Appendix C:

Evaluating Potential Effects of Projects

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EVALUATING POTENTIAL EFFECTS OF PROJECTS

This appendix presents details about the technical analyses the BRTB (through the efforts of BMC staff) has conducted during the development of *Maximize2045*. These analyses help the BRTB to evaluate and understand the potential effects of the proposed projects and programs of *Maximize2045* with respect to adopted regional transportation goals, including conserving and enhancing the environment, increasing mobility, and improving accessibility.

Analysis of Preferred Alternative – Air Quality Conformity

Chapter 1 describes the federal requirements each MPO must follow to make sure the projects in its long-range transportation plan will not cause new air quality violations, worsen existing violations, or delay timely attainment of air quality standards.

To protect public health, the U.S. Environmental Protection Agency (EPA) sets the national ambient air quality standards (NAAQS) for "criteria pollutants." The EPA then determines the areas that do not meet these standards.

The EPA has determined that the Baltimore region does not meet the national standard for ground-level ozone. As a result, the EPA has classified the region as a "nonattainment" area with regard to the 8-hour ozone standard. The EPA also has classified the region as a "maintenance" area for carbon monoxide (CO) and fine particulate matter (PM2.5).

The State Implementation Plan (SIP) developed by the Maryland Department of the Environment establishes a plan for how the region will achieve the NAAQS by the required attainment date. The SIP addresses all sources of pollution in the region. For on-road mobile sources of pollution (e.g., cars, trucks, and buses), the SIP establishes motor vehicle emission budgets.

Conformity Evaluation

The Clean Air Act Amendments require careful evaluation of the conformity between transportation plans and programs and the SIP for attaining air quality standards. The region must show that its transportation plans and programs conform to the air quality goals in the SIP and are within the motor vehicle emission budgets.

This process is coordinated through the Interagency Consultation Group, a subcommittee of the BRTB. The Maryland Department of the Environment (MDE) submitted SIPs for 8-hour ozone, PM2.5, and CO. The maintenance SIP for CO was approved in 2003. The "rate of further progress" budget for mobile sources from the 8-hour ozone SIP was deemed adequate by EPA in 2016. The maintenance SIP for PM2.5 was approved in 2014.

The results of the conformity analysis indicate that projected mobile source emissions are below the established budgets for years 2020, 2030, 2040, and 2045. Based on the conformity analysis, the BRTB, in its capacity as the MPO for the Baltimore region, has concluded that implementation of the projects in *Maximize2045* and the FY 2020-2023 Transportation Improvement Program will not worsen the region's air quality or delay the timely attainment of national ambient air quality standards.

Air Quality Conformity – Final Emissions Results (in tons)

	2020	2030	2040	2045
Daily Summer NOx				
Total Emissions Modeled	47.0	20.1	17.4	17.9
Motor Emissions Budget	93.5	93.5	93.5	93.5
Conformity Result	Pass	Pass	Pass	Pass
Daily Summer VOC				
Total Emissions Modeled	21.6	12.3	9.7	9.6
Motor Emissions Budget	40.2	40.2	40.2	40.2
Conformity Result	Pass	Pass	Pass	Pass
Summer Weekday VMT	80,889,022	86,454,879	92,706,638	94,680,542

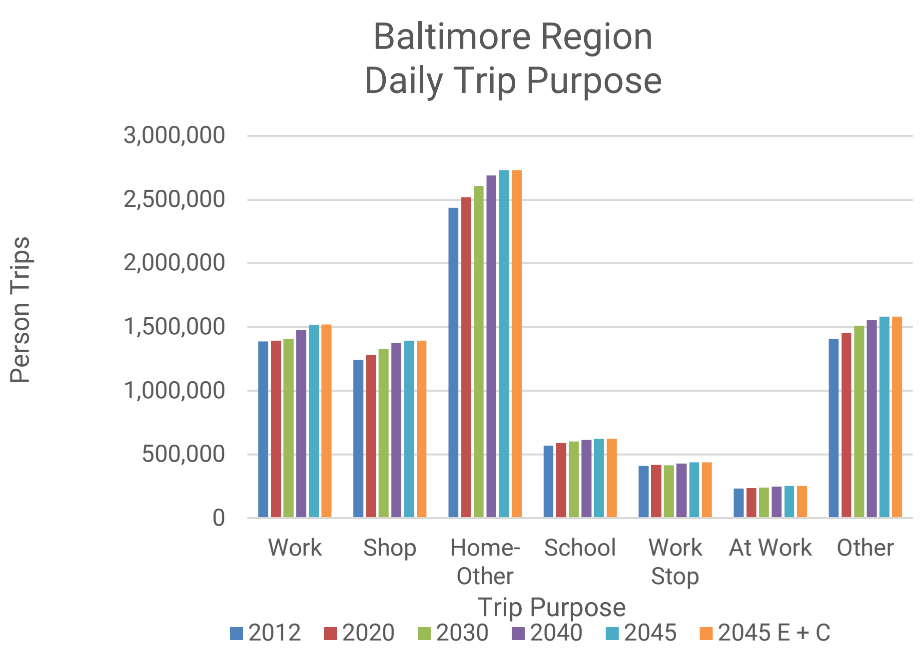
The region must show that its transportation plans and programs conform to the air quality goals in the SIP and are within the motor vehicle emission budgets.

Analysis of Preferred Alternative – Travel Demand Model

BMC staff applied performance measures to quantify the effects of simulated horizon year travel on the Baltimore region transportation network. Numerical data collected to quantify *Maximize2045* performance measures came from the Baltimore Region Travel Demand Model (Version 4.4a). Staff validated the travel demand model against 2012 reported observed conditions.

The Version 4.4a model includes seven person-level trip purposes: (1) Home-Based Work, (2) Home-Based School, (3) Home-Based Shopping, (4) Home-Based Other, (5) Journey to Work, (6) Journey at Work, (7) Other-Based Other. The model also includes three truck purposes: Commercial Vehicle, Medium Trucks, and Heavy Trucks. Staff used the Round 9 socioeconomic forecasts to simulate household and non-household travel behavior choices.

The following figure illustrates model simulated travel for 2012, 2020, 2030, 2040, and 2045 conditions for an average Baltimore region weekday. Based on horizon year input assumptions, the model forecasts a 0.04% decrease in total household person trips (motorized and non-motorized) from the Existing + Committed (no-build) condition to the 2045 Preferred Alternative, resulting in a total of 8.5 million total person trips produced in 2045. Trips for 2023 and 2045 are distributed throughout the region and the output vehicle trip tables from the mode choice module are assigned to the 2023 and 2045 transportation networks, respectively.



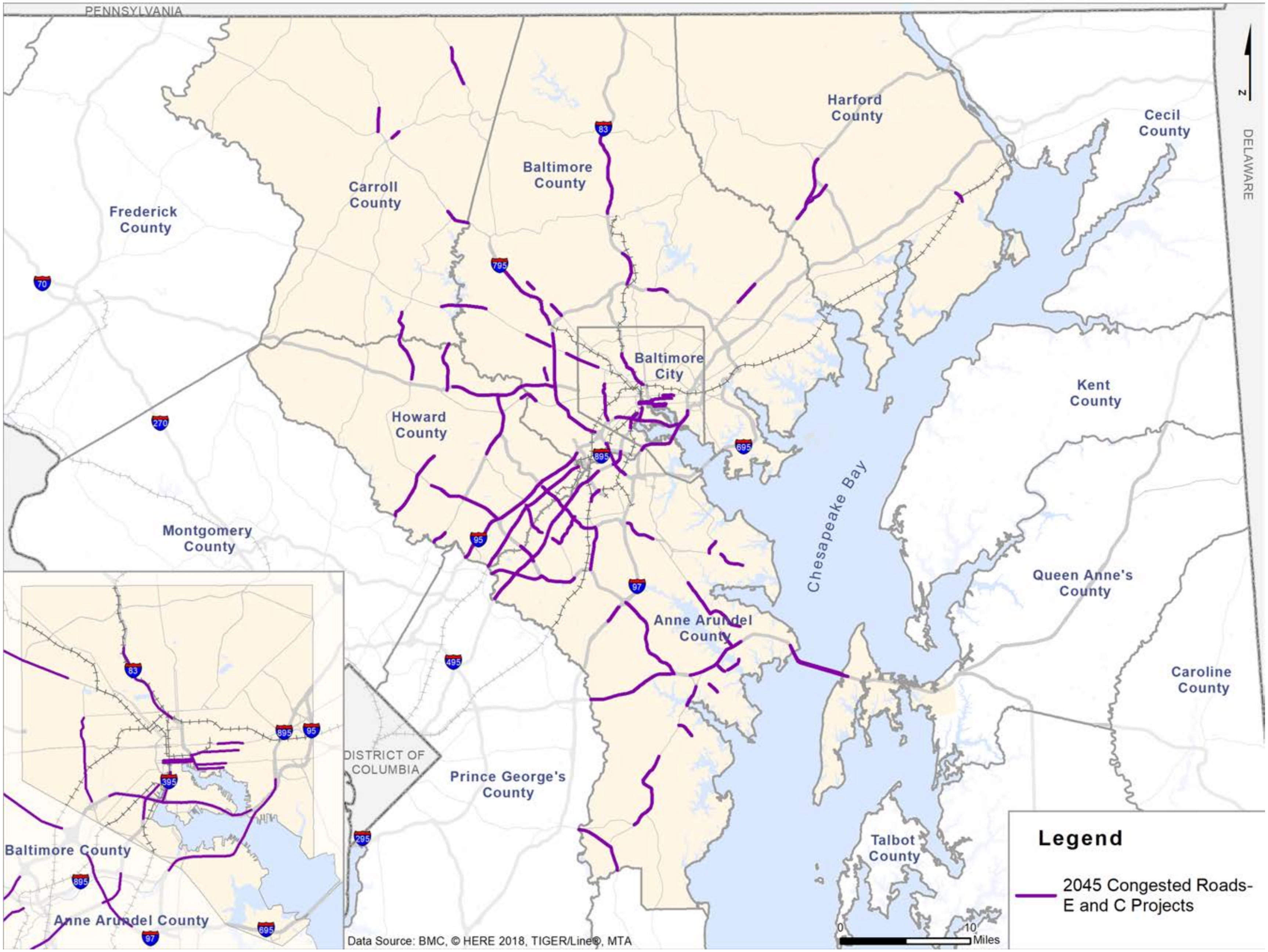
Performance measures have been developed to analyze simulation characteristics to show travel demand results. Performance measures were calculated for two simulations:

- Existing and Committed (E + C) projects only[1],
- E + C and *Maximize2045* Preferred Alternative projects.

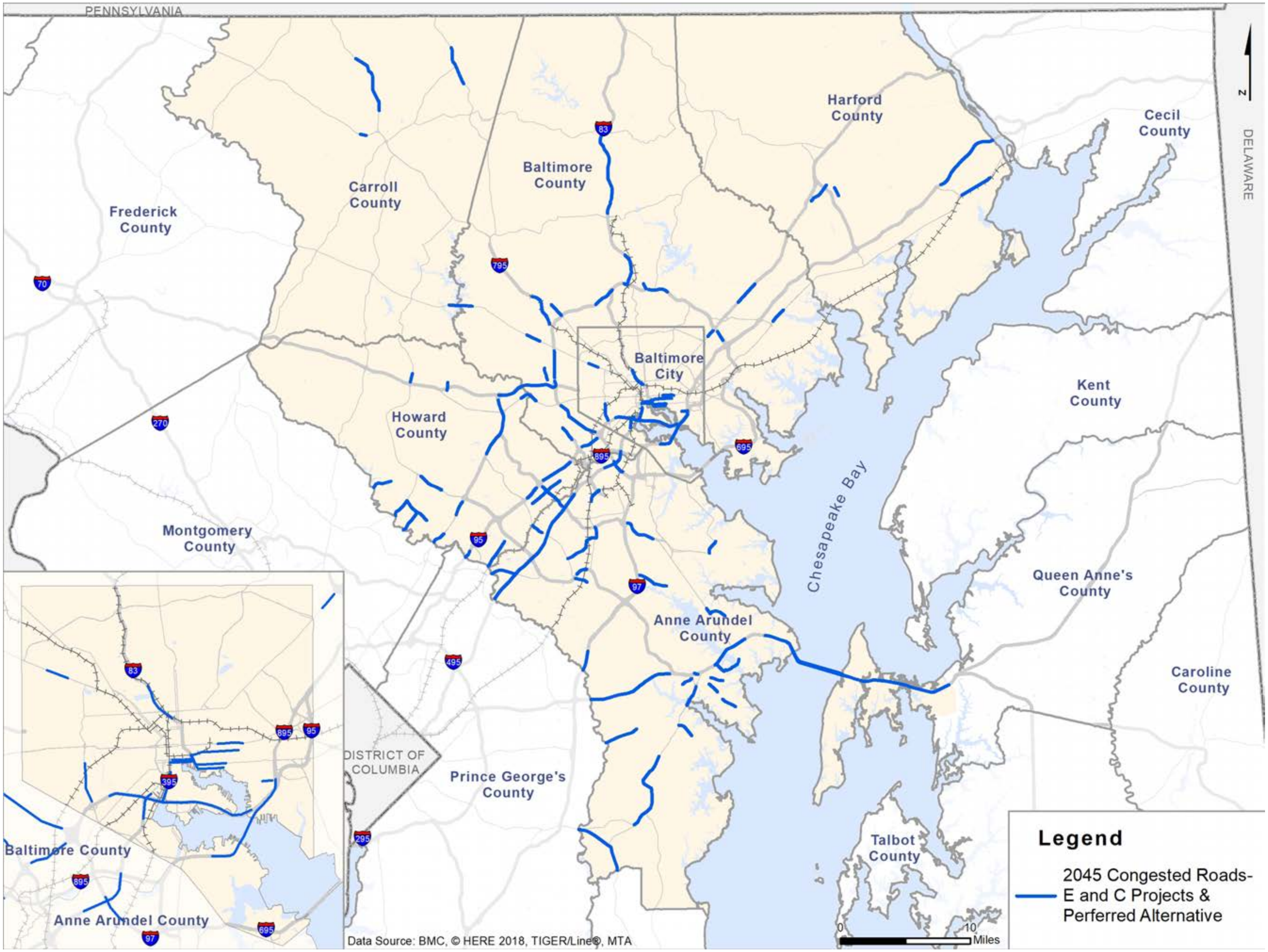
The E + C network illustrates the forecasted level of service that would result in year 2045 if only the projects currently built, or the limited group scheduled for construction by calendar year 2023, were completed. E + C, in this case, shows what is referred to as a “no-build” scenario, wherein all project planning terminates with the projects that are currently funded and scheduled.

1 This is the 2023 network (existing + committed projects), assuming 2045 population and employment projections.

2045 Congested Roadway Forecast – E + C Projects Only



2045 Congested Roadway Forecast – E + C Projects and Preferred Alternative Projects



The following table displays 2012, 2045 E + C, and 2045 Preferred Alternative (PA) performance measures for the 24-hour period:

Travel Demand Performance Measures for Baltimore Region						
	Indicator of Travel Demand	**2012 Base Year**	**2045 E + C**	**2045 PA**	**2012 to 2045 E + C % Change**	**2045 E + C to 2045 PA % Change**
Vehicle Miles Traveled (VMT)	Interstates	33,103,000	40,817,000	41,823,000	23.3%	2.5%
	Arterials	26,052,000	32,052,000	31,397,000	23.0%	– 2.0%
	Collectors	5,554,000	7,309,000	6,754,000	31.6%	– 7.6%
	All Roads	64,710,000	80,178,000	79,974,000	23.9%	– 0.3%
Congested VMT (LOS E and F)	Interstates	9,829,000	15,322,000	14,730,000	55.9%	– 3.9%
	Arterials	7,510,000	13,093,000	11,035,000	74.3%	– 15.7%
	Collectors	1,632,000	3,317,000	2,723,000	103.2%	– 17.9%
	All Roads	18,972,000	31,732,000	28,488,000	67.3%	– 10.2%
Percentage of Congested VMT (LOS E and F)	Interstates	29.7%	37.5%	35.2%	7.8%	– 2.3%
	Arterials	28.8%	40.8%	35.1%	12.0%	– 5.7%
	Collectors	29.4%	45.4%	40.3%	16.0%	– 5.1%
	All Roads	29.3%	39.6%	35.6%	10.3%	– 4.0%
	Total Transit Ridership (Linked Trips)	274,000	295,000	298,000	7.7%	1.0%
	Travel Characteristics					
Auto Occupancy Ratio	Home-Based Work Trips	1.09	1.09	1.09	0.0%	0.0%
	Home-Based Non-Work Trips (Shop/Other)	1.52	1.52	1.52	0.0%	0.0%
	All Home-Based Trips	1.65	1.65	1.65	0.0%	0.0%
	Home-Based Transit Mode Share	4.17%	3.97%	4.03%	– 0.2%	0.1%
	Performance					
Congested Speed (mph) for a.m. Peak Period	Interstates	47.7	41.4	43.8	– 13.2%	5.8%
	Freeways	46.2	38.1	41.2	– 17.5%	8.1%
	Principal Arterials	32.6	29.6	31.1	– 9.2%	5.1%
	Minor Arterials	30.3	27.7	28.8	– 8.6%	4.0%
	Collectors	30.3	27.5	28.6	– 9.2%	4.0%
	All Roads	36.9	32.6	34.5	– 11.7%	5.8%
	Vehicle Hours of Delay (a.m. Peak Period)	86,000	255,000	175,000	196.5%	– 31.4%
	Vehicle Hours of Delay (24-Hour Period)	271,000	834,000	583,000	207.7%	– 30.1%

Following are some significant observations related to the travel demand model data as presented in the table:

- The Baltimore region on an average weekday is projected to have a 23.6 percent growth in VMT from a 2012 total of 64.7 million to a 2045 Preferred Alternative projection of 80.0 million.
- Congested VMT (Level of Service E and F) is projected to increase 50 percent from 19.0 million VMT in 2012 to 28.5 million in the 2045 Preferred Alternative. The congested VMT in the 2045 Preferred Alternative accounts for nearly 35.6 percent of total VMT in the region while the 2023 E + C shows a 39.6 percent level compared to the 2012 network at 29.3 percent.
- Transit ridership shows an increase of 8.9 percent from 2012 to 2045, but the transit mode share for work trips decreases by 0.2 percent while the share increases for home-based shop and other by 17 percent.
- Vehicle hours of delay for the a.m. peak period in 2023 E + C are three times greater than the hours of delay for 2012 because of increased traffic congestion (255,252 in 2023 and 85,516 in 2012).
- Vehicle hours of delay for the 2045 Preferred Alternative are projected to decrease by 32 percent from 2023 E + C to 174,689 hours of delay.
- Average speed for all roads under the 2045 Preferred Alternative shows a decrease of 6.5 percent between 2012 and 2045 due to increased traffic congestion. The average speed improves from the 2023 E + C from 32.6 mph to 34.5 with the implementation of the 2045 Preferred Alternative, a 5.8 percent increase.

Analysis of Preferred Alternative – Environmental Justice

This section describes how the BRTB addresses the principles of environmental justice (EJ) in *Maximize2045*.

As discussed earlier in the plan, *Maximize2045* contains a list of the major surface transportation projects the region expects to implement in the period from 2024 to 2045. These investments will affect the travel patterns and transportation decisions of people living in and traveling through the Baltimore region. Some of these impacts will be positive (benefits) while others will be negative (burdens). Furthermore, these impacts will be unevenly distributed throughout the region. For example, transportation investments may decrease the travel time to work for some people while increasing congestion could result in longer travel times for others. In the context of metropolitan transportation planning, the core of an EJ analysis is evaluating the distribution of these benefits and burdens on EJ and non-EJ populations.

The section begins with the definition of EJ and its guiding principles, followed by a summary of EJ populations in the Baltimore region. The methods section focuses on identifying EJ and non-EJ areas in the Baltimore region. The identification of EJ and non-EJ areas sets the stage for an analysis of the benefits and burdens associated with the implementation of the projects included in *Maximize2045*. To accomplish this, BMC staff identified a series of accessibility and mobility measures of interest. The section concludes with a discussion of the impact of *Maximize2045* in the context of these accessibility and mobility measures.

Definition / Guiding Principles

EJ seeks to ensure that the benefits and burdens of transportation investments are shared as equitably as possible among all affected communities. Specifically, EJ considers whether low-income and minority populations bear disproportionate impacts resulting from governmental decisions.

Historically, EJ grew out of civil rights and environmental complaints from low-income and minority communities. Concerns were raised, showing that these communities may suffer disproportionately from exposure to toxic chemicals and the siting of industrial plants and waste facilities.

In February 1994, President Clinton signed Executive Order 12898, titled "Federal Action to Address Environmental Justice in Minority and Low-Income Populations." In 1997, the U.S. Department of Transportation (DOT) issued an "Order to Address Environmental Justice in Minority Populations and Low-income Populations."

The DOT order directs consideration of two groups: low-income persons and minorities.

- **Low-income**: A person whose household income is at or below the U.S. Department of Health and Human Services poverty guidelines is considered low-income.
- **Minorities**: A person belonging to any of the following groups is considered part of a minority population:
  - Person of origin in any of the black racial groups of Africa
  - Person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin
  - Person having origins in any of the original peoples of the Far East, Southeast Asia, Indian subcontinent, or Pacific Islands
  - Person having origins in any of the original peoples of North America (American Indian, Alaskan Native) and who maintains cultural identification through tribal affiliation or community recognition.

The DOT Order applies to all policies, programs and other activities undertaken, funded, or approved by the DOT, including metropolitan planning. There are three fundamental DOT Environmental Justice principles:

- To avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.
- To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process.
- To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations.

Metropolitan planning organizations (MPOs) are responsible for assessing the benefits and burdens of transportation system investments for different socioeconomic groups. This includes both a data collection effort and engagement of minority and low-income populations in public involvement activities.

EJ Populations in the Baltimore Region

Low-income

As stated previously, low-income refers to persons whose household income is at or below the U.S. Department of Health and Human Services (HHS) poverty guidelines. The primary source of data on low-income persons is the U.S. Census Bureau's American Community Survey (ACS). The Census Bureau uses a set of income thresholds that vary by household size and composition to determine poverty. If a household's total income is less than the threshold, then that household and every individual in it is considered to be in poverty. For example, the 2018 threshold for a four-person household with two dependents is $25,465. The HHS poverty guidelines are a simplified version of the poverty thresholds utilized by the Census Bureau.

While low-income refers to persons living at or below the poverty line, the BRTB utilizes households in poverty to identify low-income populations due to data constraints. EJ analysis relies on BMC's travel demand model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to predict travel times and distances for persons living in the Baltimore region. The ACS does not provide poverty data for individuals at the level of granularity required by the travel demand model, but does so for households in poverty. Households in poverty proves to be a suitable proxy for individuals living in poverty as the data yields similar results for the region as a whole. According to the ACS, 10.2% of households in the Baltimore region fall below the poverty line compared to 10.5% of individuals.

The table below summarizes low-income households by jurisdiction. Households at or below the poverty line are not evenly distributed throughout the region, ranging from 4.8% of households in Howard County to 20.8% of households in Baltimore City. In total, 106,144 out of the 1,040,704 households in the Baltimore region, or 10.2%, have incomes at or below the poverty line.

Low-Income Households by Jurisdiction

Jurisdiction	Total Households	At or Below 100% of Poverty Line	
		Households	Share
Anne Arundel	205,395	11,818	5.8%
Baltimore City	239,791	49,940	20.8%
Baltimore County	312,859	27,209	8.7%
Carroll	60,432	3,174	5.3%
Harford	92,895	7,539	8.1%
Howard	111,337	5,385	4.8%
Queen Anne's	17,995	1,079	6.0%
BRTB Region Total	**1,040,704**	**106,144**	**10.2%**

Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates (Table B17017)

Minority

The ACS also serves as the primary data source for identifying minority populations. Minorities include individuals who are members of several population groups, including Hispanic persons and non-Hispanic persons who are Black, American Indian or Alaskan Native, and Asian or Pacific Islander. Non-minorities are defined as those that are both white and non-Hispanic.

The tables and figure on the next page summarize minority individuals by Hispanic/Latino origin and race as well as by jurisdiction. As with low-income populations, minorities are not evenly distributed throughout the region. According to the latest 5-year estimates from the ACS, the share of minorities in BRTB jurisdictions ranges from 10.2% in Carroll County to 72.4% in Baltimore City. In total, minorities make up 42.5% of the Baltimore region population while white, non-Hispanics make up the remaining 57.5%.

Total Population in the BRTB region by Hispanic or Latino Origin and Race

Categories		BRTB Population		Share	
White, non-Hispanic		1,605,111	1,605,111	57.5%	57.5%
Minorities	Black, non-Hispanic	1,186,939	801,713	42.5%	28.7%
	American Indian and Alaska Native, non-Hispanic		5,327		0.2%
	Asian, non-Hispanic		148,872		5.3%
	Native Hawaiian and Pacific Islander, non-Hispanic		1,069		0.0%
	Some other race, non-Hispanic		7,496		0.3%
	Two or more races, non-Hispanic		69,896		2.5%
	HIspanic, all races		152,566		5.5%
Total		**2,792,050**	**2,792,050**	**100.0%**	**100.0%**

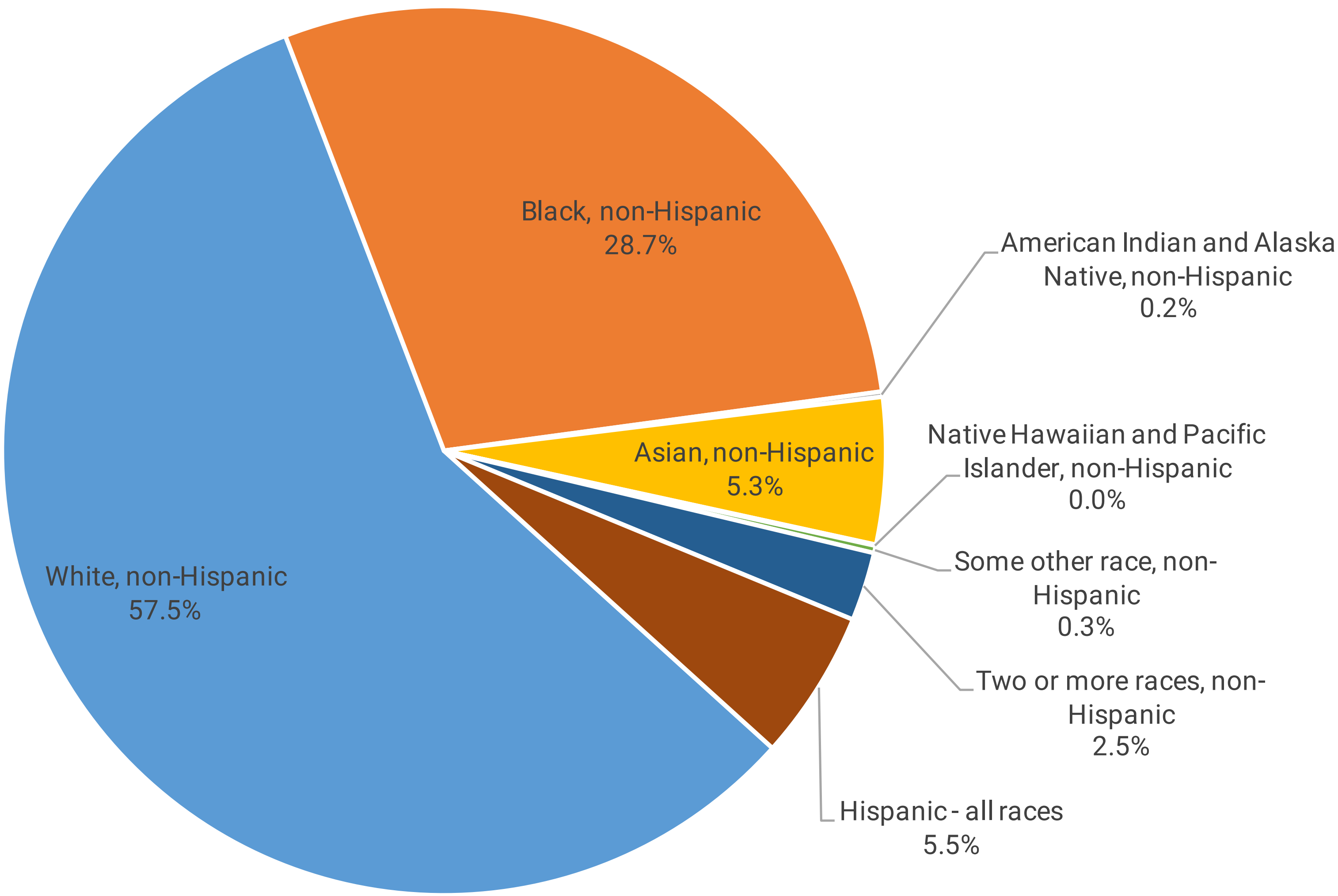
Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates (Table B03002)

Minorities by Jurisdiction

Jurisdiction	Minority Population	White, non-Hispanic Population	Minority Share	White, non-Hispanic Share
Anne Arundel	171,461	393,139	30.4%	69.6%
Baltimore City	448,880	170,916	72.4%	27.6%
Baltimore County	341,945	486,692	41.3%	58.7%
Carroll	17,022	150,297	10.2%	89.8%
Harford	57,623	192,509	23.0%	77.0%
Howard	143,426	169,069	45.9%	54.1%
Queen Anne's	6,582	42,489	13.4%	86.6%
BRTB Region Total	**1,186,939**	**1,605,111**	**42.5%**	**57.5%**

Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates (Table B03002)

BRTB Region Minority Populations



Methodology

Identifying EJ Populations

The first step in analyzing the effects of plans and programs on EJ populations is to identify where minority and low-income populations live. The BRTB uses Transportation Analysis Zones (TAZs) as a basis for identifying EJ areas. TAZs are a basic unit of geography used to predict travel behavior in the BRTB's travel demand model. They are constructed using census block information and are smaller than census tracts.

BMC staff used a regional threshold to identify EJ and non-EJ TAZs. A TAZ is identified as an EJ area if it has a concentration of households living in poverty or minorities at or greater than their respective regional averages. The percentage of households with incomes at or below the poverty line in the Baltimore region is 10.2%. Thus, TAZs with a concentration of households in poverty greater than or equal to 10.2% are considered low-income TAZs for EJ purposes. Similarly, TAZs with a concentration of minorities greater than or equal to the regional average of 42.5% are considered minority TAZs for EJ purposes. EJ TAZs are summarized in the table below and the map on the next page.

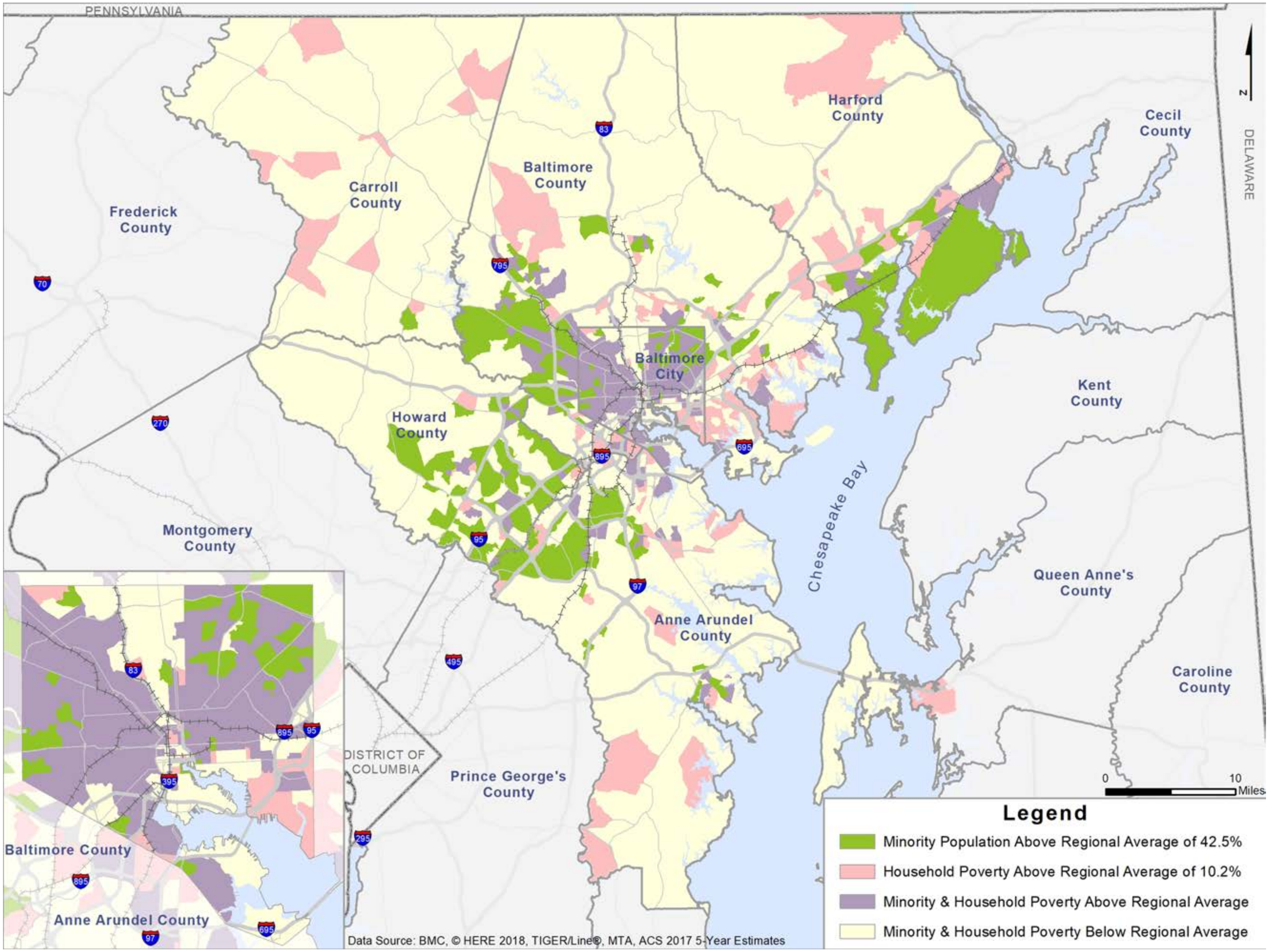
Of the 1,392 TAZs in the BRTB region, 661 qualify as EJ TAZs and 731 are non-EJ TAZs. Of the 661 EJ TAZs, 212 exceed the regional average for minority population, 142 exceed the regional average for households in poverty, and 307 exceed both the minority and poverty thresholds. Total population is relatively evenly split between EJ and non-EJ TAZs, with 1.47 million people living in EJ TAZs and 1.32 million people living in non-EJ TAZs.

MPOs frequently utilize a regional threshold method to identify EJ areas for analysis. It's important to point out that this method has the shortcoming of excluding small pockets of EJ populations from the analysis. This is because some low-income and minority persons will necessarily live in TAZs identified as non-EJ. However, the table below shows that EJ TAZs account for most of the EJ populations. EJ TAZs account for 79.7% of the region's minority population. This means that the other 20.3% of minorities live in non-EJ TAZs. Similarly, 80.2% of the region's households living in poverty are located in TAZs identified as EJ, with the remaining 19.8% of these households located in non-EJ TAZs.

Summary of EJ and Non-EJ TAZs by Type

TAZs by Type	Number of TAZs	BRTB Region Totals		EJ Populations			
		Population	Households	Minority Population	Minority Share	Households in Poverty	Households in Poverty Share
EJ TAZs	661	1,470,791	550,963	946,573	79.7%	85,090	80.2%
• Minority > 42.5%	212	535,585	192,685	350,579	29.5%	9,919	9.3%
• Poverty HH > 10.2%	142	265,318	104,293	65,060	5.5%	16,126	15.2%
• Both Minority and Poverty	307	669,888	253,985	530,934	44.7%	59,045	55.6%
Non-EJ TAZs	731	1,321,259	489,742	240,366	20.3%	21,054	19.8%
Total	**1,392**	**2,792,050**	**1,040,705**	**1,186,939**	**100%**	**106,144**	**100%**

EJ and Non-EJ TAZs by Type



Scenarios and Measures Used in the EJ Analysis

As noted previously, TAZs are the base geographic unit for the model. In addition to TAZs, the travel demand model requires a number of inputs to estimate travel patterns. These inputs include the existing road and transit network; the future road and transit network; and demographic forecasts for population, households, and employment. For the purposes of this section, the future road network includes all surface transportation improvements identified in the preferred alternative of *Maximize2045*. The model takes these inputs and estimates travel times and distances from each TAZ to all other TAZs.

The travel demand model enables BMC staff to compare how travel patterns differ for EJ and non-EJ TAZs. To facilitate this analysis, staff identified a number of specific measures related to accessibility, mobility, and proximity. Results for each of these measures were calculated for EJ and non-EJ TAZs across two scenarios. These scenarios include:

- **2045 Existing and Committed (2045 E+C)**: The 2045 E+C scenario includes all projects that are either already in place or are committed. "Committed" means that a schedule is in place and either (1) sponsors are currently spending funds on these projects (for design, right-of-way acquisition, or construction) or (2) sponsors have identified fund sources and have committed funds to design or build these projects by FY 2023. It assumes that there will be no new capacity adding infrastructure projects between now and 2045 beyond what is programmed as of FY 2023.
- **2045 Preferred Alternative Scenario (2045 PA)**: The 2045 Preferred Alternative scenario includes all projects in the 2045 E+C scenario as well as implementation of all surface transportation projects in the preferred alternative of *Maximize2045*.

Both of these scenarios incorporate 2045 demographic forecasts for population, households, and employment. This enables staff to isolate the impact of implementing the projects contained in the preferred alternative of *Maximize2045* while holding demographic variables constant. A complete EJ analysis should include a discussion of analysis both within and between these scenarios. First, the analysis compares how conditions differ in the 2045 E+C scenario between EJ and non-EJ areas. Second, the analysis compares how conditions differ in the 2045 PA scenario between EJ and non-EJ areas. Finally, the analysis looks at the relative change in benefits that each group is expected to experience with the implementation of the plan.

The chosen measures used for the EJ analysis are listed and summarized below. These measures quantify how *Maximize2045* might change access to jobs and shopping opportunities, travel times to common destinations, and the percentage of the population close to certain important destinations such as supermarkets and hospitals. In all, there are eight different measures, with each applied to both auto and transit. Auto and transit travel times are TAZ to TAZ. For auto, travel times include time estimates for parking and walking to the destination. For transit, they include time estimates for walking to a transit stop, wait times, transfer times (walking and waiting), and walking from the final transit stop to the destination. The transit measures are limited to walk access only (i.e., they exclude transit trips involving driving to transit).

- **Average number of jobs accessible**: This measures the average number of jobs accessible from EJ and non-EJ TAZs within a specified travel time by both auto and transit. The travel times selected for auto and transit were 30 and 60 minutes, respectively, during the peak travel period. A weighted average of the number of jobs accessible from EJ and non-EJ TAZs was calculated based on TAZ population. For example, assume TAZ A contains 40 people and 80 jobs are accessible within a 30-minute drive and TAZ B contains 60 people and 200 jobs are accessible within a 30-minute drive. The weighted average is calculated as follows: (40/100) x 80 + (60/100) x 200 = 152.
- **Average number of shopping opportunities accessible**: This measures the average number of shopping opportunities accessible from EJ and non-EJ TAZs within a specified travel time by both auto and transit. The

travel times selected for auto and transit were 30 and 60 minutes, respectively, during the peak travel period. Shopping opportunities do not measure the number of stores within these travel times because data for every retail store is not available in the travel demand model. Rather, shopping opportunities represent the number of home-based shopping trips retail employment attracts on a typical day. Attractions are influenced by both the location and concentration of retail employment throughout the region. A weighted average of the number of shopping opportunities accessible from EJ and non-EJ TAZs was calculated based on TAZ population.

- **Average commute time**: This measures the average number of minutes it takes to commute to work during the peak travel period from EJ and non-EJ TAZs by both auto and transit.
- **Average travel time for shopping purposes**: This measures the average number of minutes it takes to travel for shopping purposes from EJ and non-EJ TAZs by both auto and transit.
- **Average travel time to closest hospital**: This measures the average number of minutes it takes to travel to the closest TAZ containing a hospital from EJ and non-EJ TAZs by both auto and transit. The travel time is to the closest TAZ containing a hospital because the travel demand model calculates all travel times from zone to zone rather than from a particular destination to a particular destination. Hospital location data is available from Maryland iMAP's GIS data catalog (https://data.imap.maryland.gov/). Hospitals included are acute, general, and special hospitals licensed by the Maryland Department of Health and Mental Hygiene Office of Health Care Quality.

- **Percent of population close to a supermarket**: This measures the percent of the population living in EJ and non-EJ TAZs that lives close to a supermarket by both auto and transit. Rather than defining what "close" means, the data are presented as the percent of the population within 15, 30, 45, and 60 minutes of the closest supermarket. Supermarket location data are sourced from the Maryland Food System Map (http://mdfoodsystemmap.org/) produced by the Johns Hopkins Center for a Livable Future.
- **Percent of population close to a hospital**: This measures the percent of the population living in EJ and non-EJ TAZs that lives close to a hospital by both auto and transit. Rather than defining what "close" means, the data are presented as the percent of the population within 15, 30, 45, and 60 minutes of the closest hospital. Hospital location data are identical to those used for the average travel time measure above.
- **Percent of population close to a college or university**: This measures the percent of the population living in EJ and non-EJ TAZs that lives close to a college or university by both auto and transit. Rather than defining what "close" means, the data are presented as the percent of the population within 15, 30, 45, and 60 minutes of the closest college or university. College and university location data are available from Maryland iMAP's GIS data catalog (https://data.imap.maryland.gov/). Colleges and universities included are public and private two- and four-year higher education institutions sourced from the Maryland Higher Education Commission.

Results and Discussion of Environmental Justice Analysis

The following tables and paragraphs present and discuss the results of the EJ analysis. The tables present results for EJ and non-EJ TAZS for both the 2045 E+C and 2045 PA scenarios. In addition, the tables include the percent change from the 2045 E+C to the 2045 PA scenario. Percent changes highlighted in green represent improvements (i.e., an increase in jobs accessible) while those highlighted in red represent deteriorating conditions (i.e. an increase in travel time).

Average number of jobs accessible by auto and transit

Measure	TAZ Category	2045 E+C Scenario	2045 PA Scenario	Percent Change (E+C to PA)
Average number of jobs accessible by **auto** within 30 minutes	EJ TAZs	302,725	308,793	**2.0%**
	Non-EJ TAZs	249,532	253,534	**1.6%**
Average number of jobs accessible by **transit** within 60 minutes	EJ TAZs	47,340	49,126	**3.8%**
	Non-EJ TAZs	43,184	43,577	**0.9%**

EJ TAZs have a higher average number of jobs accessible by auto and transit in both the E+C and PA scenarios. The difference is particularly pronounced for auto, where the average number of jobs accessible to EJ TAZs exceeds that for non-EJ TAZs by more than 20% in both scenarios. There are far fewer jobs accessible by transit (within 60 minutes) than by auto (within 30 minutes) regardless of TAZ categorization or scenario.

Comparing results between scenarios, both EJ and non-EJ TAZs benefit from the implementation of the projects in *Maximize2045*. Average job accessibility by auto increases by 2.0% and 1.6% for persons living in EJ and non-EJ TAZs, respectively. For transit, the percent change for EJ TAZs outpaces that for non-EJ TAZs from the 2045 E+C scenario to the 2045 PA scenario. EJ TAZs see a 3.8% increase in the average number of jobs accessible by transit versus an increase of 0.9% in non-EJ TAZs.

Average number of shopping opportunities accessible by auto and transit

Measure	TAZ Category	2045 E+C Scenario	2045 PA Scenario	Percent Change (E+C to PA)
Average number of shopping opportunities accessible by **auto** within 30 minutes	EJ TAZs	247,669	254,041	**2.6%**
	Non-EJ TAZs	188,280	195,238	**3.7%**
Average number of shopping opportunities accessible by **transit** within 60 minutes	EJ TAZs	38,622	40,589	**5.1%**
	Non-EJ Tazs	22,256	23,037	**3.5%**

The average number of shopping opportunities accessible by auto and transit is significantly greater in EJ TAZs versus non-EJ TAZs. Persons living in EJ TAZs have access to approximately 30% and 75% more shopping opportunities by auto and transit, respectively, regardless of scenario. Similar to job accessibility, auto access is significantly greater than transit access.

Shopping opportunities accessible by auto and transit are projected to increase from the 2045 E+C scenario to the 2045 PA scenario. For auto, EJ and non-EJ TAZs see increases of 2.6% and 3.7%, respectively. Transit access to shopping opportunities increases by 5.1% and 3.5%, respectively, for EJ and non-EJ TAZs.

Average commute time by auto and transit

Measure	TAZ Category	2045 E+C Scenario	2045 PA Scenario	Percent Change (E+C to PA)
Average commute time by **auto** (minutes)	EJ TAZs	24.5	24.7	**0.7%**
	Non-EJ TAZs	30.8	30.7	**– 0.5%**
Average commute time by **transit** (minutes)	EJ TAZs	56.0	55.8	**– 0.2%**
	Non-EJ TAZs	63.4	63.4	**0.0%**

Average commute times for EJ TAZs are lower than those for non-EJ TAZs across both modes and scenarios. Auto commute times are 24.5 and 24.7 minutes for EJ TAZs while those for non-EJ TAZs are approximately 25% longer at just over 30 minutes. Auto commute times remain essentially flat from the E+C to the PA scenario. The average commute time in EJ TAZs increases by 0.7% while the commute time in non-EJ TAZs decreases by 0.5%.

Average transit commute times are significantly longer than those for auto across both TAZ categories and scenarios. However, EJ TAZs have lower average transit commute times as compared to non-EJ TAZs. As with auto, average transit commute times do not change significantly from the E+C to the PA scenario. The average transit commute in EJ TAZs decreases by 0.2% while the average transit commute in non-EJ TAZs does not change.

Average travel time for shopping purposes by auto and transit

Measure	TAZ Category	2045 E+C Scenario	2045 PA Scenario	Percent Change (E+C to PA)
Average travel time for shopping purposes by **auto** (minutes)	EJ TAZs	14.0	14.0	**0.0%**
	Non-EJ TAZs	14.1	13.9	**– 1.5%**
Average travel time for shopping purposes by **transit** (minutes)	EJ TAZs	43.8	43.6	**– 0.3%**
	Non-EJ TAZs	46.2	46.0	**– 0.5%**

Average travel times for shopping purposes by auto for the 2045 E+C scenario are approximately 14 minutes for both EJ and non-EJ TAZs. These times remain almost unchanged in the 2045 PA scenario. EJ TAZs see no change while the average travel time in non-EJ TAZs decreases by 1.5%.

Average travel times for shopping purposes by transit are approximately two minutes shorter for EJ TAZs as compared to non-EJ TAZs. Both TAZ categories see slight decreases in transit travel times in the 2045 PA scenario. The average travel time decreases by 0.3% in EJ TAZs and by 0.5% in non-EJ TAZs.

Average travel time to closest hospital by auto and transit

Measure	TAZ Category	2045 E+C Scenario	2045 PA Scenario	Percent Change (E+C to PA)
Average travel time to closest hospital by **auto** (minutes)	EJ TAZs	10.3	10.1	**– 1.3%**
	Non-EJ TAZs	15.7	15.3	**– 2.0%**
Average travel time to closest hospital by **transit** (minutes)	EJ TAZs	45.6	45.2	**– 0.7%**
	Non-EJ TAZs	57.1	56.4	**– 1.3%**

Average travel times to the closest hospital for EJ TAZs are lower than those for non-EJ TAZs across both modes and scenarios. Auto travel times for EJ TAZs are projected to decrease from 10.3 minutes in the E+C scenario to 10.1 minutes in the PA scenario, a decrease of 1.3%. Non-EJ travel times to the closest hospital decrease from 15.7 minutes to 15.3 minutes, a projected decrease of 2.0%.

As with average commute and shopping travel times, average travel times to the closest hospital are significantly longer for transit than they are for auto. However, transit travel times for EJ TAZs are approximately 20% lower than those for non-EJ TAZs in both scenarios. Average transit travel times to the closest hospital decrease slightly in EJ and non-EJ TAZs, with decreases of 0.7% and 1.3%, respectively.

Percent of population close to a supermarket by auto and transit

Measure	Time	TAZ Category	2045 E+C Scenario	2045 PA Scenario	Percent Change (E+C to PA)
Percent of population within 15, 30, 45, and 60 minutes of the closest supermarket by **auto**	15 min	EJ TAZs	99.7%	99.7%	**0.0%**
		Non-EJ TAZs	97.1%	97.6%	**0.5%**
	30 min	EJ TAZs	100.0%	100.0%	**0.0%**
		Non-EJ TAZs	99.3%	99.3%	**0.0%**
	45 min	EJ TAZs	100.0%	100.0%	**0.0%**
		Non-EJ TAZs	99.3%	99.3%	**0.0%**
	60 min	EJ TAZs	100.0%	100.0%	**0.0%**
		Non-EJ TAZs	100.0%	100.0%	**0.0%**
Percent of population within 15, 30, 45, and 60 minutes of the closest supermarket by **transit**	15 min	EJ TAZs	7.1%	7.1%	**0.0%**
		Non-EJ TAZs	2.1%	1.9%	**– 11.1%**
	30 min	EJ TAZs	62.7%	62.5%	**– 0.2%**
		Non-EJ TAZs	33.4%	34.0%	**1.7%**
	45 min	EJ TAZs	85.68%	85.75%	**0.1%**
		Non-EJ TAZs	55.3%	55.4%	**0.1%**
	60 min	EJ TAZs	92.0%	92.4%	**0.4%**
		Non-EJ TAZs	59.4%	59.6%	**0.5%**

Auto access to a supermarket in the Baltimore region is uniformly good. Nearly 100% of the population is within a 15-minute drive regardless of scenario. 99.7% of the population in EJ TAZs is within a 15-minute drive and 100% is within the remaining drive lengths. For non-EJ TAZs, more than 97% of the population is within a 15-minute drive, more than 99% is within a 30-minute drive, and 100% is within a 45 or 60-minute drive.

Transit results are more mixed than those for auto. EJ TAZs have consistently higher percentages than those for non-EJ TAZs, but access remains significantly less than that for auto. Approximately 7% and 2% of the population in EJ and non-EJ TAZs, respectively, is within a 15-minute transit trip of the closest supermarket. Increasing the travel time to 30 minutes increases these percentages significantly to approximately 62.5% and 33.5%. Increasing the transit trip length to 60 minutes yields results of greater than 90% of the population in EJ TAZs and nearly 60% of the population in non-EJ TAZs.

The percentage of the population close to a supermarket by transit remains essentially unchanged from the 2045 E+C scenario to the 2045 PA scenario. The largest change is experienced by those in non-EJ TAZs, with the percent of the population within a 15-minute transit trip decreasing from 2.1% to 1.9%. This amounts to a decrease of 11.1%. The remaining percent changes are less than 2%.

Percent of population close to a hospital by auto and transit

Measure	Time	TAZ Category	2045 E+C Scenario	2045 PA Scenario	Percent Change (E+C to PA)
Percent of population within 15, 30, 45, and 60 minutes of the closest hospital by **auto**	15 min	EJ TAZs	84.0%	84.8%	**1.0%**
		Non-EJ TAZs	59.0%	61.4%	**3.9%**
	30 min	EJ TAZs	98.9%	99.2%	**0.3%**
		Non-EJ TAZs	93.3%	94.5%	**1.3%**
	45 min	EJ TAZs	99.5%	99.5%	**0.0%**
		Non-EJ TAZs	97.6%	97.5%	**– 0.1%**
	60 min	EJ TAZs	100.0%	100.0%	**0.0%**
		Non-EJ TAZs	99.3%	99.3%	**0.0%**
Percent of population within 15, 30, 45, and 60 minutes of the closest hospital by **transit**	15 min	EJ TAZs	3.1%	3.1%	**0.0%**
		Non-EJ TAZs	0.5%	0.5%	**0.0%**
	30 min	EJ TAZs	28.1%	28.1%	**0.0%**
		Non-EJ TAZs	8.75%	8.72%	**– 0.4%**
	45 min	EJ TAZs	56.8%	57.4%	**1.0%**
		Non-EJ TAZs	26.4%	26.8%	**1.4%**
	60 min	EJ TAZs	71.06%	71.13%	**0.1%**
		Non-EJ TAZs	39.2%	40.2%	**2.6%**

Similar to supermarket data, auto access to the closest hospital is relatively good throughout the Baltimore region. Approximately 85% and 60% of the population in EJ and non-EJ TAZs is within a 15-minute drive of the closest hospital. Increasing the drive time to 30 minutes increases access to approximately 99% and 94% of the population in EJ and non-EJ TAZs, respectively. Nearly 100% of the population is within a 45 and 60-minute drive time of the closest hospital regardless of TAZ categorization. The percentage of the population within the specified auto travel times increases slightly from the E+C to the PA scenario for 15 and 30-minute drive times. Forty-five and 60-minute drive time access remains essentially unchanged with the implementation of the preferred alternative.

EJ TAZs have consistently higher percentages within the specified transit travel times. The percentages of the population in EJ TAZs is approximately 6 times higher for 15-minute transit trips (3.1% vs. 0.5%), 3 times higher for 30 minutes, and approximately 2 times higher for 45 and 60-minute transit trips. However, transit access is once again significantly less than that for auto travel. Approximately 3.1% of the population in EJ TAZs is within a 15-minute transit trip of the closest hospital, while just 0.5% of the population in non-EJ TAZs meets this criteria. Percentages for EJ TAZs gradually increase to approximately 28%, 57% and 71% for the remaining transit travel times. Just 40% of the population in non-EJ TAZs is within a 60-minute transit trip of the closest hospital.

The percentage of the population close to a hospital by transit does not vary much between scenarios. The percentage of the population within 15 and 30-minute transit trips is nearly unchanged, while 45 and 60-minute transit trips see small increases of 2.6% or less.

Percent of population close to a college or university by auto and transit

Measure	Time	TAZ Category	2045 E+C Scenario	2045 PA Scenario	Percent Change (E+C to PA)
Percent of population within 15, 30, 45, and 60 minutes of the closest college or university by **auto**	15 min	EJ TAZs	81.8%	82.3%	**0.5%**
		Non-EJ TAZs	54.5%	54.7%	**0.5%**
	30 min	EJ TAZs	99.3%	99.4%	**0.1%**
		Non-EJ TAZs	92.6%	93.5%	**0.9%**
	45 min	EJ TAZs	99.5%	99.5%	**0.0%**
		Non-EJ TAZs	97.8%	97.3%	**– 0.5%**
	60 min	EJ TAZs	100.0%	100.0%	**0.0%**
		Non-EJ TAZs	99.3%	99.3%	**0.0%**
Percent of population within 15, 30, 45, and 60 minutes of the closest college or university by **transit**	15 min	EJ TAZs	3.2%	3.2%	**0.0%**
		Non-EJ TAZs	0.5%	0.5%	**0.0%**
	30 min	EJ TAZs	27.4%	27.4%	**0.0%**
		Non-EJ TAZs	10.6%	10.6%	**0.0%**
	45 min	EJ TAZs	54.4%	55.0%	**1.1%**
		Non-EJ TAZs	27.3%	28.2%	**3.3%**
	60 min	EJ TAZs	71.1%	71.4%	**0.4%**
		Non-EJ TAZs	37.4%	38.2%	**2.1%**

Auto access to the closest college or university is greater than 90% for travel times of 30 minutes or greater for the population in both TAZ categories. There is a sharper discrepancy between EJ and non-EJ TAZ results for 15-minute auto access. More than 80% of the population in EJ TAZs is within a 15-minute auto trip of the closest college or university while 54.5% and 54.7% of the population in non-EJ TAZs fits this criteria in the E+C and PA scenarios, respectively. Neither EJ nor non-EJ TAZs see appreciable changes in auto access to the closest college or university from the 2045 E+C scenario to the 2045 PA scenario. The percent of the population within the specified travel time increases slightly with the implementation of the plan for 15 and 30-minute auto trips. Forty-five and 60-minute auto trips do not change between scenarios with the exception of a slight decrease in non-EJ TAZs for a 45-minute auto trip.

Similar to the other closeness measures, the TAZ percentages for transit are significantly less than those for auto. EJ TAZs have consistently higher percentages as compared to non-EJ TAZs across all time thresholds and scenarios. The scale of the difference between EJ and non-EJ TAZs mirrors that for hospitals, with approximately 3% and 0.5% of the population in EJ and non-EJ TAZs within 15 minutes, increasing to approximately 71% and 38% of the population in EJ and non-EJ TAZs within 60 minutes. Once again, neither EJ nor non-EJ TAZs see large changes in transit access to the closest college or university when comparing results between scenarios. There is no change for short transit trips of 15 and 30 minutes. Percent changes for 45 and 60-minute transit trips are positive for both EJ and non-EJ TAZs, with non-EJ TAZs seeing slightly larger percentage increases.

Conclusion

The measures analyzed indicate that the surface transportation investments in *Maximize2045* should not have disproportionate impacts on EJ TAZs. The measures are discussed below in the order the results were presented above. They are grouped broadly into accessibility measures (jobs and shopping), travel time measures (commute, shopping purposes, closest hospital), and proximity measures (supermarket, hospital, college/university). The full results table appears after the conclusion section.

EJ TAZs have access to more jobs and shopping opportunities on average as compared to non-EJ TAZs across both scenarios. This holds for both auto and transit access. All TAZs see increases in accessibility with the implementation of the preferred alternative of *Maximize2045*. Percent increases are larger in EJ TAZs for all measures except for average shopping opportunities by auto, where EJ TAZs see an increase of 2.6% and non-EJ TAZs see an increase of 3.7%.

EJ TAZs have lower average travel times across nearly all measures including commute time, travel time for shopping purposes, and travel time to the closest hospital. The lone exception is average travel time for shopping purposes by auto. Implementation of the preferred alternative does not have a significant impact on average travel times in the region. This holds for both EJ and non-EJ TAZs. Average travel times change by 2.0% or less in either direction from the 2045 E+C scenario to the 2045 PA scenario.

Proximity to supermarkets, hospitals, and colleges/universities by auto is quite good throughout the Baltimore region. More than 90% of the population in EJ and non-EJ TAZs lives within a 30-minute auto trip of all of these important destinations. EJ TAZs have consistently higher percentages as compared to non-EJ TAZs. This is most pronounced for the percentage of the population within a 15-minute auto trip of a hospital and college/university. Greater than 80% of the population in EJ TAZs is within a 15-minute auto trip versus less than 62% in non-EJ TAZs. Implementation of the preferred alternative yields only small changes in the percentage of the population close to these destinations. All percent changes for auto are 1% or less except for two cases: percent of population within 15-and 30-minute auto trips to a hopsital in non-EJ TAZs.

Proximity to these important destinations by transit is significantly less than that for auto. EJ TAZs see higher percentages in close proximity to these destinations as compared to non-EJ TAZs. However, implementation of the preferred alternative once again yields only small changes in the percentage of the population close to supermarkets, hospitals, and colleges/universities by transit.

One trend that emerges is that auto access and mobility is uniformly better than that for transit. This holds for both EJ and non-EJ TAZs. For example, EJ TAZs are accessible to an average of 308,793 jobs in the preferred alternative scenario by auto versus 49,126 by transit. These numbers for non-EJ TAZs are 253,534 and 43,577, respectively.

It is also important to point out that the individual projects in *Maximize2045* have largely not yet gone through the required environmental approvals or design process. As a result, the scope and limits of these projects could change. In addition, all projects involving federal funds are required to include an Environmental Justice analysis as a part of the federal approval process.

Full Results: Environmental Justice Analysis

Maximize2045 EJ Analysis	2045 E+C Scenario		2045 PA Scenario		Percent Change (E+C to PA)	
Measure	**EJ TAZs**	**Non-EJ TAZs**	**EJ TAZs**	**Non-EJ TAZs**	EJ TAZs	**Non-EJ TAZs**
Average number of jobs accessible by **auto** within 30 minutes	302,725	249,532	308,793	253,534	**2.0%**	**1.6%**
Average number of jobs accessible by **transit** within 60 minutes	47,340	43,184	49,126	43,577	**3.8%**	**0.9%**
Average number of shopping opportunities accessible by **auto** within 30 minutes	247,669	188,280	254,041	195,238	**2.6%**	**3.7%**
Average number of shopping opportunities accessible by **transit** within 60 minutes	38,622	22,256	40,589	23,037	**5.1%**	**3.5%**
Average commute time by **auto**	24.5	30.8	24.7	30.7	**0.7%**	**– 0.5%**
Average commute time by **transit**	56.0	63.4	55.8	63.4	**– 0.2%**	**0.0%**
Average travel time for shopping purposes by **auto**	14.0	14.1	14.0	13.9	**0.0%**	**– 1.5%**
Average travel time for shopping purposes by **transit**	43.8	46.2	43.6	46.0	**– 0.3%**	**– 0.5%**
Average travel time to closest hospital by **auto**	10.3	15.7	10.1	15.3	**– 1.3%**	**– 2.0%**
Average travel time to closest hospital by **transit**	45.6	57.1	45.2	56.4	**– 0.7%**	**– 1.3%**

EJ TAZs have access to more jobs and shopping opportunities on average as compared to non-EJ TAZs across both scenarios.

***Maximize2045* EJ Analysis**					
Measure	Time	**TAZ Category**	**2045 E+C Scenario**	**2045 PA Scenario**	**Percent Change (E+C to PA)**
Percent of population within 15, 30, 45, and 60 minutes of the closest supermarket by **auto**	15 min	EJ TAZs	99.7%	99.7%	**0.0%**
		Non-EJ TAZs	97.1%	97.6%	**0.5%**
	30 min	EJ TAZs	100.0%	100.0%	**0.0%**
		Non-EJ TAZs	99.3%	99.3%	**0.0%**
	45 min	EJ TAZs	100.0%	100.0%	**0.0%**
		Non-EJ TAZs	99.3%	99.3%	**0.0%**
	60 min	EJ TAZs	100.0%	100.0%	**0.0%**
		Non-EJ TAZs	100.0%	100.0%	**0.0%**
Percent of population within 15, 30, 45, and 60 minutes of the closest supermarket by **transit**	15 min	EJ TAZs	7.1%	7.1%	**0.0%**
		Non-EJ TAZs	2.1%	1.9%	**– 11.1%**
	30 min	EJ TAZs	62.7%	62.5%	**– 0.2%**
		Non-EJ TAZs	33.4%	34.0%	**1.7%**
	45 min	EJ TAZs	85.68%	85.75%	**0.1%**
		Non-EJ TAZs	55.3%	55.4%	**0.1%**
	60 min	EJ TAZs	92.0%	92.4%	**0.4%**
		Non-EJ TAZs	59.4%	59.6%	**0.5%**
Percent of population within 15, 30, 45, and 60 minutes of the closest hospital by **auto**	15 min	EJ TAZs	84.0%	84.8%	**1.0%**
		Non-EJ TAZs	59.0%	61.4%	**3.9%**
	30 min	EJ TAZs	98.9%	99.2%	**0.3%**
		Non-EJ TAZs	93.3%	94.5%	**1.3%**
	45 min	EJ TAZs	99.5%	99.5%	**0.0%**
		Non-EJ TAZs	97.6%	97.5%	**– 0.1%**
	60 min	EJ TAZs	100.0%	100.0%	**0.0%**
		Non-EJ TAZs	99.3%	99.3%	**0.0%**

Maximize2045 EJ Analysis					
Measure	Time	**TAZ Category**	**2045 E+C Scenario**	**2045 PA Scenario**	**Percent Change (E+C to PA)**
Percent of population within 15, 30, 45, and 60 minutes of the closest hospital by **transit**	15 min	EJ TAZs	3.1%	3.1%	**0.0%**
		Non-EJ TAZs	0.5%	0.5%	**0.0%**
	30 min	EJ TAZs	28.1%	28.1%	**0.0%**
		Non-EJ TAZs	8.75%	8.72%	**– 0.4%**
	45 min	EJ TAZs	56.8%	57.4%	**1.0%**
		Non-EJ TAZs	26.4%	26.8%	**1.4%**
	60 min	EJ TAZs	71.06%	71.13%	**0.1%**
		Non-EJ TAZs	39.2%	40.2%	**2.6%**
Percent of population within 15, 30, 45, and 60 minutes of the closest college or university by **auto**	15 min	EJ TAZs	81.8%	82.3%	**0.5%**
		Non-EJ TAZs	54.5%	54.7%	**0.5%**
	30 min	EJ TAZs	99.3%	99.4%	**0.1%**
		Non-EJ TAZs	92.6%	93.5%	**0.9%**
	45 min	EJ TAZs	99.5%	99.5%	**0.0%**
		Non-EJ TAZs	97.8%	97.3%	**– 0.5%**
	60 min	EJ TAZs	100.0%	100.0%	**0.0%**
		Non-EJ TAZs	99.3%	99.3%	**0.0%**
Percent of population within 15, 30, 45, and 60 minutes of the closest college or university by **transit**	15 min	EJ TAZs	3.2%	3.2%	**0.0%**
		Non-EJ TAZs	0.5%	0.5%	**0.0%**
	30 min	EJ TAZs	27.4%	27.4%	**0.0%**
		Non-EJ TAZs	10.6%	10.6%	**0.0%**
	45 min	EJ TAZs	54.4%	55.0%	**1.1%**
		Non-EJ TAZs	27.3%	28.2%	**3.3%**
	60 min	EJ TAZs	71.1%	71.4%	**0.4%**
		Non-EJ TAZs	37.4%	38.2%	**2.1%**

Potential Effects of Preferred Alternative – Natural and Cultural Resources

When agencies collaborate in their planning for the natural, cultural, and community context of the transportation system, it can lead to better results. Collaboration can lead to the avoidance or minimization of impacts to important resources, improved procedures for mitigation on a regional basis, fewer project delays and avoidance of repeated consultations, added trust among stakeholders, and, ultimately, better transportation solutions and environmental outcomes.

The FAST Act and MAP-21 (and their corresponding implementing regulations) include legal requirements for coordination with resource agencies during planning. These requirements state that planning agencies (such as MPOs) should consult with federal, state, and local agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation as part of the development of the long-range transportation plan. These consultations are expected to involve a comparison of transportation plans with conservation plans, maps, and inventories of natural, cultural, and historic resources. Additionally, the FAST Act and MAP-21 require MPO plans to include a discussion of potential environmental mitigation activities and potential areas to carry out mitigation activities based on this resource agency consultation.

The BRTB understands the potential benefits of effective coordination with resource agencies during planning. For *Maximize2045*, the BRTB has built on the previous consultation process performed for the *Maximize2040* plan. For *Maximize2045*, the environmental coordination process involved updated mapping data and further communication. The goals of this coordination are to:

- determine potential mitigation areas and types
- enhance the linkage between long-range transportation planning and the NEPA process.

The BRTB continues to be involved in the Interagency Review meetings, hosted by MDOT SHA and involving the resource and regulatory agencies, in order to understand and discuss potential impacts of projects that are at all stages of planning and design. These meetings provide an opportunity for the BRTB to share projects that are very early in the planning stages with the resource and regulatory agencies. As agencies are exposed to the location and magnitude of proposed projects, an appropriate strategy can be developed that provides benefits beyond the impact of an individual activity.

Consultation to Improve Environmental Impact Mitigation

In developing this plan, the BRTB has consulted with federal, state, and local agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation (concerning plan development). During this consultation process, involved agencies were provided opportunities for coordination at an MDOT SHA-led interagency review meeting in March 2019, emails, and the online interactive mapping application. The online interactive mapping application was created to enable staff to conduct a broad analysis comparing proposed projects with resources in the area. The following resources have been mapped with the proposed projects and shared with coordinating agencies:

- Maryland Department of Natural Resources Protected Lands (Maryland Agricultural Land Preservation Foundation Districts, Rural Legacy Areas, Maryland Environmental Trust Easements, Forest Legacy Easements, DNR Lands, County Parks, Federal Lands, Private Conservation Properties)
- Greenways
- Maryland Green Infrastructure Network
- Chesapeake Bay Critical Area
- Impaired Watersheds
- National Register of Historic Places
- Maryland Inventory of Historic Properties

- Maryland Department of Planning Land Use / Land Cover Data
- Sensitive Species Project Review Areas
- Wetlands of Special State Concern
- Sea Level Rise

Through these comparisons, and ongoing conversations with resource/regulatory agencies, this environmental consultation process creates the opportunity to bring issues to light in advance of project planning. Analysis of natural and historic resources becomes very detailed at the short-range project planning level, so it is important to provide an opportunity for broad-based discussions of resources during long-range transportation planning that considers all proposed projects.

In addition to the mapping information listed above, the U.S. Fish and Wildlife Service provides a web site: Information for Planning and Consultation (IPaC) available at https://ecos.fws.gov/ipac/. IPaC is a tool designed to streamline the FWS review process of projects. It has the ability to provide an initial project scoping of threatened or endangered species, critical habitat, migratory birds or other natural resources. This service will be explored further in the future in regard to long range transportation planning. Mapping of the National Wetlands Inventory with plan projects will be explored in the future as well.

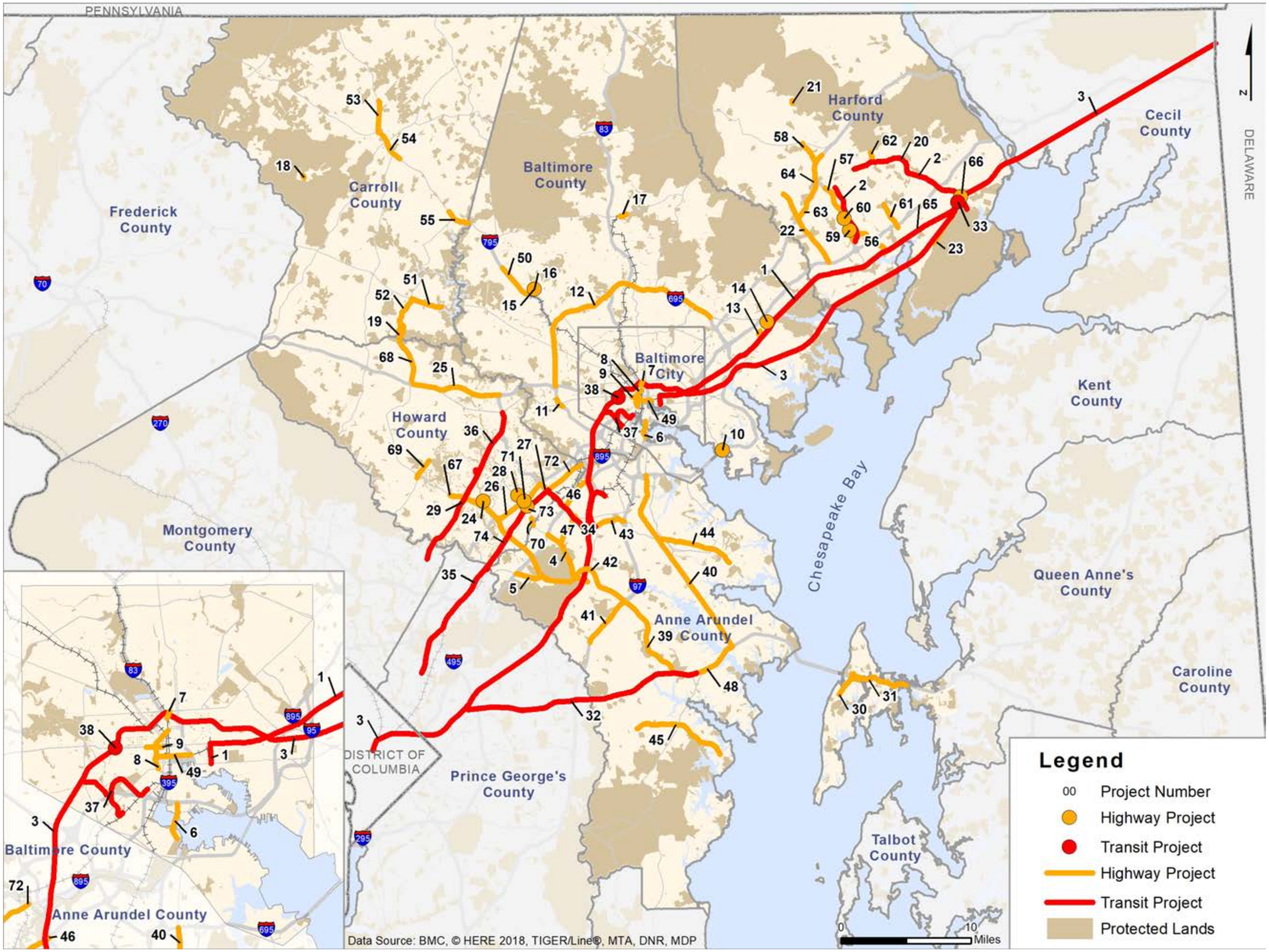
U.S. Fish and Wildlife Service regional priorities include the following:

1. Use of Landscape Conservation to conserve suites of species and their watersheds from a landscape perspective
2. Use of Aquatic Connectivity to provide for passage of aquatic species, community protection, and enhanced recreational opportunities

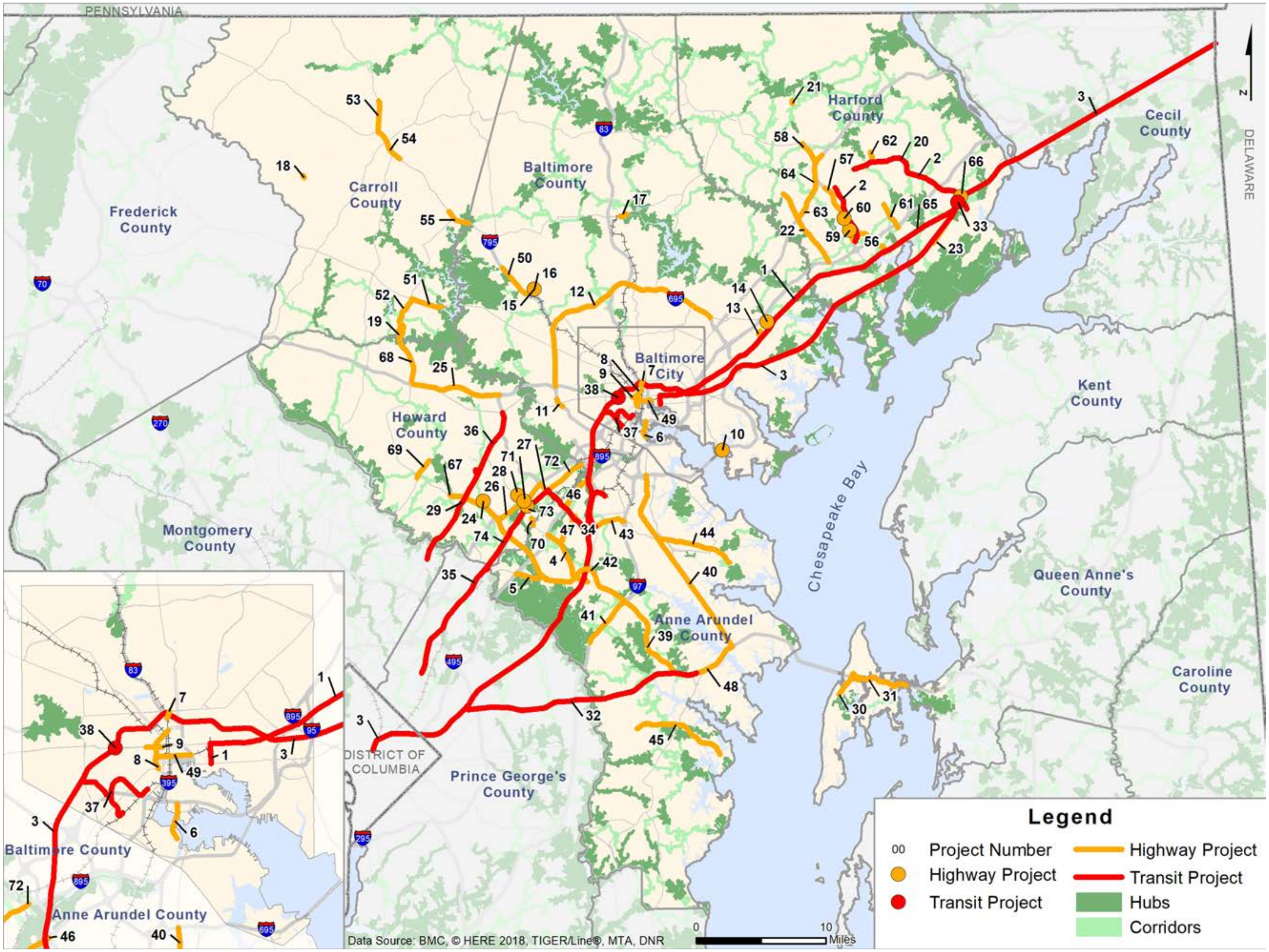
3. Use of new and developing planning tools, adaptive management, and partnerships with states to proactively address threats, help at-risk species, and avoid the need to list these species under the Endangered Species Act
4. Application of green and hybrid approaches to provide for a more resilient shoreline that better withstands storms, sea level rise, and other climate-related changes to provide more resilient habitat for wildlife, as well as protect communities and infrastructure.

The following maps have been created to assist the environmental coordination process. The maps, as shown here, display a comparison of highway and transit projects in the Preferred Alternative with resource data.

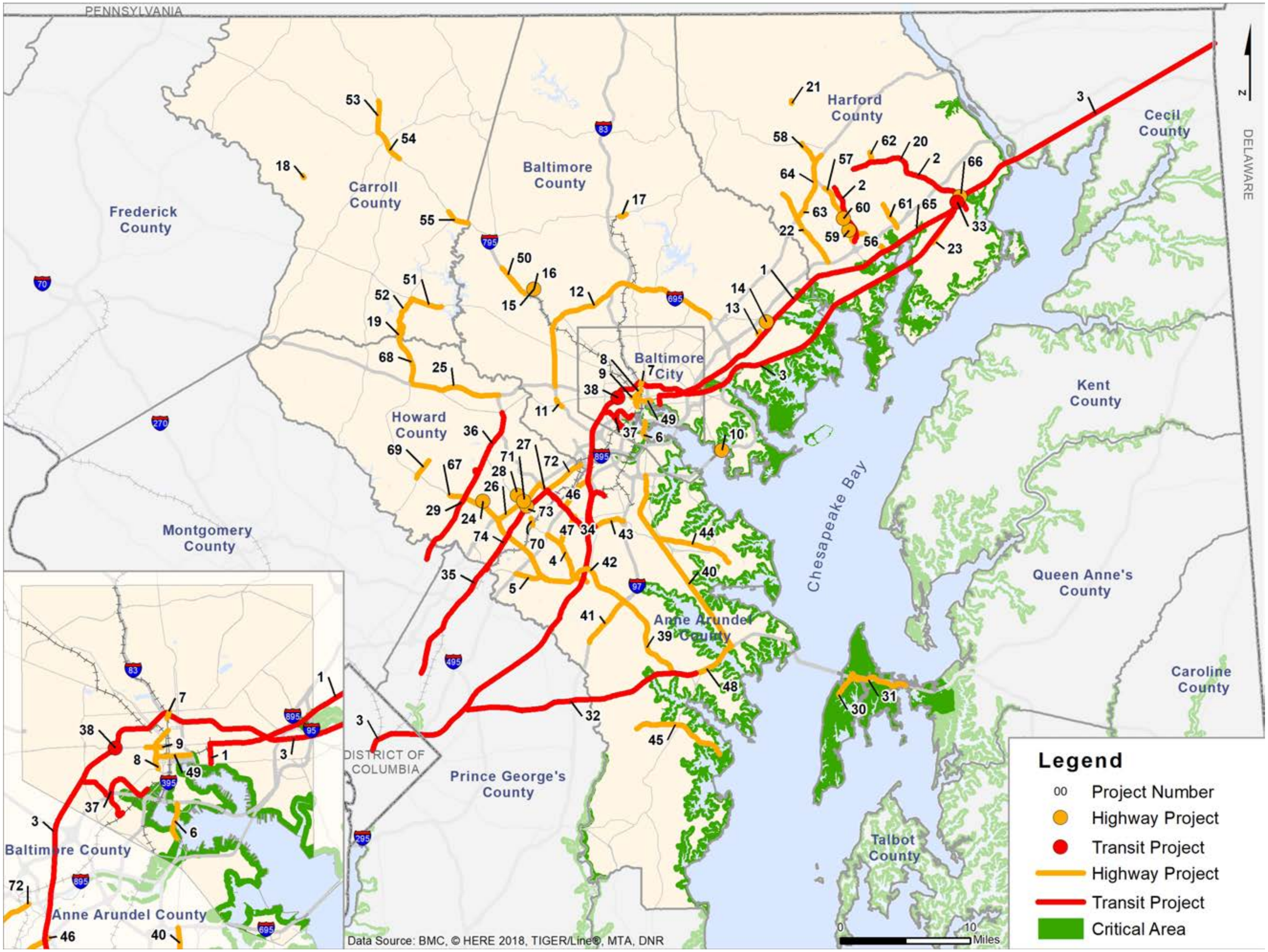
Protected Lands



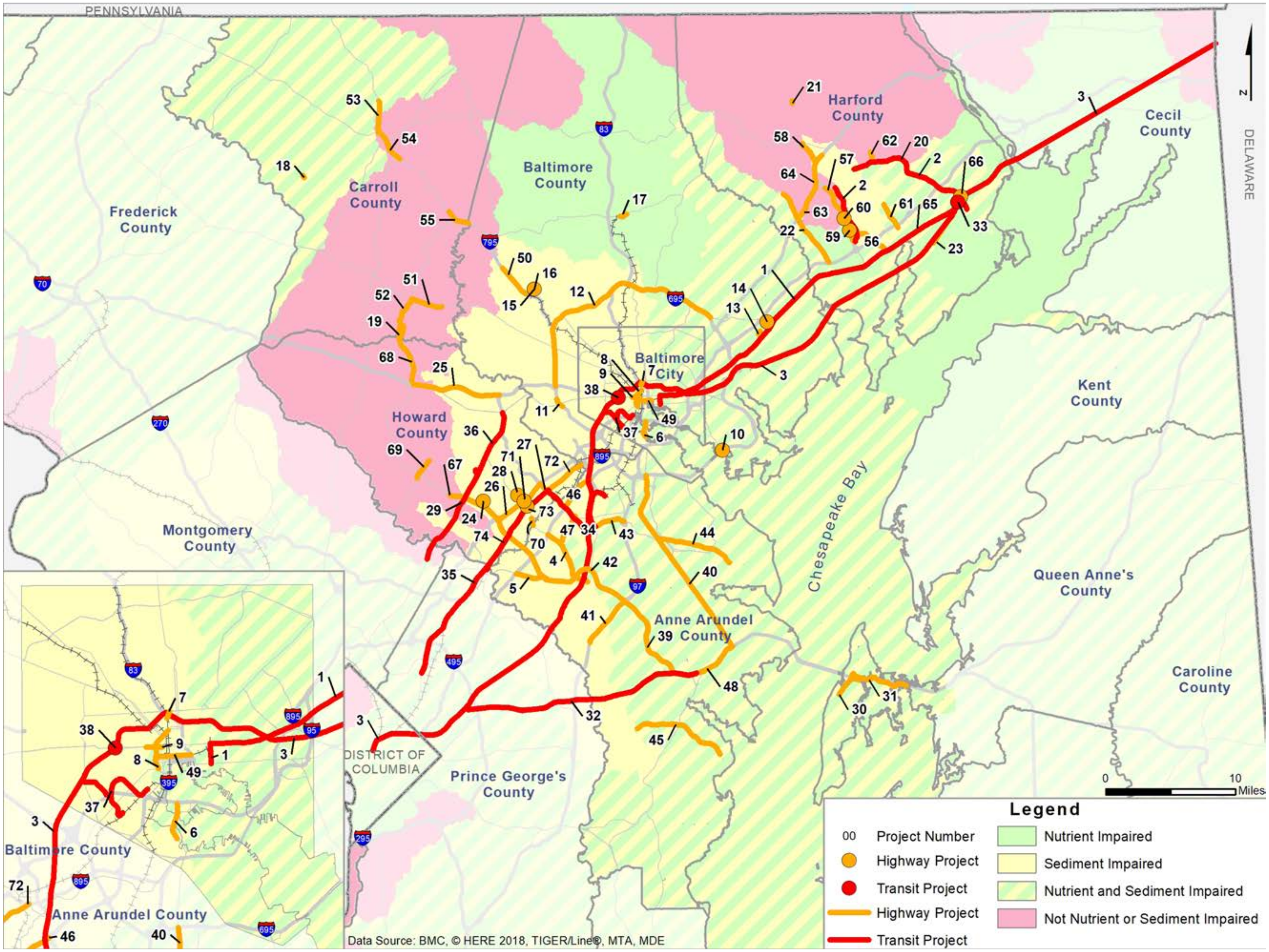
Green Infrastructure



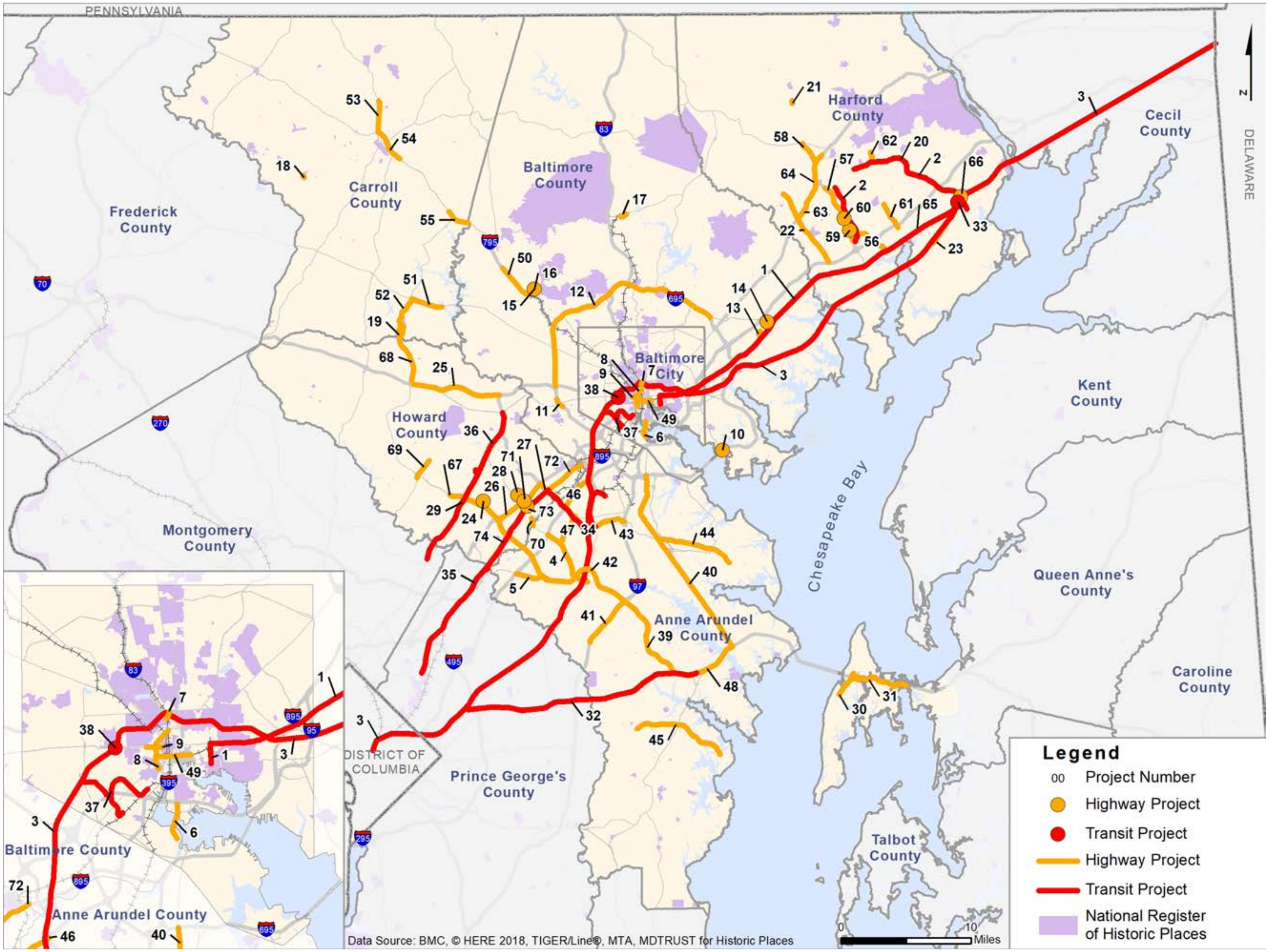
Chesapeake Bay Critical Area



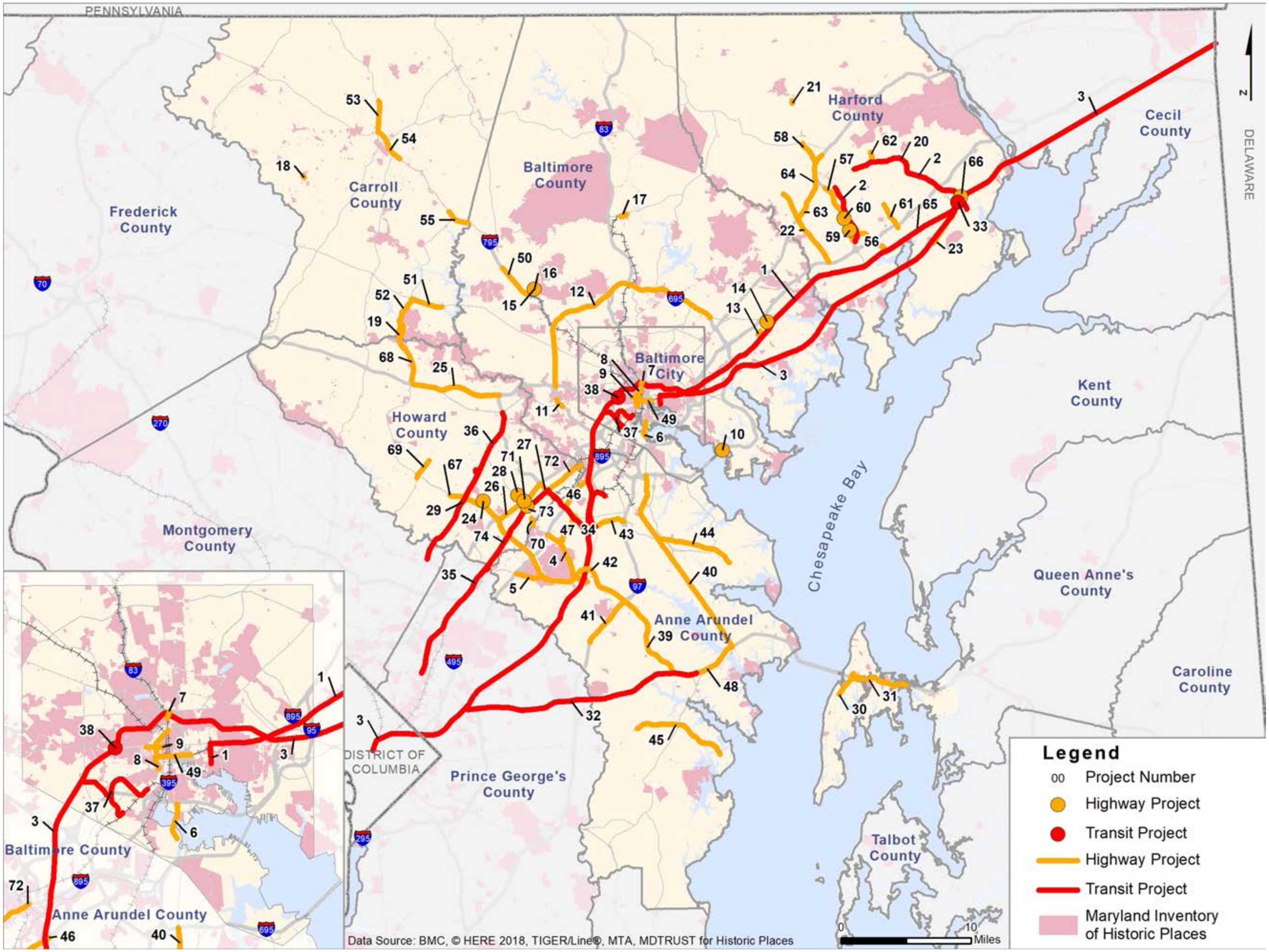
Impaired Watersheds



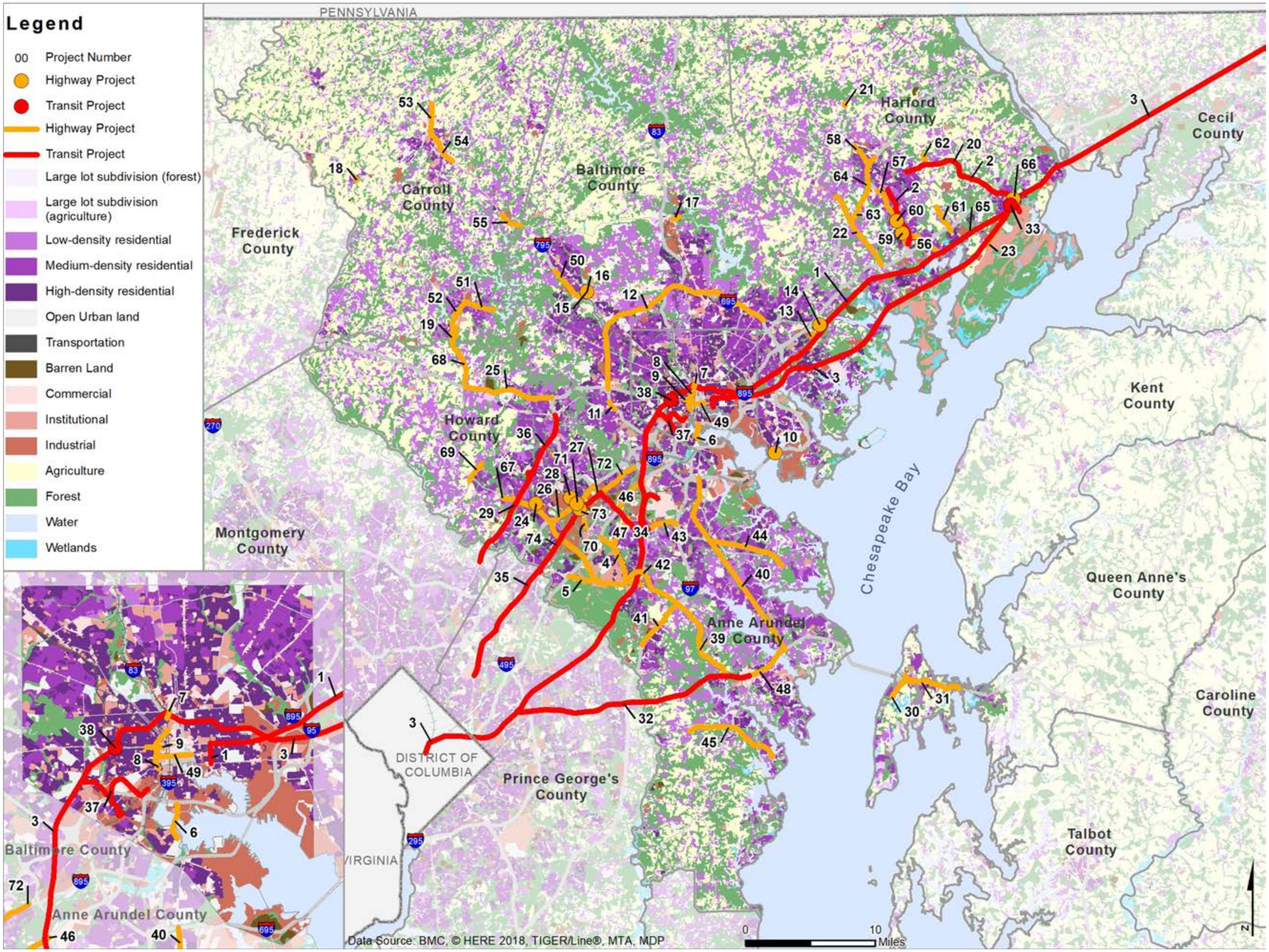
National Register of Historic Places



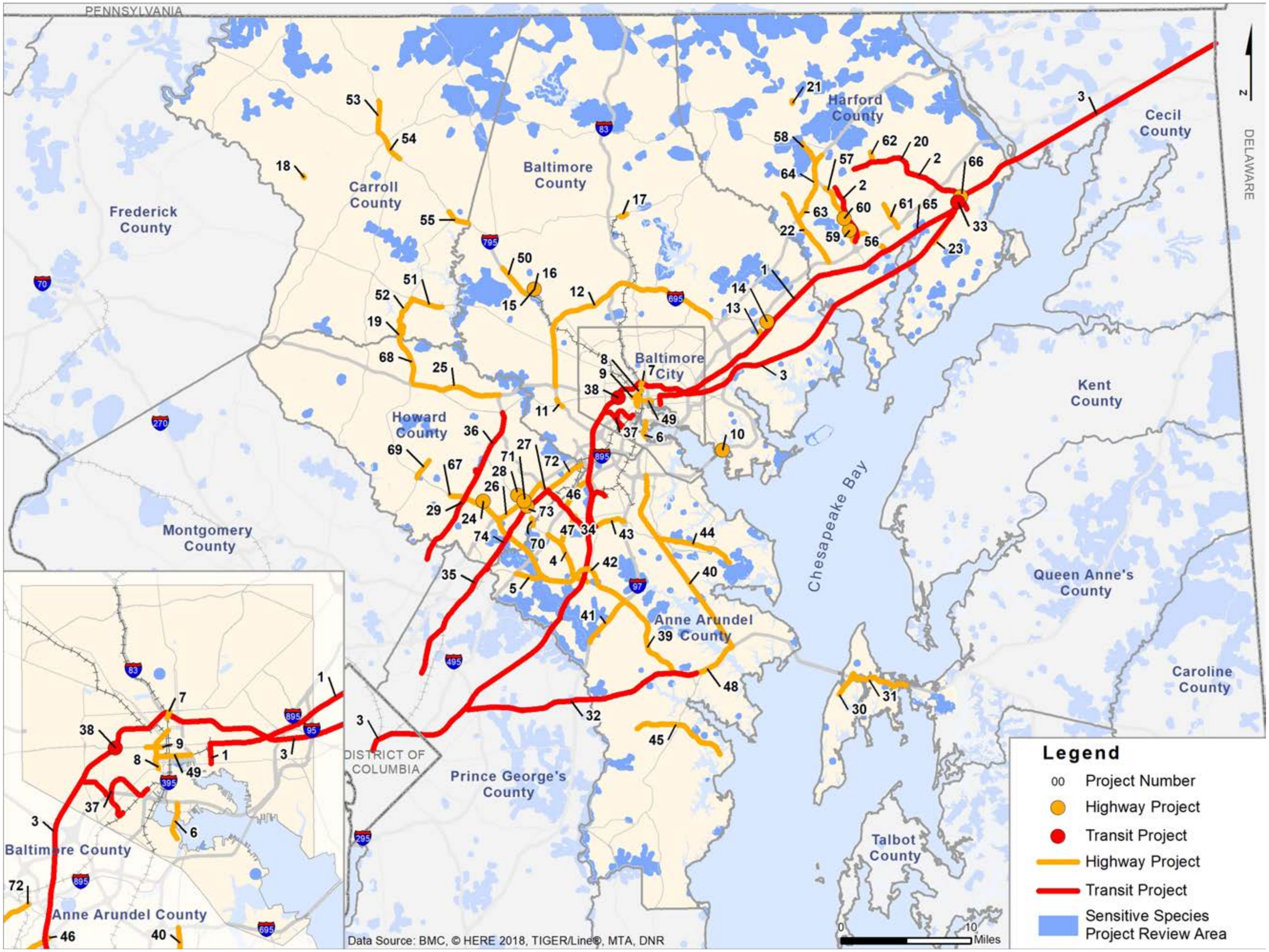
Maryland Inventory of HIstoric Properties



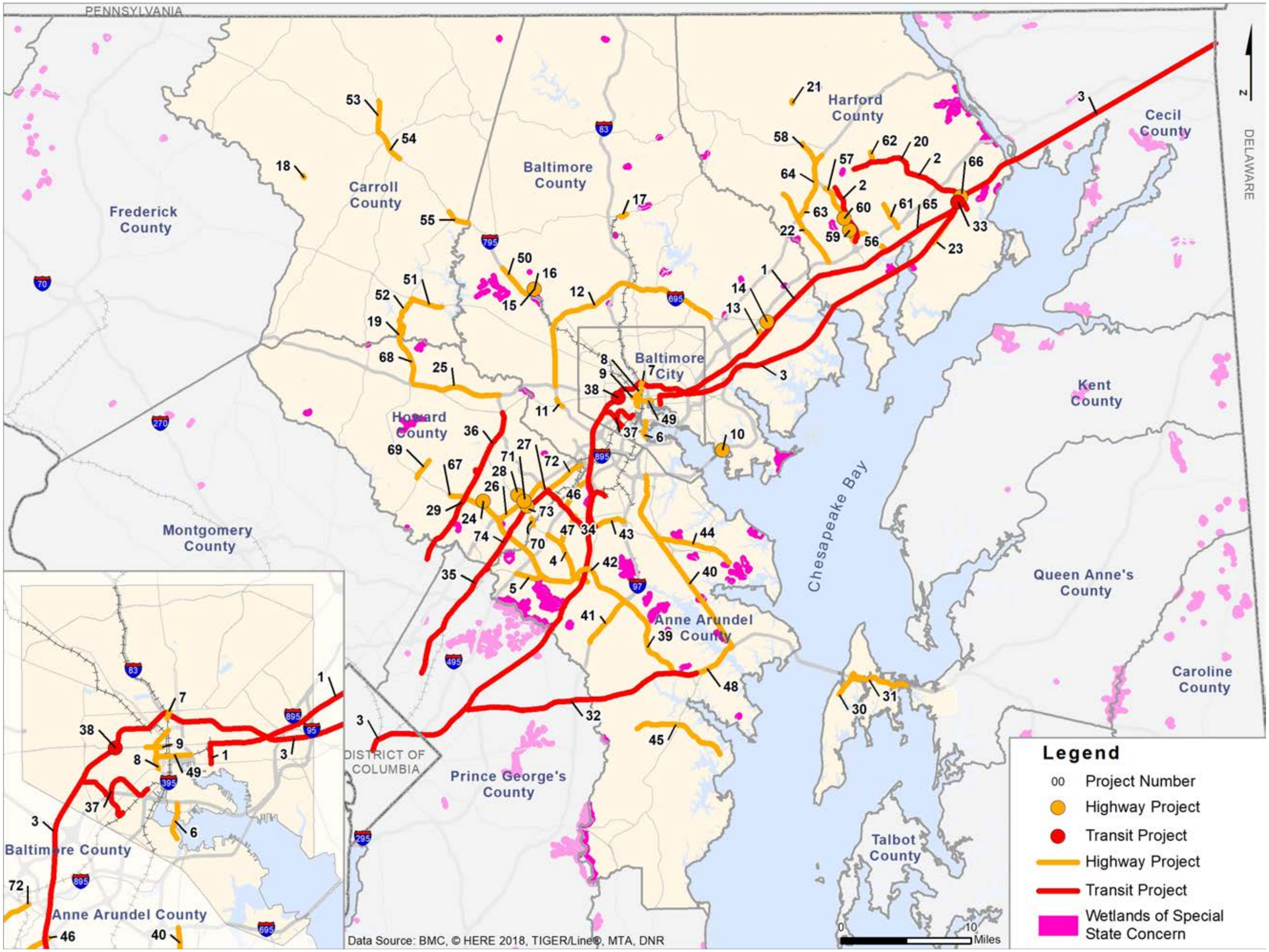
Land Use / Land Cover



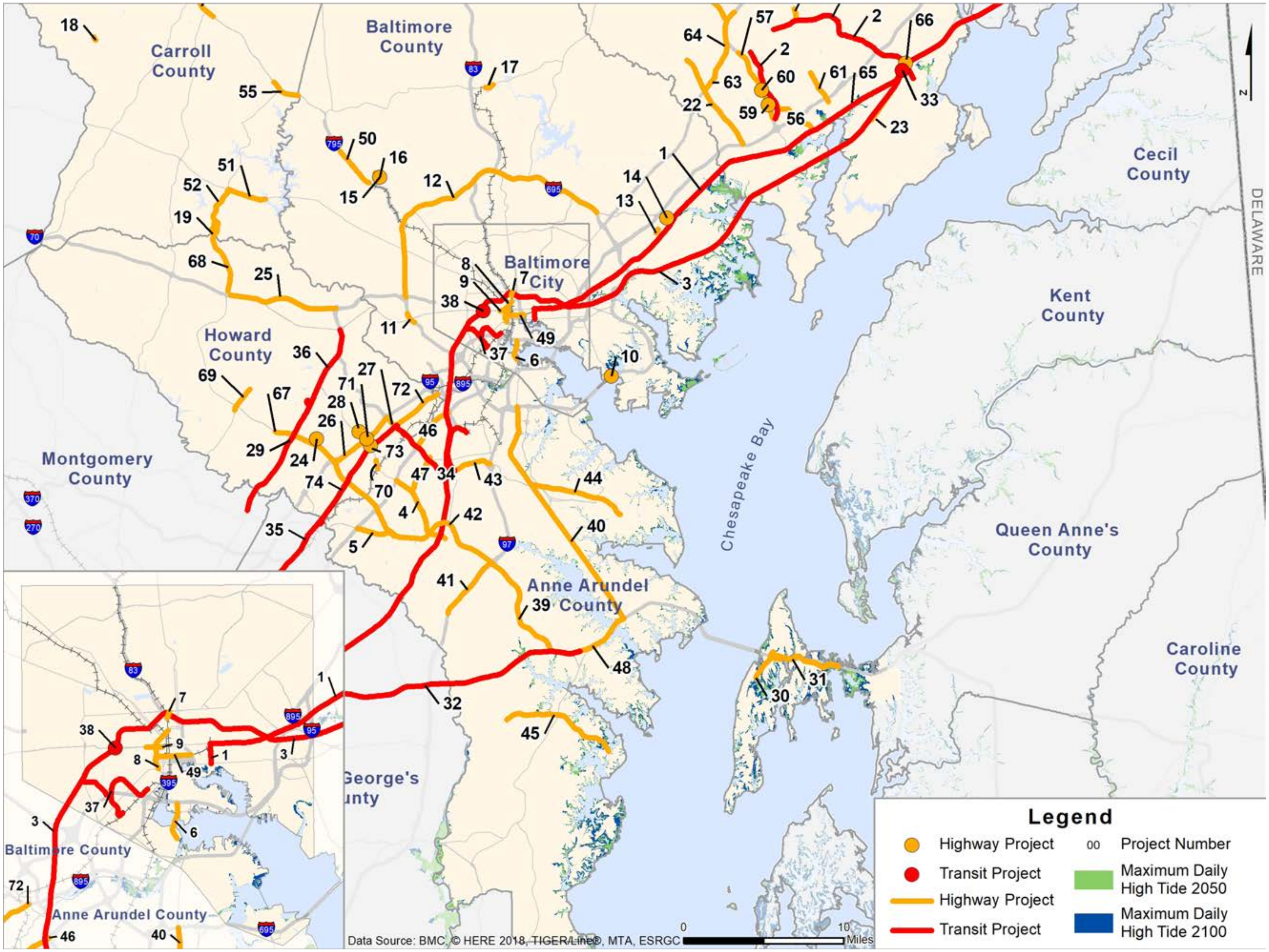
Sensitive Species Project Review Areas



Wetlands of Special State Concern



Sea Leve Rise – Coastal Areas



The project planning process, which involves NEPA, is heavily detailed and time consuming. Performing coordination and discussing regional mitigation opportunities ahead of time is meant to improve process efficiency and identify any regional mitigation goals. The environmental coordination process will continue through the partnerships that have been made during this analysis process. Bringing together environmental concerns and regional mitigation planning into the long-range planning process is the ultimate goal.

Specific Impact Mitigation Strategies and Measures

The purpose of considering mitigation early in the long-range planning process is to focus attention on regional level conservation and restoration needs. This focus provides a context in which subsequent decisions on specific mitigation concepts and strategies can be developed during the later project development process. The following table displays resource types along with corresponding legislation that provides protection and possible mitigation strategies and measures that could be applied during later project development.

Examples of Mitigation Measures

Resource	Examples of Mitigation Measures	Regulation
Parks and Recreation Areas	For publicly owned parks, replace land with land of equivalent value and equivalent location, replace impacted facilities, restore and landscape disturbed area.	Section 4(f) of the U.S. Department of Transportation Act
Wildlife and Waterfowl Refuges	For publicly owned refuges, replace land with land of equivalent value and equivalent location, incorporate habitat features.	Section 4(f) of the U.S. Department of Transportation Act
Cultural Resources	Preservation enhancement measures, context-sensitive design criteria, traditional and digital public historical interpretation, architectural recordation, impact avoidance through design, archaeological data recovery.	Section 4(f) of the U.S. Department of Transportation Act; Section 106 of the National Historic Preservation Act ; Maryland Historical Trust Act
Water Resources and Wetlands	Mitigation for wetland and waterway impacts includes creation, restoration, preservation, enhancement, or monetary compensation into an In-lieu Fee Program or the purchase of Bank credits. Site-specific stormwater management plans; low-impact development (LID) stormwater design; BMP tracking; stormwater discharge monitoring; design of stormwater management capacity for new and existing impervious surfaces; water quality banking program with MDE; sediment control during construction.	Rivers and Harbors Act of 1899; Clean Water Act; COMAR Title 26.17, Waterway Construction; COMAR Title 26.23, Nontidal Wetlands; COMAR Title 26.24, Tidal Wetlands; 2000 Maryland Stormwater Design Manual (with 2009 Environmental Site Design Revisions); Maryland Phase II Watershed Implementation Plan for the Chesapeake Bay TMDL

Examples of Mitigation Measures		
Resource	**Examples of Mitigation Measures**	**Regulation**
Endangered and Threatened Species	Mitigation may include placing conservation easements on properties occupied by the species, expanding/linking habitat areas through habitat creation areas, or enhancing low-quality habitat.	Endangered Species Act
Forests	Forest replacement on a 1:1 basis, for construction activities.	Maryland Reforestation Law, Forest Conservation Act
Chesapeake and Atlantic Coastal Bays Critical Area	Mitigation for impacts to the Critical Area may include planting or offsets for disturbance to forests and developed woodlands, the minimum 100-foot buffer, and stormwater management practices to reduce pollutants. For specifics, refer to applicable jurisdiction's local Critical Area program or existing Memorandum of Understanding for projects proposed by a state agency.	Critical Area Act (1984); COMAR 27
Nontidal Wetlands of Special State Concern	Mitigation for wetland impacts includes creation, restoration, preservation, enhancement, or monetary compensation into an In-lieu Fee Program or the purchase of Bank credits. Acreage replacement ratios vary depending on wetland and mitigation type.	COMAR 26.23.06.01-.02
Prime Farmland Soils	A farmland conversion impact rating form is completed for major capital projects. The resulting score is intended for use as an indicator for the project sponsor to consider alternative sites if the potential adverse impacts on the farmland exceed the recommended allowable level.	Farmland Protection Policy Act

Mitigation of Natural Resource Impacts

When MDOT SHA is issued authorizations from the Maryland Department of the Environment (MDE) and the U.S. Army Corps of Engineers (COE) for activities that will cause unavoidable losses of wetlands, those impacts must be compensated for through wetland mitigation. Wetland mitigation is the creation, restoration, enhancement, and preservation of wetlands lost due to regulated maintenance and construction project activities. In order to meet the "no net loss" goals of MDE and the COE, MDOT SHA utilizes the "creation" technique. In addition, to overcome temporal wetland function loss and comply with regulatory wetland replacement ratios, MDOT SHA mitigates at a 2:1 ratio for shrub/scrub and forested wetlands, and at a 1:1 ratio for emergent wetlands for most impacts to wetlands by highway projects. The COE compensatory mitigation rule was approved in 2008. The rule establishes a preference hierarchy for mitigation options (i.e., mitigation bank credits, in-lieu fee program credits, and permittee-responsible mitigation projects). The permittee may use any of these three options to mitigate for project impacts. However, the COE preference is the use of mitigation banks.

Meeting the Chesapeake Bay TMDL

In 2010, the U.S. EPA issued a "pollution diet" or Total Maximum Daily Load (TMDL) for water draining into the Chesapeake Bay. With the TMDL, and the resulting Maryland Phase I and Phase II Watershed Implementation Plans (WIPs), caps were set on levels of phosphorus, nitrogen, and sediment going into watershed segments of the Bay. Through the use of the Phase I MS4 permits, MDE has required 10 large and medium local jurisdictions and MDOT SHA to provide "impervious restoration" by treating water pollution from 20 percent of impervious surfaces that were constructed prior to 2005 and received no stormwater runoff treatment. For MDOT SHA, this requirement is approximately 4,600 acres and is to be met by October 2020. The next Phase I permit is anticipated to continue this impervious restoration initiative, with another 15-20 percent restoration required by 2025.

In 2018, MDE issued Phase II MS4 general permits that also include the 20 percent impervious restoration condition to be met by 2025. The Phase II general permits cover both small municipal MS4s and State and Federal agencies. The other MDOT transportation business units. including MVA, MAA, MTA, MDTA, and MPA, are now also covered under the MS4 general permits and must adhere to the 20 percent restoration.

This level of required treatment led to a significant number of BMPs being developed by MDOT modal administrations and local jurisdictions. MDOT SHA has made dramatic progress in treating stormwater runoff. Existing MS4 impervious restoration BMPs are tracked using GIS tools and impacts to these facilities must be avoided or mitigated to maintain current and future levels of pollutant reductions.

Maryland recently released a draft Phase III WIP in April 2019, intended to establish a strategy for reaching reduction goals for Maryland's pollutant effluent to the Chesapeake Bay by 2025. Due to the increasing costs of maintaining current BMPs, the draft Phase III WIP proposes a requirement to be implemented in the fifth generation of MS4 Permits, for permit holders to annually restore two percent of their impervious surface areas that currently have little or no stormwater treatment.

Ongoing and Future MDOT SHA Mitigation Strategies

Moving forward, MDOT SHA is working closely with the state and federal review agencies, local planning groups, the business community, environmental organizations, the general public, and other stakeholders, engaging in several other wetland and stream impact mitigation strategies. The watershed approach, wetland banking, and advanced mitigation (mitigation constructed in advance of the highway improvements) and out-of-kind mitigation are just a few examples of what is anticipated. With the new mitigation rules in place, mitigation will be pursued earlier in the project development process, through a watershed approach, utilizing new tools such as the Watershed Resources Registry found at www.watershedresourcesregistry.com. The watershed approach is described below.

The watershed approach to compensatory mitigation is a flexible approach that encourages various partnerships among all state and federal review agencies, local planning and regional planning organizations, as well as the general public. This approach involves assessing the needs of the watershed in a comprehensive manner that allows planners and review agencies to determine the improvements that are most needed within a particular watershed and sub-watersheds. Areas targeted for improvement may include water quality and quantity, stormwater runoff, riparian buffer, stream restoration, wetland creation and restoration, wildlife habitat creation and restoration, fish passage reforestation, etc. The watershed approach balances the needs of the watershed by often using out-of-kind mitigation strategies that would be most beneficial based on those identified needs. By identifying the most needed improvements within a given watershed, MDOT SHA and its partners can create a priority ranking of mitigation strategies that can serve as a long-term plan for the overall improvement to the watershed. MDOT SHA is currently using the Watershed Resources Registry that includes DNR's Green Infrastructure Network and is consistent with FHWA's Eco-logical Approach to assess the improvement needs of the watersheds potentially impacted by highway projects.

Although not in the Baltimore region of Maryland, MDOT SHA used the watershed approach on large and complex projects such as the InterCounty Connector (ICC) in Montgomery and Prince Georges counties and the U.S. 301 Transportation Study in Charles County. Similar watershed approaches to mitigation are also employed on smaller projects in MDOT SHA's design and construction program.

Mitigation of Historic Resource Impacts

Cultural resources typically encountered during the highway development process may include buildings, historic districts, roadway structures such as bridges, and terrestrial or underwater archaeological sites dating to the precontact and historic era time periods. Mitigation measures may take many forms depending on the resource itself and the project's impact. Commonly used strategies include design refinement to ensure avoidance of impacts where possible, sensitivity and compatibility with historic contexts, the recovery of significant information through the excavation of archaeological sites, Historic American Buildings Survey (HABS) and Historical American Engineering Record (HAER) recordation, photo-documentation of buildings and building relocations, scholarly journal articles and "popular" historical reports for public enjoyment, as well as other outreach efforts designed to benefit school children and communities.

There are specific procedural requirements necessary for compliance with the National Historic Preservation Act and its implementing regulations found at 36CFR800, and the Maryland Historical Trust Act, that involve consideration of mitigation treatments to resolve adverse effects on National Register eligible or listed historic resources in the later stages of project planning. In general, mitigation strategies are context-specific; tailored to the specific resources and impacts after avoidance and minimization strategies are implemented; and developed in consultation with the Maryland Historical Trust, the Federal Highway Administration, the Advisory Council on Historic Preservation, and other consulting parties specified in the regulations. However, MDOT SHA does engage the agencies and stakeholders in discussions that explore opportunities for more programmatically oriented treatments that are sensitive to local and regional priorities as strategies for environmental stewardship.