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CMU Pedestrian Safety Mobility Study

A. Project Planning and Development

Pennsylvania Communities Transportation Initiative

Oakland/CMU Pedestrian Safety and Mobility Study

The heart of academic and medical institutions in the Pittsburgh region, Oakland is a vital component to the continuing growth of Western Pennsylvania. And while serving as both a destination as well as a through route, the integration of vehicles, bicycles, pedestrians and transit is a continuing challenge. This challenge is particularly acute in the two main arterials of Oakland – Fifth Avenue and Forbes Avenue.

Recognizing the need for an integrated approach to congestion mitigation, the Oakland Transportation Management Association (OTMA) was founded to advocate for an infrastructure necessary to support multi-modal access, including walking and bicycling, safety and mobility for all users and creating an overall ease of access to Oakland and its destinations while allowing the necessary through traffic.

Over the last decade, the Oakland Taskforce representing institutions, businesses, community organization and residents, the City of Pittsburgh and the Pennsylvania Department of Transportation, have embarked on an aggressive and systematic approach to improving the core streets of Oakland – Fifth and Forbes. The Schenley Plaza restoration (2006) transformed a parking lot into its original use: a grand entrance to Schenley Park from Oakland. The opening of the collaboratively designed Boulevard of the Allies Bridge portal project (2008) created a gateway to Oakland while realigning access to the regional system and reducing congestion. The Hometown Streets Pedestrian Safety and Mobility Improvement project, co-sponsored by the Oakland Transportation Management Association (OTMA) and the City of Pittsburgh (2009) targeted eleven intersections along Forbes Avenue and Fifth Avenue to install pedestrian improvements and for traffic calming. Finally, the Forbes Avenue eastbound bike lane and westbound curb bump-outs (2010), helped integrate bicycles and calm traffic.

During the progression of those projects and building upon those efforts, OTMA and Carnegie Mellon University (CMU) began a dialogue to identify short term and long term mobility improvements within the CMU campus. In 2009 OTMA and CMU were awarded funding through the Pennsylvania Communities Transportation Initiative to study the impact on pedestrian safety and mobility by all modes. The study addresses both Fifth Ave and Forbes Ave, the main arterials that extend through the CMU campus and connect Oakland to Shadyside and Squirrel Hill, as well as South Craig Street and Morewood Avenue, which serve as connectors between the arterials. In addition to pedestrian safety, the study explored multi-modal, smart transportation components to inform and enhance current land-use planning efforts. By pursuing a “context-sensitive solution” that coordinated transportation planning with local land use, the study builds upon the previous successes and continues to improve the corridors in the City of Pittsburgh.

The elements of the smart transportation project within the study area focused on the following principles:

- + context sensitive design elements
- + enhancements to the local roadway network
- + level of service enhancements
- + intermodal connections
- + leverage new /preserves existing investments

After receiving the grant, OTMA and CMU included representatives from PennDOT, the City of Pittsburgh, Oakland Planning and Development Corporation into a project Working Group. Following a PennDOT endorsed selection process the Working Group selected GAI Consultants, their sub consultants of T.W. Engineering, Incorporated and Kittleson & Associates, Incorporated, to complete the study. The study itself was broken into two major components: the Macro study which assessed Oakland regional trends and land use patterns, and the Micro Study, which analyzed traffic and turning counts, parking supply and demand and ultimately made recommendations for improvements (see project history below).

The results of the full study recommend three near-term improvements (2-5 years) and three mid-term improvements (5-10 years). These recommendations are as follows.

Near Term Recommendations

- + Upgrade all 10 intersections within the study to current traffic signal and ADA standards. (Forbes Avenue and: Craig Street, Hamburg Lot, Morewood Avenue, Beeler Street and Margaret Morrison Street; Fifth Avenue and: Bellefield Avenue, Dithridge Street, Craig Street, Neville Street and Morewood Avenue)
- + Implement a “road diet” of Forbes Avenue within the entire study area from Craig Street to Margaret Morrison Street to include elimination of the curbside motorized vehicular travel lanes and the establishment of bicycles lanes.
- + Implementation of a physically separated two-way trail separate from the sidewalk on Morewood Avenue between Forbes and Fifth Avenues.

Mid-Term Recommendations

- + Urban design enhancements to Craig Street consisting of resurfacing of the street, elimination of individual parking meters and rehabilitation of streetscape elements.
- + Reconstruction of intersections at Fifth Avenue and Neville Street and Morewood Avenue, which have the highest number of vehicle accidents. Improvements would include significant signage upgrades, and curb and sidewalk bulb outs where feasible, to reduce lengths of pedestrian crossings.
- + Further study to consider additional pedestrian crossings of Forbes Avenue in the heart of the CMU campus as the direct result of the major expansion of the Carnegie Mellon University Campus embodied in the 2011 Master Plan.

Project History

August 2008	PCTI Program announced
December 2008	PCTI Application submitted by OTMA & CMU
May 2009	PCTI Project Awards announced
August 2009	Oakland/CMU PCTI project initiated
October 2009	PCTI Working Group formed
March 2010	Contract between PennDOT and CMU signed Advertisements for consultants posted
April 2010	4 Firms shortlisted for Project (GAI, Orth-Roberts, PB and Wilbur Smith)
May 2010	GAI selected and approved by PennDOT
July 2010	Contract between CMU and GAI signed First Working Group meeting / Study Begins
September 2010	Traffic Counts/Movements Recorded
November 2010	Phase 1 report completed Public Meetings on Project
February 2011	Phase 2 Report completed
March 2011	Comments from City, PennDOT, CMU and OTMA
April 2011	Study Complete
June 2011	Final Report issued Next Steps identified

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B. Phase One – The Macro Level Report

Executive Summary

This report addresses the major transportation safety and mobility issues within the Carnegie Mellon campus, and will be incorporated into the CMU Institutional Master Plan 2010. It will be utilized in the future as a core document to facilitate growth of the campus and transform the surrounding street system into a pedestrian and bicycle friendly system, serving not only the future campus, but also the surrounding neighborhoods.

However, it can be much more than that, as the following excerpts from the MOVEPGH document demonstrate:

“The City has acknowledged that an automobile dominated transportation network is not sustainable and has initiated efforts to enhance and augment its network through projects and policy that further diversify its transportation system. A system of finite proportion based on Pittsburgh’s geographic, cultural, and socio-economic setting that has evolved around the Single Occupancy Vehicle cannot be improved through the addition of auto-capacity. It is necessary to take a step back and consider moving people instead of their cars.

The paradigm shift of moving people, goods and services rather than just automobiles will guide the provision of safe and efficient facilities (for all modes) to the greatest extent possible. A greater degree of equity between modes and Quality of Service improvements that affect transportation choice will support modes that enhance our quality of life and constitute a performance-based system. The intent is to apply a Complete Streets policy approach across a collection of rights of way to produce a Complete Multimodal System. MOVEPGH will identify the transportation policy and multimodal system development opportunities that allow the City to accomplish this. Consequentially, MOVEPGH will outline strategies to enhance safety, maximize transportation efficiency, decrease Single Occupancy Vehicle dependency, and position the City to secure project funding. Safety is paramount when considering transportation. The City’s transportation network can be best defined as a spaghetti network of pot holed, circumlunar, one-way, narrow streets that can puncture tires, shorten site lines, and confuse drivers. Nevertheless, speeding and aggressive driving continue to be a major issue for law enforcement. With the rising number of bicyclists and pedestrians, speeding and aggressive driving hazards are greatly amplified. It is anticipated that improved design, policy, and enforcement initiatives will directly result in safer streets as well as improved efficiency for all street users.

In recent years, the number of commuting cyclists and pedestrians has been growing within the City. According to the 2008 American Community Survey, the City ranks 16th (1%) in the nation for commuters who bike to work and ranks second (12.4%) for those who walk to work. This is ultimately a result of nearly 15% (American Community Survey, 2008) of the City’s residents not owning an automobile. These percentages are expected to increase as the City actively encourages residents to walk and/or bike to work, school, church, the grocery store, etc. instead of driving. As a result, a need for enhancements to improve the City’s biking and walking friendliness must be addressed. The City’s over arching goal is to continue this trend and encourage residents to leave their cars at home”.

With this bold effort, the city itself will be transformed. In addition it is quite clear the results of the Oakland /CMU Pedestrian Mobility study can become the model for implementing the strategies of MOVEPGH and an outstanding showcase for the paradigm shift of putting people ahead of vehicles.

The study has already enlightened many stakeholders to the major issues all of which have a direct effect on the movements of people: the students, faculty employees of Carnegie Mellon University, as well as the public at large within the study area. The six major issues are as follows:

- + Lack of ADA and Traffic Signal Standards Compliance at Intersections
- + Lack of Long Term Pavement Markings at Intersections
- + Lack of Wayfinding/Destination Signage
- + Narrow Sidewalks – Far Below Required Capacity
- + Lack of Buffer Between Sidewalks and Vehicle Travel Lanes
- + Excess Speeds on Forbes and Fifth Avenues

All of these issues directly affect the entire campus and neighborhood population. In our investigation of accidents, while there was no apparent direct correlation to the pedestrian and bicycle accidents, as well as overall accidents, that any one intersection is of particular concern for pedestrian safety in the study area. However, the overall number of pedestrian crashes, as well as the total number of crashes does represent a significant traffic safety concern, and will be addressed via our final recommendations and resolution of the six (6) issues noted above.

Our analysis of the overall parking situation has revealed that there is significant underutilization of major automobile facilities across the entire campus, with some facilities less than 50% utilized at midday. Conversely, there is a strong and growing demand for additional bicycle parking throughout campus, with one-half of the bicycle racks at or over 100% utilization.

In our development of the land use components, it became vividly clear that while east-west movement within the current campus plan were adequate, and significantly improved in the proposed 2010 Master Plan via the addition of facilities across the Neville/Boundary Street ravine, the same cannot be said for north-south movements, where there is a severe deficiency for all users, and in particular significant restraints to the movement of pedestrians via existing north south corridors. These movements are particularly compromised by the lack of sufficient crossings of the entire length of Forbes Avenue within the study area, as well as the eastern portion of Fifth Avenue.

The result of our focus on the six (6) major issues and the balance of our investigations to date have lead us to the development of concepts for, first and foremost, increasing the safety of the ten (10) intersections and travel corridors between them while also becoming the catalyst to a transformation of these corridors into truly pedestrian and bicycle friendly facilities. Due to the numerous deficiencies our broadest effort was on Forbes Avenue where separate traffic calming, pedestrian and bicycle focused concepts were developed, while realizing the final recommendation may well be hybrid of all three (3) concepts. For Morewood Avenue, Fifth Avenue, and Craig Street the limitations of right-of-way, buildings, and topography all played a role. However, viable options have been presented to significantly enhance safety on each of these facilities.

With the upcoming input of the key stakeholders: Carnegie Library of Pittsburgh, Carnegie Museums of Art & Natural History, City of Pittsburgh School Board, Craig Street Merchants, Diocese of Pittsburgh-Central Catholic High School, Oakland Community Council, Port Authority of Allegheny County, Shadyside Action Coalition, Squirrel Hill Urban Coalition, and the University of Pittsburgh, we will achieve a sense of consensus and priority for moving the concepts forward into sound recommendations. Furthering these efforts will be a public workshop to be held to assist GAI and the project sponsors, the Oakland Transportation Management Association and Carnegie Mellon University to finalize the range of recommendations.

In conclusion, we feel the objective of the study afforded via the funding of PennDOT's Pennsylvania Community Transportation Initiative Program will be well served by the outcomes and recommendations. We also feel the transformation of the study area into a "people first" pedestrian and bicycle friendly environment will become a model for the city and the region.


Section 1 - Identification of Major Transportation, Safety, and Mobility Issues

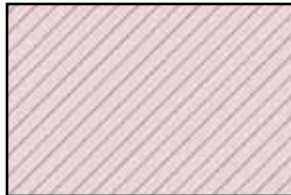
The discussion below is a compilation of observations from three (3) field views conducted by the staffs of GAI Consultants and Kittleson Associates, over a three (3) month period from June through September 2010. The field view encompassed the entire study area as shown on Figure 1 which follows. Although some contributing factors listed below have changed slightly since the field views were conducted, six (6) major issues within the study area have been demonstrated consistently.

Figure 1
**Study Area &
Master Plan Overview**

The study area addresses both Fifth Avenue and Forbes Avenue, main arterials that extend through the CMU campus and connect Oakland to Shady-side and Squirrel Hill, as well as South Craig Street and Morewood Avenue, which serve as connectors between the arterials. The two avenues, key east-west arterials, also serve as important inter-campus connections and, more often than not, act as barriers to the campus. Forbes Avenue effectively bi-sects the campus, creating pedestrian/vehicle conflicts throughout the breadth of the campus. Fifth Avenue, on the northern edge of the campus, creates a similar condition for many students who live in the dense residential area of North Oakland. Both South Craig Street and Morewood Avenue are important pedestrian and vehicular connections, and are integral to the campus community.

Key

 Existing Buildings

 Proposed Development

Source: CMU's 2010 Campus Master Plan is shown as the base condition for proposed development

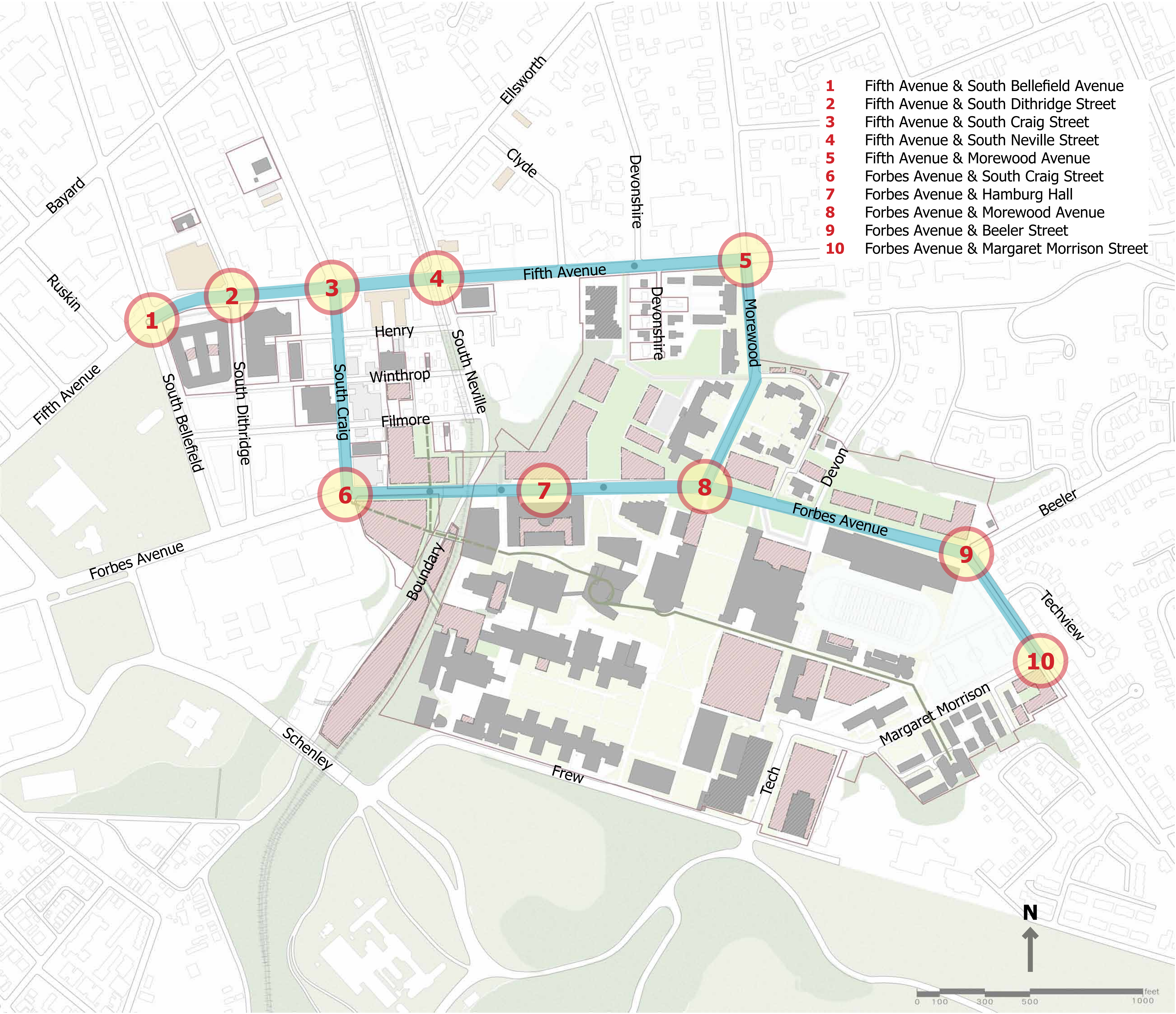
**Oakland/CMU
Pedestrian Safety Mobility Study**
October 15, 2010



PCTI
PENNSYLVANIA COMMUNITY
TRANSPORTATION INITIATIVE
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Management Association
Carnegie Mellon



gai consultants
transforming ideas into reality.



A. Major Issues

1. Lack of ADA and Traffic Signal Standards Compliance at Intersections

Curb ramps enable persons in wheelchairs and with strollers to safely and easily cross at intersections, and are required in order to meet federal ADA accessibility standards. Two (2) directional ramps are normally provided at each corner, with one (1) leading to each crosswalk. All study area intersections have at least some form of curb ramp, but all the curb ramps in the study area are non-compliant with current standards, and many individual crosswalks do not have corresponding ramps. For instance, Fifth Avenue lacks curb ramps on its southern side at the unsignalized intersections between Neville Street and Morewood Avenue.

Pedestrian signal heads indicate to pedestrians when they are permitted to use a crosswalk at a signalized intersection. More importantly, the pedestrian clearance interval (i.e., the flashing don't walk phase) warns pedestrian of an impending phase change, allowing pedestrians to safely clear the intersection prior to traffic entering the intersection. Without pedestrian signal heads, many pedestrians are either stranded in the crosswalk after the phase changes or are unclear on whether it is safe to cross, creating a potentially unsafe situations.

Note that all new pedestrian signals must include countdown timers per the MUTCD to inform pedestrians of the time remaining in the flashing "don't walk" phase.

Most of the signalized intersections in the study area have traditional pedestrian signal heads, while other intersections have no pedestrian signals at all. No intersections currently have countdown pedestrian signals. Intersections with no pedestrian signal heads should be prioritized for pedestrian signal head retrofits as soon as possible. Existing pedestrian signal heads should be replaced with countdown timers.

Proposed Solution: Develop an implementation plan to upgrade all ten (10) intersections within the study area to current ADA and traffic signal standards. Refer to Appendix B (pgs. 3-5) for an overview of this item of work.



Photo 1 -- A busy intersection, Fifth at Neville, with substantial elderly pedestrian crossings but no ADA ramps at this crossing.

2. Lack of Long Term Pavement Markings at Intersections

Marked crosswalks indicate to motorists the location of a crosswalk and can be accompanied by signs, curb extensions, and/or median refuge islands. Most signalized intersections in the study area, as well as several unsignalized locations, have marked crosswalks. However, none of the crosswalks feature high-visibility striping and all were extremely faded. The lack of long-term, well-defined crosswalks, stop bars, and lane striping represents a significant safety and mobility issue, particularly for incoming freshmen and graduate students who are unfamiliar with the campus, and may be unaccustomed to urban street conditions. Although the City does repaint the crosswalks periodically, there is a need for more aggressive striping and marking throughout the study area, preferably with more durable material than paint. In addition, all crossings within the study area should be variable width, a minimum of 8-feet, and up to 20-feet wide, dependent upon the results of the traffic counts.

Proposed Solution: Develop an immediate action plan to install special emphasis, variable width, barred cross walk markings in epoxy paint, at all ten (10) study area intersections. Refer to appendix B (pg. 6) for an overview of this proposed action.



Photo 2 - Morewood at Forbes Avenue, a high-density pedestrian crossing with no visible pedestrian crosswalks.

3. Lack of Wayfinding/Destination Signage

A comprehensive pedestrian and bicycle network connects destinations and enables people to travel safely and comfortably between locations. As a campus environment with a traditional urban street grid, the study area generally has good connectivity. The primary exception is Junction Hollow ravine that cuts through the campus along South Neville and Boundary Streets, with the only crossings at Forbes Avenue on a bridge, and at Fifth Avenue. In addition, Neville Avenue/Boundary Street lacks pedestrian facilities, even though there is access to buildings and parking from this roadway that could generate considerable pedestrian and bicyclist activity. Future planned improvements that add an additional link for pedestrians and bicyclists will help improve network continuity.



Photo 3 - The major outbound bus stop at Forbes and Morewood for commuting students, with no local or campus wayfinding present.

Wayfinding systems indicating the location of destinations, transit facilities, and areas of interest are beneficial to all roadway users. Wayfinding targeted at cyclists typically includes distance and average travel times to these destinations, while pedestrian wayfinding often include maps, directions, and point of interest.

All existing wayfinding in the study area is directed at drivers, indicating City- and University-related destinations. While there are some signs at recently built and acquired buildings, and at information desks within core buildings, there remains an opportunity to complement the existing wayfinding with much more detailed information for bicyclists and pedestrians, as well as vehicles. Hard evidence of this is demonstrated in Figures 3 through 6, which show that while multiple parking facilities are at capacity, numerous large facilities and a surprising number of bicycle racks are underutilized, many near the core areas of the campus. The initial wayfinding signage will be of course static. However, interactive signing that can be applied to smart phone internet and vehicle interfacing should be a long-term goal.

Off-street pathways provide additional connectivity, and a comfortable pedestrian and bicycling environment when well-designed. If there are a high volume of users, wider paths and striping, or other treatments can be used to decrease conflicts between bikes and pedestrians.

The Carnegie Mellon University campus provides a number of off-street pathways. However, the near total lack of internal campus signage makes these pathways underutilized. There are considerable opportunities via an aggressive signing campaign to connect these to a more complete pedestrian and bicycle network in the study area, which already exists as vividly depicted in Figure 10.

For example, there is currently no way for students to realize that there are major campus facilities across the Forbes Avenue Bridge toward the west, where there are six (6) major buildings. (See Figure 1).

Proposed Solution: Develop concept plans for a three-tiered plan for wayfinding and destination signing. The first tier would be to develop a concept plan for an internal static wayfinding and destination signing plan for internal use throughout the Carnegie Mellon Campus. The second tier would be to implement the city-wide effort to upgrade destination signage and integrate it via the city-wide “City of Pittsburgh Bicycle Route and Sign Plan” with supplemental signage for major Carnegie Mellon University destination elements throughout the study area. The third-tier would be a full interactive wayfinding system, with complete interactive capabilities with vehicle telematics systems and smart phone applications. Refer to Appendix B for an overview of the scope of the proposed.

4. Narrow Sidewalks – Far Below Required Capacity – With Additional Restrictions

Much of Forbes and Fifth Avenues have relatively narrow sidewalks, five feet or less and immediately adjacent to the travel lane. Wider sidewalks and/or more separation between pedestrian and cars would make both roads a safer and more attractive pedestrian environment and provide opportunities for safe bicycle routing.

In general, sidewalks should have adequate width to accommodate persons in wheelchairs, allow pedestrians to pass one another, and provide comfort for pedestrians to walk two or three abreast in high activity areas. The U.S. Access Board specifies that sidewalks should be at least 4-feet wide at all times, including locations where fixed elements obstruct a portion of the path. While nearly all locations met these requirements, there are several specific locations (e.g., Forbes Avenue/Beeler Street) where poles, hydrants, etc., are in the sidewalk, and reduce the effective width close to or below the legal minimum.

In an attempt to establish a campus-like environment throughout the corridor, and to reposition Forbes Avenue as the “Main Street” to the campus, minimum standard widths should be established for the entire campus environment. In the campus core, around the “Cut” and the “Mall”, the sidewalks are 8-feet wide; this should be the minimum standard where practical along all city streets in the study area. In many locations there will likely be a need for even wider sidewalks, especially at the more congested intersections where pedestrians and bicyclists congregate for various reasons (i.e. transit stops and high volume intersections) with exclusive pedestrian phases.

The lack of facilities and good alternatives for bicyclists has prompted risky bicycle riding behavior, and many riders use the already narrow sidewalks, in particular along Forbes and Fifth, but also notably along Craig Street, considered a bicycle friendly environment. The principal inhibiting factors are obvious in Figure 10, which depicts the bike routes. Notably, Forbes Avenue is a cautionary bike route over its entire length in this study area. Fifth Avenue is cautionary for



Photo 4 - Northeast corner of Morewood at Forbes Avenue. The landing area for wheelchair occurs over block stone and grass. The block stone is utilized in numerous places along Forbes Avenue in an attempt to widen pedestrian pathways. The area settles and subsequently becomes filled with silt and standing water during rains and ice in freezing weather.



Photo 5 - An area along Fifth near Morewood Avenue with a recently constructed sidewalk far below standards.

Bellefield Avenue to Neville Street, but not even denoted at the cautionary level, indicating unsafe and not recommended passage from Neville Street to Morewood Avenue.

Creating dedicated bicycle facilities to connect such existing “bikable” streets, and other bicycle facilities provides the highest benefit to cost ratio of any bicycle improvements. Just as with pedestrian facilities, a complete network of safe and comfortable bicycle routes will encourage more cycling and prompt better riding behavior.

Proposed Solution: Develop a long range plan to reconstruct all sidewalks within the study area and abutting the campus boundaries to create a true campus environment for all users, pedestrians, and cyclists alike. The final plan should reflect the typical sections developed for the Study, either by retaining the curb alignment or by offset alignments with the creation of verges/tree lawns. Refer to Figures 13 through 17 for concepts to provide this system.

5. Lack of Buffer Between Sidewalks and Vehicle Travel Lanes

Sidewalks not only need to provide adequate width for walking, but should also provide sufficient separation between pedestrians and vehicles to create a comfortable walking environment. Separation can be achieved through wider sidewalks, landscape strips/verges, tree islands, and/or on-street parking. While some sidewalks such as Craig Street, in the area do have separation and thus are inviting to pedestrians, most sidewalks in the study area have insufficient buffer areas between the sidewalk and the travel lanes. This is particularly true along Forbes and Fifth Avenues. Wider sidewalks and/or more separation between pedestrians and cars would make both roads a more attractive pedestrian environment. This is dramatically shown on Figure 11, where almost no trees exist between sidewalk and curb, and almost all sidewalks are adjacent to the curb.

Landscaping can affect pedestrian comfort both positively and negatively, and should be considered in design of sidewalks and pathways. Some sidewalks in the study area have buffer strips of grass or planted trees, a verge, or tree lawn, between the roadway and the sidewalk, which can make the sidewalk feel safer and more protected from the roadway.

However, it should be noted that this will be challenging and will likely require additional elements to be addressed, such as the need to dedicate permanent public easements if sidewalks are relocated onto university property.

Proposed Solution: Develop a phased short and long range plan in concert with Major Issue 4, and in concert with the Master Plan to create verges or tree lawns to reposition Forbes as the “Main Street” of campus. The final plan should fully or closely match all typical sections developed for the Study. See Figures 13 and 14.



Photo 7 - This photo was taken along Morewood Avenue the major access route to dormitories and fraternity houses. Not only is no buffer afforded here, but pedestrian couples passing in opposite directions, a common occurrence, cannot pass each other. Therefore, on occasion pedestrians will step in the street to pass.



Photo 8 - A buffer or tree lawn here would eliminate the need for pedestrians to move around this light pole along Forbes Avenue near Beeler Street. Settlement of the block stone here approaches 6 inches.

6. Excess Speeds on Forbes and Fifth Avenues

The exclusive pedestrian phases at several intersections within the study area create large queues at the intersection and large gaps of traffic free roadway in the street section beyond the signal. Upon a green signal, these large queues form platoons of vehicles that move along the nearly empty streets at high rates of speed. Both Forbes and Fifth Avenues, as four-lane sections, create an obvious invitation to move at higher speeds, as well as fostering attempts to “beat” the next red phase at the upcoming intersection. Refer to Figures 13 through 17 for alternative concept designs for Forbes and Fifth Avenue, and Craig and Morewood Streets.

This creates a substantial risk for much slower moving bicyclists and to crossing pedestrians. (Note that signs are properly posted in much of the study area prohibiting bicyclists from riding on the sidewalks in accordance with Pennsylvania law banning bike riders from the sidewalk in business districts). However, the lack of safe and comfortable on-street alternatives, along with the observed high speeds causes many cyclists to continue to ride on the sidewalk. In addition, frequent buses and the lack of dedicated bicycle facilities simply prevent many cyclists from comfortably riding on the roadway. Thus, bicycles have no reasonable alternative to traverse campus.

While exclusive pedestrian phases can improve safety and operations by eliminating pedestrian-vehicle conflicts, they are not appropriate in every situation. Exclusive pedestrian phases result in longer total cycle lengths, which increase average intersection delay for pedestrians and motorists alike. In addition, pedestrians often choose to ignore the signal and cross with parallel traffic movements, which can create conflicts with turning vehicles. Noticeable noncompliance with the exclusive pedestrian phases is evident at all intersections where it is employed in the study areas. Further analysis will be conducted when the capacity analyses are completed for the intersections to determine if the exclusive phases can be eliminated without raising safety concerns.

The land use map, Figure 7, notes the heavy movement of pedestrians moving north-south through the study area, which automatically requires crossing Forbes and/or Fifth Avenues, while the closely spaced intersections of Bellefield Avenue, Dithridge Street, and Craig Street can handle these flows, the wide spacing of signals, and therefore pedestrian crossings, throughout the balance of the study area, forces high concentration of pedestrians that utilize existing crossings, or indirectly encourages jaywalking. This pent up demand for additional pedestrian crossings of Forbes Avenue provided at Craig Street



Photo 9 - This photo was taken at 5:15 PM during weekday rush hour. The shot looks east on Forbes Avenue back towards Craig Street. It clearly demonstrates the effect the exclusive pedestrian phase at Craig Street produces by creating large gaps in vehicle occupancy between the exclusive pedestrian phases. Subsequently, during the green phase of the following cycle a large platoon of vehicles is released accelerating to high speed well above the speed limit due to the open road condition.

where significant pedestrian noncompliance occurs outside of the exclusive pedestrian phase, with pedestrians often crossing at will.

The demand for an increase in pedestrian crossings cannot be ignored, and will require solutions along Forbes Avenue, especially from Craig Street to Beeler Street, a distance of nearly two-thirds of a mile, with only three (3) pedestrian crossings through the heart of the CMU campus.

Figures 1 and 10 vividly demonstrate the inadequacy of north-south pedestrian movement with no pedestrian through movements accommodated between (and across) Forbes and Fifth, from Craig Street to Morewood Avenue, a distance of over 1500-feet.

Proposed Solution: Develop a plan for the elimination of the exclusive pedestrian phase, which contributes to excessive speeds on Forbes and Fifth Avenues, and confirm that intersection capacities would not be lowered below acceptable levels. Pedestrian movements would then be accommodated via the normal phases of the traffic signals, along with leading pedestrian intervals implemented in the traffic signal timings and coordination plans, and by introducing additional crossings of Forbes Avenue. In addition, the concept plans are presented on Figures 13 through 16 depict significant measures for calming traffic on Forbes and Fifth Avenues, which will greatly enhance pedestrian and bicycle safety, the key objective of this study. (The implementation of the 2010 Master Plan will yield additional crossing design lines across Forbes Avenue and future action/new crossings).



Photo 10 – This photo taken at the height of rush hour shows the problem of jaywalking between Morewood Avenue and Craig Street.

B. Specific Intersection Issues Which Affect Safety and Mobility

1. Fifth Avenue at Bellefield Avenue

- + Lack of advance directional signing. The current signing is too close to the intersection and causes confusion during peak hours.
- + A very large depression exists in the left turn lane on Bellefield at Fifth, slowing traffic in the lane to a near crawl condition and/or causing sudden weaving into the center lane to avoid the situation.
- + No pedestrian signals exist.
- + Dual left turns from Northbound Bellefield Avenue to Westbound Fifth Avenue are prevalent, although this move is prohibited.
- + Lack of guide striping for left turn and right turn movements.
- + Lack of “No Pedestrian Crossing” signage on the east side of the intersection.

2. Fifth Avenue at Dithridge Avenue

- + Excess speeds on Fifth, greater than 35 miles per hour.
- + The pedestrian signal on northwest corner is blocked by foliage.

3. Fifth Avenue at Craig Street

- + No pedestrian signal head on the southeast corner, only a three-section signal head exists there.
- + Lack of advanced directional signage for left turn lanes on north and southbound movements on Craig.
- + Significant pedestrian noncompliance to exclusive pedestrian phase.
- + Significant bicyclist noncompliance to exclusive pedestrian phase.

4. Fifth Avenue at Neville Street

- + Illegible northbound turning restriction timing on northbound Neville.
- + Excessive queuing of school buses at Central Catholic blocking eastbound curb lane of Fifth Avenue, from approximately 2:30 PM to 3:30 PM. The overall length of this queue varies but generally occupies two (2) blocks, Craig Street to Neville Street, and Neville Street to just slightly beyond mid-block eastward to Morewood Avenue. This causes a severe degradation of capacity on Fifth Avenue, which persists into the PM peak hour.
- + Idling of same school buses in the above queue formation.
- + A Catholic priest is directing traffic mid block on Fifth Avenue between Neville and Morewood Streets during the school bus period noted above.

5. Fifth Avenue at Morewood Avenue

- + A nearly full lane offset exists for southbound and northbound through movements on Morewood Avenue crossing Fifth Avenue
- + High speeds exist on Fifth Avenue, approximately 40 mph.

6. Forbes Avenue at South Craig Street

- + Blind pedestrians are not accommodated in ADA crosswalks, although signage is present.
- + Neither campus nor Port Authority buses are using turnout along eastbound Fifth Avenue.
- + Neither campus nor Port Authority buses pull to the curb to discharge or board passengers, blocking both lanes in peak hours and the thru lane in off-peak hours, right lane on westbound Forbes.
- + Buses along right lane of eastbound Fifth Avenue encroach into eastbound through lane to navigate the short radius without overtopping sidewalk area at southeast corner of intersection, causing a potential for sideswipe accidents.
- + Significant pedestrian noncompliance to exclusive pedestrian phase.
- + Significant bicyclist noncompliance to exclusive pedestrian phase.
- + Narrow crosswalks exist throughout the intersection
- + Pedestrians are unaware of the requirement to activate the exclusive pedestrian phase, thereby often blocking the sidewalk or occupying vehicle lanes in the street waiting for the cycle to be activated.

7. Forbes Avenue at Hamburg Hall

- + High speeds exist on Forbes Avenue, approximately 40 mph.
- + Crosswalks not recently restriped, although all others on Forbes Avenue were recently done.
- + Large gaps in through traffic eastbound and westbound exist due to the platoon effect of the exclusive pedestrian phases at both Craig Street and Morewood Avenue. Therefore at the end of the pedestrian cycle moderate to large platoons of vehicles are released along Forbes Avenue, often at high speeds
- + Very high incidence of jaywalking exists between Morewood Avenue and Hamburg Hall and parking driveway, significantly encouraged by the large gaps in vehicle traffic due to the platoon effect mentioned above in item A.6.

8. Forbes Avenue at Morewood Avenue

- + Extremely narrow through sidewalks exist on all approaches.
- + High speeds on Forbes Avenue, approximately 40 mph.
- + Extremely narrow crosswalks exist.
- + Large pools of patrons at both eastbound and westbound bus turnouts, essentially blocking sidewalks.
- + Pedestrians pool and stand in the bus turnout lane in peak hours due to lack of adequate storage at bus stops on the narrow sidewalks

- + All Buses, campus and Port Authority, routinely do not fully pull into eastbound and westbound bus turnouts.
- + Conflicts exist with substantial bicycle through traffic on Forbes and buses idling in through lanes to pickup or discharge passengers, with bicyclists occasionally weaving between patrons and the buses they are boarding or alighting from rather than routing around buses to the left to avoid high speed traffic on Forbes Avenue
- + The narrow ADA ramp to the “The Cut” is also highly utilized by bicyclists, setting up conflicts between disabled and bicyclists.
- + A tripping hazard exists in the western crosswalk due to a sunken water valve box in the center of the crosswalk approximately 3-inches deep.
- + A drop off of approximately 6 inches exists to a storm drain at rear edge of sidewalk at southwest corner.
- + Significant pedestrian noncompliance to exclusive pedestrian phase.
- + Significant bicyclist noncompliance to exclusive pedestrian phase.
- + Idling campus buses dwell in the holding area in front of the Morewood Gardens dormitory.



Photo 13 - Cyclist utilizing ADA ramp from the main campus “Cut” to Morewood Avenue. This is the only ADA access to and from the “Cut”, the main pedestrian circulation area of the existing main campus.



Photo 11 - At the outbound bus stop at Forbes and Morewood Avenue, heavy loads of commuting students congregate to depart campus during evening rush hour. The burgundy bus is in the right travel lane of Forbes Avenue, blocking the through traffic (and had arrived at the stop prior to the gold bus). This location should be further studied for development of a full transit platform per Chapter 914 of the City of Pittsburgh Development Code.



Photo 12 - Bicyclist is blocked from proceeding through bus loading area due to narrow sidewalk. (behind the left pool of pedestrians). The potential exists here to provide a path for through pedestrians and bicyclists to bypass the bus patrons and provide pedestrian access around the rear side of this shelter.

9. Forbes Avenue at Beeler Street

- + Additional “no pedestrian crossing” at west side of intersection appears warranted due to alignment of this intersection.
- + High speeds on Forbes Avenue exist along the curb lane as drivers weave into the through lane to avoid lane drop at Margaret Morrison Street.
- + No pedestrian signals exist.

10. Forbes Avenue at Margaret Morrison Street

- + Lack of pedestrian signals.
- + Foliage of trees blocking “right turn only” signage in eastbound lane.
- + Limited use of eastbound right turn lane overall, especially in peak hours.
- + Weaving of traffic from right turn lane at the intersection into the through lane eastbound, occasionally beyond the intersection.



Photo 14 - Eastbound rush hour traffic near Margaret Morrison Street. The right turn lane is lightly utilized here, which causes extensive weaving mid-block and occasional weaving through the intersection at Margaret Morrison Street, an unsafe practice.

Section 2 – Accident Analysis

Crash Data Analysis Approach

The study area includes ten (10) intersections located along Fifth Avenue and Forbes Avenue in the vicinity of the Carnegie Mellon University campus in the Oakland neighborhood of Pittsburgh, Pa. Crash data for the study area was obtained from PennDOT and covers years 2005 through 2009. The data shows that there were a total of 93 crashes over this period, of which 77 occurred along Fifth Avenue and 16 along Forbes Avenue. There were 44 injury-causing crashes, and one (1) led to a fatality. Additionally, ten (10) of these crashes involved pedestrians or bicycles. Table 1 shows a breakdown of the details for each of these crashes, while Table 2 shows the breakdown of all crashes by year and type.

Pedestrian crashes occurred at seven (7) different intersections, and from the data, it is not apparent that any one intersection is of particular concern for pedestrian safety in the study area. However, the overall number of pedestrian crashes, as well as the total number of crashes (particularly along Fifth Avenue at Neville Street and Morewood Avenue) does represent a significant traffic safety concern. There is likely an opportunity to improve safety for all road users along these corridors. The information collected through the field review, data analysis, and improvements toolbox will be used to identify specific improvements to address these safety challenges.

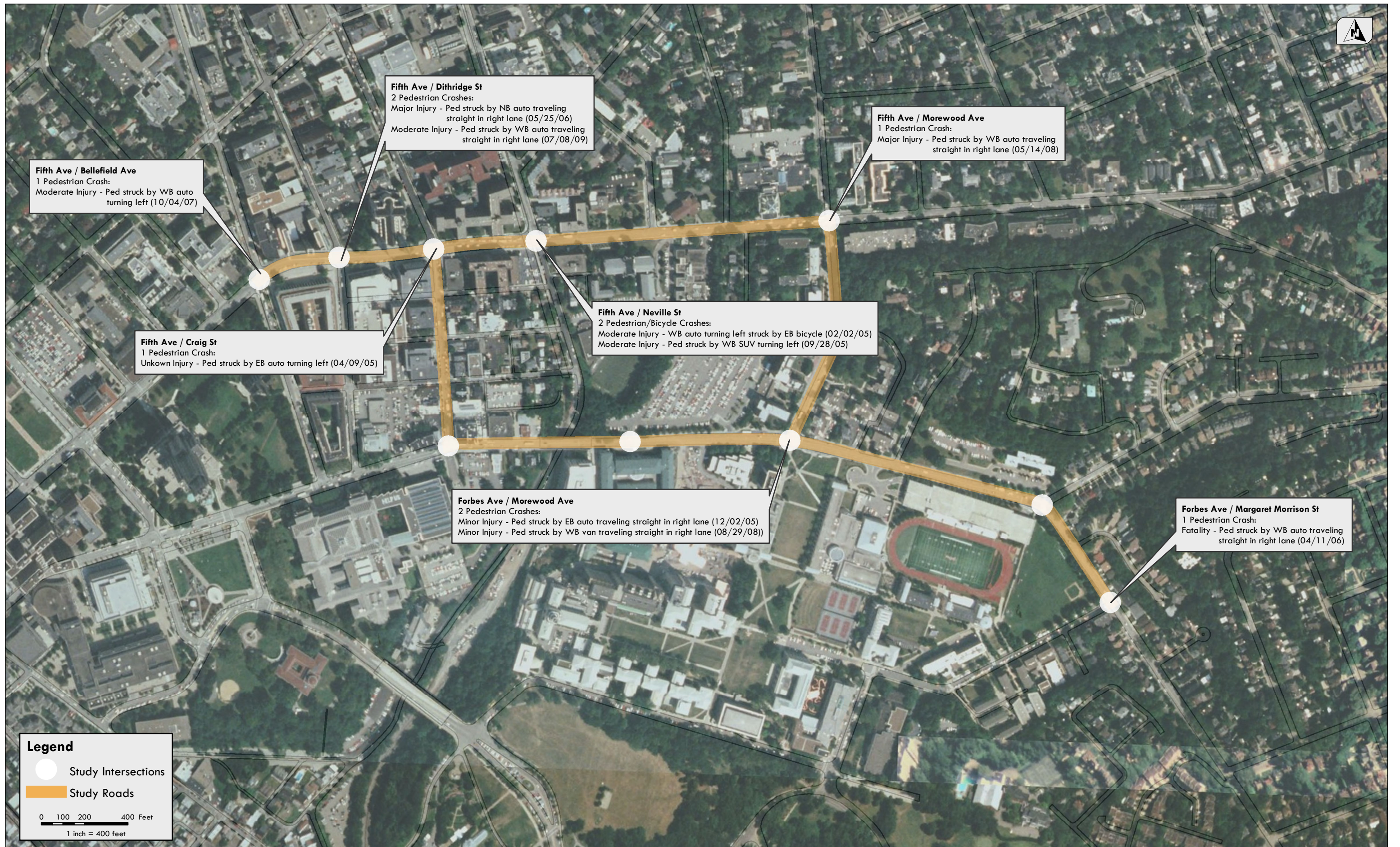


Figure 2: Pedestrian Crash Locations
Oakland/CMU Pedestrian Safety Mobility Study

October 2010

Table 1: Pedestrian and Bicycle Crash Details

Intersection	Date	Crash Description	Type	Injuries	Severity
1 - 5th Ave & Bellefield Ave	10/4/2007	Pedestrian struck by WB turning left in LTL	Ped	1	Moderate
2 - 5th Ave & Dithridge St	5/25/2006	Pedestrian struck by NB auto traveling straight in RL	Ped	1	Major
2 - 5th Ave & Dithridge St	7/8/2009	Pedestrian struck by WB auto traveling straight in RL	Ped	1	Moderate
3 - 5th Ave & Craig St	4/9/2005	Pedestrian struck by EB auto turning left in LTL	Ped	1	Unknown
4 - 5th Ave & Neville St	2/2/2005	WB auto turning in LTL struck by EB bicycle traveling straight in RL	Angle	1	Moderate
4 - 5th Ave & Neville St	9/28/2005	Pedestrian struck by WB SUV turning left	Ped	1	Moderate
5 - 5th Ave & Morewood Ave	5/14/2008	Pedestrian struck by WB auto traveling straight in RL	Ped	1	Major
8 - Forbes Ave & Morewood Ave	12/2/2005	Pedestrian struck by EB auto traveling straight in RL	Ped	1	Minor
8 - Forbes Ave & Morewood Ave	8/29/2008	Pedestrian struck by WB van traveling straight in RL	Ped	1	Minor
10 - Forbes Ave & Margaret Morrison St	4/11/2006	Pedestrian struck by WB auto traveling straight in RL	Ped	1	Fatal

Table 2: Total Intersection Crashes

		Crashes by year					Crashes by Type							Totals	Injury Crashes	Fatal Crashes
		2005	2006	2007	2008	2009	Ped/Bike	Angle	Rear-end	Side-swipe	Fixed Object	Head-on	Other			
Intersection	1 - 5th Ave & Bellefield Ave	2	0	2	0	1	1	3	1	-	-	-	-	5	3	0
	2 - 5th Ave & Dithridge St	0	3	2	3	2	2	6	2	-	-	-	-	10	5	0
	3 - 5th Ave & Craig St	1	3	4	0	1	1	7	-	1	-	-	-	9	7	0
	4 - 5th Ave & Neville St	6	6	4	3	6	2	18	3	1	1	-	-	25	13	0
	5 - 5th Ave & Morewood Ave	6	7	7	5	3	1	18	3	1	2	2	1	28	10	0
	6 - Forbes Ave & S Craig St	1	0	1	2	0	-	2	2	-	-	-	-	4	2	0
	7 - Forbes Ave & Parking lot	0	0	0	0	0	-	-	-	-	-	-	-	0	0	0
	8 - Forbes Ave & Morewood Ave	1	0	0	1	1	2	1	-	-	-	-	-	3	2	0
	9 - Forbes Ave & Beeler St	0	0	0	0	0	-	-	-	-	-	-	-	0	0	0
	10 - Forbes Ave & Margaret Morrison St	0	2	0	0	2	1	-	1	1	1	-	-	4	0	1
Midblock on Forbes Ave		0	0	1	1	3	-	2	1	-	2	-	-	5	2	0
Study Area Totals		17	21	21	15	19	10	57	13	4	6	2	1	93	44	1

Section 3 – Parking Utilization and Analysis

GAI obtained inventories for campus parking garages, surface lots, and bike racks from the Carnegie Mellon University Parking and Transportation Services. Inventories for metered (on-street) parking facilities within the study area were obtained from the Pittsburgh Parking Authority. GAI reduced the inventories into formats suitable for collecting field data, and took parking occupancy counts (a minimum of three[3]) at each location during weekday, 10:00 AM to 2:00 PM time periods in September of 2010.

Average utilization rates were calculated for each location (see Tables 3 and 4). The range of rates varied from:

- + Surface Lots: 33% at Hamburg Hall to 100% at Margaret Morrison and West Campus – (only 11% of the 19 lots counted were full)
- + Garages: 46% at Gates to 100% at 5th and Craig – (only 17% of the six [6] garages counted were full)
- + Bike Racks: 33% at Roberts Engineering Hall to 133% at Newell-Simon Hall – (notably, 50% of the 22 racks counted were utilized at 100% or more)

The overall utilization rate for the 3,011 parking spaces and bike racks counted was 78%. Individual count locations and their respective utilization rates are shown on Figures 2, 3, 4, and 5.

Vehicular Parking Findings:

Further study analysis will be required, but with a utilization rate of only 82% for surface lots and 75% for garages, a clear mandate exists for developing a projection of need lower than that utilized for the current campus configuration. Additionally as the wayfinding program is developed, static signage, as well as future active real time signage should be developed for all university parking facilities, vehicles, and bicycles.

Bike Rack Findings:

1. The results of the study indicate the need for an additional bike rack at Newell-Simon Hall, where the three existing racks had bikes affixed to their sides, equating to a utilization rate of 133%, as well as all locations where the utilization was at 90% or higher as follows:
 - + Doherty Apartments (100% utilization)
 - + Fine Arts (100% utilization)
 - + Fraternities (100% utilization)
 - + Gates (100% utilization)
 - + Henry Street (100% utilization)
 - + Morewood (100% utilization)
 - + Porter-Hamerschlag-Wean (100% utilization)
 - + Scaife Hall (100% utilization)
 - + Hamerschlag Hall (100% utilization)
 - + 407 South Craig (100% utilization)

These rates also indicate a clear need for additional racks.

2. The need for a full bike rack or multiple racks is also evident along Craig Street near Forbes Avenue, where an average of five (5) bikes were affixed to various parking meters during the parking occupancy counts.

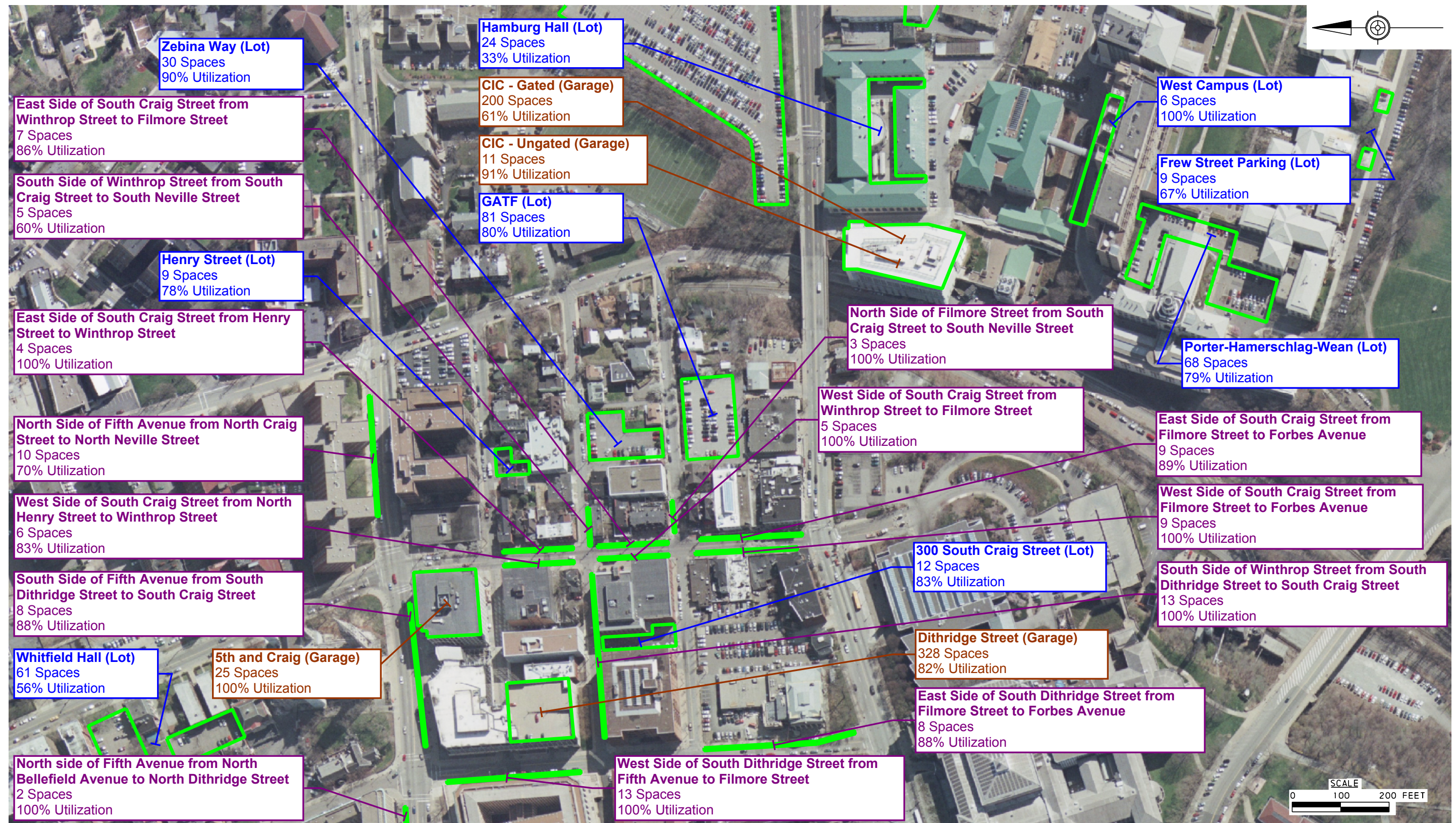


Figure 3
Vehicular Parking Utilization - Surface Lots, Garages, and Metered (On-street) Parking

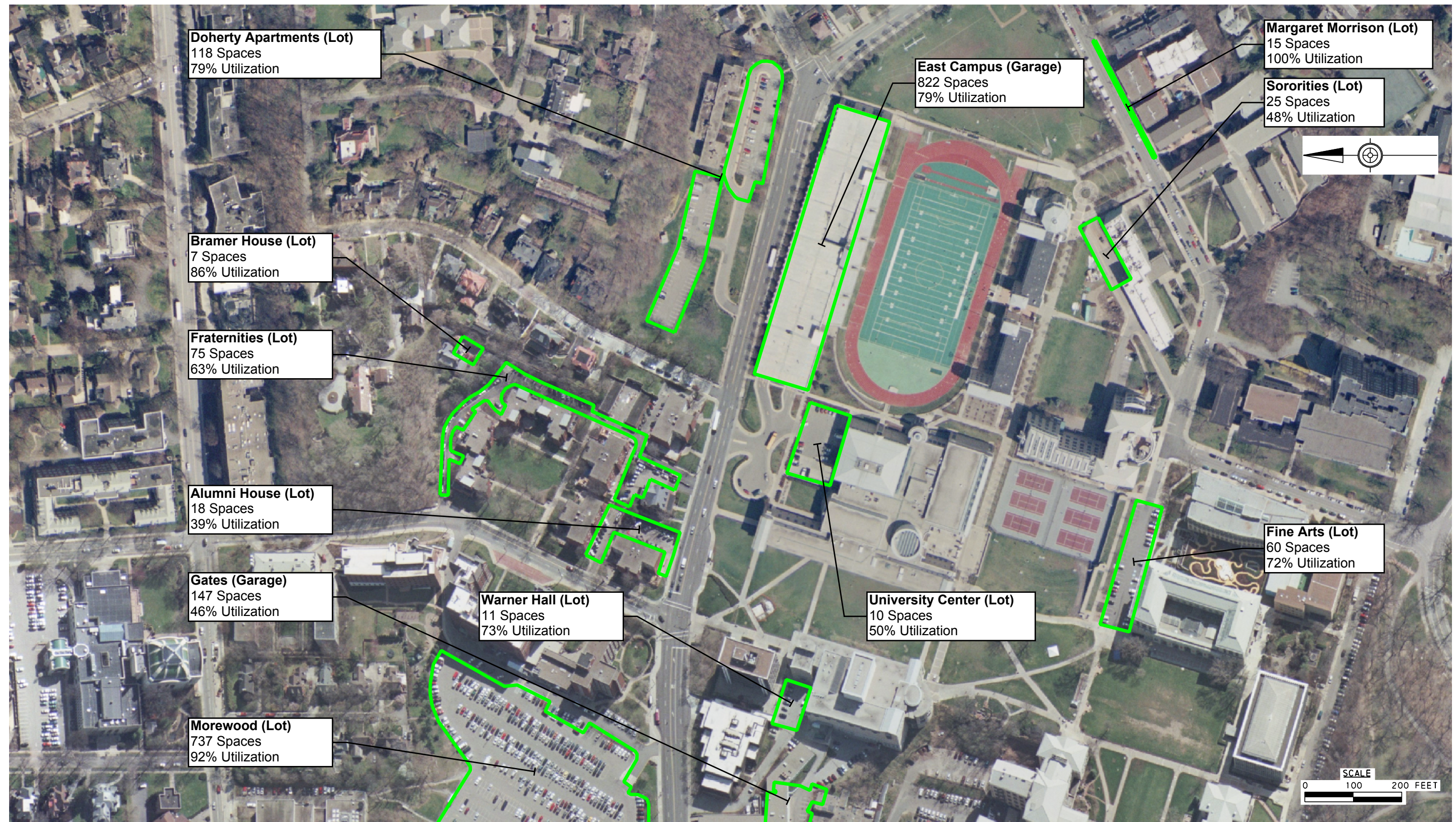


Figure 4
Vehicular Parking Utilization - Surface Lots, Garages, and Metered (On-street) Parking

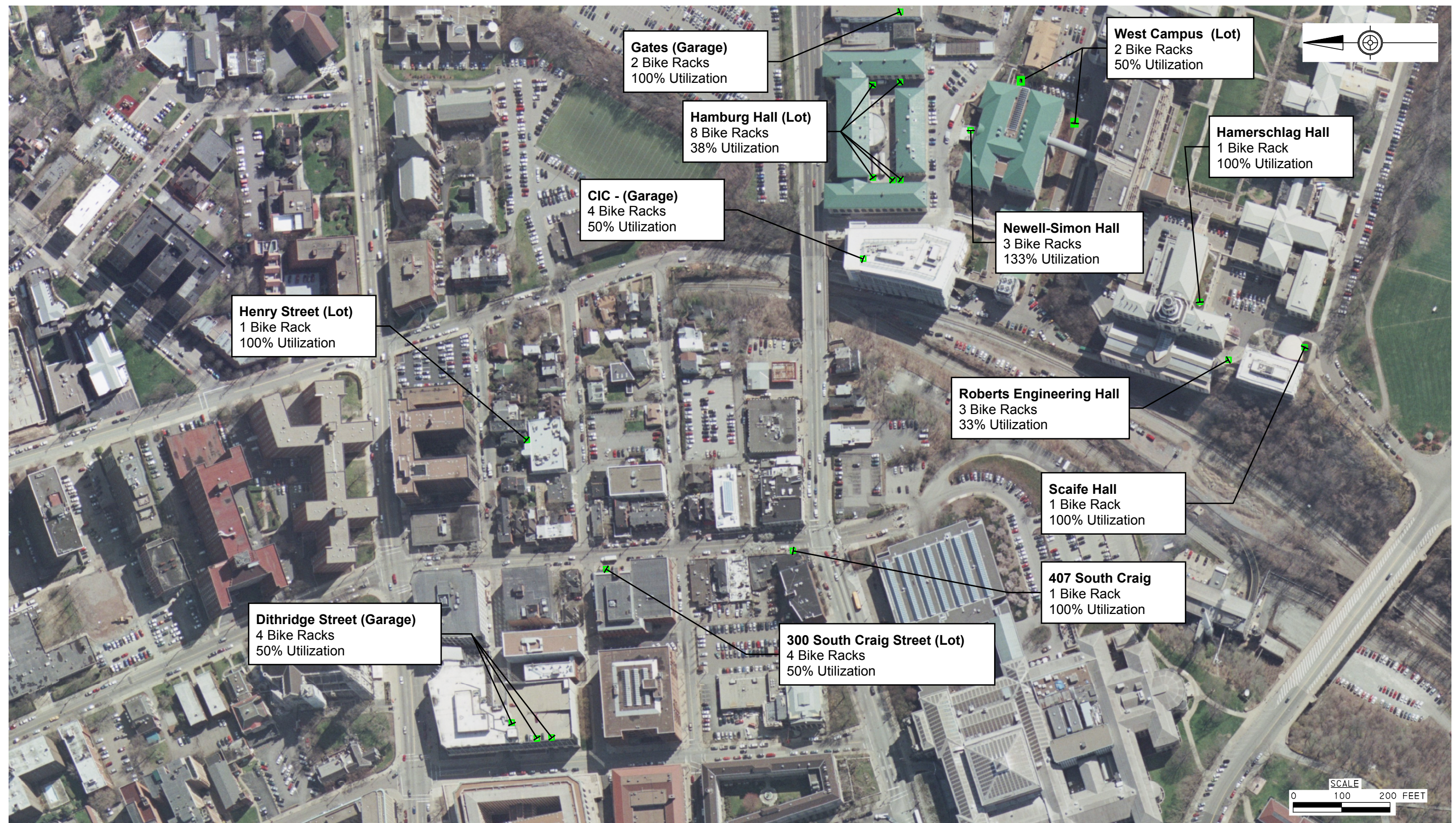


Figure 5
Bike Rack Utilization

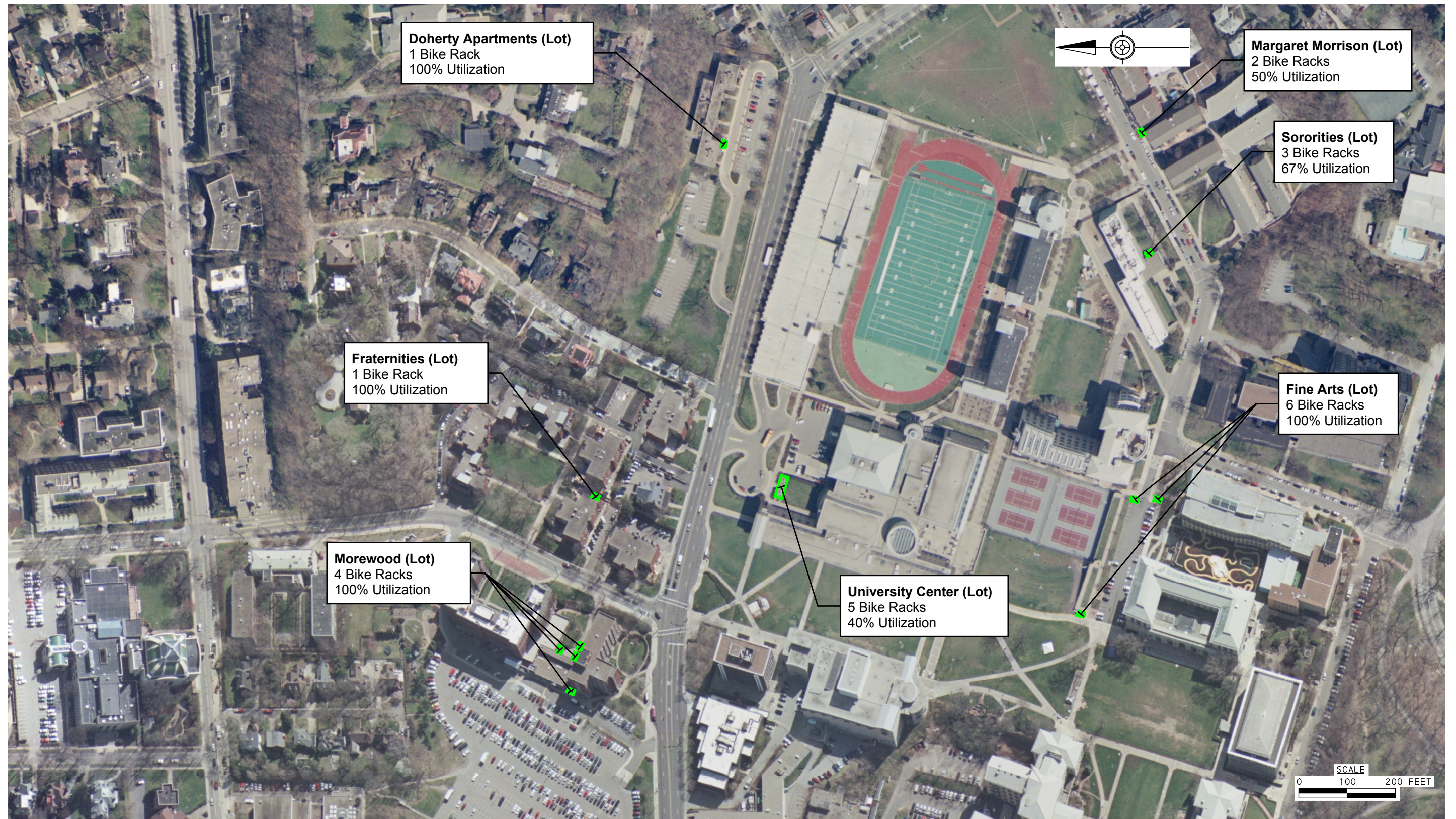


Figure 6
Bike Rack Utilization

Parking Utilization - Lots and Garages Near Carnegie Mellon University

Location		Total	Disabled	Motorcycle	Meters	Bike Racks
300 South Craig Street (Lot)	Spaces:	12	-	-	-	4
	10:30	8	-	-	-	1
	11:21	12	-	-	-	1
	12:00	11	-	-	-	2
	12:49	12	-	-	-	2
	1:11	8	-	-	-	2
	1:30	11	-	-	-	2
	1:51	10	-	-	-	2
	Average:	10	-	-	-	2
	Utilization:	83%	-	-	-	50%
6555 Penn Avenue (Lot)	Spaces:	55	2	-	5	-
(Not Counted, Off Campus)						
Alumni House (Lot)	Spaces:	18	1	-	-	-
	10:15	7	0	-	-	-
	10:55	7	0	-	-	-
	11:35	7	0	-	-	-
	12:05	7	0	-	-	-
	12:30	6	0	-	-	-
	1:05	7	0	-	-	-
	1:40	6	0	-	-	-
	Average:	7	0	-	-	-
	Utilization:	39%	0%	-	-	-
Bramer House (Lot)	Spaces:	7	-	-	-	-
	10:10	6	-	-	-	-
	11:50	6	-	-	-	-
	11:30	6	-	-	-	-
	12:00	6	-	-	-	-
	12:25	5	-	-	-	-
	1:00	5	-	-	-	-
	1:35	6	-	-	-	-
	Average:	6	-	-	-	-
	Utilization:	86%	-	-	-	-
CIC - Gated (Garage)	Spaces:	200	-	-	-	2
	11:00	121	-	-	-	1
	12:00	127	-	-	-	1
	1:10	117	-	-	-	1
	1:50	123	-	-	-	1
	Average:	122	-	-	-	1
CIC - Ungated (Garage)	Utilization:	61%	-	-	-	50%
	Spaces:	11	-	-	-	2
CIC - Ungated (Garage)	10:50	9	-	-	-	1
	12:00	9	-	-	-	1
	1:10	10	-	-	-	1
	1:50	10	-	-	-	1
	Average:	10	-	-	-	1
CIC - Ungated (Garage)	Utilization:	91%	-	-	-	50%

Parking Utilization - Lots and Garages Near Carnegie Mellon University

Location		Total	Disabled	Motorcycle	Meters	Bike Racks
Dithridge Street (Garage)	Spaces:	328	-	-	-	4
	10:05	244	-	-	-	1
	11:06	273	-	-	-	1
	11:46	279	-	-	-	2
	12:35	275	-	-	-	2
	1:05	278	-	-	-	2
	Average:	270	-	-	-	2
	Utilization:	82%	-	-	-	50%
Doherty Apartments (Lot)	Spaces:	118	-	-	-	1
	10:20	88	-	-	-	1
	11:00	90	-	-	-	1
	11:40	95	-	-	-	1
	12:15	97	-	-	-	1
	12:40	95	-	-	-	1
	1:10	92	-	-	-	1
	1:50	93	-	-	-	1
East Campus (Garage)	Average:	93	-	-	-	1
	Utilization:	79%	-	-	-	100%
5th and Craig (Garage)	Spaces:	822	19	-	-	-
	9:52	680	7	-	-	-
	12:10	634	6	-	-	-
	1:05	643	8	-	-	-
	Average:	652	7	-	-	-
	Utilization:	79%	37%	-	-	-
Fine Arts (Lot)	Spaces:	25	-	-	-	-
	11:17	25	-	-	-	-
	11:57	25	-	-	-	-
	12:45	25	-	-	-	-
	1:10	25	-	-	-	-
	1:28	25	-	-	-	-
	1:50	25	-	-	-	-
	Average:	25	-	-	-	-
Fraternities (Lot)	Utilization:	100%	-	-	-	-
	Spaces:	60	4	-	-	6
	10:20	37	4	-	-	6
	11:30	46	4	-	-	6
	12:30	43	4	-	-	6
	1:25	45	4	-	-	6
	Average:	43	4	-	-	6
	Utilization:	72%	100%	-	-	100%
Fraternities (Lot)	Spaces:	75	-	-	-	1
	10:10	39	-	-	-	1
	10:50	44	-	-	-	1
	11:30	48	-	-	-	1
	12:00	49	-	-	-	1
	12:25	50	-	-	-	1
	1:00	48	-	-	-	1
	1:35	52	-	-	-	1
	Average:	47	-	-	-	1
	Utilization:	63%	-	-	-	100%

Parking Utilization - Lots and Garages Near Carnegie Mellon University

Location		Total	Disabled	Motorcycle	Meters	Bike Racks
Frew Street Parking (Lot)	Spaces:	9	9	-	-	-
	10:25	5	5	-	-	-
	11:35	6	6	-	-	-
	12:40	5	5	-	-	-
	1:30	6	6	-	-	-
	Average:	6	6	-	-	-
	Utilization:	67%	67%	-	-	-
Gates (Garage)	Spaces:	147	5	-	-	2
	10:50	61	3	-	-	2
	12:30	72	2	-	-	2
	1:32	70	3	-	-	2
	Average:	68	3	-	-	2
	Utilization:	46%	60%	-	-	100%
GATF (Lot)	Spaces:	81	2	-	-	-
	11:08	67	2	-	-	-
	12:44	64	2	-	-	-
	1:43	64	2	-	-	-
	Average:	65	2	-	-	-
	Utilization:	80%	100%	-	-	-
Hamburg Hall (Lot)	Spaces:	24	1	6	-	8
	11:15	7	1	5	-	3
	12:50	9	1	5	-	3
	1:50	7	1	7	-	3
	Average:	8	1	6	-	3
	Utilization:	33%	100%	100%	-	38%
Henry Street (Lot) Note: An automatic lift with boom for a painting crew was parked in one (1) spot for the duration of the counts.	Spaces:	9	-	-	-	1
	10:47	7	-	-	-	1
	11:30	7	-	-	-	1
	12:20	8	-	-	-	0
	12:57	7	-	-	-	1
	1:20	6	-	-	-	1
	1:39	8	-	-	-	1
	1:59	9	-	-	-	1
	Average:	7	-	-	-	1
	Utilization:	78%	-	-	-	100%
	Spaces:	15	-	-	-	2
	10:07	15	-	-	-	1
Margaret Morrison (Lot)	11:25	15	-	-	-	1
	12:25	15	-	-	-	1
	1:20	15	-	-	-	1
	Average:	15	-	-	-	1
	Utilization:	100%	-	-	-	50%
	Spaces:	737	8	-	15	4
Morewood (Lot)	10:00	649	1	-	14	4
	10:40	673	1	-	14	4
	11:20	683	1	-	13	4
	11:50	688	1	-	13	4
	12:15	682	1	-	14	4
	12:55	689	1	-	13	4
	1:25	694	1	-	10	4
	Average:	680	1	-	13	4
	Utilization:	92%	13%	-	87%	100%

Parking Utilization - Lots and Garages Near Carnegie Mellon University

Location		Total	Disabled	Motorcycle	Meters	Bike Racks
Porter-Hamerschlag-Wean (Lot)	Spaces:	68	4	8	-	-
	10:30	51	1	7	-	-
	11:40	53	1	6	-	-
	12:50	57	2	7	-	-
	1:35	55	2	7	-	-
	Average:	54	2	7	-	-
	Utilization:	79%	50%	88%	-	-
Pittsburgh Technology Center (Lot)		91	-	-	-	-
(Not Counted, Off Campus)						
Sororities (Lot)	Spaces:	25	-	-	-	3
	9:50	13	-	-	-	2
	11:20	15	-	-	-	2
	12:25	9	-	-	-	2
	1:20	11	-	-	-	2
	Average:	12	-	-	-	2
	Utilization:	48%	-	-	-	67%
University Center (Lot)	Spaces:	10	1	2	-	5
	11:29	5	0	0	-	1
	1:00	7	0	0	-	2
	1:57	4	1	0	-	3
	Average:	5	0	0	-	2
	Utilization:	50%	0%	0%	-	40%
Warner Hall (Lot)	Spaces:	11	5	-	-	-
	11:25	10	2	-	-	-
	12:54	8	2	-	-	-
	1:55	7	3	-	-	-
	Average:	8	2	-	-	-
	Utilization:	73%	40%	-	-	-
West Campus (Lot)	Spaces:	6	3	-	-	2
	10:45	5	0	-	-	1
	11:50	4	0	-	-	1
	12:55	7	1	-	-	1
	1:40	7	1	-	-	2
	Average:	6	1	-	-	1
	Utilization:	100%	33%	-	-	50%
Whitfield Hall (Lot)	Spaces:	61	1	-	10	-
	10:55	36	1	-	9	-
	11:35	37	1	-	9	-
	12:27	31	1	-	10	-
	1:00	26	1	-	10	-
	1:22	31	1	-	10	-
	1:43	35	1	-	10	-
	2:05	40	1	-	10	-
	Average:	34	1	-	10	-
	Utilization:	56%	100%	-	100%	-

Parking Utilization - Lots and Garages Near Carnegie Mellon University

Location		Total	Disabled	Motorcycle	Meters	Bike Racks
Zebina Way (Lot)	Spaces:	30	-	-	-	-
	10:39	27	-	-	-	-
	11:26	27	-	-	-	-
	12:15	26	-	-	-	-
	12:54	25	-	-	-	-
	1:18	26	-	-	-	-
	1:37	28	-	-	-	-
	1:58	29	-	-	-	-
	Average:	27	-	-	-	-
	Utilization:	90%	-	-	-	-
Maggie Stoefferts	Spaces:	(Not, Counted, Could Not Locate)				1
Hill Dorms	Spaces:	(Not, Counted, Could Not Locate)				6
Scaife Hall	Spaces:	-	-	-	-	1
	10:35	-	-	-	-	1
	11:35	-	-	-	-	1
	12:45	-	-	-	-	2
	1:35	-	-	-	-	1
	Average:	-	-	-	-	1
	Utilization:	-	-	-	-	100%
Hamerschlag Hall	Spaces:	-	-	-	-	1
	10:35	-	-	-	-	1
	11:40	-	-	-	-	1
	12:45	-	-	-	-	1
	1:35	-	-	-	-	1
	Average:	-	-	-	-	1
	Utilization:	-	-	-	-	100%
Roberts Engineering Hall	Spaces:	-	-	-	-	3
	10:40	-	-	-	-	1
	11:45	-	-	-	-	1
	12:50	-	-	-	-	1
	1:40	-	-	-	-	1
	Average:	-	-	-	-	1
	Utilization:	-	-	-	-	33%
407 South Craig	Spaces:	-	-	-	-	1
	10:33	-	-	-	-	1
	11:23	-	-	-	-	1
	12:01	-	-	-	-	1
	12:50	-	-	-	-	1
	1:14	-	-	-	-	1
	1:33	-	-	-	-	1
	1:54	-	-	-	-	1
	Average:	-	-	-	-	1
	Utilization:	-	-	-	-	100%
Newell-Simon Hall	Spaces:	-	-	-	-	3
	11:10	-	-	-	-	4
	11:50	-	-	-	-	4
	12:55	-	-	-	-	5
	1:45	-	-	-	-	5
	Average:	-	-	-	-	4
	Utilization:	-	-	-	-	133%
Sum of all "Spaces:" =		2909	63	16	25	56
Sum of all "Average:" =		2280	30	13	23	38
Total Utilization =		78%	48%	81%	92%	68%

Parking Utilization - Metered (On-street) Parking Near Carnegie Mellon University

Location		Total	1-hour	2-hour	4-hour	Disabled	Loading
North side of Fifth Avenue from North Bellefield Avenue to North Dithridge Street	Spaces:	2	-	2	-	-	-
	10:20	2	-	2	-	-	-
	11:00	2	-	2	-	-	-
	11:40	2	-	2	-	-	-
	12:30	2	-	2	-	-	-
	1:02	2	-	2	-	-	-
	1:24	2	-	2	-	-	-
	1:46	2	-	2	-	-	-
	Average:	2	-	2	-	-	-
	Utilization:	100%	-	100%	-	-	-
South Side of Fifth Avenue from South Dithridge Street to South Craig Street	Spaces:	8	8	-	-	-	-
	10:20	6	6	-	-	-	-
	10:59	8	8	-	-	-	-
	11:39	6	6	-	-	-	-
	12:30	8	8	-	-	-	-
	1:02	7	7	-	-	-	-
	1:24	6	6	-	-	-	-
	1:46	6	6	-	-	-	-
	Average:	7	7	-	-	-	-
	Utilization:	88%	88%	-	-	-	-
North Side of Fifth Avenue from North Craig Street to North Neville Street	Spaces:	10	-	8	-	2	-
	10:50	8	-	8	-	0	-
	11:31	5	-	5	-	0	-
	12:22	3	-	3	-	0	-
	12:58	6	-	6	-	0	-
	1:21	8	-	8	-	0	-
	1:41	9	-	8	-	1	-
	2:01	8	-	7	-	1	-
	Average:	7	-	6	-	0	-
	Utilization:	70%	-	75%	-	0%	-
South Side of Winthrop Street from South Dithridge Street to South Craig Street	Spaces:	13	-	13	-	-	-
	10:30	13	-	13	-	-	-
	11:20	12	-	12	-	-	-
	11:58	13	-	13	-	-	-
	12:47	13	-	13	-	-	-
	1:11	13	-	13	-	-	-
	1:30	13	-	13	-	-	-
	1:51	12	-	12	-	-	-
	Average:	13	-	13	-	-	-
	Utilization:	100%	-	100%	-	-	-
South Side of Winthrop Street from South Craig Street to South Neville Street	Spaces:	5	-	4	-	-	1
	10:36	2	-	2	-	-	0
	11:25	3	-	3	-	-	0
	12:11	4	-	4	-	-	0
	12:52	4	-	4	-	-	0
	1:17	4	-	4	-	-	0
	1:36	4	-	4	-	-	0
	1:57	2	-	2	-	-	0
	Average:	3	-	3	-	-	0
	Utilization:	60%	-	75%	-	-	0%

Parking Utilization - Metered (On-street) Parking Near Carnegie Mellon University

Location		Total	1-hour	2-hour	4-hour	Disabled	Loading
North Side of Filmore Street from South Craig Street to South Neville Street	Spaces:	3	-	3	-	-	-
	10:35	2	-	2	-	-	-
	11:24	3	-	3	-	-	-
	12:10	3	-	3	-	-	-
	12:51	3	-	3	-	-	-
	1:17	3	-	3	-	-	-
	1:36	3	-	3	-	-	-
	1:57	2	-	2	-	-	-
	Average:	3	-	3	-	-	-
	Utilization:	100%	-	100%	-	-	-
West Side of South Dithridge Street from Fifth Avenue to Filmore Street	Spaces:	13	-	-	13	-	-
	10:22	13	-	-	13	-	-
	11:00	13	-	-	13	-	-
	11:40	13	-	-	13	-	-
	12:31	13	-	-	13	-	-
	1:03	13	-	-	13	-	-
	1:25	13	-	-	13	-	-
	1:47	13	-	-	13	-	-
	Average:	13	-	-	13	-	-
	Utilization:	100%	-	-	100%	-	-
East Side of South Dithridge Street from Filmore Street to Forbes Avenue	Spaces:	8	-	-	5	-	3
	10:23	8	-	-	5	-	3
	11:02	5	-	-	5	-	0
	11:41	7	-	-	5	-	2
	12:32	8	-	-	5	-	3
	1:03	8	-	-	5	-	3
	1:25	8	-	-	5	-	3
	1:47	8	-	-	5	-	3
	Average:	7	-	-	5	-	2
	Utilization:	88%	-	-	100%	-	67%
West Side of South Craig Street from Henry Street to Winthrop Street	Spaces:	6	6	-	-	-	-
	10:29	4	4	-	-	-	-
	11:18	4	4	-	-	-	-
	11:58	5	5	-	-	-	-
	12:46	5	5	-	-	-	-
	1:11	6	6	-	-	-	-
	1:29	5	5	-	-	-	-
	1:50	6	6	-	-	-	-
	Average:	5	5	-	-	-	-
	Utilization:	83%	83%	-	-	-	-
West Side of South Craig Street from Winthrop Street to Filmore Street	Spaces:	5	5	-	-	-	-
	10:32	3	3	-	-	-	-
	11:23	5	5	-	-	-	-
	12:01	5	5	-	-	-	-
	12:50	5	5	-	-	-	-
	1:14	5	5	-	-	-	-
	1:33	5	5	-	-	-	-
	1:54	5	5	-	-	-	-
	Average:	5	5	-	-	-	-
	Utilization:	100%	100%	-	-	-	-

Parking Utilization - Metered (On-street) Parking Near Carnegie Mellon University

Location		Total	1-hour	2-hour	4-hour	Disabled	Loading
West Side of South Craig Street from Filmore Street to Forbes Avenue	Spaces:	9	8	-	-	-	1
	10:33	9	8	-	-	-	1
	11:23	9	8	-	-	-	1
	12:01	8	8	-	-	-	0
	12:50	9	8	-	-	-	1
	1:14	8	7	-	-	-	1
	1:33	8	7	-	-	-	1
	1:54	9	8	-	-	-	1
	Average:	9	8	-	-	-	1
	Utilization:	100%	100%	-	-	-	100%
East Side of South Craig Street from Filmore Street to Forbes Avenue	Spaces:	9	8	-	-	-	1
	10:34	8	8	-	-	-	0
	11:24	8	8	-	-	-	0
	12:10	8	8	-	-	-	0
	12:51	8	7	-	-	-	1
	1:17	7	6	-	-	-	1
	1:36	8	8	-	-	-	0
	1:57	8	8	-	-	-	0
	Average:	8	8	-	-	-	0
	Utilization:	89%	100%	-	-	-	0%
East Side of South Craig Street from Winthrop Street to Filmore Street	Spaces:	7	7	-	-	-	-
	10:35	4	4	-	-	-	-
	11:25	7	7	-	-	-	-
	12:11	7	7	-	-	-	-
	12:51	7	7	-	-	-	-
	1:17	7	7	-	-	-	-
	1:36	7	7	-	-	-	-
	1:57	6	6	-	-	-	-
	Average:	6	6	-	-	-	-
	Utilization:	86%	86%	-	-	-	-
East Side of South Craig Street from Henry Street to Winthrop Street	Spaces:	4	4	-	-	-	-
	10:45	1	1	-	-	-	-
	11:29	4	4	-	-	-	-
	12:19	4	4	-	-	-	-
	12:56	4	4	-	-	-	-
	1:20	4	4	-	-	-	-
	1:39	4	4	-	-	-	-
	1:59	4	4	-	-	-	-
	Average:	4	4	-	-	-	-
	Utilization:	100%	100%	-	-	-	-
Sum of all "Spaces:" =		102	46	30	18	2	6
Sum of all "Average:" =		92	43	27	18	0	3
Total Utilization =		90%	93%	90%	100%	0%	50%

Section 4 – Land Use and Relationship to Transportation

In order to effectively understand the complexity and interconnectedness of the study area, an urban design analysis that breaks down the various land uses and dissects the various modes of transportation was conducted indicating the following:

- + Land Use
- + Street Network
- + Public Transit
- + Bike Routes
- + Sidewalks
- + Pedestrian Corridors & Destinations

In general, the primary land use in the Fifth and Forbes Avenue corridor is institutional (CMU, Pitt, and UPMC campuses) but also includes neighborhood commercial along South Craig Street and vast residential areas to the north and east. The study area also lies between these residential areas and downtown Pittsburgh, which leads to a strong commuter (motorists, cyclists, and pedestrians) flow to and across the study area on a constant basis.

The foundation of the street network is Fifth and Forbes Avenues, serving as the main east-west arterials, with South Bellefield Avenue, South Craig Street, and Morewood Avenue providing the connections between. This network can be visualized as a "ladder" system with Fifth and Forbes acting as the supports and the other streets acting as the rungs. The study area is well served by public transit, which is provided by the Port Authority of Allegheny County. In addition to the many bus stops and handful of bus shelters in the area, there are two bus layover areas located near the intersection of Forbes and Morewood Avenues, at the core of the current campus of the university.

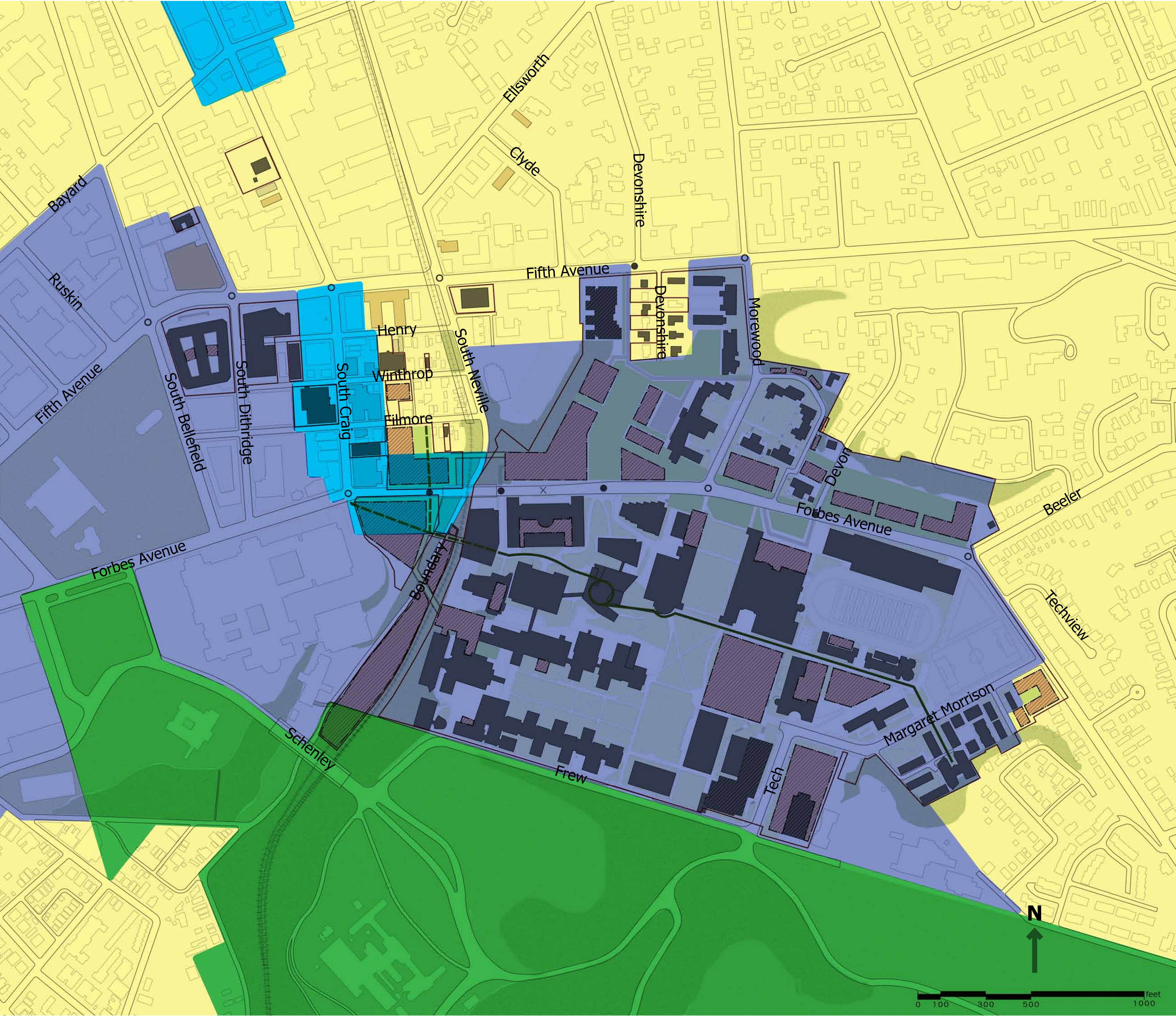
However, even to the casual observer, the "ladder" is missing a few rungs in the north-south network in pedestrian and vehicular movements between Forbes and Fifth Avenues. For vehicles, Craig Street and Morewood Avenue are separated by almost 1500 feet, not a major detriment but one, which causes congestion on each of these streets in the peak hours. Neville Street occupies the ravine below Forbes Avenue, and connectedness of this street to the network above on Forbes is problematic, but connectedness via pedestrian and cyclist movements can certainly be enhanced, along with future parking facilities, which can contribute to sufficient local diversion of vehicles during peak hours hopefully reducing congestion on Morewood Avenue and Craig Street. The pedestrian deficiencies lie in the lack of cross campus north-south routes other than through the open lot opposite Hamburg Hall. However more significant deficiencies exist for pedestrians crossing Forbes Avenue with only one legal crossing between Craig Street and Morewood Avenue, again at Hamburg Hall.

For cyclists, the popularity of bike commuting has seen a significant increase on the roads throughout the City in the past few years. This has resulted in several actions by the City of Pittsburgh. The first action is the ongoing development a bike route planning and signage study. The second more direct action was the conversion of an on-street parking lane on Forbes Avenue from Margaret Morrison Street to Schenley Park (just outside of the study area). Cycling is also popular on the CMU campus, which is evident by the lack of available bike parking. The study area is well connected to the regional bike trail network via South Neville Street at the intersection with Fifth Avenue. From there, cyclists can travel south along Boundary Street to

get on the Panther Hollow Trail. This trail connects to the Eliza Furnace Trail, which is part of the Great Allegheny Passage that links Pittsburgh to Washington, DC. Sidewalks in the study area are typically narrow and are located directly adjacent to the street curb. The lack of a tree lawn and street trees in the study area generally contributes to increased traffic speeds and pedestrian safety concerns, each identified as major issues, and both of which will be addressed by this study.

Figure 7
Land Use

The existing land use in the study area is predominantly educational and medical including the CMU campus, Carnegie Museum, the Pitt campus, and UPMC facilities. This includes most of Forbes, and Morewood, all South Bellefield and South Dithridge, and portions of South Neville. The section of Forbes between South Craig and South Neville, and South Craig between Forbes and Fifth is predominantly neighborhood commercial and professional office uses. North and east of the CMU campus and South Craig Street business district is predominantly residential of varying densities. Schenley Park, a major regional open space destination, borders the CMU campus to the south. Therefore, there is a dominant pedestrian flow south and west from the residential areas to campus and park destinations beyond.



Key

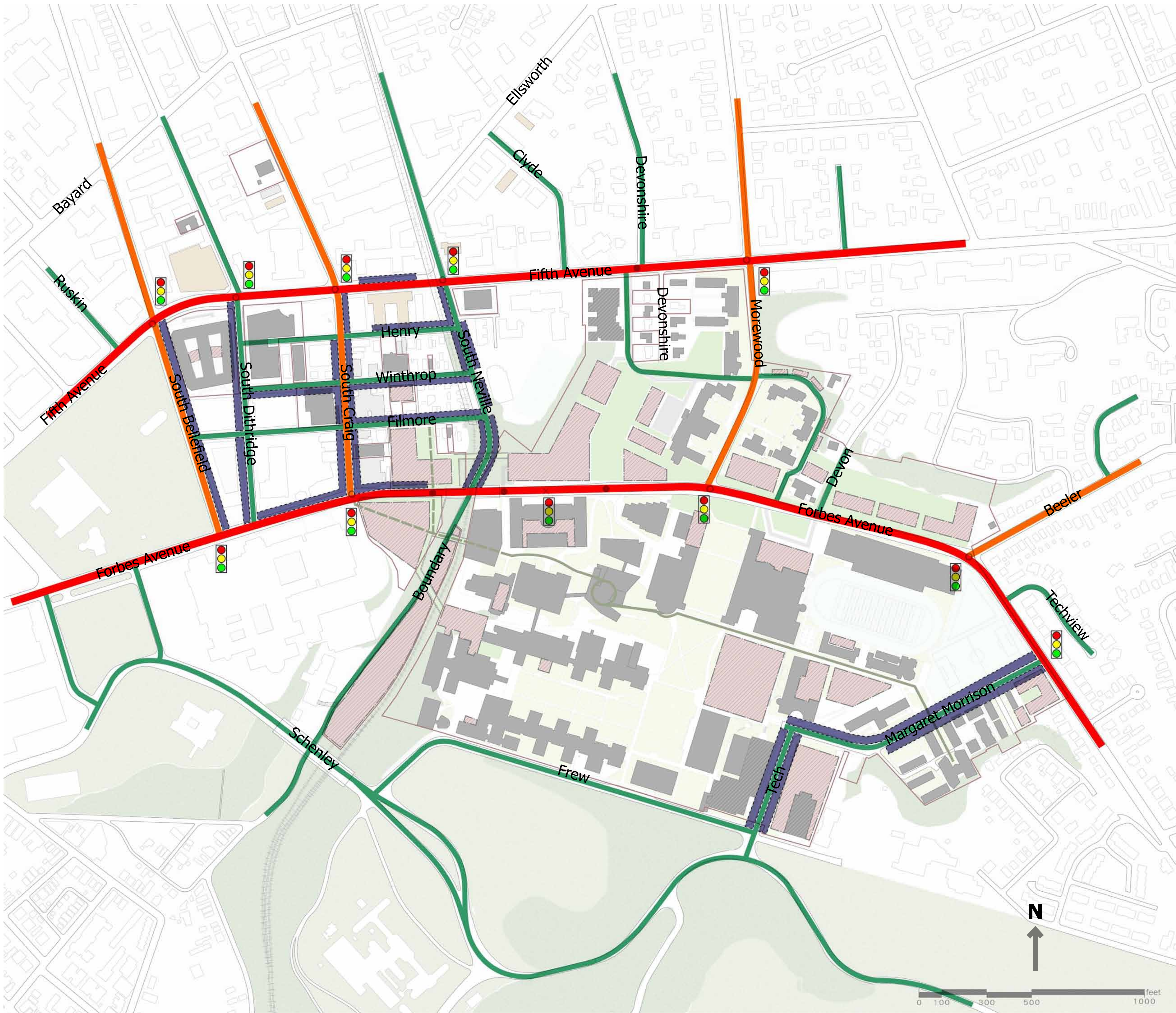
- Education/Medical
(zoning: EMI)
- Special
(zoning: OPR-B)
- Residential
(zoning: R1A-H, R1D-L, R1D-VL, R2-H, R2-L, RM-H, RM-VH, RM-M, RP)
- Open Space
(zoning: P)

Source: City of Pittsburgh Department of City Planning

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Figure 8
Street Network

There are three basic working classifications of roadways within the study area based. Arterials include Forbes and Fifth Avenues that run east-west, connecting the Shadyside and Squirrel Hill neighborhoods to Oakland and beyond through the CMU campus. Forbes Avenue bisects the historic campus area to planned expansion areas to the north. North-south collector streets include South Bellefield Avenue, South Craig Street, and Morewood Avenue, which connect South Oakland and the CMU campus to North Oakland and Shadyside. Other neighborhood streets that run north-south include South Dithridge and South Neville/Boundary Street. Signalized intersections occur along Fifth at South Bellefield, South Dithridge, South Craig, and South Neville, and along Forbes at South Bellefield, South Craig, Hamburg Hall, Morewood, Beeler, and Margaret Morrison.



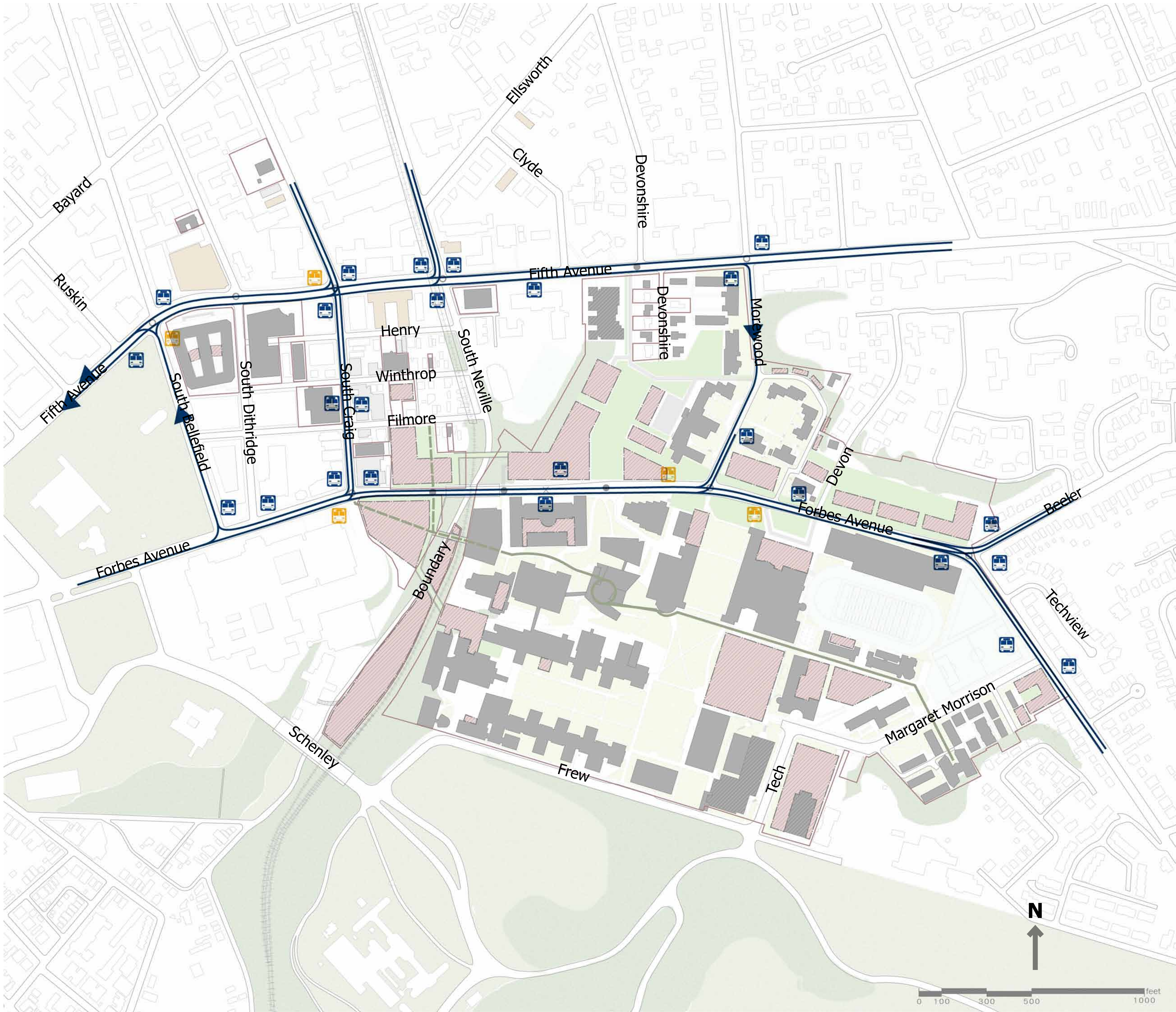
Key

- Arterial
- Collector
- Neighborhood
- On-Street Parking
- Signalized Intersection

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Figure 9
Public Transit

The study area is well served by public transit in the form of buses. Fifth and Forbes carry all of the east-west traffic while South Bellefield, South Craig, and Morewood handle the north-south routes. Buses traveling along North Neville (north of Fifth Avenue) connect to and from the East Busway, an express route to Downtown, at Centre Avenue. The 28X, or Airport Flyer, bus loops through the study area along South Bellefield, Fifth, Morewood, and Forbes. Only a handful of bus stops are equipped with shelters located at Forbes and Morewood, Forbes and South Craig, Fifth and North Craig, and Fifth and South Bellefield. The diagram reflects current changes in the bus schedule that took effect September 5, 2010.



Key

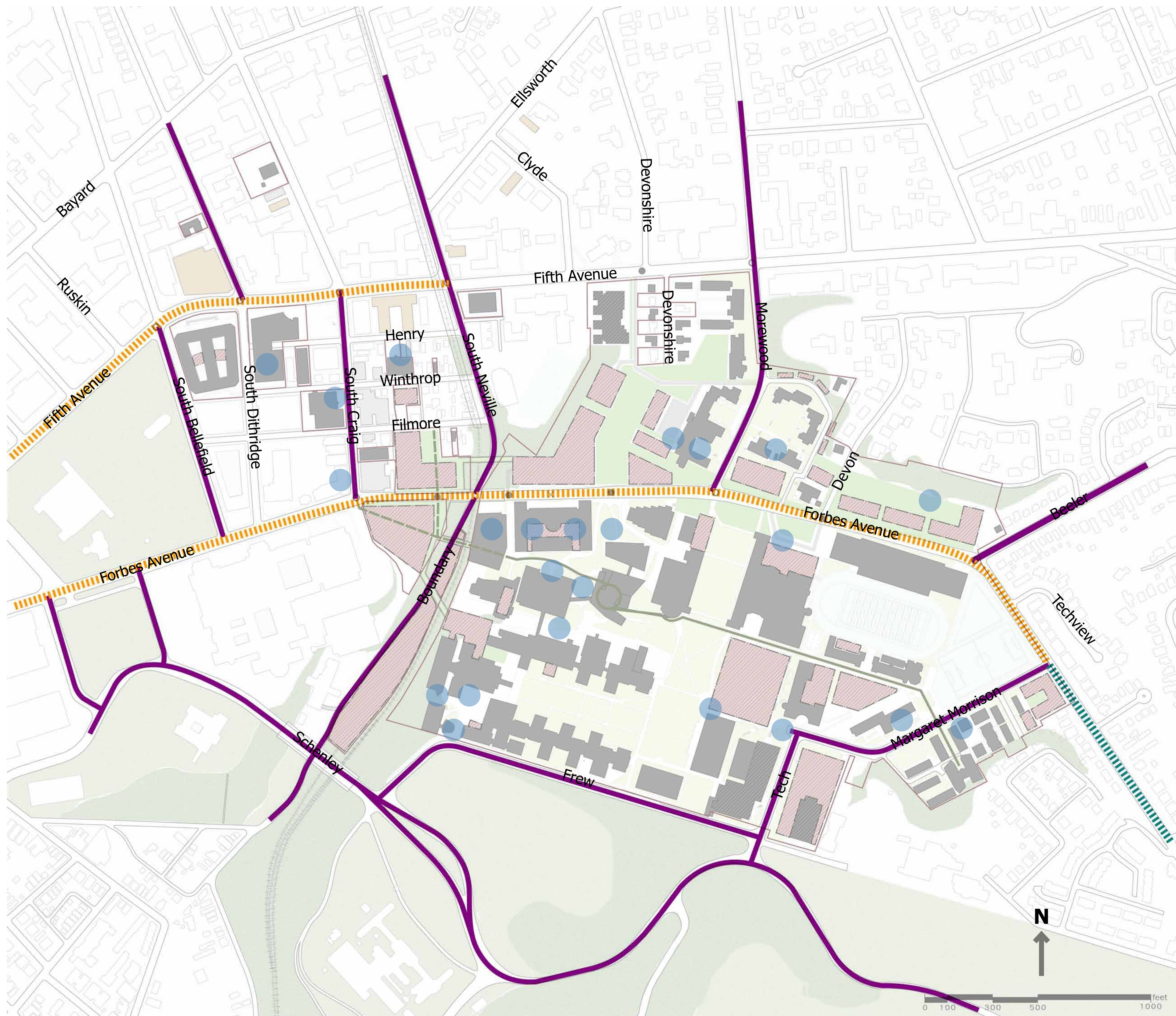
- Bus Route
- Bus Stop w/ Shelter
- Bus Stop

Source: Port Authority of Allegheny County
(effective September 5, 2010)




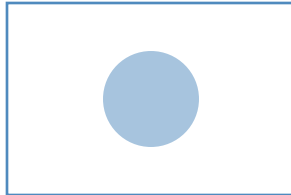
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Figure 10
Bike Routes

Existing bike routes in the study area reflect a similar pattern to the street network hierarchy. The information represented on the diagram is taken from the most current version of the Bike Pittsburgh Map released earlier in 2010. The City of Pittsburgh is currently undertaking a bicycle route planning study that will further define bike routes and destinations within the study area and beyond. There is a dedicated bike lane on outbound Forbes Avenue from Margaret Morrison to Schenley Park. On-street bike routes include South Bellefield, South Craig, South Neville/Boundary, Morewood, and Beeler. Cautionary bike routes include Forbes from Margaret Morrison west to Oakland, and Fifth from South Neville west to Oakland. It is important to note that the Boundary Street bike route connects to the Panther Hollow Trail that ties into the Eliza Furnace Trail, which is part of the Great Allegheny Passage trail linking Pittsburgh to Washington, DC.



Key

-  Dedicated Bike Lane
-  On-Street Bike Route
-  Cautionary Bike route
-  Bicycle Parking

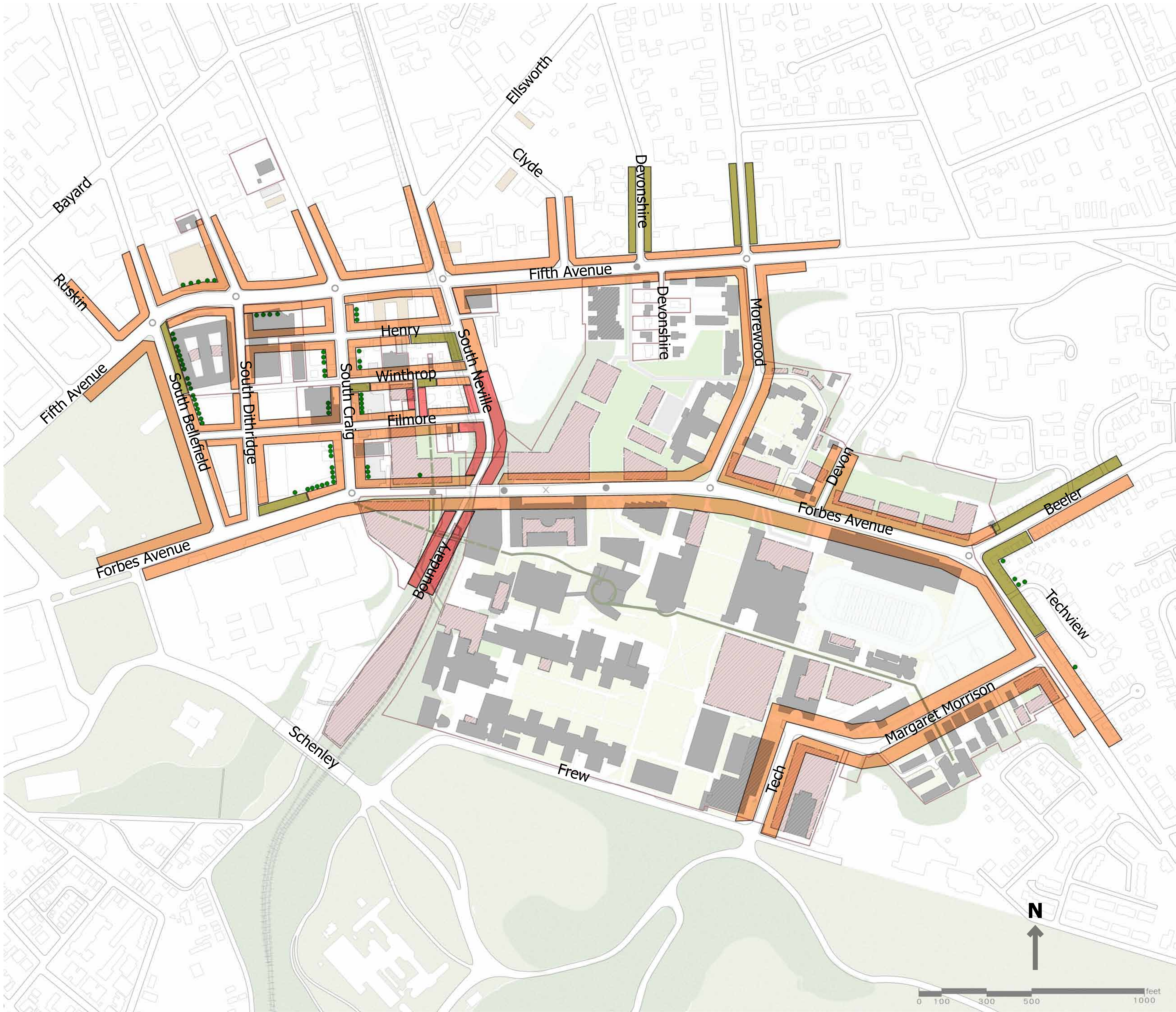
Source: BikePGH's "Pittsburgh Bike Map" (2010) and CMU Parking and Transportation Services

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Figure 11
Sidewalks

A majority of the pedestrian circulation system within the study area is comprised of sidewalks directly adjacent to the street curb. Only a small portions of Forbes, between South Dithridge and South Craig and Beeler and Margaret Morrison, and South Bellefield contain tree lawns ("verges"). South Neville, south of Winthrop, and all of Boundary are void of sidewalks entirely. The lack of tree lawns means that most of the streets do not contain street trees within the public right-of-way. Street trees exist along the east side of South Bellefield, between Winthrop and Fifth, and along South Craig, between Forbes and Fifth. The trees along the remaining streets in the study area occur predominantly on private property.



Key

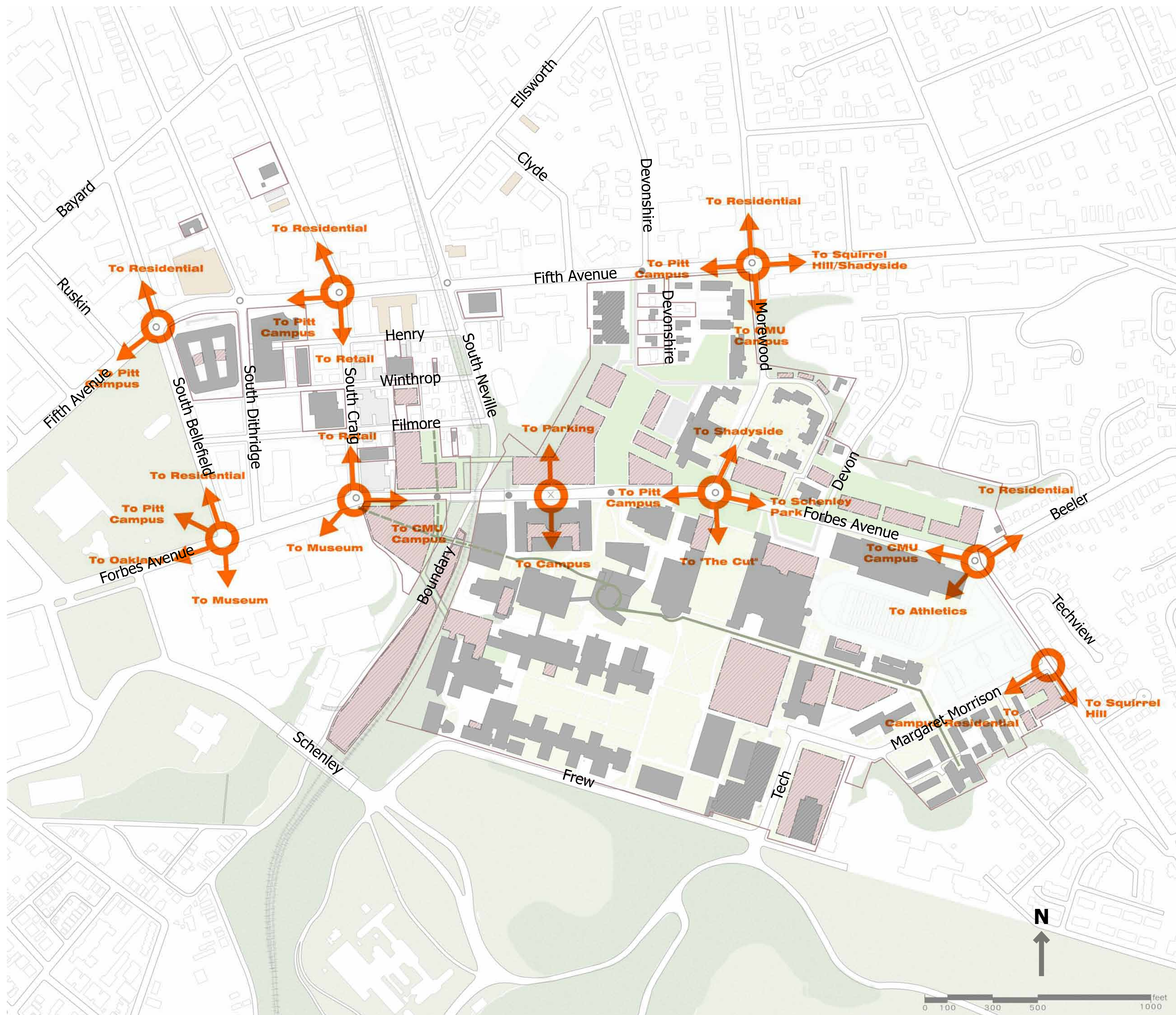
- Sidewalks Against Curb
- Sidewalks Against Tree Lawn
- No Sidewalks
- Street Trees within R/W

Source: GAI field reviews

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Figure 12
Pedestrian Corridors & Destinations

The Fifth and Forbes east-west corridors carry vehicular and pedestrian traffic to and from the Oakland and Squirrel Hill neighborhoods and beyond. Oakland destinations include the CMU campus, Pitt campus, UPMC, the Oakland business district, Schenley Park, and the Carnegie Museum. The north-south streets carry traffic from the North Oakland and Shadyside neighborhoods to destinations south including the Carnegie Museum (using South Dithridge), South Craig Street business district, CMU campus (using South Craig, South Neville, Morewood, and Beeler), and Panther Hollow Trail/Eliza Furnace Trail (using South Neville/Boundary).



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Section 5 – Concept Alternative Designs

The concepts presented herein were developed within Smart Transportation and Complete Streets guidelines with the intent of presenting options to increase overall safety and mobility for all users. However there are also the realities of funding, physical constraints and time to consider as the Study moves forward to define the optimal solutions for the 10 intersections and the intersecting street corridors between them.

The concepts were developed with several goals in mind. First it was determined that as the campus will now be greatly expanded, the study looked inward to the campus to determine if there were elements of the campus environment which could be utilized throughout the study area. Two key factors were identified which can be translated into the Forbes Avenue corridor to create a campus-like environment while at the same time achieve the study objectives of safety and mobility. These two factors are wider sidewalks and separation of pedestrians from the street environment. To this end the sections along Forbes and Morewood Avenues were developed. However bicyclists were not accommodated fully until a section was developed with the bike track/lane. As these concepts were presented to the project sponsors, it was noted that a likely hybrid of the concepts would emerge from the individual concepts and hopefully move forward into final recommendations.

For Craig Street the density of the street with the retail aspect creates its own environment, which we felt needed to be retained but enhanced. The high concentration of pedestrian, cyclist and vehicle uses all overlapping, often creates unsafe conditions, which must be addressed within a very confined street envelope. The physical constraint of the buildings themselves precludes a range of options.

Fifth Avenue likewise has a range of constraints from multiple users, such as a large elderly population, students of two campuses, CMU and Pitt, and high volumes of local and downtown commuting traffic, not in conflict but also not fully under the influence of the current or future campus of the university. To serve the many users of the street environment will prove challenging but will be resolved in the next stages of the study.

These next stages, the interview and public workshop sessions, will be critical to the success and direction of the project. Therefore, at this time it would be premature to assume any concept will move forward until the interview sessions are conducted with the key stakeholders and the public workshop will be held. With the combined input of these two events, the concepts can then be distilled into sound recommendations for design and implementation.

Figure 13
**Street Sections
Forbes Avenue**

Forbes Avenue - Existing Conditions

This section depicts a narrow 40-foot wide section with 10-foot wide lanes operating as a PENNDOT owned arterial through campus.

- High speeds over 35 mph at times
- No campus environment
- Sidewalks narrow and adjacent to the roadway, below ADA standards in some areas
- No tree lawns
- No accommodation for bicyclists
- Large gaps in traffic, even during rush hours

Forbes Avenue - Median Alternative Concept

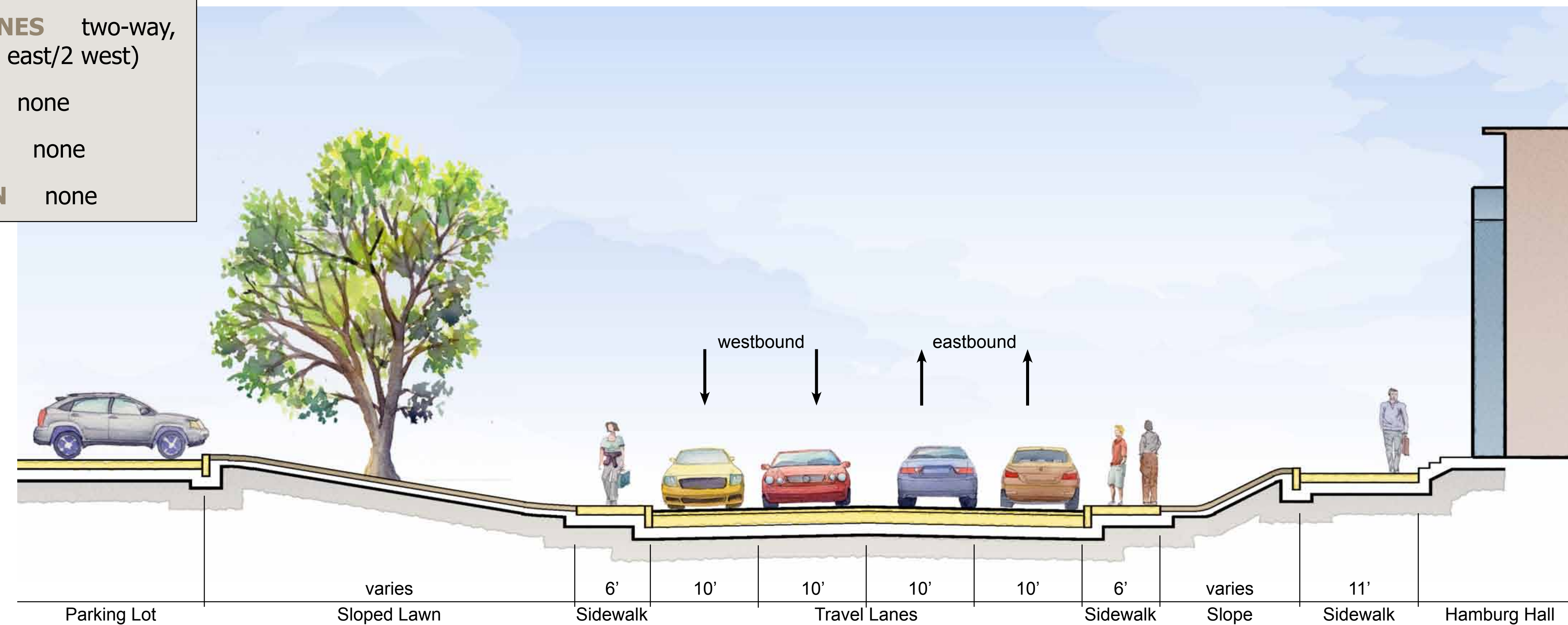
This section depicts a median with low-level trees and shrubs occupying the left lane of inbound Forbes Avenue to act as a traffic calming feature.

- Provides some campus-like effects
- Will have a modest effect on slowing travel speeds
- Can be varied to accommodate turning lanes
- A landscaped area is created along the south curb line to provide a long-term canopy over west/outbound Forbes Avenue
- Costly construction for the creating a tree lawn in the former travel lane
- Creates tree lawn on outbound side of Forbes, and subsequent campus like environment

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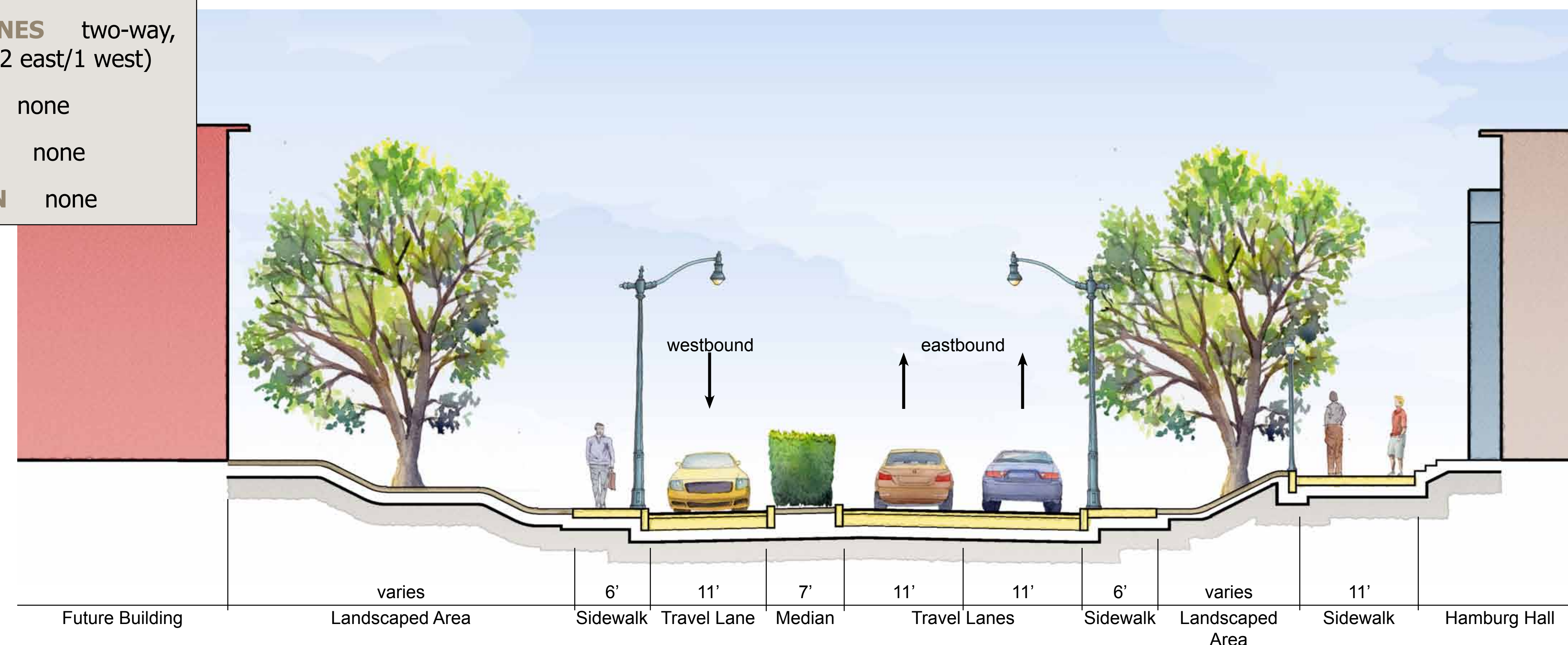
October 15, 2010

SPEED LIMIT	25 mph
TRAVEL LANES	two-way, four lanes (2 east/2 west)
PARKING	none
BIKE LANE	none
TREE LAWN	none



Forbes Avenue - Existing Conditions Concept

SPEED LIMIT	25 mph
TRAVEL LANES	two-way, three lanes (2 east/1 west)
PARKING	none
BIKE LANE	none
TREE LAWN	none



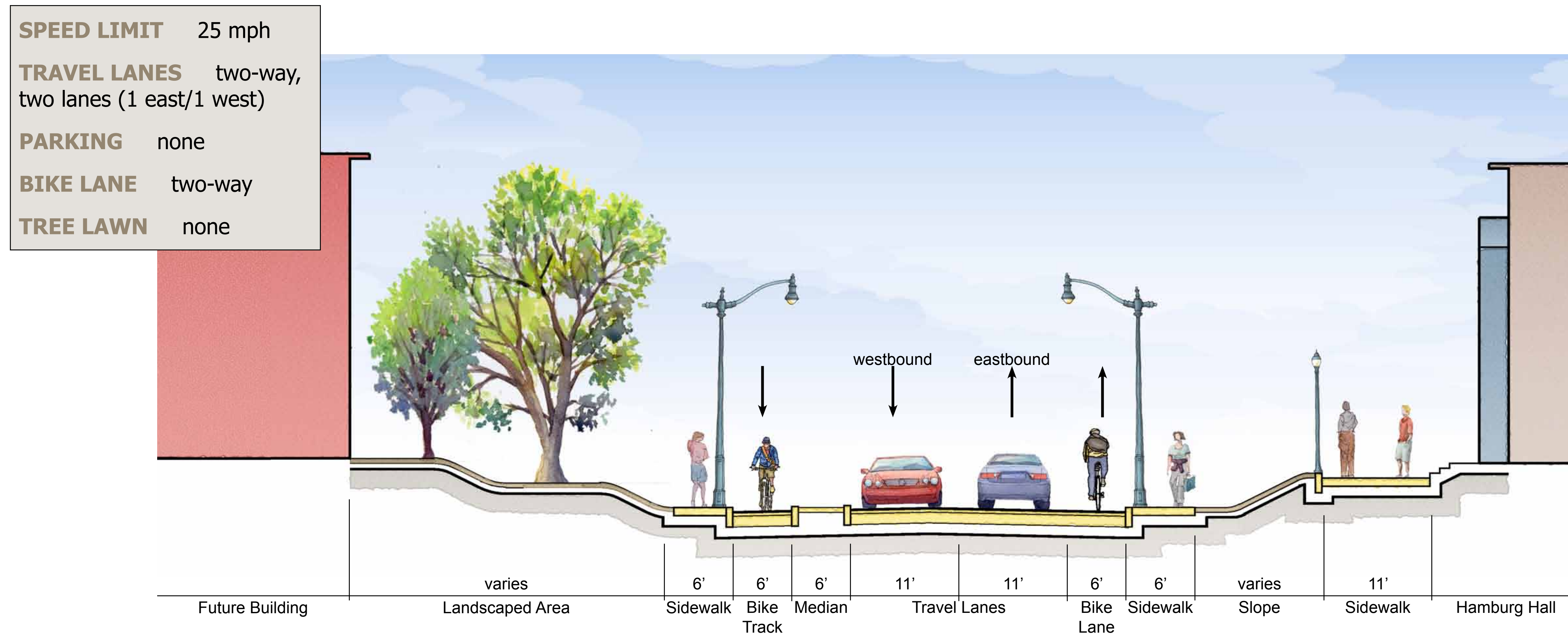
Forbes Avenue - Median Alternative Concept

Figure 14
**Street Sections
Forbes Avenue**

Forbes Avenue - Bike Lane Alternative Concept

This section introduces a bike track inbound and a bike lane outbound on Forbes Avenue. Any combination is possible with dual bike track and dual bike lanes also possible with this section. Forbes Avenue is reduced to two lanes, one lane in each direction.

- Accommodate bicyclists
- Achieves traffic calming
- Ease of construction and economical for the separated lane

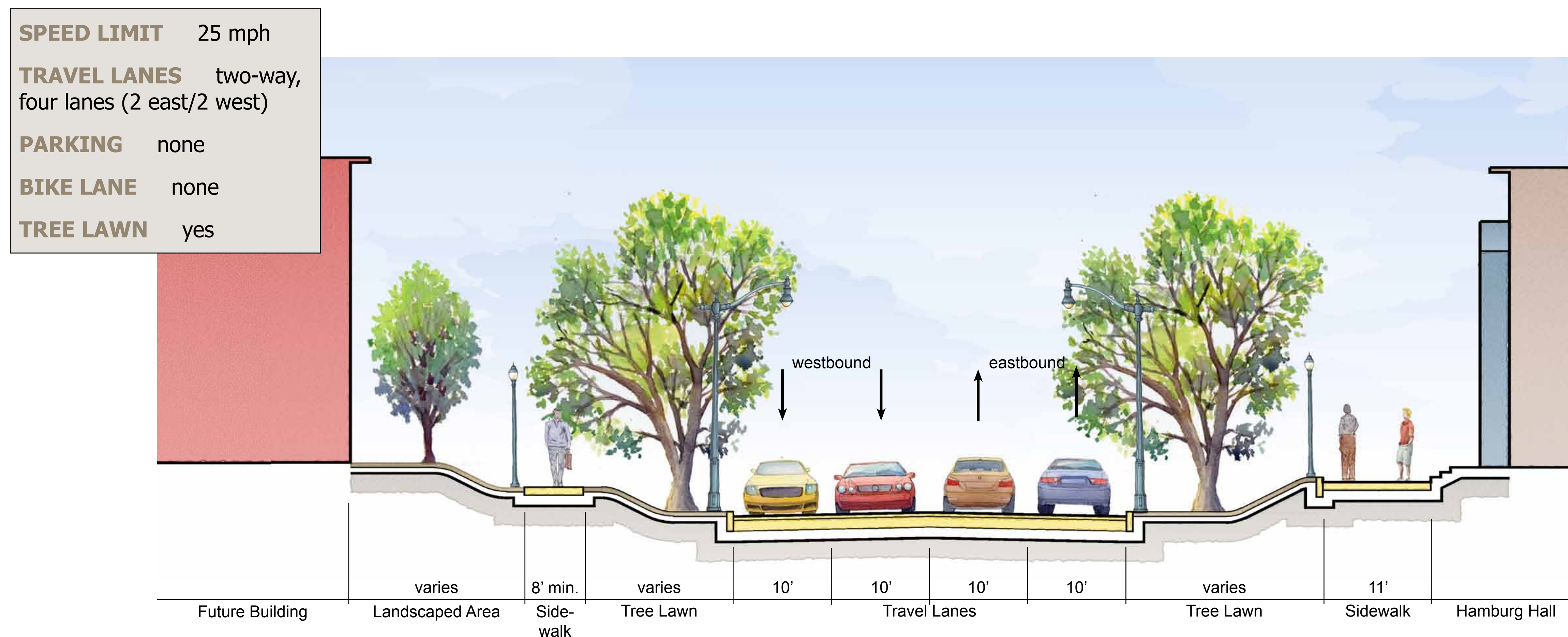


Forbes Avenue - Bike Lane Alternative Concept

Forbes Avenue - Sidewalk Alternative Concept

This section retains then four existing lanes on Forbes Avenue but provides for a complete separation of pedestrians from the cart way via wide sidewalks separated by substantial tree lawns along both directions of Forbes Avenue.

- Achieves a campus-like look by creating large tree lawns capable of sustaining large trees
- Moves pedestrians away from the street environment
- Enables wide sidewalks to be constructed similar to campus walks in the "Cut" and "Mall"
- Creates some traffic calming due to size of tree lawn and future size of trees

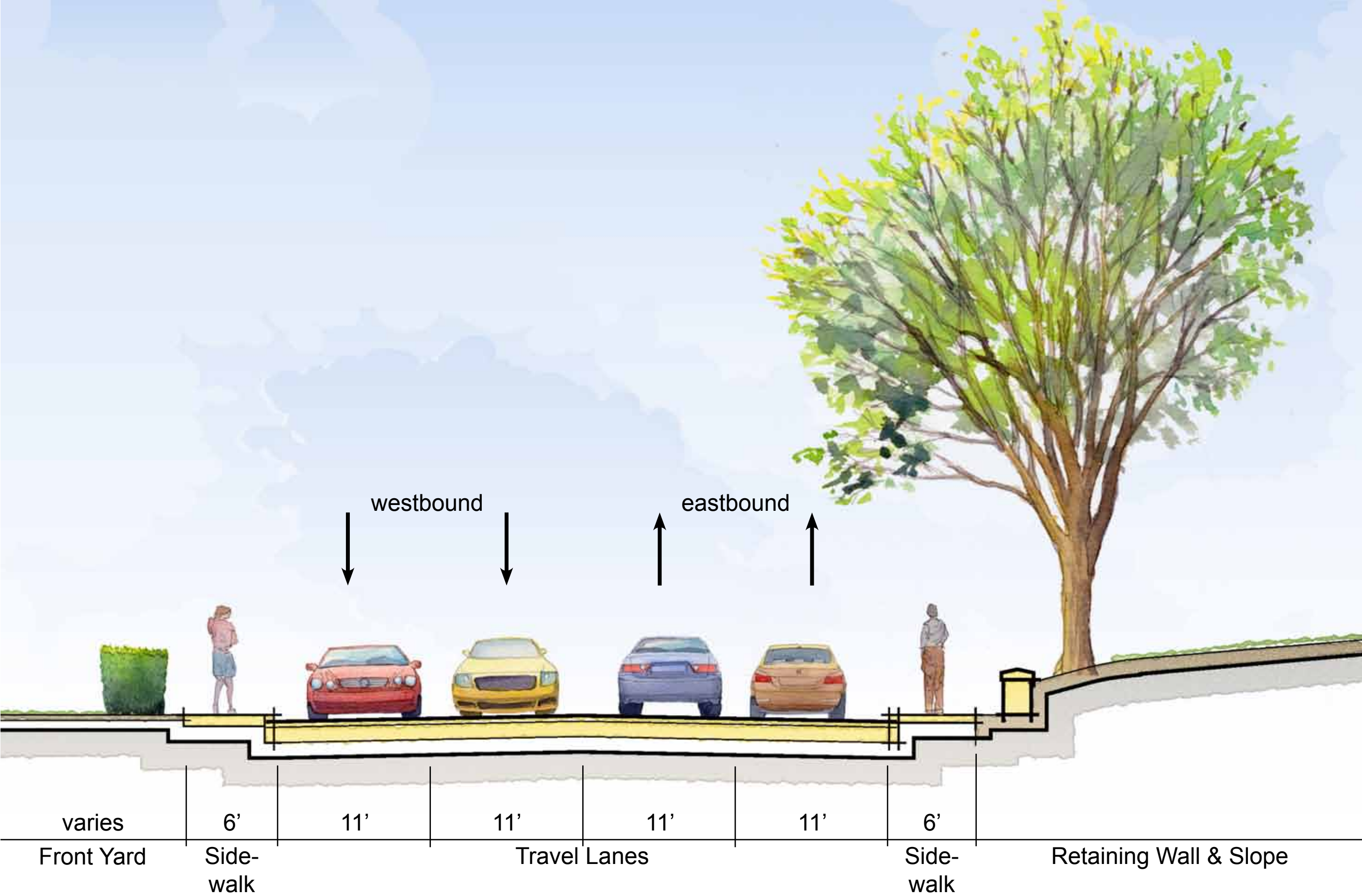


Forbes Avenue - Sidewalk Alternative Concept

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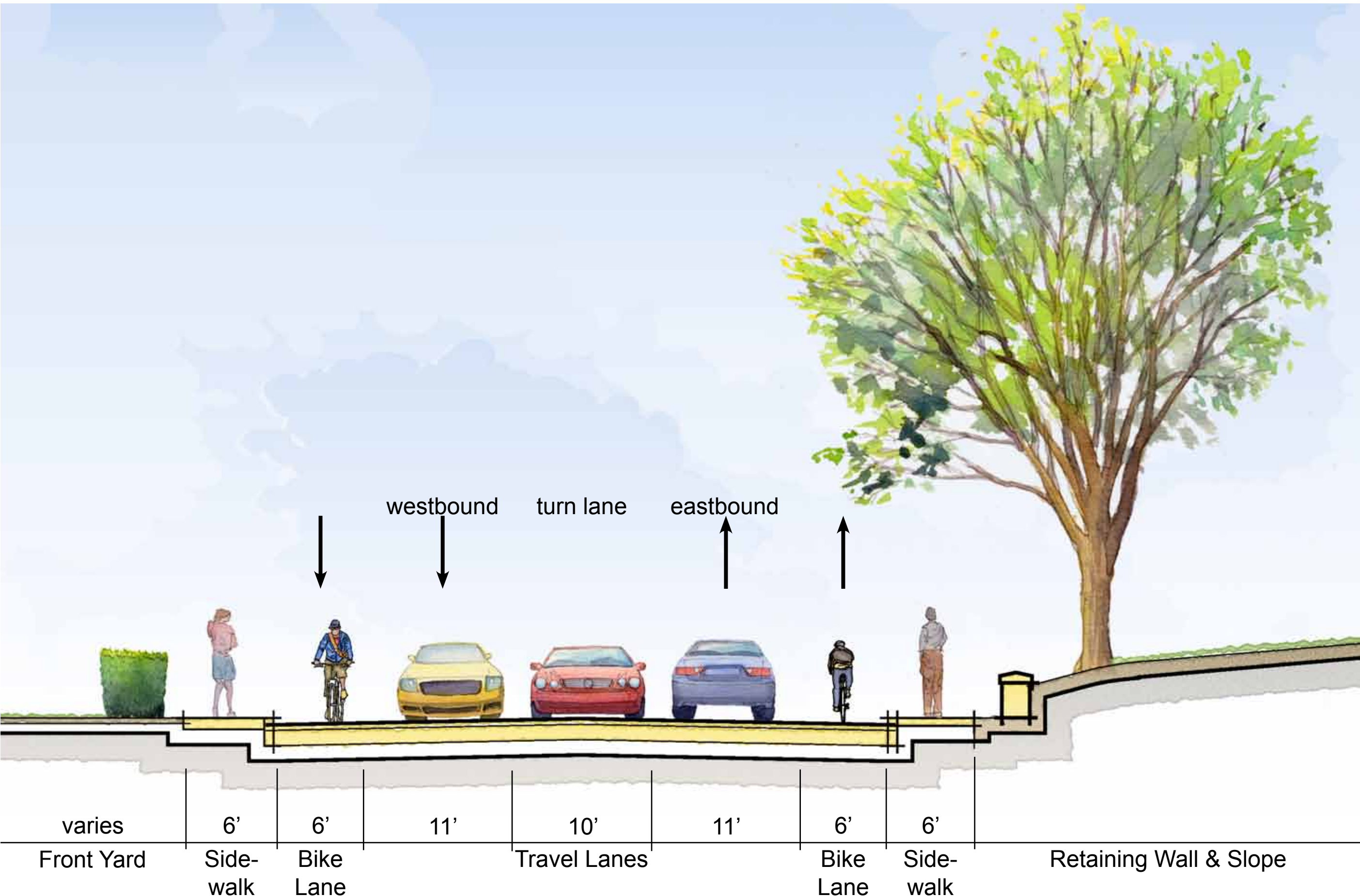
October 15, 2010

SPEED LIMIT	25 mph
TRAVEL LANES	two-way, four lanes (2 east/2 west)
PARKING	Sundays only
BIKE LANE	none
TREE LAWN	none



Fifth Avenue - Existing Conditions

SPEED LIMIT	25 mph
TRAVEL LANES	two-way, two lanes w/ turning lane
PARKING	Sundays only
BIKE LANE	two-way
TREE LAWN	none



Fifth Avenue - Bike Lane Alternative Concept

Figure 15
Street Sections
Fifth Avenue

Fifth Avenue - Existing Conditions

This section represents Fifth Avenue east of South Neville Street, containing a 44-foot wide cart way of four lane traffic. West of South Neville Street, the cart way widens with the addition of parking on both side of Fifth Avenue but the vehicle lanes remain at 11 feet wide.

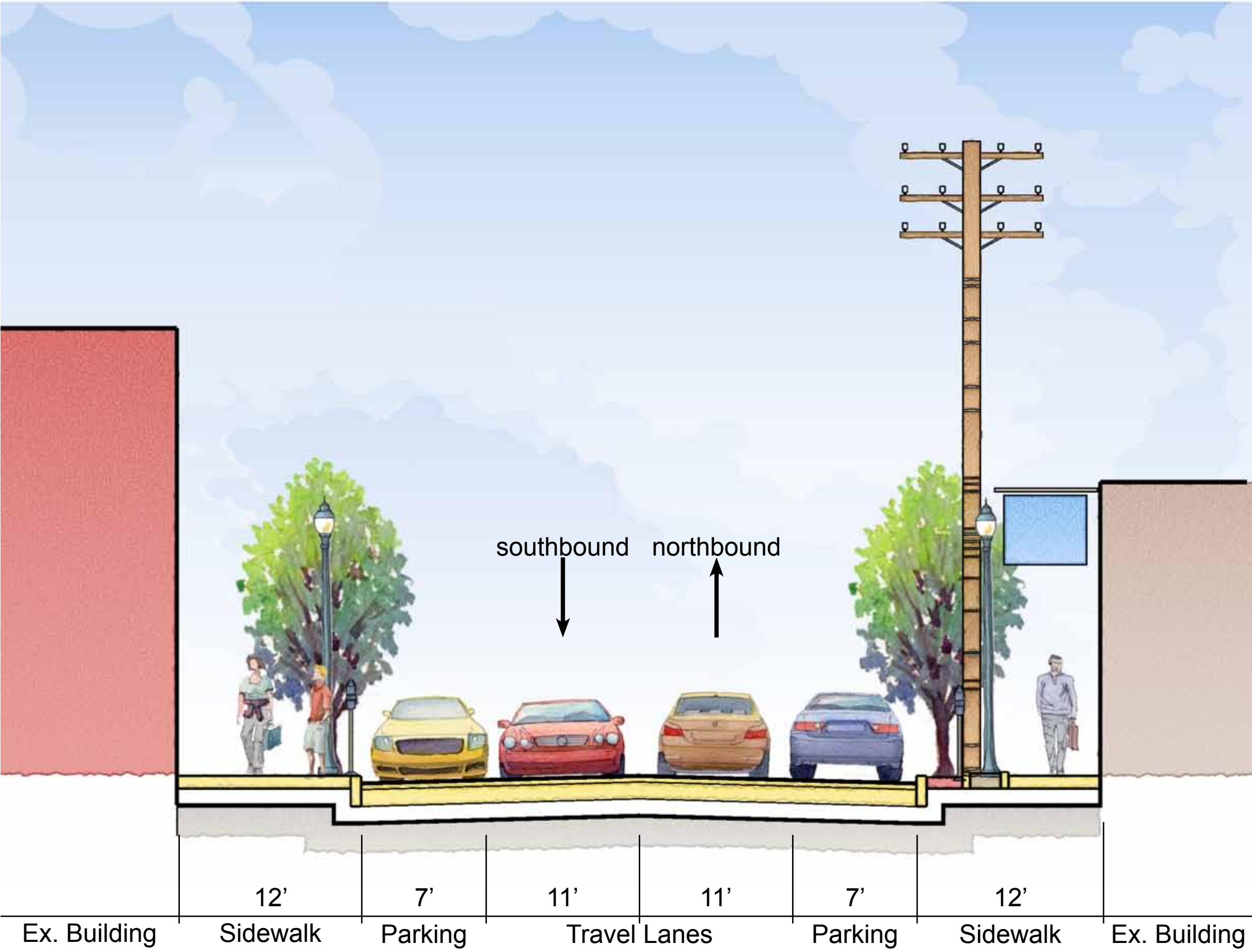
- High speeds exceeding 40 mph at times
- Very narrow sidewalks adjacent to street, below ADA standards in some areas
- No bicycle lanes or sharrows
- No turning lanes

Fifth Avenue - Bike Lane Alternative Concept

This section consist of three lanes of vehicle traffic and two bike lanes. The center lane becomes a bi-directional continuous left turn lane with dedicated left turn lanes at Morewood Avenue and South Neville Street as well as South Craig and South Dithridge Streets.

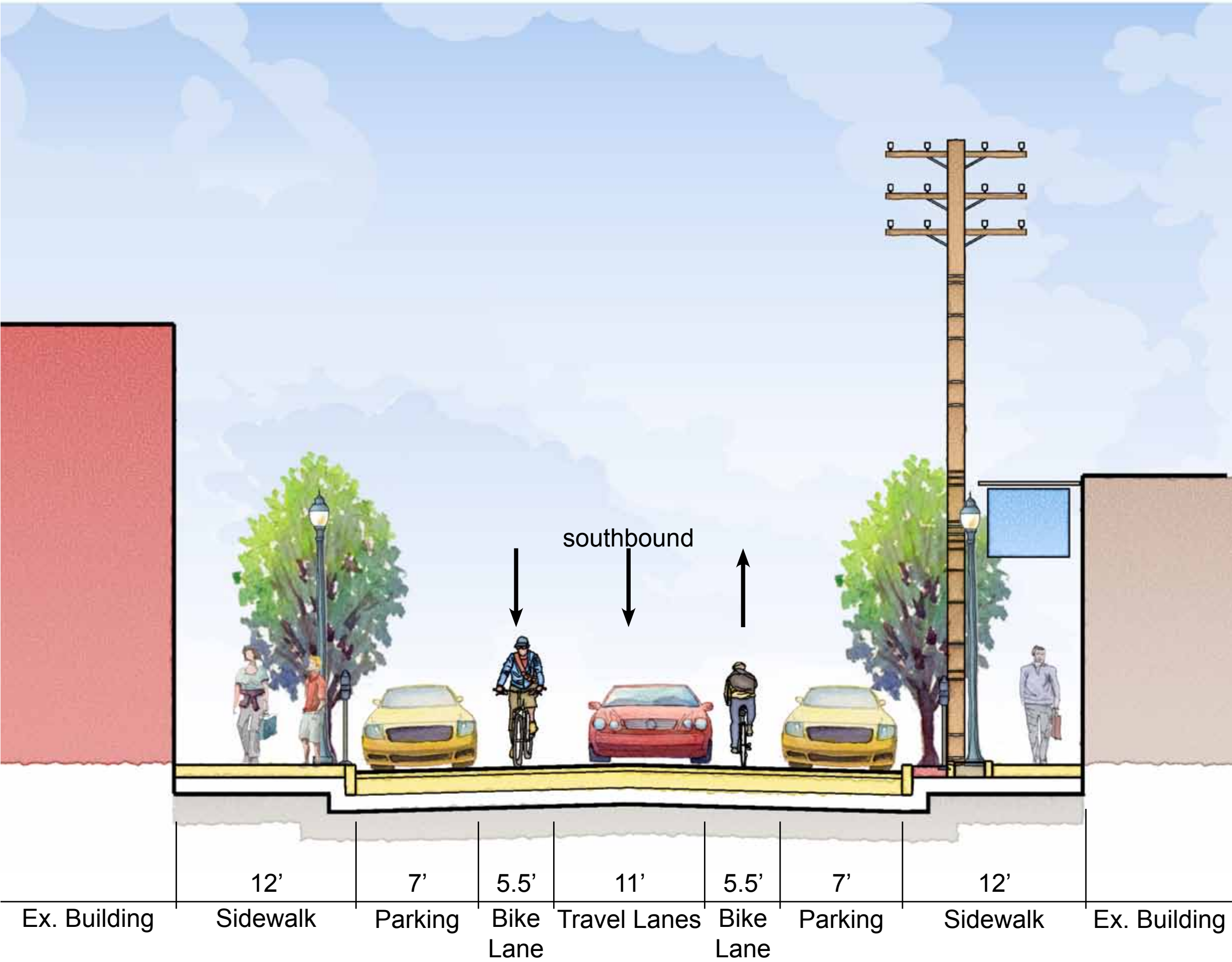
- Creates a center left turn lane in midblock areas for access to multiple uses
- Creates a separate turning lane at all major intersections
- Economical to achieve

SPEED LIMIT	25 mph
TRAVEL LANES	two-way, two lanes (1 north/1 south)
PARKING	both sides
BIKE LANE	none
TREE LAWN	yes



South Craig Street - Existing Conditions

SPEED LIMIT	25 mph
TRAVEL LANES	two-way, one lane (1 south)
PARKING	both sides
BIKE LANE	two-way
TREE LAWN	yes



South Craig Street - Bike Lane Alternative Concept

Figure 16
Street Sections
South Craig Street

South Craig Street - Existing Conditions

- This section consists of a narrow cart way containing single lane two-way traffic and two lanes of parking within a total width only 36 feet.
- Existing street functions well as a low speed connection between Forbes and Fifth Avenues
 - Congestion exists on many levels, within movements of vehicles, pedestrians and cyclists
 - In spite of traffic, the street supports an abundance of commercial activities

South Craig Street - Bike Lane Alternative Concept

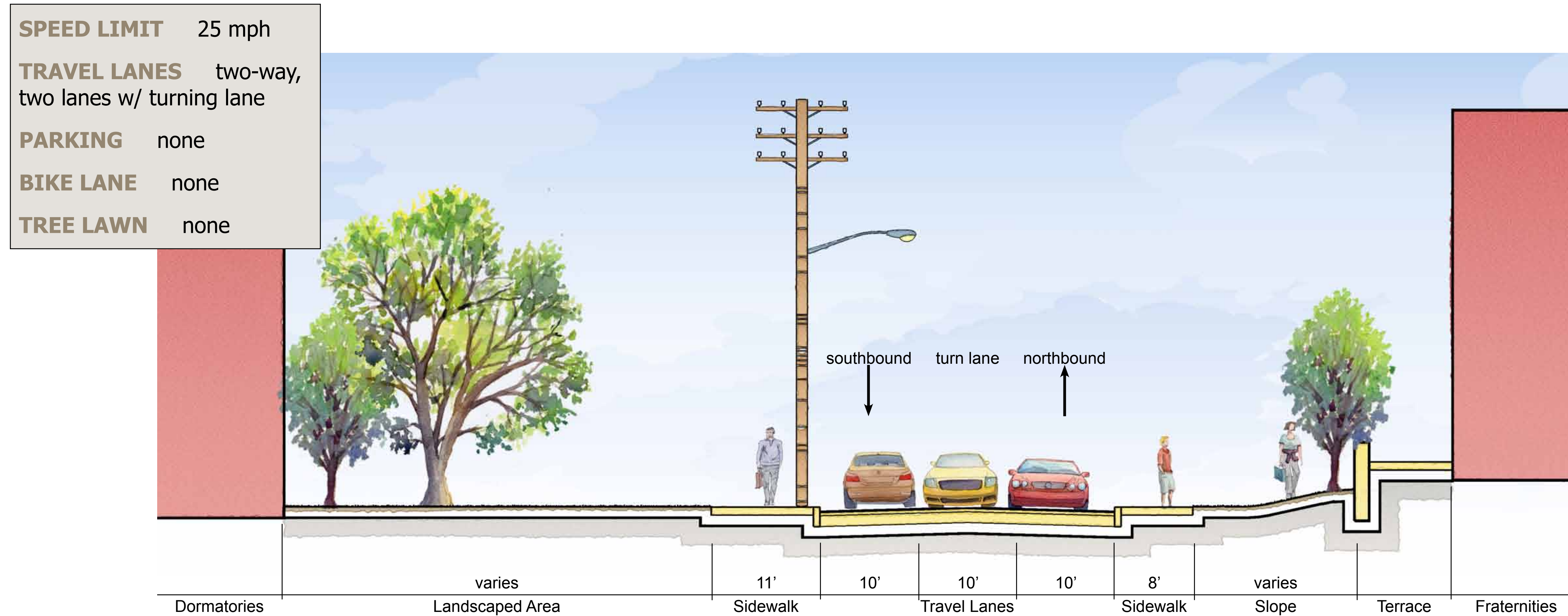
- This section depicts a bike lane in each direction created by the elimination of northbound traffic on South Craig Street from Forbes Avenue to Fifth Avenue.
- Creates a one way street southbound
 - Creates a two way bicycle street
 - Retains existing parking
 - Rerouting of former northbound traffic can be handled within two blocks, all within the Study Area
 - Removes bicycle traffic from sidewalks

Figure 17
Street Sections
Morewood Avenue

Morewood Avenue - Existing Conditions

This section depicts the exiting three lane section contained in only a 30-foot wide cart way with sidewalks immediately adjacent to the cart way.

- Narrow vehicle travel lanes
- Sidewalks adjacent to street
- Narrow sidewalks
- No bicycle lanes

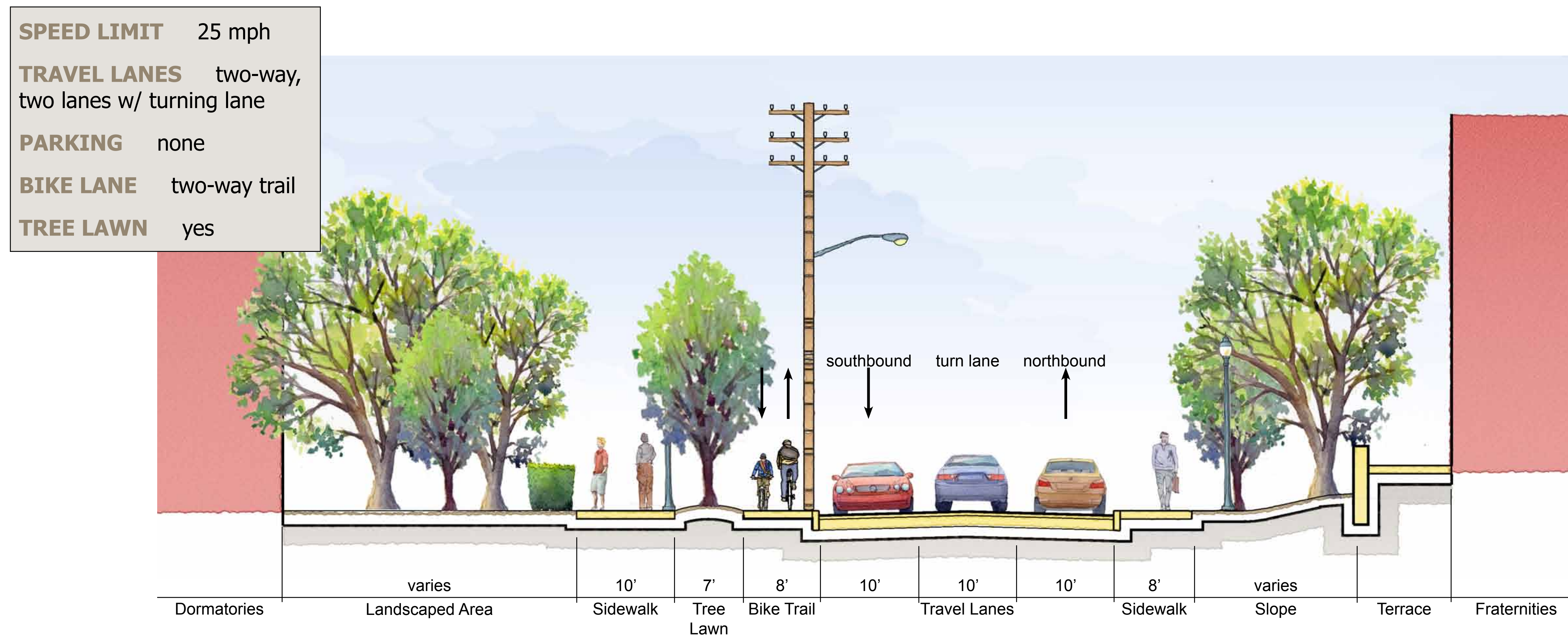


Morewood Avenue - Existing Conditions

Morewood Avenue - Sidewalk Alternative Concept

This section depicts the exiting cart way remaining to the northern driveway of the fraternity section, whereupon the sidewalk along the eastern side of Morewood is eliminated and the street widened to Fifth Avenue. The pedestrian movement would be accommodated via a 10-foot wide sidewalk placed behind a tree lawn along the western frontage of the street. The existing sidewalk would remain becoming a two-way bike lane.

- 10-foot wide sidewalks and separate bike trail
- Tree lawn created along western curb line
- Potential for street widening via sidewalk elimination midblock north of fraternity house driveway
- Eliminate sidewalk along eastern curb north of fraternity driveway



Morewood Avenue - Sidewalk Alternative Concept

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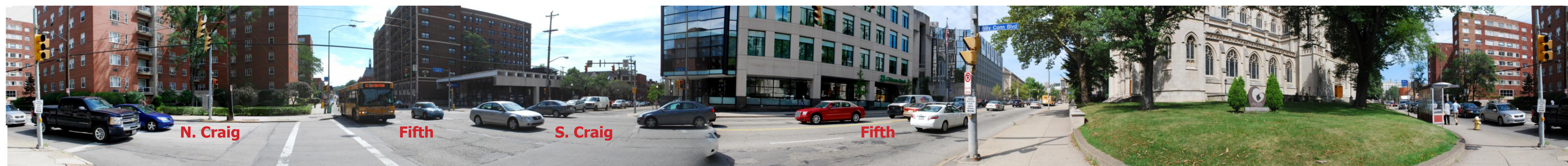
October 15, 2010



1 Fifth Avenue & South Bellefield Avenue



2 Fifth Avenue & South Dithridge Street



3 Fifth Avenue & South Craig Street

**Figure 18
Intersection Panoramas**

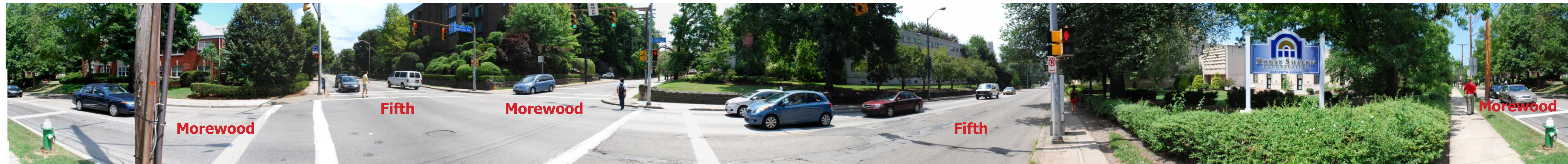
- 1** Fifth Avenue & South Bellefield Avenue
- 2** Fifth Avenue & South Dithridge Street
- 3** Fifth Avenue & South Craig Street

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4 Fifth Avenue & South Neville Street



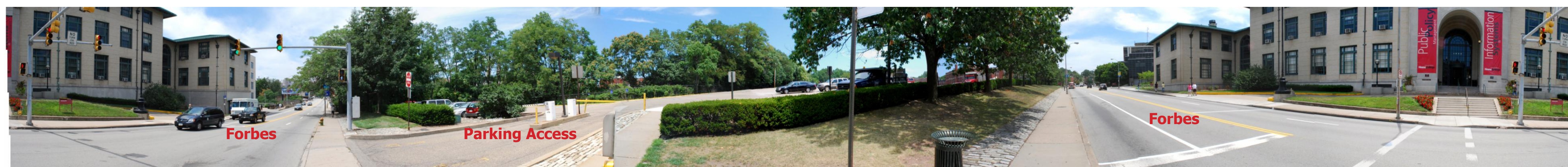
5 Fifth Avenue & Morewood Avenue

**Figure 19
Intersection Panoramas**

- 4** Fifth Avenue & South Neville Street
- 5** Fifth Avenue & Morewood Avenue



6 Forbes Avenue & South Craig Street



7 Forbes Avenue & Hamburg Hall



8 Forbes Avenue & Morewood Avenue

**Figure 20
Intersection Panoramas**

- 6** Forbes Avenue & South Craig Street
- 7** Forbes Avenue & Hamburg Hall
- 8** Forbes Avenue & Morewood Avenue



9 Forbes Avenue & Beeler Street



10 Forbes Avenue & Margaret Morrison Street

**Figure 21
Intersection Panoramas**

- 9** Forbes Avenue & Beeler Street
- 10** Forbes Avenue & Margaret Morrison Street

C. Phase Two – The Micro Level Report

Executive Summary

Section 1 – Options for Corridor Improvements to Enhance Safety, Movement, and Aesthetics.

Section 2 – Options for Pedestrian Enhancements

Section 3 – Options for Improved Bicycle Facilities

Section 4 – Options for Bus Stop Relocations or Eliminations

Section 5 – Recommendations on Proposed Options

Section 6 – Refine Concept Designs and Schematics

CMU Pedestrian Safety Mobility Study

Executive Summary

The Phase Two Micro Level Report will be used to present recommendations for project development on three (3) levels, immediate, near term, and long term. The development of these three (3) levels was a result of a review of the options for improvements at the project sponsor meeting of December 8, 2010.

The recommendations were developed based upon review of all of the options, which have been developed over the course of the study, and are presented in Sections 1 through 4 of this report. Section 1 covers the options for corridor improvements, Section 2 the options for pedestrian enhancements, Section 3 the options for improved bicycle facilities and Section 4 options for bus stop eliminations or relocations.

From these options a series of recommendations follow in Section 5, which describe the recommendations for proposed options, and the process of ranking the recommendations into three (3) levels immediate, near term, and long term. Within each Section, 1 through 4, the rankings of the immediate and near term recommendations are identified with footnotes 1 and 2, respectively. All other listings will be considered long term issues to be considered over time, as the immediate and near term components are completed.

The basis for the recommendations were developed from two (2) primary sources, stakeholder interviews, and a public workshop

Stakeholder interviews were held with the following over the period of October 22, 2010 through October 29, 2010:

- | | |
|--------------------------------|--------------------------------------|
| + Central Catholic High School | + Squirrel Hill Urban Coalition |
| + University of Pittsburgh | + Port Authority of Allegheny County |
| + Craig Street Merchants | + Carnegie Library |
| + Shadyside Action Coalition | + Pittsburgh School Board |

These personal, one-on-one interviews were conducted to present the objectives of the study, but more importantly, to gather input for two (2) key documents:

- The ranking of the six (6) major issues identified in the Phase 1 report and,
- The ranking of the level of need for improvements at the ten (10) intersections within the study.

These first two (2) core documents form the basis for proceeding with our recommendations. In addition, the third core document is the compilation of the input received from the public workshop conducted by Carnegie Mellon University, the Oakland Transportation Management Association, GAI Consultants, and Kittelson & Associates on November 17, 2010. The workshop provided the attendees with the six (6) major issues, and requested that they rank the six (6) major issues and provide additional feedback to the study team for further evaluation and guidance for this report. The overall compilation of the feedback for the workshop is contained in Appendix A.

The results of the stakeholder interviews are presented on the next two pages

Figure 1
Stakeholder Interview Summary
Major Issues Rankings

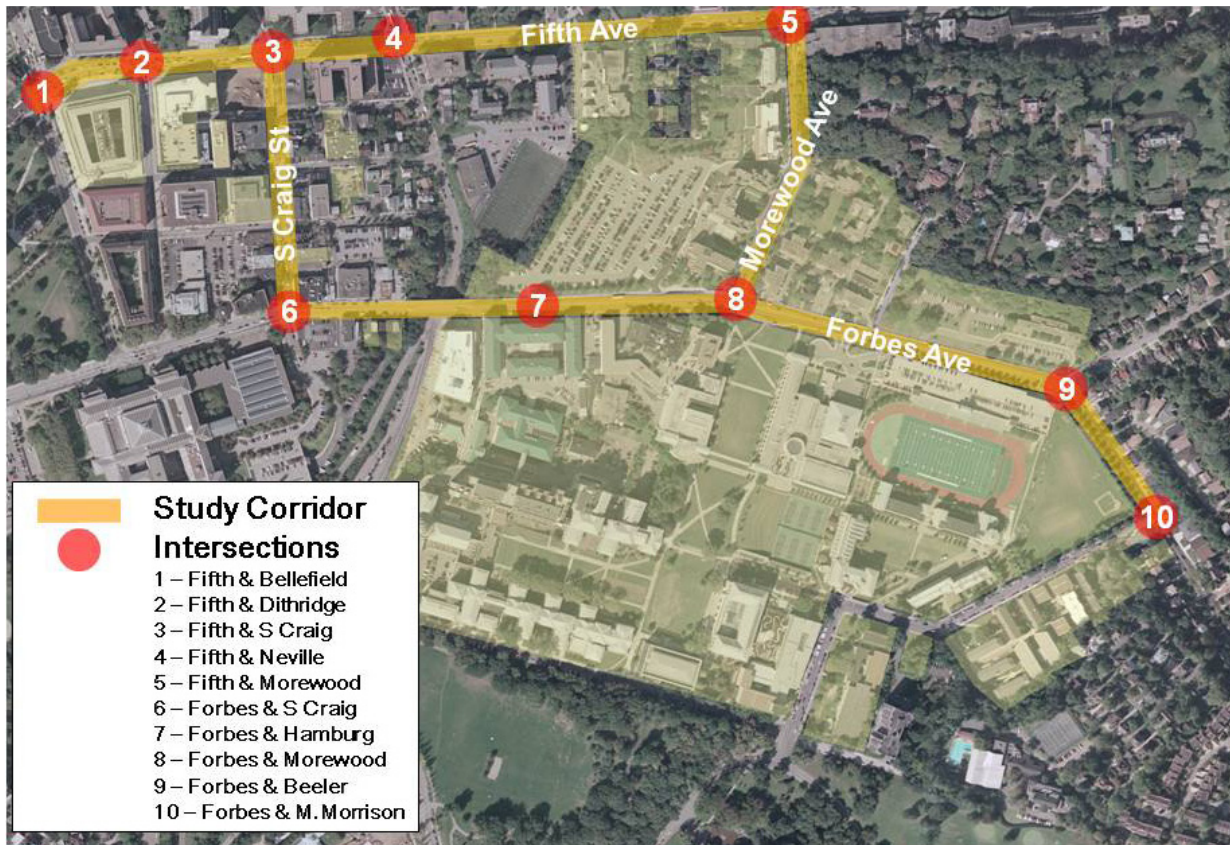
Stakeholders	Issues	Lack of Standards Compliance	Lack of Long Term Markings	Lack of Signage	Lack of Buffer	Narrow Sidewalks	Excess Speeds
Central Catholic		5	4	6	1	2	3
University of Pittsburgh		5	4	6	1	2	3
Craig Street Merchants		3	2	6	5	4	1
Shadyside Action Coalition		5	6	4	2	3	1
Squirrel Hill Urban Coalition		5	4	3	1	6	2
Port Authority		4	3	6	5	2	1
Carnegie Library		1	3	6	4	5	2
Pittsburgh School Board - Did not respond							
Total Score Lowest Score = Highest Significance		28	26	37	19	24	13

Figure 2
Stakeholder Interview Summary
Intersection Rankings

Intersection Stakeholders	Fifth & Bellefield	Fifth & Dithridge	Fifth & S. Craig	Fifth & Neville	Fifth & Morewood	Forbes & S. Craig	Forbes & Hamburg	Forbes & Morewood	Forbes & Beeler	Forbes & M. Morrison
Central Catholic			X	X		X				
University of Pittsburgh	X		X					X		
Craig Street Merchants			X			X		X		
Shadyside Action Coalition				X	X			X		
Squirrel Hill Urban Coalition					X	X		X		
Port Authority	X			X				X		
Carnegie Library			X	X		X				
Pittsburgh School Board	X		X			X				
Total Votes	3	0	5	4	2	5	0	5	0	0
High Scores = High Significance										

Welcome to the Open House.

The concepts presented today are intended to foster a safe, pedestrian-friendly and well-connected campus that supports all modes of transport, from bikes to buses, from cars to pedestrians. The study involves the ten intersections and four streets as indicated on the map below. The study's design and engineering team welcome your ideas, and will answer questions and explore opportunities for the future of the Carnegie Mellon campus.



The reverse side of this handout presents the most significant findings to date, but you may have other thoughts as you participate in the workshop. We welcome all input as you view the presentation and interact with the study staff and the staff of Carnegie Mellon and the Oakland Transportation Management Association.

Please mark what you would rank as the top three priorities to be addressed.

- ☐ Lack of ADA and Traffic Signal Standards Compliance at Intersections
- ☐ Lack of Long Term Pavement Markings at Intersections
- ☐ Lack of Wayfinding/Destination Signage
- ☐ Lack of Buffer Between Sidewalks and Vehicle Travel Lanes
- ☐ Narrow Sidewalks - Far below Required Capacity
- ☐ Excess Speeds on Forbes and Fifth Avenues

You may have other thoughts as you view the display and interact with the staff. Please provide them here.

Based upon these three (3) core documents, the following are the immediate and near term actions recommended by the study. Further details on all of these recommendations are found in Sections 5 and 6.

Immediate Action Recommendations

- Implementation of the upgrade of all of 10 intersections within the study to current traffic signal and ADA standards. The intersections along Forbes Avenue are Craig Street, Hamburg Lot, Morewood Avenue, Beeler Street, and Margaret Morrison Street. The intersections along Fifth Avenue are Bellefield Avenue, Dithridge Street, Craig Street, Neville Street, and Morewood Avenue.
- Implementation of the road diet of Forbes Avenue within the entire study area from Craig Street to Margaret Morrison Street via elimination of the curbside motorized vehicular travel lanes on Forbes Avenue, and the establishment of bicycles lanes within those travel lanes.
- Implementation of a physically separated local neighborhood walkway and campus walkway on Morewood Avenue for its entire length within the study area from Forbes Avenue to Fifth Avenue in accordance with future design standards of the University.

Near Term Recommendations

- Pedestrian and Vehicular enhancements to the entire length of Craig Street consisting primarily of three (3) elements, resurfacing of the street, elimination of individual parking meters, and rehabilitation and addition of streetscape elements. Conversion to a pay station system is a primary element to eliminate interference to pedestrian traffic caused by bicyclists utilizing meter posts to park bicycles, which interferes with pedestrian movements and drivers accessing the walk area from parked vehicles.

A range of streetscape elements will be considered by enhanced mobility and reduce conflicts between pedestrians, cyclists, and vehicles. These include the pay station parking system, bicycle pads, bus stops relocation at Forbes and Craig, street furniture, and trash receptacles. In addition, as campus expansion plans progress, the intersections of Winthrop, Filmore, and Henry would receive crosswalk markings consistent with the upgrade of the ten (10) study area intersections.

- Safety Improvements to Fifth Avenue intersections at Neville Street and Morewood Avenue. These intersections have the highest number of vehicle accidents over the five-year period covered in this study (2005-2009), with 25 and 28 total accidents, respectively. Improvements at Neville would include not only a complete upgrade of the signals, ADA accommodations, but also significant signage upgrades on all approaches, and curb and sidewalk bulb outs where feasible, to reduce lengths of pedestrian crossings. Improvements at Morewood would include realignment of the southbound through movement of Morewood Avenue crossing Fifth Avenue, along with complete upgrades of signal hardware and ADA accommodations.

Further study will be needed to determine the exact nature of the contributing causes of the accidents, including the effects of speed on accidents which, of all six major issues, received the most significant feedback at the public workshop on November 17, 2010.

- Implement studies to consider additional pedestrian crossings along Forbes Avenue within the study area. This element is the direct result of the major expansion of the Carnegie Mellon University Campus as embodied in the 2011 Master Plan. As the campus expands north of Forbes Avenue, the demand for north-south crossings will greatly increase, and will result in the need to identify future planned traffic signals and crossings. In their review of the Phase 1 Report, the City of Pittsburgh Bureau of Engineering and Transportation Department on December 12, 2010, noted that “Proper development of the site plan (master plan) should include encourage crossing at existing/planned signalized intersections....” .

As the build out of the 2011 Master Plan occurs, it is imperative that concurrent studies be conducted to study the need for additional crossings to provide a smooth evolution of pedestrian desire lines into well defined, efficient, safe crossings for the future campus population.

Section 1 - Options for Corridor Improvements to Enhance Safety, Movement, and Aesthetics.

Issues:

1. Lack of ADA compliance
2. Lack of traffic signal standard compliance
3. Lack of long term pavement markings to intersection
4. Lack of wayfinding/destination signage
5. Lack of buffer between sidewalks/vehicle travel lane
6. Excessive speeds on Fifth and Forbes Avenues
7. High accident location exists at Neville Street and Fifth Avenue.
8. High accident location exists at Morewood Avenue and Fifth Avenue
9. Tree canopy decline exists along Craig Street
10. Underutilization of parking facilities.

Option:

Upgrade ADA ramp access, upgrade signal hardware. ①

Upgrade all signals at ten (10) study intersections. ①

Install special emphasis crosswalks at all ten (10) intersections.①

Implement a three (3) tier system:

- a) Static on campus signage
- b) A system linked to the city-wide signing plan
- c) Interactive wayfinding system via smart phone applications
- d) Mimic the “ParkPgh” system.

Develop tree lawns where feasible. Relocate sidewalks away from curb line.

Develop a plan to provide a road diet on Forbes Avenue. ①

Recommend a lower speed limit on Fifth Avenue in the study area, if warranted, based upon appropriate studies.

Upgrade signal, signing, and pavement markings, and potentially reduce speed limit to 25 MPH from 35 MPH. ②

Upgrade signal, signing, and pavement markings, lower speed limit, realign southbound Morewood Avenue to reduce/eliminate lane offset across intersection. ①

Provide standard unpaved tree planting areas, 3 ft. x 7 ft., for all healthy trees, per the Forestry Dept standards.

Implement on campus wayfinding mimicking and perhaps linking to the “ParkPgh” system, the real time parking garage space availability software, currently utilized in Downtown Pittsburgh.

① Immediate Action Recommendation

②Near Term Recommendation

11. Combined movements of pedestrians, bicyclists and vehicles are currently congested on Craig Street
 - a) Facilitate vehicle passage on Craig Street via complete street resurfacing, provide full special emphasis pedestrian crosswalk markings at all cross streets, Filmore and Winthrop, on Craig Street from Forbes Avenue to Fifth Avenue.
 - b) Minimize impediments to pedestrian movements. Additional reference, Section 1, Issues 3 and 4.
12. Bicycle and pedestrian movements along Morewood Avenue are impeded due to narrow vehicle lanes, high levels of congestion, and narrow sidewalks along Morewood Avenue. Implement sidewalk alternative per Section 3, Item 2.b. ①

① Immediate Action Recommendation

② Near Term Recommendation

Section 2 - Options for Pedestrian Enhancements

Issues:

1. Narrow sidewalks
2. Lack of buffer between sidewalk and vehicle travel lanes.
3. Narrow sidewalk on Forbes Avenue along north curb line at Craig Street.
4. Narrow sidewalk on Fifth Avenue along south curb line approaching Morewood.
5. Lack of adequate pavement markings at intersections.
6. Lack of wayfinding signage.
7. Lack of pedestrian signals at all intersections.
8. Inadequate north/south movement accommodation of pedestrian across Forbes Avenue
9. Narrow sidewalks on Forbes Avenue bridge.
10. High patron loads at Morewood bus stops in both directions impede pedestrian flow.

Option:

- CMU to modify overall campus-wide sidewalk replacement program to utilize 10-ft. wide sidewalks as a standard replacement width where feasible.
- a. Create tree buffer as part of sidewalk replacement program in Option 1 above.
 - b. Relocate sidewalk along western curb line of Morewood to directly serve the dormitories. ①
- Widen sidewalks to uniform width and eliminate offset curb alignment. (part of Forbes Avenue Road Diet per Section 1 Item 6 and Figure 4 ①)
- Widen sidewalk to full 10 foot width as part of Morewood Avenue sidewalk Alternative, per Figure 8. ①
- Replace all crosswalk markings per Section 1, Item 3. ①
- Implement three-tiered program per Section 1, Item 4.
- Upgrade traffic signals and add pedestrian signals per Section 1, Item 2.
- Implement studies to expand existing pedestrian crosswalks and determine future crosswalk/signal locations. ②
- a) Long term Master Plan components include separate pedestrian crossing structures over Neville/Boundary Streets.
 - b) Consideration of widening of sidewalks on Forbes Avenue bridge is not practical due to structural design constraints.
- Create separate sidewalk bypass of bus stops on Forbes at Morewood Avenue.

① Immediate Action Recommendation

②Near Term Recommendation

Section 3 – Options for Improved Bicycle Facilities

Issues:

1. Certain bicycle parking areas are at 100% or greater utilization.
2. No distinct bicycle facilities exist on any street within the study area.
- 3.. Internal circulation of bicycles within the campus is hampered by lack of a route structure within the campus and numerous discontinuities within the few routes which exist

Option:

- Increase bike rack placements for all locations with greater than 80% utilization. Develop wayfinding application for smart phones per Section 1, Item 4 for directions to underutilized bicycle facilities.
- a) Implement Forbes road diet per Figures 4, 5, and 6. ①
 - b) Implement Morewood Avenue Sidewalk Alternative per Figures 6 and 7. ①
 - c) Provide connectivity to City bicycle route system
- Develop a complete, continuous bicycle routing plan for bicycles within the campus environment with links to connecting City routes.

① Immediate Action Recommendation

Section 4 – Options for Bus Stop Relocations or Eliminations

Issues:

1. Confusion of utilization of Forbes Avenue stops at Morewood within existing layover areas.
2. High utilization of bus stops at Morewood Avenue inbound and outbound.
3. Increased student enrollment will place higher demands on transit service
4. Bus unloading and boarding create congestion at high volume stops at/near Craig Street.
5. Utilization of eastbound curb lane by Central Catholic school buses causes capacity failures on Fifth Avenue eastbound.

Option:

- Expand Morewood at Forbes stops to accommodate both layover and regular stop functions. ②
- Expand bus stops into full transit center configurations during the implementation of building and site developments as part of the 2010 master Plan. ②
- Relocate bus stops where such action would facilitate increased student population utilization of services and/or would reduce heavy loads at stops which increase boarding and discharge times and/or which impact schedules of the bus routes
- a) Relocate Forbes Avenue westbound stop to far side of intersection at Craig Street.
- b) Relocate eastbound stop to Dithridge ① Street. (Required for Forbes Avenue Road Diet)
- a) Reschedule school buses to minimize layover time on Fifth Avenue to 10 minutes or less.
- b) Relocate layover entirely to other less traveled city street, i.e. Ellsworth Avenue.

① Immediate Action Recommendation

② Near Term Recommendation

Section 5 – Recommendations on Proposed Options

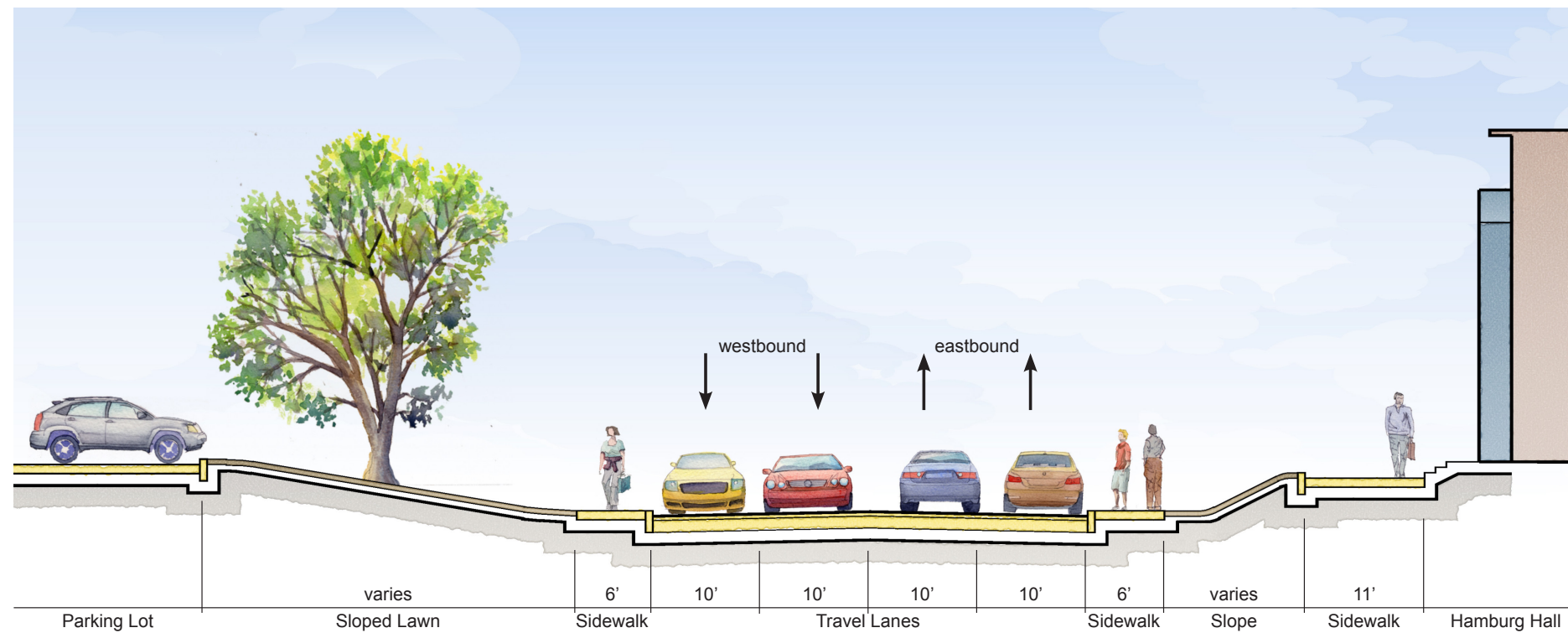
The recommendations presented below include the three (3) Immediate Action Recommendations consisting of the following three items:

1. Complete upgrade of the signal system at all ten (10) of the study intersections. This Recommendation evolved from an initial observation that pavement markings and all of the existing signal equipment within the study area did not meet current standards. A suggested immediate action recommendation was to only upgrade the crosswalk pavement markings only at the ten (10) intersections to achieve immediate safety improvements at minimal cost. It became apparent at the December 8, 2010 Project Sponsor meeting that this would not achieve the overall objectives of the study, to achieve greater overall pedestrian safety and mobility, and that the benefits of only upgrading the crosswalks were felt to have moderate effect on mobility across an intersection, but minimal or no effect on overall mobility. Therefore this initial recommendation was expanded to include the complete upgrade of all signals within the study area to current standards for pedestrians and motorized vehicles. Conceptual drawings are not presented, but a summary cost estimate is presented for typical four and three-leg approaches in Section 6.
2. The second Immediate Action Recommendation is to implement a road diet on Forbes Avenue. This plan would involve the reduction in the number of travel lanes on Forbes Avenue and the creation of bike lanes in both directions on Forbes Avenue. This recommendation fulfills multiple objectives of the study at very low cost, while not degrading levels of service along Forbes Avenue as demonstrated in Appendix C. It achieves increased pedestrian safety by creating a buffer of a bicycle lane between pedestrian movements along Forbes Avenue and vehicle traffic. It acts as a traffic calming strategy while not reducing capacity on Forbes Avenue, recognizing that additional turning lanes will be provided as needed to maintain capacity. It also provides a bicycle routing system through the heart of campus, as well as connections to Oakland and Squirrel Hill beyond campus, which immediately compliments the overall flow of the bicycle routing plans of the City of Pittsburgh. Details of the Road Diet Plan are presented on Figures 1 thru 5 showing details of the intersections of Craig Street and Morewood Avenue at Forbes Avenue, which also represents the typical conditions along the entire length of Forbes Avenue within the study area. Figure 1 is a plan sheet 22 x 34 inches contained in the rear pocket of the binder. In addition, further details on scope and cost can also be found in Section 6. Table 2. Validation of the minimal effects of implementation of this Immediate Action item is contained in Appendix C.
3. The third Immediate Action Recommendation is the development of a campus sidewalk and neighborhood/local sidewalk system along Morewood Avenue from Forbes Avenue to Fifth Avenue. This concept achieves numerous objectives of the study as well. It provides well connected routes to the largest on campus dormitory facilities along Morewood Avenue, and provides a safe alternative for bicyclists formerly traveling along Morewood Avenue by removing them totally from the narrow lanes along heavily congested Morewood Avenue. The bicycle trail will be safely connected to the bike lanes on Forbes Avenue via appropriate signage along with appropriate signage for crossing Fifth Avenue at its northern terminus. This concept also achieves major objectives of the study by providing significantly improved dual pedestrian routes between the main campus and dormitories, as well as providing mobility and significantly enhanced safety for the rapidly growing pedestrian commuters beyond campus. The summary of costs of this recommendation is presented in Section 6. Figures 6, 7, and 8 present this recommendation.

Figure 2
Forbes Avenue
Existing Conditions

This section depicts a narrow 40-foot wide section with 10-foot wide lanes operating as a PENNDOT owned arterial through campus.

- High speeds over 35 mph at times
- No campus environment
- Sidewalks narrow and adjacent to the roadway, below ADA standards in some areas
- No tree lawns
- No accommodation for bicyclists
- Large gaps in traffic, even during rush hours

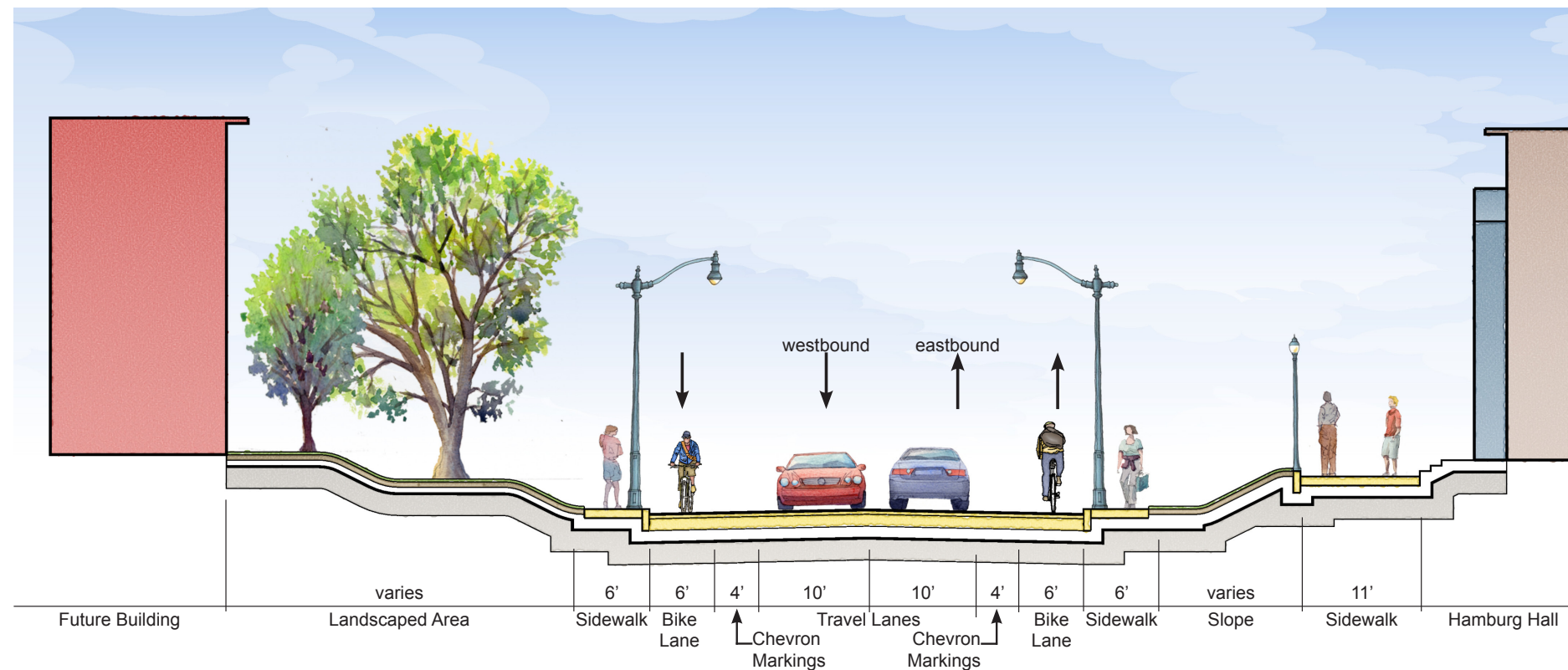


January 21, 2010

Figure 3
Forbes Avenue
 Road Diet Recommendation

This section reduces Forbes Avenue to two travel lanes and introduces bike lanes inbound and outbound on Forbes Avenue.

- Achieves traffic calming/reduces speeds
- Ease of construction and economical for the separated lane
- Accommodate bicyclists
- Turning lanes remain at Morewood Avenue and Beeler Street outbound
- Right turn lane at Margaret Morrison Street is eliminated.
- A new dedicate left turn lane to north bound Craig Street is created
- Bus stop at Hamburg Hall is eliminated
- Bus stop at Craig Street remains
- Bus stops at Morewood Avenue share layover areas



January 21, 2010

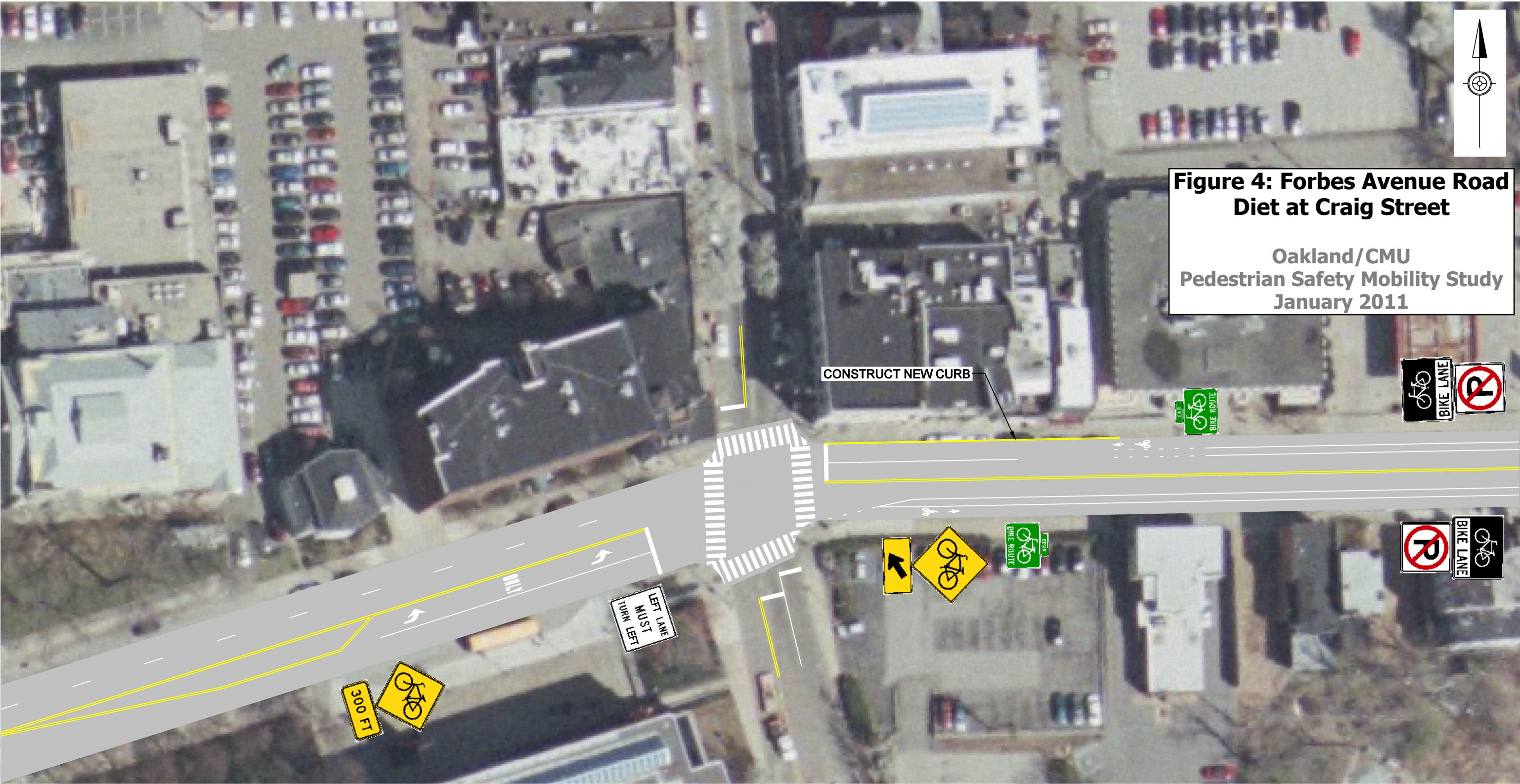


Figure 4: Forbes Avenue Road Diet at Craig Street

Oakland/CMU
Pedestrian Safety Mobility Study
January 2011

SCALE
0 25 50 FEET

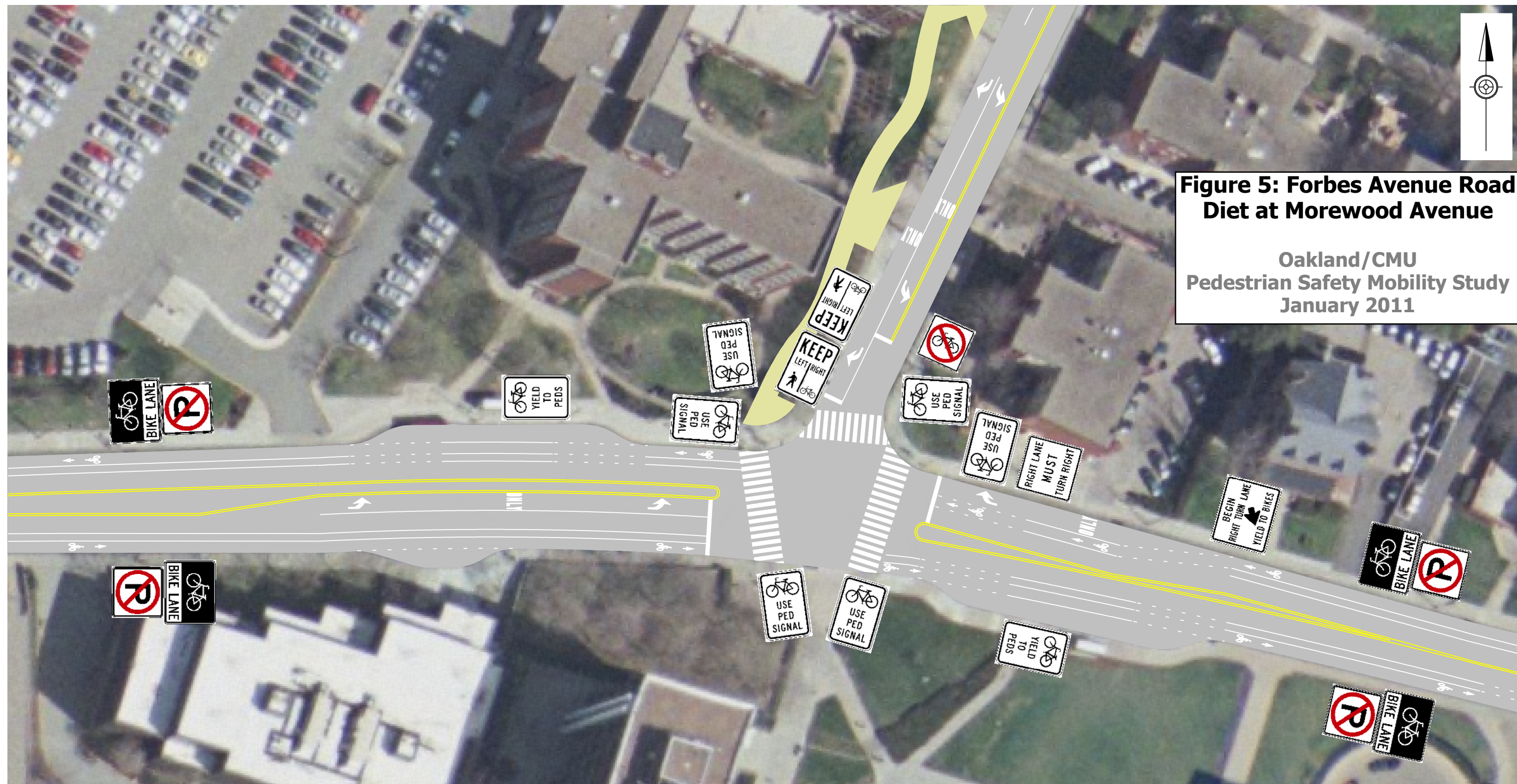
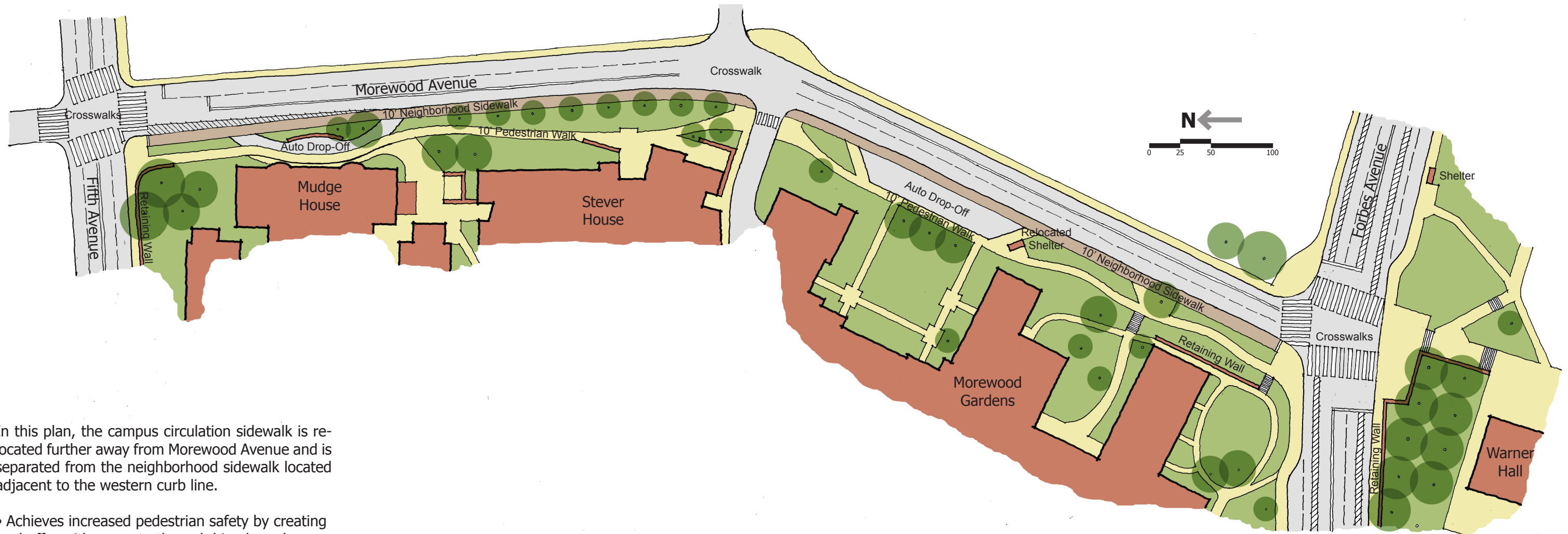


Figure 5: Forbes Avenue Road Diet at Morewood Avenue

Oakland/CMU
Pedestrian Safety Mobility Study
January 2011

SCALE
0 25 50 FEET

Figure 6
Morewood Avenue
 Sidewalk Alternative Recommendation



In this plan, the campus circulation sidewalk is re-located further away from Morewood Avenue and is separated from the neighborhood sidewalk located adjacent to the western curb line.

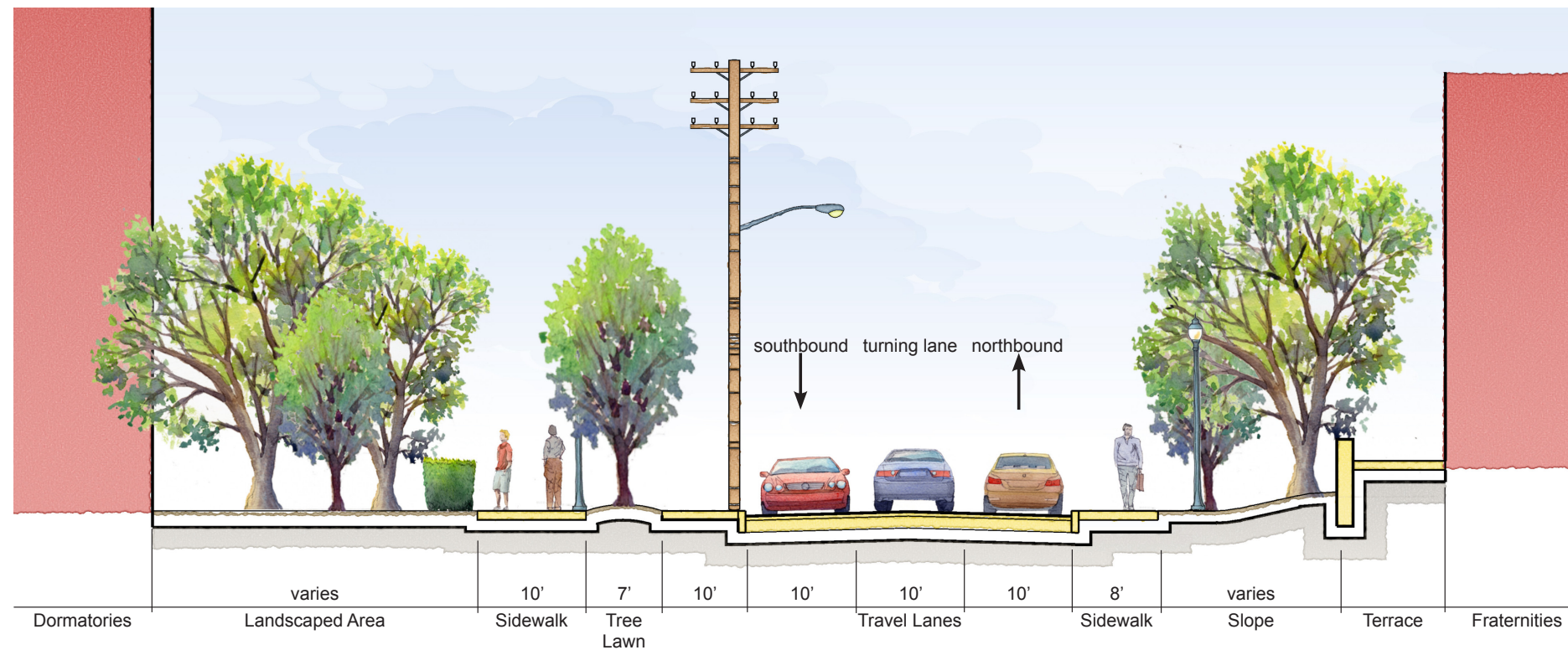
- Achieves increased pedestrian safety by creating a buffer with separate through bicycle and pedestrian movements along Morewood Avenue
- Landscaped area is created between the campus sidewalk and neighborhood walkway
- Intersection alignment improvements at Fifth Avenue would improve southbound vehicular traffic movements along Morewood Avenue
- Intersection improvements at Forbes Avenue and Fifth Avenue would improve pedestrian safety

January 21, 2010

Figure 7
Morewood Avenue
 Sidewalk Alternative Recommendation

This section depicts the existing cartway remaining unaltered. The campus pedestrian movement would be accommodated via a 10-foot wide sidewalk placed behind a tree lawn along the western frontage of the street. The existing sidewalk would remain becoming a neighborhood connecting walkway.

- 10-foot wide campus sidewalk and separate 10-foot wide neighborhood walkway
- Tree lawn created along western curb line
- Campus sidewalk just north of Forbes Avenue requires a retaining wall along approximately 100 feet along Morewood Gardens Dormitory frontage
- Sidewalk termini at Fifth Avenue requires partial removal of approximately 100' of retaining wall along Fifth Avenue and a wall entirely along Morewood Avenue to achieve the required width of the neighborhood walkway

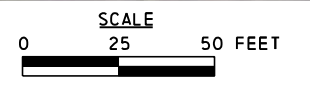


January 21, 2010



Figure 8: Morewood Avenue Sidewalk Alternative at Fifth Avenue

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Pedestrian Safety Mobility Study
January 2011



Section 6 – Refined Immediate Action Concept Designs with Estimates of Costs

Immediate Action Item 1 – The Signal System and ADA upgrade of all 10 study intersections

The scope of the work will involve the complete replacement of all signal equipment and replacement with standard equipment meeting current city of Pittsburgh standards. Pedestrian signals will be incorporated at all ten (10) study intersections and fully compliant ADA ramps will be installed on all legs of the intersections. It would be prudent to construct certain signals as other improvements are made, such as the signal at Morewood and Forbes Avenues to be constructed with the Forbes Avenue Road Diet, but this is not mandatory. In addition, if the University desires to move ahead with the widening of Morewood Avenue to eliminate the offset intersection at Fifth Avenue it would certainly be prudent, but again, not required to perform this work simultaneously with the Morewood Avenue Sidewalk Alternative, Immediate Action Item 3.

Our cost estimates for engineering and construction were developed based upon GAI's 2010 costs for design and construction of signalized intersections in urban areas under PennDOT guidelines. They are based upon standard poles per City standards, and will include lighting requirements provided by the City. We are also assuming that no vaults of any kind will be encountered at any intersection. The costs presented, as based upon each intersection being developed as a standalone intersection, and bid separately. There will be some economies of scale in engineering costs for multiple designs, but no economies of scale for construction. The plans will also call for milling of the entire intersection area to the curb return limits to eliminate rutting, and provide complete eradication of any pavement markings, as well as initially providing a high contrast for the new pavement markings.

The field survey boundaries for public improvements will extend 150 feet in each direction for the intersections along Fifth Avenue at Bellefield Avenue, Dithridge Street, S. Craig Street, Neville Street, and Morewood Avenue and along Forbes Avenue at the intersections of S. Craig Street, Hamburg, Morewood Avenue, Beeler Street, and Margaret Morrison Street. The limits of the survey will be within the existing right-of-way.

GAI will also perform research at the County, City, and/or PennDOT for available record documents, comprised of, but not limited to, deeds, tax maps, recorded plans, road docket, and other documents to show "fee simple" ownership and "easements" having impact in the project area.

The survey crew will locate the existing monuments within the vicinity for establishing the existing right-of-way and property. GAI will establish the road alignments, centerline stationing, right-of-way lines, pertinent easements, and traffic control device easements available and identified on record documents.

Preliminary Cost Estimate Intersection Signal Upgrades – Per Intersection

Engineering: \$50,000

Construction: \$220,000 – 3-way intersection (3 in study)

\$280,000 – 4-way intersection (7 in study)

Construction Management: \$35,000

Total Cost of Ten (10) Intersections in Study Area: \$3,500,000

Assumptions:

1. Based upon Individual Intersection Design and Construction
2. Street Lighting Design by City of Pittsburgh
3. Cost does not include costs of Design or Construction of underground vaults, as existence of vaults is unknown at this time.

Immediate Action Item 2 – The Forbes Avenue Road Diet

The scope of work will consist of signage, a pavement marking program and two (2) bicycle lanes on Forbes Avenue from Craig Street to Margaret Morrison Avenue. The existing eastbound left turn lanes will be maintained at Morewood Avenue and Beeler Street. Two (2) new turning lanes will be added. First, a left turn lane will be established eastbound on Forbes Avenue to Craig Street northbound with pavement markings in the existing eastbound left lane. This will effect a channelization of eastbound Forbes Avenue as a lead in to the single lane configuration for the development of the bike lane. This plan is shown in Figure 1. A similar configuration on Forbes will be developed for westbound Forbes Avenue at Margaret Morrison Street. Additionally, a right turn lane at Forbes Avenue westbound to Morewood Avenue northbound will be designated which will interrupt the bicycle lane for the length of the turning lane, but the bike lane will resume beyond the intersection. This is shown in Figure 5.

GAI's costs for engineering and design cost were based upon standard PennDOT design guidelines. If this project does proceed on its own ahead of any signal design it would be our recommendation to include the pavement markings contained within the signal system upgrade, Immediate Action Item 1, above. A functional road diet plan will need to include upgrades of the pedestrian crosswalks along Forbes Avenue.

The primary pavement markings for the separation of the bicycle lane from the vehicle lane will consist of two (2) white stripes separated by 4-feet with 24-inch wide chevrons contained within the 4-feet of clearance between the two (2) white stripes. The potential for introducing a rumble strip within the 4- foot separation area will be further investigated.

The field survey boundaries for the Forbes Avenue Road Diet are anticipated to extend up to 5-feet beyond the back of curb on both sides of Forbes Avenue beginning at a point approximately 300-feet west of the intersection of S. Craig Street to a point approximately 300-feet east of the intersection of Margaret Morrison Street, an overall length of approximately 2,400-feet.

The addition of a five (5) section signal head for southbound Morewood Avenue would require a signal permit revision, and potential rewiring of the signal system, but not full replacement and upgrade of the signal at Morewood. These costs cannot be determined at this time.

Preliminary Cost Estimate – Forbes Avenue Road Diet

Engineering:	\$85,000
Construction:	\$175,000
Construction Management:	\$35,000

Total Cost of Forbes Road Diet: \$300,000

Assumptions Action Item 2:

1. Crosswalks along Forbes Avenue at five (5) intersections are required and will be at additional cost (construction cost only).

Immediate Action Item 3 – The Morewood Avenue Sidewalk Alternative

The scope of the work on Morewood consists of widening the existing sidewalk along the west side of Morewood to create a separate through sidewalk for neighborhood and pedestrians accessing the main campus. Improvements will be needed to create a uniform width of 10-feet along the entire length from Forbes to Fifth Avenue. A separate 10-foot wide sidewalk will be constructed to carry only students and staff to and from the three (3) major dormitories along the west side of Morewood, to and from the main campus.

The original plan was to create a bicycle trail along Morewood to physically separate the cyclists from the congestion of Morewood Avenue. The plan was rejected by the City of Pittsburgh Planning Department, suggesting instead widening of Morewood Avenue to incorporate northbound and southbound 5-ft. wide bike lanes within the street. The concept plan presented within consists of the alternative of providing separate paths for students on campus, and those students, faculty, staff, and public at large. This concept mimics future policy of the University, which will be implemented throughout campus by the University. The concept of the bicycle trail may be pursued at a later date as the cost of implementation of the City Planning Department recommendation of widening Morewood Avenue may be cost prohibitive, but will be fairly studied at a future date.

An added aspect of the project is the widening of Morewood Avenue to eliminate the offset of southbound Morewood Avenue crossing Fifth Avenue. This option can be incorporated with Item 3, with Immediate Action Item 1, the Signal System Upgrade, or as a standalone project. In any event, the local and campus walkways will be constructed to accommodate this widening, should it be deferred from the core project.

The balance of the core work for this Action Item will include the sidewalk areas with the most significant construction efforts at both termini of the project. At Forbes Avenue, the pedestrian path will require the construction of a wall to retain the campus walk along Morewood Gardens Dormitory, a distance of approx 100 feet. At Fifth Avenue, the walkways will merge and will require partial demolition and rebuilding of the stone wall at the intersection with Fifth Avenue. In addition, significant landscaping, hardscape, and lighting along both walkways is included in the scope of work. However, certain elements may be a joint effort with other campus and facilities input to the design parameters for these elements.

The field survey boundaries for public improvements along Morewood Street are anticipated to extend to the existing buildings along the west side of Morewood Street and to the right of way line on the east side of Morewood Street from Forbes Avenue to Fifth Avenue (+/- 1000 LF).

GAI will also establish a survey baseline along Morewood Avenue and perform cross sections at 25 foot intervals. The sections will extend to the existing face of buildings or a distance of 100 feet along the west and to the right of way line on the east side. The section data will be incorporated into the drawing file and utilized for the DTM surface necessary for contouring.

Preliminary Cost Estimate – Morewood Avenue Sidewalk Alternate

Engineering:	\$415,000
Construction:	\$1,265,000
Construction Management	\$95,000

Total Cost of Morewood Avenue Sidewalk Alternate \$1,800,000