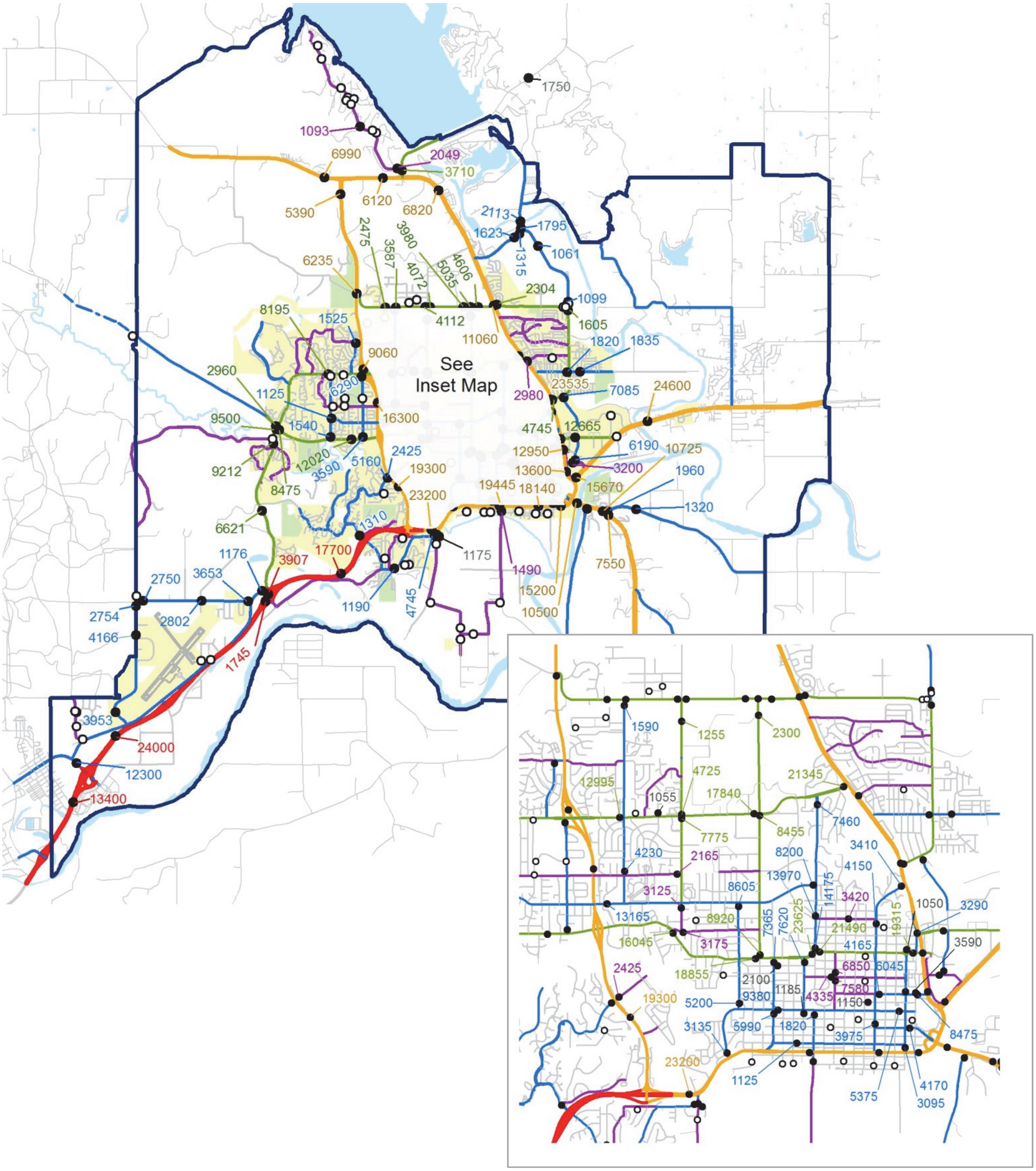
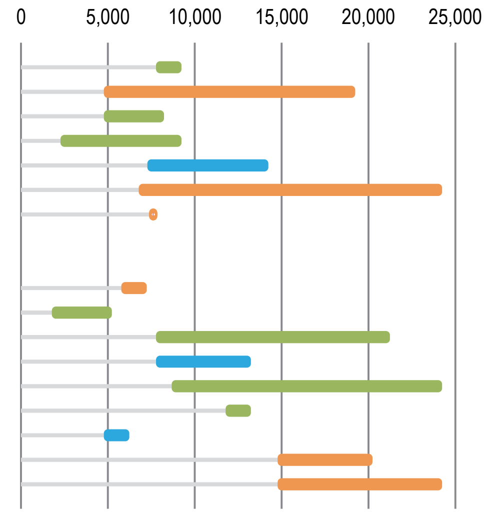


Table 6-2 summarizes the traffic volumes on the more significant roadways and highways in the study area, and highlights at least two noteworthy issues:

- K-113 and US-24 are the north-south "workhorses" in the area. Although there are several other north-south roadways, they do not carry traffic volumes anywhere near those of these two state routes because they do not provide comparable connectivity or capacity. North-south travel is heavily reliant on these two transportation spines.
- At first glance, Manhattan Avenue appears to be misclassified as a Major Collector, because it carries much more traffic than several other streets classified as Minor Arterials. However, its fairly short length drives its classification.

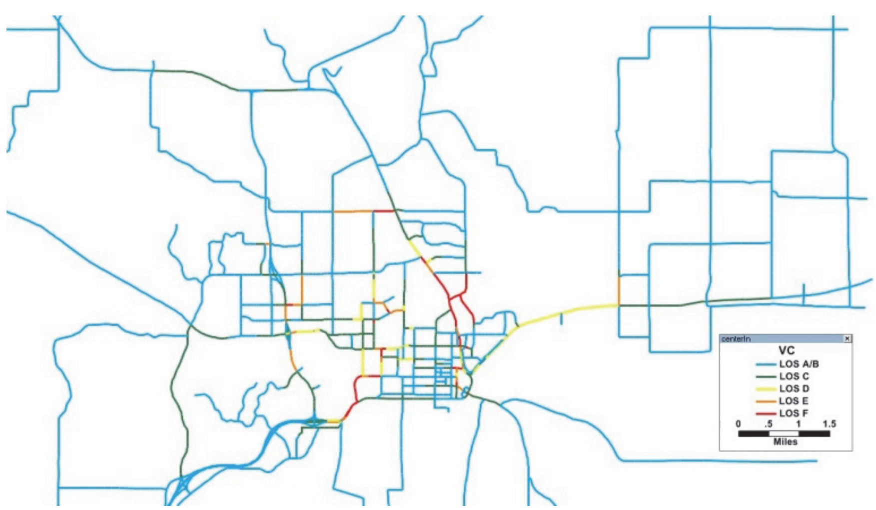
Table 6-2: Daily Traffic Volumes – Major Highways and Roadways

Facility	Extents	Average Daily Traffic (ADT) Range
North - South		
Scenic Dr	Kimball Ave – K-18	
K-113 (Seth Child Rd)	US-24 – K-18	
College Ave	Marlatt Ave – Claflin Rd	
Denison Ave	Marlatt Ave – Bluemont Ave	
Manhattan Ave	Kimball Ave – Bluemont Ave	
US-24 (Tuttle Crk Bl)	Fort Riley Bl – K-113	
K-177	US-24 – south study boundary	
East - West		
US-24 (Tuttle Crk Bl)	Western study boundary – K-113	
Marlatt Ave	Seth Child Rd – US-24	
Kimball Ave	Vanesta Dr – US-24	
Claflin Rd	Seth Child Rd – Manhattan Ave	
Anderson Ave/Bluemont Ave	Kimball Ave – US-24	
McCall Rd	Tuttle Crk Bl – US-24	
Poyntz Ave	Manhattan Ave – 3rd St	
US-24	Fort Riley Bl – east study boundary	
K-18 (Fort Riley Bl)	56th Ave – US-24	



xx = Principal Arterial | xx =Minor Arterial | xx = Major Collector

FHMPO is currently developing a travel demand model to forecast traffic volumes on the region's roadways and highways. For illustration purposes, **Figure 6-5** illustrates the level of roadway network included in the "Existing Conditions" model, and also includes some preliminary indications of existing network performance – specifically, volume-to-capacity (v/c) ratios. This model is expected to be completed in 2015, and will become a tool to support land-use and transportation planning for the region. Future versions of MATS can use model forecasts to develop/support roadway-capacity-related recommendations.



System Safety

Crash history is an important measurement of the safety of a roadway system. Often, for specific projects or studies, crash rates are computed along corridors and at intersections, factoring in the number of vehicles using the facility over the study period and (in the case of corridors) the length of the facility. MATS does not examine crashes at this second level of detail; rather, overall totals and crash clusters are examined at a high level where data is available.

- *Riley County:* Riley County maintains a crash database that is not geographical, but is keyed to quadrants in the County's mapping system (which allows auto-location of the crashes to within about 250 feet). The database contains about 40 fields, including information on date/time, light conditions, roadway data, weather, accident location, collision type, severity indicators, and movement prior to collision. The "accident description" field often includes narrative on crash cause. One issue with the database as it currently stands is that nearly 70 percent of the records do not have dates associated with them, so it is difficult to analyze time trends. The database has data from 1998 to the current year, but data from earlier years appears to be thin. The most representative recent data appears to come from the years 2011 through 2013, although it is unclear how many undated records in the database fall within these years. **Table 6-3** summarizes statistics gleaned from the County's database.

Table 6-3: Riley County Crash Statistics
2011 – 2013 *

	MATS Area of County	Total County
Total Crashes*	**131**	**264**
Severity		
Fatal	0.8%	0.4%
Injury	15%	19%
PDO > $1000	50%	53%
PDO < $1000	12%	9%
Collision Type		
Fixed Object	31%	28%
Animal	31%	41%

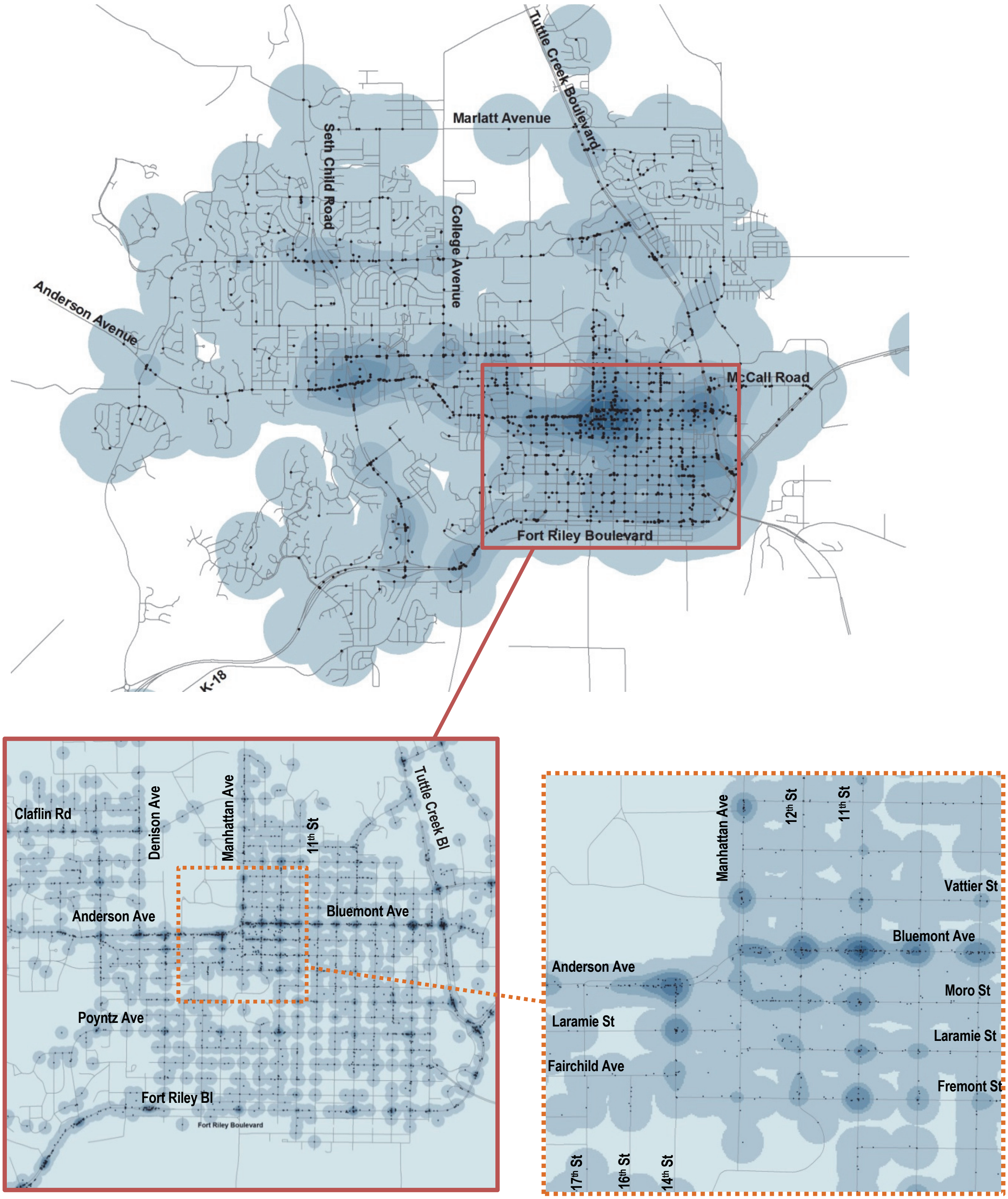
** The crashes in the table potentially represent an incomplete sample of the entire crash record; see text.*

- *Pottawatomie County:* The County has individual crash reports on file, but does not systematically track them in a database. At this time, no systematic information is available regarding crashes in the Pottawatomie County portion of the Urban Area.

- *City of Manhattan:* The City tracks crashes in a GIS database. The reporting system has changed over time; for MATS, information was available for 2009 through 2013. However, due to variations in database management over the years, the record is not complete. Furthermore, analysis beyond counting crashes and identifying their locations is not possible with the database as currently structured. The crash analysis that follows must be read understanding these limitations.

  Between 2009 and 2013 there were 5,046 reported crashes within the city. Six of those crashes (0.1%) involved fatalities; 1,052 (20.8%) were injury crashes, and 3,988 (79.1%) were property-damage-only crashes. **Figure 6-6** illustrates the crashes contained in the database for this five-year period. The figure uses density contours to indicate areas (darker colors) with higher crash concentrations, and includes successive levels of focus on the some of the higher-crash areas in the City.

Figure 6-6: Recorded Crashes in the City of Manhattan, 2009-2013*



As the upper map in **Figure 6-6** indicates, there are several general areas of the city that have experienced high crash totals. The list below is divided into these larger areas, with sub-level discussion for specific intersections and segments.

- *Bluemont/Anderson corridor:* This corridor experienced approximately 17 percent of the City's crashes. This issue has persisted for many years; in the 2000 MATS document, the top five identified high-crash intersections were along this corridor, and overall nine of the 30 high-crash intersections were on this corridor. Anderson Avenue carries some of the highest daily traffic volumes in the region – higher even than those on I-70 and K-177, and comparable to those on Tuttle Creek Boulevard, US-24, and K-18 – thus, it is not completely unexpected that it would have high crash totals. However, that is not a reason to not investigate ways to improve the corridor – especially since, along with Kimball Avenue, it is the highest-volume minor arterial in the region (the comparison with Kimball is further investigated later).

  The City continues to explore ways to improve this corridor. A raised median was recently (2014) installed on the 850-foot section of Bluemont Avenue between Manhattan Avenue and 11th Street, including turn restrictions at 12th Street. This area is a focus for both campus and Aggieville traffic. The improvements will certainly have a beneficial safety effect that the City should be able to trace through future crash analyses.

  In 2012, the City also installed both fiber and wireless traffic signal interconnect along this corridor, and implemented an adaptive traffic signal control system. Initial findings were that the system reduced travel times along the corridor by 11 to 56 percent, depending on time-of-day and direction. More information on this and other similar initiatives can be found below under the "Intelligent Transportation Systems" section.

  At the east end of the corridor, the Bluemont Avenue/4th Street roundabout was opened in late 2010. The reconfiguration also included the installation of a raised median on Bluemont Avenue between Tuttle Creek Boulevard and 4th Street, restricting turns at 3rd Street. This change, coupled with the changes brought about by the massive Manhattan Marketplace development, has certainly affected crash patterns within the corridor that have occurred within the time-frame of the five-year crash data examined for MATS – thus, the City should continue to monitor safety conditions at this location.

  Further west along this corridor, the area near the Seth Child Road interchange exhibits a fair number of crashes. The most likely contributing circumstance is the lack of access control on Anderson Avenue both east and west of the interchange: between Wreath Avenue and Hylton Heights Road (a distance of 3,300 feet), there are 22 driveways on the north side of Anderson Avenue, and 18 on the south side – a driveway density ranging from 28 to 35 per mile. This density is well above that recommended in the Urban Area's access management guide (previous MATS), and well above national recommendations as well. This portion of the corridor has been in this configuration for many years, and making access changes would be difficult – but it is an excellent candidate for well-considered access management.

- *Tuttle Creek Boulevard near Downtown:* The intersections of Tuttle Creek Boulevard with Leavenworth Street and US-24 (Poyntz Avenue East) experienced a fairly high number of crashes. Heavy traffic volumes and congestion certainly contribute to this total, but there may be other factors at play. Although Tuttle Creek Boulevard generally has excellent access management, these two intersections are roughly 760 feet apart. In addition, they are located within a pair of reverse curves. Finally, the fact that the US-24 intersection is the "front door" to the Manhattan Town Center mall, situated at a major state highway intersection, creates a mixture of traffic operations and competing objectives (commute vs. shopping). Capacity and geometric improvements at and between these two intersections would improve operations, reduce congestion, and enhance safety.

- *K-18, southwest side:* Fort Riley Boulevard/K-18 between 17th Street/Yuma Street and Rosencutter Road experienced a high number of crashes. This is the highest-volume non-freeway segment of Fort Riley Boulevard, and also is on a pair of reverse curves. Alternative intersection configurations (such as a Displaced Left-Turn arrangement) could reduce conflicts at K-18/Rosencutter Road.

- *Claflin Road corridor:* Of the high-crash corridors described in this section, Claflin has the lowest traffic volume. The segment from Denison Avenue to Seth Child Road exhibits a fair amount of crashes, with the area in the vicinity of College Avenue exhibiting the highest crash density. The long, straight, gently rolling nature of this road, and its semi-rural feel – all in comparison to its low posted speed (30 mph) could be contributing to its safety record. Four-lane undivided roads also have generally poorer safety records than their divided counterparts. Given its traffic volume, the Claflin Road corridor could potentially benefit from a road diet.
- *Kimball Avenue Corridor:* Similar to the Claflin Road corridor, Kimball Avenue between College Avenue and Seth Child Road is a four-lane undivided roadway, fronted almost extensively by residential driveways – a difficult configuration for a minor arterial. However, Kimball Avenue carries nearly double the traffic volume of Claflin Road. Expansion to a five-lane section might be a consideration to improve the safety of access to abutting properties.

Intelligent Transportation Systems (ITS)

Figure 6-7 illustrates the location of traffic signals and ITS hardware/communications in the Urban Area. The new (2012) Manhattan Traffic Operations Facility (MTOF), which includes an ITS Control Center, is located four blocks south of Manhattan City Hall. The system includes point-to-point communications networks, fiber optic networks, Advanced Traffic Signal (ATC) controllers, fixed closed-circuit television (CCTV) cameras, pan-tilt-zoom (PTZ) cameras, Road Weather Information Systems (RWIS), and specialized server and control software for all devices. As the figure illustrates, communications are provided along several corridors: 11th Street, McCall Road, Fort Riley Boulevard, Seth Child Road, Anderson Avenue/Bluemont Avenue, and US-24. Future fiber connections are planned along Manhattan Avenue, Tuttle Creek Boulevard, and Kimball Avenue.

Figure 6-7: Existing Traffic Signals and ITS Hardware/Communications

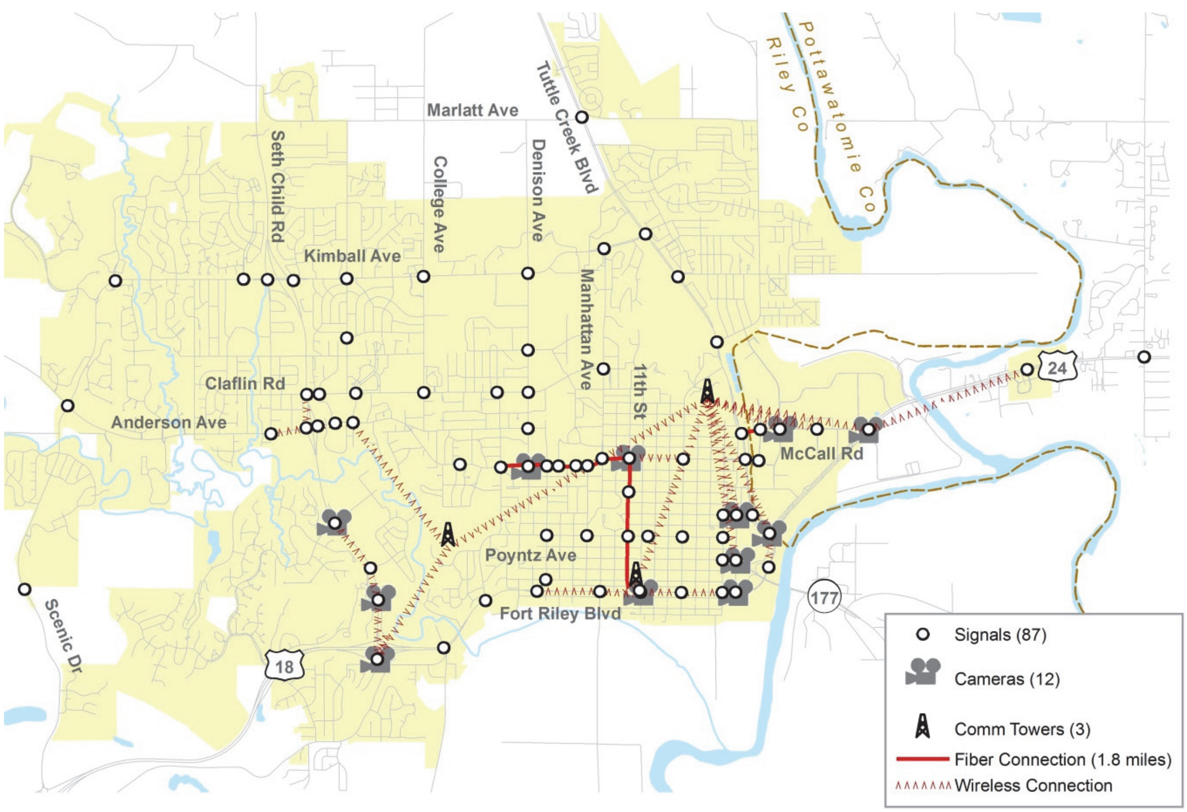


Table 6-4: Travel-Time Reduction Resulting from Adaptive Control on Anderson Ave Corridor

A.M. Peak	EB WB	45% 25%
Mid-day Peak	EB WB	56% 11%
P.M. Peak	EB WB	39% 23%

As alluded to previously, the City recently (2012) installed an Adaptive Traffic Control System along the Anderson Avenue corridor from Sunset Avenue to 11th Street (4,500 feet, eight signals). **Table 6-4** summarizes one of the reported findings from preliminary analysis when the system was installed: the average travel time through the corridor decreased dramatically in the eastbound (EB) direction (a 39- to-54 percent drop), and more modestly in the westbound (WB) direction (an 11- to 25-percent drop).

Neighborhood Traffic Management

Although arterial and collector streets are typically designed with traffic capacity as a foremost consideration, local streets in neighborhoods are intended to provide direct access to residential properties, promote low traffic speeds, and serve as a safe environment for neighborhood activities. In some cases, neighborhood streets, whether through sub-optimal layouts or as a result of congestion on parallel roads, carry more traffic ("cut-through") or encourage higher speeds than residents are comfortable with. Such concerns typically occur in more urbanized areas, so this section focuses on the City of Manhattan proper, although recommendations later in this chapter can be applied to growing residential areas in outlying areas, such as Blue Township in Pottawatomie County.

Currently, the City's neighborhood management approach is to respond to citizen requests as they arise, whether they be for stop signs, parking restrictions, speed reductions, or other such neighborhood concerns. The City had begun developing a neighborhood traffic management (traffic calming plan), and this policy is finalized and formalized in **Section 6.2**.

Access Management

TRB's *Access Management Manual* defines Access Management as follows:

> *The systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections to a roadway. It also involves roadway design applications, such as median treatments and auxiliary lanes, and the appropriate spacing of traffic signals. The purpose of access management is to provide vehicular access to land development in a manner that preserves the safety and efficiency of the transportation system.*

The higher the functional classification (the more mobility the roadway is intended to provide), the more essential is well-controlled access. Access management guidelines were included in the previous MATS, and addressed median opening spacing, driveway/street spacing, turn-lane/taper lengths, and turn-lane warrants. Since that time, a specific access management plan has been adopted for the US-24 corridor. In **Section 6.2**, elements of an expanded and more formalized access management program are discussed.

6.2 Achieving Roadway System Objectives

As mentioned at the beginning of **Section 6.1**, this Chapter has two groups of Objectives. The first is oriented toward the "local" scale, at which access and safety considerations outweigh automobile throughput considerations. The second is oriented to the backbone transportation system of the Urban Area, for which the access-mobility-safety balance is more complicated.

> ***Objective G-1:*** *Implement local road traffic control policies and practices, and adjust conditions when necessary to respond to community needs and national practices.*

Section 6.1 describes the City of Manhattan's current approach to neighborhood traffic control issues, which is based on citizen requests and case-by-case evaluations. There are two types of areas in which the City addresses requests:

- *Basic operational and safety issues.* This includes requests about traffic control and regulation, such as stop signs, parking signs/marking, and sight distance issues. It makes sense for the City, as well as the Counties as they operate within the Urban Area, to address these as they are requested, with engineering evaluations and appropriate engineering solutions. These items are already addressed regularly by each agency and MATS does not recommend any changes.

- *Speed and cut-through concerns.* When issues related to the design of a street cause it to become a short-cut route, and speeds are higher than desired, a toolbox of countermeasures are available that have been implemented across the country (as well as in the Manhattan Urban Area). According to the Institute of Transportation Engineers (ITE), these fall into four categories:
  - Vertical deflections (speed humps, speed tables, raised intersections)
  - Horizontal Shifts (neighborhood traffic circles, chicanes)
  - Roadway Narrowings (chokers, center islands)
  - Closures (diagonal diverters, half-closures, full closures, median barriers)

  Many cities have adopted procedures that more intimately involve the neighborhood in making the request, developing solutions, and funding countermeasures. Two keys to the success of such programs in many communities is (1) requiring a certain percentage of the neighborhood to support the process (typically via petition), and (2) requiring the residents to pay a portion (or all) of the costs for both the study and the installation of the countermeasures themselves. The financial component has the effect of limiting frivolous requests as well as necessitating that residents collaborate to achieve a common solution (since each has a financial stake).

  The MATS policy for the Urban Area's citizen-driven process is as follows:

  - *Scope.* The process can be initiated for pedestrian, bicycle, or automobile safety concerns caused by traffic speed or traffic intrusion on streets with a functional class of "Local" or "Minor Collector", as long as the requested section is over 50% fronted by residential homes. The total length of the street segment in question must be greater than 1,000 feet, and the endpoints must be clearly defined.

  - *Process Initiation.* The appropriate Public Works Department will approve the initiation of a traffic-calming study if 75 percent or more of the property owners and residents along the street (between the endpoints defined in the previous step) are in support – demonstrated through a petition. The individual, group or neighborhood making the request is responsible for obtaining the approval of property owners and residents, and submitting a letter of request to the Public Works Department. The letter should describe the nature of the problem (speeding, cut-through, etc.) and may indicate the type of solution proposed. It should also clearly indicate that the petitioners commit to funding the traffic study and are willing to participate in the funding of any resulting solutions. The petition should be attached. The Public Works Department – in consultation with emergency service providers – will review the letter and confirm that a study is reasonable, and if so, will authorize such a study.

- *Traffic Study.* The traffic study must be funded by the petitioners, and must be completed by a licensed professional engineer in the State of Kansas with demonstrated professional experience conducting traffic engineering studies. The study should include the collection and presentation of data sufficient to demonstrate whether or not the street meets the criteria for implementation of traffic calming devices (see below). The study recommendations should not be in conflict with the MUTCD, AASHTO or other national reference material recognized by the professional engineering community. The study should demonstrate that no new traffic impacts will be created as a result of implementing traffic-calming measures. The study should be submitted to the Public Works Department for review.
- *Calming Devices.* Traffic-calming devices may include but are not limited to Traffic-Calming Circles, Speed Humps, Speed Cushions, Speed Tables, Partial Diverters, Full Diverters, Center Island Narrowing, Chokers, Raised Intersections, and Road Closures. *Note: Roundabouts are traffic control devices, not traffic calming devices, and are not subject to this policy.*
- *Criteria.* To be eligible for the implementation of traffic-calming devices, the roadway must satisfy the following criteria:

Local	**Minor Collector**
One of the following conditions is satisfied:	*One of the following conditions is satisfied:*
a. The 85th -percentile speed of traffic exceeds the speed limit by **5** mph or more	a. The 85th -percentile speed of traffic exceeds the speed limit by **10** mph or more
b. A documented safety issue (based on crash data and standard safety analysis methods)	b. A documented safety issue (based on crash data and standard safety analysis methods)
c. Cut-through traffic (defined as trips from one non-local road to another non-local road) comprises more than **30%** of the peak-hour traffic (**50** vehicles minimum).	c. Cut-through traffic (defined as trips avoiding a higher functional-class roadway) comprises more than **40%** of the peak-hour traffic (**160** vehicles minimum).
d. Pedestrian crossing volume > **25** pedestrians in any hour during which the peak-hour automobile volume > **180** vehicles	d. Pedestrian crossing volume > **50** pedestrians in any hour during which the peak-hour automobile volume > **400** vehicles

In the event that a requested location does not meet these criteria, subsequent requests will not be considered for a minimum of two years.

- *Implementation.* If a project is recommended in the traffic study and approved by the governing body, it will only be constructed if 75 percent or more of the property owners and residents fronting the street segment on each side approve of the installation or if directed by the City Commission. The individual, group or neighborhood making the request is responsible for obtaining the property owners' and residents' approval and submitting it to the Public Works Department. If constructed, the project will be funded by a benefit district approved by the government body.
- *Trial Period.* Prior to implementation, a trial period may be considered using temporary installations.
- *Other Discovery.* If any safety issues discovered in the process that are not solvable by traffic calming, the City as a separate action will determine how they should be addressed.

Objective G-2: *Promote consistency and safety in local street design while recognizing the variety of local street types and their relationship to the total street system.*

Pottawatomie County has a set of residential street standards. The City of Manhattan also has a section (5600) reserved for "Street Design" in Division V of its Design Criteria. It is recommended that the City adopt the relevant portions of the APWA's *Standard Specifications for Public Works Construction* ("The Greenbook") and *Standard Plans for Public Works Construction* as its street design standards.

One issue that causes concern in the Urban Area is the pavement of alleys. For example, in the residential areas east of the K-State campus, alleys provide mid-block access to parking areas behind residential units. Many of these alleys are unpaved, or are paved but in very poor condition. They are the City's responsibility to maintain, but (being alleys) are fairly low-priority and are not on a regular maintenance cycle. MATS recommends that the Urban Area take the opportunity to pave (or repave) these alleys as redevelopment occurs – for example, the Multi-Family Redevelopment Overlay (M-FRO) area east of campus would provide an excellent opportunity to address this situation. A question has arisen as to alternative means for funding such improvements (and ongoing maintenance). Beyond dedicating funds from the City budget, potential methods include:

- *Benefit District:* A district could be formed (comprising adjacent property owners), and assessments exacted, for the purpose of paving and maintaining the alleys.
- *Permit/fee:* A permit could be required to be purchased, or a fee required to be paid, for parking or deliveries along an alley.
- *Grants:* Traditional federal grants for urban areas, such as Community Development Block Grants (CDBGs), have been used to pave or improve alleys. In addition, the City could consider pursuing funds from less traditional sources:
  - *Water quality:* A runoff-demonstration project could be assembled, perhaps using permeable pavement.
  - Bicycle/pedestrian: If the City were willing to designate/configure alleys as a shared space to include bicycles and pedestrians, perhaps even ultimately including these in a Bicycle Master Plan, bicycle/pedestrian funding sources could potentially be leveraged.
- *Volunteers:* Some agencies have used "Adopt an Alley" volunteer programs to cover ongoing maintenance of alleys, as appropriate. Such programs would typically cover capital items such as paving or engineering improvements.
- *Privatization:* Alleys could be turned over to private ownership (adjacent property owners). The City would certainly lose some control, but would also no longer be responsible for capital and maintenance items. Some level of regulation would still be needed to ensure public safety.

Any new funding stream would need to be dedicated so that it would not be diverted. Some cities have developed Alleyways Management Plans to cover asset management, administrative policies, capital improvements, and maintenance programs.

All of these strategies are worth considering, but MATS recommends that the first priorities be the exploration of the benefit district concept and the idea of grants related to a pedestrian/bicycle shared space.

Objective G-3: *Minimize automobile/truck "through" traffic on residential streets, while maximizing connectivity for non-motorized modes.*

Minimize "Through" traffic

The Manhattan Urban Area Subdivision Regulations directly support the first portion of this Objective ("through" traffic) by stating "Through traffic on local residential streets should be discouraged." However, the Regulations do not provide a great deal of guidance on how this should be achieved through subdivision design. In fact, they offer a fair amount of latitude in this regard: "Any type of street layout pattern may be used that best fits the topography. A curvilinear system, grid system, or modified grid system are acceptable alternatives." MATS recommends modifying and supplementing this statement to further describe the kinds of street layouts that discourage cut-through traffic while promoting connectivity and effective dispersion of traffic – to the extent that topography, context, and other barriers allow. Added recommendations include:

- Average intersection spacing for local streets: around 300-400 feet; maximum: 600 feet.
- Maximum block size: around 5-12 acres.
- Maximum spacing between pedestrian/bicycle connections: around 400 feet (via mid-block paths and pedestrian shortcuts).
- Percent streets that are cul-de-sacs: 20 percent. Maximum length of cul-de-sac: 200 to 400 feet. Where dead-end streets or cul-de-sacs exist, encourage creation of paths that provide shortcuts for walking and cycling (via dedicated right-of-way or easements).
- Minimum Roadway Connectivity Index: 1.4. The Roadway Connectivity Index is calculated as the ratio of the number of links (roads between intersections) to the number of nodes (intersections).
- Favor pedestrian and bicycle connections, and sometime connections for transit and emergency vehicles, where through traffic is closed to general automobile traffic.
- Provide multiple access connections between a development and arterial streets.

Objective G-1 also provides guidance that can support **Objective G-3** for streets that already exist; the formalized Neighborhood Traffic Management process can address cut-through traffic in areas where design may not have succeeded.

Maximize Non-motorized Connectivity

Several statements from the Regulations support this portion of the Objective:

- "At a minimum, the layout of streets and other public ways on plats shall be adequate to accommodate bicycle lanes and routes, wherever such lanes or routes are identified by the Bicycle Master Plan." *This language is adequate as is.*
- "At a minimum, the layout of streets and other public ways on plats shall be adequate to accommodate sidewalks…." *This language is adequate as is.*
- "Pedestrian easements not less than sixteen (16) feet in width shall be dedicated to the public through blocks where deemed beneficial by the MUAPB to provide for pedestrian access." *The opening words should be modified to "Pedestrian/bicycle easements…."*

- "…Where residential subdivisions abut an arterial or collector street, pedestrian access from the local street to the arterial or collector street shall be provided every 600 feet." *"Pedestrian access" should be changed to "pedestrian/bicycle access".*

Even though streets in a new subdivision may not fall on the Bicycle Master Plan map, bicycle considerations can be incorporated into subdivision design. Subdivision layouts that promote low traffic volumes and low speeds also promote safe bicycle travel. This is another reason to soften the "any type of street layout pattern" language that appears in the regulations.

Objective G-4: *Maximize development access opportunities along local streets while maintaining safe conditions for all users.*

The Access Management guidelines discussed under Objective H-2, coupled with the Neighborhood Traffic Management policies discussed under Objective G-1, address this Objective.

Objective H-1: *Maintain a master street classification system defining a hierarchical series of street classification/typologies representative of function and context in the community.*

Figure 6-1, introduced earlier in this Chapter, provides the functional classification component of this Objective. The other modal maps in this document – **Figure 2-9** (pedestrians), **Figure 3-6** (bicycle), **Figure 4-1** (transit), **Figure 5-1** (parking), and **Figure 7-1** (truck routes) serve as additional layers reflecting context. In addition, the Complete Streets elements addressed in **Objective H-3** and **Appendix C** also address the community context aspect.

Objective H-2: *Design/maintain the roadway system to provide automobile continuity/connectivity, safety, and capacity.*

This objective covers a host of roadway-related items, including pavement maintenance, access management, transportation study guidelines, and roadway improvements. Safety and ITS are discussed under **Objective H-4** and **Objective H-5**, respectively.

Pavement Maintenance

Current pavement maintenance policies and pavement condition ratings are described earlier in this Chapter. The City of Manhattan uses a Pavement Management System, which allows systematic tracking and forecasting of pavement conditions. A recent analysis by City staff concluded the following:

- The City's annual budget for contractor maintenance of pavements is $1.1 million.
- The current citywide average PCI is approximately 72, above the target of 70.
- If the present funding model remains ($1.1 million/year), by 2024 the citywide average PCI is predicted to drop to approximately 58.
- To maintain a citywide average PCI of 70 over 10 years, the annual budget would need to be increased to $3.3 - $4.0 million.

City staff identified several possible methods to increase the funding available for pavement maintenance, including (1) decrease of the use of the Special Street and Highway Fund for grant match projects, (2) dedication of one mill levy to pavement maintenance, (3) a per-vehicle wheel tax, and (4) direction of 0.10 percent of the city sales tax toward pavement maintenance. All together, these potential funding sources could generate $3.2 to $3.8 million. Thus, some combination of these sources would be sufficient to keep citywide pavement conditions at acceptable levels.

MATS endorses the PCI target of 70, and recommends that this index be tracked by functional class as part of the annual performance monitoring recommended in **Chapter 1**. Furthermore, since some level of pavement-condition reporting to FHMPO will be needed for the entire MATS boundary, MATS recommended that the City, with the cooperation of the two Counties, expand its Pavement Management System to cover the remainder of the Urban Area.

Access Management Guidelines

The full Access Management Guidelines are included in **Appendix A.** A summary of the topics addressed in each of these guidelines is included in **Table 6-4**. These guidelines should be enforced consistently by the City and both Counties.

Table 6-4: Access Management Guideline Topics

Access near interchanges
Intersection functional areas
Traffic signal spacing
Median Opening Spacing
Driveway/Street Spacing
Median types and applications (raised and TWLWT)
U-turns
Turn Lane/Taper Length
Left-Turn Lane Warrants
Right-turn lane warrants
Roadway network planning
Subdivision and land development access guidelines
Unified access and circulation – neighboring properties
Driveway connection geometry

Transportation Impact Study Guidelines

The full Transportation Impact Study Guidelines are included in **Appendix B.** The analysis of transportation impacts of a proposed development is guided by a checklist that, for each transportation mode (automobile, truck/rail, pedestrian, bicycle, transit), identifies the items to be inventoried and studied. This checklist is reviewed at the scoping stage with the City and the project applicant (and/or representative), to arrive at an agreement as to what will be studied. Potential items to be studied for each mode are summarized at right. These guidelines should be enforced consistently by the City and both Counties.

Existing and No-Project Conditions	Proposed Conditions
Infrastructure/Service Inventory	Connectivity and Circulation
Demand/Usage	Demand/Usage
Safety	Operational Performance
Operational Performance	Safety

Travel Demand Forecasting

As mentioned previously, FHMPO is developing a travel-demand forecasting model that is expected to be completed by the end of 2014. This model will become the new tool for forecasting regional transportation needs. Thus, the list of improvements that follows in the next section will be adjusted in the near future as forecasting methods improve.

Roadway and Infrastructure Improvements

Based on the analysis presented in this chapter, along with input from stakeholders throughout the process, **Tables 6-5 a, b, and c** contain a list of roadway infrastructure projects divided into three time horizons. High-level order-of-magnitude costs are presented for the near- and mid-term projects. As can be seen, these projects represent a significant investment, and are not financially constrained at this point. As funding realities are determined over the MATS horizon, it is possible that projects may need to be shifted later in the time horizon.

Table 6-5a: Roadway Infrastructure Improvements, Near-Term (1-5 Years)*

		Length (mi)	Cost ($2015)**
K-113/K-18	address SB-to-EB movement, safety improvements, new signal	--	$2,250,000
15th Street/UPRR	crossing signals, gates	--	$300,000
K-113 & Kimball	intersection improvements	--	$500,000
17th/Yuma	intersection improvements	--	$150,000
US-24/Excel Rd	turn lanes	--	$650,000
US-24/Tuttle Creek Bl	safety/capacity improvements	--	$660,000
11th St/Fremont St	intersection improvements	--	$440,000
Anderson Ave/17th St	intersection improvements	--	$240,000
Green Valley Rd/Elk Creek Rd	capacity improvements, realignment, bridge rehab, bike/ped	--	$720,000
Kimball Ave/Denison Ave	intersection improvements	--	$3,000,000
Tuttle Creek Bl/Leavenworth Rd	safety/capacity improvements	--	$300,000
Poyntz Ave/17th St	intersection improvements	--	$570,000
Poyntz Ave/9th St	HAWK signal	--	$30,000
K-18 Bridges at Wildcat Creek	new bridges	--	$5,900,000
K-18	investigate designation as an I-70 business loop.	--	na
K-113, K-18 to US-24	corridor study	5.60	$150,000
US-24 (Tuttle Creek Bl), K-13 to K-177	resurfacing	5.62	$6,910,000
Anderson Ave, Wreath Ave to Hylton Heights Rd	access management study	0.63	$50,000
Anderson Ave, Sunset Ave to Manhattan Ave	safety study	0.68	$50,000
K-18, K-177 to K-113	corridor study	2.71	$200,000
Casement Rd, Marlatt to Brookmont	widen, add path, safety improvements	0.46	$3,450,000
Casement Rd, Brookmont to Griffith	widen, add path, safety improvements	0.30	$2,200,000
Casement Rd, Griffith to Allen	widen, add path, safety improvements	0.25	$1,400,000
Casement Rd, Allen to Hayes	widen, add path, safety improvements	0.41	$2,296,000
McDowell Creek Rd, K-177 SW 3 miles	reconstruction, turn lanes, shoulders	3.00	$6,200,000
N Manhattan Ave, Kimball Ave to Research Park Dr	widen to four lanes, signal	0.25	$2,150,000
W Anderson Ave, Anneberg Park to Scenic Dr/Kimball Ave	widen to four lanes	0.68	$6,500,000
Subtotal			***$47,266,000***

** Some of the near-term projects are already under construction.*

*** Total cost shown may include some costs that have already been incurred if they are known or may exclude them if they are not known. These are mainly preliminary engineering, right of way, and utilities costs.*

Table 6-5b: Roadway Infrastructure Improvements, Mid-Term (5-10 Years)*

		Length (mi)	Cost ($2015)*
Claflin Rd/Wreath Ave	signalize intersection, add turn lanes	--	$300,000
Sunset Ave/College Heights Rd	geometric/safety improvements	--	$300,000
K-113 Corridor, K-18 to US-24	access control, capacity/safety improvements	5.60	$10,600,000
K-177, Stadel Rd towards Lafayette Dr	reserve right-of-way for a frontage Rd	0.83	$1,100,000
K-18, Rosencutter Rd to 17th St/Yuma St	safety/intersection improvements	0.76	$1,200,000
Denison Ave, Claflin Ave to Kimball Ave	pavement reconstruction, intersection improvements	0.77	$4,300,000
Hayes Dr, Sarber Lane to Casement Rd	curb and gutter	1.11	$1,200,000
Kimball Ave, Hudson Ave to Anderson Ave	widen to four lanes, intersection improvements	1.41	$5,600,000
Kimball Ave, College Ave to Manhattan Ave (N. Campus Corr)	safety/capacity improvements	1.23	$3,400,000
US-24 (Tuttle Creek Bl), K-13 to US-77	access control, safety/geometric improvements	9.55	$9,100,000
Claflin Rd, Denison Rd to Seth Child Rd	road diet or other safety improvements	1.44	$1,700,000
Denison Ave, Marlatt Ave to Kimball Ave	geometric/capacity improvements	1.00	$2,400,000
Scenic Dr, Anderson Ave to K-18	widen to four lanes, intersection improvements at Miller Parkway	2.72	$13,100,000
Wildcat Creek Rd, Scenic Dr to Eureka Dr	geometric improvements	4.87	$9,300,000
US-24, Tuttle Creek Rd to Lake Elbo Rd	spot widening, geometric improvements, median-opening consolidation, signal timing improvements, pedestrian/bicycle provisions, speed enforcement.	4.27	$8,757,250
Subtotal			***$72,357,250***

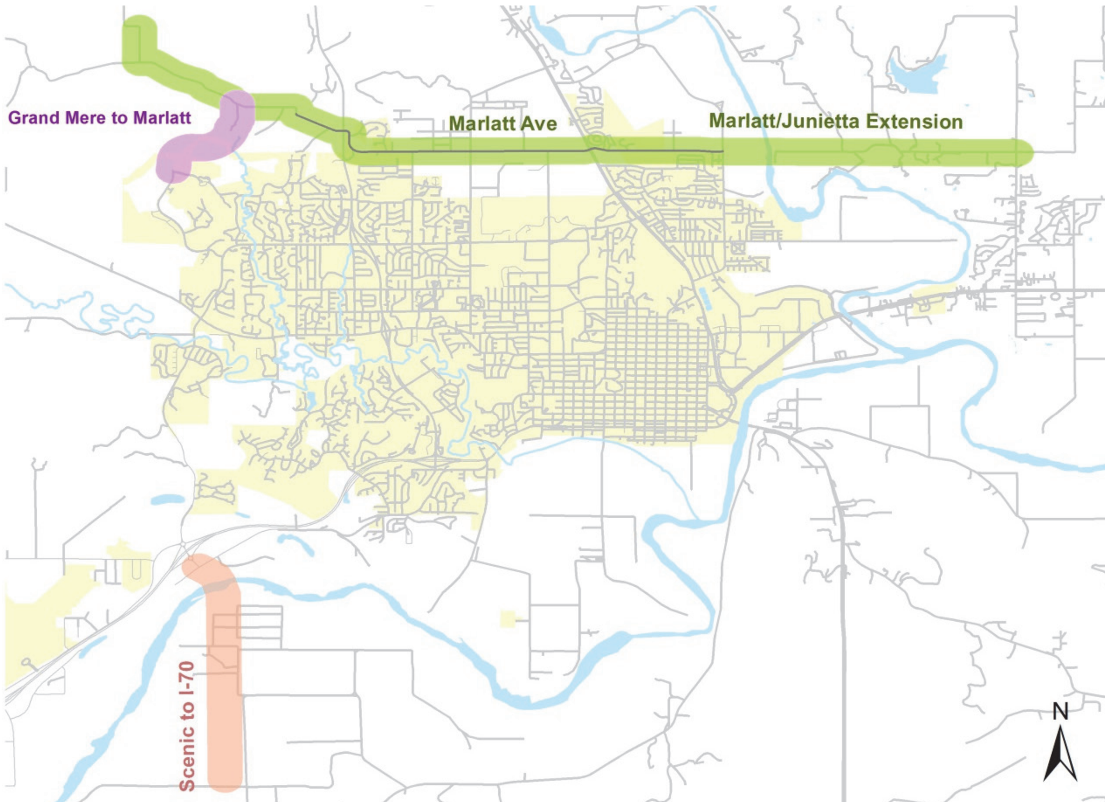
** Total cost shown may include some costs that have already been incurred if they are known or may exclude them if they are not known. These are mainly preliminary engineering, right of way, and utilities costs.*

Table 6-5c: Roadway Infrastructure Improvements, Long-Term (10-20 Years)*

		Length (mi)
Grand Mere Parkway	extension, Colbert Hills to Marlatt Ave	1.00
Marlatt Ave, Tuttle Creek Bl (US-24) to Seth Child Rd (K-113)	realignment/improvements	2.30
Marlatt Ave/Junietta Rd, Tuttle Creek Bl (US-24) to Lake Elbo Rd	extension, improvements	5.16
Wreath Avenue	extension, Hemlock Avenue to Anderson Avenue	0.74
Scenic Dr	extension, K-118 to I-70	6.10
K-18, Eureka Valley	create a collector street network	1.7
US-24, Tuttle Creek Rd to Green Valley Rd	widening to six lanes, intersection improvements	2.80
Blue Township	create a collector street network	--

Figure 6-9 illustrates the first four of these long-term improvements. One other potential new roadway that has been discussed is a north-south connector on the west side of the Urban Area. For the horizon of MATS, the Grand Mere – Kimball – Scenic corridor is considered to fill that role. If the Urban Area contemplates westward growth in the future, the FHMPO travel-demand model can be used to test the effects of a higher capacity north-south corridor further west.

Figure 6-9: Long-Term Roadway Extensions – Conceptual



> ***Objective H-3:*** *Consider all modes in the planning, design, improvement, and monitoring of arterial and collector streets and intersections.*

This Objective relates to concepts currently grouped under the term "Complete Streets". According to the National Complete Streets Coalition:

> *Complete Streets are streets for everyone. They are designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities. Complete Streets make it easy to cross the street, walk to shops, and bicycle to work. They allow buses to run on time and make it safe for people to walk to and from [transit].*

Appendix C contains a toolbox of Complete Street elements that can become part of the Urban Area's road design vocabulary. For each element, the Appendix includes guidance on application and design. Elements, many of which are employed in the Urban Area to some degree already, include:

- Bicycle Lanes
- Sharrows
- Sidewalks
- Narrower Lane Widths
- Medians
- Street Trees
- Lighting
- Right-Turn Channelization
- Raised Crossing at Right-Turn Islands
- High-Visibility Crosswalk Markings
- Stop Lines
- Corner Radii
- ADA Access (Universal Design)
- Median Noses
- Pedestrian Signals
- Leading Pedestrian Interval
- Exclusive Pedestrian Signal Phase
- Yield-to-Pedestrian Blank-Out Signs
- Bicycle Detector Marking
- Mid-Block Crosswalk

Objective H-4: *Regularly monitor crash data and develop strategies to remedy conditions where correctable accident patterns appear.*

Many of the improvements listed in **Objective H-2** have specific safety benefits, so the discussion of **Objective H-4** is at a more programmatic level. MATS recommends that crashes be monitored consistently throughout the Urban Area, and reported annually. The following crash attributes should be tracked, at a minimum:

- Date, Time-of-Day
- Location
- Weather/Lighting Conditions
- Crash Type (sideswipe, rear-end, fixed object, etc.)
- Severity
- Contributing Circumstances
- Direction of Travel
- Pedestrians Involved; Pedestrians Injured
- Bicyclists Involved; Bicyclists Injured

Annual monitoring reports should include both high-crash intersections and segments. MATS recommends that the City and the two Counties explore ways to create a common crash database covering the entire Urban Area.

Objective H-5: *Employ technology solutions to optimize arterial traffic flow, gather/disseminate traffic data, and address incidents.*

This Objective primarily relates to the ITS network of the City and region. As previously indicated, the City has begun building an ITS network with the intent to optimize existing traffic capacity and monitor incidents. Planning for a regional (Flint Hills) ITS architecture is underway with FHMPO. The goals of the system should include:

- High-speed communication connections between all traffic signals and the Manhattan Traffic Operations Facility (MTOF) to allow monitoring of signal controllers and remote adjustment of settings as necessary.
- Closed-Circuit Television (CCTV) cameras at every arterial signal (and every grade-separated highway interchange with unsignalized ramp termini) for incident monitoring, and for public viewing access via the internet.
- Real-time interagency information sharing (between jurisdictions but also with emergency responders).
- Traffic signal coordination along all arterials.
- Road weather monitoring.

The Urban area might also explore targeted use of dynamic message signs related to its two biggest traffic generators – KSU (especially for special events) and Fort Riley.

Ultimately, the system will need to be prepared to interact with Smart (connected) Vehicles. The recommendations above, specifically those related to communications and sensors, are the first step toward achieving this long-term objective.

Table 6-6: MATS Roadway Infrastructure Strategy Summary		
Strategy	**Responsible**	**Priority***
Local Road Traffic Control Policies/Practices		
Address routine traffic control requests related traffic control, regulations, safety, etc.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning	O
Implement Neighborhood Traffic Management Policy (See text)	**Lead:** Public Works – City and Counties **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners	1
Local Street Design		
Adopt relevant APWA standards for Street Design	**Lead:** City Public Works **Involve:** Public Works - Counties	2
Explore Alley Benefit District concept	**Lead:** City Public Works **Involve:** City Community Development	2
Pursue grants for alley pavement	**Lead:** City Community Development **Involve:** City Public Works	3
Minimize "Through" Traffic		
Incorporate local street connectivity principles into Subdivision Regulations (block lengths, ped/bike connections, cul-de-sac percentage, connectivity index, etc.) – see text.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	2
In Subdivision Regulations, adjust pedestrian connection language to include bicycles as well (see text).	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission	1
Roadway System Design		
Increase funding available for pavement maintenance (see text)	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning, FHMPO	3
Track PCI by functional class (target = 70)	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning, FHMPO	O
Expand Pavement Management System to cover entire Urban Area	**Lead:** Public Works – City and Counties **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission, FHMPO	3
Adopt updated access management guidelines (see text)	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning, FHMPO	1
Adopt updated transportation impact study guidelines (see text)	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning, FHMPO	1
Use FHMPO travel-demand forecasting model for long-range transportation planning	**Lead:** FHMPO, City Public Works, City Community Development **Involve:** Public Works – Counties, Riley County Planning and Development, Pottawatomie County Zoning	O
Adopt near-term, mid-term, and long-term roadway improvement recommendations (see text)	**Lead:** Public Works – City and Counties, City Community Development, Riley County Planning and Development, Pottawatomie County Zoning, **Involve:** City Commission, Riley and Pottawatomie Boards of County Commissioners, Riley County Planning Board, Pottawatomie County Planning Commission, FHMPO, KDOT	O
Adopt Complete Streets principles/toolbox in the design of new roads and upgrade of existing roads (see text)	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning, FHMPO	1

Table 6-6: MATS Roadway Infrastructure Strategy Summary		
Strategy	**Responsible**	**Priority***
Safety		
Systematically monitor crashes throughout the Urban Area in a common database, including bicycles and pedestrian data (see text)	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley Co Planning and Development, Pottawatomie Co Zoning, FHMPO, Riley Co Police Dept, Pottawatomie Co Sherriff	2
Include high-crash intersections and segments in annual monitoring reports	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning, FHMPO	2
Technology (ITS)		
Provide high-speed communications between all traffic signals and the MTOF	**Lead:** Public Works – City **Involve:** KDOT, Public Works – Counties, FHMPO	3
Provide CCTV cameras at every arterial signal and every grade-separated highway interchange with unsignalized ramp termini	**Lead:** Public Works – City **Involve:** KDOT, Public Works – Counties, FHMPO	3
Provide real-time interagency information sharing between jurisdictions and emergency responders	**Lead:** Public Works – City **Involve:** KDOT, Public Works – Counties, emergency response agencies, FHMPO	3
Coordinate traffic signals along all arterials	**Lead:** Public Works – City **Involve:** KDOT, Public Works – Counties, FHMPO	3
Provide road weather monitoring.	**Lead:** Public Works – City **Involve:** KDOT, Public Works – Counties, FHMPO	O
Explore targeted use of Dynamic Message Signs for KSU and Ft. Riley	**Lead:** Public Works – City and Riley Co **Involve: K-State, Ft. Riley, FHMPO,** KDOT	3

***1 = Immediate Priority,** to be implemented with MATS adoption or shortly thereafter; **2 = High Priority,** to be initiated as soon as possible and completed within one to two years after MATS adoption; **3 = Moderate Priority,** to be completed within three to five years after MATS adoption; **O = ongoing,** actions that occur continually.*

7.0 Freight/Goods Movement

MATS Goal K: Facilitate freight movement while minimizing freight's impact on the transportation system.

7.1 Existing/Historical Conditions

Existing Infrastructure

Figure 7-1 illustrates freight infrastructure in the Urban Area, which includes 45 miles of designated truck routes and approximately 20 miles of Union Pacific rail track.

Trucks

Regarding truck routes, the City of Manhattan's Code of Ordinances states:

> *It shall be unlawful for any person, firm, or corporation to operate a truck, trailer, or semitrailer with a registered gross vehicle weight in excess of 30,000 pounds, on any street or alley within the corporate limits of the city other than on the following designated truck routes:*
>
> *(1) U.S. Highway 24, inclusive of the street Tuttle Creek Boulevard.*
> *(2) Highway K18, inclusive of the street Ft. Riley Boulevard.*
> *(3) Highway K113, inclusive of the street Seth Child Road.*
> *(4) Kimball Avenue from Tuttle Creek Boulevard to Anderson Avenue.*
> *(5) Bluemont Avenue from Tuttle Creek Boulevard to Manhattan Avenue.*
> *(6) Anderson Avenue from Manhattan Avenue to the west city limits.*
> *(7) McCall Road from U.S. Highway 24 to Tuttle Creek Boulevard.*
>
> *It shall not be a violation of this section for a person to operate a truck, trailer or semitrailer upon such streets or alleys as are required to reach a destination located off a truck route if such is necessary to accomplish the business of, or purposes related to, the truck, trailer or semitrailer. Trucks deviating from the truck routes for such business or purpose shall use the most direct route between the nearest truck route and the destination, and shall return in a similar manner. In deviating from truck routes, alleys shall only be used where they are required to reach the destination of the vehicle.*

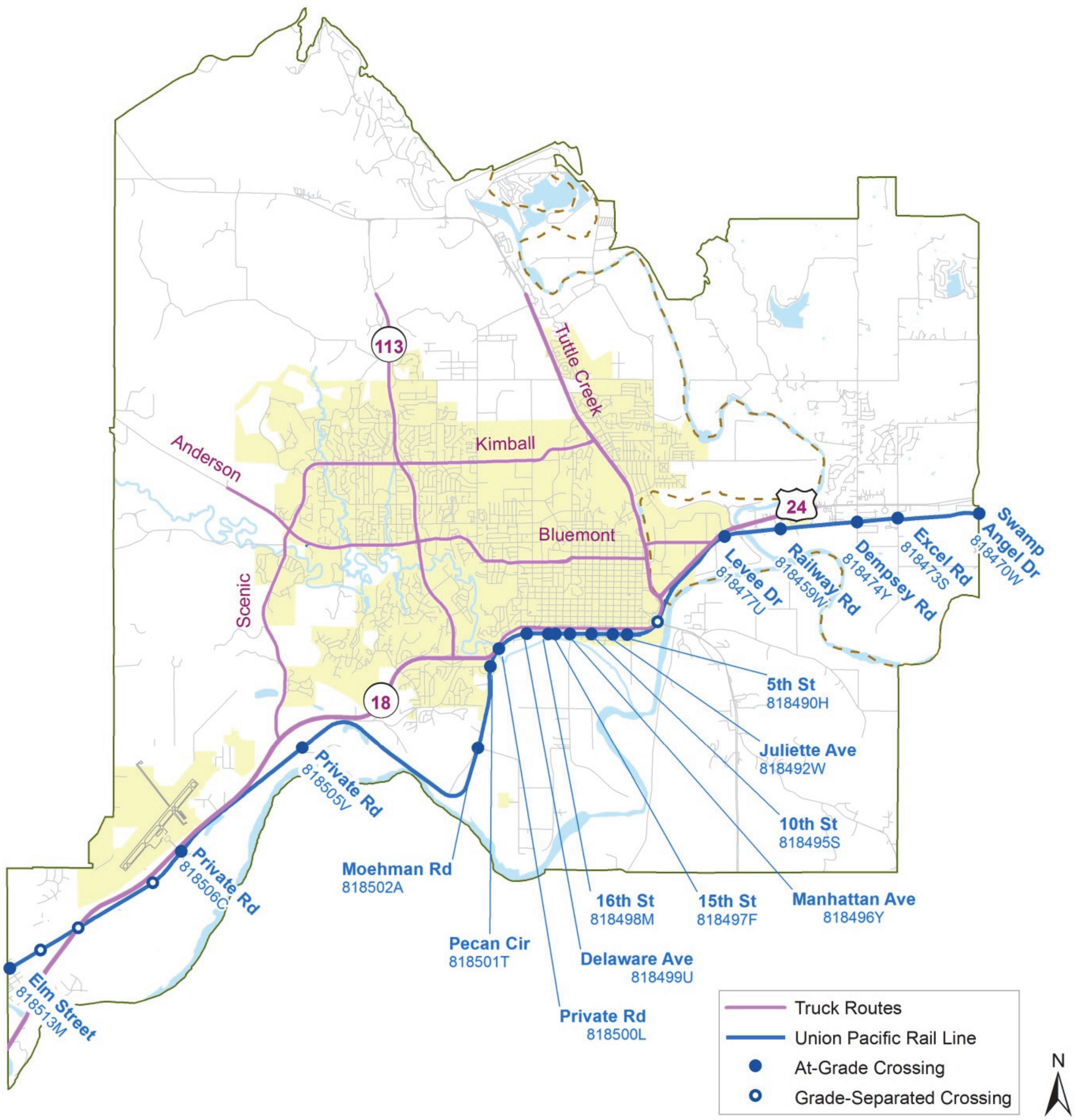
Rail

Although rail runs through the entire southern portion of the developed part of the Urban Area, there is no active direct rail access within the Urban Area. The nearest direct rail access to the Urban Area is via spurs into Camp Funston southwest of Ogden. There is a group of maintenance-of-way tracks on the southeast side of US-24 between Tuttle Creek Boulevard and McCall Road, and there are a few older sidings in the vicinity of downtown that do not appear to be currently used for industry.

The rails generally run on the south side of K-18/Fort Riley Boulevard, and then US-24, through most of the study area with no tracks crossing either of these two highway facilities. South and west of the airport, the tracks cross under K-18 to its north side and run through the middle of Ogden. In this area, there are three grade-separated rail crossings: (1)

under William Wood Road just south of its recently constructed interchange with K-18, (2) under K-18 itself (where the tracks cross to the north side), and (3) under (recently reconstructed) Skyway Drive north of its interchange with K-18. K-177 also has a grade-separated crossing just north of the Kansas River. There are 17 at-grade crossings throughout the rest of the Urban Area.

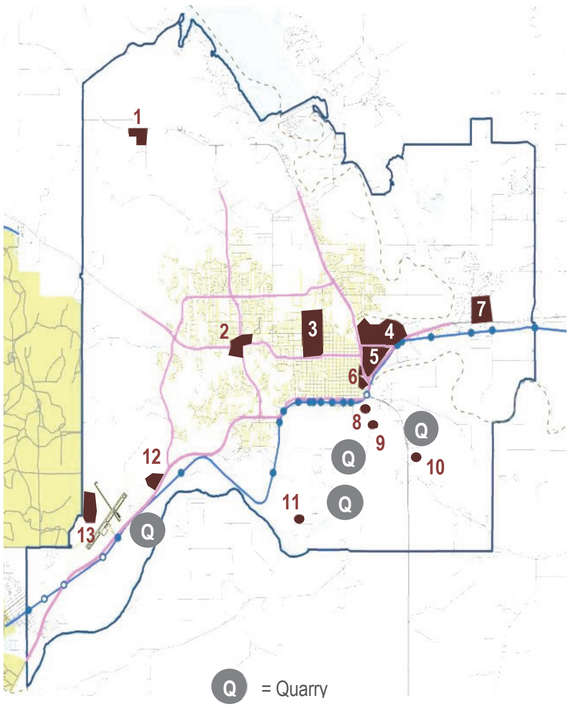
Figure 7-1: Freight Network



Freight Generators

Figure 7-2 illustrates some of the more significant freight-generating businesses, or groups of businesses, in the Urban Area. Industrial parks tend to be clustered along the K-18 and US-24 corridors. The major retail clusters along southern Tuttle Creek Boulevard also are sizeable enough to be considered freight generators. In general, these freight generators are located appropriately with relation to designated truck routes.

Figure 7-2: Freight Generators



1. Riley County Shops	
2. West Side Retail	
Westloop Place	
Max Fitness/Ray's Apple/etc.	
Ed Schram Dodge	
3. K-State	~24 shipments/day, trucks & FedEx / UPS
4. Manhattan Industrial Pk (N)	
Pepsi-Cola	
UPS	
National Guard	
Parker Hannifin	
Continental Mills	Food manufacturer
FedEx Shipping Center	<50 employees
Baker Distributing Co	A/C, refrig / heating parts & supplies
Griffith Lumber	
Menards	200 employees
5. Manhattan Industrial Pk (S)	
Manko Window Systems	245 employees
Wal-Mart	
6. East side retail	
Manhattan Marketplace	
Manhattan Town Center	
7. Green Valley Industrial Park	
CBS Manhattan	
Liberty Inc.	
Tallgrass Brewing Co	
8. Midwest Concrete Materials	
9. Shilling Construction Co	
10. Bayer Construction Co	
11. Riley Co Transfer Station	
12. Industrial Park (Eureka Drive)	
Star Lumber	
Penny's Concrete, Inc.	
13. Manhattan Corporate Technology Pk	
Florence Manufacturing	519 employees
Coleman American Moving Services	Local / long-distance moving services
Flint Hills Beverage	Anhueser-Busch distributor, < 50 emps

K-State does not currently have a central distribution center for freight. This idea has been discussed in the past, but has not been listed as a priority in the K-State Master Plan. As **Figure 7-2** shows, the University receives approximately 24 shipments per day, both by FedEx/UPS and other trucks. Freight activities/destinations include construction and custodial items, housing/dining, Pittman Hall (southeast corner of Jardine Drive/Denison Avenue), and the Student Union. Some truck parking and loading docks are located along 17th Street (see photo at right).

Fort Riley (outside the study area) does receive and send freight, and is also identified by the U.S. Military Surface Deployment and Distribution Command as a defense installation requiring rail service.

System Usage

Trucks

Figure 7-3 illustrates daily truck volumes on the state and U.S. highways in the Urban Area. As the figure shows, truck volumes on these facilities range from a low of 115-125 trucks per day (tpd) on K-13 to a high of 700-1,100 tpd on K-18. These volumes generally range from 2 to 6 percent of total traffic. By comparison, truck volumes on I-70 in the region range from 3,700 to 3,800 tpd (22 to 30 percent of total daily traffic).

The lower left graph in **Figure 7-3** illustrates how hourly truck volumes compare to total traffic volumes throughout a typical day, in this case on US-24 near downtown. The lower right graph makes more obvious a point that the lower left graph hints at – truck volumes peak during the middle of the day, generally outside of the traffic "rush hours".

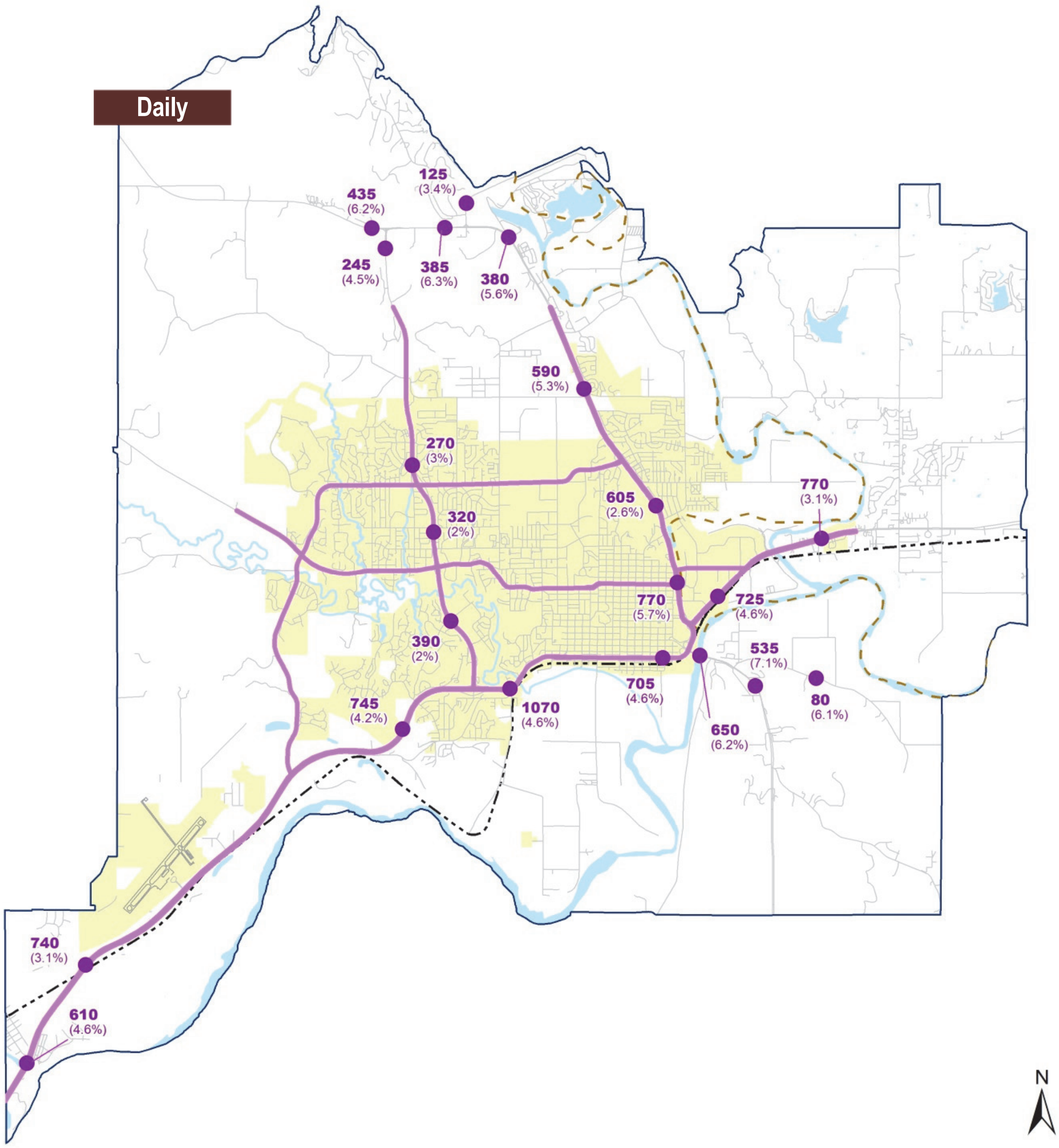
Rail

The Federal Railroad Administration (FRA) publishes a rail grade-crossing inventory, in which each at-grade crossing has an assigned number (as shown in **Figure 7-1**). According to this inventory, the UP tracks through the study area carry 6 to 15 trains per day, with three "through" trains during daylight hours. Average daily vehicle traffic (according to FRA) crossing these tracks is generally low, well under 1,000 vehicles per day (vpd). The exceptions are Juliette Avenue (1,043 vpd), Manhattan Avenue (1,550 vpd), and Moehman Road (2,303 vpd), which intersects Rosencutter Road approximately 1.1 miles south of K-18. **Table 7-1** summarizes some of the data from the FRA inventory.

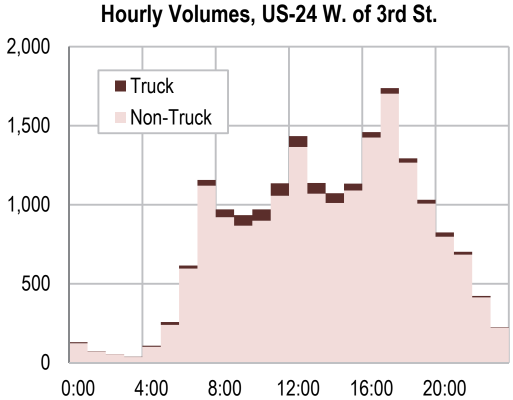
Table 7-1: Crossing Data from FRA Inventory

Crossing #	Street	Crossing Type	Total Trains / Day Thru	Avg Speed over Crossing	ADT / Percent Trucks (Year)
818470W	Swamp Angel Drive	Flashing	10 / 3	20 – 65 mph	112 / 8% (2006)
818473S	Excel Road	Gates	6 / 3	5 – 40 mph	527 / 8% (2006)
818474Y	Dempsey Road	Gates	10 / 3	20 – 65 mph	283 / 8% (2006)
818459W	Railway Road		10 / 3	15 – 50 mph	15 / 8% (2006)
818477U	Levee Drive	Gates	9 / 3	20 – 40 mph	106 / 7% (2000)
--	K-177	Grade-Separated	--	--	--
818490H	5th Street	Gates	15 / 3	20 – 40 mph	677 / 5% (2000)
818492W	Juliette Avenue	Gates	12 / 3	20 – 40 mph	1043 / 5% (2000)
818495S	10th Street	Gates	9 / 3	20 – 40 mph	559 / 5% (2000)
818496Y	Manhattan Avenue	Gates	9 / 3	20 – 40 mph	1550 / 5% (2010)
818497F	15th Street	Passive	9 / 3	20 – 40 mph	103 / 5% (2000)
818498M	16th Street	Gates	9 / 3	20 – 40 mph	200 / 5% (2000)
818499U	Delaware Avenue	Passive	9 / 3	20 – 40 mph	122 / 5% (2000)
818500L	Private Road		--	--	--
818501T	Pecan Circle	Gates	0 / 0	--	2303 / 8% (2000)
818502A	Moehman Road	Gates	10 / 3	20 – 65 mph	454 / 8% (2000)
818505V	Private Road		--	--	--
818506C	Private Road		--	--	--
---	William Wood Rd/W. 56th Ave	Grade-Separated	--	--	--
---	K-18/Fort Riley Blvd	Grade-Separated	--	--	--
---	K-114/Riley Road	Grade-Separated	--	--	--
818513M	Elm Street (Ogden)	Gates	6 / 3	20 – 65 mph	589 / 5% (2000)

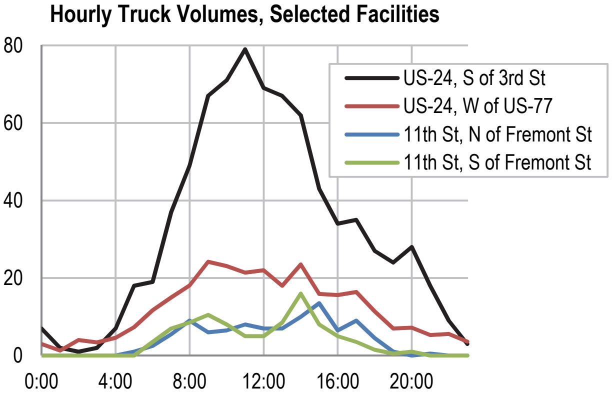
Figure 7-3: Truck Volumes in the Urban Area



Hourly Volumes, US-24 W. of 3rd St.



Hourly Truck Volumes, Selected Facilities



System Safety

Trucks

Truck crashes are not currently systematically tracked in the Urban Area, but such information is likely extractable from crash reports.

Rail

According to the FRA database, there has been one grade crossing accident within the project limits during the past five years - in 2013 at 16th Street (crossing number 818498M). The accident involved a car's tire stuck on the tracks; there were no injuries or fatalities.

7.2 Achieving Freight Objectives

Objective K-1: *Delineate a preferred truck network and implement associated policies.*

As mentioned in **Section 7.1**, the City of Manhattan currently has a delineated set of truck routes and a weight-restriction policy associated with them (<30,000 pounds). These policies appear reasonable and not overly restrictive. MATS offers two recommendations regarding the future of the truck route system:

- Riley and Pottawatomie County should adopt the truck routes designated by the City in order to extend them to the boundaries of the Urban Area.
- As discussed in **Chapter 6**, Marlatt Avenue/Junietta Road is anticipated to become a more significant regional east-west connector in the future – extending eastward into Pottawatomie County, and being improved westward/northward in Riley County. This important future connector should become a future addition to the Urban Area's truck route network, and as the roadway is built out, designs should take this potential designation into account.

Objective K-2: *Facilitate safe and efficient freight operations on the truck network, and between the truck network and freight-related land uses.*

Truck Mobility

Since there are essentially six continuous designated truck routes through the Urban Area, providing safety and efficiency is largely a matter of ensuring that travel lanes are of adequate width, and that pavement is of sufficient depth and quality, to accommodate trucks. Along the state and U.S. routes, these design considerations will happen as a matter of course, following KDOT standards. Along the other routes – Anderson Avenue/Bluemont Avenue, Kimball Avenue/Scenic Drive, and McCall Road – it is recommended that the appropriate standards be applied when and if these routes are upgraded or reconstructed. Perhaps more key are the locations where truck routes intersect each other. There are currently 10 such intersections in the urban area, many of which are actually interchanges. If and when future improvements are made to any of these intersections, MATS recommends that appropriate truck turning-movement considerations be applied in planning and design. Perhaps the intersection to monitor most closely is the intersection of Kimball Avenue/Scenic Drive/Anderson Avenue, which is the only intersection of two non-state highway truck routes in the Urban Area. The intersection currently carries one through lane in each direction, with turn lanes at key locations on two legs, and appears to have been designed to accommodate large truck turns. As the intersection is expanded in the future, truck considerations should continue to play a role in planning and design.

Future Truck Freight Growth

The 574,000-square-foot National Bio and Agro-Defense Facility (NBAF) is under construction in the southwest quadrant of the Kimball Avenue/Denison Avenue intersection. The site will receive some amount of deliveries and research materials by truck. Given its direct access to a truck route (Kimball Avenue), it is expected that NBAF-related freight movements will be adequately served.

More generally, MATS recommends that development policies encourage the location of freight-generating developments along or near the truck route system. Existing zoning largely supports this approach.

Truck Safety

MATS recommends that the Urban Area, in the crash database recommended in **Chapter 6**, specifically track truck crashes so that the safety of this travel mode can be monitored.

Other Truck Freight Considerations

MATS recommends that the Urban Area monitor truck volumes on the truck route system annually, and use the truck volumes reported by KDOT, supplemented with available counts on non-KDOT truck routes, to compute a rough Truck-Miles Traveled (TMT) value for the truck route network. This value will provide insight into truck freight trends, and can be used to identify potential "hot spots" of growth.

Regarding efficiency, MATS also recommends that the Urban Area encourage the use of alternative fuels (e.g., Compressed Natural Gas, CNG) among local commercial/institutional users of trucks and other heavy vehicles.

Delivery truck parking in alleys has been noted as an issue both in Aggieville, and to some extent downtown. Alleys are discussed in more detail in **Chapter 6**. Poyntz Avenue downtown has also been noted as a location in which delivery trucks occasionally park in the middle of the street. The City may wish to consider either delivery time-windows on this four-block section (restricting deliveries to times outside peak travel hours), or explicitly prohibit truck parking altogether, delineating alternative locations for parking and loading.

Objective K-3: *Maintain safe conditions at rail crossings.*

In its 1986 *Railroad-Highway Grade Crossing* Handbook, the U.S. Department of Transportation (USDOT) provided a crash prediction formula for at-grade railroad crossings, based on the type of crossing, number of trains, number of crossing vehicles, number of main tracks, highway surface, rail timetable speed, highway type, and highway number of lanes. **Table 7-2** summarizes the results of this formula applied to the grade crossings in the Urban Area. (The formula actually predicts crashes per year, but since these predictions are all well below 1, the values can also be interpreted as the probability of a single crash in any given year.) As the table indicates, probabilities are generally very low (two percent or lower), with only the 16th-Street crossing as high as 4 percent – largely due its recent crash experience (discussed in **Section 7.1**).

Table 7-2: Predicted Annual Crash Probabilities, Existing Grade Crossings

Crossing #	Street	Crossing Type	Predicted Annual Crash Probability*
818470W	Swamp Angel Drive	Flashing	2.1%
818473S	Excel Road	Gates	1.3%
818474Y	Dempsey Road	Gates	1.3%
818459W	Railway Road		
818477U	Levee Drive	Gates	0.9%
--	K-177	Grade-Separated	0
818490H	5th Street	Gates	1.8%
818492W	Juliette Avenue	Gates	1.9%
818495S	10th Street	Gates	1.5%
818496Y	Manhattan Avenue	Gates	2.0%
818497F	15th Street	Passive	1.4%
818498M	16th Street	Gates	4.3%
818499U	Delaware Avenue	Passive	1.5%
818500L	Private Road		--
818501T	Pecan Circle	Gates	0.1%
818502A	Moehman Road	Gates	1.5%
818505V	Private Road		--
818506C	Private Road		--
---	William Wood Rd/W. 56th Ave	Grade-Separated	0
---	K-18/Fort Riley Blvd	Grade-Separated	0
---	K-114/Riley Road	Grade-Separated	
818513M	Elm Street (Ogden)	Gates	0.6%

** See text*

Although the 16th Street crossing is not seen as a major safety concern, a review of the four at-grade crossings between Delaware Avenue and Manhattan Avenue (roughly a half-mile of track) suggests that perhaps some future crossing consolidation might be worth considering in this area. In the future, an east-west roadway south of the tracks connecting all of the parcels in this area could allow the closure of the 15th Street and 16th Street crossings, much as Pottawatomie Avenue east of Manhattan Avenue provides a collector-like function and eliminates the need for certain crossings. Railroads and public agencies are constantly looking for ways to eliminate at-grade crossings, and this particular stretch of track lends itself to such long-term considerations.

MATS recommends that the Urban Area continue to monitor at-grade safety through the FRA inventory reports, and simultaneously track predicted crashes at each at-grade crossing (as crossing traffic grows). These measures will provide indications of which grade crossings might need additional protection, or even grade-separation, in the future.

Table 7-3: MATS Freight Strategy Summary		
Strategy	**Responsible**	**Priority***
Trucks		
Extend the existing truck route designations from the City boundaries to the Urban area Boundaries (US-24 West, US-24 East, K-113 North, Anderson Avenue West).	**Lead:** Riley Co Planning and Development, Pottawatomie Co Zoning, Public Works – Counties **Involve:** Riley and Pottawatomie Boards of County Commissioners, FHMPO, KDOT	1
Plan the Marlatt Avenue/Junietta Avenue extension as a truck route and design accordingly.	**Lead:** Riley Co Planning and Development, Pottawatomie Co Zoning, Public Works – Counties **Involve:** Riley and Pottawatomie Boards of County Commissioners, FHMPO, KDOT	3
Use appropriate standards when truck routes are upgraded; carefully consider truck turning movements when planning future improvements at intersections of truck routes.	**Lead:** Public Works – Cities and Counties **Involve:** KDOT, City Community Development, Riley Co Planning and Development, Pottawatomie Co Zoning	O
Encourage the location of freight-generating developments along or near the truck route system.	**Lead:** City Community Development, Riley County Planning and Development, Pottawatomie County Zoning **Involve:** FHMPO	O
Specifically track truck-related crashes as part of the Urban Area crash database.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley Co Planning and Development, Pottawatomie Co Zoning, FHMPO, Riley Co Police Dept, Pottawatomie Co Sherriff	2
Monitor truck volumes on truck routes annually, compute rough truck-miles traveled value.	**Lead:** Public Works – City and Counties **Involve:** City Community Development, Riley Co Planning and Development, Pottawatomie Co Zoning, FHMPO	O
Encourage the use of alternative fuels (e.g., CNG) among local commercial/institutional users of trucks and heavy vehicles.	**Lead:** City Community Development, Riley Co Planning and Development, Pottawatomie Co Zoning **Involve:** FHMPO	2
Explore alternatives to delivery truck parking on Poyntz Avenue Downtown (delivery windows or designated alternative loading)	**Lead:** City Public Works, City Community Development **Involve:** Riley Co Police Dept	3
Rail		
Explore rail crossing consolidation between Delaware Avenue and Manhattan Avenue (including a potential parallel collector road)	**Lead:** City Public Works, UPRR **Involve:** City Community Development, KDOT	3
Track and report FRA grade-crossing inventory data annually, including crash predictions.	**Lead:** City Public Works **Involve:** City Community Development, FHMPO, KDOT, UPRR	O

****1 = Immediate Priority,*** *to be implemented with MATS adoption or shortly thereafter;* ***2 = High Priority,*** *to be initiated as soon as possible and completed within one to two years after MATS adoption;* ***3 = Moderate Priority,*** *to be completed within three to five years after MATS adoption;* ***O = ongoing,*** *actions that occur continually.*

8.0 Airport Facilities

MATS Goal K: Leverage transportation and economic-development potential of the Manhattan Regional Airport (MHK)

MHK is a major generator of economic activity. Economic impacts associated with the airport include 489 jobs, $13.4 million in payroll, and $46.3 million in economic output.

8.1 Existing/Historical Conditions

Existing Infrastructure

The Manhattan Regional Airport (MHK) is located along K-18 in the southwest corner of the Urban Area, as shown in the aerial photographs in **Figure 8-1**.

Figure 8-1: Manhattan Regional Airport (MHK) – Aerial Views

Owned by the City of Manhattan, MHK is classified as a Non-Hub Primary Commercial Service Airport. An airport of this type typically has more than 10,000 annual passenger enplanements, but less than 0.05 percent of all commercial passenger enplanements. MHK holds a Class II Airport Operating Certificate from the FAA, which allows an airport to be served by scheduled operations of small air carrier aircraft and the unscheduled passenger operations of large air carrier aircraft.

The airport began as a general aviation-only airport in 1928, when the only runway was a turf strip. Today, the general aviation services at MHK include air charter, aircraft rental, flight instruction, aerial photography, major aircraft maintenance, transient aircraft refueling, tie-downs, and hangar space. Kansas State University is a major user of charter aircraft out of MHK, particularly the Athletic Department traveling to various sporting events. With the proximity of the airport to the Fort Riley Military Base, some charter military operations are served at MHK. However, as discussed later in this chapter, it is an objective of the airport to increase the amount of military service provided.

The infrastructure at MHK includes two runways, a network of taxiways, three aircraft parking aprons, an Aircraft Rescue and Fire-Fighting (ARFF) fire station, 48 aircraft hangars, a multi-tank fuel farm, and a City-funded Air Traffic Control Tower. The primary runway (Runway 3-21) is 7,000 feet long and 150 feet wide with 25-foot wide turf shoulders. The crosswind runway (Runway 13-31) is 5,000 feet long and 75 feet wide with turf shoulders (recently rehabilitated and improved, from 3,801 feet long and 100 feet wide).

A terminal expansion project began in early 2014 and is currently ongoing, and is described in more detail in **Section 8.2**. The $15.8 million project is being funded through grants from the Federal Aviation Administration and City of Manhattan Funding.

Commercial Service

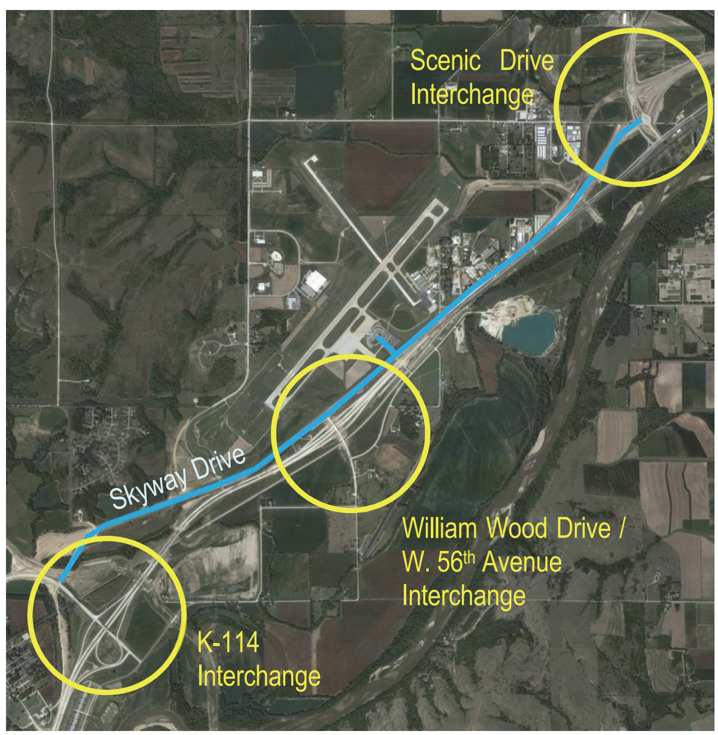
American Eagle currently offers nonstop service to Chicago twice daily, and Dallas/Fort Worth three times daily. The service is operated with 50-seat Embraer ERJ-145 regional jets.

Land-Side Access

The airport is located along K-18, which recently underwent a major capacity upgrade to become a freeway section from the City of Ogden to Miller Davis Drive in Manhattan. Primary access from K-18 to the airport is via the William Wood Drive/W. 56th Avenue interchange, but the development of the Skyway Drive frontage road provides additional access via the K-114 and Scenic Drive interchanges (see **Figure 8-2**).

There is no fixed-route transit service that provides access to the airport. The terminal houses two rental car facilities, which processed 6,252 rentals in 2014 (average rental length of 5.31 days) and 7,460 rentals in 2013 (average rental length of 4.74 days).

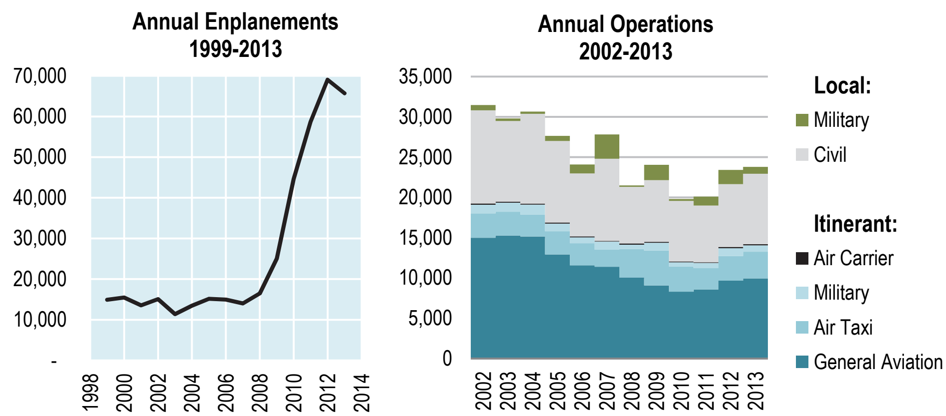
Figure 8-2: Access to MHK via New Interchanges on K-18



System Usage

MHK enplaned (boarded) 65,683 commercial passengers in 2013 and had a total of 23,781 aircraft operations (takeoffs and landings): 60 percent itinerant (arriving from or departing to a destination outside the airport) and 40 percent local (training, instruction, simulated takeoffs/landings, etc.). Of the itinerant operations, 70 percent were general aviation, 6 percent were military, and 24 percent were air carrier or air taxi. As **Figure 8-3** illustrates, operations declined by 24 percent between 2002 and 2013 (although the trend since 2012 has been an increase), while enplanements quadrupled over the same period. The increase in enplanements is a result of the introduction of service to Dallas-Fort Worth in August of 2009 and Chicago-O'Hare in November, 2010. **Figure 8-3** also benchmarks MHK against other Kansas airports; MHK was second to Wichita in commercial enplanements in 2013.

Figure 8-3: MHK Aviation Activity and Comparisons, 1999 - 2013



Kansas Airports with 2013 Enplanements >1,000	
Wichita Eisenhower Nat'l	736,220
Manhattan Regional	65,683
Garden City Regional	24,456
Topeka Regional	9,339
Hays Regional	8,726
Liberal Mid-America Regional	6,265
Dodge City Regional	5,789
Salina Municipal	3,052

8.2 Achieving System Objectives

Objective I-1: *Provide convenient and economical commercial air service at MHK.*

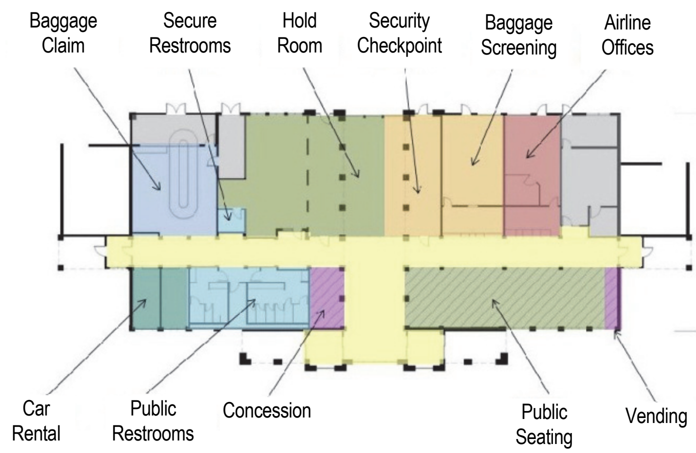
Infrastructure Improvements

MHK's 2011 Terminal Area Master Plan projects 111,000 annual enplanements in 2030. The terminal is currently undergoing a $15.8 million expansion project (see **Figure 8-4**) that will increase its size from 12,500 square feet to 42,000 square feet, and will provide two gates (each with an enclosed passenger boarding bridge), an expanded parking area, and many other enhancements.

The 2009 Airport Master Plan found that both the short- and long-term parking lots had capacity challenges. At the time, there were a total of 132 parking stalls. Since that time, an estimated 300+ parking stalls have been added southeast of the terminal by paving an old dirt overflow lot. Additional modifications were proposed as a part of the 2011 Terminal Master Plan. The construction effort was broken into phases so that portions of the project could be built as funds become available. Upon completion of the final phase, the number of parking stalls will exceed 1,000 (see **Figure 8-5**).

Figure 8-4: Current Terminal Expansion Project

Existing Layout



Proposed Layout

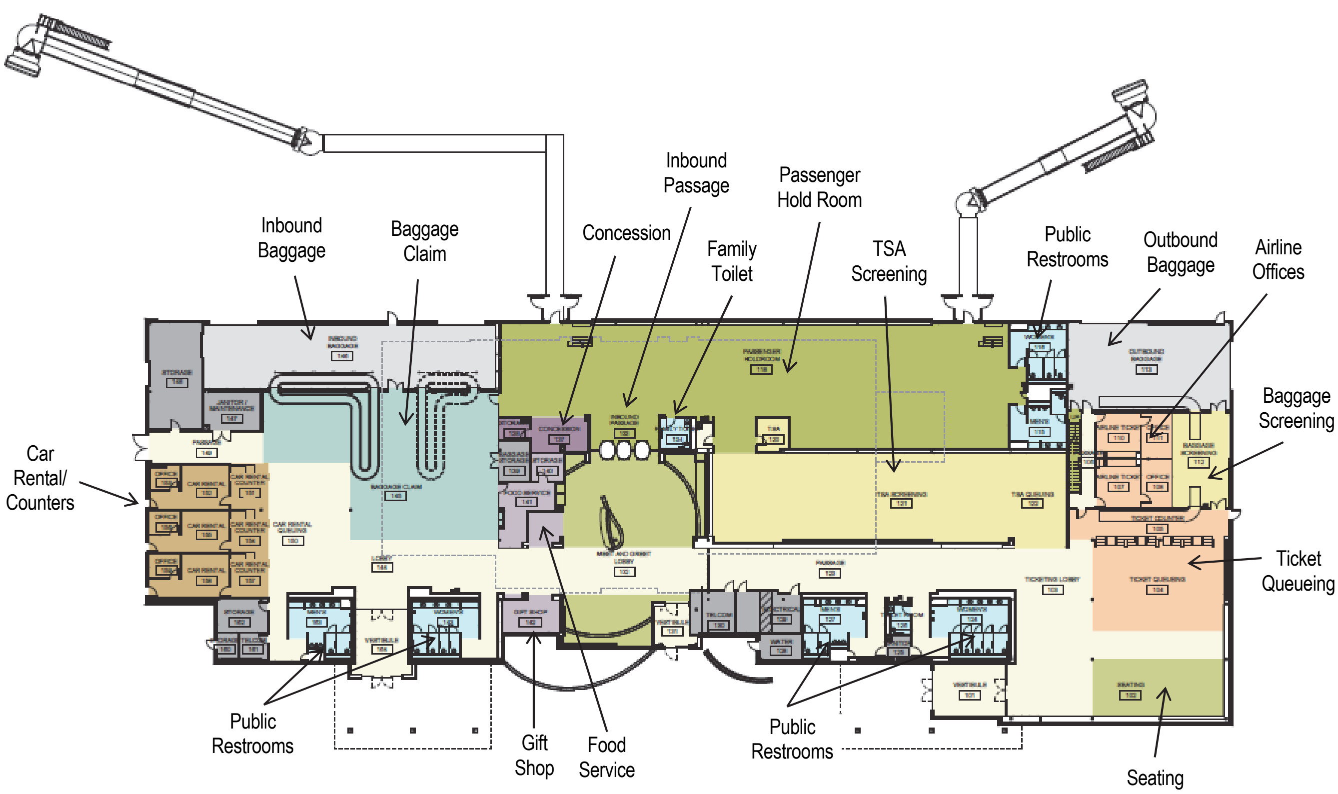
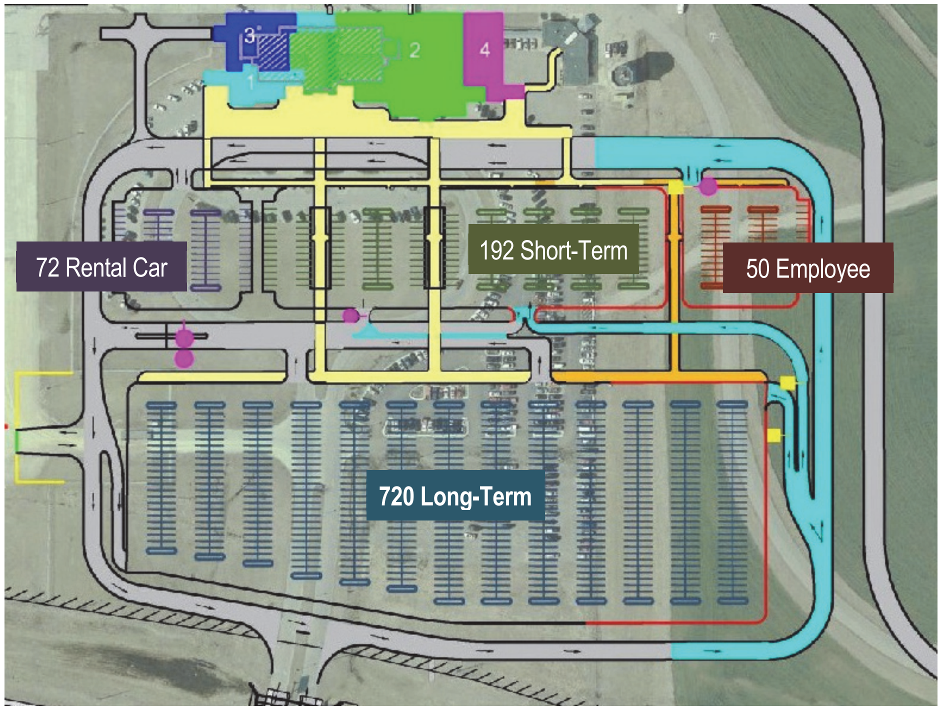


Figure 8-5: Final Configuration – MHK Parking Lot Expansion



MHK has a robust three-phase capital improvement program to address its expansion needs. **Table 8-1** summarizes the planned capital projects included in the 2009 Airport Master Plan, many of which have already been completed. Between 2009 and 2024, the project costs estimates totaled $145 million, about $50 million of which (34 percent) was identified to be funded from local sources – the majority of these local expenditures being forecasted in Phase III (2018-2024).

Commercial Aviation Growth

Forecasts of enplanements (commercial passenger boardings) were prepared for the 2009 Airport Master Plan, which was written prior to the significant increases in service offerings that have occurred in the past five years. Therefore, those projections are now considered to be very low. New forecasts were developed for the Terminal Master Plan developed in 2011. Projections now exceed 100,000 enplanements in the long-term, as opposed to remaining stagnant at around 14,000 enplanements. **Figure 8-6** compares these projections. Key connections to Chicago and Dallas-Fort Worth have bolstered these projections.

Figure 8-6: Enplanement Projections

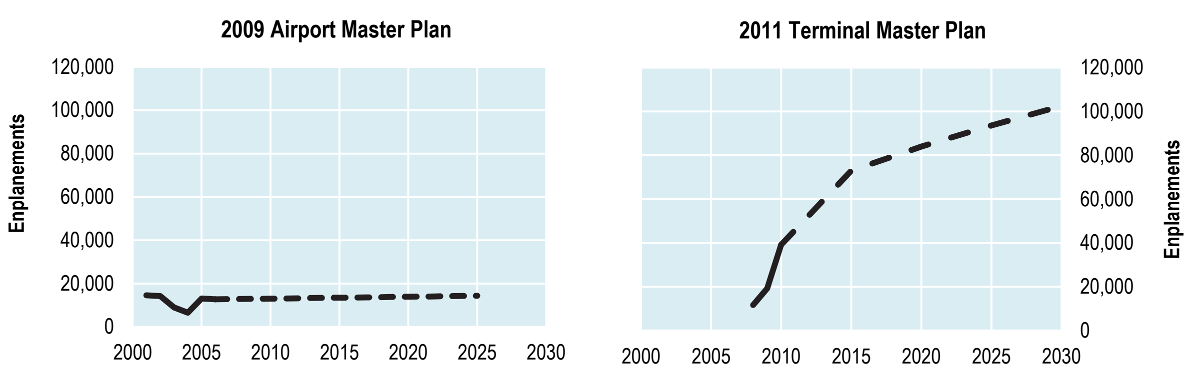


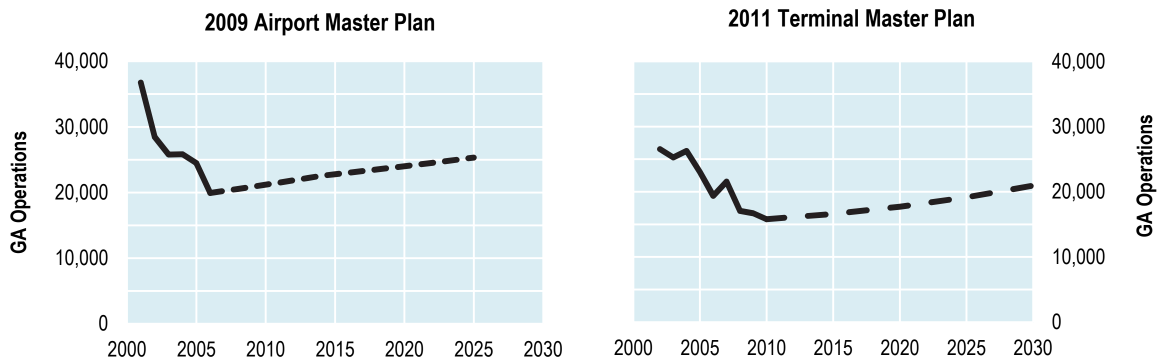
Table 8-1: MHK Airport Master Plan Capital Improvement Projects and Funding Summaries (2009)

Year	Project No. and Description		FAA Eligible	Local	Total Cost
Phase I Development					
2009	1.	Runway 3-21 and Taxiway A Extension	$8,372,350	$440,650	$8,813,000
2009	2.	Update Pavement Management System	$87,400	$4,600	$92,000
2010	3.	Runway 13-31 Reconstruction and Extension	$8,037,950	$423,050	$8,461,000
2010	4.	Roadway and Utility Development for Restaurant/Retail	$0	$996,000	$996,000
2011	5.	Construct Commercial Hangar and Apron	$0	$1,547,000	$1,547,000
2011	6.	Construct Wildlife Fence (Phase II) and Airport Perimeter Service	$2,642,900	$139,100	$2,782,000
2011	7.	Reconfigure and Expand Short-Term Parking Lot	$1,486,750	$78,250	$1,565,000
2012	8.	Rehabilitate Terminal Apron	$163,400	$8,600	$172,000
2012	9.	Replace 10-Unit T-Hangar	$0	$862,000	$862,000
2012	10.	Replace 7-Unit T-Hangar	$0	$667,000	$667,000
2012	11.	Renovate Departure Lounge Room	$317,300	$16,700	$334,000
2012	12.	Construct 60' x 60' Hangar	$0	$427,000	$427,000
2012	13.	Construct 7-Unit T-Hangar	$0	$667,000	$667,000
Estimated Total Cost for Phase I Development			**$21,108,050**	**$6,276,950**	**$27,385,000**
Phase II Development					
2013	14.	Reconstruct Taxiway E (Portion East of Taxiway A)	$1,821,150	$95,850	$1,917,000
2013	15.	Reconstruct T-Hangar Taxilanes - Phase 1	$1,477,250	$77,750	$1,555,000
2013	16.	Rehabilitate GA Apron East	$521,550	$27,450	$549,000
2013	17.	Reseal Runway 3-21 Pavement Joints	$242,250	$12,750	$255,000
2014	18.	Environmental Assessment (EA) for 1000 ft. Runway 3-21 Extension	$497,800	$26,200	$524,000
2014	19.	Reconstruct and Expand GA Apron West	$1,701,450	$89,550	$1,791,000
2015	20.	Renovate Stone Hangar	$0	$1,307,000	$1,307,000
2015	21.	Reconstruct T-Hangar Taxilanes - Phase 2	$1,064,950	$56,050	$1,121,000
2016	22.	Construct FBO Complex	$0	$4,376,000	$4,376,000
2017	23.	Construct Cargo Apron	$9,549,400	$502,600	$10,052,000
2017	24.	Reconstruct T-Hangar Taxilanes - Phase 3	$1,481,050	$77,950	$1,559,000
Estimated Total Cost for Phase II Development			**$18,356,850**	**$6,649,150**	**$25,006,000**
Phase III Development					
2018	25.	Extend Runway 3-21 by 1,000 Feet and Construct Overruns	$0	$23,578,000	$23,578,000
2018	26.	Install Passenger Boarding Bridge and Construct Terminal Addition	$1,744,200	$91,800	$1,836,000
2019	27.	Construct 100' x 100' Hangar and Apron	$0	$2,476,000	$2,476,000
2020	28.	Expand Fuel Farm	$0	$759,000	$759,000
2020	29.	Widen Parallel Taxiway A to 75'	$6,570,200	$345,800	$6,916,000
2021	30.	Widen Taxiways B, C, and D to 75'	$3,515,000	$185,000	$3,700,000
2021	31.	Renovate and Expand Terminal Building	$3,241,400	$170,600	$3,412,000
2022	32.	Construct 75' x 80' Hangar and Apron	$0	$1,593,000	$1,593,000
2022	33.	Replace FBO Building (GATTS) with 140' x 140' Hangar	$0	$2,605,000	$2,605,000
2023	34.	Construct Airport Vehicle Maintenance Building	$2,642,900	$139,100	$2,782,000
2023	35.	Reconstruct Runway 3-21; Construct Shoulders and Blast Pads	$37,747,300	$1,986,700	$39,734,000
2024	36.	Construct 75' x 80' Hangar, 80' x 180' Hangar, and Aprons	$0	$3,304,330	$3,304,330
Estimated Total Cost for Phase III Development			**$55,461,000**	**$37,234,330**	**$92,695,330**

Objective I-2: *Promote general aviation growth at MHK.*

General Aviation operations have declined in recent years, a function of the number of based aircraft decreasing as well as the operations per craft decreasing. In 2010, the number of annual operations per based aircraft was 351, down from 590 per aircraft in 2002. Both the 2009 and 2011 Plans forecasted a steady increase in operations for the future horizon years, despite the decreasing trend over the past 10+ years. When the forecasts were revisited in the 2011 Plan, the future projections were slightly more modest. **Figure 8-7** illustrates the comparison.

Figure 8-7: Aircraft Operations Projections



Charter operations are expected to remain about the same as the 2010 demand – 174 operations – for the projection period (through 2030). The primary users of these charters are expected to remain Kansas State University, at 66 annual operations, and Fort Riley, at 58 operations. The remaining 50 charter operations fall under the category of diverted.

Objective I-3: *Provide access and intermodal connections to MHK for all relevant passenger modes.*

MHK automobile access occurs via three interchanges on K-18, as previously described. Ongoing parking expansions are being implemented as needed. Two rental car agencies are located on-site. It is anticipated that the new terminal will provide adequate circulation and waiting areas. Thus, MHK serves automobile traffic well.

There is currently no fixed-route transit service to MHK, although the airport can be reached by FHATA's demand-response service. In FY 2012-2013, a total of 46 demand-response trips were recorded traveling to the airport, and 19 were recorded traveling from the airport to another destination. These numbers do not indicate a strong propensity to use transit to access the airport, but they are also not a definitive indicator of how many of the 70,000 annual boarding passengers might be willing to use transit if a fixed-route were provided. If fixed-route transit is ultimately established between Manhattan and Junction City, MATS recommends that the airport be considered as a potential intermediate destination.

Given its relatively remote location in the Urban Area, MHK is not a destination for pedestrians and bicyclists. However, designing the airport grounds to be pedestrian friendly is important, especially as the drop-off and parking areas are expanded. MATS recommends that adequate, safe pedestrian connections be incorporated into the design of these areas.

***Objective I-4:** Ensure compatible land use within five miles of the airport.*

MATS is not a land-use document, and as such, it does not contain detailed recommendations for land-use and zoning policy. However, A few relevant existing policies are discussed below.

The City of Manhattan's Zoning Regulations establish an Airport Overlay (AO) District. In addition to height restrictions, the AO restricts the following noise-sensitive land uses within the Airport Noise Exposure Zone:

- Prohibited: Residential, manufactured home parks
- Conditional Uses (provided they match the underlying zoning): Hotels, lodging/boarding houses, bed and breakfast, hospitals, nursing homes, retirement complexes, schools, churches, chapels, temples, synagogues, auditoriums, concert halls

Similarly, Riley County's Airport Noise Hazard Zone imposes land-use restrictions, allowing airports, agricultural uses and some commercial and industrial activities – but prohibiting residential uses.

The City's regulations also define Airport zone height limitations, including the areas known as the Conical Zone, the Horizontal Zone, the Precision Instrument Runway Approach Zone, the Runway Larger Than Utility Visual Approach Zone, The Runway Larger Than Utility With A Visibility Minimum Greater Than 3/4 Mile Nonprecision Instrument Approach Zone, Transitional Zones, The Utility Runway Nonprecision Instrument Approach Zone, and the Utility Runway Visual Approach Zone. The Precision Instrument Runway Approach Zone extends 50,000 feet from the primary surface, well over the five miles mentioned in **Objective I-4.**

Airport Compatible Use Permits must be issued for developments to proceed, when applicable. MATS recommends that the jurisdictions of the Urban Area continue to work with MHK to ensure this **Objective I-4** is met.

***Objective I-5:** Support use of MHK as Fort Riley's official Aerial Port of Embarkation (APOE).*

While some occasional military transport operations are handled out of MHK, the majority cannot be handled due to certain infrastructure deficiencies. Forbes Field (FOE) in Topeka, Kansas currently serves as Fort Riley's Aerial Port of Embarkment (APOE) – an air terminal at which troops, units, military-sponsored personnel, unit equipment and material are loaded. A key objective of MHK's Master Plan was to make MHK Fort Riley's APOE. This would be a monumental change for the airport in terms of activity and infrastructure.

The following infrastructure projects would need to be completed in order for MHK to serve as the APOE .

- Widen taxiways associated with Runway 3-21, construct Hot Cargo Pad, and access road to cargo pad.
- Extend Runway 3-21.
- Expand Deployment Ramp (south towards approach end of Runway 3).

MATS recommends that the Urban Area support MHK's efforts in this regard by facilitating the dialogue between MHK and Fort Riley and assisting in the search for funding for the necessary infrastructure improvements.

Table 8-2: MATS Airport Strategy Summary		
Strategy	**Responsible**	**Priority***
Build out the MHK Airport Master Plan.	**Lead:** MHK **Involve:** City Commission, Riley Co Board of Commissioners	3
Support ongoing commercial aviation growth at MHK.	**Lead:** MHK **Involve:** City Commission, Riley Co Board of Commissioners	O
Support general aviation growth at MHK.	**Lead:** MHK **Involve:** City Commission, Riley Co Board of Commissioners	O
Study the establishment of scheduled transit service to MHK, coordinated with commercial flight schedules.	**Lead:** Transit Agency, FHRTA, MHK **Involve:** MHK Riley Co Planning and Development, City Community Development, FHMPO	2
Incorporate adequate, safe pedestrian connections into the design of future drop-off and pick-up areas at MHK	**Lead:** MHK **Involve:** City Public Works, Riley Co Public Works	2
Coordinate to ensure compatible land-use within five miles of MHK.	**Lead:** MHK, City Community Development, Riley County Planning and Development **Involve:** FHMPO, FAA	O
Support efforts to allow MHK to serve as Fort Riley's Aerial Port of Embarkment (APOE) by facilitating dialogue and assisting in search for funding.	**Lead:** MHK, Fort Riley **Involve:** City Community Development, Riley County Planning and Development	3

***1 = Immediate Priority,** to be implemented with MATS adoption or shortly thereafter; **2 = High Priority,** to be initiated as soon as possible and completed within one to two years after MATS adoption; **3 = Moderate Priority,** to be completed within three to five years after MATS adoption; **O = ongoing,** actions that occur continually.*

Appendix A:

Access Management Guidelines

Manhattan Urban Area
Access Management Guidelines

Purpose

Access management can be defined as "the systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections to a roadway."[1] Underlying this definition is the acknowledgement that poorly designed access systems can significantly impact the operation, safety and flow of traffic on the roadway network. This in turn can negatively affect property access, public perceptions, and community character. Inadequate access systems can also require expensive remedial measures. Conversely, good access management can promote safe and efficient traffic flow, facilitate orderly property access, protect the substantial public investment in the street system, and benefit the community at large.

The purpose, therefore, of these Access Management Guidelines are to provide for and manage access to land development, while preserving the regional flow of traffic in terms of safety, capacity, and speed. The guidelines recognize both the right of reasonable access to private property and the right of the citizens of the Urban Area to safe and efficient travel. To achieve this policy intent, the guidelines draws on existing regional and national access management guidelines to set policies and standards.

Applicability

These guidelines apply to all roadways and roadway right-of-ways (public and private) within the Urban Area, as well as to all properties within that boundary that abut these roadways. These guidelines are in addition to other state or local standards and requirements that may be in force on these roadways (such as the 2013 KDOT Access Management Policy).

Conformance with Plans and Policies

The guidelines are intended to implement the plans and policies as set forth in the Manhattan Urban Area Comprehensive Plan and Manhattan Area Transportation Strategy. In addition, they are intended to conform to, support, and supplement policies and plans of KDOT and the Flint Hills Metropolitan Planning Organization (FHMPO).

Conflicts and Revisions

While efforts have been made to ensure that these guidelines do not conflict with the any local municipal codes, subdivision regulations, zoning ordinance, roadway design standards, or other city and county planning and design regulations or documents, there may be occasions where discrepancies between these documents arise. Upon such an occasion, the responsible review agency and/or governing body should determine which document applies. If there are conflicts between the guidelines and the requirements or standards of another agency, the review agency staff will coordinate with staff from the other agency to determine which document applies.

[1] *Transportation Research Board, Access Management Manual, 2003*

Functional Classification for Access Management

In order to apply access management principles effectively, it is important to classify roadways based on their functional and operational characteristics. As discussed in Chapter 6.0 of MATS, the roadways in the MUA have been classified using the seven categories based on the standard Federal Highway Administration (FHWA) categories. As indicated on **Figure A-1**, the higher functional classes emphasize traffic flow, while the lower classes emphasize property access.

- *Freeways and Expressways:* Serve the major portion of trips entering and leaving the urban area, longer intra-city trips, as well as the majority of trips bypassing the central city; provide continuity for Arterials that intercept the urban area boundary. Directional travel lanes are usually separated by some type of physical barrier, and their access and egress points are limited to on- and off-ramp locations or a very limited number of at-grade intersections.
- *Other Principal Arterials:* Serve major centers of metropolitan areas; provide a high degree of mobility.
- *Minor Arterial:* Interconnect and augment with the higher-level Arterial system; provide intra-community continuity and serve intra-city trips of moderate length. May carry local bus routes.
- *Major Collectors:* Distribute and channel trips between Local Streets and Arterials, usually over a distance of greater than three-quarters of a mile. Serve both land access and traffic circulation in higher density residential and commercial/ industrial areas.
- *Minor Collectors:* Distribute and channel trips between Local Roads and Arterials, usually over a distance of less than three-quarters of a mile. Serve both land access and traffic circulation in lower density residential and commercial/ industrial areas.
- *Local:* Serve short travel. Connect to higher functional classes. Often designed to discourage through traffic. Typically do not carry bus routes. Often classified by default; once all Arterial/Collector roadways have been identified, all remaining roadways are classified as Local.

Figure A-1
Roadway Functional Classifications: Serving Mobility vs. Access

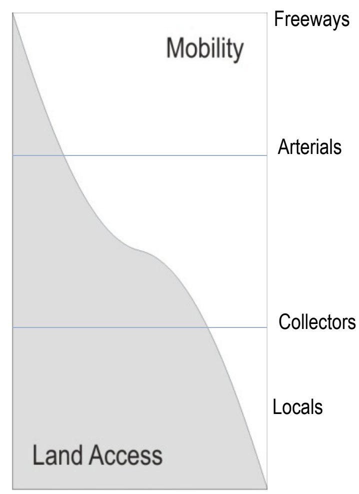
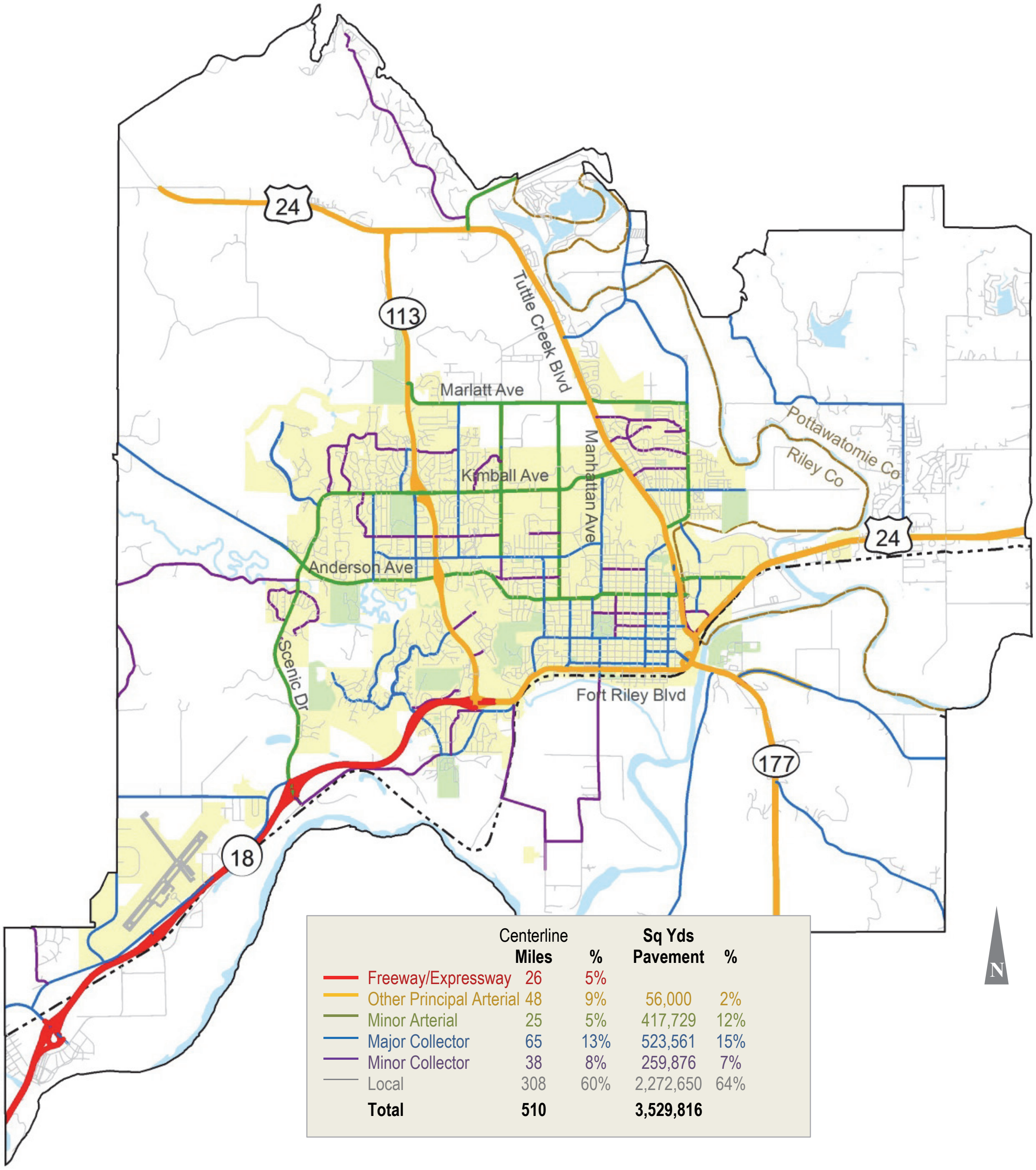


Figure A-2 shows the Urban Area roadway network with the designated roadway classifications.

For purposes of these guidelines, four primary categories are employed: Freeway, Arterial, Collector, and Local. Arterials include both Other Principal and Minor Arterials. Collectors include both Major and Minor Collectors. These guidelines apply to no-state roadways; consult KDOT's Access Management Policy (January 2013) for all state highways.

Figure A-2: Functional Classification of Manhattan Urban Area Roadways



	Centerline Miles	%	Sq Yds Pavement	%
Freeway/Expressway	26	5%		
Other Principal Arterial	48	9%	56,000	2%
Minor Arterial	25	5%	417,729	12%
Major Collector	65	13%	523,561	15%
Minor Collector	38	8%	259,876	7%
Local	308	60%	2,272,650	64%
Total	**510**		**3,529,816**	

Access Near Interchanges and Intersections

It is important in access and roadway design to keep the areas near interchanges and intersections clear of street and driveway connections. Research has demonstrated that the presence of connections within the functional area of an interchange or intersection can negatively impact safety and obstruct the efficient flow of traffic. (Rakha et al, 2008. Zhou, Williams & Farah, 2008.)

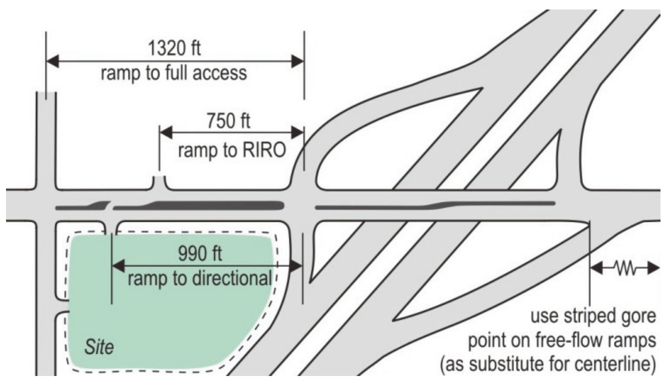
Interchange Functional Areas

The requirements of this section apply to the functional area around an interchange. An interchange functional area is defined as a linear zone extending at least 1,320 feet from the centerline of all ramp intersections as illustrated in **Figure A-3**. An interchange is defined as a location where any grade-separated facility (e.g. K-18 near the airport) is connected to the local street system using ramp connections.

The requirements apply to areas where substantial development has not yet occurred. In situations where it is not possible to achieve the desirable interchange area spacing, the connection spacing distances described later in this document should be used as the minimum standards for a new or modified street or driveway connection or median opening.

Figure A-3 shows the minimum spacing requirements in an interchange functional area. Distances are measured from the extended centerline of the nearest ramp to the centerline of the new or modified access point or median opening. These distances are to facilitate safe and efficient traffic operations including merging, weaving, and storage. The minimum distance from the ramp to the first full-access connection regardless of type is 1,320 feet. The distance between the nearest off-ramp and the first right-in / right-out only connection on the departure from the interchange is 750 feet. Likewise, the distance between the nearest on-ramp and the nearest right-in / right-out connection on the approach to the interchange is 750 feet. If the nearest connection is a directional median opening, then the distance from the nearest ramp should be increased to 990 feet.

Figure A-3:
Minimum Spacing Requirements in an Interchange Functional Area



Where possible, direct property access within an interchange area should be provided by side-streets (typically collector or local roadways) and not the main interchange crossroad. This could include using shared access serving multiple properties as described later in this document.

Intersection Functional Areas

According to AASHTO's *A Policy on Geometric Design of Highways and Streets*, "Ideally, driveways should not be situated within the functional area of an intersection." (AASHTO, 2004, p. 558) Access points located within this functional area can have a significant negative impact on both traffic flow and safety. In order to decrease the probability of crashes and to maintain efficient traffic flow, new or modified access points (streets, driveways, and median openings) should not be located inside intersection functional areas.

The functional area of an intersection is the area both upstream and downstream from an intersection that is influenced by slowing, stopped, turning, merging, or accelerating vehicles. **Figure A-4** illustrates the intersection functional area. As shown, the upstream functional area is typically larger than the downstream area

Figure A-4: Intersection Functional Areas

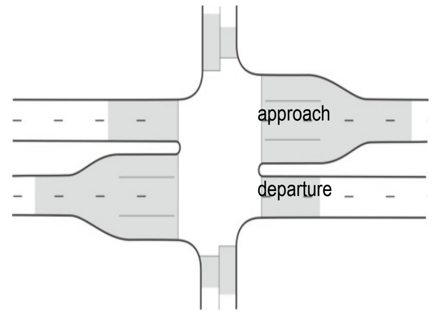
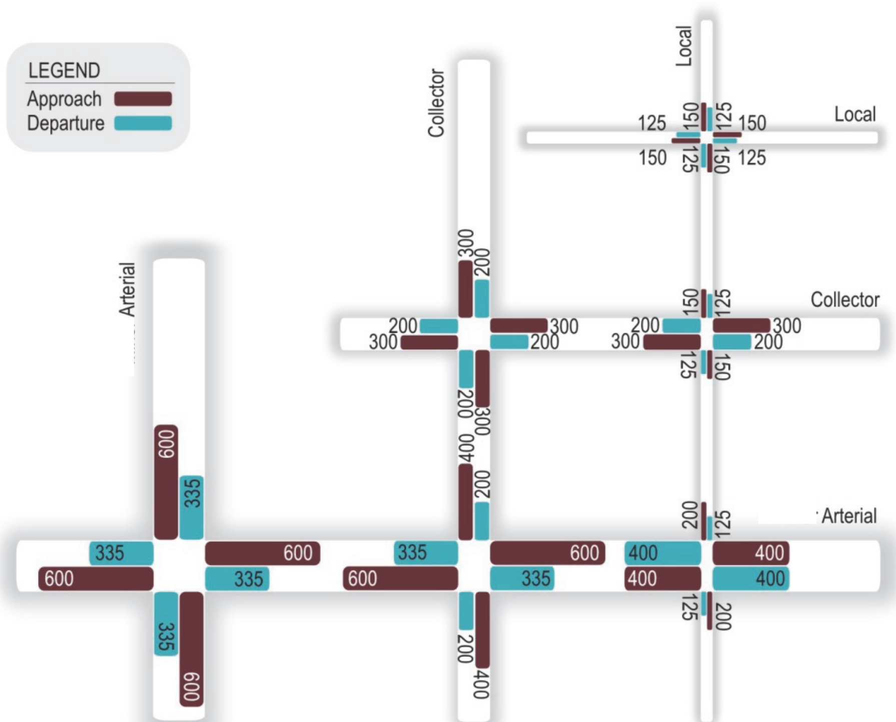


Figure A-5 presents approximate approach and departure functional areas for the various intersection combinations in the Urban Area. These values should be used to guide access connection planning. However, in some cases it may be necessary to prepare a more detailed analysis of the functional area – for example, where speeds differ from the assumptions shown in **Figure A-5**. This additional analysis may be initiated by an applicant, or it may be required by agency staff. The Access Management Manual, 2nd Ed. (TRB, 2014) and other similar documents should be consulted for appropriate methods.

Figure A-5: Typical Lengths of Intersection Functional Areas



Notes: The lengths presented in the above figure are based on urban conditions with the following assumed speeds: minor arterial – 40 mph, collector – 30mph, and local – 20 mph. Other assumptions are as outlined in TRB's Access Management Manual (2003) Tables 8-3 and 10-2. Assumed queues range from 25ft to 200ft depending on the intersection. The distances shown for local streets intersecting other local streets do not apply to single family residential driveways. Additional analysis of functional areas may be initiated by a project applicant or required by agency staff.

Street and Connection Spacing Requirements

Recent research has verified that adequate spacing between access points significantly benefits traffic safety as well as traffic flow and operations on the local street system. This includes not just avoiding intersection functional areas, but appropriate and uniform spacing for major intersections, especially signalized intersections. Key factors to consider in regards to connection spacing include:

- Avoid interchange and intersection functional areas to limit conflicts and maintain capacity
- Establish appropriate and uniform spacing to promote consistent and suitable traffic flows and speeds
- Reduce the overall frequency of access points to limit conflicts and improve safety
- Maintain safe distances between access points to provide appropriate stopping, intersection, and decision sight distances.

All new or modified street and access connections in the Urban Area should meet or exceed the minimum connection spacing requirements shown in Table A-1. Connection spacing shown on the table should be measured from centerline to centerline. These standards are in addition to the requirement to avoid new connections in intersection functional areas. As discussed later in this document, shared-use driveways should be used when necessary to meet the spacing requirements. Traffic signal spacing requirements are discussed further later in this document.

The spacing requirements are not intended to constrain infill or small site developments or redevelopments. In these cases it may be appropriate to reduce the requirements based on existing site and street constraints and an engineering analysis demonstrating that the connection will function adequately and safely.

Table A-1: Minimum Street and Access Connection Spacing

Functional Class	Median Treatment	Connection Spacing, ft*		Median Opening spacing, ft		Min. Signal Spacing, ft
		≤45 mph	>45 mph	Directional	Full	
Arterial	Median is Desirable	440	660	660	1,320	1,320
Major Collector	Varies	330	440	330	660	660
Minor Collector	Typically No Median	330	--	--	--	--
Local**	Typically No Median	150	--	--	--	--

* applies to roadways, driveways, and any other connections to public roadways

** this spacing requirement does not apply to individual driveways on local residential streets.

Traffic Signal Installation and Spacing

The spacing of traffic signals influences traffic capacity, speed, safety, air pollution, and progression along a roadway. The most efficient and safe signalized corridors typically have long and uniform signal spacing. Uniform signal spacing of ½ mile has been determined to provide efficient operations at speeds of 35 mph to 45 mph, therefore this is recommended as the preferred distance for new installations. Reduced distances may be determined to be acceptable based on engineering studies.

The installation of a traffic signal in the Urban Area should meet the following requirements.

- The intersection should meet one or more of the signal warrants in the Manual on Uniform Traffic Control Devices (MUTCD). As stated in the MUTCD, use of the peak hour warrant should be limited only to "unusual cases".

- Warrants should be based on existing traffic volumes or existing plus proposed development volumes with the approval of the reviewing agency.

Table A-2: Traffic Signal Spacing (New Installations)

	Distance (ft)	
Classification	Preferred	Minimum
Arterial	2,640	1,320
Collector	1,320	660
Local (All)	1,320	660

Table A-2 defines the spacing guidelines for new traffic signals in the Urban Area. The preferred spacing should be pursued in all new street and access point construction. However, if the preferred signal spacing cannot be achieved, then the reviewing agency may adjust the requirement if determined to be appropriate. An engineering study could be used to make this determination. Furthermore, if *minimum* signal spacing cannot be achieved, an engineering study should be completed prior to making a determination as to whether the requirement can be adjusted. The engineering study must be provided to demonstrate the need for, and acceptability of, the lower standard. This will include documenting that the traffic signal will not degrade traffic conditions (current or future operations and safety) below acceptable levels. The installation of a traffic signal (and any study of a potential signal location) should take into account possible future signals in the vicinity of the intersection, such that the build-out land-use and traffic condition will not require signals spaced more closely than the minimum distances specified in **Table A-2** (unless adjusted as described above).

Medians

The three primary median types on street systems include restrictive (raised or depressed) medians, painted medians, and two-way left-turn lane medians. Medians are an important and effective method for managing street access and can improve both roadway safety and traffic flow. In particular, raised medians can be essential to controlling access on higher functional class facilities (i.e. principal and minor arterials). The presence of medians affects both the types and frequency of access that can be allowed on roadways. Undivided multi-lane roadways are discouraged.

Restrictive Medians – Installation and Standards

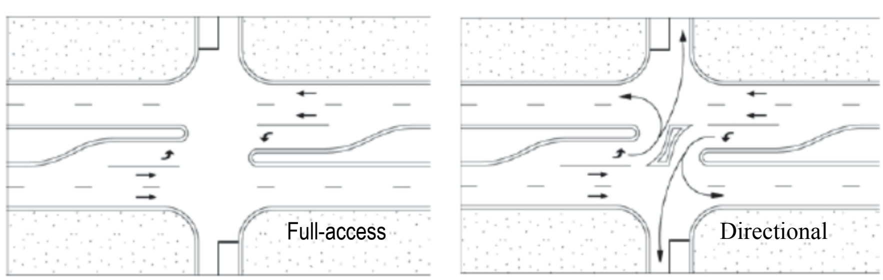
Restrictive medians should be installed on streets in the Urban Area in accordance with the following guidelines:

- On all new or widened arterial streets.
- On four-lane streets where existing daily traffic volumes exceed 24,000. Between 17,500 and 24,000 ADT, an evaluation should be prepared. Where future daily traffic projections (for build-out conditions) exceed these thresholds, the roadway and access should be designed to accommodate the future installation of a raised median, including reserving right-of-way, identifying potential median opening locations, and employing a 16-foot center turn lane (to allow for future 12-foot turn lanes plus four-foot median separation at intersections).
- On multi-lane streets with posted speed limits of 45 MPH or above.
- Adjacent to left-turn lanes at signalized intersections (existing or planned signal locations) where access connections are present within the intersection functional area (although, in accordance with other sections of this code, such access connections should be eliminated where possible).
- Adjacent to dual left-turn lanes.
- On multi-lane roadways (two or more through lanes in each direction) within the functional area of an interchange.
- On streets with three or more through lanes in each direction.

Median Openings Types and Installation Requirements

Median openings are designed to allow one or more left-turn movements across a restrictive median. They can be full-access openings or directional (left-in only) openings as shown in **Figure A-6**. Left-turn lanes are required at all new or modified median openings.

Figure A-6: Median Openings



Regardless of type, the spacing of new or modified median openings should conform to the functional area, connection spacing, and traffic signal spacing requirements outlined previously. They should only be constructed where they meet the minimum connection spacing requirements, avoid intersection and interchange functional areas, provide adequate sight distance, provide adequate left-turn storage and deceleration length, and meet any other necessary design requirements or guidelines. An engineering study should be provided to support the location of a new or modified median opening.

Continuous Two-Way Left-Turn Lanes – Installation and Standards

The use of continuous two-way left-turn (TWLT) lanes should be considered based on the following guidelines.

- TWLT lanes can be used on a roadway when an engineering study shows that they will be effective in maintaining adequate traffic flow, while providing safe property access.
- TWLT lanes should be considered on streets with numerous access points and high left-turn volumes – on two-lane roads, where daily traffic exceeds 8,000, and on four-lane roads, where daily traffic exceeds 17,500. (Consult NCHRP 395 for further guidance.)
- Prior to construction of a TWLT, every effort should be made to eliminate as many access points as possible.

U-Turns

With the construction of medians with adequately spaced median openings on major streets in the Urban Area, the importance of U-turns will increase. U-turns are employed in many communities where good access management is in place. Streets with medians should be designed such that U-turns can be completed at full and directional median openings when there are no operational or safety restrictions that would limit such movements. Providing for U-turns includes widening the receiving side of the street and/or median itself such that a U-turn can be made by an appropriate design vehicle.

Auxiliary Lanes

The provision of auxiliary turn lanes at intersections and driveways is essential to the safe and efficient flow of traffic on the local roadway system. Left- and right-turn lanes allow vehicles to slow and queue without undue disruption to the through vehicles in the traffic stream. In particular, this helps reduce the speed differential between through and turning vehicles until the turning vehicles are safely in the turn lane. Turn lanes also increase intersection capacity and facilitate safe turning movements even at large heavily traveled intersections.

Left-Turn Lane Requirements

Left-turn lanes should be provided in the following locations and conditions:

- Approaches to all new connection points on arterial streets;
- Approaches to signalized (or possible future signalized) arterial or collector intersections;
- Arterial street approaches to intersections with other arterial and collector streets;
- New connections intersecting with arterial streets (where left-turn egress is permitted);
- Median openings on roadways with medians;
- Collector streets at the intersection with a connection serving non-residential development;

Possible future dual left-turn lane configurations should be planned for at all arterial/arterial intersections.

In addition, left-turn lanes (including dual left-turn lanes) should be provided where an engineering study indicates that they are needed for safety, access, or traffic operations. If a left-turn lane required above is to be omitted, an engineering study must show that its elimination will not negatively impact traffic safety and operations.

The minimum length of a left-turn lane should be 250 feet plus taper on an arterial street intersecting another arterial street and 200 feet plus taper at other locations. Taper lengths should conform to agency design standards. The length of the left-turn lane should be increased as necessary to accommodate estimated queue length based on standard traffic-engineering queue calculations. Continuous two-way left turn lanes may be used in lieu of individual left-turn lanes where permitted.

Right-Turn Lane Requirements

Right-turn lanes should be provided in the following locations and conditions:

- On arterials at all new intersections or connection points. The required length should be determined by an engineering study. If, in the judgment of the reviewing agency, the required length is not feasible, minimum lengths should be:
  - 250 feet plus taper at arterial/arterial intersections
  - 150 feet plus taper at other locations
- On collector streets in non-residential areas at the intersection with any street or driveway where the right-turn volume on the collector street is or is projected to be at least 100 vehicles during any one hour. The minimum length should be 100 feet plus taper.

Taper lengths should be determined by agency design standards. The design length of the right-turn lane at intersections controlled by traffic signals should be based on the longer of the queues in the turn lane or the adjacent through lane. The estimated queue length should be based on 20-year traffic volume projections. Turn lane lengths should be measured from the end of the taper to the start of the curb return for the access point.

Roadway Network Planning Requirements

Roadway network planning is essential to a successful access management program. The following items outline some of the agency's and developer's responsibilities in planning for and implementing a safe and effective roadway network in the Urban Area.

- The Manhattan Urban Area Comprehensive Plan (MUACP) and the Manhattan Area Transportation Strategy (MATS) together serve as the overall blueprint for roadway planning in the Urban Area. These documents plan potential new arterials and collectors based on the information available at the time they are drafted, revised, or amended.

- Prior to the approval of any new development, the reviewing agency should develop a conceptual collector street system for the area bounded by the section line roads containing the development based on the MUACP and MATS. Consideration should also be given to existing or planned connections and collector streets in adjacent sections, existing property lines and topographic features.

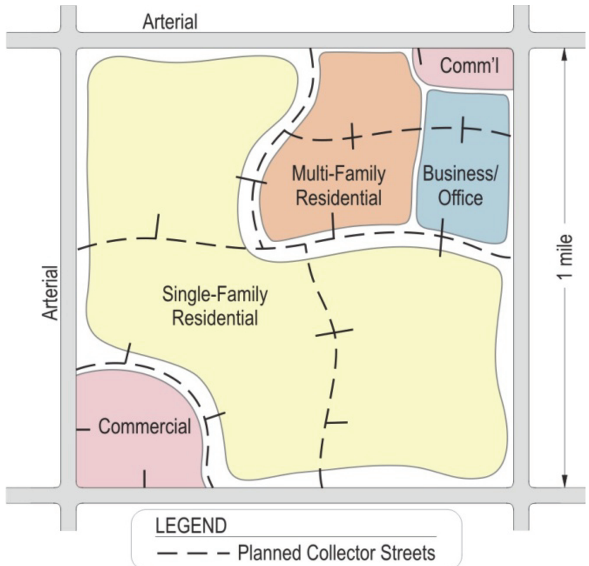
- A development plan may propose modifications or alternatives to the conceptual collector street system described above, as long as the principles described above are followed. Within exclusively residential areas, continuous collector streets are desirable, but not essential. In these areas, a less-defined collector system may be utilized, but should provide connectivity between developments and relatively direct access to the designated collector street connections to the arterial street system (note that access at other connections to the arterial street system may be restricted per this policy).

- Collector streets can serve both residential and commercial land-uses, but they should be planned to discourage commercial traffic intrusion into residential areas per MATS principles.

- Collector streets should connect to arterial streets at full median opening locations in accordance with the parameters of this document. Where feasible, the connection should also be made at a location suitable for a future traffic signal installation.

An example of a collector street network is shown in **Figure A-7**. Any new development(s) along an arterial street should be part of a network of on and off-site connections and roadways to allow for movement between destinations without using the arterial street network. Limiting short trips on the roadway network decreases congestion on the network.

Figure A-7: Collector Street Network



Subdivision and Land Development Access Guidelines

The purpose of this section is to describe land development strategies that promote the access management goals defined in this document.

Creation of New Lots

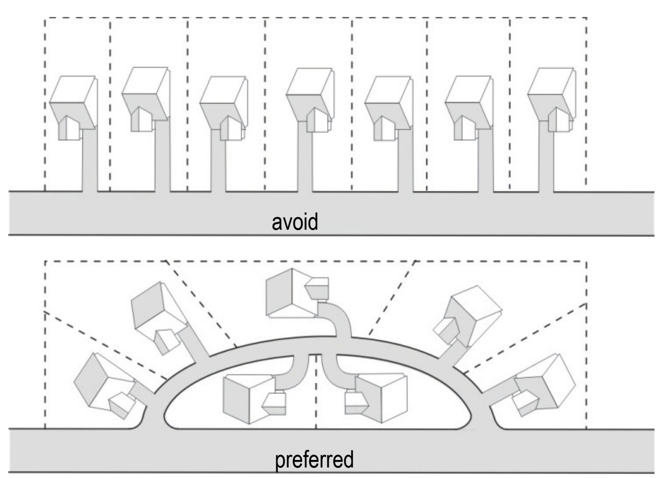
Subdivision of lots that would result in situations that would potentially conflict with the provisions of these guidelines should be discouraged. For example, configurations such as the flag lot development shown in **Figure A-8** should be discouraged.

Figure A-8: Avoidance of Flag Lots

Subdivision Access

- When a subdivision is proposed that would abut or contain an arterial or collector street, it should be designed to provide lots along the arterial or collector with access from an interior local street. **Figure A-9** contrasts an undesirable configuration with a desirable one.
- Direct residential driveway access to individual one-family and two-family dwellings should be prohibited on any arterial or collector street, unless approved by the reviewing agency.
- Residential corner lots should obtain access from the street with the lower functional classification, and access should be placed as far from the intersection as possible to achieve the maximum available corner clearance.

Figure A-9: Indirect Access to Arterial or Collector



Connectivity of Supporting Streets

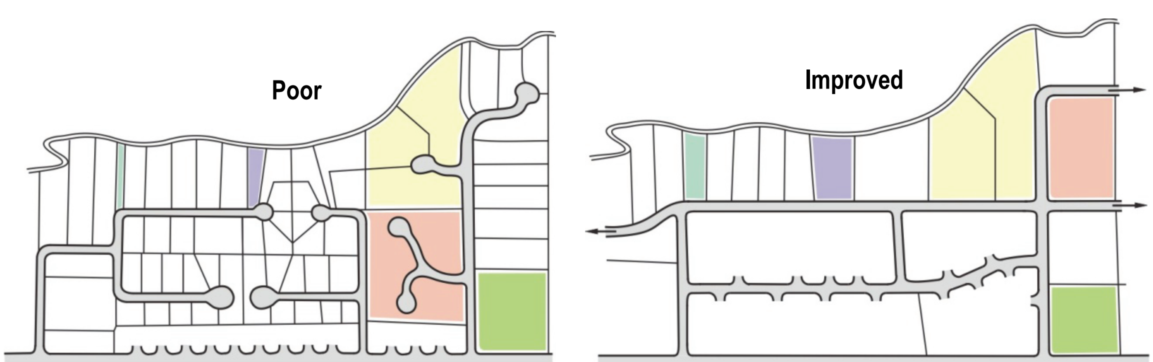
As the Urban Area continues to grow and land is subdivided for development, it will be essential to provide a balanced network of local and collector streets to avoid traffic congestion on major arterial roadways. Without a supporting street system, all local trips are forced onto a few major streets, resulting in significant traffic delays and driver frustration.

Reasonable connectivity of the local street network is also important. Fragmented street systems impede emergency access and increase the number and length of individual trips. Residential street systems should be designed in a manner that discourages "through" traffic, without eliminating connectivity. To accomplish these objectives, the following should apply:

- New residential subdivisions should be designed to coordinate with existing, proposed and anticipated streets.
- New developments should be designed to discourage the use of local streets by non-local traffic while maintaining the connectivity with the surrounding system of roadways. This may be accomplished through the use of modified grid systems, T-intersections, roadway jogs, or other appropriate traffic calming or roadway design measures.
- Proposed streets should be extended to the boundary lines of the proposed development where such an extension would connect with streets in another existing, platted or planned development. The extension or connection should be based upon traffic circulation or public safety issues and compatibility of adjacent land uses.
- When a proposed development abuts unplatted land or a future development phase of the same development, stub streets should be provided to allow future access to abutting properties or to logically extend the street system into the surrounding areas. All street stubs serving more or other than two residential units should be provided with a temporary turn-around or cul-de-sac, and the restoration and extension of the street would be the responsibility of any future developer of the abutting land. The ends of these street stubs should be clearly and prominently signed "Future Street Extension".

Figure A-10 illustrates ways in which development and street layouts can be designed to improve connectivity while achieving the above goals.

Figure A-10: Street Connectivity



- Walking, bicycling, transit use impeded
- Local trips on major roads increased
- Properties cannot be developed properly

- Local trips shortened
- Multimodal mobility improved
- Local mobility enhanced
- Internal site access opportunities increased

Unified Access and Circulation

Internal connections between neighboring properties and shared driveways allow vehicles to circulate from one business or development to the next without having to reenter a major roadway. Unified access and circulation improves the overall ease of access to development and reduces the need for individual driveways. The purpose of this section is to describe and facilitate unified access and circulation systems, especially for commercial development.

In order to limit the number of access points and short trips along an arterial, parcels should have shared and/or joint and cross access to and from their properties. Developments should have proper site designs that allow for movement between different trip destinations without forcing the traveler on to the main roadway network. Individual "strip" development(s) are discouraged if a supporting road network is absent. Developments with multiple destinations should have internal access to one another. Neighboring parcels with driveways that could reasonably be shared (as determined by the reviewing agency) should share access points.

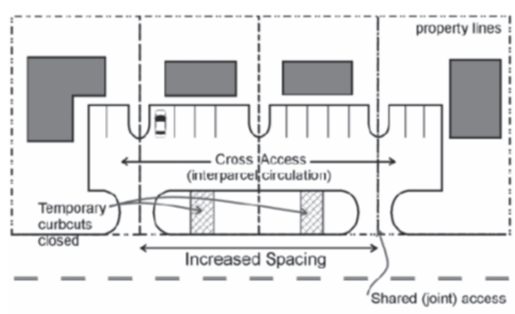
Outparcels and Shopping Center Access

Unified access and circulation plans should be prepared for all development sites that consist of more than one building site. This applies to sites with one owner as well as sites with multiple owners that are consolidated for the purposes of development. In addition:

- The number of connections should be the minimum number necessary to provide reasonable access to the overall development and not the maximum available for the development's frontage.
- Direct outparcel access should be provided from the development's interior roadways and aisles and not from the development's external frontage.
- All necessary easements and agreements should be recorded in an instrument that runs with the deed to the property, and/or included as a part of the subdivision plat.
- Unified access for abutting properties under different ownership and not part of an overall development plan should be addressed through the Joint and Cross Access provisions below.

Joint and Cross Access

Joint and cross access policies promote connections between major developments, as well as between smaller businesses along a corridor. These policies help to achieve unified access and circulation systems for individual developments under separate ownership that could not otherwise meet access spacing standards or that would benefit from interconnection, e.g., adjacent shopping centers or office parks that abut shopping centers and restaurants.



Adjacent commercial or office properties and major traffic generators, e.g. shopping plazas, should provide a cross-access drive and pedestrian accessway to allow circulation between adjacent properties. This also applies to a building site that abuts an existing developed property, unless the reviewing agency finds that this would be impractical.

To promote efficient circulation between smaller development sites, the reviewing agency may require dedication of a 30-foot easement that extends to the edges of the property lines of the development site under consideration to provide for the development of a service road system. The service road should be of sufficient width to accommodate two-way travel aisles and incorporate stub-outs and other design features that make it visually obvious that abutting properties may be tied in to it. Abutting properties should be required to continue the service road as they develop or redevelop in accordance with the requirements of this policy. The easement may be provided to the front or rear of the site or across the site where it connects to a public roadway.

Property owners should record all necessary easements and agreements, including an easement allowing cross access to and from the adjacent properties, an agreement to close driveways provided for access in the interim after construction of the joint use driveway(s) or service road system, and a joint maintenance agreement defining maintenance responsibilities of property owners that share the joint-use driveway and cross-access system.

Joint and cross access requirements may be waived when, in the reviewing agency's judgment, such a waiver is warranted. Instances in which a waiver may be warranted include incompatible uses (e.g., a gas station next to a child care center), or major physical constraints (e.g., significant change in grade between properties).

Redevelopment Application

These access management guidelines are not directed at existing access along existing roadways. Existing access connections are "grandfathered" in based on the requirements in place when they were constructed. This protects the existing property owners' rights and recognizes the expense of bringing non-conforming properties into conformity. However, the goal of this document is to bring the roadway system into compliance over time. Properties with access connections not meeting these guidelines should be brought into alignment with the guidelines to the maximum extent possible when one or more of the following conditions occur.

- When the roadway with the access connections is modified.
- When a new access connection is requested or required.
- When a preliminary and/or final development plan is required.
- When a proposed redevelopment, in comparison to the existing use, is forecasted to experience an increase of 50 trips or more, as determined by one of the following methods:
  - An estimation based on the ITE Trip Generation manual (latest edition) for typical land uses, or
  - Traffic counts made at similar traffic generators in the metropolitan area, or
  - Traffic counts conducted during the peak hour of adjacent roadway traffic for the property.
- When principal activity is discontinued for a period of a year or more, or construction has not been initiated for a previously approved development plan within a period of one year from the date of approval.

Driveway Connection Geometry

The design of driveways is important in access management in that it affects the speed of traffic turning into and out of driveways. This in turn affects the speed differential between through traffic and turning traffic where auxiliary turning lanes are not provided. Large speed differentials are created where driveways are inadequately designed, and these higher speed differentials are associated with higher crash rates and diminished traffic operations. (Generally, this section is not relevant to single-family residences and duplexes.)

Another critical aspect of the driveway or connection design is the potential for traffic operations on private property to become congested and spill or queue back onto a public street. Adequate separation of internal conflict points from the public street is necessary to eliminate or diminish this potential. Driveway designs should always be based on the results of a study of the traffic likely to use them.

Lining Up Driveways Across Roadways: Driveways should align with driveways across the roadway on roadways without nontraversable medians or should be offset as described in the connection spacing standards.

Angle of Intersection to the Public Roadway: Driveways that serve two-way traffic should have angles of intersection with the public street of 90 degrees or very near 90 degrees. The minimum acceptable angle for driveways that serve two-way traffic is 80 degrees. Driveways that serve one-way traffic may have an acute angular placement of from 60 to 90 degrees.

Corner Radius: The corner radius at intersections should be large enough to allow inbound vehicles to enter at a reasonable rate of speed. The agency's design standards and specifications should be consulted for minimum corner radii. Larger approach radii are allowable for driveways; however, the impact on lane definition, the view angle of right-turning traffic to see cross-traffic, and the impact on pedestrian crossing times should all be considered. Corner radii of greater than 75 feet should not be used.

Driveway Width: Driveway widths should conform to the agency's design standards. Commercial and industrial driveways should be curbed. Parking lots and driveways leading to or connecting with parking lots should also be curbed.

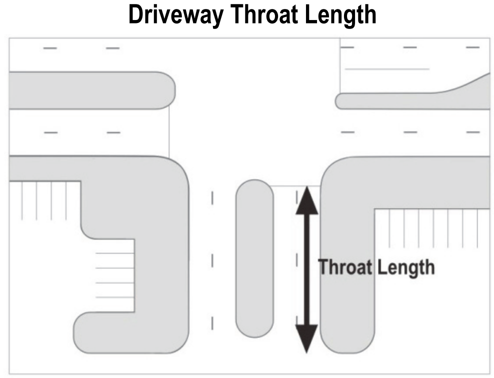
Accommodation of Pedestrians: Driveways should adequately accommodate pedestrians using sidewalks or paths. Crosswalk and ramp locations should be placed to balance the pedestrian crossing distance and the width of the intersection for vehicular traffic (typically this is at about the center point of the corner radius). Crosswalks should not be placed where pedestrians would likely have to cross behind or between stopped vehicles, except at roundabouts and "pork chop" right-turn islands. Where four or more driveway lanes are created, they should be designed so that pedestrians have a refuge between the entering and exiting traffic.

Accommodation of Bicycles: Where a new driveway crosses a bicycle facility (such as a dedicated bike path or an on-street bike lane), the driveway should be designed so as to accommodate the safe crossing of bicyclists. Likewise, when a new bicycle facility is built that crosses existing driveways, the bicycle facility should be designed with safe crossings in mind.

Driveway Throat Length: The throat length should minimize or eliminate the condition where inbound traffic queues back onto a public street (see **Figure A-11**). The throat length also provides a place for exiting vehicles to queue, better definition of the driving lanes, and separation between the parking area and the adjacent street. Driveway throat lengths should meet the following requirements and should be based on the ultimate public street section anticipated:

- Driveways should provide at least 50 feet of throat length adjacent to local streets and 100 feet adjacent to collector and arterial streets.
- For driveways serving between 100 and 400 vehicles in the peak hour (two-way traffic volumes) the driveways should provide at least 150 feet of throat length.
- For driveways serving over 400 vehicles per hour (two-way traffic volume) and for all driveways controlled by a traffic signal, adequate throat length should be determined by a transportation impact study.
- For driveways serving extremely low volumes (10 vehicles or fewer in the peak hours) on streets with low volumes (fewer than 100 vehicles existing or projected in any hour) and low speeds (25 miles per hour speed limit), a throat depth of 30 feet may be permitted at the review agency's discretion.

Figure A-11:
Driveway Throat Length



Turning Radius: The path that a vehicle follows when turning left to or from a cross street or drive is defined as the turning radius. This path should be a continuous, smooth curve from the stopping point e.g. the stop line, the end of the median nose, or the location the vehicle typically waits to make a left turn, to beyond the farthest conflicting travel lane. Left-turning drivers should not have to pull out straight into the intersection and then begin the turn maneuver. The minimum recommended turning radii are as follows (reckoned from the left side of the car):

- For low-volume drives or streets (less than 100 vehicles in the peak hour) serving primarily passenger cars, 40 feet minimum.
- For dual left-turn movements, 75 feet minimum (for the inner left-turn movement).
- For all other situations, 60 feet minimum.
- Opposing left-turn movements, e.g. eastbound left turns and westbound left turns, at the same intersection should provide at least 10 feet of separation between the outside edges of the two turning paths.

Sight Distance: All driveways should be designed with adequate intersection sight distance and sight triangles as defined by AASHTO.

Exceptions

Flexibility is essential when administering access spacing requirements, in order to balance access management objectives with the needs and constraints of a development site. The following administrative procedures are intended to provide flexibility, while maintaining a fair, equitable and consistent process for access management decisions. The processes described below apply to all of the guidelines in this document.

Requests for Modification: Requests for modifications (access proposals that do not meet the guidelines) should be approved by the appropriate Public Works Department. Public Works may reduce the connection, median opening, signal, and roadway spacing requirements by up to 10 percent or 100 feet (whichever is less) where it is impractical to meet the guidelines, except where explicitly prohibited by the guidelines. Modifications greater than these require documentation justifying the need for the modification and an access management plan for the site that includes site frontage plus the distance of connection spacing standards from either side of the property lines. The analysis should address existing and future access for study area properties, evaluate impacts of the proposed plan versus impacts of adherence to standards, and include improvements and recommendations necessary to implement the proposed plan.

Waivers: Where the existing configuration of properties and driveways in the vicinity of the subject site precludes spacing of a connection in accordance with the spacing guidelines, Public Works, in consultation with appropriate agency departments, may waive the spacing requirement if the following conditions have been met:

- No other reasonable access to the property is available.
- The connection does not create a potential safety or operational problem as determined by Public Works based on a review of a transportation impact study prepared by the applicant's professional engineer.

An access connection along the property line farthest from the intersection may be allowed. The construction of a median may be required on the street to restrict movements to right-in/right-out, and only one drive should be permitted along the roadway having the higher functional classification. Joint access should be considered with the property adjacent to the farthest property line. In these cases:

- A joint-use driveway with cross-access easements should be established to serve two abutting building sites,
- The building site should be designed to provide cross access and unified circulation with abutting sites; and

- The property owner agrees to close any pre-existing curb cuts after the construction of both sides of the joint use driveway.

Temporary Access: A development that cannot meet the connection spacing guidelines and has no reasonable alternative means of access to the public road system may be allowed a temporary connection. When adjoining parcels develop that can provide joint or cross access, the property owner should coordinate the new connection and ultimately remove the temporary access. Conditions for temporary access should include, but not be limited to, the following:

- Applicants sign an agreement to participate in any future project to consolidate access points.
- Applicants sign an agreement to abandon the interim or temporary access when adequate alternative access becomes available.
- The transportation impact study should consider both the temporary and final access/circulation plan (from both operational and safety standpoints).

A limit may be placed on the development intensity of small corner properties with inadequate corner clearance, until alternative access becomes available.

Glossary

AASHTO: American Association of State Highway and Transportation Officials

Access Point: See definition for connection.

ADT: Average Daily Traffic. The average number of vehicle trips generated over a specific time period.

Connection: Any street or driveway intersection with a public street. It also includes median openings on public streets.

Driveway throat: The portion of the driveway extending back from the public street, uninterrupted by any internal site access points (through physical prohibition by raised islands).

FHWA: Federal Highway Administration

Flag lots: Lots created such that each parcel has access to the main roadway instead of the preferred method where the parcels would connect on a private drive or local roadway.

KDOT: Kansas Department of Transportation

LOS: Level of service. A measure of effectiveness that determines the quality of service on transportation infrastructure.

Outparcels: Lots on the perimeter of a larger parcel that break its frontage along a roadway. They are often created along arterial street frontage of shopping center sites, and leased or sold separately to businesses that desire the visibility of major street locations.

Queue: A line of vehicles.

Trip Generation: Prediction of the amount of traffic originating from a particular location.

V/C: The ratio of demand flow rates to capacity for a given type of transportation facility.

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Appendix B:

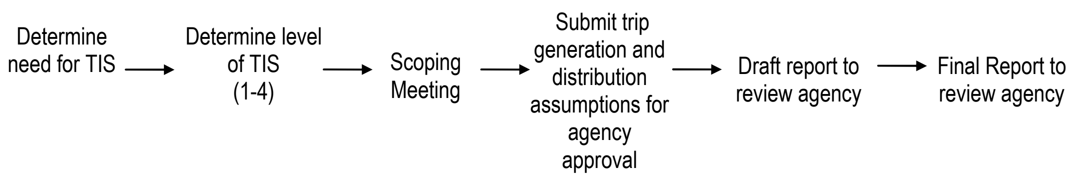
Transportation Impact Study Guidelines

Transportation Impact Study (TIS) Requirements – Manhattan Urban Area

The purpose of this document is to clearly outline the minimum requirements for a TIS prepared as part of the land development approval process in the Manhattan Urban Area. A TIS identifies and quantifies the potential impacts of site development on the local and regional transportation system and specifies the measures necessary to mitigate those impacts. Any deviations from the guidance herein must be approved by the review agency.

The general process for scoping and preparing a TIS is outlined in **Figure B-1**. Submittal timeline requirements will vary by review agency. The subsequent sections present more detailed information on the TIS preparation requirements.

Figure B-1: TIS Process Flow Chart



B.1 TIS Triggers and Scope

The following situations will require a TIS:

- A currently undeveloped property proposed for development and/or rezoning.
- A currently developed property proposed for expansion, intensification, or redevelopment – to a level that requires agency approval.
- A previously approved project in either category above that has not been developed within time-frames specified in this section and is re-starting.

The final determination of whether a TIS is required will be made by the review agency.

The scope of the TIS for a proposed development is gauged by the amount of new automobile traffic trips the development, redevelopment, or expansion is expected to add to the roadway system. This document establishes four Levels of TIS, depending on the magnitude of traffic generated – as shown in **Table B-1**. The review agency can request a TIS and/or modify the scope requirements of a TIS based on local conditions and knowledge.

Table B-1: Traffic Impact Study Levels	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Criteria				
Projected net new peak-hour automobile trips generated by project	20-99	100 – 499	≥500	≥500
Proposed land-use deviates from Manhattan Urban Area Comprehensive Plan?	n.a.	n.a.	No	Yes
Requirements				
Connectivity and circulation review, trip generation estimates, access management review	✓	✓	✓	✓
Multimodal Impact Analysis				
Existing, Opening Day		✓	✓	✓
20 years (No Project)				✓
20 Years (With Project)			✓	✓

Scoping Meeting. The review agency must approve the scope of work and technical approach. At the outset of the TIS, the applicant (or authorized representative) should hold a scoping meeting to determine the scope of work. The **Scoping Meeting Checklist**, provided at the end of this appendix, should be filled out. The Checklist has been developed to ensure that all potential scope elements are discussed in the scoping meeting, and that agreement will be reached regarding which transportation modes are to be studied, and in what level of detail. **For most studies, many of the elements in the Checklist will not be needed** – but this format gives the review agency the ability to draw in almost any element that could be needed. Each item that will be part of the TIS, and other study specifics (study intersection list, peak hours, clarifications, what data the review agency or other agencies can provide, etc.) should be attached on a separate sheet. The discussion on pages B-5 and following provides guidelines for each step and element of the checklist.

Horizon Years. Study horizon years are associated with each TIS Level in **Table B-1**. Note that 20-year analyses, which should use the FHMPO travel-demand model and other available sources, are required for Levels 3 and 4. Level 3 analysis does not require a "No Project" scenario – it is treated as a cumulative analysis. In contrast, Level 4 analysis requires comparison of conditions with and without the project – a true long-term impact analysis.

Phased Projects. If a large project (expected to generate more than 500 peak-hour automobile trips) is phased, the opening day for each major phase should be studied as well as the build-out. For later-year phases, an updated TIS will be required if the original study is more than two years old; unless the applicant can demonstrate that the nature of the proposed development, and the near-term and long-term forecasted background transportation conditions, have not changed substantially, with concurrence from the review agency.

Study Area. For Level 1 studies, the study area contains the site and its bounding transportation infrastructure (streets, trails, etc.). For all other Levels: at a minimum, the study area should contain roadways extending in all directions from the site to the nearest arterial or collector intersection. As a rule of thumb, all intersections experiencing an increase of 50 or more vehicles during any peak hour as a result of the project should be studied – within a reasonable distance of the project. The review agency should make the final determination of what study area is reasonable.

Data Collection. The applicant is responsible for collecting all of the required transportation data. The applicant should confer with review agency staff, and the staff of other agencies (such as FHMPO and the transit agency, as appropriate) regarding available transportation data in the agency's possession.

Responsibility and Qualifications. It is the applicant's responsibility to prepare the TIS. The individual preparing the TIS must be a registered engineer in the state of Kansas, qualified and experienced in preparing a TIS. The review agency will make the final determination as to whether a particular individual is qualified, and will provide a reviewer meeting the same qualification criteria.

Submittal Requirements. TIS reports should generally follow a consistent outline (**See Section B.2**). Alternate formats must be approved by the review agency prior to submittal. A minimum of two copies of a draft report should be submitted to the review agency. After the applicant receives the review agency's comments, a minimum of two copies of a final report should be submitted to the review agency. The report should contain, in Appendices, detailed calculations supporting the main body of the report, such as intersection LOS analysis.

B.2 TIS Report Outline

The TIS should be prepared according to generally acceptable professional practice and should address the study elements listed below. The reviewing agency must approve all major assumptions. The TIS should provide sufficient text, maps, graphics, and tables to describe the study findings and recommendations.

Executive Summary: This section should summarize key findings of the TIS, including the identified impacts and proposed mitigation.

Introduction and Study Scope: This section should explain the context of the TIS and the scope of the work.

Existing Conditions: The TIS should document existing transportation conditions – covering the Scoping Checklist's infrastructure/service inventory, existing demand/usage, safety issues, and operational performance.

Project Description: This section should provide the following information:

- Proposed site location, layout, access (motorized and non-motorized), land-uses, and development phasing
- Existing site access (motorized and non-motorized), land-uses (types, intensities, building arrangement), and parking
- Information on nearby parcels' access and land-use, and their relationship to the proposed project

Opening Day Conditions (No Project): The TIS should present the background transportation conditions on the assumed opening day. This includes any changes in transportation infrastructure, service, demand, safety, or operational performance anticipated to take place between the existing conditions and opening day – for each mode identified on the Scoping Meeting Checklist. If opening day is within one year of existing conditions, and no substantial changes are expected during that time-frame, existing conditions can be used for Opening Day.

Opening Day Conditions (With Project): This section should present the opening day conditions with the proposed project added, evaluating all the elements identified in the Scoping Meeting Checklist. If the project will cause any impact thresholds to be exceeded (see "Description of Checklist Elements" beginning on **Page B-6**), mitigation measures should be identified, and their effect on the performance of the relevant mode should be identified.

Long-Term (20-Year) Conditions (without project): This section is only required for Level 4 studies. The goal of this analysis is to provide a base scenario against which to compare "with project" conditions against, in cases where the project is large and represents a land-use change from the Comprehensive Land-Use Plan. In most cases, this scenario should be based on traffic forecasts provided by FHMPO. For large projects (more than 500 peak-hour trips), the applicant should develop a forecasting methodology subject to approval by the review agency.

Long-Term (20-Year) Conditions (with project): This section is only required for Level 3 and 4 studies. The goal of this analysis is to provide the review agency with a clear picture of how the proposed project affects the City's long-range roadway and land-use planning. See the above paragraph for specifics on developing this scenario.

- For Level 3 studies, a detailed impact comparison is not required. The section should present long-term conditions, identify areas where impact thresholds are exceeded in the long-term, and identify possible long-term mitigation measures.
- For Level 4 studies, long-term conditions with and without the proposed project should be compared. If the project causes an impact threshold to be exceeded for any mode, mitigation measures should be identified.

Recommendations: This section should summarize the mitigation measures and other recommendations developed in the TIS.

B.3 Technical Details

Details supporting the **Scoping Meeting Checklist** are included on the following pages. (The checklist itself is included at the end of the Appendix.) Some common terms are defined here:

- *Study Area:* The geographic area to be included in the TIS. It is selected to contain the site boundaries and all study intersections, study non-motorized crossings, and study transit stops. For more details on the definition of the study area, see **Section B.1**.
- *Study Roadways:* Includes all collectors and arterials in the study area, and any local street that connects directly to the project site.
- *Study Intersections:* As a rule of thumb, all signalized intersections on the study roadways experiencing an increase of 50 or more vehicles during any peak hour as a result of the project should be studied – within a reasonable distance of the project. Key unsignalized intersections, at which the project affects side-street movements, should also be considered. The review agency should make the final determination of what study intersection list is reasonable.
- *Study Non-Motorized Crossings:* Includes all existing mid-block pedestrian crossings of study roadways, and off-street bicycle path intersections with study roadways, if they have the potential to either (1) be crossed by automobile traffic generated by the proposed site or (2) be used by pedestrian or bicycle trips generated by the proposed site.
- *Study Transit Routes:* Includes any fixed-route transit route that runs through the study area.
- *Study Transit Stops:* Includes any fixed-route transit stops within one-quarter mile of the project site.
- *Study Railroad Crossings:* Includes any at-grade railroad crossing of a study roadway.
- *Safety Focus Areas:* Includes any areas, within the study area, identified as a safety concern (for any transportation mode) by the review agency.
- *Freight Generator:* Any proposed site that is anticipated to generate 100 or more truck trips per day, or more than 10 trucks during any peak hour.
- *Impact Threshold:* A value above which a study element (intersection, pedestrian crossing, etc.) is considered to be operating unacceptably.
- *Mitigation Measures:* Infrastructure modifications required to address the identified impacts. Modifications could be on- or off-site and could affect any of the study modes (auto, truck, bus, bike, pedestrian). Typical mitigation measures include the addition of turn lanes, installation of signals (if warranted), provision of sidewalk connections, or other such improvements.

Existing and No-Project Conditions

	Ped	Bike	Transit	Auto	Truck/Rail
Infrastructure/ Service Inventory	☐Sidewalks ☐Trails/Paths ☐Mid-block crossings ☐Signalization	☐On-street ☐Off-Street ☐Signalization	☐Routes/Stops ☐Park-and-Ride ☐Operating Hours ☐Headways	☐Functional Classes ☐Lanes ☐Traffic Control ☐Speeds ☐Parking – On-Street ☐Parking – Off-Street	☐Truck Routes ☐Grade Xings

The purpose of the infrastructure/service inventory is to identify transportation infrastructure in the study area that is relevant to the analysis of the proposed site. **These inventories are conducted for all TIS Levels (1-4).**

Pedestrians: The TIS should clearly describe the locations of existing sidewalks, trails and paths in the study area, including widths and surface type. Gaps should be noted. Study intersections with missing crossings should be noted. The type of crossing control used at each study pedestrian crossing should be described (crosswalk markings, pedestrian signalization, countdown signals, detection, etc.).

Bicycles: The TIS should clearly describe the locations of existing on-street and off-street bicycle facilities, including widths and surface type. Gaps should be noted. The TIS should also note existing bicycle parking locations within the study area. The type of crossing control used at each study bicycle crossing should be described (extended markings, bike signalization, detection, etc.).

Transit: The TIS should clearly describe the locations of existing fixed-route transit routes, stops, and park-and-ride facilities in the study area. For study transit stops, the TIS should also identify the general endpoints and major destinations served, operating hours, and time-of-day headways / service frequencies for the transit route(s) serving the stop(s) or park-and-ride facility(ies). The TIS should also describe existing passenger amenities (signing, benches, shelters, etc.) or special infrastructure provisions (such as bus turnouts) at these locations.

Automobiles: The TIS should clearly describe the locations of all study roadways, as well as number of lanes, posted speeds, and functional class. Any existing local streets that are proposed to be directly connected to the site should be similarly described. The existing traffic control type (signal, two-way stop, four-way stop, roundabout, etc.) at each of the study intersections should be identified. Traffic signal timing information for study intersections should be obtained from the review agency at this stage.

- *Automobile Parking:* The TIS should clearly describe the locations of existing on-street parking in the study area. If any existing off-street parking area is relevant to the site under study (either an adjacent use for which parking could potentially be shared, or a public parking lot that could potentially be used by automobiles generated by the proposed site), the TIS should clearly describe its location as well. For any existing automobile parking that may be used by the proposed project, the TIS should also document the parking capacity, time/usage restrictions, and pricing characteristics (if any).

Trucks: The TIS should clearly describe the locations of any existing truck routes on the study roadways.

Rail: The TIS should clearly describe the locations of study grade crossings, including the type of control (gated, flashers, etc.) and number of train tracks at each.

For each of the modes described above, the TIS should also identify known/planned changes to the inventoried infrastructure anticipated over the planning horizon selected for the TIS. This includes specific funded projects as well as those contained in relevant plans such as MATS.

	Ped	Bike	Transit	Auto	Truck/Rail
Demand/ Usage	☐Intersection Crossings ☐Mid-block Crossings	☐ Turning Mvmts	☐Ridership – Route Level ☐Ridership – Stop Level	☐ADT ☐Turning Mvmts ☐Parking Occupancy	☐ Truck Mvmts ☐Truck ADT ☐Grade Xing Vols

The purpose of the Demand/Usage element is to identify the extent to which existing transportation infrastructure in the study area is being used, to set up for the comparative analysis of Proposed Conditions. **These items are not evaluated for Level 1 studies, unless specifically noted.**

Pedestrians: The TIS should include pedestrian counts at each study pedestrian crossing, separated by direction. These counts should be conducted simultaneously with the automobile turning movement counts described below, and reported in the same time increments.

Bicycles: The TIS should include counts of existing on-street bicycle turning movements at each study bicycle crossing. These counts should be conducted simultaneously with the automobile turning movement counts described below, and reported in the same time increments.

Transit: For developments generating over 500 trips during any peak hour, or if the review agency determines detailed transit analysis is warranted, the TIS should identify existing daily weekday ridership for study transit routes and study transit stops. This information is typically available from the Transit Agency.

Automobiles: The TIS should identify existing Average Daily Traffic (ADT) volumes on study roadways for which information is available. The review agency, at its discretion, may require new ADT counts to be conducted on specific study roadways (preferably for 48 continuous hours in 15-minute increments) if available counts are outdated (over two years old) or if no counts are available.

The TIS also should identify existing peak-hour automobile turning movements at each study intersection as well as each study crossing. Typically, both the a.m. (7-9) and p.m. (4-6) peak hours should be studied. If it can be demonstrated that the project will not generate traffic during one of the peak hours (for example, a restaurant that is only open for lunch and dinner), the review agency may waive the requirement to analyze that period. Mid-day and weekend counts may also be required, based on the nature of the proposed project, at the discretion of the review agency. Where current agency-approved turning-movement counts (no more than two years old) are not available, new counts must be conducted (and should be provided in 15-minute increments). As mentioned in other areas, the counts should include (and identify) bicycles, pedestrians, and heavy vehicles.

Any new peak-hour and daily counts should be conducted on a Tuesday, Wednesday, or Thursday while school is in session (except for special studies when weekends or Monday/Friday counts are needed).

- *Automobile Parking:* If any existing on- or off-street automobile parking areas may be used by the proposed project, the analysis should include counts to identify peak peaking occupancies in these areas.

Trucks: The vehicular peak-hour turning-movement counts at all study intersections and non-motorized crossings should include heavy vehicles, to support the accuracy of operational calculations. For a TIS involving a freight generator, the vehicular ADT counts should also break out heavy vehicles separately.

Rail: For study railroad crossings, the TIS should identify daily train volumes and automobile volumes. Unless otherwise directed by the review agency, this data can be obtained from the FRA railroad crossing inventory.

	Ped	Bike	Transit	Auto	Truck/Rail
Safety	☐Crash Patterns	☐Crash Patterns	☐Safety Issues	☐Crash Patterns	☐ Xing Crashes

The purpose of the safety element is to identify existing safety issues (primarily crash patterns) that could affect, for be affected by, the proposed project. **Safety analyses are not included in Level 1 studies, and are only included in other TIS Levels if very specific safety issues have been identified in the study area by the relevant agencies.**

For *pedestrians, bicycles, automobiles, trucks, and grade crossings*: If a safety concern for a given transportation mode has been identified within the study area by the review agency, the TIS will include analysis of the most recent available five-year record of crashes related to that mode in the safety focus area(s) identified for that mode, to determine if a crash pattern exists. For *transit:* The TIS should verify with the transit agency whether there are any existing safety concerns relevant to the site and should document them.

	Ped	Bike	Transit	Auto	Truck/Rail
Operational Performance	☐ Ped LOS	☐ Bike LOS	☐Peak Loading	☐ Auto LOS ☐Queueing	☐Grade Xing Delay

The purpose of the Operational Performance element is to identify how well the existing transportation infrastructure currently serves each of the studied transportation modes, to set up for the comparative analysis of Proposed Conditions. **These items are not evaluated for Level 1 studies.**

Pedestrians: For study intersections or crossings with 200 or more pedestrians per hour crossing any leg (both directions) during any of the studied peak hours, intersection pedestrian LOS (as defined in the TRB's *Highway Capacity Manual*) should be computed for the relevant peak hours. The impact threshold for pedestrian LOS is D in all areas.

Bicycles: For study intersections or crossings that include bike lanes and at which any single approach experiences more than 100 bicycles per hour, intersection bicycle LOS (as defined in the TRB's *Highway Capacity Manual*) should be computed for the relevant peak hours. The impact threshold for bicycle LOS is D in all areas.

Transit: If transit demand is to be analyzed for proposed conditions, the TIS should identify peak loading for study transit routes and study transit stops.

Automobiles: The TIS should examine the following items:

- *Level of Service (LOS):* The TIS should include computation of Level of Service (LOS) for each study intersection using the methods described in the most recent version of the Transportation Research Board's

Highway Capacity Manual (HCM). LOS should be reported for each movement (or lane group) at the intersection. If required by the review agency, traffic simulation will be conducted for closely spaced intersections, improvements relying on signal timing/phasing, or complex traffic conditions. The impact thresholds for intersection-wide LOS are:

- LOS A – D acceptable on all arterials and collectors
- LOS A – C acceptable on all other roadways (the highest class of road defines an intersection)

- *Queuing:* The TIS should identify whether any existing study-intersection queues exceed acceptable thresholds. The impact threshold for queuing is a queue storage ratio of 1.0 (queue exceeds length) for 95th percentile queues.

- *Residential Traffic:* The TIS should identify whether traffic volumes on any study roadways that are local residential streets exceed acceptable thresholds. The impact threshold for local residential streets is 2,000 vehicles per day.

- *Automobile Parking:* If automobile parking demand will be studied under Proposed Conditions, and potential on- or off-street areas to share site-generated parking were identified as part of the Infrastructure/Service Inventory, the TIS should include the ratio of peak bicycle parking demand to capacity at the existing bicycle parking locations identified in the Demand/Usage element. The impact threshold for automobile parking is a peak occupancy of 85 percent.

Rail: For any study railroad crossings at which the peak-hour automobile volume exceeds 200 vehicles per hour and the conflicting hourly train volume (determined by dividing the daily train volume by 24) exceeds 2 trains per hour, the TIS should analyze automobile delay at the crossing. This delay should be converted to an LOS using the HCM signalized intersection scale, and the impact thresholds are the same as for intersections.

Conditions with Project

	Ped	Bike	Transit	Auto	Truck/Rail
Connectivity and Circulation	☐ Pedestrian Gaps ☐ Site Review	☐ Bike Gaps ☐ Site Review	☐ Consistency with identified transit plans	☐ Network Connectivity ☐ Access Management ☐ Site Review	☐ Proximity to Truck Route ☐ Site Review

The purpose of the Connectivity and Circulation element is to determine whether the project provides necessary internal connectivity and circulation for all relevant transportation modes, as well as necessary connectivity to the existing transportation system. **Connectivity analyses are conducted for all study Levels (1-4).**

Pedestrians: The TIS should identify whether the internal site plan provides adequate sidewalks and pedestrian connections as required by the relevant regulations and standards of the review agency. This also includes pedestrian connections between abutting cul-de-sacs, intermittent pedestrian connections to adjacent collectors/arterials, and consistency with Safe Routes to School principles. If the site abuts or includes collector/arterial roadways that have been identified as pedestrian gaps by the review agency, the TIS should address the ways in which the project will address these gaps. Similarly, if the site abuts or includes uncompleted portions of the planned trail system, the TIS should address the project's role in their completion.

Bicycles: The TIS should identify whether the internal site plan provides any impediments to bicycle travel, as well as the steps needed relieve those impediments. As with the pedestrian analysis, this also includes bicycle connections between abutting cul-de-sacs, intermittent bicycle connections to adjacent collectors/arterials, and consistency with Safe Routes to School principles. If the site abuts or includes roadways or connections that have been shown as future (on- or off-street) bikeways on the Bicycle Master Plan, the TIS should address the project's role in completing these bikeways. If the site presents an opportunity to add to the bicycle network in a previously unplanned or unforeseen way, the TIS should address this as well.

Transit: If the site abuts or includes any roadways or areas identified as future transit stops in applicable transit agency plans, the TIS should address the project's role in the provisions of the stop(s).

Automobiles: For automobiles, three major categories are evaluated:

- *Connectivity:* If the site has an internal street system, the TIS should evaluate it against the following MATS connectivity goals, which are designed to promote multi-modal connectivity while discouraging "through" traffic:
  - Average intersection spacing for local streets: around 300-400 feet; maximum: 600 feet.
  - Maximum block size: around 5-12 acres.
  - Percent streets that are cul-de-sacs: 20 percent. Maximum length of cul-de-sac: 200 to 400 feet.
  - Minimum Roadway Connectivity Index: 1.4. The Roadway Connectivity Index is calculated as the ratio of the number of links (roads between intersections) to the number of nodes (intersections).
  - Provide multiple access connections between a development and arterial streets.
- *Site Plan Review:* The TIS should evaluate and comment on the on-site circulation. Items discussed should include an assessment of on-site intersections and driveways/roadways with respect to operations and safety (including driveway throat length, driveway widths, vehicle turning radii, sight distance, queueing, emergency access, etc.). Shared access and cross-parcel traffic flows should also be considered.

- *Access Management Review:* The TIS should compare the proposed site access to the MATS Access Management Guidelines as well as other applicable design standards and guidelines, and comment on the plan's consistency with the guidelines.

Trucks: If the site is identified as a freight generator, the TIS should discuss the site's proximity and connectivity to the truck route system and any truck connectivity issues raised by the site design or location. The TIS should also evaluate the site plan from a truck standpoint – items such as on-site truck circulation, truck loading area dimensions, truck parking, truck queueing etc.

Rail: If travelways to/from or within the site involve an at-grade railroad crossing(s), the TIS should identify the alternative routes that may be available if the railroad tracks are blocked for unexpected lengthy periods of time.

	Ped	Bike	Transit	Auto	Truck/Rail
Demand/ Usage	☐Pedestrian Trip Generation	☐Pedestrian Trip Generation ☐Bicycle Parking Ratio	☐Need for Transit Service	☐ Auto Trip Generation ☐ Auto Trip Distribution ☐Auto Trip Assignment ☐ Auto Parking Generation	☐Truck Trip Generation

The purpose of the Demand/Usage element is to evaluate the effects of the demand generated by the site for each relevant mode of transportation.

Pedestrians: Pedestrian trip generation will generally not be calculated for projects unless the project is known to be a major pedestrian generator anticipated to affect study intersections or crossings. In such cases, the added pedestrian demand should be incorporated into the operational analysis.

Bicycles: Bicycle trip generation will generally not be calculated for projects unless the project is known to be a major bicycle generator anticipated to affect study intersections or crossings. In such cases, the added bicycle demand should be incorporated into the operational analysis.

- *Bike parking:* The TIS should identify the agency-required bicycle parking ratio for the proposed site, and document how bicycle parking will be provided to meet that ratio. If the bicycle parking ratio is not met, an impact threshold is considered exceeded.

Transit: For Level 3 or 4 projects, or projects that are known destinations for transit (high-intensity retail, medical uses, or other activity centers), the TIS should evaluate whether fixed-route transit service is recommended near or on the site.

Automobiles: The TIS should evaluate projected automobile demand in the following ways:

- *Automobile Trip Generation:* Automobile trip generation should be calculated (for the previously identified peak hours) using the most recent version of ITE's *Trip Generation*. Local trip generation characteristics may be used if deemed to be properly collected and consistent with the subject development application, and are especially encouraged in three cases:
  - When a proposed use(s) does not have a corresponding ITE category
  - When an ITE rate is based on antiquated data or a small sample
  - When the TIS addresses an existing project that is relocating or expanding

For redevelopment or rezoning projects, the applicant should calculate both the total project trip generation and the net difference between the proposed project and the existing use. **If operational analysis is required, the trip generation assumptions and calculations must be approved by the review agency prior to initiation of the operational analysis.**

- *Automobile Trip Distribution and Assignment:* **This step is not required for Level 1 studies.** For Level 2 and above, The TIS should clearly present and support the assumed trip distribution throughout the study area for the previously identified peak hours (including project driveways for developments that are not single-family residential). Similarly, the major assignment assumptions will be presented and explained. For redevelopment or rezoning projects, the applicant will need to determine whether the distribution of the proposed project differs from that of the existing or previously approved/zoned use, because the assignment will need to represent the net difference. **If operational analysis is required, the trip distribution assumptions must be approved by the review agency prior to initiation of the operational analysis.**

- *Automobile Parking:* The TIS should discuss the proposed site's parking provisions in relationship to the review agency's required parking ratios, and confirm that both the ratios and the proposed parking are reasonable. When a use does not fit into the categories identified by the parking ratio requirements, or it is more specialized in a way that could affect parking ratios, ITE's *Parking Generation* should be consulted as a source for determining potential parking demand. If a use is not covered by *Parking Generation* or the parking ratio requirements, actual field studies of similar uses should be conducted to verify expected demand. In the case of mixed-use developments, or projects that are proposing to share parking with other uses, the TIS should include a shared parking analysis that accounts for the time-of-day variations in on-site demand in order to prevent inefficient, oversized parking provisions. The TIS should also discuss the site's provisions of accessible parking in relation to review agency policies and ADA requirements.

Trucks: If the site is identified as a freight generator, the trip-generation, distribution, and assignment components of the automobile analysis should identify trucks separately.

	Ped	Bike	Transit	Auto	Truck/Rail
Operational Performance	☐ Ped LOS	☐HCM Bike LOS		☐ LOS ☐Queueing	☐Grade Xing Delay

The purpose of the Operational Performance element is to identify the operational impacts of the proposed project on the transportation system. **These items are not evaluated for Level 1 studies.** If impacts are identified, the TIS should evaluate mitigation measures to address them.

Pedestrians: Study intersections or crossings for which pedestrian LOS was evaluated under Existing Conditions should be re-evaluated for all future scenarios using the same methodology. In addition, if any future scenario causes any other pedestrian crossing to exceed 200 pedestrians per hour (both directions), that intersection should be evaluated with this methodology.

Bicycles: Study intersections or crossings for which bicycle LOS was evaluated under Existing Conditions should be re-evaluated for all future scenarios using the same methodology. In addition, if any future scenario causes any other bicycle crossing to exceed 100 bicycles per hour (both directions), that intersection should be evaluated with this methodology.

Automobiles:

- *Level of Service (LOS):* The TIS should duplicate the operational analysis conducted for No Project conditions (with LOS reported by movement or lane group), but using automobile traffic volumes and assumptions for the project for appropriate horizon years. The future scenarios should also include applicable study driveways and/or new intersections created as part of the project.

- *Queuing:* The TIS should examine intersection queues for the future scenarios using the same impact thresholds described under Existing Conditions.

- *Residential Traffic:* The TIS should identify whether traffic volumes on any study roadways that are local residential streets will exceed the automobile volume impact threshold under the "With Project" scenarios.

Rail: For any study railroad crossings at which the peak-hour automobile volume will exceed 200 vehicles per hour with the proposed projectand the conflicting hourly train volume (determined by dividing the daily train volume by 24) exceeds 2 trains per hour, the TIS should analyze automobile delay at the crossing with the same impact thresholds used for No Project conditions.

	Ped	Bike	Transit	Auto	Truck/Rail
Safety	☐Safety Impacts	☐Safety Impacts	☐Safety Impacts	☐Sight Distance ☐Safety Impacts	☐Safety Impacts

The purpose of the safety element is to identify the project's impacts on any safety issues identified under No Project conditions.

If a safety concern for any of the transportation modes was analyzed under "No Project" conditions, the TIS should include analysis of the project's anticipated impact to that safety concern using available standard safety methodology.

For automobiles, the TIS should identify whether adequate sight distance has been provided at project driveways and any intersections whose design will change in conjunction with the project.

Scoping Meeting Checklist – Items to Potentially Be Addressed in TIS

TIS level: ☐1 ☐2 ☐3 ☐4 **Horizon Years:** ☐Opening Day ☐5 Years ☐20 Years ☐Other:

	Ped	Bike	Transit	Auto	Truck/Rail
Existing and No-Project Conditions					
Infrastructure/ Service Inventory	☐Sidewalks ☐Trails/Paths ☐Mid-block crossings ☐Signalization	☐On-street ☐Off-Street ☐Bike Parking	☐Routes/Stops ☐Park-and-Ride ☐Operating Hours ☐Headways	☐Functional Classes ☐Lanes ☐Traffic Control ☐Speeds ☐Parking – On-Street ☐Parking – Off-Street	☐Truck Routes ☐Grade Xings
Demand/ Usage	☐Intersection Crossings ☐Mid-block Crossings	☐ Turning Mvmts	☐Ridership – Route Level ☐Ridership – Stop Level	☐ADT ☐Turning Mvmts ☐Parking Occupancy	☐ADT ☐ Turning Mvmts ☐Grade Xing Vols
Safety	☐Crash Patterns	☐Crash Patterns	☐Safety Issues	☐Crash Patterns	☐ Xing Crashes
Operational Performance	☐ Ped LOS	☐ Bike LOS	☐Peak Loading	☐ Auto LOS ☐Queueing	☐Grade Xing Delay
Conditions with Project					
Connectivity and Circulation	☐ Pedestrian Gaps ☐Site Review	☐ Bike Gaps ☐Site Review	☐Consistency with identified transit plans	☐Network Connectivity ☐Access Management ☐Site Review	☐Proximity to Truck Route ☐Site Review
Demand/ Usage	☐Pedestrian Trip Generation	☐Pedestrian Trip Generation ☐Bicycle Parking Ratio	☐Need for Transit Service	☐Auto Trip Generation ☐Auto Trip Distribution ☐Auto Trip Assignment ☐Auto Parking Generation	☐Truck Trip Generation
Operational Performance	☐ Ped LOS	☐HCM Bike LOS		☐ LOS ☐Queueing	☐Grade Xing Delay
Safety	☐Safety Impacts	☐Safety Impacts	☐Safety Impacts	☐Sight Distance ☐Safety Impacts	☐Safety Impacts

Appendix C:

Complete Streets Toolkit

"Complete Streets" Guidance for the Manhattan Urban Area

Introduction

The National Complete Streets Coalition defines complete streets as "…designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities. Complete Streets make it easy to cross the street, walk to shops, and bicycle to work. They allow buses to run on time and make it safe for people to walk to and from [transit]." Complete streets balance the needs of all road users. Typically, complete streets guidance focuses on appropriate treatments for integrating bicyclists and pedestrians on shared roadway environments and at intersections, since roadway standards already cover vehicle capacity. The guidance below includes a series of treatments and approaches that can be implemented throughout the Urban Area to make streets more complete. Below is a summary of the elements included:

Street Design Guidance		
Element	**Page**	**Highlight**
Narrower Lane Widths	C-2	Applied appropriately, can reduce speeds and allow more space for other uses
Medians	C-3	Can increase capacity, safety, and aesthetics
Street Trees	C-4	Impart some traffic-calming benefits, and can make streets more inviting places
Sidewalks	C-5	Access and comfort are key
Lighting	C-6	A key component of roadway safety
Transit Guidance	C-6	Bulbouts add space for passengers and can increase transit reliability
Bicycle Lanes	C-7	Parking, right turns, and debris are important considerations
Shared Lane Markings ("Sharrows")	C-9	A good solution for space-constrained streets under 35 mph

Intersection Design Guidance		
Right-Turn Channelization	C-12	Design for low speed and high visibility
Raised Crossing at Right-Turn Island	C-13	Elevation change can increase compliance
High-Visibility Crosswalk Markings	C-14	Emphasizing the presence of pedestrians enhances safety
Stop Bars (Stop Lines)	C-15	Placement is important to discourage vehicle crosswalk encroachment
Corner Radii	C-15	Design vehicle is important
ADA Access (Universal Design)	C-17	Appropriate guidance for users is important
Median Noses	C-18	Can increase pedestrians' feeling of safety; turning radii are an important consideration
Pedestrian Signals	C-19	Countdown signals increase pedestrian understanding
Leading Pedestrian Interval (LPI)	C-19	Delaying motorist green gives pedestrians a visibility advantage
Exclusive Pedestrian Signal Phase	C-20	May work best in downtown locations with high traffic and low speeds
"Yield to Pedestrian" Blank-Out Signs	C-20	Increase awareness of crossing pedestrians
Bicycle Detector Marking	C-20	Assist bicyclists with positioning
Mid-Block Crosswalk	C-21	Angled crossings, RFFBs, and HAWK signals are key variations

Narrower Lane Widths

Drivers will typically drive at speeds at which they feel comfortable. Wide roadways and lanes encourage higher speeds. Crash rates tend to increase at higher speeds, while motorist desire to yield to pedestrians drops significantly. A number of urban area multi-lane roadways are now being built with 11-foot, and even 10-foot, travel lanes (in areas with low volumes of truck traffic). Many storage lanes are 10 feet wide, or even as narrow as 9 feet.

A project on Rodeo Drive in Beverly Hills, CA narrowed the travel lanes to 9 feet (not including gutter pans) to lower speeds and enhance the corridor for non-motorized modes.

Benefits

- Traffic calming effect (lower vehicle speeds).
- Increased safety due to lower speeds.
- Lower construction and right-of-way costs for new roads.
- Reduced drainage impact on new roads.
- Shorter crossing distances for pedestrians and less exposure time to traffic.
- Improved traffic capacity due to intersections being more compact (reduces required pedestrian clearance time).
- Space gained may allow for the inclusion of bicycle lanes.

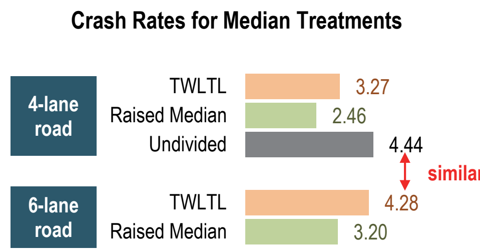
Reducing typical arterial and collector travel lane widths from the standard 12 feet improves safety for all road users as it provides a traffic calming benefit. Research on the effect of varying lane widths on arterial and collector roadways across the U.S. has proven that as more lane widths are increased up to 12 feet or more, traffic fatalities and injuries increase; this is significant as it has been generally accepted practice to improve the safety of roads by increasing lane widths. Wider lanes can increase driver comfort, which leads to an increase in speeds and therefore offsets the expected safety benefits (Noland, *"Traffic Fatalities and Injuries: Are Reductions the Result of 'Improvements' in Highway Design Standards?", November 2000, TRB*).

Medians

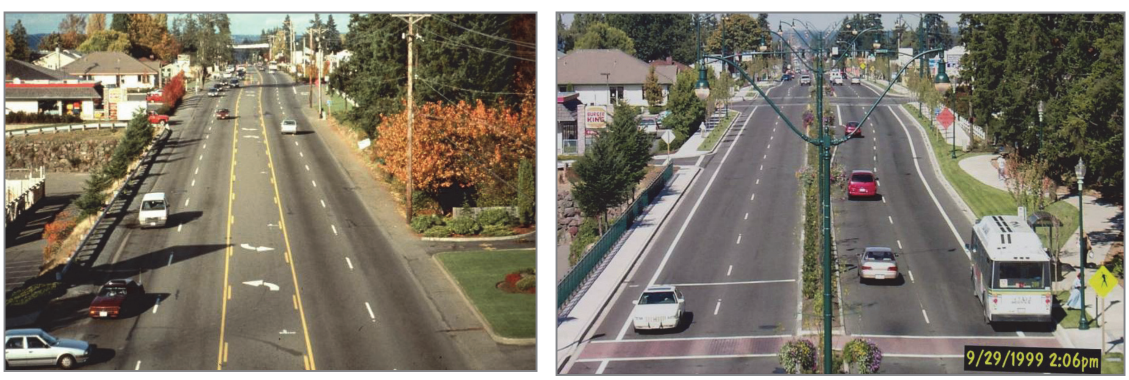
Medians are one of the most valuable roadway performance-enhancing tools in terms of safety and capacity benefits. They can be used in rural, suburban, and urban areas, even in downtowns, and are often used to replace two-way-left-turn lanes (TWLTL's).

Benefits

- Reduce the number and severity of injury and fatal crashes across all modes of travel. They have been shown to reduce personal injury crashes significantly compared with TWLTL's.
- Reduce crashes in the following ways:
  - Reduce the number of conflicts, from 18 to as few as 2.
  - Control where conflicts are allowed to occur, often placing them in the most benign locations.
  - Reduce head-on crashes, the most lethal type of crashes.



- Increase the carrying capacity of roadways by as much as 30%.
- Increase property values and retail trade 10-50%.
- Serve as an aid for informal pedestrian crossings, providing pedestrians a refuge, and allowing them to complete a roadway crossing in two stages, focusing on one direction of traffic at a time.
- Enhance the aesthetics of a corridor when landscaped.



Bridgeport Way in University Place, WA, before (left) and after (right) a project to enhance the corridor for all users, which included the replacement of a TWLTL with a narrow center median, bike lanes, and midblock crossings.

General Design Guidance

- Install, whenever feasible, as part of new roadway construction and as part of roadway reconstruction.
- Minimum median widths of 12 feet are preferred, but when right-of-way or other factors limit the potential median width, lesser widths as narrow as 2-4 feet can be used. (A minimum width of 4 feet is typically necessary if the median has a sign in it.)
- When landscaping, use native or other low maintenance ground cover that can be kept trimmed to no more than 2 feet in height.
- Trees used in medians should be able to withstand under-trimming to 7 feet. As a general rule, 4-foot setbacks are needed to meet most standards.
- If complete medians cannot be constructed on a roadway, consider constructing small median islands, particularly near areas of observed pedestrian crossing activity (near transit stops and retail areas) to provide refuge for informal midblock pedestrian crossing.

Street Trees

Example of street trees along International Parkway in Seminole County, FL (Source: Dan Burden)

Proper placement of trees in roadway medians is an important feature of multiple lane roads and other roads with widths of 40 feet or more. Median trees in urban environments are no less safe than medians without trees (2003 Caltrans Study). Some traffic calming effects can be anticipated with urban boulevards (multiple-lane roadways). When trees of a caliper considered non-frangible (6 inches or more) are placed in medians, it is best to have at least an 8-foot median, with trees set back from edges 4 feet. These trees are often set back 100 feet from intersections (based on speed). Trees not expected to have calipers of 6 inches or greater can be placed closer to median edges.

Benefits

- People linger longer in a cooling or green main street, and are more likely to exchange money for services, products, and goods. It has been documented that people under a main street canopy spend 12 percent more for the same product (gives a main street its green edge against big box retail).
- Summer temperatures can be 8-12 degrees cooler at street levels with street trees. As such, pavement life is extended from 30-60 percent longer (less extreme heating and cooling, which reduces expansion and shrinking of asphalt).
- Trees capture 30 percent of rainwater and transpire it back into the atmosphere (cooling the temperatures they do).
- Water hitting the ground and making it to root systems may comprise another 30 percent of rainwater. Thus, as little as 30-50 percent of storm water may make it to the drains, thus reducing stream and aquifer pollution. This role of trees around a paved environment can help when storm drains are already near peak capacity, thus reducing flooding.

- Street trees capture and convert harmful auto gases into useful oxygen nine times more efficiently than do trees planted elsewhere. By keeping street temperatures more moderate, the effects of harmful gases are reduced. It is believed that cities having large percentages of streets covered with green can reduce asthma and other emissions effects on their residents.

Sidewalks

The orientation and alignment of sidewalks are important considerations to ensure that the walk provides an access between destinations. Pedestrians, and in some cases bicyclists, are more exposed to the environment as the users of sidewalks. Thus, sidewalk design elements – such as location, width, utility interferences, shading, plantings, and the presence of amenities – have a strong effect on these users. A narrow sidewalk abutting the curb not only gets diminished by sharing space with utility poles, but makes the user feel less secure because there is no buffer from traffic. Conversely, a planting strip with room for trees provides buffering and shade, but requires more right-of-way and may interfere with utilities. Pedestrians' comfort can be increased if they are buffered from passing vehicles. Elements that serve as buffers include planting strips and landscaping, bicycle lanes, and on-street parking. Walking can be encouraged if the perceived distance can be minimized – through methods such as creating direct connections between land uses, providing mid-block crossings, and offering amenities along the way (such as benches, landscaping, defined paving, shelters and other resting-area-type design features). These amenities are also important design elements for transit stops.

General Design Guidance

- Sidewalks should be provided on both sides of all collector and arterial roadways, and should be provided on at least one side of all local streets, along with safe crossing locations. In any areas where sidewalks have not been provided on local streets, sidewalks should be pursued where there is sufficient resident support.
- All sidewalks should have a minimum width of 5 feet, with 6 feet used if the sidewalk is placed at the back of curb. In areas where significant use is anticipated, such as primary walking routes near schools, retail areas, main streets, etc., minimum sidewalks widths should be increased to 8-10 feet, with wider facilities provided based on need. Additional space in urban areas can be used for street furniture, outdoor cafes, and shy distance from buildings.
- When possible, use planter strips with 6-foot widths (minimum) as a buffer between sidewalks and the roadway curb. If the roadway does not have curb and gutter, use a minimum sidewalk separation of 10 feet from edge of roadway, with sidewalk placement on outside of drainage (ditch/swale) preferred.
- In adding missing sections of sidewalks, prioritize the most needed locations first, such as near schools, transit stops, parks, hospitals, and waterfront areas.

Lighting

The most deadly combination of factors for pedestrians is high-speed roads (40 mph or higher) with no street lighting. Pedestrians can have difficulty judging the speed of approaching cars at night when there are no street lights. An error in judgment by the pedestrian can easily result in a crash because even a driver with good eyesight can rarely see a pedestrian from more than 200 feet away, and a driver going 45 mph needs about 350 feet to see, react to and slow or stop for a pedestrian. Street lighting should be used along both sides of arterial and collector roadway. The longitudinal spacing should be such that there are no dark areas along the roadway. On divided roadways, it may be appropriate to also install street lights in the median, so that the middle of the roadway is properly illuminated. Lighting is especially important in the areas near any schools that have early morning start times, which requires students to walk or bike to school in the dark for a portion of the year. In addition, all marked midblock crosswalks should be well lit, since these are locations where pedestrians are being directed to cross at.

Transit Guidance

For bus transit, bulbouts and turnouts can be effective. Where it is not acceptable to stop a bus in traffic and a bus turnout is justified, a far-side or midblock stop is generally preferred. Stops located on the far side of a traffic signal are preferred so a bus does not get delayed waiting to re-enter traffic. Bus bulbouts allow more room for riders waiting to access transit, can reduce delay to motorists waiting behind the transit vehicle by allowing for faster loading and unloading of passengers, and allow buses to re-enter the flow of traffic more quickly.

Bus turnout

Bus bulbout

Bicycle Lanes

Bicycle lanes are the portion of a roadway that has been designated by striping, singing, and pavement markings for the preferential or exclusive use of bicyclists. They are most appropriate and most useful on arterial and collector streets. Typically, unless traffic volumes are heavy, bicycle lanes are not needed on residential or local streets.

General Design Guidance

Bicycle lanes should be designed to the minimum standards contained in *AASHTO's Guide for the Development of Bicycle Facilities*. The following are minimum or preferred characteristics:

- Minimum width (no curb and gutter) is 4 feet.
- Minimum width (with curb and gutter) is 5 feet measured from the face of curb. It is desirable to maintain a smooth longitudinal joint between the pavement and the gutter pan. However, if the joint is not smooth, 4 feet of ridable pavement surface should be provided.
- If a full-width bicycle lane cannot be provided, consider providing a wide curb lane/outside travel lane or use shared lane markings.

- If on-street parking is permitted, bicycle lanes should always be placed between the parking lane and the travel lane and have a minimum width of 5 feet. However, in areas with substantial parking volume or high turnover, bicycle lane widths adjacent to parking are often increased to 6-7 feet, while the parking width is limited to as little as 7 feet. A narrower parking lane encourages motorists to park closer to the curb. Providing 14 feet for the combined parking lane/bicycle lane is preferred as it allows cyclists to ride completely outside the "door zone".
- Bicycle lanes should be designated by pavement markings and signs so that more bicyclists will recognize the lanes as an area of the roadway that has been set aside for them to ride, and that they are to ride with traffic when using the bike lane. Riding in the correct direction with traffic can be reinforced through the use of "WRONG WAY' and "RIDE WITH TRAFFIC" signs mounted so that they face bicyclists riding against traffic.

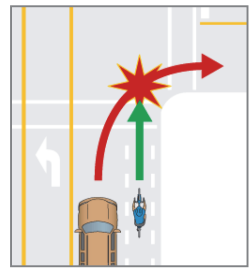
Benefits

- Perceived to encourage bicycling. Studies have shown increased levels of bike commuting trips based on proximity to bicycle facilities.
- Serve as a symbol to many that "bicyclists belong on the road rather than the sidewalk".
- Encourage more predictable behavior by both motorists and bicyclists.
- Allow motorists to pass bicyclists with less delay and with fewer passing conflicts.
- Increased border width to fixed objects.
- Increased turning radius into and out of intersections and driveways.
- Improved sight distances when exiting driveways.
- Buffer to sidewalks and pedestrians.
- Buffer increases comfort of pedestrians and people exiting parked cars.
- Traffic calming (narrower travel lanes can be adopted).

- Improved turning for trucks and transit.
- Space for disabled vehicles, mail delivery, bus stops, and place for cars to pull into when emergency response vehicles pass.
- Provide structural support to the pavement.
- Discharge water further from the travel lanes.
- Accommodate driver error.
- Provide more intersection and safe stopping sight distance.

Issues/Cautions

- Bicycle lanes at intersections and driveways that are placed to the right of potential right turning vehicle traffic encourage poor behavior by through bicyclists and right turning motorists and may cause conflicts (i.e., "right hooks"). Bicycle lane striping should be dashed for, at minimum, the last 50 feet prior to an intersection if there is no exclusive right turn lane placed to the right of the bicycle lane. Bicycle lane striping should also be dashed in front of major driveways (those with a significant right turning volume), but can remain solid across minor driveways. To prevent conflicts with right turning vehicles, bicycle lanes must always be placed to the left of exclusive right turn lanes.



The "right hook".

- Extreme care should be used in providing sufficient bicycle lane width adjacent to parallel on-street parking. Bicyclists should never ride or be forced or encouraged to ride within 3 feet of a parked car (the "door zone"). Crashes involving a bicyclist and an opening car can have serious consequences. The *AASHTO Guide for the Development of Bicycle Facilities* illustrates a combined parking lane/bicycle lane of 11 feet (measured from the curb face to the inside bicycle lane stripe), and recommends 13 feet for areas with "substantial parking turnover" (e.g. commercial areas); however, with these dimensions, a bicyclist who rides in the center of the bicycle lane will be within the "door zone." Providing 14 feet for the combined parking lane/bicycle lane allows cyclists to ride completely outside the door zone. Designers should consider not striping a bicycle lane in places where right-of-way or pavement width are insufficient to provide 14 feet; shared lane markings can be used in lieu of bicycle lanes where insufficient width exists to provide a wide enough bicycle lane to ensure safety.

(Top) An example of a bike lane located within the "door zone" of the adjacent parallel parking lane. (Bottom) Providing a striped buffer between on-street parking and a bicycle lane is a potential design solution to encourage riding outside the "door zone".

- Bicycle lanes often collect debris and broken glass, and are often overlooked in maintenance and repair, which can potentially make them (or sections of them) unusable. For this reason, it is important to establish a regular program of street sweeping and repair to ensure that bicycle lanes will be usable and free of debris, glass, and potholes.

Implementation Guidance

- Bicycle lanes (and pedestrian facilities) should be considered for implementation on all new roadway projects and resurfacing projects.
- Where possible, roadway lanes should be narrowed for inclusion of signed and marked bicycle lanes. Roadway lanes can be narrowed to 11 feet in nearly all cases, and can be narrowed to 10 feet on urban roadways having low volumes of truck traffic, generally less than 10 percent. Lanes as narrow as 10 feet can safely accommodate traffic on lower-speed roadways. Generally, the outside lane of a roadway needs to be a minimum of 14 feet wide (not including gutter width) to include a standard signed and marked bicycle lane.
- On roadways with excess vehicle capacity, one or more travel lanes can be eliminated in favor of bicycle lanes and other features such as left turn lanes or on-street parking. This type of roadway project is known as a "road diet". The most common type of road diet project is to convert a four-lane undivided roadway to a two-lane roadway with continuous two-way center turn lane and bicycle lanes.
- Incorporate bicycle lanes (and other bicycle and pedestrian improvements) into larger funded projects.

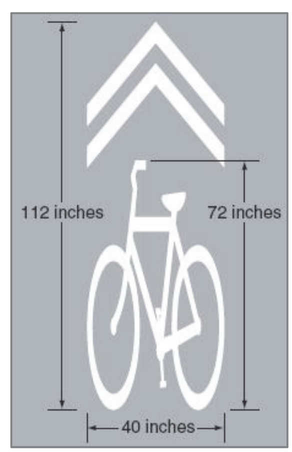
This road has 10-foot lanes (which easily accommodate large trucks) adjacent to 5-foot designated bike lanes (4 feet of asphalt, plus gutter pan).

A "road diet" project conerted this facility from a 4-lane undivided roadway to 2-lanes with center turn lane and bicycle lanes.

Shared Lane Markings ("Sharrows")

Shared Lane Markings, also known as "Sharrows", are markings that are used in lanes that are shared by bicycles and motor vehicles when a travel lane is too narrow to provide a standard-width bicycle lane. The markings have been incorporated into the 2009 version of the MUTCD. They let motorists know to expect bicyclists, provide lateral positioning guidance to bicyclists, and reinforce good bicycling behavior through the following:

- Discouraging bicycle riding within the "door zone" on streets with on-street parking.
- Encouraging bicyclists to ride further out into the travel lane rather than hugging the curb, which encourages motorists to give bicyclists more space when passing, rather than squeezing by.
- Discouraging wrong-way bicycling.
- Discouraging sidewalk bicycling, which is statistically less safe than riding with traffic in the roadway.



Situations for Use

- On roadways too narrow for bicycles and motor vehicles to share side by side (typically less than 14 feet wide).
- On roadways with on-street parking.
- Where there are gaps in a bicycle lane (use before a bicycle lane begins or after a bicycle lane ends).
- For designated bicycle routes.
- On a roadway with a hill where there is only enough width to provide a bicycle lane in one direction (provide an uphill bicycle lane, and sharrows in the downhill direction).

General Design Guidance

- Use only on roads with posted speeds of 35 mph or less.
- The MUTCD recommends placement after intersections and not more than every 250 feet thereafter; the 250-foot spacing is preferred on roadways with on-street parking, but greater spacing is acceptable for roadways without on-street parking (up to 500 feet).
- On roadways with on-street parking, place laterally a minimum of 11 feet from face of curb or edge of pavement to the center of the marking; a 13-foot lateral placement is preferred, which ensures the centers of the markings are completely outside the "door zone" of larger vehicles such as trucks and SUVs. Bicycle riding within the "door zone" is hazardous, particularly at the edge, where a bicycle handlebar could catch a door, throwing the cyclist into traffic. For this reason, it is strongly recommended to exceed the minimum lateral placement of the markings.

- On roadways without on-street parking, the centers of the markings should be placed a minimum of 4 feet from the face of curb or edge of roadway; in lanes 12 feet wide or narrower, it is preferred to place the markings in the center of the lane.
- Bicycle warning signs with "Share the Road" supplemental plaques can be used in conjunction with markings. This may especially be helpful for the first few applications of the markings to help motorists and bicyclists alike understand the meaning of the markings. However, it is recommended to limit the use of these signs so as to limit the amount of sign clutter.

Intersection Design Guidance

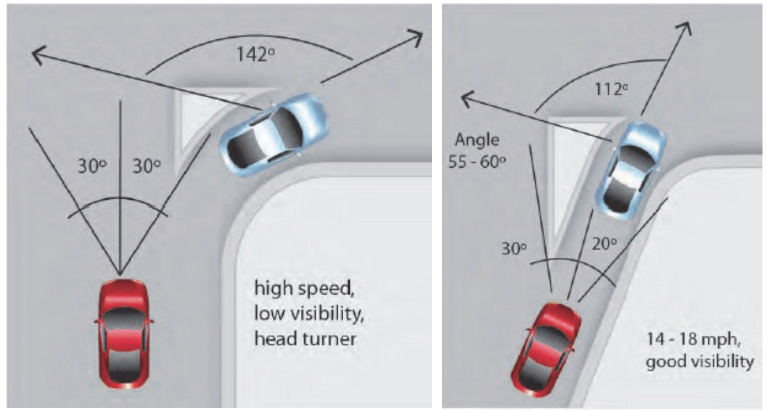
Intersections are places of managed conflict, and are often very intimidating places for pedestrians; this is often why pedestrians are witnessed crossing streets away from intersections. Efficiently designed intersections keep numbers of lanes and lane widths under control and costs of roadway systems affordable. Conflict-reducing designs provide for: low-speed entries and turns, separation of conflicts in time and place, positive guidance, and operations clarity. Well designed, complete intersections pass the following performance measures:

- Incorporate the needs of all modes of travel.
- Efficiently move all forms of traffic through all approaches (crossing islands are found on all legs of all multilane road approaches).
- Reduce the need for added lanes used to store vehicles for long signal cycles.
- Attract pedestrians to marked crossings. Poorly designed intersections are easily recognized, as they result in many people crossing away from intersections at midblock locations.
- Are free of driveways and other nearby intersections that complicate movements and compromise safety.
- Have low turning speeds. Safe turns are made at speeds of 5-10 mph for right turns, and 15-20 mph for left turns.

Intersections are kept compact through a combination of appropriately narrow lanes, appropriate curb radii, and curb extensions. Effective use of curb extensions, especially when on-street parking is used, is a common way to assure safe and easy access to streets, minimize pedestrian crossing distances, and maximize the efficiency of signal cycles and intersection performance.

At left, a poorly designed intersection that fails in safety and efficiency. At the right, an example of how the same intersection could be modified to be pedestrian- and motorist-efficient and safe. The improved condition takes advantage of channelizing islands, medians, median noses and other compact intersection tools. People-friendly intersections are capable of moving more traffic than older, larger designs. Due to medians and islands, the crossing distance at the improved intersection would decrease from 177 feet to 50 feet of actual lane exposure.

Right-Turn Channelization



Overly wide intersections discourage pedestrian use. Right turn channelizing islands (sometimes called "pork chops") minimize pedestrian crossing times and distances. In some cases crossing distances are reduced from 120-160 feet to only 50-60 feet. At signalized intersections, the use of right turn islands also reduces the required pedestrian signal clearance interval time (flashing don't walk) due to the shorter crossing distance. However, traditional right-turn island design is not friendly to pedestrians, nor as safe as it could be for mixing pedestrians and motorists. Typical right-turn channelization results in higher speeds, less visibility for pedestrians, and more sightline issues for motorists (who have to greatly turn their head to check for gaps in traffic). In contrast, the more modern approach (sometimes referred to as "Australian rights" or "Gap Acceptance Right Turns"), provides tighter angles, better pedestrian visibility and crossing safety, and improved motorist sightlines.

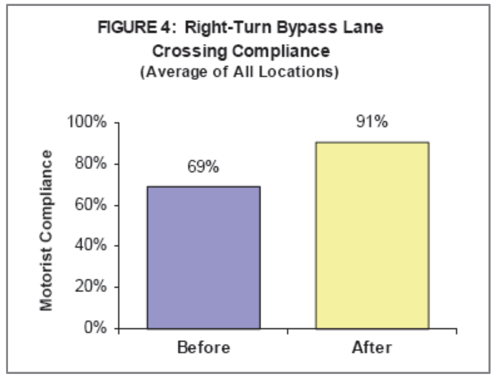
General Design Guidance

- Entry angles should generally be in the 50-60 degree range (essentially the angle of the upper right corner of the right-turn island; see illustration above), keeping entry and exit speeds to 7-11 mph. Increasing this angle encourages speeding, decreases capacity, and increases crash potential and crash severity for motorists and pedestrians.
- Pedestrian crossings to islands should be placed at 90 degree angles to the flow of traffic in the right-turn "slip" lane (maximizing the view of approach traffic) approximately one vehicle length (22-26 feet) back from the yield line.
- The tail of the island should face approaching motorists.
- The right-turn lane width should be minimized (14-15 feet is often sufficient) to guide low-speed entries and safe exits.
- Triple-centered, compound curves should be used to keep lanes tight while supporting the largest truck wheel bases.
- Acceleration lanes should be avoided in urban areas. Urban acceleration lanes are inappropriate, often leading to crashes and overly wide intersections.
- Islands should contain at least 100 square feet of surface, with non-mountable curbing. On smaller islands, it is appropriate to eliminate ramps (using "cut-outs") and use a slight crown to drain water.

- Tactile and contrasting surfaces (i.e., truncated domes) should be used to denote when a person has reached the edge of each ramp.
- Pedestrian signal poles should be placed within the island. In nearly all cases, the crossing between the edge of the roadway and the island does not need to be controlled; only in instances with very heavy right-turning traffic is signal control typically considered.

Raised Crossing at Right-Turn Island

For crossings of channelized right turn lanes where motorist yielding behavior may be problematic, consider raised speed tables between the edge of the roadway and the island. Raised crossings at these locations have proven to increase the instances of motorists yielding to pedestrians and slow speeds in advance of right turns.



A study of channelized right turn lanes in Boulder, CO showed that motorist yielding to pedestrians increased after installing raised crossings.

General Design Guidance

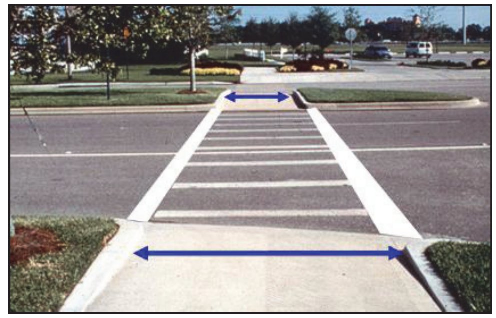
- A trapezoidal, flat-top speed table design is preferred with pedestrian crossing width of 10 feet. Transitions ranging from 6-7 feet are typical, with a raised table height of 3-6 inches.
- Tables/crossings can be raised to match the curb heights at the roadway edge and island for a more dramatic effect in vertical deflection and speed reduction, or can be more subtle with heights equal to one-half that of the adjacent curbs.
- Colorized or patterned materials should be used to accentuate the effects of this yield condition.

An example of a raised crossing in Columbia, MO.

High-Visibility Crosswalk Markings

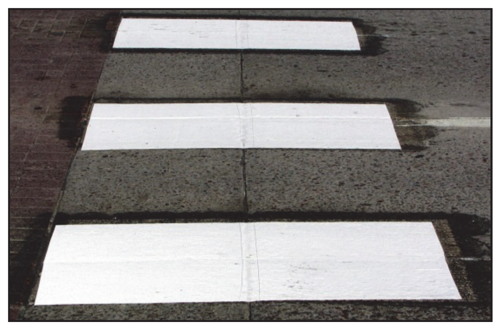
Well-marked crossings are essential to good walking environments. Zebra- or ladder-style crosswalk markings are more visible to motorists and should be used in areas of high pedestrian activity or crossing of special emphasis. Ladder-style markings are preferred by visually impaired people, since the ladder rails (shore lines) help guide them across streets. Well marked crosswalks:

- Alert motorists to pedestrian conflict areas.
- Increase motorists yielding to pedestrians.
- Enhance motorists' recognition of intersections.
- Assist people with visual impairment in their crossings.
- Attract pedestrians to the best crossing places with the most appropriate sight distances.



Ladder-style crosswalk markings.

Zebra-style crosswalk markings.



Inset crosswalk markings (Source: Dan Burden).

General Design Guidance

- Crosswalks should typically be a minimum of 8-10 feet wide, although 12-foot widths are often preferred.
- Ramp and median openings should be as wide as the markings.
- Crossings need to be as close to the intersection as practicable (generally 2-10 feet). If ramps are set back further to match the tangent roadway section, then overly wide markings (12-20 feet wide) can be used to help draw motorists' attention to crossings.
- Crosswalks should be highly visible at all times of the year. When thermoplastic is used, it is helpful to add extra crushed glass content (increasing the coefficient of friction as well as night visibility).
- Crossings should be provided on all legs of signalized intersections (with few exceptions). Omitting a crossing on a leg of an intersection forces pedestrians to cross three legs (18 conflicts versus 6 conflicts), which may result in a desire to cross away from the intersection.
- Crosswalk markings may also be inset into the pavement, with the markings carefully spaced to allow motorist wheels to pass around the markings. With inset markings, the asphalt or concrete is milled and the thermoplastic is placed below grade. This style of placement can allow markings to remain strong and visible for years.

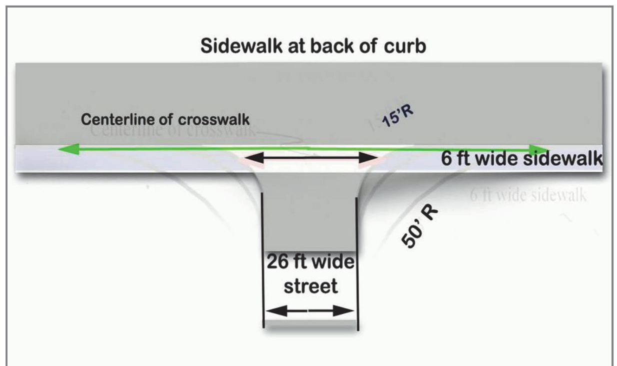
Stop Lines (Stop Bars)

Stop lines should most often be placed 4 to 6 feet back from marked crosswalks at intersections. Lines placed up to 10 feet back from crosswalk markings should be considered when sight distance permits; more distant placement has been shown to reduce the number of motorists pulling forward into crosswalks. At midblock crosswalks, stop bars (or advance yield lines) should be placed 20 to 30 feet back from the crosswalk on two-lane roadways, and 30 to 50 feet back from the crosswalk on multilane roadways; the further setback on multilane roadways is needed to provide adequate motorist sight distance to crossing pedestrians and to prevent multiple-threat crashes (in which a vehicle in one lane stops, but the view of a motorist in an adjacent lane is blocked and that second motorist does not stop).

Placing stop bars too close to crosswalks can lead to vehicle encroachment.

Corner Radii

Many intersection and driveway corners are wider than necessary. Larger radii create longer crossing distances for pedestrians and encourage higher vehicle turning speeds, which can put pedestrians in danger. If a particular intersection has a low turning volume of trucks and buses, smaller corner radii can be used. While retrofitting corners with tighter radii helps to create a friendlier walking environment, this type of improvement is less important than other pedestrian improvements such as building new sidewalks and marking safe crosswalks. However, corner radii on all new projects or reconstruction should be scrutinized carefully. **Table C-1** provides guidance on the selection of an appropriate intersection design vehicle, and **Table C-2** provides information on the operating characteristics of intersection corner radii. Based on this guidance, many street intersections, particularly those on local streets, could be designed based on a smaller design vehicle, with the occasional larger vehicle (including fire trucks) allowed minor lane encroachment.



Radius	Crossing Distance	Increased Crossing	Percent Increase
15'	37'	+11'	42%
25'	50'	+24'	92%
50'	89'	+53'	203%

Effect of corner turning radii on pedestrian crossing distances.

Table 1: Guidelines for the Selection of Intersection Design Vehicles

Roadway Type	Design Vehicle
Rural Highways	
Interstate/Freeway Ramp Terminals	WB-50
Primary Arterials	WB-50
Minor Arterials	WB-50 or WB-40
Collectors	SU-30
Local Streets	SU-30
Urban Streets	
Freeway Ramp Terminals	WB-50
Primary Arterials	WB-50 or WB-40
Minor Arterials	WB-40 or B-40
Collectors	B-40 or SU-30
Residential/Local Streets	SU-30 or P

Source: *Intersection Channelization Design Guide,* NCHRP Report 279, 1985.
Note: WB-50 = Semi-Trailer Combination (large); WB-40 = Semi-Trailer (intermediate); SU-30 = Single Unit Truck; B-40 = Single Unit Bus; P = Passenger Car.

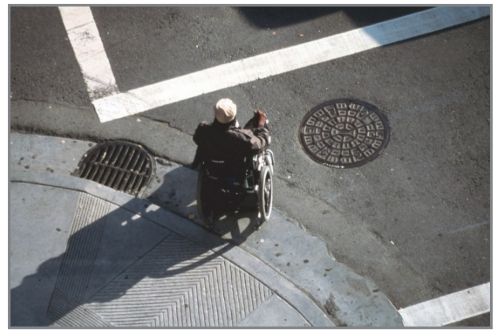
Table 2: Operating Characteristics of Intersection Corner Radii

Corner Radius	Operational Characteristics
<5	Not appropriate for even Passenger Cars as design vehicle
10	Crawl-speed turn for Passenger Cars
20-30	Low speed turn for Passenger Cars; crawl-speed turn for Single Unit Trucks with minor lane encroachment
40	Moderate speed turn for Passenger Cars; low-speed turn for Single Unit Trucks with minor lane encroachment
50	Moderate-speed turns for all vehicles up to WB-50

Source: *Intersection Channelization Design Guide,* NCHRP Report 279, 1985.
Note: WB-50 = Semi-Trailer Combination (large).

ADA Access (Universal Design)

People of all abilities need and appreciate designs that work for everyone (Universal Design). Sidewalks, crossings, entire blocks and corridors, parking lots, parks, waterfronts, and trails are to be designed or retrofit for full access. Retrofits are also needed for all areas lacking ADA-compliant curb ramps. The highest priority should be in areas with transit, near medical care facilities, and where special populations are most commonly found. Well-designed blocks include adequate widths for turning and maneuvering wheelchairs, landscaping and other guidance to help all people remain oriented toward crossings (two curb ramps per corner are best) and utilities and other features that present no barriers.



Due to insufficient space, this design forces pedestrians with disabilities against traffic. Two ramps on this corner would eliminate the problem (Photo: Dan Burden).

General Design Guidance

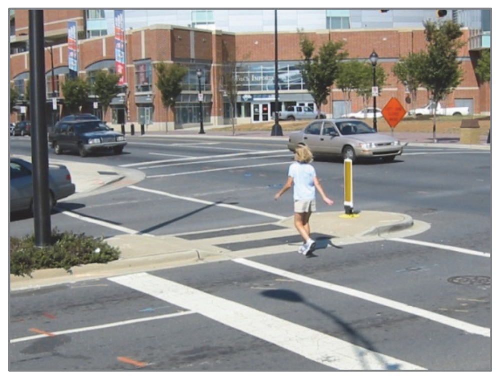
- Corner radii should be kept to appropriate levels, never so wide as to induce speed.
- Curb extensions should be used to inset parking, and allow for planter boxes and other furniture to help orient and guide people. Curb extensions also protect corners from illegal parking, reduce crossing distances and time, and increase awareness when a person enters and exits a street or other place of danger or safety.
- Color, texture, and tactile features should be used to help orient and guide.
- Entry and exit widths should be maximized; minimum widths should only be used when necessary.
- As a general rule, pedestrians are able to enter and exit streets most efficiently when two ramps are provided on each corner. For a modest increase in cost, benefits can be significant. Dual ramps are especially important to people who are using wheelchairs or are blind. There are no requirements for two ramps per corner, though they are much preferred. As corner radii increase, ramps line up too far back from intersections, which takes pedestrians out of the sightlines of turning motorists and places them in locations of higher vehicle speeds. Thus, unless curb extensions are used, corner radii of 30 feet or more may call for a single ramp, allowing crosswalks to be placed closer to intersections. In some cases, a single ramp can force pedestrians into oncoming traffic.

Median Noses

Median noses can be used to help provide a protective refuge for any pedestrians caught in the middle of the street during a crossing, and help to control the speeds of left-turning vehicles. Noses can be deep (6-12 feet), shallow (2-4 feet), or set behind crosswalks when no further extensions are possible. In rare cases, crosswalks can be skewed a few degrees in order to get median noses to fit, although more than a few degrees of skew can be problematic to blind people. Although it is not possible to include median noses on all legs of all intersections, careful attention to design can result in placements in many locations.

General Design Guidance

- Contrasting colors and materials should be used, in order to be more easily detected by approaching motorists.
- Truck turning templates should be used to determine the proper placement of median noses. The structure should be reinforced for the first 6-10 feet, as some large turning vehicles might cross these noses when poor driving judgments are made.
- Reflectors, raised pavement markers (RPMs), and ground cover should be used to aid motorists in detection of islands.

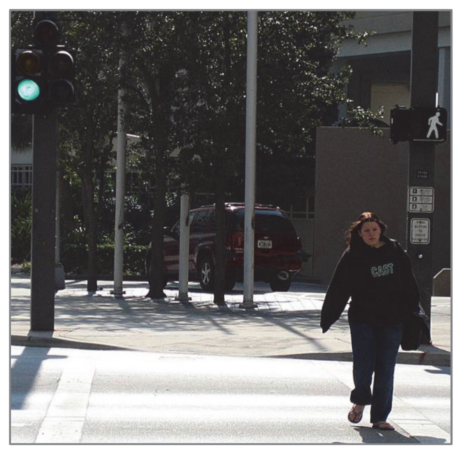


- Landscaping materials, if used, should be kept trimmed to two feet or less to aid motorists in detecting crossing pedestrians. Native plants and low-maintenance materials should be used.
- Some signing is acceptable and necessary. However, signs should not be oversized, overpowering quality landscaping features. Oversized signs or too many signs are an indication that intersections are poorly designed and insufficient landscaping is being used.
- Island widths of eight feet or more are preferred. In some cases, narrower islands may apply. Even a four-foot-wide island is preferred over no island at all.
- Tactile, contrasting surfaces (truncated domes) should be used to denote the median edge.
- Island cuts should be wide enough to permit two people in wheelchairs to pass one another on the island.
- Adequate lighting should be provided.
- If signals are used on very wide multi-lane roads, median islands may require re-activation systems (push-buttons or detectors).

Pedestrian Signals

All signalized intersections require well-maintained pedestrian signal heads on all legs. When signal heads are omitted, pedestrians may not know when they are permitted to cross. Pedestrian countdown signals end much of the confusion that standard signal heads create ("I only had four seconds to cross the street before the hand started to flash at me"), and give a clear idea of the actual time left to complete the crossing. Countdown signals should be used on all new construction projects, and should be used as a retrofit replacement of older pedestrian signals, particularly on multi-lane roadways. Pedestrian push buttons that provide immediate feedback to users concerning a request made for a pedestrian phase are preferred; this is similar to elevator buttons that light up when pushed. Per the 2009 MUTCD, the pedestrian clearance interval at signals should be set for walking rates of 3.5 feet per second in typical areas, and for rates of 3.0 feet per second in areas with a significant population of seniors or those with disabilities. The walk interval for crossings should be no less than 4 seconds, with a minimum 7 seconds a more common time.

Leading Pedestrian Interval (LPI)



An LPI provides the pedestrian a head start in crossing at a signalized intersection (typically 3-5 seconds) before motor vehicle traffic is given a green light, and thereby helps to reduce pedestrian conflicts with turning vehicles. LPIs have been shown to increase the percentage of motorists who yield the right of way to pedestrians because pedestrians are in the crosswalk by the time the traffic signal turns green for parallel vehicle movements. LPIs should be accompanied by an audible noise that lets visually impaired pedestrians know that it's safe to cross. Right-turn-on-red rules can limit the effectiveness of LPIs; thus, restrictions on right-turn-on-red use should be considered in conjunction with LPI implementation.

Exclusive Pedestrian Phase

Also known as a “pedestrian scramble”, this term refers to a pedestrian signal phase that is active only when all conflicting vehicle movements are stopped across an approach to an intersection. Vehicles are stopped while pedestrians are given a WALK indication. Intersections with pedestrian scramble phases often feature pedestrian crossing markings indicating pedestrians may walk diagonally across the intersection. Exclusive pedestrian timing has been shown to reduce pedestrian crashes by 50 percent in some downtown locations with heavy pedestrian volumes and low vehicle speeds and volumes.

“Yield to Pedestrian” Blank-Out Signs

These signs increase awareness of crossing pedestrians at intersections. Signs typically read “Yield to Pedestrians” during the concurrent movement green signal phase; this message can be displayed automatically during all signal cycles or only when the pedestrian phase has been actuated. During conflicting movement phases, the sign can either be blank, or can read “No Rights on Red” if it is desired to prohibit this movement for the benefit of pedestrians legally crossing the path of the right on red movement.

Bicycle Detector Marking

Bicycle detector markings show bicyclists the proper positioning at an intersection to trigger a green light. The marking should be placed over either a separate bicycle-specific loop detector, or over the most sensitive part of a typical vehicle loop detector. Complementary signing is used to reinforce the message to cyclists.

Mid-block Crosswalk

Pedestrians have a desire and need to move freely across streets where they live, shop, go to school, enter and exit transit, and work. Pedestrians will often travel up to 150 feet out-of-direction in order to be rewarded by a well-designed, safe crossing. For blocks longer than 400-500 feet, there may be a need to place crossings and crossing islands if pedestrians are frequently observed crossing mid-block. Suburban locations sometimes have signal spacing of 1,400 to 8,000 feet, making designated crossing locations inconvenient for many.

General Design Guidance

- Identified crossings should be well-placed, well-marked and well-lit. Placement is critical to desire lines (e.g., between a courthouse parking lot and the courthouse).
- Crossings and crossing islands should be designed with the same principles at all locations. They keep crossing distances as short as practicable, provide ideal crossing locations, are convenient, and create no surprise conditions.
- Conflicts can be separated in time and location through use of median islands. Use of these islands becomes more important at higher volumes and speeds.
- Crossing locations should be kept compact, and curb extensions can be used to eliminate the possibility of screening by parked cars and other obstructions.
- W11-1 (bicycle) or W11-2 (pedestrian) signs should be used 200 to 300 feet in advance and at the actual crossing. W16-7p supplemental plaques should be used at actual crossing locations. Pedestrian and bicycle warning signs may be either yellow or fluorescent yellow-green for additional visibility.
- Sufficient lighting should be provided for motorists and pedestrians to detect one another, and competing light and glare should be eliminated or controlled.
- High-visibility crosswalk markings and other pavement messages should be used.
- Safety advantages of near-side, far-side, and mid-block transit stops should be weighed at all potential locations before determining stops.
- Angling the crosswalk opening within refuge islands by 45 degrees toward traffic is a design that forces pedestrians to look toward drivers before going forward across the far-side travel lane.
- Extreme care should be used when designing a marked midblock crossing. Markings and conventional warning signing should not typically be used as stand-alone treatments at crossings of multilane roads, or roads with high speeds or heavy traffic volumes. FHWA's *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations* should be consulted with regard to appropriate treatments at potential crossing locations

A mid-block pedestrian crossing at transit stops in Seattle, WA, which allows pedestrians to cross one direction of traffic at a time with a median refuge. The refuge can be signalized using half-signals, which stop traffic in each direction independently, limiting the amount of vehicle delay incurred.

An angled median break forces crossing pedestrians and bicyclists to face traffic.

under different traffic and roadway characteristics. There are a number of advanced traffic control options available to provide additional visibility and enhanced safety at difficult crossings – some examples are as follows:

- Pedestrian actuated, flashing, in-pavement warning lights.
- Rectangular Rapid Flashing Beacons (RRFBs) have shown great promise in increasing the percentage of motorists who yield to pedestrians. The lights are mounted immediately below the standard pedestrian crossing warning signs placed at the crosswalk (on both the outside of the road and within the median). In one study, motorists have been shown to yield to crossing pedestrians over 82% of the time with RFFBs installed, compared to an average of only 11% with side-mounted round flashing beacons. With the success of the implementation in several U.S. locations, the RFFB has earned interim approval from FHWA for inclusion in the MUTCD. These RRFBs and warning signs should be supplemented with advance pedestrian warning signs and advance yield lines placed approximately 20 to 50 feet in advance of the crosswalk.

RFFB (Source: NACTO)

- Pedestrian Hybrid Beacons (also known as HAWK crossings) have been incorporated into the 2009 MUTCD and can be used in locations where a full traffic signal is not warranted. The HAWK consists of a standard traffic signal RED-RED over YELLOW format. The unit is dark until activated by a pedestrian. When pedestrians wish to cross the street, they press a button which activates a warning FLASHING YELLOW light on the main street. The indication then changes to a SOLID YELLOW advising drivers to prepare to stop. The signal then displays a DUAL SOLID RED and shows the pedestrian a WALK symbol. The beacon then displays an ALTERNATING FLASHING RED and the pedestrian is shown a FLASHING DON'T WALK with a "countdown" signal advising them of the time left to cross. Drivers are allowed to proceed during the flashing red after coming to a full stop and making sure there is no danger to a pedestrian. The 2009 MUTCD contains guidance on when this type of crossing may be appropriate based on the volumes of pedestrians and conflicting vehicles. Although it uses the same treatments as signals and some stop-controlled intersections having flashing red beacons, some education for drivers may also be necessary.

Pedestrian Hybrid Beacon (Source: NACTO)

Appendix D:

Project Lists –

Pedestrian Continuity Projects

Long-Term Bicycle Projects

Table D-1: Pedestrian Continuity Project List – Near-Term (0-5 Years)

Street Name	From	To	Side	Mileage	Type
Allison Ave	Dondee Dr	Seth Child Rd	Both	0.34	Major Collector/Minor Arterial
Allison Ave	Seth Child Rd	Stagg Hill Rd	South	0.08	Major Collector/Minor Arterial
Anderson Ave	College Heights Rd	Midland Ave	North	0.26	Major Arterial
Anderson Ave	Lee St	Sunset Ave	North	0.18	Major Arterial
Anderson Ave	400 ft. west of 14th St	Manhattan Ave	North	0.18	Major Collector/Minor Arterial
Anderson Ave	14th St	Manhattan Ave	South	0.05	Major Collector/Minor Arterial
Claflin Rd	College Ave	Wharton Manor Rd	South	0.24	Major Collector/Minor Arterial
Claflin Rd	Meadowbrook Ln	Heywood Dr	South	0.87	Major Collector/Minor Arterial
Dickens Ave	Wreath Ave	Seth Child Rd	North	0.23	Other Connections
Dickens Ave	Seth Child Rd	Browning Ave	South	0.27	Other Connections
Dickens Ave	Browning Ave	College Ave	North	0.49	Other Connections
Dickens Ave	Jefferson Ridge	College Ave	South	0.23	Other Connections
Dondee Dr	Gillespie Dr	Allison Ave	Both	0.35	Other Connections
Elk Creek Rd	Green Valley Rd	Timbercreek Pkwy	North	0.16	Other Connections
Elk Creek Rd	Timbercreek Pkwy	Excel Rd	Both	0.68	Other Connections
Excel Rd	Elk Creek Rd	Cara's Way	West	0.11	Other Connections
Excel Rd	Cara's Way	Harvest Rd	Both	0.74	Other Connections
Fort Riley Blvd	Poliska Ln	0.15 Mi. west of Richards Rd	North/West	0.28	Major Arterial
Gillespie Dr	Geneva Dr	Dondee Dr	Both	0.07	Other Connections
Griffith Dr	Tuttle Creek Blvd	Brockman St	Both	0.10	Other Connections
Griffith Dr	Brockman St	Northview Dr	South	0.31	Other Connections
Hudson Ave	Kimball Ave	Crescent Dr (N)	West	0.10	Major Collector/Minor Arterial
Hudson Ave	Crescent Dr (S)	Anderson Ave	West	0.75	Major Collector/Minor Arterial
Kimball Ave	College Ave	Meadowlark Rd	North	1.14	Major Arterial
Manhattan Ave	Blue Hills Rd	McCain Ln	East	0.52	Major Collector/Minor Arterial
Research Park Cir	Research Park Dr	End	East	0.09	Major Collector/Minor Arterial
Research Park Dr	Manhattan Ave	End	South/East	0.16	Major Collector/Minor Arterial
Research Park Dr	Manhattan Ave	Research Park Cir	North	0.05	Major Collector/Minor Arterial
Stagg Hill Rd	Allison Ave	Galaxy Dr	South	0.17	Major Collector/Minor Arterial
Stagg Hill Rd	Galaxy Dr	Rosencutter Rd	Both	0.40	Major Collector/Minor Arterial
Sunset Ave	Platt St	College Heights Rd	West	0.09	Major Collector/Minor Arterial
Sunset Ave	College Heights Rd	Hunting Ave	East	0.05	Major Collector/Minor Arterial
Sunset Ave	Fairchild Ter	Delaware Ave	East	0.16	Major Collector/Minor Arterial
Wreath Ave	Claflin Rd	Anderson Ave	East	0.23	Major Collector/Minor Arterial
Subtotal Near-Term				**10.13**	

Table D-2: Pedestrian Continuity Project List – Mid-Term (5-10 Years)

Street Name	From	To	Side	Mileage	Type
Amherst Ave	Oakwood Cir	Seth Child Rd	Both	1.23	Major Collector/Minor Arterial
Amherst Ave	Seth Child Rd	Linear Trail	Both	0.25	Other Connections
Anderson Ave	Hilton Heights Rd	College Heights Rd	North	0.24	Major Arterial
Casement Rd	Tuttle Creek Blvd	Hayes Dr	Both	0.38	Major Arterial
Casement Rd	Hayes Dr	Knox Ln	West	0.40	Major Arterial
Casement Rd	Marlatt Ave	Butterfield Rd	Both	1.18	Major Arterial
Casement Rd	Butterfield Rd	Parker Dr	East	0.10	Major Arterial
College Ave	Marlatt Ave	City Limits	Both	1.03	Other Connections
Davis Dr	Fort Riley Blvd	Wilson Dr	West	0.16	Major Collector/Minor Arterial
Davis Dr	Wilson Dr	Gillespie Dr	East	0.11	Major Collector/Minor Arterial
Denison Ave	Marlatt Ave	Kimball Ave	Both	2.04	Other Connections
Ehlers Rd	Ratone St	Skyline Dr	West	0.15	Major Collector/Minor Arterial
Ehlers Rd	Skyline Dr	Tuttle Creek Blvd	Both	0.40	Major Collector/Minor Arterial
Farm Bureau Rd	Redbud Estates	Seth Child Rd	Both	0.23	Other Connections
Gary Ave	Candlewood Dr	Seth Child Rd	Both	0.17	Major Collector/Minor Arterial
Green Valley Rd	Nature Ave	Elk Creek Rd	East	0.56	Other Connections
Green Valley Rd	Elk Creek Rd	Hunter's Rd	West	0.16	Other Connections
Green Valley Rd	Hunter's Rd	US Hwy 24	East	0.32	Other Connections
Hayes Dr	Casement Rd	McCall Rd	Both	1.41	Other Connections
Hayes Dr	Bluemont Pl	Sarber Ln	Both	0.26	Other Connections
Juliette Ave	Kearney St	Ratone St	West	0.21	Major Collector/Minor Arterial
Knox Ln	Casement Rd	Spruce Pl	North	0.45	Major Collector/Minor Arterial
Knox Ln	Patricia Pl	NE Community Pk	South	0.16	Major Collector/Minor Arterial
Marlatt Ave	1/3 mi. west of Tatarrax Dr	Browning Ave	South	0.51	Major Arterial
Marlatt Ave	Browning Ave	400 ft. west of TCB	Both	2.96	Other Connections
New Trail (along Wildcat Creek)	New Trail (Amherst Extension)	Wildcat Creek Linear Park	Not on-street	0.27	Other Connections
New Trail (Amherst Extension)	Plymate Ln	Anderson Ave	Not on-street	0.46	Other Connections
Poyntz Ave	Pine Dr	Evergreen Ave	South	0.10	Major Collector/Minor Arterial
Sarber Ln	Frontage Rd	US Hwy 24	Both	0.61	Other Connections
Seth Child Frontage Rd	Commons Pl	Frontage Rd	Both	0.22	Other Connections
Seth Child Rd	Farm Bureau Rd	Fort Riley Bl On-rmp	West	0.49	Other Connections
Seth Child Rd	Farm Bureau Rd	Allison Ave	East	0.63	Other Connections
Stagg Hill Rd	Cox Cir	Sunrise Dr	North	0.29	Major Arterial
Stagg Hill Rd	Sunrise Dr	Juniper Dr	Both	0.29	Major Arterial
Stagg Hill Rd	Juniper Dr	Allison Ave	West	0.32	Major Arterial
Sunset Ave	Evergreen Ave	Poyntz Ave	East	0.05	Major Collector/Minor Arterial
Warner Park Rd	Arbor Dr	End	Both	0.48	Other Connections
Westwood Rd	Fort Riley Blvd	Oak St	Both	0.63	Major Collector/Minor Arterial
Westwood Rd	Oak St	Pine Dr	East	0.11	Major Collector/Minor Arterial
Wreath Ave	Kimball Ave	Lundin Dr	East	0.32	Major Collector/Minor Arterial
Subtotal Mid-Term				**20.34**	

Table D-3: Pedestrian Continuity Project List – Long-Term (10-20 Years)

Street Name	From	To	Side	Mileage	Type
3rd St	Thurston St	Bluemont Ave	West	0.20	Major Collector/Minor Arterial
Anderson Ave	Christy Dr	Pebblebrook Cir	Both	1.09	Major Arterial
Anderson Ave	Pebblebrook Cir	Sharingbrook Dr	North	0.38	Major Arterial
Dickens Sidewalk	College Ave	Hillcrest Dr	Not on-street	0.32	Other Connections
Fort Riley Blvd	Westwood Rd	Yuma St	North	0.31	Major Arterial
Fort Riley Blvd	Westwood Rd	Delaware St	South	0.23	Major Arterial
Fort Riley Blvd	Yuma St	11th St	South	0.59	Major Arterial
Fort Riley Blvd	9th St	3rd St	South	0.52	Major Arterial
Fort Riley Blvd	3rd St	K-18 On-Ramp	North	0.10	Major Arterial
Grand Mere Pkwy	Kimball Ave	Grand Ridge Ct	South	0.13	Major Collector/Minor Arterial
Harvest Rd	Excel Rd	Lake Elbo Rd	Both	2.00	Other Connections
Kimball Ave	Grand Mere Pkwy	Anderson Ave	Both	1.44	Major Arterial
Manhattan Ave	Pierre St	Pottawatomie Ave	West	0.32	Major Collector/Minor Arterial
Manhattan Ave	RR Tracks	Pottawatomie Ave	East	0.05	Major Collector/Minor Arterial
Marlatt Ave	Tuttle Creek Blvd	Country Meadow Apts. Entrance	North	0.98	Other Connections
Marlatt Ave	Country Meadow Apts. Entrance	Casement Rd	North	0.10	Major Arterial
Marlatt Ave	Brookpointe Cir	Casement Rd	South	0.18	Major Arterial
Miller Pkwy	End Existing	Scenic Dr	Both	1.31	Other Connections
Scenic Dr	Anderson Ave	Stone Crest Dr	Both	1.89	Major Arterial
Scenic Dr	Stone Crest Dr	Stagg Hill Rd	Both	4.09	Other Connections
Tuttle Creek Blvd	Marlatt Ave	Leavenworth St	Both	0.16	Other Connections
Tuttle Creek Blvd	Leavenworth St	US Hwy 24	West	5.84	Major Arterial
Tuttle Creek Blvd	Leavenworth St	US Hwy 24	East	0.14	Other Connections
US Hwy 24	Tuttle Creek Blvd	Green Valley Rd	Both	5.62	Other Connections
Yuma St	18th St	Rockhill Rd	North	0.09	Major Collector/Minor Arterial
Yuma St	15th St	11th St	South	0.35	Major Collector/Minor Arterial
Subtotal Long-Term				**28.43**	

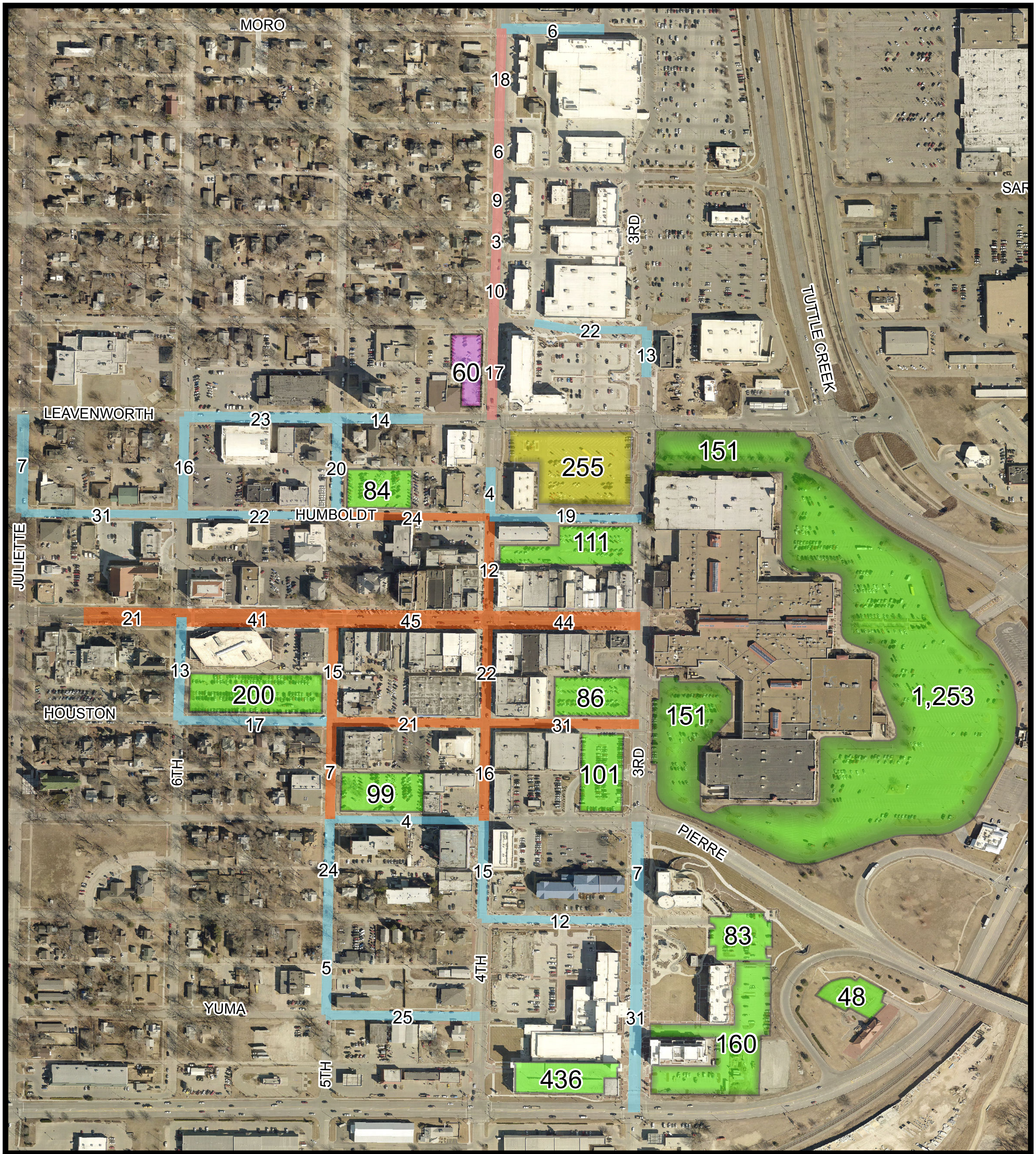
Table D-4: Long-Term Bicycle Facility Recommendations (Facility Type to Be Determined in Future)

Street Name	From	To	Length (mi)
3rd St	Pierre St	Colorado St	0.05
4th St	Vattier St	Moro St	0.15
4th St	Yuma St	Fair Ln	0.11
5th St	Fair Ln	Pottawatomie Ave	0.11
8th St	Ratone St	Thurston St	0.14
10th St	Yuma St	Pottawatomie Ave	0.22
11th St	Claflin Rd	Moro St	0.53
Allen Rd	Tuttle Creek Blvd	Casement Rd	0.53
Allison Ave	Seth Child Rd	Stagg Hill Rd	0.09
Amherst Ave	Oakwood Cir	Farm Bureau Rd	0.97
Anderson Ave	Kimball Ave/Scenic Dr	Pebblebrook Ln	0.30
	Wreath Ave	College Heights Rd	0.90
Candlewood Dr	Gary Ave	Kimball Ave	0.51
Casement Rd	Tuttle Creek Blvd	Hayes Dr	0.20
Claflin Rd	Hudson Ave	Westport Dr	0.83
	Manhattan Ave	11th St	0.18
College Ave	Marlatt Ave	Kimball Ave	1.02
Colorado St	4th St	3rd St	0.09
Denison Ave	Marlatt Ave	Kimball Ave	1.02
Fair Ln	4th St	5th St	0.09
Fairman Dr	Anderson Ave	End	0.26
Firethorn Dr	Hemlock Ave	Amherst Ave	0.18
Fort Riley Blvd	Linear Trail	Westwood Rd	0.29
	Westwood Rd	Yuma St	0.44
Grand Mere Pkwy extension	Colbert Hills Dr	Marlatt Ave	1.06
Harris Ave	Hunting Ave	Montgomery Dr	0.04
Hayes Dr	Sarber Ln	Casement Rd	1.11
Hemlock Ave	Wreath Ave	Firethorn Dr	0.09
Hunting Ave	Lee St	Harris Ave	0.04
Juliette Ave	Yuma St	Pottawatomie Ave	0.22
Kimball Ave	Anderson Ave	Hudson Ave	1.42
	Wreath Ave	College Ave	1.01
Leavenworth St	4th St	Tuttle Creek Blvd	0.19
Lee St	College Heights Rd	Hunting Ave	0.07
Marlatt Ave	Grand Mere Pkwy Extension	Tuttle Creek Blvd	3.35
	Brookpointe Cir	East of Big Blue River	TBD
McCall Rd	Tuttle Creek Blvd	Limey Pl	0.08
Miller Pkwy extension	Scenic Drive	Current End Miller Pkwy	0.72
Montgomery Dr	Harris Ave	Sunset Ave	0.13
New Road	End Fairman Dr	End Wreath Ave	0.25
New Trail along Wildcat Creek	New Trail (Amherst extension)	Wildcat Creek Linear Park	0.33
New Trail (Amherst extension)	Plymate Ln	Anderson Ave	0.53

New Trail East of Connecticut Ave	Anderson Ave	0.14 miles south of Anderson Ave	0.14
Outer Road (E) Adj to Seth Child Rd	Southwind Rd	Linear Trail	0.20
Outer Road (W) Adj to Seth Child Rd	Southwind Rd	Allison Ave	0.54
Pottawatomie Ave	Manhattan Ave	4th St	0.79
Ratone St	Manhattan Ave	8th St	0.44
Sarber Ln	Tuttle Creek Blvd	Hayes Dr	0.17
Scenic Dr	Anderson Ave	Future Miller Pkwy connection	1.27
	Future Miller Pkwy connection	Stagg Hill Rd	1.67
Seth Child Rd	Amherst Ave	Southwind Rd	0.59
Shuss Rd	Brush Creek Ln	Southwind Rd	0.07
Skyway Dr	Scenic Drive	TBD	TBD
Southwind Rd	Shuss Rd	Outer Road	0.20
Stagg Hill Dr	Scenic Drive	Davis Dr	1.85
Sunset Ave	Montgomery Dr	Grandview Dr	0.28
Susan B. Trail extension	Browning Ave	College Ave	0.50
Temple Ln	Pottawatomie Ave	Linear Trail	0.08
Thurston St	Manhattan Ave	5th St	0.71
	4th St	3rd St	0.08
Tuttle Creek Blvd	Marlatt Ave	Hwy 177 Off-Ramp	3.22
Valley Dr	Pierre St	Rockhill Rd	0.13
Vattier St	4th St	Tuttle Creek Blvd	0.11
Waterbridge Rd extension	Anneberg Cir	Wreath Ave	0.63
Westloop Pl	Claflin Rd	Anderson Ave	0.24
Wreath Ave	End	Miller Pkwy	1.00
Total			**34.76**

Appendix E:

Parking Inventory Maps – Downtown and Aggieville



Downtown Public Parking

Street Parking

- Free & Unlimited
- 2-Hour Limit
- Permit Zone

Lot Parking

- Free & Unlimited
- Farmer's Market*
- Senior Center

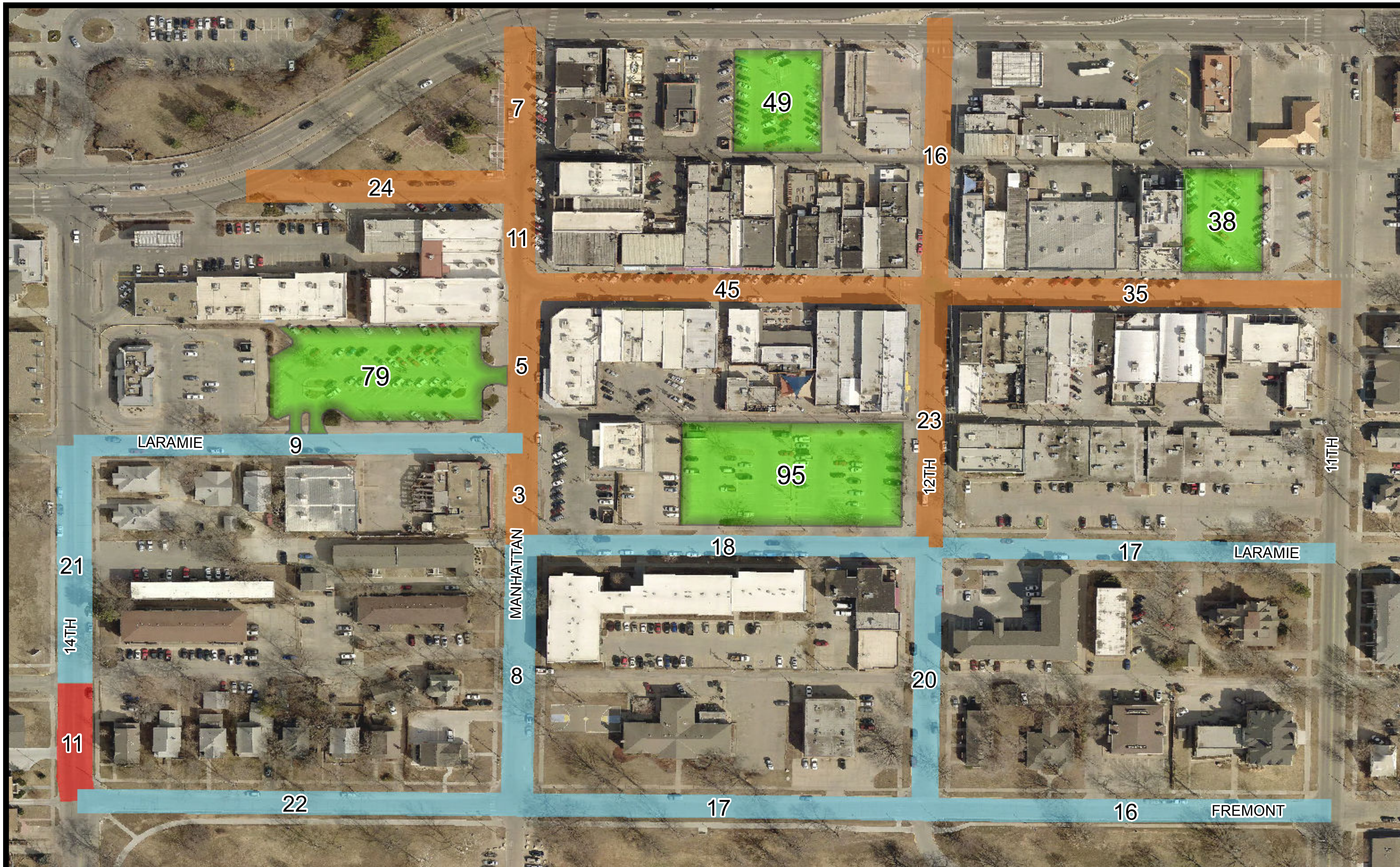
*Unlimited Parking, with the exception of Saturdays 7am to 2 pm, April to October for the Downtown Farmer's Market

Parking Stall Totals (Approx.)

On-Street: Unlimited	354
On-Street: 2-Hour Limit	299
On-Street: Permit Zone	63
Parking Lot: Unlimited	2963
Farmers Market Lot	255
Total Public Parking	**3,934**

0 400 800 Feet

NORTH



Aggieville Public Parking

Street Parking

- Free & Unlimited
- 2-Hour Limit
- Restricted 8am-5pm

Lot Parking

- Public (3-Hour Limit)

Parking Totals (Approx.)

On-Street, Unlimited	148
On-Street, 2-Hour Limit	169
On-Street Restricted	11
Lot, 3-Hour Limit	261
Total Public Parking	589

NORTH

0 200 400 Feet