



Whitemarsh Township

MONTGOMERY COUNTY, PA

Stormwater Management & Basin Stewardship Plan

FEBRUARY 9, 2022



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Stormwater Management and Basin Stewardship in Whitemarsh Township

*McCarthy, Miles, Koontz, & Valley Green Parks, and the basin
and field on Woodbine Way*



The naturalized basin at McCarthy Park provides habitat, beauty, and stormwater management.

Introduction

Whitemarsh Township owns many stormwater management basins, designed to serve the suburban residential and commercial development common in the area, as well as schools and parks. As the name implies, Whitemarsh is a wet area, and needs to manage as much stormwater as possible. Much like buildings, over time, basins can suffer from wear and tear and deterioration. Berms settle, concrete structures crumble, vegetation clogs flow structures and sediment accumulates, reducing a basin's capacity and changing the ecosystem within it.

Over the past 50 years our understanding of the effects of stormwater on our local streams has

increased greatly. We now understand that simply slowing the flow of stormwater into streams by routing it through basins is not effective. We must capture and infiltrate as much stormwater as possible. It may seem antithetical, but we need to keep water out of basins, by infiltrating it before it ever gets into a basin. Infiltrating stormwater and recharging groundwater are the best ways to keep our local streams healthy, a point underscored by the introduction of MS4 regulations.

Designers and community leaders also recognize that stormwater management areas can be designed to fit into nature, parks and trail systems more cohesively and can even

become a focal point themselves. Basins have typically been relegated to the most hidden corners of subdivisions, the areas that percolate best and are at the lowest elevation. But now we know that through sensitive design we can manage basins to provide habitat and food sources for native insects and animals, to beautify our public spaces and to serve as recreational amenities, as well as to manage stormwater.

Goals

Whitemarsh Township owns and maintains many basins throughout the township, within both the Schuylkill River direct drainage watershed and the Wissahickon watershed, a subwatershed of the Schuylkill. The Township recognizes the importance of clean and abundant groundwater and wants to ensure that the basins are contributing to groundwater health and recharge. Basins also exist within the context of their surrounding ecosystems. Vegetated basins often spread plant species into their surroundings by way of seeds. Unvegetated, or turf stormwater management features, which often accommodate quickly flowing water, can carry seeds or cuttings of both native and invasive species from one property to another as they are washed through the system. Many of Whitemarsh's basins and other stormwater management features are in parks, at community centers and libraries and in prominent locations in the community. Therefore, it's important that they look well maintained and contribute to the aesthetics of their surroundings. This does not mean that they need to be neatly trimmed or frequently mowed, but rather that they are not overgrown or overrun with invasive species, and that structures are well maintained.

With all of this in mind, this report seeks to provide recommendations and strategies which



This rain garden at Natural Lands' Stoneleigh: A Natural Garden uses native plants to soak up stormwater running off the parking lot.

will advance three goals for the Township's stormwater management features, as follows:

1. Improve water quality and increase groundwater quantity.
2. Allow the stormwater management systems to exist cohesively with their surrounding ecosystems.
3. Incorporate the stormwater management systems into their surrounding landscapes such that they contribute to the beauty and function of the surrounding parks, communities, and the Township as a whole.

We believe stormwater management systems can function and be maintained to benefit water quality, exist as part of a greater ecosystem and become assets to public spaces.

Methods

The scope of this report has grown from an initial inquiry about stewardship and maintenance of the basins at McCarthy Park. Natural Lands team began there, assessing the plant communities in these basins and the surrounding features, on the adjacent school's property and throughout the surrounding neighborhood. The recommendations related to McCarthy Park will help the Township manage this well-established site.

We also sought to provide information about other types of stormwater management features, which may not currently exist in the township. We intended to prepare simple case studies and descriptions of rain gardens, vegetated swales, stormwater parking islands and meadows. But after exploring Miles, Koontz and Valley Green Parks, and two stormwater management areas on Woodbine Way, we found opportunities to describe these other features in the context of real life sites which could accommodate them in the future!

Our team of cartographers, stewardship planners and landscape architects assessed the sites. We first prepared base maps by

assembling GIS information, including topography, hydrology, soils and aerial photographs. We also examined existing design plans, maps of the township storm sewer system and other published plans. We used online tools such as mapmywatershed.com to confirm drainage areas and assess existing conditions. We also visited the sites and their surroundings to visually assess the stormwater management features. We've prepared the recommendations and the whole of this report based on information gathered through the methods above.



Through site visits and review of maps and aerial photography, we've identified opportunities from implementation of green stormwater infrastructure, like the planted island above, which captures and infiltrates stormwater.

Context



Water flows out of Miles Park carrying sediment, nutrients, and grass clippings into the ponds downstream.

Detailed descriptions and recommendations related to each basin and stormwater management site are found later in this report. However, a number of findings and existing conditions relate to most or all of the stormwater features in the study. These are primarily the results of similar land management in the developments and parks which drain into the basins. The following section provides a description of the state of the basins, the effects of their surroundings and an overview of some of the common issues.

A Connected System

Conservation organizations are fond of placing stickers on inlets to let people know that the stormwater “drains to the river.” This is good simple messaging to let people know that what they put into their inlets matters, as it does eventually make its way to our drinking water supply. However, few people think about the journey that water takes between the inlet and the river. In Whitemarsh Township, that journey can be long and meandering.

A drop of rain, excess lawn watering, and soapy car wash water can travel miles from the nearest inlet to the Schuylkill River. Along the way, that water may infiltrate into the ground. It may drop pollutants into the soil. It may pick up sediment or nutrients. It may stagnate in ponds, wash through pipes and become the base flow of streams.

For instance, when someone washes their car on Flourtown Road near Joshua Road, the excess water, likely carrying phosphorous based soap, possibly picking up oils, sediment and other pollutants, will flow along the curb until it can drain to the nearest inlet. From there, it will flow through a few hundred feet of underground pipe before washing into the Joshua Knoll basin. If that basin is full, it will spill over into the McCarthy Park wetland basin. If that basin is full, it will flow out of the basin and travel overland through the adjacent woodlands, after which it will enter another pipe, near the end of Fairway Road. It will flow through a few hundred feet of pipes beneath the neighborhood streets, collecting more water from the surrounding inlets, before resurfacing and flowing across Miles Park in a

shallow channel, unbuffered and accepting runoff and grass clippings from the park. It then flows into another pipe, under Germantown Pike, and into a pond on the Green Valley Country Club golf course. When that pond flows over its banks, the water continues through the golf course in a series of ponds, open channels and pipes, before flowing through a culvert under Ridge Pike. The water warms as it flows through these unshaded ponds and channels, accepting sheet flow, fertilizers and herbicides from the manicured turf.



Neighborhoods across the region, like Joshua Knoll, feature too much asphalt and turf grass, and not enough trees and rain gardens.

From there, all of the stormwater collected in so many upstream inlets, ponds, and channels, comes together to form Spring Mill Creek, which snakes between developments, flowing overland within a protected ribbon of forests. But before it can reach the Schuylkill River, it must enter one final stretch of pipe to carry it beneath the train tracks in the Spring Mill area. Finally, the water cascades out of a pipe, creating a man-made waterfall into the Schuylkill.

The journey from one end of the watershed to the Schuylkill River is typical of communities throughout the watershed. Our region has developed over the course of centuries, and our understanding of stream health and stormwater management has slowly evolved too, leading to the creation of a mixed system of pipes, ponds, basins and streams spread across the land. This means that every action in the watershed

affects the system downstream. The soap which enters the inlet on Flourtown Road may eventually lead to fish kills in the ponds on the golf course. The sediment which washes off the golf course eventually flows into the Schuylkill River, contributing to the need for periodic dredging.

A Disconnected Population

Most people don't remember the middle school lessons about the water cycle. When rain falls, some of it should evaporate or evapotranspire, but most should be absorbed into the ground to recharge our aquifers below. However, we've disrupted the cycle with so much turf and impervious surface. Now, much of the stormwater runs off of these surfaces and flows through pipes into the nearest stream. It sounds counter intuitive, but we're putting too much water into our streams. This causes erosion, sedimentation and pollution.

Most people don't understand how stormwater management works. And why should we? We've built a system which prioritizes moving water off of private property – our roofs, lawns and driveways – and into a drain as quickly as possible. We don't know where it goes, but we know it's gone, somewhere else. We don't follow it on its journey. We don't see it eroding our streams and clogging our drinking water intakes with sediment. We don't see fish dying downstream because the water is too warm. We just know that our basements are dry.

Even when we're close to stormwater management features, we don't typically pay much attention. Mowed turf isn't very interesting. Especially when it's dug out below grade. It doesn't attract animals. It doesn't flower with bright, vibrant colors. It doesn't have an interesting shape or form. It doesn't even sway in the breeze.



Grass clippings are washing into this inlet in the Joshua Knoll neighborhood, carrying nutrients into the basin and the watershed beyond.

The McCarthy Park and Joshua Knoll basins are different though. So is the small basin at Miles Park and the naturalized basin at Koontz Park. They are filled with native plant species which support native birds, mammals and insects. They offer brightly colored flowers and berries. They show a beautiful spectrum of fall colors. People notice these basins and the animals that visit them. When people care about the plants and animals in the basins, and they love the beautiful colors and forms of the plants, they'll start to care more about the water that flows in and out of them too. No one wants to poison the herons that hunt for tadpoles and insects in the wet bottoms. No one wants to kill the swamp milkweed that offers food for monarch caterpillars, and provides beautiful pink, purple and maroon flowers.

When people see and pay attention to what's happening in the basins, streams and ponds and begin to care about them, they will start to ask questions like: Where is this water coming from? Is it clean? Is it good for the fish and tadpoles and water birds? Is it causing algae in the connected ponds? Is there some way I can help? The neighborhoods surrounding the parks and basins, which create the stormwater can play a vital role in improving the water quality, but first they need a reason to care. Through a

holistic approach, improvements can be made which benefit water quality, the wildlife that depends on them and the parks and people who surround them.

State of the Watersheds

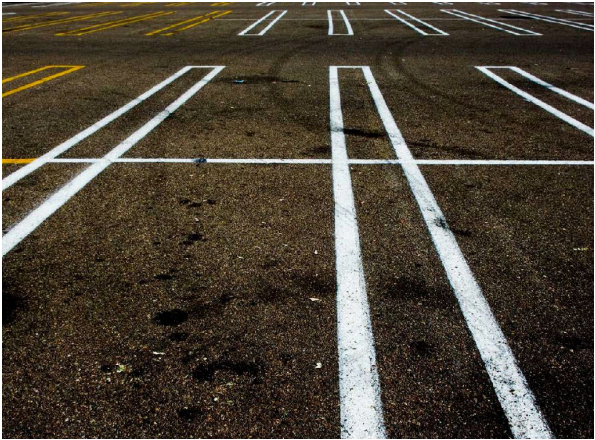
Whitemarsh Township is divided between the Wissahickon Creek and Schuylkill River direct drainage watersheds. McCarthy Park, Miles Park, Koontz Park and the Woodbine Way stormwater management areas are within the direct drainage watershed. Valley Green Park is within the Wissahickon watershed. Each of the stormwater management features is connected to a series of pipes, streams and ponds, similar to the previous example. Therefore, conditions in a single basin and the conditions of the water entering it, may affect conditions in the larger storm sewer network, existing streams and ponds.

The Pennsylvania Department of Environmental Protection (DEP) has designated Spring Mill Run as a Cold Water Fishery (CWF) but has also deemed it impaired for aquatic life, due to **siltation, flow regime modification, and algae**. Sources include roads and bridges, golf course and rural land. DEP has designated the Wissahickon Creek as a Trout Stocking Fishery, and a Migratory Fish Stream. However, it is also listed as impaired for aquatic life. The impairments include **point source discharges, nutrients, siltation, pathogens, biochemical oxygen demand and flow regime modification**. Sources include wastewater treatment plants, urban runoff and storm sewers. (Information about impairments is available at gis.dep.pa.gov/emappa and gis.dep.pa.gov/integrated_report_viewer/index.html .)

These impairments are commonly found throughout the region. Nearly 1/3 of Pennsylvania's streams are impaired. While the



When too much water enters our stream system, it overloads the channel and erodes the banks, as has happened to this stream nearby in Chester County.



Too much paving causes streams to become overloaded with stormwater.

Township and its residents can't do much about impairments caused by wastewater treatment facilities, residents can take action to reduce the amount and quality of stormwater flowing off of their properties, which will in turn help to improve the health of Spring Mill Run and the Wissahickon Creek.

Surrounding Development, Erosion & Sedimentation

Streams throughout the state have been overwhelmed with stormwater, leading to degradation, erosion, siltation and water flow variability. The basins, swales and other stormwater control measures in this study are also affected, as they are part of the same stormwater system. The Joshua Knoll basin is fed by inlets and pipes, which convey stormwater directly from the surrounding roofs, lawns and streets into the basin. The McCarthy Park wetland basin receives overflow from the Joshua Knoll basin, as well as sheet flow from the surrounding park. The drainage channel in Miles Park receives stormwater from the impervious surfaces in the adjacent

neighborhood. The turf swale in Miles Park receives sheet flow, and a lot of sediment, from the dirt and gravel parking lot in the park. With all this stormwater comes sediment and chemicals, washed off the streets, lawns, playing fields, parking lots and neighboring residential properties. The sediments and chemicals eventually make their way into the local streams, connected ponds and eventually into the Wissahickon Creek and/or the Schuylkill River.

Based on observations taken while driving around the neighborhoods surrounding the basins, it seems that the amount of impervious surfaces including roofs, driveways, sidewalks and streets, and mostly impervious surfaces, such as lawns, appears typical of most suburban communities. Its not clear whether these specific neighborhoods are generating more stormwater than the system can handle. However, we know, based on the DEP reports and designations, that too much stormwater is making its way into the destination streams.

The hydrologic cycle has been thrown out of balance. Too much water flows off of roofs and driveways, and across lawns, picking up sediment and chemicals along the way. It then washes into inlets and through pipes. When it reaches a basin, it slows down and drops its sediment, slowly filling the basin over time. When this water enters a stream or channel, like those in Miles Park, the force of the water erodes the banks and channel. The eroded sediment, drops out of the water and settles when the water slows down as it reaches a downstream pond, basin or stream. Over time, enough sediment fills the basins to reduce their holding capacities, thereby making them shallower and affecting their ecology. The sediment can also choke a stream and make it uninhabitable for aquatic life. All of this sediment also carries attached nutrients, which can negatively affect water quality.



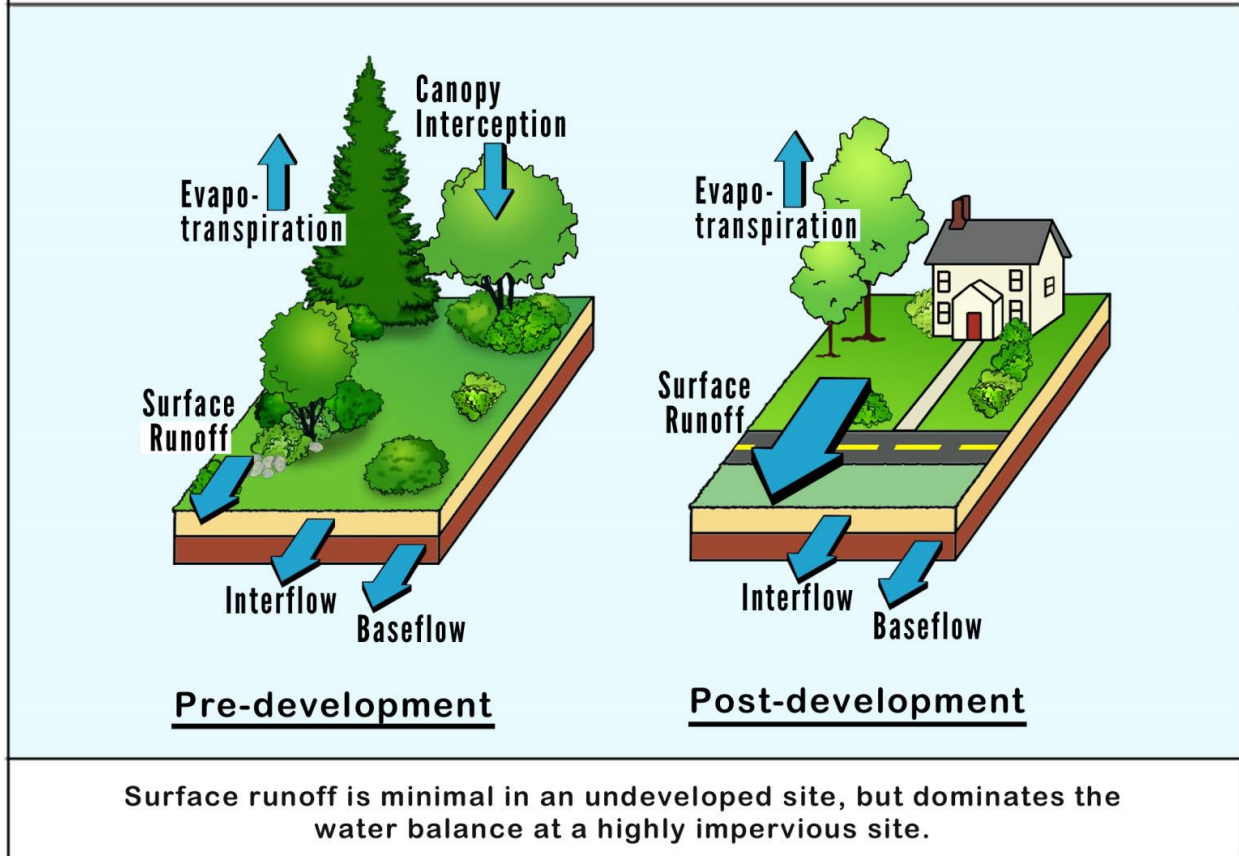
Common lawn fertilizers typically contain phosphorous and nitrogen. These wash off lawns and into the water system, polluting our streams with nutrients.

Phosphorous, Nitrogen and Algae

“A shallow, nutrient rich pond, exposed to sunlight with little water flowing through it will be teeming with algae and aquatic plants,” according to [Pond Ecology](#), an article posted online by the Penn State Extension. While our study does not include any ponds specifically, we know that ponds exist in the township and are connected to the stormwater and stream system. Additionally, the same nutrients can cause the same effects on wetland basins. Phosphorous and nitrogen are the nutrients referenced in the quote above. They can travel on soil particles in sediment. They also come from animal waste and decomposing plant material. Many fertilizers used in commercial, recreational, and residential settings also contain phosphorous and nitrogen and can wash into basins, ponds and streams.

Canada geese can also contribute nutrients through their waste. While we did not observe flocks of geese or their waste, they are prevalent throughout the region and may congregate in the athletic fields in Miles Park and the school property adjacent to McCarthy

Figure 1.1 Water Balance at a Developed and Underdeveloped Site
(Source: Schueler, 1987)



The water cycle has been altered significantly across the region, due to the amount of impervious surface.

Park. The combination of goose waste and grass clippings adjacent to streams and in areas of sheet flow, could lead to phosphorous in the ground and surface water. Additionally, sediment washing into the stormwater system may also carry phosphorous. These factors could lead to algae growth in ponds and basins throughout the watershed.

Without conducting chemical tests, we don't know with certainty whether the stormwater systems, streams and ponds feeding the Spring Mill Run are carrying too much phosphorous or nitrogen. We do know with certainty that DEP has stated that the Wissahickon Creek does carry too much phosphorous and nitrogen. Considering that DEP has designed the Wissahickon as impaired due to nutrients, has

designated Spring Mill Run as impaired due to algae, and that phosphorous and nitrogen are so prevalent in streams throughout the region, its reasonable to attempt to reduce the amount of these nutrients entering the ground and surface waters through the stormwater management systems.

Warm Water and Dissolved Oxygen

Dissolved oxygen is an important component of water quality. Fish need dissolved oxygen to breathe. Aerobic bacteria, which play a crucial role in breaking down waste materials, also depend on it. Flowing water tends to have higher levels of dissolved oxygen. Dissolved

oxygen is also incorporated into water through photosynthesis conducted by aquatic plants. Cooler water also tends to hold more dissolved oxygen than warmer water.

We don't have measurements of dissolved oxygen within the Wissahickon, Spring Mill Run or the contributing watersheds. However, the Wissahickon is stocked with trout annually. Spring Mill Run is designated as a Cold Water Fishery. Fish need dissolved oxygen, so it is important to implement strategies which will help to keep the water cool and oxygenated.



Water which is too warm can't hold enough dissolved oxygen, leading to fish kills.

General Recommendations



The graphic above shows a strong riparian buffer on the left, alongside the effects of no riparian buffer on the right. Notice the severely eroded bank adjacent to the lawn.

Considering DEP's designations for the Wissahickon Creek and Spring Mill Run, and the known effects of nutrients and sediment on water quality, it is recommended that the Township, homeowners and others take actions which will:

- Reduce Phosphorous and Nitrogen Levels
- Increase Dissolved Oxygen Levels
- Reduce Sediment Levels

Several measures can be implemented to take these steps. Some are as simple as planting trees and changing mowing schedules, while others, such as installing forebays, will require additional engineering and further study.

Friends groups, commissions, or community organizations could be created to assist in implementing many of these recommendations.

Reduce Phosphorous and Nitrogen

There are three main approaches which can be taken to reduce the amount of phosphorous and nitrogen entering the stormwater system. All are relatively simple and straightforward. These include the installation of vegetated buffers, reduction in use of fertilizers and other chemicals and reduction of the goose population.

Implement Vegetated Buffers



Riparian buffers can be started by planting small trees in tubes to protect them from deer browse and rubbing.

Areas of mown grass, with little tree, shrub or herbaceous plant material nearby provides a relatively unimpeded course for stormwater to flow into a basin, pond, wetland or stream. Mowed grass is directly adjacent to McCarthy Park basin and the drainage channel which flows through Miles Park. This stormwater, flowing quickly over turfgrass, carries with it sediment, grass clippings, animal waste and any chemicals, such as fertilizers, which may have been applied in the area. All of these bring phosphorous and nitrogen into the ground, surface and storm water system.

Vegetated buffers made up of trees, shrubs and more hardy herbaceous materials would help to filter nutrients out before reaching the stormwater facilities. When water flows over turf grass, it is able to flow quickly. The short and narrow grass blades do little to slow the water. Additionally, soil under turf grass is typically very compacted, as turf has shallow root systems which do not keep the soil loose and aerated. Therefore, the water is able to flow quickly through the turfgrass over the hard soil. This fast-moving water is able to strip sediment away from the lawn and carry it into the nearby basins, streams, swales and channels. The ponds on the golf course are

likely also receiving sediment from sheet flow across their vast turf areas.

Vegetated buffers would better protect streams and stormwater systems and improve water quality. Trees, shrubs, meadow grasses and perennials keep the soil healthier and act as physical barriers. When water, carrying the nutrients towards a basin, stream or pond, encounters a vegetated buffer, it is slowed down. As the water slows down, it is forced to drop its sediment and nutrient load before reaching the pond. Additionally, as the water slows down, it has a better chance to infiltrate directly into the soil, before ever reaching the surface water. Infiltrating more stormwater into the ground helps protect the basins and the streams they are connected to, by reducing the amount of stormwater that enters them. Too much stormwater is causing the watershed wide degradation of streams, leading to sedimentation and siltation. Additionally, measures which encourage infiltration may help Whitmarsh Township meet state mandated MS4 requirements.

The Township could establish buffers along surface waters by seeding the turfgrass areas with meadow seed mixes and planting additional trees and shrubs. Alternatively, but less effectively, the Township could simply reduce the mowing frequency of the turfgrass, allowing it to grow taller and thicker. Mowing could be done just once or twice a year, to eliminate woody plants, vines and other invasive plant species. When the grass is mowed, the clippings should be collected, not allowed to wash into nearby surface water.

The Township zoning ordinance, Article XXXV, Section 116-258, establishes a minimum required riparian width of 150'. Requirements of the zoning ordinance are most frequently applied to new developments. But the requirements in the ordinance could also be applied to the parks to improve water quality. A

similar width would be appropriate, though ANY width of a vegetated buffer would be an improvement over mowed streambanks and basin edges. For instance, at Miles Park, there is not adequate space to establish a 150' buffer, but even a 25' buffer would be an improvement.

Limit the Introduction of Soaps, Fertilizer and Other Chemicals



Residents should wash their cars at commercial car washes, which are required to collect the excess wash water, rather than washing their cars on streets or driveways, which allows soap to enter the water system.

Fertilizers and other products, including soap, can contain phosphorous and nitrogen as main ingredients. While fertilizers help lawns and landscape plants grow, they can be detrimental to the health of ground, surface and storm water. Where stormwater flows over lawns and landscaped areas, it can pick up fertilizers, and other chemicals, and carry them into the storm and stream system. It is unclear whether the Township, the resident athletic associations, or other neighbors use fertilizers on their lawns and athletic fields. It is likely that some residents do fertilize their own lawns. The Township should further inform residents as to the damage that fertilizers can do, as they can

encourage the growth of algae by adding nutrients to the water.

Many soaps made for washing cars also contain phosphates. So when a resident washes their car in their driveway, or on the street, these soap phosphates drain to an inlet and eventually reach a basin, stream or pond. The phosphates then promote the growth of algae. Residents should be encouraged to use biodegradable, phosphate free soaps, wash their cars on pervious surfaces such as grass or visit a commercial car wash, which are regulated and required to drain the used water to a water treatment plant, rather than into our streams.

Swimming pool water can also contain phosphates. It is illegal in Pennsylvania to drain a pool to a storm sewer system. Residents should be reminded to always drain their pools in accordance with local and state regulations.

Reduce the Goose Populations



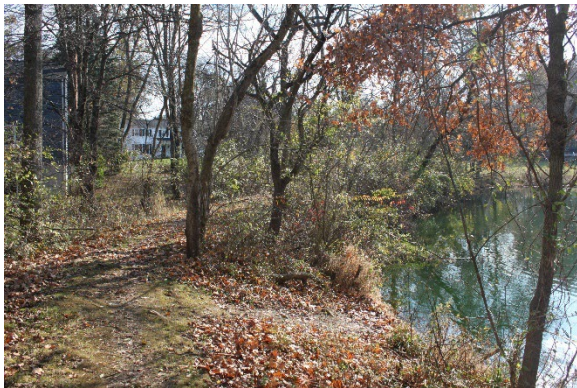
Geese contribute nutrients and bacteria to our waterways but can be easily discouraged with tall vegetation along stream and pond banks.

Waste from geese and other animals can contribute to the nutrient loads in the water system. Aside from that, their waste can make an open space, park or athletic field area unenjoyable for residents who don't want to walk through it. Additionally, the geese themselves can be unfriendly and discourage people from using the area. Goose

management is an issue that municipalities throughout the area are dealing with. Measures to control populations include adding eggs, dispatching dogs and placing silhouettes or other decoys of predators.

These measures may work to some degree. However, in Natural Lands' experience, we find the best way to discourage geese is to remove their habitat. Geese like open, mowed grass areas, as they can easily detect predators. At our preserves, we strive to eliminate grass areas, for many reasons. We have largely eliminated geese from our preserves simply by eliminating their habitats. Meadows and other vegetation, as described above, provide the dual benefit of filtering water and eliminating goose habitat. Eliminating grass areas will reduce the goose populations, leading to less waste in the water system and in the parks, open spaces and surrounding neighborhoods.

Increase Dissolved Oxygen



Dense vegetation at the water's edge can keep it cooler and allow it to hold more dissolved oxygen.

Dissolved oxygen is an important component of the overall health of the water system. Dissolved oxygen is important to support fish populations. The Wissahickon is stocked with trout annually. Spring Mill Run is designated as a Cold Water Fishery. Dissolved oxygen levels

can typically be increased through relatively simple means.

Provide Shade over Water

Previous sections of this report described the filtering and infiltration benefits of vegetated buffers. By planting trees as part of these buffers, close to the waters' edge, they can also potentially increase the amount of dissolved oxygen that the water can hold. Cooler water can hold more dissolved oxygen than warmer water. Planting large tree species, such as oaks and maples near the shorelines will provide shade to cool the water.

Decrease Plant and Animal Waste

Plant and animal waste can increase nutrient levels in ponds, as described above, but it can also cause the elimination of dissolved oxygen. Aerobic bacteria act in the process of breaking down and decomposing plant and animal waste. An abundance of this waste can lead to an abundance of the bacteria, which will exhaust the supply of oxygen. Low levels of dissolved oxygen can lead to fish kills and algae growth. Recommendations for reducing the goose populations and the amount of plant waste through changes in mowing regimes and plant types have been described previously in this report. The same recommendations can help increase dissolved oxygen.

Install Aquatic Plants in Connected Ponds

None of the township facilities included in this study feature permanent ponds. However, aerial photographs, Township utility maps and DEP maps show that ponds exist on the golf course. There are likely other ponds throughout the township as well, remnants of former farms. As discussed previously, the entire storm, ground and surface water system in the Township is connected. The water which flows into the Township's basins may eventually make

its way into the golf course's ponds. The water in those ponds will eventually enter Spring Mill Run. Therefore, any improvements to the ponds will also serve to improve the entire system.

As aquatic plants "breathe", they process carbon dioxide and produce oxygen. This oxygen is released into the water. The ponds currently have very few aquatic plants. More



Aquatic plants can help to oxygenate standing water, filter runoff and provide shade and habitat.

aquatic plants of diverse, native species could be introduced to the ponds at their edges, through bench plantings. (See Appendix for planting list) Sediment from within the ponds could be regraded to create a shallow "bench", a gradually sloped ramp down into the pond. Aquatic plants could be planted on the bench. The plants would help to clean and filter the pond water, while providing habitat and food sources for other aquatic species, while, most importantly, providing more dissolved oxygen. Additionally, benches could make the ponds safer, as they would eliminate any steep drop-offs from the pond banks into the water.

Coverage of approximately 40-60% of the pond surface with aquatic plants would be ideal for

shading the water and introducing additional dissolved oxygen. This ratio of aquatic plants would lead to a balanced population of algae, rather than complete algae coverage.

Additionally, aquatic plants at this ratio would reduce phosphates, especially during the growing season, as they would utilize and process the nutrients.

Install Aeration Systems in Connected Ponds

Aerators keep water in motion, which makes it harder for algae to establish itself in ponds. More importantly, aeration incorporates more dissolved oxygen into the water, which helps keep healthy levels of bacteria which break down nutrients and waste. Fish rely on dissolved oxygen to breathe, and they die off when not enough dissolved oxygen is present. If the ponds on the golf course are found to hold inadequate levels of dissolved oxygen, aerators could be installed to improve this condition.

Reduce Sediment Levels

Sediment is entering the water system in two ways – through direct sheet flow into surface water and basins from the surrounding land, and through stormwater flowing through pipes and into the connected system. There is already too much sediment in the Wissahickon and Spring Mill Run, per DEP's statements.

Install Forebays

Forebays are smaller ponds or catchment areas which filter sediment out of water as it enters a larger body. Forebays are typically planted with wet tolerant or aquatic plant species and constructed from rock or earth. As water flows out of a pipe, into a pond or basin, it first flows into the forebay. The water hits the rocks and plants, slows down and drops the sediment there, before entering the larger basin area. As nitrogen and phosphorous can cling to

sediment, they too would be reduced. Some older basins in the township could potentially benefit from the installation of forebays. The Joshua Knoll basin appears to act as a large forebay to the McCarthy Park basin.

Forebay design would require additional study and engineered design. Forebays would not eliminate sediment from the system, but would capture it and keep in one small area, which would make it easier to remove the sediment as it builds up. This could mean that the sediment could be removed more cheaply, with simpler equipment such as a vacuum truck, rather than entering a large basin with heavy equipment.

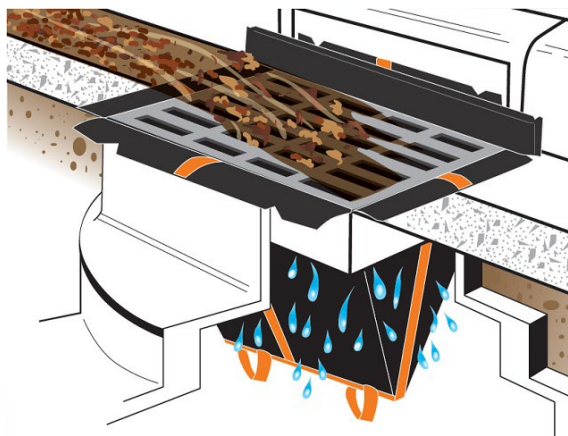
Implement Vegetated Buffers

Vegetated buffers were previously described at length in the section regarding reduction of phosphorous and nitrogen. While buffers help to eliminate nutrients, they are also effective at filtering out sediment and stabilizing shorelines and streambanks. Buffers should be installed along basin banks, and stream channels where they can intercept sheet flow. Trees and shrubs should also be planted where channelized water flows through the landscape. In these situations, the roots of the trees and shrubs will help stabilize the channels and hold the soil in place, rather than allowing it to be carried downstream.

Install Inlet Filter Bags

Much of the sediment entering the water system comes directly from water piped through inlets along the Township streets. Therefore, protecting the inlets and keeping sediment from ever getting into the stormwater system would benefit the water system. The PA DEP Erosion and Sediment Pollution Control Program Manual lists inlet filter bags as an effective sediment barrier. However, they should only be used where an inlet has a ¼ acre maximum drainage area. They also need to be

inspected on a weekly basis and after each runoff event and need to be cleaned out when they are half full. Inlet filter bags require more annual care, but may reduce the frequency and cost of dredging. (See Appendix)



Inlet filter bags, like those produced by Hanes Geo pictured above, can capture sediment before it reaches local streams.

Due to the quantity of inlets feeding the water system, inlet filter bags should be used strategically. The township could install them at the inlets which appear to receive the most sediment, based on visual observations. A small number of filter bags could likely be managed by Township staff, who could also track their time spent maintaining them. The Township could then determine whether to expand use of inlet filter bags by measuring the amounts of silt captured in the bags. This could be coupled with water quality testing in the golf course's ponds and stream water quality monitoring to determine the impact.

Rain Gardens and Rain Barrels

Sediments and chemicals are carried into the water system by stormwater. By capturing stormwater and infiltrating it in place or collecting it for reuse, homeowners can do their part to keep the water system healthy. Residential properties are a primary producer of stormwater, as roofs, driveways and turf grass all generate runoff during storms. This is the



water which eventually carries sediment, chemicals and nutrients to the water system. Rain gardens on private properties can help to capture water and infiltrate it into the ground, rather than allowing it to drain to pipes. Rain gardens can also benefit native pollinators, birds and small mammals, by providing food sources and habitat. Rain barrels can also help protect the water system. By draining roof drains into barrels, the water can be collected for garden use before it reaches the inlets. When this collected water is used in the garden in smaller quantities at a time, it can infiltrate into the ground, watering plants and recharging ground water supplies.

The Rain Garden Alliance has created a tool to help determine proper sizing and calculating benefits of rain gardens (<http://raingardenalliance.org/right/calculator>). The calculator allows for the adjustment of many variables, including drainage area, quantity of downspouts, soil quality and slope.



Rain barrels and rain gardens capture stormwater on site, before it flows into the local storm system. (Both photos (c) Eastern Delaware County Stormwater Collaborative)

The following examples describe outcomes from a 30' x 30' (900 sf) roof area, which would be typical for the area. According to the calculator, a rain garden of 150 square feet, dug to a depth of 6" and planted with 66 plants, can absorb approximately 401 gallons of rainfall in a single ½" storm event. Doubling the size of the rain garden to 300 square feet, again dug to a 6" depth, and planted with 132 plants, increases the amount of rainwater which can be captured to 681 gallons. These estimates are for clay soils, similar to those found throughout our area. Sandy or loamy soils have the ability to capture and infiltrate even more water. A 300 sf rain garden may seem large, but many existing residential garden beds could be retrofit to capture stormwater and serve as rain gardens.

Due to the variability of size, soil types, planting designs and other factors, it is difficult to simply quantify the benefits of rain gardens. However, the US Environmental Protection Agency has prepared a summary of literature regarding Green Stormwater Infrastructure (https://owl.cwp.org/mdocs-posts/collinsk_runoff_reduction_methods_appendix_f/). The summary includes many studies related to BMP's which could be used in Whitmarsh, including vegetated swales, bioretention

What is a Rain Garden?

Nature's Water Filter: Rain gardens are shallow landscaped depressions that capture, clean and absorb stormwater runoff from roofs, parking lots and roads.



© The Nature Conservancy

Rain gardens can infiltrate stormwater before it reaches the storm system, keeping sediment, nutrients and other pollutants out of our waterways.

features such as rain gardens, and vegetated filter strips. One study (CWP, 2007) included in the summary, states that bioretention, including rain gardens, can reduce the amounts of Total Suspended Solids by 59%, Total Nitrogen by 46%, and heavy metals such as copper and zinc by approximately 80%. Another study (Davis et al., 2001) found that bioretention can reduce Total Phosphorous by up to 81%, and Ammonium by up to 102%. The summary includes many more studies which conclude that bioretention features reduce the amounts of nutrients and reduce runoff.

The Prince George County, Department of the Environment (MD), Rain Garden Fact Sheet is included in the appendix. It states that the typical cost of installing a rain garden ranges from "\$4 to \$35 per square foot, depending on the source of the materials, site conditions and who does the work. Use of a professional contractor and landscaper will result in higher costs." Furthermore, the calculator above simply states the recommended quantity of plants, but costs will vary by plant species, plant

type (trees and shrubs are more expensive than perennials) and size. It may be best to hire a contractor to install a large rain garden from scratch or a series of rain gardens in a community wide project, but most gardeners could slowly retrofit or create a new rain garden in phases without incurring the additional expense.

Commissions, Friends Groups and Community Organizations

It is important to connect the residents to the basins, swales, ponds and streams, for them to see how their own properties affect water quality. Friends groups dedicated to each park or basin, or organized by the community members, or facilitated by Township commissions, would help to keep the neighbors connected, informed and educated. More importantly, they could empower the citizens to make positive changes at the parks, by working alongside with the Township, as partners. They could also feel more confident in making changes on their own private properties.

Friends groups could take some of the workload off the Township, and could also strengthen the communities, by bringing neighbors together and by giving them ownership of their community spaces.

The Township commissions and staff could work with the surrounding communities to create friends groups for each park, basin or community. They may wish to refer to the Philadelphia Park Friends Group Toolkit, a 48 page guide to establishing friends groups, available on the Philadelphia Parks and Recreation website

(<https://www.phila.gov/media/20180619163452/2018-Park-Friends-Toolkit.pdf>).



The Philadelphia Parks and Recreation Department's Friends Group Toolkit can serve as a guide in creating support groups to maintain stormwater BMP's.

Site Specific Recommendations



The McCarthy Park naturalized basin provides stormwater management, habitat, and beautification of the park.

The general recommendations included previously apply to McCarthy, Miles, Valley Green and Koontz Parks, and the stormwater facilities along Woodbine Way. However more specific recommendations are included below to facilitate the reduction of sediment and nutrients and an increase in infiltration and groundwater recharge. These strategies will help to improve and maintain the health of the basins and the connected water system.

McCarthy Park

The park, owned by the Township, is adjacent to property owned by the local school district.

The school property and township properties are not separated visually or physically. The Township owned parcels contain the Joshua Knoll basin and the McCarthy Park basin. The basins are surrounded by residences, a forest, meadows and turfgrass. A paved trail encircles the park, cutting between the basins, running through the school property around the athletic fields, and back into the woods. The trail connects to the surrounding neighborhoods as well and appears to be a popular destination for walkers and runners. A series of grass paths also follow the perimeter of the basin and wind through the meadow.

Stewardship of the Existing Basins and Surrounding Natural Landscapes

McCarthy Park features a range of vegetation types including wet meadows within stormwater basins, woodlands, and a meadow. The stormwater basins are the main hydric feature at this site. Historically, the property was used for agriculture.

Plant Communities

Three plant communities were identified at McCarthy Park. These were delineated based on cover type, dominant plants, and hydrologic conditions. The Stewardship Features Map shows the location of the plant communities as well as notable stewardship features and issues. A plant list that includes all species identified during the site visit is included after the plant



The stormwater basins help manage stormwater while providing scenic views and habitat for wildlife.

community descriptions. Invasive plants are noted in **bold**.

Wet Meadow Stormwater Basins (+/- 8.5 acres)

The two stormwater basins contain wet meadows with a mix of native, non-native, and invasive plants. Though there are two distinct basins, the plant composition is similar between the two and the basins should be managed together. Invasive plant species is the key stewardship issue at the basins. The Township is already working with a consultant to control the invasive plants. This work should continue on a regular basis to control the remaining invasive plants. The site features a highly diverse community of native plants which can support a range of wildlife and pollinator species. Additional native plants could be added to further support birds or pollinators.

Woodlands (+/-7.4 acres)

There are two main areas of woodlands within the park. The first is between the paved trail and the basins and meadow. The second area is a small pocket to the north between the basins. The woodlands are dominated by sycamore and tuliptree in the canopy. The majority of canopy and understory trees are native. However, the shrub layer is heavily invaded by invasive plants such as shrub honeysuckle. Trees were planted



The woodlands add habitat diversity and contribute to the stormwater management within the park.

along the edges of the woodland along the path.

Terrestrial Meadow (+/-1.1 acres)

The terrestrial meadow is between the woodland and the larger stormwater basin. It contains a mix of native, non-native, and invasive plants, with the dominant plants being goldenrod, a native, and crown-vetch, an invasive plant. There is not a highly diverse mix of native plants. Diversity can be increased to improve community resiliency, support wildlife and pollinators, and provide scenic beauty throughout the year. Mowing annually when the ground is frozen, generally in March, can help control invasive plants and maintain the area as a meadow by controlling woody plants. The meadow should be mown to a height of 8-12 inches.



Crown-vetch, seen in the foreground, is an invasive plant that is dominant in the terrestrial meadow.

Existing Plant Species in McCarthy Park Basins

Wet Meadow - Upper Basin	
Trees	
black walnut	<i>Juglans nigra</i>
mulberry	<i>Morus</i> sp.
sycamore(saplings)	<i>Platanus occidentalis</i>
bradford pear	<i>Pyrus calleryana</i>
Shrubs and Vines	
morning-glory	<i>Calystegia silvatica</i>
multiflora rose	<i>Rosa multiflora</i>
brambles	<i>Rubus</i> sp.
grape	<i>Vitis</i> sp.
Herbaceous Plants	
indian-hemp	<i>Apocynum cannabinum</i>
mugwort	<i>Artemisia vulgaris</i>
swamp milkweed	<i>Asclepia incarnata</i>
common milkweed	<i>Asclepias syriaca</i>
false nettle	<i>Boehmeria cylindrica</i>
Canada thistle	<i>Cirsium arvense</i>
crown-vetch	<i>Coronilla varia</i>
fleabane	<i>Erigeron</i> sp.
boneset	<i>Eupatorium perfoliatum</i>
rushes	<i>Juncus</i> sp.
mint	<i>Lamiaceae</i> sp.
common reed	<i>Phragmites australis</i>
sedges	<i>Scirpus</i> sp.
goldenrod	<i>Solidago</i> sp.
common cat-tail	<i>Typha latifolia</i>
ironweed	<i>Veronia noveboracensis</i>

Wet Meadow - Lower Basin	
Trees	
sweetgum	<i>Liquidambar styraciflua</i>
mulberry	<i>Morus</i> sp.
sycamore	<i>Platanus occidentalis</i>
bradford pear	<i>Pyrus calleryana</i>
willow	<i>Salix</i> sp.
Shrubs and Vines	
morning-glory	<i>Calystegia silvatica</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
Virginia creeper	<i>Parthenocissus quinquefolia</i>
wineberry	<i>Rubus phoeniculasius</i>
brambles	<i>Rubus</i> sp.
Herbaceous Plants	
wild onion	<i>Allium</i> sp.
indian-hemp	<i>Apocynum cannabinum</i>
mugwort	<i>Artemisia vulgaris</i>
swamp milkweed	<i>Asclepias incarnata</i>
common milkweed	<i>Asclepias syriaca</i>
Canada thistle	<i>Cirsium arvense</i>
crown-vetch	<i>Coronilla varia</i>
fleabane	<i>Erigeron</i> sp.
rushes	<i>Juncus</i> spp.
common reed	<i>Phragmites australis</i>
pokeweed	<i>Phytolacca americana</i>
sedges	<i>Scirpus</i> sp.
goldenrod	<i>Solidago</i> spp.
common cat-tail	<i>Typha latifolia</i>

Terrestrial Meadow	
Trees	
bradford pear	<i>Pyrus calleryana</i>
Shrubs and Vines	
Japanese honeysuckle	<i>Lonicera japonica</i>
multiflora rose	<i>Rosa multiflora</i>
grape	<i>Vitis</i> sp.
Herbaceous Plants	
common milkweed	<i>Asclepias syriaca</i>
Canada thistle	<i>Cirsium arvense</i>
crown-vetch	<i>Coronilla varia</i>
Queen Anne's-lace	<i>Daucus carota</i>
fleabane	<i>Erigeron</i> sp.
	<i>Eupatorium</i>
boneset	<i>perfoliatum</i>
sedges	<i>Scirpus</i> sp.
goldenrod	<i>Solidago</i> sp.
	<i>Vernonia</i>
ironweed	<i>noveboracensis</i>

Woodlands	
Canopy Trees	
black walnut	<i>Juglans nigra</i>
tuliptree	<i>Liriodendron tulipifera</i>
mulberry	<i>Morus</i> sp.
sycamore	<i>Platanus occidentalis</i>
pin oak	<i>Quercus palustris</i>
black locust	<i>Robinia pseudoacacia</i>
willow	<i>Salix</i> sp.
Understory Trees	
box-elder	<i>Acer negundo</i>
Japanese maple	<i>Acer palmatum</i>
silver maple	<i>Acer saccharinum</i>
river birch	<i>Betula nigra</i>
redbud	<i>Cercis canadensis</i>
eastern red-cedar	<i>Juniperus virginiana</i>
	<i>Liquidambar</i>
sweetgum	<i>styraciflua</i>
magnolia	<i>Magnolia</i> sp.

Understory Trees (Continued)	
crabapple	<i>Malus</i> sp.
mulberry	<i>Morus</i> sp.
blackgum	<i>Nyssa sylvatica</i>
white pine	<i>Pinus strobus</i>
bird cherry	<i>Prunus avium</i>
black cherry	<i>Prunus serotina</i>
bradford pear	<i>Pyrus calleryana</i>
white oak	<i>Quercus alba</i>
willow	<i>Salix</i> sp.
elm	<i>Ulmus</i> sp.
Shrubs and Vines	
morning-glory	<i>Calystegia silvatica</i>
oriental bittersweet	<i>Celastrus orbiculatus</i>
English ivy	<i>Hedera helix</i>
rose mallow	<i>Hibiscus</i> sp.
spicebush	<i>Lindera benzoin</i>
shrub honeysuckle	<i>Lonicera</i> sp.
multiflora rose	<i>Rosa multiflora</i>
wineberry	<i>Rubus phoeniculasius</i>
brambles	<i>Rubus</i> sp.
elder	<i>Sambucus canadensis</i>
maple-leaved viburnum	<i>Viburnum acerifolium</i>
grape	<i>Vitis</i> sp.
Herbaceous Plants	
white snakeroot	<i>Ageratina altissima</i>
	<i>Apocynum</i>
indian-hemp	<i>cannabinum</i>
mugwort	<i>Artemisia vulgaris</i>
common milkweed	<i>Asclepias syriaca</i>
false nettle	<i>Boehmeria cylindrica</i>
crown-vetch	<i>Coronilla varia</i>
fleabane	<i>Erigeron</i> sp.
jewelweed	<i>Impatiens capensis</i>
	<i>Microstegium</i>
Japanese stiltgrass	<i>vimineum</i>
	<i>Toxicodendron</i>
poison ivy	<i>radicans</i>
	<i>Vernonia</i>
ironweed	<i>noveboracensis</i>
periwinkle	<i>Vinca minor</i>

Stewardship Recommendations

Through discussions with the Township, it was determined that the conservation priorities are managing stormwater, supporting native plant communities and biodiversity, and passive recreation. These priorities can support and enhance each other. The primary function of the naturalized basins is to manage stormwater. Maintaining and enhancing the native plants will maintain this functionality while providing habitat for wildlife and insects and a scenic area for passive recreation. The woodlands and terrestrial meadow provide additional stormwater control by slowing and filtering stormwater prior to it reaching the basins. Passive recreation through the trail was identified as an important use for the park. In addition to the mental and physical health benefits of spending time recreating, connecting people to native plant communities through passive recreation can build public support for maintenance of these resources.

The greatest threats to the health of the plant communities are deer and invasive plants, which together, can edge out native plants from all the communities and compromise their sustainability. Invasive species can frequently outcompete our native species and become the dominant plants in an area. Deer contribute to the problem by primarily eating native plants. Once the deer decimate native plants, the invasive species can thrive with little competition. Controlling deer and invasive plants should be a high priority at the park.

Invasive Plant Control

Invasive plants are primarily exotic species that can out-compete native vegetation and drastically reduce species diversity. They offer fewer benefits to wildlife, providing low quality food sources and preventing growth of plants that provide better habitat. It is important to note that not all non-native plants are invasive.

An invasive species displays one or more of the following characteristics:

- susceptible to few herbivores or diseases
- adaptation to disturbance
- fast germination
- high population growth
- early reproductive maturity
- vegetative as well as sexual reproduction
- pollination by wind or multiple insect species
- wide tolerance to many habitat types
- fast growth rate
- long-range seed dispersal capability
- fruit used by wildlife (food) or humans (decoration)

Due to these characteristics, invasive plants are able to aggressively move into an area and outcompete native plants. Additionally, they are not readily used as a food source by native animals, including deer. This can lead to deer overbrowsing native species, allowing invasive plants to further colonize the area. Climate change is likely to aid invasive species dispersal, with species expanding their range north as a result of increasing temperatures.

Invasive plants impact all of the Park's plant communities to varying extents. To protect and improve biodiversity and wildlife habitat, invasive species should be managed to: 1) protect critical areas; 2) limit further degradation; 3) reduce the possibility of recolonization from previously controlled species and colonization by new invasive species; and 4) best utilize stewardship resources.

The Township is already taking action to manage invasive species. They have hired Red Tail Restoration and Land Management to help steward the park. They actively remove invasive species and replace them with native plants. They have also installed native plant gardens to benefit pollinators. They also work to restore

the natural forest ecosystem. The Township should be commended for undertaking this work and acknowledging the threat invasive species pose to our native ecosystems. This work should continue as it is a crucial part of land stewardship at the park.

Preventing new invasive species from colonizing is the most efficient way to save resources, as it takes less effort to eradicate a small, young population than a wide-spread and well-established population with an extensive seed bank. The Park should be monitored for new infestations, and likely invaders from neighboring areas should be noted. Boundary encroachment can be a source of invasive species as invasive ornamental plants may spread from neighboring properties. Yard waste discarded along property boundaries may contain seeds or clippings of invasive plants which can escape into the park. Early detection and treatment of new invasive plant species should be given high priority for management. To help prevent the spread of invasive plants from nearby properties, the Township should reach out to neighbors about the problems with invasive plants and encourage them to plant native species instead. Some options for outreach include presentations, articles in newsletters, neighbor-to-neighbor outreach, and posts on social media.

When soil is disturbed, dormant seeds within the ground, including those of invasive species, can spring to life. Therefore, it is as important to limit soil disturbance as it is to address existing invasive plant populations. Motorized equipment should be used selectively and cleaned often to reduce disturbance and introduction of invasive plant material.

Due to the relatively compact size of the park, invasive plants can be addressed simultaneously across plant communities by species rather than area. Individual invasive species should be prioritized based on their

ecological impact. Species that would have the greatest impact on an ecosystem should be targeted first. This includes those that can destroy the canopy layer. This generally follows a top-down strategy where invasive plants in the canopy layer are addressed first but allows for exceptions for very aggressive species. If the township would prefer to target all invasive plants within one plant community, the stormwater basins should be the highest priority since they are the main focus for the property. Within a given species, mature, seed producing individuals should be targeted to eliminate spreading new seeds and to deplete the seed bank. For the Park, vines within the canopy, Bradford pear, and phragmites within the stormwater basins should be prioritized first. For a full list of invasive plants noted during the site visit and recommended priority order, see the following recommendations table.

Finally, staff should prioritize controlling species which pose a specific risk to human health, safety, or welfare. Vines covering trees along trails and roads should be prioritized for management as they may cause the crowns or entire trees to fall, possibly endangering people. Highly toxic plants, such as poison hemlock or giant hogweed, should also be prioritized if identified at the park. If these, or other similarly toxic plants, are found, they should be treated as soon as possible.

Where invasive species make up most of a structural layer, less than 50% of that layer should be removed at a time. This will avoid abruptly removing all wildlife food and cover and allow native plants time to regenerate in treated areas. Once invasive species have been removed, disturbed areas should be replanted with native species to restore habitat and discourage invasive plants from reestablishing. At McCarthy Park, this is only a concern in the forest where the shrub layer is almost entirely

invasive plants. Sections of the shrub layer can be treated over time by first controlling the invasive plants and then replacing them with native species.

Staff should monitor the site on an on-going basis to track the effectiveness of treatment of existing invasive species and to determine if further treatments are necessary. Treatment efforts often need to be repeated to be successful. Current efforts may also need to be reassessed and other treatments pursued. Monitoring is important after treatment to address any regrowth from the seed bank and to prevent reestablishment of the population.

Township staff should educate visitors about the importance of cleaning shoes and clothing before entering the park to reduce the introduction of new invasive plants. A short explanation posted on a kiosk or entrance sign could help make the public more aware of the risks of being unintentional carriers of invasive seeds.

After invasive plant control, the plant communities can be enhanced by adding additional native plant species to each community. In the woodlands, additional native shrubs can help fill gaps left after invasive plant control. In the terrestrial and wet meadows, the emphasis should be on filling seasonal gaps. That is, the communities should have plants blooming from spring through fall. An additional consideration is to add plants that fruit and provide seeds at different times of the year to provide food for insects and wildlife throughout the year.

Deer Management

Deer populations in this region have been increasing due to a loss of large predators, fragmentation of forests, and previously strict hunting limits (though this policy has been changed to better control deer populations). High population levels pose a risk to

conservation lands due to overbrowsing of herbs, shrubs, and tree seedlings which can dramatically decrease structural and species diversity. This creates plant communities with



Deer play a significant role in the spread of invasive species, as they primarily eat native species, allowing invasives to thrive. Photo © Bill Moses

little or no understory except for invasive plants. Invasive plants, which are not a preferred food source for deer, can take advantage of the newly opened spaces and disturbed soil to colonize an area.

Based on the moderate native plant diversity and low regeneration of native trees and shrubs in the woodlands, the deer population is too high. Controlling the deer population can help support native plants and sustain the communities at the park. Options include managed hunting or fencing. Based on work on Natural Lands Preserves, managed hunting through a hunting program is the more effective option. This option will have to be carefully considered due to the close proximity of the school and neighbors. Fencing can be used to fence in entire areas or new plantings. Fencing entire areas, either the full park or select areas, can be expensive to install and maintain. Maintenance is needed to make sure any damages are fixed as soon as possible and that any deer that managed to get inside the fence are removed. Fencing around new plantings or naturally regenerating seedlings is

recommended when no deer management is enacted or when managed hunting is used.

Deer populations can be monitored annually based on the condition of the plant communities to determine the level of control needed. Missing structural layers, such as a native understory in forests, or a high level of browsing on native meadow plants can indicate high deer populations. If monitoring indicates an overabundant deer population over time, this could add support to the need for deer management.

The deer population depends in large part on if deer are managed on surrounding properties. Informal outreach can be done to encourage neighbors with large properties to control the deer on their land as well.

Climate Change

Climate change is another major threat to the sustainability of the natural systems. According to DCNR’s Climate Change Mitigation and Adaptation Plan, this region of Pennsylvania is expected to experience rising temperatures, increased precipitation, and heavier storms. These changes are likely to affect plant hardiness and stormwater intensity. This can affect plant survival and regeneration, as well as what species are appropriate to plant when planning for the future. It also increases the importance of riparian buffers and natural vegetation to slow and infiltrate stormwater to reduce flooding and protect water quality.

Planting for Diversity, Wildlife Support, and Filling Growing Space

All three plant communities may benefit from additional plantings. The wet meadows in the stormwater basin already have a moderate diversity. However, there are still invasive plants that need to be controlled and are controlling a significant amount of growing space. As these invasive plants are controlled,

this growing space will be opened to new plants. This presents the opportunity to add additional species if desired and resources allow. Conversely, if invasive plant control continues, these areas can be allowed to naturally revegetate with species present. If the Township chooses to plant additional species, some options include:

Rushes	
New England aster	<i>Aster novae-angliae</i>
Swamp milkweed	<i>Asclepias incarnata</i>
Blue flag iris	<i>Iris versicolor</i>
Swamp sunflower	<i>Helianthus angustifolius</i>
Joe pye-weed	<i>Eupatorium purpureum</i>

Penn State Extension offers a more complete list of possible plants, though it also include shrubs and trees: <https://extension.psu.edu/rain-gardens-the-plants>

The woodlands could benefit from shrub plantings after invasive plant removal in both the shrub and canopy layers. This will help fill growing space previously occupied by the invasive plants and will help filter and slow stormwater. Any plantings will need to be protected from deer with fencing. Some options include:

Trees (for canopy gaps and bradford pear removal areas)	
Blackgum	<i>Nyssa sylvatica</i>
White oak	<i>Quercus alba</i>
Silver maple (interior areas)	<i>Acer saccharinum</i>
Sweetgum (interior areas)	<i>Liquidambar styraciflua</i>
White pine	<i>Pinus strobus</i>

Shrubs (replacement after invasive plant removal)	
Blackhaw viburnum	<i>Viburnum prunifolium</i>
Black or red chokeberry	<i>Aronia arbutifolia/Aronia melanocarpa</i>
Witch hazel	<i>Hamamelis virginiana</i>
Spicebush	<i>Lindera benzoin</i>
Sweet pepperbush	<i>Clethra alnifolia</i>
Maple-leaved viburnum	<i>Viburnum acerifolium</i>

Herbaceous Plants	
Aromatic aster	<i>Aster oblongifolius</i>
Little bluestem	<i>Schizachyrium scoparium</i>
Purpletop	<i>Tridens flavus</i>
Common milkweed	<i>Asclepias syriaca</i>
Bee balm	<i>Monarda didyma</i>
Mountain mint (plant in limited quantities, readily spreads)	<i>Pycnanthemum muticum</i>

The terrestrial meadows have limited diversity of native plants. Increasing diversity can provide better habitat for wildlife and insects, including pollinators. As the invasive plants are controlled, plugs of native plants can be added. Choosing plants that bloom at different times of the year, have different heights, and offer different types of cover can add scenic and habitat benefits. Some options include:

Conservation Priorities and Stewardship Recommendations

		Conservation Priorities:		Stormwater management through native plant communities Passive recreation							
		Top Strategies:		Control deer Control invasive plants Enhance plant diversity Maintain public access							
Priority¹	Stewardship Recommendations	Spring	Summer	Fall	Winter	Who could implement?²	Entire Park	Stormwater Basin	Woodlands	Terrestrial Meadow	
<i>Wet Meadow Stormwater Basin</i>											
1	Avoid unnecessary disturbance from heavy equipment or construction within the wet meadow and stormwater basin					Staff					
1	Cut meadows once annually when ground is frozen with a brush cutter, avoiding desired woody plants				Nov-Mar	Staff or Contractor					
1	Continue managing invasive plants	See below				Staff or Contractor					
1	Monitor stormwater basin for proper functioning					Staff					
2	Maintain plant diversity, adding new species as desired to enhance habitat for wildlife and insects					Staff, Contractor, or Volunteers					

Priority ¹	Stewardship Recommendations	Spring	Summer	Fall	Winter	Who could implement? ²	Entire Park	Stormwater Basin	Woodlands	Terrestrial Meadow
Woodlands										
1	Maintain previously planted trees, protecting from deer and invasive plants					Staff or Volunteers				
2	Plant tree seedlings as needed in canopy gaps; protect seedlings from deer					Staff or Volunteers				
3	Increase understory diversity by planting shrubs after invasive plants are controlled; protect seedlings from deer					Staff or Volunteers				
Terrestrial Meadows										
1	Mow meadows once annually to a height of 8-12 inches				Nov-Mar	Staff				
2	If crown-vetch or other invasives persist, mow 1/3-1/2 of the meadow in July, rotating areas each year		July			Staff				
3	Increase diversity of plants by adding additional native species					Staff or Volunteers				
Deer Management										
1	Consider implementing a deer management program to reduce deer impact					Staff				
2	Protect new plantings and natural regeneration as needed					Staff				
2	Monitor Park for deer impact by assessing impact on plants (browsing evidence and level of regeneration)					Staff or Volunteers				
Invasive Plants										
1	Monitor for and prevent colonization of new species					Staff				

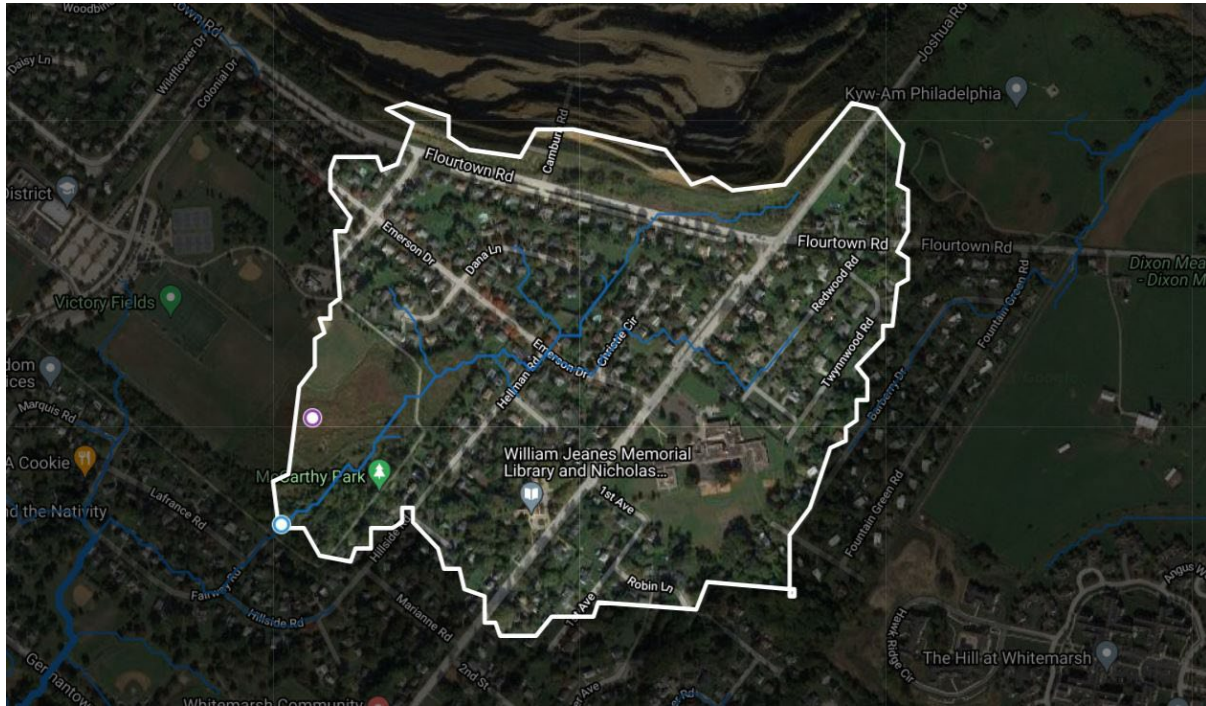
Priority ¹	Stewardship Recommendations	Spring	Summer	Fall	Winter	Who could implement? ²	Entire Park	Stormwater Basin	Woodlands	Terrestrial Meadow
1	Control invasive plants and prevent their spread. Community prioritization: 1. Wet meadow stormwater basins 2. Woodlands 3. Terrestrial meadows	Based upon the vegetation communities habitat value priority ranking, begin focused invasive removal using techniques described below.				Staff or Volunteers				
1	Mow meadows twice annually if invasive plants are dominant - the full meadow once in Nov-March and 1/3-1/2 of the meadow once in July. Recommendations related to meadows below are for more targeted treatments and can be used in tandem with a second mowing if needed.		July		Nov-March	Staff or Volunteers				
1	Control Callery pear through mechanical girdling, manual removal, or a cut stump treatment. A basal bark application can be used for trees with 6" dbh or smaller.					Staff or Volunteers				
1	Control Japanese honeysuckle by cutting vines at ground level and at 5 feet above the ground, treat the stumps with herbicide in the Fall					Staff or Volunteers				
1	Control oriental bittersweet by cutting vines at ground level and at 5 feet above the ground, treat the stumps with herbicide in the Fall					Staff or Volunteers				
1	Control English ivy by cutting vines at ground level and at 5 feet above the ground, treat the stumps with herbicide in the Fall					Staff or Volunteers				
1	Control Japanese maple trees by applying a basal bark application					Staff or Contractor				

Priority ¹	Stewardship Recommendations	Spring	Summer	Fall	Winter	Who could implement? ²	Entire Park	Stormwater Basin	Woodlands	Terrestrial Meadow
1	Control common reed by applying an herbicide directly to the stalks or by a drip application into cut stalks (Late Summer to early Fall)					Staff				
2	Control shrub honeysuckle through a basal bark application or cut stump treatment					Staff or Contractor				
2	Control wineberry through a basal bark application or cut stump treatment					Staff or Contractor				
2	Control crown-vetch by hand pulling or herbicide application					Staff or Contractor				
3	Control Canada thistle by cutting, pulling, or herbicide application					Staff or Contractor				
3	Control periwinkle by raking back runners and mowing close to the ground, this can be followed by a foliar herbicide application					Staff or Contractor				
3	Control mugwort by applying herbicide					Staff				
4	Control Queen Anne's-lace through mowing, cutting, or hand pulling					Staff, Contractor, or Volunteers				
4	Control multiflora rose through a basal bark application or cut stump treatment. Alternatively, multiflora rose can be killed naturally by the rose rosette disease if present.					Staff or Volunteers				
2	Revegetate as needed after invasive control					Staff or Volunteers				
2	Reach out to neighbors and other community members about problems with invasive plants and benefits of native species					Staff or Volunteers				

Priority ¹	Stewardship Recommendations	Spring	Summer	Fall	Winter	Who could implement? ²	Entire Park	Stormwater Basin	Woodlands	Terrestrial Meadow
3	Educate visitors through interpretive signs about ways to prevent the spread of invasive plants.					Staff				
Exotic Pests										
1	Follow quarantine requirements for spotted lanternfly					Staff				
1	Utilize traps to help manage spotted lanternfly	April-July				Staff or Volunteers				
3	Scrape spotted lanternfly egg masses					Staff or Volunteers				
Hazards										
1	Monitor for and remove hazard trees - annually and after severe weather events					Staff				
Boundary Encroachment and Illegal Use										
1	Mark boundaries with vinyl markers and maintain as needed					Staff				
1	Monitor park regularly for encroachment					Staff				
1	Communicate with neighbors to prevent debris dumping and remove any debris as soon as identified					Staff				
2	Recruit trail ambassadors and park monitors					Staff				
Climate Change										
1	Increase plant biodiversity to build resiliency					Staff or Volunteers				
3	Monitor changes in precipitation and temperature, noting effects on plant or wildlife health					Staff or Volunteers				
Volunteers										
2	Recruit regular volunteers to help with park management					Staff				

* Volunteers should not be used to apply herbicide unless they have proper certification and personal protective equipment

On Site Strategies for Stormwater Management



The basins in McCarthy Park capture stormwater from the nearby neighborhoods, as far as Flourtown Road.

Key BMP Recommendations

1. Reduce turf grass surroundings
2. Vegetate swales
3. Implement original landscape plan

The basins are a primary feature within the park. They are home to frogs, toads and likely other amphibians and possibly even small fish. Insects, like bees and butterflies are attracted to the flowering perennials. Aquatic insects make their homes in the water and wet soil. Birds follow the insects as they are an important part of their diets. Some seek out the plants for nectar too. The basins are alive and visitors are treated to the sites, smells and sounds as they follow the trail between them.

The forest and meadows add different natural character to the park. Like most forests in our region, the woodlands have been impacted by invasive species and deer, but still provide shade, peace and quiet to the trail. The



Tree planting events could improve stormwater management, beautify the park, build community and serve as educational events.

meadows here would benefit from a greater diversity of plant species, but they are much more beneficial to insects and birds, and the water system, than turf grass would be.

The school property and the athletic fields provide a wholly different character, an abrupt change from the basins, woodlands and meadows. The mowed fields and paved courts don't support natural communities, but provide opportunities for residents, especially students, to enjoy tennis, softball and other sports.

These four sections of the park – basins, forests, meadows, athletic fields- contribute differently to the character of the park. They function differently and provide different opportunities for visitors. They generally work well together, but the strategies below can make for better transitions between the spaces and improved stormwater management.

Tree Plantings

Every tree helps to manage stormwater, in addition to providing many other benefits. The engineered plans for the McCarthy and Joshua Knoll basins include a landscape plan which shows trees and shrubs along the northern basin fence. It appears that this landscaping either was never installed or has since been removed. The entire site could be planted with more trees in general.

The basins could be planted with more trees along their edges and within the wet bottoms. The existing sycamores will likely continue to spread seeds resulting in more trees popping up in the basins. The landscaping shown on the engineered plans could still be implemented along the fence. Trees could be planted along the trail between the basin as well. However, these would likely need to be planted on the basin floors, as the berm holding the trail includes a layer of hard plastic geotextile

reinforcement. These trees would help to soak up stormwater, keep the water in the basins shaded and cool and would also provide shade and beauty along the trail.

Mowing

It appears that some areas adjacent to the basins are mowed much more frequently than is necessary. This not only wastes time, fuel and money, mowed grass is detrimental to stormwater management and water quality. It seems that at least some of the grass could be allowed to grow or be replanted with meadow grasses or other plantings which would better manage stormwater and beautify the park.



The grass just beyond the basin fence could be allowed to grow taller, to better slow, filter and infiltrate stormwater, and keep sediment and pollutants out of the basin.

The area directly north of the basin is of the greatest concern as it appears to create sheet flow into the basin. The grass is mowed all the way to the edge of the basin. However, it appears that an additional 50 – 75' between the north of the basin could be allowed to grow into a meadow strip to better filter water flowing into the basin. Stormwater flowing into the basin here likely carries grass clippings, nutrients like nitrogen and phosphorous and possibly fertilizers and herbicides. A meadow strip would slow that water down and catch clippings and sediment before it could reach the basin.

Swale Erosion

Many narrow and shallow swales exist throughout the sites. It's unclear if these were created to manage stormwater or if they are the result of settling, perhaps over utility lines. Either way, they are beginning to show some erosion. The swales do feature some stone, possibly added with the intention of slowing the erosion. These swales could be planted with a simple line of low growing, hardy native perennials, or could be developed into a more robust vegetated swale. The swale, as it exists, is not a major issue. It is likely carrying some sediment into the basin. However, the longer it is allowed to erode, the bigger issue it will become.



Swales are forming as storm water is collecting and eroding the fields as it flows to the basin. These areas could be improved with simple, easy to maintain plantings.

Off Site Strategies for Stormwater Management (at all sites)

Key BMP Recommendations

- 1. Street tree plantings**
- 2. Residential rain gardens**
- 3. Residential rain barrels**

Most of the stormwater that makes its way in the Joshua Knoll and McCarthy basins comes from the surrounding neighborhoods. Rain and snow fall on roofs, driveways, lawns and streets, then flow into the storm sewer system which leads to the basins. Of course, this stormwater may pick up degrading roof shingle granules, road salts and cinders, oil and other automotive chemicals, lawn fertilizers, pesticides and herbicides, and anything else it flows across. So the best way to keep these contaminants out of the basins and the connected water system is to capture them before they ever get there. The following strategies could be applied to the neighborhoods around McCarthy Park, and throughout the township.

Street Tree Plantings

Street trees provide an abundance of benefits, including habitat and food sources for animals, clean air, shading and reduction of the heat island effect, traffic calming and increased property values. And of course, they also manage stormwater. Even without creating a detailed inventory of street trees, it is clear that many of the surrounding streets would benefit from more tree planting. Tree canopies catch rainwater, keep some of it in the canopies, and then evapotranspire that water back into the atmosphere before it reaches the ground. Their roots provide pathways for water to infiltrate into the ground and also soak up some water before it can flow overland and into inlets. Trees also shade the streets, keeping the

asphalt cooler, which keeps the stormwater cooler, which means it can hold more dissolved oxygen, better supporting aquatic species.

Rain Gardens

Residential rain gardens are becoming more and more popular, as some communities now require individual on-lot stormwater management in new developments. This means that each new home is essentially required to have a rain garden on their lot. Additionally, non-profit organizations like the Lower Merion Conservancy and the Eastern Delaware County Stormwater Collaborative have created programs which support the creation of rain gardens at established residences. These rain gardens are often designed to capture the first 2" of runoff from the roof and driveway of a single family home generated during a storm. A series of rain gardens built to this standard can make a big impact, especially in older

communities which are not connected to basins. Around McCarthy Park, rain gardens would help capture stormwater and infiltrate it locally, before it ever reaches the basins.

Rain Barrels

Similar to rain gardens, rain barrels are a simple and effective way to capture and manage stormwater. These simple cisterns are connected to downspouts, so stormwater is collected as an asset rather than being allowed to flow into the sewer system. Water collected in rain barrels can be used to water the garden in drier times, when excess will infiltrate into the soil. It can also save the homeowner on their water bill and conserve water. However, the water in rain barrels must be used fairly frequently. If the barrel fills and overflows, it will no longer benefit the stormwater system.

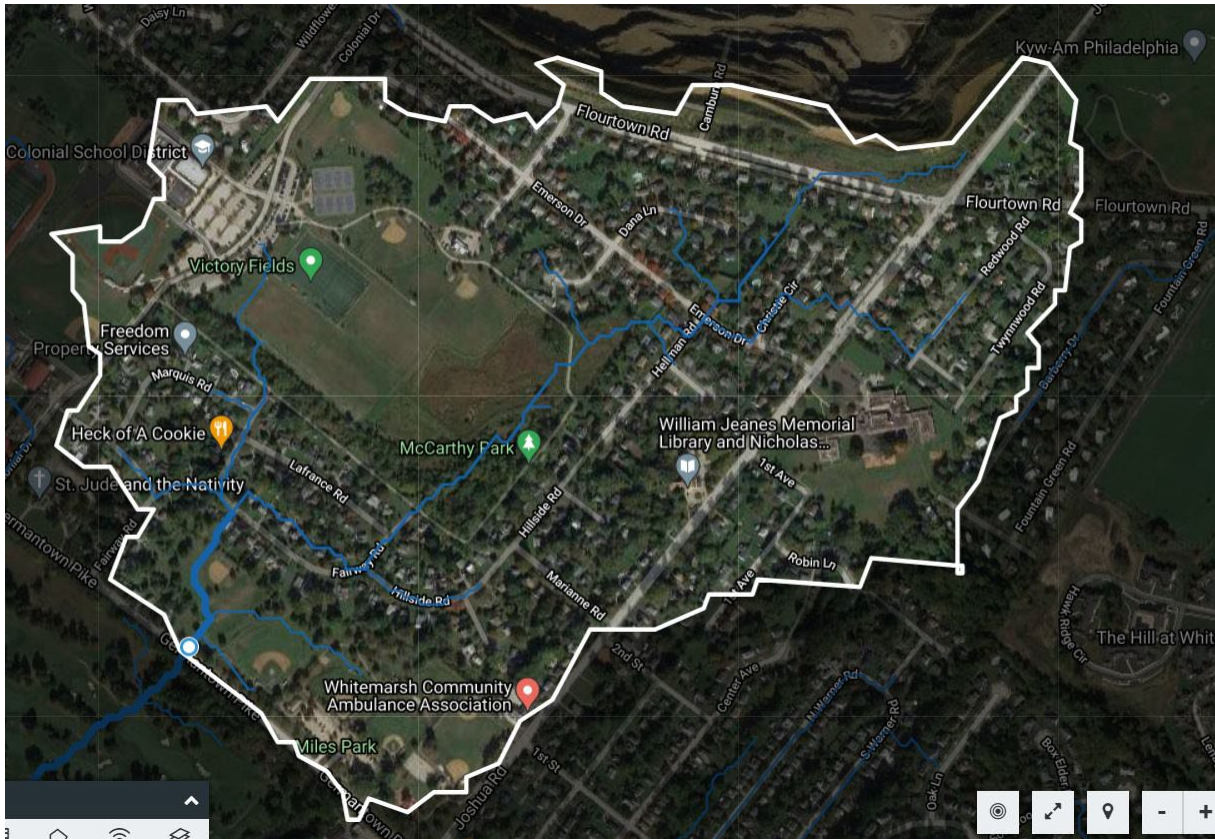
McCarthy Park - Site Analysis



McCarthy Park - Conceptual Plan



Miles Park



The Miles Park watershed includes McCarthy Park, as water which flows out of the basins there eventually flows into Miles Park.



A portion of the stormwater system at Miles Park is naturalized. The same methods could be applied to the other swales and channels.

Separated only by one small subdivision and as little as 500', Miles Park is McCarthy's downstream partner in managing stormwater.

Any overflow which spills out of McCarthy Park gets piped through the subdivision and eventually ends up in Miles Park, at least for a brief period. The eastern end of the park has recently been upgraded to include a veterans memorial and stormwater management improvements. However, the western end of the park shows the effects of too much stormwater. However, there are opportunities to improve the situation through installation of simple BMP's on site. Additionally, all of the off-site recommendations included in the McCarthy Park section above would also apply to the neighborhood adjacent to Miles Park, as the stormwater which flows off of their streets and landscapes washes through the park.

On-Site Strategies for Stormwater Management



Too much water, dirt and gravel are flowing into the grate (above) causing erosion and sedimentation at the outflow pipe (below). A rain garden surrounding the grate could help improve the situation.



The parking lot could be redesigned to incorporate a center planting island to capture stormwater, like this one at Stoneleigh.

Key BMP Recommendations

- 1. Incorporate planted stormwater islands in parking lot**
- 2. Install rain garden at southern corner of parking lot**
- 3. Resize inlet grate & pipe and install inlet filter bag**
- 4. Naturalize existing grass swale**
- 5. Plant a riparian buffer along intermittent stream**

The western end of the park features three stormwater control measures: a turf swale, a naturalized basin and a drainage channel. Each of these features are showing some wear and tear as the result of handling too much, or too intense, stormwater. The following strategies would improve stormwater management, reduce maintenance and beautify the park.

Stormwater BMPs at the Parking Lot

The stone parking lot drains into a small grate in the northwest corner. This drain feeds a pipe which dumps water into the adjacent swale. It appears that the drain and pipe may be

undersized, as the soil is eroding downhill from the pipe. Water may be flowing out of the pipe with too much force. It also appears that stone and fines are washing out of the parking lot, into the drain and then out the pipe, as stone and fines can be found downstream in the swale. This could potentially be fixed with a series of rain gardens. One rain garden could surround the drain, allowing more water to infiltrate, and using the existing drain as an overflow. This would also catch more stone in one location, allowing it to be scooped out and placed back in the parking lot. Another rain garden could be installed at the end of the pipe, to catch the water flowing out, to slow it down and infiltrate it. It would also help to stop more stone and dust from flowing further down the swale.

Additionally, the parking lot could be redesigned to incorporate stormwater planting islands within the lot. Now, nothing stops water from flowing from one end of the lot to the other. A long island between the center rows of parking spaces could capture stormwater from the northern half of the lot. It could also capture some stone before it washes out of the lot. Trees and shrubs planted here would also beautify the lot and help to make it feel like a series of smaller parking lots, rather than one large one, dominating that area of the park.

Naturalize the Turf Swale

The turf swale which eventually receives much of the stormwater from the gravel lot, as well as stormwater from the upper end of the park,



The turf swale is receiving runoff from the parking area and stormwater captured in other parts of the park. This swale could be naturalized to filter and infiltrate more stormwater and to provide more buffering between the park and the street.

could be converted from turf grass to a mix of perennials and native grasses. This would help slow erosion of the channel. It would also slow down the flow of the stormwater, allowing sediment and nutrients to drop out before they reach the nearby stream. Naturalized vegetation here would also provide more buffering between the parking lot, the park and Germantown Pike.

Establish a Buffer on the Stream

One small intermittent stream flows through Miles Park, between the baseball field and the soccer field. This stream carries stormwater from the adjacent neighborhood and collects water directly from the soccer field and baseball field into this stream. While it appears it just be a stormwater ditch, it is a headwater of the Spring Mill Run. From Miles Park, this water flows under Germantown Pike and into the golf course's series of ponds, channels and stream segments. As a headwater stream, this is an excellent place to start implementing strategies to improve the health of Spring Mill Run.

Currently, the surrounding turf grass is being mowed right to the top of the bank, which is extremely bad for water quality. Mowed banks allow grass clippings to wash into the water, contributing nutrients. It also allows runoff to



The stream flowing through Miles Park originates in McCarthy Park. Unbuffered, it is eroding and contributing sediment to the ponds downstream at the golf course, as well as the stream segments farther down the watershed.



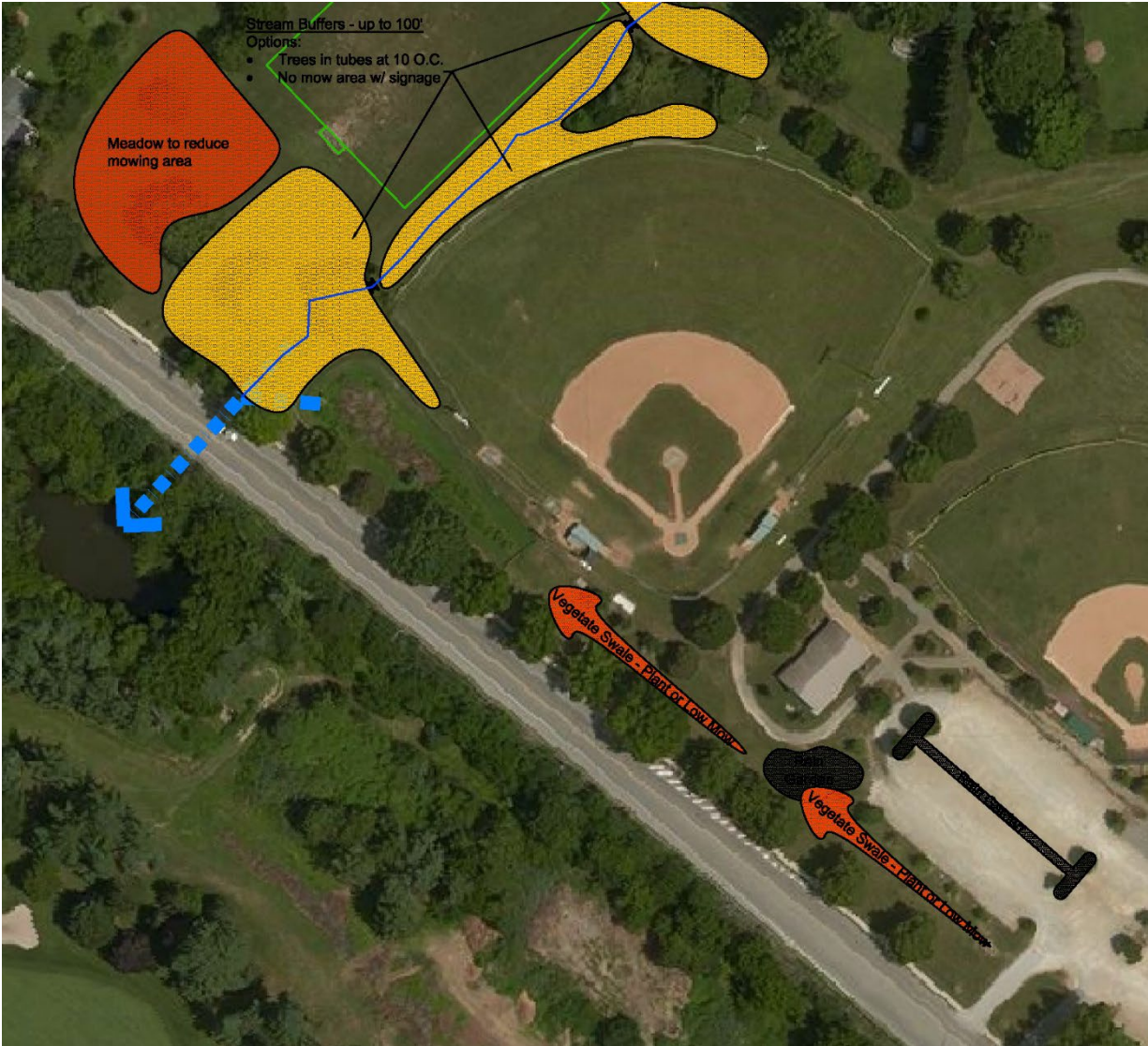
Buffer plantings could incorporate a batter's eye beyond center field and provide shade for spectators at the soccer field.

flow quickly into the stream, carrying sediment and contaminants. It does nothing to encourage stormwater to infiltrate before reaching the stream. This little stream just looks like a drainage ditch now, but it offers the potential to become a highly visible example of better management for stream health.

The streambanks should be planted with perennials, shrubs and trees. Plantings would benefit water quality by shading the stream, cooling the water, stabilizing the banks and holding sediment, filtering stormwater and

encouraging infiltration. These measures would also benefit the downstream ponds on the golf course, as the water would be cooler and cleaner as it enters. Plantings would also beautify the park further. A well-designed planting could even benefit the sports fields. Trees with dark foliage, including evergreens, would create a solid "batter's eye" beyond the centerfield fence. Shade trees along the stream would provide shade for teams and parents on the sidelines of the soccer field.

Miles Park - Conceptual Plan



Valley Green Park

Key Recommendations

- 1. Adjust mowing schedule**
- 2. Spot treat invasive species**
- 3. Establish new native planting areas in meadow**

The meadow at Valley Green Park is a good case study for meadow management. The area was allowed to naturally transition from turf grass to a meadow in 2017. A mix of native, non-native, and invasive plant species have emerged. Native plants include common milkweed (*Asclepias syriaca*), goldenrod (*Solidago* spp.), and purpletop (*Tridens flavus*). The invasive species found in the meadow include porcelain berry (*Ampelopsis brevipedunculata*), Canada thistle (*Cirsium arvense*), Japanese stiltgrass (*Microstegium vimineum*), and mugwort (*Artemisia vulgaris*). The meadow should be maintained with a goal of controlling invasive plants and supporting native species that manage stormwater, add scenic beauty and provide habitat for wildlife and pollinators.

Township staff should continue to mow the meadow annually to control invasive and woody plants. The meadow should be mowed when the ground is frozen, generally from November to March though preferably in March. The established sections of meadow should be mown to a height of 8-12 inches.

Due to the heavy spread of invasive plants, additional control measures are needed. The township should continue mowing of the Canada thistle a second time each year until the thistle is removed. One-third to one-half of the meadow can receive a second mowing annually.



The park receives some water from Patriot Way and Redcoat Drive, but most of the stormwater is generated in the park.



Thistle has taken over portions of the meadow and has been managed with timed mowing.



The meadow at Valley Green Park includes walking trails which bring people closer to nature.

Targeted herbicide applications can also help control invasive plants. As the invasive plants are controlled, staff or volunteers should monitor the meadow for new species or populations of invasive plants. Identifying and quickly controlling new infestations early is the best way to keep invasive species at bay while saving time and resources.

Once invasive plants are controlled, additional native plants can be added to the meadow. The meadow is made up of patches of invasive and native plants. Therefore, the patches of invasive species can be remediated, while the patches of natives can be left to continue growing and providing habitat. The patches of invasive species should be cleared to open growing space for native plants. The cleared areas can



The existing swale features tall grasses and naturalized vegetation, which slows, filters and infiltrates water flowing off the meadow and the parking area.



The vegetated swale acts as an extension of the meadow, resulting in a connected system of stormwater BMP's.

be replanted with plugs or seeded with a native seed mix. Plant species should be chosen based on soil hydrology and diversity. Emphasis should be placed on choosing a mix of grass and flowering species that bloom at different times of the year. If the meadow is to be replanted using a seed mix, the area should be mown frequently during the first growing season. When the plants reach a height of 8-12 inches, they should be mowed back to a height of approximately 8 inches. If invasive plants remain an issue in the second year, the area should be mowed according to the same schedule. The area should then be mowed annually with the rest of the meadow in year three and beyond.

Recommendations

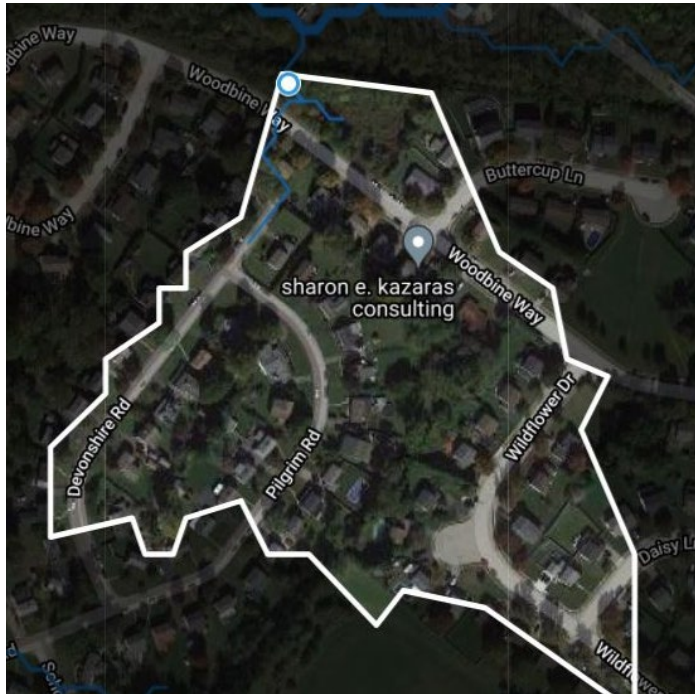
- Mow entire meadow once annually during November to March to a height of 8-12 inches
- $\frac{1}{3}$ - $\frac{1}{2}$ of the meadow can be mowed a second time in July to help control invasive plants
- Additional targeted mechanical and herbicide control can be used to help control invasive plants
- Create sections of new plantings in areas without desirable native plants either with plugs or seed mixes, to replace invasive plants, as follows:
 - Clear invasive plants and other non-native plants in desired area

- In the spring or fall, add plugs or seed mix
- If using plugs, mow area once annually
- If using a seed mix, mow throughout the growing season when plants reach a height of 12-18 inches back to a height of 8 inches; this mowing regime can be used in year 2 as well if invasive plants are a problem
- Spot control invasive plants

Meadows are included in the PA Department of Environmental Protection's Stormwater BMP Manual, created in 2006. The manual states that compared to turf grass, meadows provide *low to medium* improvements in volume reduction, recharge and peak rate control.

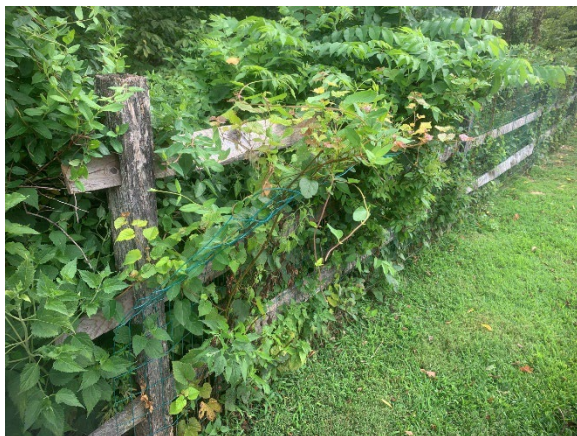
However, the manual also states that meadows provide *very high* improvements in water quality. Therefore, even if a meadow doesn't reduce water volume, the water flowing through and out of a meadow is much cleaner. The manual goes on to state that water flowing through a meadow can show reductions in Total Suspended Solids up to 85%, Total Phosphorous up to 85% and Nitrate up to 50%. These findings are particularly relevant to the meadow at Valley Green Park, as some water flowing out of the meadow directly enters a nearby vegetated swale, which drains into the Wissahickon watershed.

Woodbine Way



The Woodbine basin collects stormwater from part of the surrounding neighborhood.

Woodbine Way, a residential street which runs roughly parallel to Flourtown Road, features two areas which manage stormwater. The first is a deep, naturalized stormwater basin. The second area is an open field between Woodbine Way and Buttercup Lane, presumably provided by the developer to meet open space or recreation area requirements. The basin is fed



The basin is lush with vegetation, but invasive (and native) vines threaten to destroy the fence and damage or kill mature trees.



Signage is important to inform residents that the naturalized vegetation is appropriate. Similar signs should accompany future naturalization or BMP projects.

by numerous storm sewer pipes from the surrounding neighborhood and Flourtown Road. The open field does not appear to contain any features and was likely never intended to manage stormwater. However, it is showing erosion and efforts to stem that erosion.

Woodbine Basin

Key Recommendations

1. **Cut and/or remove vines**
2. **Mow basin bottom annually**
3. **Conduct comprehensive stewardship study**

The basin was largely inaccessible due to steep slopes and dense vegetation. But from the road, a mix of native and invasive mature trees, shrubs, vines and meadow species were all



The lawn on Woodbine only captures water which falls on it, but it is part of a larger watershed.

visible. Native tree species include sycamore, black walnut, elm and locust, while the invasive ailanthus is also present. The shrub layer is dense with invasive shrub honeysuckle. The herbaceous plants include native species such as goldenrod, blackberry, grape vines and mare's tail, as well as invasive species such as mugwort, wineberry, bindweed and honeysuckle vines. Many more species likely exist here but weren't observed due to the steep slopes and dense vegetation.

The sign posted nearby states that the basin has been naturalized from a previously mown state. The basin has definitely naturalized! The Township should continue mowing the basin bottom annually. Vines appear to be a potential

issue and should be addressed. They haven't yet taken over the tree canopy, but should be removed, or at least cut, before they get into the trees. While native and invasive species were observed, this basin may benefit from a more comprehensive study of the species there, to determine whether additional or altered maintenance methods should be applied to the sloped sides, where the trees and shrubs dominate. In general, the recommendations provided for the McCarthy Park basin can be applied to this basin as well. It appears that the basin is functional, so the township should continue monitoring the plant species and mowing annually.

Woodbine Lawn



The open lawn offers opportunities to install green stormwater infrastructure alongside recreation space.

Key BMP Recommendations

- 1. Create pocket park w/ master planning and neighborhood input**
- 2. Plant trees uphill to soak up more stormwater**
- 3. Reduce mowing or establish meadow**
- 4. Incorporate rain gardens and vegetated swales**
- 5. Plant street trees on cul-de-sac**

The lawn which connects Woodbine Way to Buttercup Lane is showing fairly severe erosion. Channels have formed, which appear to have been filled with stone. Its unclear how effective

the stone has been in slowing erosion. Typically, we see stone fill slow erosion, but not eliminate it, as flowing water will sometimes erode beneath the stone, or alongside the stone. Due to the stone channels and eroded trenches and pits, it doesn't appear that the lawn is suitable for any kind of active recreation. However, with the installation of trees, a meadow, rain gardens or vegetated swales and some minor grading, the lot could be transformed into a neighborhood pocket park which also manages stormwater.

The sloped lawn is currently eroding, so regardless of what uses could ultimately be accommodated here, the erosion issue needs to

be fixed. Typically, erosion needs to be addressed from the source, then uphill to downhill. It appears that no water is entering the site from the nearby street as it is curbed. Some water may be flowing off the sidewalk, but it appears that the erosion is primarily caused by stormwater which hits the lawn as precipitation and flows down the slope.

A row of callery pear trees line the top edge of the slope. This is an invasive species which causes considerable damage to our native ecosystems, particularly in wetlands, where they form thorny brambles. These trees should be removed and replaced with two to three rows of shade trees of native species. By planting the trees on alternating centers, rather than in columns, they can be placed such that their roots and trunks slow the flow of water down from the top of the hill. This would also help to stabilize the soil in this area.

A series of vegetated swales could be installed down the hillside, roughly parallel to Woodbine Way. They should be perpendicular to the existing stone swales, which should be removed. A series of two to three swales across the property would capture stormwater as it flows down the slope, before it can achieve enough velocity to erode the soil and create channels.

The turfgrass lawn should all be converted to meadow. As discussed in the Valley Green Park section, meadow performs better than lawn for volume reduction, recharge and rate control, and far better than lawn for water quality. A consistent meadow cover over the entire lawn area, including the suggested swales, should slow the water, filter it and capture it for infiltration. Meadow would also require less annual maintenance and could provide food and habitat for so many of our native animals.

A more formal rain garden should be established at the bottom of the slope, to capture any additional runoff that comes off the meadow. It should be vegetated with beautiful, but easy to maintain and easily recognizable plants, such as black eyed susans, coneflowers and other well-loved native perennials. This would provide an additional touch of beauty to this now barren stretch.

Finally, a row (or two) of native street trees should be planted along the sidewalk. These trees would help to soak up any additional stormwater but would also provide the many benefits of street trees. They would beautify the cul-de-sac, shade the asphalt and sidewalk reducing heat island effect, clean the air and much more. Together, the tree plantings, swales, rain gardens and meadow establishment would better manage stormwater and beautify the area.

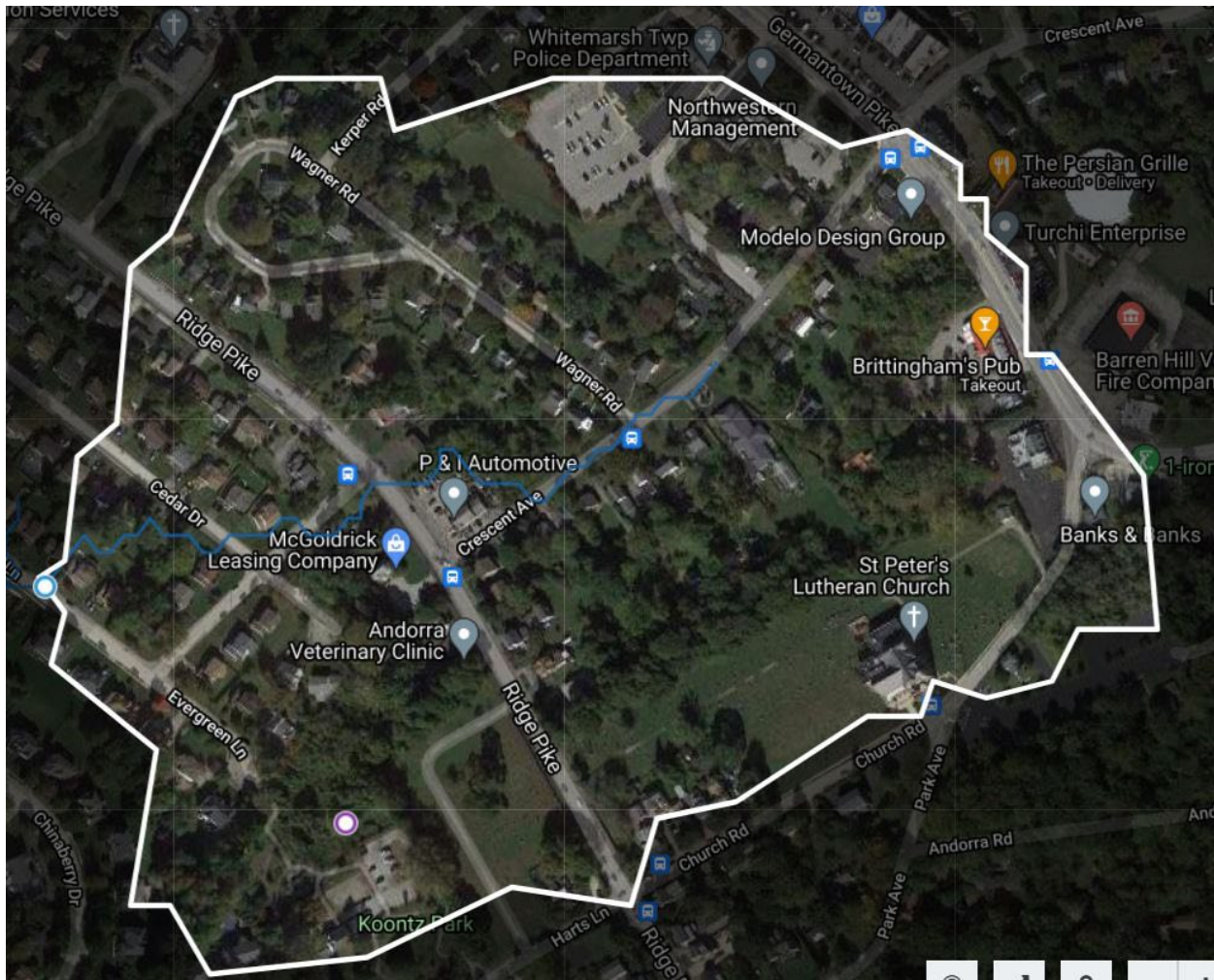


Erosion channels have formed in the lawn. Treated with stone, they will continue to erode unless the stormwater itself is managed.

These stormwater improvements could also be designed to accommodate public use. Trails and breaks in the meadow could be provided to create a small gathering area within the meadow. This area could be graded to flatten the slope. Swales could be designed above this area to keep it dry. Benches could be provided here too. While the meadow would be

relatively small, it could still attract birds and wildlife. The neighbors may enjoy spending time here together, or alone to relax and enjoy the surrounding nature.

Koontz Park



The basin at Koontz Park (shown at purple dot) appears to receive stormwater only from the park, but it is part of a watershed dominated by turfgrass lawns and a cemetery.

Key Recommendations

1. Assess retaining wall
2. Cut and/or remove vines
3. Mow annually

The basin at Koontz Park is very similar to the basin along Woodbine Way, in that it is fairly deep, naturalized and appears to hold a mix of native and invasive species. This basin is not fed by storm sewer pipes and appears to accept sheet flow off the adjacent park and parking lot. A pvc pipe exists near the basin, which may be an outlet from the parking island planting



The retaining wall appears to need maintenance as the result of a collision or shifting ground.

nearby, but it is unclear. Additionally, it is assumed that the basin features an overflow outlet pipe or spillway, but it was not visible beneath the dense vegetation.

Additionally, more trees could be planted around the basin. Since it appears to receive sheet flow, more trees surrounding it would help to slow, filter and infiltrate more water



Native species including joe-pye weed, cardinalflower and goldenrod persist, but the basin is being overrun by porcelainberry and other invasive vines.

Like the basin at Koontz Park, this basin has naturalized substantially. Native trees, such as serviceberry and bayberry, were likely planted as nursery stock. Native perennials including goldenrod and cardinalflower, likely planted as part of the original meadow persist. But the basin has largely been overrun by invasive species, including worrisome vines, which could begin to top the trees and overtake the shrubs. Here too, vine removal should be the number one priority for ongoing maintenance.

before it reaches the basin. More trees would also further beautify the park and shade the parking lot.

Finally, a few portions of the retaining wall below the parking area are in disrepair. The stacked concrete units near the eastern end of the wall are misaligned. It's unclear if they've been hit by a maintenance vehicle and knocked out of place, or whether the ground around them has shifted them. Either way, the wall should be repaired and monitored to determine whether the ground is shifting.



Hildacy Preserve
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natlands.org