Phase 2
Pulaski Highway Redevelopment Study

Final Transportation Report **October 2010**

This study was prepared under contract with Harford County, Maryland with financial support from the Office of Economic Adjustment, Department of Defense, and in coordination with the Chesapeake Science and Security Corridor (CSSC) Consortium. The content does not necessarily reflect the views of the Office of Economic Adjustment or Harford County.

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EXECUTIVE SUMMARY

The Phase 2 Pulaski Highway Redevelopment Study team created several possible land use and transportation scenarios. The team then modeled and tested a subset of those scenarios, comparing them to status quo projections, to understand the needs and constraints of the road network as a basis for further district planning. Projecting out to 2035 with relatively low levels of development in the study area, according to current zoning and development rules shows considerable congestion will occur on Pulaski Highway between Rossville Boulevard and Mohrs Lane. This is due to regional growth that occurs outside of the study area, including BRAC-related growth to the northeast. The limited growth forecast within the study area has a minimal contribution to future congestion.

The analysis presented in this report shows that significantly higher levels of growth can occur in the study area with little or no additional negative impact on forecast congested conditions. In fact, if area growth is planned to provide a mix of land uses and builds a more complete network of connected streets the area is well-suited for growth. New reliever roads, envisioned and built with new development, will also permit residents and employees to enjoy shorter trips, to walk and bicycle within the district, and have the choice of taking transit for trips beyond. The district concept will reduce the number of auto trips on Pulaski Highway and thus releive congestion at the district's largest intersections.

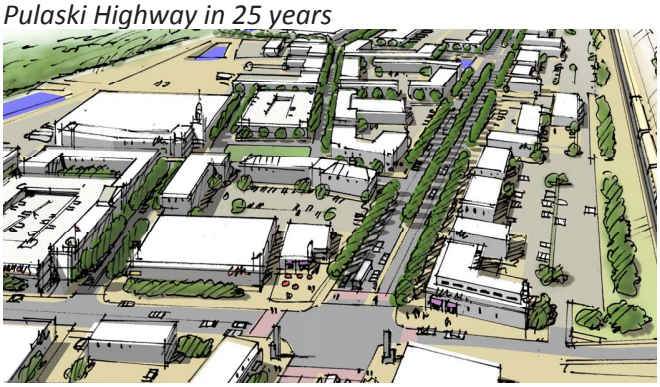
The vision for redevelopment in the district established in Phase I called for a mixed-use, walkable environment where transit and bicycling are viable and desirable travel options. This can only be achieved by both changing the design aspects of auto-oriented roadways in the study area and creating a connected system of local streets. Analysis detailed in this report has demonstrated that proposed redevelopment, if accompanied by road network-building concepts for the Pulaski Highway–Philadelphia Road corridor, will permit more development of a higher quality and can help to mitigate area congestion. Redevelopment scenarios are not only feasible but desirable from traffic congestion and transportation perspectives; but only if both public and private infrastructure investment is coordinated and comprehensive.

The redevelopment area currently has access to several key roadway connections to the Baltimore region and beyond. The study area suffers from the lack of lower order road network connectivity resulting from piecemeal development patterns where each parcel and subdivision handles its own access to main roads. Most residential and commercial development in the area has only one access point, and many local trips are forced to use the arterial network, including Pulaski Highway and Philadelphia Road, for every trip. These streets are auto-dominated, and travel by other modes within the overall area is unpleasant and, in many places, unsafe. To provide additional connectivity for all modes of transportation, the future conditions analysis assumes a grid-type transportation network that would be built as land is redeveloped.

Traffic analysis performed for the year 2035, based upon the current planned transportation improvements and land developed according to current zoning and development guidelines in the Baltimore Metropolitan Council's regional travel demand model, identifies major congestion in the study area, particularly at intersections on Pulaski Highway. The regional model anticipates significant auto-oriented growth in surrounding areas of Baltimore County and the entire Baltimore region. This assumption regarding future land use patterns is important to acknowledge when using the model as it influences the "background traffic" conditions present in all scenarios and is a critical factor in much of the anticipated area congestion.

New connections proposed as part of a new set of land use options introduce the concept of a grid-type network with each future land use scenario. These new connections coupled with the concept of mixing compatible land uses have either no effect or help to reduce congestion levels at several key intersections within the study area modeled with 2035 redevelopment scenarios. New connections parallel to Pulaski Highway were found to be particularly effective at disbursing traffic and lessening traffic at major intersections within and near the redevelopment area. Key connections include the reopening of Mohrs Lane, the extension to Yellow Brick Road to Mohrs Lane and the extension of Bird River Road (via Transverse Avenue) to Martin Boulevard. Additional crossings of the CSX railroad also offer connectivity benefits but are less critical to reduced congestion. The most feasible location for a new crossing is between Middle River Road and Mohrs Lane. In addition to their traffic-serving benefits, proposed new streets will introduce additional bicycle and pedestrian connections, which can be designed to attract a wider variety of users with a broad range of skill and mobility levels.

Pulaski Highway in 25 years



Gateway intersections to the area, such as Pulaski Highway at Rossville Boulevard, receive little benefit from the added roadway network in the future analysis scenarios. Broader area growth in traffic will require major changes regardless of redevelopment and network-building efforts. Incremental new capacity, such as additional traffic lanes, will be sufficient to significantly reduce congestion at all other intersections in the study area.

The addition of more lanes, particularly at intersections, can further alienate the pedestrian and bicyclist from the area. The success of high quality future transit, expected to be important to the viability of any significant business district, will require a safe and comfortable environment for pedestrians. To avoid creating arterial barriers to pedestrians, careful attention will be required in the design of future improvements. Cross-sections of major streets demonstrating the concept of "complete streets" are included in Future Roadway Concepts section. One such section is also included on the following page. Streets and intersections expected to attract high levels of traffic must provide adequate and appropriately separated space for non-motorized users. The type of activity on the street will also help to inform the attributes of street design: for example roads with street-oriented retail will require wider sidewalks and on-street parking. As Pulaski Highway changes it could become a priority bus corridor. Its outside or inside lanes could then be reassigned and dedicated to premium bus service. These would not constitute new lanes, but involve a reallocation of available cartway space.

The study area performs relatively well from a safety perspective. Only five of the twenty-five study intersections were found to have a high vehicular crash rate, and road segments (away from intersections) exceed state performance metrics. A concentration of pedestrian crashes occurred on Pulaski Highway near the Holly Drive intersection (east of the Martin Boulevard interchange). Other pedestrian crashes were scattered throughout the study area.

Changes to the area's transportation system that improve mobility and safety for all users will require streets that connect to one another and provide more than one access route for any area destination. Street improvements will need careful and complete designs that anticipate a greater diversity of transportation options. Specific improvements recommended as a result of this analysis include:

- Transformation of Pulaski Highway into a six-lane boulevard complete with wide shaded sidewalks and highly-visible crosswalks for comfortable pedestrian use; treed and landscaped buffer and median areas to introduce vertical elements to scale down the wideness of the road; on-street buffered bicycle lanes for cyclists traveling adjacent to highway traffic; and amenity-rich transit stops with seating, shelter and passenger information to attract a range of riders. Analysis determined that to meet peak period performance criteria an additional lane in each direction would be needed in the vicinity of the Mohrs Lane and Middle River Road intersections, regardless of whether either of the proposed CSX crossings is built. However, if a long segment of Pulaski Highway (Chesapeake

Science & Technology Corridor) were to redevelop as a series of concentrated nodes of activity, such as the one proposed in this area, introduction of premium transit service might provide a compelling case to convert a general travel lane in each direction to bus-only.

- Transformation of Philadelphia Road into a complete street consistent with the envisioned community "main street" proposed. It is recommended that Philadelphia Road remain a two-to- three lane road except 1) between King Avenue and Middle River Road and 2) between Mohrs Lane and Campbell Boulevard. On these segments, an additional travel lane in each direction will be required.
- Creation of a grid roadway network in the area. Key streets within the grid would serve a collector function by bringing traffic from Pulaski Highway or Philadelphia Road to several sites and transitioning traffic to lower-order local streets. These key collector connections include the extension of Yellow Brick Road to Mohrs Lane and the extension of Bird River Road to Martin Boulevard via Transverse Avenue. A new crossing of the CSX Railroad between Middle River Road and Mohrs Lane is recommended and the terrain in this area makes a crossing feasible. Large parcels developing, for example those lying east of Pulaski Highway should be planned with through connections and small scale blocks.

Finally, the report identifies short term improvements to the area's transportation network that can be made to improve intersection safety and capacity. These improvements can be built regardless of zoning and land use plans. Due to current demands for pedestrian and bicycle accommodation present today, all improvements should seek solutions that remedy the very poor condition for use by those modes of transportation.

This report addresses only the transportation aspects of Phase II of the Pulaski Highway Redevelopment Study. The accompanying Summary Report includes information on other aspects of the redevelopment study.

Pulaski Highway in 25 years

BACKGROUND

Concept development in Phase 1

In 2009, Baltimore County and the Chesapeake Science and Security Corridor Consortium conducted Phase I planning studies of Pulaski Highway between Baltimore City and Harford County(See summary report for more detail). This effort identified an 850 acre area between Martin Boulevard (MD 700) and White Marsh Boulevard (MD 43) on Pulaski Highway as a desired location for investment and redevelopment to achieve a sustainable, mixed use, multi-modal development node. Initial economic and land use analysis indicated potential for 7.3 million square feet of new and revitalized development laid out in an urban pattern complete with new streets and a more walkable Pulaski Highway-oriented building orientation.

In summer and fall of 2010, this Phase II project began a feasibility evaluation of the initial concepts for the 850 acre redevelopment area. Phase II planning included:

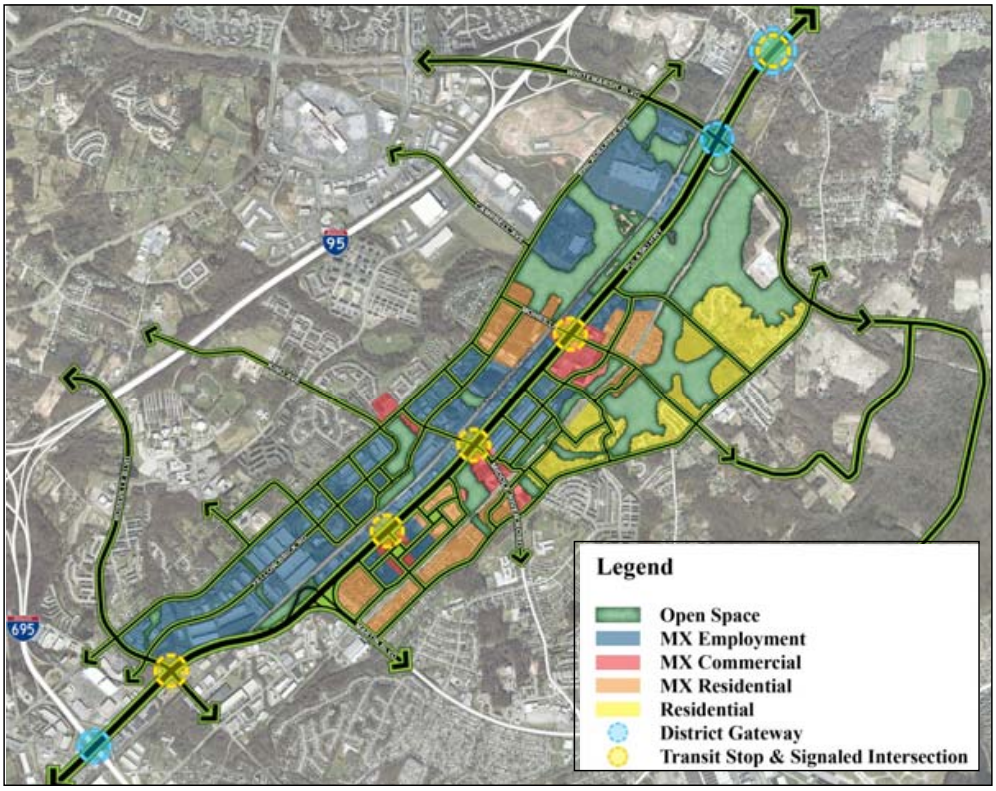
- further development of land use scenarios based on discussions with property owners in the area,
- transportation analysis using travel demand modeling and intersection operational analysis, and
- identification of environmental features and other potential barriers to redevelopment within the study area.

This report summarizes the Phase II transportation analysis.

Phase II transportation analysis began by identifying near-term existing roadway, traffic operations, and safety deficiencies. As plans for the area are realized, identified safety deficiencies should be addressed. Therefore, they are included in this report.

Evaluation of future scenarios formed the largest component of Phase II transportation analysis. Future analysis tested the feasibility of redevelopment scenarios consisting of road network and land use changes which were also developed in Phase II. The results of the Phase II transportation analysis will, in part, determine which redevelopment scenarios are viable and might be the basis for the actual plan development to occur during the Phase III charrette process.

Figure 1 - Phase 1 District Concept



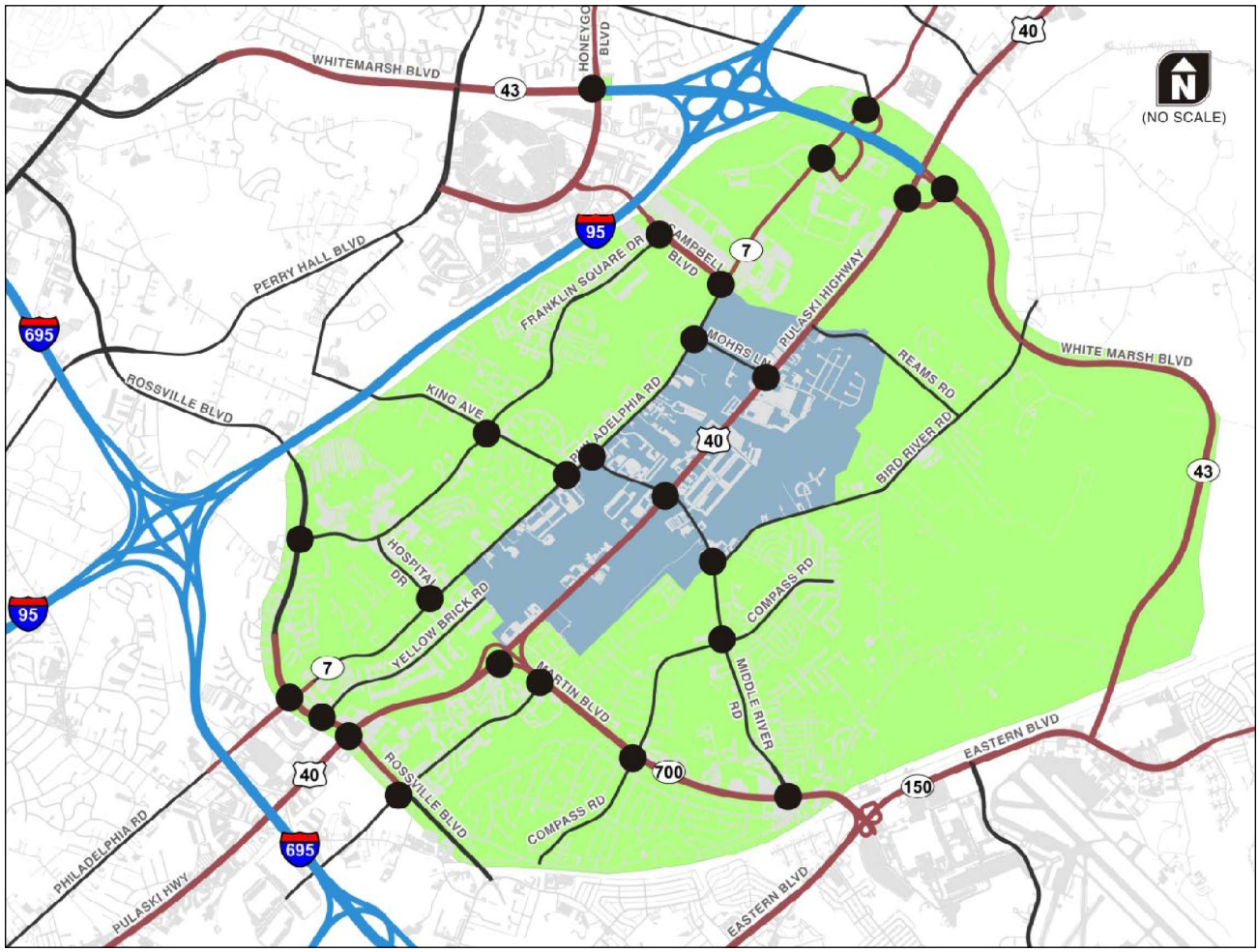
Phase II also produced conceptual roadway cross sections that align with the walkable, mixed use environment that is envisioned in the redevelopment area. These concepts will also support Phase III refinement efforts.

STUDY AREA

Two study areas were defined for this project – a redevelopment area and a transportation influence area. The redevelopment area is approximately 850 acres in size and consists of the areas in which land use changes are proposed. It is within this 850 acre area that the majority of street network building will occur.

The redevelopment area is surrounded by a much larger transportation influence area. As is the case with any development project, the potential exists for the transportation system near but not actually within the redevelopment area to be impacted. The transportation influence area identified for this project includes major corridors leading to the 850 acre redevelopment area, as well as 25 intersections.

Figure 2 - Phase 2 Study Area



LEGEND: Project Boundaries | Transportation Influence Area | Study Area Intersection

EXISTING TRANSPORTATION NETWORK

The transportation network presently serving the redevelopment area has developed with the assumption that nearly all trips within and to the area will be made by automobile or truck. The area is well-served and well-connected to regional highways, but has only the most basic transit service and very limited space dedicated to pedestrians and bicycle users. A "Complete Streets" approach is needed throughout the study area to make transit, pedestrian, and bicycle travel desirable and safe. Service to non-motorized travel will require retrofit of existing roads and the addition of new streets with context-appropriate sidewalks and street space for bicycles and parking.

ARTERIAL ROADS

The roadway network in the study area is characterized by single and multi-lane roadways with relatively high speed traffic. Streets in the study area are a mix of open section (without curb and gutter) and closed section, with sidewalks also present in only some locations. Apart from Pulaski Highway with its wide shoulder, roads either have narrow shoulders or no shoulders at all.

Pulaski Highway (US 40) south of MIddle River Rd. (south): Most conditions adjacent to the Pulaski Highway shoulder range from gravel pull-offs, as shown here, to grassy or wooded areas, and parking lots.

Pulaski Highway (US 40) south of MIddle River Rd. (north): Typical view of median crossover with shoulders along Pulaski Highway.

Philadelphia Road (MD7) south of MD 43 (north): The roadway design characteristics and lack of development activity near the roadway encourages higher vehicle speeds along the stretch of Philadelphia Road.

Philadelphia Road (MD7) south of Middle River Rd. (north): The presence of sidewalks and crosswalks in this area is sporadic and there are numerous curb cuts for commercial driveways.

The primary route through the study area is Pulaski Highway, designated as US 40. This roadway developed in the 1930's as an upgrade of the Baltimore to Philadelphia route. It is a regional facility connecting this area to Baltimore City to the southwest and Harford and Cecil Counties and ultimately Delaware to the northeast. Pulaski Highway is a four lane arterial facility, carries high-speed traffic through the area, and provides access to commercial and industrial uses as well as several residential communities.

Philadelphia Road, designated Maryland Route 7, is an old road, and as its name suggests, was once the primary route between Baltimore and Philadelphia. Today, it varies from two to four lanes through the study area and carries traffic primarily destined to commercial establishments and residential subdivisions along the corridor in the Middle River and Perry Hall areas.

White Marsh Boulevard, designated Maryland Route 43, is a new expressway just north of the study area with a mixture of intersections and interchanges. This road was built in the 1990s and 2000s and connects I-95, Pulaski Highway and Philadelphia Road to the newer developments to the east and west.

Both Pulaski Highway and Philadelphia Road generally run parallel to Interstate 95. Connecting roadways include Middle River Road, Martin Boulevard (MD 700), Rossville Boulevard, King Avenue, and Campbell Boulevard. These roads carry less traffic at more moderate speeds than Pulaski Highway. Intersections of these connecting roadways along Pulaski Highway and Philadelphia Road are spaced relatively far apart at distances of 3000 to 5000 feet. The study area contains few collector and local streets. Those that do exist do not connect to other lower order streets making parcel access highly reliant on the arterial streets.

LAND USE CONTEXT

Land uses adjacent to roadways in the study area include scattered development of single-family detached and attached developments, strip commercial centers, light industrial uses, flex space, stand-alone commercial establishments, and undeveloped woodlands. Most of these land uses include considerable setbacks from the roadway and include frequent driveways and/or parking lots between the building and the road. Interconnecting local roadways in this area are few. A complete inventory of typical roadway sections is included in the appendix.

Pulaski Highway (US 40) north of Mohrs Lane (south): Numerous highway-oriented commercial businesses, including a used truck dealership, shown here, currently abut Pulaski Highway.

PUBLIC TRANSIT SERVICES

Transit service in the study area is provided by the Maryland Transit Administration (MTA). Service is limited, and there is no bus route on this segment of Pulaski Highway.

Philadelphia Road (MD7) south of Campbell Blvd. (south): This two-lane section of Philadelphia Road traverses a wooded area, which makes this existing bus stop location feel particularly isolated and uncomfortable for transit patrons.

Bus Route #35 provides local service connecting the Philadelphia Road corridor to the White Marsh Mall complex, Franklin Square Hospital, Community College of Baltimore County – Essex and downtown Baltimore. This bus service generally serves “transit dependent” residents who live and work in the area.

Peak hour headways for the #35 bus are approximately 15 minutes during the weekday a.m. and p.m. peak hours, 20 minutes during the weekday midday peak hours and 30 minutes during the weekday late evening/off-peak hours and weekends. The travel time on this bus from a stop at Philadelphia Road and King Avenue to downtown Baltimore is approximately 45 minutes.

A number of other local bus routes operate south of the study area including the #4 and #55 routes. These have similar service characteristics to the #35, if of somewhat less frequency.

PULASKI HIGHWAY EXISTING CONDITIONS

Bus stops in this area are extremely basic, typically limited to bus stop signs mounted on poles. Some bus stops are in locations where sidewalks are present and in front of commercial uses while others are located along residential or wooded areas where no sidewalk or other pedestrian access or refuge is present.

Rail and premium bus services are not currently planned to serve this area. The closest commuter rail service is the MARC Penn Line which stops at Martin State Airport (MSA) one to two miles southeast of the study area. The service is limited to a handful of weekday-only trips, primarily serving suburb-to-downtown commutes, and currently operates between Perryville, stopping at Baltimore Penn Station, and continuing to Washington Union Station. No bus service exists between the study area and the MSA Marc Station.

MTA's commuter bus route 420 travels down Pulaski Highway from Harford County, but transitions to I-95 at White Marsh Boulevard north of the study area. The stop closest to the study area is at Pulaski Highway and Ebenezer Road; this is also the last stop on the route before downtown Baltimore. Service is limited to four inbound buses during the a.m. peak and four outbound buses during the p.m. peak. Scheduled travel time from Ebenezer Road to downtown Baltimore is approximately 40 minutes.

Pulaski Highway (US 40) north of Mohrs Lane (north): The northbound shoulder of Pulaski Highway north opf Mohrs Lane is marked as a bike lane.

PEDESTRIAN FACILITIES

In general, neither the road design characteristics nor the development patterns in the study area are currently conducive to pedestrian activity. There are no sidewalks along Pulaski Highway, and Philadelphia Road has only intermittent sidewalks.

Sidewalks are provided along some sections of intersecting local roadways, either on one side or both sides of the roadway. Most signalized intersections in the study area are provided with crosswalks and pedestrian-actuated signals but generally have long crossing distances for pedestrians. In some cases, intersection pedestrian amenities are provided in isolation without sidewalk connections to other areas.

Middle River west of Pulaski HIghway (US 40) (west): Sidewalks along this section of Middle River Road are narrow and overgrown with vegetation.

Middle River Road west of Bird River Road (east): Continuous sidewalks on both sides of Middle River Road facilitate basic pedestrian movement.

High quality pedestrian facilities would be needed to support increased transit use in the area. Currently, many bus stops are not along sidewalks and are difficult for pedestrians to reach.

BICYCLE FACILITIES

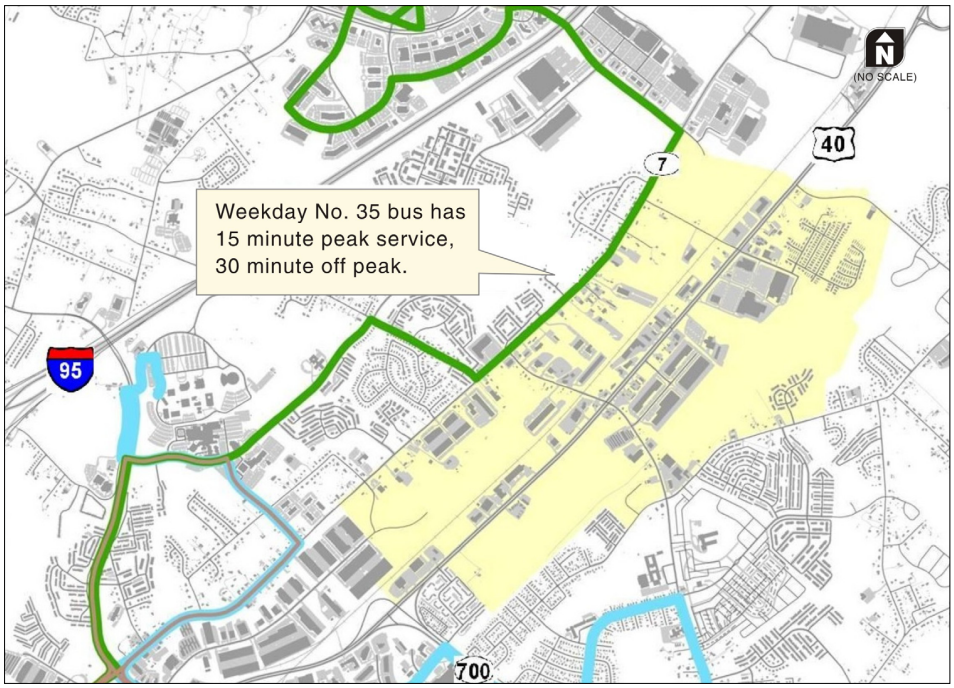
The lack of local and collector connections in the area makes bicycling difficult. Arterials in the area are characterized by high traffic volume, incompatible travel speeds, and numerous driveways. The wide right shoulder on Pulaski Highway is marked as a bike lane, but is not well utilized. The shoulder is also marked as a right turn lane in some areas, and is wide enough to function as a de-facto right turn lane where it is not marked as such. Philadelphia Road has no shoulder in many areas, and thus is also poorly suited for bicycle travel.

Baltimore County's current (2006) bicycle plan is shown in the map in Figure 4. The plan calls for bike lanes on most of the major roadways in the study area. The plan does not, however, offer new routes on lower speed and lower volume roads, because few such roads are present in this study area and because those that do exist do not connect to existing destinations.

Transportation Network Summary:

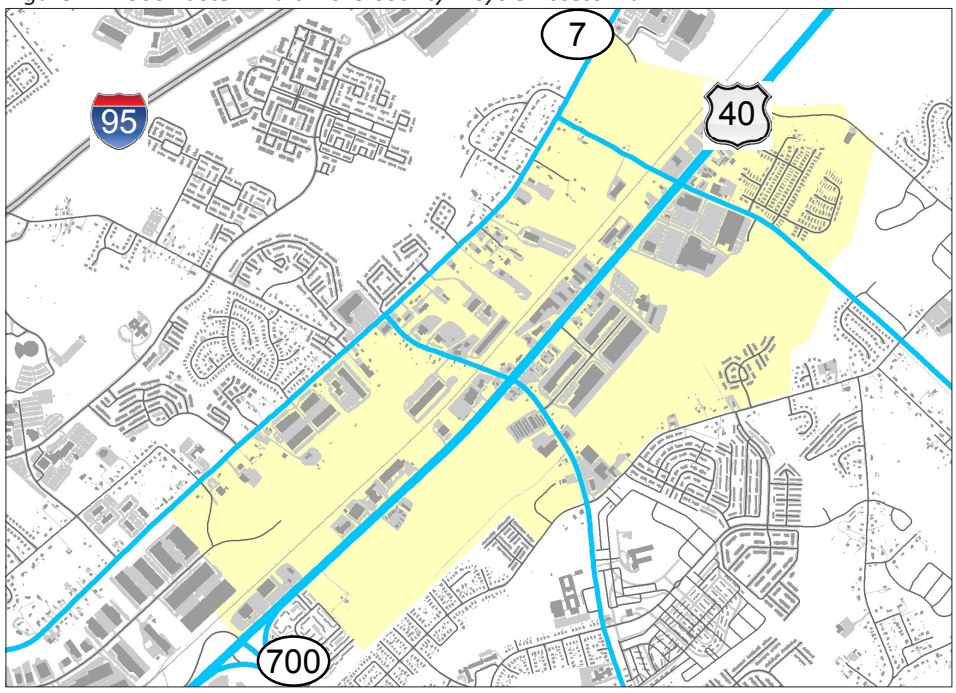
- Area well served by arterial roads
- Lacks system of connected collector streets
- Little transit service present or planned
- Poor bicycle network & infrastructure
- Few sidewalks including to access bus stops & intersection crossings and in areas of high pedestrian demand

Figure 3 - Existing Transit Service



LEGEND: Route 4 Route 35 Route 55

Figure 4 - 2006 Eastern Baltimore County Bicycle Access Plan



LEGEND: Bike Lane

EXISTING INTERSECTION CONGESTION

To gauge how well the road network is currently serving traffic demand and to identify congestion issues within the transportation influence area, an existing conditions traffic operations analysis was performed for the a.m. and p.m peak hours.

Intersection turning movement counts were provided by Baltimore County and obtained from SHA's website. The counts available represented different years and months, and therefore were adjusted and balanced as necessary to represent 2010 non-summer conditions. Traffic signal timing was provided by Baltimore County and SHA.

Analysis was performed with Synchro 7, a software package that analyzes signalized and stop-controlled intersections using the methodology of the Highway Capacity Manual. For the purposes of this study, level of service (LOS) D or better was identified as acceptable intersection operation. Intersections operating at LOS E or F were flagged and investigated in greater detail.

Intersection operation is summarized graphically in Figure 5. The appendix presents lane configurations, turning movement counts, delay, LOS, and v/c for each intersection.

INTERSECTIONS OF CONCERN

Three of the study intersections were found to be operating at LOS E or F during the a.m. or p.m. peak. Operational issues at these intersections and strategies to improve traffic operations are noted below.

Pulaski Highway/Rossville Boulevard

The Pulaski Highway/Rossville Boulevard intersection currently operates at LOS F during the a.m. peak and LOS E during the p.m. peak. This is the first major intersection on Pulaski Highway outside of the Baltimore Beltway (I-695) and traffic to and from the Beltway funnels through it. Peak directional through volumes on Pulaski Highway at this intersection are heavy (over 2,400 eastbound through vehicles during the a.m. peak, for example). Three of the four left turn movements have over 400 vehicles during the p.m. peak hour.

The intersection is presently designed to accommodate high volumes. All approaches have three through lanes, and three of the approaches to the intersection (i.e. northbound, southbound and eastbound) have double left turn lanes. Grade separation may be necessary to reasonably accommodate the high traffic demand that is expected to continue to rely upon this intersection. Two interchanges are already near this intersection on Pulaski Highway – the full cloverleaf interchange at the Beltway and the partial interchange on Martin Blvd. Grade separation of this intersection would effectively create an expressway on this segment of Pulaski Highway impacting the road's ability to directly serve adjacent land use and potentially creating a major obstacle for bicycles and pedestrians.

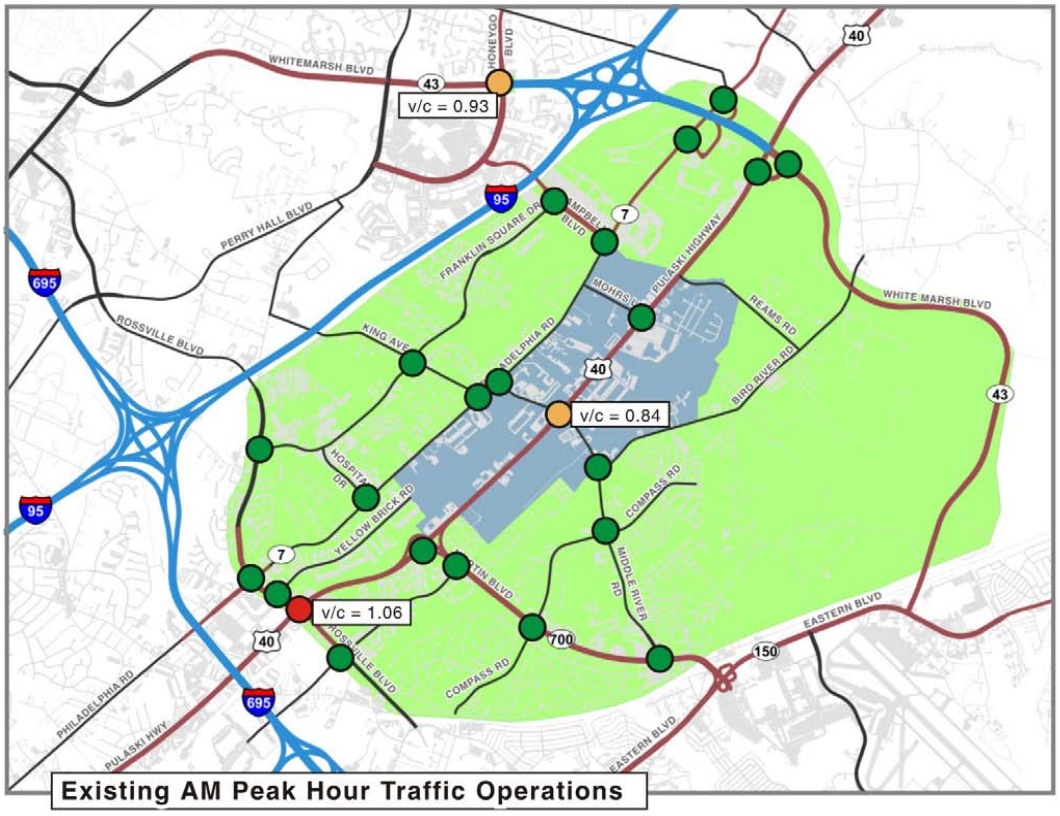
Pulaski Highway/Middle River Road

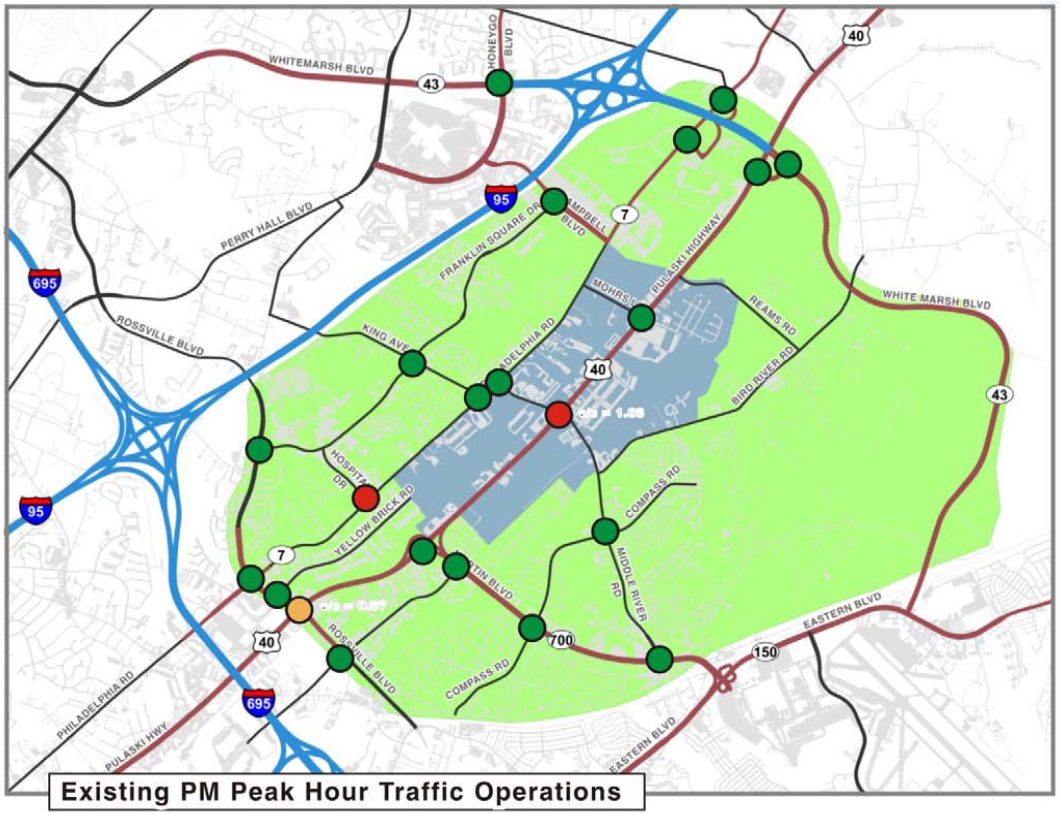
Despite recent lane additions, the Pulaski Highway/Middle River Road intersection currently operates at LOS E during the a.m. peak hour and LOS F during the p.m. peak hour. Middle River Road is the only road connecting Philadelphia Road and Pulaski Highway between Rossville Boulevard and White Marsh Boulevard, since the closure of Mohrs Lane due to a failing bridge.

Pulaski Highway has two basic through lanes and one auxiliary through lane in each direction at this intersection. The auxiliary through lanes were constructed in 2009. Additional options for low-cost improvements are relatively limited. The addition of lanes on Middle River Road would require widening of a bridge over the CSX railroad immediately north of the intersection.

Relief for the intersection will occur when additional road network is added to the area, including the reconstruction and reopening of the Mohrs Lane Bridge (anticipated by 2014). New access to and the addition of routes that parallel Pulaski Highway, that can provide alternatives to existing high volume intersections, will have significant benefit to the intersection and the area as a whole.

Figure 5 - Traffic Operations Level of Service





Traffic Operations Level of Service

- Level of Service A-D
- Level of Service E
- Level of Service F

- ProjectBoundaries
- Transportation Influence Area

CM = Critical Movement (for unsignalized intersection)

v/c = Volume-to-Capacity Ratio (for signalized intersections)

White Marsh Boulevard/ Honeygo Boulevard

The White Marsh Boulevard/Honeygo Boulevard intersection currently operates at LOS E during the a.m. peak hour. Nearly 1,000 vehicles turn left from Honeygo Boulevard southbound to White Marsh Boulevard eastbound during the a.m. peak. This intersection serves as the main point of access to the White Marsh and Perry Hall areas from I-95.

All approaches have two through lanes and two left turn lanes. Space both within the median and on the outside of the roadway is available to add lanes. Viable options for short-term improvements include the addition of a third through lane in each direction on White Marsh Boulevard and addition of a third left turn lane on Honeygo Boulevard southbound. In the long term, this intersection will likely be impacted by the construction of express toll lanes on I-95. That project will require redesign of the I-95/White Marsh Boulevard interchange, which will likely impact the White Marsh Boulevard/Honeygo Boulevard intersection. At that time, the White Marsh Boulevard/Honeygo Boulevard intersection will likely require major redesign to meet future needs.

Pulaski Highway/Mohrs Lane

The reopening of Mohrs Lane will be beneficial to the area, as it will begin the process of network building. Mohrs Lane is currently closed to through traffic due to the poor condition of a bridge over the CSX railroad. However, replacement of the bridge is planned and funded, and Mohrs Lane is expected to reopen within four years. When this occurs, travel patterns in the area will be altered. Congestion is projected to be relieved at the Pulaski Highway/Middle River Road intersection, but will increase at the Pulaski Highway/Mohrs Lane intersection. Additionally, a traffic signal or roundabout will be needed at the Philadelphia Road/Mohrs Lane intersection, as the existing stop-control will be unable to accommodate projected traffic volumes.

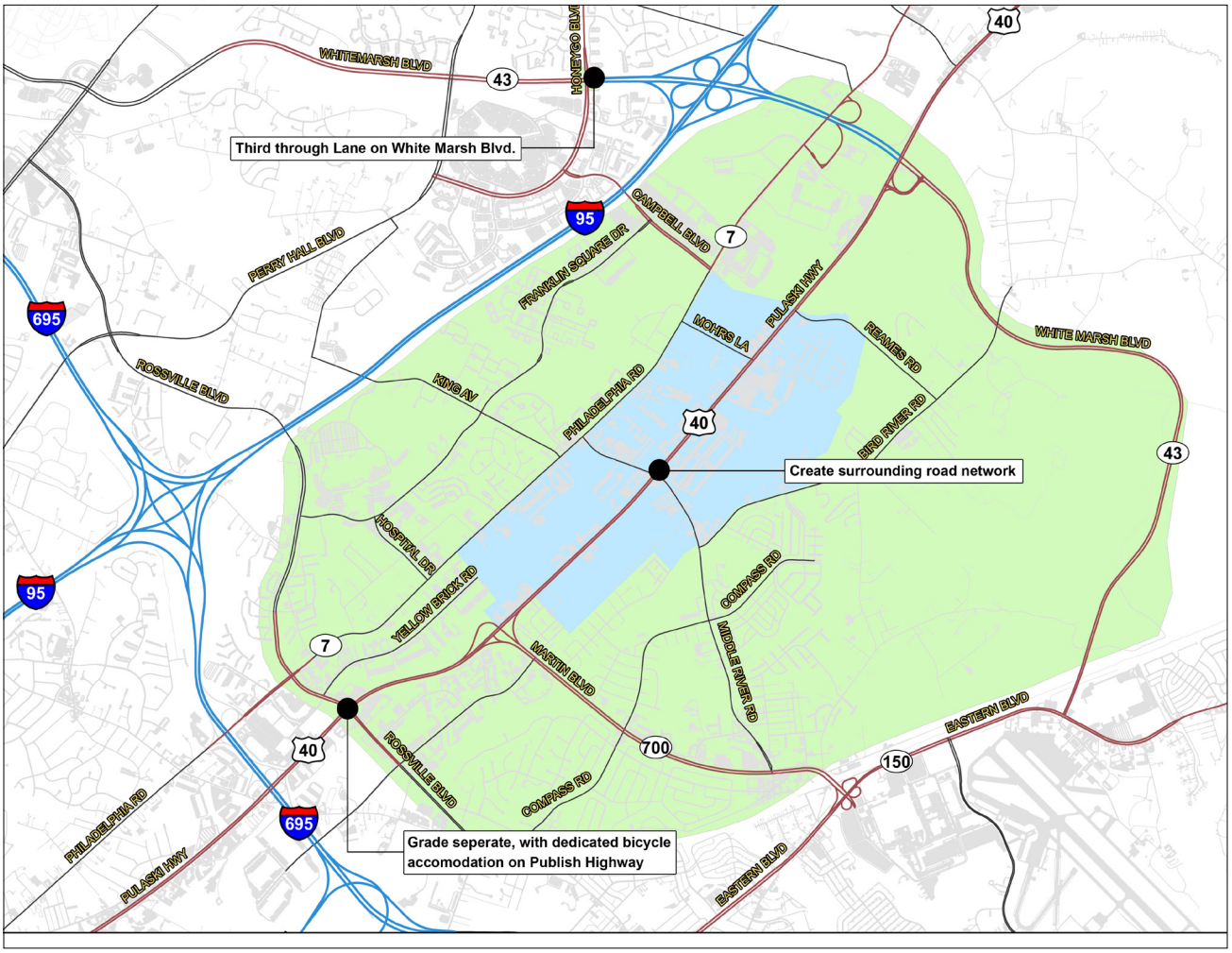
Existing Network Summary:

- Heavy through volumes are present on Pulaski Highway and Philadelphia Road
- Transit service is downtown commuter oriented, is not available on Pulaski Highway, and does not accommodate local trips.
- Three intersections operate at level-of-service E or F. Potential traffic operations improvements are shown on figure 6.

Table 1 - Existing congested intersection and mitigation

Intersection	Mitigation
Pulaski Highway/ Rossville Boulevard	Construction of a grade separated intersection, including dedicated bicycle space along Pulaski Highway
Pulaski Highway/Middle River Road	Creation of additional road network and route options
White Marsh Boulevard/Honeygo Boulevard	Addition of a third through lane on White Marsh Boulevard

Figure 6 - Existing congested intersections and recommendations



PEDESTRIAN AND BICYCLE OPERATIONS

Multimodal level of service (MMLOS) was used to document existing bicycle and pedestrian conditions on two important arterial segments in the study area:

- Pulaski Highway between Middle River Road and Mohrs Lane
- Philadelphia Road between Middle River Road and Mohrs Lane

These segments were selected because they are within the redevelopment area and are similar to other segments of Pulaski Highway and Philadelphia Road. The results of existing conditions MMLOS form a baseline to which future conditions can be compared and measured.

Example of a cycle track

ANALYSIS PROCEDURE

MMLOS is a new procedure that will be added to the 2010 Highway Capacity Manual and is presently documented in NCHRP Report 616: Multimodal Level of Service Analysis for Urban Streets. MMLOS provides a quantifiable basis for analyzing the quality of service provided to motorists, bicyclists, pedestrians, and transit riders on urban streets. The MMLOS analysis method for urban streets consists of a set of recommended procedures for predicting traveler perceptions of quality of service and associated performance measures. A level of service (LOS) for each mode is based on several inputs related to cross-sections and other conditions along the corridor. The types of inputs considered by this analysis for bicyclists and pedestrians include peak hour traffic volumes, presence and width of sidewalks and bicycle lanes, crossing delay, driveway and unsignalized intersection density, and vehicular speeds. For the pedestrian mode, the overall facility LOS score is based on a combination of the segment LOS, intersection LOS, and uncontrolled crossing LOS. The overall facility LOS score for bicyclists is based on the segment LOS, intersection LOS, and the density of driveways and unsignalized intersections along the corridor.

Below is a list of parameters that have a significant influence on the bicycle and pedestrian LOS scores. This is not a comprehensive list of all inputs.

Influences to Bicycle LOS

- Vehicle volume in outside (right) lane
- Heavy vehicle percentage
- Vehicle speeds
- Travel lane and bicycle lane widths
- Pavement quality
- Signalized intersection cross street width
- Unsignalized intersections/driveways density

Influences to Pedestrian LOS

- Vehicle volume in outside (right) lane
- Vehicle speeds
- Presence and with of sidewalk and buffer
- Lateral separation between vehicles and pedestrians
- Right-turns on red and permitted left-turns during “Walk” phase
- Crossing delay (signalized and uncontrolled)

RESULTS

Pedestrian and bicycle LOS on the segments of Pulaski Highway and Philadelphia Road between Middle River Road and Mohrs Lane today is poor. Most of these segments do not have sidewalks, resulting in pedestrian LOS F. Exceptions to this (i.e. the presence of sidewalks) include the north side of the Philadelphia Road just east of Middle River Road (LOS D) and the north side of Pulaski Highway just east of Middle River Road (LOS E).

Bicycle LOS on Philadelphia Road and Pulaski Highway is LOS F and E, respectively. Philadelphia Road has virtually no shoulder, and bicyclists must share a single, high volume lane with cars. Pulaski Highway has a shoulder approximately 14 feet in width, which would normally be favorable to bicyclists. However, the effective width of the shoulder over the course of the entire segment is much narrower due to both marked and de-facto right turn lanes.

SAFETY

As redevelopment occurs in the project area, opportunities will be created to reduce crash frequency and improve connections and crossing opportunities for pedestrians and bicyclists. Crash data from 2006 through 2008 was analyzed to evaluate current crash conditions. Intersections were evaluated using a "critical crash rate" method, which is explained under "Intersections", below. Several intersections were found to exceed the critical crash rate. These intersections were then analyzed in greater detail to determine potential near-term safety improvements. An additional corridor analysis (excluding major intersections) was conducted to evaluate safety along uncontrolled segments of Philadelphia Road and Pulaski Highway. Using safety performance measures provided by the state, the two roads were found to perform relatively well. Complete crash data for the study area is included in the appendix.

CORRIDORS

Corridor safety was analyzed on Pulaski Highway and Philadelphia Road between Rossville Boulevard and White Marsh Boulevard. The analysis considered crashes that occurred on the roadway segments between major intersections. Crashes occurring at the intersections were analyzed separately.

All segments of Pulaski Highway within the study area had a crash rate below the state average rate for similar roadways. Six pedestrian crashes occurred on Pulaski Highway, all in the segment between Martin Boulevard and Middle River Road. Four of these six pedestrian crashes occurred near the Pulaski Highway/Holly Drive intersection, which serves a large apartment complex.

One segment of Philadelphia Road – between Rossville Boulevard and Hospital Drive - had a crash rate above the state average for similar roadways. Forty-two percent of crashes on this segment were rear-end collisions, the majority of which were in the eastbound direction. Two pedestrian crashes occurred on Philadelphia Road: one just east of Rossville Boulevard and one between Middle River Road and Mohrs Lane.

INTERSECTIONS

Crash data was reviewed at 18 signalized intersections and two stop controlled intersections. For the signalized intersections, a critical crash rate analysis was used. This analysis is a statistical method that considers the average crash rate in an area, and then identifies intersections with rates significantly greater (i.e. more than one standard deviation) than the average. The critical crash rate identified high crash rates at four signalized intersections, which were then studied in greater detail. A critical crash rate could not be computed for the two stop-controlled intersections due to the small sample size. However, one of the two intersections (Philadelphia Road and Hospital Drive) had a relatively high crash frequency and was identified by the community as having safety issues; this intersection was also studied in greater detail.

Pulaski Highway/Rossville Boulevard

Sixty-four percent of the crashes occurring at the Pulaski Highway/Rossville Boulevard intersection were rear-end collisions. A large number of both rear end and total collisions occurred on each of the four approaches to the intersection. Many of the crashes occurred during peak periods, when this intersection becomes congested. The long queues that form at this intersection during peak periods may be unexpected by drivers unfamiliar with the area. The intersection is already quite large, with three through lanes in each direction and double left turns for three of four movements.

RECOMMENDATION: Grade separation, which will have high cost and right-of-way impacts, is needed to achieve significant congestion reduction. Grade separation should be designed in a manner that recognizes use by non-auto modes and the urbanizing nature of the area. Typical freeway interchanges are not appropriate for this location. Strategies to reduce traffic volume, and thus exposure, at this intersection should be explored as well.

Figure 7 - Pulaski Highway and Philadelphia Road Corridor Safety

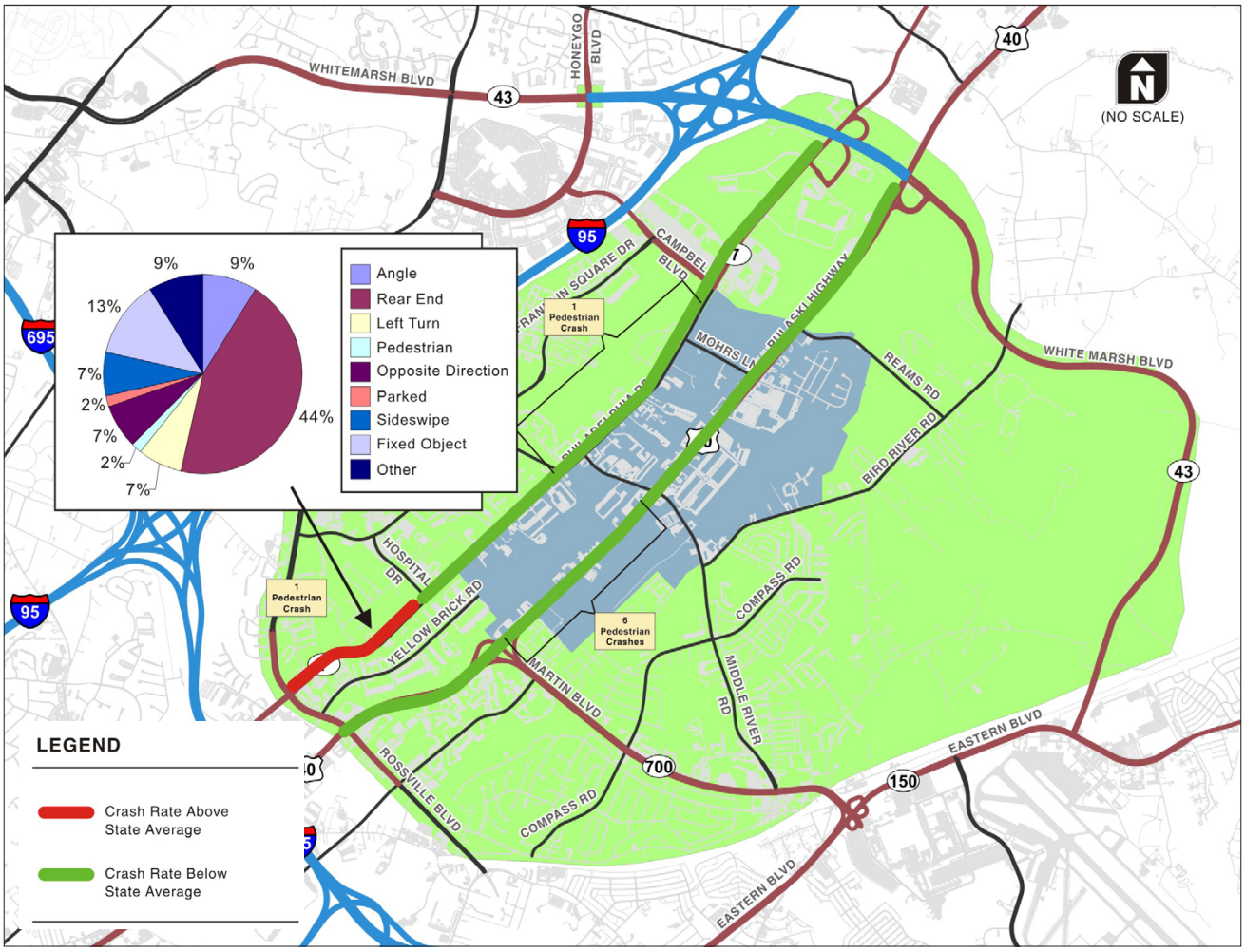
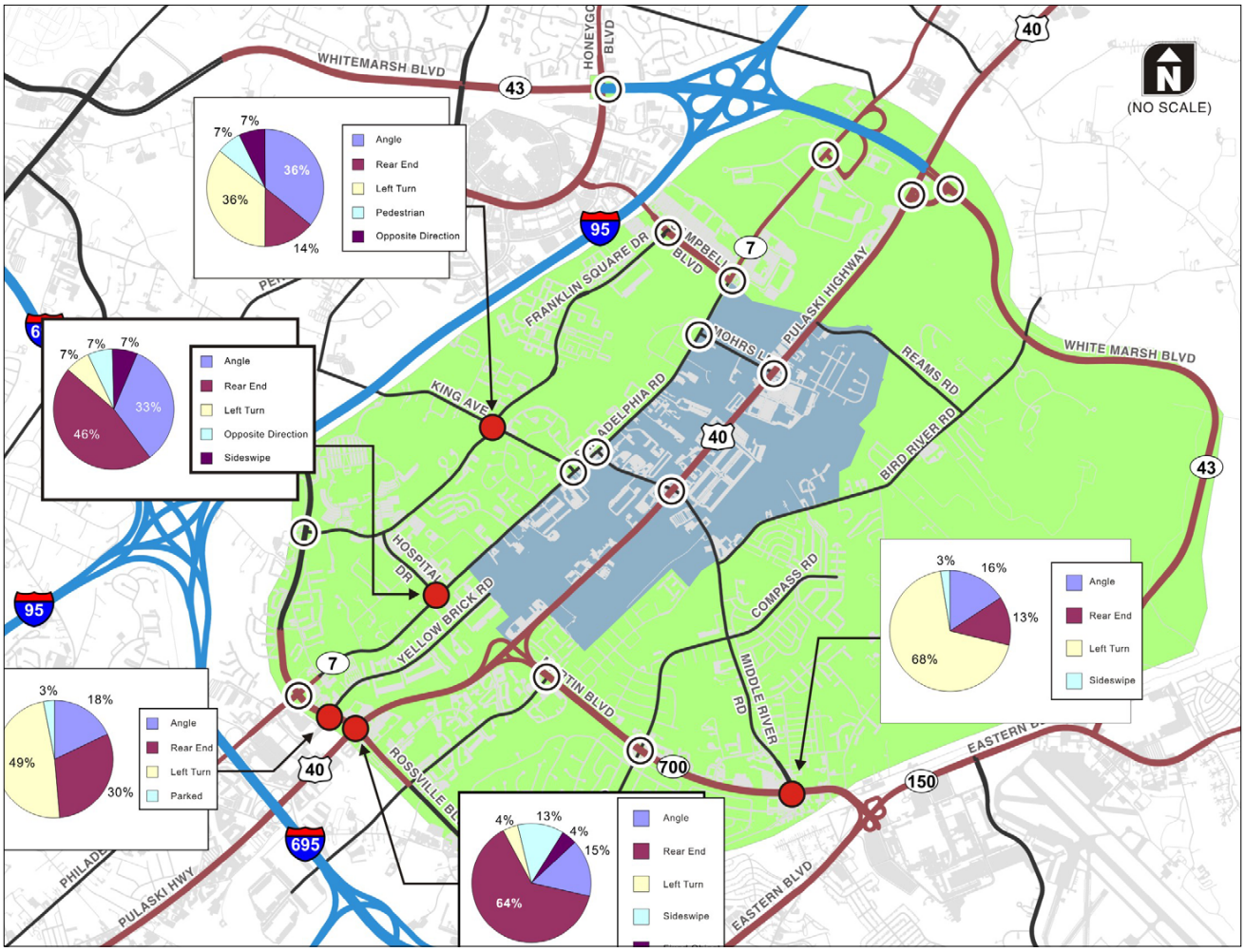


Figure 8 - Intersections Safety



Rossville Boulevard/Yellow Brick Road

Left turn collisions (49%) were the most common type of crash at the Rossville Boulevard/Yellow Brick Road intersection, followed by rear end collisions (30%). Twelve of the 16 left turn collisions at this intersection involved a northbound left turning vehicle (from Rossville Boulevard into Golden Ring Mall) and a southbound through vehicle. This is a permissive left turn which requires crossing the three southbound lanes of Rossville Boulevard. The movement is made by over 100 vehicles during the p.m. peak hour.

RECOMMENDATION: Modify the traffic signal to create a protected-permitted northbound left turn. Such a configuration would stop opposing (southbound) traffic on Rossville Boulevard and provide a left turn arrow for a portion of the cycle, in addition to allowing permissive left turns (i.e. with opposing traffic). According to the Highway Safety Manual, a 16% reduction in injury left turn crashes would be expected if the left turn were converted to protected-permitted operation. This conversion would also reduce delay at the intersection.

Philadelphia Road/Hospital Drive

The Philadelphia Road/Hospital Drive intersection is a T-intersection with stop control on Hospital Drive and a flashing beacon on all approaches. Forty seven percent of the crashes at this intersection were rear end collisions, and 30 percent were angle collisions. Six of the seven rear end collisions occurred on Philadelphia Road eastbound, and four of the five angle collisions involved a southbound and a westbound vehicle. Many of these crashes occurred during peak periods. High traffic volume and the method of control at this intersection may be contributing to the high crash rate. Through drivers on Philadelphia Road eastbound may not expect drivers in front of them to stop and wait for a gap in oncoming traffic before turning left. A crest vertical curve on Philadelphia Road east of the intersection limits sight distance for drivers on Hospital Drive. The Hospital Drive approach also experiences congestion due to the high volume on Philadelphia Road, and drivers may be turning onto Philadelphia Road with less than adequate gaps.

RECOMMENDATION: Add a left-turn lane on Philadelphia Road eastbound, and a traffic signal or roundabout. The intersection currently meets the warrants for a traffic signal per the Manual of Uniform Traffic Control Devices (MUTCD).

Franklin Square Drive/King Avenue

The two most frequently occurring crashes at the Franklin Square Drive/King Avenue intersection were left turn collisions and angle collisions (36% each). Twelve of the 14 total crashes at this intersection occurred on Franklin Square Drive. The intersection is controlled by a two-phase signal. All approaches are wide enough for two vehicles side-by-side, but only the westbound Franklin Square Drive approach is striped as a two lane approach.

RECOMMENDATION: Stripe all of the approaches to the intersection with separate turn lanes and through lanes. Better delineation of lanes at this intersection would offer a safety benefit.

Martin Boulevard/Middle River Road

The two most frequently occurring crashes at the Franklin Square Drive/King Avenue intersection were left turn collisions and angle collisions (36% each). Twelve of the 14 total crashes at this intersection occurred on Franklin Square Drive. The intersection is controlled by a two-phase signal. All approaches are wide enough for two vehicles side-by-side, but only the westbound Franklin Square Drive approach is striped as a two lane approach.

RECOMMENDATION: Both left turns from Martin Boulevard to Middle River Road should be converted to protected-only signal phasing.

INTERSECTION PEDESTRIAN CRASHES

Seven pedestrian crashes occurred at the study intersections from 2006 to 2008. Two of these crashes were at the Martin Boulevard/Compass Road intersection, and none occurred at the intersections along Pulaski Highway. The remainder was spread out at other intersections throughout the study area with no pattern.

The community has identified pedestrian safety and the lack of pedestrian amenities as a concern. In general, the study area has few sidewalks and crosswalks, and those that exist are not well maintained. Pedestrians must often cross wide, high volume roadways to reach destinations due in part to the lack of connectivity on a lower order road network. Additionally, the long spacing between signalized intersections leads many pedestrians to cross roads such as Pulaski Highway at midblock locations.

At the Martin Boulevard/Compass Road intersection, there is only one marked crosswalk (south Martin Boulevard leg of the intersection), and the pavement marking is nearly worn away. This is also the only leg of the intersection with pedestrian signal heads.

RECOMMENDATION: Specifically, sidewalks should be constructed in all quadrants of the Martin Boulevard/Compass Road intersection, crosswalks should be marked on all approaches, and count-down pedestrian signal heads should be installed (especially for the wide crossing of Martin Boulevard).

RECOMMENDATION: A complete sidewalk retrofit plan should be created for the study area with priority for projects and dedicated funding for priority gaps in areas accessing bus stops, intersection crossings and where pedestrian generators are present. All public works and private development projects should include sidewalk, pedestrian and bicycle network and amenity.

Safety Evaluation Summary

- Corridor crash rates below state average
- Highest concentration of pedestrian crashes is on Pulaski Highway segment between Martin Boulevard and Middle River Road
- Crash rates at some intersections exceed the critical crash rate. Improvements noted in Table 2 are recommended.

Table 2 - Intersection Safety Recommendations

Intersection	Recommendation
Pulaski Highway/ Rossville Boulevard	Reduce congestion, as many crashes are congestion-related
Rossville Boulevard/ Yellow Brick Road	Convert northbound left turn to protect-permitted phasing
Philadelphia Road/ Hospital Drive	Install signal or roundabout
Franklin Square Drive/ King Avenue	Better delineate lanes
Martin Boulevard/ Middle River Road	Convert left turns on Martin Boulevard to protected-only phasing

FUTURE TRAFFIC DEMAND SCENARIOS

The redevelopment of the Pulaski Highway corridor is projected to occur gradually over 25 years. Analysis of future traffic conditions was performed using the regional 2035 forecast year p.m. peak hour. Future traffic volumes were developed for a business-as-usual assumption with current zoning and development trends as well as for proposed redevelopment scenarios. In all, seven land use and transportation network scenarios were developed of which four were evaluated with the travel demand model and traffic operations analysis. This section summarizes this evaluation.

The purpose of the future traffic conditions analysis was two-fold. First, the analysis gauged the impact of development on road network in the vicinity of the 850 acre redevelopment area. Second, the analysis guided the development of the future roadway cross-sections and other design elements.

Roadway cross-section development and traffic operations were conducted in an iterative fashion to achieve a balance between capacity and mobility needs. While serving future demand on area roads designed to move large volumes of traffic is important, it is also critically important to ensure that road planning anticipates the presence of pedestrians, bicyclists, and transit riders. So handling traffic without creating cross-sections and intersections wider than needed will be necessary to avoid creating obstacles to walking and transit use and realization of the character envisioned for the district.

Existing conditions analysis determined that p.m. peak congestion in the study area is generally more severe than a.m. peak congestion. For this phase of the project, future year traffic analysis only considered p.m. peak hour conditions. This analysis was sufficient to assess the feasibility of the development scenarios and determine the number of basic lanes on major roads Pulaski Highway and Philadelphia Road.

The Baltimore Metropolitan Council (BMC) 2035 travel demand model was used as the starting point to the project modeling. As described below, modifications were made to land use and the transportation network in the model.

Table 3 - Future Scenerios

Scenario	Land Use	Transportation	Traffic Analysis Performed?
1	BMC 2035 Model	BMC 2035 Model	No
1A	BMC 2035 Model + COPT	BMC 2035 Model	Yes
1B	Maximum likely buildout without redevelopment effort	Planned projects in area, as identified by County staff	No
2	Low Intensity Redevelopment*	Modified BMC 2035 Model** + added road network	Yes
3	Medium Intensity Redevelopment*	Modified BMC 2035 Model** + added road network + 1 new CSX Crossing	No
4A	High Intensity Redevelopment*	Modified BMC 2035 Model** + added road network + 2 new CSX Crossing	Yes
4B	High Intensity Redevelopment*	Modified BMC 2035 Model** + added road network	Yes

* Including COPT development project (Nottingham Ridge)
** The modified BMC 2035 model has a two-lane Philadelphia Road and two-lane Campbell Boulevard Extension

FUTURE SCENARIOS

Scenario 1

Scenario 1 is the background/no-built scenario that is reflected in the BMC 2035 Model. Lane use in the BMC model is based on the Round 7C population, household, and employment forecasts developed by Baltimore County planning staff in summer 2010. The transportation network is based upon the region's Long Range Transportation Plan that is represented in the BMC model. Key projects included in (or omitted from) the 2035 BMC model are listed in Table 4. Traffic operations analysis was not performed for this scenario because Scenario 1A supersedes it.

Table 4 - Projects in 2035 BMC Model

Planned Improvements in BMC 2035 Model
The BMC 2035 model contains transportation improvements specified in the region's long range transportation plan. Improvements include:
• Widening of Philadelphia Road to four lanes between Rossville Boulevard and Campbell Boulevard • "Extension" of Campbell Boulevard from Pulaski Highway to White Marsh Boulevard • Widening of portions of the I-695, including widening the section between I-83 and the northern I-95 interchange from six to eight lanes • Addition of two express toll lanes in each direction on I-95 from I-895 to MD 22 (Aberdeen exit) and rebuilding of interchanges to serve both general purpose and express toll lanes • Widening of I-95 from MD 22 to the Susquehanna River bridge from six to eight lanes
The BMC model does not include the following:
• Any rail or major transit improvements in the I-95/Pulaksi Highway corridor. • Extension of the MTA Metro Green Line (Baltimore's existing heavy rail line) currently shown in the 2000 Regional Rail Plan. • Additional ramps at the White Marsh Boulevard/ Philadelphia Road interchange

Scenario 1A

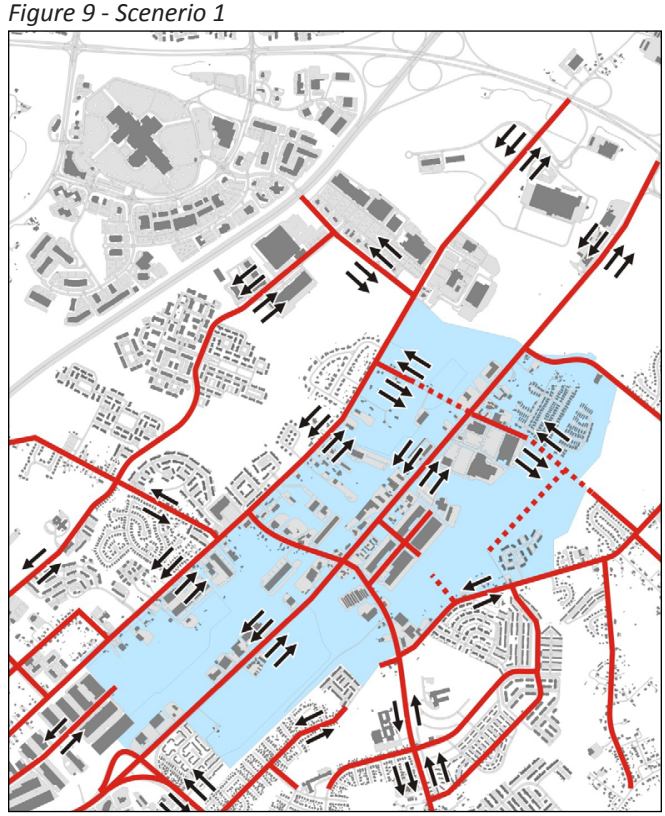
Scenario 1A is Scenario 1 with one addition: the Nottingham Ridge development proposed by the COPT development firm. This development would be located at the southeast quadrant of the I-95/White Marsh Boulevard interchange, and all access would be from Philadelphia Road, which would be widened to three lanes in each direction from Campbell Boulevard to the interchange at White Marsh Boulevard. The development was not in the BMC's model only because it was approved after the most recent updates to the model.

Scenario 1A is the baseline/no-build scenario for which traffic analysis was performed.

Scenario 1B

Scenario 1B is a market assessment of the 850 acre area that determined the likely intensity of land use by 2035 without any focused redevelopment effort in the corridor. Scenario 1B was initially developed in Phase I of the Pulaski Highway Redevelopment study, before the BMC Model was being used or formal traffic analysis was being conducted. Scenario 1B is included in Phase 2 for continuity, and is fully described in the Summary Report. Traffic operations analysis was not performed for Scenario 1B.

Figure 9 - Scenerio 1



Scenario 2

Scenario 2 introduces alternative mixed use concepts developed as part of this study. Of each of the study-based concepts, Scenario 2 represents the lowest intensity redevelopment future within the 850 acre area. It includes the addition of a grid roadway network (but no additional crossings of the CSX Railroad), and changes to the BMC 2035 model's road network. The Nottingham Ridge development is included in Scenario 2. Key components of the grid roadway network are:

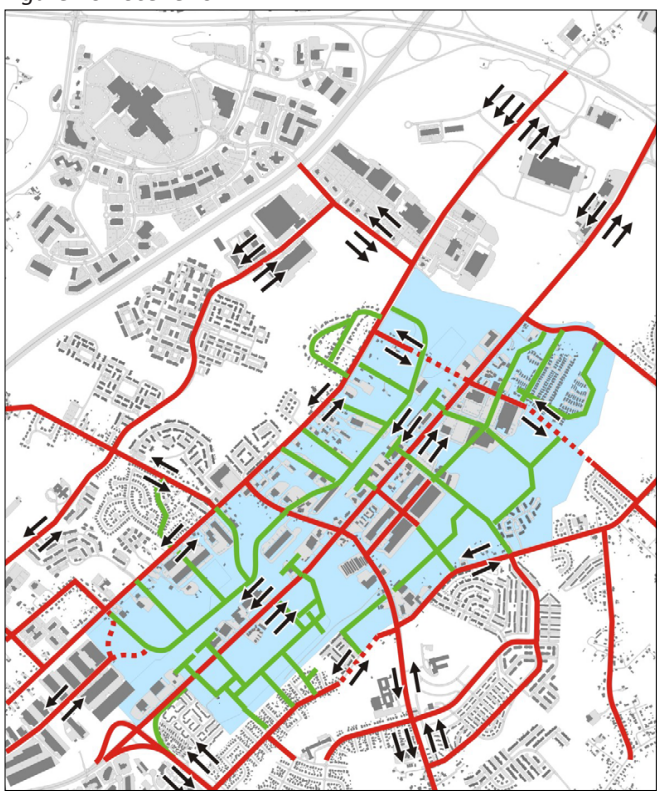
- Extension of Yellow Brick Road to Mohrs Lane
- Extension of Bird River Road to Martin Blvd (using Transverse Ave),

The changes to the BMC 2035 model road network for Scenario 2 are:

- A four-lane Campbell Boulevard extension is not included. County staff has indicated that the Campbell Boulevard extension is currently planned to have only one lane in each direction, so it was modeled as a two-lane roadway rather than a four-lane roadway. Subsequent intersection-level analysis assumed a three-lane cross section (one through lane in each direction and left turn lanes).
- The widening of Philadelphia Road to two lanes in each direction from Rossville Boulevard to Mohrs Lane is not included. The widening of this portion of Philadelphia Road would be out of context with the character of development envisioned for the 850 acre area. Model runs were conducted without widening of this roadway to test the feasibility of this concept. Subsequent intersection-level analysis assumed a three-lane cross section (one through lane in each direction and left turn lanes),

Traffic operations analysis was performed for Scenario 2.

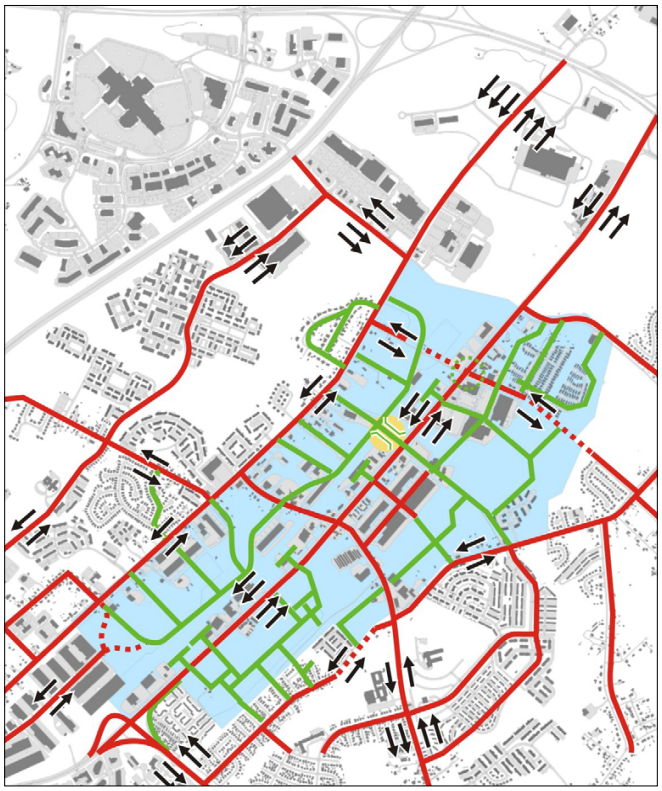
Figure 10 - Scenerio 2



Scenario 3

Scenario 3, also developed as part of this study, offers a mixed use development program similar to Scenario 2. Scenario 3 raises the level of redevelopment within the 850 acre area to medium-intensity, and includes the Nottingham Ridge development, addition of the same grid roadway network as Scenario 2, the same changes to the BMC 2035 model road network as Scenario 2, and one new crossing of the CSX Railroad between Middle River Road and Mohrs Lane. Traffic operations analysis was not performed for Scenario 3 because it would have offered fewer insights compared to the analysis of Scenarios 2 and 4A.

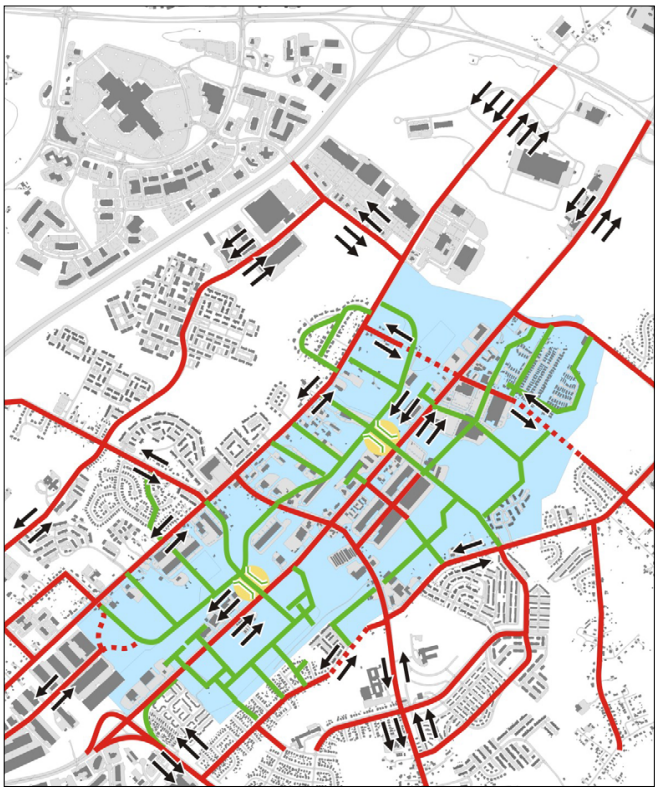
Figure 11 - Scenerio 3



Scenario 4A

Also developed as part of this study, Scenario 4A builds upon the same mixed use development programs as Scenario 3. Scenario 4 consists of high intensity redevelopment within the 850 acre study area, the Nottingham Ridge development, addition of the same grid roadway network as Scenarios 2 and 3, the same changes to the BMC 2035 model road network as Scenarios 2 and 3, and two new crossings of the CSX Railroad (the crossing in Scenario 3, and a crossing between Middle River Road and Martin Boulevard). Traffic operations analysis was performed for Scenario 4A.

Figure 12 - Scenerio 4A



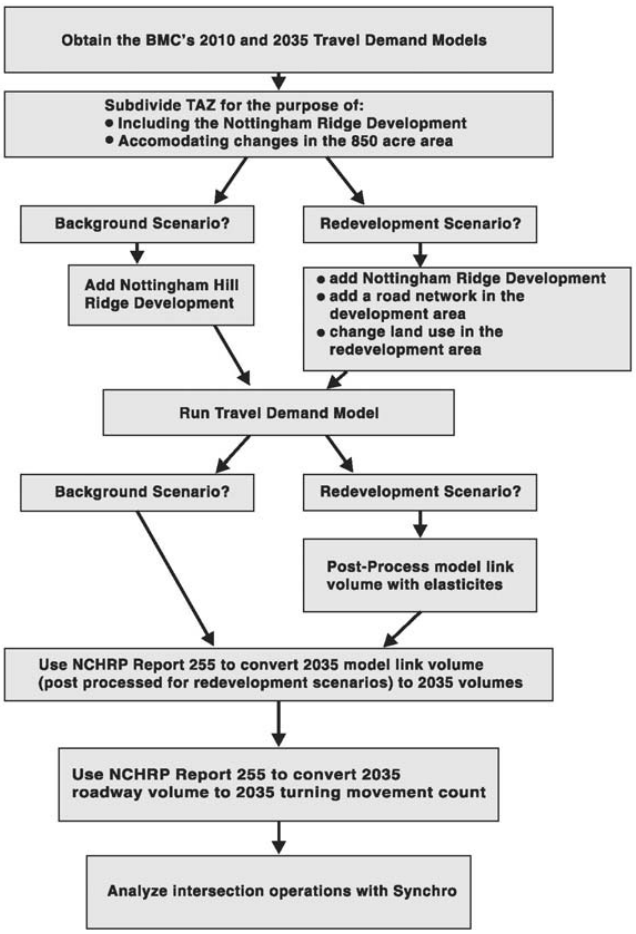
Scenario 4B

Scenario 4B is Scenario 4A without the additional crossings of the CSX railroad. This scenario examines the feasibility of high intensity redevelopment without additional railroad crossings, to assess the viability of the high-intensity scenario without the upfront investment in the proposed crossings. Land use in Scenario 4B is the same as 4A. Traffic operations analysis was performed for Scenario 4B.

METHODOLOGY TO DEVELOP FUTURE VOLUMES

There were three fundamental steps in the process to develop future 2035 p.m. peak hour turning movement counts: 1) Refine and apply the BMC model; 2) post-process the model roadway segment volumes to account for pedestrian, bicycle and transit and shorter vehicle trips; 3)post post-process the roadway segment volumes to create the intersection turning movement volumes. The flowchart illustrates this entire methodology, and the remainder of this section describes the steps in detail. The following describes the major steps in the development of the forecast p.m. peak hour volumes.

Development and Analysis of Future Traffic Volumes



TRAVEL DEMAND MODELING

The BMC maintains a travel demand model for the Baltimore region. The model was created with the Cube/TP+ software package. The BMC maintains several versions of the model which correspond to different years, including an existing conditions 2010 model and a future conditions 2035 model. The 2010 and 2035 models were obtained from the BMC. The primary use of the 2010 model for this project was in the final step to convert the 2035 post-processed segment volumes to 2035 p.m. peak hour intersection turning movement counts.

PLANNED IMPROVEMENTS IN BMC 2035 MODEL

The BMC 2035 model contains transportation improvements specified in the region's long range transportation plan. Improvements include:

- Widening of Philadelphia Road to four lanes between Rossville Boulevard and Campbell Boulevard
- "Extension" of Campbell Boulevard from Pulaski Highway to White Marsh Boulevard
- Widening of portions of the I-695, including widening the section between I-83 and the northern I-95 interchange from six to eight lanes
- Addition of two express toll lanes in each direction on I-95 from I-895 to MD 22 (Aberdeen exit) and rebuilding of interchanges to serve both general purpose and express toll lanes
- Widening of I-95 from MD 22 to the Susquehanna River bridge from six to eight lanes

The BMC model does not include the following:

- Any rail or major transit improvements in the I-95/ Pulaksi Highway corridor.
- Extension of the MTA Metro Green Line (Baltimore's existing heavy rail line) currently shown in the 2000 Regional Rail Plan.
- Additional ramps at the White Marsh Boulevard/ Philadelphia Road interchange

LAND USE ASSUMPTIONS

The BMC 2035 model also assumes additional development that is consistent with the comprehensive plans in effect for the Baltimore region. County staff noted that one large development near the 850 acre study area – Nottingham Ridge - was recently approved and had not yet been incorporated into the BMC model. The County provided information for this development, and it was added to the model for all Scenarios (except Scenario 1) by creating a new traffic analysis zone (TAZ)

TRAFFIC ANALYSIS ZONES

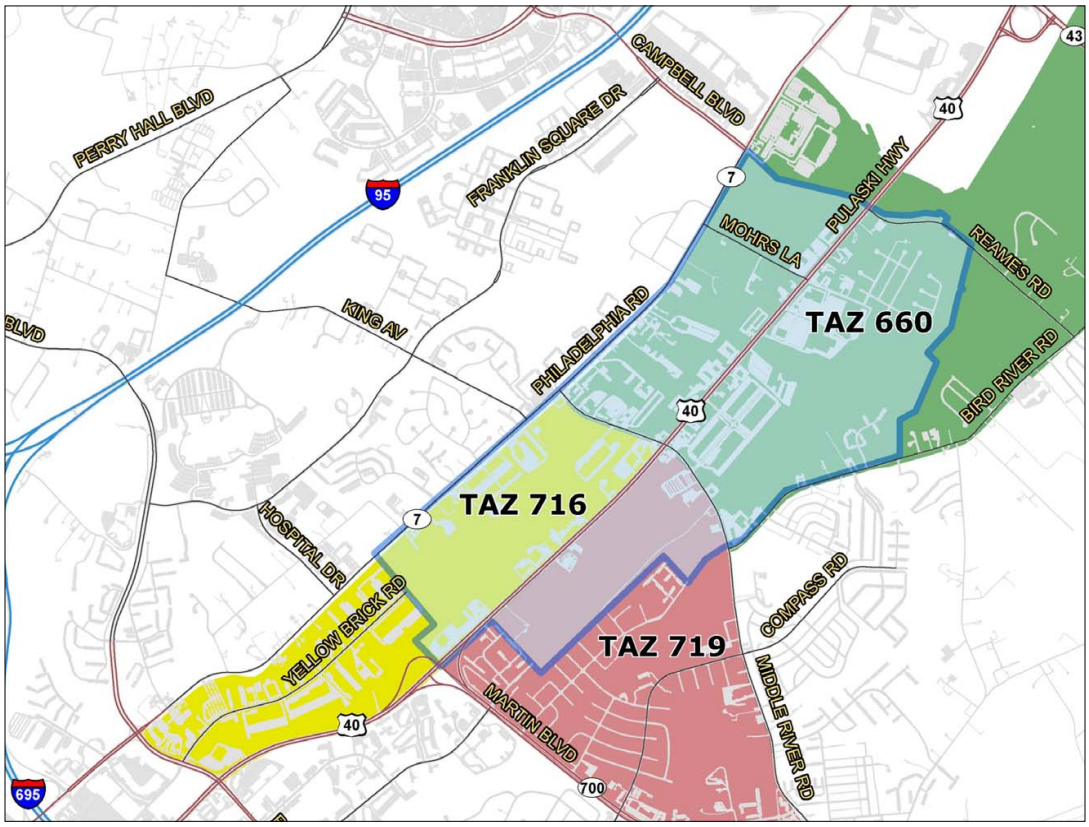
Modeling the extensive redevelopment within the 850 acre study area required subdividing existing TAZs within the BMC's model. The additional TAZs were necessary to differentiate portions of existing TAZs inside and outside of the 850 acre study area, and to more accurately place planned development and load roadway links within the 850 acre study area. In the base model, the 850 acre area formed a portion of three TAZs: 660, 716, and 719. (See Figure 13)

These TAZs were subdivided based upon natural barriers to travel within the study area and transitional areas within future development scenarios. The natural barriers were the CSX railroad and power lines between Pulaski Highway and Bird River Road/Transverse Avenue. Subdivided TAZs are shown in Figure 14. Subdivided TAZs are identified by the number of their parent and a letter. "A" was assigned to the portion of the parent TAZ lying outside of the study area (not shown in Figure 14), and the letters "B" and above were assigned to the subdivided TAZs lying within the study area. Two areas outside of the 850 acre redevelopment area were included within the "study area" for the purposes of travel demand modeling:

- The industrial park along Yellow Brick Road (subdivided TAZ 716D)
- The apartment complex and mobile home park in the northwest quadrant of the Pulaski Highway/ Martin Boulevard interchange (subdivided TAZ 719D)

These two areas were not initially anticipated to be part of the redevelopment effort. However, it was determined during this phase of the project that they may be suitable for redevelopment and they were placed into a separate sub-TAZ to account for this. The inclusion of these two areas within the proposed redevelopment should be revisited during the next phase of this project.

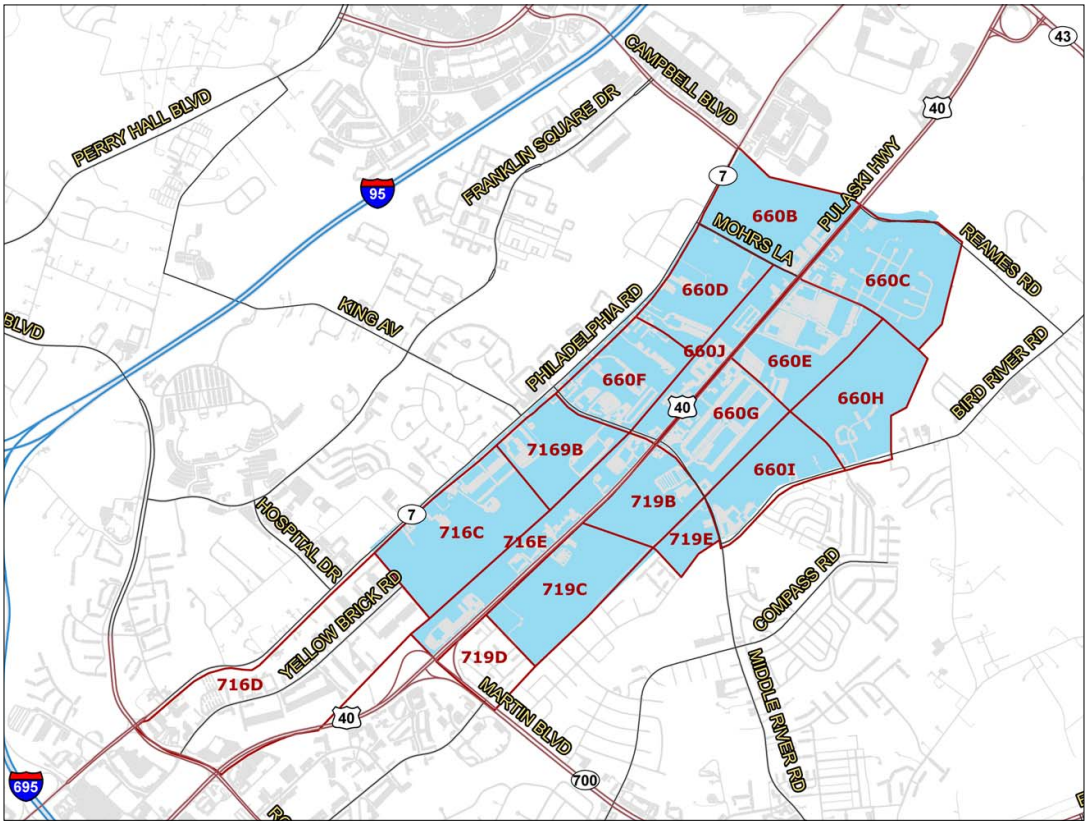
Figure 13 - Existing TAZs



Subdividing the existing TAZs required re-distributing the TAZs' attributes to the disaggregated TAZs. Each TAZ attribute is listed below, and the process by which values were determined for the disaggregated TAZs is noted.

- Total population – Population (i.e. number of residents) in a sub-TAZ was defined as a percentage of population in the parent TAZ. A field visit and aerial photography were used to estimate this percentage.
- Population living in institutionalized group quarters – This was distributed proportionally based upon total population. Within the three parent TAZs only a small percentage of the population was living in institutionalized group quarters.
- Population living in non-institutionalized group quarters – This was distributed proportionally based upon total population. Within the three parent TAZs only a small percentage of the population was living in non-institutionalized group quarters.
- Median household income – The value for the parent TAZ was used for each sub-TAZ.
- Total number of resident workers (labor force) – This was distributed proportionally based upon total population.
- Retail employment – Retail employment in a sub-TAZ was defined as a percentage of retail employment in the parent TAZ. A field visit and aerial photography were used to estimate this percentage.
- Office employment – Office employment in a sub-TAZ was defined as a percentage of office employment in the parent TAZ. A field visit and aerial photography were used to estimate this percentage.
- Industrial employment – Industrial employment in a sub-TAZ was defined as a percentage of industrial employment in the parent TAZ. A field visit and aerial photography were used to estimate this percentage.
- Other employment – Other employment in a sub-TAZ was defined as a percentage of other employment in the parent TAZ. A field visit and aerial photography were used to estimate this percentage.
- Land acreage in the zone – This was determined by measuring the size of each subdivided TAZ in GIS.
- Truck zone code – None of the parent TAZs were part of a truck zone, so the value of 0 was used for all sub-TAZs
- School enrollment (K-12) – This was distributed proportionally based upon total population.

Figure 14 - Subdivided TAZs



POST-PROCESSING MODEL RESULTS

A key goal of the redevelopment of the Pulaski Highway corridor is to change the character of the area from an automobile-dominated environment to a mixed-use, multi-modal environment. The future Pulaski Highway is envisioned as a place where walking, bicycling, and transit use are as viable a means of travel as driving. The envisioned mix of uses and the grid street network will place residences, jobs, shopping, and entertainment within much closer proximity to one another than exists today.

Regional travel demand models are typically not designed or calibrated to analyze the travel impacts of fine-scale changes to the built environment. Outside of urban cores, the level of density, the mix of land uses, and completeness of the street network that is envisioned for the Pulaski Highway area is relatively rare within most metropolitan areas. Recent research by Ewing and Cervero has sought to quantify reductions in auto travel that occur in places like the redeveloped Pulaski Highway in comparison to conventional suburban environments. Ewing and Cervero conducted a meta-analysis of built environment-travel literature using hundreds of published studies, and they computed the average effect of various measures of the built environment on total Vehicle Miles Traveled (VMT). The findings of Ewing and Cervero's research was used to post-process model link volumes for the redevelopment scenarios (Scenarios 2, 3, 4A, and 4B)

Elasticity Overview

The results of the Ewing and Cervero study are reported in terms of weighted average elasticities. Elasticities are a measure of the rate of change of a dependent variable with respect to the rate of change of an independent variable. Suppose the toll on a bridge was increased from $3.00 to $4.00 (33% increase), and it is known from prior experience with similar toll bridges that the elasticity of a toll increase is -0.05. If the average daily traffic (ADT) on the bridge prior to the toll increase was 25,000 vehicles per day, the ADT on the bridge after the increase can be estimated as follows (E = Elasticity):

$$E = \frac{\text{\% change in dependent variable}}{\text{\% change in independent variable}}$$

% change in dependent variable = E * % change in independent variable

% change in ADT = -0.05 * 0.33 = -0.0165.

Per the elasticity, a 1.65% reduction in ADT (to 24,588) would be expected following the toll increase.

ELASTICITIES USED IN MODEL POST-PROCESSING

Three of the built environment measures studied by Ewing and Cervero were relevant to the Pulaski Highway Redevelopment Study and were readily quantifiable from the travel demand model data and the assumptions for the project. The table below defines these three variables and specifies their elasticity.

Table 5 - Elasticities

Measure	Definition	Elasticity
Density	Residents & Jobs per Acre	-0.04
Diversity	Land Use Mix	-0.09
Design	Side street intersection legs per mile of major roadway	-0.12

These elasticities were used to post-process link volumes in the model associated with the 850 acre study area. Only volumes associated with the 850 acre study area (i.e., trips with an origin and/or destination within the 850 acre study area) were post-processed. No adjustments were made to trips passing through the study area, such as a trip on Pulaski Highway beginning inside of the Baltimore Beltway and ending north of White Marsh Boulevard.

While Ewing and Cervero's study examined VMT, most traffic analysis tools and metrics including those used in this study consider roadway link volumes and/or intersection turning movement counts. Thus, to apply the elasticities, a relationship between VMT associated with a development and the number of auto trips associated with a development was needed. Potential relationships include the following scenarios:

- If all auto trips generated by a development were the same length, percent changes in VMT and percent changes in number of auto trips would be equivalent. In practicality, this is an unlikely scenario.

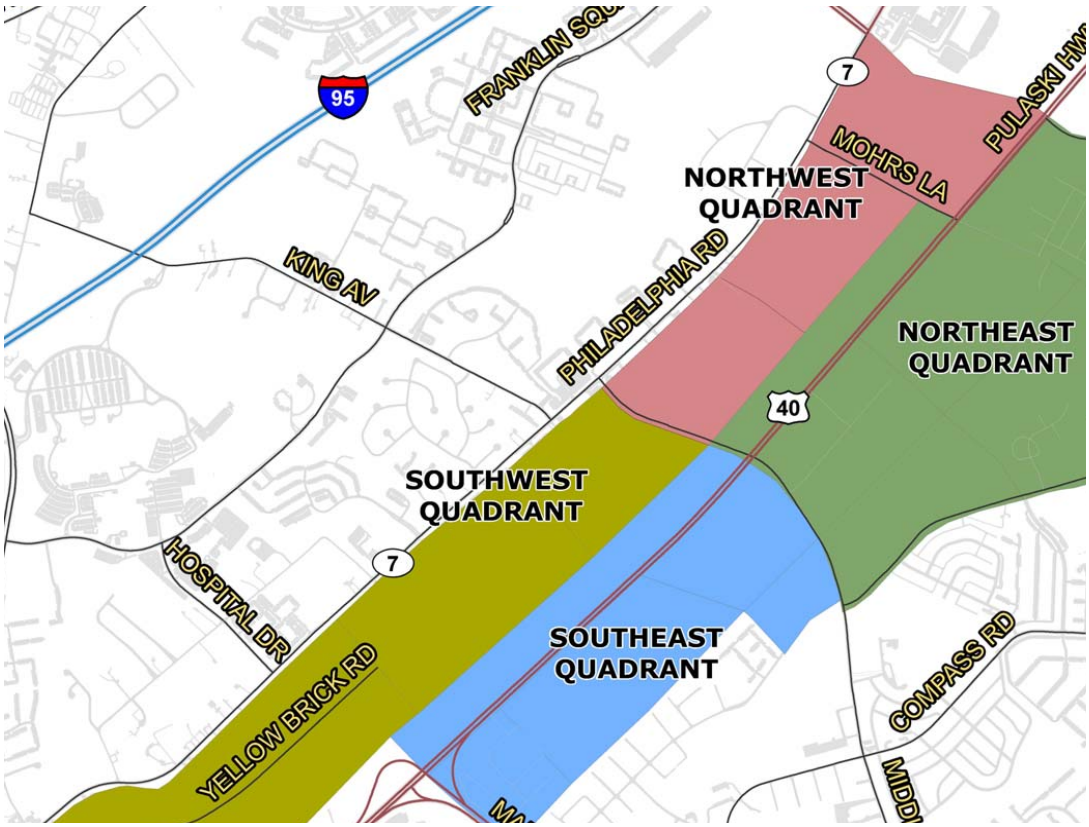
- If a given reduction in VMT occurred because a few long auto trips were eliminated, the corresponding percent reduction in number of auto trips would be lower.
- If a given reduction in VMT occurred because many short auto trips were eliminated, the corresponding percent reduction in the number of auto trips would be higher.

During this phase of the study, it was assumed that the percent reduction in VMT as specified by elasticities resulted in an equivalent percent reduction in the number of auto trips generated within the study area. This can be thought of as a conservative estimate of the relationship described in the third bullet point. The walkable, mix-used environment proposed within the 850 acre area will allow many short trips to be made without auto use. During future phases of the study, an attempt should be made to verify the assumption that percent reduction in VMT be equivalent to percent reduction in auto trips.

APPLYING THE ELASTICITY

The 850 acre redevelopment area is large enough that applying a single elasticity to it could have yielded results not reflective of actual travel behavior. For example, an increase in density within the northwest portion of the study area would not necessarily change travel behavior within the southeast portion of the study area. As a result, the subdivided TAZs within 850 acre study area were grouped into four quadrants and separate elasticity calculations were performed for each. This is also detailed in the next section of the report. As shown in the figure, the CSX railroad and Middle River Road were selected as the borders of the quadrants because they form natural barriers to mobility and connectivity within the study area.

Figure 15 - Quadrants for Elasticity Calculations



ELASTICITY CALCULATIONS

For scenarios involving redevelopment of the 850 acre study area, elasticities were used to post-process model link volumes. Three elasticities associated with individual aspects of the built environment (density, diversity, and design) were applied to each quadrant of the 850 acre study area, and a multiplicative process was then used to compute a single trip reduction factor for each quadrant. These calculations are detailed below. Scenario 2 and the northwest quadrant of the 850 acre study area are provided as example calculations.

DENSITY

Density describes the number of people per acre living in an area. As this number increases opportunities for supporting land uses such as retail services or employment also increase. Bringing these activities closer together enables a reduction in the number and length of vehicle trips.

The 2035 Base BMC Model has approximately 985 residents and workers in the northwest quadrant of the redevelopment area, and Scenario 2 assumes 4310. This is equivalent to 5.33 people per acre and 23.32 people per acre, respectively. Using the elasticity of -0.04 to reflect density increases, the percent reduction in auto trips (in comparison to the model output) for the northwest quadrant under Scenario 2 is calculated as follows:

$$E = \frac{\text{\% change in dependent variable (auto trips)}}{\text{\% change in independent variable (density)}}$$

% change in dependent variable = E * % change in independent variable

% change in # of the auto trips = -0.04 * (5.33-23.32)/5.33 = 13.5%

This result indicates that, based upon the proposed higher density within the northwest quadrant, 13.5% fewer auto trips than would normally be generated by 4310 people (workers and residents) can be expected. This is the first of three auto trip rate reductions which will be computed for the northwest quadrant and then combined into a single auto trip reduction factor.

DIVERSITY

Diversity is the mix of land use per acre (i.e. residential, commercial and retail). The greater the mix of land use per acre, the greater the opportunity for shorter non-auto trips by people living or working in the area.

An entropy index is a mathematical technique to describe the degree of uniformity within a given area. The index ranges from 0 (complete uniformity) to 1 (no uniformity). For the diversity aspect this study, the entropy index considered the mixture of population (residents), retail workers, office workers, industrial workers, and other workers within each quadrant; these are all data fields within the BMC model. The entropy index in this case is:

Entropy Index = -[Aln(A)+Bln(B)+Cln(C)+Dln(D)+Eln(E)] / ln(5)

where

A = % of people in an area who are residents

B = % of people in an area who are retail workers

C = % of people in an area who are office workers

D = % of people in an area who are industrial workers

E = % of people in an area who are other workers

In the northwest quadrant in Scenario 2 the resulting entropy indexes are 0.77 and 0.39, respectively. Note that Scenario 2 actually decreases the entropy within the northwest quadrant. Therefore, the application of an elasticity in this case will yield an increase in the number of auto trips projected by the model. Using the -0.09 elasticity specified by Ewing and Cervero, the percent reduction in auto trips for the northwest quadrant under Scenario 2 is:

% change in dependent variable = E * % change in independent variable

% change in # of the auto trips = -0.09 * (0.77-0.39) = -4.4%

The negative value indicates that the number of auto trips will increase relative to the rate specified by the model. This is second of three auto trip reduction (in this case an increase rather than reduction) rates which will be computed for the northwest quadrant and then combined into a single auto trip reduction factor.

DESIGN

The design variable accounts for street network characteristics within an area measured by intersection density. Grids offer increased connectivity, allowing for short trips within an area to be made without use of an arterial. Autos are able to use other routes, and non-auto trips become more attractive because they can be made on local and collector level streets.

Design is the number of side street intersection legs in the area. As this number increases the degree of interconnectivity of the network increases and the greater the opportunity for local trips on local roadways, or pedestrian or bicycle trips on lower volume, lower speed streets. By counting side street intersection legs, a four-leg intersection is considered to offer twice the connectivity benefit of a three-leg intersection.

The road network of the 2035 Base BMC model has three side street intersection legs on major roads within the northwest quadrant, and Scenario 2 has five side street intersections. This results in 2.04 and 3.40 side street intersections per mile of major roadway, respectively.

Using the elasticity of -0.12 to reflect intersection density increases, the percent reduction in auto trips (in comparison to the model output) due to the increased density is calculated as follows:

% change in dependent variable = E * % change in independent variable
% change in # of the auto trips = -0.12 * (2.04-3.40)/2.04 = 8.0%

This result indicates that, based upon the enhanced street grid within the northwest quadrant, 8.0% fewer auto trips than would normally be generated by 4310 people (workers and residents) can be expected. This is the third of the three auto trip rate reductions computed for the northwest quadrant that will be combined into a single auto trip reduction factor.

COMPUTATION OF A SINGLE TRIP ADJUSTMENT FACTOR PER QUADRANT

Because the three elasticities each reflect a separate aspect of the built environment (i.e., density, diversity, and design), it is appropriate to combine the elasticities to account for the cumulative impact of the changes anticipated for the northwest quadrant. As is standard practice for elasticities, the combined effect is calculated by multiplying the individual reduction factors to develop a single auto trip reduction factor.

Again using the northwest quadrant under Scenario 2, the auto trip reduction factor (ATRF) is computed as:

ATRF = (1-0.135) * (1+0.044) * (1-0.080) = 0.831

This auto trip reduction factor indicates that 83.1% of the auto trips estimated by the BMC model to be generated by the northwest quadrant of the study area under Scenario 2 would be expected to occur given the type of redevelopment proposed. The remaining 16.9% of the trips predicted by the model will likely be internalized or made with an alternative mode due to the density, diversity, and design of development within Scenario 2. Auto trip reduction factors for each quadrant under each redevelopment scenario are shown in table 6.

Figure 16 - Auto Reduction Factors

Quadrant	Scenario 2	Scenario 3	Scenario 4
Northwest	0.831	0.692	0.624
Southwest	0.951	0.858	0.829
Southeast	0.696	0.656	0.645
Northeast	1.000	0.906	0.856

The table indicates that as changes to the built environment become greater (i.e. Scenario 4 versus Scenario 2), a greater percentage of the auto trips predicted by the model are not expected to occur. However, the total number of auto trips projected by the model is greater under Scenario 4 than Scenario 2, so the increased auto trip reduction rate does not necessarily predict less auto trips overall in Scenario 4 versus Scenario 2.

LINK VOLUME ADJUSTMENTS

The next step of model data post-processing was to apply the elasticity factors from the table above. Calculations were performed within Cube/TP+. To apply the auto trip reduction factors only to volume being generated by a given quadrant, four select zone analyses were performed for each scenario. Each select zone analysis showed the volume on each link within the model generated by a given quadrant. The appropriate auto elasticity factors were applied to each link volume for each select zone analysis. New link volumes were then computed for each scenario, thus completing the post-processing of the model results.

DEVELOPMENT OF TURNING MOVEMENT COUNTS

Finally, model link volumes (post-processed volumes for the redevelopment scenarios) were converted to future roadway volumes and then to future turning movement counts using the methodology of NCHRP Report 255. This report is used regularly by traffic engineers and transportation planners for this purpose. The methodology of the report converts future model link volumes to future roadway volumes by comparing existing model link volumes and existing roadway volumes. Likewise, the methodology uses an iterative process to compare future roadway volumes and existing turning movement counts to compute future turning movement counts.

At a handful of the study intersections, new legs get added as part of redevelopment scenarios or, in the case of the intersections at the ends of Mohrs Lane, travel patterns will change so dramatically in the future that existing turning movement counts are not a reasonable starting point for the computation of future turning movement counts. In these situations, some manual adjustments were made to the turning movement counts computed by NCHRP Report 255.

FUTURE ROAD NETWORK NEEDS

A key component of the redevelopment of the Pulaski Highway corridor is the creation of a grid network of roads. The redundancy provided by a grid system helps to distribute auto traffic away from congested intersections such as Pulaski Highway at Middle River Road. It also creates connectivity on lower-order roadways that are suitable for walking and bicycling.

A CSX railroad line parallels Pulaski Highway throughout the study area

The new street network in the district would provide frequent intersections where local streets intersect, helping to disperse traffic through the network and creating pedestrian-friendly block sizes as previously described. Desirable intersection spacing for pedestrian friendly environments is much closer than present conditions, with specific values varying depending upon orientation of the street and building types along them. A block size of 300-400 feet with signalized intersections at no greater than 1000 feet would be desirable for the district.

Intersection spacing will be somewhat longer where local streets intersect Pulaski Highway, but should still be minimized whenever possible. Baltimore County has a minimum spacing requirement of 750' where county roads meet state roads, whereas SHA generally has a 1000' minimum requirement for this type of condition. However, both Baltimore County and SHA recognize the importance of context sensitive design solutions and have been willing to consider design flexibility when circumstances warrant it.

Road network building in the southwest/northeast direction (parallel to Philadelphia Road and Pulaski Highway) will be relatively simple from an engineering perspective. Yellow Brick Road can be extended to Mohrs Lane, and Bird River Road can be extended to Martin Boulevard via Transverse Avenue. In addition to these collector extensions, new collectors are proposed to complete the grid network creation.

Network building in the southeast/northwest direction will be more challenging due to the CSX Railroad line that runs between Pulaski Highway and Philadelphia Road. Currently, Middle River Road is the only open roadway connecting Pulaski Highway and Philadelphia Road between Rossville Boulevard and White Marsh Boulevard. Mohrs Lane, which also connects Pulaski Highway and Philadelphia Road, is closed due to the condition of the bridge over the CSX Railroad. However, Mohrs Lane is expected to reopen in approximately 4 years when the bridge is replaced. Additional grade-separated crossings of the CSX railroad, in addition to those on Middle River Road and Mohrs Lane, would be desirable as part of the redevelopment effort. The spacing between major (signalized or grade-separated) interchanges on Pulaski Highway is currently one half to one mile and additional intersections could be easily accommodated.

Table 7 - Feasibility of Additional CSX Railroad Crossings

	Crossing	Feasibility
1	Extension of Martin Boulevard to Philadelphia Road	Not Feasible
2	Extension of King Avenue to Pulaski Highway	Requires Further Study
3	New Pulaski Highway/ Philadelphia Road link between Middle River Road and Mohrs Lane	Feasible
4	Connection between Campbell Boulevard and Reames Road	Not Feasible

The topography along four potential links between Pulaski Highway and Philadelphia Road was analyzed to determine feasibility of potential CSX crossings. Elevations were obtained from Baltimore County's GIS contour layer. The four links evaluated were:

1. An extension of Martin Boulevard to Philadelphia Road (at the Hospital Drive intersection)
2. An extension of King Avenue to Pulaski Highway
3. A new Pulaski Highway/Philadelphia Road link between Middle River Road and Mohrs Lane
4. A link between the existing Campbell Boulevard and Reames RoadThe feasibility of each of these crossings is described below.

1) Extension of Martin Boulevard to Philadelphia Road

The Philadelphia Road/Hospital Drive intersection lies approximately 40 feet above Yellow Brick Road, the CSX railroad, and the developed area surrounding Yellow Brick Road. These areas, in turn, lie approximately 20 feet above Pulaski Highway at the Martin Boulevard partial interchange.

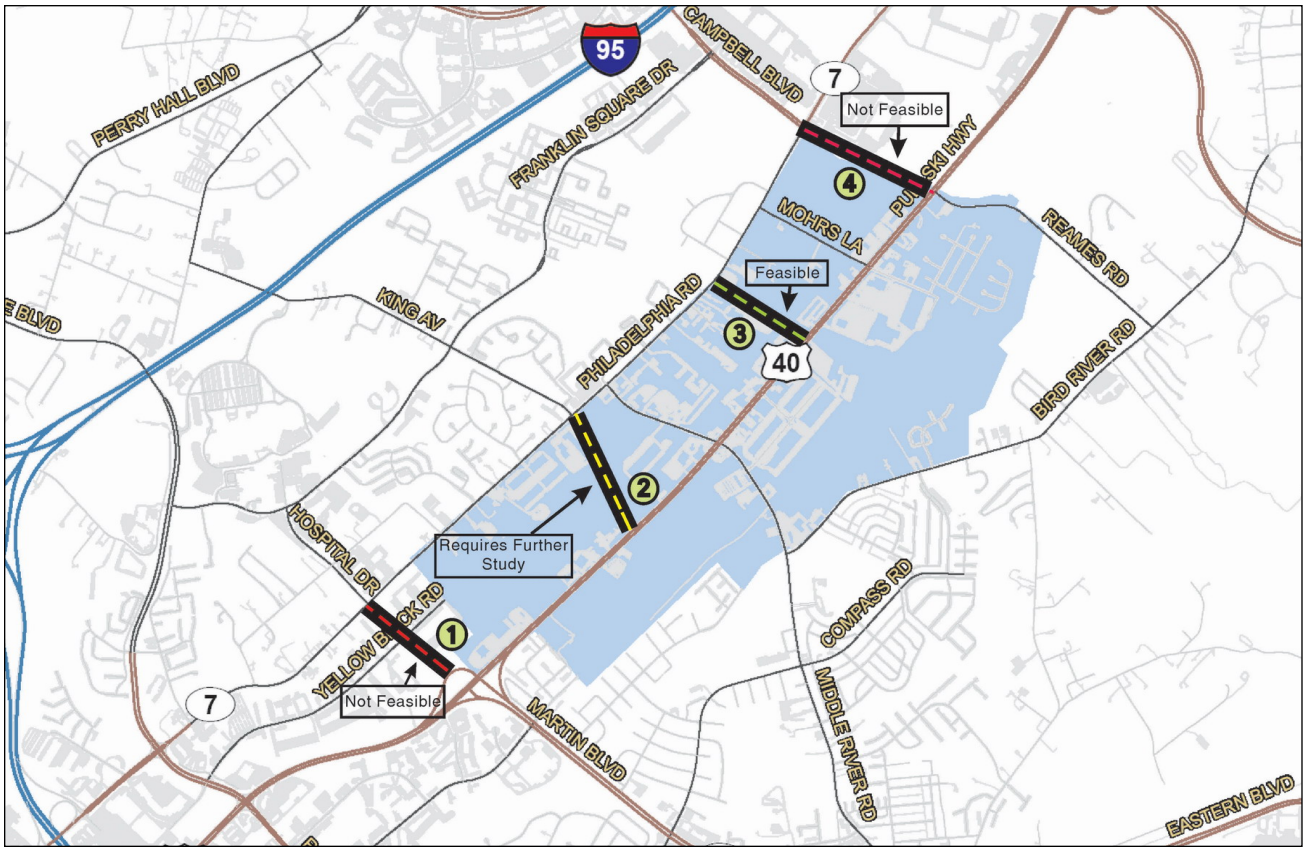
If Martin Boulevard were extended, the bridge over Pulaski Highway would need to be rebuilt to serve through movements and potentially raised to clear the CSX railroad. Reconfiguration of the interchange would also be necessary. After crossing Pulaski Highway, Martin Boulevard would need to remain elevated to pass over the CSX railroad and to meet Philadelphia Road. As a result, the extended Martin Boulevard would pass over Yellow Brick Road and not connect to it.

The long elevated section, lack of a connection to Yellow Brick Road, and need for modifications to the Pulaski Highway/Martin Boulevard interchange in close proximity to the CSX railroad combine to make this an infeasible crossing.

2) Extension of King Avenue to Pulaski Highway

The CSX railroad and Pulaski Highway lie at approximately the same elevation at the points at which they would be crossed by an extended King Avenue. Philadelphia Road lies 5 to 10 feet below this elevation.

Figure 16 - Feasibility of Additional CSX Railrod Crossings



An extension of King Avenue beginning at Philadelphia Road would proceed up to a bridge over the CSX railroad and then descend on a steep grade to Pulaski Highway. The steepness of the grade between the CSX railroad and Pulaski Highway is near the limit of what is desirable on a collector roadway, and a more detailed analysis is needed to fully assess the feasibility of a roadway here.

An extension of King Avenue would likely require additional lanes at the Philadelphia Road/King Avenue intersection. A large intersection at this location would alter the "neighborhood center" character proposed for the 850 acre redevelopment area.

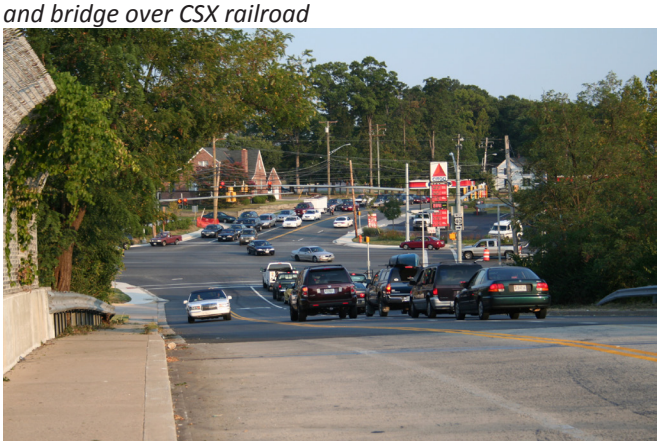
An extension of King Avenue to Pulaski Highway may be feasible, and further analysis should be performed if a crossing here is deemed desirable.

3) New Pulaski Highway/Philadelphia Road link between Middle River Road and Mohrs Lane

At a location approximately midway between Middle River Road and Mohrs Lane, the CSX railroad is approximately 10 feet above Philadelphia Road, and Pulaski Highway is approximately 30 feet above the CSX railroad. Beginning at Philadelphia Road, a roadway would proceed up to a bridge over the CSX railroad and then remain nearly level until intersecting Pulaski Highway.

A new roadway is feasible from vertical design perspective at this location.

A steep grade on Middle River Road between Pulaski Highway and bridge over CSX railroad



4) Connection between Campbell Boulevard and Reames Road

The Campbell Boulevard/Philadelphia Road intersection and the Reames Road/Pulaski Highway intersection are located such that they could be connected with a straight section of roadway nearly perpendicular to Philadelphia Road and Pulaski Highway. However, the CSX railroad at this location is approximately 5 feet above the Philadelphia Road/Campbell Boulevard intersection and 20 feet above the Pulaski Highway/Reames Road intersection. A roadway crossing the CSX railroad on a bridge could not descend to the elevation of Pulaski Highway within the short distance between the two.

A connection between Campbell Boulevard and Reames Road is not feasible.

FUTURE TRAFFIC CONDITIONS

Analysis of future conditions traffic analysis was performed using Synchro for several scenarios representing the range of potential study area conditions in the year 2035. The analyzed scenarios are fully described in the "Future Traffic Demand Scenarios" section. Briefly, they are:

- Scenario 1A – This scenario is the BMC's Base 2035 model with the Nottingham Ridge Development added. This scenario assumes no redevelopment effort within the 850 acre study area.
- Scenario 2 – This scenario adds a collector road network within the study area and low intensity, mixed-use redevelopment.
- Scenario 4A – This scenario adds the proposed collector network; two new crossings of the CSX railroad and high intensity, mixed-use redevelopment.
- Scenario 4B – This scenario does not have new crossings of the CSX railroad but is otherwise the same as Scenario 4A.

Similar to existing conditions, the following pages graphically summarize intersection performance and the full results are presented in the appendix. As previously noted, analysis was performed for p.m. peak hour.

Assumed Additions of Vehicular Capacity
The following traffic capacity improvements are assumed in the baseline future conditions analysis. They were derived from the travel demand model and information provided by State and County Transportation staff.

- Philadelphia Road/Hospital Drive – Under Scenario 1A, Philadelphia Road is widened to two lanes in each direction through this intersection per the BMC's model. The model also assumed that this intersection is signalized and a left turn lane from Philadelphia Road to Hospital Drive is added in Scenario 1A. It should be noted that Scenarios 2, 3, and 4 do not widen Philadelphia Road through this area, and thus the intersection remains stop controlled under these scenarios.

- Philadelphia Road/King Avenue – Under Scenario 1A, Philadelphia Road is widened to two through lanes in each direction through this intersection per the BMC's model. Under Scenario 4A, the southern leg of this intersection becomes an extension of King Avenue (connecting to Pulaski Highway via a new crossing of the CSX railroad). In Scenario 4A, lanes are added to the Philadelphia Road and King Avenue approaches.
- Philadelphia Road/Middle River Road – Under Scenario 1A, Philadelphia Road is widened to two lanes in each direction through this intersection per the BMC's model. Under redevelopment scenarios, Philadelphia Road is not widened here.
- Philadelphia Road/Mohrs Lane – Under all future scenarios, this intersection is signalized and lanes are added. Lane additions include double left turns onto Mohrs Lane, double right turns onto Philadelphia Road, and two through lanes on Philadelphia Road eastbound.
- Pulaski Highway/Mohrs Lane – Under all future scenarios, an auxiliary through lane is added on Pulaski Highway in both directions and the southbound approach is widened to include a right-turn lane, a through lane, and a left-turn lane. The lane configuration at this intersection was chosen after discussions with SHA and Baltimore County staff involved in the design of the replacement Mohrs Lane Bridge over the CSX railroad.
- Philadelphia Road/Campbell Boulevard – Under all future scenarios, a second left-turn lane from Philadelphia Road eastbound to Campbell Boulevard is added. This widening is associated with the reconstruction of the Mohrs Lane Bridge.
- Philadelphia Road/Industrial Park Drive – The west leg of this intersection becomes the main entrance to the Nottingham Ridge development under all future scenarios, and the approved changes to the intersection were included in the analysis. These changes include a third through lane at Philadelphia Road northbound, right-turn lanes on Philadelphia Road (both directions), triple left-turn lanes exiting the Nottingham Ridge development, and a second through lane into the Nottingham Ridge development.

- Philadelphia Road/Ramp to White Marsh Boulevard westbound – Under all future scenarios, a second through lane on Philadelphia Road is added per the approved mitigations associated with the Nottingham Ridge development. The intersection remains unsignalized.

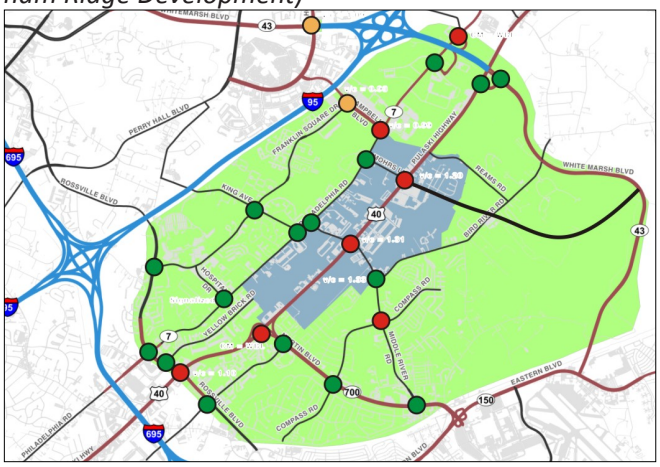
All of these vehicular capacity additions are specified in one or more plans that currently exist, such as the 2035 BMC model, the Mohrs Lane reopening/Campbell Boulevard extension, or the Nottingham Ridge development.

The 2035 traffic analysis assumed that right turn lanes, where needed, would not be channelized in any manner, except where such channelization already exists. In suburban and rural areas, right turn lanes are often channelized through use of a raised traffic island that separates right-turn traffic. Right-turn traffic is yield-controlled or provided with a dedicated receiving lane to allow continuous turns. This design makes bicycle and pedestrian travel difficult, and should not be used within the redevelopment area.Lane configurations and operational analysis results for all intersections under all analyzed scenarios are shown in the Appendix. General traffic and congestion trends under each scenario are highlighted in the sections below, followed by a more detailed discussion of specific intersections at which congestion is anticipated.

Scenario 1A

This future baseline scenario results in substantial increases in congestion relative to today. All intersections on Pulaski Highway except the connector to White Marsh Boulevard will experience failing operation, and some intersections are well over capacity. On Pulaski Highway under 2035 baseline conditions, westbound through volume more than doubles and eastbound through volume increases 30 to 50 percent relative to 2010. The western portion of Philadelphia Road will operate at LOS D or better due to the addition of a second lane in each direction. However, the intersections of Philadelphia Road and Campbell Boulevard and Philadelphia Road and the ramp to White Marsh Boulevard westbound will experience congestion due to the Nottingham Ridge development and other growth in the White Marsh area. Other intersections in the White Marsh area will fail as well.

Figure 17 - 2035 Scenerio 1A (BMC base model + Nottingham Ridge Development)

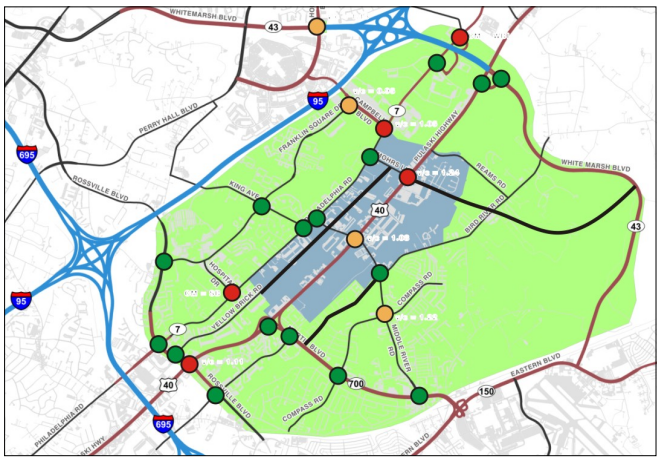


The future baseline scenario will have substantial increases in congestion relative to today due to major increases in through volume on Pulaski Highway and growth in the White Marsh area, including the Nottingham Ridge development.

Scenario 2

Traffic conditions under Scenario 2 are similar to Scenario 1A. The added road network relieves congestion at some intersections, but the added development increases congestion at others. This is the least intense redevelopment scenario, and as a result the changes to density, diversity, and design that reduce auto trips have less of an impact on this scenario than on the other redevelopment scenarios.

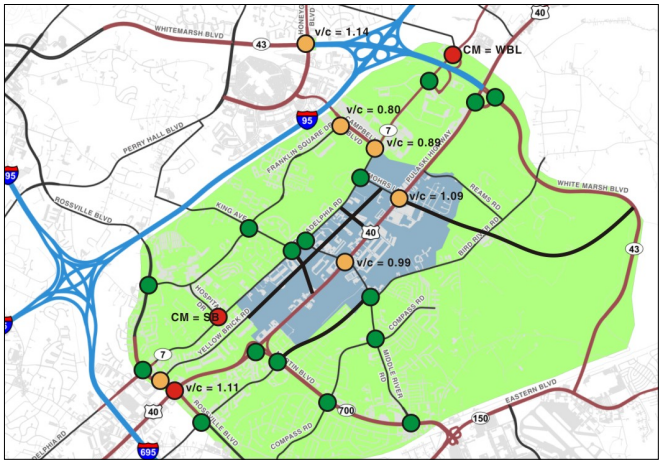
Figure 18 - 2035 Scenerio 2 (Low-Intensity Redevelopment)



Scenario 4A

The addition of two new crossings of the CSX railroad and greater changes to the built environment generally reduce congestion at intersections within and close to the redevelopment area, such as Pulaski Highway/Middle River Road, Pulaski Highway/Mohrs Lane, and Philadelphia Road/Campbell Boulevard. Intersections on fringes of the transportation influence area such as Pulaski Highway/Rossville Boulevard and White Marsh Boulevard/Honeygo Boulevard experience slight increases in congestion.

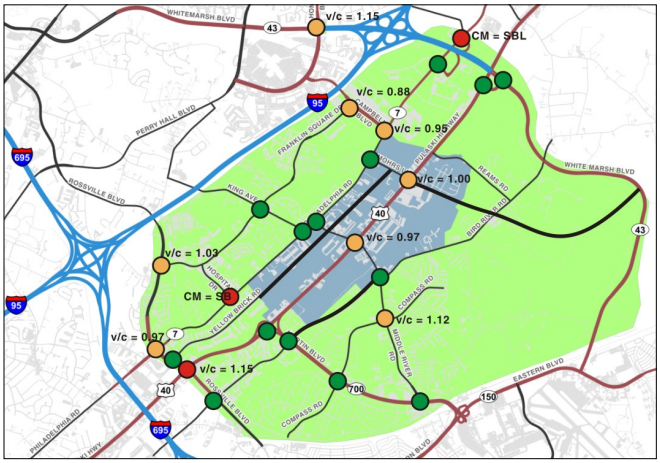
Figure 19 - 2035 Scenerio 4A (High-Intensity Redevelopment)



Scenario 4B

Scenario 4 land use without the addition of the two new crossings of the CSX railroad has a similar operational performance to Scenario 4A. This suggests that changes in land use and the creation of through roads parallel to Pulaski Highway provide more congestion relief than additional crossings of the CSX railroad. However, additional CSX crossings do offer circulation and connectivity benefits.

Figure 20 - Scenerio 4B (High-Intensity Redevlopment)



KEY INTERSECTIONS

Causes of congestion and potential mitigation measures are discussed below for intersections that are projected to operate at LOS E or F in any of the future scenarios. Intersection locations are depicted in Figure 21. In some cases, specific intersections only operate at LOS E or F under one or two scenarios but the potential mitigations would create substantial operational improvements under all scenarios. Therefore, many of the recommendations noted below are not scenario-specific. Recommendations achieve LOS D or better operation unless noted.

While this section notes all intersections that are not projected to operate at LOS D or better, it is important to note that achieving this threshold at all intersections is not necessarily desirable. Under redevelopment scenarios, Pulaski Highway is envisioned to become a town center environment. In such an environment, small degrees of congestion that occur during only small portions of the day such as the peak hour may be acceptable. Tolerance of a small degree of congestion prevents roads from becoming excessively wide and detracting from the walkability that is desirable in a town center environment.

Recommendation: Pursue change in level of service standard for the study area similar to the White Marsh Town Center. Accept worse congestion in the peak hour to allow smaller intersections and improved non-auto mobility in the study area.

Rossville Boulevard/Franklin Square Drive (A)

This intersection operates at LOS E under Scenario 4B. 575 vehicles are projected to make the left turn from Franklin Square Drive westbound to Rossville Boulevard southbound, but only a single left turn lane is present.

Recommendation (Scenerio 4B): Recommendation (Scenario 4B): A second left turn on Franklin Square Drive westbound is recommended under Scenario 4B, this would achieve LOS D.

Philadelphia Road/Rossville Boulevard (B)

This intersection operates at LOS E under Scenario 4B. Like Rossville Boulevard/Franklin Square Drive, vehicles funnel through this intersection to reach the Beltway.

Recommendation (Scenerio 4B): A second left-turn lane from Philadelphia Road westbound to Rossville Boulevard southbound will offer only an incremental improvement, but it will be sufficient in improving the intersection to LOS D. An improved road network (i.e. Scenario 4A) offers more substantial improvements for all scenarios.

Rossville Boulevard/Yellow Brick Road (C)

This intersection operates at LOS E under Scenario 4A. Volumes are highest on Yellow Brick Road under this scenario because of its increased connectivity with the new CSX railroad crossings in place. 545 vehicles are projected to make the left turn from Yellow Brick Road to Rossville Boulevard southbound. This movement is currently a single lane permissive turn.

Recommendation (Scenerio 4A): Convert the traffic signal at this intersection to split phase operation and add a second left-turn lane on Yellow Brick Road. This will achieve LOS D. This modification would also be valuable under existing conditions.

Pulaski Highway/Rossville Boulevard (D)

This intersection, which currently operates at LOS E, is projected to operate at LOS F under all future scenarios. As noted in the Existing Conditions section of this report, the intersection is large enough already that basic capacity improvements such as lane additions will offer only incremental benefits.

Recommendation (All Scenarios): Grade separate this intersection. It is far removed from the 850 acre redevelopment area and between two existing interchanges on Pulaski Highway (the Beltway and Martin Boulevard), so impacts to the character of the redevelopment area would be minimal. However, a design that is less obtrusive to non-auto travel than a typical freeway interchange should be used. The current connection between Pulaski Highway and White Marsh Boulevard is an example of grade separation that is more desirable for urbanizing areas.

Philadelphia Road/Hospital Drive (E)

This stop-controlled intersection, which currently operates at LOS F, will continue to fail under all future scenarios except Scenario 1A. Scenario 1A calls for the widening of Philadelphia Road, and signalization of this intersection is assumed. Under all other scenarios, installation of a signal or roundabout is recommended. With a signal, addition of a left-turn lane from Philadelphia Road to Hospital Drive is recommended. These changes will greatly improve traffic operations at this intersection.

Recommendation All Scenarios): Install a traffic signal or roundabout at this intersection. This modification would also be valuable under existing conditions.

Pulaski Highway/Martin Boulevard (F)

Under Scenario 1A, the left turn from Pulaski Highway westbound onto Martin Boulevard operates at LOS F. Under all other future scenarios, the extension of Bird River Road/Transverse Avenue to Martin Boulevard reduces the left-turn volume to the extent that LOS D or better operation exists. This intersection may need to be partially signalized in the future with a Maryland T if no road network.

Recommendation All Scenarios): Design and construct a connection between Bird River Road via Transverse Avenue to Martin Boulevard. This modification would also be valuable under existing conditions.

Philadelphia Road/King Avenue & Middle River Road (G)

These two intersections will not operate at LOS E or F under any future scenarios. However, under Scenarios 4A and 4B the through volume on Philadelphia Road is near capacity and long queues will form.

Recommendation (Scenarios 4A & 4B): Widen Philadelphia Road to have two through lanes through these intersections. This would result in a five-lane section (including left turn lanes) of Philadelphia Road between King Avenue and Middle River Road. All other sections of Philadelphia Road would remain as two-lane roads.

Pulaski Highway/Middle River Road (H)

This intersection, which currently operates at LOS F, is projected to operate at LOS F under Scenario 1A and LOS E under Scenarios 2, 4A, and 4B. The extension of Yellow Brick Road and the connection of Bird River Road to Martin Boulevard reduce volumes at this intersection under the redevelopment scenarios. Additional crossings of the CSX railroad (i.e. Scenario 4A) will also improve operation at this intersection by reducing side street and left-turn volumes. Although there are currently three through lanes in each direction on Pulaski Highway at this intersection, one through lane in each direction is an auxiliary lane that is added upstream of the intersection and dropped downstream of the intersection. These lanes are not as well utilized as conventional through lanes. If a continuous six-lane section were created along Pulaski Highway beginning west of Middle River Road and ending east of Mohrs Lane, LOS D could be attained at this intersection under Scenarios 4A and 4B. Further capacity additions would be necessary to achieve LOS D under Scenarios 1A and 2. One possibility would be the addition of a second left-turn lane from Pulaski Highway westbound onto Middle River Road southbound and the widening of Middle River Road to receive these two lanes. A second left-turn lane could require the acquisition of additional right-of-way.

Recommendation (All Scenarios): Pulaski Highway should have three continuous through lanes at this intersection (beginning west of Middle River Road and ending east of Mohrs Lane), and peak period congestion with LOS E should be allowed to avoid further large-scale roadway expansion that would negatively impact the redevelopment district. Three continuous through lanes on Pulaski Highway are needed, though, to avoid LOS F operation.

Middle River Road/Compass Road (I)

This intersection is projected to operate at LOS F under Scenario 1A and 2 and 4B. This intersection is currently controlled by a two-phase signal and has no turn lanes (all approaches are one lane).

Recommendation (Scenarios 1A,2, & 4B): Add a northbound left-turn lane on Middle River Road with a protected-permitted signal and an eastbound right-turn lane. These relatively minor changes will substantially improve operations. This modification would also be valuable under existing conditions.

Pulaski Highway/Mohrs Lane (J)

This intersection is projected to operate at LOS F under Scenarios 1A and 2, and LOS E under Scenarios 3 and 4. All future scenarios assume that an auxiliary through lane is added on Pulaski Highway in each direction. Like the Pulaski Highway/Middle River Road intersection, the operation of this intersection can be improved by creating a continuous six-lane section along Pulaski Highway. This change will achieve LOS D operation under Scenario 4A. Substantial capacity additions would be necessary to achieve LOS D under the other future scenarios, such as the widening of Mohrs Lane to two through lanes in each direction and the addition of a second left turn lane on all approaches. These changes would require the Mohrs Lane bridge over the CSX railroad to be substantially wider than is currently proposed and likely require right-of-way acquisition along Pulaski Highway. Additional crossings of the CSX railroad are more beneficial to this intersection than any other.

Recommendation (All Scenarios): Pulaski Highway should have three continuous through lanes at this intersection, and peak period congestion with LOS E should be allowed to avoid large-scale expansion of Mohrs Lane that would negatively impact the redevelopment district. Three continuous through lanes on Pulaski Highway are needed, though, to avoid LOS F operation.

Campbell Boulevard/Franklin Square Drive (K)

This intersection is heavily impacted by the proposed Nottingham Ridge development and is projected to operate at LOS E under all future scenarios. In all scenarios over 300 vehicles are projected to make the left turn from the mall onto Campbell Boulevard.

Recommendation (All Scenarios): Add a second left-turn lane from the mall to Campbell Boulevard southbound.

Philadelphia Road/Campbell Boulevard (L)

This intersection is heavily impacted by the proposed Nottingham Ridge development and is projected to operate at LOS F under Scenarios 1A and 2 and LOS E under Scenarios 4A and 4B. Future scenarios project 600 to 800 left turns from Philadelphia Road eastbound to Campbell Boulevard, and 900 to 1000 left turns from Campbell Boulevard to Philadelphia Road eastbound.

Recommendation (All Scenarios): Widen Philadelphia Road to three through lanes in each direction through the intersection and expand the double left-turn lane from Campbell Boulevard to Philadelphia Road to a triple left-turn lane. Plans for the Nottingham Ridge development call for three through lanes on Philadelphia Road east of this intersection, so the added lanes at this intersection would tie into the planned six-lane section.

White Marsh Boulevard/Honeygo Boulevard (M)

This intersection is projected to operate at LOS E under all future scenarios.

Recommendation (All Scenarios): In the short term, addition of a third through lane in each direction on White Marsh Boulevard is recommended. In the long term, when the nearby White Marsh Boulevard/I-95 interchange is rebuilt to accommodate express toll lanes, grade separation will be needed.

Philadelphia Road/Ramp to White Marsh Boulevard Westbound (N)

This intersection is heavily impacted by the Nottingham Ridge development. Under all future scenarios, the left turn from Philadelphia Road onto the ramp to White Marsh Boulevard operates at LOS F due largely to the lack of gaps in the opposing traffic stream. It is recommended that this intersection be partially signalized. Philadelphia Road eastbound and the left onto the ramp would be controlled with a signal, and Philadelphia Road westbound, which conflicts with no movements at the intersection, would operate freely. This would be similar to a Maryland T, but without a turn from the side street to the major street because the side street is an on-ramp. This change would greatly improve the performance of the intersection to better than LOS D.

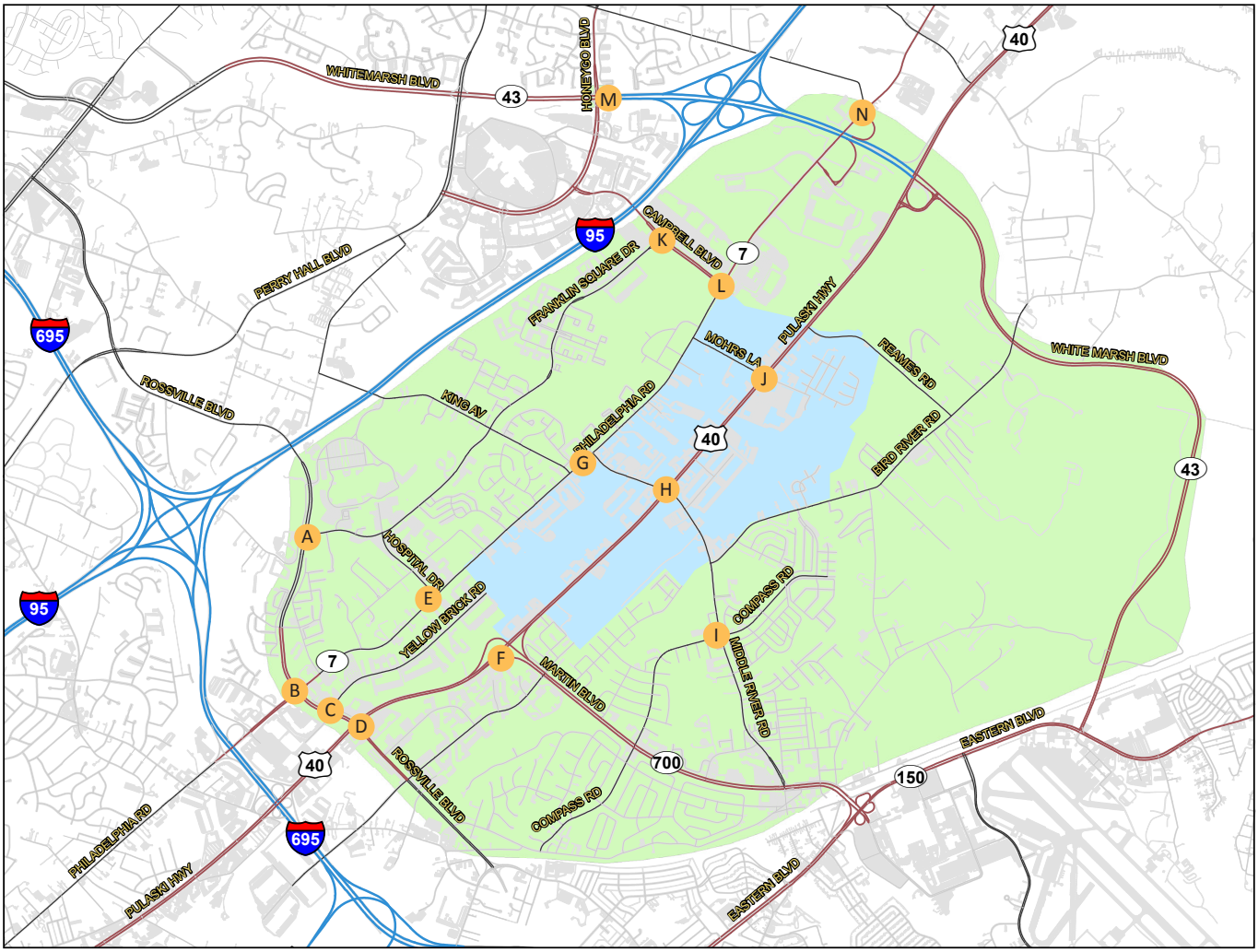
Recommendation (All Scenarios): This intersection should be partially signalized.

CONCLUSIONS

The 2035 traffic operations analysis indicates that, with or without a redevelopment effort and the recommended transportation improvements, the study area will experience significant congestion. This is due to increased regional through traffic and the generation of new local traffic from the Nottingham Ridge development. While the BMC model calls for both Philadelphia Road and Pulaski Highway to be four lanes in 2035, Philadelphia Road remains at two lanes in redevelopment scenarios (2, 3, 4A, 4B) for the purpose of creating a "main street" for the community.

The travel demand model was run with Pulaski Highway as a four-lane roadway (as it is today) for all 2035 scenarios, but subsequent intersection operations analysis indicated the need for three through lanes in each direction on Pulaski Highway at Middle River Road and Mohrs Lane with additional turn lanes. If additional signalized intersections are added to Pulaski Highway in this area as part of the redevelopment effort, three through lanes on Pulaski Highway would likely be needed at these new intersections as well. For this reason, a six-lane Pulaski Highway is recommended in the vicinity of the Middle River Road and Mohrs Lane intersections. This six-lane section could be a continuation of the six-lane section that currently extends from the Baltimore Beltway to Martin Boulevard. A six-lane section is preferred over a four-lane section with auxiliary through lanes at intersections because a series of intersections with auxiliary through lanes would be confusing to drivers and are generally not well utilized.

Figure 21 - Location of Intersections with projected 2035 congestion



FUTURE STREET CONCEPTS

Future street concepts discussed in this section illustrate the mixed-use, multimodal environment that is envisioned for the district. Future concepts are presented for the two major roadways in the study area (Pulaski Highway and Philadelphia Road), and for Mohrs Lane as an example of area collectors and local streets. In addition to traditional traffic function, classification of roads in the district, used to prescribe design elements, should also recognize priority users and activities. Bicycle accommodation, parking needs for both cars and bikes, and transit stop space are examples of these elements. As concepts are further developed in Phase 3, street characteristics will also be refined to include multifaceted functions and needs of the street.

CONTEXT

The redevelopment area today is suburban, and not well served by transit. In the future, a development pattern with both industrial and urban neighborhood elements is envisioned. Two types of transit will be needed to effectively serve the district. Frequent circulator bus service will serve trips within the district that are beyond the range of walking or bicycling, and will also connect the district to nearby activity centers such as the White Marsh Mall, CCBC and Franklin Square Hospital, and the commuter rail station at Martin State Airport. Along Pulaski Highway, longer distance bus service will be needed. The frequency and operating characteristics of this service will largely depend upon the extent of other redevelopment efforts throughout the entire corridor. If a series of dense, urban districts is created along Pulaski Highway, bus-rapid transit with a dedicated lane and headways in the range of five minutes could be implemented. If redevelopment efforts are limited to the 850 acre area, travel demand along Pulaski Highway would be much less and bus service would be less frequent.

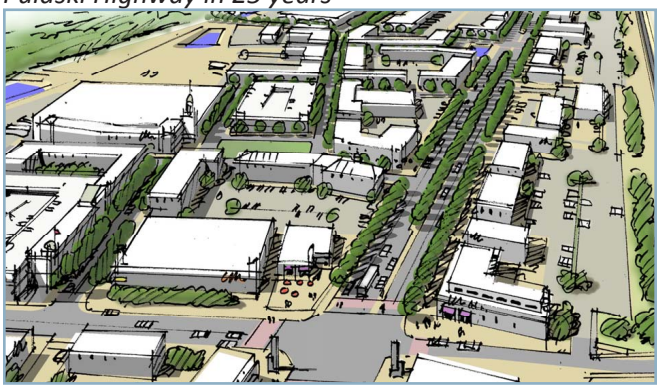
In addition to increased transit service, the density within the district will greatly increase pedestrian and bicycle activity. To better accommodate these modes, a lower-order street network should be created and high quality bicycle lanes and sidewalks should be added to all roadways.

PULASKI HIGHWAY

More so than any other road in the study area, Pulaski Highway will serve a broad range of users in the future and needs to be designed in a manner that accommodates all of them. The road will be used heavily by through vehicles, trucks, buses, bicyclists, and pedestrians. Fortunately, the state currently owns enough right-of-way (ROW) to serve all of these modes sufficiently. Throughout the redevelopment area, approximately 150 feet of ROW is available, which is generally 50 feet wider than the current width of pavement.

Pulaski Highway today

Pulaski Highway in 25 years



Improvements to Pulaski Highway should begin with the median. A landscaped median 28 feet wide would continue to provide the safety benefits of the current concrete divider median while offering many other benefits. Landscaping would begin to improve the aesthetics of Pulaski Highway and create a “green” environment within the district. Treatment of runoff through bio-retention systems can also be provided to a sufficiently sized median. At 28 feet, the median would also accommodate double left-turn lanes, needed at the few major intersections along Pulaski, and a raised pedestrian refuge island. While not part of the cross-section, wide and highly visible crosswalks will also be important.

Beyond the median, 11-foot travel lanes are recommended. In the near term, two lanes in each direction will be sufficient. By 2035, three lanes will be needed to serve regional growth that is projected. One of these three lanes could be a dedicated bus lane if transit service is frequent enough to justify it. On-street parking is not recommended for Pulaski Highway in the short or long term due to the large scale of the roadway, the heavy through volume it serves, and the high percentage of trucks.

The concepts, on pages 47 to 52, show two alternatives to bicycle accommodations: one adjacent to traffic, the second, raised and just beyond the curb. In the first a painted, paved 2' to 3' buffer would be placed immediately adjacent to the outside travel lane. A paved buffer will minimize maintenance issues and keep bicycles visible to motorists but not immediately adjacent to moving traffic. This could occur in an interim beautification project where the curb would remain in its existing location. For the longer term, one way bike paths or cycletracks separated from the roadway could be designed between the landscaped buffer and the sidewalk. This option is particularly desirable where turning conflict points have been eliminated or are traffic controlled. Separated one way paths may also be appropriate in the vicinity of the Martin Boulevard interchange and in the vicinity of Rossville Boulevard, if the Pulaski Highway/Rossville Boulevard intersection becomes grade-separated. On the one-way frontage road discussed below, bicyclists could alternatively use the low volume cartway rather than a separately marked lane or cycletrack.

Pulaski Highway bus stops should offer the highest level of amenity; shelters with benches, lighting both at the shelter and along the approach routes from nearby businesses and residences, and customer information regarding routes, schedules, and real-time arrival time information would be located on the curbside of Pulaski Highway. Stops located on the far side of intersections would be preferable to provide time for bus drivers and bicyclists to become aware of each other and maneuver accordingly.

Beyond the curb, a landscaped area of ten feet or less and a ten-foot sidewalk are recommended. A wide sidewalk will fit with the scale of what will be a large roadway, and create the boulevard effect that recognizes the presence of pedestrians. Building setback from the sidewalk should be minimal, creating an urban feel along the corridor.

Landscaped median

A one-way frontage road may be desirable on the north side of Pulaski Highway to facilitate development. The CSX railroad is separated from the north side of Pulaski Highway by approximately 400 feet. As a result, much of the development in this area will need to front Pulaski Highway and a frontage road could help to reduce the number of driveways onto Pulaski Highway. A frontage road would also create opportunities for on-street parking (on the frontage road). Several options exist for the start and end points of a frontage road. The road could diverge off of Pulaski Highway at a mid-block location, or it could begin on a cross-street. The diverging option would be preferable from a traffic operations perspective and would have fewer conflict points from a safety perspective. Bicyclists would be directed onto the frontage road and share a lane with autos or have a marked bicycle lane on the left side of the frontage road.

Frontage road with parking and shared bicycle use

SHORT-TERM VISION

As shown on page 52, Implementation can begin in the short term with the construction of a 28' landscaped median using the existing paved median area and part of the travel lanes. The travel lanes can then shift making use of the current very wide shoulder. The remaining shoulder could be reconfigured as a bike lane with a

painted buffer. Narrowing the shoulder by moving the travel lanes outward would discourage its use as a de-facto right turn lane, a phenomenon that occurs today and is hazardous to bicyclists.

REPRESENTATIVE PULASKI HIGHWAY CROSS SECTIONS

Two alternative concepts of the long-term vision of Pulaski Highway in the redevelopment district are shown as cross-sections on the following pages. Cross-sections were developed to fit within the 150 foot right-of-way that is present along most of Pulaski Highway. The concepts are intended to illustrate a "complete street" concept within the district. While actual design details will be developed during subsequent planning efforts, the elements shown emphasize the need to incorporate features for priority bicycle, pedestrian and transit use expected as part of the transportation solution in this section of Pulaski Highway.

High visibility crosswalk

Concept A

Concept A presents a six-lane Pulaski Highway with a green median and dedicated bicycle facilities. A 28' green median provides a visual improvement to the corridor, a refuge for pedestrians, and sufficient width for double left turn lanes where needed. Landscaping, wide sidewalks, and a narrow (10') building setback help to create an urban environment within the corridor.

Two options are presented for the bicycle facilities. Concept A1 places traditional bicycle lanes adjacent in the roadway. A two-foot painted buffer separates the bicycle lane from the outside travel lane. Concept A2 uses a one-way cycle track beyond the curb and immediately adjacent to the sidewalk. Cycle tracks are a recent innovation in bicycle transportation that places cyclists close to the roadway but not within it.

Cycletrack beside sidewalk

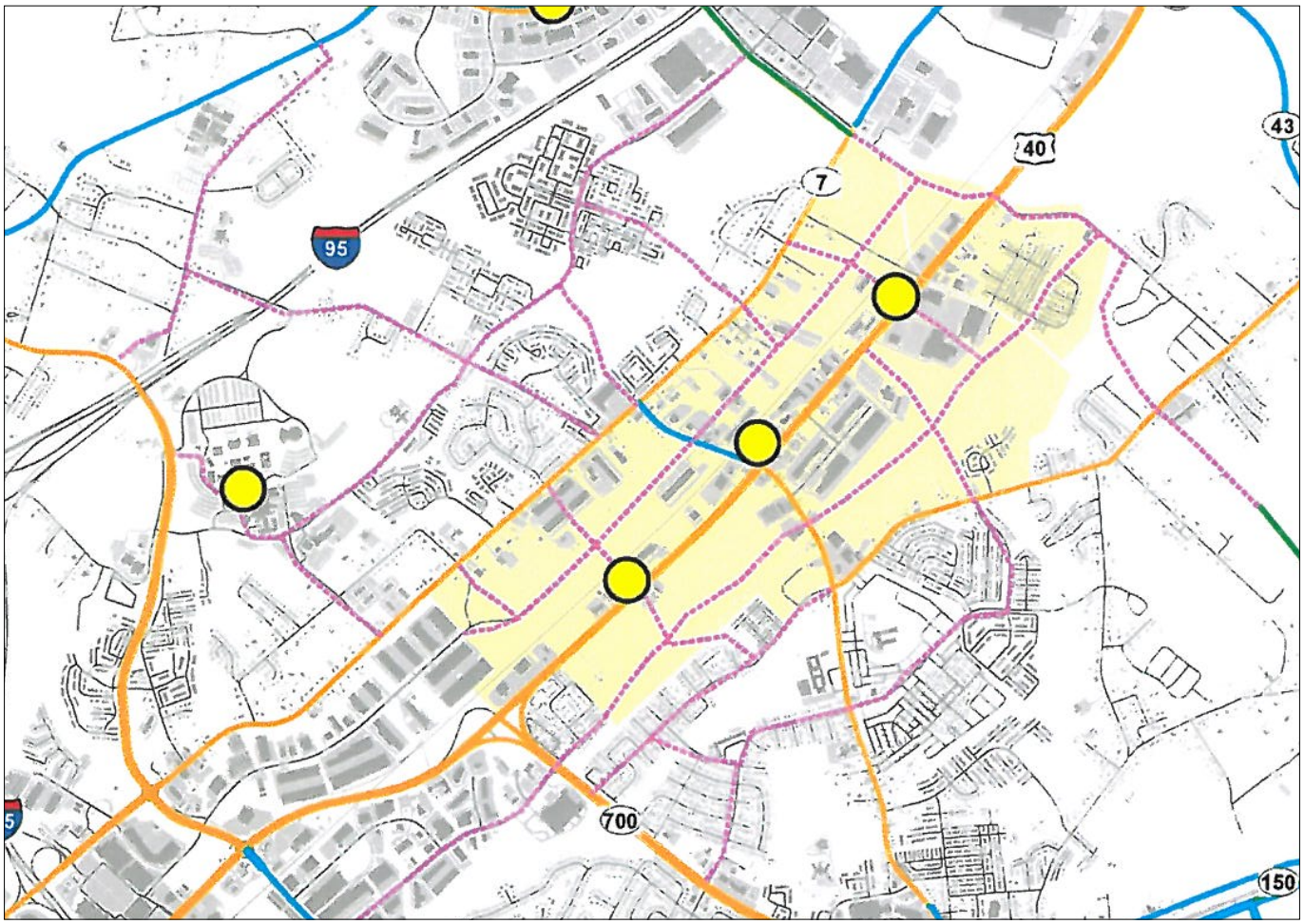
Concept B

This concept presents a frontage road on the north side of Pulaski Highway to serve properties on the narrow strip of land between Pulaski Highway and the CSX railroad. Bicyclists travelling westbound on Pulaski Highway are directed onto the frontage road, and a marked bicycle lane is provided. The frontage road requires more right-of-way than either variation of Concept A, and sidewalks and buffers are reduced in width as a result.

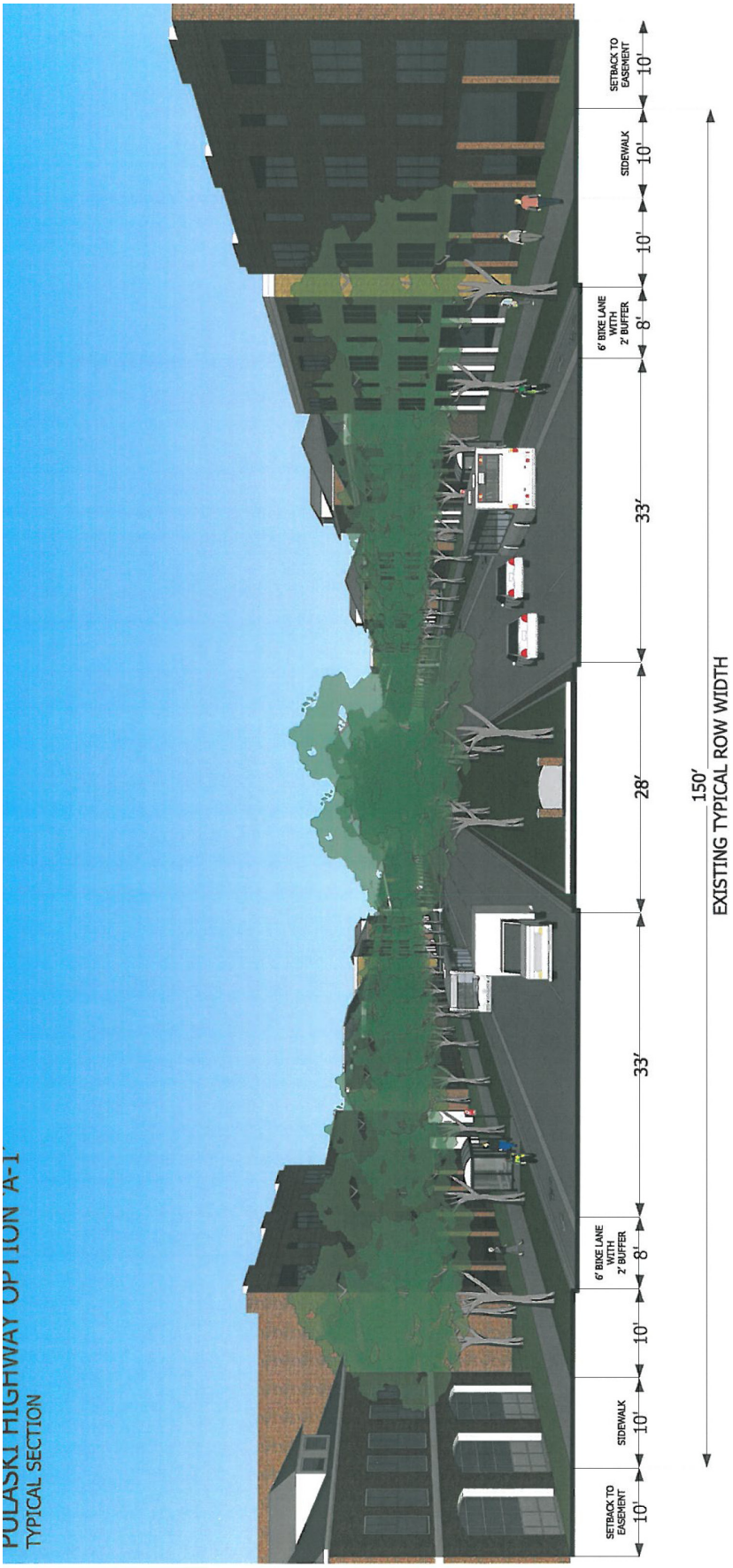
Interim Concept

Some elements of the long-term concepts for Pulaski Highway can be implemented in the near-term. Implementation should begin by improving the median.

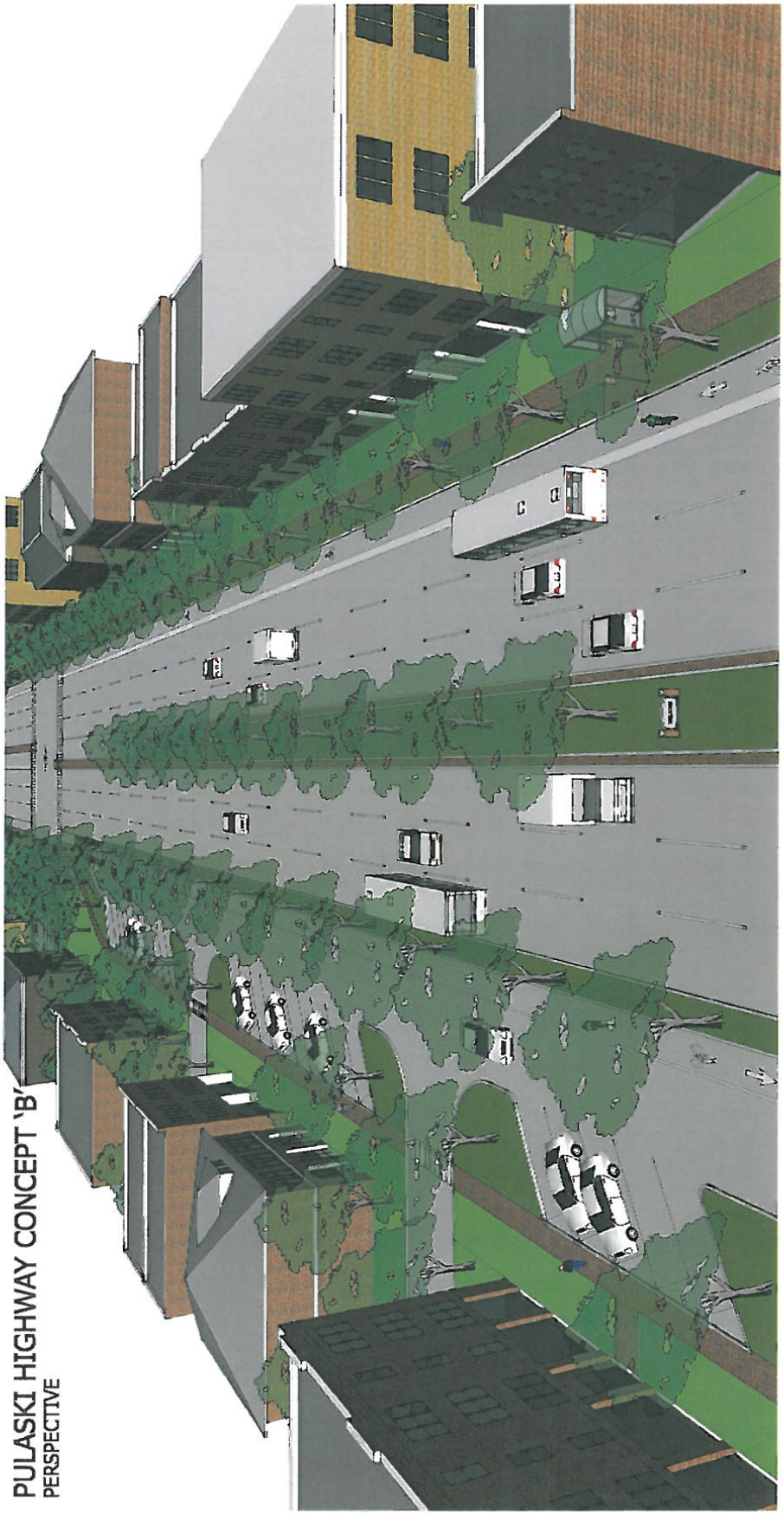
Figure 22 - Potential Local Bicycle Connections

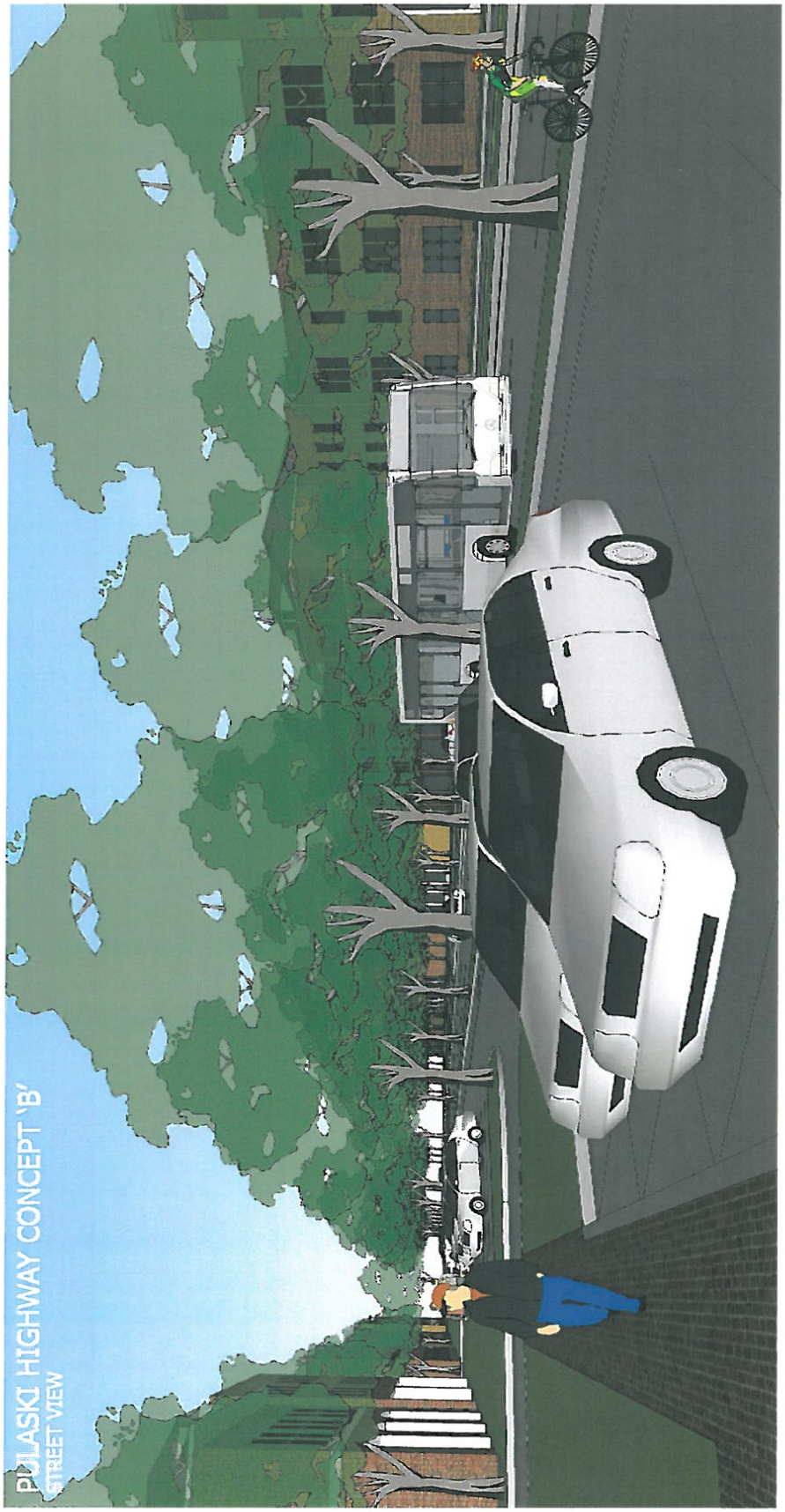


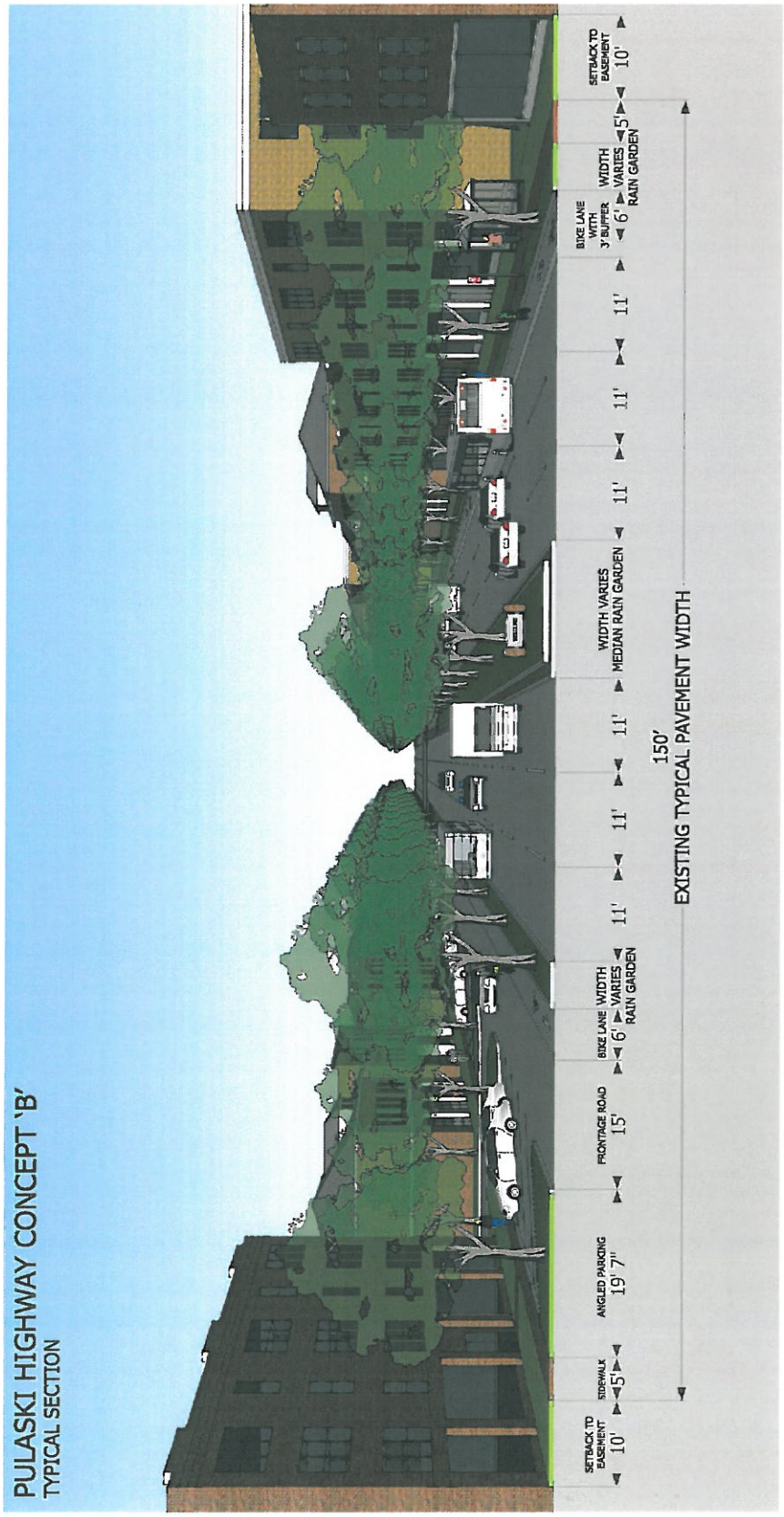
Bike network concept for district. The creation of a well-connected local street network in conjunction with compact, mixed-use development will provide many new opportunities for bicycle routes to destinations.

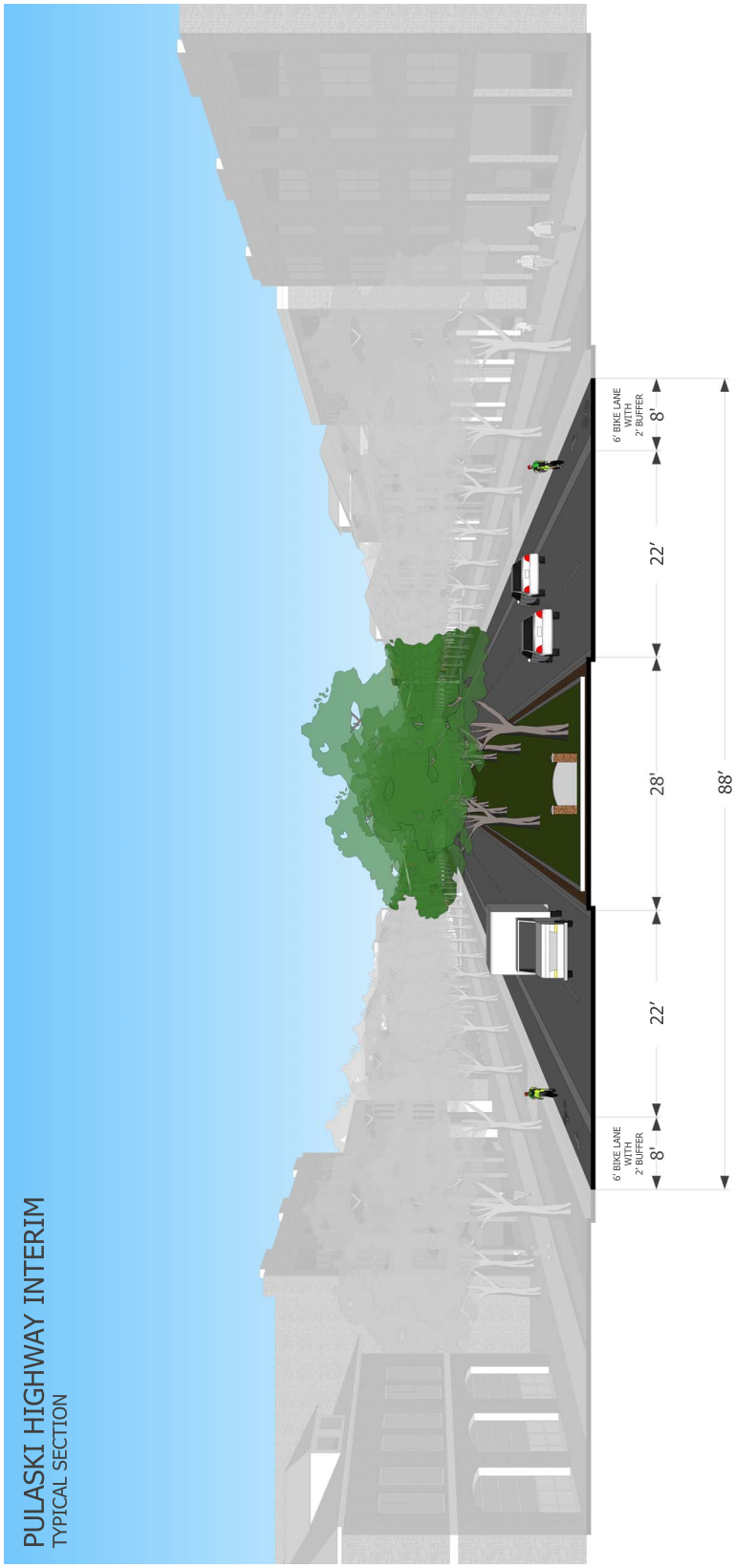

PULASKI HIGHWAY OPTION 'A-1'
TYPICAL SECTION
SETBACK TO EASEMENT
10'
SIDEWALK
10'
10'
6' BIKE LANE WITH 2' BUFFER
8'
33'
28'
33'
6' BIKE LANE WITH 2' BUFFER
8'
10'
SIDEWALK
10'
SETBACK TO EASEMENT
10'
150'
EXISTING TYPICAL ROW WIDTH

PULASKI HIGHWAY OPTION 'A-2'
TYPICAL SECTION
SETBACK TO EASEMENT
10'
SIDEWALK
10'
6' BIKE LANE WITH 1' BUFFER
7'
11'
33'
28'
33'
11'
7'
6' BIKE LANE WITH 1' BUFFER
10'
SIDEWALK
10'
SETBACK TO EASEMENT
150'
EXISTING TYPICAL ROW WIDTH


PULASKI HIGHWAY CONCEPT 'B'
PERSPECTIVE


PULASKI HIGHWAY CONCEPT 'B'
STREET VIEW


PULASKI HIGHWAY CONCEPT 'B'
TYPICAL SECTION
SETBACK TO EASEMENT
10'
SIDEWALK
5'
ANGLED PARKING
19' 7"
FRONTAGE ROAD
15'
BIKE LANE
6'
WIDTH VARIES
RAIN GARDEN
11'
11'
11'
11'
11'
WIDTH VARIES
MEDIAN RAIN GARDEN
11'
11'
BIKE LANE
WITH
3' BUFFER
6'
WIDTH VARIES
RAIN GARDEN
5'
SETBACK TO EASEMENT
10'
150'
EXISTING TYPICAL PAVEMENT WIDTH


PULASKI HIGHWAY INTERIM
TYPICAL SECTION
6' BIKE LANE WITH 2' BUFFER
8'
22'
28'
22'
6' BIKE LANE WITH 2' BUFFER
8'
88'

PHILADELPHIA ROAD

More so than Pulaski Highway, Philadelphia Road has the potential to become the main street of the redeveloped area. The lower through volume and lower percentage of trucks lessen capacity needs. Greater emphasis can be placed upon walkability and bicycling.

THROUGH LANES

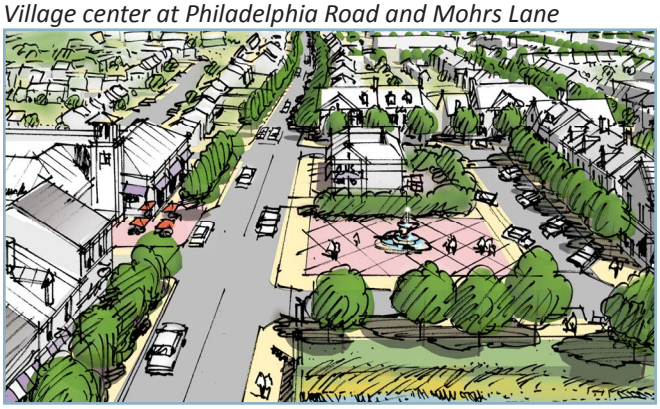
Plans reflected in the BMC's 2035 model call for Philadelphia Road to be widened to two through lanes in each direction throughout the study area. However, travel demand modeling and capacity analysis activities conducted as part of this project have identified the need for only one through lane on most of Philadelphia Road, with two through lanes needed between King Avenue and Middle River Road and two or three through lanes needed east of Mohrs Lane.

For the segments of Philadelphia Road in which only one through lane is needed two alternative sections are possible: a three-lane cross-section with a two-way left-turn lane (TWLTL) or a two-lane cross-section with roundabouts at intersections. A TWLTL will provide space designed for motorists to wait for a gap and make the turn, improving both capacity and safety. Over time, as the land uses change and driveway access gives way to shared access, the TWLTL could be landscaped or removed completely to make way for on-street parking. In sections bracketed by roundabouts, left turns into businesses could be prohibited because of the ease with which u-turns can be made at roundabouts. Philadelphia Road should have speeds and traffic characteristics as well as the connectivity and access that are very compatible with bicycling. Bicycle lanes are recommended along the entire length and bicycle parking should be fully integrated into planted buffer areas between the roadbed and the sidewalk. As the area begins to change, on-street parking will likely be appropriate and desirable to reinforce the "Main Street" concept.

The area between King Avenue and Middle River Road will likely need two through lanes in each direction, as well as a left-turn lane at the intersections of King Avenue and Middle River Road. On this short segment of Philadelphia Road, a landscaped median would be preferred over a two-way left-turn lane to prohibit mid-block left turns, provide pedestrian refuge, and improve the roadway's image During off-peak periods, when only one through lane per direction is needed between King Avenue and Middle River Road, curbside lanes could be used for on-street parking rather than travel lanes.

Figure 23 - Future Philadelphia Road Concept

Village center at Philadelphia Road and Mohrs Lane



INTERSECTION CONTROLS

The transformation of the Philadelphia Road corridor presents an opportunity to remake not only the segments, but also the intersections. At Hospital Drive, King Avenue, Middle River Road, and Mohrs Lane, both traffic signals and roundabouts were evaluated. Roundabouts often require fewer approaching lanes than traffic signals, but that was not found to be the case on Philadelphia Road. Two lane roundabouts would be needed at all four intersections.

Roundabouts on Philadelphia Road could help to define the redevelopment area. At Hospital Drive and Mohrs Lane they would serve as gateways to the district, and at King Avenue and Middle River Road they would form focal points in the core of the district.

The lane configurations presented in figure 23 assume one new crossing of the CSX railroad. The crossing would be located between Middle River Road and Mohrs Lane. This crossing is the most feasible based upon terrain and offers greater congestion relief than a crossing formed by extending King Avenue to Pulaski Highway. The extension of King Avenue to Pulaski Highway, in addition to being potentially infeasible, substantially increases traffic volume and lane needs at the Philadelphia Road/King Avenue intersection. For example, with a roundabout, a portion of the roundabout would require three lanes. The King Avenue extension, while beneficial to network connectivity, has the potential to change the character of the Philadelphia Road/King Avenue and Middle River Road area to be more auto-dominated.

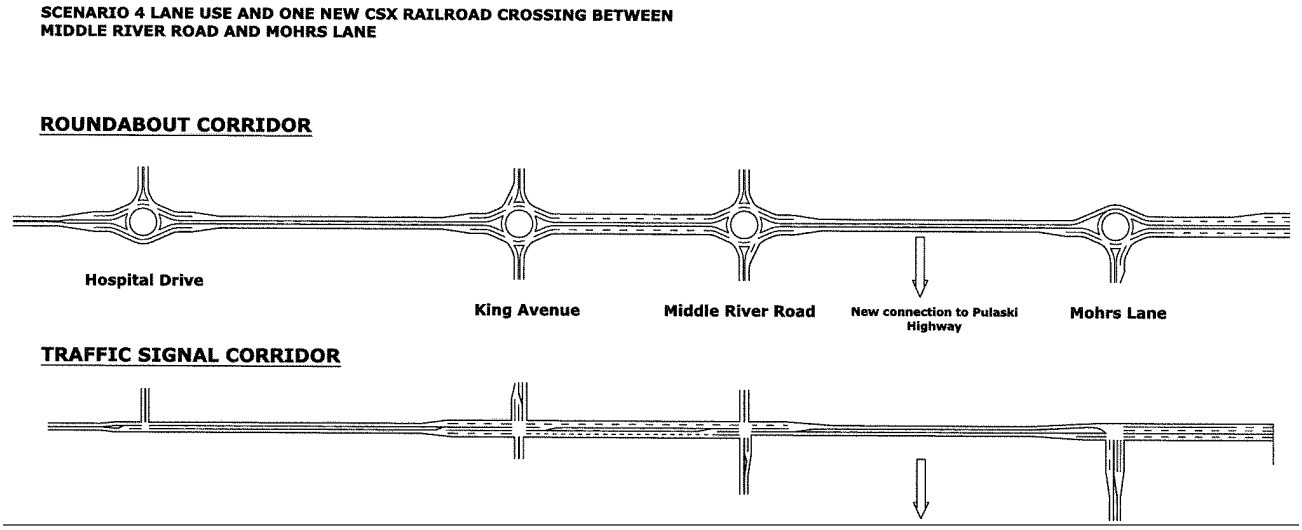
COLLECTOR STREETS

Collector streets will play a vital role in the redevelopment area. Short trips within the district by all modes of transportation will be able to use these roadways rather than be forced onto arterials adding to traffic levels and intersection congestion. Their character can also vary with lower speeds to be more comfortable locations for street-level retail and truck routing to businesses. Direct access to individual parcels should not be promoted on collector streets. Access should instead be spaced and shared through local side streets that lead to off-street parking or loading areas. The character of collectors to carry foot and bicycle traffic comfortably should be a high priority in the district.

Mohrs Lane

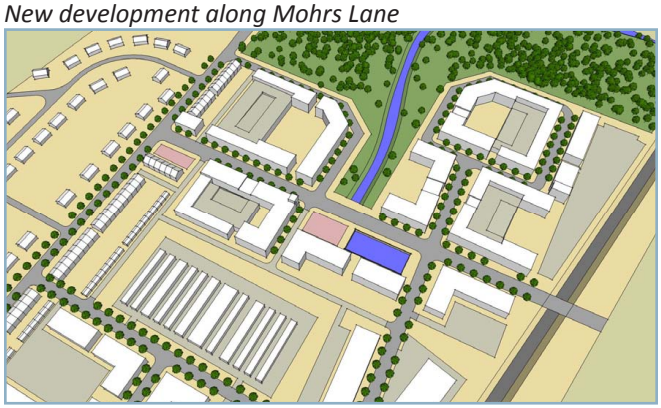
Mohrs Lane will be a key urban collector within the district. Although only one through travel lane will be needed in each direction, ROW should provide for a three-lane section with full-time on-street parking, marked 5' bicycle lanes and intersection left-turn bays. At intersections, curb extensions should be used to narrow the roadway, shorten pedestrian crossings, and

Figure 24 - Future Philadelphia Road Concept



create a more urban environment. Streetscaping should include trees and street furniture in the buffer zone and an 8' sidewalk associated with redevelopment. These same design elements should also be used on the segment of Campbell Boulevard south of Pulaski Highway when it is constructed.

New development along Mohrs Lane



On the bridge over the CSX railroad, a three-lane section is appropriate. While adding on-street parking would have a high cost and contribute little to the district's urban environment, the inclusion of bicycle lanes and sidewalk on both sides of the bridge are critically important design elements.

Yellow Brick Road

Yellow Brick Road is an example of an existing collector street whose transformation will be key to creating the envisioned character of the district. Yellow Brick Road today is 48 feet wide, but has only one travel lane in each direction and no on-street parking. It is also a dead-end roadway, forcing all trips onto Rossville Boulevard and into the congested intersections at Pulaski Highway or Philadelphia Road.

In the future Yellow Brick Road should be extended, first to Middle River Road and eventually to Mohrs Lane. This extension would allow for trips to and from Yellow Brick Road to be made without use of Rossville Boulevard, The ability to make short trips without use of an arterial would encourage bicycle and pedestrian use. These modes could be further supported with changes to the roadway. The wide right-of-way could be modified to include sidewalks, bicycle lanes, and on-street parking. If vehicles speeds and volumes are low enough, bicycles could travel in a mixed-flow lane with vehicles.

Yellow Brick Road is one of the few collectors existing in the study area today. Many additional ones will be needed to complete the grid network. A key to the success of the collector network is the relatively small size of the streets. Sidewalks should be placed directly adjacent to the curb, bicycle lanes should not be added on lower volume streets, and treatments such as curb extensions should be present at intersections to minimize their width.

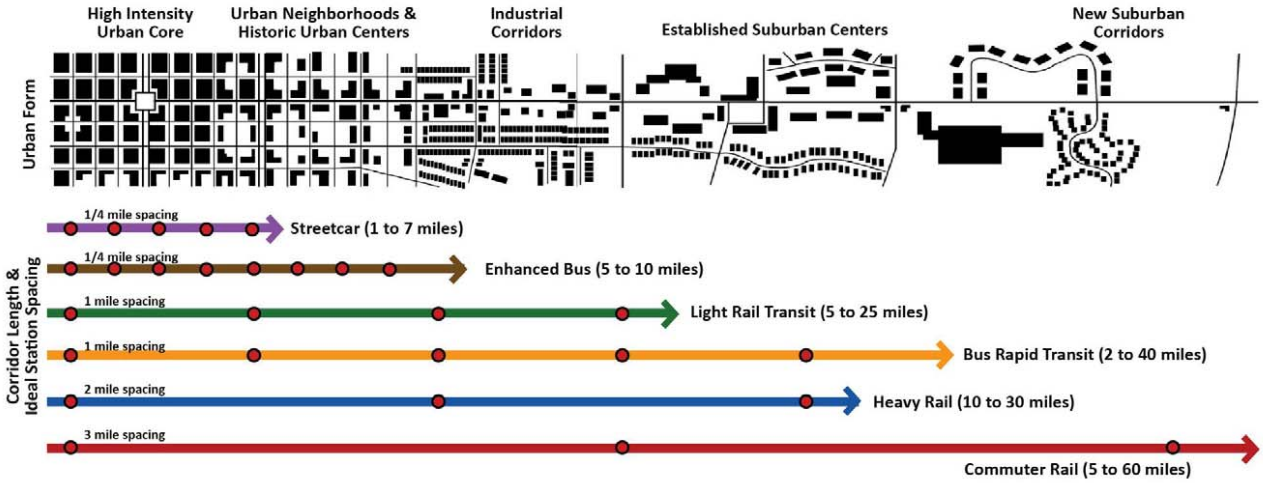
INTEGRATING TRANSIT

Transit options have become increasingly diverse in response to goals of the service and the built environment that is being served. Figure 25 shows the various types of transit service, with land use, operating, and stop placement characteristics. The redevelopment district is envisioned as an urban district within the larger White Marsh/Middle River sector. Pulaski Highway running through the District connects the district to major employment centers at Aberdeen Proving Ground and Downtown Baltimore. As a result, two types of transit are envisioned to serve the district in the future.

Within the district, a high-quality circulator bus service is envisioned to serve short trips beyond the range of walking, and to connect the district to activity centers within a 1-2 mile range, such as the Martin State Airport MARC Station, White Marsh Mall, and Franklin Square Hospital. Circulator service would operate on collector and local streets where possible to maximize proximity to residents and other users. Stops would be placed approximately ¼ mile apart.

Along Pulaski Highway, bus service should connect the district to other destinations in the Baltimore Region, including APG and Downtown Baltimore. Specific aspects of this service are highly dependent upon other redevelopment efforts in the Pulaski Highway corridor. A series of districts like this one might support replacement of a general purpose lane with a bus-only lane for bus rapid transit and bus arrivals with all day service at 10 to 15 minute intervals. By itself, this district could support an enhanced bus on Pulaski Highway. Arrivals would be less frequent, and buses would travel in mixed flow traffic. "Enhanced" aspects of the service would include limited but well-developed stops with rider amenities and transit signal priority to improve travel time and reliability. A major connection to local circulator service would be located along Pulaski Highway at one of the district's major intersections

Figure 25 - Conceptual Land Use and Transit Service Relationship



CONCLUSION

The transformative redevelopment concepts proposed for the Pulaski Highway corridor are more desirable than current trends from a transportation perspective. These concepts introduce a mix of uses whose concentration and proximity results in more internal trips, thus reducing congestion on major arterial roads. The proposed new development will facilitate construction of identified network links necessary to take full advantage of a location which is highly accessible but limited by poor internal connectivity and an aging and inadequate infrastructure.

The BMC's regional travel demand model currently predicts congestion on Pulaski Highway in 2035 that is largely due to development outside of the study area. Building the proposed secondary network of streets as part of the area's redevelopment will help to relieve growing congestion in the area with alternate routes for traffic and by improving conditions for other travel modes. The concepts tested place, density, and a mix of uses in close proximity to one another rather than in a typical suburban pattern. This more town-like urban pattern will result in fewer and shorter auto trips producing less traffic than a typical suburban development of the same magnitude. This is due to walkability, the prospect of more efficient transit service, and less circuitous routes to destinations for all modes.

Historically, the 850 acre redevelopment area has been automobile-oriented in both land use pattern and transportation infrastructure, with small homesteads and roadside businesses built along and oriented to the Pulaski Highway and Philadelphia Road corridors. Recent decades introduced larger-scale suburban development to the area. More recently the area has become increasingly attractive to developers. The increased development unfortunately has not been accompanied by comprehensive and network-supporting changes to the area's transportation system.

The Pulaski Highway Redevelopment Project proposes changes to the land use vision and the transportation network to allow denser development, yielding opportunities for transit, pedestrian, and bicycle travel, while maintaining mobility on its major roads. The study's main findings recommend:

- The creation of a grid-like network of street connections to allow local auto trips to be made without using arterials, thereby reducing congestion on Pulaski Highway. Lower speed and lower volume collector streets in this system will be better suited to handle bicycle and pedestrian trips, and auto usage will decrease accordingly.
- The design or retrofit of roadways as "multi-modal" streets by including elements of a more balanced environment for all users: pedestrians, cyclists, transit patrons, and drivers.
- Coordinated planning to create a multimodal environment that will attract the investors and developers who can produce large scale change while benefiting small businesses, existing residents, and potential new homebuyers.
- Consideration of a change in the level of service standard within the redevelopment area to tolerate small increases in episodic and peak hour congestion to encourage redevelopment and to avoid road widenings that reduce levels of service for pedestrians and bicyclists.

Near-term improvements to Pulaski Highway and Mohrs Lane will help to jump-start the changes proposed; the details of their design plans will set the stage for the character and quality of private investment. Other actions identified during the study will demonstrate the County's commitment to the area and to the concerns of neighbors and property owners who have participated in Phases 1 and 2. Those actions identified during the course of this study include intersection safety and operations upgrades, new connections of existing network, and enhancements to existing pedestrian and transit infrastructure. The highest priorities for immediate action include:

- Modifying safety through traffic signal phasing changes at:
    - Rossville Boulevard/Yellow Brick Road
    - Martin Boulevard/Middle River Road
    - Constructing a roundabout or traffic signal at Philadelphia Road and Hospital Drive
- Constructing sidewalks
    - Along a section of Middle River Road near Pulaski Highway where gaps currently exist,
    - to bus stops along Philadelphia Road
- Providing benches and passenger information at bus stops, adding shelters at where possible along Philadelphia Road
- Constructing an 800' connection between Transverse Avenue and Middle River Road that will effectively extend Bird River Road to Martin Boulevard
- Design the proposed connection from Yellow Brick Road to Mohr's Lane to properly locate the intersection, reserve ROW, and build the connection as a part of the Mohr's Lane reconstruction.

During the next stages of district planning, the transportation network will be fine tuned in support of plans for the actual character and function of different roadways in the district. That process will address the physical attributes of the roadways and the specific improvements at both major and lower order intersections along Pulaski Highway or Philadelphia Road. In addition to network and design plans, the Phase 3 effort should include review and modification as appropriate of transportation related policies, regulations and administrative procedures including street design guidelines, traffic impact analysis requirements, and access management strategies. Combined, this effort will offer a complete blueprint for specific county, state and private actions to ensure development opportunities create desired outcomes.

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