APPENDIX 4: Technical Memoranda

The following memoranda are included:

Technical Memorandum #1: Summary of Prior Transportation Studies

Technical Memorandum #2: Developing a Vision, Goals and Performance Measures

Technical Memorandum #3: Travel Demand Forecast Review

Technical Memorandum #4: Revenue Forecast

Technical Memorandum #5: Analysis of Traffic Crashes

Technical Memorandum #6: Transportation Systems, Management and Operations Strategies

Technical Memorandum #7: Transit Considerations

Technical Memorandum #8: Review of Key Corridors

Technical Memorandum #9: Analysis of Shared-Use Paths

Technical Memorandum #10: Summary of Technical Scoring Process

ANNE ARUNDEL COUNTY
TRANSPORTATION MASTER PLAN

TECHNICAL MEMORANDUM #1
Summary of Prior Transportation Studies

ANNE ARUNDEL COUNTY
MARYLAND

Prepared for the Anne Arundel County Office of Transportation
May 2018 – Final

SABRA & ASSOCIATES
Engineering Innovative Solutions

Table of Contents

Note: The purpose of each Technical Memorandum prepared for the Office of Transportation is to present facts, analysis, ideas, issues and recommendations that will inform the Anne Arundel County Transportation Master Plan. The views expressed and recommendations offered in each memorandum are solely based on the consultant's judgment and should not be considered as endorsed by the Office of Transportation or any other County agency or officer.

Introduction

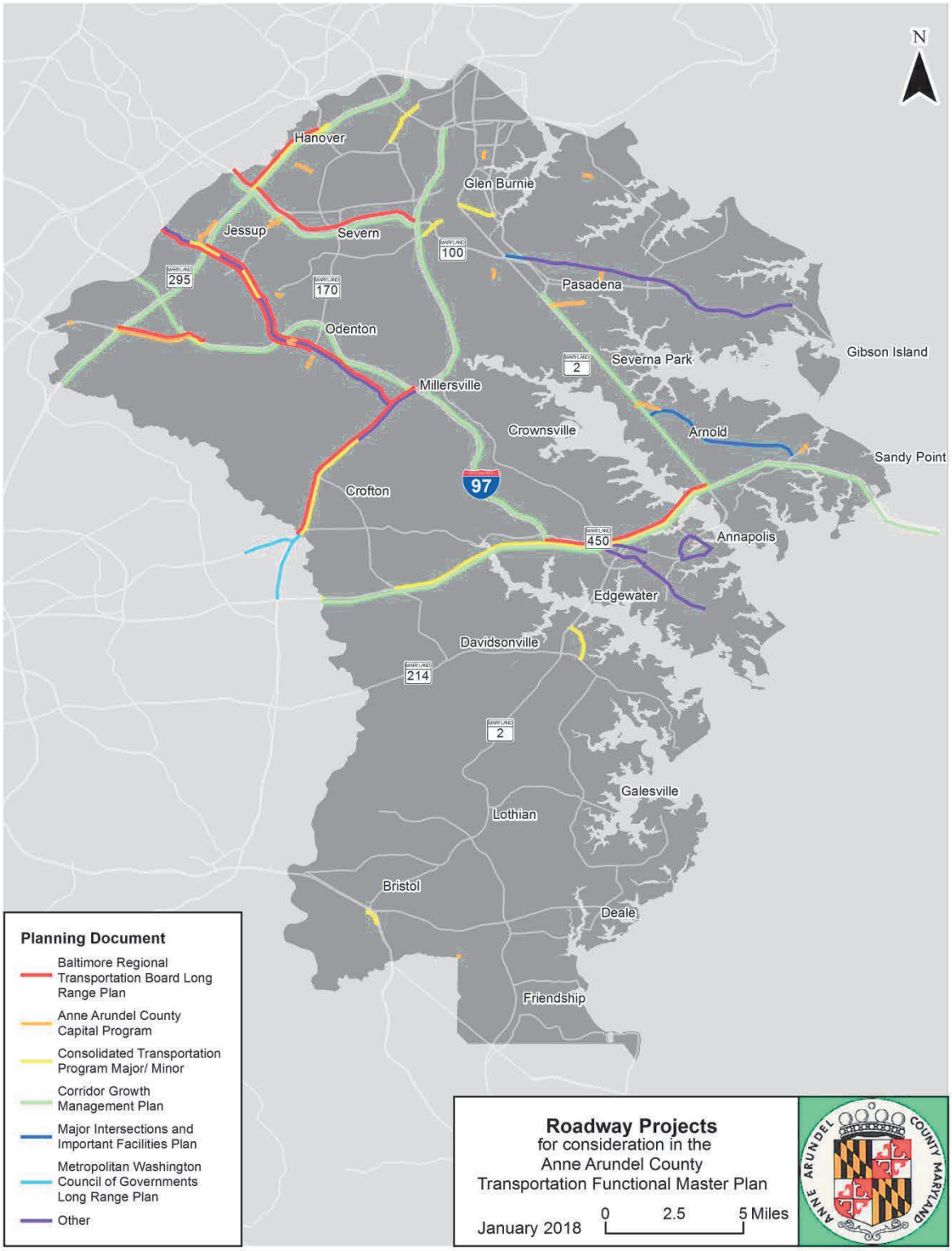
The Anne Arundel County Office of Transportation is responsible for coordinating the County's short- and long-term transportation policy and planning activities, including establishment of a Transportation Functional Master Plan (TFMP). The purpose of the TFMP is to guide the County's future investments in and advocacy for the County's multimodal transportation network. The TFMP will yield a long range transportation plan that is fiscally constrained; and, the plan will also include funding and policy options to ensure that the County has adequate resources for plan implementation. Finally, the TFMP will inform *Plan* 2040, the County's General Development Plan.

Purpose and Summary of this Technical Memorandum

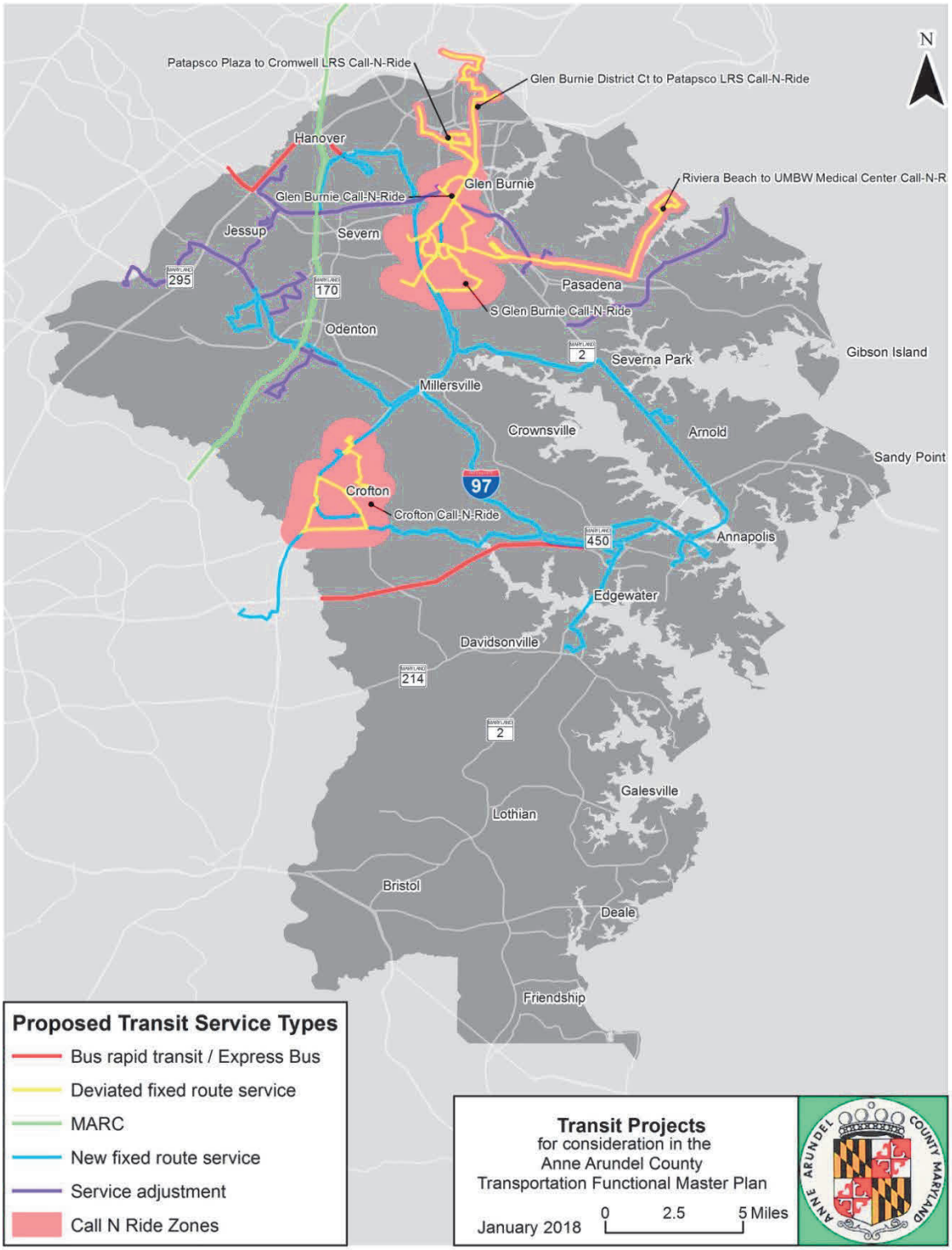
The purpose of this Technical Memorandum is to provide a comprehensive listing of transportation plans and projects identified by local, state and federal agencies for potential implementation in Anne Arundel County. This inventory makes no judgment as to the efficacy of any particular project; it is assumed that if a project is included in a plan then it has some level of endorsement by the sponsoring agency.

An online geodatabase has been created for ease of reference and analysis in preparing the TFMP. The geodatabase lists of each specific project and includes a brief description, project source and sponsoring agency, modal type, status, and cost estimate. Appendices 1 – 3 provide a full tabular listing of all bicycle/pedestrian, roadway and transit projects entered into the geodatabase.

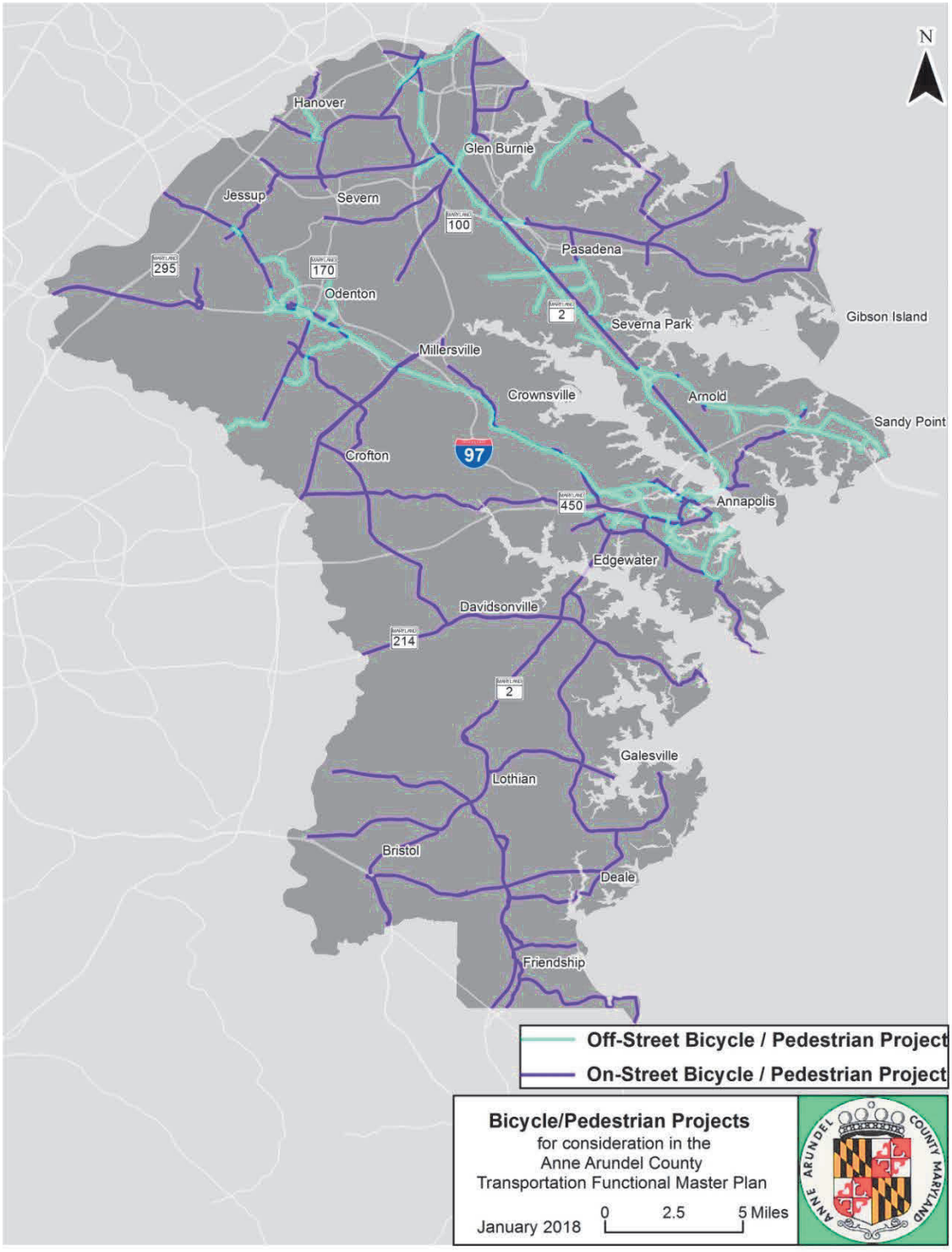
Map 1: Potential Roadway Project for Consideration in TFMP



Map 2: Potential Transit Projects for Consideration in TFMP



Map 3: Bike/Ped Projects for Consideration in TFMP



County Planning, Policy and Funding Documents (including City of Annapolis)

Anne Arundel County General Development Plan

Department of Planning and Zoning, 2009

The 2009 General Development Plan a comprehensive land use plan prepared in compliance with State planning requirements and guidelines. It is a policy document that is formally adopted by the County Council and establishes policies and recommendations to guide land use decisions over a 10 to 20 year planning horizon. Additional information on the 2009 General Development Plan will be included in Technical Memorandum #2 (Goals, Vision, Objectives and Measures) and Technical Memo #3 (Analysis of Previous Studies).

Anne Arundel County Annual Transportation Priority Letter

Office of the County Executive, 2017

Every year, each of Maryland's 24 local governments provides a letter to the Maryland Department of Transportation (MDOT) listing the jurisdiction's priorities for the county. The 2017 letter provides a list of ten (10) projects Anne Arundel County would like MDOT to include in the FY 2018 Consolidated Transportation Program (CTP) which schedules improvements on state-managed properties. This year's priorities included a focus on bicycle related improvements on state roadways, MD 175 (Annapolis Road) and MD 3 (Robert Crain Highway) improvements for improved access to Fort Meade, safety, intersection and access management improvements along Mountain Road, Davidsonville Road (MD 424) sidewalks, as well as parking, bicycle improvements at the Odenton MARC Station, Annapolis/Parole Intermodal Center, B&A Trail Connector and Washington, Baltimore & Annapolis (WB&A) Trail bridge over the Patuxent River. The County priority also included fifteen priority sidewalk projects along state roads, additional bicycle trails to be funded under the Transportation Alternatives project, and restoration of funding for noise walls along eligible state roads.

Anne Arundel County Capital Budget and Capital Improvement Program

Office of Finance, 2017

The Proposed Capital Budget and Program gives a comprehensive summary of the current financial standing for the County and anticipated costs for the next five years. The document includes overviews of the anticipated fiscal year (FY 2018) debt, use of bonds and "pay as you go" in the proposed budget, grants and aid, impact fees in different districts, and projected spending in different project categories. The capital budget also provides comparisons between the Planning Advisory Board spending recommendations and the county executive spending recommendations. The capital budget includes all manner of investments from system preservation to safety improvements and capacity expansion on County-owned roadways and bridges.

Anne Arundel County Complete Streets Policy

Anne Arundel County Office of Planning and Zoning Transportation Division, 2014

The County's Complete Streets Policy aims to improve transportation options and safety throughout Anne Arundel County. The Policy ensures that alterations to transportation systems are implemented in a way that provides all users regardless of age or ability with a comprehensive and connective multi-modal network. Guiding principles of the policy fall under the categories of Program Administration, Regulations, and Design. Guiding principles of the CSSP are to:

- Evaluate resurfacing and reconstruction projects as well as access permit requests to public right of way for Complete Streets inclusion.

- Approach every transportation improvement and project phase as an opportunity to create safer, more accommodating, and more accessible streets for all users.
- Maintain skill and knowledge levels consistent with the state of the practice with the recommended practices of the American Association of State Highway and Transportation Officials (AASHTO), the National Association of City Transportation Officials (NACTO), and the Manual of Uniform Traffic Control Devices (MUTCD).
- Report the success of implementation of the Complete Streets Policy, and its Guiding Principles, through measurable goals including, but not limited to, crash reduction, level of service and comfort, transit ridership, and changes in mode share.
- Accommodate forecasted travel demand and improvements through periodic updates of the County Design Standards.
- Adhere to design standards, federal requirements, and construction specifications, using the best and latest standards available.

Anne Arundel County Corridor Growth Management Plan

Anne Arundel County Office of Planning and Zoning Transportation Division, 2012

The purpose of the Corridor Growth Management Plan (CGMP) is to develop concept-level transportation solutions in response to increased population and employment growth. The Plan includes impacts and costs for different alternatives for nine regional and four connector corridors identified in the County. Ultimately, the transportation improvements aim to decrease congestion, enhance travel choices, and improve safety for all modes. This document is a stand-alone report that is intended as a base for future project planning and preliminary engineering, by securing funding commitments with appropriate state, federal and private sector partners.

Key Regional Corridors			
Project	**From**	**To**	**Length (miles)**
US Route 50	Prince George's County Line	Chesapeake Bay Bridge	19
MD 2 (Governor Ritchie Highway)	US Route 50	I-695	17
MD 2 (Solomons Island Rd)	MD 450 (West Street)	MD 214 (Central Ave.)	4
I-97	US Route 50	I-695	17
MD 32 (Patuxent Freeway)	I-97	Howard County Line	11
MD 100 (Paul T. Pitcher Memorial Highway)	MD 648 (Baltimore Annapolis Boulevard)	Howard County Line	5
MD 295 (Baltimore-Washington Parkway	Prince George's County Line	I-695	14
MD 3 (Crain Highway):	Prince George's County Line	MD 32	7
MD 173 (Fort Smallwood Road), MD 607 (Hog Neck Road) and Magothy Bridge Road	Baltimore City Line	MD 173 end	14
Secondary Corridors			
Benfield Blvd	I-97	MD 2 (Ritchie Highway)	5
MD 176 (Dorsey Road)	MD 170 (Telegraph Rd)	MD 2 (Ritchie Highway)	6
MD 170 (Telegraph Road)	MD 2 (Governor Ritchie Highway)	MD 175 (Annapolis Road)	13
MD 713 (Rockenbach Rd/Ridge Rd)	MD 176 (Dorsey Rd)	MD 175 (Annapolis Road)	3

Anne Arundel County Pedestrian and Bicycle Master Plan

Anne Arundel County Office of Planning and Zoning Transportation Division, 2013

The Anne Arundel County Pedestrian and Bicycle Master Plan (2013) was developed to identity improvement opportunities which increase the potential for safe walking and biking trips and decrease dependence on motor vehicles. While the 2003 Pedestrian and Bicycle Master Plan focused on isolated recommendations in specific geographic improvement areas, the 2013 Update focuses on ensuring transportation alternatives for urban residents. Pedestrian and bicycle improvement recommendations in the 2013 update include infrastructure and non-infrastructure projects, policy recommendations, and implementation recommendations. Select infrastructure projects are identified as "credible for consideration of construction." Projects were prioritized based on their location within needs bicycle/pedestrian generator areas and bicycle/pedestrian attractor areas. Scenic and Historic Roads, as designated by the Office of Planning and Zoning, limits the ability to modify the roadway for pedestrian and bicycle infrastructure.

Central Maryland Transit Development Plan (Anne Arundel County Element)

Regional Transportation Agency (RTA), 2017

The Transit Development Plan (TDP) serves as a guide for implementing service and organizational improvements for transit services in the Central Maryland Region, including potential service expansion, during the next five years. The plan addresses the area's transit goals and objectives, status of transit services, and steps for implemented the state objectives. According to the Plan, the main obstacles for the Regional Transportation Agency's (RTA) goals are a fixed route system with an unreliable fleet, circuitous routes, infrequent service, and high costs. The Plan aims to target these issues by expanding routes, reducing travel times, creating more direct routes, introducing new vehicles, assessing key origins and destinations, and creating more frequent service times.

City of Annapolis Comprehensive Plan

City of Annapolis Planning Department, 2009

The transportation component of the Annapolis Comprehensive Plan seeks to enhance mobility and accessibility within the city by addressing the increased net inflow of workers and visitors each day. The Plan emphasizes that motor vehicle use in the city cannot be allowed to grow as a percent of total trip making. Access to and from the regional highway system is confined to only a few routes, and the movement of people and goods through the city and to and from the growing residential and shopping areas is increasing. The plan also emphasizes the need for improvements to cross-town movements.

City of Annapolis Transit Development Plan

Annapolis Department of Transportation

The City of Annapolis is currently updating its Transit Development Plan and is anticipated for release in draft form by February 2018. This memorandum will be updated when the plan is available.

Major Intersections and Important Facilities Study

Office of Planning and Zoning, 2014

The Major Intersections and Important Facilities (MIIF) Study evaluates the mobility and accessibility needs of residents, commuters, and businesses along specific facilities of the regional travel network in Anne Arundel County. The facilities selected for this study are supplemental to the Corridor Growth Management Plan and serve an important public safety function as they are the main roadways accessing the many peninsulas of the county.

Corridor	From	To	Length (miles)
College Parkway	MD 2 (Governor Ritchie Hwy)	MD 179 (St. Margaret's Rd)	4.8
Forest Drive	Chinquapin Round Road	Bay Ridge Avenue	2.3
MD 177 (Mountain Road)	MD 2 (Governor Ritchie Highway)	Lake Shore Drive	7.8
MD 214 (Central Avenue)	MD 424 (Davidsonville Road)	Shoreham Beach Road	7.5
MD 256 (Deale Road) and MD 468 (Shady Side Road)	MD 2 (Solomons Island Road)	Snug Harbor Road	8.1
MD 665 (Aris T. Allen Blvd.)	US 50	Chinquapin Round Road	2.7

Anne Arundel County Project Planning Studies

Anne Arundel County Department of Public Works, Various Dates

The Anne Arundel County Department of Public Works is currently managing project planning studies for the areas listed below. The scope of these studies is generally related to minor capacity improvements, safety improvements and establishing facilities for bicycles and pedestrians.

Corridor	Project Description	Project Status
Andover Road from West Nursery Road to Camp Meade Road (MD 170)	The scope of this project is for a planning-level study only with concept-level plans. If advanced, the project would upgrade the conditions along Andover Road from West Nursery Road to MD 170 to improve travel conditions for motorists, pedestrians, bicyclists, and transit service. The study also includes West Nursery Road south of Andover Road and Elkridge Landing Road from West Nursery Road to Terminal Road. The proposed design includes various methods for speed mitigation and sight distance improvements. Upgraded facilities for non-motorized users are recommended at various points along the corridor.	Planning study underway
Jumpers Hole Road from Benfield Road to Kinder Road	This project entails the development of a planning study that will focus on Jumpers Hole Road between Benfield Road and Kinder Road. This segment of the road network has experienced an increase in traffic volumes and serves as access to a local school and park. The potential issues that have developed include, but are not limited to, sight distance, speed, and a lack of pedestrian and bicycle facilities.	Planning study nearing completion
Jumpers Hole Road from Ritchie Highway (MD 2) to Mountain Road (MD 177)	The scope of this project is for a planning-level study only with concept-level plans. The proposed design includes upgrades through the residential portion of the roadway, including with curb and gutter where appropriate and feasible. Upgraded bicycle facilities are recommended in the form of on-road bicycle lanes and/or off-road shared-use paths. Additional pedestrian facilities are proposed, including new sidewalks and designated crossings.	Planning study nearing completion
Ridge Road from Hanover Road (MD 176) Corporate Center Drive	The purpose of the Ridge Road transportation facility planning study is to identify future year 2040 deficiencies, evaluate build alternatives to address deficiencies, improve travel in the corridor by reducing current and forecasted congestion, reduce crash potential, improve pedestrian and bicycle compatibility, while minimizing impacts to the natural and built environment.	Planning study complete

Corridor	Project Description	Project Status
Odenton Grid Streets	This project is to design, acquire rights-of-way, and construct roadways, pedestrian and bicycle facilities, and streetscape improvements to grid streets within the Odenton Town Center area (Hale St., Nevada Ave., Duckens St., Dare St.). A change order has been requested to include Baldwin Rd. (Berger St. to Duckens St.) and Duckens St. (Nevada Ave. to Baldwin Rd.) as 3 well as scenarios if Nevada Ave. were to be closed between MD 175 and Hale St. for the park concept.	Design is underway for this project.
Waugh Chapel Road	The Waugh Chapel Road Transportation Facility Planning study was initiated to identify gaps in the sidewalk and bicycle facilities that connect Waugh Chapel Shopping Center to the existing and planned neighborhoods to the west. The limits of the Waugh Chapel Road study corridor are from Maytime Drive to New Market Lane. The prepared a multimodal, context-sensitive approach to identify and recommend improvements to the existing corridor that strike a balance between future vehicular traffic volumes and pedestrian/bicyclists and to enhance safety and connectivity for all modes of transportation.	Planning study is underway
Edwin Raynor Blvd.	This Project will improve operating conditions for motorists, pedestrians, and bicyclists on Edwin Raynor Boulevard by providing extra capacity, a new traffic signal at Deering Road, widened shoulders for bicyclists, and sidewalks from Deering Road to Countryside Drive. Congestion and safety concerns at MD 177 and the commercial entrances just north of MD 177 are included.	Planning study is underway.
MD 214 Corridor Planning Study	This Project is a concept-level planning study to accommodate future traffic demand by focusing on intersection improvements, bicycle and pedestrian improvements, etc. from MD 468 (Muddy Creek Road) to its eastern terminus, immediately east of Oakford Avenue,	Planning study is underway.
Solley Road	This study is to identify potential near-term and long term safety, capacity and operational improvements that will enhance auto, bicycle and pedestrian travel in the 3.9 mile corridor between between MD 177 (Mountain Road) and MD 173 (Fort Smallwood Road)	Planning study completed in 2017.
BWI-Arundel Mills Trail	The BWI Trails Schematic Plan is to develop a safe and convenient route that will connect the existing BWI Trail, the Arundel Mills shopping and entertainment complex and the surrounding communities and office/retail/light industrial land uses in the area.	Planning study nearing completion

Corridor	Project Description	Project Status
South Shore Trail Phase 2	Phase 2 of the South Shore Trail will use the abandoned WB & A railroad from MD 175 and Sappington Station Rd. to Bon Heur Avenue.	Design Development

State Planning, Policy and Funding Documents

BWI Thurgood Marshall Airport Master Plan

Maryland Aviation Administration

The Maryland Aviation Administration is currently updating its 20-year master plan. As of the writing of this memorandum, the document is not publicly available. When the plan is available, this technical memorandum will be updated as appropriate.

Highway Needs Inventory (HNI)

Maryland State Highway Administration (SHA), 2017

The Highway Needs Inventory (HNI) identifies highway improvements that will benefit both the existing and projected population and economic activity in the State of Maryland. The HNI is based on a technical evaluation of highway conditions, and it is expected that more precise cost estimates and planning studies would need to be determined before ultimate implementation. The projects identified aim to address safety and structural problems that would warrant major construction or reconstruction, but the inclusion of a project in the document does not imply definitive implementation. The HNI serves as a technical reference and reflection of the key planning documents developed by the Maryland Department of Transportation that establish the priority of various proposed highway improvements.

MARC Growth and Investment Plan: Update 2013 – 2050

Maryland Transit Administration, 2013

The MARC Growth and Investment Plan (MGIP) is a guiding document for MTA's improvements that foster a State of Good Repair and establishes bold, new objectives for MARC service on the Penn, Camden and Brunswick lines. The document presents a program that ties together future ridership increases, rolling stock investments, and facility/parking expansions to meeting increasing demand and enhance the customer experience. While only a handful of projects in the MGIP are physically located within the County, the nearly $2 billion in systemic improvements included in the plan greatly affect MARC's ability to serve residents of Anne Arundel County.

Maryland Strategic Goods Movement Plan

Maryland Department of Transportation, 2015

The Strategic Goods Movement Plan is to examine existing conditions and long-range projections for the logistics chains of Maryland's industries, as well as the infrastructure required to support their efficient multimodal transportation throughout the region. The Plan evaluates current conditions for major roadways, rail, air and waterway freight movements and recommends policies and strategies for MDOT and freight stakeholders to adopt over the next five years. Recommendations include strategies for improving quality of service, system preservation, environmental stewardship, community vitality, safety and security, and economic prosperity. The Strategic Goods Movement Plan does not specify infrastructure improvements recommendations but does support MDOT subagency plans with highway, port and rail recommendations.

Maryland Transportation Authority (MDTA) Project Planning Studies

Maryland Transportation Authority, Various Dates

The Maryland Transportation Authority (MDTA) oversees all toll roads within the State of Maryland such as I-95 and MD 200 (Intercounty Connector). In Anne Arundel County, the main MDTA facility is U.S. Route 50 at the Chesapeake Bay Bridge and the William Preston Lane, Jr. Memorial Bridge connecting the Western and Eastern Shores of Maryland. These crossings are the only land connection over the Chesapeake Bay between the Susquehanna River to the north and the Chesapeake Bay Bridge and Tunnel to the south in Virginia. The MDTA Project Planning Studies includes all planning for existing and future roadways managed by the MDTA. Within Anne Arundel County, the MDTA Project Planning Studies includes:

Baltimore Harbor Traffic Management Study

This study, which was completed in 2009, analyzed existing conditions on these three Baltimore Harbor crossing facilities and evaluated improvements to better distribute the traffic across them during the peak and off-peak times on the weekdays and weekends along the following roadway limits:

- I-895 in its entirety, from the I-95 / I-895 Split south of Baltimore to the I-95 / I-895 Split interchange on the north side of the city - 15 miles.
- I-695 on the southeast side of the city, from the I-95 / I-695 interchange south of Baltimore to the I-95 / I-695 interchange north of Baltimore - 24 miles.

Chesapeake Bay Crossing Study, 2016 - 2020

This four-year study aims to identify a preferred corridor alternative for addressing congestion at the Chesapeake Bay Bridge. The study area spans the entire length of the Chesapeake Bay in Maryland. This is a Tier I National Environmental Protect Act (NEPA) study to establish the purpose and needs, identify the corridor for a new crossing, determine environmental feasibility, gauge public input and evaluate financial feasibility for a new bay crossing.

William Preston Lane Jr. Memorial Bay Bridge Life Cycle Cost Analysis Report, 2015

The Maryland Transportation Authority (MDTA) completed the William Preston Lane Jr. Memorial (Bay) Bridge Life Cycle Cost Analysis Study (Bay Bridge LCCA) to evaluate the traffic operations and structural condition of the Bay Bridge, and to understand the costs and time frame associated with implementing future Bay Bridge improvements. The study also evaluated the complementary improvements that would be needed if/when a new structure(s) were built including mainline US 50/301 improvements.

State Highway Administration (SHA) Project Planning Studies & Design Development

State Highway Administration, Various Dates

Within Anne Arundel County, current SHA planning studies and design development for major projects include:

Corridor	Project Description	Project Status
MD 198 (MD 295 to MD 32)	The purpose of the project is to improve existing capacity, traffic operations, as well as vehicular and pedestrian safety along MD 198, while supporting existing and planned development in the area. Bicycle and pedestrian access will be provided where appropriate. (BRAC Related)	Planning completed. Project on hold until additional funding is available for design and construction.

MD 175 from National Business Parkway to McCarron Court	Widen from two lanes to six lanes and reconfigure ramps at MD 295 interchange to create signalized left turns at MD 175.	Final design is underway. Utility relocation to begin in Fall 2018 and road construction in 2019.
MD 175 (Mapes Road to MD 32)	Convert existing four lane roadway to six lane highway, including sidewalk and shared use path.	Conceptual storm water management plans have been submitted for approval. Roadway plans are 30 percent complete. Future phases of this project are currently unfunded.

Regional Planning, Policy and Funding Documents

Baltimore Regional Long Range Transportation Plan – Maximize 2040

Baltimore Regional Transportation Board (BRTB), 2017

Maximize 2040 is the long-range transportation plan for the Baltimore region, which encompasses Anne Arundel, Baltimore, Carroll, Harford, and Howard Counties, Baltimore City and the City of Annapolis. Maximize 2040 was developed in accordance "Moving Ahead for Progress in the 21st Century" (MAP-21) requirements for the authorization and funding of federal surface transportation programs, and it adopted nine regional transportation goals that are targeted by the recommended projects and programs. *Maximize 2040* includes sections with explanations of these goals, a revenue forecast, future needs and conditions, project evaluation criteria, a congestion management process, and a public involvement process. Seven Anne Arundel County capacity expansion projects are included in the plan. As of the writing of this memorandum, the document is not publicly available. When the plan is available, this technical memorandum will be updated as appropriate.

Regional Transportation Improvement Plan

Baltimore Regional Transportation Board, 2016

The Baltimore Region Transportation Improvement Program is a four-year, fiscally constrained, and prioritized set of transportation projects from the Regional Long Range Transportation Plan. The TIP includes all forms of surface transportation improvements including but not limited to system preservation, management and operations, emission reduction projects, safety, roadway capacity expansion, transit vehicle purchases, bicycle and pedestrian projects and more. The TIP is published annually, generally following adoption.

Patapsco Regional Greenway Concept Plan and Implementation Matrix

Baltimore Metropolitan Council (BMC), 2017

The Patapsco Regional Greenway (PRG) Concept Plan and Implementation Matrix identifies and prioritizes a shared-use path system along the Patapsco Valley between Sykesville and the Inner Harbor of Baltimore. This 58-mile system uses existing trails, roads and utility corridors to connect neighborhoods and destinations in Baltimore City and Baltimore, Anne Arundel, Howard and Carroll Counties. A completed greenway system will improve opportunities for transportation, recreation and economic development for communities along the route. Within Anne Arundel County, two greenway alignments are proposed. The first follows the county's Bicycle and Pedestrian Plan recommendation of a proposed Baltimore Washington International (BWI) Trail and Baltimore and Annapolis (B&A) Connector Trail from the Patapsco River at MD 648 to Maple Road. The second greenway segment proposes a new trail parallel to Stony Run from the Patapsco River at I-195 to the BWI Trail following Ridge Road and Corporate Center Drive.

Washington Area Constrained Long-Range Transportation Plan (2016)
National Capital Region Transportation Planning Board

The Constrained Long-Range Transportation Plan (CLRP) shows how the Washington, D.C. region plans to invest in its transportation system over the next 20 to 30 years. The CLRP highlights major highway projects, strategies for system maintenance, expanded transit capacity, targeted congestion relief, development of activity centers, and environmental protection. Any project that might affect future air quality by adding or removing highway or transit capacity is considered to be "regionally significant" and must be included in the plan, in addition to any project that will require federal funding or federal approval during the timespan that the CLRP covers. The following projects are included in the CLRP for Prince George's County and directly connect to Anne Arundel County roadways and rail service:

- MD 3 (Robert Crain Hwy) - widen to 6 lanes, 2030 ($399M)
- MD 450 (Annapolis Rd) - widen to 4 lanes, 2020 ($65M)
- MARC - Increase trip capacity and frequency along all commuter rail lines, 2029 ($1.1B)

Federal Planning, Policy and Funding Documents

Fort George G. Meade Strategic Action Plan: 2012 – 2017
United States Army, 2012

The SAP is the Army's guiding document for all facility improvements related to the social and physical infrastructure necessary to support the needs of 56,000+ active forces, dependents, civilians, reservists and retirees at Fort George G. Meade in western Anne Arundel County. While transportation improvements included in the plan are typically "inside the fence," their implementation relates directly to county and state owned transportation facilities outside the fence.

Conclusion

In total, the plans reviewed include 287 unique projects which can be categorized as follows:

Project Type	Number of Projects
Roadway	59
Transit	19
Bicycle/Pedestrian	209
TOTAL	287

This inventory does not include recommendations from the 16 Small Area Plans crafted by communities and the County government in between in the early 2000s; nor are the Parole and Odenton Town Center plans specifically included for the reasons described below. Many of the transportation recommendations speak to quality-of-life improvements that would improve transportation safety and improve the quality of roadways, sidewalks, bus stops and other facilities. The scale of projects included in the SAPs are typically implemented by county and state agencies within the operating budget; or, from within a "systemic" account within the capital budget. Nonetheless, the Office of Transportation is fully cognizant of the important quality of life issues raised in each of the plans and will use them to inform the final Transportation Functional Master Plan. Additionally, the Office of Planning and Zoning is preparing a status report on the 16 Small Area Plans that will also inform Plan2040.

This memorandum also does not include a detailed description of every project planning study undertaken by the County, State Highway Administration or other agency. Individual projects can be found in the online geodatabase; detailed information on each project can be found by referring back to the planning study which included the project.

Finally, project costs identified with any specific project are as published at the time of the planning study and have not been updated for this technical memorandum. In total, this plan represents at least $3 billion in projects that could be funded by the County or State government, developer impact fees, federal grants or other sources.

ANNE ARUNDEL COUNTY
TRANSPORTATION MASTER PLAN

TECHNICAL MEMORANDUM #2
Developing a Vision, Goals and Performance Measures

ANNE ARUNDEL COUNTY
MARYLAND

Prepared for the Anne Arundel County Office of Transportation
June 2018 – Final

SABRA
& ASSOCIATES
Engineering Innovative Solutions

Contents

Note: The purpose of each Technical Memorandum prepared for the Office of Transportation is to present facts, analysis, ideas, issues and recommendations that will inform the Anne Arundel County Transportation Master Plan. The views expressed and recommendations offered in each memorandum are solely based on the consultant's judgment and should not be considered as endorsed by the Office of Transportation or any other County agency or officer.

Executive Summary

The Anne Arundel County Office of Transportation is responsible for coordinating the County's short- and long-term transportation policy and planning activities, including establishment of a Transportation Functional Master Plan (TFMP). The purpose of the TFMP is to guide the County's future investments and advocacy for the County's multimodal transportation network. The TFMP will yield a long range transportation plan that is fiscally constrained; and, the plan will also include funding and policy options to provide the County with adequate resources for plan implementation. Finally, the TFMP will inform *Plan* 2040, the County's General Development Plan.

This technical memorandum provides background information and options for the County to consider in identifying a potential vision, goals, objectives and performance measures (VGOPM) for the TFMP. An updated technical memorandum will be prepared once the County has decided on the appropriate direction of the TFMP. As a starting point, the vision and goals from the 2009 General Development Plan is summarized; and, a look at VGOPM for several comparator jurisdictions from Maryland and elsewhere is provided. This memorandum then explores current thinking from Anne Arundel County residents on key transportation issues and lays out potential VGOMP for the County.

Finally, options are presented for the County to consider in deciding upon the appropriate Vision, Goals, Objectives and Performances Measures for the Transportation Functional Master Plan.

PART 1: Policies and Practices in Setting Vision, Goals, Objectives and Performance Measures

Part 1 of this memorandum reviews relevant federal, state, regional and local transportation visions, goals, objectives and performance measures with the intent being to align the County's approach, to the extent possible.

Federal Transportation Policy

For the first time in the history of the federal transportation policy, program and funding authorization law currently known as MAP-21[1] establishes a performance and outcome based regime to drive state investments in transportation. Its goals are based on seven subject areas, and each corresponds to outcomes for the National Highway System (NHS).

Table 1: Summary of goals for MAP-21

Goal	National strategy
Safety	To achieve a significant reduction in traffic fatalities and serious injuries on all public roads
Infrastructure condition	To maintain the highway infrastructure asset system in a state of good repair
Congestion reduction	To achieve a significant reduction in congestion on the NHS
System reliability	To improve the efficiency of the surface transportation system
Freight movement and economic vitality	To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development
Environmental sustainability	To enhance the performance of the transportation system while protecting and enhancing the natural environment
Reduced project delivery delays	To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through elimination delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices

[1] MAP-21 has since been superseded by the Fixing America's Surface Transportation (FAST) Act. The FAST Act retains all of the performance measurement policies as MAP-21

Through a joint effort by the Secretary of Transportation, State DOTs, MPOs, and other stakeholders, the Department of Transportation may only implement performance measures around the following seven items.

- Pavement condition on the Interstate System and on remainder of the NHS
- Performance of the Interstate System and the remainder of the NHS
- Bridge condition on the NHS
- Fatalities and serious injuries, both number and rate per vehicle mile traveled, on all public roads
- Traffic congestion
- On-road mobile source emissions
- Freight movement on the Interstate System

States and MPOs are required to set performance targets around each of these measures. See below for sample performance targets by the Baltimore Regional Transportation Board.

Regional and State Points of Reference

Much of the funding for Anne Arundel County's transportation projects comes from the State of Maryland or with approvals required by the Baltimore Regional Transportation Board, on which the County has a voting membership. The Maryland Department of Transportation, via MTA and SHA, own and operate all of the major roadways and rail/bus transit services in the county. This section summarizes their vision, goals and performance measures.

Baltimore Regional Transportation Board: Maximize 2040

Maximize 2040, authored by the Baltimore Regional Transportation Plan, addresses transportation needs and challenges of the Baltimore region for the period from 2020 to 2040. The Baltimore region spans Anne Arundel County, Baltimore County, Carroll County, Howard County, Hartford County, and Baltimore City. The BRTB adopted nine goals, each with corresponding performance measures and targets:

- Improve System Safety
- Improve and Maintain the Existing Infrastructure
- Improve Accessibility
- Increase Mobility
- Conserve and Enhance the Environment
- Improve System Security
- Promote Prosperity and Economic Opportunity
- Foster Participation and Cooperation Among Stakeholders
- Promote Informed Decision Making

Regional Performance Measures[2]:

- Reduce serious injuries per 100 million VMT to 3.0 by 2040
- Reduce fatalities per 100 million VMT to zero by 2040
- Reduce number of serious injuries to 676 by 2040
- Reduce number of fatalities to zero by 2040
- Reduce number of preventable crashes per 100,000 revenue vehicle miles to zero by 2040
- Maintain portion of state-owned roadway miles with acceptable ride quality at 82% or above
- Maintain portion of structurally deficient state and local bridges below 5.0%
- Maintain average age of MTA and local transit agency bus fleets below 7.0 years
- Maintain portion of VMT in congested conditions on state-owned arterials during the evening peak hour (5-6 PM) below 25%
- Maintain average truck turnaround time at Seagirt Marine Terminal below 58 minutes
- Maintain levels of VOC, NOx, PM2.5, and CO emissions at levels less than motor vehicle emission budgets in the State Implementation Plan
- Increase percentage of urban area state-owned directional roadway miles that have sidewalks (both sides of the roadway) to 25% by 2040
- Increase bicycle/walk-to-work mode share to 5.0% by 2040
- Increase average weekday MTA and local agency transit ridership (all modes) to 500,000 by 2040

2035 Maryland Transportation Plan: Moving Maryland Forward

Updated every five years, the Maryland Transportation Plan is the guiding policy document for the Maryland Department of Transportation. It serves as a 20-year blueprint to guide Maryland in making strategic transportation investments. The 2014 update introduces a new, region-based framework, focusing on county-to-county and community-to-community connections. Its vision is to provide a well-maintained, sustainable, and multimodal transportation system that facilitates the safe, convenient, affordable, and efficient movement of people, goods, and services within and between population and business centers.

The specific goals tied to this vision are:

- Enhance the safety of transportation system users and provide a transportation system that is resilient to natural or man-made hazards.
- Preserve and maintain the State's existing transportation infrastructure and assets.
- Maintain and enhance the quality of service experienced by users of Maryland's transportation system.
- Ensure that the delivery of the State's transportation infrastructure program conserves and enhances Maryland's natural, historic, and cultural resources.
- Provide options for the movement of people and goods that support communities and quality of life.

[2] Performance measures developed as per MAP-21 requirements

- Support a healthy and competitive Maryland economy.

The plan focuses its attention on its five distinct regions: the Baltimore region, Washington Region, Eastern Shore, Southern Maryland, and Western Maryland. Each region may have four place types: urban centers, rural and agricultural areas, towns and suburban centers, and natural areas. It applies the goals to each one, noting location-based challenges and barriers. Challenges for the State will be its aging transportation system assets, safety for all users, changing travel patterns as a result of changing demographics and economies, new technologies for transportation, supporting community quality of life and wise land use choices, managing congested infrastructure, building foundations for economic prosperity, and assuring environmental quality.

The next update of the Maryland Transportation Plan will be completed in 2019. It will expand upon the current goals and prioritize them based on stakeholder engagement and outreach. Draft goals for the plan were published in January 2018. Notable changes are goals of user-friendly technology and operational improvements, fiscal responsibility, a focus on transportation connections, and explicitly stated system-wide congestion reduction.

MDOT Excellerator

The MDOT Excellerator develops and implements performance measures across ten objectives for the Maryland Department of Transportation. These performance measures are tied to departmental operations in support of the Maryland Transportation Plan. Performance measures are variable in their tracking; some are updated quarterly and some are updated annually at different points throughout the year. Each performance measure has an overarching supervisor, as does each of the corresponding tracking measures.

The objectives are to:

- Provide Exceptional Customer Service
- Use Resources Wisely
- Provide a Safe and Secure Transportation Infrastructure
- Deliver Transportation Solutions and Services of Great Value
- Provide an Efficient, Well Connected Transportation Experience
- Communicate Effectively With Our Customers
- Be Fair and Reasonable to Our Partners
- Be a Good Neighbor
- Be a Good Steward of Our Environment
- Facilitate Economic Opportunity in Maryland

Of particular interest to Anne Arundel County may be objectives 3, 5, and 10. Anne Arundel County has an opportunity to work with the State on these goals for mutually beneficial transportation outcomes.

Objective 3: Provide a Safe and Secure Transportation Infrastructure

- Number of Crimes Against Persons and Property Committed at MDOT Facilities (tracked quarterly)

Objective 5: Provide an Efficient, Well Connected Transportation Experience

- On-Time Performance of MTA (tracked quarterly)
- Average Time to Restore Normal Operations After Disruptions/Weather Events (tracked annually)
- Percent of Transportation Services and Products Provided Through Alternative Service Delivery (ASD) Methods (tracked semi-annually)

Objective 10: Facilitate Economic Opportunity in Maryland

- Economic Return from Transportation Investment
- Change in Market Access due to Improvements in the Transportation Network
- Percent of VMT in Congested Conditions on Maryland Freeways and Arterials in the AM/PM Peak Hours

Views from the County

In establishing a vision, goals, objectives and performance measures for the TFMP, the 2009 General Development Plan provides some guidance. Additionally, the perspective of County residents and workers and agency staff on transportation issues is a key input, as is input from the recently formed Anne Arundel County Transportation Commission and the County's Bicycle Advisory Committee. Several opportunities for public participation in County and State transportation planning processes were ongoing as the TFMP was being developed; as such, opportunities to review and comment on the TFMP itself will be provided once in draft form.

This section summarizes the two most broad and robust public participation opportunities relating to transportation planning in the County: listening sessions in preparation for the County's General Development Plan update and responses to a web-based survey for the Maryland Transportation Plan. County staffs from the Office of Transportation, Office of Finance, Department of Planning and Zoning and Department of Public Works were interviewed, and minutes of the Anne Arundel County Transportation Advisory Commission were reviewed.

The 2009 General Development Plan

The County's 2009 General Development Plan is the starting point for potential vision statements, goals, objectives and performance measures of a comprehensive, multimodal long-range transportation plan for Anne Arundel County. The GDP is based on four broad planning themes for the County: balancing growth and sustainability, community preservation and enhancement, environmental stewardship, and quality public services. The elements of the County's transportation planning approach flows from the GDP themes:

- Maintenance of the existing transportation facilities inventory to protect public investment in facilities and to support redevelopment and revitalization of the County's neighborhoods and commercial areas;
- Expansion of the transportation facilities inventory to meet the increasing travel demand;
- Emphasis on improving safety for motorists, pedestrians, and bicyclists;
- Provision of alternative means of mobility through increased transit service;
- Implementation of travel demand management strategies;
- Inclusion of emergency management principles in transportation plans; and
- Expansion of pedestrian and bicycle facilities.

The County's stated transportation objective is to create a safe and well-managed transportation network that provides greater choice for the traveler and limits or even reduces congestion on the road system. Various roadway improvements, improved regional and local transit, expanded bicycle and pedestrian networks, and improved connections between the different modes will help to lessen reliance on the single-occupancy vehicle and reduce vehicle emissions. Additionally, land use and housing policies supporting mixed-use development, higher densities around transit hubs, and retention of neighborhood retail and services will further promote transit use and help reduce new trips.

Anne Arundel County Plan 2040 Listening Sessions

Anne Arundel County conducted a series of listening sessions in the fall of 2017 and the winter of 2018, in preparation for updates to the General Development Plan. Participants enthusiastically described their rural and suburban oasis proximal to several major economic hubs. The location of the county allows an educated workforce to enjoy a slower, simpler life. Residents feel protective over the Chesapeake Bay and the state capital, Annapolis, and are proud of the accompanying heritage of each. They deeply cherish the county's natural amenities and small community, family-friendly culture. Residents also appreciate low taxes coupled with quality county services, such as policing and services for the elderly and disabled.

Participants were asked to recommend improvements for Anne Arundel County. Two common themes emerged from the feedback. Anne Arundel County residents want the county to prioritize road congestion improvements, implementing more widespread public transportation with increased transit, bicycle, and pedestrian facilities. When it comes to public transportation, county residents are more interested in bus expansion than light rail expansion, as bus transit has less physical impact on residential neighborhoods. Residents are also concerned about the pace of land development within Anne Arundel County. A major recommendation was to ensure that development does not outpace infrastructure, resulting in increased road congestion. County residents also feel that the development process could be more transparent; they would like more of a say in land development to ensure the local character of the county is preserved. Finally, county residents are concerned over the degradation of Anne Arundel County's natural resources, as a consequence of excessive development. They are specifically worried about poor water quality, air pollution, and noise pollution.

When asked to suggest priorities for the future, Anne Arundel County residents highlighted the importance of balanced growth, environmental and cultural preservation, an enjoyment of intra-county travel, and high quality education, while maintaining its ability to keep taxes low. Ideally, these values would be implemented through the Small Area Plans. Table 2 details the ranked priorities of Anne Arundel County residents, as a result of five administered surveys.

Table 2: Ranked Values of Anne Arundel County General Development Plan Listening Sessions Participants (All Issues)

Rank	Value
1	Infrastructure Capacity in Line with Growth or Decline Demands
2	Natural Resources and Sensitive Areas
3	Water Quality
4	Open Space, Parks, Greenways
5	Balanced Economic/Adequate Land-Use Mix
6	Conserving Rural Areas
7	Greenways, Open Space
8	Education
9	Preserving Character of Established Communities
10	Transportation System for All Users

Input from the Maryland Transportation Plan

As the Transportation Functional Master Plan was being initiated, MDOT was wrapping up early-stage public participation activities for the 2040 Maryland Transportation Plan update. A total of 471 persons residing and/or working in Anne Arundel County participated in a web-based survey on statewide transportation issues and priorities. Administered in 2017, the survey was framed around the State of Maryland's eight transportation goals. Table 3 shows the top ten transportation improvement strategies of Anne Arundel County residents and workers.

Table 3: Top 10 transportation improvement strategies, ranked by Anne Arundel County residents and workers on the 2040 Maryland Transportation Plan survey

Strategy 1	**New Highways and Lanes** Increase the vehicle capacity on key State roads
Strategy 2	**Public Transit Services** Ensure on-time and efficient operation of transit services
Strategy 3	**Travel Reliability Technology** Implement technologies that inform the populace about travel times
Strategy 4	**System Maintenance Technology** Implement technologies that allow the State to alleviate transportation issues quickly
Strategy 5	**Port Assets- Maintenance** Ensure easy, quick, and pleasant operations at ports
Strategy 6	**Air Assets- Maintenance** Reduce flight delays as a function of poor preparedness at airports and maintain cleanliness
Strategy 7	**Reliable Travel Time** Reduce variability in trip length from accidents, congestion, and poor system performance
Strategy 8	**Transit Assets- Maintenance** Promote clean, user-friendly, and functional transit facilities
Strategy 9	**Minimize Improvements - Tax Dollars Spent Wisely** Prioritize capital improvements based on need and impact
Strategy 10	**Education and Awareness - Safety and Security** Educate populace about safety and security prevention

Anne Arundel County Transportation Commission

The Anne Arundel County Transportation Commission serves as the transportation advisory body for Anne Arundel County. Its thirteen members study the planning, design, delivery, and operation of transportation services in the county. The Commission then provides transportation recommendations to the County Executive, with environmental protection, economic competitiveness, and citizen quality of life in mind. Two main focuses are on coordinating transportation services among city, region, and state transportation organizations, and recommending smart growth projects with the collaboration of the Office of Planning and Zoning. They also analyze county budgets, review state and federally-mandated plans, and discuss the way zoning changes might be used to provide more accessible multimodal transportation. Current projects are the Commission's update to the County Code, the role of the Office of Transportation, county budget recommendation letter regarding Fiscal Year 2019 priorities, understanding the Transit Development Plan, and advising on the Transportation Functional Master Plan.

In preliminary discussions of the TFMP, the Commission emphasized the importance of scenic and historic roads, a ferry recommendation, the traffic problems on the Broadneck Peninsula, and the bicycle and pedestrian network with a particular emphasis on sidewalk connectivity. In its most recent meeting, these initial suggestions were translated into a working developed vision. Initial proposed objectives were:

- Congestion relief
- Facilitate getting employees to work and maintain high quality of life that attracts employees to live, work, and play in Anne Arundel County, through multimodal means and transportation demand management
- Reduce fatal and serious injuries for drivers, pedestrians, and cyclists
- Transit-oriented development and land use
- Bringing federal and state funding sources together for increased budget flexibility

Strategies outlined to meet these goals were:

- Expand public transportation system to include new bus lines/stops, reduce wait times, and extend operational hours
- Increase access to affordable public transportation fares
- Incorporate other forms of programs to close transportation gaps, such as rideshare, shuttles, or a voucher program with Uber or Lyft
- Lower fares for disabled residents
- Create accessibility-based models
- Expand trip destinations for para-transit (getting to work, disability meetings)

The Commission also brainstormed performance measures. Mode share shift was proposed as an umbrella measure, with sub-categories measured as percent change per five-year period. A corridor performance index was discussed, with measures such as autonomous vehicle readiness and Complete Streets. The Commission is interested in achieving Bronze Bike-friendly status by 2020 and Silver by 2025, with a focus on connecting major recreational facilities with bicycle and pedestrian pathways and waterways. Sidewalk connectivity between schools and neighborhoods was also discussed as a measure. Additionally, they would like the TFMP to prioritize development on corridors that are more-transit oriented, i.e. those with denser zoning, and Peninsulas (which only have one inflowing and outflowing road). To thread it all together, these priorities should be optimized to create town centers where it is possible to live car-free.

An issue raised was the ability to measure performance by a common metric. A proposed solution was human and freight mobility, which is passenger miles divided by cost and travel time (two measures), and average speed of delivery trucks, respectively.

Comparator Counties

In this section, we have identified eight jurisdictions with similar suburban orientation and similar economic, demographic and mode of travel profiles to those in Anne Arundel County. Three of the comparator jurisdictions are in Maryland: Baltimore County, Howard County and Frederick County; five of the comparators are outside of Maryland, including two in the Philadelphia suburbs, and each in the suburbs of Raleigh, St. Louis, and Denver. From these comparators we were able to glean insights into County-level transportation visions, goals, objectives and/or performance measures; these observations will be helpful in developing an appropriate approach to and scale of goal setting and performance measurement for Anne Arundel County.

Arapahoe County, Colorado

Arapahoe County, Colorado is a vast jurisdiction a few miles east of Denver with a population of 618,668. It is included in the Denver-Aurora-Lakewood metropolitan region, but has fairly low housing density, implying sprawling residential and rural development. Density is mainly clustered within the metropolitan region. Despite its vastness and dispersion, Arapahoe tops Anne Arundel in public transportation ridership, carpooling, and non-automotive commuting, though not by much. More similarities and differences are illustrated in Table 4.

Table 4: Key Demographics of Anne Arundel County and Arapahoe County, CO

	Anne Arundel County	Arapahoe County, CO
Median Household Income	$91,918	$66,288
Poverty Rate	6.1%	10.7%
Employment Rate	64.2%	66.5%
Average Commute Time	29.9	27.4
% Drove Alone	80.1%	77.6%
% Carpool	7.6%	8.6%
% Public Transportation	3.7%	4.6%
% Walk, Bike, Work from Home, Other	8.6%	9.2%
% High School Diploma	91.9%	92.3%
% Bachelor's Degree or Higher	39.4%	40.7%
% Owner-Occupied Housing	73.9%	62.4%
Population / sq mile (2010)	1,296	717

(Source: American Community Survey, 2016)

Arapahoe County released a transportation plan in 2010, entitled Arapahoe County 2035 Transportation Plan. The Plan does not include a vision, but it does have a stated purpose. It also includes objectives and proposes performance measures and a monitoring system (Table 5).

Table 5: Purpose, objectives, and proposed performance measures for Arapahoe County 2035 Transportation Plan

Purpose	Objectives	Priority and Performance Measure		Measurement Tool
Become part of the County's Comprehensive Master Plan through the year 2035.	Promote an efficient and balanced transportation system.	Customer/Stakeholder	Travel Time	Travel time on primary corridors or between major origins/destinations
			Roadway Congestion	Traffic volume/threshold comparison
Serve as a strategic plan to provide guidance to decision-makers in developing the transportation system.	Promote alternative transportation solutions.		Infrastructure Condition (Roads, Bridges, Traffic Signals)	Health index for conditions of paved roads, gravel roads, bridges, and traffic signals
		Financial	Projects Readiness	Funding agreements in place at sufficient levels for full project or project phasing
Identify alternatives/options and provide input to decision-makers regarding local and regional implications of each alternative so that they can fully understand the ramifications and benefits of identified transportation improvements.	Coordinate land use and transportation.		Economic Development Potential	Acres of undeveloped lands that would benefit from project
			Project Delivery	Schedule for project completion and project completed on time
Help in developing short and long term strategies for implementation, consistent with area land use plans developed by the County.	Develop a strategic management and tracking approach to the county's transportation system.	Process	Intelligent Transportation Systems (ITS) (Signal Systems)	Percentage of signals on County system
			Intelligent Transportation Systems (ITS) (Travelor Information)	Frequency of real-time congestion and incident information messages
			Key Intersections	Top 10 intersections (west) (Accidents per year, severity, rate)
			Primary Corridors	Top 10 corridors (east) (Accidents per year, severity, rate)
			Travel Demand Strategies	Program Awareness

Baltimore County, Maryland

Baltimore County is Maryland's third largest county with a population of 831,026. It is part of the combined Baltimore-Washington metropolitan area and its residents commute all over the state. Baltimore County and Anne Arundel County diverge the most significantly on diversity, poverty, housing cost, and housing ownership, with more residents renting in Baltimore County than Anne Arundel. Otherwise, the two counties share numerous similarities, summarized in Table 6.

Table 6: Key Demographics of Anne Arundel County and Baltimore County, Maryland

	Anne Arundel County	Baltimore County
Median Household Income	$91,918	$68,989
Poverty Rate	6.1%	9.0%
Employment Rate	64.2%	66.4%
Average Commute Time	29.9	29.3
% Drove Alone	80.1%	79.4%
% Carpool	7.6%	8.8%
% Public Transportation	3.7%	4.7%
% Walk, Bike, Work from Home, Other	8.6%	7.1%
% High School Diploma	91.9%	91.0%
% Bachelor's Degree or Higher	39.4%	37.2%
% Owner-Occupied Housing	73.9%	65.8%
Population / sq mile (2010)	1,296	1,346

(Source: American Community Survey, 2016)

Baltimore County released its Master Plan 2020 in November 2010, which incorporates transportation. The plan includes a vision, goals, and a set of policies and corresponding actions and projects, but does not include performance measures (Table 7). It does, however, express a necessary relationship to other transportation coordinating agencies, such as the Baltimore Regional Transportation Board, and encourages collaboration.

Table 7: Vision and objectives of Baltimore County Master Plan 2020, transportation section

Vision	Objectives
"Create and maintain safe and sustainable communities, to achieve a sensible balance of economy, equity, and environment for people to reside, work, pursue careers, raise families, and enjoy the amenities in Baltimore County, Maryland."	Support diverse travel needs within the region. Foster responsible land use decisions. Enhance economic development strategies. Promote environmental stewardship.

Boulder County, Colorado

Boulder County is a jurisdiction in Colorado with a population of 322,226. It includes the Boulder, CO Metropolitan Statistical Area, which is also part of the Denver-Aurora, CO Combined Statistical Area. The county seat and most populous municipality is Boulder, home to the University of Colorado at Boulder. Housing is relatively concentrated around Boulder and Longmont, with natural amenities and rural areas occupying the rest of the county. Similar to Anne Arundel County, many Boulder County residents live and work in different communities, and many workers commute in from outside the county. As compared to Anne Arundel County, Boulder County has a higher rate of education and non-vehicle commuting. It also has a higher rate of poverty. Other similarities and differences are summarized in Table 8.

Table 8: Key Demographics of Anne Arundel County and Boulder County, CO

	Anne Arundel County	Boulder County, CO
Median Household Income	$91,918	$72,282
Poverty Rate	6.1%	10.8%
Employment Rate	64.2%	69.1%
Average Commute Time	29.9	22.4
% Drove Alone	80.1%	65.2%
% Carpool	7.6%	7.6%
% Public Transportation	3.7%	5.0%
% Walk, Bike, Work from Home, Other	8.6%	22.3%
% High School Diploma	91.9%	94.5%
% Bachelor's Degree or Higher	39.4%	59.3%
% Owner-Occupied Housing	73.9%	61.9%
Population / sq mile (2010)	1,296	406

(Source: American Community Survey, 2016)

Boulder County adopted its Transportation Master Plan in 2012. The Transportation Master Plan was in response to the 2009 update to the Boulder County Comprehensive Plan, which outlined a vision and objectives for Boulder County's Transportation System (Table 9).

Table 9: Vision and objectives of Boulder County Transportation Master Plan

Vision	Objectives
Provide high quality, safe, sustainable, and environmentally responsible transportation infrastructure and services across all modes, to meet the mobility and access needs of all users.	Ensure effective and efficient management of the existing transportation system. Manage and maintain existing transportation infrastructure and services in a cost-effective manner. Minimize environmental impacts. Minimize the negative environmental impacts of the transportation system such as air pollution, greenhouse gas (GHG), emissions, noise , pollution, water pollution, land and wildlife habitat fragmentation, land disturbance, and resource consumption Ensure safety for all modes. Provide for transportation system development and operations that result in safe and secure travel by all modes and that enable prompt and effective emergency response. Support a healthy and sustainable economy. Develop a transportation system that supports a robust economy and increases resiliency to economic fluctuations. Ensure equitable access to the transportation system. Ensure that adequate transportation exists for all users regardless of age, income, or ability. Enhance county identity and community character. Promote a transportation system that preserves, highlights, and enhances the county's diverse rural character and the history and culture of its unique communities.

Though it does not identify performance measures, the Boulder plan frames each of its projects from the following five principles: develop a multimodal transportation system, create the complete trip, invest in key transportation corridors, increase accessibility, and enhance mountain area connections. The Transportation Master Plan also maps existing and proposed facilities for each strategy with corresponding implementation actions.

Bucks County, Pennsylvania

Bucks County, Pennsylvania is a moderately sized jurisdiction, with a population of 626,220. Much like Anne Arundel County, it is proximal to several economic centers; namely, Philadelphia and Trenton. Bucks County is located farther north of Philadelphia than Montgomery County, making it less dense and more rural by nature. Other statistic similarities are summarized in Table 10.

Table 10: Key Demographics of Anne Arundel County and Bucks County, PA

	Anne Arundel County	Bucks County, PA
Median Household Income	$91,918	$79,559
Poverty Rate	6.1%	5.9%
Employment Rate	64.2%	63.4%
Average Commute Time	29.9	29.3
% Drove Alone	80.1%	81.9%
% Carpool	7.6%	7.4%
% Public Transportation	3.7%	3.3%
% Walk, Bike, Work from Home, Other	8.6%	7.4%
% High School Diploma	91.9%	93.6%
% Bachelor's Degree or Higher	39.4%	38.3%
% Owner-Occupied Housing	73.9%	76.5%
Population / sq mile (2010)	1,296	1,035

(Source: American Community Survey, 2016)

Though the county lacks a full transportation plan, the Bucks County Comprehensive Plan includes a section on transportation. The transportation section includes a vision and objectives. While there are specific strategies for each objective, there are no explicit performance measures (Table 11)

Table 11: Vision and objectives of Bucks County Comprehensive Plan (transportation section)

Vision	Objectives
"A mature multi-modal transportation system meets the needs of our residents and visitors with safe, reliable mobility and supports our expanding population and developing economy. This transportation system connects our residents and visitors with other areas in our county and in the region. Biking and walking are an integral part of the county's transportation network. The system is not only safer, but more enjoyable, and adequately meets travel demand."	Effectively manage traffic congestion. Increase multi-modal capabilities of the transportation system. Improve safety. Provide a well-functioning public transit system. Promote non-motorized means of travel. Move goods efficiently. Maintain air travel. Strengthen the transportation-land connection.

Frederick County, Maryland

Frederick County, Maryland is located within the Washington-Arlington-Alexandria Metropolitan Statistical Area, but like Anne Arundel County, many of its residents commute into the Baltimore-Columbia-Towson Metropolitan Area. While Frederick County sits at the apex of two metropolitan areas, it is not especially close to either of them. This is represented in its high average commute time. The county has a relatively small population, of 243,465, but has seen growth in the past few years. Frederick County land use skews rural with pockets of suburban, represented by its low housing density and low public transportation use. Otherwise, it is very statistically similar to Anne Arundel County, as shown in Table 12.

Table 12: Key Demographics of Anne Arundel County and Frederick County

	Anne Arundel County	Frederick County
Median Household Income	$91,918	$85,715
Poverty Rate	6.1%	7.1%
Employment Rate	64.2%	67.0%
Average Commute Time	29.9	34.8
% Drove Alone	80.1%	77.3%
% Carpool	7.6%	9.9%
% Public Transportation	3.7%	2.9%
% Walk, Bike, Work from Home, Other	8.6%	9.9%
% High School Diploma	91.9%	92.6%
% Bachelor's Degree or Higher	39.4%	39.7%
% Owner-Occupied Housing	73.9%	74.1%
Population / sq mile (2010)	1,296	354

(Source: American Community Survey, 2016)

In April 2010, Frederick County adopted its Comprehensive Plan. The Plan includes a section on transportation, entitled Providing Transportation Choices. The transportation section provides a vision and goals, but excludes performance measures (Table 13).

Table 13: Vision and objectives of Providing Transportation Choices, Frederick County

Vision	Objectives
"For tomorrow's citizens and employers of Frederick County, solutions to the myriad transportation crises facing the region emerge, at least in part, due to changes in the patterns of land use. Coming into its own as a center of employment, Frederick County will continue to take full advantage of its proximity to the Washington DC metropolitan area while seeking ways in which workers can greatly reduce their commuting distance. For many information workers, the need to commute to a job site will have diminished greatly in the first half of the 21st century, while those that continue to commute will increasingly do so over shorter distances as the proliferation of mixed use neighborhoods makes it viable – and attractive – to live and work in the same place. Improvements to the transportation network – guided as much by network management as by tangible infrastructure development – will be completed on a regional basis in an attempt to maximize both limited funding and valuable energy resources. For tomorrow's Frederick County, the transportation technology with the greatest potential to improve the quality of life for citizens not be the wheel, train, or turbine – it may indeed be the shoe."	Plan a safe, coordinated, and multi-modal transportation system on the basis of existing & future development needs, land uses, and travel patterns. Integrate transit, pedestrian, bicycling, and ADA accessible facilities into the County's existing roadways and communities and the design of new roadways and communities. Maintain and enhance the quality of the transportation system to assure an acceptable level of service, safety, and travel conditions for all roadway users. Reduce the need for single occupancy auto use through travel demand management and increasing the share of trips handled by bus, rail, ride-sharing, bicycling, and walking.

Howard County, Maryland

Howard County is a county located in central Maryland with a modest population of 308,447. It is part of the DC-MD-VA-WV-PA Combined Statistical Area, with proximity to Baltimore, Washington D.C., and several smaller cities in between. It is home to many major corporations, and is relatively affluent and educated. Howard County has higher rates than Anne Arundel in diversity, education, and housing cost. Anne Arundel has a shorter average commute time, with higher rates of public transit ridership and non-motorized transportation. The differences between Howard County and Anne Arundel County are small but notable, as depicted in Table 14.

Table 14: Key Demographics of Anne Arundel County and Howard County

	Anne Arundel County	Howard County
Median Household Income	$91,918	$113,880
Poverty Rate	6.1%	4.9%
Employment Rate	64.2%	68.6%
Average Commute Time	29.9	30.3
% Drove Alone	80.1%	81.3%
% Carpool	7.6%	7.4%
% Public Transportation	3.7%	3.6%
% Walk, Bike, Work from Home, Other	8.6%	7.7%
% High School Diploma	91.9%	95.3%
% Bachelor's Degree or Higher	39.4%	61.9%
% Owner-Occupied Housing	73.9%	73.4%
Population / sq mile (2010)	1,296	1,145

(Source: American Community Survey, 2016)

Howard County does not have a comprehensive transportation plan, but it does have a general plan that was amended in 2015, PlanHoward 2030, an upcoming Pedestrian Master Plan and Complete Streets Policy and a Bicycle Master Plan. According to PlanHoward 2030, the transportation vision for Howard County is aligned with the State of Maryland's vision (Table 15). PlanHoward 2030 requires short-term monitoring across each of their outlined policies. The metrics are qualitative status updates, including completed work, work to be completed, and barriers to implementation.

Table 15: Vision and objectives of PlanHoward 2030, transportation section

Vision	Objectives
State of Maryland: "A well-maintained, multimodal transportation system facilitates the safe, convenient, affordable, and efficient movement of people, goods, and services within and between population and business centers." Howard County: "PlanHoward 2030 aims to promote a better balance among all of the County's transportation options."	Increase public awareness of the relationship between personal vehicles miles traveled and highway congestion, air quality, greenhouse gases, and energy independence, as well as how more compact growth patterns and alternate modes of travel can help achieve a sustainable and more environmentally and personally healthy balance. Coordinate State, regional, and local planning and implementation for critical improvements and new transportation facilities based on evaluation of options using a wide range of performance, health, environmental, and financial criteria. Prioritize and pursue cost-effective, long-term capacity improvements to the road and highway network to support future growth in accordance with place type designations. Enhance the accessibility and quality of existing and future transit services. Utilize regional studies to develop an effective plan for significantly expanded regional transit service. Reduce highway congestion, energy consumption, and greenhouse gases by increasing the number of residents using alternate modes of transportation. Reduce highway congestion, energy consumption, and greenhouse gases through transportation demand management.

Montgomery County, Pennsylvania

Montgomery County, Pennsylvania is a large suburban jurisdiction, with a population of 815,876, located northwest of Philadelphia. Similar to Anne Arundel County, it contains a variety of land uses, ranging from farms and open land to townhouses and single family homes, and is proximal to a thriving urban region. The cost of living in Montgomery County is considerably lower than Anne Arundel County and it is less diverse, but the two counties are otherwise statistically similar (Table 4).

Table 16: Key Demographics of Anne Arundel County and Montgomery County, PA

	Anne Arundel County	Montgomery County, PA
Median Household Income	$91,918	$81,902
Poverty Rate	6.1%	6.6%
Employment Rate	64.2%	64.0%
Average Commute Time	29.9	28.1
% Drove Alone	80.1%	76.4%
% Carpool	7.6%	9.3%
% Public Transportation	3.7%	5.1%
% Walk, Bike, Work from Home, Other	8.6%	9.2%
% High School Diploma	91.9%	93.9%
% Bachelor's Degree or Higher	39.4%	47.5%
% Owner-Occupied Housing	73.9%	72.2%
Population / sq mile (2010)	1,296	1,656

(Source: American Community Survey, 2016)

In 2005, Montgomery County published a Comprehensive Transportation Plan, with amendments added in 2010. It includes a vision, objectives, and performance measures (bike only). Montgomery County frames its plan under guiding smart growth principles, recognizing the symbiotic relationship between land use and transportation. A summary of the plan is found in Table 5.

Table 17: Vision, objectives and performance measures (bike only) of Montgomery County Comprehensive Transportation Plan

Vision	Objectives	Performance Measures
"In 2025, the County will have better managed traffic congestion and more transportation choices."	Manage traffic congestion.	Number of municipalities that incorporate the bicycle mobility policies and recommendations into local comprehensive plans. Number of municipalities with adequate ordinance provisions addressing bikeable roadway design.
	Improve transportation safety.	Number of municipalities with ordinance requirements for the provision of end-of-trip bicycle facilities. Miles of programmed projects that will increase bikeable roads.
	Increase opportunities to take public transit, walk, ride a bike, or other non-automotive transportation means.	Miles of road that accommodate Group A bicyclists. Miles of road that accommodate Group B/C bicyclists.[3] Percentage of work destinations that have installed end-of-trip facilities, including showers.
	Move goods efficiently and considerately.	Percentage of shopping, recreation, academic and, intermodal destinations that have installed end-of-trip facilities.
	Maintain air travel as a transportation option.	Percentage of buses (serving bus routes in the county) equipped with a bike rack. Percentage of transit vehicles that accommodate bicyclists by permitting bikes to be carried aboard. Miles of trails.

[3] Groupings refer to skill/comfort level of bicyclists on certain roadway types with Group A being the most skilled and Group C being the least skilled

St. Charles County, Missouri

St. Charles County is a large jurisdiction in Missouri, northwest of St. Louis, with a population of 379,856. It is bisected by two major interstates and several other highly trafficked highways. It has strikingly low diversity and is the wealthiest county in Missouri, containing many of St. Louis's northern suburbs. St. Charles County is more reliant on personal vehicles than Anne Arundel County, and accordingly has lower housing density. Table 18 summarizes key demographic similarities and differences.

Table 18: Key Demographics of Anne Arundel County and St. Charles County, MO

	Anne Arundel County	St. Charles County, MO
Median Household Income	$91,918	$75,603
Poverty Rate	6.1%	6.1%
Employment Rate	64.2%	68.2%
Average Commute Time	29.9	25.4
% Drove Alone	80.1%	86.4%
% Carpool	7.6%	6.1%
% Public Transportation	3.7%	0.2%
% Walk, Bike, Work from Home, Other	8.6%	7.4%
% High School Diploma	91.9%	94.3%
% Bachelor's Degree or Higher	39.4%	36.1%
% Owner-Occupied Housing	73.9%	79.66%
Population / sq mile (2010)	1,296	643

(Source: American Community Survey, 2016)

In 2007, the East-West Gateway Council of Governments created The St. Charles County Transportation Plan 2030. The plan includes a vision and goals, excluding performance measures (Table 19).

Table 19: Vision and objectives of St. Charles County Transportation Plan 2030

Vision	Objectives
"Our transportation system provides alternative, affordable, and efficient modes of transportation that are congestion free, safe, environmentally friendly, and promote economic development."	Provide an efficient, congestion-free, and well managed road system. Provide alternative and affordable modes of transportation. Provide an airport that serves the needs and economic growth of the area. Provide an environmentally friendly and safe transportation system. Continue the expansion of the roadway system in a way to accommodate the population and economic development

Wake County, North Carolina

Wake County is a county in North Carolina, with Raleigh at its center. It has a population of 998,576, making it North Carolina's second most populous county. It is part of the Raleigh-Durham-Chapel Hill "Research Triangle", named for the area's three anchor universities. Accordingly, residents are highly educated; over 50% have a college education or higher, as compared to the national average of 30.3% or the Anne Arundel County average of 39.4%. Very few Wake County residents use alternative modes of transportation to commute to work; in fact, the high rate of non-automotive transportation in Wake County is because a significant number of residents work from home, a symptom of a thriving technology industry. Similar to Anne Arundel County, Wake County residents cherish its rural charm. More demographics are summarized in Table 20.

Table 20: Key Demographics of Anne Arundel County and Wake County, NC

	Anne Arundel County	Wake County, NC
Median Household Income	$91,918	$70,720
Poverty Rate	6.1%	10.8%
Employment Rate	64.2%	66.7%
Average Commute Time	29.9	24.5
% Drove Alone	80.1%	79.5%
% Carpool	7.6%	9.1%
% Public Transportation	3.7%	1.1%
% Walk, Bike, Work from Home, Other	8.6%	10.3%
% High School Diploma	91.9%	92.3%
% Bachelor's Degree or Higher	39.4%	50.1%
% Owner-Occupied Housing	73.9%	63.4%
Population / sq mile (2010)	1,296	1,079

(Source: American Community Survey, 2016)

The Wake County Transportation Plan was published in 2003 in response to a rapid growth. It outlines projects spanning over 30 years, and includes a vision. Its goals are repurposed from its Comprehensive Plan, with an additional list provided by working citizen group. Table 21 contains the vision, county objectives, and objectives from Citizen Advisory Groups (CAGS). Performance measures are qualitative and project-based, by transportation mode. The plan identifies responsible parties for each strategy and recommends annual progress reports. Wake County also coordinates with the Capitol Area Metropolitan Planning Organization to plan for transportation improvements and public transportation in the Research Triangle region.

Table 21: Vision and objectives of the Wake County Transportation Plan

Vision	County Objectives	CAG Objectives
"The goal of the Wake County Transportation Plan is to identify a diversified multimodal transportation investment program to provide safe, efficient, and effective mobility for all citizens and visitors."	Respect the uniqueness of each community. Water and sewer facilities shall be planned rationally and shall not promote the premature conversion of open space, nor encourage development in environmentally sensitive or hazardous areas. Land use plans and growth management tools shall promote mixed-use centers with a diversity of non-residential and residential development types and costs. The growth management plan shall endorse neighborhood/community schools as a critical building block in creating a sense of community. Open space recommendations shall include buffers along streams, lakes, and infrastructure corridors, and connect with transportation routes. A planned system of interconnected local roads designed for multimodal use shall be supported. Growth-induced demand and costs for infrastructure shall be borne by those primarily responsible for the increased demand and costs.	Develop a plan compatible with future land use plans Create a plan that accommodates community growth and its related traffic increases Create a system of interconnected streets (thoroughfares, collector streets, and local streets) Preserve future transportation corridors Maintain and improve roadway safety Relieve existing congestion on key roadways Create interconnected bicycle and pedestrian networks Preserve the county's rural character Provide and plan for future public transit service expansions Minimize environmental impacts Implement roadway projects such as the Outer Loop and US 64 Bypass Support the implementation of long-range regional and commuter rail transit plans

Summary on Vision, Goals, Objectives and Performance Measures from Comparator Jurisdictions

Based on our review of comparator jurisdictions, local governments in Maryland and across the country generally express similar values in the transportation realm. Table 22 lists subjects among each jurisdiction's goals. The top five mentioned subjects are highlighted in blue.

Table 22: Subjects covered in transportation goals for a subset of jurisdictions statistically similar to Anne Arundel County.

Subject	Montgomery	Bucks	Arapahoe	Frederick	Baltimore	Howard	St. Charles	Wake	Boulder
Safety	**X**	**X**		**X**			**X**		
Maintenance				X				X	X
Service Quality		X	X	X					
Conservation/ Environment					**X**	**X**	**X**	**X**	**X**
Non-Automotive Options	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Goods	X	X							
Air Travel	X	X					X		
Congestion	**X**	**X**				**X**	**X**	**X**	
Land Use/ Transportation		**X**	**X**	**X**	**X**			**X**	
Accessibility						X			X
Economic					X		X		X
Transportation Mindfulness						X			
Community Stewardship								X	X
Agency						X			
Transit Service Expansion						X		X	
Transportation Demand Management				X		X			
Resiliency									
Cost-Effectiveness						X			X
Affordability							X		
Public Involvement									
Equity									X
Tracking			X						

Approximately half of the jurisdictions surveyed referred back to their general or comprehensive plan as providing the guiding vision for transportation systems, three gave no vision statement at all, and the remainder had some form of vision statement.

As to performance measures, only one jurisdiction notes performance as part of their transportation planning process. Two other jurisdictions recognize that performance measures are needed and call for the establishment thereof; one specifies a wish list, while the other mentions the subject in passing. At the regional level, the Baltimore Metropolitan Council's long-range plan incorporates tracking mechanisms. At the state level, MDOT has a separate initiative for long-range plan goal tracking, the MDOT Excellerator. Interestingly, each set of aforementioned performance measures is misaligned with their corresponding plan's goals. The MDOT Excellerator is a notable exception, as its explicit purpose is to create performance measures that reflect the goals of the state. Table 23 illustrates the misalignment of goals and performance measures for each surveyed plan that incorporates both.

Table 23: Comparison of goals and performance measures among Montgomery County, Arapahoe County, the Baltimore Metropolitan Council, and the MDOT Excellerator

	Montgomery County		Arapahoe County		Baltimore Metropolitan Council		MDOT Excellerator	
	Goals	Performance Measures	Goals	Performance Measures (proposed)	Goals	Performance Measures	Goals	Performance Measures
Safety	X			X	X	X	X	X
Maintenance				X	X	X		
Service Quality		X	X	X	X		X	X
Conservation/Environment					X	X	X	X
Non-Automotive Options	X	X	X		X	X		
Goods Movement	X					X		
Air Travel	X							
Congestion	X			X	X		X	X
Land Use/ Transportation			X					
Accessibility				X	X			
Economic Development				X	X		X	X
Transportation Mindfulness					X			
Community Stewardship							X	X
Agency Coordination					X		X	X
Transit Service Expansion					X	X		
Transportation Demand Management				X				
Resiliency								
Cost- Effectiveness							X	X
Affordability								
Public Involvement				X			X	X
Equity								
Tracking			X					

While each jurisdiction has its own "spin" or precise language used to reflect the values, nearly all of the jurisdictions surveyed expressed the following value statements:

- Transportation systems should be available, safe and efficient for all users
- Transportation systems should provide choices in mode of travel to major destinations
- Transportation and land use planning should be closely aligned
- Managing congestion is a priority
- Transportation systems should include a focus on environmental conservation

PART 2: Developing the Vision, Goals, Objectives and Performance Measures

Best Practices in Establishing Performance Measures

Without meaningful performance measures, goals amount to little more than aspirational statements and buzzwords. The lack of alignment between performance measures and goals is pervasive, evident not only among the plans reviewed in this report, but in transportation plans across the world. A 2017 Brookings report illlustrates this issue for a particularly ambiguous word, accessibility. Accessibility is the ease of reaching valued destinations for all demographics, as defined by cost, logistics, time traveled, and facility of use; it is a great umbrella term that encompasses numerous ideals of a transportation plan.

Many transportation plans state accessibility as a goal, but do not define it precisely in their objectives or metrics. After reviewing several plans that provide more focused guidance around accessibility, Brookings recommends defining accessibility by access to destinations, rather than to transport amenities, and then gauging accessibility across multiple modes. Intuitive measures are user cost and time traveled. Additionally, the plans that Brookings dubs "success stories" incorporate accessibility maps that illustrate the difference in accessibility measures before and after the proposed improvements are made. Maps are a helpful tool because they can heighten the visceral effect of a proposal's potential.

The Federal Highway Administration, the Federal Transit Administration, and the Transportation Research Board are excellent reasources for establishing performance metrics. In each of their overviews, they express the importance of linking performance measures back to goals, concuring with the Brookings report. Within the pedestrian and bicycle facility realm, the FHWA identifies seven subjects that are common to transportation plan aspirations- connectivity, economic, environment, equity, health, livability, safety- and links them to 28 unique measures with guidence on how to track them and where they are already being tracked.[4] They also suggest data sources; some already exist while others need to be observed per jurisdiction. TRB has a comprehensive guide on how to develop performance measures for ten categories of measures; availability, service delivery, community, travel time, safety and security, maintenance and construction, economic, capacity, paratransit, and comfort. In their report, they include what they consider to be a best practice for a county, St. Lucie County, Florida. Their measures include total annual ridership, passengers per mile, passengers per hour, subsidy of cost per passenger, cost per vehicle hour, cost per vehicle mile, passenger complaints, percentage of no-shows, per capita cost of service, operating expense, miles between safety incidents, passenger trips per employee, average fare, average age of fleet, trips per vehicle, and cost per trip.

A major issue is that useful metrics are not consistently collected in jurisdictions, or that the data is unreliable or subjective. A focus of practitioners must be implementing tracking systems that allow for the quantification of performance measures, especially spatially to illustrate the relationship between

[4] FHWA Guidebook for Developing Pedestrian and Bicycle Performance Measures, March 2016

land use and transportation. A strategy for implementing tracking systems is to promote their shared use among other official documents that drive decision-making. When establishing performance measures, it is helpful to agree upon desired outcomes between agencies.

Practical Considerations in Establishing Anne Arundel County's Vision, Goals, Objectives and Performance Measures

As indicated above, there is broad agreement on transportation planning goals at the federal, state, and regional levels. Anne Arundel County's goals as expressed in the 2009 General Development Plan, views of County residents and discussions with County staff indicate a similar agreement. We turn now to a series of questions for consideration of the County's transportation vision, goals, objectives and performance measures. These are practical questions that affect how the County uses the TFMP to drive and measure performance over the 20-year time horizon. Specifically, should the vision, goals, objectives and performance measures

- be related to matters where the state controls the inputs and outcomes?
- include matters related to system preservation/asset management or only capacity improvements?
- include measures that require new data collection at the County level?
- be defined at the countywide level or have the option of being disaggregated by corridor or a smaller planning area?

These questions are discussed below and are very interrelated.

State vs. County Inputs and Outcomes

This is arguably the most difficult of the questions to answer. The TFMP is intended to guide both county investments and county advocacy for investments in state transportation facilities. As a very practical matter, state investments in transportation dwarf county investments. In FY2018, state investments total approximately $175 million[5], while county investments come in at $56 millionSystem users certainly travel more on state facilities than local facilities, except presumably for bicycle and pedestrian facilities. But their use does not reflect the funding disparity. Breaking down the numbers, VMT on state roads is about 75% of total VMT for Anne Arundel County, while county VMT is about 25% (Table 24). Additionally, there are more miles of roadway in Anne Arundel County that are county or municipality-owned.

Table 24: County and State-owned roads in Anne Arundel County

Measure	County	State
Vehicle Miles Travelled	24.8%	75.2%
Lane Miles	75.9%	24.1%
Centerline Miles	83.3%	16.7%

[5] County-specific projects being undertaken by SHA, MdTA and The Secretary's Office.

Additionally, congestion and transit mobility measurements are far more accurate for state transportation facilities rather than local facilities. Finally, the life-cycle of developing and implementing projects on state facilities can be orders of magnitude longer than the project development lifecycle for projects on local facilities.

It is recommended that the TFMP:

- Periodically report on existing goals and performance measures for state transportation facilities in the time cycle and form set at the state level, but not set targets for those performance measures unless they can be disaggregated to the county level.
- Establish performance measures only for outcomes that can be controlled by the county.

System Preservation[6] vs. Transportation Capacity

In discussions with County staff, reviewing the 2009 General Development Plan and public comments on the Maryland Transportation Plan, it is clear that the maintenance of current transportation assets – roads, bridges, transit vehicles, etc. is a priority in Anne Arundel County. As described in the 2017 State Transportation Improvement Program, MDOT indicates that

> asset maintenance and preservation are prioritized to extend the useful life of existing facilities and equipment in a fiscally responsible manner. MDOT seeks to maximize the value and performance of current resources in order to capture all of the benefits from the existing system before making new investments.[7]

In 2017, system preservation accounted for 38.7% of MDOT's capital budget. In 2016, 47.7% of the MDOT capital budget was for system preservation. A review of Anne Arundel County's capital budget since FY02 indicates that an average of 67% of all transportation capital funds is appropriated annually for system preservation projects.[8]

Traffic congestion and the reliability of travel times is undoubtedly a quality of life concern for County residents and workers, while a dollar spent on system preservation is a dollar not spent to expand system capacity. As shown in the long list and range of system capacity projects listed in Technical Memorandum #1 - Summary of Prior Transportation Studies, there is no shortage of capacity improvement projects identified throughout the County. Rather than debating over *capacity or system preservation*, we suggest that a more appropriate focus be on *how* system capacity needs are met

[6] System preservation refers to asset maintenance work on all modes of surface transportation owned and operated by the County or in certain instances, the Regional Transit Authority (RTA). System preservation includes safety improvements. "Capacity" refers to any transportation system expansion including roads, bicycle/pedestrian improvements and transit services.
[7] MDOT 2017 State Transportation Improvement Program, Page 11
[8] SWA consolidated and sampled the annual capital program for FY02 – FY17 in order to arrive at this estimate. Additional detail will be provided in the technical memorandum supporting the draft Constrained Long Range Plan.

whether via transportation systems and management operations projects, new or expanded roads, or improved transit services.

It is recommended that the County performance measures focus on system preservation activities (pavement conditions, bridge ratings, etc.) and add capacity-related performance measures that are uniquely related to County-owned facilities and where such data is readily accessible. Otherwise, the County should simply use existing data from the Baltimore Metropolitan Council or the State Highway Administration to report on capacity-related data on state transportation facilities.

Recommendation

It is recommended that the TFMP define objectives and establish targets for performance measures where the County can control the transportation outcome through its own investments and policies (i.e. on County-owned or operated facilities). Where the County can influence but not control *a transportation outcome (i.e. State-owned or operated facilities), the County should periodically report on progress towards performance targets but not set performance* targets*.*

Capacity for New Data Collection, Reporting and Disaggregation

SMART goals share five qualities; they are specific, measurable, attainable, relevant, and time-based. Specificity refers to the purpose of the goal; what is being accomplished, its importance to the vision, who is involved, the location, and possible limitations. Measurability is quantitative and it should have a clear end point. This aspect grounds the goal, ensuring that subjectivity cannot be at play in measuring achievement. Attainability refers to realistic goal-setting, given a budget, land use constraints, staff reach, and existing technologies. It answers the question of how the goal can be achieved. Relevance refers to the context of the existing conditions and possible barriers. If a goal is relevant, it is carried out in a place and time where it may be achieved, it is being enacted by the right organization, it matches a need, and it is applicable to the current socioeconomic environment. Time-based means a reasonable rate of progress. Each goal should have a time line of achievement, in weeks, months, and years. Ultimately, each of these adjectives points towards goals that are results-driven.

Anne Arundel County staff is stretched thin in managing daily performance of the County's transportation system and in planning, coordinating and delivering system preservation and capacity projects. As such their capacity to accurately collect and manage data sets is constrained. There is no shortage of transportation data collected at the regional level that can be disaggregated to the County level or smaller geographic units.

Recommendation

It is recommended that County should use existing data from the Baltimore Metropolitan Council or the State Highway Administration to report on capacity-related data, however the County will have to produce performance data for elements under the County's control.

Part 3: Proposed Vision, Goals, Objectives and Performance Measures

Based on a review of planning documents from similarly situated jurisdictions and with an intent to reflect the goals of partner agencies at the regional and state level, the following vision statement is proposed for the Anne Arundel County Transportation Plan.

> *Anne Arundel County aspires to provide safe, efficient, equitable, and sustainable multi-modal mobility that provides residents, travelers and visitors with connectivity and choice.*

Goal: A safe transportation system

Objective: Reduce injuries and fatalities and injuries for all modes.

PERFORMANCE MEASURES

Performance Measure	Baseline	2040 Target
Number of vehicle occupant fatalities annually	34	0
Number of bicycle fatalities annually	1	0
Number of pedestrian fatalities annually	8	0
Number of vehicle occupant serious injuries annually	728	0
Number of bicycle user serious injuries annually	14	4
Number of pedestrian serious injuries annually	60	15

Goal: A multimodal transportation system that provides practical and reliable transportation choices and connections for all users.

Objective: Improve transportation system reliability

PERFORMANCE MEASURES

Performance Measure	Baseline	2040 Target
Travel time reliability on major roadway corridors	See details below	
Travel time reliability on secondary roadway corridors		
On-time performance of RTA and County-operated transit services	44%	85%

	Corridor	AM	PM	
Travel Time Reliability on Selected State Roads	I-97	1.23	1.27	2016 Maryland State Highway Mobility Report http://www.roads.maryland.gov/OPPEN/2016_mobility_report_appendix.pdf this uses the PTI
	MD 32	1.15	1.26	
	US 50	1.10	1.20	
	MD 100	1.14	1.37	
	MD 295	1.26	1.73	
		AM	PM	
	MD 2 -- Ordnance Road (MD 710) to Furnace Branch Road (MD 270)	S/B	N/B	
	MD 3 -- Annapolis Road (MD 175) to St. Stephens Church Road	N/B	S/B	
	MD 175 -- MD 295 to Ridge Rd.	W/B	E/B	
	MD 198 -- MD 197 to Brock Bridge Road	E/B	W/B	
	MD 450 -- Riva Road to MD 2	E/B	W/B	
	Benfield Blvd from I-97 to MD 2	Data not currently collected by MDOT SHA or Anne Arundel County. A travel monitoring program should be established and performance goals set.		
	MD 170 from MD 175 to MD 2			
	MD 713 from MD 176 to MD 175			
	College Parkway from MD 2 to MD 179			
	MD 665/Forest Drive from US 50 to Bay Ridge Avenue			
	MD 214 from MD 424 to Shoreham Beach Roard			
	MD 256 from Rockhold Beach Road to MD 2			
	MD 177 from MD 2 to Lake Shore Drive			

*** The Travel Time Reliability Index represents the extra time that travelers must add to their average travel time when planning trips to ensure on-time arrival on the worst traffic day of the month. For example, a Travel Time Index of 40 percent (1.40 as expressed above) means that for a trip that usually takes 20 minutes a traveler should budget an additional 8 minutes to ensure on-time arrival most of the time. For secondary corridors, SHA does not publish a specific travel time index; however, the color coding represents the agency's estimate of travel time reliability using a color-coding system.

Objectives

Provide practical transportation choices throughout the County.
Increase non-single occupant vehicle mode share for commuter trips to and from Town Centers.

Performance Measures

Performance Measure	Baseline	2040 Target
Directional miles of striped on-street bicycle lanes	25.9	69.9
Directional miles of protected on-street bicycle lanes	0.9	6
Miles of shared-use path	30	81
Number of daily round trip MARC Trains to Washington DC daily -- Penn Line	27	32
Number of daily trips between Baltimore and Washington DC on the MARC Camden Line	10	20
Number of daily commuter bus trips from Anne Arundel County to Washington, DC (1)	22	44
Number of daily commuter bus trips from Anne Arundel County suburban DC employment centers (2)	18	36
Percentage of State-owned roadway directional miles within urban areas that have sidewalks compliant with the Americans with Disabilities Act	11%	22%
Percentage of County-owned roadway directional miles within urban areas that have sidewalks that are compliant with the Americans with Disabilities Act	Data Not Currently Available. It is recommended that the County update its GIS database to capture this information.	
% of seniors and persons with mobility challenges within one-mile of a bus route.	67%	80%
Countywide non-single occupant vehicle mode share for commute trips	14.80%	16.30%

	Odenton		Glen Burnie		Parole	
	2017	2040	2017	2040	2017	2040
Drove alone	79%	71%	82%	74%	79%	71%
Walk, Bike, Transit, Carpool, Work from Home	21%	29	18%	26%	21%	29%

Goal: A transportation system that is resilient and protects the environment

Objectives:

Improve air quality
Improve water quality
Identify assets vulnerable to the effects of climate change.

PERFORMANCE MEASURES:

Performance Measure	Baseline	2040 Target
% of unmanaged impervious acres within County Jurisdictional Municipal Separate Storm Sewer System (MS4) area.	79%	60%
Electrical charging stations installed	44	150
Vehicle miles traveled per capita	10,965	10,417
% 0f County-owned transit fleet that is low or no emission	0%	100%

Goal: A transportation system that is in good condition

Objective: All County-owned transportation assets should be in good condition.

PERFORMANCE MEASURES

Performance Measure	Baseline	2040 Target
% of roadway lane miles in good condition	92%	95%
% of bridges in good or fair condition (4)	97.5%	97.5%
% of miles of shared use paths in good condition	N/A	95%
Average age of County-owned transit fleet	13	12
Average age of County-owned paratransit fleet	5.3	8

Conclusion

Objectives and performance measures are recommended to advance and monitor the County's achievement of the transportation vision again recognizing that only certain assets are under its direct control. Performance measures are intended to be practical, transparent and relate to the quality of life of County residents. All performance measures use data that is published by other transportation agencies using data provided by the County or rely on existing geospatial data available on the County's website so that it is possible to report outcomes in a consistent manner, year-over-year.

ANNE ARUNDEL COUNTY
TRANSPORTATION MASTER PLAN

TECHNICAL MEMORANDUM #3
Travel Demand Forecast Review

ANNE ARUNDEL COUNTY MARYLAND

Prepared for the Anne Arundel County Office of Transportation
March 2019 – Final

SABRA & ASSOCIATES
Engineering Innovative Solutions

Note: The purpose of each Technical Memorandum prepared for the Office of Transportation is to present facts, analysis, ideas, issues and recommendations that will inform the Anne Arundel County Transportation Master Plan. The views expressed and recommendations offered in each memorandum are solely based on the consultant's judgment and should not be considered as endorsed by the Office of Transportation or any other County agency or officer.

The purpose of this memorandum is to document SWA's methodology, analysis and findings concerning the efficacy of transportation demand forecasts prepared for the 2012 Corridor Growth Management Plan. This was done relative to the use of those same forecasts for the 2040 Transportation Functional Master Plan. In other words, can the County have reasonable confidence in the 2012 analysis so that a transportation plan through 2040 can be prepared?

Travel Forecasting Model Comparison

The Anne Arundel County travel forecasting model, known as "Sam2" (referred to herein as the "CGMP model"), is based on previous generations of travel forecasting models prepared by the Baltimore Metropolitan Council (the "BMC model"). The CGMP model is based on actual and forecasted population, household and employment from 2005 through 2035. It was used in preparation of the Corridor Growth Management Plan (GCMP). The current BMC model used in this analysis for comparative purposes is based on actual and forecasted population, households and employment from 2012 through 2040. It is more robust in its technical detail regarding tolling, TAZs, mode split and information regarding trips to and from BWI Thurgood Marshall Airport.

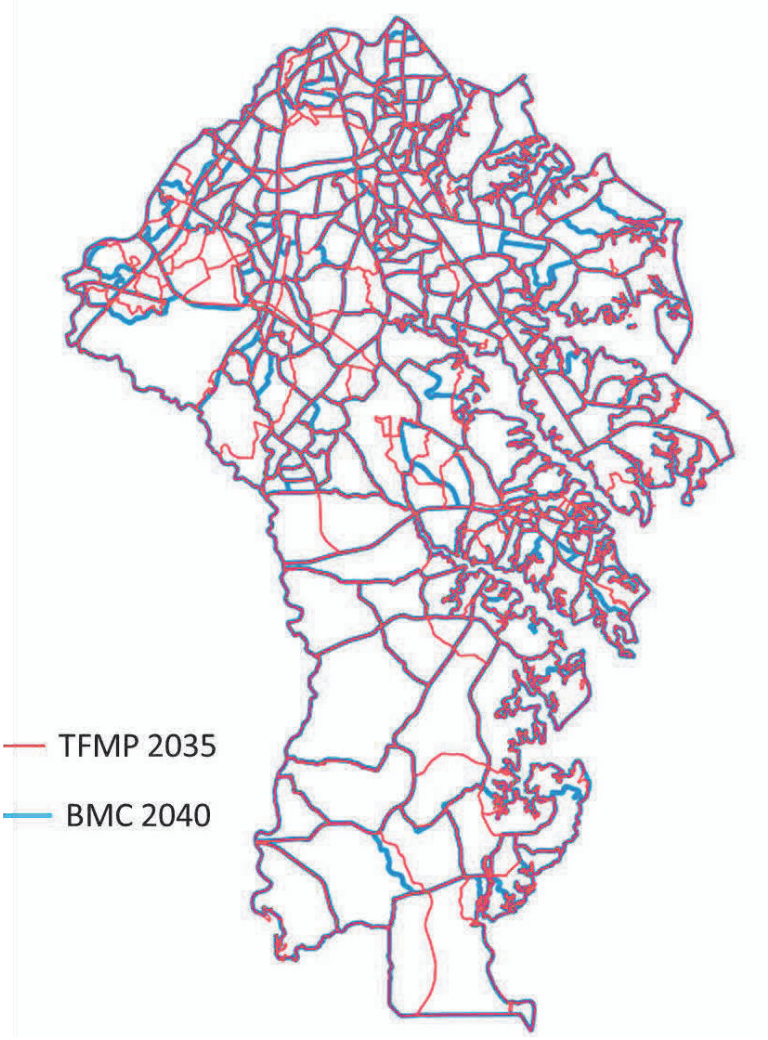


Figure 1 Traffic Analysis Zone (TAZ) comparison

While references are made in this memorandum to the BMC model, it is important to note that travel forecasting includes data for Washington, DC, Montgomery County, Prince George's County and Frederick County, in addition to the BMC member jurisdictions of Anne Arundel County, Baltimore City, Baltimore County, Carroll County, Harford County, and Howard County. As part of the previous 2012 TFMP exercise, the TAZs within Anne Arundel County were subdivided and additional network detail added. The comparison of the TAZs for Anne Arundel County between the two models is shown in **Figure 1.**

Regional Population and Employment Distribution

Changes in population, households and employment affect the number of trips to, from and within Anne Arundel County. The CGMP model assumed year 2035 regional population of 6.34 million people and the BMC model assumes year 2040 regional population of 6.45 million people, a difference of less than 1%. Only Washington, DC is forecasted in the BMC model to have a change in share of regional population more than 1% greater (or less) than the CGMP model. Household data tracks similarly to population data between the two models.

Changes in employment size and share in each jurisdiction were slightly more pronounced. The total number of jobs in the region in the CGMP model (2035 horizon) and the BMC model (2040 horizon) is forecasted to be approximately 150,000 jobs less in 2040 than had been projected for 2035. For Washington, DC, approximately 13,000 more jobs are forecasted between the CGMP model (2035 horizon) and the BMC model (2040 horizon), a 3.47% total difference. Nearly 24% of all jobs in the region are projected to be in Washington, DC and nearly 17% in Montgomery County by 2040 compared to 20% and 16%, respectively, forecasted for 2035.

> ***Finding:*** *Based only on population and housing differences in the two models, no further modeling is necessary for the TFMP. A shift in regional employment towards Washington, DC and Montgomery County from Baltimore City and Baltimore County may give rise to further travel demand forecasting conducted jointly with the MWCOG. However for preparation of the TFMP, qualitative rather than quantitative consideration is enough.*

Regional Travel Patterns

The differences in population, households, and employment assumptions between the 2012 TFMP 2035 CLRP and the BMC 2040 2040 forecasts in combination with the changes in network assumptions cause shifts in the travel to, from, and within Anne Arundel County (in travel forecasts, this is called trip distribution). illustrating this, **Figure 4** and **Figure 5** provide county-to-county summaries of the daily vehicle trips to, from, and within Anne Arundel County (in origin to destination format). As can be seen, the largest numerical difference is the increase within Anne Arundel County itself, although this amounts to only a 10. 9 % increase in travel

Table 1. Comparison of trips to, from and within Anne Arundel County

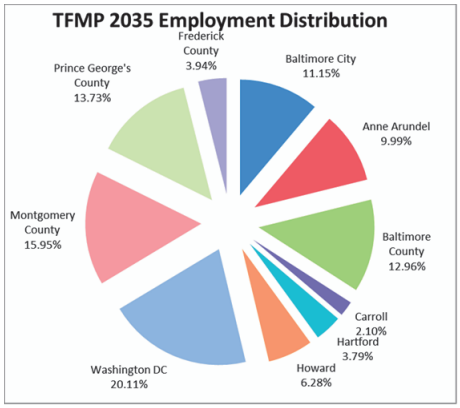
	FROM:				TO:			
	TFMP 2035 CLRP	BMC 2040 CLRP	Change	% Change	TFMP 2035 CLRP	BMC 2040 CLRP	Change	% Change
Baltimore City	68,368	77,521	9,153	13.4%	68,643	79,195	10,552	15.4%
Anne Arundel Co.	1,126,001	1,248,346	122,345	10.9%	1,126,001	1,248,346	122,345	10.9%
Baltimore Co.	67,105	70,792	3,687	5.5%	67,718	71,934	4,216	6.2%
Carroll Co.	3,002	10,085	7,083	235.9%	3,031	10,186	7,155	236.1%
Harford Co.	3,805	5,842	2,037	53.5%	3,766	5,738	1,972	52.4%
Howard Co.	75,172	118,867	43,695	58.1%	75,604	119,278	43,674	57.8%
Queen Anne Co.	NA	6,419	NA	NA	NA	6,420	NA	NA
Washington DC	12,547	23,852	11,305	90.1%	12,523	24,294	11,771	94.0%
Montgomery Co.	17,869	36,333	18,464	103.3%	17,779	36,491	18,712	105.2%
Prince George's Co.	77,835	104,412	26,577	34.1%	77,924	105,592	27,668	35.5%
Frederick Co.	1,935	8,966	7,031	363.4%	1,925	8,967	7,042	365.8%
External	60,794	36,239	-24,555	-40.4%	60,884	34,631	-26,253	-43.1%
Total	1,514,433	1,747,674	233,241	15.4%	1,515,798	1,751,072	235,274	15.5%

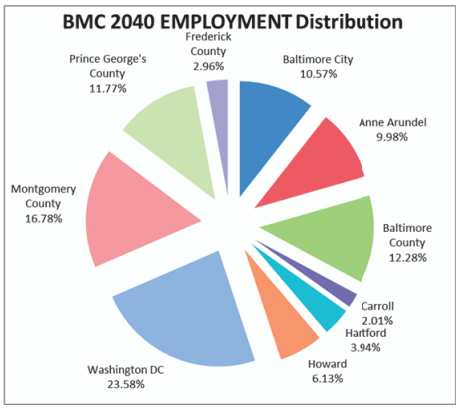
within the County. The largest increases in origin trips from Anne Arundel County occur destined to Howard County. This followed by vehicle trips destined to Prince George's County, Montgomery County, and Washington, DC. The largest increase in vehicle trips destined to Anne Arundel County follows a similar pattern, reflecting the return of commuter trips at the end of the day.

Note that while very low numerically, the highest percentage increase in vehicle trips occurs traveling both to and from Carroll and Frederick Counties. The number of vehicle trips traveling both to and from Montgomery County also more than doubles.

Overall, there is an increase in vehicle trips of 233,241 traveling from Anne Arundel County (15.4%) and 235,274 trips traveling to Anne Arundel County (15.5%) between the two forecasts. This is significant, because, as is discussed in the next section, there a reduction in the network assumed to meet this demand. This may also give rise to the need for discussion of additional capacity on facilities parallel to the SHA network as well as increased transit options within the county.

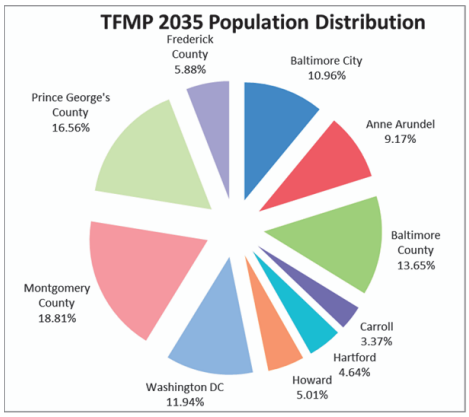
> ***Finding:*** *The growth of travel towards Carroll, Frederick, Howard and Montgomery Counties being at a greater rate than to Baltimore City and Baltimore County potentially has significant impacts on the regional transportation network and policy setting.*

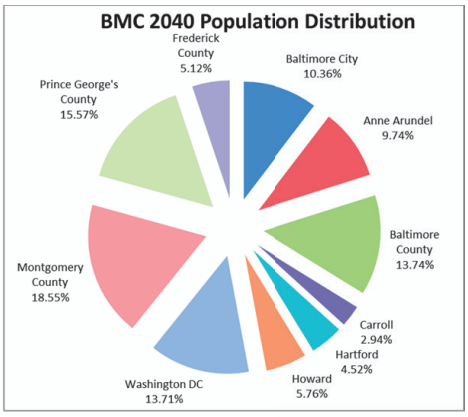




Employment	TFMP 2035		BMC 2040		% Share
County	Employment	% EMP	Employment	% EMP	Change
Baltimore City	485141	11.15%	449081	10.57%	-0.58%
Anne Arundel	434510	9.99%	424052	9.98%	-0.01%
Baltimore County	563630	12.96%	521519	12.28%	-0.68%
Carroll	91314	2.10%	85348	2.01%	-0.09%
Hartford	165002	3.79%	167266	3.94%	0.14%
Howard	273062	6.28%	260318	6.13%	-0.15%
Washington DC	874689	20.11%	1001814	23.58%	3.47%
Montgomery County	693610	15.95%	712926	16.78%	0.84%
Prince George's County	596986	13.73%	499847	11.77%	-1.96%
Frederick County	171156	3.94%	125556	2.96%	-0.98%
Total	4349100	100.00%	4247727	100.00%	

Figure 2. Comparison of Regional Population Assumptions





Population	TFMP 2035		BMC 2040		% Share
County	Population	% Pop	Population	% Pop	Change
Baltimore City	694778	10.96%	667677	10.36%	-0.60%
Anne Arundel	581588	9.17%	628048	9.74%	0.57%
Baltimore County	865312	13.65%	885783	13.74%	0.09%
Carroll	213536	3.37%	189574	2.94%	-0.43%
Hartford	294429	4.64%	291089	4.52%	-0.13%
Howard	317302	5.01%	371621	5.76%	0.76%
Washington DC	757073	11.94%	883568	13.71%	1.76%
Montgomery County	1192459	18.81%	1195538	18.55%	-0.27%
Prince George's County	1050055	16.56%	1003754	15.57%	-0.99%
Frederick County	372772	5.88%	329955	5.12%	-0.76%
Total	6339304	100.00%	6446607	100.00%	

Figure 3. Comparison of Regional Population Assumptions

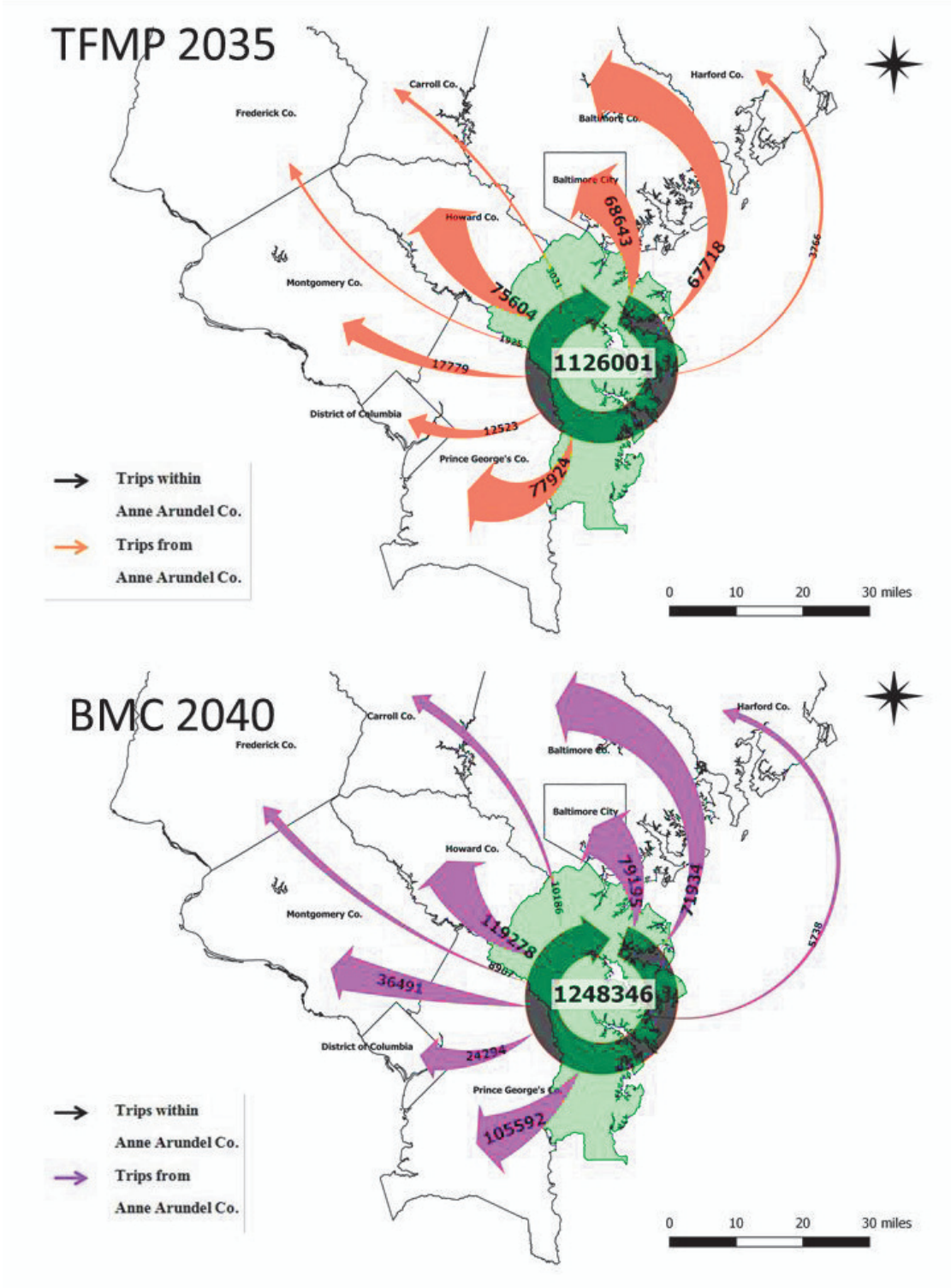


Figure 4. Comparison of Daily Vehicle Trips from Anne Arundel County

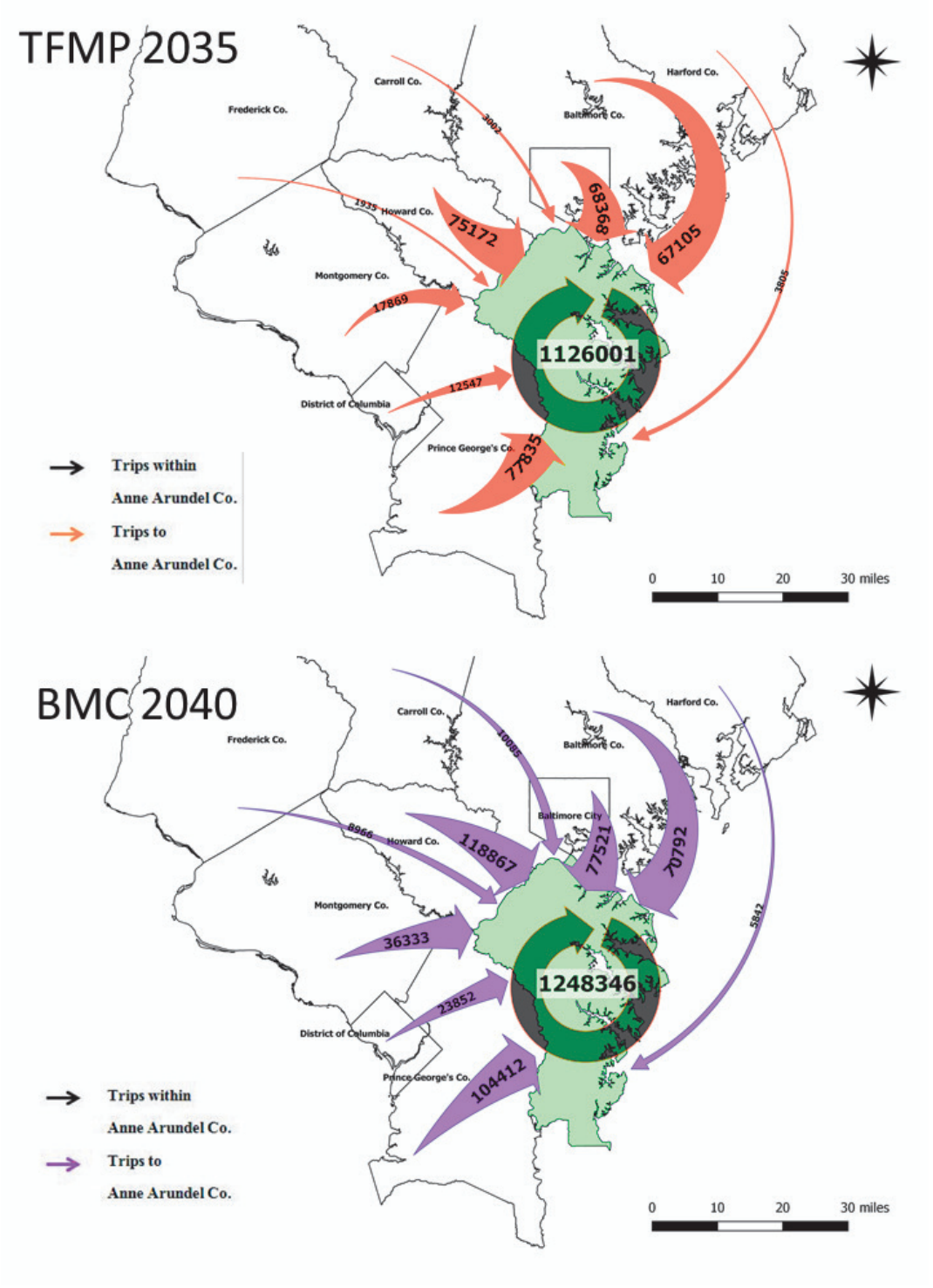


Figure 5. Comparison of Daily Vehicle Trips to Anne Arundel County

Major Corridor Facility Assumptions

The most significant distinction between the CGMP 2035 Model and the BMC 2040 Model scenarios is the assumed/planned roadway capacity and facility types within Anne Arundel County. After the 2008 economic downturn and the 2010 Census, there was a major reassessment of what is financially feasible within the regional Constrained Long Range Plan. As a result, **there is a significant reduction in planned roadway capacity between the two models in nearly every corridor being studied as part of the Transportation Functional Master Plan**. The differences in the network assumptions for the major corridor facilities are summarized in **Table 2**. Network maps of the corridors where there were different Network assumptions (Facility types, Number of Lanes) are also provided. There are no changes in facility type or capacity on MD 2 south of Annapolis, MD 295, MD 665/Forest Drive and MD 713.

> ***Finding:*** *Based on the significant changes in roadway capacity between the CGMP model and the BMC model, there may be value in performing additional travel demand forecasting at the corridor or subarea level.*

Table 2. Comparison of Major Corridor Facilities

Corridor	Change in Capacity Assumption
US 50	Three lanes in each direction rather than four lanes are assumed between the Prince George's County line and I-97, and between the Severn River bridge and Chesapeake Bay Bridge.
MD 2 North	Two lanes in each direction rather than three lanes are assumed between US 50 and just south of College Parkway
I-97	Two lanes rather than three lanes are assumed between Millersville Rd and MD 450.
MD 32	Three lanes in each direction rather than four lanes are assumed between the Howard County line and MD 295. Two lanes rather than three lanes are assumed between MD 295 and US 50.
MD 100	Reduced facility type in the BMC 2040 network (reduces capacity/lane and speeds)
MD 3	Two lanes rather than three lanes are assumed between St Stephens Church Road and I-97. Between St Stephen's Church Road and Johns Hopkins Road, the BMC 2040 network no longer assumes an upgrade in facility type to a freeway.
Magothy Bridge Road	A reduction in lanes from MD 100 to MD 173 and an increase in lanes from MD 173 to Chestnut Hill cove
Benfield Road	A reduction in lanes from West Benfield Rd to Veterans Highway, and some spot increases in lanes along the corridor
MD 176	One lane in each direction rather than two lanes are assumed between Steward Avenue and Old Telegraph Rd.; an additional lane from Wagners Pond and Baltimore Annapolis Rd. is assumed in the BMC model that was not included in the CGMP model.
MD 170	One lane in each direction rather than two lanes is assumed South of MD 100
MD 177	A reduction from 3 lanes to one lane eastbound and from 2 lanes to one lane westbound is assumed in the BMC model from MD 100 to North Shore Road
College Parkway	An increase in facility type is no longer assumed from MD 2 to the Anne Arundel Community College. Lanes are reduced from 2 to 1 around the college entrances

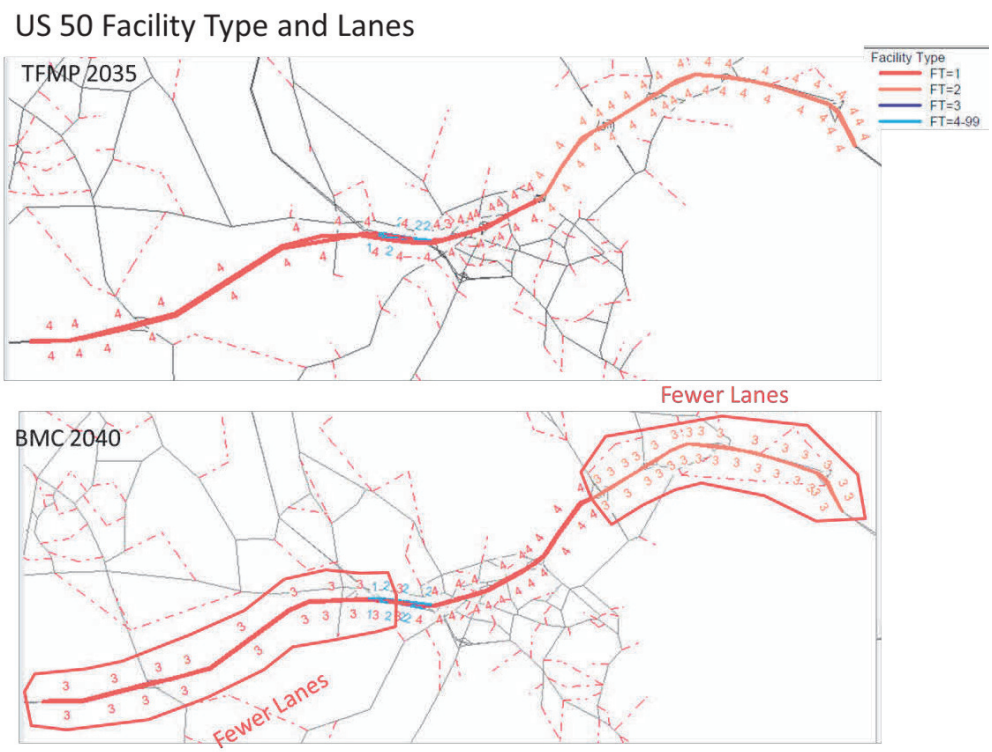


Figure 6. US 50 Facility Assumptions

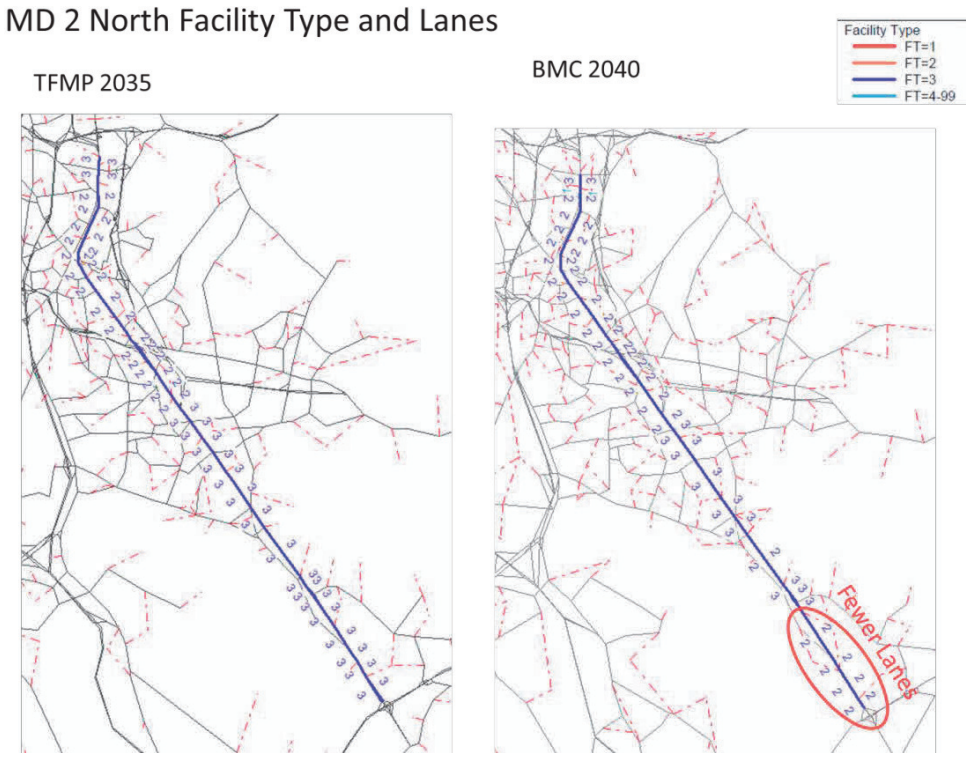


Figure 7. MD 2 Facility Assumptions (north of US 50)

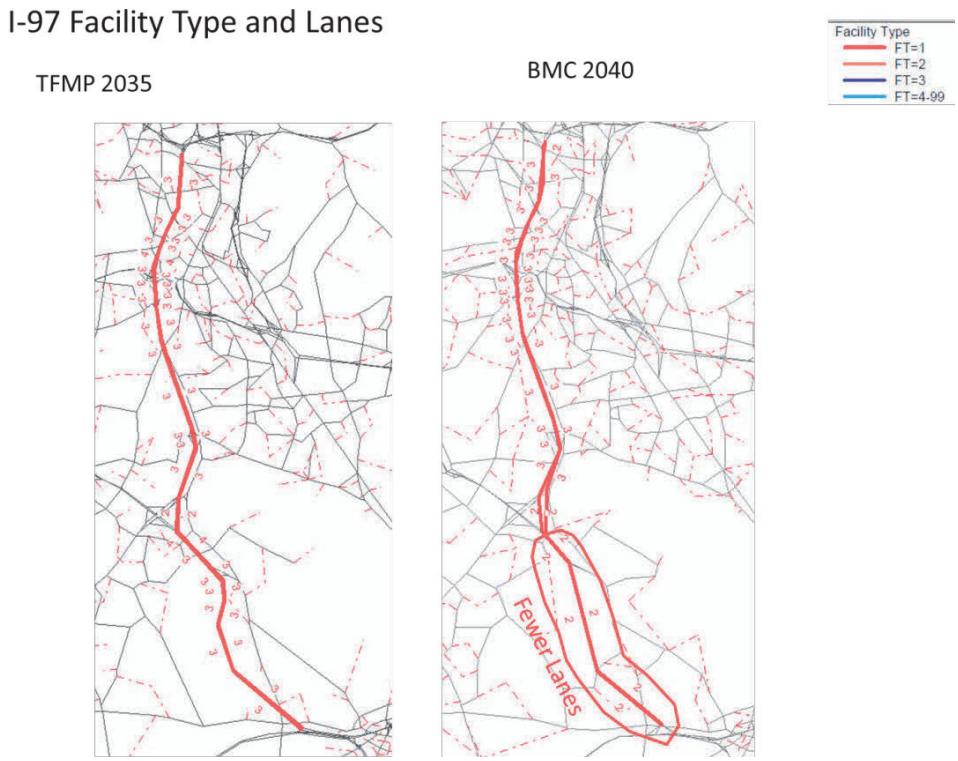


Figure 8. I-97 Facility Assumptions

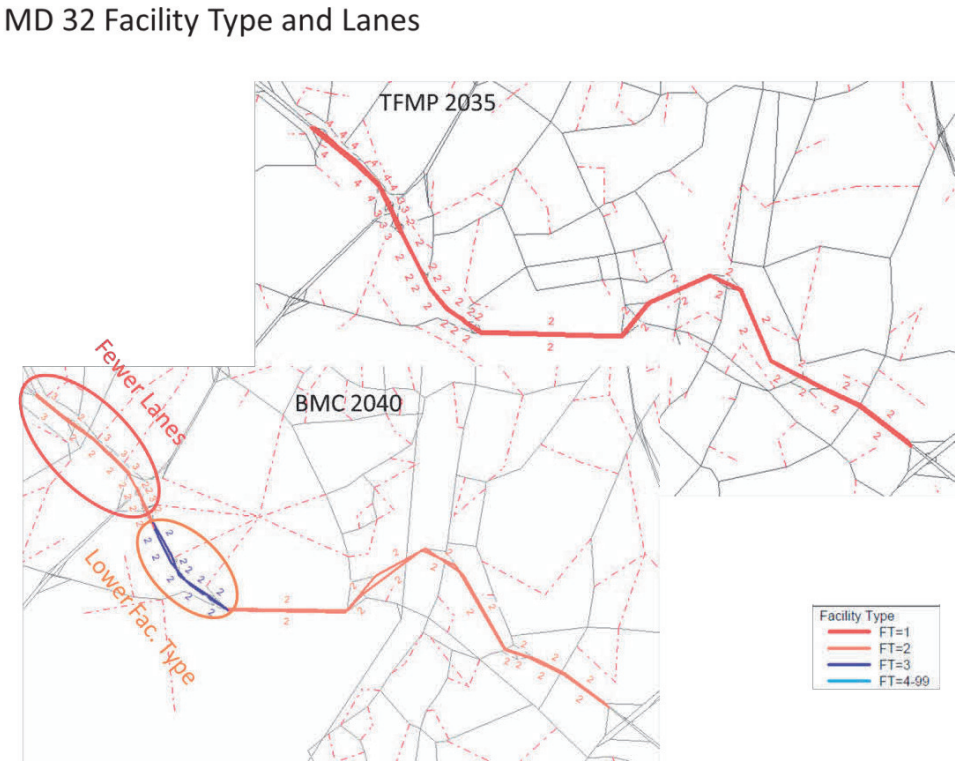


Figure 9. MD 32 Facility Assumptions

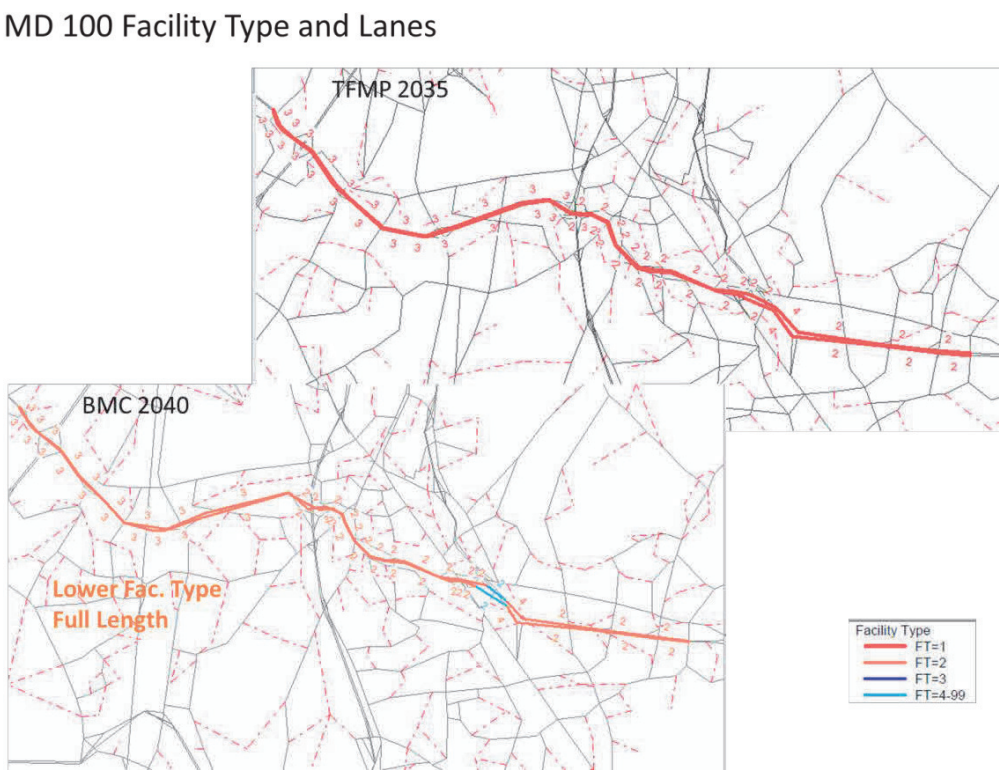


Figure 10. MD 100 Facility Assumptions

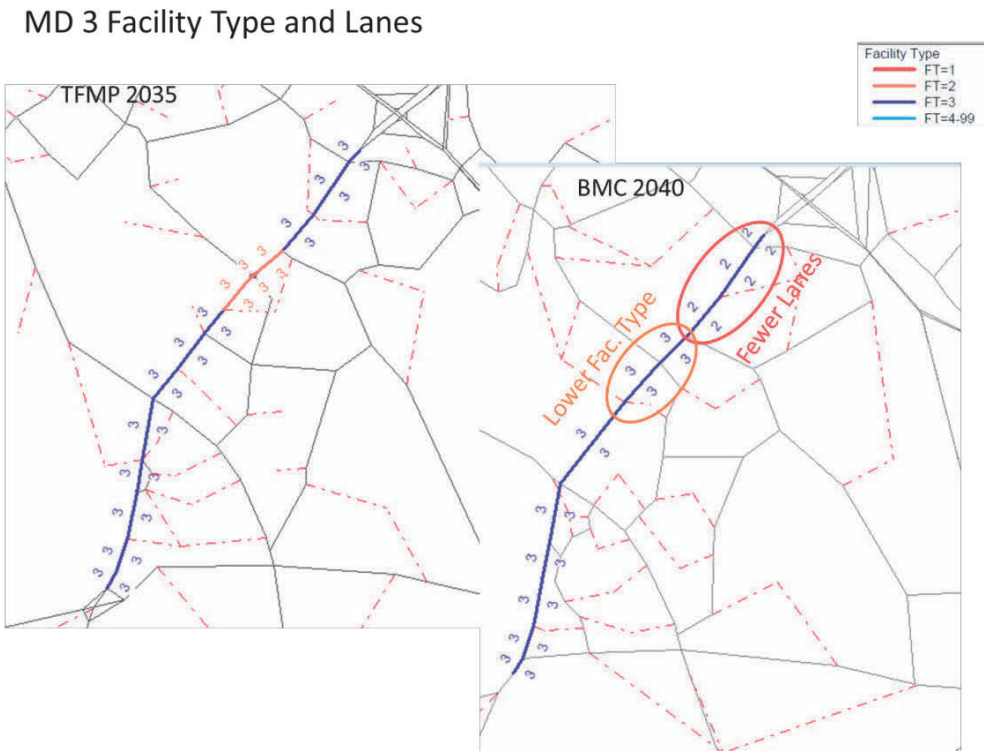


Figure 11. MD 3 Facility Assumptions

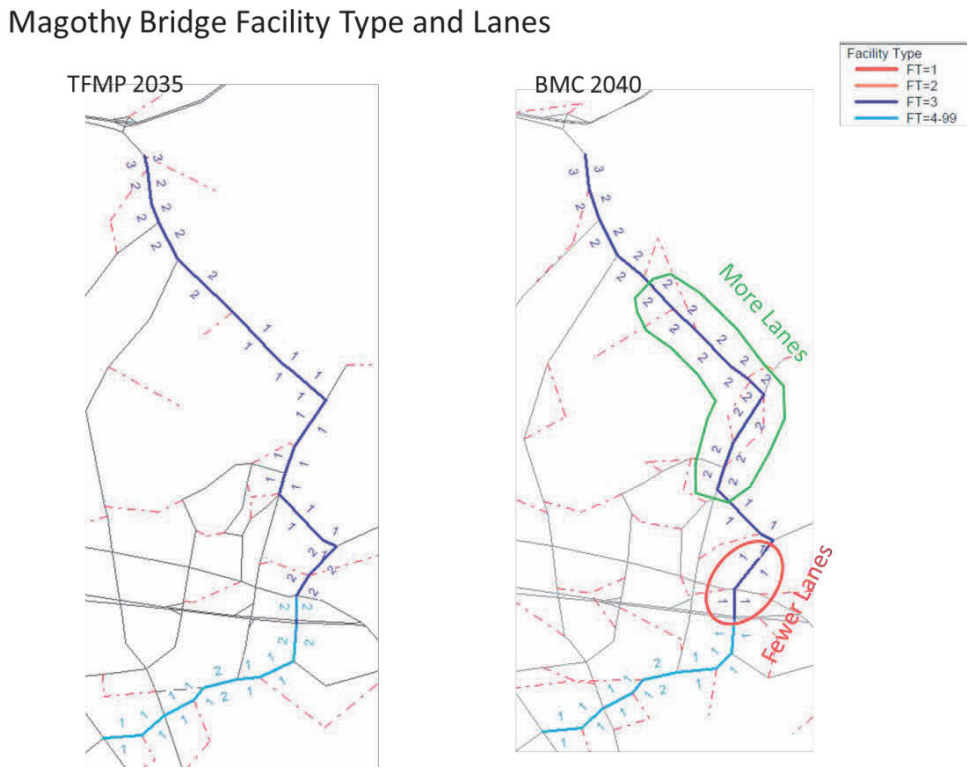


Figure 12. Magothy Bridge Corridor Facility Assumptions

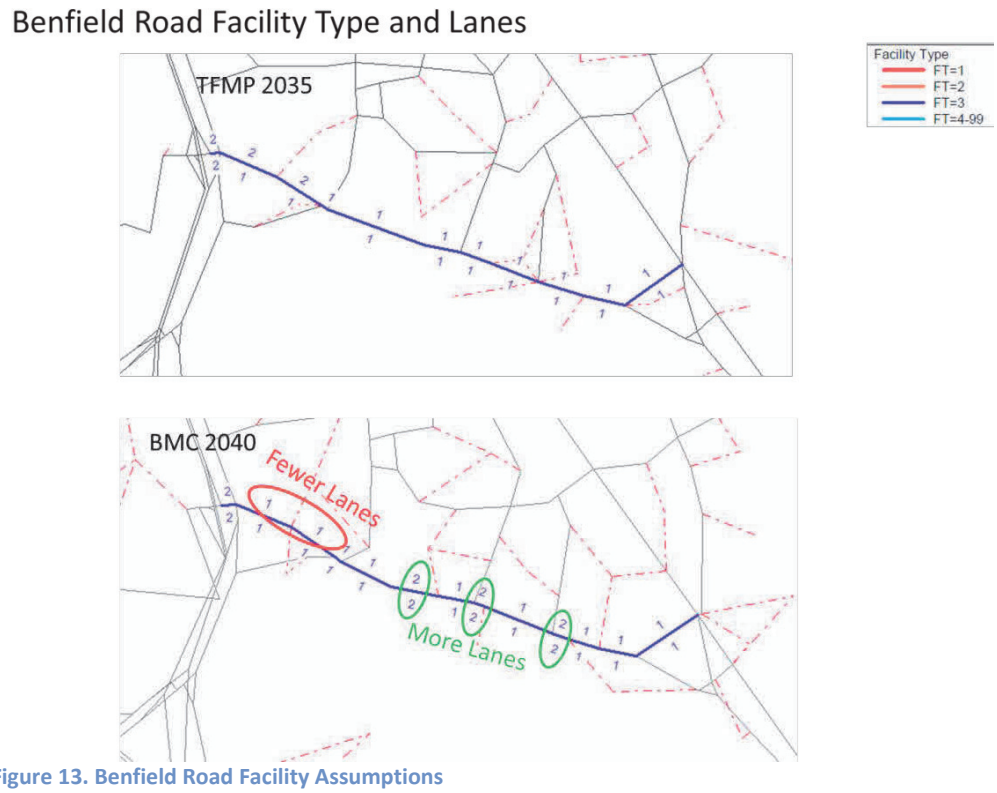


Figure 13. Benfield Road Facility Assumptions

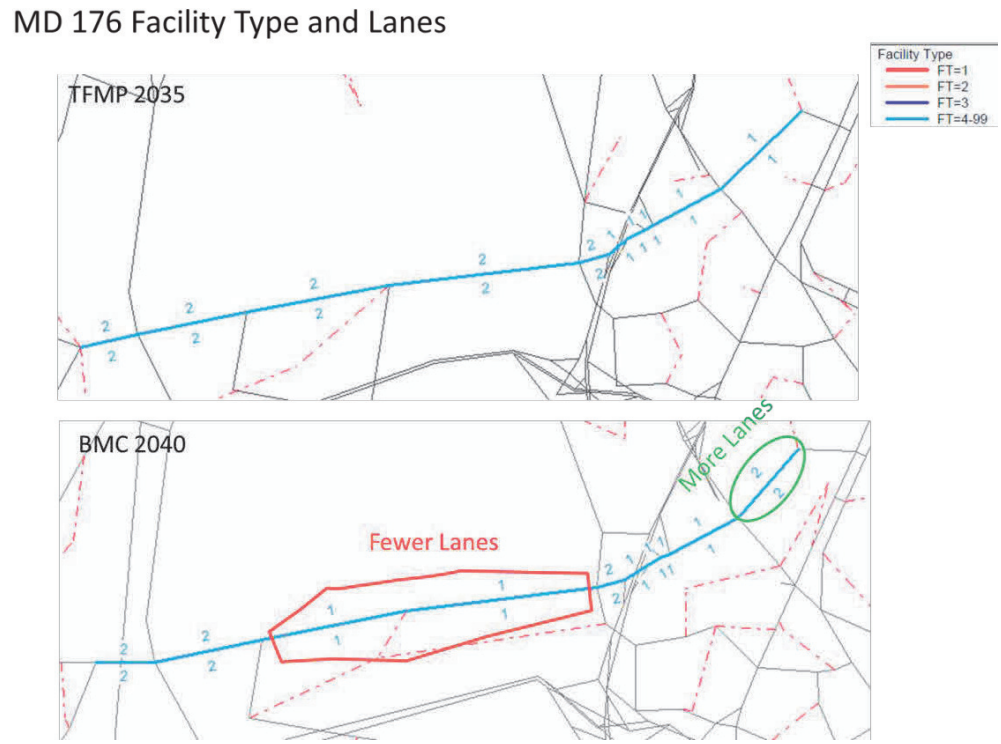


Figure 14. MD 176 Facility Assumptions

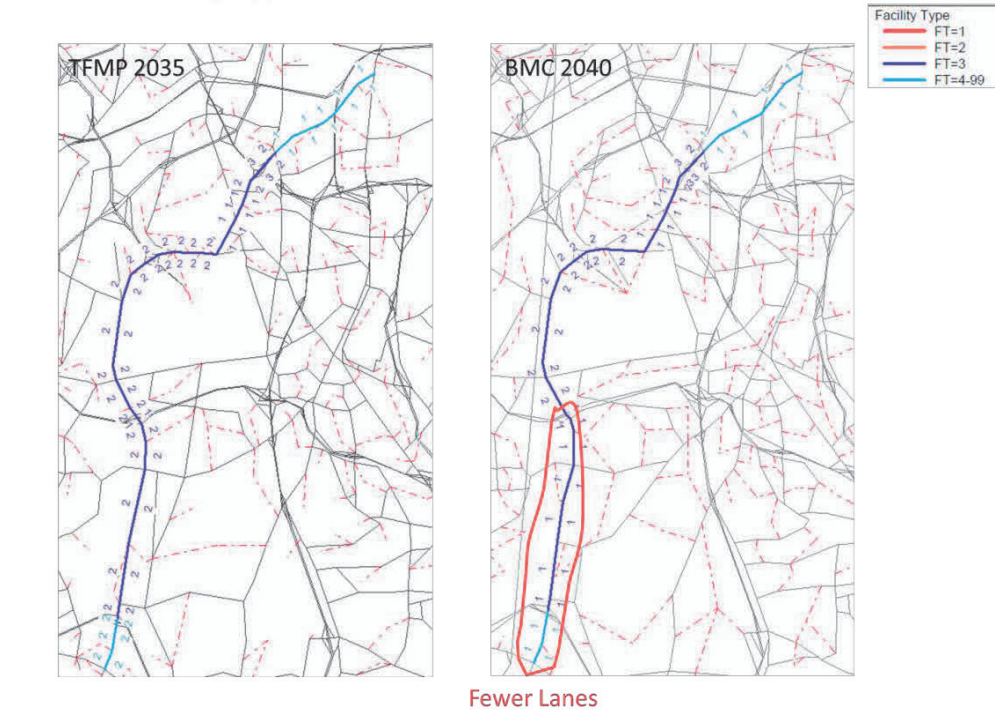


Figure 15. MD 170 Facility Assumptions

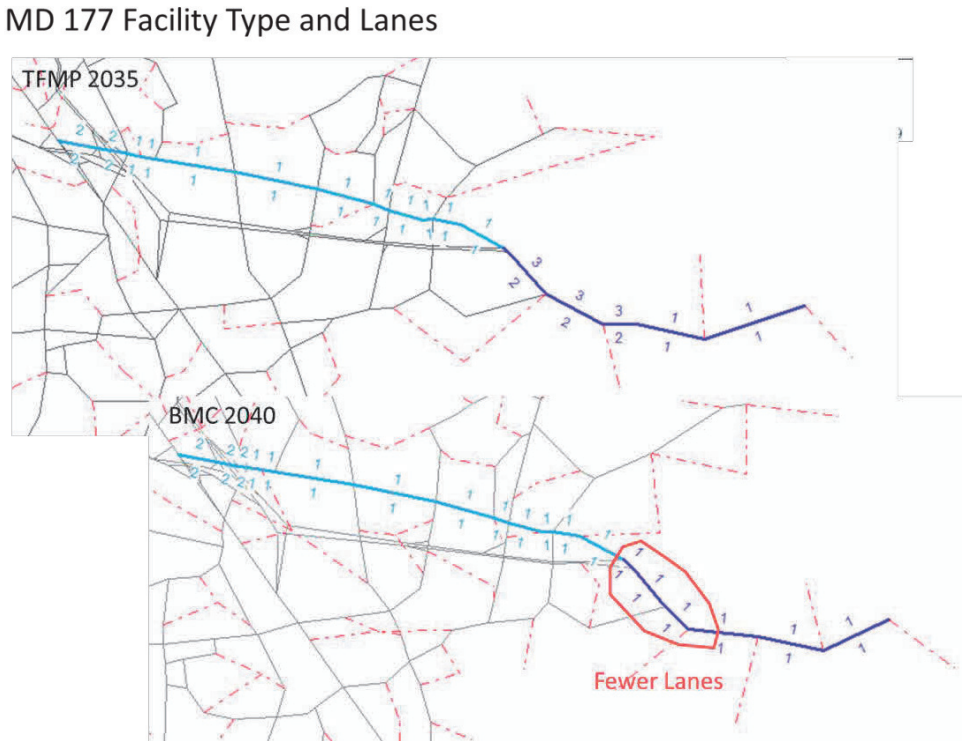


Figure 16. MD 177 Facility Assumptions

Forecast Network Performance (Volumes, Speeds, Volume to Capacity).

As shown in **Figure 17**, the trips to, from and within Anne Arundel County found in the BMC 2040 forecasts, when compared to what was assumed for the 2012 TFMP 2035 forecasts, shows an increase in 24-hour volume forecasts for the major corridors within the county.
Sections of US 50 and I-97 now have directional 24-hour volumes greater than 75,000 vehicles per day (> 150,000 vehicles/day in both directions). Likewise, MD 295, MD3, and MD 100 have sections that have increased from less than 50,000 vehicles per day in each direction to between 50,000 and 75,000 vehicles per day. More moderate increases in travel are shown on the other corridors.

These increases in volumes in combination with the assumed reductions in the highway network lead to significantly decreased performance in the BMC 2040 BMC forecasts. This decrease in performance is illustrated by the comparison of AM peak period speeds and volume/capacity Ratios shown in **Figure 18.** AM peak period speeds in the BMC 2040 BMC forecasts are less than 10 mph on significant portions of US 50 westbound, as well as on MD 295 both in both directions. There are also spots where the speed is less than 5 mph on MD 295. Sections of MD 2, MD3, I-97, MD 32 and MD 100 also have AM peak period speeds of less than 10 mph.

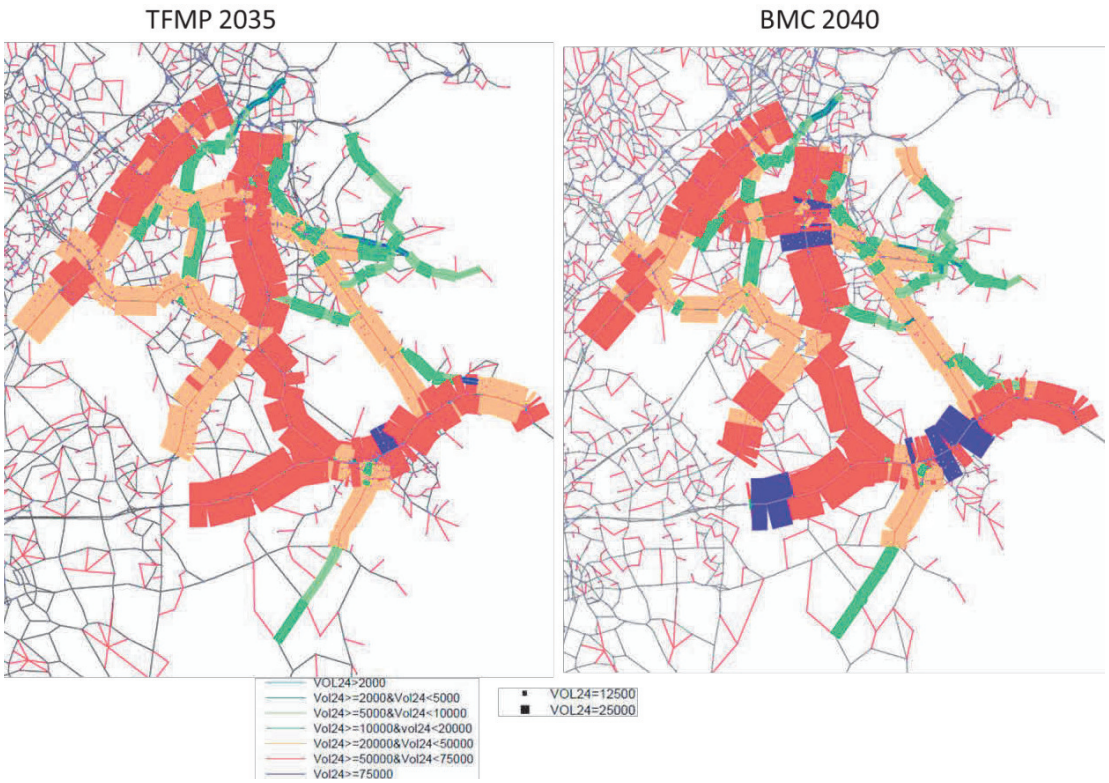


Figure 17. Comparison of 24-hour Directional Volumes

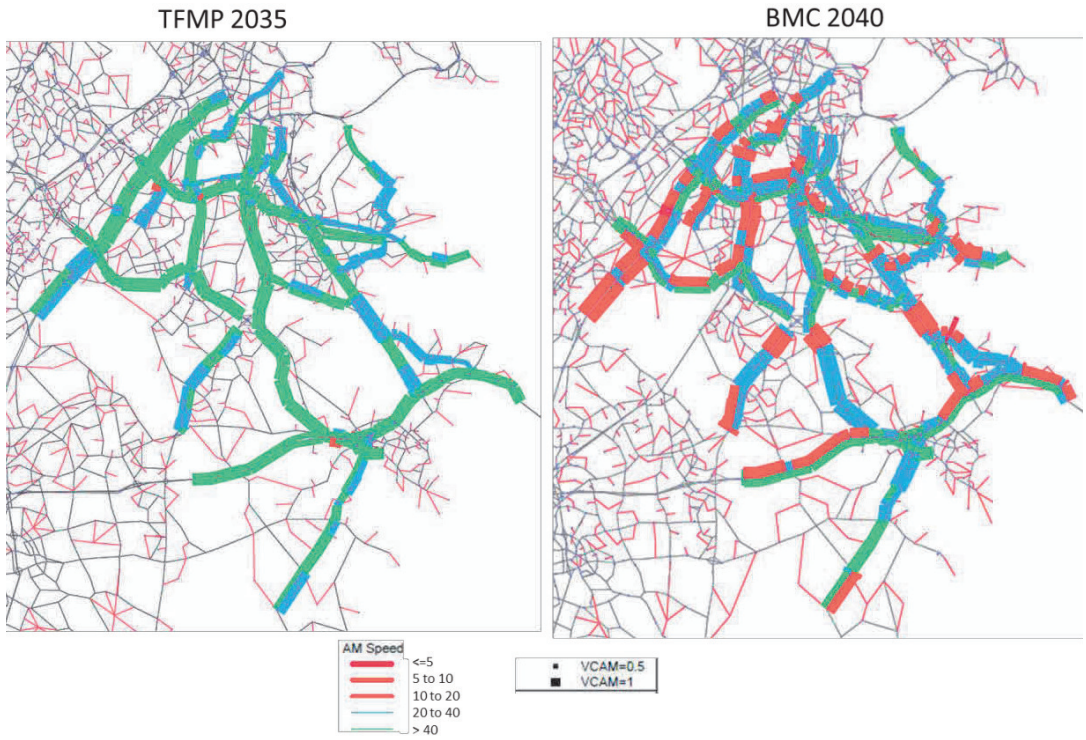


Figure 18. Comparison of Network Performance (AM Speeds and Volume Capacity Ratio)

Conclusion

Finding:
There are three issues which may indicate the need for further travel demand modeling:

- significant reductions in roadway capacity between the CGMP model and the BMC model owing to changes in the regional long-range transportation plan.

- Population and housing growth at a rate greater than forecasted during the CGMP (with employment growth remaining consistent between the two models).

- Growth of travel towards Carroll, Frederick, Howard and Montgomery Counties being at a greater rate than to Baltimore City and Baltimore County potentially has significant impacts in both the Baltimore and Washington regions.

Notwithstanding the *rate* of change, there is a reasonable countywide uniformity projected for population and housing growth, and for reductions in roadway capacity. Said differently, "everything is getting worse everywhere" in terms of traffic congestion and travel speeds during both model periods. We believe that a qualitative understanding of the changes at a countywide level is enough to make reasonable judgements in making recommendations as to priority investments.
That said, there are two further analyses that are warranted:

- Travel forecasting at the subarea or corridor level at the time of a project advancing through the project development process; and,

- Additional integration of Anne Arundel County inputs to the MWCOG travel forecasting process.

ANNE ARUNDEL COUNTY
TRANSPORTATION MASTER PLAN

TECHNICAL MEMORANDUM #4
Revenue Forecast

ANNE ARUNDEL COUNTY MARYLAND

Prepared for the Anne Arundel County Office of Transportation

May 2019 – Final

SABRA & ASSOCIATES
Engineering Innovative Solutions

Note: The purpose of each Technical Memorandum prepared for the Office of Transportation is to present facts, analysis, ideas, issues and recommendations that will inform the Anne Arundel County Transportation Master Plan. The views expressed and recommendations offered in each memorandum are solely based on the consultant's judgment and should not be considered as endorsed by the Office of Transportation or any other County agency or officer.

Anne Arundel County has determined that a long-range, functional master plan that is fiscally-constrained through the year 2040 is needed for transportation. In order to identify available revenues for transportation purposes over the course of the next 20 years, Sabra and Associates (Sabra) reviewed the County's Capital Improvement Programs from year 2002 onward as well as reports from bond rating agencies and the County's Spending Affordability Committee; met with County finance, planning and public works staff; and reviewed macroenomic data sets from the Federal government. It should be noted that the County government is not required to develop revenue forecasts beyond the five-year window of the Capital Improvement Program.

Sabra focused on existing fund sources used by the County for transportation purposes and assumed relative economic stability over the 20-year horizon. A best fit linear regression method was used to forecast revenues. An annual inflation rate of two per cent was assumed. To reasonably control for major fluctuations, several major appropriations and de-appropriations were screened out from the analysis in consultation with County staff. Predicting and forecasting revenues can be extremely challenging. This is especially true at the local government level with a relatively small capital budget. A significant grant from the state or federal government for a major construction or a development project can generate windfall revenues for the Capital Improvement Program.

Additional assumptions used in this analysis were:

- The County has broad discretion on how it allocates locally-generated revenues. For example, a dollar spent on schools could alternatively be spent on roads, libraries or parks. The primary exception is impact fees, which must be spent for a specific purpose: schools, roads or other public facilities, as required by law. For the purpose of this analysis, **it is assumed that the allocation of the County's capital funds remains constant.**

- Anne Arundel County's locally owned transportation system includes roadways, bridges, sidewalks, traffic signals, street lights, and trails. In addition, the County is a partner in the Central Maryland Transportation & Mobility Consortium, which owns and operates a regional bus system within Anne Arundel, Howard, and northern Prince George's Counties, contributing both operating and capital funds annually. **Expenditures related to all of these transportation modes are included in this analysis.**

- Excepting the extent to which the County participates in the funding for planning, design or construction of a state roadway, **expenditures on state transportation facilities are not included in the analysis.**

- The County allocates transportation funds between "system preservation" (such as road resurfacing and bridge rehabilitation, traffic signal and street light replacement, etc.); and "capacity expansion" projects (such as new roadways, sidewalks and trails, and additional buses or other capital equipment). A "miscellaneous" category accounts for planning studies, project closeouts, etc. **The historical average allocation of expenditures for system preservation and capacity expansion remains constant.**

- **The County's use of PAYGO funds vs. general obligation bond funds is not considered in the analysis.** However, it should be noted that in 2016, the County took a new and more aggressive posture regarding the issuance of GO bonds. This resulted in a significant benefit

for transportation improvements. This new posture is accounted for within the 20-year linear regression.

- Highway impact fees are estimated to recover only a small fraction of the cost of associated improvements**; impact fees are not anticipated to change during the forecast period, nor are they indexed to inflation.**

- The County's capital improvement program has historically been underfunded in years 4, 5 and 6. Transportation allocations in the proposed FY19 – 24 CIP are not considered as "real" allocations and, thus, **FY19 – 24 are within the forecast years.**

Average Revenues Per Fund Source 2002 to 2017

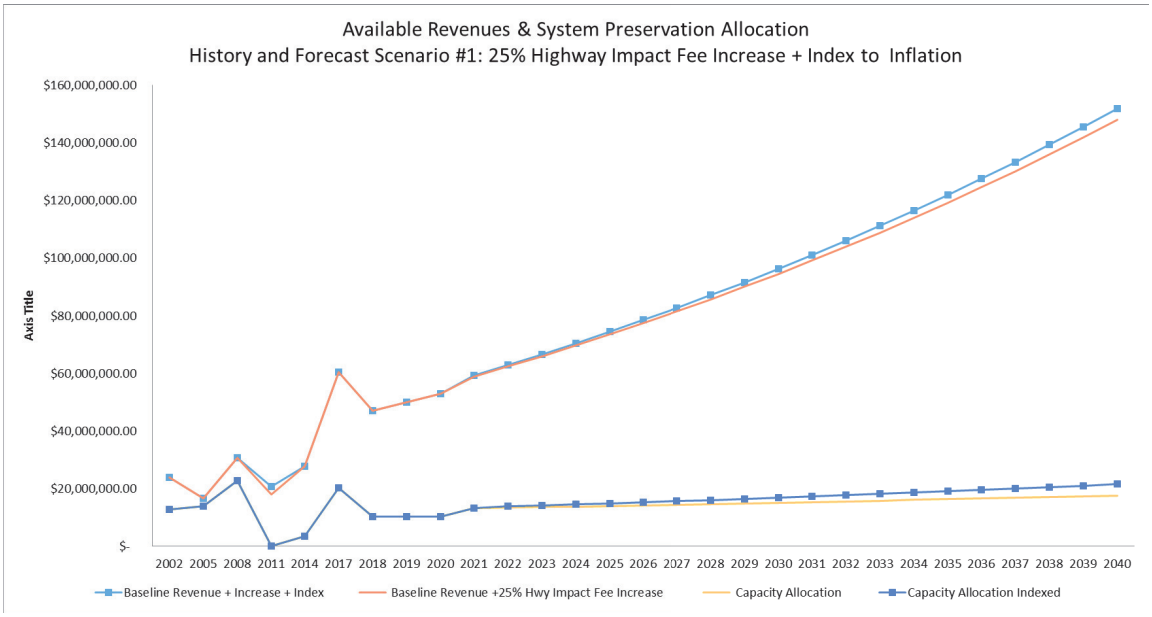
Source	Average Revenue
Developer Contributions	$ 192,167
Highway Impact Fees	$ 3,853,483
General Obligation Bonds	$ 13,733,833
General Fund Paygo	$ 7,723,310
Bond Premium	$ 2,080,333
Federal Aid – Bridge	$ 408,167
Federal Grants	$ 253,333
State Grants	$ 207,167
Other	$ 977,617

Baseline Forecast

Under the baseline forecast, between 2020 and 2040 Anne Arundel County will have approximately $1.932 billion available for transportation-related capital improvements. Of these funds, $210.7 million would be allocated for capacity expansion. Developer contributions and highway impact fees represent approximately 75% of funds used for capacity expansion, nearly all of which has been used for roadway projects.

Scenario: Highway Impact Fee Increase

One scenario holds all revenue sources equal to the baseline forecast except for Highway Impact Fees. A 25% increase in Highway Impact Fees (assumed to take effect in FY2021 following adoption of the General Development Plan) would generate $99.5 million for capacity expansion projects over 20 years. Further indexing Highway Impact Fees to an inflation index (assumed at 2.5% per year) would yield an additional $29.5m over the forecast period.



ANNE ARUNDEL COUNTY
TRANSPORTATION
MASTER PLAN

TECHNICAL MEMORANDUM #5
Analysis of Traffic Crashes

ANNE ARUNDEL COUNTY
MARYLAND

Prepared for the Anne Arundel County Office of Transportation
March 2019 – Final

SABRA
& ASSOCIATES
Engineering Innovative Solutions

Note: The purpose of each Technical Memorandum prepared for the Office of Transportation is to present facts, analysis, ideas, issues and recommendations that will inform the Anne Arundel County Transportation Master Plan. The views expressed and recommendations offered in each memorandum are solely based on the consultant's judgment and should not be considered as endorsed by the Office of Transportation or any other County agency or officer.

When prioritizing funding for transportation improvements, one the most important factors to be taken under consideration is increasing the safety of a facility for the user. This purpose of this Technical Memorandum is to examine the location and frequency of automobile accidents in Anne Arundel County. Accident data at County and sub-County level was compiled and analyzed, as well as an examination of specific high accident locations. The results of the analysis are intended to be used as one of several tools which can serve as an aid in choosing which projects need an allocation of funds.

This analysis uses data from crashes that occurred in 2015, 2016, and 2017. Data is compiled and maintained by the Department of Maryland State Police. The datasets are updated quarterly and only include approved crash reports. Incorrectly located/reported crashes have been removed from the analysis, and accuracy of crash locations are subject to a reasonable degree of human error in the field. Over 30,000 crashes were reported in Anne Arundel County between January 1, 2015 and December 31, 2017.

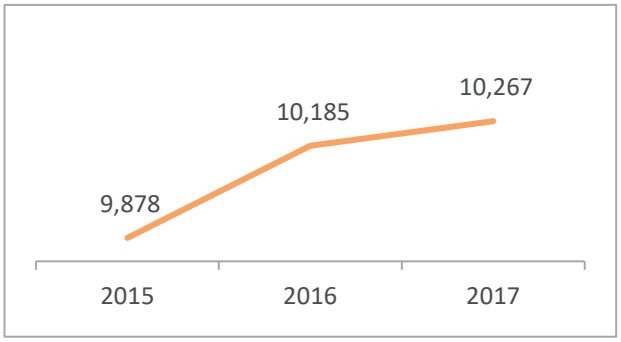
The data used in this analysis includes descriptive information regarding each individual crash collected in the official crash report. Information in the reports include; the specific latitude and longitude coordinate location of the crash, lighting and weather conditions at the time of crash, vehicle collision or fixed object collision type, circumstantial roadway obstructions, lane designation and position, and the extent of injuries resulting from the incident. Most reports also contain additional information about drivers and other persons involved in crashes as well as details about the vehicles involved and the responding Emergency Medical Technician team on scene, if applicable.

Crash Trends: 2015 – 2017

Figure 1 depicts the trend in the total number of accidents in the county in the years 2015, 2016 and 2017. The numbers of accidents increased slightly in each year.

Figure 2 depicts the spatial distribution of these accidents throughout the County. Most of them occurred in the City of Annapolis and its adjacent suburbs; or along the I-97 corridor between MD 100 and I-695. Additional findings related to these data are discussed in further sections of this report.

Figure 1. Total Crashes in Anne Arundel County



Further analysis of the combined years crashes revealed patterns of distribution that were consistent with crash distribution in individual years, shown below. Patterns and spatial distribution trends of crashes in Anne Arundel county will be discussed further in upcoming sections of this report. Crashes concentrate around Annapolis and its surround suburban areas and in northern Anne Arundel County near the Baltimore Beltway and Glen Burnie. Significant clusters and specific intersections with high crash rates will be discussed further in this report.

Crashes by Roadway Type

The Highway Location Reference (HLR) is a database is maintainted by the State Highway Administration (SHA) and the Maryland Transportation Authority (MdTA). In this database, accident data are included for all routes roads that are part of the state roadway network, regardless of responsible jurisdiction (Federal, State, County, etc). For the purpose of the following analysis, the facility types were consolidated into 1) Interstate roads and various interstate roadway components (ramps, etc), 2) State-owned and maintained roads, and 3) Local County and Municipal Roads. Figure 3 depicts the accident locations for by facility type.

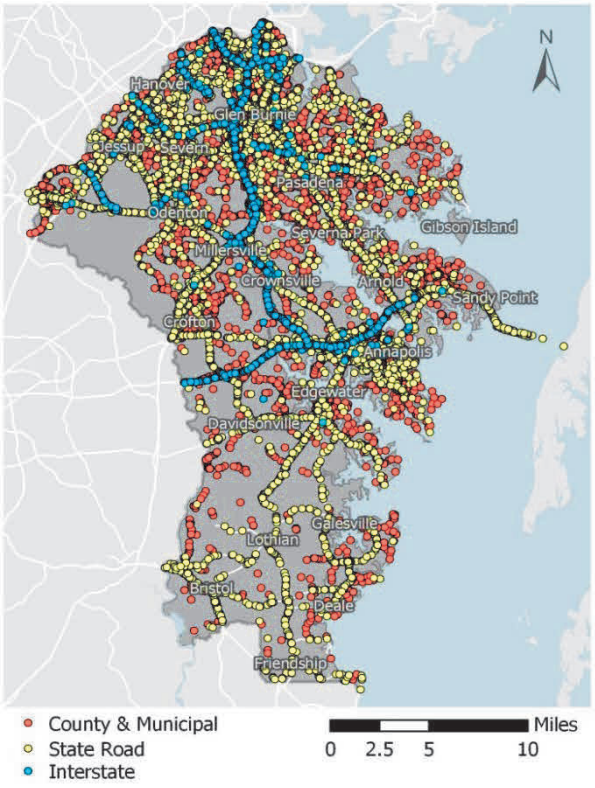
The data were then summarized by category for years 2015, 2016 and 2017. Figure 4 shows the percentage of total accidents by facility type. Most accidents occurred on state routes, more than double the number that occurred on county and municipal routes.

Table 1. Number of Crashes by Roadway Type

	Number of Accidents
Interstate	2,816
State	18,771
County/Municipal	8,752

For the following analysis, centerline data was downloaded from Maryland's Mapping & GIS Data Portal (MD iMap). Centerline data for roadways are maintained by the responsible jurisdictions—Federal Highway Administration, the Maryland Department of Transportation State Highway Administration, county governments and municipal governments.

Figure 2. Spatial Distribution of Accidents by Roadway Type



The centerline data was grouped by facility type to determine the number of road miles in each category. The results are shown in Figure 5. According to centerline data, there are approximately 110 miles of Interstate roads, 528 miles of state roads, and there are more than 2,400 miles of local and municipal roads in Anne Arundel County. Of the total, 17% of the roadway miles in Anne Arundel County are State roads and 79% of roadway miles are local and municipal roads. Interstate routes only make up 4% of the County's roadway network.

Figure 3.
Roadway Milage by Facility Type

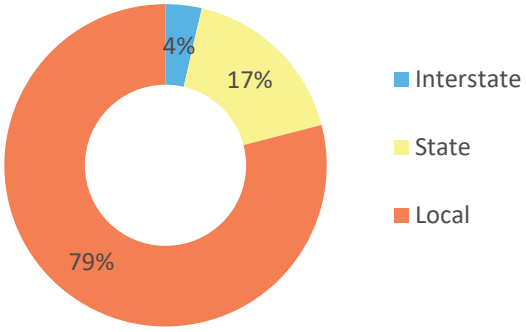


Figure 4
Accidents by Facility Type

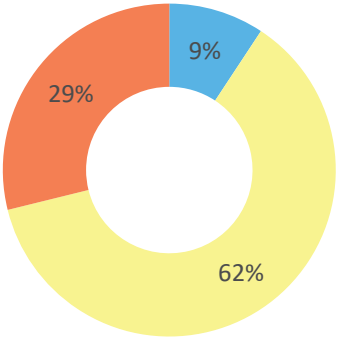


Table 2 shows a comparison of the percentage of route miles with accident data for each of the facility types. Of the three categories of road types, Interstates have the fewest accidents. His can be partially attributed to the low mileage of Interstate routes in the County. In contrast, 79% of roadway miles in Anne Arundel County are local roads county and municipal roads. They often have lower speed limits, are less frequently traveled, and are often residential with traffic calming measures. Therefore, while there are less than 550 miles of state-maintained roads, 62% of accidents occur on them. Only 29% of accidents occur on local roads.

Table 2. Comparison of Crash Types by Roadway Type and Miles

	Total Crashes 2015-2017	Percentage of Total Crashes	Total Roadway Miles	Percentage of Total Roadway Miles
Interstate	2,816	9%	110	4%
State	18,771	62%	528	17%
County/Municipal	8,752	29%	2404	79%

Normalization by Vehicle Miles Traveled

In 2015, the total Vehicle Miles Traveled (VMT) in Anne Arundel County was 5.9 billion. This is arrayed against the total number of accidents by roadway category in Table 3. Assuming the percentage of total roadway miles is proportional to total VMT, 235.7 million VMT occurred on Interstate Roads, 1 billion VMT occurred on State Roads, and 4.7 billion VMT occurred on Local or Municipal roads. Crashes per 100 Million VMT on each road type were: 1,195 on interstate routes, 1,874 on state routes, and 188 on local roads.

Figure 5. Crashes per 100m Vehicle Miles Travelled

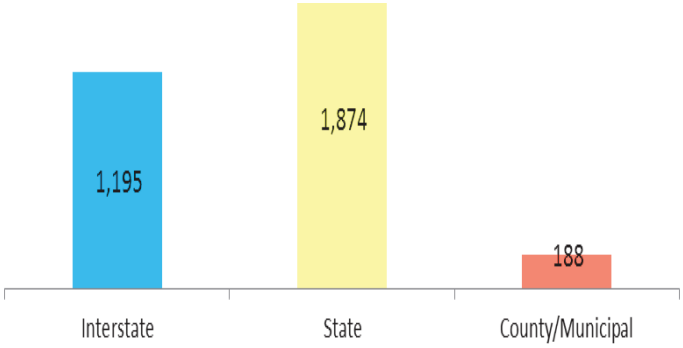


Table 3. Crashes per Vehicle Miles Travelled (VMT)

	Percentage of Total Roadway Miles	Total VMT (millions)	Total Crashes 2015-2017	Crashes per 100 Million VMT
Interstate	4%	235,680	2,816	1,195
State	17%	1,001,640	18,771	1,874
County/Municipal	79%	4,654,680	8,752	188

Crashes are nearly 10 times more likely to occur on state roads than local roads. Crashes are roughly two-thirds more likely to occur on state roads than on interstate roads.

Cluster Density Analysis

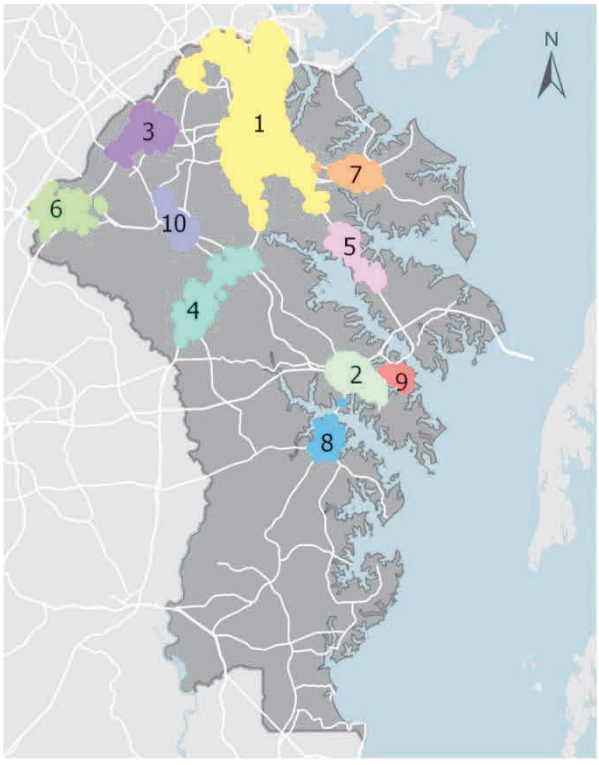
To assist in further defining locations where a significant number of accidents occur, a cluster density analysis was performed. Natural clusters were found using a self-adjusting method. Clusters must contain a minimum of 300 accidents. Any accidents that are not considered part of clusters, or clusters that are less than 300 accidents are considered noise and are not shown on this map. The locations of the clusters are shown in Table 4 and in Figure 6.

Table 4. Cluster Density Analysis

	Cluster Area	Number of Crashes Included in Cluster	Percentage of Total Crashes
1	Glen Burnie	8,843	29%
2	Annapolis – Parole	2,340	8%
3	Jessup/Severn	1,667	5%
4	Millersville/Crofton	1,507	5%
5	Severna Park	840	3%
6	Laurel	665	2%
7	Pasadena	618	2%
8	Edgewater	553	2%
9	Annapolis-Naval Academy	485	2%
10	Odenton	315	1%
		TOTAL: 17,833	**59%**

The largest clustering of accidents occurs in the Glen Burnie area. This area contains dense concentrations of accidents, and it has a consistent number of accidents in close proximity. This cluster contains 29% of the total accidents included in the analysis. Annapolis is broken down into two clusters. The second largest cluster is the western part of Annapolis, called “Annapolis-Parole”, and the eastern and significantly smaller cluster is called “Annapolis-Naval Academy.” Naturally, as accidents occur along roadway corridors, clusters tend to spread along these routes. These tend to have oblong shapes. The “Millersville/Crofton” cluster along Route 3 and the “Severna Park” cluster along Route 2 are two examples.

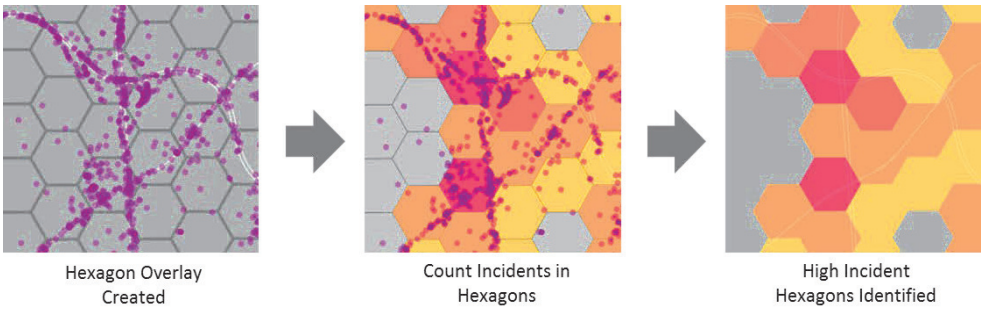
Figure 6. Top 10 Crash Clusters



Top 10 Crash Locations on Interstate and State Routes

The top 10 crash locations on Interstate and state routes in the County were determined by using an optimized hot spot analysis to aggregate incident data using a hexagonal grid overlaying a county layer.

Figure 7. Hexagonal Analysis Description



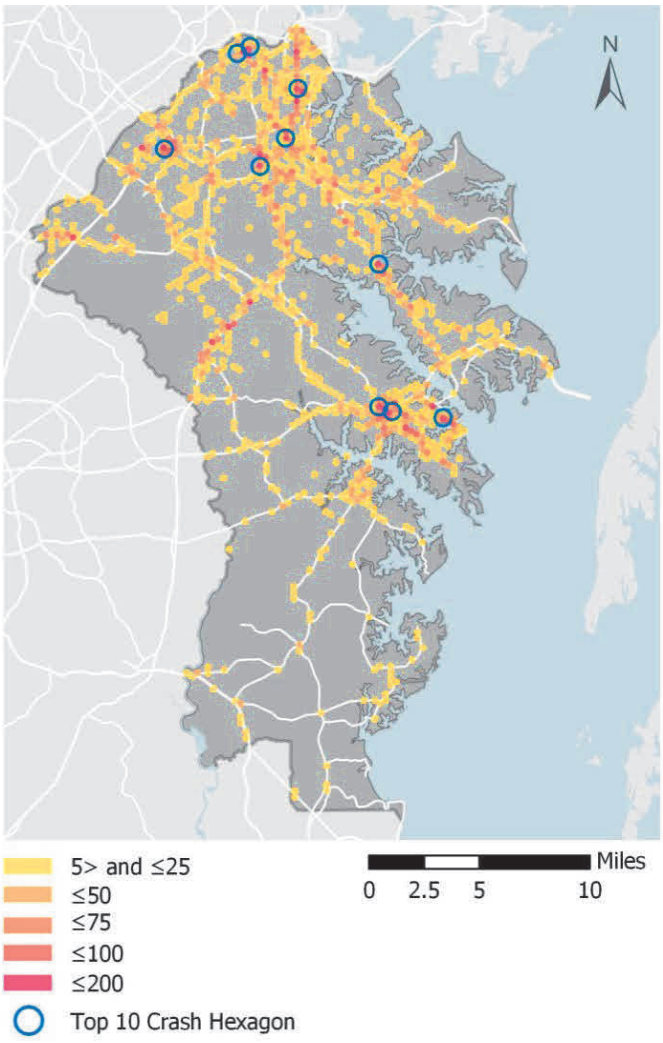
Each hexagon is approximately 175,000 square feet, or about 4 acres. The number of crashes, or incidents, in each hexagon are totaled. Hexagons with a higher count of incidents are hot spots for crashes. The approximate intersections, roadway segments, or interchanges where crashes are likely to occur on or near are calculated based on these hexagons.

Top 10 Crash Locations in Anne Arundel County 2015-2017

1. *695 and 295 (Exit 7B)* ***189***
2. *US 50/MD 301 at West St (Exit 23/ 23B)* ***184***
3. *I-97 and Quarterfield Rd (Exit 13)* ***148***
4. *Arundel Mills Circle/Parking Lot Area* ***142***
5. *Church Circle, Annapolis* ***140***
6. *Ritchie Hwy & Baltimore Annapolis Blvd* ***139***
7. *US 2, Riva Rd, Annapolis Towne Center* ***135***
8. *Ritchie Hwy & Robinson Rd* ***127***
9. *Ritchie Hwy just N of Ordinance Rd* ***124***
10. *695 and 295 (Exit 7A)* ***123***

Concentrations of accidents are likely to occur on major roadways, particularly near on and off ramps. Additionally, busy intersections or where many roads converge create dense concentrations of crashes.

Figure 8. Top 10 Crash Locations – State Routes and Interstates



Top 10 Crash Locations on Local Routes

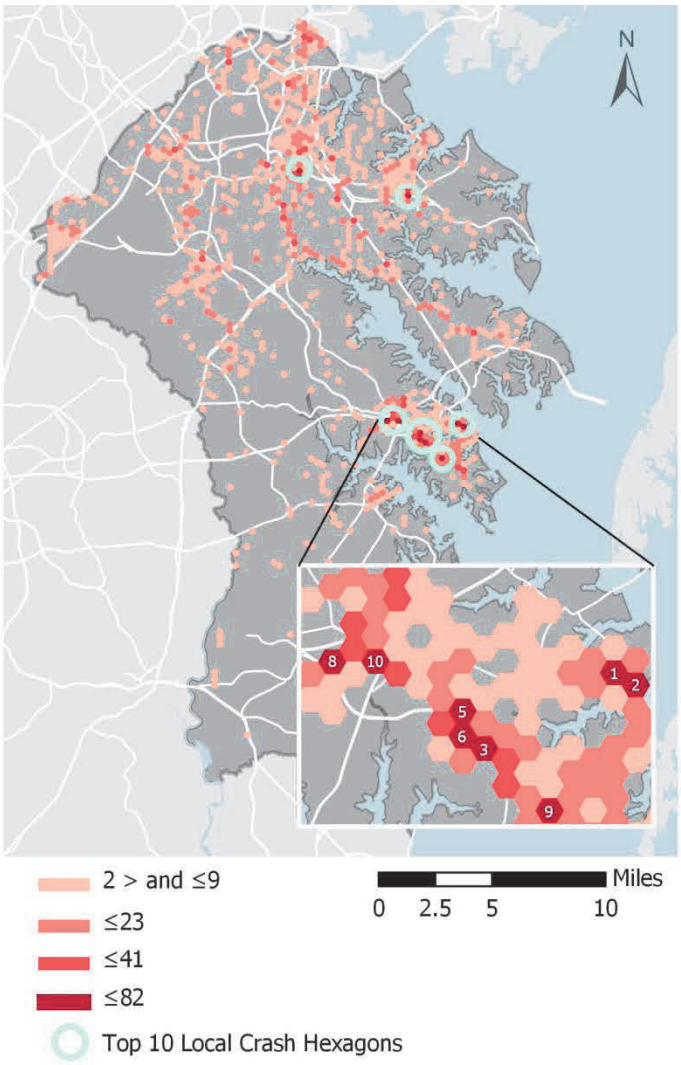
The same methodology was used to determine the major accident locations on local streets and roadways. They are depicted below and in Figure 9.

Top 10 Local Route Crash Locations in Anne Arundel County 2015-2017

1. *Maryland State House Area, Annapolis* ***82***
2. *Main St Annapolis* ***79***
3. *Forest Dr & Hilltop Ln* ***69***
4. *Oakwood Dr near Rt 100 (BWMC)* ***65***
5. *Forest Dr & Bywater Rd* ***60***
6. *Forest Dr & S Cherry Grove Ave* ***51***
7. *Edwin Raynor Blvd & Mountain Rd* ***48***
8. *Riva Rd near Rt 665* ***46***
9. *Forest Dr & Tyler Ave* ***45***
10. *Forest Dr & Solomons Island Rd* ***42***

Five of the top ten local route crash hot spots occur on Forest Drive in Annapolis, making up 45% of the crashes. Eight of the top ten high crash concentration locations were in or near Annapolis. Outliers were in Pasadena near a shopping center, and in Glen Burnie, near the University of Maryland Baltimore Washington Medical Center.

Figure 9. Top 10 Local Route Crash Locations



Pedestrian & Bicycle Crashes

Between 2015 and 2017 there were 100 documented crashes involving pedestrians and 27 involving bicycles across the county. 58% of pedestrians were involved in crashes that occurred on State roads, and 41% of pedestrian involved crashes occurred on local roads. Local roads were slightly more dangerous for bicyclists—59% of bicycle involved crashes occurred on local roads, and 37% occurred on state roads. There were two crashes reported on interstate highways; a bicycle involved accident on a ramp, and a pedestrian involved accident on an interstate.

Figure 10. Bicycle and Pedestrian Crashes

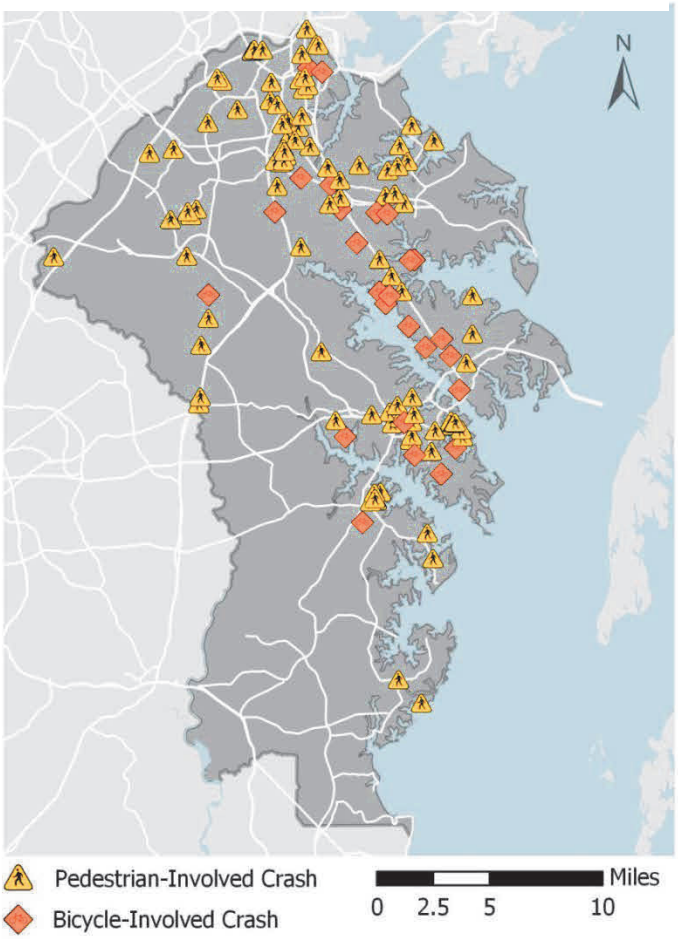


Table 5. Total Pedestrian and Bicycle Crashes

Road Type	Pedestrian Involved Crashes	Bicycle Involved Crashes
State	58%	37%
Local	41%	59%

Table 6. Injury Severity – Pedestrian and Bicycle Crashes

Injury Severity	Pedestrian Involved Crashes	Bicycle Involved Crashes
No Injury	67%	74%
Non-Incapacitating Injury	8%	7%
Possible Incapacitating Injury	21%	19%
Incapacitating/Disabling Injury	4%	-

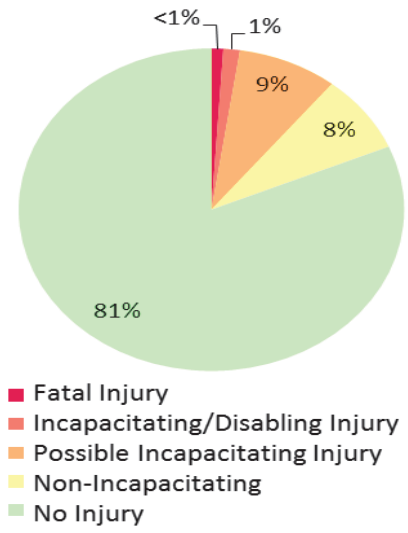
Auto-Involved Crash Severity

Table 7 and Figure 11 provide a breakdown of auto-involved injuries and fatalities. There were 53 fatal crashes in Anne Arundel County during the three-year period. Fortunately, most accidents, 81%, resulted in property damage only and did not result in officially reported injuries.

Table 7. Auto-Involved Crash Injuries and Fatalities

Injury Severity	Number of Reports	Percentage of Crashes	Injury Rate Per 100 Million VMT
No Injury	24,972	81%	423.8
Non-Incapacitating Injury	2,405	8%	40.8
Possible Incapacitating Injury	2,576	9%	43.7
Incapacitating/Disabling Injury	333	1%	5.7
Fatal Injury	53	<1%	0.9

Figure 11. Percentage of Auto-involved Crash Injuries and Fatalities



15 fatal crashes occurred on local county and municipal roads, 32 fatal accidents occurred on state roads and 6 fatal accidents on interstate roads. A fatal accident distinction means that there was at least one fatality resulting from the accident. The number of fatal accidents may not equal the total number of fatalities caused by vehicle accidents in Anne Arundel County.

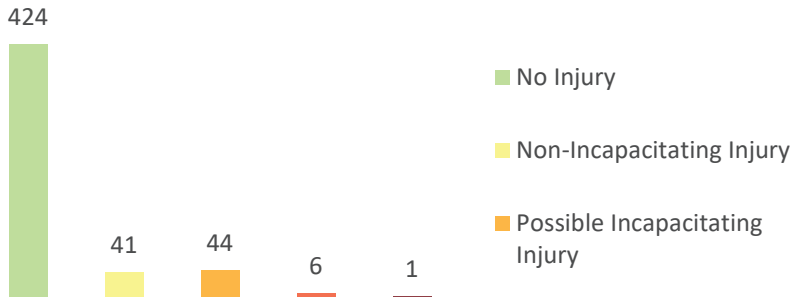
In terms of injury severity, no route type is significantly more dangerous than others. Crash severity is distributed proportionally for each route type. Less than 1% of all crashes on local roads are fatal. 28% of fatal crashes occur on local roads. Less than 1% of all crashes on state roads are fatal. 60% of fatal

crashes occur on state roads. Less than 1% of all interstate crashes are fatal. 11% of fatal crashes occur on interstate roads.

Normalization by Vehicle Miles Traveled

A comparison of total crashess havinge been normalized by the total Vehicle Miles Traveled (VMT) is shown in Figure 12. The total VMT in 2015 in were 5.9 billion. For every 100 Million VMT in Anne Arundel County, approximately 423.8 non-injury crashes occurred, 5.7 crashes resulting in serious injuries occured, and one fatal accident occured.

Figure 12.
Severity of Auto Crashes Per 100 Million VMT



Anne Arundel County has slightly fewer fatal crashes than the national average. The accident fatality rate in Anne Arundel County for 2015 to 2017 is approximately 0.9 per 100 Million VMT. The national average accident fatality rate for 2015 was 1.12 per 100 Million VMT, according to the NHTSA. The County's rate is similar to the state's average. In 2015, Maryland's statewide total fatal crashes per 100 Million VMT was 0.89.

Sources:

https://data.maryland.gov/Public-Safety/Maryland-Statewide-Vehicle-Crashes-CY2015-Quarter-/x8nz-kacb

http://www.aacounty.org/departments/transportation/forms-and-publications/2013_Pedestrian_Bicycle_Master_Plan.pdf

https://cdan.nhtsa.gov/STSI.htm# > Maryland > Anne Arundel County

https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812318 Fatal Crashes VMT

http://www.iihs.org/iihs/topics/t/general-statistics/fatalityfacts/state-by-state-overview/2015 State Fatal Crashes VMT

ANNE ARUNDEL COUNTY
TRANSPORTATION
MASTER PLAN

TECHNICAL MEMORANDUM #6
Transportation Systems, Management and Operations Strategies

ANNE ARUNDEL COUNTY
MARYLAND

Prepared for the Anne Arundel County Office of Transportation

March 2019 – Final

SABRA
& ASSOCIATES
Engineering Innovative Solutions

Note: The purpose of each Technical Memorandum prepared for the Office of Transportation is to present facts, analysis, ideas, issues and recommendations that will inform the Anne Arundel County Transportation Master Plan. The views expressed and recommendations offered in each memorandum are solely based on the consultant's judgment and should not be considered as endorsed by the Office of Transportation or any other County agency or officer.

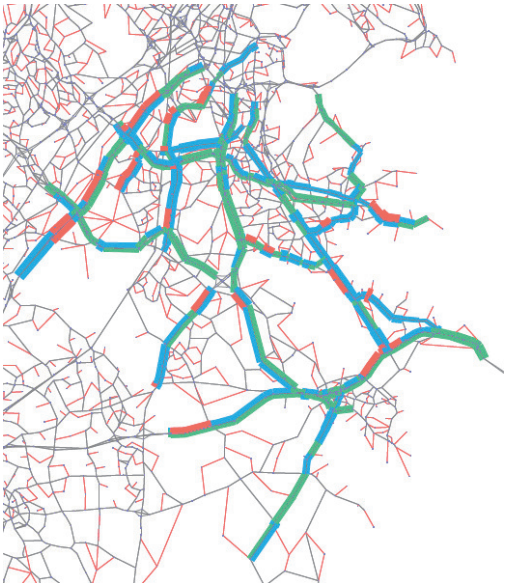
Increasing capacity on roadways is an expensive and lengthy process and is generally not within the County's power to implement. Lane addition also tends to only temporarily reduce congestion. An increase in traffic demand often follows capacity increases, eventually leading to more congestion. There are a multitude of less expensive solutions that can maximize existing roadway capacity and that can also be implemented more quickly than adding new capacity. Transportation System Management and Operation (TSM&O) strategies aim to optimize the safe, efficient, and reliable use of existing transportation infrastructure, often using real-time information to redistribute traffic on the roadway network.

In 2017, the Maryland State Highway Annual Mobility Report rated four Anne Arundel freeways in its top 20 most congested freeways statewide and four Anne Arundel collectors in its top 20 most congested arterials statewide. Current projections show that road capacity in the southern part of the county is adequate for current and future traffic flows. However, congestion in the north part of the county (encompassing the area from U.S. 50 to I-695) continues to increase as land development, commuting patterns, and population growth outpace the few roadway capacity improvements programmed by MDOT SHA in the County.

The primary mode of transportation in Anne Arundel County is the personal motor vehicle. This results in heavily congested roads within the County, a function of both intra-county travel and commuting to from the County. Anne Arundel County residents make most of their trips within the county, followed by trips to the Baltimore region, the Washington, D.C. region, and Howard County. Within the next few decades, projected increased in the County's population will bring changes in land use, employment, and consequentially, commuting patterns. In 2040, the proportion of trips within the county is expected to increase when compared to trips to other counties. Trips heading with origins or destinations outside the county are expected to skew more towards the Washington Metropolitan Region rather than the Baltimore Metropolitan Region. Current congestion patterns are depicted in **Figure 1** while future congestion patterns (accounting for planned roadway improvements by the State) can be found in **Figure 2**.

Figure 1: 2017 Freeway and Arterial Speeds in Anne Arundel County

AM Peak Period Speed



PM Peak Period Speed

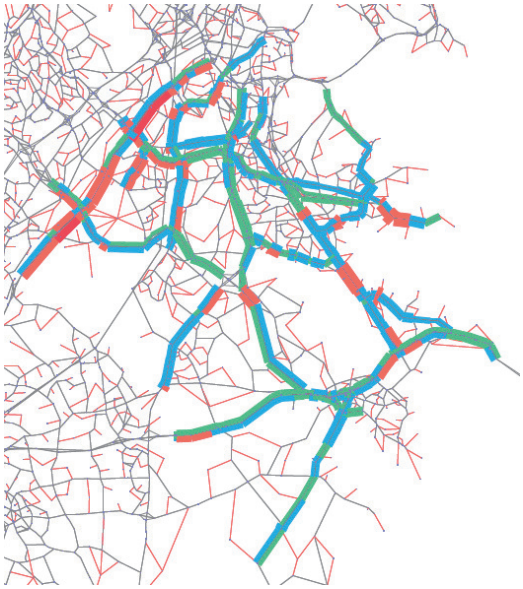
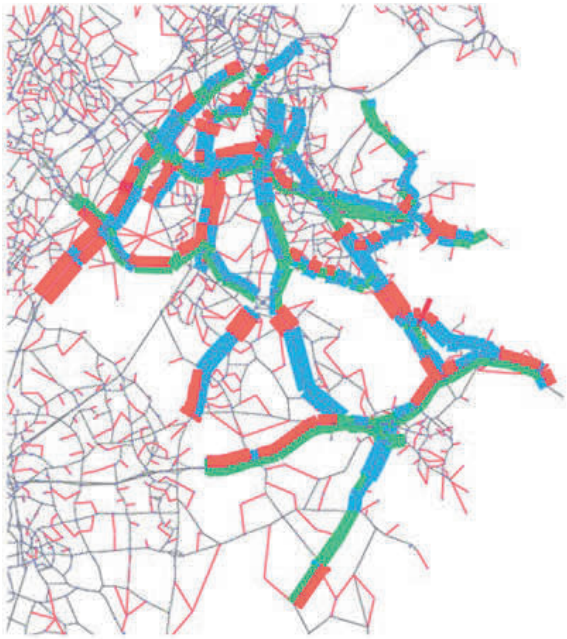
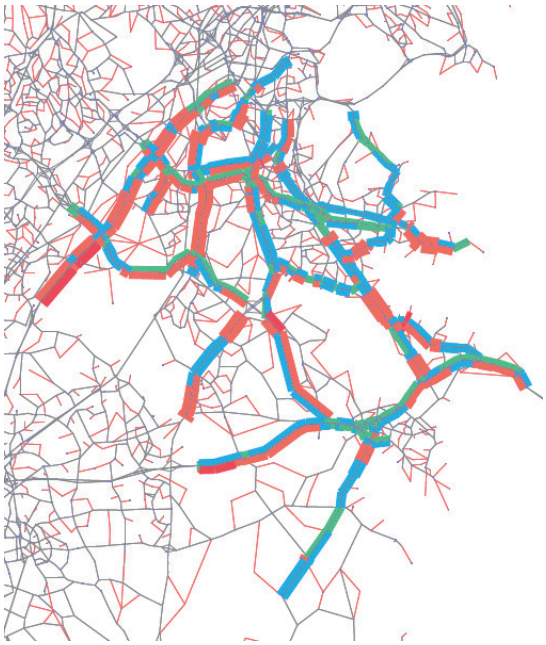


Figure 2: 2040 Projected 2017 Freeway and Arterial Speeds in Anne Arundel County

AM Peak Period Speed



PM Peak Period Speed



There are several TSM&O measures that could mitigate some of this congestion:

- For freeways where one direction is significantly more congested than the other direction, a **reversible lane** is a potential solution. Reversible lanes facilitate traffic flow in the peak direction by using capacity from lanes in the off-peak direction. Two prominent reversible lanes already exist in Anne Arundel County: at the Bay Bridge and on MD 177, from MD 100 to west of South Carolina Avenue.
- **High Occupancy Vehicle (HOV) lanes** are another example of a congestion management strategy. Lanes reserved for carpools, vanpools, and buses during designated time periods may help to incentivize motorists to increase carpooling, thereby reducing the number vehicles on the road, increasing capacity. An existing example has been implemented on U.S. 50 in Prince George's County.
- To further incentivize motorists to use the HOV system, **High Occupancy Toll (HOT) lanes** could be introduced, incurring a toll on single-occupancy vehicles while allowing vehicles in HOV lanes to travel free. The Governor's Traffic Relief Plan, which would enable implementation of HOT lanes along I-270 and I-495, is currently under study.
- **Variable toll pricing** is often coupled with HOT lanes to and bases road access pricing peak period traffic demand. Sensors along the roadway monitor traffic volume and can automatically adjust toll pricing accordingly. Variable toll pricing may be implemented in conjunction with a HOT lane, where high-occupancy vehicles (and sometimes motorcycles, electric vehicles, and hybrid vehicles) can use a toll road free of charge.
- **Variable speed limits** are speed limits that change based on road, traffic, and weather conditions. By preventing sudden changes in flow speeds, they can help keep flow smooth, efficient, and safe.
- **Ramp metering** is an effective tactic used to regulate the number of vehicles entering a freeway. Typically, a device or traffic signal is installed at freeway on-ramps to manage the rate of motor vehicles entering the freeway. This can ensure that flow along the mainline is not overly interrupted and that capacity does not become oversaturated.

These strategies could be implemented in real-time with the implementation of **Intelligent Transportation Systems (ITS).** A traffic management system could be implemented that collects and monitors information on roadway conditions. This system can then direct drivers through the roadway network at varying speeds, lane configurations, and prioritize routing. This allows traffic to flow in the most efficient way possible. Reversible lanes and HOV lanes, as detailed previously, are examples of possible dynamic configurations. Shoulders may also be reassigned as an additional lane to maximize the capacity.

Another advantage of real-time information is that currently available technology can now enable it to be delivered to the traveling public. This can be done via permanent freeway electronic message boards, cell phone alerts, portable roadside electronic message boards, highway advisory radio, internet, and in-vehicle or mobile navigation systems. Travelers may use information about roadway conditions to make informed decisions about their driving routes, ultimately increasing the mobility and safety of both the individual and the system.

Table 1 presents a preliminary list of suggested TSMO improvements for consideration by MDOT SHA for freeways in Anne Arundel County.

Table 1: Short-term and long-term TSM&O recommendations for Anne Arundel freeways

Short-term recommendations	Long-term recommendations
Morning peak hour: Work with SHA to implement trial reversible lanes on northbound MD 295, from Prince George's County line to MD 32 (4.7 miles), and on northbound I-97, from MD 3 to MD 178 (6.4 miles)	Implement a freeway ITS system to inform dynamic lane assignments and variable speed limits on US-50, MD 295, I-97, MD 32 (Fort Meade/Odenton area), and MD 100
Evening peak hour: Work with SHA to implement trial reversible lanes on eastbound MD 100, from MD 713 to the Howard County line (1.91 miles), and on the inner loop of I-695 (1.63 miles)	Investigate the feasibility of an HOV lane on I-97
Implement Dynamic Message Signs on MD 295, MD 100, and I-97	

TSMO on Arterials

TSM&O strategies are also applicable on arterials. A prominent example in Maryland is the reversible lane on Georgia Avenue. However, especially in the case of reversible lanes, dynamic assignment is not just a function of the congestion on a single road. When interchanges are involved, the entire network must be considered for lane and speed configurations to be optimized for maximum safety and efficiency. As employment and population in Anne Arundel County continues to increase, several activity centers require additional attention to manage congestion.

Adaptive control already exists on several Anne Arundel corridors such: as Riva Road, Jennifer Road, and Forest Drive in Annapolis. With actuation, signal timing parameters, such as cycle length, are adjusted as a function of demand via the use of a vehicle detection system. One area of immediate concern is the Fort Meade/Odenton area, where two failing intersections are in immediate proximity to each other. Adaptive control should be considered in this area, with a perimeter extending to the I-97 and MD 32 exchange and the Baltimore-Washington Parkway. Other areas of potential concern are BWI, Annapolis, and Pasadena.

Table 2 summarizes a priority list of areas to incorporate into an adaptive signal control system, followed by additional active traffic management systems, such as dynamic lane assignment and dynamic intersection configuration. Ultimately, ITS should be pursued on an as-needed basis as activity cores emerge in Anne Arundel County.

Table 2: Short-term and long-term ITS priorities for Anne Arundel County

Short-term recommendations	Long-term recommendations
Expand Annapolis adaptive control network to include Arnold area and Severna Park	Implement new adaptive control systems in BWI area
Implement adaptive control in Fort Meade/Odenton activity core	Implement new adaptive control systems in Pasadena (including Jacobsville and Lake Shore)
	Upgrade adaptive control systems to ITS, including dynamic lane and intersection configuration assignments on an as-needed basis by activity core

Finally, to effectively manage traffic systems in the County, it is recommended that the County work with the State and across agencies to develop an inter-agency, integrated traffic management center. This would centralize data collection and facilitate seamless tracking and system performance monitoring and allow system changes to occur in real time.

ANNE ARUNDEL COUNTY
TRANSPORTATION
MASTER PLAN

TECHNICAL MEMORANDUM #7
Transit Considerations

ANNE ARUNDEL COUNTY
MARYLAND

Prepared for the Anne Arundel County Office of Transportation
March 2019 – Final

SABRA
& ASSOCIATES
Engineering Innovative Solutions

Note: The purpose of each Technical Memorandum prepared for the Office of Transportation is to present facts, analysis, ideas, issues and recommendations that will inform the Anne Arundel County Transportation Master Plan. The views expressed and recommendations offered in each memorandum are solely based on the consultant's judgment and should not be considered as endorsed by the Office of Transportation or any other County agency or officer.

The purpose of this technical memorandum is to outline the results of the analysis performed by Sabra and Associates of the available transit system in Anne Arundel County. It provides a review of transit opportunities in the County and recommendations for further actions which would encourage and increase the usage of transit in the County.

Regional Transit Planning & Coordination

Anne Arundel County's public transit system is a disparate set of routes, modes and providers. Unfortunately, there is no core policy direction from the county government. The guiding document for transit planning and policy in any jurisdiction is its Transit Development Plan (TDP). Historically, TDPs have been prepared on a county-by-county basis as a guide for the locally operated transit system. The 2017 TDP process is a significant step forward in the regional transit planning process. That plan has been created jointly by Howard and Anne Arundel Counties with some considerations given to northern Prince George's County and the City of Laurel. However, the TDP is not successful in advocating a more regional approach to transit. A more expansive plan is needed that also includes the MTA and WMATA systems to meet the needs of existing and potential transit users in the county.

The draft 2018 Central Maryland Transit Development Plan states in its scope of work to "formulate the county's or region's goals and objectives for transit, review and assess current transit services, identify unmet transit needs, and develop an appropriate course of action to address the objectives in the short-range future, typically a five-year horizon." Chapter 7 of the TDP, "Future Transit Development" contains a list of proposals from other plans. However, there is no evaluation of which projects may have true value to the County and at what level of priority they should be implemented. Interestingly, the TDP makes no mention of the one major transit project contained in the 2009 General Development Plan. This is the proposed extension of the Yellow Line (Central Light Rail Line) from the BWI Business Park to the Dorsey Road MARC station on the Camden Line, ultimately connecting to Columbia in Howard County. The GDP Transportation Plan includes this alignment and recommends its

Anne Arundel County is currently served by four transit operators:

- The **Maryland Transit Administration** which operates local bus service, light rail, commuter bus service, MARC Train and provides complementary paratransit services for the above;
- **Annapolis Transit** which provides local bus service generally within the borders of Maryland's capital city; and,
- the **Regional Transportation Agency of Central Maryland** which serves the western communities of Anne Arundel County, much of Howard County and northern Prince George's County, including the City of Laurel.
- the **Anne Arundel County Office of Transportation** manages the South County Circulator (SoCo Go!) and the Arundel Mills Jobs Connector.
- The **Washington Metropolitan Area Transit Authority (WMATA)** provides express service between the Greenbelt Metrorail Station and BWI Thurgood Marshall.
- In addition, many private transit services operate in -Anne Arundel County, including Greyhound and Megabus long-distance carriers, an extensive shuttle bus system supporting BWI Airport, as well as shuttles operated by area hotels, medical facilities and others.

implementation between the BWI Business Park Light Rail Station and the Dorsey MARC station.[1]

The plan includes a series of proposals to add or adjust RTA services in the County but makes no mention of Light Rail or Commuter Bus services. It only contains a few references to the MARC Train system, noting that certain RTA routes stop at MARC stations. WMATA is not mentioned at all, nor are intercity carriers.

The Case for Transit to, from and within Anne Arundel County

There are compelling reasons for the County to consider further investment and policy advocacy for improved local and regional transit services.

- **Nearly 75% of all vehicle trips begin and end within Anne Arundel County.** This indicates that the distance travelled to or from work or for other purposes could reasonably be accommodated by a strong local transit network, specifically with service that operates more frequently than the current 30-minute peak period buses operated by RTA. With greater density and better land use controls (building all the way to the right-of-way line, including sidewalks on all property edges fronting roadways, etc.) that make transit ridership more hospitable, certain corridors may develop to a level such that higher frequency intra-county service is warranted.

- **The proportion of trips from Anne Arundel County to the District of Columbia and its suburbs is increasing, while the proportion of trips to Baltimore City and Baltimore County is steadily decreasing.** As D.C. and its suburbs have a robust and recognizable transit system/culture, there is an opportunity to shift some vehicle trips to commuter bus or MARC Train service if enough transit capacity was to exist. We believe that this is especially true in the MD 3 corridor south of Waugh Chapel Road, across the US 50 corridor from Annapolis to New Carrollton or downtown D.C., and from Severna Park/Davidsonville, as the commute is becoming more difficult and unreliable.

- The County's **changing demographics (specifically, the age and socioeconomic condition of its residents)** also gives rise to greater need for transit services. With economically struggling populations in the northern part of Anne Arundel County, there is a greater need for connectivity to and from areas which are showing increases in employment growth. A bus trip from Brooklyn Park to Arundel Mills Mall takes an average of 1 hour, 25 minutes to travel less than 8 miles. Depending on the time of day or day of week, service may only run once an hour or less. Traditional fixed route transit services may or may not be the best way to serve such trips; the TDP calls for deviated fixed route services in many parts of the County which is possibly a better alternative, given the relatively low density of land uses throughout the County. Seniors and persons with disabilities can also be better served by deviated fixed-route services than by traditional bus routes.

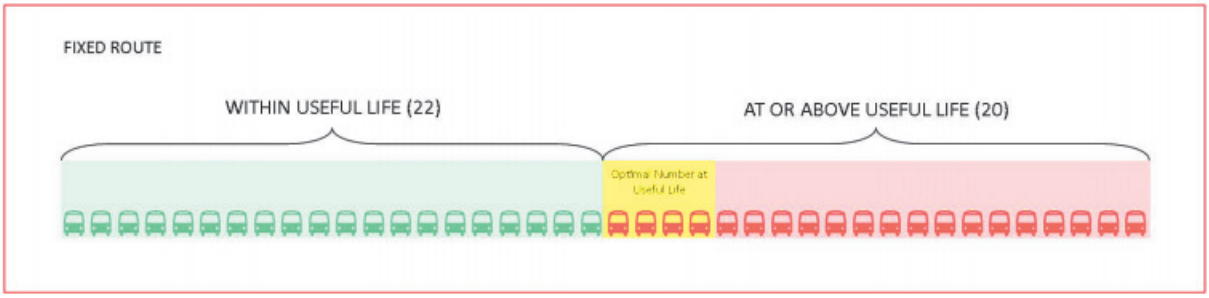
[1] 2009 General Development Plan, Page 161

Asset Management

Service reliability is a significant issue for RTA users. For services operating primarily within Anne Arundel County, on-time performance is estimated at 44%. One of the reasons for poor on-time performance is fleet reliability. Anne Arundel County only owns two vehicles (which are used on Anne Arundel fixed routes), while six vehicles owned by TMCM are also assigned to Anne Arundel fixed route services. Although the RTA fleet inventory assigns vehicles to a type and jurisdiction of service, it is clear from daily assignments (in the inventory) that vehicles are not operated in separate sub-fleets. Nor is the relationship between ownership and vehicle requirements for the jointly funded regional services clear. As a practical matter and because of the condition of the fleet, it is likely that any or all operating vehicles are assigned based on daily need, rather than based on ownership.

Federal transit funds are sometimes used to support fleet purchases for locally-operated transit systems, either through formula funding to MTA or through discretionary grants directly from FTA. One determinant of federal funding is the extent to which a local system is maintaining its assets in a state of good repair. Overall, RTA is at a tipping point in fleet asset management – and the ability to improve service reliability -- with nearly 50% of its 42 transit vehicles being at or above their useful life.

Figure 1. RTA Age of Fleet



In the coming decade, Anne Arundel County will have to contribute more to the fleet plan for RTA. Replacements for six vehicles used in Anne Arundel service that are owned by Transit Management of Central Maryland (the RTA) and the two vehicles owned by Anne Arundel County have (or will soon) reach the end of their useful life. The County's FY 2018 capital budget included $1 million for the replacement of four medium-duty buses. In the next five years, an additional $1.21 million will be required to meet the useful life benchmark for transit vehicles as defined by FTA.

Major Transit Corridors

The County should use 2019 General Development Plan as an opportunity to frame future transit/multimodal investments of a larger scale. Specifically, the following projects have the potential to ease congestion growth, improve travel reliability and change the transportation trajectory in the corridor. The County should work with Howard County to preserve a **transit corridor and develop a supportive land use plan from BWI to Arundel Mills to Columbia.**

Considerations for the Next 5 Years

The establishment of the Office of Transportation, creation of the RTA, and additional funding for local transit services all indicate an increased in policy commitment to transit than previously existed in Anne Arundel County. The following recommendations are provided as an aid in maximizing transit use for all potential riders in the county:

- **Advocate that MTA increase its commuter bus services to Washington, DC.** The most congested corridors in the County where no commuter bus service is currently provided are the MD 3 corridor between Crofton and Bowie, and the MD 100 corridor between Pasadena. In addition, cross-county services such as the Inter County Connector Commuter Buses 201 (Gaithersburg to BWI) and 202 (Fort Meade to Gaithersburg) should be adjusted to better serve central County commuters. Recognizing the westward shift in the County's travel patterns away from Baltimore, new services should focus on moving commuters along the Capital Beltway, with stops in New Carrollton, College Park, Silver Spring and Bethesda. There may be value in encouraging MTA to run express or skip stop service from the New Carrollton station to Bethesda. Additional commuter bus service from South County is also warranted.

- As an increase its transit investment is considered, **the County should be cautious of spreading its resources too thin such that no corridor or community is served well at all.** Local services that operate every 45 – 60 minutes on routes that serve an excessive number of destinations are unlikely to attract new riders who have a choice to use a private auto. The County should look to serve a few communities or corridors well, rather than many corridors ineffectively. The Transit Development Plan includes new routes, route changes and improvements to service frequency and span. Careful analyses should be undertaken before any new routes are implemented. In Table 1, recommendations are made concerning some of the proposed new routes.

- **Bus route and stop coordination, along with improved bus stop infrastructure, needs to be an operational priority.** The Baltimore Metropolitan Council's pending study on regional bus service coordination should be used to focus partner agencies on the many opportunities to improve connectivity. One such opportunity is near Marley Station Mall. There, five current or proposed bus services operate close to each other, but the direct connections among the services are limited. Implementation of **transit hubs** with varying degrees of infrastructure investment should also be advanced.

Table 1. Review of Proposed Locally-Operated Transit Routes from Transit Development Plan

Proposed Service	Weekday Service Frequency	Comments
Anne Arundel Community College to Fort Meade/NSA	Hourly	• Mid-County and cross-county services are definitely needed. • It is unclear whether the connection into NSA is feasible, based on current security restrictions. Consideration should be given to terminating the route at Odenton and timed to meet MARC service. • The eastern half of the route (from MD 2 to I-97) be operated as deviated fixed-route service.
Crofton Park and Ride to Annapolis Town Center	Hourly	• Crofton park-and-ride is not a logical terminus; consider extending to Waugh Chapel Road. • Crofton to Annapolis is not believed to be a strong origin-destination pair. The central portion of the route doesn't have enough density or community facilities to warrant service. • Consider using US 50 for the central portion of the route rather than MD 450; extend the Crofton call-and-ride zone to St. Stephen's Church Road.
Annapolis to Arundel Mills Mall/BWI Airport	60 minutes	• This is a logical service for tourism trips between BWI, Arundel Mills and Annapolis; however, it is unclear that enough market exists to warrant the service. • There is some duplication with existing MTA service.
Crofton Call and Ride	45 minutes	• Deviated fixed-route service is definitely the appropriate service plan for this area; however, further demographic analysis should be used in this area to determine if a sufficient ridership market exists and trip generators served.
Glen Burnie to Cromwell LRS Call and Ride Riviera Beach to UMBW Medical Center Call and Ride S. Glen Burnie Call and Ride Patapsco Plaza to Cromwell LRS Call N Ride	45 minutes	• It is likely that there is strong demand for call-and-ride service in these areas which are increasingly transit dependent and somewhat difficult to serve with traditional fixed routes. • There is overlap with MTA service in some of these areas; further coordination should be undertaken with MTA to create an overall Glen Burnie/Pasadena strategy.

ANNE ARUNDEL COUNTY
TRANSPORTATION
MASTER PLAN

TECHNICAL MEMORANDUM #8
Review of Key Corridors

ANNE ARUNDEL COUNTY
MARYLAND

Prepared for the Anne Arundel County Office of Transportation

May 2019 – Final

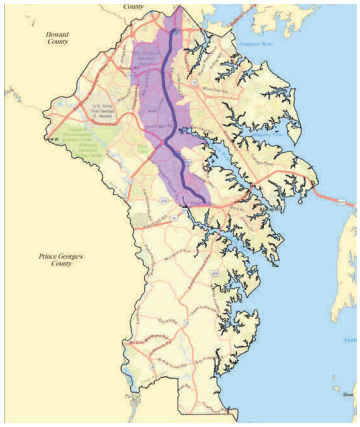
SABRA
& ASSOCIATES
Engineering Innovative Solutions

Note: The purpose of each Technical Memorandum prepared for the Office of Transportation is to present facts, analysis, ideas, issues and recommendations that will inform the Anne Arundel County Transportation Master Plan. The views expressed and recommendations offered in each memorandum are solely based on the consultant's judgment and should not be considered as endorsed by the Office of Transportation or any other County agency or officer.

A summary of travel demand, planning gaps and conflicts, existing conditions and potential projects among all modes was prepared for each state-owned roadway considered in the Transportation Functional Master Plan; county-owned roadways had much less data to be considered in formulating recommendations for the plan. These summaries were one input into the analysis performed in creating the plan's final recommendations.

Readers must understand the context for these summaries. As published in this technical memorandum, draft documents were prepared for discussion purposes among the project team but were not updated following team discussion. Any information used in these summaries must be verified prior to use.

INTERSTATE 97



Travel Demand Forecasting

Since the 2009 General Development Plan, the expansion of housing development has been rapid outside of future major job centers, such as BWI, Fort Meade, Brooklyn Park, and the University of Maryland Baltimore Washington Medical Center. This corresponds to Ferndale, Pumphrey, Severn, and Pasadena, along the I-97 travel shed, with buffers of low growth in the immediate area adjacent to major roads. Immediately south of the University of Maryland Baltimore Washington Medical Center is the site of new senior housing, with condominiums currently under construction. Population is expected to outpace previous forecasts with the influx of employment opportunities throughout the travel shed.

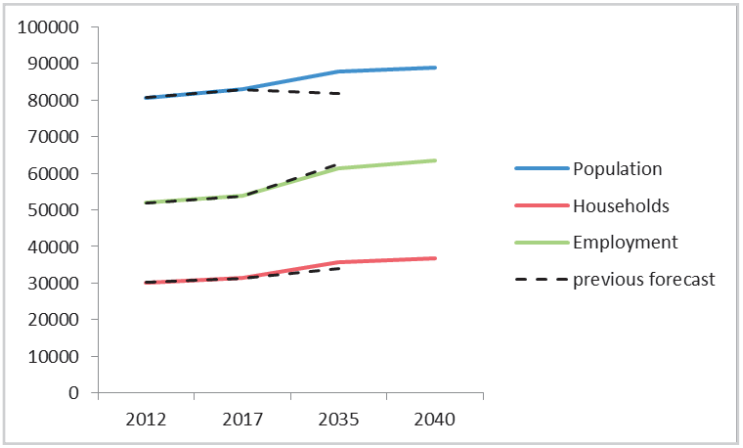
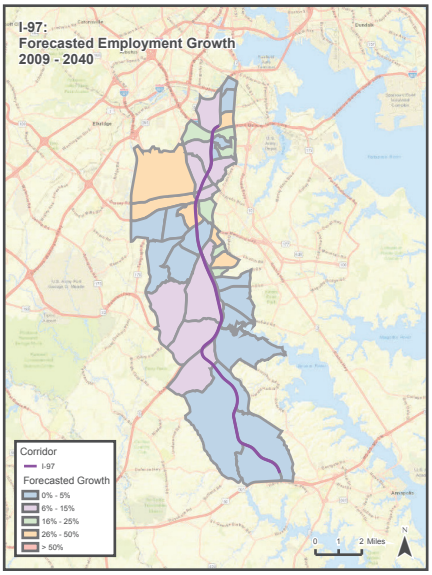
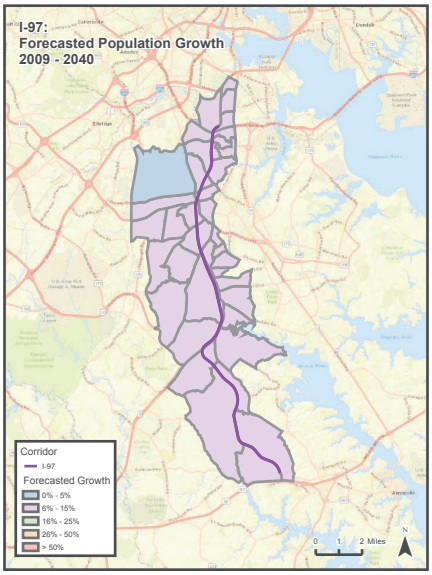


Table 1: Comparison of CGMP Forecasts

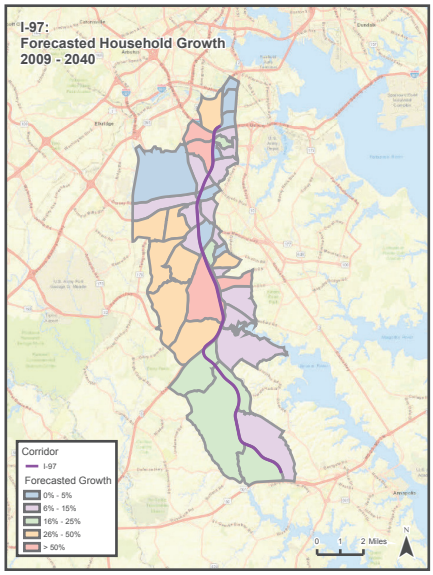
Employment



Population



Housing



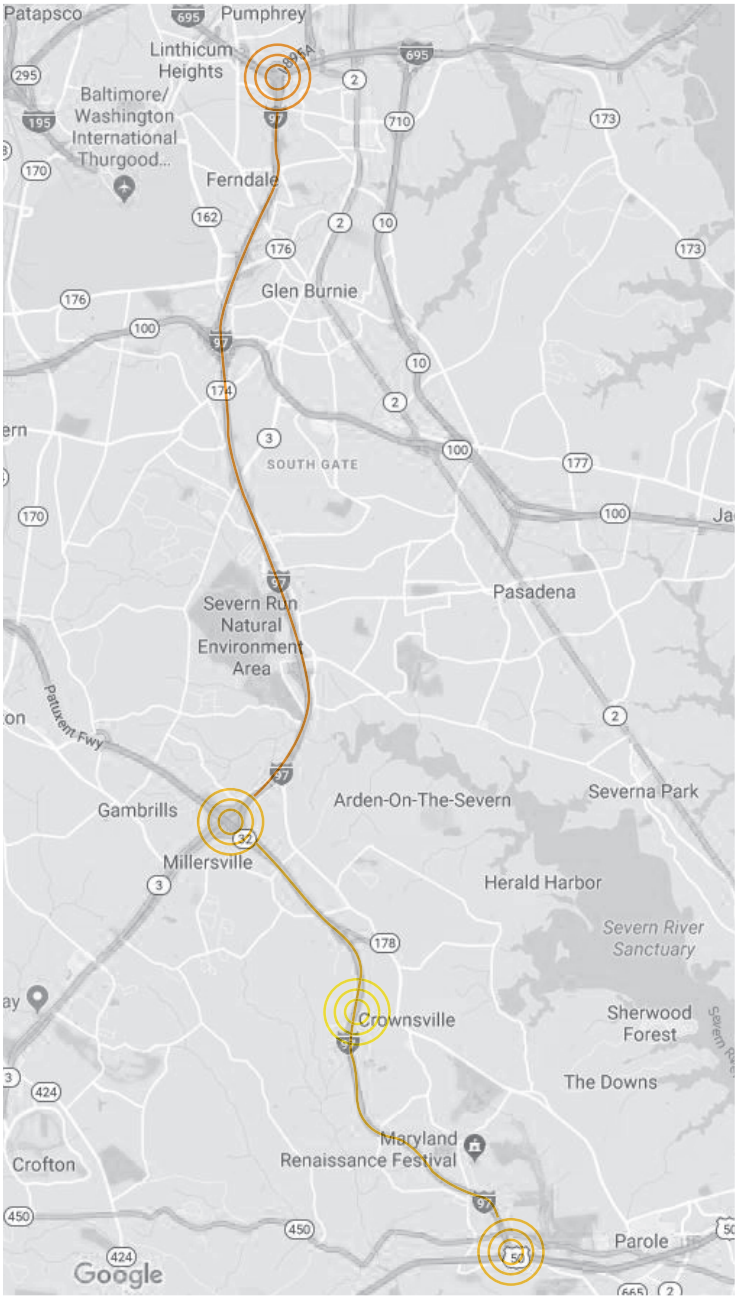
Recent and Committed Projects

» There have been no capacity improvements along I-97

TFMP Candidate Roadway Projects

Project	Status	Cost Estimate
Widen I-97 from 4 to 6 lanes between US 50 to MD 32	No action planned	$283,300,000
Interchange improvements at US 50	No action planned	N/A
New interchange near Crownsville	No action planned	N/A
Widen I-97 from 6 to 8 lanes from MD 32 to I-695	No action planned	$321,000,000

Roadway Project Locations



Planning Gaps & Conflicts

Highway

» The widening of I-97 is consistently noted among the plans reviewed, but the project is not included in the Baltimore Region Constrained Long Range Transportation Plan.
» The County's targeted growth area at the former state hospital complex in Crownsville may require regional access via I-97, but no improvements are identified in any of the plans reviewed.
» There are ongoing discussions of interchange improvements or transportation systems management/operations (TSMO) strategies at I-97.
» SHA's Annual Mobility Report shows significant congestion and delay at the junction of I-97 and MD 32, primarily in the southbound to eastbound direction.

Transit

» Today in the I-97 corridor MTA provides:
  ◦ Three express trips daily between downtown Baltimore and downtown Annapolis via Cromwell Light Rail Station (Route 215).
  ◦ Three express bus trips from Kent Island to downtown Baltimore via Annapolis with two additional trips originating in Annapolis (Route 210).
» The Central Light Rail Line's Cromwell Station is the southernmost stop and serves trips from I-97 to downtown Baltimore and to the north. The Harry S. Truman Park and Ride is located at near the junction of I-97 and US 50 at Riva Road.
» The Corridor Growth Management Plan recommends adding premium bus service from Parole Town Center to BWI Airport and Arundel Mills.
» The Transit Development Plan recommends makes no specific recommendations for transit service in the I-97 corridor.

Bicycle and Pedestrian Facilities

» Bicycle traffic is not permitted on access-controlled freeways and interstate highways, unless it is located on an approved adjacent path or facility. As such, parallel routes should be explored. The Bicycle and Pedestrian Master Plan contains recommendations along MD 178 (Generals Highway) to MD 450 (Defense Highway), and West Street continues the corridor into Annapolis.
» Pedestrian and bicycle improvements on MD 178 are recommended from Knollwood Drive to the Annapolis city line. Intersection improvements are recommended at the intersection of Housley Road, Bestgate Road, and MD 178.
» Recommendations:
» Use existing wide shoulders and right-of-way on MD 178 between West Street and Knollwood Drive for separate bike lanes
» MD 178 north of Knollwood Drive could support separated bike facilities up to the Paul Birch Drive intersection, where the right-of-way narrows significantly
» Consider bike lanes on West Street from US 50 to Taylor Avenue
» Incorporate separated bike lanes with improvements at the Housley Road/Bestgate Road/MD 178 intersection.

Recommendations

Highway

» Along I-97, the high priority improvement is capacity, systems management and operations improvements from MD 32 to US 50.
» Further study is required of regional access to the Crownsville area.

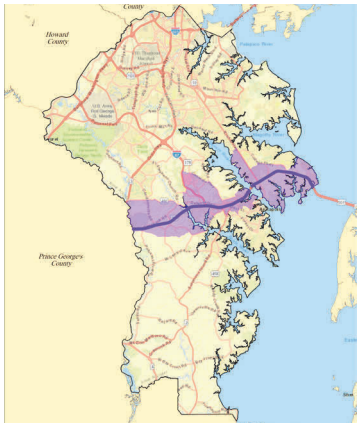
Transit

» MTA should increase the level of express service along I-97 between Annapolis and Baltimore; additional study is required on specific destinations within Baltimore City, where the high-growth Boston Street corridor is unserved and connectivity north to State Center and Penn Station could be warranted.

Bicycle and Pedestrian Facilities

» Advance the bicycle and pedestrian facility recommendations in coordination with land use changes at the former Crownsville state hospital.

US 50



Travel Demand Forecasting

Since the 2009 General Development Plan, several new residential subdivisions have been approved to support the planned commercial growth of the Annapolis Town Center. The area's commercial and residential growth is expected to continue into 2040, as it becomes an expansion of urban Annapolis. The Annapolis Town Center will be home to dense housing, while the surrounding area can expect growth in single family homes. Other employment growth is projected for the US Naval Academy, with corresponding moderate housing growth north of US 50, along the B&A Trail. Additional moderate housing growth is projected for the Crofton area of the travel shed, also north of US 50.

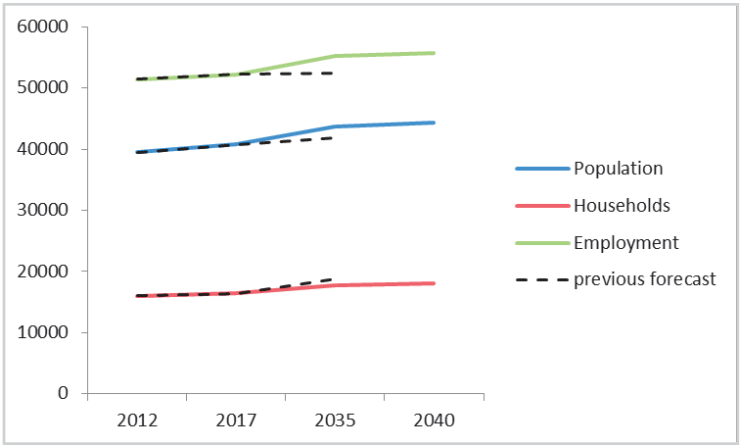
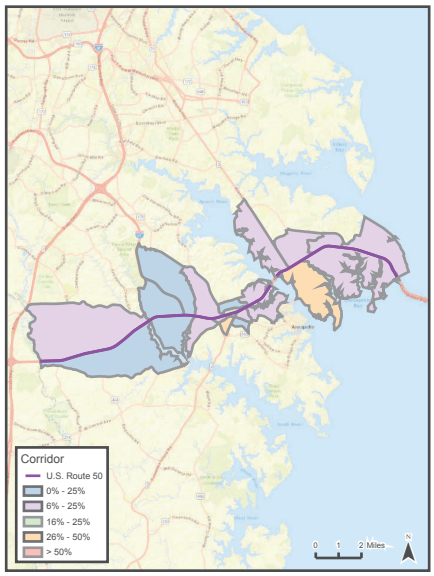
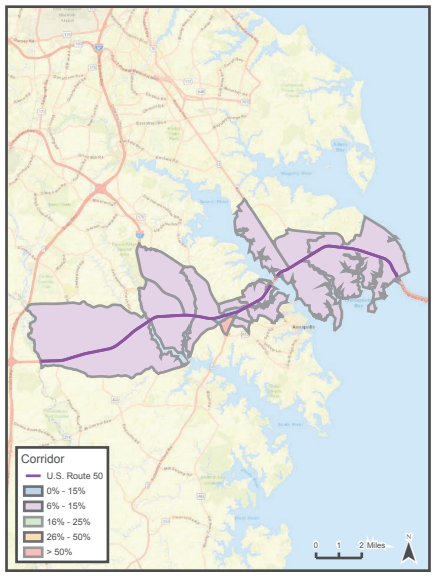


Table 1: Comparison of CGMP Forecasts

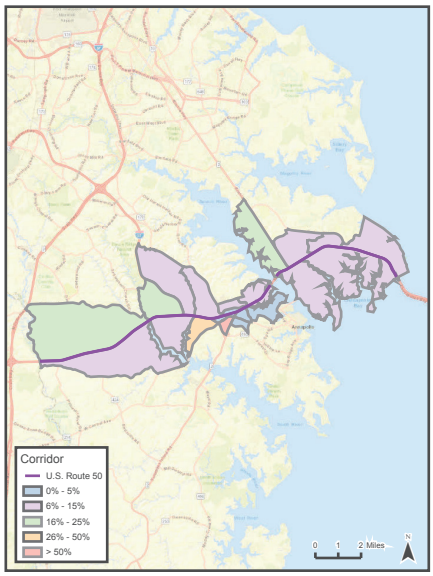
Employment



Population



Housing



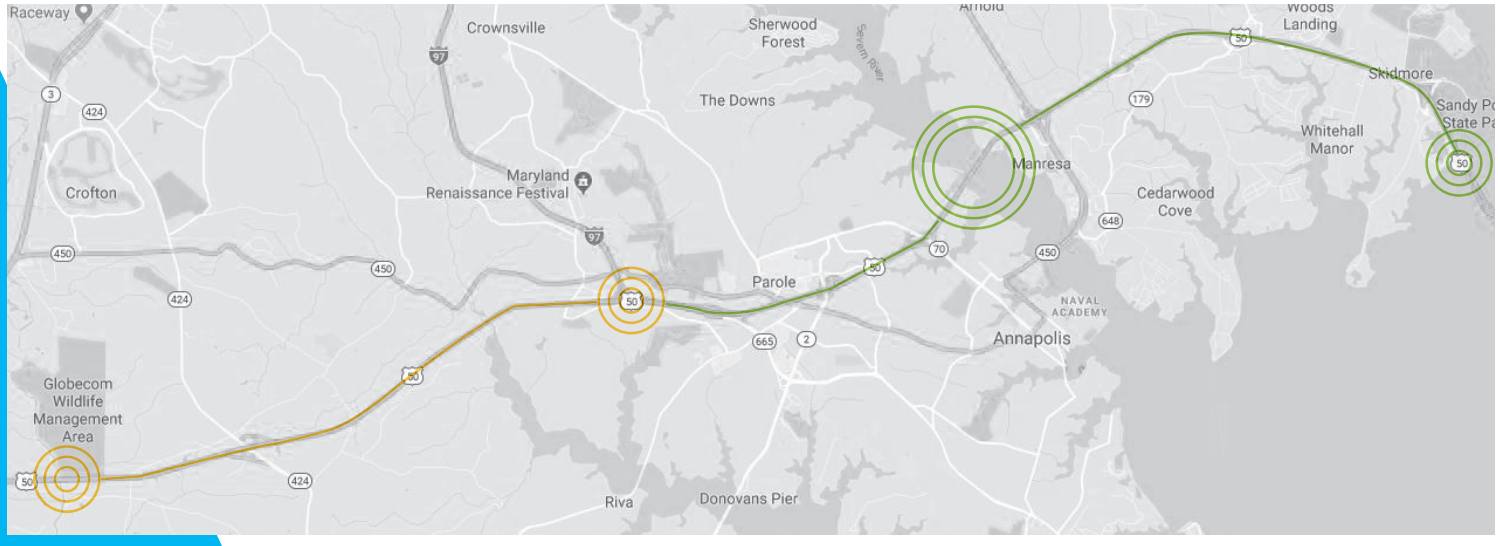
Recent and Committed Projects

- No significant roadway projects have been placed in service since the 2009 General Development Plan.
- Under Construction: Project to ease congestion on US 50 from MD 70 to MD 2 (northbound), by restriping lanes on the Severn River Bridge to accommodate one additional eastbound travel lane.
- SHA expanded a park and ride lot at US 50 at MD 424 in 2016.
- MTA implemented Commuter BusLink Route 210 from Kent Island and Annapolis to Downtown Baltimore.

TFMP Candidate Roadway Projects

Project	Status	Cost Estimate
Widen US 50 between I-97 and Bay Bridge from 6 to 8 lanes.	Reconfiguration of Severn River Bridge is underway to allow for westbound expansion to 4 lanes; no impact on eastbound traffic.	---
Extend car pool lanes from I-97 to Prince George's County line.	No action planned.	---
Interchange improvements at I-97.	No action planned.	---

Roadway Project Locations



Planning Gaps & Conflicts

Highway

- With reconfiguration of the US 50 bridge over the Severn River, SHA expects significant congestion relief in the area which is the most congested segment of the corridor west of the Bay Bridge. The recommended widening from 6 to 8 lanes may not be warranted unless coupled with HOV/transit service expansion.
- SHA is not currently planning widening or improvements along US 50; however, SHA's Highway Needs Inventory identifies the HOV lanes as a priority project.
- There are ongoing discussions of interchange improvements or transportation systems management/ operations (TSMO) strategies at I-97 but no specific project is identified in any plan.

Transit

- MTA currently offers commuter bus service departs Annapolis, Davidsonville and Severna Park every 15 minutes between 5:00 AM and 8:00 AM
- The Corridor Growth Management Plan calls for premium bus service along US 50 from Annapolis to downtown DC using HOV lanes. The Transit Development Plan also includes this recommendation.

Bicycle and Pedestrian Facilities

- No pedestrian or bicycle improvements are recommended for US 50. This corridor is a limited access highway, and no pedestrians or bicycles are permitted.
- Continuous, parallel routes should be explored. MD 179 (St Margaret's Road), MD 450 (Baltimore Annapolis Boulevard), and MD 450 (Defense Highway) are parallel routes to US 50 that are included in the BPMP. Bicycle improvements are recommended:
  - On MD 179 from Baltimore Annapolis Boulevard to Whitehall Road.
  - On MD 450 from MD 3 (Crain Highway) to MD 424 (Davidsonville Road).

Recommendations

Highway

- Defer recommendation for US 50 eastbound widening and consider along with improvements to I-97 interchange. As an interim strategy, advance TSMO and transit/HOV strategies in the entire corridor including between Prince George's County line and MD 70.
- As a long-term strategy, advance HOV lanes in the corridor.

Transit

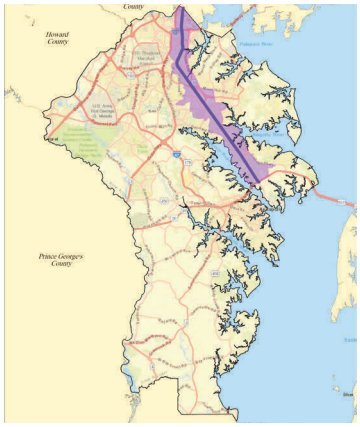
- Additional commuter bus service in the US 50 corridor is warranted over time, especially when coupled with HOV lane expansion.

Bicycle and Pedestrian Facilities

Advance projects from the BPMP and:

- Upgrade bicycle lanes to separated facilities on Naval Academy Bridge over the Severn River.
- Enhance and complete the Loews Trail or consider bicycle lanes on West Street from Taylor Avenue to US 50.
- Consider advisory bike lanes on Defense Highway west of MD 178 at certain segments or elements to slow vehicle traffic due to varying roadway widths.

MARYLAND
2



Travel Demand Forecasting

Since the 2009 General Development Plan, population and housing development have thrived at the intersection of four corridors: MD 100, MD 10, MD 2, and MD 177. This is driven by high employment growth in surrounding areas, namely in the Severna Park and Glen Burnie portions of the MD 2 travel shed. The Southdale Shopping Center and the Marley Station Mall expansions, in particular, can expect to encounter employment growth and housing development in Pasadena. In 2014, Usterra purchased a large parcel in Brooklyn Park, west of MD 2. This development, in addition to several shopping malls and commercial developments planned along the corridor, are projected to increase employment in the area. As a result, housing development is expected to grow significantly east of the corridor, north of 695.

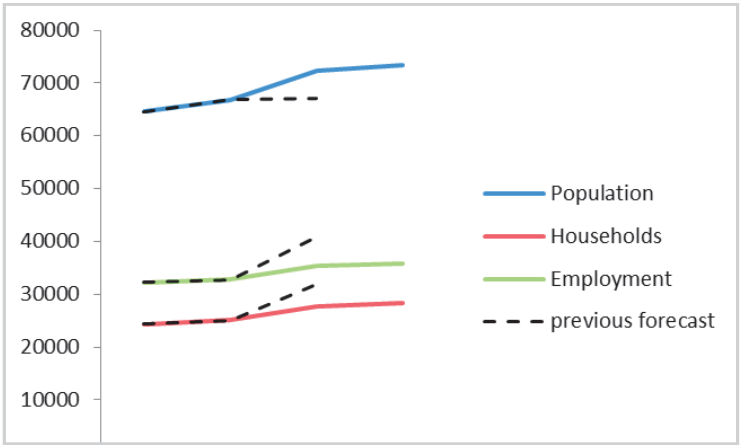
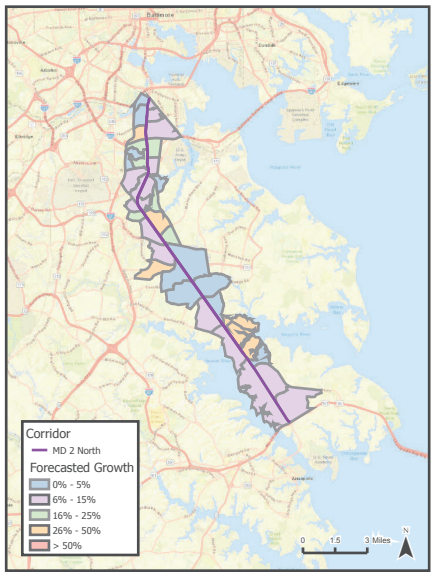
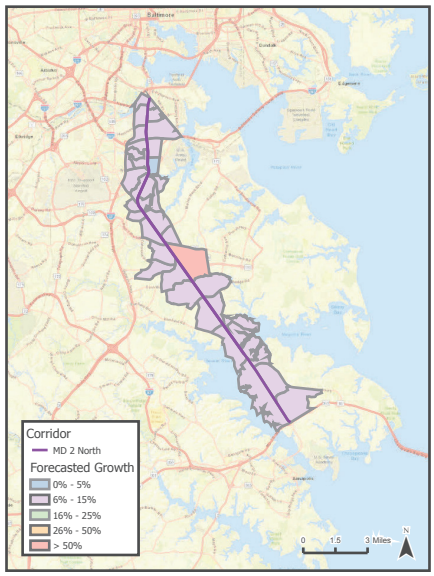


Table 1: Comparison of 2015 Corridor Growth Management Plan forecast for 2035 vs. 2040 long-range plan of the Baltimore Regional Transportation Board

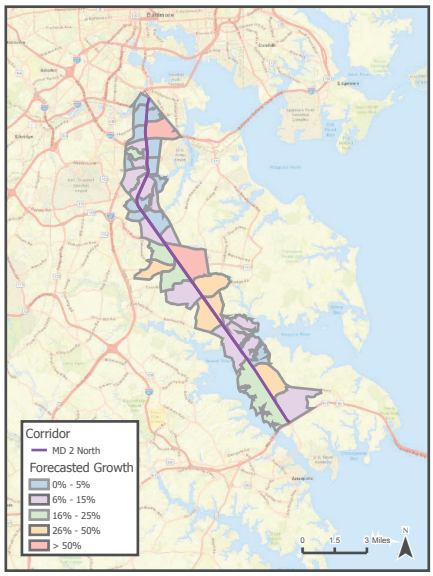
Employment



Population



Housing



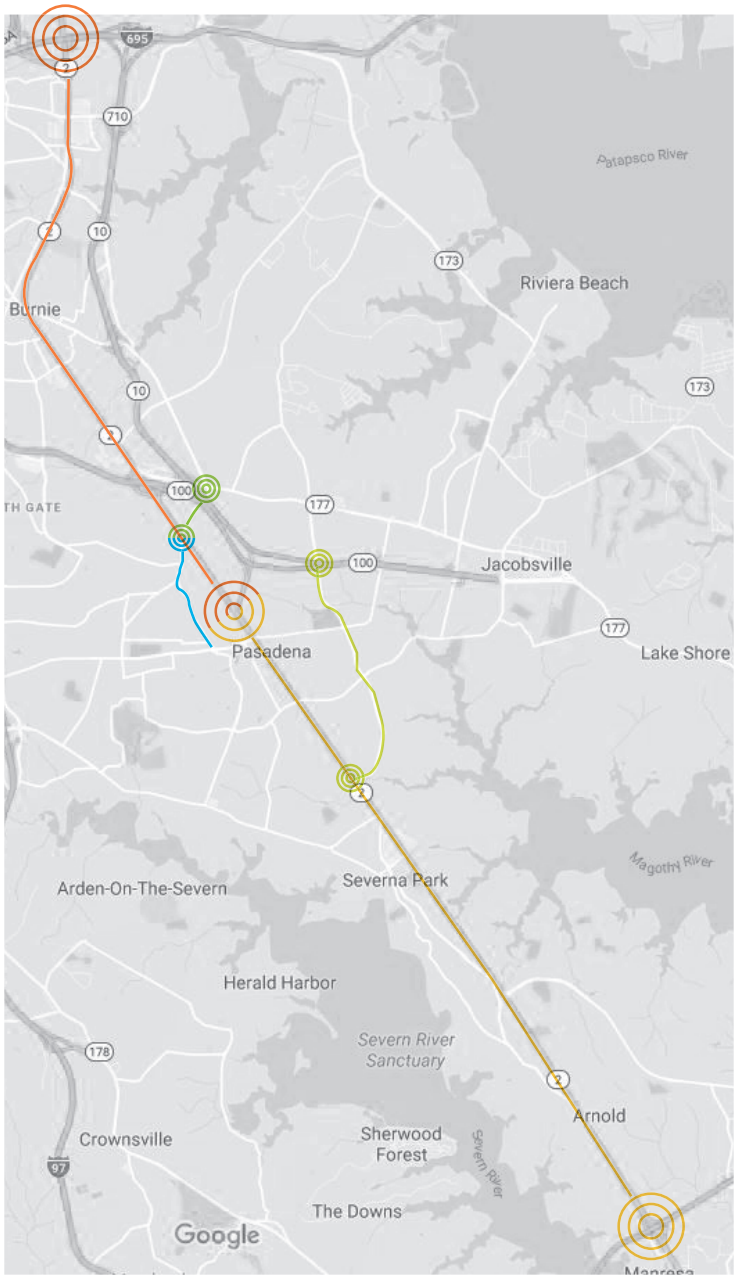
Recent and Committed Projects

- No significant roadway projects have been placed in service since the 2009 General Development Plan.
- No roadway capacity projects are projected in the corridor.
- MD 2 North is part of SHA's Smart Traffic Signals program.
- MD 2 North was not included in the high-frequency BaltimoreLink network.

TFMP Candidate Roadway Projects

Project	Status	Cost Estimate
Widen MD 2 North from 4 to 6 lanes between US 50 and MD 10	No action	$100,800,000
Reconstruction of MD 2 between I-695 and Baltimore City line	No action	$63,900,000
Reconstruction of MD 2 between MD 10 and I-695	No action	$144,000,000
Jumpers Hole Road operations, safety and bicycle/pedestrian improvements between MD 2 and East-West Blvd.	Planning study complete	$8,600,000
Jumpers Hole Road operations, safety and bicycle/pedestrian improvements between MD 2 and MD 177	Planning study underway	N/A
Reconstruction of MD 648 operations, safety and bicycle/pedestrian improvements between MD 2 and MD 10	Preliminary Engineering	---

Roadway Project Locations



Planning Gaps & Conflicts

Highway

SHA's Annual Mobility Report shows that all signalized intersections in the MD 2 North corridor between MD 10 and the Baltimore Beltway (I-695) operate at Level of Service D or better during both the morning and evening peak periods. No capacity improvements are recommended, however this section of MD 2 north has the highest concentration of crashes of any corridor in the County and improvements should be evaluated.

Between MD 10 and US 50, congestion is more significant and roadway widening is recommended with an interchange at College Parkway. It is unclear whether or not the potential TSMO improvements along I-97 will relieve some of the pressure on MD 2 in Severna Park and near Anne Arundel Community College.

Transit

MTA provides limited bus service in the Ritchie Highway corridor with service every 45 minutes between Annapolis and the Patapsco Light Rail station (LocalLink 70) and service between Patapsco Light Rail Station and Jumpers Hole Road every 45 – 60 minutes (Local Link 69). Based on a review of MTA schedules, service departures from Patapsco are not synchronized with LRT schedules and provide for uneven headways at joint time points along the route.

The Corridor Growth Management Plan does not recommend additional service but does call for improvements to transit infrastructure such as real-time traveler information, benches and shelters, etc. which are lacking in the corridor.

The Transit Development Plan recommends a new route between Anne Arundel Community College and Annapolis. This service overlaps with MTA's Local Link 70. The TDP also recommends "call and ride" service in the northern part of the corridor to provide additional service to BW Medical Center and Patapsco Light Rail.

Bicycle and Pedestrian Facilities

MD 2 is a four-lane divided roadway with recommendations for many opportunities for bicycle and pedestrian improvements, as there are long and frequent gaps in the sidewalk network and few accommodations for bicyclists who would use this corridor. Sidewalks extend along cross streets into residential neighborhoods at most intersections, but they do not parallel Governor Ritchie Highway.

MD 2 North is one of the most dangerous sections of roadway for bicyclists and pedestrians in Anne Arundel County with particular hotspots at Ordnance Road, B&A Boulevard, and Benfield Boulevard.

The B&A Trail parallels MD 2 from US 50 to Crain Highway and provides a quality, low-traffic stress bicycle and pedestrian facility. With improved connections from MD 2, shorter bicycle trips may be more likely using the the B&A Trail may use , improvements are needed along MD 2 to provide access to area businesses.

Recommendations

Highway

» A corridor-wide traffic safety study should be performed for the MD 2 North corridor and associated improvements made as soon as possible.

» As part of the I-97 TSMO study, SHA should consider benefits that may inure to MD 2 between MD 10 and US 50.

Transit

» MTA should review schedules for LocalLink routes 69 and 70 to coordinate departures from common timepoints.

» MTA and RTA should review service between Annapolis and Anne Arundel Community College to identify efficiencies and/or schedule coordination.

» MTA should advance a package of bus stop improvements along MD 2 in conjunction with safety improvements recommended above.

Bicycle and Pedestrian Facilities

Significant attention is warranted for improved safety of bicyclists and pedestrians along MD 2.

Sidewalk gaps should be filled:

» Jumpers Hole Road to Robinson Road
» Furnace Branch Road (MD 270) to Baltimore Annapolis Blvd (MD 648)
» Robinson Road to Jones Station Road
» I 695 to Furnace Branch Road (MD 270)
» Jones Station Road to West Campus Drive

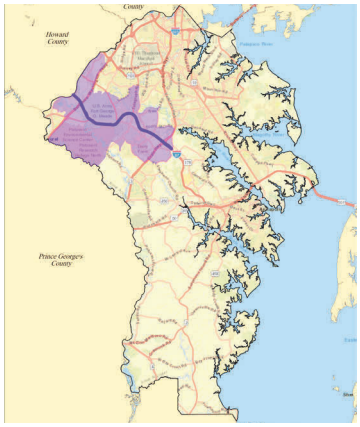
Intersection improvements with bicycle and pedestrian accommodations should be targeted to:

» McKinsey Road
» Hammonds Lane
» Jones Station Road

Bicycle lanes should be considered from Belle Grove Road to I-695 and I-695 to Furnace Branch Road; separated bike lanes may be possible in some areas.

Maintain/improve connections to the B&A Trail for alternative long-distance trip routes parallel to MD 2

Continue to advance the Broadneck Trail but consolidate the phasing to reduce overall project costs by eliminating construction inefficiencies.



Travel Demand Forecasting

High population growth in the MD 32 travel shed is expected for the area around Fort Meade, especially for Annapolis Junction and Dorsey, along MD 295, all of which is under contract by Shipley's Grant and Fort Meade contractors. Odenton Town Center is also projected to see high population growth, as is the area west of Tipton Airport, which is being developed into townhouses and single family homes by Hogan Realty. Household growth should mimic population growth, with the highest growth areas concentrated in the highest population growth areas. Additional household growth is projected for Gambrills, where a senior housing complex is planned, and along the train line. Major employment growth is projected for Odenton, Fort Meade, Annapolis Junction, National Business Park, and Patuxent Environmental & Science Center.

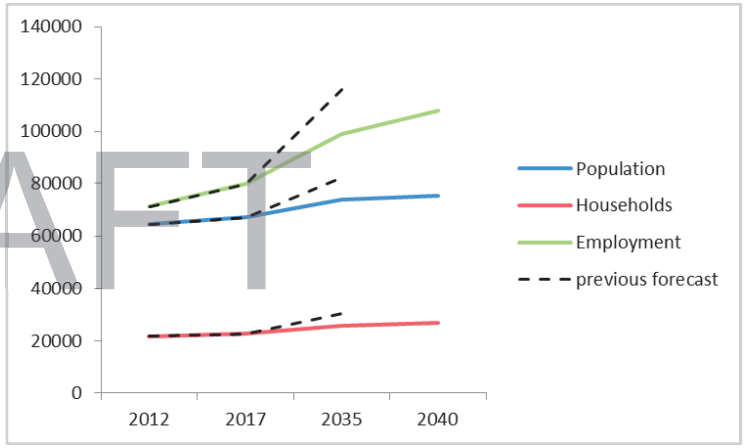
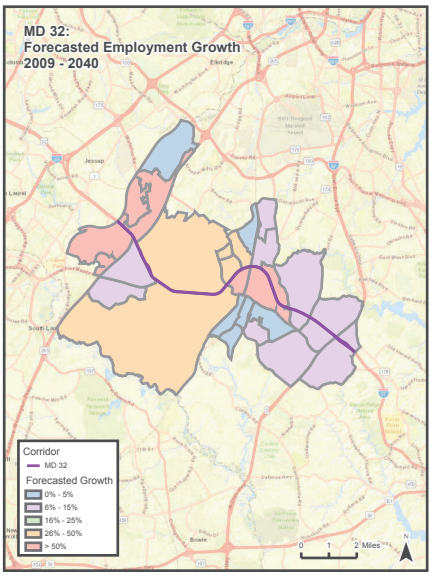
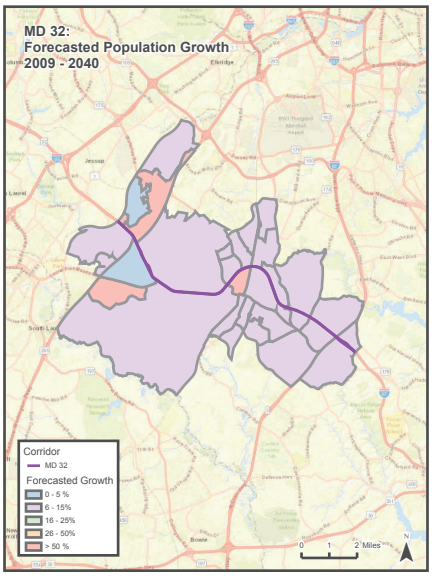


Table 1: Comparison of CGMP Forecasts

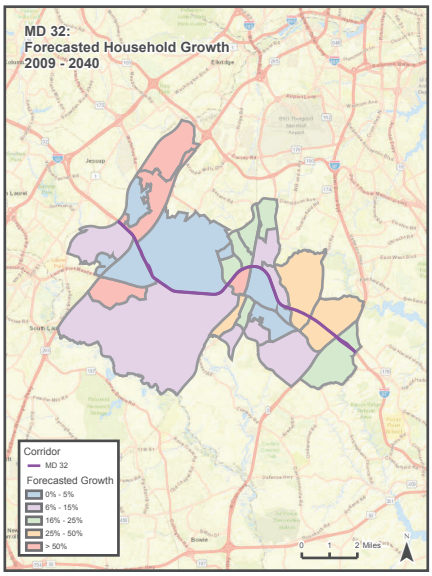
Employment



Population



Housing



Recent and Committed Projects

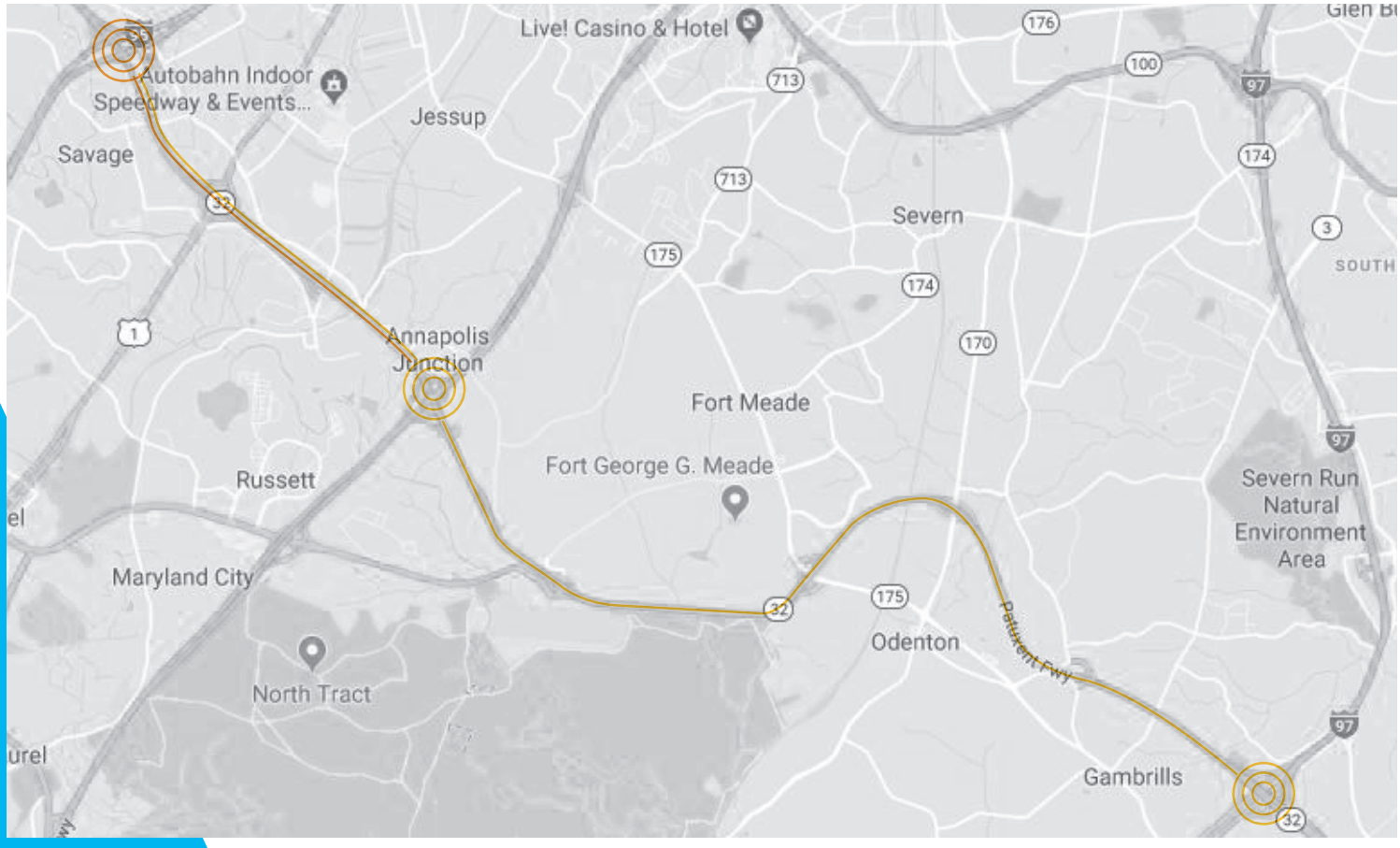
» Since the 2009 General Development Plan there have been no new projects have been placed in service along MD 32.

» There are no projects in the TIP or CLRP for MD 32; however capacity improvements at intersecting corridors (MD 175 & MD 198) are under construction.

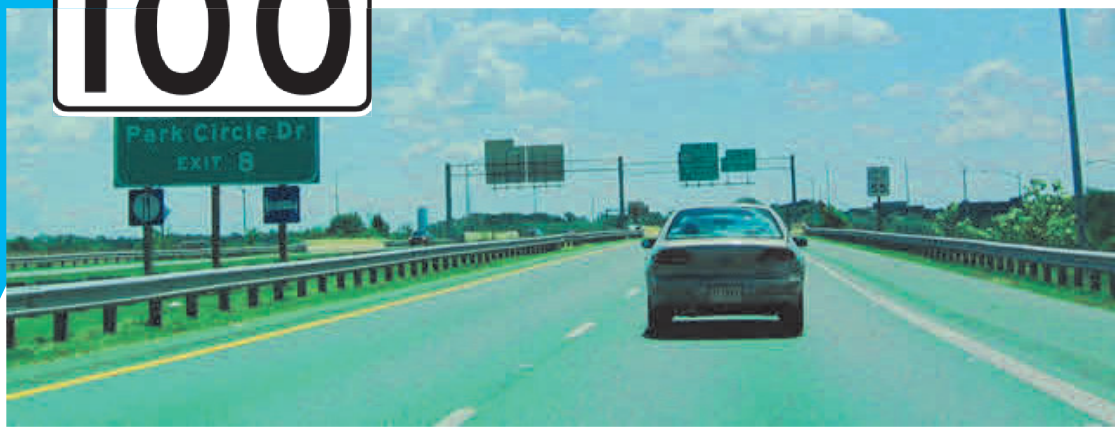
TFMP Candidate Roadway Projects

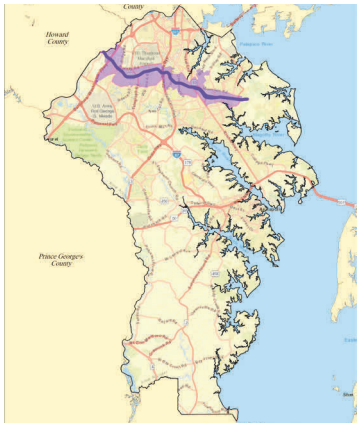
Project	Status	Cost Estimate
Establish carpool/HOV lanes on MD 32 between I-97 and I-95	No action planned	$435,370,000
Widen to 8 lanes between MD I-95 and MD 295	No action planned.	$661,500,000

Roadway Project Locations



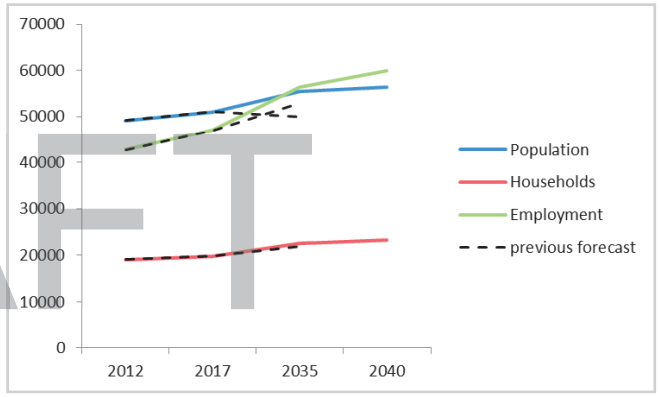
Planning Gaps & Conflicts	Recommendations
Highway » The candidate roadway projects approach congestion in the corridor at a macro level; more attention needs to be paid to where and how the congestion is occurring within the corridor. » According to SHA's annual Mobility Report: ◦ AM peak hour traffic is lightly to moderately congested westbound between MD 170 and the entrance to Fort Meade. ◦ PM peak hour traffic is moderately to severely congested between MD 295 and I-95 westbound on MD between the exit from Fort Meade to I-95 and eastbound between the Howard County line and MD 175.	**Highway** » Corridor-long widening is not warranted at this time. The projected employment growth has slowed significantly in the corridor largely owing to post-BRAC stabilization at Fort Meade. » Advance Traffic Systems and Management Operations improvements in the most congested areas during peak hours. Alternatives could include ramp metering from Fort Meade onto mainline MD 32 or extending the eastbound deceleration lane into the base.
Transit » There is no transit service along MD 32; however, there are several locally-operated services that operate in communities and business areas along the corridor. Although not proposed in any of the plans, commuter bus service to the base is likely warranted as well but has never been seriously explored due to security restrictions at Fort Meade. Transit buses are not allowed to enter the base unless operated by the federal government.	**Transit** » The County and MDOT need to work together to advance transit center solution at Fort Meade that is acceptable to base commanders. The potential transit services for the base are needed but unprogrammed due to the lack of base access.
Bicycle and Pedestrian Facilities » No pedestrian or bicycle improvements are recommended for MD 32 in the Anne Arundel County Bicycle and Pedestrian Master Plan as this corridor is a limited access highway, and no pedestrians or bicycles are permitted; however, parallel routes are explored in the Bicycle and Pedestrian Master Plan.	**Bicycle and Pedestrian Facilities** » Routes parallel to and intersecting with MD 32 should be further explored and are described in recommendations for MD 175, MD 170 and MD 713.





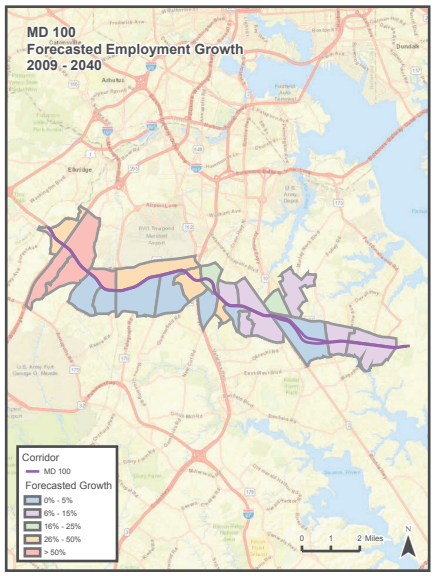
Travel Demand Forecasting

Table 1: Comparison of CGMP Forecasts

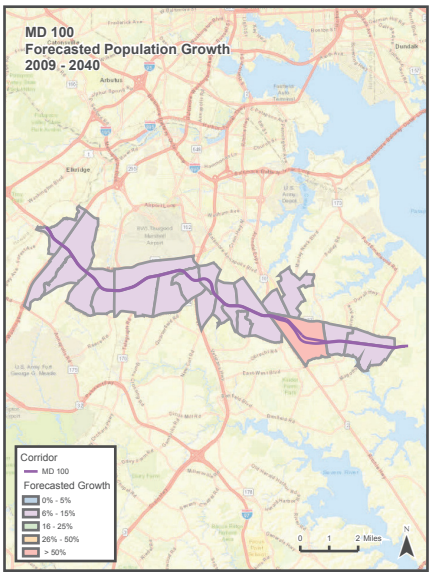


Since the 2009 General Development Plan, steady growth has occurred throughout the MD 100 travel shed. In particular, the area of Pasadena—where MD 100, MD 10, MD 2, and MD 177 intersect—is growing rapidly, with significant increase in population and housing development. Eastern Glen Burnie is also planned for increase in population with a new residential development, including townhomes and senior living. Some of this growth can be attributed to an expected rise in employment just west of this area, in and around the Southdale Shopping Center. This area was approved for an expansion in May of 2016. Housing and population growth is projected to expand out to other areas of Pasadena as well, namely the eastern-most areas. The most significant employment growth is slated for the BWI Business Corridor, at the intersection of MD 295 and MD 100. The moderate to high employment growth around the parts of MD 100 which fall in the BWI activity center should give way to moderate housing growth. Such housing growth is expected to thrive in Severn, adjacent to the BWI employment growth area.

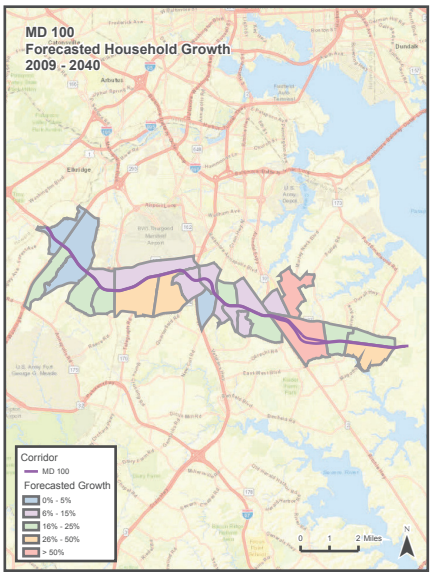
Employment



Population



Housing



Recent and Committed Projects

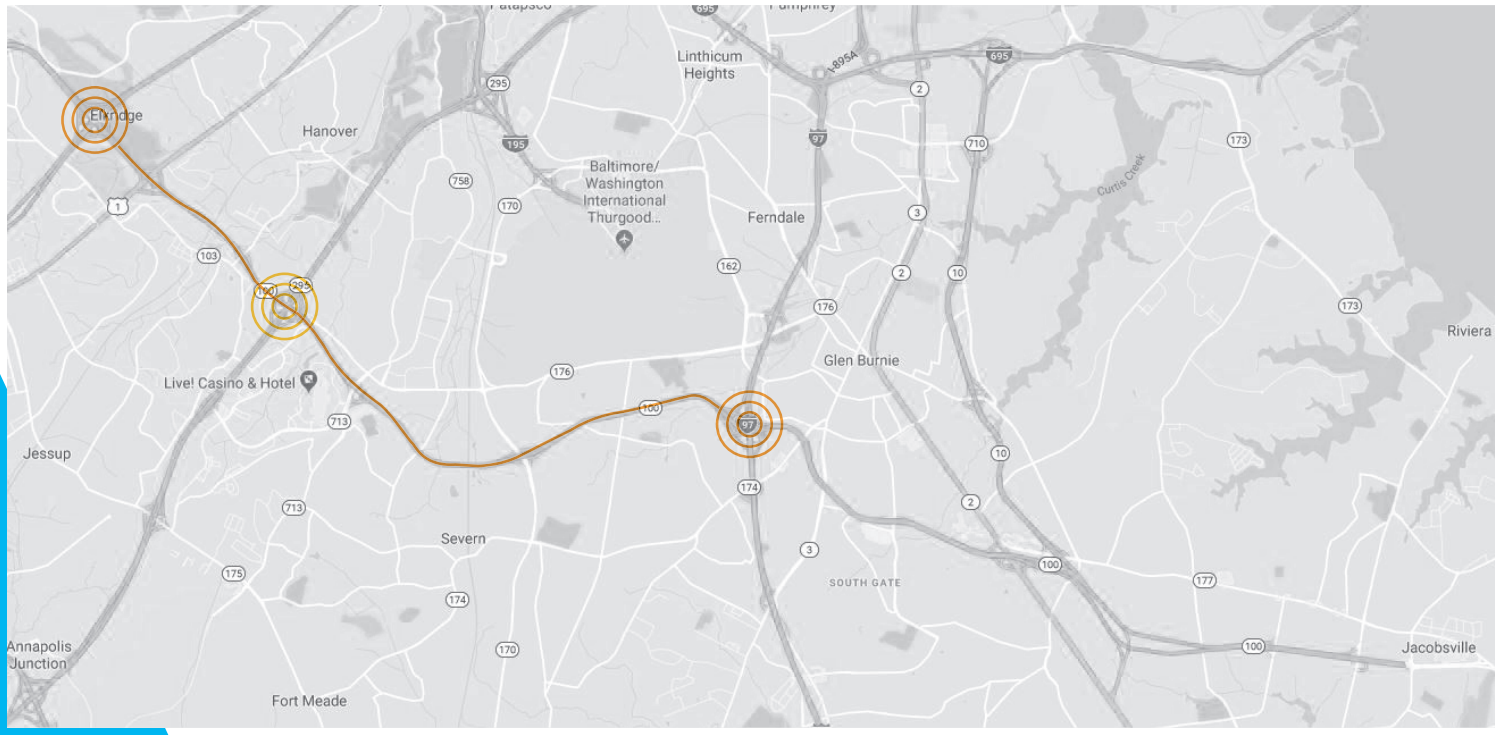
» No significant roadway projects have been placed in service since the 2009 General Development Plan.

» There are no significant roadway projects included in the TIP.

TFMP Candidate Roadway Projects

Project	Status	Cost Estimate
Reconstruct MD 295/MD 100 interchange	No action planned.	$118,600,000
MD 100 - Widen from 4 to 6 lanes from I-95 to I-97	No action planned.	$120,000,000

Roadway Project Locations



Planning Gaps & Conflicts

Highway

» In the MD 100 corridor, there are no gaps or conflicts in planning studies reviewed; however, in the corridor it is observed that there is considerable PM peak hour congestion in both directions on MD 100 from east of MD 170 to I-95.

Transit

In the MD 100 corridor, there are three types of transit services proposed in the planning studies reviewed:

» Locally-operated service including an adjustment to RTA Route 202K to improve connections between Odenton to the business area along Coca Coca Drive via Arundel Mills Boulevard, and new RTA routes between Arundel Mills Mall and Freetown Village, and between Arundel Mills Mall and downtown Annapolis.

» Deviated fixed route services within and between Glen Burnie and Pasadena communities on the eastern edge of the community eastern.

» Express or bus rapid transit service between Dorsey MARC Station and BWI Airport.

While the above proposals do not necessarily conflict, the current justification for express or bus rapid transit service is weak. The MD 100 corridor's dispersed land use patterns make it difficult to see how express or bus rapid transit service would be successful in the near or mid-term. RTA-operated transit services on the western side of the corridor are "middle of the pack" in terms of ridership. Moreover, Howard County no longer identifies bus express or bus rapid transit as even a planning-level priority which further diminishes the potential ridership of such service in the long-term.

Bicycle and Pedestrian Facilities

No pedestrian or bicycle improvements are planned along MD 100 in the Bicycle and Pedestrian Master Plan (BPMP). As a limited access roadway MD 100 is designated primarily for motor vehicle traffic. The BPMP identifies several parallel roadways that can be improved to accommodate pedestrian and bicycle traffic. These road have more convenient access to residences, businesses and other community destinations for people who are walking and bicycling. Two area trails provide a low-traffic stress network spine parallel to MD 100. Between MD 170 (Telegraph Road) and I-97, the BWI Trail parallels MD 100 in an east-west direction and connects to the B&A Trail which bears in a north-south direction. In conjunction with the BWI and B&A Trails, additional bicycle and pedestrian improvements on MD 170, MD 177 and MD 176 are possible to create a parallel bicycle and pedestrian route parallel to MD 100.

Recommendations

Highway

» In the near term, traffic systems management and operations alternatives should be explored for MD 100. Strategies might include separating local and express lanes between I-97 and MD 2, ramp metering between MD 295 and MD 2.

Transit

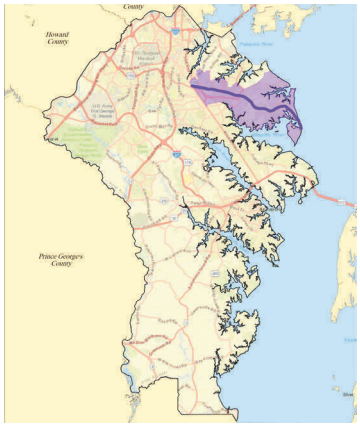
» Eliminate express or bus rapid transit service from further consideration in the MD 100 corridor but use the General Development Plan update to explore opportunities for more dense and mixed-use development that could ultimately support a more premium form of transit service.

» Increase the frequency of RTA services as recommended in the Transit Development Plan to support access to employment opportunities and further develop a long-term transit market.

Bicycle and Pedestrian Facilities

» Improved pedestrian and bicycle access for crossing MD 100 is encouraged as intersecting roadways are scheduled for improvements.

» Planned and designated bicycle routes such as MD 170, Edwin Raynor Boulevard, Magothy Bridge Road MD 177 (Mountain Road) should have improved pedestrian and bicycle access at the intersections with MD 100. Wherever possible, facilities should be separated from higher-speed motor vehicle traffic enters and exits MD 100.



Travel Demand Forecasting

The MD 173 corridor area is one of the County's few concentrations of parcels zoned for industrial uses. Although a very small share of the County's overall employment, job growth is expected to raise employment from approximately 10,000 jobs to greater than 15,000 by 2040.. As the amount of land available around the Port of Baltimore becomes scarcer, opportunities for port-related uses may increase in northern Anne Arundel County. More significantly, residential growth is expected to push population from 35,000 to nearly 50,000 by 2040 – despite projections just five years ago that the area would lose population. New residential subdivisions are planned for the areas along Marley Neck and Solley Road.

The greater Pasadena communities along MD 177 (Mountain Road) are also expected to see residential growth despite projected population losses just five years ago. An increase in residents from approximately 50,000 to just below 60,000 cam be expected; the highest growth rates are expected between Lake Shore and Lake Shore Drive. Commercial and employment growth in the corridor is expected to be modest with the most growth occurring along Ritchie Highway.

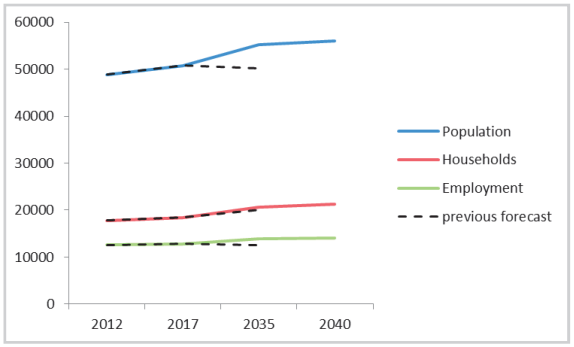
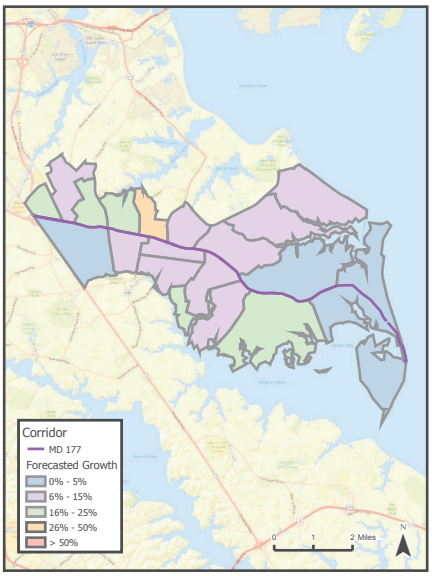
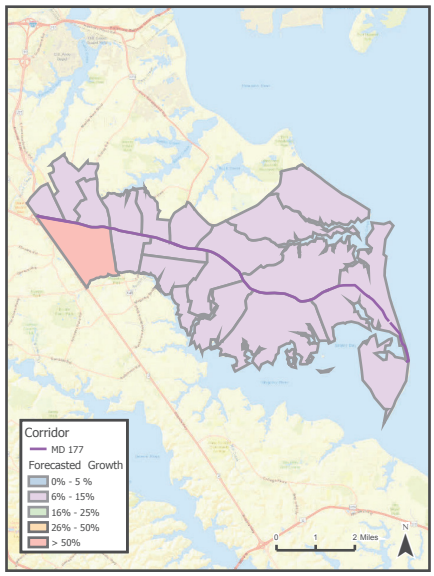


Table 1: Comparison of 2015 Corridor Growth Management Plan forecast for 2035 vs. 2040 long-range plan of the Baltimore Regional Transportation Board

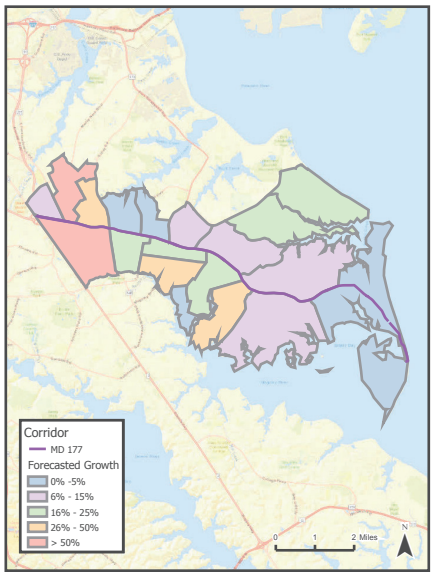
Employment



Population



Housing



Recent and Committed Projects

- Pasadena Road improvements are under construction including bicycle and pedestrian facilities, widening for raised median and turn lanes, and relocation of Spruce Avenue intersection.
- Widening of Catherine Avenue between 228th Street and 231st Street is under construction creating two thru travel lanes in the northbound direction.
- Widening of MD 177 from Catherine Avenue to Edwin Raynor Blvd (Mountain Road Revitalization, Phase 1) is in design and right-of-way acquisition underway. Construction is expected to begin in 2020.
- Sidewalk and safety improvements along Tanyard Springs Lane at Solley Road is in design. The project is funded for construction.
- Planning Studies include the Mountain Road Revitalization Study and the Solley Road Improvements

TFMP Candidate Roadway Projects

Project	Status	Cost Estimate
Widen from 2 to 3 lanes between Edwin Raynor Blvd and MD 100	Corridor study has been completed for Catherine Avenue to Edwin Raynor Blvd. Other parts of corridor require project planning and phasing.	$21,700,000
Widen and reconstruct MD 177 between MD 2 and MD 100.		$110,300,000
Widen and reconstruct MD 177 between MD 100 and South Carolina Avenue		$55,600,000
Jumpers Hole Road operations, safety and bicycle/pedestrian improvements between MD 2 and MD 177	Planning study underway	---
Magothy Bridge Road -- Reconstruction, Safety and Operational Improvements	No action	$000
Solley Road capacity, safety and operations improvements between MD 177 and MD 173. Specifically: » Traffic signal optimization is warranted at MD 173 to accommodate future growth. » Construction of bicycle/pedestrian improvements between Chestnut Springs Lane and MD 173.	Planning study complete	Total project cost is est. $74.8 million. Element-specific costs are not included.

Planning Gaps & Conflicts

Highway

Significant roadway improvements to operations and safety are planned or underway in the Pasadena/Marley Neck communities which should result in improved travel time reliability.

Transit

- Establish deviated fixed route service (call and ride) from UM Baltimore-Washington Medical Center (UMBW) to Pasadena, Riviera Beach and Lake Shore communities.
- Extend MTA Local Link #67 from bus service from Marley Neck to Chesterfield Plaza.
- Extend RTA Route 201 currently serving Freetown Village to also serve Wal-Mart in Freetown.

Bicycle and Pedestrian Facilities

Although not identified as such in the Anne Arundel County Bicycle and Pedestrian Master Plan, MD 177 can serve as an effective parallel route to MD 100 with improved shoulders and shared use paths and other improvements. This would facilitate connections to both the residential and commercial areas along MD 100 and the residential neighborhoods east of MD 100.

The northern section of MD 173 is home to manufacturing, light industrial and logistics facilities in business parks that are difficult to serve via transit. Creating safe bicycle and pedestrian access to these business parks is difficult with gaps in sidewalks and inconsistent shoulder widths need to be addressed including:

- Bicycle lanes from County Line to Edwin Raynor Boulevard
- Intersection improvements for pedestrian facilities at the intersection of MD 173 and Bar Harbor Road. Install curb ramps, and crosswalks, and fill sidewalk gaps.
- Separated bike lanes from Edwin Raynor Blvd to Water Oak Point Road
- Construct missing sidewalks between Hog Neck Road and Edwin Raynor Boulevard
- Bicycle lanes on existing shoulders between Hog Neck Road and Bayside Beach

Recommendations

Highway

A phasing plan should be developed to achieve the full set of recommended improvements to Mountain Road.

Transit

- The proposed extension of MTA LocalLink #67 and deviated fixed route service connecting UMBW to the Marley Neck communities are overlapping. As the MTA's service plan is very limited (including a 4-hour late morning/early afternoon gap), it is recommended that the deviated fixed route service should be further explored as a more cost-effective alternative to provide service in this area
- Similarly the extension of Route 201 to Walmart can also be served by the proposed deviated fixed route service.
- Explore appropriate locations for a transit hub in the Glen Burnie area similar to Arundel Mills and Columbia Mall.

Bicycle and Pedestrian Facilities

- Most of the potential bicycle and pedestrian improvements will be incorporated into the Mountain Road projects.
- A consolidated package of bicycle and pedestrian improvements should be developed for the MD 173 corridor, including improved access to adjacent business parks.

MARYLAND
175

Travel Demand Forecasting

Since the 2009 General Development Plan, employment growth in the MD 175 corridor has occurred as expected with an influx of jobs at Fort Meade owing to the Base Realignment and Closing process. Employment is projected to continue to grow through 2040 although not to the level previously forecasted. On the western end of the corridor near MD 295, population and household growth is expected to continue rapidly with several major subdivisions already approved and under construction or completed. In the central part of the corridor near MD 173, population growth lorem ipsem dulum population growth lorem ipsem dulum population growth lorem ipsem dulum. On the eastern end of the corridor, the Odenton's projected growth is driven by the Odenton Town Center transit-oriented development project which has begun to take shape but the pace of redevelopment has been slower than expected.

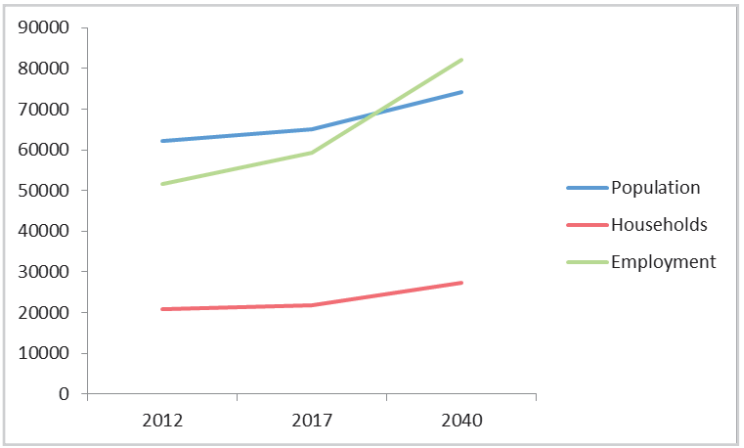
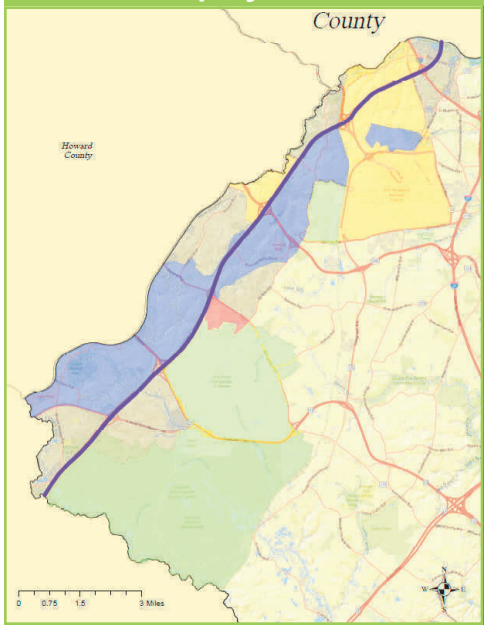
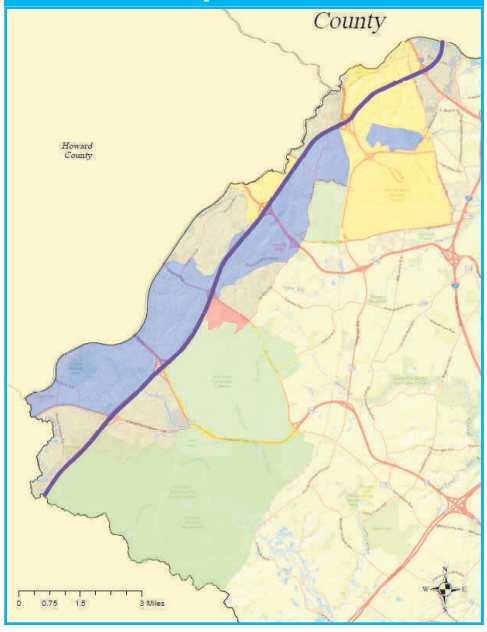


Table 1: Comparison of CGMP Forecasts

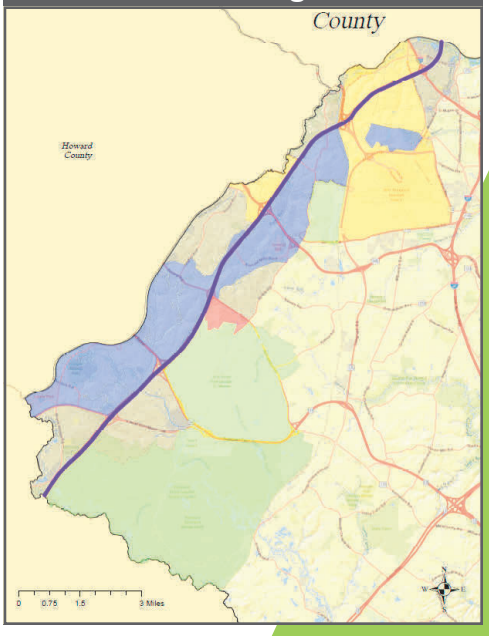
Employment



Population



Housing



Recent and Committed Projects

The following state roadway projects are under final design construction along MD 175:

- Widen MD 175 from National Business Parkway to McCarron Court –from a two-lane roadway to a six lane roadway and reconfigure ramps at MD 295.
- Widen MD 175 from Disney Road to Reece Road, from the existing two lane roadway to a six lane roadway.
- Widen MD 175 from Reece Road to Mapes Road

The Odenton MARC Train Station has seen significant expansion of parking lots and platform improvements in anticipation of TOD project.

TFMP Candidate Roadway Projects

Project	Status	Cost Estimate
Odenton Grid Streets, including Odenton Avenue connection between MD 175 and Town Center Blvd.	Additional traffic analysis is... . The project is funded for planning, engineering, acquisition, and construction. Project will be jointly funded by County and developers	
Town Center Boulevard	This project is subject to DRRA with Halle Companies. Construction is expected to be completed in 2018	
MD 175 widening from Mapes Road to Nevada Avenue (Odenton MARC Train Station)	No action planned	$41,200,000
MD 175 widening / access management from MD 295 to Howard County line	No action planned	35,900,000

Planning Gaps & Conflicts

Highway

» The MD 175 corridor continues to undergo significant transformation of its roadways between MD 295 and MD 170; plans made in preparation for the expansion of Fort Meade are largely coming to fruition.

» Potential land use and transportation interaction at the eastern and western edges of the corridor have not been analyzed in any of the plans reviewed for this study.

Transit

» The Transit Development Plan calls for new fixed route bus service in the MD 175 corridor to better serve Fort Meade, Odenton, Piney Orchard, Waugh Chapel and business parks to the north, as well as connections to US 1 in Howard County and the MARC Train at Savage and Odenton.

» MTA's MARC Growth and Investment Plan and County's General Development Plan works synergistically to increase Penn Line service, advance transit-oriented development at Odenton MARC Station, including construction of platform canopies and a parking garage.

» Neither the MARC Growth and Investment Plan nor the Transit Development Plan makes any mention of potential improvements to the Jessup MARC Station which straddles the Howard-Anne Arundel County line. At present, only one train per day stops at this location.

Bicycle and Pedestrian Facilities

» Construction of roadway improvements along MD 175 includes sidewalks and a shared use path between MD 713 and Mapes Road. On-street bike lanes are included beyond the above limits. It is unclear what improvements are under consideration, if any, west of MD 295 to the Howard County line.

» Construction of the Odenton Trail is planned concurrent with redevelopment in the Odenton Town Center.

Recommendations

Highway

» Concurrent with the 2019 General Development Plan update and in consideration of the potential Dairy Farm Redevelopment, the County should study capacity constraints along Annapolis Road between Sappington Station Road and MD 3.

» Similarly, Anne Arundel and Howard Counties should work together on a coordinated land use and transportation planning approach to MD 175 between US 1 and MD 295.

Transit

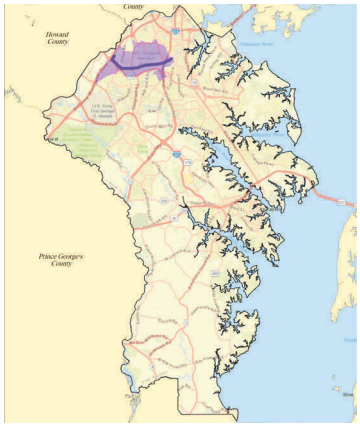
» Service adjustments on Routes 201 and 202 should proceed as soon as possible per Phase 1 of Transit Development Plan, as should improvements to frequency of service. This will improve the private sector's confidence in RTA's ability to meet job growth in the corridor.

» As discussed in the MD 32 corridor plan, the County and MDOT need to work together to advance transit center solution at Fort Meade that is acceptable to base commanders. Access to the base from the MD 175 corridor is critical to improving the ability of nearby residents to access jobs on the base.

» In the 2019 General Development Plan update, the County should consider the viability of future development at the Jessup MARC station. If redevelopment is unlikely or undesirable, the County should offer its support to close this station to allow for other service improvements along the Camden line.

Bicycle and Pedestrian Facilities

» No recommendations.



Travel Demand Forecasting

In the MD 170/MD 176 corridor which is just west and south, respectively of BWI Airport, the number of jobs is forecast to soar from approximately 70,000 jobs to nearly 100,000 jobs by 2040; continued strength in passenger trips and increasing freight cargo shipments to and from BWI will drive this growth. Much of this growth can be expected in the Stoney Run District. Residential growth is expected to be strong in the Severn and Hanover communities; communities closest to the airport are expected to see little residential growth perhaps owing to noise-related issues.

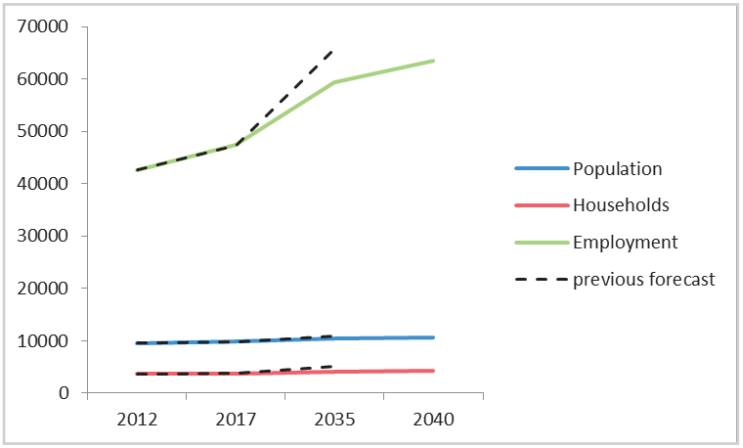
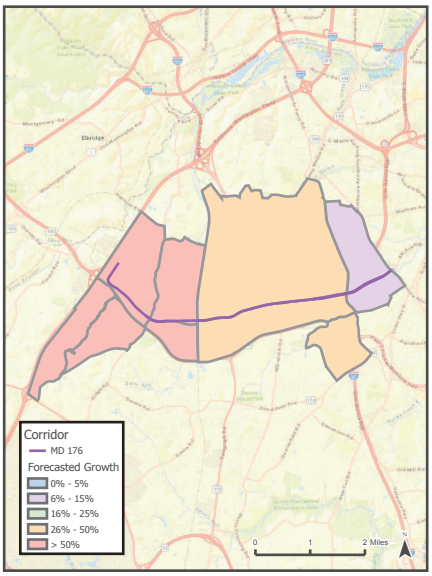
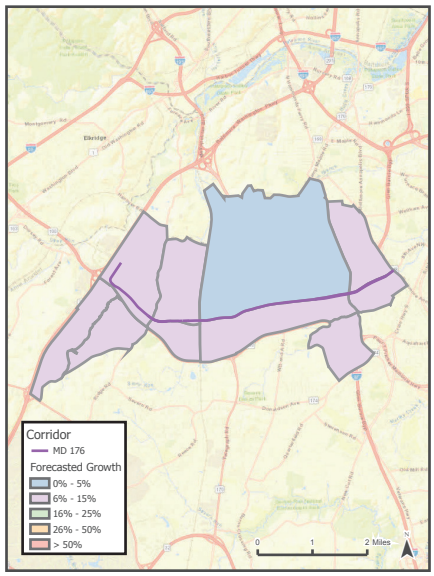


Table 1: Comparison of 2015 Corridor Growth Management Plan forecast for 2035 vs. 2040 long-range plan of the Baltimore Regional Transportation Board

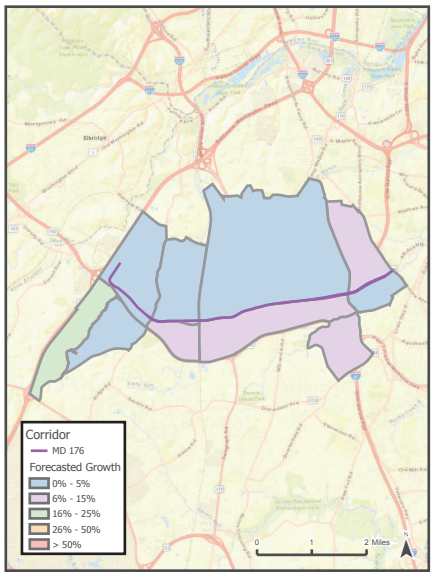
Employment



Population



Housing



Recent and Committed Projects

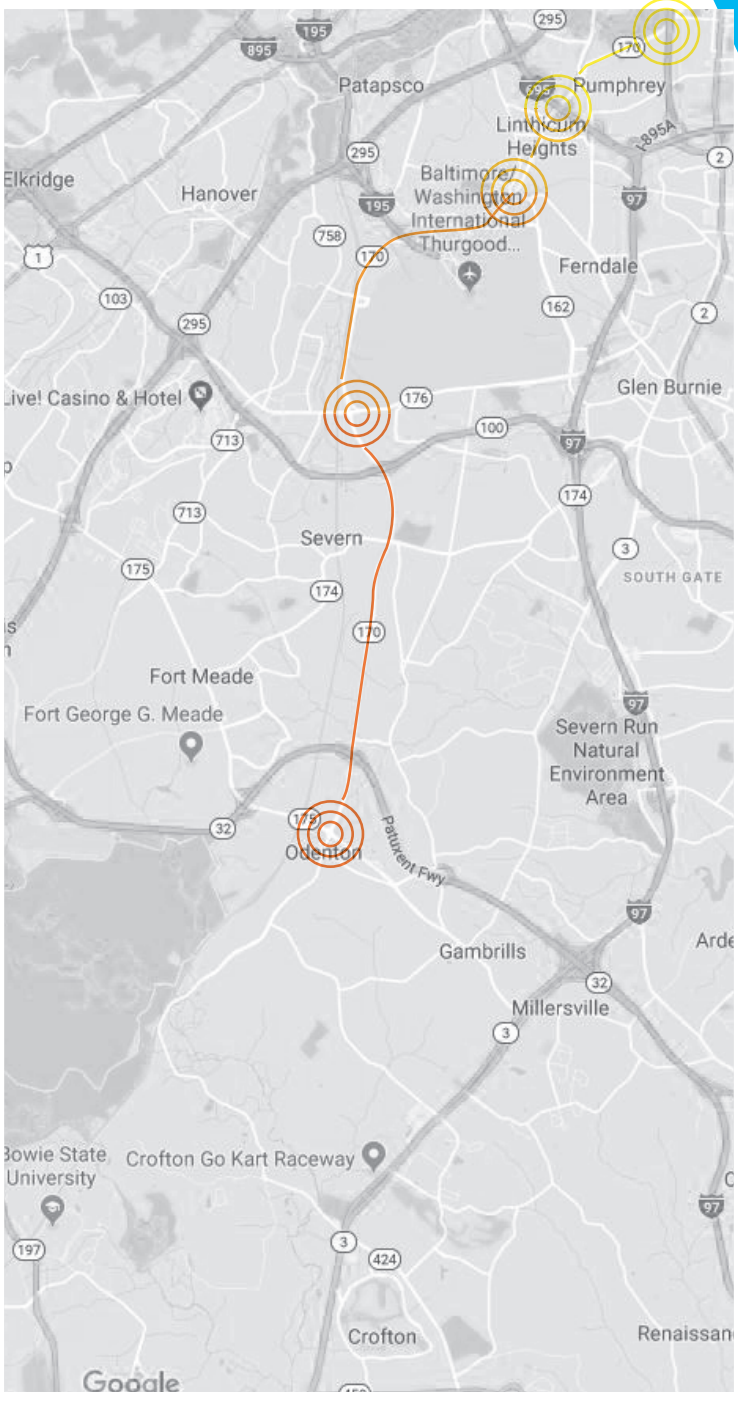
» Between MD 648 (B&A Blvd) and Andover Road, SHA has completed bicycle and pedestrian safety improvements.

» Planning study completed for Andover Road between West Nursery Road and MD 170

TFMP Candidate Roadway Projects

Project	Status	Cost Estimate
MD 170 (Camp Meade/ Belle Grove Road -- I-895 to MD 2) - Two lane reconstruct with access management	No action	$26,000,000
MD 170 (Camp Meade Road) from I-695 to MD 648 -- Two lane reconstruct with access management	No action	$6,900
MD 170 (Aviation Boulevard) from MD 176 to MD 162 - Multi-lane reconstruct	No action	$61,100
MD 170 (Telegraph Road) from MD 175 to MD 176 -- Two lane reconstruct with access management	No action	$96,800
Andover Road – TBD pending study completion		---

Roadway Project Locations



Planning Gaps & Conflicts

Highway

In the MD 170, there are no gaps or conflicts in roadway recommendations. It is noted that the County does not appear to have a proactive goods movement strategy. In particular, continued growth in cargo at Thurgood Marshall BWI Airport and related logistics, warehouse and distribution centers in MD 170 and other adjacent corridors will place additional demands on local and state roads. Ancillary airport facilities such as the consolidated car rental facility, aircraft maintenance and service providers, long-term parking, etc. which are outside of the BWI fence-line have a significant impact on localized congestion.

Transit

The following transit proposals would affect mobility in the MD 170 corridor:

- Express or bus rapid transit service between Dorsey MARC Station, the consolidated car rental facility, and BWI Airport.
- A new RTA bus route from BWI Airport to Annapolis.

Bicycle and Pedestrian Facilities

MD 170 is a wide corridor connecting Brooklyn Park near the Baltimore City Line to MD 32. Shoulders of varying widths and a turn lane for the majority of its length to facilitate access to neighborhoods and other destinations on either side. At other locations, it contains four travel lanes with or without a median. As a result, bicyclists are expected to share travel lanes with motor vehicles, and while existing bike lanes are present in some locations, they are not continuous. There are also frequent gaps in the sidewalk system.

A shared use path circles much of the BWI airport fence-line; spokes are proposed to connect to the East Coast Greenway, and the Linthicum and Patapsco Light Rail stations. Future plans for bicycle accommodations in the MD 170 south of MD 176/Dorsey Road are less clear in the Bicycle and Pedestrian Master Plan.

Recommendations

Highway

- The County needs to be an active participant in master planning for BWI Airport. Employment, cargo and traveler growth must all be considered at both the regional and local scale and secondary impacts on residential communities must be mitigated if not avoided altogether.
- If the forthcoming BWI Marshall Airport Master Plan does not address off-site mobility patterns, the County should partner with MDOT to assess long-term needs.

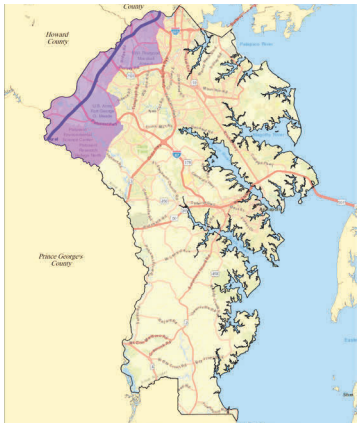
Transit

- Increase the frequency of RTA services as recommended in the Transit Development Plan to support access to employment opportunities.

Bicycle and Pedestrian Facilities

- Construct shared-use path parallel to MD 170 and provide connections to the Park-and-Ride facilities at the Nursery Road and the North Linthicum Light Rail stations (Light Rail Trail)
- Construct shared-use path from Buckingham Place to MD 176 (Dorsey Rd) to connect to BWI Trail.
- Provide bicycle improvements along Airport Loop, specifically between Terminal Road and Old Stoney Run Road
- Construct shared-use path connection to proposed Patapsco Regional Greenway at MD 648 (Baltimore Annapolis Boulevard) intersection
- Construct bike lanes and sidewalks from 10th Avenue to Potee Street

MARYLAND
295



Travel Demand Forecasting

Since the 2009 General Development Plan, the MD 295 corridor has seen significant residential development particularly in the area between MD 32 and MD 100, specifically in the Arundel Mills and Hanover communities and near MD 198. Looking ahead, population growth is expected to continue at a strong pace and in line with previous forecasts. After a period of significant employment growth between 2000 and 2015, employment is forecasted to continue climbing to approximately 170,000 jobs by 2040. However, the pace of employment growth is not as strong as previously indicated where the MD 295 corridor had been projected to exceed 180,000 jobs by 2035. Employment at BWI Airport and at Fort Meade is expected to slow to less than 5% growth through 2040. While slower growth at and around Fort Meade is understandable, slower growth at and near BWI Airport is less so considering the continued rise in cargo and passenger trips at the airport.

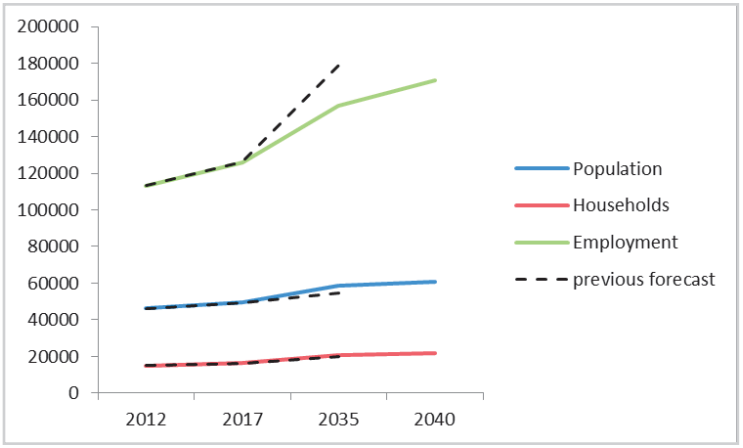
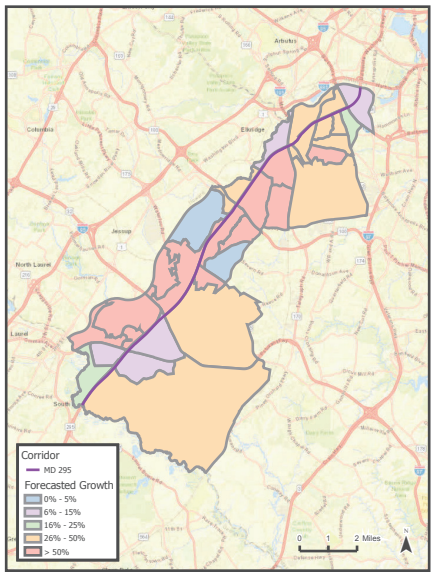
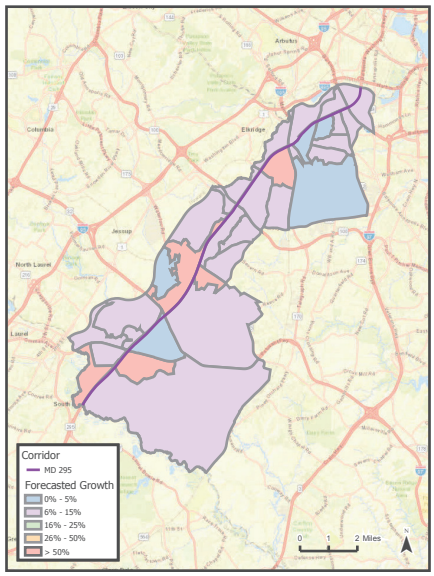


Table 1: Comparison of 2015 Corridor Growth Management Plan forecast for 2035 vs. 2040 long-range plan of the Baltimore Regional Transportation Board

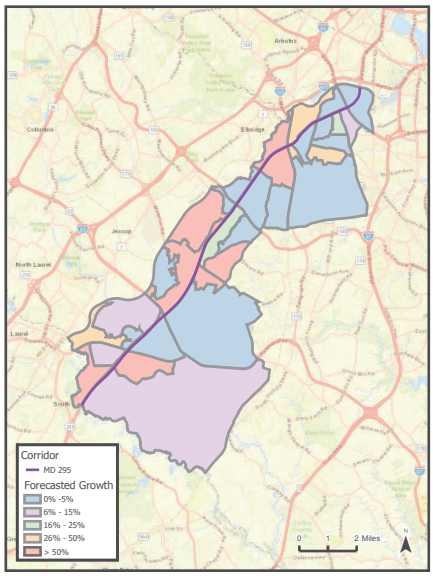
Employment



Population



Housing

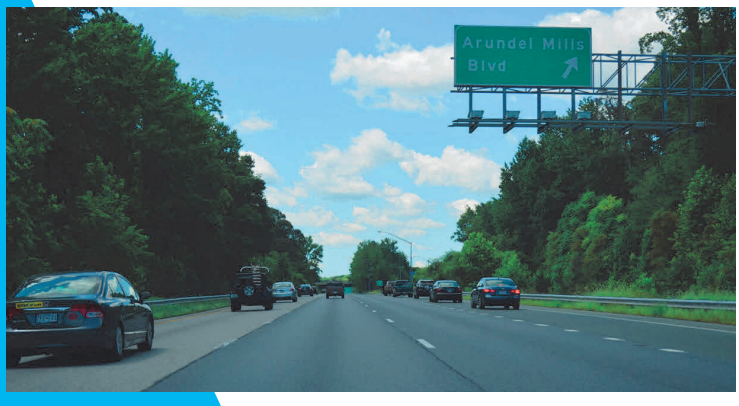


Recent and Committed Projects

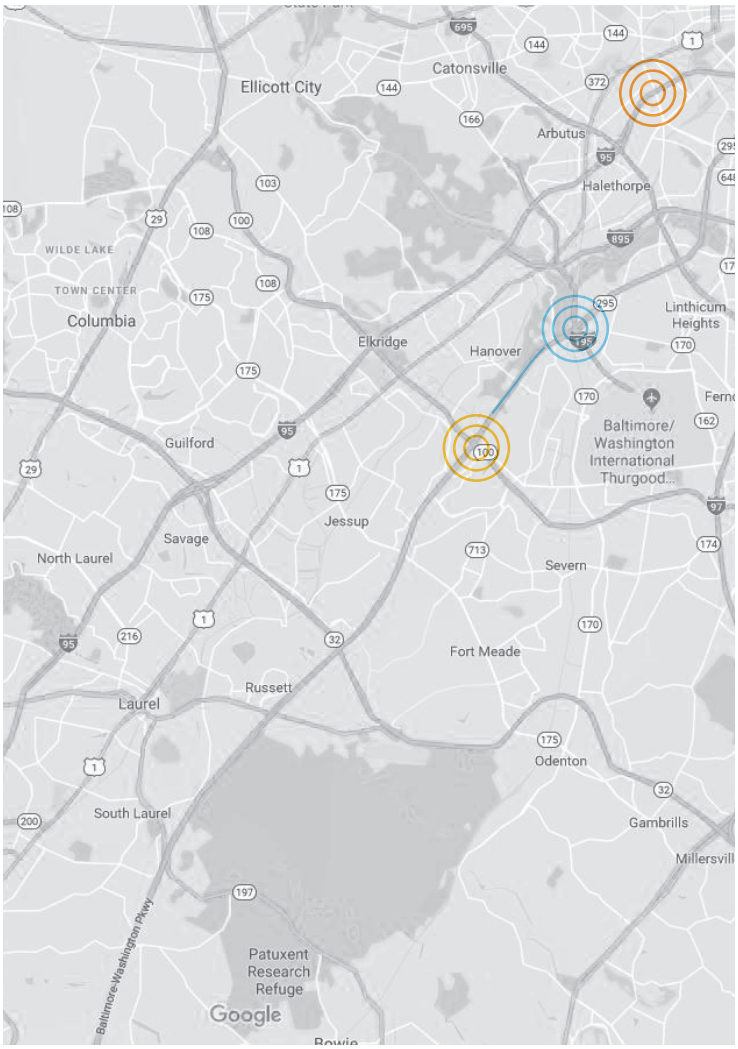
- MD 295 was widened from four to six lanes between I-695 and I-95 in 2011.
- At MD 175, ramps are being reconfigured to create signalized left turns. Construction is expected to begin in early 2019.
- Planning study completed to widen MD 295 from four to six lanes between I-95 and MD 100 and construct new interchange at Hanover Road.
- MD 295 is a candidate for Express Toll Lanes under the Governor's Traffic Relief Plan currently being evaluated for P3 implementation.
- **Project on Hold** at MD 198, ramps to and from southbound MD 295 will be widened from one to two lanes. Design is complete.

TFMP Candidate Roadway Projects

Project	Status	Cost Estimate
Reconstruct MD 295 interchange at MD 100	None	$118,600,000
Reconstruct MD 295 interchange at W. Nursery Road	None	$87,700,000
Widen MD 295 between MD 100 and MD 195 from 4 to 6 lanes, including new interchange at Hanover Road.	Planning Study Complete	$186,500,000

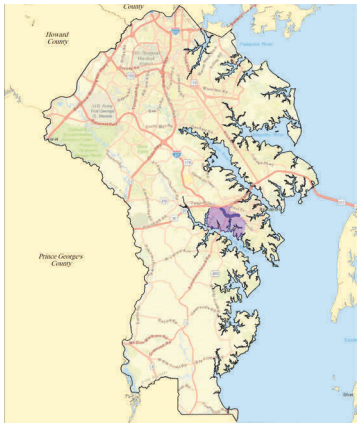


Roadway Project Locations



Planning Gaps & Conflicts	Recommendations
Highway Concepts to widen the MD 295 corridor north of MD 100 are in place; however, the SHA Highway Needs Inventory, lists no capacity or operational improvement needs along MD 295 south of MD 100 to the Prince George's County line. The SHA Mobility Report identifies eight segments (north and southbound) in this corridor as being among the 25 least reliable and most congested roads in the state.	**Highway** The Hanover Road interchange should be the County's priority in the MD 295 corridor as it will provide some mitigation for capacity and operational problems at MD 100. The rationale for the interchange reconstruction at West Nursery Road is less clear and should be a lower priority than improvements to the MD 100 interchange. The County should closely monitor the Governor's Traffic Relief Initiative to ensure that the County's needs are met, particularly in the area between MD 100 and the Prince George's County line.
Transit MTA's MARC Growth and Investment Plan contain projects important to mitigating congestion on MD 295 such as adding sidings or additional track segments, upgrading signal equipment and expanding station capacity.	**Transit** Anne Arundel County should play a leadership role in supporting the MARC Growth and Investment Plan. Additional and reliable service with competitive travel times are key to realizing the County's transit-oriented development vision at Odenton and improving the quality of life for County residents commuting to Washington, D.C.
Bicycle and Pedestrian Facilities MD 295 is a limited access highway and no bicycle or pedestrian facilities are permitted. Recommendations as to parallel and related bicycle facilities are contained in the chapters on MD 170, MD 100 and MD 32.	**Bicycle and Pedestrian Facilities** » None

MARYLAND
665



DISCUSSION DRAFT.
ALL INFORMATION MUST BE VERIFIED
PRIOR TO USE IN FINAL REPORT.

Travel Demand Forecasting

Since the 2009 General Development Plan, Annapolis Towne Center has emerged as a new activity hub. Its population, housing, and employment rates have risen sharply and are expected to continue their rise into 2040. The growth of Annapolis Towne Center is also expected to influence housing development in its surrounding suburbs, on the western edge and middle portion of the MD 665 travel shed. The construction of single-family homes in the area is expected to rise at a moderate pace, trailing the development of Annapolis Towne Center.

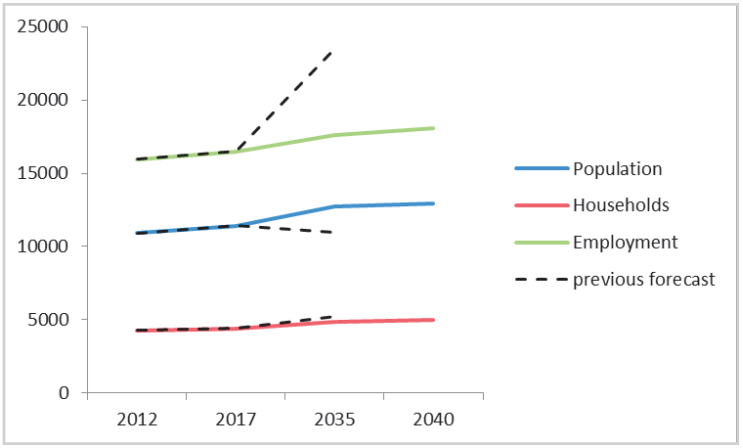
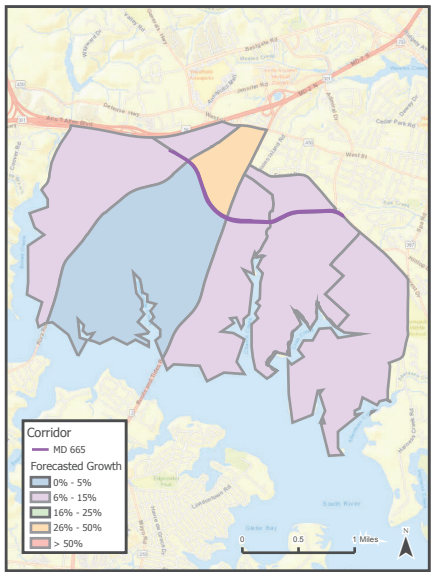
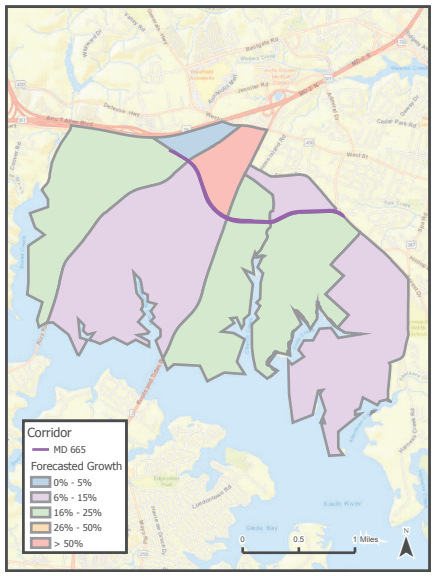


Table 1: Comparison of 2015 Corridor Growth Management Plan forecast for 2035 vs. 2040 long-range plan of the Baltimore Regional Transportation Board

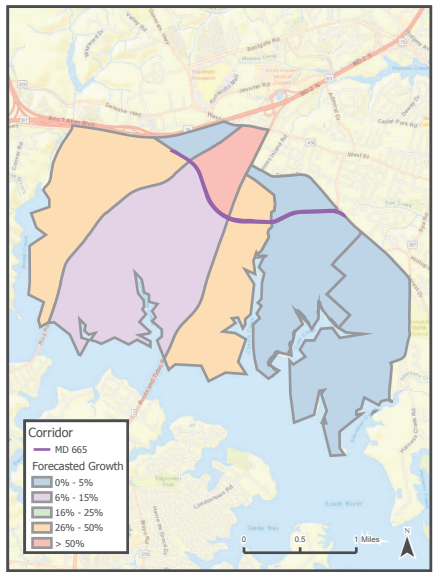
Employment



Population



Housing



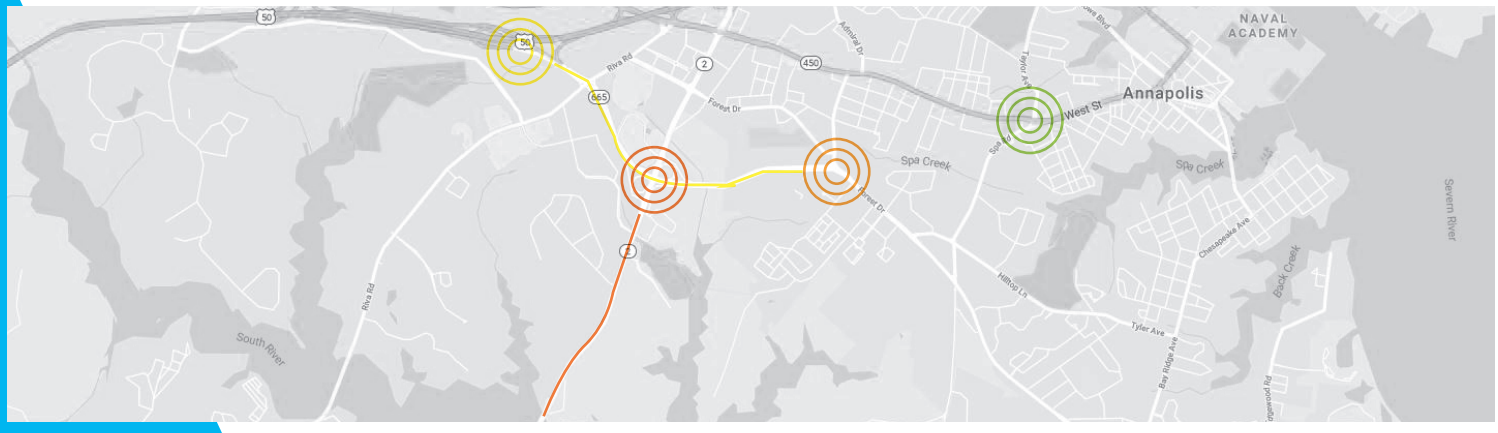
Recent and Committed Projects

- The City of Annapolis is currently undertaking a Forest Drive/Eastport Sector study. Mobility priorities in the study are focused on improving bicycle and pedestrian facilities, managing traffic congestion, and increasing transit service. The final report is expected to be published by the end of 2018
- SHA is conducting an engineering study for West Street (MD 450) from Defense Highway to Chinquapin Round Road
- The BRTB's Unified Planning Work Program includes funding to identify a site for a potential Annapolis transit hub.

TFMP Candidate Roadway Projects

Project	Status	Cost Estimate
Widen MD 665 (Aris Allen Blvd)	No action	$379,600,000
Intersection Improvements at Spa Road and Chinquapin Round Road	N/A	N/A
MD 435 (Taylor Avenue) and MD 450 (King George Street) with the goals of alleviating peak period traffic backups, improving transit efficiency, adding bike lanes, and enhancing access.	Engineering study to be performed but not funded	N/A
MD 450 from MD 50 to Chinaquapin Round Road	No action	
Widen and reconstruct Solomons Island Road from MD 450 to South River	No action	$51,600,000

Roadway Project Locations



Planning Gaps & Conflicts

Highway

» The network of roadways in and around the greater Annapolis area is increasingly congested and traffic shifts and cuts through local roadways depending on daily conditions. Numerous studies are underway by SHA and the City of Annapolis to address congestion in the area, although it is unclear how these projects fit together and can be phased to improve traffic congestion and reliability.

Transit

The Transit Development Plan proposes three new services:

» The Gold Route from Edgewater to Arnold/Anne Arundel Community College.

» A new bus route from Crofton Park and Ride to Annapolis Town Center

» A new bus service from Annapolis to Arundel Mills Mall and BWI Airport

The Corridor Growth Management Plan envisions additional commuter or premium bus service from the Greater Annapolis area to Washington, DC.

Anne Arundel County and the City of Annapolis have long envisioned a transit center in the Greater Annapolis area to serve Annapolis Transit, MTA local and commuter bus services, park-and-ride and other mobility options.

Bicycle and Pedestrian Facilities

MD 665 (Aris T Allen Boulevard) is designated primarily for motor vehicle traffic. As MD 665 is not recommended for pedestrian and bicycle improvements, continuous, parallel routes should be explored. Forest Drive contains sidewalks along the majority of the road, but also contains multiple gaps with missing crosswalks and curb ramps. Where Forest Drive becomes Bay Ridge Road, a bicycle lane begins within the vicinity of Peninsula Park.

Recommendations

Highway

» A detailed review of and phasing plan for improvements in greater Annapolis are necessary. Transportation systems management and operations strategies such as access management, turning lanes and restrictions, and traffic signal coordination should be a near-term strategy.

Transit

» Unclear why the Arundel Mills to Annapolis Route – seems redundant of MTA service

Bicycle and Pedestrian Facilities

Move forward with the following improvements recommended by the BPMP:

» Fill sidewalk gaps between Annapolis High School and downtown Annapolis.

» Connect the proposed bicycle facility along Forest Drive at County/City line.

» Fill sidewalk gaps between Spa Road and Bay Ridge Road

» Install crosswalks and curb ramps at various intersections

» Bicycle lanes on Forest Drive including segment from MD 2 to Chinquapin Round Road

ANNE ARUNDEL COUNTY
TRANSPORTATION
MASTER PLAN

TECHNICAL MEMORANDUM #9b
Analysis of Shared-Use Path

ANNE ARUNDEL COUNTY
MARYLAND

Prepared for the Anne Arundel County Office of Transportation
March 2019 – Final

SABRA & ASSOCIATES
Engineering Innovative Solutions

Note: The purpose of each Technical Memorandum prepared for the Office of Transportation is to present facts, analysis, ideas, issues and recommendations that will inform the Anne Arundel County Transportation Master Plan. The views expressed and recommendations offered in each memorandum are solely based on the consultant's judgment and should not be considered as endorsed by the Office of Transportation or any other County agency or officer.

Shared-Use Path Analysis

There are numerous types of bicycle facilities identified in the PBMP including shared-use paths, on-street bicycle lanes, shared lanes, and signed routes. To create a bicycle network that will attract a larger segment of the population, a low-stress network is needed. By separating bicycle traffic from motorized vehicle traffic, people of all ages and abilities have a greater sense of comfort when bicycling. A limited number of on-street separated facilities, such as separated bike lanes and buffered bike lanes are identified in the PBMP. The PBMP also identified numerous shared-use paths which provide a separated travelway for both people walking and riding bicycles. The proposed shared-use path system was used as the basis for analysis to determine how to invest in the county's bicycle network in the coming years.

Bicycle Network Analysis

To evaluate the shared-use path system, the project team employed a **Bicycle Network Analysis (BNA)** tool developed on behalf of People For Bikes.[1] The BNA tool focuses on connecting low-stress bicycle routes to people and to destinations. The BNA score is part of an evolving project to measure how well bike networks connect people with the places they want to go. Because most people are interested in biking only when it's a low-stress option, these maps recognize only low-stress biking connections. The BNA scores are computed using a three-step process: data collection, traffic stress, and destination access. The results from the BNA tool help communities measure the quality of their low-stress bicycle network and assess how connected people are to the places people want to go using low-stress routes.

Data Collection

The BNA tool used in this analysis relies on data from two open data sources: The **U.S. Census Bureau** and **OpenStreetMap (OSM**). Census blocks, obtained directly from the U.S. Census, serve as the basic unit of analysis for much of the connectivity measures. Information about jobs is provided by the U.S. Census as part of its Longitudinal Employer-Household Dynamics data. OSM provides fully-routable transportation network data that includes on-street and off-street transportation facilities, including fine-grain details about the types of bicycle facilities on any given street segment if available. OSM also includes data for all destination types used in the BNA (parks, businesses, doctors, etc.). The OSM data analyzed to build the bike network uses a system of tags to represent different elements of a roadway. Tags are used to quantify the physical features of a roadway including the presence of bike lanes, presence of bike lane buffers, parking, two-way or one-way traffic, turn lanes and adjacent land uses. Every link and intersection in the transportation network is rated for Traffic Stress.

The BNA tool also used data that was developed as part of the Anne Arundel Transportation Functional Master Plan, which highlighted the use of shared-use path projects identified in the 2013 Anne Arundel County Pedestrian and Bicycle Master Plan. These shared-use paths were built into the "future" bicycle network to be able to measure and compare future condition BNA scores with existing condition BNA scores. Additionally, select major destinations within Anne Arundel County were identified and mapped with a focus on bicycle connectivity.

Bicycle Level of Traffic Stress

The concept of **Bicycle Level of Traffic Stress (LTS)** has emerged as a useful way to think of streets in terms of the types of users who would be comfortable riding on them in a given situation. Since the BNA

[1] People for Bikes. PlacesForBikes Bike Network Analysis (BNA) Score. Retrieved from https://bna.peopleforbikes.org/#/

measures low-stress bicycling, the analysis methodology focuses on roadway characteristics that generally translate to an LTS 1 or LTS 2 rating (low-stress routes). In practical terms, this is intended to correspond with the comfort level of a typical adult with an interest in riding a bicycle but who is concerned about interactions with vehicular traffic. Low-stress routes are typically shared-use paths and typically roadways with low vehicle speeds, low traffic volumes, and maximum separation between bicyclists and motorists.

There are many forms of bicycle facilities, from shared-use paths, to separated bike lanes, and traditional bike lanes These facilities interact with motor vehicle traffic differently from maximum separation (shared-use path, left) to no physical separation like bike lanes on major arterials (center). Some low-traffic volume, low-speed streets like most residential roadways, need no separation and are a low-stress bicycle route as is. (right).

Destination Access Methodology

Using the results from the systemwide LTS analysis, roadways and trails are evaluated as one interconnected system to assess how each census block (or neighborhood area) is connected to destinations via a low-stress bicycle travel. This is accomplished by assigning a destination access score. Each census block is scored according to how well the overall bicycle network serves the people within the census block. How that facility connects and contributes to the overall network as a whole has more of an effect on the area's scoring than individual segments. An area where there are more connected and contiguous shared-use paths or low-stress routes that take people to where they want to go will have a more positive impact on an area's scoring than areas with fragments of low-stress routes.

The BNA tool assumes a biking distance of ten minutes at an average speed of ten miles per hour (one and two-thirds miles or 8,765 feet). To avoid detours, a low-stress route is assumed only available if the route doesn't force a person to go out of their way by more than 25% compared to a car trip. Every census block is assumed to be connected to any road that either follows its perimeter or serves its interior. This means people bicycling can get to a destination that has a front door on a stressful street if you can get to a low-stress street around the corner. Census blocks are assumed to be connected only if there is an unbroken low-stress connection between them. In other words, even a short stretch of stressful biking negates a potential connection. This is consistent with the Traffic Stress concept and highlights the importance of a continuous network, rather than a patchwork of facilities.

The transportation network is used to route from each census block to every other census block within biking distance (1.67 miles), noting whether a low-stress connection between the two census blocks is

possible. A summary of the number and types of destinations is coded in each census block. Using the coded destinations paired with the knowledge of which census blocks are connected on the low-stress network, the total number of destinations accessible is calculated on the low-stress network and compared with the total number of destinations that are within biking distance regardless of whether they are accessible via the low-stress network.

Points are assigned on a scale of 0-100 for each destination type based on the number of destinations available on the low-stress network, as well as the ratio of low-stress destinations to all destinations within biking distance. The BNA scoring places a higher value on the first few low-stress destinations by assigning points on a stepped scale. Beyond the first few low stress destinations, points are prorated up to 100 based on the ratio of low-stress to high-stress. For example, a census block with low-stress access to only one park out of five nearby parks would receive 30 points. A census block with low-stress access to two parks out five would receive 50 points (30 for the first park, 20 for the second). A census block with low-stress access to four parks out of five would receive 85 points (30 for the first, 20 for the second, 20 for the third, and 15 out of the remaining 30 points for connecting one of the remaining two parks).

The BNA's six destination access analysis scoring categories are:

1. People
2. Opportunity
3. Core Services
4. Recreation
5. Retail
6. Transit

Many of the categories are composed of a mix of destination types. In these cases, the category score is calculated by combining the scores of each of its member destination type scores. Weights for each destination type are used to represent their relative importance within the category. For census blocks where a destination type is not reachable by either high- or low-stress means, that destination type is excluded from the calculations. For example, the Opportunity score within a city with no institute of higher education is produced by excluding the Higher Education destination type so the score is unaffected by its absence.[2]

In addition to the various destinations with the OSM used to score the LTS, several major destinations were identified in Anne Arundel County that serve as major employment, transportation and commercial centers. These destinations were prioritized in the bicycle network analysis to illustrate how the destinations can be more accessible to the public through a low-stress bicycle network. A bicycle network analysis was completed which weighed these destinations more favorably. The results from this analysis are available in **Figure 5**.

1. Anne Arundel Community College, 101 College Parkway, Arnold, MD 21012
2. Glen Burnie Town Center, 101 Crain Highway North, Glen Burnie, MD 21061
3. Anne Arundel Medical Center, 2001 Medical Pkwy, Annapolis, MD 21401
4. Northrup Grumman, 1580-A West Nursery Road, Linthicum, Maryland 21090
5. Baltimore/Washington International Airport

[2] For more information regarding the BNA methodology, please visit https://bna.peopleforbikes.org/#/methodology

6. Waugh Chapel Town Center, 1417 S Main Chapel Way, Gambrills, MD 21054
7. Odenton MARC Station, 1400 Odenton Rd, Odenton, MD 21113
8. National Security Agency
9. Fort George G. Meade
10. Arundel Mills
11. University of Maryland Baltimore Washington Medical Center
12. Westfield Annapolis
13. Annapolis City Dock
14. Cromwell Light Rail Station
15. BWI Light Rail Station
16. Severna Park Park and Ride
17. Arundel Mills Bus Transfer
18. Annapolis Towne Center

Preliminary Bicycle Network Analysis

The first **bicycle network analysis (BNA)** of Anne Arundel County provided the anticipated results in describing bicycling conditions throughout the county. In **Figure 5**, the roadway network is presented using red and blue lines. Red lines represent roadways where bicycling conditions are challenging, with either no bicycle facilities, shared lane conditions, or bike lanes on major arterial roadways. Blue lines represent roadways with low traffic speeds and traffic volumes that connect to other roadways or trails with similar conditions. Roadways where bicycle traffic is prohibited, such as Interstate 97, US 50 and MD 100 are not shown. Within the study area, connected low-traffic stress street networks are evident in Annapolis, Cape St. Claire, Severna Park, Riviera Beach, Glen Burnie, and Crofton. Aggregating the Level of Traffic Stress (LTS) score for each census block in **Figure 6** illustrates how these areas are rated for bicycle travel. While low-stress bicycle travel within these communities is possible, stressful roadway crossings still act as barriers to expanding the range of travel for most people choosing to bicycle along low-stress routes.

Anne Arundel County's **shared-use path system expands the low-traffic stress network.** Shared-use paths such as the Baltimore and Annapolis (B&A) Trail, Baltimore Washington International (BWI) Trail, and the Washington- Baltimore-Annapolis Trail provide a low traffic stress routes for most of the northern county. The presence of these trails contributes to enhanced LTS scoring for communities along those corridors such as Linthicum, Glen Burnie, Severna Park and Odenton. The absence of many shared-use paths in Annapolis is illustrated in the aggregated LTS score as most Annapolis neighborhoods are rated with a low BNA score.

An analysis was performed to gauge the extent to which **major destinations of Anne Arundel County** are accessible by a low-stress bicycle route. This analysis revealed that most of the north county destinations around BWI Airport are very accessible by low-stress routes. The BWI Trail and B&A Trails contributed to the accessibility of the BWI Airport destinations including Northrup-Grumman, the BWI MARC station, and area light rail stations. (Note: The BWI Trail contributes to the BWI census block's favorable LTS score, even though the majority of this block is restricted access for all users, whether bicycle, pedestrian or motor vehicle.) The B&A Trail further expands this low-stress bikeable area southward in Glen Burnie to connect to the Glen Burnie Town Center, Cromwell Light Rail Station, and the University of Maryland Baltimore Washington Medical Center. Further south along the B&A Trail, the Severna Park Park and Ride

and Anne Arundel Community College are included in this low-stress bicycle area. In the Annapolis area, City Dock is the only destination in a low-stress area. Even though the Westfield Mall, Anne Arundel Medical Center and Annapolis Towne Center are located nearby, no low-stress routes exist to form a low-stress network. As US 50 is a restrictive roadway to bicycle travel, this roadway also acts as a barrier to connecting major destinations in the Annapolis area. As the B&A Trail terminates just north of US 50 outside of Annapolis, the decline in LTS score at the trail's southern terminus is evident.

Proposed Conditions Bicycle Network Analysis

To determine which shared-use paths would have the greatest impact on level of traffic stress (LTS) score, an analysis was performed in which **proposed shared-use paths** were integrated into the bicycle network topology. The results are available in **Figure 7**. For the purposes of this analysis, shared-use paths are considered to be paved-surface pathways for bicycle and pedestrian use that may have an independent alignment or be parallel to a roadway. There is typically a 6-foot-wide buffer between the shared-use path and parallel roadway to increase the separation between the pathway traffic and adjacent motor vehicle traffic. The proposed shared-use paths are primarily identified in the 2013 Anne Arundel County Pedestrian and Bicycle Master Plan (PBMP), although some shared-use paths are identified in other plans where the adjacent roadway calls for a shared-use path, such as MD 175 (Annapolis Road). While other bicycle facilities, such as bike lanes, are mentioned in the PBMP, shared-use paths provide the lowest level of traffic stress. Therefore, shared-use paths are the only facility used to gauge LTS as illustrated in **Figure 7**. Additional projects, such as bike lanes, are identified in the PBMP that may contribute to an improved LTS score and should be considered for future implementation. Given the higher design and construction costs and greater influence on LTS score, only shared-use paths were used for the purposes of this analysis. Some of the prominent proposed shared-use paths include:

1. The Broadneck Trail along College Parkway between Maryland Route 2 (Governor Ritchie Highway) and US 50
2. The South Shore Trail between Odenton and Annapolis. While most of the South Shore Trail is outside the study area, it's connection to Odenton and the Annapolis area serve major destinations. Phases of the South Shore Trail are proposed around Westfield Mall.
3. The B&A Trail northern extension from Linthicum to the Anne Arundel County line at the Patapsco River.
4. The B&A Trail southern extension from its current terminus near US 50, over the Severn River to Annapolis.
5. The MD 175 (Annapolis Road) shared-use path and
6. The shared-use path along East-West Boulevard/Pasadena Road between Maryland Route 2 (Governor Ritchie Highway) and Baltimore-Annapolis Boulevard.

Proposed Conditions Bicycle Network Results

The bicycle network was analyzed to determine the impact of the proposed shared-use path on the level of traffic stress. Proposed shared-use paths were analyzed in accordance with how these new projects interacted with the existing bicycle network, whether on-street conditions or existing shared-use paths. With this analysis complete and new LTS scores assigned to each census block as shown in **Figure 8**, the change in LTS score was mapped to determine those areas where the LTS score improved the most, per **Figure 9.**

Within the study area, the **greatest improvement to level of traffic stress score is evident in the Annapolis area and on Magothy Neck.** The presence of the B&A Trail and area low-stress roadways is accentuated by the B&A Trail's extension into Annapolis. Not only is the B&A Trail's extension connecting destinations from the north, but also connecting to neighborhoods, community destinations and other low-traffic stress roadways south of the US 50 intersection. The B&A Trail's extension over the Severn River into Annapolis connects to even more community destinations, major Anne Arundel County destinations, and increased population density areas. As such, more people will be served by this low-traffic stress connection of the B&A Trail in Annapolis.

Additionally, the **South Shore Trail's** connections improve the LTS score for the Annapolis area. Similar to the B&A Trail, the South Shore Trail through the Parole area along Bestgate Road improves access to numerous businesses, residences, and major destinations. The improved LTS score for the South Shore Trail can also be attributed to the **shared-use path along Maryland Route 70** (Rowe Boulevard). This shared-use path along Rowe Boulevard connects to the proposed B&A Trail and state government-related employment centers in Annapolis. By connecting to the **Poplar Trail,** a shared-use path paralleling West Street in Annapolis, the overall LTS score is improved for the West Annapolis area. The LTS score for Annapolis also improves with the shared-use paths along **Spa Road** and **Hilltop Lane**. These shared-use paths solidify the low-stress street network on the south side of Spa Creek and connect to the shared-use path along Forest Drive.

On Magothy Neck, the improved LTS score can be attributed with the expansion of the **Broadneck Trail** along College Parkway. With some of the eastern sections already complete, extending the Broadneck Trail westward will connect more low-traffic stress roadway and ultimately to the B&A Trail. The improved score can also be attributed to the population density of the area in relation to it's low-stress roadway network, numerous area schools and Anne Arundel Community College. As a major destination, Anne Arundel Community College would be more accessible by low-stress bicycle routes to adjacent neighborhoods and the B&A Trail with the construction of the Broadneck Trail.

To the northwest of Ferndale, completing the **B&A Trail's northern extension** from Linthicum to the Anne Arundel County line at the Patapsco River will greatly improve low-stress bicycle access. This section of trail connects to the BWI Trail spur at Maple Road and provides a shared-use path connection that avoids the Interstate 695 interchange at Maryland Route 170 (Camp Meade Road). Already in the preliminary engineering stage, the B&A Trail's northern extension improves access to two light rail stations and residential areas in the North Linthicum and Pumphreys communities.

Another area with significant LTS improvement is **Ferndale**. While located near the BWI Trail and the B&A Trail, creating a **shared-use path along Baltimore-Annapolis Boulevard** from the Anne Arundel County line at the Patapsco Rive to these trails in Glen Burnie will greatly improve low-stress bicycle access to Linthicum. This improvement in LTS score can be attributed to the existing low-stress neighborhood roadways being integrated by the shared-use path. The proximity of North County High School and light rail line also contributes to a greatly improved LTS score with the creation of the shared-use path. Whereas other proposed shared-use path projects have available right-of-way for creation, the shared-use path along Baltimore-Annapolis Boulevard would require easements of takings of adjacent properties. While a shared-use path along Baltimore-Annapolis Boulevard would greatly improve the low-traffic stress conditions for the Ferndale area, the cost of the project may outweigh the benefits.

Just north of Ferndale, the area of Pumphreys is improved with the creation of a shared-use path along **Maryland Route 170** (Belle Meade Road). While a shared-use path is proposed along this roadway, a 6 to 8-foot-wide sidewalk was created along this road. With numerous driveway crossings, many experienced cyclists in this area choose to ride in the roadway and avoid the driveway curb cuts. A shared-use path along Belle Meade Road would likely utilize the same roadway space as the recent sidewalk improvements. A proposed shared-use path along Belle Meade Road greatly improves the level of traffic stress trough Pumphreys as more community destinations are connected in the Linthicum and Brooklyn neighborhoods.

Increased LTS score differential can also be noted along MD 175 (Annapolis Road) in the **Odenton** area. Several shorter-length shared-use paths are planned for the Odenton area. Even with their shorter-length, these proposed shared-use paths along area roadways improve bicycle access for the area. Coupled with the WB&A Trail, South Shore Trail and shared-use path along MD 175, these shorter shared-use paths connect directly to local and major destinations. The low-stress street grid of Odenton also contributes to the increased score as the grid is connected to the area-wide low-stress bicycle route.

With numerous shared-use path projects identified in countywide planning documents, Anne Arundel County can greatly improve the low-traffic stress access for residents, commuters, and tourists alike. While the existing shared-use path system has seen notable use and success over the past decades, creating additional shared-use paths will connect more communities, destinations via low-traffic stress bicycle routes.

Shared-use Path Recommendations

The bicycle network analysis (BNA) of Anne Arundel County's proposed shared-use path system provided a realistic approach to determine where improvements would provide the greatest benefit to the county. Whereas bicycle level of comfort (BLOC) analysis is a vehicular measurement to determine if a roadway would be improved for competent cyclists, the Level of Traffic Stress (LTS) analysis more accurately captures how comfortable people will feel bicycling on various types of roads. As the county aims to increase the number of county residents that bicycle, especially for short distance trips, developing the shared-use path system is a viable strategy.

The bicycle network analysis illustrated which neighborhoods would have the greatest increase in LTS through an expanded shared-use path network. Using this process, the proposed shared-use paths with the greatest positive impact were identified. The following shared-use paths are recommended for implementation.

1. **B&A Trail southern extension** into Annapolis via MD Route 450 over the Severn River Bridge. While a bicycle lane exists along this route now, having a shared-use path separated from motor vehicle traffic will greatly improve access to neighborhoods, businesses and other community destinations into Annapolis.
2. The **South Shore Trail phases** along Bestgate Road in Parole. With its density of residence, businesses and major destinations, the South Shore Trail in Parole would improve the low-traffic stress network of both Parole and Annapolis.
3. As the **shared-use path along Maryland Route 70** (Rowe Boulevard) directly contributes to the improved LTS score of the South Shore Trail, the development of this shared-use path should be considered for implementation as well.

4. The construction of the **Broadneck Trail** along College Parkway will greatly improve low-stress connectivity along Magothy Neck. With direct access to the B&A Trail, Anne Arundel Community College and the low-stress network of neighborhoods streets, the Broadneck Trail will solidify the low-stress network of the entire peninsula.
5. The **B&A Trail northern extension** into North Linthicum will greatly improve access to transit and avoid an interstate interchange while connecting to the BWI Trail to the south.
6. The **Hilltop Lane** and **Spa Road shared-use paths** will improve the low-stress network of the Annapolis area. While these projects may be implemented independent of one another, the combined effect of both projects contribute to the overall improved LTS score for the area.
7. The shared-use paths along **Maryland Route 175 (Annapolis Road)** should also be considered for implementation. While under the management of the Maryland Department of Transportation State Highway Administration, the shared-use path along Annapolis Road would improve access to Fort Meade, Odenton and the neighborhoods and low-stress roadway network in the area.
8. The shared-use path along **East West Boulevard/Pasadena Road** should be considered for implementation. This path's creation will improve access across Maryland Route 2 (Governor Ritchie Highway) which contributes to the LTS score improvement. This path will also improve connection to Kinder Farm Park and serve as a local alternative route to Maryland Route 100.

Future Analysis

Based on the completed bicycle network analysis performed as a part of this project, Anne Arundel County should evaluate how shared-use paths constructed in the future influence the LTS. BNA may be performed in the future, but is contingent on the accurate updating of both the Open Streets Map (OSM) and the Anne Arundel County bicycle network geodatabase. Even as OSM or county GIS is updated, it is imperative that the geodatabase topology connects to existing street and trail databases. Having a distinct connection where geodatabase street elements intersect with other elements is essential to accurate BNA results.

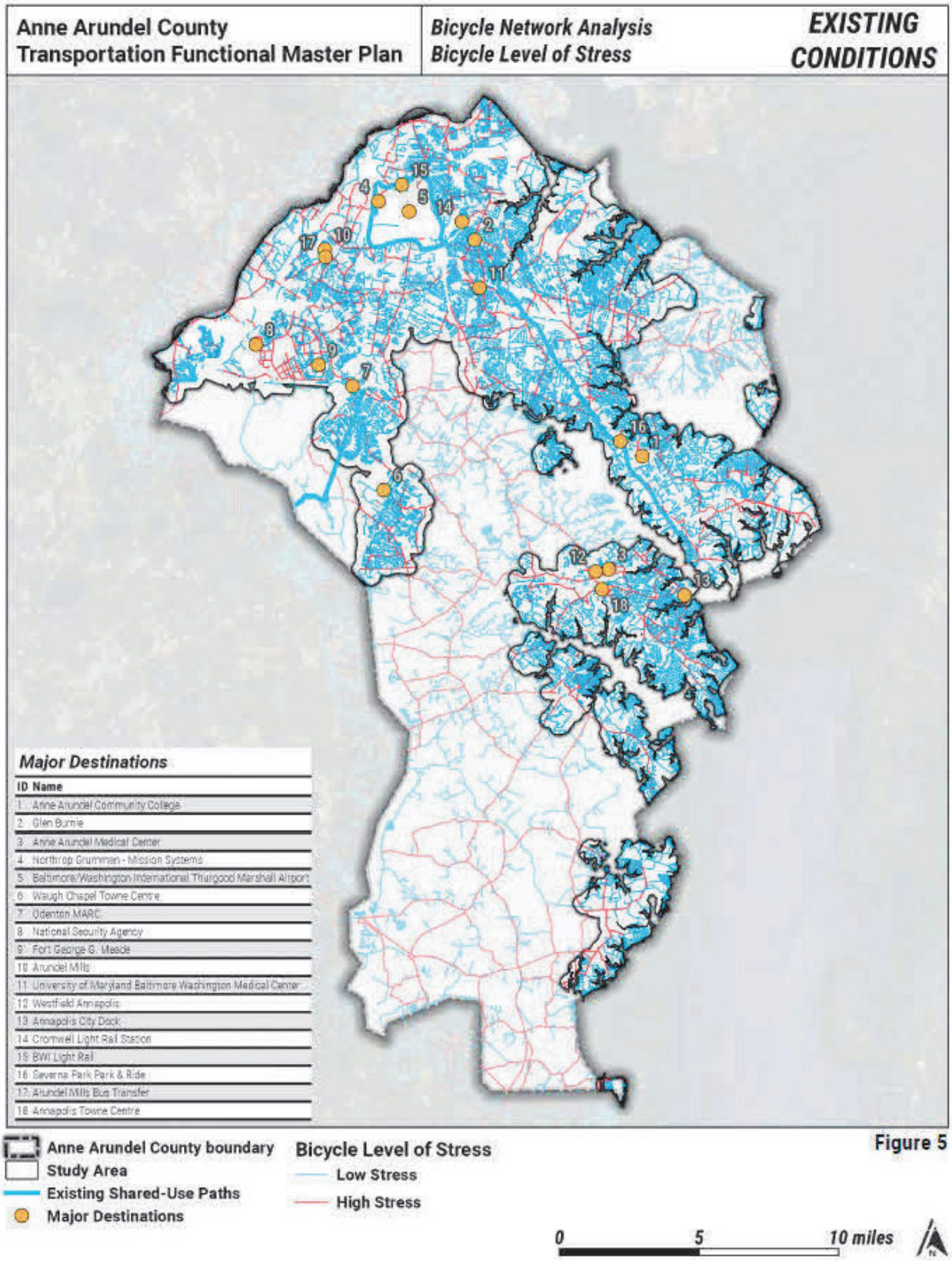
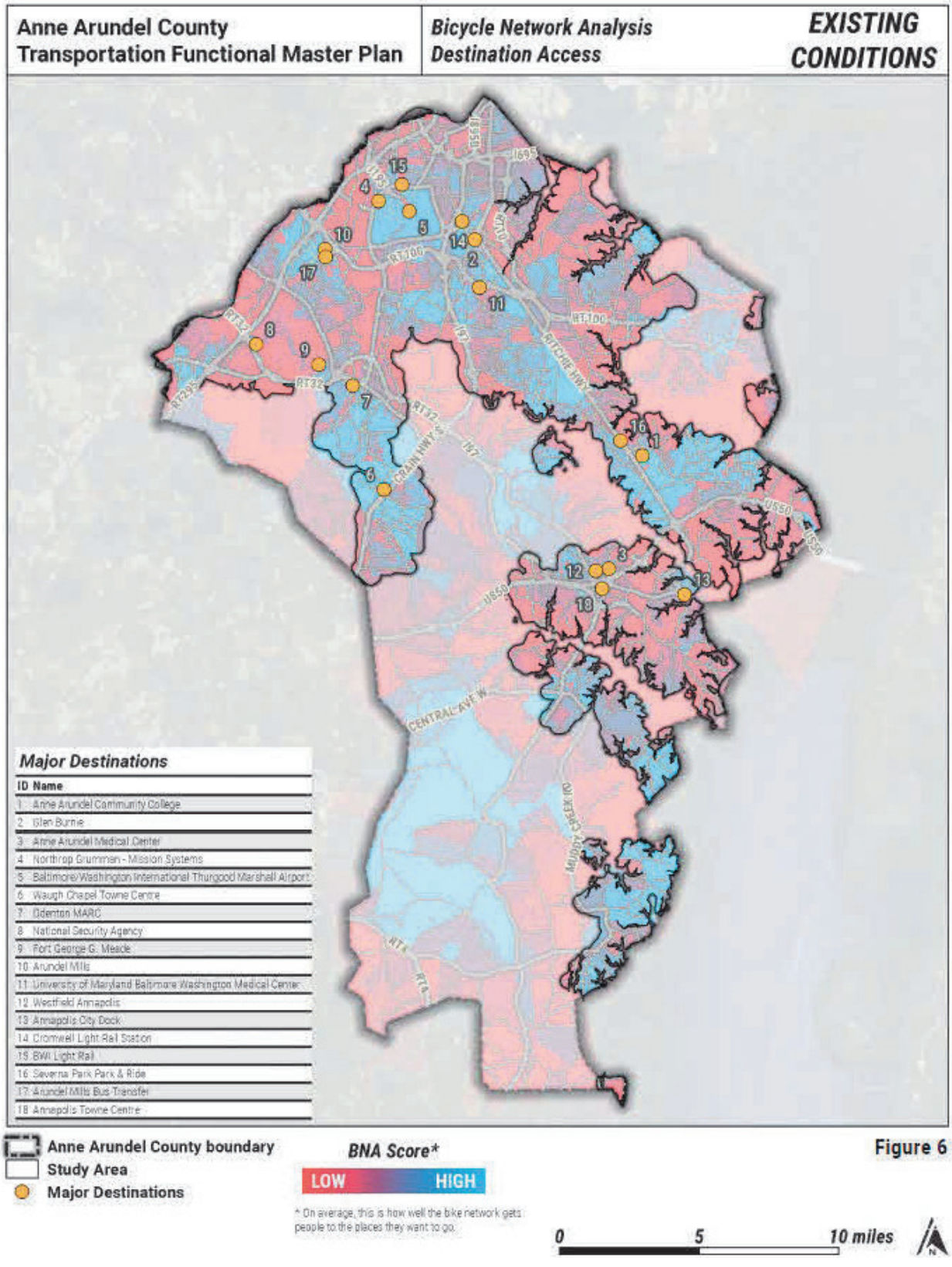

Anne Arundel County
Transportation Functional Master Plan
Bicycle Network Analysis
Bicycle Level of Stress
EXISTING
CONDITIONS
Major Destinations
ID Name
1 Anne Arundel Community College
2 Glen Burnie
3 Anne Arundel Medical Center
4 Northrop Grumman - Mission Systems
5 Baltimore/Washington International Thurgood Marshall Airport
6 Waugh Chapel Towne Centre
7 Odenton MARC
8 National Security Agency
9 Fort George G. Meade
10 Arundel Mills
11 University of Maryland Baltimore Washington Medical Center
12 Westfield Annapolis
13 Annapolis City Dock
14 Cromwell Light Rail Station
15 BWI Light Rail
16 Severna Park Park & Ride
17 Arundel Mills Bus Transfer
18 Annapolis Towne Centre
Anne Arundel County boundary
Study Area
Existing Shared-Use Paths
Major Destinations
Bicycle Level of Stress
Low Stress
High Stress
0
5
10 miles

Figure 5


Anne Arundel County
Transportation Functional Master Plan
Bicycle Network Analysis
Destination Access
EXISTING
CONDITIONS
Major Destinations
ID Name
1 Anne Arundel Community College
2 Glen Burnie
3 Anne Arundel Medical Center
4 Northrop Grumman - Mission Systems
5 Baltimore/Washington International Thurgood Marshall Airport
6 Waugh Chapel Towne Centre
7 Odenton MARC
8 National Security Agency
9 Fort George G. Meade
10 Arundel Mills
11 University of Maryland Baltimore Washington Medical Center
12 Westfield Annapolis
13 Annapolis City Dock
14 Cromwell Light Rail Station
15 BWI Light Rail
16 Severna Park Park & Ride
17 Arundel Mills Bus Transfer
18 Annapolis Towne Centre
Anne Arundel County boundary
Study Area
Major Destinations
BNA Score*
LOW
HIGH
* On average, this is how well the bike network gets people to the places they want to go.
0
5
10 miles
Figure 6

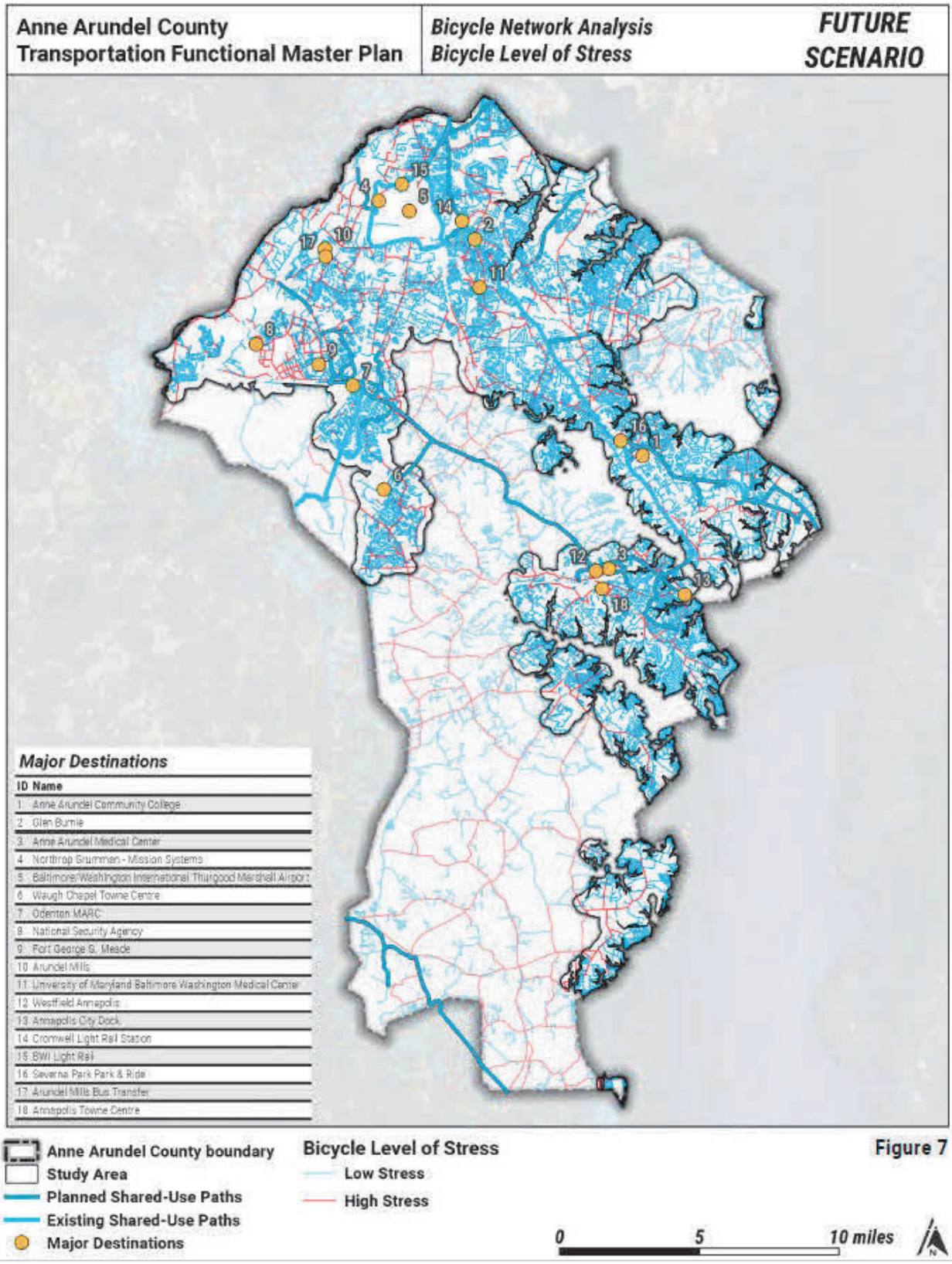
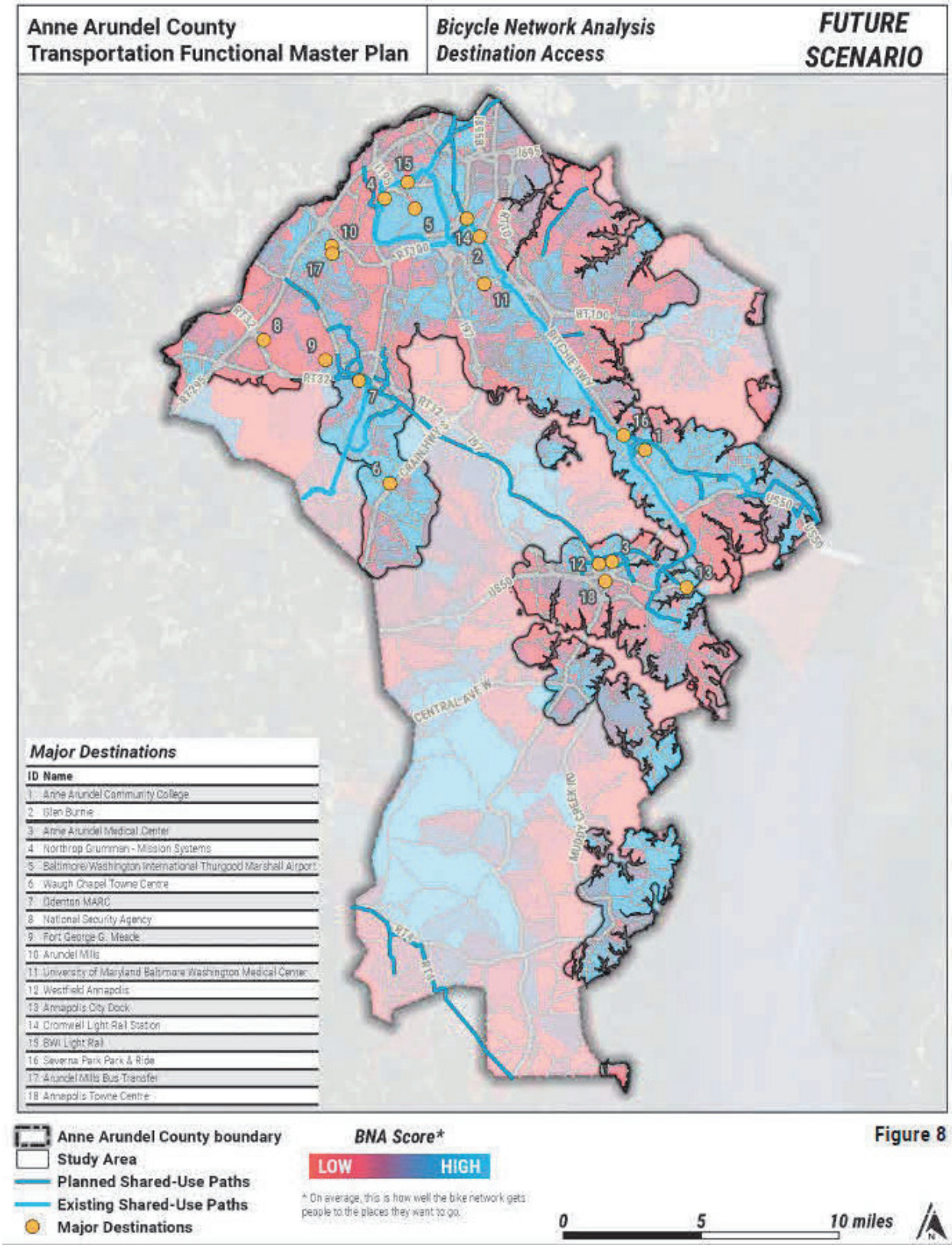

Anne Arundel County
Transportation Functional Master Plan
Bicycle Network Analysis
Bicycle Level of Stress
FUTURE
SCENARIO
Major Destinations
ID Name
1 Anne Arundel Community College
2 Glen Burnie
3 Anne Arundel Medical Center
4 Northrop Grumman - Mission Systems
5 Baltimore/Washington International Thurgood Marshall Airport
6 Waugh Chapel Towne Centre
7 Odenton MARC
8 National Security Agency
9 Fort George G. Meade
10 Arundel Mills
11 University of Maryland Baltimore Washington Medical Center
12 Westfield Annapolis
13 Annapolis City Dock
14 Cromwell Light Rail Station
15 BWI Light Rail
16 Severna Park Park & Ride
17 Arundel Mills Bus Transfer
18 Annapolis Towne Centre
Anne Arundel County boundary
Study Area
Planned Shared-Use Paths
Existing Shared-Use Paths
Major Destinations
Bicycle Level of Stress
Low Stress
High Stress
0
5
10 miles

Figure 7


Anne Arundel County
Transportation Functional Master Plan
Bicycle Network Analysis
Destination Access
FUTURE
SCENARIO
Major Destinations
ID Name
1 Anne Arundel Community College
2 Glen Burnie
3 Anne Arundel Medical Center
4 Northrop Grumman - Mission Systems
5 Baltimore/Washington International Thurgood Marshall Airport
6 Waugh Chapel Towne Centre
7 Odenton MARC
8 National Security Agency
9 Fort George G. Meade
10 Arundel Mills
11 University of Maryland Baltimore Washington Medical Center
12 Westfield Annapolis
13 Annapolis City Dock
14 Cromwell Light Rail Station
15 BWI Light Rail
16 Severna Park Park & Ride
17 Arundel Mills Bus Transfer
18 Annapolis Towne Centre
Anne Arundel County boundary
Study Area
Planned Shared-Use Paths
Existing Shared-Use Paths
Major Destinations
BNA Score*
LOW
HIGH
* On average, this is how well the bike network gets people to the places they want to go.
0
5
10 miles
Figure 8

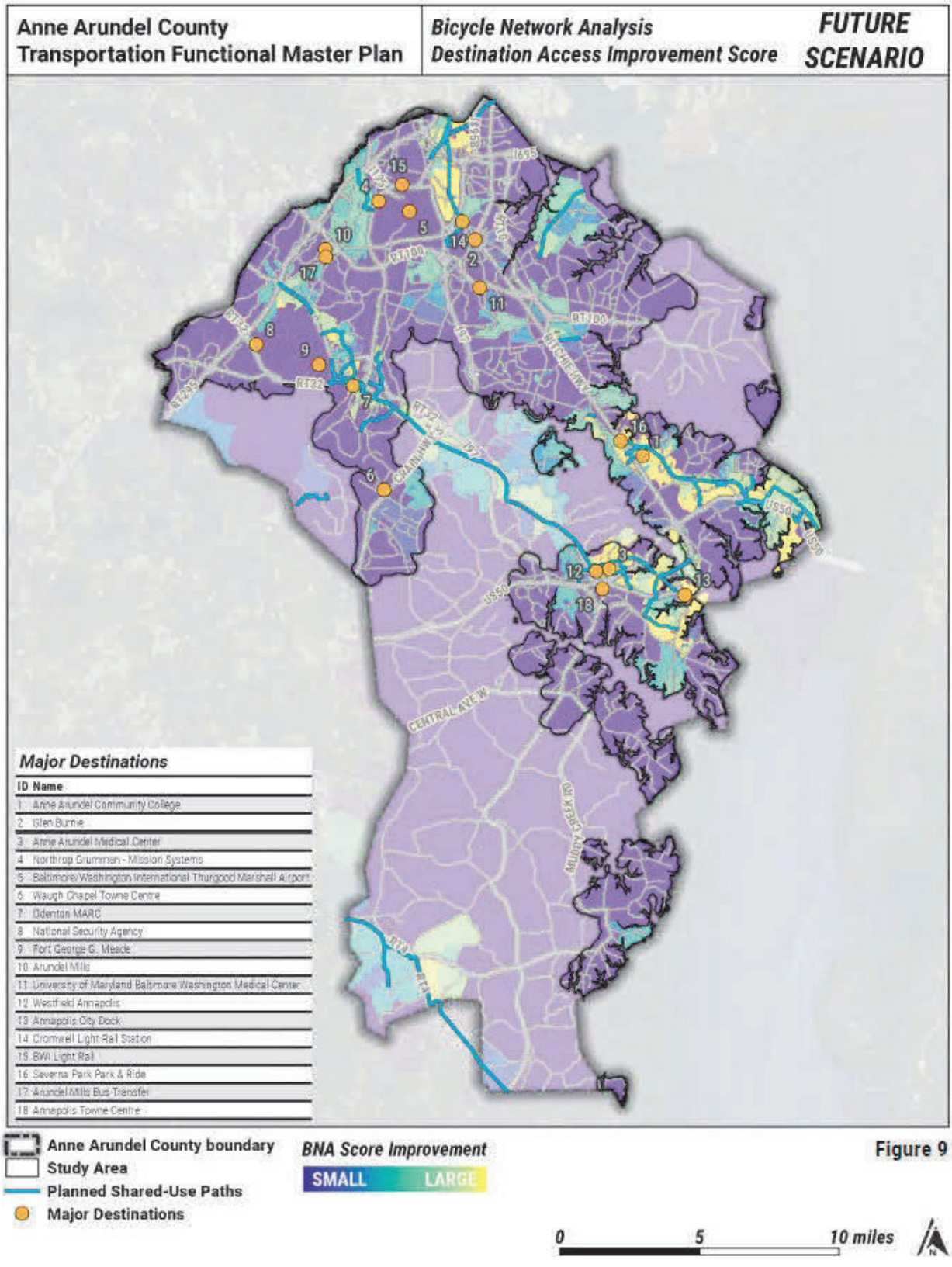

Anne Arundel County
Transportation Functional Master Plan
Bicycle Network Analysis
Destination Access Improvement Score
FUTURE
SCENARIO
Major Destinations
ID Name
1 Anne Arundel Community College
2 Glen Burnie
3 Anne Arundel Medical Center
4 Northrop Grumman - Mission Systems
5 Baltimore/Washington International Thurgood Marshall Airport
6 Waugh Chapel Towne Centre
7 Odenton MARC
8 National Security Agency
9 Fort George G. Meade
10 Arundel Mills
11 University of Maryland Baltimore Washington Medical Center
12 Westfield Annapolis
13 Annapolis City Dock
14 Cromwell Light Rail Station
15 BWI Light Rail
16 Severna Park Park & Ride
17 Arundel Mills Bus Transfer
18 Annapolis Towne Centre
Anne Arundel County boundary
Study Area
Planned Shared-Use Paths
Major Destinations
BNA Score Improvement
SMALL
LARGE
0
5
10 miles

Figure 9

ANNE ARUNDEL COUNTY
TRANSPORTATION MASTER PLAN

TECHNICAL MEMORANDUM #10
Summary of Technical Scoring Process

ANNE ARUNDEL COUNTY
MARYLAND

Prepared for the Anne Arundel County Office of Transportation
March 2019 – Final

SABRA & ASSOCIATES
Engineering Innovative Solutions

Note: The purpose of each Technical Memorandum prepared for the Office of Transportation is to present facts, analysis, ideas, issues and recommendations that will inform the Anne Arundel County Transportation Master Plan. The views expressed and recommendations offered in each memorandum are solely based on the consultant's judgment and should not be considered as endorsed by the Office of Transportation or any other County agency or officer.

This document summarizes the preliminary technical scoring of projects considered in the Transportation Functional Master Plan. The accompanying spreadsheets and spatial layers have been provided to the Office of Transportation for future use. Technical scoring is one of many considerations used in selecting priority projects for inclusion in the plan. Other considerations may include geographic equity, modal balance, regional and state coordination, and relationship to projects already in progress. Nearly 300 projects identified in Technical Memorandum #1 – Review of Prior Studies plus other projects identified in the Technical Memorandum #8 – Corridor Reviews were examined using this scoring system.

Roadway Project Technical Scoring

Projects are categorized separately as regional or community corridors

Plan Consistency 35%

Factors relative to inclusion in adopted planning documents:

- County CIP (or currently under study) or MDOT CTP
- BRTB Constrained Long Range Plan
- Priority Funding Area

+

TFMP Outcomes 65%

The extent to which a project could be used to advance priority outcomes:

- Traffic safety
- Travel Time Reliability
- Improved pedestrian and bicycle facilities
- Community revitalization
- Minimize environmental impacts and improve resiliency

=

Total Score

Roadway Project Criteria Weighting

Projects are categorized separately as regional or community corridors

			20 points		10 points
Planning Consistency (35% of Total Score)	**Weight**	**Data Source**	**Highest Ranking**		**Lowest Ranking**
Is the project consistent with the General Development Plan? & PFA law?	20%	GDP	Yes		No
Is the project consistent with the County's CTP priority letter?	20%	OOT	Yes		No
Is the project included in the CTP (for any phase)?	20%	MDOT	Yes		No
Is the project included in the CLRP?	20%	MDOT	Yes		No
Included in MIIF or CGMP	20%	OOT	Yes		No

			20 Points	15 points	10 points
Extent to which project advances TFMP Outcomes (65% of Total Score)	**Weight**	**Data Source**	**Highest Ranking**	**Medium Ranking**	**Lowest Ranking**
is the project in an area that is a high priority for safety improvements?	30%	SAI Safety Analysis	Located within the Top 5 crash clusters	Located within Crash Clusters 6-10	Located outside of top 10 crash clusters
Is the project in an where travel time reliability is a concern?	25%	SHA Mobility Report	TTI is greater than 1.5	TTI is between 1.25 and 1.49	TTI is less than 1.25
To what extent will the project improve bicycle/pedestrian facilities?	15%	Bike/Ped Master Plan	Project is in Tier 1 of BPMP	Project is in Tier 2 of BPMP	Project is in Tier 3 of BPMP
Is the located in a Commercial Revitalization Area or an approved Sustainable Community	10%	County/HCD GIS layers	Yes		No
To what extent would there be adverse impacts on natural resources?	10%	SAI enviro analysis template	Low Impact	Moderate Impact	Significant Impact

Transit Service Technical Scoring

Demographics 40%

BMC projections for 2040 by TAZ:
Population
- Employment
- Unemployment
- Low-Income Workers
- Zero-car Households

+

Destinations 40%

Major trip attractors:
- Colleges
- High Schools
- Post Offices
- Senior Centers
- Libraries
- Shopping Centers
- County, State, and Federal buildings

+

Transit Connectivity 20%

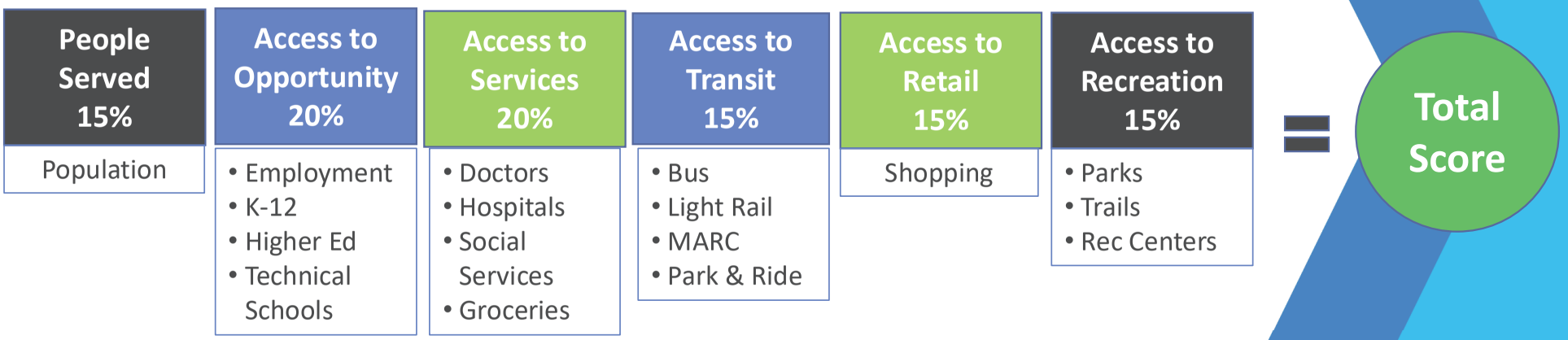
Connections to existing transit services, including:
- MTA (Bus, Light Rail MARC, Commuter Bus)
- RTA
- Annapolis Transit

=

Total Score*

**Call-N-Ride zones received a 10% bonus adjustment to the total scores as they provide very flexible operational parameters.*

Shared Use Path Technical Scoring



Rankings on improvement to the level of stress in accessing life activities

This page is intentionally left blank.