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Background

Harford County is located in the north central portion of Maryland, at the confluence of the Susquehanna River and the Chesapeake Bay. It is surrounded by Baltimore County on the west, Pennsylvania on the north, the Susquehanna River on the east, and the Chesapeake Bay on the south. The County has a land area of 440 square miles. There is a lot of rural land in this County, dominating the northern and western portions. The fall line, roughly running along I-95, divides the County into two physiographic provinces: Coastal Plain occupying 20% of the County along the Chesapeake Bay and Piedmont occupying 80% or the northern portion of the County. The Coastal Plain is characterized by flat to gently rolling slopes and elevations ranging from 40 to 200 feet above sea level. The Piedmont contains rolling hills and often steep, rocky slopes along streams and elevations ranging from 200 to 750 feet above sea level. There are two major dams within the County: Conowingo Dam on the Susquehanna River and Atkisson Dam on Winters Run (Harford County, 1998). The three municipalities are Aberdeen, Bel Air, and Havre de Grace. Aberdeen Proving Ground, a 61 square mile federal facility, is also in the eastern portion of this County. The Bay is bordered by tidal marsh, tidal streams, and estuarine areas (Harford County, 1998).

The land use of Harford County (based on MDP 2002 land use GIS data) is 26% urban, 37% agriculture, 34% forest and 3% wetlands (Figure 1). Note that wetland acreage estimates based on this land use data may be grossly underestimated. Better wetland estimates, as discussed later, are based on GIS data from DNR. There are large amounts of rural land in the northern and western parts of the County. Currently, mining operations occur in both physiographic provinces, with most being in the Route 40/I-95 corridor (Harford County DPZ, 2004).

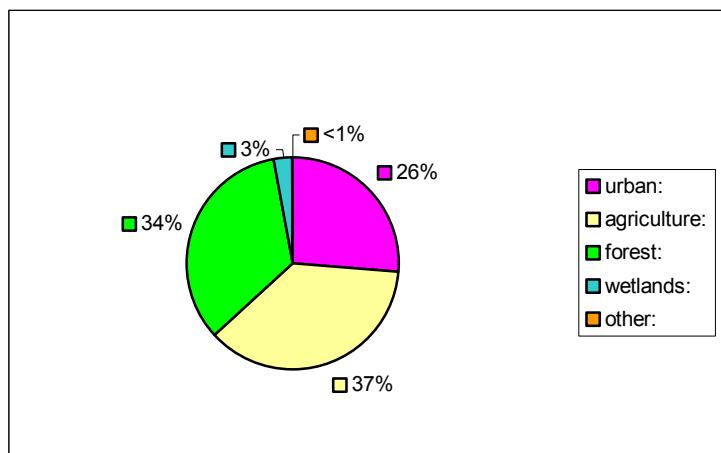


Figure 1. Land use in Harford County.

Some of the soil is classified as prime farmland (based on NRCS SSURGO GIS data). In order to preserve agriculture in the County, wetland restoration/creation should attempt to avoid areas classified as prime farmland.

Soils in the Upper Piedmont (northwest) are generally well-drained. There are some large poorly-drained soil areas in the Lower Piedmont. The Coastal Plain has the most poorly-drained soils. While many hydric soils are found along the streams, there are some larger patches along Rte. 1, between Rte. 155 and Rte. 22, and along Rte. 40 (Harford County, 1998).

There are three State-designated 6-digit watersheds and thirteen 8-digit watersheds in this County. The Lower Susquehanna River (021202) includes Lower Susquehanna River (02120201), Deer Creek (02120202), Conowingo Dam (02120204) and Broad Creek (02120205); Bush River (021307) includes Bush River (02130701), Lower Winters Run (02130702), Atkisson Reservoir (02130703), Bynum Run (02130704), Aberdeen Proving Ground (02130705), Swan River (02130706); Gunpowder River (021308) includes Gunpowder River (02130801), Little Gunpowder Falls (02130804) and a small portion of Loch Raven Reservoir (02130805).

Streams

The County is bordered by Little Gunpowder Falls on the west, the Susquehanna River on the east, and the Chesapeake Bay in the south. Other major waterways include Broad Creek, Bynum Run, Deer Creek, and Winters Run.

The Maryland Tributary Strategies document *Maryland Upper Western Shore Final Version for 1985-2002 Data: February 2, 2004* describes the success of BMPs in the Upper Western Shore Watershed (an area containing all of Harford, and part of Carroll, Baltimore, and Cecil) like this:

BMP implementation for animal waste management, nutrient management plans, conservation tillage and cover crops, forest conservation and buffers, shore erosion control, marine pump outs, and storm water management retrofits and conversion are making good progress toward Tributary Strategy Goals. For other issues, such as treatment and retirement of highly erodible land, runoff control, stream protection, erosions and sediment control, septic connections and pumping, and urban nutrient management, progress toward Tributary Strategy Goals has been slower.

Land use for the entire basin is dominated by agriculture and forest/wetlands (38% each), followed by urban (25%). Roughly 70% of the houses are on public water and 75% are on municipal sewer. In 2002, the main nitrogen, phosphorus, and sediment sources within the Upper Western Shore basin was agriculture (39%, 33%, and 69% respectively). Other sources included point sources (21% N and 16% P), urban sources (18% N, 30% P, and 14% sediment), mixed open land (18% P and 7% sediment), and forest (10% sediment). Tributary stations sampled had total nitrogen ranked generally good. Two sites were ranked poor (Upper Gunpowder River – Prettyboy and Deer Creek) and one was ranked fair (Middle Gunpowder River - Glencoe). Levels were decreasing in some areas during the period 1985-2002. Total phosphorus was ranked fair or good, with some stations improving. Total suspended solids were generally good, but one site was ranked poor (Lower Gunpowder River – Cromwell) and two were ranked fair (Susquehanna River and

Bush River). Of the three sites sampled for SAV abundance between 1984 and 2000, two of the sites exceeded SAV goals during portions of that period (Bush River and Gunpowder River Oligohaline). The Middle River Oligohaline did not meet the SAV goal but was close in 2000. In 1995-2000, benthic communities were generally good.

Wetlands

Wetland classifications

The largest mapped wetlands (based on DNR and NWI GIS data) are located in the southern portion of the County, near the Chesapeake Bay. Many of these are within Aberdeen Proving Ground, near the mouth of the Bush River or Gunpowder River. According to Tiner and Burke (1995), in 1981-1982 there were 12,527 acres of wetlands (2.1% of the State's total). The wetland types were Estuarine (6,649 acres), Palustrine (5,863 acres), Riverine (11 acres), and Lacustrine (4 acres). Comparisons of this 1981-1982 wetland acreage with historic wetland acreage (based on hydric soils) represent a 32%, or 5,773 acre, loss (MDE, 2002).

Wetlands in Harford County occur along the shoreline as tidal wetlands, in floodplains of streams, at the heads of drainageways, and in isolated depressions. Tidal wetlands are not extensive, and transition into other wetland types or terminate at the steeper, adjacent upland slopes. The supporting hydrology of nontidal wetlands is primarily through groundwater or a combination of groundwater and overbank flooding. Most are located in the floodplains, though even in these areas the primary source of hydrology is groundwater. Wetland and floodplain areas are generally more extensive in the Coastal Plain portion of the County, though the adjacent slopes limit the extent of these wetlands in comparison with lower Eastern Shore nontidal wetlands. Wetlands may also occur at the bases of slopes, where they are supported by seepage from the hillside. Wetlands have also developed at mined sites. There are also small wetland areas, primarily in the Coastal Plain, that are supported by surface water ponding over soil with a fragipan that impedes drainage.

The following wetland plant community descriptions are based on Tiner and Burke (1995).

- Estuarine wetlands have vegetation that is largely dependent upon salinity and hydrology, with plant diversity increasing with decreased salinity and decreased flooding. They can be classified into five groups:
 - Estuarine intertidal flats are mud or sand shores that are exposed twice a day (at low tide) or less. These areas have sparse macrophytic vegetation.
 - Estuarine emergent wetlands have vegetation composition that is strongly influenced by salinity level and duration/frequency of inundation (Cecil County does not contain any brackish marsh).
 - Brackish marshes are the most common type of Maryland Estuarine wetland, found along the Chesapeake Bay and tidal rivers. Low brackish marsh is often dominated by smooth cordgrass-tall form and water hemp while the high brackish marsh

- is often dominated by salt hay grass, salt grass, black needlerush, smooth cordgrass-short form, Olney three-square, switchgrass, common three-square, big cordgrass, common reed, salt marsh bulrush, seaside goldenrod, rose mallow, and narrow-leaved cattail.
- Oligohaline marshes are only slightly saline and are located in the upper tidal rivers. Low oligohaline marshes are often dominated by arrow arum, pickerelweed, spatterdock, wild rice, soft-stemmed bulrush, narrow-leaved cattail, water hemp, and common three-square while high oligohaline marshes are often dominated by big cordgrass, common reed, narrow-leaved cattail, wild rice, broad-leaved cattail, and sweet flag.
 - Estuarine scrub-shrub swamps are often dominated by high-tide bush and groundsel bush.
 - Estuarine forested swamps are often dominated by loblolly pine. Due to sea level rise bringing in more salinity, some of these systems are being converted into salt marshes.
 - Estuarine Aquatic beds generally contain submerged aquatic vegetation, including eelgrass and widgeongrass in high salinity areas and widgeongrass and other species in lower salinity areas.
 - Palustrine wetlands can be classified into four major groups depending on the dominant vegetation type: forested, scrub-shrub, emergent, and aquatic. These wetlands were described for the Maryland Coastal Plain Province and the Piedmont Province.
 - Coastal Plain palustrine wetlands
 - Palustrine forested wetlands are the dominant palustrine wetland type on the Coastal Plain and are located in floodplains, depressions, and drainage divides. They can be classified into four main groups:
 - Tidally flooded wetlands are freshwater wetlands that are tidally influenced. Common tree species may include red maple, green ash, black willow and black gum.
 - Semipermanently flooded wetlands are nontidal wetlands that are flooded for much of the growing season. These are uncommon in Maryland. Some examples, dominated by bald cypress, are along Battle Creek and the Pocomoke River. Higher elevations may be dominated by red maple, black gum, sweet bay, swamp black gum, fringe tree, ironwood, and swamp cottonwood.
 - Seasonally flooded wetlands are nontidal wetlands that are flooded for generally longer than two weeks during the growing season. Some of the more common tree dominants include red maple, sweet gum, pin oak, willow oak, loblolly pine, or swamp chestnut oak. There is often a thick shrub understory.

- Temporarily flooded wetlands are nontidal wetlands that are flooded the least of the four types, about a week. Seasonally saturated wetlands, wetlands having a high water table during the cooler months, are also included in this category. Some of these areas are managed for loblolly pine harvesting. Other tree dominants include red maple, sweet gum, black gum, willow oak, water oak, basket oak, swamp white oak, southern red oak, sycamore, black willow, American holly, sweet bay.
- Scrub-Shrub wetlands are less common than forested wetlands on the Coastal Plain. They are often dominated by buttonbush (in the wetter systems), silky dogwood, arrowwood, alder and tree saplings.
- Emergent wetlands are very diverse in the Coastal Plain region due to the occurrence of both tidal and nontidal wetlands. They can be categorized into several different types:
 - Tidal fresh marshes occur along the large coastal waterways, between the brackish marshes and tidal freshwater swamps. It is speculated that in addition to tidal flooding, temporary periods of salt water in these areas may discourage woody succession. These freshwater wetlands are often more diverse than wetlands with higher salinity levels. Vegetative dominance changes seasonally. There is often a distinct vegetative zonation pattern based on elevation. Some common dominance types according to McCormick and Somes (1982) are arrowheads, big cordgrass, bulrushes, bur-marigold, cattails, common reed, giant ragweed, golden club, pickerelweed/arrow arum, purple loosestrife, reed canary grass, rose mallow, and smartweed/rice cutgrass
 - Interdunal wet swales have a very high water table, allowing hydrophytic plants to grow adjacent to dunes having xeric plant species. These sites are often dominated by common three-square, salt hay grass, and rabbit-foot grass.
 - Semipermanently flooded marshes are often dominated by cattail, spatterdock, arrow arum, water willow, and bur-reeds.
 - Seasonally flooded marshes include isolated depressional wetlands called “potholes” or “Delmarva Bays” (mostly in Caroline, Kent, and Queen Anne’s)
 - Temporarily flooded wet meadows include areas recently timber harvested that will soon revert back to woody vegetation.
- Aquatic beds include small ponds with vegetation on the bottom and/or surface. These are the wettest of the Palustrine types.

- Piedmont Province palustrine wetlands
 - Palustrine wetlands can be classified into four major groups depending on the dominant vegetation type: forested, scrub-shrub, emergent, and aquatic. These wetlands were described for the Piedmont Province.
 - Palustrine forested wetlands are often found in stream floodplains. They can be categorized into two main types.
 - Seasonally flooded palustrine forested wetlands: These wetlands are flooded for some period (e.g. greater than two weeks) during the spring. Common tree species include Red maple, Black willow, and Green ash. There is often a dense understory of shrubs (e.g. Spicebush and Southern arrowwood) and herbaceous species (e.g. Skunk cabbage). Tiner and Burke gave an example of a seasonally flooded forested wetland community within Frederick County. The example was a Silver maple-Black willow dominated community. Associate tree species were Red maple, shrub species were Alder and Dogwood, and herbaceous species were Jewelweed, Joe-Pye weed, Blue vervain, Lurid sedge, and Big arrowhead.
 - Temporarily flooded palustrine forested wetlands: These wetlands are flooded for some period (e.g. a week or less) during the spring, less than that in the seasonally flooded forested wetlands. These systems may contain Red maple, Sycamore, Green ash, Silver maple, Pin oak, Tulip poplar, Black walnut, Black locust, or Box elder. The shrub layer may be less dense than in the seasonally flooded system. Temporarily flooded forested wetlands along the Potomac River floodplain are often dominated by Eastern cottonwood and Silver maple, with some Sycamore and Black willow. Tiner and Burke give two examples of wetland communities found within Frederick County. The first system, a Green ash-Sycamore-Box elder dominance, was found along Bennett Branch. Associate tree species were Pawpaw, Ironwood, Beech, Hackberry, and Tulip poplar. Associate shrubs species were spicebush and elderberry, herbaceous species were wood nettle, garlic mustard, wood sorrel, Lady's thumb, False nettle, and clearweed. Other associate vine-like species were Virginia creeper and poison ivy. The second example was a Red Maple dominance. Associates tree species were Sycamore, Box elder, and Silver maple. Shrub species were Multiflora rose, herbaceous species were Jewelweed and Goldenrod, and other species were Japanese honeysuckle and Blackberry.

- Palustrine shrub wetlands contain shrubs and tree saplings. The wetter systems are often dominated by Buttonbush, while the drier seasonally flooded systems may be dominated by a number of different species. Herbaceous species may form an understory.
- Palustrine emergent wetlands:
 - Semipermanently flooded marsh
 - Seasonally flooded marsh: These systems may be dominated by cattail, rice cutgrass, arrow arum, and rush.
 - Seasonally flooded meadow: This is the most common wetland type in the region. These systems would naturally be forested wetlands, but were cleared. Many have high plant diversity.
 - Temporarily flooded wet meadow: These systems may be adjacent to the seasonally flooded meadows, but they are flooded less often and for shorter durations.
- Palustrine aquatic beds are small ponds with partial or total vegetative cover.
- Riverine wetlands are found within the channel and include nonpersistent vegetation.
- Lacustrine wetlands are associated with deepwater habitat (e.g. freshwater lakes, deep ponds, and reservoirs). They can be classified into lacustrine aquatic beds (wetlands are located in the shallow water) and lacustrine emergent wetlands (wetlands are located along the shoreline).

This same document (*Wetlands of Maryland*) provides numerous examples of various wetland communities found within each County and complete plant lists for certain wetland types.

Tidal wetland acreage was also estimated in *The Coastal Wetlands of Maryland* (Table 1). Harford County had 6,439 acres of vegetated tidally-influenced wetlands (excluding SAV). The majority of vegetated wetland is fresh marsh. There are smaller amounts of brackish high marsh, and shrub and wooded swamp. Due to the higher stress associated with higher salinity levels, brackish marsh often has lower species richness and species diversity than fresh tidal marsh. Brackish marsh may also have quite distinct plant zonation patterns.

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Major Vegetation Type	Vegetation Type	Acreage
Shrub Swamp (<i>Fresh</i>)	Swamp rose	1
	Smooth alder/Black willow	13
	Red maple/Ash	59
Swamp forest (<i>fresh except pine, which is often brackish</i>)	Bald cypress	0
	Red maple/Ash	104
	Loblolly pine	73
Fresh marsh	Smartweed/Rice cutgrass	127
	Spatterdock	19
	Pickerelweed/Arrow arum	496
	Sweetflag	146
	Cattail	2,909
	Rosemallow	800
	Wildrice	158
	Bulrush	957
	Big cordgrass	247
	Common reed	176
Brackish High Marsh	Meadow cordgrass/Spikegrass	2
	Marshelder/Groundselbush	2
	Needlerush	0
	Cattail	0
	Rosemallow	0
	Switchgrass	150
	Threesquare	0
	Big cordgrass	0
	Common reed	0
Brackish Low Marsh	Smooth cordgrass	0*
Saline High Marsh	Meadow cordgrass/Spikegrass	0
	Marshelder/Groundselbush	0
	Needlerush	0
Saline Low Marsh	Smooth cordgrass, tall growth form	0
	Smooth cordgrass, short growth form	0
Submerged Aquatic Vegetation	Submerged aquatic plants	472

Table 1. *Tidal wetland acreage within Harford County based on vegetation type (McCormick and Somes, 1982). *Although brackish low marsh was present, it was not measured in this County.*

Wetland functions

Stormwater and Flood Control

Wetlands are often credited with providing natural stormwater and flood control benefits. Inland wetlands adjacent to rivers, streams and creeks hold excess discharge and runoff during periods of increased precipitation such as tropical storms and hurricanes and

during periods of rapid snow-melt in mountainous regions. Coastal wetlands also hold excess discharge from inland drainage networks as well as tidal waters during storms.

Several factors influence the effectiveness of a wetland in reducing adverse effects of stormwater and floods. Factors include the characteristics of the wetland, local land conditions, and landscape features in the surrounding larger watershed, as well as the type of storm itself. The physical structure of many wetlands, with dense vegetation, fallen trees, topography (hummocks, depressions), and complexity of stream channel systems serve as resistance features to slow flow of surface water from floods and surface runoff, the height of peak floods, and delay the timing of the flood crest. Wetlands are typically in topographically low position, which provides a natural basin for water storage. The depth of the basin and soil characteristics affect the wetland's storage capacity at surface and subsurface levels. Water is released more slowly from the wetlands, thereby reducing both erosion and damage to property and structures farther downstream. In the surrounding areas, the ability of the land to also reduce runoff may aid the wetland in its flow retention/reduction function. At the landscape level, the position of the wetland in the watershed and the ratio of size of the wetland to the size of the watershed also affect the function. Wetlands higher in the landscape and of large size in relation to the watershed are most effective. While wetlands retain surface flows that enter the wetlands at a gradual rate, they are considered to be more effective at reducing damages from short duration storms.

Also, some water will be removed from the wetland through ground water recharge, soil retention and evapotranspiration.

Development and increases in impervious surfaces have resulted in stream channel erosion and downcutting of stream channels. This has in some instances resulted in less out of bank flooding for low intensity storm events, thus less opportunity for adjacent wetlands to provide the flood attenuation function. Some floodplain wetlands are also found in pasture land with little natural vegetation. Lack of dense vegetation reduces the ability of a wetland to slow velocities of floodwaters, further reducing the flood attenuation function. Floodplains are relatively narrow, particularly in the Piedmont region in the County, which is another limitation to the storage capacity of wetlands in the floodplain. In areas of less development, headwater streams still may provide some flood attenuation functions.

Groundwater Recharge and Discharge

Functions

Wetlands facilitate the flow of water between the ground water system and surface water system. Wetlands periodically perform different functions, depending on the gradient of the groundwater table and the topography of the land surface. The relationship of the groundwater table and the land surface dictates which function - groundwater recharge or discharge - a wetland performs.

Nearly all of Maryland's wetlands are ground water discharge areas, at least for some portion of the year (Fugro East, Inc., 1995). Variations in the depth of the ground water

table, resulting from seasonal changes in climate, dictate which of these functions - discharge or recharge - a wetland will perform at a given time.

Values

Ground water discharge helps maintain a wetland's water balance and water chemistry. This wetland function is also critical to the formation of hydric soils and the maintenance of ecosystem habitats in different types of wetlands. The hydric soil Watchung, found in the Piedmont of Harford County, has some characteristics associated with ground water discharge. These soils are found in heads of drainages and at the base of slopes.

Ground water recharge is the primary mechanism for aquifer replenishment which ensures future sources of groundwater for commercial and residential use. Recharge would not be expected in a wetland with a hydric soil containing a fragipan, such as Leonardtown soils found in the Coastal Plain portion of the County.

Modification of Water Quality

Water Quality Improvement

Wetlands are valued for their ability to maintain or improve quality of adjacent surface waters. This ability is primarily accomplished by the following processes:

- Nutrient removal, transformation, and retention
- Retention of toxic materials
- Storage of the sediment transported by runoff or floods.

Hydrophytic vegetation (adapted to live in water) and microbial activity in soils help remove toxic substances and excess nutrients from surface water. Dissolved solids and other constituents may be removed or degraded, such that they become inactive, or incorporated into biomass. This occurs through adsorption and absorption by soil particles, uptake by vegetation and loss to the atmosphere through decomposition and exchange between atmosphere and water.

Nutrient Cycling: Addition, Removal and Transformation

Nutrients are carried into wetlands by hydrologic pathways of precipitation, river flooding, tides, and surface and ground water inflows. Outflows of nutrients are controlled primarily by outflow pathways of waters. The inflow and outflow of water and nutrients are important processes that effect wetland productivity.

Wetland biological and chemical processes remove suspended and dissolved solids and nutrients from surface and ground water and convert them into other forms, such as plant or animal biomass or gases. Debris and suspended solids (fine sediment or organic matter) may be removed by physical processes, such as filtering and sedimentation.

Soil characteristics, landscape position, and hydrology all contribute to the relative ability of a wetland to perform nutrient removal and transformation. Sufficient organic matter must be present for microorganisms in the soil to consume or transform the nutrients. Wetlands are often depressions in the landscape that hold water, transported sediment, and attached or dissolved nutrients for a longer period of time than a sloping area or areas

with relatively higher elevations. A longer retention time allows for chemical interactions and plant uptake to occur. Fine particle soils are generally more effective at retaining phosphorus than coarser sediments. Elkton soils in the Coastal Plain wetlands on the interfluvial flats and Watchung soils in flats, depressions, toes of slopes, and headwaters in the Piedmont have the highest clay content. Areas shown as Swamp or tidal marsh would have the highest organic matter content of hydric soils in the County.

Nitrogen undergoes some chemical transformations and may be taken up in soluble form, absorbed by plants through their roots, or consumed by anaerobic microorganisms that convert the nitrogen to organic matter (Mitsch and Gosselink, 2000). Anaerobic microbes may also convert the nitrogen from a nitrate form to nitrogen gas. Phosphorus is often bound to clay particles, and these fine sediments are transported into wetlands by riparian flooding and tidal action. Phosphorus may be stored in a wetland attached to the clay particles, however, phosphorus becomes available for plant uptake in its soluble form after flooding, saturation and anaerobic conditions typical of a wetland occur. Nutrient processes vary seasonally. Cooler temperatures slow microbial activity and plant uptake while higher flows of water transport more materials out of non-isolated wetland systems. The transported organic material is critical for downstream food chain support.

Tidal wetlands are highly effective sinks and/or transformers of nutrients, as nutrients are taken up and stored by plants or released as nitrogen gas into the atmosphere. However, the uptake and transformation occurs on a seasonal basis during the growing season. At the end of the growing season, as plants die and decompose, nutrients are released back into the aquatic system.

Wetlands are most effective at nutrient transformation and uptake when there are seasonal fluctuations in water levels (Tiner and Burke, 1995). Wetlands that are temporarily flooded (saturated or inundated for brief periods early in the growing season) and those that are permanently inundated would generally be less effective than seasonally wet areas (saturated or inundated for longer periods during the early-mid growing season but are drier by the end of the growing season).

Toxics Retention

Retention of heavy metals has been reported most often in studies of tidal wetlands, though most wetlands are believed to serve as sinks for heavy metals. Accumulation is primarily in soils, with plants playing a more limited role (Mitsch and Gosselink, 2000). Plants such as cattails, bulrushes, and *Phragmites* are among the more effective and commonly used plants for uptake of toxic materials such as metals. As is the case for nutrient transformation and sediment retention, soil characteristics, landscape position, vegetation, and hydrology all contribute the relative ability of a wetland to retain toxic materials. The longer the duration that water and transported materials remain in the wetland, the greater the likelihood that the materials will be retained. Many wetlands have been constructed as part of stormwater management facilities to treat surface runoff.

Sediment Reduction

Wetlands along rivers, streams and coastal areas are important for removing sediment from surface and tidal waters. During large flood events, rivers frequently overtop their

banks and water flows through adjacent floodplains and wetlands. Flood waters carry large volumes of suspended sediment, mostly fine sand, silt and clay. Because floodplains and wetlands provide resistance to flow - from dense vegetation, microtopography, and woody debris - the flow of water is slowed and sediment is deposited and stored in these areas. Similarly, coastal marshes and estuaries retain sediment brought in by tides and residual suspended sediment from rivers.

Lack of dense vegetation in some floodplains, and narrow width of floodplains, would reduce the ability of wetlands to slow velocities of floodwaters and allow settling of transported sediments.

Tidal wetlands are not extensive in Harford County, though there are large contiguous expanses of tidal and nontidal wetlands on Aberdeen Proving Ground and Otter Point Creek. Due to the width of these areas, the area would likely be one of the most effective at stabilization of shoreline sediments.

Wildlife Habitat/Biodiversity

Wetlands provide important habitat for fish, wildlife, and plant species, including rare species. While vegetated wetlands are not extensive along the Susquehanna River shoreline due to the steep adjacent slopes, they provide supporting habitat to the unvegetated intertidal zone and several rare species found there. Vegetated wetlands also provide important shade to the natural cold water trout streams in the Piedmont region of Harford County.

The County contains potential habitat for the endangered bog turtle. The turtles favor saturated, emergent wetlands such as those found in pastures.

Chesapeake Bay Critical Area Overlay District

Harford County “prohibits the alteration of nontidal wetlands of 40,000 square feet or greater, as well as requiring the retention of a 75-foot buffer around them. Protection will also be provided to notidal wetlands regardless of their size that are found to be hydrologically connected through surface or subsurface flow to streams, tidal waters, and/or determined to be of special importance to fish, wildlife or plant habitat by appropriate federal, State and local agencies” (Harford County, 2002).

Nontidal Wetlands of Special State Concern

There are several State-designated Wetlands of Special State Concern within this County. Specific information on these wetlands is discussed in that individual watershed section.

There are several additional Habitats of Local Significance as designated by Harford County (Harford, 2002), that should be high priority for protection. Specific locations are described in the individual watershed section. Other Habitats of Local Significance as designated by Harford County include:

- Lower Winters Run
- Restoration
 - Non-structural shore erosion control measures
 - Buffers in Deer Creek
- Preservation
 - Wetlands on potential natural park sites
 - Swan Creek Marsh
 - James Run/Bush Creek Marsh
 - Church Creek Marsh
 - Otter Point Creek
 - Habitats of Local Significance
 - Riparian forested buffers (greater than 300 feet in width)
 - Forest Interior Bird Dwelling Habitat
 - Nontidal Wetlands of Special State Concern

Wetland Restoration Considerations

Hydric soils suggest where wetlands are currently or were historically. There are some hydric soils that are not mapped wetlands (based on MDP Natural Soil Groups GIS data and NWI/DNR wetlands). Hydric soils that are not currently wetlands may be good potential sites for wetland restoration.

Wetland restoration and preservation may be another useful tool for achieving TMDL requirements. Wetland restoration designed to achieve maximum water quality benefits towards the TMDL should be focused at the head of tide and upstream. The headwater zone of tidal waterbodies tends to be the location of maximum algal concentrations for several reasons. The tidal headwaters are more stagnant because they tend to be shielded from the wind-generated mixing. This zone is also the depositional area of nutrients from the tidal river's primary nontidal stream system. Finally, this area tends to be shallow. As a consequence, the water tends to be slightly warmer, which increases the rate of algae growth. Additionally, less water volume is available to dilute nutrient fluxes from the bottom sediments (George, 2006, pers. comm.).

Vegetated stream buffers have the potential to intercept and remove nutrients, sediments, and other pollutants. Peterson et al. (2001) found that the smallest headwater streams, which are often found in association with springs and groundwater discharge wetlands, have the most rapid uptake and transformation of inorganic nitrogen (ammonium and nitrate) in comparison with other surface waters. The authors believed that the large surface to volume ratio in small streams resulted in rapid nitrogen uptake and processing. An excess of discharges to overload these systems would result in nitrogen being transported farther down the drainage systems to rivers and estuaries. Forested stream buffers can also improve down stream biodiversity by contributing organic matter to the food web, providing woody debris which increases diversity of physical habitat, and reducing stream temperature. Headwater streams are thought to be the most beneficial at these processes. Therefore, wetlands adjacent to streams should be high priority for restoration/preservation, with emphasis on headwater stream systems. Wetlands adjacent

to Scenic Rivers and around all tributaries of waterways used for drinking water (COMAR Use P) should also be ranked higher.

DNR assessed the development risk for all land within Maryland. Wetlands within areas of high development risk should be higher priority for preservation.

In order to maintain water quality of surface water reservoirs, wetlands within the watersheds of surface water reservoirs should be higher priority for preservation.

Wetland restoration may be more desirable in land uses that contribute high pollution, currently provide relatively low amounts of biodiversity, and are easy to convert to wetlands. As a general rule, agriculture fits these criteria more than other land use types. Forested land is generally not as high of a pollutant source and it also provides better habitat for plants and wildlife. For these reasons, converting upland forest to wetland may provide fewer benefits than converting agriculture to wetlands. However, projects that have converted artificially drained forest to wetland have resulted in beautiful wetlands with diverse ecology. Additionally, wetlands may be built in urban land use, but they are generally much smaller and sometimes more costly. Urban areas may provide good potential for wetlands designed for storm water management.

MDE has designated some areas as Wellhead Protection Areas (WPAs). In some WPAs, the water table is near the surface, with only a few feet of soil to filter any water entering the ground. Excavation of a few feet would significantly reduce the filtering capacity of the soil, allowing the wetland to act as a direct pathway for nutrients and other pollutants to enter the groundwater. Therefore, wetland creation designs within WPAs should consider the impact to groundwater quality.

Sensitive Resources

The 1992 Planning Act requires the local jurisdictions to address seven “Visions”:

- Development should be focused in suitable areas
- Protect sensitive areas
- In rural areas, protect resources and direct growth to existing population centers
- Protect the Chesapeake Bay and the land
- Conserve resources and reduce consumption
- Encourage economic growth and provide regulatory means to achieve the above visions.
- Provide funding options to achieve the above visions.

To address the above “Visions,” local jurisdictions must develop a sensitive areas element plan as part of their master plan process. This plan should address protecting streams and their buffers, 100-year floodplains, threatened and endangered species habitats, and steep slopes.

The Harford County Natural Resources Element Plan address five main goals. Relevant portions of these recommendations follow:

- Resource Protection and Growth Management. Direct growth away from sensitive areas, including Leight Park, Swan Harbor Park, Forest Greens conservation easement, Harford Glen Environmental Education Center, Bush Declaration Area, and the State Parks. Improve management of environmental areas.
- Protection of “Sensitive Area” Resources. Maintain and improve stream health and water quality by protecting existing environmental areas (as discussed above) and maintaining adequate vegetated stream buffer widths. Improve floodplain protection by leaving them in their natural State or in agriculture where possible. Protect steep slopes. Steep slopes occupy roughly 19% of the County, excluding Aberdeen Proving Ground. Protect and manage habitats of rare, threatened, and endangered species. This also includes protecting serpentine soils that have a high potential for containing RTE species. The DNR Natural Heritage Program’s Conservation Database lists 9 animal species and 64 plant species within this County as being RTE. These species are found within 58 rare habitat locations. There are also many rare bog turtle habitats (Harford County, 1998). Native trout are located in Deer Creek and Little Gunpowder Falls. Both these streams have forested buffers. (Harford County, 1998).
- Protection of Water Resources, including quality and quantity. Implement watershed-based natural resource planning. Watershed studies have been completed for Swan Creek and Bynum Run. These studies identified possible projects to improve water quality in the stream and stormwater retrofits. Protect wetland resources, including developing a wetland mitigation bank. The Natural Resource District regulates nontidal wetlands greater than 40,000 square feet and their 75-foot buffer. Protect the Chesapeake Bay. Harford County protects the stream buffer (75 to 150 foot from centerline of stream, depending on drainage area of stream). The County currently has high-quality groundwater (Harford County, 1998).
- Protection of Woodlands, Greenways, and Wildlife Habitat Connections. This includes implementing the Deer Creek Scenic River Plan.
- Preservation and Improvement of Air Quality.

In the original mapping of the Critical Area in 1988, Harford County chose to expand their Critical Area to include (Harford County, 2002):

- Some contiguous nontidal wetlands.
- Protection for RTE species and Habitats of Local Significance.
- 100-year floodplain in some cases or the County’s Natural Resources District.
- Certain contiguous parks.
- Headwaters of tributary streams already included in the Critical Area.

Numerous sourcewater assessments (SWAs) were conducted for water supplies within this County. For small community water systems located throughout the County, they were susceptible to nitrates, VOCs, SOCs, microbiological contaminants, and naturally occurring radon. The sourcewater assessment for transient non-community water systems, wells withdrawing from unconfined and semi-confined aquifers, were susceptible to nitrates, microbiological contaminants, and VOCs (at a few wells). Other

SWAs describing water systems within a particular watershed are described in that watershed section.

The County's wastewater treatment plants at Sod Run and Joppatowne have been upgraded for Biological Nitrogen Removal (BNR) to improve nutrient reduction.

Stream assessments have been completed for Swan Creek, Bynum Run, Foster Branch, Winters Run, Little Gunpowder Falls, James Run, and Church Creek. These stream corridor assessments resulted in many capital improvement projects, including several stream restoration projects (Moose Lodge, Perry Avenue, Plumtree Run, Woodbridge, Bynum Ridge, Riverside, and Joppatowne HS) and stormwater retrofits (Harford County, 2004). An additional stream corridor assessment is currently underway through the WRAS process for Deer Creek.

Harford County designated certain sensitive areas within the critical area as Habitats of Local Significance (HLS) areas. These areas were adopted in the County's Critical Area Program Appendices. Areas identified include several Eagle's nests, mostly along the Susquehanna River and Aberdeen Proving Ground. Other critical habitat for RTE species are scattered throughout the County, mostly along the major waterways (Harford County, 2004).

Other Relevant Programs

Green Infrastructure and Greenways

Green infrastructure hubs and corridors run throughout the County, with the largest Green Infrastructure hub in the southern portion of the County, protected by Aberdeen Proving Ground. Areas within the Green infrastructure network that are currently unprotected should be protected. There are also small sections of green infrastructure considered to be "gaps," currently in development, agriculture, or barren land. It is desirable to restore these areas back to natural vegetation, as they can provide a wildlife corridor, a protective buffer, and may be especially important along the waterways. For more detailed information, refer to section on the individual watershed.

Ecologically Significant Areas

DNR designates areas that contain habitat for rare, threatened and endangered species and rare natural community types. These areas are buffered to create the "sensitive species project review areas" GIS layer, intended to assist in assessing environmental impacts and reviewing potential development changes. This layer generally includes designated Natural Heritage Areas, Wetlands of Special State Concern, Colonial Waterbird Colonies, and Habitat Protection Areas.

Natural Heritage Areas

There are no designated State-designated Natural Heritage Areas (NHA) located in this County.

Rural Legacy

Designated rural legacy lands are located in two parts of the County, along Deer Creek and Little Gunpowder River. For detailed information about the program, refer to the individual watershed sections.

Priority Funding Areas

The main Priority Funding Areas are located in the southeast portion of the County, running from Bel Air south along the Rte. 24 corridor to Rte. 40 and the entire northeast span of the County, along the Rte. 40 corridor (connecting Joppatowne with Aberdeen and Havre de Grace).

Stakeholders in wetland management may have conflicting goals for wetlands in Priority Funding Areas. Some may advocate preserving wetlands in these areas as greenways, for aesthetics, or as unique communities in a developing area. Other interests may seek flexibility and expedited review of proposals to impact wetlands due to other goals for growth and economic development in a designated area. There may be benefits to protecting and restoring wetlands for water quality in a growth area, particularly as an offset against future or existing TMDLs. Preservation of biodiversity may be more of a challenge due to possible increases in nonpoint source pollution and fragmentation. Stormwater management associated with growth may also reduce certain nonpoint source impacts to wetlands in PFAs.

Protected Land

In the 1990's the County purchased almost 800 acres of bay-front property with approximately 13,770 feet of shoreline for preservation and appropriate passive use. Harford County is also the location of the Otter Point Creek National Estuarine Research Reserve, one of three Chesapeake Bay National Estuarine Research Reserve sites in Maryland. Included in the 690 acre Research Reserve are two land areas connected by water: Leight Park (93 acres), Bosley Conservancy (336 acres) and State-owned water (261 acres). A visitors' center at Leight Park, on Otter Point Creek, provides a teaching and learning center for this important resource, critical to the health of the Bay.

Throughout this document, we refer to "protected land" as County-owned, State-owned, Federally-owned, Maryland Environmental Trust easements, and private conservation land. We do not consider County agricultural preservation easements (22,700 acres) and Maryland Agricultural Land Preservation Foundation (MALPF) areas (12,000 acres) as "protected" for the purposes of this project. While these are important protected areas, the goal of these programs is for agriculture, which may or may not compliment wetland preservation.

Some properties are within agricultural easements. Some are permanent and some are shorter-term. There is some controversy about conducting wetland restoration within agricultural easements. Most would agree that it is desirable to preserve good farmland. However, properties within these easements may also contain spots of soil with lower productivity due to wetness. These low productivity spots may be a hassle to the farmer and may be good areas for wetland restoration. First, the property owner may be able to

benefit from an additional program for that low productivity area, resulting in the owner getting more money for the land and utilizing the land to its full extent. Since these property owners are already involved in a preservation program, they may be more likely to consider additional programs. Second, since some of these agricultural easements are temporary, after the agricultural easement expires, the land owner may decide to get out of agriculture, and a wetland program could help to preserve some of the land from development.

Watershed Restoration Action Strategy

A Watershed Restoration Action Strategy was completed for the Bush River watershed and one is currently being completed for Deer Creek watershed.

Watershed Information

Lower Susquehanna River Basin (021202)

The larger 27,000 mi² Susquehanna River drainage area encompasses portions of New York, Pennsylvania, and Maryland. Originating in central New York, it flows roughly 477 miles before emptying into Chesapeake Bay at Havre de Grace. Based on the total volume of water passing through the mouth of the Susquehanna River, it is the largest river on the east coast. It is also the largest tributary to the Chesapeake Bay, providing about half of the freshwater, 40% of the sediment, 39% of the nitrogen, and 24% of the phosphorus to the Bay.

The Lower Susquehanna basin is the second largest sub-basin of the larger Susquehanna River drainage. The Lower Susquehanna River basin is located within Harford, Cecil, and Baltimore Counties. Of the 5,809 mi² in the Lower Susquehanna River Basin, 275 mi² are in Maryland. The Maryland portion lies entirely within the Piedmont Upland Physiographic Province, characterized by rolling uplands with broad hills and steep-sided valleys. Land uses in the basin are primarily agriculture and forest. The Lower Susquehanna River, Deer Creek, Octoraro Creek, and Broad Creek are all within the basin. Eighty-five percent of Lower Susquehanna basin are small nontidal headwater streams. The Lower Susquehanna River 6-digit watershed has four 8-digit watersheds in Harford County.

Susquehanna State Park and Palmer State Park, along with other wilderness areas in the basin, provide many recreational opportunities including hiking, camping, fishing, swimming, picnicking, and nature watching.

According to the 1999 document entitled *Lower Susquehanna Basin – Environmental Assessment of Stream Conditions*, the major impacts to non-tidal streams in this basin appear to be excessive nutrient enrichment and habitat degradation, likely due to a loss of riparian habitat. While all waterways met State water quality standards, fish and benthic Indices of Biotic Integrity showed evidence of biological impairment. Considering the continuing impacts to the system and the predicted changes in land use, population, and water demands, the streams will likely become more degraded. Implementation of best-

management practices (BMPs), such as riparian zone protection and reforestation, may reduce, but not eliminate these impacts.

Information on the individual 8-digit watersheds within the Lower Susquehanna River basin is as follows:

Lower Susquehanna River (02120201)

Background

Roughly half of this watershed is within Harford County, with the remaining portion in Cecil County.

The Susquehanna River originates in New York and drains an area of 27,548 mi², with only 1% being in Maryland. Near the area of the Susquehanna State Park, the river is about one mile wide and is fairly shallow with a high velocity. The water level fluctuates with the opening and closing of the gates to the Conowingo dam (DNR, 1979).

The main park areas are Susquehanna State Park and some parks in Havre de Grace. The Susquehanna State Park is partially located within this watershed, on the Susquehanna River, downstream of the Conowingo Dam.

Based on MDP 2002 GIS land use data, the Harford County portion of the Lower Susquehanna River watershed has 2,237 acres of open water and 7,560 acres of land. The land acres are divided as follows: urban 2,187 acres (29%), agriculture 2,503 acres (33%), and forest 2,871 acres (38%) (Figure 2).

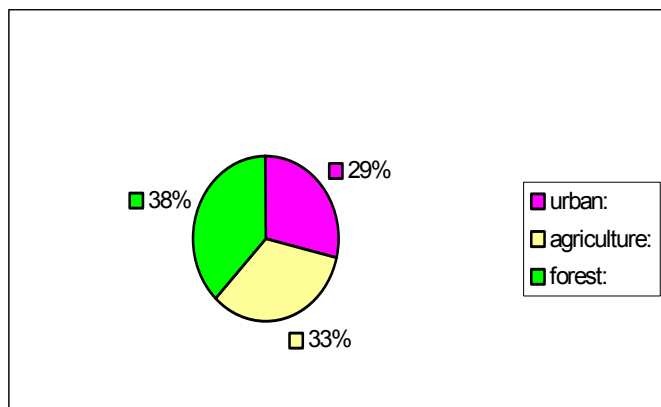


Figure 2. Land use in the Susquehanna River watershed.

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Palustrine
 - Aquatic bed: <1 acre
 - Emergent: 50 acres
 - Scrub shrub: 5 acres

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- Forested: 114 acres
- Unconsolidated bottom: 32 acres
- Unconsolidated shore: 1 acre
- Farmed: 8 acres
- Riverine unconsolidated shore: 2 acres
- Total: 212 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02120201	-3.99	5.70	0	0	1.70

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. All rivers, streams and tributaries in the Lower Susquehanna River watershed are designated Use I-P; water contact recreation, protection of aquatic life, and public water supply.

Water Quality

The Susquehanna River Basin Commission conducted a Source Water Assessment of the Susquehanna River. Harford County has two surface water plants that can draw water from the lower Susquehanna Sub-basin. Potential sources of contamination are agricultural land use, urban/residential development, boating activities, sewage effluent, major transportation corridors (highways, railroads) and nuclear power generating plants. It was determined that the water supply is susceptible to contamination by turbidity and sediment, microorganisms, inorganic compounds, organic compounds, disinfection byproducts, and radionuclides (Susquehanna River Basin Commission. 2003).

A sourcewater assessment and protection report was completed for Havre de Grace and Harford County water supplies by the Susquehanna River Basin Commission. Contaminants of potential concern in this area are turbidity, sediments, microbiological, disinfection byproducts, inorganic compounds, organic compounds, and radionuclides.

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It is also classified as a “Selected” Category 3, a pristine or sensitive watershed most in need of protection. Failing indicators include high percent impervious surface (12%). Wetland loss was estimated to be 3,273 acres. Indicators for Category 3 include high imperiled aquatic species indicator, migratory fish spawning areas, trout spawning areas, and the presence of five drinking water intakes.

According to the 2002 305(b) report, the tidal mainstem (Chesapeake Bay to Rock Run) fails to support all uses due to PCBs, while the nontidal mainstem (Rock Run to Conowingo Dam) fully supports all designated uses. A portion of the wadeable tributary streams fails to support all designated uses due to poor biological community from urban runoff and channelization.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Susquehanna River* (tidal); cadmium, nutrients, sediments, PCBs (in fish tissue).
- *Susquehanna River Unnamed Tributary* (021202010319 non-tidal in Cecil County); poor biological community.
- *Herring Run* (021202010318 non-tidal in Harford County); poor biological community.

A Draft Water Quality Analysis was completed in 2005 for eutrophication in the Tidal Lower Susquehanna River. This analysis found no impact to the designated uses due to high levels of nutrients and the dissolved oxygen criteria was met. Therefore, they recommend removal of the tidal Lower Susquehanna River from the 303(d) List for eutrophication (MDE, 2005).

Restoration/Preservation

Green Infrastructure hub covers the entire waterfront section of the Susquehanna River, except around Havre de Grace (DNR, 2000-2003). A large section is protected by Susquehanna State Park, with a Green Infrastructure hub north and south of this park being unprotected.

According to the 2000 Maryland Greenways Commission document, an existing or proposed greenway is the Lower Susquehanna Heritage Greenway. This partially established trail system and corridor could provide a connection between the town of Havre de Grace, Susquehanna State Park and the Conowingo Dam as well as towns and natural areas on the shoreline in Cecil County.

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review*. Lower Deer Creek includes approximately 15,900 acres. This area is currently largely undeveloped (81%). This area was chosen in order to protect Deer Creek water quality and the rural Lower Deer Creek valley. The goal is to protect 13,202 acres (83%). Currently, 10,250 acres (64%) of this land is protected through various methods. The sponsor is Harford County. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements.

There are several State-designated Wetlands of Special State Concern (WSSC) in this watershed, described as follows:

- *Northern Susquehanna Canal*. This wetland in the Critical Area is a mature floodplain community with well-developed shrub and herbaceous layers. A State rare fern and several State endangered herbaceous species are found on the site. The site also provides habitat for forest interior dwelling birds. Management recommendations include preserving the canopy, protecting endangered species or forest interior bird habitat, and avoiding herbicide or pesticide use. The site overlaps the protection area for the federally endangered Maryland Darter (Harford County, 2002). While Critical Area regulations do provide some protection, this site is not preserved.
- *South Lapidum*. This site includes a portion of the Susquehanna River shoreline and several tributaries. Forested floodplain, emergent marsh, and open water areas are part of the community types. State endangered and threatened plant species and a State endangered reptile are found on site. The site also provides forest interior dwelling bird habitat and supports small stands of hemlock. Management recommendations include preserving the forest canopy, preventing adverse sediment and stormwater impacts and protecting water quality (Harford County, 2002). This site is mostly within Susquehanna State Park, with the exception of a linear portion following a tributary of the Susquehanna River.
- *Stafford Road Slopes*. This area is located along the Susquehanna River in the Critical Area. The slopes have a north-east exposure unique to the Piedmont region in Maryland. The site has a cool microclimate that supports a watchlist amphipod, two rare or threatened plant species, and dense wildflowers. Retention of the forest cover is necessary to maintain the microclimate and species composition (Harford County, 2002). This site is within Susquehanna State Park.
- *I-95 Crossing*. This site is on the shoreline of the Susquehanna River and contains diverse wetland habitats and a State endangered reptile. Hemlocks and forest interior birds are also present. Management recommendations include preservation of the forest canopy, preservation of the cool microclimate in the hemlock stands and prevention of adverse sedimentation and stormwater runoff in the wetlands. Another management concern is that expansion of an adjacent quarry would lower the groundwater table and alter wetland communities (Harford County, 2002). This site is partially unprotected.

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along the Susquehanna River.
- Protect WSSC and their buffers.
- Protect additional wetland areas designated as Ecologically Significant Areas.
- Protect area within the Rural Legacy Area.
- Protect wetlands and streams within the headwaters.

Deer Creek (02120202)

Background

The Deer Creek watershed is in the northern part of Harford County, with only a small portion in Baltimore County. Based on MDP 2002 GIS land use data, the Harford County portion of the Deer Creek watershed has 71 acres of open water and 86,866 acres of land. The land acres are divided as follows: urban 12,562 acres (14%), agriculture 47,099 acres (54%), forest 27,108 acres (31%), and barren land 97 acres (<1%) (Figure 3). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead. No large cities are within the watershed.

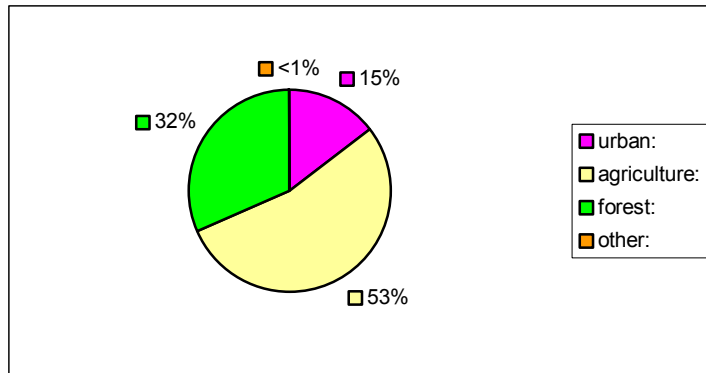


Figure 3. Land use in the Deer Creek watershed

The Susquehanna River originates in New York and drains an area of 27,548 mi², with only 1% being in Maryland. This River and its tributaries contribute about 75% of the freshwater entering the Bay (DNR, 1979).

A portion of Susquehanna State Park is located within this watershed. This park is on the Susquehanna River, downstream of the Conowingo Dam.

According to the 1978 document entitled *Deer Creek Scenic River*, Deer Creek is a healthy trout stream, but is threatened by sediment, development (increased water demand, development within the valley, and reduced farming), and water-oriented recreation.

A Watershed Restoration Action Strategy is currently being conducted for this watershed.

The Maryland General Assembly designated Deer Creek as a scenic river. Deer Creek is within the Piedmont Province. The headwaters begin in Pennsylvania and it empties into the Susquehanna River. The landscape of Deer Creek retains much of its unique historical character. The following management recommendations were made in the 1978 document entitled *Deer Creek Scenic River* for each unique landscape type:

- Bogs
 - Preserve the natural condition within a wildlife sanctuary
 - Recreation: bird-watching, botanizing
 - The County should develop an inland wetlands protection plan
- Gorge

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- Preserve the natural rugged character of the gorge
- Relocate parking and prohibit parking along the gorge
- Improve road safety
- Recreation: since this is a dangerous area, increase supervision of the river front
- Mill pond
 - Restore and maintain historical structures
 - Acquire easements for public access and canoe portaging
 - Maintain stable water level in mill pond
 - Recreation: swimming, ice-skating, fishing, archeology
- Tidewater
 - Stabilize streambanks to minimize erosion
 - Establish parking areas away from stream
 - Revitalize canal and other historical features
 - Provide for litter disposal
 - Recreation: Skate Park, designed for intensive use; boating, fishing, camping, hiking, bicycling, education, field games and picnicking
- Wooded torrent
 - Preserve delicate character of stream and forest
 - This area is suited for limited use recreation: hiking, contemplation
- Rural pool & Riffle
 - Provide public access at stream crossings
 - Maintain streambank vegetation for wildlife and fish cover
 - Respect private property
 - Recreation: scenic drives, bicycling, canoeing and rafting, trout fishing, inner tubing, landscape painting and photography
- Agricultural pool & Riffle
 - Revegetate denuded streambanks
 - Use sound agricultural practices (i.e. terracing, fencing animals from creek, careful application of fertilizer and pesticides)
- Suburban pool & Riffle
 - Avoid high density development
 - Adopt streamfront as open-space corridor used and maintained by the community
 - Establish buffer strip to reduce runoff
 - Recreation: wading, bank fishing, bicycling and other family activities
- Rural meander
 - Protect floodplain from development
 - Allow special features such as meander scars, natural levies, and sand bars to remain in their natural form
 - This area is suitable for crops and pasture
 - Recreation: canoeing, bird-watching and fishing

Estimates of wetland acreage for the entire Maryland portion of the watershed, based on DNR mapped wetlands, are as follows:

- Palustrine

Prioritizing Sites for Wetland Restoration, Mitigation, and Preservation in Maryland.
 May 18, 2006 - Maryland Department of the Environment

- Aquatic bed: 1 acre
- Emergent: 88 acres
- Scrub shrub: 8 acres
- Forested: 29 acres
- Unconsolidated bottom: 264 acres
- Unconsolidated shore: 1 acre
- Farmed: 6 acres
- Riverine unconsolidated shore: 5 acres
- Total: 402 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02120202	-0.97	2.11	0	0	1.14

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08:

- Use III-P, natural trout waters and public water supply:
 - Deer Creek and all tributaries, above the Eden Mill Dam
 - Kellogg Branch and all tributaries
 - North Stirrup Run and all tributaries
 - South Stirrup Run and all tributaries
 - Gladden Branch and all tributaries
 - Rock Hollow Branch and all tributaries
- Use IV-P, recreational trout waters and public water supply:
 - Deer Creek and all tributaries, from mouth to the Eden Mill Dam

Water Quality

Source water assessments were completed for some water supplies within this watershed. The water supply and susceptibility are as follows:

- *Hart* (unconfined aquifer): nitrates, radon, VOCs, and SOCs.
- *Queens Castle Mobile Home Park* (unconfined aquifer): nitrates, VOCs.
- *Community of Darlington* (unconfined aquifer): nitrates, VOCs, and SOCs.
- *Darlington Mobile Home Park* (unconfined aquifer): moderate susceptibility – VOCs and radon-222; low susceptibility – SOCs, inorganic compounds, other radionuclides, and microbiological contaminants.

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It is also classified as a “Selected” Category 3, a pristine or sensitive

watershed most in need of protection. Failing indicators include high nutrient concentrations, high percent unforested stream buffer (51%), and high soil erodibility (0.30). Wetland loss was estimated to be 4,665 acres. Indicators for Category 3 include high non-tidal instream habitat index, high non-tidal fish index of biotic integrity (FIBI), migratory fish spawning areas, trout spawning areas, and the presence of one drinking water intake.

According to the 2002 305(b) report, the lower mainstem creek fails to support all uses due to bacteria from agricultural runoff, natural sources, and unknown sources. The wadeable tributaries fully supports all designated uses.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- Plumtree Branch (021202020332); poor biological community.
- Deer Creek (021202020332); poor biological community.
- Deer Creek Unnamed Tributary 1 (021202020330); poor biological community.
- Deer Creek Unnamed Tributary 2 (021202020330); poor biological community.
- Ebaugh's Creek (021202020332 in Baltimore County); poor biological community.

Restoration/Preservation

Green Infrastructure hubs and corridors are scattered through this watershed, including Green Infrastructure hubs around Rocks State Park, Palmer State Park, Susquehanna State Park, and Deer Creek Park (DNR, 2000-2003). In addition to these protected areas, there are some County-owned properties (including Parker Conservation Area, Eden Mill Park, and Deer Creek Park) and METs. Many Green Infrastructure hubs are not protected. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation.

According to the 2000 Maryland Greenways Commission document, an existing or proposed greenway is called Deer Creek Scenic River. The Deer Creek Scenic River is a planned and partially protected greenways in northern Harford County along Deer Creek. This stream valley provides a wildlife corridor and water quality benefits and links several parcels of publicly owned land, including Susquehanna State Park, Rocks State Park, Palmer State Park and the County-owned lands at Eden Mill, Jolly Acres Road, and Sandy Hook Road.

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review*. Lower Deer Creek Valley Rural Legacy Area includes approximately 15,900 acres. This area is currently largely undeveloped (81%). This area was chosen in order to protect Deer Creek water quality and the rural Lower Deer Creek valley. Located adjacent to Palmer and Susquehanna State Parks, the plan is to protect a contiguous block of forested land and wildlife habitats with five miles of protected frontage along Deer Creek. The goal is to protect 13,202 acres (83%). Currently, 10,250

acres (64%) of this land is protected through various methods. The sponsor is Harford County. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements.

There are three State-designated Wetlands of Special State Concern (WSSC) in this watershed and several potential WSSC, described as follows:

- *Deer Creek Hillside*. The WSSC is contained within the Lower Deer Creek Macrosite in Susquehanna State Park and is comprised of a mature forest on steep slopes. A State threatened species is present and the forest provides water quality support to Deer Creek. Management recommendations include preventing trampling, prohibiting horseback riding in the protection area, and limiting timber harvest to removal of dead trees or trees that may cause safety hazards (Harford County, 2002).
- *Deer Creek Serpentine Barren*. This WSSC contains numerous rare plant species in the upland of prairie-like grasslands. Additional uncommon plants are found in the ravines around Deer Creek and an important Federally endangered fish is found in the stream. This site is surrounded by a large forest which provides habitat for many wildlife species, including forest interior dwelling species (DNR, 1991). This site is unprotected.
- *Northern Susquehanna Canal*. This WSSC wetland is the Critical Area is a mature floodplain community with well-developed shrub and herbaceous layers. A State rare fern and several State endangered herbaceous species are found on the site. The site also provides habitat for forest interior dwelling birds. Management recommendations include preserving the canopy, protecting endangered species or forest interior bird habitat, and avoiding herbicide or pesticide use. The site overlaps the protection area for the federally endangered Maryland Darter (Harford County, 2002). The small portion within this watershed that is designated WSSC is protected.
- There are numerous potential WSSC scattered throughout this watershed.

Other Habitats of Local Significance, as designated by Harford County include (Harford County, 2002):

- *Lower Deer Creek Macrosite*. This site includes Deer Creek and some of its tributaries and is in the Critical Area. This is the designated habitat area for the federally endangered Maryland Darter. The stream is generally surrounded by steep slopes and there are tidal and nontidal wetlands in the lower part of the protection area. Management recommendations include the preserving the protection area in its natural forested condition, with a 300-foot buffer around Deer Creek and a 100-foot buffer around tributaries. Use of pesticides and removal of trees in the 100-foot buffer should be prohibited. Sediment, nutrient, or stormwater runoff into Deer Creek should be avoided.
- *Northern Susquehanna Canal*. This wetland in the Critical Area is a mature floodplain community with well-developed shrub and herbaceous layers. A State rare fern and several State endangered herbaceous species are found on the site. The site also provides habitat for forest interior dwelling birds. Management recommendations include preserving the canopy, protecting endangered species

or forest interior bird habitat, and avoiding herbicide or pesticide use. The site overlaps the protection area for the federally endangered Maryland Darter. This site is unprotected.

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.
- Restore the scenic Deer Creek.
- Restore buffers along Deer Creek (Harford, 2002).

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along waterways.
- Protect WSSC and their buffers.
- Protect wetlands and streams within the headwaters.
- Protect areas designated as Habitats of Local Significance by Harford County.
- Protect additional wetland areas designated as Ecologically Significant Areas.
- Protect area within the Rural Legacy Area.
- Protect the scenic Deer Creek, including:
 - Bogs
 - Inland wetlands

Conowingo Dam (02120204)

Background

The Conowingo Dam watershed lies in the northeastern part of Harford County, and extends into Cecil County and Pennsylvania. Based on MDP 2002 GIS land use data, the Harford County portion of Conowingo Dam watershed has 1,657 acres of open water and 6,797 acres of land. The land acres are divided as follows: urban 1,085 acres (16%), agriculture 2,836 acres (42%), and forest 2,876 acres (42%) (Figure 4).

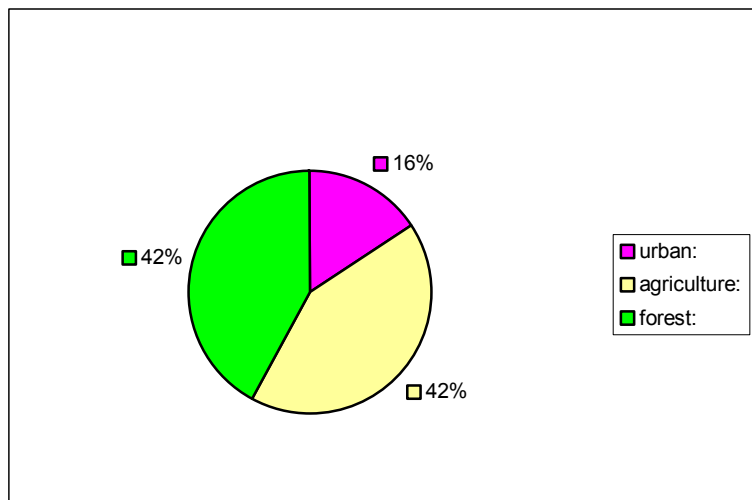


Figure 4. Land use in the Conowingo Dam watershed.

Estimates of wetland acreage for the entire Maryland portion of the watershed, based on DNR mapped wetlands, are as follows:

- Palustrine
 - Emergent: 3 acres
 - Forested: 4 acres
 - Unconsolidated bottom: 25 acres
- Total: 31 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight loss in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02120204	-0.07	0	0	0	-0.07

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. All streams and tributaries in the Conowingo Dam watershed are designated Use I-P, water contact recreation, protection of aquatic life, and public water supply.

Water Quality

Source water assessments were completed for some water supplies within this watershed. The water supply and susceptibility are as follows:

- *Clear View Mobile Home Park* (unconfined aquifer): nitrates, radon.
- *Community of Darlington* (unconfined aquifer): nitrates, VOCs, and SOCs.
- *Darlington Mobile Home Park* (unconfined aquifer): moderate susceptibility – VOCs and radon-222; low susceptibility – SOCs, inorganic compounds, other radionuclides, and microbiological contaminants.

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It is also classified as a “Selected” Category 3, a pristine or sensitive watershed most in need of protection. Wetland loss was estimated to be 895 acres. Indicators for Category 3 include high non-tidal instream habitat index, high fish index of biotic integrity (FIBI), high imperiled aquatic species indicator, and the presence of three drinking water intakes.

According to the 2002 305(b) report, a portion of the wadeable tributary streams (1 mile) fails to support all designated uses due to nutrients, bacteria, and poor biological community from sewage problems in Scotts Creek. There are plans to control this sewage problem (DNR, 2000 305b). The remainder of the wadeable tributaries fully support all

designated uses (6 miles) or had inconclusive data (8 miles). Conowingo Pool fully supports all designated uses.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The type of impairments are as follows: *Conowingo Dam Susquehanna River* (non-tidal); nutrients, sediments, biological. While this waterway is also listed for bacteria impairment, it does not need a TMDL for bacteria since other controls will likely result in attainment of water quality standards.

Restoration/Preservation

Unprotected Green Infrastructure hubs and corridors occur along the Susquehanna River, including a portion of a large hub around Lake Aaron Straus (DNR, 2000-2003).

There are no State-designated Wetlands of Special State Concern (WSSC) in this watershed.

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along the Susquehanna River.
- Protect wetlands and streams within the headwaters.
- Protect additional wetland areas designated as Ecologically Significant Areas.

Broad Creek (02120205)

Background

The Broad Creek watershed lies in the northern part of Harford County, with a small portion in Pennsylvania. Based on MDP 2002 GIS land use data, the Harford County portion of Broad Creek watershed has 114 acres of open water and 25,984 acres of land. The land acres are divided as follows: urban 3,518 acres (14%), agriculture 13,826 acres (53%), and forest 8,640 acres (33%) (Figure 5).

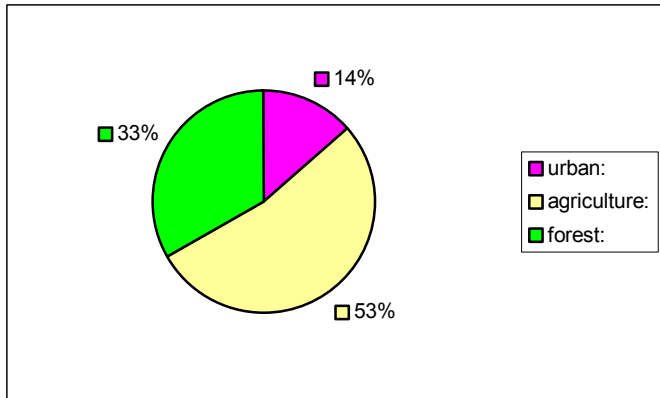


Figure 5. Land use in the Broad Creek watershed.

Estimates of wetland acreage for the entire Maryland portion of the watershed, based on DNR mapped wetlands, are as follows:

- Lacustrine unconsolidated shore: 9 acres
- Palustrine
 - Emergent: 13 acres
 - Scrub shrub: 1 acre
 - Forested: 2 acres
 - Unconsolidated bottom: 78 acres
 - Farmed: <1 acre
- Riverine unconsolidated shore: 1 acre
- Total: 106 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight loss in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02120205	-0.45	0	0	0	-0.45

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. All streams and tributaries in the Broad Creek watershed are designated Use I-P, water contact recreation, protection of aquatic life, and public water supply, except Deep Run and all tributaries, which is designated use III-P, natural trout waters and public water supply.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It is also classified as a Category 3, a pristine or sensitive watershed in need

of protection. Failing indicators include high nitrogen loading and high percent-unforested stream buffer (50%). Wetland loss was estimated to be 694 acres. Indicators for Category 3 include high-imperiled aquatic species indicator and trout spawning areas.

According to the 2002 305(b) report, data for the mainstem creek was inconclusive. Of the wadeable tributaries, the majority fully supports all designated uses (27 miles), while the remainder had inconclusive results (8 miles).

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Unnamed Tributary to Broad Creek* (021202050339 non-tidal); poor biological community.

Restoration/Preservation

A large Green Infrastructure hub, around Lake Aaron Straus, and connecting corridors occur in the southeastern portion of the watershed (DNR, 2000-2003), with some being unprotected. The area around Lake Aaron Straus is in the process of getting a Forest Legacy Easement protecting it from future development. Since some of the Green Infrastructure corridors are currently in agriculture, it may be possible to restore these sites to natural vegetation.

While there are no State-designated Wetlands of Special State Concern (WSSC) in this watershed, there are several potential WSSC scattered throughout.

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along waterways.
- Protect wetlands and streams within the headwaters.
- Protect additional wetland areas designated as Ecologically Significant Areas.

Bush River (021307)

A WRAS was completed for most of the 6-digit Bush River watershed. The following information is from that document. The 6-digit Bush River watershed is roughly 117 mi² and includes 520 stream miles (CWP, 2003). Over 25% of Harford County is located within this 6-digit basin, including the Town of Bel Air and about half of the City of Aberdeen. The majority of the watershed is within the Piedmont Plateau, while a small portion, southeast of Route 40, is within the Coastal Plain. The Bush River is a tidal estuary to the Chesapeake Bay, with major tributaries being Winters Run, Otter Point Creek, Bynum Run, James Run, Bush Creek and Church Creek. There are more than 520 stream miles. Land use is fairly evenly divided between forest, urban, and agriculture.

The population is 437 people per square mile, expected to increase by 25% over the next 20 years (Shanks, 2002).

Land use conditions within the 6-digit Bush River Basin, as Stated in the 2002 Bush River WRAS Characterization:

Land in the Bush River Basin has significant concentrations of development. Overall, the River Basin is about 35% developed. The most developed 8-digit watershed is Bynum Run (53% developed) and the least developed is Bush River (nearly 25%). Agriculture is a significant land use across the Bush River Basin except for Aberdeen Proving Ground. Agricultural land use involved 16 to 40% of the land in the other 8-digit watersheds. Overall, forest land covers more than one third of the Bush River Basin. Large concentrations of forest are found in the Aberdeen Proving Ground and Bush River watersheds. Relatively little remains in the Bynum Run and Atkisson Reservoir watersheds (about 23 and 28% respectively) (Shanks, 2002).

Wetlands cover large acreage of Aberdeen Proving Ground (about 16%) and significant acreage in the Bush River 8-digit watershed (over 7%). Compared to other Bush River Basin watersheds, Bynum Run watershed has the highest percent developed land and greatest extent of land identified for Priority Funding Areas in a Priority Funding Area. It also has the least protected land and forest interior (Shanks, 2002).

Drinking water for the Town of Bel Air and surrounding area are from Winters Run. Residents outside of this area using public drinking water get water from wells in the Church Creek and Deep Spring Branch subwatersheds. Private wells withdraw from other groundwater (CWP, 2003). The Aberdeen Proving Ground withdraws at its filtration plant in Edgewood.

A Bush River Watershed Management Plan (WAMP) was developed that includes data from the WRAS, aerial photos, and other GIS layers to prioritize restoration in the watershed. This plan is summarized in the WRAS strategy (CWP, 2003).

All of the watersheds in the 6-digit Bush River Basin are on the 303(d) list, with the exception of Lower Winters Run, suggesting widespread water quality problems. MBSS fish sampling rated about half of the stations as good and the other half as fair or poor. Sites ranked as very poor were located within the Aberdeen Proving Ground watershed. Fish consumption advisories have been issued due to high levels of PCBs and pesticides in channel catfish and white perch and methyl-mercury in lake fish. MBSS benthic sampling rated most sites as fair or poor. Benthic stations rated as good were found within Swan Creek watershed while most benthic stations within Aberdeen Proving were impacted (Shanks, 2002).

SAV populations in the river are very poor compared to the potential habitat, likely due to low light, high algal populations, high nutrients and high suspended solids (Shanks, 2002).

The WRAS characterization located preliminary sites for wetland restoration, using GIS data. Criteria used were as follows:

- hydric soils
- adjacent to existing wetlands or streams (preferably headwater streams)
- on agriculture or bare ground

For our current wetland prioritization, we incorporated additional factors into our GIS model.

After the initial GIS search for potential wetland restoration sites, Shanks (2002) suggests looking for interested landowner and for sites that would produce measurable results (e.g. focusing on one or a few tributaries or small watersheds).

A 2002 nutrient and biotic synoptic survey (Primrose, 2002) found generally low nutrient loads. High nitrate/nitrite concentrations were found in West Branch watershed, the middle of Bynum Run, upper James Run/Broad Run, and headwater streams above the reservoir, Bread and Cheese Branch, Long Branch, Hoops Branch, and an unnamed tributary to Elbow Branch. While the majority of subwatersheds had baseline orthophosphate concentrations, excessive concentrations were found at Broad Run and a headwater stream of Bynum Run. Macroinvertebrate samples ranged from good to very poor. Habitat assessments ranged from excellent to fair, with some of the habitat problems being stream bank erosion and sedimentation.

Subwatersheds were categorized and prioritized (Table 2). For “sensitive” subwatersheds, the goal is to preserve stream biodiversity and channel stability by protecting contiguous forest and enhancing riparian buffers. For “rurally impacted” subwatersheds, recommendations include preserving farmland, restoring riparian buffer, and reducing livestock access to stream (in Little East Bynum). In “impacted” subwatersheds, recommendations include education, stormwater retrofits, (including creation of shallow marsh), and protection of contiguous forest in Lower Winters Direct Drainage and Cranberry Run. For “impacted special resource” subwatersheds, recommendations include preserving wetland areas, stormwater retrofits, streambank stabilization in Haha Branch and Otter Point Creek DD, preserve contiguous forest in Haha Branch (CWP, 2003).

Grays Run subwatershed was ranked as the highest priority “sensitive” subwatershed. “Rurally impacted” subwatersheds were also considered high priority for restoration. These include Little East Bynum and West Branch subwatersheds. “Impacted” subwatersheds were ranked for restoration prioritization, with Middle Bynum, Lower Bynum, and Plumtree Run subwatersheds being high priority (CWP, 2003).

Category	Subwatershed
Sensitive	Grays Creek
Rurally Impacted	West Branch
	Little East Bynum
Impacted	Middle Bynum
	Lower Bynum
	Plumtree Run
Impacted Special Resource	Otter Point DD
	Bush Creek DD
	Church Creek DD
	Haha Branch

Table 2. Priority subwatersheds for restoration and preservation.

Information on the six individual 8-digit watersheds of the Bush River basin can be found below:

Bush River (02130701)

Background

The Bush River watershed lies in the south of Harford County. No big cities are situated within the watershed, although a small eastern part of Aberdeen lies within the borders.

Estuarine areas of the Bush River Basin may contribute to the important fish spawning and nursery of the Upper Chesapeake Bay. The Bush River water flushes out slowly, contributing to water quality problems (Shanks, 2002).

Based on MDP 2002 GIS land use data, the Bush River watershed has 8,889 acres of open water and 36,948 acres of land. The land acres are divided as follows: urban 9,766 acres (26%), agriculture 7,222 acres (20%), forest 17,194 acres (47%), wetlands 2,683 acres (7%) and barren land 83 acres (<1%) (Figure 6). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

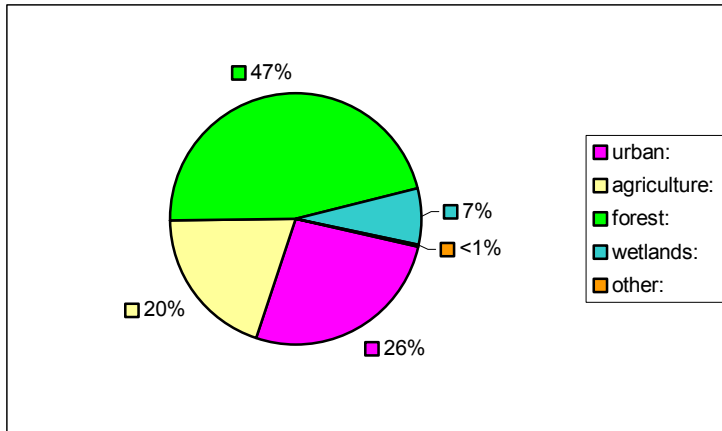


Figure 6. Land use in the Bush River watershed.

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
 - Emergent: 2,280 acres
 - Scrub shrub: 4 acres
 - Forested: 12 acres
 - Unconsolidated shore: 313 acres
- Palustrine
 - Aquatic bed: 10 acres
 - Emergent: 387 acres
 - Scrub shrub: 91 acres
 - Forested: 1,339 acres
 - Unconsolidated bottom: 183 acres
 - Unconsolidated shore: 19 acres
 - Farmed: 9 acres
- Riverine unconsolidated shore: 1 acre
- Total: 4,647 acres

Two wetlands within this watershed were surveyed, one in Church Creek Direct Drainage and one in Bush Creek Direct Drainage. Both wetlands provide flood flow attenuation and filtering (CWP, 2003).

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130701	-8.40	10.19	0	0.76	2.55

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. All streams and tributaries in the Bush River watershed are designated as follows:

- Use I: water contact recreation, and protection of aquatic life:
 - Bush River and tributaries above line from Fairview Point to Chillbury Point
 - Romney Creek above Briar Point
- Use II: shellfish harvesting waters:
 - All estuarine portions of tributaries except Bush River from Fairview Point/Chillbury Point & Romney Creek above Briar Point

Water Quality

The sourcewater assessment for Greenridge Utilities water supply, withdrawing from an unconfined aquifer, found it was susceptible to nitrates and radionuclides.

The 1998 Clean Water Action Plan classified this watershed as “Priority” Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a “Priority” Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. Failing indicators include high nutrient concentrations, high phosphorus and nitrogen loadings, poor SAV abundance and habitat index, and high percent impervious surface (12%). Wetland loss was estimated to be 9,763 acres. Indicators for Category 3 include the presence of migratory fish spawning areas.

According to the 2002 305(b) report, the tidal mainstem river and tributaries fail to support all designated uses due to dieldrin, PCBs, nutrients, poor benthic community from natural sources and eutrophication. Of the nontidal, wadeable tributaries, a portion (29 miles) fails to support all uses due to poor biological community from habitat alteration, while the remainder (12 miles) had inconclusive data.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Bush River* (tidal) PCBs in fish tissue, sediments, nutrients.
- *Broad Run* (021307011129 non-tidal); poor biological community.
- *Cranberry Run* (021307011129 non-tidal); poor biological community.

For the one long-term water quality monitoring station, total nitrogen is fair (no trend), total phosphorus is fair (but degrading), algae is poor (and degrading), dissolved oxygen is good (no trend), water clarity is poor (no trend) and suspended solids are fair (no trend) (Shanks, 2002).

The most important point source discharge for nutrients within this watershed is Sod Run WWTP, discharging into the Bush River (Shanks, 2002).

Restoration/Preservation

Green Infrastructure hubs and corridors are spread through the watershed, with the largest hubs located around Aberdeen Proving Ground and the Maryland House Service Area/Stoney Forest Demonstration Area (DNR, 2000-2003). In addition to the above-mentioned protected land, there is the Bush Declaration NRMA, County-owned properties, and METs. A large portion of the northern Green Infrastructure hub (around Maryland House Service Area) is still unprotected. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation. According to the 2000 Maryland Greenways Commission document, an existing or proposed greenway is called Bynum Run/Winters Run Loop.

There are several State-designated Wetlands of Special State Concern (WSSC) in this watershed, all unprotected, described as follows (Harford County, 2002):

- *Church Creek Pond (DNR name: Grays Run)*. This site in the Critical Area includes a pond and adjacent woods. It once supported a State endangered plant. The site is also an aesthetically pleasing habitat adjacent to a highway.
- *Perryman Woods*. This site is adjacent to Bush River and contains tidal and diverse nontidal wetlands, and a number of vernal pools. Forest interior birds are also present. The site is bisected by a powerline and there is concern that use of herbicides under the powerline could result in adverse impacts to plants and wildlife. Other management concerns are use of insecticides and herbicides throughout the site and protection of forest cover. Removal of forest cover may increase spread of exotic species throughout the diverse communities that are present.
- *Willoughby Woods*. In 2002, this site was identified as the largest wooded tract along the Bush River shoreline. Forest interior birds are present and there are extensive vernal pool areas as well as emergent nontidal wetlands. Management concerns include preserving the forest canopy to protect forest interior birds and prevent invasion of exotic species. Use of herbicides and insecticides may also harm plants and wildlife.

Other Habitats of Local Significance as designated by Harford County include (Harford County, 2002):

- *Boyer Road Shoreline*: This site is on the Bush River shoreline in the Critical Area. There are three State endangered or threatened plant species in the intertidal zone of cobbles, sand, and mud. Management recommendations are to locate water dependent facilities outside of the rare plant habitat. Other considerations are that increases in sediment or runoff could adversely impact the rare plants.
- *Belcamp Beach*: This site is in the Critical Area and consists of shoreline, intertidal areas, and tidal marsh. Rare species are found in the intertidal zone in an uncommon substrate of cobble, sand, and mud. Management recommendations include the planting of additional native wooded vegetation.
- *Leight Park*: This site is part of Otter Point Creek shoreline and is a part of the Chesapeake Bay National Estuarine Research Reserve. The site contains a forested hillside and adjacent wetlands, including a tidal fresh and brackish

- marsh. The shoreline contains a sandy area for three rare plant species. Management considerations include protection against highway runoff and excessive foot traffic and erosion.
- Gray's Run: This site contains tidal and nontidal wetlands, streams, and their floodplain. A State rare rush is in the tidal wetlands. The site is near the Church Creek Habitat of Local Significance. Management recommendations include the preservation of existing hydrology in the wetlands, prevention of polluted runoff from entering the marsh, and avoidance of activities such as filling and development adjacent to the nontidal wetlands.
 - Otter Point Creek: Otter Point Creek is a designated part of the Chesapeake Bay National Estuarine Research Reserve. The site contains tidal fresh wetlands and forested and emergent nontidal wetlands. A State rare plant is also present. Management recommendations include monitoring of water quality, removal of multiflora rose, prevention of littering and eliminating harmful bike traffic.

Otter Point Creek is part of the National Estuarine Research Reserve. Research at this preserve has found that sedimentation within Otter Point Creek is resulting in marsh expansion. Another study reported that old sewage lagoons within this reserve are acting as nitrogen sinks (Shanks, 2002).

In a 1981 MDP document, Bush Creek Marsh, Church Creek, and Otter Point Creek Marsh were designated as Areas of Critical State Concern. Bush Creek Marsh, located at the mouth of Bynum Run, north and south of Rte. 40, provides important habitat for fish and wildlife. This system seems to have relatively low plant species diversity, possibly due to high rates of sedimentation. Church Creek Marsh is at the head of the Bush River, near Belcamp, extending up Church Creek. Plant diversity is higher than at Bush Creek Marsh. Various birds and mammals (including nutria) have been surveyed here. Otter Point Creek Marsh is located just north of the community of Edgewood. This is a large privately owned freshwater marsh that is still relatively undisturbed. The Smithsonian Institution noted the importance of this wetland in their report entitled *Natural Areas of the Chesapeake Bay Region* and recommended protection of this marsh and surrounding buffer. This site has fairly diverse vegetation, with many being of high wildlife value. Due to the high interspersion of vegetation type and high water to marsh edge ration, there is diverse habitat and food available. This area is also a spawning and nursery for anadromous fish. The marsh has a valuable water quality function, trapping a large amount of sediment and nutrients before it can flow into Otter Point Creek and Bush River. The adjacent sewage lagoons also provide good habitat for waterfowl and mammals (MDP, 1981).

A Stream Corridor Assessment was completed for Bush River.

A Special Area Management Plan (SAMP) was completed for the Perryman area to steer future development away from valuable wetland systems. This SAMP area is roughly 10 square miles and is between the town of Aberdeen and Abingdon. Wetlands within this area are mostly on broad flat lowland depressions and headwater areas. Assessments were completed only where property-owner permission was granted: 57 individual

wetlands within 24 wetland systems. Of the individual wetlands assessed, 64% of the total acreage was ranked as Outstanding. While there was a high acreage of wetlands ranked as Outstanding, this ranking class consisted of a low number of individuals. This suggests that a few large wetlands are comprising the majority of the highest function rating. Many of these high functioning, large wetland systems are located on areas of little development. Therefore, future development should avoid impacting these high functioning wetlands. Of the remaining assessed wetland acreage, 32% was rated Above Average and only 4% was rated Average. Within the SAMP boundary, five areas were designated as Habitat Protection Areas: Belcamp Beach, Grays Run, Perryman Woods, Boyer Road Shoreline, and Church Creek (Harford County and Greenhorne and O'mara, Inc, 2001).

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.
- Stream restoration as identified in the Bush River Stream Corridor Assessment (available through the County).
- Restore potential mitigation/enhancement sites as identified in the Perryman Special Area Management Plan:
 - K13 – This recently graded 1.9 acre site (within the City of Aberdeen near the intersection of Old Philadelphia Road and CSX railroad) may provide possible restoration/creation.
 - J9 – This recently graded 4.8 acre site (within the City of Aberdeen, south of the CSX railroad near the headwaters of Cranberry Run) may provide possible restoration/creation.
 - D5 – This 2.9 acre site (near Cranberry Run) may provide possible restoration/enhancement.
 - Q1 – This 3.8 acre site (near Cranberry Run) may provide areas for restoration/enhancement.
- Remove fish blockages (DNR Fish Blockages Database):
- Restore streams:
 - Gray’s Run (Carsins Run Road)
 - James Run (0.25 miles above I-95)
 - James Run (James Run Road)
 - Unnamed tributary (Gulf Road)
 - Unnamed tributary (0.3 miles below Rte. 159)

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along waterways.
- Protect WSSC and their buffers.
- Protect wetlands and streams within the headwaters.
- Protect areas designated as Habitats of Local Significance by Harford County.
- Protect additional wetland areas designated as Ecologically Significant Areas.
- Protect high functioning wetlands, as identified in the Perryman SAMP (Harford County and Greenhorne and O'mara, Inc, 2001).

- Protect wetlands within the Critical Habitat for Rare, Threatened and Endangered Species (Harford County and Greenhorne and O'mara, Inc, 2001):
 - L2 – within Belcamp Protection Area for Critical Habitat (designated by DNR). This intertidal estuarine wetland is 17.9 acres and turns into a tidal tributary of Church Creek. It contains two State-designated RTE plant species.
 - G1 – This seasonally flooded palustrine forested wetland is 34.5 acres and is dissected by Grays Run. This wetland scored high for plant and wildlife habitat and flood control potential. This wetland contains critical habitat for a State rare plant species and is within the Grays Run Protection Area for Critical Habitat (designated by DNR).
 - G4 – This temporarily flooded palustrine forested wetland is 1 acre and is within the headwaters of a tributary to Grays Run. This wetland contains critical habitat for a State rare plant species and is within the Grays Run Protection Area for Critical Habitat (designated by DNR).
- Protect high quality mature forest upland surrounding the wetland systems C (footslopes of Cranberry Run), D (interfluvial flats adjacent to Cranberry Run and tributary), G (Grays Creek and tributary), H (along Cranberry Run), I (headwaters of Cranberry Run), and R (headwaters of Cranberry Run) within the Perryman SAMP (Harford County and Greenhorne and O'mara, Inc, 2001).
- Protect Bush Creek Marsh, Church Creek, and Otter Point Creek.
- Preserve wetlands on potential natural park sites: James Run/Bush Creek Marsh, Church Creek Marsh (Harford, 2002).

Lower Winters Run (02130702)

Background

The Lower Winters Run watershed is situated in the southern part of Harford County, just west and north of the Aberdeen Proving Grounds. Based on MDP 2002 GIS land use data, the Lower Winters Run watershed has 69 acres of open water and 8,399 acres of land. The land acres are divided as follows: urban 3,602 acres (43%), agriculture 1,359 acres (16%), forest 3,275 acres (39%), and wetlands (2%) (Figure 7). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

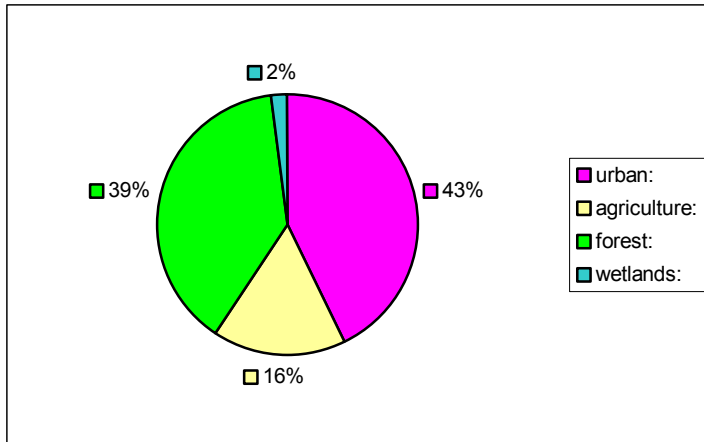


Figure 7. Land use in the Lower Winters Run watershed.

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
 - Emergent: 82 acres
 - Unconsolidated shore: 67 acres
- Palustrine
 - Emergent: 54 acres
 - Scrub shrub: 4 acres
 - Forested: 172 acres
 - Unconsolidated bottom: 39 acres
- Riverine unconsolidated shore: 3 acres
- Total: 422 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130702	-3.63	8.93	0	0	5.30

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life.

For this watershed, they are designated as follows:

- Winters Run and tributaries (from Otter Point Creek to upstream boundary of Atkisson Reservoir): Use I-P, recreation contact, protection of aquatic life, and potable water supply.
- All estuarine portions: Use II, shellfish harvesting.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include high nitrogen loadings, high percent impervious surface (18%), and high soil erodibility (0.33). Wetland loss was estimated to be 3,102 acres. Indicators for Category 3 include high imperiled aquatic species indicator, migratory fish spawning area, and the presence of one drinking water intake.

According to the 2002 305(b) report, wadeable creek and tributaries fail to support all uses due to poor biological community from urban runoff and hydromodification. Edgewater Village Lake fails to support all uses due to nutrients from urban runoff and unknown sources.

The DRAFT 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Edgewater Village Lake*; nutrients.
- *Winters Run* (021307021130); poor biological community.
- *Unnamed Stream* (021307021130); poor biological community.

Restoration/Preservation

There is one main Green Infrastructure hub, located in the southern part of the watershed, and several Green Infrastructure corridors running across the watershed (DNR, 2000-2003). The hub is protected by the Izaak Walton League. Other protected areas, outside of the Green Infrastructure network, are County-owned properties and METs. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation. According to the 2000 Maryland Greenways Commission document, an existing or proposed greenway is called Bynum Run/Winters Run Loop.

In a 1981 MDP document, Otter Point Creek Marsh was designated an Area of Critical State Concern. This site is located just north of the community of Edgewood. This is a large privately owned freshwater marsh that is still relatively undisturbed. The Smithsonian Institution noted the importance of this wetland in their report entitled *Natural Areas of the Chesapeake Bay Region* and recommended protection of this marsh and surrounding buffer. This site has fairly diverse vegetation, with many being of high wildlife value. Due to the high interspersed vegetation type and high water to marsh edge ratio, there is diverse habitat and food available. This area is also a spawning and nursery for anadromous fish. The marsh has a valuable water quality function, trapping a large amount of sediment and nutrients before it can flow into Otter Point Creek and Bush River. The adjacent sewage lagoons also provide good habitat for waterfowl and mammals (MDP, 1981).

Other Habitats of Local Significance as designated by Harford County include (Harford County, 2002): Otter Point Creek is a designated part of the Chesapeake Bay National Estuarine Research Reserve. The site contains tidal fresh wetlands and forested and emergent nontidal wetlands. A State rare plant is also present. Management recommendations include monitoring of water quality, removal of multiflora rose, prevention of littering and eliminating harmful bike traffic.

There are no State-designated Nontidal Wetlands of Special State Concern in this watershed (WSSC).

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.
- Remove fish blockages (DNR Fish Blockages Database).
- Restore streams
 - Lower Winters Run (50ft below Atkisson Dam)
 - Lower Winters Run (0.2 miles above Singer Road)

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along waterways.
- Protect wetlands and streams within the headwaters.
- Protect additional wetland areas designated as Ecologically Significant Areas.
- Protect Otter Point Creek Marsh (Harford, 2002).

Atkisson Reservoir (02130703)

Background

Atkisson Reservoir is in the western part of Harford County and includes the western portion of Bel Air. Based on MDP 2002 GIS land use data, the Atkisson Reservoir watershed has 55 acres of open water and 29,021 acres of land. The land acres are divided as follows: urban 10,666 acres (37%), agriculture 10,856 acres (37%), forest 7462 acres (26%), and barren land and wetlands (<1%) (Figure 8). Since estimates of wetland acreage based on this MDP data are often underestimated, DNR wetland estimates, as presented later in this document, should be used instead.

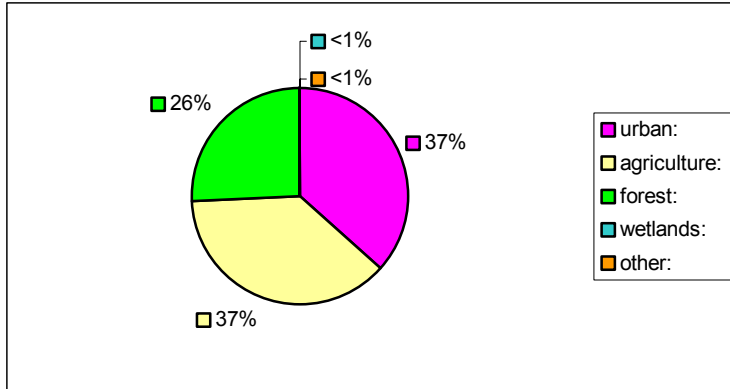


Figure 8. Land use in the Atkisson Reservoir watershed.

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Palustrine
 - Emergent: 22 acres
 - Forested: 28 acres
 - Unconsolidated bottom: 93 acres
 - Unconsolidated shore: <1 acre
- Riverine unconsolidated shore: 17 acres
- Total: 160 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130703	-4.94	9.33	0	0	4.40

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life.

For this watershed, they are designated as follows:

- Winters Run, tributaries, and Atkisson Reservoir (from Otter Point Creek to upstream boundary of Atkisson Reservoir): Use I-P, recreation contact, protection of aquatic life, and potable water supply.
- Winters Run and tributaries (above Atkisson Reservoir): Use IV-P, Recreational trout waters and potable water supply.
- All estuarine portions: Use II, shellfish harvesting.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include poor non-tidal BIBI, high percent impervious surface (10%), high soil erodibility (0.30), and being listed on the 303d list. Wetland loss was estimated to be 1,631 acres. Indicators for Category 3 include high non-tidal FIBI, high imperiled aquatic species indicator, and the presence of one drinking water intake.

According to the 2002 305(b) report, of the wadeable mainstem and tributaries, a portion fails to fully support all uses due to poor biological community from urban runoff, sewage/septic systems, and hydromodification. The remaining portion fully supports all uses.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Atkisson Reservoir*; sediments, nutrients.
- *Unnamed Tributary to West Branch Winters Run* (021307031133 non-tidal); poor biological community.
- *East Branch* (021307031134 non-tidal); poor biological community.
- *Plumtree Run* (021307031132 non-tidal); poor biological community.

Restoration/Preservation

Small linear Green Infrastructure hubs and corridors are located throughout the watershed (DNR, 2000-2003) and are largely unprotected, with the exception of Atkisson Reservoir and a small MET. Other protected land, outside of the GI network, includes County-owned properties. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation.

According to the 2000 Maryland Greenways Commission document, there are two existing or proposed greenways including:

- *Bynum Run/Winters Run Loop*. The Bynum Run/Winters Run Loop is a planned stream valley greenways in southwestern Harford County. This open space system is anticipated to provide a variety of environmental and recreational benefits, and some portions of the greenways may accommodate pathways and trails for hiking. Several County sites have been acquired along or near these stream areas, and developers have also set aside local open space for passive use in these sensitive areas. The State owns over 250 acres in the Bush Declaration Natural Resources Management Area along Bynum Run. Trail construction within homeowner association land has begun, and long-range planning efforts are underway. Winters Run borders the western edge of the development envelope, and protection of this corridor would provide an important buffer.
- *Ma and Pa Heritage Corridor*. When completed, the seven-mile trail will run from Heavenly Waters Park on Tollgate Road to Friends Park in Forest Hill. The

trail will provide connections to several small and regional parks, wildlife sanctuaries, and a proposed sculpture park.

There is one State-designated Wetlands of Special State Concern (WSSC) in this watershed located on Atkisson Reservoir, called Harford Glen. This site is a seep draining into a man-made lake. The seep supports an uncommon amphipod, a indicator species for good groundwater quality. Development has destroyed large areas of habitat for this amphipod (DNR, 1991). It is protected by Harford Glen Environmental Education Center. There are several additional potential WSSC in this watershed.

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.
- Remove fish blockages on Winters Run (25 yards above Rte. 1) (DNR Fish Blockages Database).
- Restore wetlands designed to improve water quality of water entering the reservoir.

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along waterways.
- Protect wetlands and streams within the headwaters.
- Protect additional wetland areas designated as Ecologically Significant Areas.
- Protect wetlands that function to improve water quality of water entering the reservoir.

Bynum Run (02130704)

Background

The Bynum Run watershed lies in the middle of Harford County. Most of the city of Bel Air is within this watershed. Based on MDP 2002 GIS land use data, the Bynum Run watershed has 6 acres of open water and 14,577 acres of land. The land acres are divided as follows: urban 8,089 acres (55%), agriculture 3,172 acres (22%), forest 3,184 acres (22%), and barren land 132 acres (1%) (Figure 9).

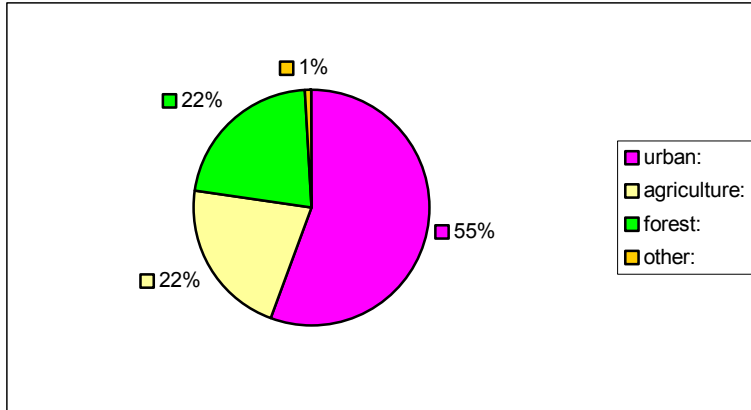


Figure 9. Land use in the Bynum Run watershed.

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Palustrine
 - Aquatic bed: 1 acre
 - Emergent: 6 acres
 - Scrub shrub: 1 acre
 - Forested: 78 acres
 - Unconsolidated bottom: 56 acres
 - Unconsolidated shore: 1 acre
- Riverine unconsolidated shore: 4 acres
- Total: 149 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight loss in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130704	-8.68	6.15	0	0	-2.53

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Bynum Run and tributaries: Use III: natural trout waters.
- All estuarine portions: Use II, shellfish harvesting.

Water Quality

Source water assessments were completed for some water supplies within this watershed. The water supply name and susceptibility are as follows:

- *Fountain Green Mobile Home Park* (unconfined aquifer): radon.
- *Greenridge Utilities* (unconfined aquifer): nitrates, radionuclides.

The 1998 Clean Water Action Plan classified this watershed as “Priority” Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a “Priority” Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. Failing indicators include high nitrogen loading, high percent impervious surface (21%), high percent unforested stream buffer (70%), and high soil erodibility (0.34). Wetland loss was estimated to be 3,321 acres. Indicators for Category 3 include high non-tidal fish index of biotic integrity (FIBI).

According to the 2002 305(b) report, non-tidal mainstem and tributaries fail to support all designated uses due to poor biological community and siltation from habitat alteration, poor streambank stability, and channelization.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Bynum Run* (non-tidal); sediments, nutrients.
- *Bynum Run* (021307041131 non-tidal); sediments.

Restoration/Preservation

A Stream Corridor Assessment was completed for Bynum Run in 1995-1996. Of the 784 potential problem sites identified, the most frequent was erosion (214 sites), followed by pipe outfalls (172 sites), fish blockages (143 sites), inadequate buffers (118 sites), channel alteration (71 sites), exposed pipe (24 sites), unusual conditions (23 sites), trash dumping (10 sites) and livestock present (9 sites) (Shanks, 2002).

Unprotected Green Infrastructure corridors run in the northern and southern portion of the watershed (DNR, 2000-2003). Protected areas include Bush declaration NRMA, a MET easement, and County-owned properties. Since some of the Green Infrastructure corridors are currently in agriculture, it may be desirable to restore these sites to natural vegetation.

According to the 2000 Maryland Greenways Commission document, there are two existing or proposed greenways including:

- *Bynum Run/Winters Run Loop*. The Bynum Run/Winters Run Loop is a planned stream valley greenways in southwestern Harford County. This open space system is anticipated to provide a variety of environmental and recreational benefits, and some portions of the greenways may accommodate pathways and trails for hiking. Several County sites have been acquired along or near these stream areas, and developers have also set aside local open space for passive use in these sensitive areas. The State owns over 250 acres in the Bush Declaration

Natural Resources Management Area along Bynum Run. Trail construction within homeowner association land has begun, and long-range planning efforts are underway. Winters Run borders the western edge of the development envelope, and protection of this corridor would provide an important buffer.

- *Ma and Pa Heritage Corridor*. When completed, the seven-mile trail will run from Heavenly Waters Park on Tollgate Road to Friends Park in Forest Hill. The trail will provide connections to several small and regional parks, wildlife sanctuaries, and a proposed sculpture park.

In a 1981 MDP document, Bush Creek Marsh was designated an Area of Critical State Concern. This area, located at the mouth of Bynum Run, north and south of Rte. 40, provides important habitat for fish and wildlife. This system seems to have relatively low plant species diversity, possibly due to high rates of sedimentation (MDP, 1981).

There is one State-designated Wetlands of Special State Concern (WSSC) in this watershed, Bynum Run. This wetland is a meadow with a relatively large population of a State-Threatened wildflower species requiring an open wetland habitat to thrive. This type of wetland opening was historically maintained by fires and flooding and have now become uncommon. The open herbaceous community here is maintained by periodic mowing. However, this mowing should be timed to allow the wildflower to complete its life cycle. This site also provides a natural stream buffer for upland runoff (DNR, 1991). This site is unprotected.

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.
- Remove fish blockages on Bynum Run (DNR Fish Blockages Database):
 - 1 miles below Wheel Road
 - 1 miles above Wheel Road
 - 0.8 miles above Wheel Road
 - 0.5 miles below St. Andrews Road
 - 0.1 mile below St. Andrews Road
 - 0.6 miles below Rte. 1
 - 0.7 miles below Rte. 23
 - Rt. 23

Specific recommendations for preservation:

- Protect Green Infrastructure.
- Protect WSSC and their buffers.
- Protect wetlands and streams within the headwaters.
- Protect additional wetland areas designated as Ecologically Significant Areas.
- Protect Bush Creek Marsh.

Aberdeen Proving Ground (02130705)

Background

The Aberdeen Proving Ground watershed lie in the southern part of Harford County. Based on MDP 2002 GIS land use data, the Aberdeen Proving Ground watershed has 1,845 acres of open water and 16,608 acres of land. The land acres are divided as follows: urban 8,070 acres (41%), agriculture 236 acres (1%), forest 8,302 acres (42%), and wetlands 3,172 acres (16%) (Figure 10). Note that wetland acreage is often grossly underestimated in MDP GIS data. A better estimate of wetland acreage is from DNR wetlands GIS data, as present later.

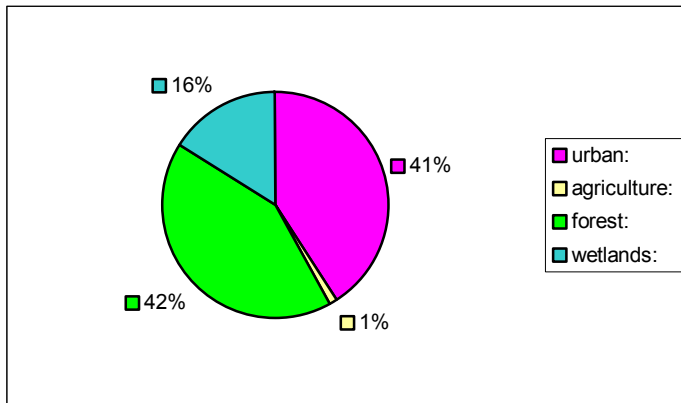


Figure 10. Land use in the Aberdeen Proving Grounds watershed.

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
 - Emergent: 2,438 acres
 - Scrub shrub: 2 acres
 - Forested: 4 acres
 - Unconsolidated shore: 314 acres
- Palustrine
 - Aquatic bed: 25 acres
 - Emergent: 584 acre
 - Scrub shrub: 190 acres
 - Forested: 1,262 acres
 - Unconsolidated bottom: 154 acres
 - Unconsolidated shore: 3 acres
- Total: 4,975 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight loss in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130705	-0.78	0.64	0	0	-0.13

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Romney Creek (above Briar Point): Use I recreation contact and protection of aquatic life.
- All estuarine portions except those listed above: Use II, shellfish harvesting.

Water Quality

A sourcewater assessment for City of Aberdeen found the water supply withdrawing from an unconfined aquifer was susceptible to VOCs.

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Failing indicators include high percent impervious surface (32%). Wetland loss was estimated to be 258 acres. Indicators for Category 3 include migratory fish spawning areas.

According to the 2002 305(b) report, data for the embayments and tidal tributaries (within Aberdeen Proving Ground) was inconclusive. Of the nontidal wadeable tributaries, a portion (16 miles) fails to support all uses due to poor biological community from urban runoff, while the remainder (8 miles) has inconclusive data.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- (tidal); toxics, sediments, nutrients
- *Romney Creek* (021307051126 non-tidal); poor biological community.
- *Romney Creek Unnamed Tributary* (021307051126 non-tidal); poor biological community.

This watershed appears on the 303(d) List of Impaired Waters. That means that pollution associated with nutrients, suspended sediment and/or toxic materials are preventing full use of these waters based on State criteria. For this 8-digit watershed, the impairments are Nutrients, Suspended Sediment and Toxic Substances with a natural character for both Point Source and Non-Point Source sources. Those three have a low priority. There is also a natural Non-Point Source Toxic Substance impairment that is classified with a priority of 18.

Restoration/Preservation

A large Green Infrastructure hub covers the southern portion of this watershed (DNR, 2000-2003). Another Green Infrastructure hub is located just south of the city of Aberdeen. Most of this area is on the Aberdeen Proving Ground.

While there are no State-designated Wetlands of Special State Concern (WSSC) in this watershed, there are some potential WSSC.

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along waterways.
- Protect additional wetland areas designated as Ecologically Significant Areas.
- Protect wetlands and streams within the headwaters.

Swan Creek (02130706)

Background

Swan Creek is in the east Harford County. The lower portion of Swan Creek is a small shallow tidal embayment. Based on MDP 2002 GIS land use data, the Swan Creek watershed has 729 acres of open water and 16,134 acres of land. The land acres are divided as follows: urban 5,368 acres (33%), agriculture 5,187 acres (32%), forest 5,451 acres (34%), wetlands (1%) and barren land (<1%) (Figure 11). Note that wetland acreage is often grossly underestimated in MDP GIS data. A better estimate of wetland acreage is from DNR wetlands GIS data, as present later.

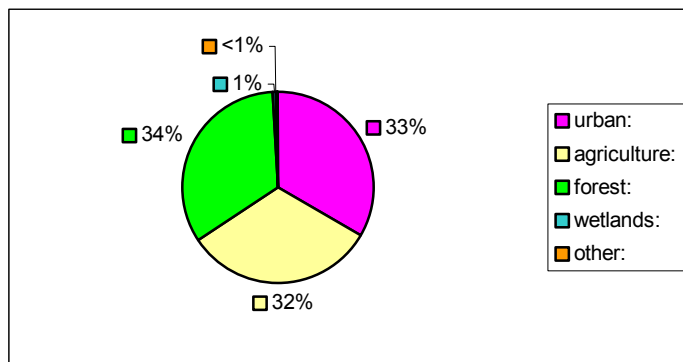


Figure 11. Land use in the Swan Creek watershed.

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
 - Emergent: 92 acres
 - Unconsolidated shore: 16 acres
- Palustrine
 - Aquatic bed: 3 acres
 - Emergent: 26 acres
 - Scrub shrub: 22 acres

Prioritizing Sites for Wetland Restoration, Mitigation, and Preservation in Maryland.
 May 18, 2006 - Maryland Department of the Environment

- Forested: 247 acres
- Unconsolidated bottom: 42 acres
- Unconsolidated shore: 1 acre
- Farmed: 17 acres
- Riverine unconsolidated shore: 1 acre
- Total: 465 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130706	-6.53	8.65	2.20	0	4.32

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Swan Creek and tributaries (above mouth): Use I, recreation contact and protection of aquatic life.
- All estuarine portions except those listed above: Use II, shellfish harvesting.

Water Quality

The sourcewater assessment for Swan Harbor Dell Mobile Home Park, a water supply withdrawing from an unconfined aquifer, found a high susceptibility to VOCs and nitrates, moderate susceptibility to SOCs, radon-222, and microbiological contamination, and low susceptibility to other inorganic compounds and other radionuclides.

The 1998 Clean Water Action Plan classified this watershed as “Priority” Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a “Priority” Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. Failing indicators include high phosphorus and nitrogen loadings, high percent impervious surface (14%), and high soil erodibility (0.33). Indicators for Category 3 include the presence of migratory fish spawning areas.

According to the 2002 305(b) report, data for the tidal mainstem and tributaries was inconclusive. Nontidal, wadeable tributaries fail to support all uses due to poor biological community from habitat alteration and hydromodification.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Swan Creek* (tidal); sediments. A TMDL has been completed for nutrients within this waterway.
- *Swan Creek* (021307061135 non-tidal); sediments.
- *Carsins Run* (021307061135 non-tidal); sediments.
- *Gasheys Run* (021307061135 non-tidal); sediments.

Swan Creek was identified on the State's 1996 list of Water Quality Limited Segments (WQLSs) as impaired by excess nutrients and suspended sediments. Total Maximum Daily Loads (TMDLs) were set for nitrogen and phosphorus in 2002 in Swan Creek. The suspended sediment impairment will be addressed at later date (MDE, 2002b).

In 1998, a stream and wetland corridor assessment was performed as part of U.S. Army Corps of Engineers requirements for an in-stream stormwater facility. Water quality, stream habitat, fish and benthic macroinvertebrates were initially examined at more than twenty sampling points. Sampled parameters included water temperature, pH, conductivity, total suspended solids, coliform levels, and nutrient levels. Fish and invertebrate sampling took place at a smaller number of stations. In a second field inventory, the entire watershed was walked by agency volunteers and information was collected for potential restoration and "problem" areas, such as unshaded stream segments, pipe outfalls, and evidence of erosion (MDE, 2003).

Restoration/Preservation

A linear Green Infrastructure hub is located west of Havre de Grace and corridors run across the watershed. Most of this area is unprotected, except County-owned properties, METs, and the northern tip of Aberdeen Proving Ground. Since some of the Green Infrastructure corridors are currently in agriculture, it may be possible to restore these sites to natural vegetation.

Wetlands of Special State Concern (WSSC) (Harford County, 2002).

- *Gashey's Run*. Gashey's Run and tributaries are designated habitat for the federally endangered Maryland Darter. Management recommendations include maintaining a minimum 300 foot buffer adjacent to Gashey's Run, avoiding use of herbicides and pesticides, and reducing sediment, nutrient, or stormwater discharge by maintaining the forest buffer. Gashey's Run was declared critical habitat for the Federally endangered Maryland darter by the US Fish and Wildlife Service in 1984. This designation, in part, means that the US Fish and Wildlife Service reviews activities that meet two conditions 1) a federal permit, license and/or funding is involved, and; 2) there is a potential to impact the species or its habitat. This site is partially protected by the County-owned Swan Harbor Farm Park.
- *Oakington Shore*. This site along the Chesapeake Bay includes streams, tidal and nontidal wetlands supporting an intertidal zone of an uncommon habitat type of

cobbles, sand, and mud. A rare plant species is found in the intertidal zone. This site is protected by the County-owned Swan Harbor Farm Park and a MET.

Other Habitats of Local Significance as designated by Harford County (Harford County, 2002) include: Swan Creek watershed. The above-mentioned 1998 stream and wetland corridor assessment revealed numerous stream restoration and some wetland creation opportunities. A 2.2 acre wetland (1.2 acres forested, 1 acre emergent) programmatic mitigation site was constructed in 1997 on agricultural land.

In a 1981 MDP document, Swan Creek Marsh was designated an Area of Critical State Concern. This tidal marsh is located along Swan Creek, southeast of the City of Aberdeen. A small portion is also located within Aberdeen Proving Ground. This area is largely undeveloped and provides important wildlife habitat. The mouth of Swan Creek contains a sandy delta, with an extensive tidal mudflat and marshes upstream. Due to the presence of desirable plant food, this area would provide prime waterfowl habitat during migration.

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.
- Remove fish blockages (DNR Fish Blockages Database):
 - Gashey’s Creek (0.2 miles below Chapel Road)
 - Gashey’s Creek (Chapel Road)
 - Swan Creek (0.1 miles above Rte. 40)
 - Swan Creek (100 feet above Oak Street)
 - Swan Creek (130 yards above Oak Street)
 - unnamed tributary to Gashey’s Creek (0.33 miles below Chapel Road)
 - unnamed tributary to Gashey’s Creek (Chapel Road)

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along waterways.
- Protect WSSC and their buffers.
- Protect wetlands and streams within the headwaters.
- Protect additional wetland areas designated as Ecologically Significant Areas.
- Protect wetlands on potential natural park sites: Swan Creek Marsh (Harford, 2002).
- Protect areas designated as Habitats of Local Significance by Harford County.

Gunpowder River (021308)

The Gunpowder River basin is located in Baltimore, Harford and Carroll Counties. Land use in the 478 square miles of the basin remains relatively rural (36% Agriculture, 35% Forest, 22% Urban and 7% Wetlands), but development pressure is significant and threatens the natural resources. About 1.5 million people receive their drinking water from two reservoirs on the Big Gunpowder Falls: Prettyboy and Loch Raven.

Easement purchases will fill in and round out an existing large block of preserved private lands enrolled in MET and MALPF easements. The Manor Area joins the Gunpowder Rural Legacy Area on the west, and extends across the Harford and Baltimore County boundary (DNR, 2003a).

The Gunpowder River 6-digit watershed has three 8-digit watersheds in Harford County. Information on the individual 8-digit watersheds is as follows:

Gunpowder River (02130801)

Background

The Gunpowder River watershed is within Harford and Baltimore Counties. Most of the Harford County portion of the watershed is within Aberdeen Proving Grounds. Based on MDP 2002 GIS land use data, the Gunpowder River watershed has 4,288 acres of open water and 8,150 acres of land. The land acres are divided as follows: urban 3,930 acres (48%), agriculture 282 acres (3%), forest 2,998 acres (37%), wetlands 923 acres (11%) and barren land 17 acres (<1%) (Figure 12). Note that wetland acreage is often grossly underestimated in MDP GIS data. A better estimate of wetland acreage is from DNR wetlands GIS data, as present later. Gunpowder Falls State Park is located along the stream valleys of Big and Little Gunpowder Falls.

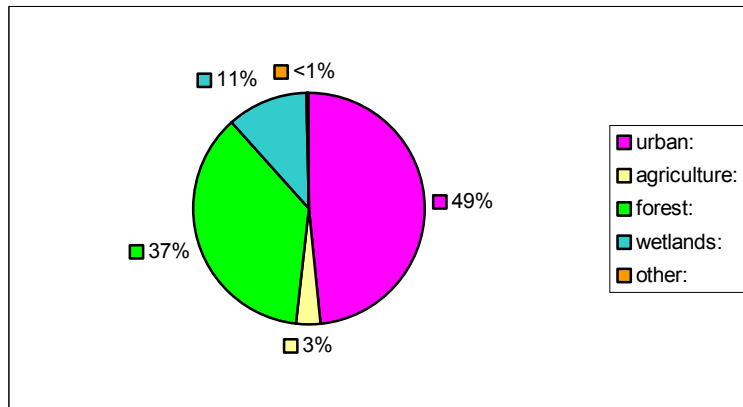


Figure 12. Land use in the Gunpowder River watershed.

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine
 - Emergent: 1,751 acres
 - Unconsolidated shore: 114 acres
- Palustrine
 - Aquatic bed: 3 acres
 - Emergent: 79 acres
 - Scrub shrub: 14 acres
 - Forested: 253 acres
 - Unconsolidated bottom: 138 acres

- Unconsolidated shore: 8 acre
- Total: 2,360 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130801	-1.05	7.19	0	0	6.14

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Gunpowder River and tributaries (above Oliver Point and Maxwell Point): Use I recreation contact and protection of aquatic life.
- All estuarine portions except those listed above: Use II, shellfish harvesting.

Water Quality

The sourcewater assessment for Williams Mobile Home Park, withdrawing from an unconfined aquifer, found the water supply was susceptible to VOCs, SOCs, and radon.

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include poor SAV abundance and habitat index, and high percent impervious surface (14%). Wetland loss was estimated to be 3,830 acres. Indicators for Category 3 include the presence of migratory fish spawning areas and trout spawning areas.

According to the 2002 305(b) report, tidal mainstem and tributaries fail to support all designated uses due to nutrients from natural sources and eutrophication. Results for nontidal, wadeable tributaries were inconclusive.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Gunpowder River* (tidal); poor biological community, nutrients, sediments.
- *Reardon Inlet Unnamed Tributary* (021308010293 non-tidal in Harford County); poor biological community.

Restoration/Preservation

Several Green Infrastructure hubs and corridors are located along the Little Gunpowder Falls River, mostly within Aberdeen Proving Grounds (DNR, 2000-2003). Other protected lands are a few small County-owned properties. According to the 2000 Maryland Greenways Commission document, an existing or proposed ecological greenway is called Little Gunpowder Falls.

In a 1981 MDP document, Gunpowder Delta Marsh/Day's Cove was designated an Area of Critical State Concern. This scenic site is located at the confluence of the Gunpowder River and Little Gunpowder Falls and includes tidal and nontidal wetlands and the surrounding upland hardwood forest. The delta transitions from floodplain to shrub swamp to tidal marsh. Excluding some mineral extraction and local archeological digs, the system is relatively undisturbed. This site provides important bird habitat and spawning area. In 1981, the primary threat to the system was from potentially extensive mineral mining (MDP, 1981). Days Cove is within Gunpowder Falls State Park.

There are no State-designated Wetlands of Special State Concern (WSSC) in this watershed.

An area designated as containing habitat of local significance by Harford County (Harford, 2002) is Lower Gunpowder Shore. This site consists of tidal wetlands and an adjacent upland forest as part of a recommended protection area. An intertidal zone of cobble, sand, and mud supports several State rare and one globally rare plant species. Management recommendations include eradication of *Phragmites* and stabilization of adjacent slopes to prevent erosion. Other considerations note that the rare plants may be adversely impacted by additional sediment and pollutant runoff and trampling.

Specific recommendations for restoration:

- Restore "gaps" in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along the Susquehanna River.
- Protect wetlands and streams within the headwaters.
- Protect additional wetland areas designated as Ecologically Significant Areas.

Little Gunpowder Falls (02130804)

Background

The Harford portion of the Little Gunpowder Falls watershed forms the boundary of Harford and Baltimore Counties.

The Little Gunpowder River ranges between 30-75 feet across (DNR, 1983).

Based on MDP 2002 GIS land use data, the Harford County portion of the Little Gunpowder Falls watershed has 42 acres of open water and 20,260 acres of land. The land acres are divided as follows: urban 5,315 acres (26%), agriculture 8,643 acres (43%), forest 6,238 acres (31%), and wetlands <1% (Figure 13). Note that wetland acreage is often grossly underestimated in MDP GIS data. A better estimate of wetland acreage is from DNR wetlands GIS data, as present later.

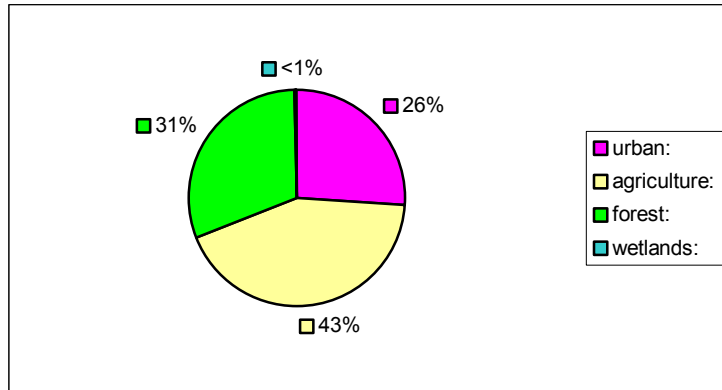


Figure 13. Land use in the Little Gunpowder Falls watershed.

Gunpowder Falls State Park is located along the stream valleys of Big and Little Gunpowder Falls, with nearly 18,000 acres in Harford and Baltimore Counties. It was established to protect the stream valleys of the Big and Little Gunpowder Falls and the Gunpowder River, which begins at Days Cove where the Big and Little Gunpowder’s converge. A variety of topography exists in this long, narrow park, from tidal marshes and wetlands to steep, rugged slopes (Maryland Greenways Commission, 2000).

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Estuarine emergent: 112 acres
- Palustrine
 - Emergent: 29 acres
 - Scrub shrub: 8 acres
 - Forested: 64 acres
 - Unconsolidated bottom: 127 acres
- Riverine unconsolidated shore: 10 acre
- Total: 349 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130804	-1.71	1.92	7.00	0	7.21

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Gunpowder River and tributaries (above Oliver Point and Maxwell Point): Use I recreation contact and protection of aquatic life.
- All estuarine portions except those listed above: Use II, shellfish harvesting.
- Little Gunpowder Falls and tributaries (above B&O bridge $\frac{3}{4}$ mile south of Rte. 7): Use III, natural trout waters.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It is also classified as a Category 3, a pristine or sensitive watershed in need of protection. Failing indicators include high population density and high soil erodibility (0.33). Wetland loss was estimated to be 2,572 acres. Indicators for Category 3 include presence of trout spawning areas and designated Wildland areas.

According to the 2002 305(b) report, the nontidal, wadeable tributaries fully support all designated uses. Results for the mainstem river are inconclusive.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Little Gunpowder Falls* (non-tidal); nutrients.
- *Little Gunpowder Falls* (021308040298 non-tidal); poor biological community.
- *Little Gunpowder Falls Unnamed Tributary 2* (021308040298 non-tidal); poor biological community.
- *Little Gunpowder Falls Unnamed Tributary 3* (021308040298 non-tidal); poor biological community.
- *Wild Cat Branch Unnamed Tributary 1* (021308040298 non-tidal); poor biological community.
- *Overshot Branch* (021308040298 non-tidal in Baltimore County); poor biological community.

The Little Gunpowder Falls was identified on the State’s 1996 list of WQLSs as impaired by heavy metals and nutrients. Recent monitoring data found that the aquatic life criteria and designated uses associated with heavy metals are being met in the Little Gunpowder Falls, so the Little Gunpowder Falls was removed from Maryland’s 303(d) list for heavy metals. The nutrient listing will be addressed separately at a future date (MDE, 2002d).

Restoration/Preservation

Several Green Infrastructure hubs and corridors are located along the Little Gunpowder Falls River and running east-west across the watershed (DNR, 2000-2003). The majority of this hub is protected by Gunpowder Falls State Park and METs. An unprotected corridor still exists along the river, north of Gunpowder Falls State Park. Since some of the Green Infrastructure corridors are currently in agriculture, there may be potential to restore portions of these sites to natural vegetation.

According to the 2000 Maryland Greenways Commission document, an existing or proposed greenway is called Little Gunpowder Falls. Little Gunpowder Falls is a partially established stream valley greenways along the western boundary of Harford County that could link the County to greenways in Baltimore County. A major portion of this area (almost 2,000 acres) is currently State-owned and managed as part of Gunpowder Falls State Park.

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review*. Manor Rural Legacy Area has approximately 17,027 acres in Baltimore and Harford Counties. This area is currently largely undeveloped (92%). This area was chosen in order to protect “agriculture lands, the scenic and rural quality of the area, productive horse and cattle farms, and water quality of the Little Gunpowder Falls, a Class 3 trout stream.” The goal is to protect 15,500 acres (91%). Currently, 7,689 acres (45%) of this land is protected through various methods. The sponsors are The Manor Conservancy.

In a 1981 MDP document, Gunpowder Delta Marsh/Day’s Cove was designated an Area of Critical State Concern. This scenic site is located at the confluence of the Gunpowder River and Little Gunpowder Falls and includes tidal and nontidal wetlands and the surrounding upland hardwood forest. The delta transitions from floodplain to shrub swamp to tidal marsh. Excluding some mineral extraction and local archeological digs, the system is relatively undisturbed. This site provides important bird habitat and spawning area. In 1981, the primary threat to the system was from potentially extensive mineral mining (MDP, 1981).

There are two State-designated Wetlands of Special State Concern (WSSC) in this watershed and some potential WSSC, described as follows:

- *Hess Pond*. This wetland complex includes floodplain forest, shrub swamp, emergent marsh, and a seasonal pond along a stream. A State-Threatened sedge is found in the marsh. This type of seasonal wetland was historically created by natural disturbances such as fire or beaver, creating downed trees that clogged the stream and inundated adjacent areas. As these natural disturbances are suppressed, this habitat type becomes less common, as do the species that rely on them. Additionally, many remaining systems have been filled or drained for agriculture or development (DNR, 1991). This site is partially protected by a MET.
- *Little Gunpowder Falls*. The Little Gunpowder Falls runs through steep sloped ravines and into the floodplain. This floodplain area has natural canopy gaps and a maintained powerline right-of-way that contain a State Rare, a State Threatened, and four uncommon plant species. Historically, natural disturbances created gaps

in the canopy, maintaining habitat for species that require openings. As these disturbances have been suppressed, the habitat decreases, as do the species that depend on them. Powerline right-of-way maintenance can create habitat with canopy openings. The mature forest surrounding the Little Gunpowder Falls at this location provides a good buffer, as well as forest interior dwelling bird habitat (DNR, 1991). This site is protected by Gunpowder Falls State Park.

- There are two potential WSSC along Little Gunpowder Falls, that are not protected.

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along Little Gunpowder Falls.
- Protect WSSC and their buffers.
- Protect wetlands and streams within the headwaters.
- Protect additional wetland areas designated as Ecologically Significant Areas.
- Protect area within the Rural Legacy Area.
- Protect Gunpowder Delta Marsh/Day’s Cove

Loch Raven Reservoir (02130805)

Background

Only a small portion of Loch Raven watershed lies within Harford County, in the northwestern part, with the remaining portion being within Baltimore County and Pennsylvania. Based on MDP 2002 GIS land use data, the Harford County portion of Loch Raven Reservoir watershed has 3 acres of open water and 849 acres of land. The land acres are divided as follows: urban 47 acres (5%), agriculture 725 acres (85%), forest 78 acres (9%) (Figure 14).

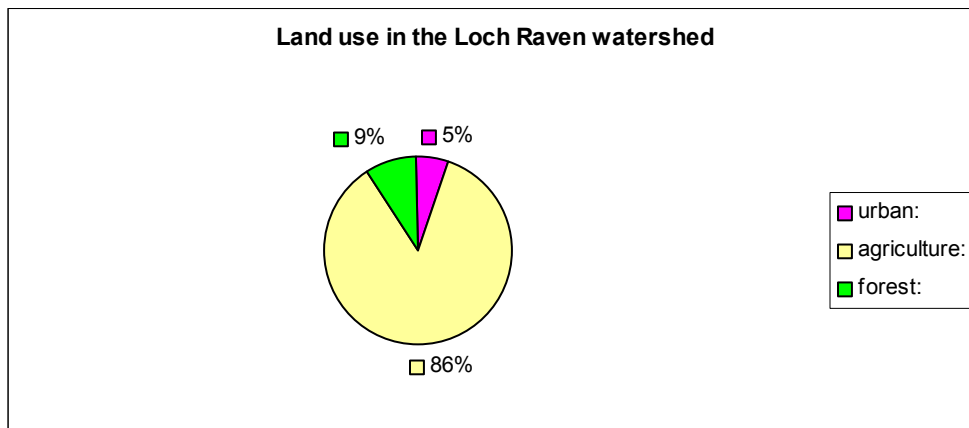


Figure 14. Land use in the Harford part of the Loch Raven watershed.

Estimates of wetland acreage for the entire Maryland portion of the watershed, based on DNR mapped wetlands, are as follows:

- Palustrine
 - Aquatic bed: 6 acres
 - Emergent: 105 acres
 - Scrub shrub: 56 acres
 - Forested: 162 acres
 - Unconsolidated bottom: 355 acres
 - Unconsolidated shore: 1 acre
 - Farmed: 2 acres
- Riverine unconsolidated shore: 14 acres
- Total: 700 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a very slight gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02130805	-1.27	1.23	0	0.08	0.05

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. Stream segments not specifically listed in COMAR are designated Use I, recreation contact and protection of aquatic life. For this watershed, they are designated as follows:

- Gunpowder Falls and tributaries (above Loch Raven dam): Use III-P, *natural trout waters and potable water supply*.

Water Quality

The 1998 Clean Water Action Plan classified this watershed as “Priority” Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a “Priority” Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. It is also classified as a “Selected” Category 3, a pristine or sensitive watershed most in need of protection. Failing indicators include high population density and high soil erodibility (0.31). Wetland loss was estimated to be 2,261 acres. Indicators for Category 3 include presence of trout spawning areas, designated Wildland acres, and a drinking water intake.

According to the 2002 305(b) report, the mainstem river (Loch Raven Reservoir to Prettyboy Dam) and the Loch Raven Reservoir fully support all designated uses. A portion of the wadeable tributaries (190 miles) supports all designated uses. Another portion fails to support all designated uses (31 miles) due to an impaired biological

community from habitat alteration (bank instability and channelization) and changes in hydrology. The remainder of the wadeable tributaries were inconclusive (16 miles).

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Loch Raven Reservoir Impoundment* (non-tidal); nutrients, sediments. Methylmercury in fish tissue also impairs water, but a TMDL has been completed for this contaminant.
- *Greene Branch* (021308050301 non-tidal in Baltimore County); poor biological community.
- *Unnamed Tributary to Carroll Branch* (021308050304 non-tidal in Baltimore County); poor biological community.
- *Little Falls* (021308050312 non-tidal in Baltimore County); poor biological community.
- *Oregon Branch* (021308050302 non-tidal in Baltimore County); poor biological community.
- *Loch Raven Reservoir Unnamed Tributary* (021308050300 non-tidal in Baltimore County); poor biological community.
- *Long Quarter Branch Unnamed Tributary* (021308050300 non-tidal in Baltimore County); poor biological community.
- *Piney Run* (021308050308 non-tidal); poor biological community.
- *Piney Run Unnamed Tributary 1* (021308050308 non-tidal); poor biological community.
- *McGill Run Unnamed Tributary* (021308050308 non-tidal in Baltimore County); poor biological community.
- *Second Mine Branch* (021308050309 non-tidal); poor biological community.
- *First Mine Branch* (021308050309 non-tidal); poor biological community.
- *Fourth Mine Branch* (021308050309 non-tidal in Baltimore County); poor biological community.

A recent water quality analysis (WQA) of heavy metals for the Loch Raven Reservoir impoundment found no impairment for heavy metals, therefore Loch Raven Reservoir impoundment was removed from the 2004 303(d) List for heavy metal impairment. The non-tidal streams are not listed for heavy metals, therefore they are not addressed in the WQA (MDE, 2003). An existing public health fish consumption advisory for Loch Raven Reservoir significantly limits the consumption of fish from this impoundment due to levels of methylmercury in fish tissue. This is a violation of the State's narrative water quality standards, because the designated use of "fishing" is not fully supported. Therefore, a TMDL for methylmercury in fish tissue was completed in 2002 for this impoundment. Sources of methylmercury are largely atmospheric, often originating outside of the State (MDE, 2002c).

The Maryland Department of the Environment is currently performing an assessment of the Loch Raven Reservoir.

Restoration/Preservation

Specific recommendations for restoration:

- Restore “gaps” in Green Infrastructure to natural vegetation.
- Restore wetlands and streams within the headwaters.
- Design wetlands that provide water quality function to improve water entering Loch Raven Reservoir.

Specific recommendations for preservation:

- Protect Green Infrastructure, especially along the Susquehanna River.
- Protect wetlands and streams within the headwaters.
- Protect wetlands that provide water quality function to water entering Loch Raven Reservoir.

Upper Chesapeake Bay (02139996)

According to the 2002 305(b) report, the upper mainstem bay fully supports all uses.

The DRAFT 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

Upper Chesapeake Bay (tidal); nutrients.