TECHNICAL APPENDIX A
ENVIRONMENT

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Introduction

This appendix presents supplemental information for the Ecological Health chapter topics of climate change, water quality in local streams, restoring the Chesapeake Bay, potential impacts to watershed health from projected changes to impervious cover and forest cover (based on expected growth), and hazard and flood mitigation planning. More information is also provided for the Supporting Infrastructure chapter topic of protecting water quality for drinking water sources.

Climate Change Mitigation and Adaptation

In addition to developing climate action plans, Maryland and Howard County have taken other actions to address climate change mitigation and adaptation. Maryland established a Renewable Energy Portfolio Standard in 2004 that was amended in 2019 to set a goal of having 50% of the energy generated or sold in Maryland be from renewable sources, including 14.5% from solar by 2030 and up to 10% from offshore wind by 2025. Maryland also passed the Greenhouse Gas Emissions Reduction Act in 2009, with an update in 2016, that set a goal of reducing statewide greenhouse gas (GHG) emissions by a minimum of 60% from 2006 levels by 2031, while improving the State's economy and creating jobs. The State's Climate Solutions Now Act of 2022 increased this goal to reducing statewide GHG emissions by a minimum of 60% from 2006 levels by 2031 and to net-zero emissions by 2045.

Howard County issued an Executive Order in 2019 setting a goal to reduce GHG emissions from County government operations to 45% below 2010 levels by 2030 and to reach zero emissions by 2050. The Executive Order sets several objectives to meet this goal, including: meet 20% of the electricity demand for local government operations with distributed, renewable energy generation on County-owned properties by 2024; reduce on-road vehicle petroleum consumption by the County fleet by 20% by 2024; and reduce electricity consumption by government operations by 25% by June 2023. In 2022, a new Howard County Executive Order was issued increasing this goal to reduce GHG emissions from all public and private sectors in the County to 60% below 2005 levels by 2030 and to reach net-zero emissions by 2045

In 2019, Howard County became the first county in the nation to formally accept the United States Climate Alliance's Natural and Working Lands Challenge. That program commits communities to reduce GHG emissions and increase carbon sequestration in forests, farms, and other land, and to incorporate these strategies into GHG mitigation plans by 2020. The County is also a signatory to the "We Are Still In" declaration, a commitment from numerous communities, institutions, and businesses to continue to support the global pact to reduce emissions.

Water Quality in Local Streams

Water resources are linked together through the hydrologic cycle, which circulates water from the atmosphere to the land, groundwater, and surface water, and then back to the atmosphere. This linkage means that impacts on one water resource can have successive impacts on others.

Human activities can impact water resources by removing vegetation, disturbing and compacting the soil, and covering the land with impervious surfaces, such as buildings, roads, and parking lots. When the land's capacity to absorb and hold water is decreased, the water available for groundwater recharge is also decreased. In addition, the land generates more stormwater runoff, which flows at a faster rate into local streams.

These changes in groundwater recharge and runoff degrade water quality and habitat in local streams. Groundwater supplies the low flow or base flow in streams. As groundwater recharge decreases, groundwater levels drop, which subsequently lowers base flow levels in streams. If base flow levels drop too much, stream channels can dry up in times of low precipitation. Conversely, increased runoff flowing at a faster rate increases the frequency and magnitude of flooding and increases stream channel erosion. Increased channel erosion generates more sediment loading in the stream and undercuts banks, often toppling trees and other vegetation along the stream banks.

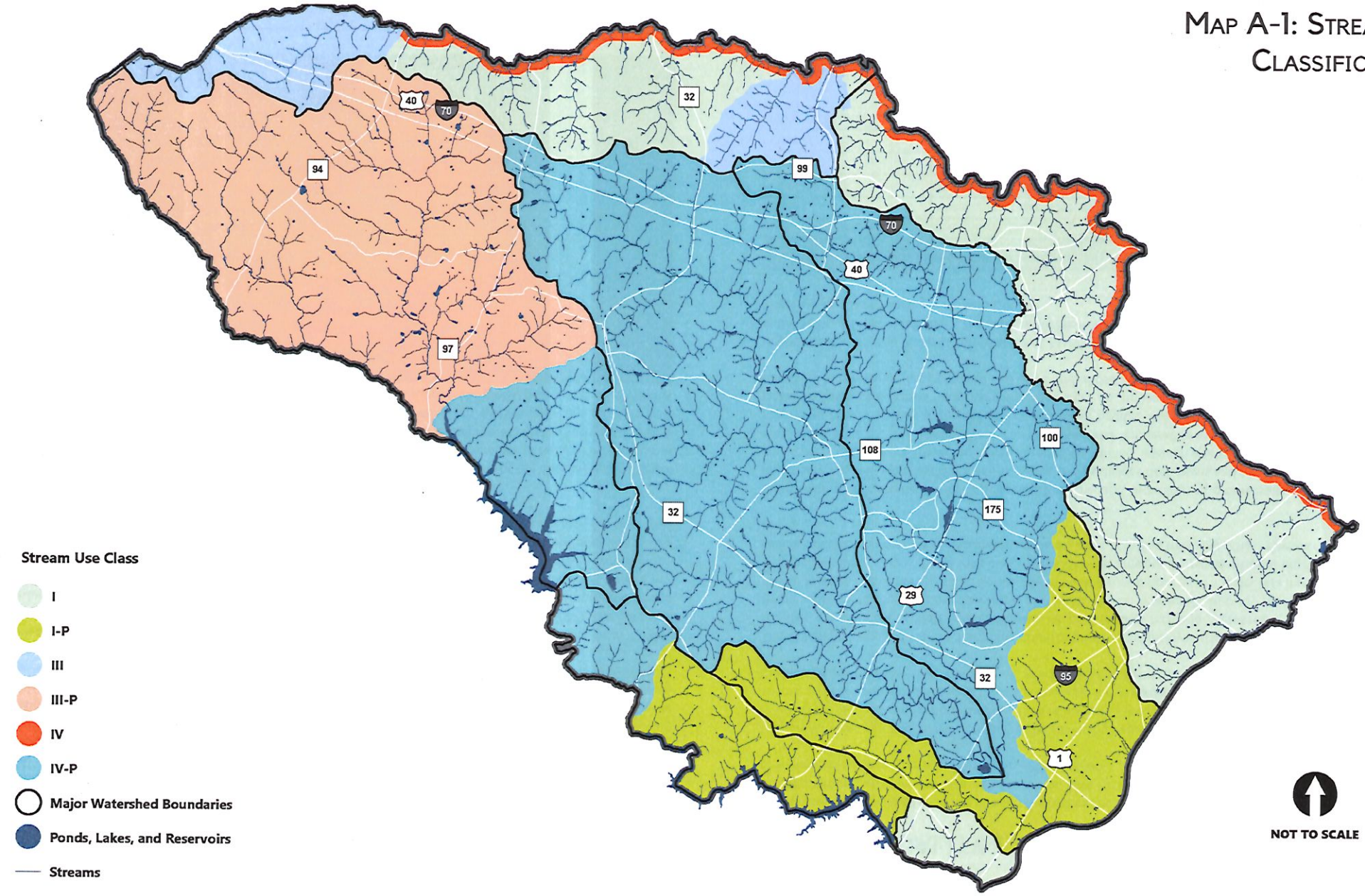
Stormwater runoff also carries many pollutants from the land, including: oil, grease, salts, and metals from roads and driveways; sediment, fertilizers, animal waste, and pesticides from lawns and agricultural fields; and nutrients and metals deposited from air pollution. In addition, during warmer weather runoff can pick up heat from impervious surfaces. This warmer runoff can raise the water temperature in nearby streams, which is particularly harmful to aquatic species that need cool or cold water habitat. This type of pollution is called nonpoint source pollution, because it comes from many diffuse sources on the land. This pollution degrades water quality and habitat in our wetlands, local streams, and lakes, and, subsequently, in the Chesapeake Bay.

In accordance with the federal Clean Water Act, Maryland has designated use classifications for all water bodies in the State, as listed in Table A-1. The use classifications for the streams in Howard County are shown in Map A-1. There are no Class II waters in Howard County.

Table A-1: Stream Use Classification

Use Classification	Designated Use
Class I	Water contact recreation and protection of nontidal warm water aquatic life
Class II	Support of estuarine and marine aquatic life and shellfish harvesting
Class III	Nontidal cold water (Natural trout waters)
Class IV	Recreational trout waters
Note: A "P" after a use classification number indicates an additional use for public water supply.	

Map A-1: Stream Use Classifications



Each use classification has specific water quality criteria for parameters such as bacteria, dissolved oxygen, pH, temperature, and turbidity. Baseline criteria are for Class I waters. The criteria are more stringent for certain parameters for Class II and IV waters, and Class III waters have the most stringent criteria. Many water bodies in Howard County and in Maryland do not meet State water quality standards for their use classification. However, there are also six Tier II stream segments in the County that have excellent water quality and habitat for aquatic life.

The County's Tier II stream segments are all located outside the Planned Service Area (PSA), as shown in Map A-2. In addition, a segment of the Patuxent River main stem is designated as a Tier II water in Anne Arundel County, so the main stem watershed in Howard County is a Tier II watershed. The State may designate additional Tier II waters as more information about stream conditions is collected.

The State determines whether a Tier II water has assimilative capacity to accept additional discharges without degrading water quality. Five of the six Tier II waters in the County have no assimilative capacity remaining, so there are additional steps required in the Tier II review process for a discharge permit. The Tier II review process applies to Water & Sewerage Master Plan amendments, wetland and waterway permits, and National Pollutant Discharge Elimination System permits issued under the federal Clean Water Act.

In 2001, the County initiated a long-term, countywide biological monitoring program to track water quality and habitat trends in local streams. The results of this sampling and sampling done by the Maryland Biological Stream Survey indicate stream water quality conditions range from very poor to good, and habitat conditions range from minimally degraded to severely degraded. Streams with lower water quality and habitat scores occur more often in the more developed areas of the County, where there is a higher level of impervious cover.

The Maryland Biological Stream Survey has identified watersheds that are the most important for the protection of Maryland's aquatic biodiversity. These Stronghold Watersheds have the highest numbers of rare, threatened, or endangered species of fish, amphibians, reptiles, or mussels. There are three Stronghold Watersheds in Howard County, as shown on Map A-2. The Stronghold Watershed within the Lower North Branch Patapsco River watershed is partially within the PSA, and the two Stronghold Watersheds within the Little Patuxent River watershed are fully within the PSA and include the Dorsey Run subwatershed.

Restoring the Chesapeake Bay

The Chesapeake Bay watershed covers more than 64,000 square miles and includes parts of six states—Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia—and the District of Columbia. Unfortunately, development within the watershed, particularly since t]he 1950s, degraded water quality and habitat in the Bay, leading to a decline in commercially important aquatic species, such as crabs, oysters, rockfish, and shad. The Bay suffers from excess sediment and nutrients (nitrogen and phosphorus) that rob the water of oxygen and light needed by underwater grasses, fish, and other aquatic life. The primary sources of these pollutants are runoff from urban, suburban, and agricultural lands; emissions from burning fossil fuels; and discharges from wastewater treatment plants, industrial plants, and septic systems.

Chesapeake Bay Agreements

In 1983, the US Environmental Protection Agency (EPA), Maryland, Virginia, Pennsylvania, and the District of Columbia signed the first Chesapeake Bay Agreement and began voluntarily working together to improve the health of the Bay. Subsequent agreements renewed and expanded that commitment, and the current 2014 Agreement adds Delaware, New York, and West Virginia as signatories.

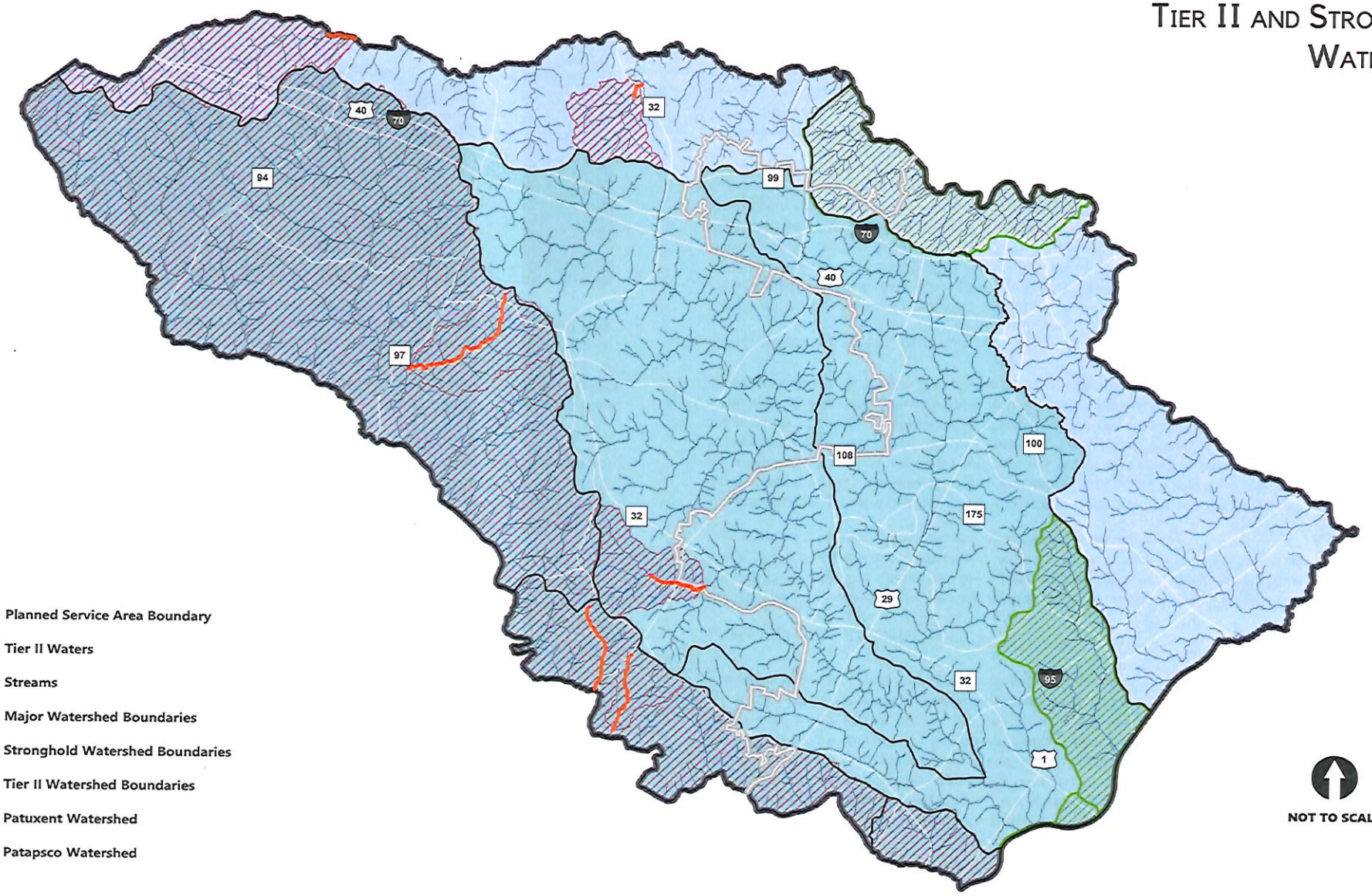
The 2000 Agreement set a deadline of 2010 to achieve water quality goals for the Bay. However, as the 2010 deadline approached, it became clear that voluntary efforts would not achieve Bay cleanup goals. The EPA determined that a stronger regulatory approach was required, as specified under the federal Clean Water Act. In response, the EPA developed the Chesapeake Bay Total Maximum Daily Loads (TMDLs), which set limits on the amounts of nitrogen, phosphorus, and sediment that can enter the Chesapeake Bay, to ensure the Bay meets water quality standards necessary to restore the Bay's ecology. These limits are significantly lower than the current pollution levels. The Bay TMDLs were finalized in December 2010.

Watershed Implementation Plans

Watershed Implementation Plans (WIPs) developed by the Bay States contain a list of actions that must be implemented by 2025, to help achieve the Bay TMDLs. The WIPs were developed in three phases. The Phase I WIP was finalized in December 2010 and specifies statewide actions that must be taken to achieve pollution reductions and maintain these levels in the face of future growth. The Phase I WIP also sets interim targets for 2017. The Phase II WIP, finalized in March 2012, specifies how these statewide actions will be implemented at the local government level to achieve the 2017 interim targets. The Phase II WIP incorporates local government plans to achieve these reductions. The Phase III WIP was published in August 2019 and addresses needed reductions statewide from 2018 to 2025.

An additional WIP was published in July 2021 to address additional needed reductions from the Conowingo Dam on the Susquehanna River. The Bay TMDLs give credit for nutrient and sediment storage behind Conowingo Dam, but the dam no longer has excess storage capacity, so large storms now flush nutrients and sediments over the dam and down into the Bay. One more WIP will be developed to address additional needed reductions in the face of impacts from climate change. Climate change is predicted to bring larger and more frequent storms, which will increase nutrient and sediment runoff to the Bay.

Map A-2
Tier II and Stronghold Watersheds



The Maryland Phase I WIP provides strategies to address pollution reductions from point sources (municipal and industrial wastewater treatment plants), urban stormwater, septic systems, agriculture, natural filters on public land, and air. Reductions from air will be achieved through the federal Clean Air Act. Most reductions by 2017 occurred in point sources through upgrades of major municipal wastewater treatment plants (WWTPs) to provide enhanced nutrient removal (ENR), which is state-of-the-art treatment for nutrient removal. Reductions after 2017 rely more heavily on reductions from other sources. Since WWTPs and urban stormwater systems are regulated under the federal Clean Water Act through National Pollutant Discharge Elimination System (NPDES) permits, EPA can require increased pollution reductions from these two sources, if overall reductions are not adequate.

Howard County's WIP

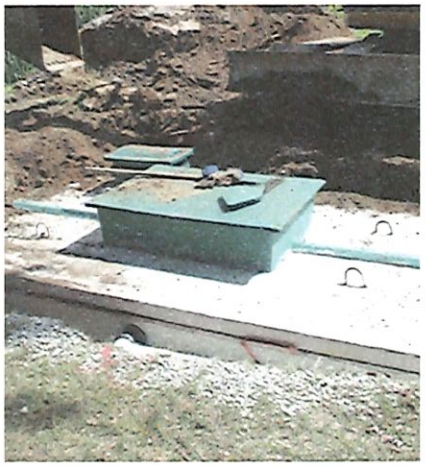
Howard County's Phase II WIP specifies local actions to achieve assigned pollution reductions from municipal wastewater treatment plants, urban stormwater, septic systems, and agriculture. Implementing actions to achieve these reductions are divided into two-year increments or milestones. These actions may include programmatic changes, as well as project implementation. Actions taken to address Howard County's share of the Chesapeake Bay cleanup also help improve water quality and habitat in the County's local streams.

Howard County is served by two major WWTPs, the Patapsco and the Little Patuxent. Both plants have assigned nutrient caps to meet the Bay TMDLs and both plants have been upgraded to ENR. The Little Patuxent's nutrient cap is based on a flow of 25 million gallons per day (MGD) and the Patapsco's is based on a flow of 73 MGD, assuming a baseline nutrient reduction is achieved with ENR. The Little Patuxent currently has a permitted discharge of 29 MGD and is still able to meet its nutrient cap because actual flow is still below 25 MGD. As flow increases from 25 to 29 MGD, the plant must be running at a higher efficiency for ENR treatment for a longer time each year to meet the nutrient cap.

The Phase I WIP requires that the County provide nutrient and sediment reductions equivalent to retrofitting 30% of the impervious area in the County. This means providing new or improved stormwater treatment for areas that do not currently have adequate treatment, which are typically older developed areas. Retrofitting areas with older development can be difficult, since there is often a lack of open space to expand existing or build new treatment facilities. The retrofit requirement was incorporated into the County's NPDES stormwater permit, which is discussed in more detail in the Ecological Health Chapter.

Septic systems are not a significant source of phosphorus, but they are a source of nitrogen. Nitrogen reductions from septic systems can be achieved by upgrading existing systems to include nitrogen reducing technologies. Another option is to connect properties with septic systems to WWTPs with ENR. The County has approximately 17,000 septic systems, with the majority located in the Rural West, but there are still a minor number of systems remaining within the Planned Service Area.

Upgrading an existing septic system costs approximately $14,000 and there is an additional annual cost of approximately $150 to $300 to run the mechanical and electrical components of the system. Partial funding for septic system upgrades is available through the State Bay Restoration Fund. However, this fund is prioritized to replace failing systems within the Chesapeake Bay and Coastal Bays Critical Areas (areas within 1,000 feet of tidal waters).



Ensuring adequate reductions from agriculture is a shared responsibility between the agricultural community, the Howard Soil Conservation District, and the Maryland Department of Agriculture. The County and State provide funding for the Howard Soil Conservation District, which provides best management practice (BMP) planning services to the agricultural community. The State provides cost share funds to supplement federal funds for BMP implementation. In addition, the State has jurisdiction over the requirements for nutrient management plans on farms.

Addressing Future Needs

To address pollution from future growth, Maryland proposed to develop and implement a system of nutrient offsets by 2013 for new development. However, the State has since decided to rely on new stormwater management and retrofits of existing stormwater management facilities to address this issue.

Maryland established nutrient trading policies for trading between point sources, trading involving the removal of septic systems, and trading involving the purchase of nonpoint source credits from agriculture. Trades involving regulated point sources, such as WWTPs, are implemented through the discharge permits for the point source, with an exception being made for trades involving regulated stormwater management systems. Trading must take place within the Potomac, Patuxent, or Eastern Shore and Western Shore basins. The Patapsco River watershed lies within the larger Western Shore basin.

A key issue for the County is how to pay for the many public and private actions needed to achieve the assigned reductions. Wastewater treatment plant upgrades and agricultural best management practice implementation are more cost-effective measures to achieve nutrient reductions than stormwater retrofits or septic system upgrades. The County may wish to supplement funding to increase agricultural BMP planning and implementation to generate nutrient trading opportunities. However, the State has indicated that reductions must occur from each source, so trading may be a more viable option to buy implementation time for reductions in other sources that will take more time and money to achieve. The County will also continue to pursue federal and State grants, loans, and cost-share opportunities to help fund implementation activities.

Projected Changes to Impervious Cover and Forest Cover

The County is required to have adequate land and water capacity for the treatment of stormwater runoff, meaning that current and future stormwater management will maintain or improve water quality in local streams receiving stormwater runoff. To provide an indirect assessment of expected impacts to water quality from future growth, changes to impervious cover and forest cover were estimated, based on projected future land use changes.

Impervious Cover

In general, as impervious cover increases with increasing development, stream health is expected to decline as forests are cleared, groundwater recharge is reduced, and polluted runoff into local streams increases in volume and frequency. This makes impervious cover a useful predictor of expected water quality and stream habitat conditions in a watershed.

The County uses a system first developed by the Center for Watershed Protection to place watersheds into one of four categories—sensitive, impacted, non-supporting (of biological diversity) and urban drainage—based on the level of impervious cover (Table A-2). Lower levels of impervious cover are not a guarantee of healthy stream conditions, because other factors, such as land use, stream channelization, and the location of the impervious cover within the watershed, can also impact stream health. However, this system can be used to prioritize healthy watersheds for actions that will protect water quality and habitat, and to prioritize degraded watersheds for efforts to restore water quality and habitat. It is easier and more cost effective to protect high quality resources in a watershed than to restore degraded resources. The more degraded conditions are within a watershed, the more difficult and expensive restoration efforts become.

Table A-2: Watersheds and Impervious Cover

Watershed Category	Percent Impervious Cover	Expected Water Quality and Stream Health
Sensitive	Less than or equal to 10	Good to excellent
Impacted	Greater than 10 and less than or equal to 25	Fair to good
Non-supporting	Greater than 25 and less than or equal to 60	Poor to fair
Urban Drainage	Greater than 60	Poor to very poor

Table A-3 shows projected changes to impervious cover by major watershed, and Table A-5 shows projected changes by Stronghold Watershed, based on projected land use changes associated with the Future Land Use Map. Because much of the projected growth in the County will occur as redevelopment, there are only minor increases in the percent impervious cover for all but one watershed.

For the major watersheds, the Brighton Dam, Middle Patuxent River, Patapsco River South Branch, and Rocky Gorge Dam watersheds will see an increase in impervious cover ranging from 0.6 to 1.6% and will all remain in the sensitive category. The Little Patuxent River and Patapsco River Lower North Branch watersheds, each with a little less than a 1% increase in impervious cover, will remain in the impacted category. The Patuxent River Upper watershed, with a less than 1% increase, will remain in the non-supporting category.

For the Stronghold Watersheds, the Davis Branch and North Branch Patapsco to Daniels Mill, and Dorsey Run watersheds will have less than a 1% increase in impervious cover. The Davis Branch and North Branch Patapsco to Daniels Mill watershed will remain in the sensitive category and the Dorsey Run watershed will remain in the non-supporting category. The Junction Industrial Park Tributary to Little Patuxent River watershed will have a 6.2% increase in impervious cover but will remain in the non-supporting category.

The current environmental site design regulations for stormwater management can achieve a pollution reduction of 50 to 90%, depending on the pollutant. However, the regulations also require redevelopment to reduce impervious cover by 50% or provide an equivalent water quality treatment. Since the majority of future new development in the County will be 'redevelopment,' this provides an important opportunity to improve water quality and mitigate the increase in nonpoint source pollution generated by the projected increase in impervious cover.

Forest Cover

Table A-4 shows projected changes to forest cover by major watershed and for the County overall, and Table A-6 shows projected change by Stronghold Watershed, based on projected land use changes associated with the Future Land Use Map. Because much of the projected growth in the County will occur as redevelopment, in the major watersheds forest loss as a percentage ranges from 1.0% for the Brighton Dam watershed to 3.8% for the Rocky Gorge Dam watershed. For the Stronghold Watersheds, forest loss as a percentage ranges from 0% for the Junction Industrial Park Tributary to Little Patuxent River watershed to less than 1% for the remaining watersheds. The County overall will see a 1.5% loss in forest cover or 2,449 acres, and just over half of this will be interior forest (the interior forest itself and the 300' buffer). Forest interior losses in the major watersheds range from a low of 33.5% of the overall forest loss in the Patuxent River Upper to a high of 70.4% in the Little Patuxent River.

This estimate of forest loss is based on 2009 existing forest cover data (the most recent available), which provides a higher baseline for forest cover than currently exists. This estimate also includes a conservative assumption that all forest on a parcel designated for development will be removed, with the exception of forest within the 100-year floodplain and a 75-foot stream buffer. The 2019 update of the Forest Conservation Act will help minimize and mitigate actual forest loss through the addition of site design requirements and higher replacement ratios for forest cleared. Site design requirements include that residential developments of more than 10 lots must meet a minimum of 75% of their obligation on-site, which encourages forest retention rather than clearing and replanting. In addition, HoCo by Design includes policies and actions intended to protect and increase forest cover in the County.

Table A-3: Projected Change In Impervious Cover By Major Watershed

Major Watershed	Watershed Area (acres)	Existing Impervious Area (acres)	Existing Impervious Area (%)	Impervious Surface Added (Sq Ft)	Impervious Surface Added (Acres)	Future Impervious Area (acres)	Future Impervious Area (%)	Change in Impervious Area (%)
Brighton Dam	36,929	1,640	4.4	10,013,851	230	1,870	5.1	0.6
Little Patuxent River	38,039	8,935	23.5	11,192,171	257	9,192	24.2	0.7
Middle Patuxent River	37,073	3,277	8.8	11,206,178	257	3,534	9.5	0.7
Patapsco River L N Br	24,210	4,354	18.0	9,176,145	211	4,565	18.9	0.9
Patapsco South Branch	16,060	692	4.3	7,919,405	182	874	5.4	1.1
Patuxent River upper	1,726	468	27.1	548,758	13	481	27.9	0.7
Rocky Gorge Dam	8,007	541	6.8	5,584,833	128	670	8.4	1.6
Countywide	162,044	19,909	12.3	55,641,341	1,277	21,186	13.1	0.8

Table A-4: Projected Change in Forest Cover by Major Watershed

Major Watershed	Watershed Area (acres)	Existing Forest Cover (Acres)	Existing Forest Cover (%)	Forest Loss (acres)	Future Forest Cover (acres)	Future Forest Cover (%)	Change in Forest Cover (%)	Interior Forest Loss (acres)	Forest Loss that is Interior Forest (%)
Brighton Dam	36,929	10,993	29.8	366	10,627	28.8	-1.0	187	51.1
Little Patuxent River	38,039	7,170	18.8	443	6,728	17.7	-1.2	312	70.4
Middle Patuxent River	37,073	10,130	27.3	516	9,614	25.9	-1.4	252	48.8
Patapsco River L N Br	24,210	8,290	34.2	417	7,873	32.5	-1.7	145	34.8
Patapsco River S Br	16,060	5,427	33.8	384	5,043	31.4	-2.4	186	48.3
Patuxent River Upper	1,726	424	24.6	20	404	23.4	-1.1	7	33.5
Rocky Gorge Dam	8,007	2,957	36.9	304	2,654	33.1	-3.8	177	58.4
Countywide	162,044	45,392	28.0	2,449	42,943	26.5	-1.5	1,265	51.6

Table A-5: Projected Change In Impervious Cover By Stronghold Watershed

Stronghold Watershed	Watershed Area (acres)	Existing Impervious Area (Acres)	Existing Impervious Area (%)	Impervious Surface Added (Sq Ft)	Impervious Surface Added (Acres)	Future Impervious Area (acres)	Future Impervious Area (%)	Change in Impervious Area (%)
Davis Branch and NBr Patapsco to Daniels Mill	5,216.3	463.1	8.9	810,895.8	18.7	481.7	9.2	0.4
Dorsey Run	5,087.9	1,874.9	36.9	2,094,800.4	48.1	1,923.0	37.8	0.9
Junction Industrial Park Tributary to Little Patuxent River	279.5	130.7	46.8	749,800.8	17.2	147.9	52.9	6.2

Table A-6: Projected Change in Forest Cover by Stronghold Watershed

Stronghold Watershed	Watershed Area (acres)	Existing Forest Coverage (acres)	Existing Forest Cover (%)	Forest Loss (acres)	Future Forest Cover (acres)	Future Forest Cover (%)	Change in Forest Cover (%)	Interior Forest Loss (acres)	Forest Loss that is Interior Forest (%)
Davis Branch and NBr Patapsco to Daniels Mill	5,216.3	2,123.5	40.7	29.5	2,093.9	40.1	-0.6	187.0	51.1
Dorsey Run	5,087.9	868.3	17.1	13.9	854.3	16.8	-0.3	312.0	70.4
Junction Industrial Park Tributary to Little Patuxent River	279.5	2.8	1.0	0.0	2.8	1.0	0.0	252.0	48.8

Hazard and Flood Mitigation Planning

The Howard County Hazard Mitigation Plan (HMP) was most recently updated in 2018. The HMP relies on the 2017 Hazard Identification and Risk Assessment (HIRA), which determined that high priority natural hazards for the County are flood, hurricane and tropical storms, severe winter weather, and drought.

The Howard County Flood Mitigation Plan (FMP), was updated concurrently with the HMP in 2018. The intent of the FMP is to reduce the impact of floods to County residents, properties, structures, and resources. Flooding can result from various weather events, such as hurricanes, thunderstorms, and winter storms. Approximately 5.5% of the County's land area is in the 100-year floodplain. The County's current floodplain maps were created by the Federal Emergency Management Agency (FEMA) and became effective in 2013. Special studies updated maps for the Little Plumtree Branch, which became effective in 2021, and the Tiber-Hudson Branch, which became effective in 2022. FEMA is in the process of updating all countywide maps and these maps will likely become effective in 2024 or 2025.

The FMP includes a detailed property flood risk assessment. Areas in the County with a significant or moderate number of buildings that are vulnerable to flooding include Columbia, Elkridge, and Ellicott City. The County's land use regulations have helped limit the number of structures in the County that are vulnerable to flooding. The County also maintains a map identifying road locations that are frequently flooded, and these locations are closed as needed during flooding events.

The County has one critical facility (a facility that will be important during the response and recovery phase of a hazard event) located within the 100-year floodplain—the Little Patuxent Water Reclamation Plant (WRP) in Savage. Newer structures at the WRP are elevated out of the floodplain whenever possible, including emergency generators installed in 2015.

In 2022 the Maryland Department of the Environment (MDE) listed 28 dams in its dam inventory for Howard County that are rated as significant or high hazard dams. Dams are rated as low, medium, or high hazard, depending on the potential loss of life or damage to a major utility if the dam were to fail. Emergency Action Plans (EAPs) for each dam delineate the danger reach or area of inundation/flooding in case of dam failure and include an emergency response plan. Additional development in the danger reach can raise the hazard level of a dam and this is known as hazard creep.

When development in the County is proposed downstream of a nearby dam, HSCD may be asked to review and comment on the proposal. Proposed impacts to medium and high hazard dams are reviewed by MDE. If downstream development will increase the hazard level of a dam, the developer may upgrade the dam to the new hazard level standards or choose not to build in the danger reach. Proposed development within the drainage area of a dam is also reviewed for impacts to the dam. If the development will increase flow to the dam during large storm events, additional management may be provided on the development site.

Both the HMP and FMP include a plan integration and mitigation strategy. Plan integration includes a review of County plans and ordinances to:

- Identify policies, actions, and ordinances that address hazard and flood mitigation-related issues.
- Provide a platform to integrate plans and ordinances so recommendations and strategies are not in contradiction with one another.

Each mitigation strategy has goals, objectives, and actions. The mitigation actions are prioritized and divided into those that are ongoing/in process and new. Ongoing actions in the FMP include:

- Evaluate infrastructure on frequently flooded roadways to determine whether the roads, bridges, and/or culverts need to be upgraded to lessen the frequency of flooding.
- Identify and pursue incentives to mitigate private and public properties from flood hazards through the following techniques: elevation, acquisition/demolition, and dry/wet floodproofing.

New actions in the FMP include:

- Assess the vulnerability of historic and cultural resources located in the 100-year floodplain and determine appropriate mitigation techniques that account for historic integrity, significance, and designation.

The 2018 HMP recognizes that hazards and the risks they present are likely to change from year to year, and that the emerging issue of global climate change will likely affect how hazards will impact the County. The County continually monitors trends in terms of probability and potential impacts to develop and calibrate mitigation activities. The HMP and FMP are updated every five years, and updates to the HMP, HIRA, and FMP will be completed in 2023.

Ellicott City Flood Mitigation Plan

In response to the 2016 flood in Ellicott City, a Hydrology and Hydraulics (H&H) Study was developed for historic Ellicott City. Hydrology is the study of how much runoff will be generated within a watershed. Hydraulics is the study of how water will behave when flowing through and around topography or structures. The H&H Study modeled three scenarios for the Tiber watershed - undeveloped, currently developed, and fully developed. The fully developed scenario results were quite close to the existing development results, since few undeveloped sites remain in the watershed.

The H&H Study was used to evaluate how to effectively reduce the amount of water on Lower Main Street and the West End when the Tiber watershed floods historic Ellicott City, while preserving as many buildings as possible. The evaluation focused on two main types of conceptual improvements – stormwater quantity management and conveyance improvements. Conveyance improvements would upgrade or supplement the storm drains and channels through the flooded area to carry more water at a lower elevation for a given flood event. The effects of the conceptual improvements were tested on the undeveloped and currently developed scenarios. The resulting flood mitigation framework for historic Ellicott City includes a combination of structural and nonstructural flood mitigation measures, which the County is currently working to implement under the Ellicott City Safe and Sound Plan.

Vulnerable Watershed Restoration and Resiliency Program

The County's new Vulnerable Watershed Restoration and Resiliency Program will begin with identifying and prioritizing vulnerable watersheds, and then select up to five watersheds to study each year (depending on funding). The County will undertake a comprehensive analysis of the watershed or drainage area, including an evaluation of any existing storm drainage and/or stormwater controls. The comprehensive analysis will then prescribe projects within the drainage area that will better manage stormwater, improve flood conditions, and create a more resilient neighborhood. The intent is to work with the affected communities to develop projects for future capital budgets, but not every assessment will lead to a capital project, due to topography, property ownership, existing infrastructure, and other challenges.

State Stormwater Management Law Updates

The 2021 amendments to Maryland's stormwater management law require that the regulations be updated to incorporate the most recent precipitation data available. Precipitation data is defined in the statute as "historical data that describes the relationship between precipitation intensity, duration, and return period" or frequency. In early 2021 Maryland, Delaware, Virginia, and North Carolina agreed to fund an update to the 2006 National Oceanic and Atmospheric Administration Atlas 14, Precipitation-Frequency Atlas of the United States, currently the most recent data available. The update, which will include future rainfall predictions based on projected impacts from climate change, is expected to be completed by 2025.

Drinking Source Water Protection

The following reviews source water assessments (SWAs) and other water quality issues for public well systems in the Rural West, and the Baltimore City and Washington Suburban Sanitary Commission (WSSC) reservoir systems.

Well Systems

Source water assessments were developed by the Maryland Department of the Environment (MDE) from 2003 to 2005, for Howard County water supply systems that serve 25 or more individuals. This included 76 well systems in Howard County for facilities such as shopping centers and schools. The SWAs found that each system assessed provides drinking water that meets federal Safe Drinking Water Act standards, but each system is susceptible to one or more contaminants. In general, the SWA recommendations to reduce this susceptibility are to maintain and strengthen existing protection and monitoring efforts.

The SWAs for the well systems recommended a number of protection measures to address potential point and nonpoint sources of contamination. Potential point sources of contamination include underground storage tanks, controlled hazardous substance generators (such as dry-cleaning operations), and groundwater discharges associated with commercial areas. Nonpoint sources of contamination include agricultural land, commercial land, roads and parking lots (associated with deicing salts), and private septic systems.

There are a few well contamination problems in various unrelated areas outside the Planned Service Area. Select areas and individual properties are experiencing well contamination problems with excess nitrates. These problems are being addressed by the property owners with individual water quality treatment devices. A few residential

areas are experiencing well contamination problems with high sodium chloride (salt) levels, primarily associated with the use of deicing salt on nearby roads. In one area, the Maryland State Highway Administration (SHA) has replaced wells at four homes. The Health Department is working with the property owners and SHA in affected areas to address the issue through new wells or individual water quality treatment devices. In addition, Lisbon continues to experience well contamination problems with gasoline and solvents, excess nitrates, and bacteria (coliforms) in several wells. MDE continues to provide carbon treatment on several sites and other problems are being addressed by the property owners with individual water quality treatment devices.

Radium and radon are naturally-occurring radioactive elements found in the Baltimore Gneiss geologic formation that underlies a significant area of central Howard County. The Health Department has done extensive testing of wells within this formation, and both elements have been detected. Property owners with elevated levels have been advised to install treatment devices and the Health Department has done follow up testing to confirm the treatment is functioning properly.

Reservoir Systems

The watersheds for the Baltimore City reservoirs lie primarily within Carroll and Baltimore Counties, and the watersheds for the WSSC reservoirs lie primarily within Howard and Montgomery Counties. Both reservoir systems are the subjects of inter-jurisdictional watershed management and protection agreements.

Signatories to the Baltimore Reservoir Watershed Management Agreement include Carroll and Baltimore Counties, the Carroll and Baltimore County Soil Conservation Districts, Baltimore City, and the Maryland Departments of Agriculture and the Environment. Signatories to the Patuxent Reservoirs Watershed Protection Agreement include Howard, Montgomery, and Prince George's Counties, WSSC, the Howard and Montgomery County Soil Conservation Districts, and the Maryland-National Capital Park and Planning Commission. As a customer of the Baltimore City water supply system, Howard County participates in the Baltimore reservoir agreement. Howard County is a signatory to the Patuxent reservoirs agreement because the County contains just over half of the watershed for this system.

Signatories to these agreements are working together to protect and improve the quality of the water flowing to these reservoirs. Ongoing activities include the following:

- Implementing best management practices, such as agricultural nutrient management, stream buffer plantings, stream channel stabilization, and stormwater retrofits, for the control of nonpoint (or diffuse) source pollution from agricultural and developed land.
- Monitoring water quality in watershed streams and the reservoirs.
- Conducting outreach and education to encourage environmental stewardship among those living, working, and recreating in the watershed.

Source water assessments were developed for the Baltimore City and WSSC reservoir systems. The SWAs found that each system provides drinking water that meets federal Safe Drinking Water Act standards, but is susceptible to one or more contaminants. In general, the SWAs recommend reducing this susceptibility by maintaining and strengthening existing protection and monitoring efforts. The SWAs recommend limiting pollution to the reservoirs, especially stormwater runoff from suburban and agricultural land uses in the watersheds.

The SWAs deferred to the Total Maximum Daily Loads (TMDLs) for each reservoir to quantify the needed pollutant reductions. TMDLs are a requirement of the federal Clean Water Act and they specify how much pollutant a water body can receive and still meet water quality standards for that pollutant. The WSSC reservoirs TMDLs specify significant reductions (48 to 58%) in phosphorus loadings, with these reductions providing concurrent acceptable reductions in sediment loadings. The reservoir protection agreements and the work done under them help Baltimore City and WSSC, as water suppliers, and the jurisdictions within the reservoir watersheds implement the recommendations of the SWAs and TMDLs.

Both reservoir systems are experiencing increased levels of sodium and chloride in watershed streams and in the reservoirs. The trend is likely due to the use of winter deicing salts on roads, parking lots, and driveways within the watershed. High levels of salt in freshwater streams are harmful to aquatic life and high levels of salt in drinking water can be harmful to human health, especially for those on a sodium restricted diet. Both interjurisdictional planning groups are researching potential solutions for this issue. However, salt is difficult and expensive to remove from water, and a reduction in the use of deicing salt must be balanced with the need for public safety.